

Spot on Biotechnology Science



Spot on Science
Biotechnology Universities and
Research Facilities in North Rhine-Westphalia

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Editorial

Dear Reader,

talking about life sciences and education in Germany means talking about universities and research facilities in North Rhine-Westphalia (NRW): the state with the valleys of Rhine and Ruhr hosts the country's highest accumulation of academic institutions. Among them are 16 universities and Germany's largest research facility, the Jülich Research Centre with nearly 6,000 members of staff. Due to the high density of academic institutions, more than a quarter of all German students is to be found in NRW. That might not be surprising as almost a quarter of the German population lives in NRW, but there is a significant focus on the so-called STEM fields (Science, Technology, Engineering and Mathematics) at the moment: nearly one third of all the STEM students study in NRW!

Since 2009, BIO.NRW Cluster Biotechnology NRW has been publishing its annual compendium of the biotech business sector in the state named "Spot on Biotechnology Business", which introduces NRW's core biotech companies via short profiles. The publication turned out to be highly valued by the community and gave the motivation to present the academic life science landscape with all its diversity in a similar manner: the 1st edition of "Spot on Biotechnology Science" (2013). The 2016 issue includes a total of 227 profiles of life science research entities and their institutes/departments in NRW. Each chapter features a brief description and relevant numbers of the respective category. Both publications are accompanied by our searchable online databases "Company Database" and "Academic Database" at www.bio.nrw.de.

We are confident that the current edition of our brochure will again be helpful for companies to find the right partner from academia or for students to identify the most suitable research facility. After introducing NRW's universities related to life sciences first, we present all the relevant universities of applied sciences in the state. The compendium then features research facilities in NRW that belong to the Fraunhofer or Max Planck Society as well as those that are members of the Helmholtz or Leibniz Association. The last part provides further information on other research centres, excellence clusters and graduate programmes. For easier quest, we also included a categorization of all the institutions based on the field of research and their chosen keywords. All in all, our aim was to provide an up-to-date overview of the academic life science landscape in NRW that is as complete as possible.

BIO.NRW is the state's official cluster for biotechnology in NRW and was initiated by the state government in 2009. We are developing the cluster together with and to the benefit of various stakeholders in the field of biotechnology in North Rhine-Westphalia, including companies, research facilities and networks. The cluster also actively promotes young academics, for instance with the BIO.NRW (PhD) Student Convention, a two-day event held since 2010 in one of the soccer arenas in NRW. At these conventions, about 100 participants get first-hand information from leaders in the life science industry and academia on how to plan their career options.

We hope that the new edition of our brochure "Spot on Biotechnology Science" is useful for you and would like to encourage you to discover NRW's excellent life science



landscape, which is embedded in a vivid cultural environment, thus combining an international competitive working location with a high standard of living. Also, do not hesitate to contact us for further questions, support or feedback.

Dr. Bernward Garthoff
Cluster BIO.NRW

Representative for Biotechnology of the German State of North Rhine-Westphalia



Research for Progress

Dear Reader

In North Rhine-Westphalia, the number of biotechnology start-ups continues to rise and biotech patents are legion.

Research excellence is combined with numerous major international biotech players and a strong and globally active chemical and pharmaceutical industry. Many of the more than 400 life-science firms in North Rhine-Westphalia concentrate their activities on pharmaceutical and industrial biotech, nano-biotechnology, research-enabling technologies as well as diagnostic and analytical services. Support comes from a first-rate research infrastructure: eleven universities, six polytechnic-style Fachhochschulen, six Max Planck Institutes, six Leibniz institutions, three Helmholtz establishments and the Bonn-based Centre of Advanced European Studies and Research conduct most of their research in the life sciences. Their activities benefit from those of seven medical faculties and numerous science parks which facilitate the transfer of technology close to the universities. The enabling biotechnology sector can also be found at almost every university and many of the non-university research institutions in North Rhine-Westphalia.

Of course, those strengths have not sprung from nowhere. The entire framework and infrastructure receive support and assistance from the State Government. After all, we firmly believe in the importance of biotech as an enabling technology. We have recognised not only the broad range of applications – such as healthcare, chemical products, food or environment – but also the potential for innovation, growth and jobs.

It is this potential we want to put to full use. We are pursuing an interdisciplinary and trans-disciplinary approach and rely on research to generate the sort of progress that benefits the people. Biotechnology has a key role in the efforts to find the right solutions.

The following pages introduce the universities and research institutions in North Rhine-Westphalia with a focus on biotechnology. Please use this biotechnology atlas for making contact with potential partners for cooperation.

Enjoy your reading.

Prof Dr Andreas Pinkwart

Minister of Economic Affairs, Innovation, Digitalization and Energy of the State of North Rhine-Westphalia



Content

Editorial	5	University of Siegen	72
Research for Progress	7	Westfälische Wilhelms-Universität Münster	77
Content	8	Universities of Applied Sciences	85
Spot on Biotechnology Science	11	Bonn-Rhein-Sieg University of Applied Sciences	86
Academic Institutions and Research Facilities in NRW*	14	FH Aachen University of Applied Sciences	88
Universities	17	Fachhochschule Bielefeld University of Applied Sciences	92
Bergische Universität Wuppertal	18	Fachhochschule Münster University of Applied Sciences	94
Bielefeld University.....	20	Fachhochschule Südwestfalen University of Applied Sciences	96
CeBiTec – The Interdisciplinary Center for Biotechnology	23	Hochschule Hamm-Lippstadt University of Applied Sciences	98
German Sport University Cologne	26	Hochschule Niederrhein University of Applied Science	99
Heinrich Heine University Düsseldorf.....	30	Hochschule Ostwestfalen-Lippe University of Applied Sciences	100
Rheinische Friedrich-Wilhelms-Universität Bonn	42	Rhine-Waal University of Applied Sciences	102
Ruhr-Universität Bochum	48	TH Köln – Technology, Arts, Sciences	104
Protein research Unit Ruhr within Europe (PURE).....	55	Westfälische Hochschule – University of Applied Sciences	108
RWTH Aachen University	56	Fraunhofer Society	111
Technische Universität Dortmund	62	Fraunhofer Institute for Algorithms and Scientific Computing SCAI	112
TU Dortmund University	62		
University of Duisburg-Essen	66		
University of Cologne	68		

Fraunhofer Institute for Applied Information Technology FIT	113	Zoological Research Museum Alexander Koenig	158
Fraunhofer Institute for Environmental, Safety, and Energy Technology UMSICHT	115	Max Planck Society	163
Fraunhofer Institute for Molecular Biology and Applied Ecology IME.....	117	Max Planck Institute for Biology of Ageing.....	164
Fraunhofer Institute for Production Technology IPT	121	Max Planck Institute for Metabolism Research	167
Helmholtz Association	125	Max Planck Institute for Molecular Biomedicine	168
Forschungszentrum Jülich	126	Max Planck Institute of Molecular Physiology	172
German Aerospace Center (DLR) DLR – Research for the Earth	131	Max Planck Institute for Plant Breeding Research	175
German Center for Neurodegenerative Diseases – DZNE	134	caesar – an Institute of the Max Planck Society	176
Helmholtz Institute for Biomedical Engineering Aachen	136	Other Research Institutions and Excellence Clusters ...	183
Leibniz Association	143	Bioeconomy Science Center – BioSC.....	184
DWI – Leibniz Institute for Interactive Materials	144	West German Cancer Center – WTZ	185
German Diabetes Center – Leibniz Institute for Diabetes Research at the Heinrich Heine University	145	West German Heart and Vascular Center – WHGZ	186
IUF – Leibniz Research Institute for Environmental Medicine	148	Cellular Stress Responses in Aging-associated Diseases (CECAD)	187
IfADo – Leibniz Research Centre for Working Environment and Human Factors	152	Cells in Motion (CiM).....	188
Leibniz-Institut für Analytische Wissenschaften – ISAS – e.V.	155	Cluster of Excellence on Plant Sciences CEPLAS	189
		ImmunoSensation	190
		Tailor-Made Fuels from Biomass (TMFB)	191
		Graduate Programmes in North Rhine-Westphalia (Life Sciences)	192
		Index	196



Spot on Biotechnology Science

Science Landscape NRW

Educating talented scientists is one of the most important investments into the future of North Rhine-Westphalia. Nowhere else is the transition from an industrial to a knowledge economy more apparent than here. The Ruhr Valley in particular has undergone enormous changes in recent decades. As the traditional coal mines and steel mills disappeared one by one, communities and their political leaders have become engaged in an intense search for new economic opportunities that could bring new jobs and prosperity. One of the stronger candidates has been the area of life sciences and one of the keys to success there, as in the many shoots of the new economy, is a well-educated workforce.

Today, the state of North Rhine-Westphalia has a higher density of academic institutions than any other part in Europe: there are more than 750,000 students at the 71 universities, universities of applied sciences (UAS) and other institutions of higher education, among which the natural and engineering sciences are strongly represented.¹ Regarding Germany, six of the ten largest universities (by number of students) are located in NRW. Furthermore, the RWTH Aachen University has been awarded the rare label "Elite University" during the "Excellence Initiative" in 2007, followed by the University of Cologne in 2012. This means that two of the eleven "Elite Universities" in Germany are located in NRW. Beside the highest national density of universities, the four large German research organisations, namely the Fraunhofer Society, the Helmholtz Association, the Leibniz Association as well as the Max Planck Society, are running several facilities with life science

activities in the state. In the following part, NRW's highly competitive and dynamic science landscape will be illustrated by a few recent examples out of different areas.

Highlights of Recent Years

In the Ruhr valley, the Max Planck Society has established a remarkable company in the area of biomedical research: the Lead Discovery Center (LDC) GmbH in Dortmund works at the intersection of academia and industry and has already become a success story shortly after its foundation in 2008. The LDC has implemented a new concept of technology transfer as it takes up drug targets from basic research and tries to develop these candidates into lead structures. Close to Dortmund, the Ruhr University Bochum and its Protein Research Unit Ruhr within Europe (PURE) just recently announced a new centre for protein diagnostics (ProDi). The costs shall amount to € 48 million and the building will connect the university, the university hospital as well as the health economy.

As a member of the Helmholtz Association, Germany's largest research facility, the Jülich Research Centre (Forschungszentrum Jülich, FZJ) with almost 6,000 employees, is located in NRW. The FZJ has become extended by a unique institution: the first research institute in Europe which is dedicated exclusively to bioeconomy research, the Bioeconomy Science Center (BioSC). The centre was founded in 2010 and is supported with the impressive investment sum of € 58 million. The BioSC is a

joint initiative of the FZJ and the universities of Aachen, Bonn and Düsseldorf and is part of the pioneering bioeconomy strategy of the state government.

The Cologne-Bonn area has developed into an internationally renowned hotspot for ageing related and neurodegenerative diseases over the last years: the Cologne Cluster of Excellence for Cellular Stress Response in Aging-Associated Diseases (CECAD, founded in 2007), the Max Planck Institute for Biology of Ageing (MPI Age, founded in 2007/08) and the German Center for Neurodegenerative Diseases in Bonn (DZNE, founded in 2009) act in concert to perform cutting-edge basic research in this area. In 2013, a total of € 110 million were invested in the construction of the new DZNE headquarters in Bonn. Just next to the DZNE, the university hospital Bonn is currently rebuilding its departments of neurology and psychiatry for € 83 million, so that clinics and research are, literally, perfectly connected in the future.

There is also an increasing focus on cancer research in NRW. The West German Cancer Center (WTZ) in Essen is steadily expanding and was awarded the title "Oncology Center of Excellence" by the nonprofit organisation German Cancer Aid in 2008. In 2005, a new cancer centre (Centrum für Integrierte Onkologie, CIO) was founded in Cologne and was awarded the title "Oncology Center of Excellence" shortly after, too. Already in 2015, € 78 million were invested in the construction of a dedicated CIO building at the University Hospital Cologne. Comprising more than 13,500 m², the new

¹ Statistisches Bundesamt: Bildung und Kultur – Studierende an Hochschulen Wintersemester 2015/2016 -Vorbericht-

building will be the largest new construction at the campus since 1970.

There are many more institutions worth mentioning here and to provide an overview as complete as possible, BIO.NRW has compiled this brochure of short profiles that are also indexed. For even more detailed and up to date information, our online database presents NRW's science landscape, down to the level of working groups, and is free text searchable (www.bio.nrw.de/wissenschaftsdatenbank).

The German Excellence Initiative

The "Excellence Initiative" of the German Federal Ministry of Education and Research and the German Research Foundation (Deutsche Forschungsgemeinschaft, DFG) is the result of lengthy negotiations between the federal government and the states dating back to 2004. It aims to promote cutting-edge research, to create outstanding conditions for young scholars at universities, to deepen interdisciplinary work between different institutions and to strengthen international research cooperation. The overall goal of the Excellence Initiative is to strengthen outstanding German universities and to raise their international visibility. The initiative is conducted by the DFG together with the German Council of Science and Humanities (Wissenschaftsrat, WR). It includes three lines of funding:

1st line of funding: the establishment of more than 40 Graduate Schools for young scientists and PhD students (each receives € 1 million per year)

2nd line of funding: the creation of thirty so-called Clusters of Excellence, that connect universities with leading German re-

search institutions (each receives around € 6.5 million)

3rd line of funding: the selection of eleven "Universities of Excellence", which will be funded for their "Future Concepts" (in the beginning, each received around € 21 million per year)

In June 2012, the Grants Committee decided to support 45 graduate schools, 43 clusters of excellence and eleven future concepts of universities in the period from 2012 until 2017. This means that 39 universities receive € 2.4 billion in total and altogether, € 2.7 billion (compared to € 1.9 billion for 2007-2012) of additional funds are distributed over these five years, most of it coming from the federal government.

MINT/STEM Students

In 2015, a record number of 750,000 students (27 % of all students in Germany) performed their studies at one of the 71 universities, universities of applied sciences (UAS) or other institutions of higher education in NRW.¹ The majority of these students (65 %) was enrolled at one of NRW's 16 universities in 2015, but the number of UAS students increased to about 35 % over the last years.¹ A topic of increasing importance, which is also widely discussed in politics and public, is the growing lack of students in the so-called MINT subjects (Mathematics, Informatics, Natural or Life Sciences and Technology) or STEM fields (Science, Technology, Engineering and Mathematics).

In 2012, about 110,000 of 590,000 students (18.5 %) in NRW had chosen a MINT subject for their studies.² With respect to the fundamental economic impact of the MINT subjects, this number was clearly

too low. The largest section of students (187,000) continued to choose law, economy or social sciences as subject followed by language and culture (128,000). Moreover, the percentage of MINT students could not be increased significantly between 2001 and 2012 (17 % in 2001). This contrasts with a steadily growing need for MINT graduates in the associated industries.

NRW now plays a pioneering role in this area as there were 285,000 MINT students in 2015¹, which corresponds to an overwhelming 38 % of all the students in the state. Compared to the country as a whole, NRW's MINT students represent 32 % of all the German MINT students (895,000). Considering that the state's number of total students is equivalent to 27 % of all the students in Germany, this is a significantly larger proportion. All in all, this positive development assures NRW's position in the area of MINT subjects and shows the current importance of life sciences.

Graduate Schools

There has been a transformation in higher education, especially graduate student education, over the last thirty years. Most obvious is the sheer number of graduate students: in 2010, about 200,000 individuals were listed as doctoral candidates, 100,000 of them as enrolled doctoral students.³ The latter value corresponded to almost 5 % of all the German students and of all the 200,000 doctoral candidates, more than 58,000 were researchers in the natural sciences (29 %). In 2010, more than 25,000 young researchers successfully completed their PhDs in Germany, among them 8,200 (32 %) in the natural sciences, which is three times the number that did so in 1980. In NRW, nearly 5,300 students completed their PhDs in 2014 (more than 5 % of all the university graduates).

To standardize and structure the doctoral studies in Germany the idea of graduate

¹ Statistisches Bundesamt: *Bildung und Kultur – Studierende an Hochschulen Wintersemester 2015/2016 -Vorbericht-*

² *Information und Technik Nordrhein-Westfalen, Geschäftsbereich Statistik – Hochschulen NRW 2015*

³ *Statistisches Bundesamt – Promovierende in Deutschland 2010*

programmes was born. The first programme called "Molecular Life Sciences" was established in Cologne in 1985. The goal behind this and the many other graduate programmes that have followed was to give an extra dimension to the education of doctoral students, in addition to the time they spend working on their thesis projects. The first so-called "DFG Research Training Group" was established at the Ruhr University Bochum in 1990. The programme entitled "Biogenesis and Mechanisms of Complex Cell Function" involved a dozen professors and as many students. The students interacted with researchers and fellow doctoral students from other departments like biology, medicine and physics on an interdisciplinary level. This kind of cooperation made departmental boundaries a thing of the past.

The success of this concept triggered the development of graduate schools at other universities in the state: today, the DFG funds 19 such graduate schools that focus on the life/natural sciences at universities in NRW (www.dfg.de/foerderung/programme/listen/index.jsp?id=GRK). Moreover, seven of the DFG graduate schools have an international scope. The DFG graduate students each receive a fellowship of more than € 1,000 per month for three years. Some also get temporary employment over the period of the graduate studies. Additionally, the DFG covers travel expenses for the students to participate in international scientific congresses. In all 19 of these programmes, training includes 'transferable skills' like scientific writing, career planning and project management to prepare the students for the diverse aspects of their possible careers.

Since 2000, the Max Planck Society has a graduate training programme as well, known as International Max Planck Research Schools (IMPRS, www.mpg.de/en/imprs). By now, there are 60 IMPRS in Germany: 26 in the chemistry, physics and technol-

ogy section, 23 in the biology and medicine section and eleven in the human and social sciences section. The excellence cluster CECAD runs another graduate school in the life sciences together with the International Max Planck Research School-AGE (IMPRS-Age, www.ageing-grad-school.de). This programme started in 2008 and is funded by the "Excellence Initiative".

In general and analogous to the US graduate system, the graduate programmes offer students a period of intensive supervision by a dissertation committee comprised of experienced scientists. Written or oral annual reports ensure optimal progress of the research project and the financial support helps the students to focus on their research.

Engaging with industry

In addition to enjoying a wider exposure to top-level research fields, graduate students also benefit from interactions with industry. From the point of view of many students, this should be an inherent part of their education, but currently is still poorly addressed by most universities and professors in the field of life sciences. To respond to this need, a remarkable and unique graduate cluster has been initiated in NRW in 2009:

The CLIB²⁰²¹ Graduate Cluster in Industrial Biotechnology (CLIB-GC) was founded by three universities (Bielefeld, Dortmund und Düsseldorf) on the one hand and life science enterprises on the other hand. This graduate cluster is supported by NRW's Ministry of Innovation, Science and Research (MIWF) and is the largest graduate cluster in Germany as well as one of the biggest graduate programmes in Europe as it employs more than 100 PhD students in total. In the area of industrial biotechnology, the graduate cluster is based on four technology platforms, namely polyomics, expression, biocatalysis and downstream processing. CLIB²⁰²¹

(Cluster Industrielle Biotechnologie e. V.) is a cluster for industrial biotechnology that connects academic and industrial members who are active in research, development, production and commercialisation.

A different approach to close the big gap between industry and academia in higher education was the foundation of the Biotechnological Student Initiative (btS, www.bts-ev.de). This nationwide organisation has had considerable success since its foundation in 1996: btS groups are active in all major university cities in NRW and representatives of many (big) biotech companies collaborate with the student network. Every year, the btS of NRW organises a fair to promote contact with industrial partners, called "ScieCon NRW", that has an excellent reputation among the exhibitors. The last ScieCon took place in November 2015 at the University of Bochum.

Academic Institutions and Research Facilities in NRW*



* with regard to Life Sciences



Universities

14

Bergische Universität Wuppertal	Wuppertal	18
Bielefeld University	Bielefeld	20
Heinrich Heine University Düsseldorf	Düsseldorf	24
German Sport University	Köln	26
Rheinische Friedrich-Wilhelms-Universität Bonn	Bonn	42
Ruhr-Universität Bochum	Bochum	48
Paderborn University	Paderborn	
Private University Witten/Herdecke	Witten/Herdecke	
RWTH Aachen University	Aachen	56
TU Dortmund University	Dortmund	62
University of Duisburg-Essen	Essen	66
University of Cologne	Köln	68
University of Siegen	Siegen	72
Westfälische Wilhelms-Universität Münster	Münster	77



University of Applied Sciences

11

Bonn-Rhein-Sieg University of Applied Sciences	Sankt Augustin	86
FH Aachen University of Applied Sciences	Aachen	88
FH Bielefeld University of Applied Sciences	Bielefeld	92
FH Münster University of Applied Sciences	Münster	94
FH Südwestfalen University of Applied Sciences	Iserlohn	96
Hamm-Lippstadt University of Applied Sciences	Hamm	98
Hochschule Niederrhein University of Applied Science	Krefeld	99
Hochschule Ostwestfalen-Lippe University of Applied Sciences	Lemgo	84
Rhine-Waal University of Applied Sciences	Kleve	102
TH Köln - University of Applied Sciences	Köln	104
Westfälische Hochschule - University of Applied Sciences	Gelsenkirchen	108



Fraunhofer Society

5

Fraunhofer Institute for Algorithms and Scientific Computing SCAI	Sankt Augustin	112
Fraunhofer Institute for Applied Information Technology FIT	Sankt Augustin	113
Fraunhofer Institute for Environmental, Safety and Energy Technology UMSICHT	Oberhausen	115
Fraunhofer Institute for Molecular Biology and Applied Ecology IME	Aachen	117
Fraunhofer Institute for Production Technology IPT	Aachen	121



Helmholtz Association

3

Forschungszentrum Jülich	Jülich	126
German Aerospace Center (DLR)	Köln	131
German Center for Neurodegenerative Diseases – DZNE	Bonn	134



Leibniz-Association

7

DWI – Leibniz Institute for Interactive Materials	Aachen	144
German Diabetes Center	Düsseldorf	145
IUF – Leibniz Research Institute for Environmental Medicine	Düsseldorf	148
Leibniz Information Centre for Life Sciences	Köln	
Leibniz Research Centre for Working Environment and Human Factors – IfADo	Dortmund	152
Leibniz-Institut für Analytische Wissenschaften – ISAS – e.V.	Dortmund	155
Zoologisches Forschungsmuseum Alexander Koenig	Bonn	158



Max Planck Society

6

Max Planck Institut für Kohlenforschung	Mühlheim	
Max Planck Institute for Biology of Ageing	Köln	164
Max Planck Institute for Metabolism Research	Köln	167
Max Planck Institute for Molecular Biomedicine	Münster	168
Max Planck Institute of Molecular Physiology	Dortmund	172
Max Planck Institute for Plant Breeding Research	Köln	175



Other Research Institutions and Excellence Clusters*

Bioeconomy Science Center – BioSC	Jülich	184
caesar	Bonn	176
CeBiTec	Bielefeld	23
Center for Integrated Oncology	Köln	
CECAD	Köln	187
Helmholtz Institute for Biomedical Engineering	Aachen	136
Protein research Unit Ruhr within Europe – PURE	Bochum	55
West German Cancer Center – WTZ	Essen	185
West German Center for Infectious Diseases – WZI	Essen	
West German Heart and Vascular Center – WHGZ	Essen	186
Cells in Motion – CiM	Münster	188
Cluster of Excellence on Plant Sciences CEPLAS	Düsseldorf/Köln	189
ImmunoSensation Cluster of Excellence	Bonn	190
Tailor-Made Fuels from Biomass – TMFB	Aachen	192

* no claim to completeness



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Universities

Universities

In Germany's federal system, almost all the universities are run and maintained by the (federal) states (Bundesländer/Länder), thus each state is responsible for building and financing its universities. Consequently, it is within the responsibility of the federal states to decide on the number and location of its universities as well as the topics, subjects and focuses of the studies that are offered. Currently, NRW's universities provide a total of about 1,500 basic study courses plus 1,100 higher study courses that are offered by 16 universities and 37 universities of applied sciences¹. University students are awarded a bachelor degree (normally after six semesters) or a master degree (after completing a bachelor and four additional semesters).

In 2015, almost 750,000 students were enrolled at one of NRW's universities (approx. 485,000 students) or universities of applied sciences (approx. 260,000

students). There were more than 125,000 new students and about 95,000 graduates in 2014.² The students find a diverse landscape at universities which have a long and rich tradition (University of Cologne, founded in 1388), Germany's largest university (Distance University Hagen, nearly 70,000 students), one of the very few private universities (University of Witten-Herdecke) or rather young yet established universities like those that were founded as the first new universities in Germany after the Second World War (Ruhr University Bochum and Technical University Dortmund). The latter two – together with the University of Duisburg-Essen – are also outstanding as they mark the beginning of a fundamental structural change in the Ruhr valley, shifting the area from a region of heavy coal mining and steel production towards a modern economy based on services and

high technologies, especially including the life sciences.

NRW's universities provide excellent education, research, scientific expertise and career development opportunities in an international environment. During the winter semester 2015/2016, about 87,000 students came from other countries to study in NRW, which corresponds to a proportion of 11,6 %.¹ This value has steadily increased over the last years and clearly shows the growing attractiveness of NRW as a location of higher education for international students.

The prestigious label "Elite University", which has again been awarded to the University of Cologne and the RWTH Aachen University, highlights NRW's excellent and competitive science landscape of today.

Sources: ¹Statistisches Bundesamt - Studierende an Hochschulen (Wintersemester 2015/2016);

²Information und Technik Nordrhein-Westfalen, Geschäftsbereich Statistik - Hochschulen in Nordrhein-Westfalen (2015)



**BERGISCHE
UNIVERSITÄT
WUPPERTAL**



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Internet	www.uni-wuppertal.de
Founded (year)	1972
Number of employees	scientific 1503 (+ 957 PhD students) administrative 688
Funding	State Government NRW 71% Federal Government (Germany) 7% Others 22%

www.uni-wuppertal.de

The University of Wuppertal is a dynamic, research oriented university with a markedly interdisciplinary teaching and research profile, that is focused on 6 strategic areas:

- Building blocks of matter, experiment, simulation, and mathematical methods
- Education and knowledge in social and cultural contexts
- Health, disease prevention, and movement
- Language, narration, and editing
- Natural environment, engineering, and safety
- Entrepreneurship, innovation, and economic change

An interdisciplinary nature, innovation, and team spirit are the hallmarks of teaching and research in Wuppertal, and the university's many successes are also reflected in good rankings. Generous staff-student ratios, as well as many service and support facilities for students and researchers, distinguish the University of Wuppertal from the large mass universities and lead in turn to lively interest from prospective students.

The University of Wuppertal is located in the heart of North Rhine-Westphalia

(NRW), which is economically the most significant German state with an outstanding educational and cultural landscape. We possess an international network of more than 150 partner universities worldwide, with regional focal points in Asia (especially China), Latin America and the USA. Our international cooperations provide not only for student and staff exchanges, but also for joint research projects at faculty and departmental level.

The university's high-profile international presence, with a network of partners across Europe and overseas, is complemented by deep regional roots. Active knowledge transfer and intense cooperation with numerous business partners and social organizations have created an excellent regional network from which graduates, faculty members, and researchers profit as much as do innovations and start-ups.

Institute of Atmospheric and Environmental Science

The Institute for Atmospheric and Environmental Research was founded in August 2014. With this institute a department-related competence centre for atmospheric and environmental research has been created that currently combines the research expertise of atmospheric chemistry, atmospheric physics, safety engineering and environmental protection at the University of Wuppertal. In addition, the promotion of young scientists is an important task of the Institute. To achieve its objectives, the Institute will conduct research in atmospheric chemistry, atmospheric physics, simulation experiments, modelling, development of new and innovative measurements techniques and evaluation algorithms.

Together with the city of Wuppertal the Institute is operating a monitoring station for air quality, which was formerly part of

the German national air quality monitoring network, which would have been closed otherwise. In addition to air quality monitoring the Institute uses the station also for the practical training of its students.

International Collaborations

York University, Toronto, Canada
 Université Paris-Est Creteil
 Peking University, Beijing, PR China

National Collaborations

Universities of Bremen, Cologne,
 MPI for Chemistry, Mainz
 Research Centre Jülich
 DLR
 Leibniz Institute for Tropospheric
 Research, Leipzig
 The National Metrology Institute of
 Germany (PTB)

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Keywords	Atmospheric Chemistry, Atmospheric Physics, Safety Engineering, Simulation Experiments, Process Studies
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Internet	www.uni-bielefeld.de
Founded (year)	1969
Number of employees	scientific 2,396 administrative 1,149
Funding	State Government NRW 100%

www.uni-bielefeld.de



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Bielefeld University

Humanities, Natural and Social Sciences, Technology – Transcending Boundaries

A founding idea still brimming with life: interdisciplinarity, that is, taking thought and research beyond the borders of single subjects, is a truly daily experience at Bielefeld University.

Scope for individuality, networked communication, reflection, and “lateral thinking” are already an integral part of the university’s unusual architecture, and they particularly promote innovative ideas and unconventional thinking. This is the basis on which the university integrates its two permanent key objectives: the continued expansion of top-level international research and the strategic further development of its prize-winning teaching achievement.

Bielefeld University, founded in 1969, now has 13 faculties housing a range of disciplines spanning the humanities, the natural sciences, the social sciences, and technology. With roughly 24,000 students taking more than 113 study courses and about 3,000 staff, it is one of Germany’s medium-sized universities that is currently expanding dynamically and with great success. This is clear to see with two successes

in the excellence initiative, award-winning concepts for further improving the quality of teaching and studying, and major new building projects that are transforming Bielefeld into an ultramodern university campus.

Faculty of Biology

Individuality & Interaction: We investigate individuality that describes the unique properties of a single cell, an organism or a whole system. Change and adaptation occurs over the lifetime and in response to the environment. In addition, individual entities also interact and even cooperate at higher functional levels (tissue, population, ecosystem).

Sustainability & Resource Efficiency: Sustainability and resource efficiency are of vital and global importance in our changing society. We characterize highly resource-efficient strategies of nature from healthy food, intact ecosystems, changing commodities to clean, renewable energy and finally implement them in technical solutions.

Networks: from genes over metabolism to diversity: Molecular, cellular and organismic networks with their emergent properties

are a hallmark of the complexity of biological systems. We investigate which types of interactions characterise networks, how networks change over time and how they react to changes in the environment.

International Collaborations

International Research (EU-FP7):
 THE Hand Embodied
 PROMYSE: Products from methanol by synthetic cell factories
 SUNBIOPATH: Towards a better sunlight to biomass conversion efficiency in microalgae
 EMICAB: Embodied Motion Intelligence for Cognitive, Autonomous Robots

National Collaborations

SFB 613, Forschergruppe 1232, GABI
 Bioindustrie2021/CLIB²⁰²¹

Membership in local and regional Networks

CLIB²⁰²¹

Research Field	Various Biological Fields of Research
Keywords	Genomics, Metabolomics, Proteomics, Stem Cell Research, Behavioural Biology, Neurobiology, Ecology, Evolutionary Biology
Head of Faculty	Prof. Dr. rer. nat. Caroline Müller
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Faculty of Chemistry

Several groups are interested in the application of enzymes as valuable and environmental friendly catalysts in organic synthetic transformations. By means of interdisciplinary research projects a range of achievements have been made in the development of synthetic processes which fulfill the criteria of high efficiency, sustainability as well as scalability.

In particular Organic Chemistry I (Prof. Gröger) focuses on (1) the development of efficient biocatalytic reactions (biotransformations) and their technical applications, (2) the combination of biocatalysis with chemocatalysis in one-pot multi-step syntheses in water and (3) target driven synthesis based on the use of biocatalysts in synthetic key steps (in particular for the synthesis of pharmaceuticals). A key feature of these research activities at the

interface between biology and organic chemistry has been the high degree of interdisciplinarity, supplemented by numerous collaborations with external academic and industrial partners.

International Collaborations

Toyama Prefectural University, Japan
 Osaka University, Japan
 University of Oslo, Norway

National Collaborations

RWTH Aachen
 University of Cologne
 Max-Planck-Institute for Chemical Energy Conversion

Research Field	Biotechnology, Organic Chemistry
Keywords	Enzymes, Peptide Synthesis, Recombinant Proteins, Small Molecules
Head of Faculty	Prof. Dr. Gabriele Fischer von Mollard
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Research Field	Biotechnology, Bioinformatics
Keywords	Analytics, Bioinformatics Biopharmaceuticals, Cell Lines/Banks, Fermentation, Genetic Engineering, Recombinant Proteins
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Faculty of Technology

Founded in 1990, the Faculty of Technology is the second-youngest department of Bielefeld University. Research and education concentrate on three core areas: Cognitive Informatics and Robotics, Bioinformatics, and Biotechnology. These areas are highly connected through common foundations in computer science and technology, and the joint interest in better understanding of biological systems. The department has 17 full professors and 3 independent junior scientists.

Study programs in the Faculty of Technology are structured along the core research areas with programs in Cognitive Informatics/Intelligent Systems (B.Sc., M.Sc., Ph.D.), Bioinformatics and Genome Research (B.Sc., M.Sc., Ph.D.), Informatics in the Natural Sciences (B.Sc., M.Sc.), and Molecular Biotechnology (B.Sc., M.Sc.).

Members of the Faculty of Technology are involved with the central research units Research Centre for Mathematical Modelling (FSPM²), Center for Biotechnology (CeBiTec), the Research Institute for Cognition and Robotics (CoR-Lab), and the Center of Excellence EXC 277: Cognitive Interaction Technology (CITEC), as well as the Collaborative Research Centre SFB 673: Alignment in Communication, where members of the Faculty of Technology are in leading positions.



CeBiTec – The Interdisciplinary Center for Biotechnology

The Center for Biotechnology is a faculty-spanning central academic institution of Bielefeld University. Its purpose is to bundle the biotechnological activities and research projects at the university, to foster cross-linking of research approaches and technologies from different research fields and to develop innovative projects within its two main research areas: “Large Scale Genomics and Big Data Bioinformatics” and “Metabolic Engineering of Unicellular Systems and Bio-production”.

The first research area focuses on genome research on bacteria relevant for biotechnology, agriculture and the environment, on structural and functional decoding of genomes of crop plants, animal cell cultures and microalgae, on metagenomics analysis of microbial communities as well as on elucidation of the function and interaction of genes and genomes with post-genomics and bioinformatics methods. Within the second research area microorganisms, unicellular algae, and mammalian cell lines are applied for the production of a broad spectrum of valuable products.

These include the sustainable production of bioproducts with microorganisms,

the production of recombinant therapeutic and diagnostic proteins in animal cell lines, studies of plant growth and development, the optimisation of the sunlight-to-biomass conversion in phototrophic microorganisms, the production of biofuels with heterotrophic and phototrophic organisms, and the protein production and secretion as well as the synthesis of hydrocarbon compounds and the biocatalytic H₂ production with microalgae.

To this end, the three Technology Platforms of CeBiTec, namely for Bioinformatics, for Genomics and for Fermentation & Bioenergy, which are equipped with state-of-the-art instrumental infrastructure, play an important role and their equipment and expertise are indispensable for the fastidious biotechnological research projects conducted by the CeBiTec.

Furthermore, the CeBiTec organises several scientific events from workshops and scientific retreats to distinguished lectures and international research conferences.



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Founded (year)	1998
Number of employees	scientific 55 administrative 2
Funding	Federal Government (Germany) 56% State Government NRW 11% EU 2% Industry 31%

www.cebitec.uni-bielefeld.de

Research Field	Bioinformatics
Keywords	Bioinformatics, Data Integration, Genomics, Postgenomics, Workflows
Head of Institute	Dr. Stefan Albaum
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Technology Platform Bioinformatics

The large amounts of data acquired from today's PolyOmics technologies demand intensive bioinformatics support including adequate data management, efficient data analysis algorithms, and user-friendly software applications.

The Technology Platform Bioinformatics can look back on many years of expertise in the computational processing of genomic and postgenomic datasets. It serves as a central bioinformatics research unit and cooperation partner, offering a comprehensive IT infrastructure for data storage and analysis.

Furthermore, the Technology Platform Bioinformatics provides access to a variety of bioinformatics tools and software applications ranging from functional genome analysis and metagenomics to transcriptomics, metabolomics, and proteomics.

New developments at the platform in particular target the integration of data from different levels of -omics as well as the development and provision of re-usable workflows for large-scale data processing and exploration.

National Collaborations

Justus-Liebig-Universität Giessen
Ruhr-Universität Bochum
Max Planck Institut Bremen

Membership in local and regional Networks

Deutsches Netzwerk für Bioinformatik-Infrastruktur (de.NBI)
CLIB²⁰²¹

Research Field	Biotechnology
Keywords	Bioenergy Research, Biomass, Fermentation
Head of Institute	Dr. Jan Mussgnug Dr. Joe Max Risse
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Technology Platform Fermentation & Bioenergy

The Technology Platform Fermentation & Bioenergy combines knowledge and experience of the chairs of Cell Culture Technology, Fermentation Engineering and Algae Biotechnology & Bioenergy of Bielefeld University. The technical infrastructure has consequently been complemented and updated and currently hosts more than 30 bioreactors from different manufacturers and scales. Major topics are the cultivation of microbial and cell cultures as well as enzymatic reactions in a semi-pilot plant scale using a broad spectrum of organisms and enzymes.

The associated BioEnergieTechnikum is a technical center for bioenergy research. Build by Bielefeld University and sponsored by the Stadtwerke Bielefeld, the interdisciplinary approach and the modern technical equipment of the center offer groups

and departments of Bielefeld University/CeBiTec access to set experiments related to bioenergy research & application upon a technical scale.

Membership in local and regional Networks

CLIB²⁰²¹, Konsortium Bioenergie OWL, Neobzym

Technology Platform Genomics

The Technology Platform Genomics (TPG) has four sections addressing the most important technologies in genome research: Genomics mainly comprises genome sequencing. The most recent high-throughput sequencing systems from Illumina (HiSeq, MiSeq) and Oxford Nanopore are currently installed. Transcriptomics covers all techniques used to analyze transcripts. This includes gene expression by microarrays as well as deep sequencing of transcriptomes. Proteomics involves gel-based and gel-free separation as well as identification and quantification of proteins by MALDI-TOF or by LC-ESI mass spectrometry. Metabolomics embraces metabolic profiling and flux analysis by gas-chromatography (GC) or liquid-chromatography (LC) coupled to mass spectrometry (MS). The TPG is running three GC-MS and two LC-ESI instru-

ments, a quadrupole TOF and an ion-trap machine. All the Omics methods have been applied to microorganisms in the past and are currently extended also to higher organisms and to microbial communities.

International Collaborations

Universität für Bodenkultur, Vienna, Austria
Czech Academy of Sciences, Prague, Czech Republic
Chinese Academy of Sciences, Beijing, China

National Collaborations

Max-Planck Institute for Marine Microbiology, Bremen
Bayer Pharma AG
Evonik Nutrition and Care GmbH

Membership in local and regional Networks

CLIB ²⁰²¹

Research Field	Biotechnology
Keywords	Genomics, Metabolomics, Microbial Genomics, Microarrays, Proteomics
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**Deutsche
Sporthochschule Köln**
German Sport University Cologne



German Sport University Cologne

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Founded (year)	1947
Number of employees	scientific 330 (+400 PhD students) administrative 300

www.dshs-koeln.de

The German Sport University Cologne (GSU), founded in Cologne in 1947, combines qualified teaching and international research of the highest level. It is Germany's only, and Europe's largest, university in the field of sport and exercise science. Research and teaching at 21 academic institutes, four affiliate institutes and nine academic centres cover many aspects – all pertaining to sport and exercise. This expertise concentrated in one location allows for a unique interdisciplinary approach and provides the opportunity to examine complex social topics from various perspectives of sport and exercise science. The spectrum ranges from basic science research topics concerning the fundamentals of movement, performance and health to applied research projects, for example in the field of exercise science and in health promotion, prevention and rehabilitation.

Located at the Müngersdorf Sport Park, in the heart of Cologne's green belt and within an ideal sport infrastructure, the GSU offers an unique environment for 630 employees and approximately 6,000 students from 72 countries. 60 university partnerships are a sign of its international focus. As an university aligned with European ideas and state-

of-the-art graduate and postgraduate degree programmes, it has constantly encouraged and influenced sport and exercise science.

The spectrum of studies at the university includes five bachelor and nine master degree programmes as well as degrees in PE and six master degrees in advanced studies. Additionally PhD Studies in German and English are offered. The variety of training options enables precise orientation which aims to facilitate future career choices and prepares students optimally for the sport and exercise as well as health job market, which is constantly growing.

The GSU consistently follows its path as a research university. Its interdisciplinary work goes beyond institute and university borders, and it encourages young academics, particularly through the establishment of postgraduate programmes.

In the most diverse disciplines, academics at the GSU research a variety of problems using basic research methods as well as greater practical orientation. In further developing research results, GSU works closely with a range of industrial partners as well as public institutions, administrations, associations and societies.

Institute of Biochemistry / Centre for Preventive Doping Research

The Institute of Biochemistry is a central unit of the Centre for Preventive Doping Research of the German Sport University Cologne as well as the European Monitoring Center for Emerging Doping Agents (EuMoCEDA), and as such represents one of the worldwide largest WADA- and IOC-accredited doping control laboratories. The main research focus is sports drug testing, including the development of new analytical approaches for efficient and comprehensive anti-doping tests, conducting metabolism studies (*in vitro* and *in vivo*) for improved detection windows for established as well as new drug entities, and the identification of scenarios resulting in anti-doping rule violations caused by an inadvertent exposure of athletes to prohibited substances. Moreover, new testing strategies employing alternative matrices and minimal- or non-

invasive sampling methods are developed, allowing for primarily mass spectrometry-based analyses of target compounds.

International Collaborations

University of California Los Angeles (UCLA), California
 King's College London, UK
 Sports Medicine Research and Testing Laboratory, Salt Lake City, Utah

National Collaborations

University of Cologne
 Saarland University
 Heinrich Heine University Düsseldorf

Research Field	Anti-Doping Research, Analytical Chemistry
Keywords	Analytics, Metabolomics, Proteomics, Small Molecules, Sports Drug Testing/Doping Controls
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Institute of Cardiology and Sportsmedicine - Molecular and Cellular Sports Medicine

The main research interests at the field of exercise biology/physiology are mechanical, metabolic and redox signalling and adaptation of endothelial cells, haematopoietic cells, cardiac cells, skeletal muscle as well as stem cell dependent tissue regeneration. The investigation of extra cellular matrix modulation and epigenetic modulation by physical activity is a further goal of research. The research includes the whole range from cell culture, animal models up to human research. The effect of physical activity / training is investigated in elite athletes, recreational athletes and in patients with different diseases including diabetes, cardiovascular diseases, cancer and neurodegeneration as well as COPD.

International Collaborations

Department of Biology, Institute of Molecular Health Sciences, ETH Zurich, Zurich, Switzerland
 Edith Cowan University Health and Wellness Institute, Joondalup, WA 6027, Australia
 Unité Transversale de la Drépanocytose, CHU de Pointe-à-Pitre, Pointe-à-Pitre, Guadeloupe

National Collaborations

Institute of Physiology I, University of Bonn, Germany
 German Aerospace Center, Institute of Aerospace Medicine and Space Physiology, Cologne
 Department of Molecular Medicine, Max-Planck Institute of Biochemistry

Research Field	Human Biology, Physiology
Keywords	Immune Modulation, Regenerative Medicine, Stem Cell Research
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Research Field	Neurobiology, Movement and Neuroscience
Keywords	Alzheimer's Disease, Cardiovascular Research, Diabetes, Metabolomics, Neurodegenerative Diseases, Neurotransmitter, Neurotrophic Factors
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Institute of Movement and Neurosciences

Department I focuses on the observation of main motor forms of demand: coordination, strength, speed, endurance and flexibility in athletics, swimming and gymnastics. Aspects of motor learning play an important role. Central focus of department II is the analysis of the effect of physical activity on the brain of active and inactive people of different ages under specific environmental conditions. Another focus is on the aspects of sport for people with disabilities. The research in Department III is focused on relationships between (in)- active leisure activities and motor development or the performance of children and adolescents. In Department IV specific aspects of physical education, stress regulations, issues of promotion resilience, and aspects of management interventions are to be processed.

International Collaborations

European space Agency (ESA)
University of the Sunshine Coast,
Australia
European Research Group in Disability Sport (ERGiDS)

National Collaborations

German Space Agency
Functional Neuroimaging Group,
Department of Radiology, University
Hospital Bonn
German Research Centre for Elite Sport
Cologne (momentum)

Research Field	Physiology
Keywords	Ageing, Nutrition, Cardiovascular Research, Space Physiology, Exercise Physiology
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Institute of Physiology and Anatomy

We investigate the responses of the human body to unusual challenges such as physical activity, spaceflight and age-related structural change. We analyse both the underlying fundamental processes and their modifiability by training and therapy. This research is mainly supported by external funding and by collaboration at the national and international level. The institute consists of three units, motor physiology, exercise physiology, and anatomy.

International Collaborations

IBMP, Moskau
Nevsehir University, Turkey
ESA, Norrdwijk

National Collaborations

University of Chemnitz
University of Leipzig
University of Stuttgart

Membership in local and regional Networks

DFG-SPP Multitasking, Neuro-NRW





HEINRICH HEINE
UNIVERSITÄT DÜSSELDORF

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Founded (year)	1965
Number of employees	scientific 3,203 administrative 1,182
Funding	State Government NRW 100 %

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Heinrich Heine University Düsseldorf

Heinrich Heine University Düsseldorf (HHU) combines first class research and education with entrepreneurship in an environment that is inspired by innovation, collaboration, exchange, and diversity following our motto “Life, Nature, Society”.

Pursuing a growth strategy from its foundation in 1965, HHU today comprises five faculties (Medicine, Mathematics and Natural Sciences, Arts and Humanities, Business and Economics, and Law) and six central and cross-faculty facilities. The faculties offer more than 80 courses of study and are home to 331 professors and over 3,833 academic and non-academic staff members. HHU is the *alma mater* for about 32.069 students. The University’s departments enjoy an excellent reputation due to for example their collaborative research centres (currently three collaborative research centres and one transregio collaborative research centre that are coordinated at HHU). The Cluster of Excellence on Plant Sciences (CEPLAS) which focuses internationally renowned expertise from the Universities of Düsseldorf and Cologne, the Max Planck Institute for Plant Breeding Research (MPIZ), and the Forschungszentrum Jülich is a unique research and

training venture to advance plant and microbial research in an ecological context. Moreover, the state capital Düsseldorf provides an attractive environment with a high quality of life.

HHU is internationally renowned for its outstanding research in life sciences and biomedicine. HHU life science and biomedical researchers closely collaborate in several collaborative research consortia and interdisciplinary university core facilities. Biotechnology is one of the key profile areas of the Faculty of Mathematics and Natural Sciences. Additionally, HHU is an active partner within the Bioeconomy Science Center (BioSC) and has close collaborations with non-university research institutions such as the Forschungszentrum Jülich and the local industry. Outstanding education and training of doctoral researchers are central to the mission of HHU which is also reflected in the high number of research training groups and graduate schools coordinated at HHU. HHU has a long-standing tradition of entrepreneurship and was selected in 2011 as one of 10 universities for funding within the EXIST IV programme of the Federal Ministry for Economics and Technology.

Group of Solid-State NMR

We study the interaction of membrane proteins within the membrane, membrane association of a paramagnetic molecule and protein misfolding of a disease relevant protein. In the future, we will exploit the novel MAS-DNP technique for sensitivity enhancement.

International Collaborations

SISSA Trieste, Italy
RIKEN, Saitana, Japan

National Collaborations

Max Planck Institute, Mülheim Ruhr

Membership in local and regional Networks

Bioeconomy Science Center (BioSC),
AcademiaNet
Liebig Alumni of the FCI, AvH Alumni

Research Field	Biophysics, Solid-state NMR Spectroscopy of Biopolymers
Keywords	Analytics, Biomaterials, Parkinson Disease, Structural Biology
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Institute of Biochemistry I – Membranetransport

Our laboratory uses state-of-the-art molecular biology in yeast and bacteria for high level protein production and isolation, protein characterization as well as X-ray crystallography to study transport processes across biological membranes. Currently we focus on membrane proteins of the ABC transporter family that are involved in bacterial protein secretion systems (type 1 secretion), bacterial, fungal and human drug resistance (multidrug resistance) as well as in human diseases of the liver. To understand the mechanistic principles of such transport processes, we employ a wide variety of techniques such as fluorescence spectroscopy, surface plasmon resonance or isothermal titration calorimetry (ITC) to study protein-ligand and protein-protein interactions in vitro. These set-ups are completed by various

in vivo approaches. For example, the type 1 secretion system has been recently optimized for the secretion of fusion proteins that principally allow high-level isolation of the fusion protein directly from the supernatant and subsequent downstream processing.

International Collaborations

University of Groningen, The Netherlands
University of Paris-Sud, France

National Collaborations

Philipps University Marburg

Membership in local and regional Networks

CLIB²⁰²¹
Bioeconomy Science Center (BioSC)
Cluster of Excellence on Plant Sciences (CEPLAS)

Research Field	Biochemistry, Structural Biology
Keywords	Enzymes, Platform Technology, Recombinant Proteins, Structural Biology
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Research Field	Biochemistry, Biocatalysis, Protein Engineering
Keywords	Biocatalysts, Enzymes, Synthetic Biology
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Institute of Biochemistry II – Biotransformation and Biocatalysis

Our research focuses on the optimization of biocatalysts for technical application. Applications of enzymes in biotransformation require high enzyme expression levels, fast substrate conversion rates, high enzyme selectivity as well as system stability in order to reach high total turnovers.

The actual research projects involved e.g. identification, cloning and high-level production of target enzymes in recombinant hosts, elucidation of the molecular mechanisms, which mediate activity and selectivity of enzymes, and improving activity, selectivity and stability of enzymes by protein engineering. The optimization strategies for enzymes target diverse areas such as the extension of substrate spectra, enzyme specificity, but also cofactor recycling and enhancement of thermal and process stability which often can be achieved by immobilization of enzymes.

International Collaborations

Free State University, South Africa
University of Oviedo, Spain
University of Kyoto, Japan
TU Delft, The Netherlands

National Collaborations

Universität des Saarlandes
Universität Leipzig
Universität Stuttgart

Membership in local and regional Networks

CLIB²⁰²¹
Bioeconomy Science Center (BioSC)

Research Field	Bioinformatics, Theoretical Biology
Keywords	Genomics, Microbial Genomics, Systems Biology
Head of Institute	Prof. Martin Lercher, Ph.D.
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Institute of Bioinformatics

In order to understand complex biological systems, we need to see them in light of their functional connections (an ancient insight now termed Systems Biology). The networks best studied experimentally are transcriptional regulation, genetic interactions, and especially metabolism. A strategy that has proven highly fruitful for the analysis of these systems is the combination of complementary methodological approaches.

Accordingly, the Institute of Bioinformatics combines modelling approaches with comparative or population genomics data, or integrates functional and evolutionary models. A major aim is to understand the co-evolution of genes and functions in the context of the complete organism. This understanding not only advances basic knowledge, but also pinpoints promising

starting points for biotechnological modifications of microbes and plants.

International Collaborations

Biological Research Centre of the
Hungarian Academy of Sciences, Szeged,
Hungary
Technion, Israel Institute of Technology,
Haifa, Israel

National Collaborations

University of Cologne

Membership in local and regional Networks

Bioeconomy Science Center (BioSC)
Center of Excellence in Plant Sciences
(CEPLAS)

Institute for Biochemical Plant Physiology

Proteins carry out many fundamental biological processes. In these processes they accomplish a remarkable variety of functions such as binding, catalysis, transport, cellular signalling and more. Knowledge of the 3D structures of proteins is critical to obtain a detailed insight into their function, molecular mechanism or interaction with their binding partner. The research at the Institute for Biochemical Plant Physiology focusses on structural and functional characterization of proteins and their interaction with small molecules.

Our group has expertise in expression, purification, crystallization, structure analysis and functional characterisation of eukaryotic proteins. The major tools employed are X-ray diffraction and fluorescence spectroscopy, but other biophysical, biochemical and molecular

biological techniques are also used. Major research topics in the laboratory are key enzymes of C4 photosynthesis, molecular chaperons and plant hormone receptors.

International Collaborations

University of Western Australia, Australia
Ghent University, Belgium
Michigan State University, USA

National Collaborations

Gottfried Wilhelm Leibniz University
Hannover
Forschungszentrum Jülich
RWTH Aachen

Membership in local and regional Networks

Bioeconomy Science Center,
Plant Biology Network (CEPLAS)

Research Field	Biochemistry, Plant Biology/Physiology
Keywords	Agricultural Biotechnology, Recombinant Proteins, Signal Transduction, Small Molecules
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Institute of Bioorganic Chemistry

The group focuses on target molecule oriented synthesis. For this the development of new synthetic methods is pursued in order to access broadly applicable (enantiomerically pure) building blocks. In recent years expertise was acquired in organoboron chemistry, but of particular interest are bio-catalytical methods: New (as well as commercially available) enzymes, e.g. hydrolases, oxidoreductases, lyases, are utilized in chemoenzymatic syntheses.

The methods were applied in natural product synthesis: Target molecules range from polyketides, glycolipids, and arachidonic acid metabolites to non-natural effectors, e.g. as optogenetic tools. Complete facilities including the essential analytical equipment are available for organic syntheses as well as molecular biology projects.

International Collaborations

University of Osaka, Japan
Russian Academy of Science, Pushchino, Russia

National Collaborations

RWTH Aachen
University of Bielefeld
University of Bonn
TU Dortmund
FH Köln

Membership in local and regional Networks

CLIB²⁰²¹,
Bioeconomy Science Center (BioSC)
BioRiver

Research Field	Biocatalysis, Organic Chemistry
Keywords	Natural Products, Total Synthesis, Small Molecules, Enzymes
Head of Institute	Prof. Dr. Jörg Pietruszka
Internet	www.iboc.uni-duesseldorf.de
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Fax	+49 2461 61-6196

Research Field	Genetics/Molecular Biology, Plant Biology/Physiology
Keywords	Crop Research, Genetic Engineering, Genomics
Head of Institute	Prof. Dr. Peter Westhoff
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Institute for Developmental and Molecular Biology of Plants

(1) Molecular evolution of C4 photosynthesis in the genus *Flaveria*; (2) Identification of nuclear-encoded auxiliary and regulatory genes for thylakoid membrane biogenesis in *Arabidopsis*; (3) Molecular characterization of agronomically important quantitative trait loci (QTL) in maize.

International Collaborations

International Rice Research Institute
University of Cambridge
University of Oxford

National Collaborations

KWS Saat AG

Membership in local and regional Networks

Cluster of Excellence in Plant Sciences (CEPLAS)
Bioeconomy Science Center (BioSC)

Research Field	Cell Biology, Plant Biology/Physiology
Keywords	Biomass, Crop Research, Microscopy, Signal Transduction
Head of Institute	Prof. Dr. Rüdiger Simon
Internet	www.devgen.hhu.de
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Address	Universitätsstr. 1 Building 26.12, Level 02 Room 22
Postal Code/City	40225 Düsseldorf
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Institute for Developmental Genetics

Research in the developmental genetics institute concentrates on the cellular and developmental biology of *Arabidopsis* and related Brassicaceae. The labs are well equipped, and the local technological infrastructure includes a robotic platform for high-throughput in situ hybridisation, tissue processors, real-time PCR, confocal, transmission and scanning electron microscopy, high resolution fluorescence microscopy with single-photon counting and image analysis. The team focusses on signal transduction pathways that control cell-cell communication during growth of meristems. Besides analysing signal release and perception, the lab investigates the transcription factor networks that regulate stem cell identity and the formation of organs and meristem-to-organ boundaries.

Standard techniques used in the lab are yeast 1- and 2-hybrid analysis, Affymetrix

microarray technology and next generation RNA sequencing, laser capture microdissection, ChIP, inducible gene expression system, fluorescence techniques for protein analysis such as FCS, FLIM, FRET, FRAP, targeted inducible gene misexpression technologies, and in situ localization of gene and protein expression in living tissues.

International Collaborations

University of Milano
University of Oslo

National Collaborations

Universität Regensburg
Universität Heidelberg

Membership in local and regional Networks

Bioeconomy Science Center (BioSC),
CEPLAS

Institute of Functional Cell Morphology Laboratory

Our research focusses on the molecular mechanisms that build and shape a functional nervous system. Using large-scale mutagenesis screens we have identified a set of genes that regulate the organization and remodelling of synapses in the genetic model organism *Drosophila melanogaster*. Several of these genes are highly conserved in humans and, interestingly, functionally inactivated in inherited neuronal diseases such as Amyotrophic Lateral Sclerosis (ALS),

Hereditary Spastic Paraplegia (HSP) or Charcot-Marie-Tooth Disease type 2 (CMT2). To study the functions of these genes in the establishment and maintenance of synapses in *Drosophila* we employ state-of-the-art techniques, such as optogenetics, genetically-encoded biosensors, intravital imaging, high-speed

videography and superresolution microscopy (STED, SIM).

International Collaborations

Friedrich Miescher Institute Basel, Switzerland
Trinity College Dublin, Ireland

National Collaborations

Free University Berlin
LIMES, Bonn
University of Cologne

Membership in local and regional Networks

iBrain - Graduate School for Translational Neuroscience
CAi - Center for Advanced Imaging

Research Field	Developmental Biology, Neurobiology
Keywords	Microscopy, Neurodegenerative Diseases, RNA/RNAi/ Antisense RNA
Head of Institute	Prof. Dr. Hermann Aberle
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Institute of Metabolic Physiology

The institute works on the cellular mechanisms of insulin secretion, pancreatic beta cell proliferation and survival as well as angiogenesis with the aim to understand the physiology of these processes. In addition, disease models are used for developing drugs for diabetes treatment.

International Collaborations

Genentech Inc., South San Francisco, Ca, USA
Eidgenössische Technische Hochschule (ETH), Basel, Switzerland
Department of Medicine, Imperial College London, London, UK

National Collaborations

Profil Institute for Metabolic Research, Neuss, Germany
University Children's Hospital, Düsseldorf, Germany
Institute of Neuro- and Sensory Physiology, University Hospital Düsseldorf, Düsseldorf, Germany

Membership in local and regional Networks

Member of the European Association of the Study of Diabetes (EASD)
Member of the Scientific Advisory Board of the German Society of Cell Biology
Speaker of the preclinical section of the Competence Network Diabetes (BMBF)

Research Field	Human Biology, Physiology, Diabetes Mellitus, Angiogenesis, Drug development
Keywords	Cardiovascular Research, Diabetes, Drug Discovery/Delivery, Lead Discovery, Therapeutics
Head of Institute	Prof. Dr. Eckhard Lammert
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Address	Universitätsstr. 1 Building 26.12, Level 00/ Room 00.80
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Fon	+49 211 81-14990
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Research Field	Biotechnology, Microbiology
Keywords	Antibody, Biopharmaceuticals, Enzymes, Pathology, RNA/ RNAi/Antisense RNA
Head of Institute	Prof. Dr. Michael Feldbrügge Dr. Kerstin Schipper
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Fon Fax	+49 211 81-15475 +49 211 81-15370

Institute for Microbiology

The causative agent of corn smut, *Ustilago maydis*, has matured as an excellent model system throughout the last decade. Currently, it belongs to the best 10 fungal pathogens in molecular plant pathology. Using this model pathogen, the Institute for Microbiology is focusing on three different aspects: cell biology, pathogenicity and biotechnology. In the cell biology section, we apply *in vivo* approaches to study different aspects of RNA biology, such as the role of endosomes, in *U. maydis*. With respect to pathogenicity, we investigate various aspects of the infection process in *U. maydis* and *Thecaphora*, i.e. to establish a Brassicaceae-smut infection system. In the applied sciences, we are applying *U. maydis* as novel protein expression system. As a unique feature we use unconventional secretion for the export of

functional proteins, such as single-chain antibodies and lipases.

International Collaborations

Michigan State University, East Lansing, USA
UNAM, Mexico City, Mexico

National Collaborations

Ludwig Maximilians University Munich,
Karlsruhe Institute of Technology
RWTH Aachen
Forschungszentrum Jülich
Max-Planck Institute for Plant Breeding
Cologne

Membership in local and regional Networks

CLIB²⁰²¹
BioSC NRW

Research Field	Botany, Plant Biology/ Physiology, Metabolite Analysis
Keywords	Analytics, Metabolomics, Plant Produced Products, Small Molecules, Signal Transduction
Head of Institute	Prof. Dr. Jürgen Zeier
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Fon	+49 211-81-14733

Institute for Molecular Ecophysiology of Plants

Plants have to cope with changing environmental conditions throughout their lifetime. To successfully grow and develop, they must adequately respond to a variety of biotic and abiotic factors. For instance, plants are equipped with an intricate defence network with which they counteract attempted invasion by bacterial, fungal, or viral plant pathogens. Our research group is interested in the molecular responses that plants activate after having recognized such microbial invaders. In particular, we are seeking to better understand systemic acquired resistance, a plant response that provides broad-spectrum resistance to the whole foliage to pathogen infection. This is achieved by the combinatory use of interdisciplinary approaches such as physiological, molecular genetic, bio-

chemical, analytical-chemical and high-end metabolite profiling analyses.

Institute of Molecular Enzyme Technology (IMET)

Scientists at IMET develop microbial expression systems and synthetic biology modules for the production of difficult-to-express enzymes, membrane proteins and secondary metabolites. In addition, mechanisms of protein folding and secretion are investigated and applications of newly discovered enzymes are examined. Another research focus is the isolation, biochemical and structural characterization of a new class of oxygen independent fluorescent proteins which can be applied as molecular reporters and sensors. State-of-the-art molecular- and opto-genetic tools, microbiological, biochemical and biotechnological methods are applied. A high-throughput robotic screening facility enables the identification of novel enzymes, e. g. from metagenomes, and their subsequent optimization using directed evolution methods. The IMET

harbors laboratories according to German security level S2 allowing to experimentally handle putative pathogens.

International Collaborations

School of Biological Sciences, Bangor University, Bangor, United Kingdom.
 Institute of Catalysis and Petrochemistry (ICP), Spanish Council for Scientific Research (CSIC), Madrid, Spain.
 Hans Kleivdal, Uni Research Environment, Bergen, Norway

National Collaborations

Institutes of Biotechnology and Biochemical Engineering, RWTH Aachen University.
 Department of Biology, Biozentrum Klein Flottbek, Hamburg University
 CEBITEC Bielefeld

Membership in local and regional Networks
 CLIB²⁰²¹, BioRiver e. V., BioSC, Cluster of Excellence on Plant Sciences (CEPLAS),

Research Field	Biotechnology
Keywords	Biocatalysts, DNA, Enzymes, Genetic Engineering, Recombinant Proteins
Head of Institute	Prof. Dr. Karl-Erich Jaeger
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Postal Code/City	52428 Jülich
Fon	+49 2461 61-3716
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Institute of Molecular Evolution

The terms that best describe our work are “early evolution” and “endosymbiosis”. In the laboratory, we mainly work on the biochemistry and evolution of bioenergetic organelles (chloroplasts and mitochondria) with a special focus on organelle origins and the role of anaerobic energy metabolism therein. At the computer, we have helped to pioneer the use of networks, instead of trees, to capture the vertical and horizontal component of genome evolution. We have made noted contributions to the understanding of gene transfer in evolution, both in the context of endosymbiotic organelle origins and in the context of gene transfer among free-living prokaryotes. Our work has been recognized with well over 10,000 citations (h-index 54) and an Advanced Grant from the European Research Council (2008).

International Collaborations

University of Utrecht, The Netherlands
 University College, London , UK
 Massey University, New Zealand

National Collaborations

Philipps-University Marburg
 Zoologisches Forschungsmuseum
 Alexander Koenig, Bonn
 Universität Wien

Membership in local and regional Networks

Bioeconomy Science Center (BioSC)
 iGRAD-Plant

Research Field	Physiology, Molecular Evolution
Keywords	Bioenergy Research, Bioinformatics, Comparative Genomics, Microbial Genomics, Systems Biology
Head of Institute	Prof. Dr. William Frank Martin
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Research Field	Microbiology
Keywords	Anti-infective Research, Fungal Biotechnology, Genetic Engineering, Recombinant Proteins
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Fon	+49 211 81-15176
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Institute for Molecular Mycology

Research in Molecular Mycology is focused on *Candida* fungal species that cause human disease or that are useful for biotechnology applications. *Candida albicans* is the most important fungal pathogen causing superficial or systemic mycoses in humans. Molecular mechanisms contributing to virulence of the pathogen are being studied with the aim to establish targets for novel antifungal compounds. *Candida utilis* is a harmless food yeast able to grow on numerous abundant biosubstrates to high density. We are establishing this fungus as an alternative host for production of heterologous proteins, investigating in particular secretion strategies to facilitate product purification.

International Collaborations

Universidad Complutense de Madrid, Madrid, Spain
Jawaharlal Nehru University, New Delhi, India

National Collaborations

Heinrich Heine University, Jülich, Germany

Membership in local and regional Networks

CLIB Graduate Cluster
MOI Graduate School
NRW ExpressO
ERA-Net PathoGenoMics

Research Field	Organic Chemistry, Polymer Chemistry
Keywords	Biocatalysts, Cancer, Colon Cancer, Enzymes, Small Molecules
Head of Institute	Prof. Dr. Thomas J.J. Müller
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Institute of Organic Chemistry and Macromolecular Chemistry

The research in our institute is focused on molecular and macromolecular functional compounds. The scope ranges from small molecule entities with biological activity or functional chromophores to supramolecular interactions of polymer-molecule host-guest interactions

International Collaborations

Cluj-Napoca, Romania
Iasi, Romania
Université de Strasbourg, France

National Collaborations

Henkel KGaA
BASF SE
Evonik

Membership in local and regional Networks

CLIB²⁰²¹

Institute for Pharmaceutical Biology and Biotechnology

The research activities of the group of Prof. Proksch focus on the discovery of new bioactive natural products from marine organisms, fungi and from higher plants with activities against cancer and infectious diseases. Other research topics include new anti-fouling compounds and plant derived insecticidal and fungicidal compounds with potential use for plant protection. We cover the isolation and spectroscopic structure elucidation of new leads from nature as well as their production through fermentation.

International Collaborations

Peking University, Beijing, RP China
Chinese Academy of Sciences, Qingdao, RP China
University of Debrecen, Hungary

National Collaborations

University Mainz
Heinrich Heine University Düsseldorf
DKFZ Heidelberg

Research Field	Biotechnology, Organic Chemistry, Bioactive Natural Products
Keywords	Analytics, Antibiotic, Anti-infective Research, Cancer, Lead Discovery, Plant Produced Products
Head of Institute Internet	Prof. Dr. Peter Proksch www.pharmazie.uni-duesseldorf.de/Institute/pharm_bio
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Institute of Physical Biology

Research of the Institute of Physical Biology (IPB) focuses on the development and application of methods to precisely investigate three-dimensional structures, dynamics, ligand interactions and molecular mechanisms of biologically and medically relevant macromolecules involved in basic cellular processes like autophagy. Function and malfunction of most investigated proteins play decisive roles in the development and progression of infectious diseases, e.g. AIDS and Hepatitis C, and neurodegenerative diseases, e.g. prion diseases, Alzheimer's and Parkinson's disease. Thus, folding, misfolding and aggregation together with protein-protein and other protein-ligand interactions need to be investigated quantitatively and – if possible – in atomic detail by liquid and solid state NMR, X-ray crystallography and computational biology methods. With the

development of novel approaches for early diagnosis of neurodegenerative disorders as well as therapeutic and preventive approaches to Alzheimer's disease, applied research is carried out as well.

International Collaborations

Institut de Biologie Structurale, CEA, Grenoble, France
University of Alabama at Birmingham, USA
Tel Aviv University, Israel

National Collaborations

Forschungszentrum Jülich, Caesar Universities of Erlangen-Nuernberg and Duisburg-Essen

Membership in local and regional Networks

NRW Research School BioStruct
GRK1033, IHRS BioSoft, Bio-N³MR Network
NRW, Competence Network Degenerative Dementias, CLIB-GC, MOI,
Neuroscience Network Düsseldorf

Research Field	Biochemistry
Keywords	Alzheimer's Disease, Biomarker, Infectious Diseases, Neurodegenerative Diseases, Structural Biology, Biomolecular NMR, Spectroscopy, Protein Ligand Interactions, Autophagy
Head of Institute Internet	Prof. Dr. Dieter Willbold www.uni-duesseldorf.de/MathNat/ipb
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Research Field	Biochemistry, Plant Biology/Physiology
Keywords	Biomass, Genomics, Metabolomics, Systems Biology, Synthetic Biology
Head of Institute	Prof. Dr. Andreas Paul M. Weber
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Institute for Plant Biochemistry

The Institute of Plant Biochemistry is using systems biology approaches to obtain a comprehensive mechanistic understanding of plant metabolism and function. Through comparative genomics and transcriptomics, we generate blueprints of plant metabolic pathways, such as C4 photosynthesis and photorespiration.

The specific focus is on compartmentation of metabolic pathways and intracellular solute transport and on transcriptional programs involved in governing leaf structure and function. Molecular blueprints of plant metabolism will permit the engineering of novel plants with improved properties, such as the ability to perform C4 photosynthesis or increased resistance to biotic and abiotic stressors. In synthetic biology approaches, we attempt to establish synthetic organelles with photosynthetic capacity in non-

photosynthetic cells, thereby creating novel photosynthetic organisms.

International Collaborations

Michigan-State-University, East Lansing, MI, USA
University of Cambridge, UK
University of Lille, France

National Collaborations

University of Erlangen-Nürnberg
Ludwig Maximilians University, Munich
University of Cologne

Membership in local and regional Networks

Bioeconomy Science Center (BioSC)
iGRAD-Plant

Research Field	Genetics/Molecular Biology, RNA Biology, Biotechnology
Keywords	Genetic Engineering, RNA/RNAi/Antisense RNA, Systems Biology, Synthetic Biology
Head of Institute	Prof. Dr. Ilka Maria Axmann
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Fax	+49 211-81-12287

Institute for Synthetic Microbiology

The Institute for Synthetic Microbiology researches molecular regulatory processes in microorganisms influenced by internal factors like small RNA molecules or the circadian clock. The plethora of regulatory mechanisms mediated by RNA, we can use for designing novel RNA regulators and RNA-based metabolite-sensors. By implementing these synthetic RNAs into microorganisms, we are aiming at a smart, automated and dynamic control of signaling and metabolic pathways. Particular focus is placed on the engineering of cyanobacteria as a future host for sustainable biotechnology.

National Collaborations

Albert Ludwig University of Freiburg
Humboldt University of Berlin
Leipzig University

Membership in local and regional Networks

Bioeconomy Science Center (BioSC),
Cluster of Excellence on Plant Sciences (CEPLAS)

International Collaborations

Utrecht University, The Netherlands
University of Vienna, Austria
Pierre and Marie Curie University, France

Section for Bioinorganic Chemistry

Our research focuses on porous coordination polymers/metal-organic frameworks (MOFs), mixed-matrix membranes, (metal) nanoparticles, ionic liquids, supramolecular chemistry, bioinorganic chemistry and catalysis. Functional aspects of this work lie in the areas of gas storage, gas separation, drug carriers and drug release, e.g. carbon monoxide (CO) releasing molecules (CORMs) as gasotransmitters, anion detection and catalytic transformations.

International Collaborations

Universidad La Laguna, Spain
Lanzhou Institute of Chemical Physics,
CAS, Lanzhou, China
Murcia University, Spain

National Collaborations

Fraunhofer Institute for Solar Energy
Systems ISE
BASF SE, Ludwigshafen

Research Field	Inorganic Chemistry, Nanotechnology
Keywords	Biomass, Drug Discovery/ Delivery, Small Molecules, Gasotransmitters, Carbon Monoxide Releasing Molecules
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Rheinische Friedrich-Wilhelms-Universität Bonn

Traditionally modern – the University of Bonn

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Address	Regina-Pacis-Weg 3
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Contact Person	Holger Impekoven, Dezernent für Forschung
Fon	+49 228 73-5944
E-Mail	impekoven@ verwaltung.uni-bonn.de
Internet	www.uni-bonn.de
Founded (year)	1818
Number of employees	scientific 4.032 administrative 1.784

www.uni-bonn.de

Bonn is one of the large universities in Germany, with around 35,000 students, 550 professors, 6,500 other staff staff. It offers a wide disciplinary spectrum comprising some 200 different degree programmes, from Agricultural Science to Tibetan Studies. This diversity is what characterizes Bonn as a full-range university with a strong international orientation. In many international university rankings Bonn is placed among the 100 best universities in the world.

Its academic and research profile features internationally renowned specializations in the fields of Mathematics, Physics/Astronomy, Economics, Chemistry, Pharma Research, Biosciences, Genetic Medicine, Neurosciences and Philosophy/Ethics. Other disciplines, such as Geography and Law, are of outstanding importance within the German research scene.

The Rheinische Friedrich-Wilhelms-Universität Bonn is rooted in a long tradition going back almost 200 years. It was founded in 1818 by Friedrich-Wilhelm III, the Prussian king whose name it bears. Imbued with the spirit of Wilhelm von Humboldt, the university quickly joined the circle of

Germany's most distinguished universities and became a major pole of attraction for leading scholars as well as students.

The list of famous professors ranges from the astronomer Friedrich Wilhelm Argelander (1799-1875), through the chemist August Kekulé von Stradonitz (1829-1896) and political economist Josef Schumpeter (1883-1950) to the philologist Ernst Robert Curtius (1886-1956) and the theologians Karl Barth (1886-1968) and Joseph Ratzinger (born 1927), now Pope Benedict XVI. Bonn's best-known students include Heinrich Heine, Karl Marx, Friedrich Nietzsche, and Konrad Adenauer.

The university is proud of a long list of award-winning scientists and scholars, with about twenty Leibniz Prize winners and around thirty ERC grantees. In the last three decades two professors have received the Nobel Prize: Wolfgang Paul (for Physics, 1989) and Reinhard Selten (for Economics, 1994).

Institute for Cellular and Molecular Botany

The IZMB (Institute of Cellular and Molecular Botany) at Bonn University consist of the three departments Molecular Evolution (Prof. Dr. Volker Knoop), Cell Biology (Prof. Dr. Diedrik Menzel) and Ecophysiology (Prof. Dr. Lukas Schreiber). Research at the IZMB is dealing with various aspects of functional plant biology. Scientific approaches include molecular biology, molecular evolution, cell biology, physiology and phytochemistry. Main research topics are molecular evolution of early land plants, membrane transport of nutrients, cytoskeleton and differentiation of plant cells and plant environment interactions occurring across plant interfaces made of cutin and suberin. Experimental approaches range from the molecular and cellular level to the organismic level of the intact plant.

International Collaborations

Chinese Academy of Sciences, Beijing, China
Shanghai Jiaotong University, Shanghai, China

National Collaborations

BASF SE, Limburgerhof
Max Planck Institute for Plant Breeding, Cologne

Research Field	Plant Biology/Physiology
Keywords	Agricultural Biotechnology, Environmental Research, Genomics, GMO, Microscopy, Plant Breeding
Head of Institute	Prof. Dr. Lukas Schreiber
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Institute for Genetics

The main interest of our research is to understand the role of the actin cytoskeleton and cell motility in mouse morphogenesis and tissue physiology.

We employ the mouse as a genetic model system to specifically manipulate cell motility in different tissues and cell types. We apply an interdisciplinary approach of molecular genetics, cell biology and biochemistry to understand basic questions of cytoskeletal dynamics during tissue morphogenesis and regeneration, during cell shape changes, cell polarization and cytokinesis. The relevance of cytoskeletal dynamics in physiological processes such as neuronal transmission, local immune responses and metastasis is indisputable, however the control mechanisms and the links of cytoskeletal dynamics to physiological readout are poorly understood.

Current and future projects in our unit focus on mechanisms of actin dynamics in synaptic plasticity, on the polarity of stem cell division, on local immune responses and mechanisms of metastasis.

International Collaborations

Margaret Frame, University Edinburgh
The University of Missouri, Columbia, USA
Instituto de Tecnologia Quimica e Biologica, Oeiras. Portugal

National Collaborations

University of Kaiserslautern
University of Erlangen

Research Field	Genetics/Molecular, Biology/Physiology
Keywords	Animal Models, Genetic Engineering, Immune Modulation, Microscopy, Neurodegenerative Diseases
Head of Institute	Prof. Dr. Walter Witke
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Research Field	Immunosciences, Infection
Keywords	Immunology, Inflammation, Medical Immunosciences, Infectious Diseases, Oncology, Rheumatology
Head of Institute	Prof. Christian Drosten, Prof. Gunther Hartmann, Prof. Achim Hörauf, Prof. Christian Kurts, Prof. Eicke Latz
Internet E-Mail	www.immunosensation.de c.gottschalk@uni-bonn.de
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Postal Code/City	53127 Bonn
Fon	+49 228 287 51286
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Institutes of Immunosciences and Infection

The Bonn Institutes of Immunosciences and Infection (BI³) represent the core institutes of the research focus area "Immunology and Infectious Diseases" at the Medical Faculty, University of Bonn. Founding members are the Institutes of Clinical Chemistry and Clinical Pharmacology (G. Hartmann), Experimental Immunology (Ch. Kurts), Innate Immunity (E. Latz), Molecular Medicine (V. Hornung), Medical Microbiology, Immunology and Parasitology (A. Hörauf), and Virology (Ch. Drosten). The BI³ provide a coordinated infrastructure to facilitate synergistic projects, promote young researchers and foster excellent training concepts. The core expertise includes immune sensing of nucleic acids, the inflammasome, immunobiology of cancer, metabolic and cardiovascular diseases, and infectious diseases. The BI³ co-operate in a number of DFG-funded

research initiatives, like the Cluster of Excellence ImmunoSensation, as well as the German Center of Infectious Diseases (DZIF) and the German Center of Neurodegenerative Diseases (DZNE).

International Collaborations

University of Massachusetts Medical School

The Hebrew University of Jerusalem
University of Melbourne

National Collaborations

LIMES Institute
caesar, DZNE, DZIF in Bonn

Membership in local and regional Networks

DFG Cluster of Excellence "ImmunoSensation",
DFG collaborative research centers SFB 645, SFB 704
DFG iRTG 2168 (Bonn/Melbourne)

Research Field	Microbiology
Keywords	Antibiotic, Enzymes, Food Science, Genetic Engineering, Microbial Physiology, Biotransformations
Head of Institute	Prof. Dr. Erwin Galinski
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Institute of Microbiology and Biotechnology

The Institute of Microbiology and Biotechnology covers a wide range of topics including microbial physiology, biochemistry, microbial genetics, food microbiology and applied microbiology and biotechnology. In education we offer a Master's degree in Microbiology.

Research interests include:

Food safety, bacterial cold adaptation and water recycling in aquaculture; application of regioselective enzymes for the production of fine chemicals; methanogenic archaea for biogas production plants; biochemistry and molecular genetics of bacterial sulfur metabolism; determinants of catalytic bias, sulfur metabolism in pathogenic bacteria, microbial energy conversion; microbial degradation and conversion of lignite (brown coal); biotechnological application of extremophilic bacteria.

International Collaborations

The University of Queensland, Brisbane, Australia

The University of Missouri, Columbia, USA
Instituto de Tecnologia Quimica e Biologica, Oeiras, Portugal
University of East Anglia, Norwich, UK

National Collaborations

Institute of Bio- and Geosciences, Biotechnology (IGB-1), Jülich, RWTH Aachen
Fraunhofer Institute of Molecular Biology and Applied Ecology (IME), Aachen
Institute for Pharmaceutical Biology and Biotechnology, Heinrich Heine Universität Düsseldorf, Technical University, Darmstadt

Membership in local and regional Networks

Bioeconomy Science Center (BioSC)
NRW International Graduate Research School Biotech Pharma

Institute for Molecular Physiology and Biotechnology of Plants

Dorothea Bartels's research group is concerned with the molecular basis of drought tolerance in plants. We work primarily with so-called resurrection plants that can adapt to extreme drought, such as *Craterostigma plantagineum* and *Oropetium thomaeum*. These plants have the remarkable ability to survive extreme drought. After rehydration the plants resume physiological activities within 24 hours of rehydration. The mechanism of desiccation tolerance resembles dormancy survival in dry seeds. recently the genome sequence of *O.thomaeum* was determined. Another area of research, are changes in sugar metabolism. In the non-stressed plant enters the unusual sugar 2-octulose in large quantities in the leaves. During the drying octulose is converted into sucrose, and vice versa in the re-watering. It is believed that the sugar has a protective

function. We further try to engineer plant-derived aldehyde dehydrogenase enzymes which function as biocatalysts to detoxify reactive, toxic aldehydes.

International Collaborations

Molecular Biology Institute of Barcelona (IBMB), Spain
 Centro de Investigaciones Biologicas-CSIC, Madrid, Spain
 Danforth Center Missouri, USA

National Collaborations

Max Planck Institut für Pflanzenzüchtung Köln
 Universität Koblenz

Membership in local and regional Networks

AkademiaNet
 Deutsche Gesellschaft für Biochemie EMBO (European Molecular Biology Organisation)

Research Field	Plant Biology/Physiology
Keywords	Agricultural Biotechnology, Environmental Research, Genomics, Plant Breeding, Proteomics, Signal Transduction
Head of Institute	Prof. Dr. Dorothea Bartels
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Institute for Pharmaceutical Microbiology

Antibiotics are arguably the most important drugs discovered in the 20th century and many disciplines of modern medicine heavily depend on effective antibiotics. Today, many antibacterial drugs lose their efficacy by the spread of multiresistant bacteria. Coinciding with this alarming trend the antibiotic development pipeline is virtually empty. For rational antibiotic development a detailed understanding of the antibacterial mechanisms is pivotal. The research at IPM focuses on the elucidation of antibiotic mechanisms combining basic and translational research. A special focus of our research is on bacterial cell wall biosynthesis as a target for novel antibiotics. Since most successful antibiotics kill bacteria not by merely binding to a single target, but by a cascade of downstream processes a detailed understanding of the cellular processes is key for the future de-

velopment of drugs. The basic research in this area is funded by the German Research Foundation. Translational activities are embedded in research consortia, including the TTU Novel Antiinfectives of the German Center of Infection Research (DZIF).

International Collaborations

Merck Sharp & Dohme Corp, USA
 Novobiotic Pharmaceuticals
 Harvard Medical School

National Collaborations

Boston University
 Aicuris Wuppertal
 University of Tübingen

Membership in local and regional Networks

DZIF TTU Novel Antiinfectives
 InfectControl 2020

Research Field	Microbiology
Keywords	Antibiotic, Anti-infective Research, Drug Discovery/Delivery, Infectious Diseases, Bacterial Cell Biology, Bacterial Cell Wall
Head of Institute	Prof. Dr. Tanja Schneider
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Research Field	Pharmacology
Keywords	Diabetes, Drug Discovery/Delivery, Neurodegenerative Diseases, Obesity, Signal Transduction
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Institute of Pharmacology and Toxicology

The major focus of the Institute of Pharmacology and Toxicology lies on pharmacological signaling pathways and non-coding RNAs like microRNAs. We use pharmacological and genetic tools to modulate signaling pathways and to study microRNAs *in vitro* as well as *in vivo*. Our work centers on metabolism and adipose tissue. The emphasis lies on determining therapeutic pathways to target obesity. Other topics are neurodegenerative disorders and diagnostic tools.

In addition to signal transduction the Institute also has an interest in drug delivery and drug discovery. Our Institute develops therapeutic approaches based on nanoparticles to deliver genetic material or cells *in vivo* to specific tissues. The Institute also established a vector facility that focuses on the generation of high titer lentiviral vectors. Moreover, a medium- to high-throughput

screening infrastructure for performing cell-based and biochemical screens has been established at the Institute for lead drug discovery in the areas of neurodegeneration and obesity.

International Collaborations

University of California, San Diego, USA
University of Tokyo, Japan
University College London, UK

National Collaborations

University of Heidelberg
UCB Pharma
University Hospital Hamburg UKE

Membership in local and regional Networks

PharmaCenter Bonn; Neuroallianz
Bonn International Graduate School of Drug Sciences; DFG Research Training Group 1873; DFG Research Unit FOR 2372

Research Field	Life and Medical Sciences
Keywords	Body Fat Regulation, Genomics, Immune Modulation, Lipid Metabolism, Nutrition, Plant Breeding, RNA/RNAi/Antisense RNA
Head of Institute	Prof. Dr. Michael Hoch
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Life and Medical Sciences Institute (LIMES)

The Life and Medical Sciences Institute (LIMES) is a center of excellence for both basic research and higher education in Life Sciences and Biomedicine at the University of Bonn. It is positioned within the Faculty of Mathematics and Natural Sciences. A common scientific focus of the LIMES Institute is to study metabolism and immunity and their cross-regulation in health and disease.

The LIMES research groups provide major research expertise in Chemical Biology, Medicinal Chemistry, Development, Genetics, Cell and Immune Biology, Membrane Biology and Lipid Biochemistry. They co-operate in a number of interdisciplinary research initiatives funded by the German Research Foundation DFG (Collaborative Research Centers SFBs 645, 704). Furthermore, the LIMES groups have set up various teaching programs including the undergraduate study

program Molecular biomedicine, the International Graduate Program Life & Medical Sciences (M.Sc./PhD) and the joint Summer School program Life Sciences & Culture Bonn with Harvard University.

International Collaborations

Waseda University Tokyo, Japan
Tokyo University of Agriculture and Technology, Japan
Harvard University USA

National Collaborations

caesar and DZNE, Bonn
Universities of Heidelberg, Dresden, Cologne

Membership in local and regional Networks

DFG Cluster of Excellence "ImmunoSensation", DFG-Sonderforschungsbereiche SFB 645, SFB 704 (Bonn), SFB 832, SFB 670 (Cologne), SFB/TR 83 (Heidelberg)



**RUHR
UNIVERSITÄT
BOCHUM**

RUB

Name	Ruhr-Universität Bochum
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Founded (year)	1961; Opened 1965
Number of employees	scientific 3,300 administrative 2,300
Funding	State Government NRW, German Research Foundation; Federal Ministry of Education and Research/Federal Funds; European Union; Foundations

www.rub.de



Ruhr-Universität Bochum

Humane, accomplished, open to the world

Located in the midst of the dynamic, hospitable metropolitan area of the Ruhr, in the heart of Europe, the Ruhr-Universität Bochum (RUB) with its 20 faculties, RUB's disciplinary institutional units, is home to 5,600 employees and over 43,000 students. All the great scientific disciplines are united on one compact campus.

The RUB is on its way to becoming one of the leading European universities of the 21st century. Almost all courses are offered as bachelor and master degree programmes.

Our excellence programmes have made themselves an international name: our research school is an international college for structured doctoral research in the life sciences, natural sciences, engineering, the humanities and social sciences. Interfaculty and interdisciplinary research departments, which are mutually, nationally and internationally networked, sharpen the profile of the RUB – especially the Cluster of Excellence “RESOLV (Ruhr Explores Solvation) - Solvents as active units”. Added to this is an unsurpassed programme for the promotion of early career researchers, and an excellent infrastructure.

What makes it all come alive is the people who meet on campus with their thirst for

knowledge, their curiosity, and their commitment. They help shape the RUB and their open-mindedness makes the RUB an attractive place for people from around the world.

Guiding principle of the RUB

The trio of values, humane, accomplished, open to the world, represent the cornerstones of the RUB environment. This space is more than just the sum of its individual elements: humane and open to the world means to respect diverse cultures and to give guests a home. Humane and accomplished means jointly developing creative forces, to “tackle” things with verve and ambition.

“Campus RUB” is the contemporary universitas – the community in which people take centre stage.

Living universitas

The members of the universitas teach others and, at the same time, learn from each other whether in science, studies, engineering, or management.

Department Biochemistry I – Receptor Biochemistry

We investigate the structure, assembly, intracellular transport, function, regulation, and modulation of ionotropic glutamate receptors (GluRs). We employ molecular biological and electrophysiological methods combined with confocal microscopy and protein biochemistry. We analyze functional properties of members of GluRs in heterologous expression systems such as *Xenopus* oocytes and HEK293 cells. In our studies, we include vertebrate glutamate receptors as well as invertebrate and plant GluRs. Current projects include the modulation of GluRs by interacting membrane proteins, the cloning and functional analysis of plant GluR homologs from *Arabidopsis thaliana*, the expression of GluRs in differentiating stem cells, the function of the orphan receptors of the delta subfamily and the antigenic properties of glutamate receptors that elicit

autoimmune responses to glutamate receptors in normal people as well as in patients with various neurological diseases.

International Collaborations

Inst. Bioorg. Chem., Moskow, Russia;
Ben-Gurion Univ. Beer Sheva, Israel;
Children’s Hospital of Philadelphia, USA;
Institut. Biol., Univ. P. & M. Curie, Paris.

National Collaborations

MPI f. Exper. Medizin, Göttingen;
Inst. f. Biowiss., Univ. Würzburg;
Abteilung Myozelluläre Elektrophysiol.,
Universitätsklinikum Münster;
Dept. Chemie/Biochem., LMU München.

Membership in local and regional Networks

Kompetenznetzwerke Neurowiss. (Neuro-NRW) u. Stammzellforschung NRW

Research Field	Molecular Neuroscience
Keywords	Neurodegenerative Diseases, Neurotransmitter Receptors, Neuroscience, Molecular Neurobiology, Signal Transduction
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Department Biochemistry II – Molecular Neurobiochemistry

Neuronal connectivity is regulated not only during development but also in the adult brain, in response to brain activity. The small GTPase protein Ras is a universal intracellular signaling protein that may mediate such mechanisms of brain plasticity through transient activation of downstream protein phosphorylation signaling cascades. We have developed a synRas animal model expressing permanently activated Val12 Ras, selectively in neurons. Using this model we investigate if neuronal Ras activity is involved in the dynamics of dendritic spine formation in neurons, in the regulation of synapse number and in the regulation of neurogenesis in the hippocampus. Current research topics comprise stem cell replacement therapy, nucleic acid functionalized calcium phosphate nanoparticles, Parkinson’s disease model and involvement of small G-proteins in apoptosis.

International Collaborations

Burke Medical Research Institute,
New York, USA
University College London, UK
Prof. Dr. Deneris, Cleveland, USA

National Collaborations

University of Duisburg-Essen
University of Bielefeld
University of Leipzig– Paul Fleschig
Institute of Brain Research

Membership in local and regional Networks

Stem Cell Network North Rhine Westphalia
University Alliance Metropolis Ruhr (UAMR)
TRANSPOL (Marie Curie FP7, ITN)

Research Field	Biochemistry
Keywords	Animal Models, Neurodegenerative Diseases, Parkinson Disease, Signal Transduction, Stem Cell Research
Head of Department Internet	Prof. Dr. Rolf Heumann www.ruhr-uni-bochum.de/mol-neurobio/Lehrstuhl/Molneurobio.html
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Research Field	Cell Biology, Neurobiology, Optogenetics
Keywords	Animal Models, Genetic Engineering, Neurodegenerative Diseases, Signal Transduction
Head of Department	Prof. Dr. Stefan Herlitze
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Department of General Zoology and Neurobiology

The overall goal of my research is to understand how G-proteins modulate ion channels and intracellular signaling pathways and how this modulation in turn determines neuronal network function and behavior.

Not easily addressed in the reduced preparations where G-protein signaling is for the most part studied is the most basic question: Why are neuronal systems modulated by G-proteins? We therefore developed a non-invasive approach to induce G-protein modulation into channels and neuronal networks by light using vertebrate rhodopsin. These light activated GPCRs are currently be used to gain an understanding of the role of this signaling pathway for emotional and motor behavior as well as their underlying physiological response in animal models of disease, i.e. anxiety, aggression, ataxia and absence epilepsy.

International Collaborations

Baylor College of Medicine, Houston, USA
Rotterdam, NL
Case Western Reserve University, Cleveland, USA

National Collaborations

University of Heidelberg

Research Field	Biotechnology, Plant Biology/Physiology
Keywords	Biocatalysts, Bioenergy Research, Fermentation, Proteomics, Synthetic Biology
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Department of Plant Biochemistry

Research at the chair is focused on basic phenomena of bioenergetics, biochemistry and molecular biology of microalgae (cyanobacteria and green algae) and bacteria, with most projects being directly or indirectly correlated to plant photosynthesis. Major aim is to understand principles how solar energy is converted into chemical energy and how these processes can be made available for practical application. Focus is especially on:

a) Development of green cell factories, with the production of chemicals or biofuels by engineered cyanobacterial photosynthesis (light-driven whole-cell biotransformations), correlated with optimized bioreactor technology (continuous cultivation)

b) Development of SolarBioHybrids, involving e.g. isolated photosystems and hydrogenases in combination with conductive supports in photo-electrochemical cells for

hydrogen production from water or the integration of redox-dependent biocatalysts for chemical conversions ("biophotovoltaics").

International Collaborations

Osaka University, Institute for Protein Research, Japan
Tokyo University of Agriculture & Technology, Dept. of Biotechnology, Japan
The Hebrew University of Jerusalem, Israel

National Collaborations

MPI Mülheim für Chemische Energiekonversion
RUB Zentrum für Elektrochemie, Fakultät für Chemie & Biochemie, Bochum
TU Berlin, Biophysikalische Chemie

Membership in local and regional Networks

RUB Cluster of Excellence RESOLV, CLIB²⁰²¹

Institute of Animal Ecology, Evolution and Biodiversity

Research in the fields of biodiversity, ecology and evolution with a geographic range from polar regions (Antarctic, deep sea) to the tropics (coral reef research, rainforests). Special emphasis on local and regional projects (climate change and anthropogenic effects on freshwater systems, chemical ecology of polinator systems), collaboration with LANUV and nature conservation agencies, fundamental research on phenotypic plasticity (metabolic pathways, genomics, ecosystem effects), phylogenetics and DNA barcoding (cryptic species, species identification, species description) and many population genetic projects (genetic diversity, population connectivity), evolution of sex.

International Collaborations

The University of Iowa, USA
 University of Otago, Dunedin, NZ
 British Antarctic Survey, Cambridge, UK
 University of Birmingham, UK

National Collaborations

University of Bayreuth
 University of Würzburg
 Alfred Wegener Institute, Bremerhaven
 TU Darmstadt

Research Field	Environmental Biology/ Chemistry, Biodiversity, Evolution, Ecology
Keywords	Biodiversity, Chemical Ecology, Ecology, Evolution, Fresh Water, Genomics, Marine Biology, Molecular Biology, Population Genetics
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Institute of Biophysics

At the chair of Biophysics at the RUB we investigate structure, function and interaction of proteins at atomic level, using a wide variety of interdisciplinary methods of biology, biophysics, biochemistry and computation. A detailed knowledge of protein structures and their interacting networks are mandatory for the understanding of the relation between misfunction of proteins and the onset of diseases.

Proteins are recombinantly expressed using biomolecular methods. The three-dimensional structure is determined using protein x-ray crystallography. The protein dynamics are investigated using spectroscopic methods. The methods for time resolved FTIR- and Raman spectroscopy, which have been actively developed and enhanced in our group, allow determination of molecular reaction mechanisms at atomic resolution. The development

of cutting-edge experimental methods in vibrational spectroscopy is a major focus of research at the chair of biophysics. For several years these new vibrational methods are also used for medical applications, especially These experimental methods are supplemented by molecular dynamics calculations.

International Collaborations

CAS-MPG Partner Institute for Computational Biology, Shanghai, China
 Northeastern University, Boston, USA
 University of California, Irvine, USA

National Collaborations

SFB 642 - GTP- and ATP-dependent membrane processes
 MPI of Molecular Physiology, Dortmund
 University Medical Center Göttingen

Membership in local and regional Networks

PURE, IMI-K4DD, Raman4Clinics

Research Field	Biophysics, Imaging
Keywords	Biomarker, Cancer, Imaging, Neurodegenerative Diseases, Spectroscopy
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Research Field	Cell Biology, Neurobiology, Stem Cell Biology
Keywords	Antibody, Microscopy, Regenerative Medicine, Stem Cell Research, Tissue Engineering
Head of Institute	Prof. Dr. Andreas Faissner
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Institute of Cell Morphology and Molecular Neurobiology

The Department of Cell Morphology and Molecular Neurobiology aims at the elucidation of the molecular and cellular bases that regulate the generation of the central nervous system. Thematic groups focus i) on the biology of radial glia stem cells, motoneurons, glial progenitors and their microenvironment, the stem cell niche during development and under pathological conditions; ii) on neuron-glia interactions and their regulatory influence on axon growth and guidance, as well as synaptogenesis and synaptic plasticity; iii) on retinal stem cells and their integration into neural networks and the possible application to visual system lesions and degeneration. On the molecular level, glycoproteins, chondroitin-sulfate proteoglycans and their receptors, tyrosine phosphatases and downstream GTPases of the RhoA-family and GEFs (e.g.

Vav-proteins) are studied using molecular and cell biological tools, and genetically modified animal models.

International Collaborations

The University of Edinburgh, UK
Hokkaido University, Sapporo, Japan
University of Cambridge, UK

National Collaborations

Ludwig Maximilians University München
Otto von Guericke University Magdeburg
Ruhr University Bochum

Membership in local and regional Networks

Stem Cell Network North Rhine
Westphalia

Research Field	Cell Biology/Physiology
Keywords	Drug Discovery/Delivery, Fertility, GPCR, Olfaction and Taste, Oncology, Proteomics, Signal Transduction
Head of Institute	Prof. Dr. Dr. Hanns Hatt
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Institute of Cell Physiology

Olfactory receptor genes constitute the largest gene family in vertebrate genomes. The structural diversity of the olfactory receptors are the basis for the astonishing capacity to discriminate so many different odorants. We are working on the identification of new receptor-ligand pairs and their protein interactions. In addition we study the odorant receptor induced signal transduction and cellular processes. Moreover, the functional characterization of olfactory receptors in non-neuronal tissues is in the focus of our interest. In collaboration with different clinical departments the physiological role of olfactory receptors in the human skin, heart, blood, intestine and prostata is under investigation.

International Collaborations

University of Florida, USA
University of Siena, Italy
University of California, Los Angeles, USA

National Collaborations

Universitätsklinikum Dresden, HNO
Universitätsklinikum Köln,
Neurophysiologie
TU München, Lebensmittelchemie und molekulare Sensorik

Membership in local and regional Networks

Stem Cell Network North Rhine
Westphalia

Institute of General and Molecular Botany

The major goal of the Department of General and Molecular Botany is to understand basic biological processes at the molecular level. Major research topics are the functional investigations of developmental processes in filamentous fungi as well as the analysis of regulators controlling the biosynthesis of secondary metabolites, such as antibiotics. We use for our genetic studies diverse fungi from the genera *Sordaria*, *Penicillium* and *Neurospora*. Another research focus is the molecular analysis of RNA-processing in the chloroplast of the green alga *Chlamydomonas reinhardtii*. To address these research questions a wide range of methods and techniques are applied including genetic engineering of eukaryotic microbes, functional genomics (genome sequencing, RNA-seq, ChIP-seq), protein biochemistry (recombinant protein technology, affinity

chromatography), high resolution microscopy and bioinformatics.

International Collaborations

University of California, Berkeley
University of Nottingham
University of Geneva

National Collaborations

Georg-August-Universität Göttingen
Leibniz-Institut für Analytische Wissenschaften (ISAS)
TU Braunschweig

Research Field	Genetics, Molecular Biology
Keywords	Antibiotic, Microbial Genomics, Genetic Engineering, Microscopy, Signal Transduction
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Institute of Microbial Biology

We work in three major research areas: (i) Sensory and regulator RNAs: We are interested in the structure, function and transcriptome-wide analysis of temperature-sensitive RNA structures (RNA thermometers), ligand-responsive RNA structures (riboswitches) and small regulatory RNAs. Most of these RNAs are involved in heat shock or virulence responses. (ii) Membrane-lipid biosynthesis: We study the mechanistic details of bacterial enzymes catalyzing novel phospholipid biosynthesis pathways (iii) Substrate recognition and degradation by ATP-dependent proteases: We identify new protease substrates by proteomics and study substrate recognition principles.

International Collaborations

Academia Sinica, Taipeh, Taiwan
Ohio University
University of California, Los Angeles, USA

National Collaborations

HZI Braunschweig
University Frankfurt
University Würzburg

Membership in local and regional Networks

SFB 642 (DFG), SPP 1617 (DFG)

Research Field	Genetics, Molecular Biology, Microbiology
Keywords	Enzymes, Microbial Genomics, RNA/RNAi/Antisense RNA, Signal Transduction, Synthetic Biology
Head of Institute	Prof. Dr. Franz Narberhaus
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Research Field	Genetics/Molecular Biology, Plant Biology/Physiology
Keywords	Agricultural Biotechnology, Biomarker, Crop Research, Next-Generation Sequencing, Plant Breeding
Head of Institute	Prof. Dr. Ute Krämer
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Institute of Plant Physiology

Using functional and next-generation genomics, we dissect evolution and the genetic and molecular functional basis of extreme abiotic stress tolerance in plants. A second focus of our research are the molecular mechanisms of the maintenance of transition metal homeostasis (Zn, Fe, Cu) in plants, and the interactions with plant growth, metabolism and development. Applications are strategies in the breeding of stress-resistant crops, crop bio-fortification, increasing crop nutrient efficiency and phytoremediation.

International Collaborations

University of California, Los Angeles, USA
University of Nagoya, Japan
John Innes Centre, Norwich, UK

National Collaborations

University of Bielefeld
Max Planck Institute for Developmental Biology, Tübingen
University of Bayreuth
Max Planck Institute of Molecular Plant Physiology, Potsdam

Membership in local and regional Networks

Stem Cell Network North Rhine Westphalia

Research Field	Toxicology, Molecular Medicine, Public Health
Keywords	Biomarker, Cancer, Environmental Research, Genomics, Proteomics
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Institute for Prevention and Occupational Medicine of the German Social Accident Insurance (IPA)

IPA's key topics are the synergistic effects of various hazardous substances upon human health, the early diagnosis of cancer, and also exposure measurements at the workplace by means of biological monitoring in humans. The focus is upon molecular and epidemiological studies on humans, conducted at workplaces and on experimental studies in an environmentally controlled exposure laboratory. This research approach is supplemented by experimental laboratory studies such as the use of in-vitro cell cultures. Conversely, results from cell cultures can also be reviewed for their actual relevance to human beings and to those obtained in field studies. Altogether, sound-scientific results are produced for the detection and interpretation of workplace-related effects upon human health. Owing to the close co-operation with

the accident insurance institutions, these results translate into findings of practical relevance for preventive measures and compensation of work-related diseases.

International Collaborations

SYNERGY
COST-Modernet
OCCUSTAT

National Collaborations

PURE (Protein Research Unit within Europe)
UroFollow (early detection of bladder cancer)
MoMar (molecular markers for early detection of cancer)

Membership in local and regional Networks

Genetic Diagnostics Commission (GEKO)
DFG; AGS



Protein Research Unit Ruhr within Europe (PURE)

At the European protein research institute PURE, internationally renowned protein researchers pool their resources at the Ruhr-University Bochum searching for biomarkers for the early detection of diseases such as cancer and neurodegenerative diseases, like Alzheimer's, Parkinson's and Multiple Sclerosis (MS).

Practically all cancerous and neurodegenerative diseases can be traced back to defect genes or gene products, the proteins. A plethora of cellular processes is regulated and determined by proteins: defect proteins trigger Alzheimer's Disease, oncogenic mutated proteins trigger cancer. These defects serve as biomarkers for the PURE approach.

PURE aims to develop innovative diagnostic technologies for markerfree bioimaging and protein analytics, based on protein alterations. Uniquely, the interdisciplinary approach integrates fundamental research into applied and clinical research towards a future oriented project. Novel, non-invasive, marker-free, spatially resolving spectroscopic methods – successfully applied in fundamental research – are transferred into clinical application. The combination of top-notch platform technologies for protein and

biomarker research with the well-established proteome analysis reach an entirely new level in protein diagnostics. Bioinformatics evaluate the concerted results together with clinical scientists. By this means, a differentiated and predictive diagnosis within the scope of personalized medicine is achieved.

The vision of PURE is to condense the essential examinations into a single, simple test on blood, urine or other minimally invasive accessible liquid samples. Just as every human has a unique finger print, every disease has a characteristic protein profile. Once characterized, it is used to predict diseases like cancer or Alzheimer's at the most early, yet symptomless stage. This is the premise for an increased chance of therapy success.



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Internet	www.pure.rub.de
Founded (year)	2010
Number of employees	scientific 115 administrative 5
Funding	State Government NRW 50% Ruhr University Bochum 50%

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Number of employees
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administrative 4,350

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RWTH Aachen University

THINKING The Future.

RWTH Aachen is in the process of developing from a polytechnic into an integrated, interdisciplinary technical university. The engineering focus of the University is closely coordinated with the natural sciences and medicine; the arts, social sciences and economics, structurally linked to the core disciplines, also make a significant contribution to the University's teaching and research profile. With its 260 institutes in nine faculties, RWTH Aachen is among the leading European scientific and research institutions. 43,721 students in 140 courses of study are registered, including almost 7,900 international students. Teaching at RWTH Aachen is first and foremost application-oriented. Its graduates are therefore sought-after as junior executives and leaders in business and industry. National rankings and international assessments attest to the RWTH graduates' marked ability to handle complex tasks, to solve problems constructively in team work and to take on leadership roles.

The competence centres of RWTH Aachen achieve very effective cross-subject, inter-faculty collaboration in interdisciplinary networks while maintaining a high level of specialisation and differentiation into distinct

subject areas. This was also the deciding factor for international research institutions to be set up in the Aachen region. The University's innovative capacity is further reflected in the high number of business start-ups (currently more than 1,400). As a result, around 32,000 jobs have been created in the region in the last 25 years. Furthermore, RWTH Aachen is the largest employer and education provider in the region. It will continue to play a decisive role as a driving force in influencing and shaping this high-tech region in the future.

Institute of Biology III – Plant Physiology

Plants must recognize pathogens as non-self and defend themselves. Plants employ a molecular ‘surveillance system’ to detect pathogens and an intricate cellular communication system to transmit the information to the nucleus. In the nucleus specific genes are activated or repressed in response to actively help the plant fight for survival. In addition to active defence mechanisms plants often have natural preformed antibiotics. Research in all of these areas is carried out in the Department and agriculturally important crops, such as soy-bean and cereals like rice, barley and wheat, as well as model plants, like the small weed Arabidopsis thaliana, are being investigated.

International Collaborations

Metabolon Inc, USA
 University of Missouri, USA
 Universidad de Chile

National Collaborations

Pflanzenschutzamt NRW
 BASF Plant Science
 University of Saarbrücken

Research Field	Biochemistry, Plant Biology/Physiology, Plant Pathology
Keywords	Agricultural Biotechnology, Bioenergy Research, Biologicals, Biomass, Plant Stress Resistance
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Institute of Biology IV – Applied Microbiology – iAMB

The ultimate aim of the Blank lab (Chair of Applied Microbiology) is to use microbes to the benefit of environment, society and economy. By studying the metabolism of bacteria and fungi we aim to optimize and control a wide array of applications, ranging from the production of cleaner detergents to the spoilage of bio diesel.

National Collaborations

TU Dortmund, Fakultät BCI
 ORGANOBALANCE GmbH
 BRAIN AG
 Universität Marburg, FB Biologie – Genetik

Membership in local and regional Networks

CLIB²⁰²¹
 Bioeconomy Science Center (BioSC)
 Excellence cluster Tailor made fuels from biomass – TMFB
 Graduate school SELECA – RWTH Aachen / Osaka University

International Collaborations

The Novo Nordisk Foundation Center for Biosustainability, DTU, Denmark
 Australian Institute for Bioengineering and Nanotechnology, Brisbane, Australia
 Systems Biology Program, National Center of Biotechnology, Madrid, Spain
 Osaka University, Japan
 Ewah womens university, South Korea
 Bari University, Italy
 IIT Madras, India

Research Field	Biotechnology, Microbiology, Metabolic Engineering
Keywords	Biocatalysts, Biomass, Fermentation, Systems Biology, Synthetic Biology
Head of Institute	Prof. Dr.-Ing. Dipl. Bio. Lars M. Blank
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Fon	+49 241 80-26600
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Research Field	Environmental Biology/ Chemistry
Keywords	Environmental Research, Renewable Energy and Resources
Head of Institute	Prof. Dr. Andreas Schäffer
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Fon	+49 241 80-26678/6815
Fax	+49 241 80-22182

Institute for Biology V – Environmental Research

We study the metabolism, bioavailability, binding of environmental pollutants and the formation of non-extractable residues in soil, water-sediment, and plants. In addition we develop remediation technologies of polluted sites, e.g. by phytoremediation.

We are developing test systems in order to assess acute, chronic and mechanism-specific toxicity caused by such pollutants by in vitro methods, various test species, populations and communities in lab- and field-based systems. The observed effects are used for the extrapolation of environmental risks.

Simulation models are able to depict and predict concentration-dependent effects and their extent on individuals, populations and communities. In individual-based simulation we use process-based models based on the life-cycle of individuals, in statistic

modelling approaches the model structure is developed in a data-based inductive way.

International Collaborations

University of Saskatchewan (Canada),
FHNW/Basel (Switzerland),
Universities Shanghai (Tongji), Nanjing,
and Chongqing

National Collaborations

Many cooperation partners from
universities, Helmholtz Centers
and Fraunhofer institutes

Membership in local and regional Networks

Bioeconomy Science Center (BioSC)
ExcellenceCluster Tailor Made Fuels from
Biomass – TMFB

Research Field	Biotechnology, Biointeractive Materials
Keywords	Protein Engineering, Directed Evolution, Hybrid- Catalysts
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Institute for Biology VI – Department of Biotechnology

Nature has developed a wonderful array of catalysts (enzymes) which we use or consume in our daily life, for instance in laundry. Natural catalysts are designed to perform well under natural conditions and do often not match performance requirements for cost-effective industrial production. Exploring the natural diversity, thereby to discover and to understand on the molecular level underlying design principles of enzymes for applications in catalysis and in material science are core research areas of the ABBt-Biotechnology Institute & DWI-Leibniz Institute for Interactive Materials. As protein engineers we developed methods (e.g. SeSaM, OmniChange, PTRec, PLICing), which enable for instance to generate 3.2 million variants in one afternoon and to sample millions of variants for improved properties in two hours. We are proud that several companies entrust us to reengineer

their enzymes for making their production processes more efficient and that 4 of our designed enzymes made into production with industrial partners.

International Collaborations

Tianjin Institute of Industrial Biotechnology
(TIB), Chinese Academy of Sciences,
China
Osaka University, Japan
EU ITNs

National Collaborations

Bioeconomy Science Center
SFB 985 Functional Microgels and
Microgel Systems

Membership in local and regional Networks

Bioeconomy Science Center,
CLIB²⁰²¹, JARA-HPC, JARA-SOFT

Institute of Biology VII – Molecular Biotechnology

The research interest of the Institute for Molecular Biotechnology is in the production of recombinant enzymes and therapeutic proteins for industrial and medical use. Applications range from drugs and vaccines against major infectious diseases to lignocellulosic biomass conversion for the production of biofuels. Our research expertise includes protein bioanalytical techniques, like X-ray based structure determination and mass spectrometry, the engineering and production of recombinant proteins and antibodies in different heterologous expression systems, including microbial expression systems as well as protein production in plants. Further research interest of our institute includes the identification and characterization of targets for chemotherapeutical and transmission blocking intervention of malaria tropica. Antibodies,

vaccines and plant virus nanoparticles are developed for diverse biomedical and selected material science applications.

The Institute of Molecular Biotechnology has a close cooperation with the Fraunhofer Institute for Molecular Biology and Applied Ecology.

International Collaborations

ISS Rome, Italy
 CWR University, Cleveland OH, USA
 CMB, Delaware, USA

National Collaborations

University of Gießen
 University of Münster

Membership in local and regional Networks

Bioeconomy Science Center (BioSC)

Research Field	Biotechnology
Keywords	Biocatalysts, Biomass, Biopharmaceuticals, Recombinant Proteins
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Institute of Materials in Electrical Engineering 1

Development of microfluidic systems for life science, microbiology and biotechnology applications. Expertise in a) polymer-based microfluidics based on SU-8 and PDMS, b) integration of thin-film based electrodes for sensors and actuators, c) assembly technologies, d) biocompatible coatings, e) flex tapes, f) hardware and software to configurate whole measurement systems. Developments are carried out in about 500 m² clean rooms and 100 m² test labs.

International Collaborations

Georgia Tech, Atlanta, GA, USA
 IMEC, Leuven, Belgium
 Bulgarian Academy of Science, Sofia, Bulgaria

National Collaborations

TU Bergakademie Freiberg
 FhG-IMS Duisburg
 University Potsdam

Research Field	Microfluidics
Keywords	Chip Technology, Diagnostic Systems, Microarrays, Microsystems, Platform Technology
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Research Field	Biotechnology, Process Development
Keywords	Biocatalysts, Bioenergy Research, Biomass, Biopharmaceuticals, Enzymes, Fermentation
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Aachener Verfahrenstechnik (AVT) – Biochemical Engineering

The AVT.BioVT has three main research areas: characterization of shaken culture systems, fermentation technology and development of new methods for online process monitoring at all (bioreactor) scales.

Until recently, the handling of shaken bioreactors was primarily based on empirical research. The AVT.BioVT has contributed significantly to an increased understanding of the cultivation conditions in microtiter plates and shaken flasks. The acquired knowledge from process monitoring and bioreactor characterization is supposed to simplify the scale-up to the future production scale. The development and commercialization of several online monitoring tools for shake flasks and microtiter plates are main achievements of the AVT.BioVT. These include RAMOS (Respiration Activity MONitoring System), COSBIOS (Continuously

Operated Shaken BIOreactor System), and BioLector devices. In addition, techniques for fed-batch operations for small-scale cultures (e.g. FeedBeads, FeedPlates, SmartPlates) have been developed. Another successful commercialization is the so-called Flowerplate, a screening platform, which allows for the same oxygen transfer rates as in large scale fermenters.

National Collaborations

Cluster of Excellence Tailor Made Fuels from Biomass (TMFB)
Bioeconomy Science Centre (BioSC)
Industrial partners

Membership in local and regional Networks

CLIB²⁰²¹

Research Field	Chemical Engineering, Process Development
Keywords	Biomass, Bio Processing, Biorefinery, Downstream Processing, Plant Produced Products
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Aachener Verfahrenstechnik (AVT) – Fluid Process Engineering

The research of the chair of fluid process engineering is focused on the low-energy-separation processes extraction, crystallization, adsorption and chromatography, particularly investigating applications for biomass utilization. We work on the understanding of fundamental phenomena, application oriented optimization and equipment design.

Biotechnological production is one key aspect for replacing petrochemical derived products in industry. A major challenge is the purification of chemicals from these processes. Purification has a significant impact on costs and thus is of high importance for the economic profitability.

In the new building "Next Generation Processes and Products – NGP²" a technical lab-scale bio-refinery will be build, where we will explore biomass utiliza-

tion with other AVT chairs and external partners.

Further topics are solid-phase extraction for the separation of compounds from plants and innovative approaches such as the separation in centrifugal fields and the influence of particles at interfaces.

National Collaborations

Cluster of Excellence Tailor Made Fuels from Biomass (TMFB)
Bioeconomy Science Centre (BioSC)
Industrial partners
DFG, SFB985, Functional Microgels and Microgel Systems

Membership in local and regional Networks

CLIB²⁰²¹
DECHEMA
VDI

Aachener Verfahrenstechnik (AVT) – Process Systems Engineering

The chair for Process Systems Engineering (SVT) was founded in 2012 and is directed by Prof. Alexander Mitsos, PhD, who moved to RWTH from MIT. It deals with computer-based methods for Process Engineering, i.e. Modeling, Simulation and Optimization. Our particular goals are process synthesis and process optimization. Our focus is on optimal design and operation of new chemical processes and energy systems based on existing and new methods. In particular we are aiming in optimal use of renewable energy and material sources for sustainable processes. In parallel we develop methods and algorithms.

International Collaborations

Imperial College London (ICL)
University of Cambridge (UCAM)
Massachusetts Institute of Technology (MIT)

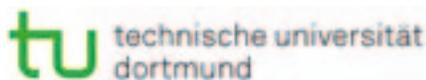
National Collaborations

Cluster of Excellence Tailor Made Fuels from Biomass
Bioeconomy Science Centre (BioSC)
DFG, SFB985, Functional Microgels and Microgel Systems

Membership in local and regional Networks

DECHEMA
VDI

Research Field	Biotechnology, Process Development
Keywords	Analytics, Biomaterials, Bioenergy Research, Biomass, Bio Processing, Biorefinery, Process Design, Process Optimization
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Technische Universität Dortmund TU Dortmund University

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Internet	www.tu-dortmund.de
Founded (year)	1968
Number of employees	total 6,200

www.tu-dortmund.de

Since its founding 48 years ago, TU Dortmund University has developed a special profile, encompassing 16 faculties ranging from science and engineering to social sciences and cultural studies. The university currently has circa 33,500 students and 6,200 staff members, including 300 professors. The curriculum is comprised of around 80 programs of study, both traditional and innovative, some even unique to this university. A broad teacher training program is offered for all school types.

The various scientific disciplines share a common university spirit in which interdisciplinarity, communication and cooperation are not only taught, but lived and experienced. This interaction creates an environment conducive to technological innovation and fosters advances in methods and knowledge. In 2015, the international QS World University Rankings listed TU Dortmund University among the top five German universities under 50 years.

In four profile areas, research at TU Dortmund University is visible both nationally and internationally: (1) Production and Logistics, (2) Chemical Biology and Biotechnology, (3) Modeling, Simulation and Optimization of Complex Processes and Systems, and (4) Youth, School and Education Research.

The second profile area, Chemical Biology and Biotechnology, brings together strong partners: Here, Europe's largest Faculty of Biochemical and Chemical Engineering, Dortmund's Max Planck Institute of Molecular Physiology, and the Faculty of Chemistry and Chemical Biology cooperate with other research institutions. Colleagues from the faculties of statistics, mathematics and computer science help to push research on modeling and big data analysis forward. In 2014, an interdisciplinary team founded the Dortmund Drug Discovery Hub (DDDH). Students can choose from courses in biochemical engineering, chemical biology, medicinal physics or statistics with a focus on biometrics. Young researchers can take part in the CLIB Graduate Cluster Industrial Biotechnology.

TU Dortmund University has played a crucial role in transforming the city into a high-tech and service hub. Since the TechnologieZentrumDortmund was founded in 1985, Europe's largest technology park has been growing in direct vicinity to the campus. Several entrepreneurs found a home for their startup in the BioMedizinZentrum next door.

Biocenter

The recently founded Biocenter at the Faculty of Biochemical and Chemical Engineering combines expertise in natural product discovery from microorganisms and plants with the development of efficient and green bioprocesses in genuine and genetically modified industrially relevant platform organisms. The labs of the working groups Bioprocess Technology (Prof. Dr. Lütz), Technical Biochemistry (Prof. Dr. Kayser) and Technical Biology (Prof. Dr. Nett) share the focus on Natural Product Biotechnology and Bioengineering. The Biocenter provides a continuous research line from the identification and structure elucidation of bioactive compounds from natural resources, elucidation of biochemical pathways, genetic reprogramming and assembly of platform organisms for low molecular weight drug candidates to the development of large-

scale production processes. The Biocenter is equipped with state-of-the-art instruments, among them mass spectrometers, bioreactors (1-300 l), downstream apparatus, and is facilitated in one of the latest S1 and S2 laboratories in NRW.

International Collaborations

Plant and Food, Auckland, New Zealand
Royal Holloway University, London, UK

National Collaborations

Institute for Plant Biochemistry (IPB), Halle
Leibniz Institute for Natural Product Research and Infection Biology, Hans-Knöll-Institute (HKI), Jena

Membership in local and regional Networks
CLIB²⁰²¹-Graduate Cluster

Research Field	Natural Product, Biotechnology, White Biotechnology
Keywords	Bioengineering, Biocatalysis, Metabolic Engineering, Natural Products, Systems Biotechnology
Head of Studies	Prof. Dr. S. Lütz Prof. Dr. O. Kayser Prof. Dr. M. Nett
Internet	www.bio.bci.tu-dortmund.de
E-Mail	bio.sek@bci.tu-dortmund.de
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Biomathematics Group

The biomathematics group is part of the Faculty of Mathematics at TU Dortmund University. The group is concerned with mathematical modeling, analysis, and numerical simulation of biological processes. We are in particular interested in processes in cells and on cell membranes, possibly coupled with mechanical remodeling of cell shape. We have investigated symmetry breaking in signaling networks, transport processes in cells, and self-organization and elasticity properties of artificial membranes. A proper description of such complex systems is challenging as it needs to account for spatial and temporal variations, a proper coupling between cytosolic and membrane-bound processes and a description of evolving cell shape. The group aims at developing mathematical analysis approaches and

numerical simulation techniques that allow to treat the specific challenges presented by biological systems.

Research Field	Biomathematics
Keywords	Biomaterials, Modeling, Mathematical Analysis and Simulation, Signal Transduction, Systems Biology
Head of Group	Prof. Dr. Matthias Röger
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Research Field	Modeling of Downstream Processing
Keywords	Antibody, Biopharmaceuticals, Downstream Processing
Head of Studies	Prof. Dr. Andrzej Górak
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Laboratory of Fluid Separations

The Laboratory of Fluid Separations is located at the Faculty of Biochemical and Chemical Engineering at TU Dortmund University. The laboratory is among international leaders in the field of modeling, simulation and experimental validation of reactive and hybrid separation processes. A multinational team of scientific and non-scientific staff members headed by Professor Andrzej Górak works closely together to gain new scientific insights. Currently, we focus on process intensifications, bioseparations with regard to white and red biotechnology, hybrid separation processes as well as conventional fluid separations. The research focus of the bioseparations group is the model-based optimization of biotechnological downstream processes. Necessary data for unit operation and process models is acquired

in experiments and used for model validation. In addition, research on fundamental separation phenomena, as mass transfer or adsorption isotherms of biomolecules, is conducted in this group.

International Collaborations

AIMs
EuroBioRef
F3-Factory

National Collaborations

MoBiDiK
PolyTE
CAEC

Membership in local and regional Networks

CLIB²⁰²¹-Graduate Cluster

Research Field	Chemical Engineering, Downstream Processing
Keywords	Biopharmaceuticals, Bio Processing, Downstream Processing, Small Molecules
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Laboratory for Plant and Process Design

Research of the Laboratory for Plant and Process Design is primarily concerned with the conceptual design of biochemical and biopharmaceutical processes, more specifically on the downstream processing of biomolecules. Key performance indicators have been introduced to guide automated experiments carried out on a robotic platform. A software has been developed allowing mass and energy balancing, resource planning (equipment, workforce, energy), and economic evaluation of process alternatives. In addition, innovative downstream technologies are experimentally investigated. Foam separation utilizes the capability of proteins to selectively adsorb at gas liquid interfaces. Gassing crystallization is used to control nucleation, growth and agglomeration in cooling crystallizers avoiding the costly preparation of seed crystals. Centrifugal

Partition Chromatography and the Tunable Aqueous Polymer Phase Impregnated Resin (TAPPIR) Technology pave the way for an industrial application of aqueous two phase extraction (ATPE) of proteins avoiding the difficult separation of two very similar water rich phases by immobilizing one phase inside a centrifugal field or inside porous material.

International Collaborations

Georgia Tech, Atlanta
Brunel, London
ERA-IB MySterl

National Collaborations

RWTH Aachen; KIT, Karlsruhe;
TUHH, Hamburg

Membership in local and regional Networks

CLIB²⁰²¹; BioIndustry; Dechema; VDI-GVC

Process Dynamics and Operations Group (DYN)

The Process Dynamics and Operations Group (DYN) is one of eleven chairs at the Faculty of Biochemical and Chemical Engineering at TU Dortmund University. Founded in 1990, the multinational group consists of around 30 scientific and non-scientific employees headed by Prof. Sebastian Engell since its beginning. The research activities of the DYN Group focus on the safe and economically and ecologically optimal operation of chemical and biochemical process plants. The group is involved in several European projects in the field of optimal operation of chemical plants together with major industrial producers and SMEs.

To apply advanced control methods to bioprocesses is a challenging field, as the complexity and non-linearity of the metabolism of the cells must be described in an adequate way such that the dynamics of

the cells and fermentations are described sufficiently accurately but by models of not too high complexity. The current focus of our work is the systematic derivation of models from the stoichiometric network of a cell and measured data from the process. Such models are suitable to be used in model based control that optimizes the operational parameters to maximize the yield of the desired product. The methods are currently applied to control the production of recombinant proteins and the production of yeast cells.

National Collaborations

Bayer AG
VH Berlin
RWTH Aachen
B + S Analytics

Research Field	Process Dynamics and Operations
Keywords	Dynamic Flux Analysis, Metabolic Flux Analysis, Model Development, Model Predictive Control, Population Dynamics and Synchronization
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UNIVERSITÄT
DUISBURG
ESSEN

Open-Minded

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E-Mail	rector@uni-due.de
Internet	www.uni-due.de
Founded (year)	2003
Number of employees	scientific 2,176 administrative 1,591
Funding	Federal Government (Germany) 100%

www.uni-due.de



University of Duisburg-Essen

Open-Minded

Located in the heart of the Ruhr metropolis, the University of Duisburg-Essen (UDE) is one of the youngest and largest universities in Germany. It's also wellknown in the international scientific community. The Times Higher Education ranked UDE 17th among the best young universities worldwide. The slogan "open-minded" stands for innovative teaching and research as well as the lively diversity and genuine educational equality practiced at the UDE.

At the UDE close to 42,000 students from more than 130 countries are enrolled in a total of over 230 courses of study ranging from the humanities and social sciences over economics and business studies all the way to the engineering sciences and natural sciences (including medicine). An important objective of the UDE's diversity management program is to offer equal opportunities to young people from non-academic backgrounds.

The research carried out at UDE covers a broad spectrum including four inter-departmental research priorities: nanosciences, biomedical sciences, urban systems and transformation of contemporary societies. The steady increase in the total influx of research money to the UDE – now well over

100 million euros annually when the third-party funding of the Medical School is taken into account – reflects the success of these research efforts.

As a global academic player, UDE works in partnership with more than 100 universities all over the world. It is a member of the University Alliance Ruhr (UA Ruhr), a strategic coalition formed by the three universities in the Ruhr area. The UA Ruhr operates liaison offices in North America, Russia, and Latin America.

Centre for Medical Biotechnology

The interdisciplinary scientific Centre for Medical Biotechnology (ZMB) integrates medical research at the University Hospital and natural sciences at the Campus.

Its mission is to elucidate molecular mechanisms of disease and to turn this knowledge into medical progress. The ZMB is active in three key areas of clinical and basic biomedical research: 1. Oncology, 2. Immunology, Infectious Diseases and Transplantation, and 3. Molecular and Chemical Cell Biology. The basic science and its translation into novel drugs and diagnostic tools are driven by 63 research groups.

The ZMB provides a dynamic, stimulating and collaborative research environment including state of the art core facilities and educational programmes in biomedical research. The BSc and MSc programmes in Medical Biology prepare for a scientific

career by including courses in molecular biology, chemical biology and medicine while postgraduates have a choice of various structured PhD programmes and Research Schools.

International Collaborations

Harvard Medical School
 Medical Research Council, NIMR, Mill Hill, London, UK
 Weizmann Institute, Israel

National Collaborations

Max Planck Institute for Molecular Physiology, Dortmund
 German Consortium for Translational Cancer Research
 Max Planck Institute of Plant Breeding Research, Cologne
 Lead Discovery Center, Dortmund

Research Field	Medical Biotechnology
Keywords	Cancer Biology and Clinical Trials, Immunology, Infectious Diseases, Molecular Cell and Chemical Biology
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Centre for Water and Environmental Research

The Centre for Water and Environmental Research was funded in 2003 with the goal to advance modern environmental research which links global social changes and challenges (such as population growth, urbanisation and megacities, climate change, water availability and sustainable energy supply) with environmental concerns and integrates their effects on human life. This kind of research is primarily interdisciplinary and ranges from natural and engineering sciences to medical and social sciences, and economics. Main focus of the ZWU activities is on water research with a wide spectrum of expertise in the field water ecology, drinking water treatment and supply (contamination, evaluation, and purification), environmental toxicology and chemistry, urban water management, hydrology, hydraulic engi-

neering, and water governance including competencies in water economy and law.

International Collaborations

Radboud University Nijmegen, NL
 Fayoum University, Egypt
 Questor Center/Queens University Belfast, UK

National Collaborations

Ruhr-University Bochum
 Hochschule Ruhr-West, Mülheim
 EBZ Business School, Bochum

Membership in local and regional Networks

Water Science Alliance
 Deutsche Gesellschaft für Membrantechnik e.V.
 Deutsche Vereinigung für Wasserwirtschaft, Abwasser und Abfall e.V.

Research Field	Integrated Water and Environmental Research
Keywords	Aquatic Ecology, Sustainable Water Management, Water and Environmental Research, Water Quality/Technologies
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Founded (year) 1388

Number of employees
scientific 7,000
administrative 1,844

www.uni-koeln.de

University of Cologne Good Ideas – Since 1388

The University of Cologne (UoC) is one of the oldest and largest universities in Europe. It is recognized for its high standards of graduate education and international reputation of academic accomplishment. In 2012 the University won substantial funding in the German Excellence Initiative and is now one of eleven German Excellence Universities. The UoC's core mission is to create, preserve, and disseminate knowledge, to provide a high level of education and training for its students and young academics, and to encourage and support top-level research with the aim of addressing the ever-changing challenges facing society.

The life and natural sciences are represented by the Faculty of Medicine and the Faculty of Mathematics and Natural Sciences, comprising biology, chemistry, geography, geosciences, mathematics, and physics. These two faculties have greatly benefited from their excellent long-standing collaborations. Cutting-edge, internationally competitive research is currently being performed in our four thematic cross-faculty research centers in the natural sciences, life sciences and in medicine: the Cluster of Excellence Cellular Stress Responses in Aging-

Associated Diseases (CECAD), the Cluster of Excellence on Plant Sciences (CEPLAS) in cooperation with Heinrich-Heine University in Düsseldorf and the Research Center Jülich (FZJ), which contributes new paradigms to the solution of urgent problems in plant performance and production through the exploitation of natural variation and biodiversity. Furthermore, the UoC boasts the Center of Excellence Quantum Matter and Materials (QM2) where researchers from the fields of mathematics, experimental and theoretical physics, inorganic and physical chemistry as well as crystallography collaborate to unravel the properties of quantum matter. Last but not least, the Cologne Center for Ethics, Rights, Economics, and Social Sciences of Health (ceres) conducts interdisciplinary research and training in the area of health and advises high-caliber policy makers and administrators on health-related matters.

Botanical Institute

The Melkonian laboratory develops innovative solid-state photobioreactors for the growth of microalgae in biotechnological applications.

The novel approach is based on the immobilization of microalgae in artificial biofilms onto porous surfaces (Twin-Layers) and aims to overcome present limitations of large-scale suspension cultures. Applications of the cultivation technology are manifold: microalgal biomass is used in human nutrition, as live feeds in aquaculture and in the production of nutraceuticals (e. g. carotenoids, PUFAs) and pharmaceuticals (toxins, antiviral compounds). Recently, the group applied the Twin-Layer technology to the treatment (removal of nitrogen and phosphorus) of municipal and industrial wastewater.

The laboratory maintains one of the world's largest public collections of living microalgae (>5000 strains; www.ccac.uni-koeln.de).

Research Field	Biotechnology
Keywords	Agricultural Biotechnology, Biomass, Environmental Research, Microalgae, Plant Produced Products
Head of Institute	Prof. Dr. Michael Melkonian
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Center for Molecular Medicine Cologne

The Center for Molecular Medicine Cologne – founded in 1994 – is a multi-disciplinary center within the Faculty of Medicine and the Faculty of Mathematics and Natural Sciences at the University of Cologne. It provides a forum that brings together clinicians with research scientists who can perform top-quality competitive research due to the outstanding constellation of faculty and facilities including state-of-the-art technologies and access to unique disease models and patient material. The CMMC's mission – based on its highly collaborative approach – is to advance the understanding of the underlying molecular and cellular mechanisms of human diseases as a prelude to improving prevention, diagnosis and treatment of many common health problems. Currently, the CMMC comprises 36 research groups investigating on the molecular level the pathogenic

mechanisms of cardiovascular disorders, cancer, inflammatory and infectious diseases as well as neurological disorders.

International Collaborations

Broad spectrum of collaborations with NIH research units, research institutions in Europe, Asia, Canada and the US; technology transfer activities with biotech enterprises; participation in large international research networks (EU-funded) ECRIN-Netzwerk (Koordinierungszentrum Klinische Studien)

National Collaborations

BMBF-Research (e.g sybacol), DKFZ, Bernstein-Cooperations, Helmholtz Centers, e.g. for Infection Research, TransRegio

Membership in local and regional Networks

InnovationsAllianz NRW, ABCD-network of Universities, BioRiver, BioCologne

Research Field	Biomedical Research
Keywords	Cardiovascular Research, Infectious Diseases, Neurodegenerative Diseases, Oncology
Head of Center	Prof. Dr. Thomas Benzing Chair Dr. Debora Grosskopf-Kroiher Scientific Coordinator
Internet	www.zmmk.uni-koeln.de
E-Mail	debora.grosskopf-kroiher@uni-koeln.de zmmk-office@uni-koeln.de
Address	Robert-Koch-Str. 11 CMMC-Research Building
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Fax	+49 221 478-4833

Research Field	Neurobiology
Keywords	Ageing, Diabetes, Microscopy, Neural Networks, Proteomics
Head of Department	Prof. E. Rugarli; Prof. H. Scholz; Prof. A. Büschges; Prof. Kloppenburg; Prof. Walkowiak; Dr. Gruhn; Dr. Wellmann and Prof. R. Predel
Internet E-Mail	www.neuro.uni-koeln.de office-neuro-physiol@uni-koeln.de
Address	Zülpicher Str. 47 b Cologne Biocenter
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Department of Neurobiology/Animal Physiology

The research groups focus on neural network function with respect to sensory processing, metabolism, and motor behavior, or study the molecular biology and genetics of nerve cell function, e.g. perform molecular genetic analysis of neural circuits, biochemistry and cell-biology, protein quality control, and several neurodegenerative diseases. The Büschges group studies the neuronal control of motor behavior in vertebrates and invertebrates from the analysis of cellular properties to the final neuro-mechanical transformation into movement. The group of the theoretician Gruhn works on across-level simulations of neuro-mechanical and cellular systems. The group of Kloppenburg studies the cellular function of individual neurons in the insect olfactory system and the neural control of feeding, metabolism and obesity. The research of the Predel group is focused on the evolution of

peptidergic signaling systems in the nervous system; the emphasis is on neuropeptides of insects. The Rugarli group studies the genetic and molecular bases of hereditary spastic paraplegia, a neurodegenerative disease. The neuronal control of addictive behavior is studied by the group of Scholz, using *Drosophila* as model organism. The Walkowiak group studies sensory integration and behavioral selection in lower vertebrates. The Wellmann group works on the neural pathways and mechanisms underlying coordination among rhythmic neuronal networks in the central nervous system of crustaceans.

International Collaborations

Dept. Biology, Athens, UoO, USA
Med. School, Huntington, WV, USA

National Collaborations

Fac. Mechanics, TUM, Munich, Med. Fac., UoC, Cologne

Research Field	Biochemistry
Keywords	Enzymes, Neurodegenerative Diseases, Peptide Synthesis, Recombinant Proteins, Structural Biology
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Institute for Biochemistry

The Institute for Biochemistry works on protein structure-function relationships in model organisms such as bacteria, algae, plants and animals. Protein structure and biological interactions of proteins are studied using modern cellular, biochemical and biophysical techniques, such as protein X-ray crystallography, surface plasmon resonance, isothermal titration calorimetry, immunofluorescence in neuronal cell culture and many more.

The major research topics involve metalloproteases, protein kinases, peptides with tailor-made delivery properties, mammalian molybdenum-dependent enzymes, plant nitrate reductase and its regulation by 14-3-3 proteins, cell biology and biochemistry of inhibitory synapses in the central nervous system, sulfur metabolism, the molybdenum cofactor in

health and disease, mitochondrial import pathways, redox regulation and oxidative folding of proteins.

International Collaborations

The Florey Institute of Neuroscience & Mental Health, Melbourne, Australia
University of Pittsburgh, PA, USA
École Normale Supérieure, Paris, France

National Collaborations

Forschungszentrum Jülich
Fraunhofer Institute for Cell Therapy and Immunology, Leipzig
Bonn University

Membership in local and regional Networks

CECAD, CMMC, IRTG1830, SFB829, SFB1218, SPP1710, SPP1927, EU ITN MagicBullet

Institute for Biochemistry I

In our institute we use biochemical and cell biological techniques to study the function of components of the cytoskeleton in cell polarity, cell motility, cell adhesion, signal transduction and differentiation. These properties of a cell are highly relevant for tumor formation. The studies are carried out in the motile amoeba Dictyostelium as well as in mouse. Of further interest are structural components of the nucleus and their involvement in human disease. We have identified novel components of the nuclear membrane and established their importance for the connection between the cytosol and the nucleus. Defects in this system can result in various disease states ranging from muscular dystrophy to premature ageing.

Our comparative and functional genomics studies are mainly concerned with

amoebzoa for which we have reported several genome sequences.

International Collaborations

University of Torino, Italy
 University of Dundee, UK
 University of Durham, UK

National Collaborations

Ludwig Maximilians University München
 University of Erlangen
 University of Bonn

Membership in local and regional Networks

Bioeconomy Science Center (BioSC),
 SyNRG

Research Field	Biochemistry, Neurobiology
Keywords	Ageing, Cancer, Cardiovascular Research, Neurodegenerative Diseases
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Institute for Biochemistry II

Our research interest is focused on the function of extracellular matrix proteins and their receptors in relation to human diseases and to animal models. Extracellular matrices are complex structures formed by proteoglycans, collagens, and noncollagenous proteins and providing the structural integrity needed in organs and tissues. The importance of the different components has been deduced from mutant phenotypes in humans or knock-out mice. Far from just having a structural function, the extracellular matrix has been linked to multiple additional roles, including regulation of cell growth, differentiation, growth factor sequestration, apoptosis, and cell migration.

International Collaborations

University of Padova, Italy
 University of Lund, Sweden

National Collaborations

University of Frankfurt
 University of Münster

Research Field	Biochemistry
Keywords	Cartilage Biology, Protein Protein Interaction, Recombinant Proteins, Skin Biology
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Contact Person André Zeppenfeld

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Internet www.uni-siegen.de

Founded (year) 1972

Number of employees
scientific 1,026
administrative 727

Funding State Government
NRW 80,6%
19,4% third-party
funding including additional
projects funded by
government

www.uni-siegen.de



University of Siegen Creating a Humane Future

The University of Siegen is an institution with a strong interdisciplinary profile. Founded in 1972 as a comprehensive university in a so-called educationally deprived region, it has now established itself as a medium-sized research university that is well networked at a regional, cross-regional and even international level. At the beginning of 2011, in order to further enhance the interdisciplinary research, what were previously twelve departments became four faculties: the Faculty of Arts, the Faculty of Education•Architecture•Arts, the School of Economic Disciplines and the School of Science and Technology. Crossing boundaries has meanwhile become an everyday occurrence, with, for example, the traditional subjects of mathematics, informatics, sciences and engineering working in cooperation with the humanities, social sciences and economics. Four key areas of research have emerged from the interdisciplinary faculties: transdisciplinary culture and media studies with an emphasis on comparative media and social research; “Creating spaces” as the focus of the exploration of the cultural and spatial architecture of educational contexts and social spaces:

“Governance” as the central guiding structure in examining the control and regulatory mechanisms of modern organizations with a particular emphasis on SMEs; “Convergent innovation” as the complementary basic and application-oriented research of scientific and technical principles, methods and systems, particularly in the fields of sensor technology, innovative materials and intelligent production technologies.

One institution of interdisciplinary scientific work is the graduate research school “Creating a humane future”, which has also proven to be extremely attractive to prestigious visiting researchers. The main idea is to research the future not for its own sake, but rather under the premise of shaping the present today in such a way as to make it worth living for humanity in the future, too.

Notwithstanding any particular research focuses, research and teaching are on an equal standing at the University of Siegen. Teaching is regarded as a research-based process. The approximately 19.400 students benefit from this. They can expect a high-quality range of courses with good support relationships.

Department Chemistry-Biology

The Department with its focus on micro- and nanochemistry has numerous connections with the life sciences and biotechnology. These activities span all the way from sensor materials synthesis, functional materials and advanced microscopic characterization to biology. The different research groups possess relevant research foci in the platform development focused at high-density sensoric arrays enabling n-dimensional biochemical analysis; the design, synthesis and characterization of new molecules as versatile DNA-binding ligands and fluorescent probes, also biologically relevant analytes; biofuel-cells and defined DNA-protein complexes; polymer-based biomaterials for bacterial detection and controlled release in wound dressings as well as fabrication and exploration of guided mesoscopic self-assembly for the creation of tailored 3D microenviron-

ments as niches for cells; polymeric hydrogel based materials for biointerfaces and sensing; time resolved spectroscopy of biologically relevant molecules as well as biology.

International Collaborations

UMR Université Bordeaux, France
 Laboratorio di Oncoematologia,
 Università di Padova, Italy
 Future Industries Institute, University of
 South Australia, Adelaide, Australia

National Collaborations

Institute of Organic Chemistry and
 Biochemistry, Johann Wolfgang
 Goethe University Frankfurt
 University Medical Center, Mainz

Membership in local and regional Networks

"Research Center for Micro- and Nano-
 chemistry and Engineering" University
 of Siegen

Research Field	Functional Materials, Micro- and Nanochemistry, Nanotechnology
Keywords	Biomaterials, DNA, Drug Discovery/Delivery, Microscopy, Small Molecules, Bioorganic Chemistry
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Section of Integrative Biology

In the fields of Behavioral Biology and Ecology my research projects covers several topics. In Behavioral Biology we study the role of social information in mate choice in fish and birds by using innovative techniques like virtual and interactive stimuli in cooperation with computer scientists. We also investigate proximate and ultimate factors of using social information and the consequences in sexual selection in these species. By studying a colony of common swifts we want to understand the life history of this long living and long-distance migratory bird with a focus on population ecology and ecophysiology aspects.

In ecotoxicology we study the fate and effect of wastewater-borned manufactured nanoparticles in daphnia and *Danio rerio* together with several partners. In freshwater ecology we monitored the effect of water

management structures and their deconstruction on the macrozoobenthos fauna. In a project regarding Biological Conservation we are involved in the first reintroduction of the European Bison into West-Germany.

International Collaborations

Evolution & Diversité Biologique, Université
 Paul Sabatier, Toulouse, France,
 Section of Integrative Biology, University
 of Austin, USA
 Department of Biology Carleton
 University Ottawa, Ontario, Canada

National Collaborations

Helmholtz Zentrum München
 Fraunhofer Institute for Molecular Biology
 and Applied Ecology IME, Schmallenberg
 Institute for real-time learning systems
 University of Siegen

Research Field	Behavioral Biology & Ecology
Keywords	Animal Models, Behavioral Biology, Conservation Biology, Ecotoxicology, Ecology, Ecophysiology
Head of Section	Prof. Dr. Klaudia Witte
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E-Mail	witte@biologie.uni-siegen.de
Address	Adolf-Reichwein-Str. 2 Raum: AR-C 3011
Postal Code/City	57068 Siegen
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Research Field	Molecular Physiology
Keywords	Agricultural Biology, Biomaterials, Genomics, Membrane Proteins, Recombinant Proteins, RNA/RNAi/Antisense RNA
Head of Section Internet	Prof. Dr. Hans Merzendorfer www.chemie-biologie.uni-siegen.de/biologie/fachgruppen/abt_molekularbiologie
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Section of Molecular Biology

Chitin is one of the most abundant organic compounds on earth and becomes increasingly important as a renewable resource for the chemical/pharmaceutical industry. To obtain more insight into chitin biosynthesis, we investigate the expression and regulation of the involved genes, analyse the functions of the derived proteins and dissect the reactions in which they participate. To allow comparative analyses and different experimental strategies, we examine these processes in different arthropods, of which some are amenable to systemic RNA interference allowing the analysis of gene functions. Additionally, we use the genetic model system *Saccharomyces cerevisiae*, because it allows us to examine intracellular maturation and trafficking of proteins involved in chitin synthesis. Several classes of commercially applied insecticides and mitocites act

as chitin synthesis inhibitors. Their mode of action, pharmacology and toxicology as well as resistance mechanisms developed by the target organisms are matters of particular interest to us.

International Collaborations

Dept. of Biochemistry, Kansas-State University, USA
Institute for Biodiversity and Ecosystems, University of Amsterdam, NL
Dept. of Entomology, North Carolina State University, USA

National Collaborations

Div. of Animal Physiology, University of Osnabrück
Molecular Plant Physiology, University of Münster
Organic Chemistry, University of Siegen

Research Field	Organic Chemistry
Keywords	Environmental Research, Microarrays, Sensing of Ions and Molecules
Head of Section Internet	Prof. Dr. Michael Schmittl www.chemie-biologie.uni-siegen.de/oc/oc1/chef/index.html
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Section of Organic Chemistry I

Our efforts center around establishing a high-density sensoric array of multifaceted essence at the 6000 nanotips of a multi-fiber optical bundle (lab-on-tips) thus enabling n-dimensional (bio) chemical analysis by electrochemiluminescence (ECL) and photoluminescence (PL). As ECL has become a powerful quantitative analytical technique for immunoassays, food/water testing and many individual analytes, the present endeavour seeks to establish a full analytical laboratory at the global tip of a 300 µm (diameter) optical waveguide with its 6000 individual fibers.

To accomplish this goal, the fiber optical nanotips (diameter: 3 µm; apex: 30 nm curvature radius) need to be addressed in an individually guided and spatially highly defined manner.

International Collaborations

Institut des Sciences Moléculaires – UMR Université Bordeaux, France

National Collaborations

Institute of Organic Chemistry and Biochemistry, Johann Wolfgang Goethe University Frankfurt

Membership in local and regional Networks

Member of the "Research Center for Micro- and Nanochemistry and Engineering" (University of Siegen)

Section of Organic Chemistry II

With the long-term goal to establish annelated quinolizinium derivatives as versatile platform for the design of DNA-binding ligands and fluorescent probes, we study the synthetic approaches to this class of compounds and investigate in detail their chemical, photophysical and DNA-binding properties. Along with the perspective of discovering novel DNA-targeting drugs, our main research interest in this area lies in the understanding of structural parameters that govern the DNA-binding properties of cationic hetarenes, in particular towards special DNA forms such as triplex- and quadruplex DNA, and DNA with abasic sites.

In another project we aim at the development of fluorescent probes based on the water-soluble benzo[b]quinolizinium fluorophore that enable the fluorimetric

detection of biologically relevant analytes, such as e.g. Hg(II), Cu(II), DNA or proteins, in water and in cells.

International Collaborations

Department of Chemistry, University of Victoria, BC, Canada
 Dipartimento di Pediatria, Laboratorio di Oncoematologia, Università di Padova, Italy
 Nesmeyanov Institute of Organoelement compounds, Russian Academy of Sciences, Moscow, Russian Federation
 Laboratoire Ondes et Matière d'Aquitaine, UMR CNRS 5798, Université Bordeaux

National Collaborations

Department Chemie, Universität Bielefeld

Membership in local and regional Networks

Member of the "Research Center for Micro- and Nanochemistry and Engineering" (University of Siegen)

Research Field	Organic Chemistry
Keywords	DNA, Bioorganic Chemistry, Photochemistry
Head of Section	Prof. Dr. Heiko Ihmels
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Section of Physical Chemistry I

Our research revolves around the physics and chemistry of polymeric materials with a focus on micro- and in particular nanostructures, self-organized systems and functional biointerfaces. We cover the complete breadth of physicochemically and biomaterial science oriented multidisciplinary research from synthesis to characterization using state-of-the-art surface analytics and microscopy. Specific research efforts focus on the autonomous detection of pathogenic bacteria, in which the detection, identification and treatment of bacteria via reactions triggered by bacterial enzymes or quorum sensing molecules are targeted. In a separate project we combine nano- and microstructuring with defined surface functionalization and mesoscopic assembly to obtain novel 3D cell microenvironments for the development of stem cell niches and novel cell culture experiments.

International Collaborations

Future Industries Institute, University of South Australia, Adelaide, Australia,
 Department of Chemistry, University of Bath, UK

National Collaborations

Institute of Materials Engineering, University of Siegen
 Biomedical Technology Center, Medical Faculty Münster
 Organic Chemistry, University of Siegen

Membership in local and regional Networks

Member of the "Research Center for Micro- and Nanochemistry and Engineering" (University of Siegen); InnovativeMedizin. NRW (Projekt "Ein Herz für NRW")

Research Field	Biointerface Chemistry and -Physics
Keywords	Anti-infective Research, Biointerface Fabrication and Characterization, Biomaterials, Personalized Medicine, Platform Technology
Head of Section Internet	Prof. Dr. Holger Schönherr www.chemie-biologie.uni-siegen.de/pc/hs/
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Research Field	Biophysics, Bioanalytical Chemistry, Organic Chemistry
Keywords	DNA, Bioelectrochemistry
Head of Section	Dr. Gilbert Nöll
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Section of Nanotechnology and Bioelectrochemistry

1) We are working on the development of electrochemical biosensors and biofuel cells based on redox-enzymes. Suitable enzymes are prepared in our laboratories or provided by external collaborators. To determine the redox potentials of redox enzymes we carry out UV/Vis spectro-electrochemical measurement using a home-made setup.

2) We are developing sensor chips for the detection of specific oligonucleotides (DNA or RNA). As readout techniques we use electrochemistry, quartz crystal microbalance with dissipation monitoring (QCM-D) measurements, surface plasmon resonance measurements and surface plasmon fluorescence spectroscopy.

3) We are developing one and more-dimensional protein-DNA nanostructures in solution and on surfaces.

4.) We generate pristine DNA hydrogels with defined viscoelastic properties for bioanalytical and biomedical applications.

National Collaborations

Wolfgang Goethe University Frankfurt,
Buchmann Institute for Molecular Life Sciences
Physical Chemistry I, University of Siegen

Membership in local and regional Networks

Member of the "Research Center for Micro- and Nanochemistry and Engineering" (University of Siegen)



Westfälische Wilhelms-Universität Münster

WWU Münster – living.knowledge

The Westfälische Wilhelms-Universität (WWU) in Münster is distinguished by outstanding research in many areas. In addition to targeted funding for top-level research (“Strengthening strengths”), one focus is on junior academics. At the same time WWU provides for a wide range of research as the basis for helping further disciplinary excellence and interdisciplinary collaboration to grow.

With around 39,000 students WWU is one of the largest universities in Germany. The teaching offered by its 15 departments comprises 250 courses in 120 subjects from practically every field of the Humanities, Social Sciences, Medicine and Natural Sciences. The government and the federal states have agreed a pact for further improvements to the quality of teaching and of study conditions. As part of the funding programme WWU is to receive an additional € 30 million up to 2016.

- 120 subjects, 250 courses
- 15 departments, 7 faculties
- 39,000 students
- 7,300 graduates per year
- 2nd place nationally in number of degree examinations taken

- Above-average rate of degrees obtained and short length of study
- Top marks in the CHE university rankings

International and interdisciplinary cooperation are, more than ever, a prerequisite for top-level research and innovation. Münster University is well placed in the international academic environment and is constantly extending this position. Internationalisation in the sense of increasingly international orientation and global networking is embedded in the University’s overall strategy and is a cross-disciplinary approach affecting all areas of the University – studying, teaching, research, administration and services.

The University motto – “knowledge and life” – describes exactly the close interplay between the University and the city of Münster. It underlines the way that the academic world and social life are interlinked, and at the same time it calls upon us to live our knowledge actively. Münster very clearly bears the stamp of WWU – through research and teaching and through its students, its academic and cultural events, its museums and theatres and the range of sporting activities it offers.

	
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Internet	www.uni-muenster.de
Founded (year)	1780
Number of employees	5,000 in total
Funding	State Government NRW 78% Others 22% EU, federal government, private financing, third Party funds, foundations
www.uni-muenster.de	

Research Field	Biochemistry, Biotechnology, Molecular Biology, Cell Biology
Keywords	Cancer, Protein Chemistry, Recombinant Proteins, RNA (Bio)Chemistry
Head of Institute	Prof. Dr. Henning D. Mootz
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Institute of Biochemistry

The Institute of Biochemistry is part of the Department of Chemistry and Pharmacy at the University of Münster. The institute provides state of the art facilities for research and houses three research groups whose activities cover a broad spectrum of topics ranging from protein chemistry to RNA biochemistry, cell and molecular biology and biotechnology. As part of the Chemistry and Pharmacy Department the institute plays a major role in the teaching of students enrolled in the chemistry Bachelor, Master, and Ph.D. degree programs and also offers lecture and laboratory courses for biology students. Major research topics are transcriptional control of cell proliferation of eukaryotic cells and novel tumor suppressor genes, novel approaches for site-specific chemical modification of proteins at the interface

of chemistry and biology as well as RNA-modifications.

International Collaborations

Princeton University, USA
Weizmann Institute of Science, Israel
University College Dublin, Ireland

National Collaborations

University of Heidelberg
University of Osnabrück
University of Düsseldorf

Membership in local and regional Networks

DFG EXC 1003 (Cells in Motion)
DFG SFB 858
DFG SPP 1623 / 1784

Research Field	Health, Medical Devices, Translational Imaging
Keywords	Cardiovascular Research, Diagnostic Systems, Oncology, Molecular Imaging, Small Molecules
Head of Institute	Univ.-Prof. Dr. med. Michael Schäfers
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European Institute for Molecular Imaging (EIMI)

Our inter-faculty team develops molecular imaging technologies in the major disease areas cardiovascular disease, inflammation, neurodegeneration and oncology. The most important applications comprise imaging studies in model systems, which can be directly translated into clinical application to serve imaging-guided patient-tailored diagnosis and treatment. Beside research efforts we foster teaching and training of young researchers.

International Collaborations

University of Groningen & University of Twente

National Collaborations

University of Tübingen

Membership in local and regional Networks

DFG CRC 656 'Molecular Cardiovascular Imaging'; DFG EXC 1003 Cluster of Excellence "Cells in Motion - CiM"

Institute of Infectiology - Center for Molecular Biology of Inflammation (ZMBE)

The research projects pursued at the Institute of Infectiology - ZMBE focus on the molecular basis of pathogenicity and the defense strategies of the host. We strive for a better understanding of the molecular interplay between pathogenic microorganisms, their target cells, and the respective host organism. Furthermore, in pursuing our mission we expect to identify new possibilities to circumvent and even exploit the ingenuity of pathogenic microbes for improving diagnosis and therapy of infectious diseases. This also includes novel options to develop innovative bacteria-based biologics to therapeutically modulate detrimental immune reactions of the host.

Research at the Institute of Infectiology recently resulted in the founding of a spin-off ('BioPIT Mining Co. GmbH'; www.biopit.

de) with the University Hospitals Münster which is based on a novel class of biologics for the treatment of autoimmune diseases.

International Collaborations

Kansas State University, Manhattan, Kansas
Imperial College London

National Collaborations

Pharma-Zentrale GmbH, Herdecke

Research Field	Cell Biology, Infectiology, Microbiology, Molecular Biology
Keywords	Biologicals, Genetic Engineering, Infectious Diseases, Microbial Pathogenicity, Signal Transduction, Recombinant Proteins,
Head of Institute	Dr. Inga Benz, Dr. Christoph Cichon, Dr. Christian Rüter
Internet	zmb.uni-muenster.de/ institutes/ifi/ifiindex.htm
E-Mail	infekt@uni-muenster.de
Address Postal Code/City	Von-Esmarch-Str. 56 48149 Münster
Fon	+49 251 835-6466
Fax	+49 251 835-6467

Institute for Molecular Cell Biology

The institute focuses on basic research in the areas of developmental biology, cell biology, signal transduction, biochemistry and biophysics. Research topics include neurogenesis, cell polarity, cell migration, cell-cell adhesion, cell-matrix adhesion, signalling by small monomeric G-proteins, host-pathogen interactions, innate and adaptive immune responses.

Membership in local and regional Networks

Excellence Cluster "Cells in motion"
SFB629

International Collaborations

University of Canterbury, York, UK
Yale University, New Haven, USA
University of Berne, Switzerland

National Collaborations

Technical University Munich
Hannover Medical School
CAEC

Research Field	Molecular Cell Biology
Keywords	Animal Models, Immune Modulation, Microscopy, Recombinant Proteins
Head of Institute	Prof. Dr. Martin Bähler Prof. Dr. Theresia Stradal Prof. Dr. Andreas Püschel Prof. Dr. Ralf Seidel
Internet	www.uni-muenster.de/ biologie.allgmzoo/
E-Mail	baehler@uni-muenster.de claudia.bethke@uni-muenster.de
Address Postal Code/City	Schlossplatz 5 48149 Münster
Fon	+49 251 832-3841
Fax	+49 251 832-4723

Research Field	Biotechnology, Microbiology
Keywords	Biomaterials, Enzymes, Fermentation, Genetic Engineering, Microbial Genomics, Biopolymers, Microbial Pathways
Head of Institute	Prof. Dr. Alexander Steinbüchel
Internet	http://mibi.uni-muenster.de
E-Mail	mibi@uni-muenster.de
Address Postal Code/City	Corrensstr. 3 48149 Münster
Fon	+49 251 83-39821
Fax	+49 251 83-38388

Institute for Molecular Microbiology and Biotechnology

The IMMB has a long tradition of research in applied microbiology and biotechnology, and it currently harbours four groups (Prof. Dr. S. Fetzner, Prof. Dr. F. Meinhardt, Prof. Dr. B. Philipp, Prof. Dr. A. Steinbüchel). All laboratories are investigating basic and applied aspects of microbiology, and many research projects are related to biotechnological processes.

The microbial metabolism of biopolymers like polyesters, polythioesters, polyamides, natural rubber and Gutta Percha, of lipids, steroid compounds, heteroaromatic compounds, aromatic flavor compounds and amino acids, as well as of extracellular enzymes, key enzymes of novel pathways and plasmids and strain optimization by metabolic engineering are major subjects of research in the laboratories. The equipment of the bioreactor

laboratory allows process optimization by parallel fermentations and scale up of processes to the 500-L scale. Novel compounds can be produced at the kilogram scale.

International Collaborations

INVISTA (UK)
University College Dublin (Dublin, Ireland)
SYNPOL (EU-Project)
OPTIBIOCAT (EU-Project)

National Collaborations

Biotech Genomik Network Centre
Göttingen
Symrise AG, Holzminden
Silantes GmbH, München

Research Field	Genetics, Molecular Biology, Neurobiology
Keywords	Animal Models, DNA, Genetic Engineering, Signal Transduction
Head of Institute	Prof. Dr. Norbert Sachser
Internet	www.uni-muenster.de/Biologie/NeuroVer/
E-Mail	k.ewers@uni-muenster.de
Address Postal Code/City	Badestrasse 9/13 48149 Münster
Fon	+49 251 83-21122

Institute for Neurobiology and Behavioural Biology

Work within the institute is devoted to an understanding of the development and function of the nervous system as well as causes and consequences of behaviour. We combine behavioral and neuroendocrine analyses, imaging, biochemistry and molecular genetics to decipher how neural networks control specific aspects of behavior. Current research topics include analysis of cytoskeletal dynamics, glial development and glial cell migration in *Drosophila*, function of the blood-brain barrier, development and dynamics of cell junctions, molecular mechanisms underlying the differentiation of wrapping glial cells, cell-cell adhesion, developmental pruning of dendrites, larval locomotion, evolution and development of social behavior, gene-environment interaction in emotion, cognition, aggressive and anxiety-like behavior as well as animal

welfare. Members of the institute strongly participate in teaching biology students at all levels in all biological BSc and MSc study programs. The institute is well-known for high end imaging techniques and houses one of the largest *Drosophila* facilities in Germany.

International Collaborations

University of California San Francisco, USA
Salpêtrière, ParisSYNPOL (EU-Project)
University of Texas, Southwestern Medical Center, USA

National Collaborations

University of Bielefeld; University of Bonn; University of Leipzig

Membership in local and regional Networks

CiM excellence cluster, SFB 1009, TRR 58, SPP 1757, FOR 1232

Institute of Pharmaceutical Biology and Phytochemistry

Natural product chemistry

Glycobiology (Oligo-, Polysaccharides, Glycoproteins): Structural aspects and pharmacological activity

Antiadhesive natural products against pathogens

Skin-active natural products and biochemical pathways to improved wound healing

Ethnopharmacology: New pharmacological activities of traditional medicinal plants

Neglected diseases

Computational lead discovery

Stability of plant-derived secondary products and herbal materials

Analytical development and standardization of herbal drug material.

Research Field	Natural Product Chemistry
Keywords	Biopharmaceuticals, Drug Discovery/Delivery, Flow Cytometry, Infectious Diseases, Lead Discovery, Microarrays, Small Molecules
Head of Institute	Prof. Dr. Andreas Hensel
Internet	www.uni-muenster.de/Chemie.pb
E-Mail	ahensel@uni-muenster.de
Address Postal Code/City	Corrensstrasse 48 48149 Münster
Fon Fax	+49 251 833-3381 +49 251 833-8341

Institute of Plant Biology and Biotechnology

The seven major groups and three junior groups use a broad range of organisms (bacteria, fungi, algae, plants) and methods (genetic engineering, protein engineering, enzymatic modification, mass spectrometry, bio-assays, transgenic plants, confocal microscopy) to address a wide range of fundamental and applied topics, including the production of hydrogen, rubber, secondary metabolites for applications in agriculture, the design of plants for biomass production, stress and pathogen resistance, the development of alternative strategies for pathogen control, various aspects of nanotechnology and structure-function relationships of functional polysaccharides.

International Collaborations

Several partners in Israel (Haifa, TelAviv)
Several partners in Europe (Barcelona, Ghent, Wageningen)
Several partners in India (Hyderabad, Pantnagar)

National Collaborations

Botanical groups University of Düsseldorf
Biotechnology groups University of Bielefeld

Research Field	Plant Biology/Physiology
Keywords	Agricultural Biotechnology, Bioenergy Research, Plant Produced Products, Proteomics, Signal Transduction
Head of Institute	Prof. Dr. Michael Hippler
Internet	www.uni-muenster.de/biologie.ibbp/index.shtml
E-Mail	ibbp@uni-muenster.de
Address Postal Code/City	Schlossplatz 8 Schlossplatz 4 48149 Münster
Fon Fax	+49 251 832-4791 +49 251 832-8371

Research Field	Physiology
Keywords	Drug Discovery/Delivery, Environmental Research, Genetic Engineering, Infectious Diseases, Systems Biology
Head of Institute	Prof. Dr. Rüdiger Paul
Internet	www.uni-muenster.de/biologie.zoophysiologie/
E-Mail	paulr@uni-muenster.de zoophys@uni-muenster.de
Address	Schlossplatz 8
Postal Code/City	48143 Münster
Fon	+49 251 832-3851
Fax	+49 251 832-3876

Institute of Zoophysiology

Three workgroups at the institute focus on the molecular principles of environmental adaptation and acclimatization in the model organisms *Caenorhabditis elegans* and *Daphnia* both within the range of tolerance and under stress conditions (AG Paul), on parasitic nematodes and the molecular mechanisms of adaptation to xenobiotic compounds and oxidative stressors in *C. elegans* (AG Liebau), and on strategies for the treatment of channelopathies (e.g., cystic fibrosis) (AG Weber). Methods and techniques utilized in the institute include tools from molecular biology (e.g., RNA interference, reporter gene assays, transcriptomics), protein biochemistry (e.g., proteomics, recombinant protein technology and structure determination), bioinformatics, cell biology, (confocal) microscopy,

and physiology (e.g., electrophysiology, optophysiology). (www.uni-muenster.de/Biologie.Zoophysiologie)

International Collaborations

University of Birmingham, UK
Washington University of St. Louis, USA
Banaras Hindu University, Varanasi, India

National Collaborations

University of Mainz
University of Hamburg
University of Göttingen





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Universities of Applied Sciences

Universities of Applied Sciences

Universities of Applied Sciences (UAS) are institutions of higher education that combine education and research with a focus on products, markets and the demands of specific job profiles. UAS in NRW offer studies in engineering, life sciences, social sciences, business, law as well as technical subjects and design, music and arts. UAS students are awarded a bachelor degree (after seven to nine semesters) or a master degree (after completing a bachelor and up to three additional semesters).

In the history of German UAS, three periods can be distinguished. After World War II and up until 1969, the concept of new institution of higher education apart from and separate to universities has been developed. In 1968, the federal state governments decided that UAS should become independent institutions – in contrast to the Universities, which are supported and maintained by the states.

In the second period up until 1999, the concept and the organisational structures of UAS have been optimized and extended with about one third of the UAS that are present today being founded in the 1990s. A central modification of the UAS concept has been the “Hochschulrahmengesetz” from 1976: this national law gave UAS the same educational status (tertiary level) as universities. This law also ensured freedom of education and research for the institutions as well as their independent academic administration.

In the third period from 2000 on and as an outcome of the “Bologna Process”, the academic degrees that can be obtained at UAS have been modified to bachelor and master. The most important consequence of this restructuring process is the equality of the academic degrees from UAS with those attained at Universities. Therefore, students that acquired a master degree

at a UAS are eligible to enter PhD programs at Universities for example.

Today, 37 UAS are located in NRW, the majority of them either in the Rhineland or the Ruhr Valley.¹ 11 of these are active in life science research and education.³ 260,000 students performed their studies at a UAS in 2015, which corresponds to about 35 % of all the students in the state. This value has increased by a lot compared¹ to the last issue of this brochure (28 %, 2013)² and shows the rising importance of the Universities of Applied Sciences in NRW.

Sources: ¹Statistisches Bundesamt - Studierende an Hochschulen (Wintersemester 2015/2016); ²Information und Technik Nordrhein-Westfalen, Geschäftsbereich Statistik - Hochschulen in Nordrhein-Westfalen (2015); ³Classification by BIO.NRW



**Hochschule
Bonn-Rhein-Sieg**
University of Applied Sciences

Name Bonn-Rhein-Sieg
University of Applied
Sciences

Address Grantham-Allee 20
Postal Code/City 53757 Sankt Augustin

Contact Person Dr. Udo Scheuer

Fon +49 2241 865-650

E-Mail udo.scheuer@h-brs.de

Internet www.h-brs.de

Founded (year) 1995

Number of employees
scientific 480
administrative 200

www.h-brs.de



Bonn-Rhein-Sieg University of Applied Sciences

excellent – international – innovative

The Bonn-Rhein-Sieg University of Applied Sciences (H-BRS) was founded in 1995. It is a dynamic and research-driven university with almost 8,000 students, approximately 150 professors, 260 research associates and 60 PhD Students. They are supported by many highly qualified lecturers from the fields of academia, business and industry. There are also roughly 200 employees working for the administration, the library and the Language Centre.

At the H-BRS you can currently choose from 14 Bachelor and 13 Master degree courses. All of these courses are practice-oriented and based on the newest research findings, and some of the courses are taught in English. The University's professors have professional experience in both business and academia. Our excellent infrastructure and our well-equipped laboratories are just as integral to our offer as our numerous PC workstations, our WiFi, our modern library and the active campus life. The three campuses are located in Hennef, Rheinbach and Sankt Augustin. In Bonn, the H-BRS runs the Bonn-Aachen International Center for Information Technol-

ogy (B-IT) jointly with Bonn University and Aachen Technical University (RWTH).

We attach a lot of importance to training highly qualified specialists and executive staff for the international and national job market. The Alumni Union links alumni and current students within a continuously growing network so as to enable them to jointly and actively shape their future.

Furthermore, we help students and employees to combine their studies, academia and family commitments by offering family-friendly facilities to students and employees alike.

A number of excellent rankings and achievement awards, above all the feedback we receive from satisfied students and alumni, prove that the H-BRS is one of the top universities in many respects.

Additionally, our International Office supports international students and academics in order to shape studying or working at the H-BRS in a comfortable and easy manner.

Department of Natural Science/Biology

Our three main interests are (1) autoimmune diseases in particular rheumatoid arthritis, where we study basic mechanisms using human samples and the K/BxN model to study both cellular and molecular pathways involved in the pathogenesis of the disease. (2) We analyze the function, shedding mechanism and involvement of soluble CD21 in immunological diseases. Here we focus on inflammatory and autoimmune diseases. (3) We do research on applicable biotechnological tools and protein expression.

International Collaborations

Systems and Cell Biology of Neurodegeneration
Yale University School of Medicine
New Haven, CT 06520-8031, USA

National Collaborations

University of Bonn, Institute for Medical Microbiology, Immunology and Parasitology
University of Jena, Institute of Pathology
University of Lübeck, Institute of Dermatology and Allergology
University of Rostock, Proteom Center

Membership in local and regional Networks

Eurora

Research Field	Immunology
Keywords	Animal Facility, Antibody, Cell Separation, Flow Cytometry, Immune Modulation
Head of Studies	Prof. Dr. Harald Illges
Internet	http://fb05.h-bonn-rhein-sieg.de/illges.html
E-Mail	harald.illges@hrs-brs.de
Address Postal Code/City	Von-Liebig-Str. 20 53359 Rheinbach
Fon Fax	+49 2241 865-570 +49 2241 865-8570

Department of Natural Science/Chemistry

Research activities include material synthesis (polymers and composites) based on renewable resources and biomass (i.e. hard and soft wood, grasses) and application of functionalized biobased materials for medical applications, e.g. tissue engineering and drug release. Special focus of current research projects are collagen-based scaffolds for stem cell differentiation in bone regeneration. In particular, functional biomimetic scaffolds are developed for template-mediated biomineralization and guided differentiation of mesenchymal stem cells.

International Collaborations

Royal Institute of Technology (KTH)
Stockholm, Sweden
Universita di Palermo, Italy

National Collaborations

Brandenburg University of Technology
Cottbus
Friedrich Schiller University Jena
University of Bonn

Membership in local and regional Networks

BioRegio
Bonnrealis
bio innovation park Rheinland

Research Field	Biomaterials, Renewable Resources
Keywords	Biomaterials, Regenerative Medicine, Tissue Engineering
Head of Studies	Prof. Dr. Margit Schulze
Internet	www.fb05.h-bonn-rhein-sieg.de/schulze.html
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Address Postal Code/City	Von-Liebig-Str. 20 53359 Rheinbach
Fon Fax	+49 2241 865-566 +49 2241 865-8566



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Internet www.fh-aachen.de
fhac.de/YouTube
fhac.de/facebook

Founded (year) 1971

Number of employees 1,150

www.fh-aachen.de



FH Aachen University of Applied Sciences

With more than 13,000 students, almost 2,000 graduates a year, ten faculties, more than 70 degree programmes, nine in-house and three affiliated institutes as well as four competence platforms, the FH Aachen University of Applied Sciences, with its Aachen and Jülich locations, is one of the biggest and most important universities of applied sciences in Germany. Around 250 professors as well as approximately 900 employees work here, in teaching, in research and in administration.

The FH Aachen offers its students a first-rate course of study in modern and trendsetting professions. Apart from the traditional MINT-subjects, such as mathematics, informatics, natural sciences, and technology, the range of courses offered by the university also includes business studies and design. In line with market requirements, more than 70 Bachelor's and Master's degree programmes aren't just offered as full-time courses of study, there is also an ever increasing number of dual study programmes.

When it comes to research, the FH Aachen strives to be among the strongest universities of applied sciences in Germany.

The competences are mainly in the future areas of energy, mobility, and life sciences. The latest research results are directly incorporated into teaching. Through the close cooperation with regional small and medium-sized businesses (SMEs), the university and business enterprises collaborate on the development of products and methods which provide added value directly in the region.

The expansion of regional, national and international networking in teaching and research is an essential part of the FH Aachen's plans for the future, especially with regard to the euroregional location of the campuses in Aachen and Jülich, in immediate proximity to Belgium and the Netherlands.

Institute for Bioengineering (IfB)

The institute (IfB) has been established by five laboratories with 15-25 years research experience. IfB focuses on solving medical and biological problems from cell physiological and microbiological questions up to the level of the full organs and organism. The international team of scientists applies biophysical methods (bioengineering) in addition to conventional approaches of engineering and natural science. The scientific background comprises biology, biochemistry, medicine, biophysics, mechanical and biomedical engineering. Therefore, IfB could perform successful research on cardiomyocytes from human induced pluripotent stem (hiPS) cell cultures, to their mathematical modelling including cell physiology and cell mechanics up to first models of the full heart.

This example of translational medical research and drug testing shows the potential

of IfB for the independent development of own tools for all levels of its research from the design of its patented Cell-Drum® for the quantification of cell forces to its own software for simulation of cell cultures or organs.

International Collaborations

University College London, UK
Institut Laue-Langevin, Grenoble, France
University of California, USA

National Collaborations

Forschungszentrum Jülich GmbH
University of Leipzig
RWTH Aachen

Membership in local and regional Networks

KOPF Bioengineering (Center of Competence in Bioengineering, Speaker)
MedLife e.V.

Research Field	Bioengineering, Biophysics, Biomechanics, Mathematical Modelling, Organ-on-a-Chip, Medical Devices, Viroids
Keywords	Personalized Medicine, Tissue Engineering, Cell Therapy, Biomechanics, Cardiovascular Research, Ophthalmology
Head of Institute	Prof. Dr.-Ing. Manfred Staat
Internet	www.ifb.fh-aachen.de
E-Mail	m.staat@fh-aachen.de
Address	Heinrich-Mußmann-Str. 1
Postal Code/City	52428 Jülich
Fon	+49 241 6009-53120/-130
Fax	+49 241 6009-53864

Center of Competence in Bioengineering

More than 10 years ago, scientists of various disciplines established the Center of Competence in Bioengineering (KOPF) as a centralized, high-profile, long-term research platform at the Universities of Applied Sciences of Aachen and Bonn-Rhine-Sieg. They combine life sciences with engineering and natural sciences. This centralization under the umbrella of only one platform contributes to the exchange of excellences in various disciplines and at the same time to sharing knowledge and improving research infrastructure due to sharing technological and personal resources. KOPF has become an attractive and strong scientific partner for both industry and neighboring universities. Research efforts are not only integrated into newest technological advances but also into state of the art university education.

Services: Basic and applied research in life sciences and neighboring disciplines, technology development, cell based drug screening assays, biotechnical devices, consulting, hardware and software developments also for crop sciences.

International Collaborations

University College London, UK
University of California, USA

National Collaborations

Forschungszentrum Jülich GmbH
RWTH Aachen University
University of Duisburg-Essen
University of Cologne

Membership in local and regional Networks

MedLife e.V.

Research Field	Bioengineering, Medical Physics, Biotechnology
Keywords	Personalized Medicine, Cardiovascular Research, Tissue Engineering, Biomechanics, Biotechnology, Diabetes
Head of Institute	Prof. Dr. rer. nat. habil. Gerhard M. Artmann
Internet	www.kopfbio.fh-aachen.de
E-Mail	artmann@fh-aachen.de
Address	Kompetenzplattform Bioengineering Heinrich-Mußmann-Str. 1
Postal Code/City	52428 Jülich
Fon	+49 241 6009-53028/-130
Fax	+49 241 6009-53864

Research Field	Sensors, Biotechnology, Nanotechnology
Keywords	Chemical-/Biosensors, DNA-Sensors, Optical Micro- and Nanosystem Technology, Industrial Microbiology, Enzyme Technology, Biocatalysis, Mammalian Cell Culture Technology, Applied Immunology
Head of Institute Internet E-Mail	Prof. Dr. Michael J. Schöning www.fh-aachen.de/inb.html schoening@fh-aachen.de info@inb.fh-aachen.de
Address Postal Code/City Fon Fax	Heinrich-Mußmann-Str. 1 52428 Jülich +49 241 6009-53144 +49 241 6009-53235

Institute for Nano- and Biotechnologies (INB)

“Biology meets microelectronics” – a phrase often quoted in recent times, and one which underlines the increasing importance of multi- and trans- disciplinary research activities. Basic scientific disciplines such as physics, electrical engineering, chemistry, biology and material sciences are increasingly seen to overlap common boundaries, so defining the interface of an exciting research environment with a high potential for innovation. In this context the INB (Institute for Nano- and Biotechnologies) at the Aachen University of Applied Sciences aims to combine synergistically its existing expertise in the fields of semiconductor technologies, nano-electronics, silicon-based chemical sensors and biosensors, DNA sensing and nanostructures along with mammalian cell culture technology, enzyme technology, biocatalysis, industrial microbiology and applied

immunology. Ten research laboratories will focus their research activities on the pioneering spectrum of nano- and biotechnologies, a broad contemporary research area, fostering new ideas and the design of new products which may change our daily life.

International Collaborations

Tohoku University, Sendai, Japan
KU Leuven
Transnational University of Limburg,
Hasselt and Maastricht

National Collaborations

Forschungszentrum Jülich GmbH
German Cancer Research Center
Heidelberg
Philipps-Universität Marburg
Heinrich Heine University Düsseldorf
University of Stuttgart





FH Bielefeld
University of
Applied Sciences

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Contact Person	Prof. Dr. Christian Schröder Vice President – Research, Development, Transfer
Fon	+49 521 106-71226
E-Mail	christian.schröder@ fh-bielefeld.de
Internet	www.fh-bielefeld.de
Founded (year)	1971
Number of employees	scientific 245 administrative 414
Funding	State Government NRW 100%

www.fh-bielefeld.de



Fachhochschule Bielefeld University of Applied Sciences

Since its foundation in 1971, the Bielefeld University of Applied Sciences (Fachhochschule) is a recognized centre for innovative education and research in the Ostwestfalen-Lippe region. Currently, 245 professors and teachers for special tasks and 414 further staff in research, teaching and administration ensure a modern, scientific, practical and cooperative education of 9851 students.

The Bielefeld University of Applied Sciences regards itself as an international scientific institution with a strong focus on applied sciences. The spectrum of studies covers the fields of design, engineering and IT, biotechnology, renewable energies, social sciences, business, architecture as well as care and health.

The key research areas at the Bielefeld University of Applied Sciences focus on the future challenges in research and innovation defined in the High-Tech-Strategy of the Federal Ministry of Education and Research and are mainly addressed through internally funded research networks (research institutes and research groups). Best-known are the three research institutes "Materials Research", "Research in Health Care, Edu-

cation and Service" and "System Dynamics and Mechatronics" which are registered in the research map (Forschungslandkarte) provided by the German Rectors' Conference since 2015.

Dept. of Engineering and Mathematics – Bioprocessing and Technical Analytics in Biotechnology

Our laboratory works on the cultivation of recombinant eucaryotic cells (mammalian cells and microalgae) as producers of valuable products (e.g. monoclonal antibodies, EPO). We are especially interested in high cell density fermentation and optimization of product formation. Upstream processing is carried out in traditional glass or stainless steel fermenters as well as modern disposable bioreactors up to 200L. Downstream processing includes ultrafiltration and protein purification up to pilot scale. Furthermore, our team is interested in the development of automated process analysis (e.g. cell density, nutrients and metabolites).

International Collaborations

Sartorius Stedim Biotech

National Collaborations

Bielefeld University

Research Field	Biotechnology
Keywords	Analytics, Downstream Processing, Fermentation, Recombinant Proteins
Head of Studies	Prof. Dr. Frank Gudermann, Prof. Dr. Dirk Lütkemeyer, Dr. Anke Rattenholl
Internet	www.fh-bielefeld.de/fb3/labore/apparative-biotechnologie
E-Mail	frank.gudermann@fh-bielefeld.de
Address	Interaktion 1
Postal Code/City	33619 Bielefeld
Fon	+49 521 106-70051
Fax	+49 521 106-70054

Dept. of Engineering and Mathematics – Fermentation and Formulation of Biologicals and Chemicals

Formulation denotes the transfer of an active ingredient into an applicable form such as capsules, layers or sprays. A suitable production of the active ingredient by fermentation and its formulation improves the characteristics of the final product e.g. increased stability and shelf life or increased efficacy by slow or controlled release depending on the material properties and the physicochemical or biochemical environment. Our working team looks into novel materials, methods and technology that are needed to fill the gap between production of this active ingredient and its application.

Here we are interested to understand and make use of the relationship between formulation components and their properties, e.g. stability or porosity of a capsule and the molecular structure. Furthermore,

the beneficial interaction of the formulation materials with the active ingredient is of interest as well as the communication with the environment.

International Collaborations

INBIOSOIL

National Collaborations

Göttingen University
Bielefeld University
Freiberg Technical University

Research Field	Biotechnology, Formulation
Keywords	Agricultural Biotechnology, Biocatalysts, Bioenergy Research, Fermentation, Formulation Technology
Head of Studies	Prof. Dr.- rer. nat. Anant Patel, Dr. Desiree Jakobs-Schönwandt, Dr. Rieke Lohse, Dr. Marina Vemmer
Internet	https://workinggrouppatel.wordpress.com
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FH MÜNSTER
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E-Mail pressestelle@fh-muenster.de

Internet www.fh-muenster.de

Founded (year) 1971

Number of employees scientific 734
administrative 404

Funding State Government
NRW 83%
Federal Government
(Germany) 17%

Fachhochschule Münster University of Applied Sciences

Advantage through Quality

13,974 students, 76 degree programmes, 280 professors – today, Münster University of Applied Sciences is one of Germany's largest and most successful universities of applied sciences. Its trademark: a practical approach, an international outlook and interdisciplinarity, not only with regard to research but also to teaching. The range of degree programmes comprises engineering, design and artistic subject areas, social and service-oriented disciplines, as well as business subjects. It is an award-winner of the contest "Exchange processes between higher education and business" and was the first university of applied sciences in Germany to receive system accreditation.

www.fh-muenster.de

EUREGIO Biotech Center

Optical imaging is the focus of the EUREGIO Biotech Center. From design and generation of recombinant tissue specific peptides and preparation of nanoparticle conjugates up to their characterization with biophysical, biochemical methods as well as cellular MTP and FACS assays and 3D models are established. Expertise with animal studies using fluorescent nanomaterials for imaging is also available.

The EUREGIO Biotech Center (340 sqm) owns excellent equipment for cloning and screening, imaging and histology, expression and fermentation, purification and characterization. Future research projects will be addressed in the fields of oncology, neurology and surgery.

Based on the business experience of the head of the Biotech Center (first price start up business plan, cofounder, patent portfolio,

legal aspects, business case identification, venture capital, coordination of medical partners, regulatory meetings) we are an experienced partner in confidential contract research for industry which is performed under SOP.

International Collaborations

University Twente, Enschede, NL
Kantonsspital Bern, CH
Life Technologies (Thermo Fisher), Eugene, US

National Collaborations

University of Osnabrück
Klinikum r.d. Isar, München
Karl Storz GmbH & CoKG, Tuttlingen

Membership in local and regional Networks

Institute of Medical Engineering
Münsterland (in foundation)
Arbeitskreis Nanobioanalytik Münster
Deutsche Plattform für NanoBioMedizin

Research Field	Biomedical Products
Keywords	Diagnostic Systems, Imaging, Microscopy, Oncology, Platform Technology, Recombinant Proteins
Head of Department	Prof. Dr. Karin Mittmann
Internet	www.fh-muenster.de/biotech
E-Mail	mittmann@fh-muenster.de
Address Postal Code/City	Stegerwaldstraße 39 48565 Steinfurt
Fon	+49 2551 962-790
Fax	+49 2551 962-771

Department Chemical Engineering

Environmental behavior and ecotoxicity of industrial bulk chemicals were assessed; distribution, abiotic and biotic degradation. Synthesis of stable isotopes and analysis of metabolites in the environment. False positive and false negative results in nitrification inhibition testing with certain substances. Element/material cycles in the environment. Recovery of resources from environmental media. Plant debris as raw material for organic substances.

International Collaborations

International Isocyanate Institute, Inc., USA

Membership in local and regional Networks

Gesellschaft Deutscher Chemiker
Fachgruppe Umweltchemie und Ökotoxikologie
Gessellschaft für Toxikologie

Research Field	Biochemistry, Environmental Chemistry, Ecotoxicology
Keywords	Regulatory Toxicology, Ecotoxicology, Risk Assessment, Life Cycle Assessment, Environmental Chemistry
Head of Department	Prof. Dr. Thomas Schupp
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Fachhochschule Südwestfalen University of Applied Sciences

Name	Fachhochschule Südwestfalen University of Applied Sciences
Address Postal Code/City	Frauenstuhweg 31 58644 Iserlohn
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E-Mail	haenssel.birgit@fh- swf.de
Internet	www.fh-swf.de
Founded (year)	2002
Number of employees	scientific 569 administrative 269
Funding	State Government NRW 104,2 Mio. Euro Drittmittelvolumen (2015): 9,9 Mio. Euro

www.fh-swf.de

The South Westphalia University of Applied Sciences has sites in Hagen, Iserlohn, Lüdenscheid, Meschede and Soest. With around 14.000 students, we are one of the largest Universities of Applied Sciences in North Rhine-Westphalia. But there is still a family atmosphere among students at the individual sites. The secrets of our success are small classes und personal support. Excellent resources and modern, future-oriented study and research focuses make this the perfect place to start a successful professional career. We produce qualified experts and managers in the fields of agricultural science, business management, early years education, engineering, information technology and natural sciences. Our range of courses, some of which are also international, is tailored to cater for both full-time students and those in employment and can also accommodate those wishing to combine vocational training with studies. Our research and development work is consistently practical and application-oriented. We use a close network of cooperation partners in business, associations and institutions.

At the site of Iserlohn we offer the full-time course of Biotechnology and Nanotechnology (B.Sc) The Bachelor in Biotechnology and Nanotechnology combines both technologies in one interdisciplinary, scientific approach. It encourages students to work independently and allows them, for example, to research biomedical substances or biocatalytic handling of chemicals.

Areas of research are for example biotechnology and nanotechnology, corrosion and surface treatment, bio-technical image processing or agricultural biotechnology.

GETEON – Center for Health Technology and Economics

The region-wide Center for Health Technology and Economics GETEON is part of the South Westphalia University of Applied Sciences. We are committed to the market introduction of safe, effective and compliant health-related products and services. GETEON operates as competent innovation partner for companies of the medical, pharmaceutical, biotechnology, cosmetic and health industries. We provide technical consultancy, quality analysis, R&D cooperation, GMP training and degree programs in life science engineering.

Our considerable expertise in research, analytics and training in combination with the accredited degree programs in the fields of life science and engineering enable innovative applied contract research as well as attractive courses of studies. We focus on technical developments that benefit people

in need, have a positive social effect and are ethically uncritical. Our close links with the regional health industry thereby guarantees the required practical relevance.

International Collaborations

University of British Columbia, Canada
 Swiss German University, Indonesia
 Institut Supérieur de Techniques Appliquées, Congo

National Collaborations

German Collection of Microorganisms and Cell Cultures
 Labor am Hygieneinstitut
 Gesellschaft für Gerontotechnik

Membership in local and regional Networks

Brancheninitiative Gesundheitswirtschaft Südwestfalen e.V.

Research Field	Biotechnology, Medical Devices, Good Manufacturing Practice
Keywords	Anti-infective Research, Biomaterials, Biomarker, Chip Technology, Diagnostic Systems, Genomics, Platform Technology
Head of Institute	Prof. Dr. Kilian Hennes
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HOCHSCHULE
HAMM-LIPPSTADT

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University of Applied
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Internet www.hshl.de

Founded (year) 2009

Number of employees
scientific 150
administrative 101

Funding State Government
NRW 100%

www.hshl.de



Hochschule Hamm-Lippstadt University of Applied Sciences

A new university in Hamm and Lippstadt with plenty of design potential. Modern campus life, 19 market- and practice-oriented study courses, openness, tolerance, team spirit, and high demands from the start. The newly constructed and barrier-free campuses in Hamm and Lippstadt provide ideal conditions for the future-oriented education of engineers and other experts. Study courses and research projects are e.g. in fields such as Biomedical Engineering, Environmental Monitoring and Forensic Chemistry, Material Design - Bionics and Photonics or Biomedical Management and Marketing.

A total floor area of 32,250 square metres provides laboratories with state-of-the-art equipment, such as scanning electron microscope, industrial CT scanner, 3D projection surfaces, embedded systems or crane tracks, as well as plenty of space for student work, communication, teaching, and research.

Working practice-oriented and in small groups, Hamm-Lippstadt University of Applied Sciences offers a study programme on a very high academic level with a clear orientation towards current and future mar-

ket requirements. The young team of professors is practically experienced. With an interdisciplinary setup, teaching focuses on both the promotion of individual strengths and the conveyance of social competences such as teamwork



© Hochschule Niederrhein

Hochschule Niederrhein University of Applied Sciences

Transcending Borders

The Hochschule Niederrhein primarily aims to deliver: a practice-orientated academic training, applied research and development, technology transfer and extensive international collaboration. This is exemplified by establishing innovative degree programmes, such as: Dual engineering programmes with selected companies from the region to provide vocational and academic training and qualifications; degree programmes leading to double degrees; International Marketing (with IUP Colmar/F); Health Care Management; Social Work, Social Management, Cultural Education; Bachelor's/Master's degrees in Textile and Clothing Management (taught in English).

International partnerships have been formed with some 100 universities worldwide. Under the EU's ERASMUS programme, the Hochschule Niederrhein cooperates with 65 European universities and higher education institutions.

The Hochschule Niederrhein also acts as a strong structural factor for the region with its applied research and development. Its priorities are: Environmental Protection

Analysis and Monitoring, Plastics Recycling, Cleaning Technology. Students learn in small groups, which ensures that graduates can advance quickly and smoothly into their aspired career.

Courses are taught by 250 professors and specialist teachers, plus more than 520 contract lecturers from business and industry as well as 634 and more staff working in research and teaching, in the workshops, the administration, the libraries and the Computer Centre. More than half the studies are completed in the form of internships and work placements, for which more than 100 laboratories equipped with state-of-the-art facilities are available at the two university campuses in Krefeld and Mönchengladbach.

The Competence Center for Microbiology and Biotechnology supports the production chain from agricultural production through to the consumer. Key topics include the contamination and microbial decay of foods as well as food-related infections and microbial intoxication.



Hochschule Niederrhein
University of Applied Sciences

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Internet	www.hs-niederrhein.de
Founded (year)	1971
Number of employees	scientific 550 administrative 336

www.hs-niederrhein.de

Hochschule Ostwestfalen-Lippe
University of Applied Sciences



Hochschule Ostwestfalen-Lippe University of Applied Sciences

Name	Hochschule Ostwestfalen-Lippe University of Applied Sciences
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Internet	www.hs-owl.de
Founded (year)	1971
Number of employees	scientific 470 administrative 191 (+ 57 apprentice)
Funding	State Government NRW 100%

www.hs-owl.de

Ostwestfalen-Lippe University of Applied Sciences is a higher education institution with four sites in Lemgo, Detmold, Höxter and Warburg. Here, more than 6,700 students lay their foundation for a successful career and benefit from unique study programs and outstanding research.

Biotechnological research and teaching facilities at OWL University of Applied Sciences are located within the main campus in Lemgo. From the natural sciences such as microbiology and chemistry to engineering and typical biotechnological fields – the university in the heart of East Westphalia-Lippe covers the whole spectrum. The close vicinity on campus to the adjacent fields of Life Science Technologies such as Pharmaceutical Technology, Technology of Cosmetics & Detergents and Food Technology as well as Microbiological and Process Technological laboratories offers additional know-how and equipment.

Each campus has its own profile. Lemgo is home to the classical engineering disciplines, supplemented by courses such as Media Production and Economics; Food Technology and Wood Technology are unique to OWL University of Applied Sci-

ences in North Rhine-Westphalia (NRW). Detmold, which focuses on disciplines involving construction and architecture, attracts attention nationwide. Interior Design and the international degree program Industrial Engineering – Construction are unique in NRW. Höxter has made a name for itself as a campus dedicated to ecological aspects in the technical sciences. This applies not only to teaching and research in Landscape Architecture, which is as well unique in NRW, but also to Environmental Engineering. The newest campus in Warburg offers business administration for small and medium-sized enterprises.

Research and innovation are fundamental for the university's success and sustainability and contribute to the quality management of its hallmark 'excellent teaching'.

Life Sciences: Industrial Biotechnology

Biotechnology research and teaching facilities cover natural sciences such as microbiology and chemistry as well as engineering skills and typical biotechnology fields from fermentation to downstream processing.

Competencies are provided in the fields of microbial and enzymatic biotransformation in white biotechnology (natural aroma chemicals, cosmetics), environmental biotechnology, cell culture technology, bioreactor design, scale up & down, process modelling and optimization as well as photobiotechnology.

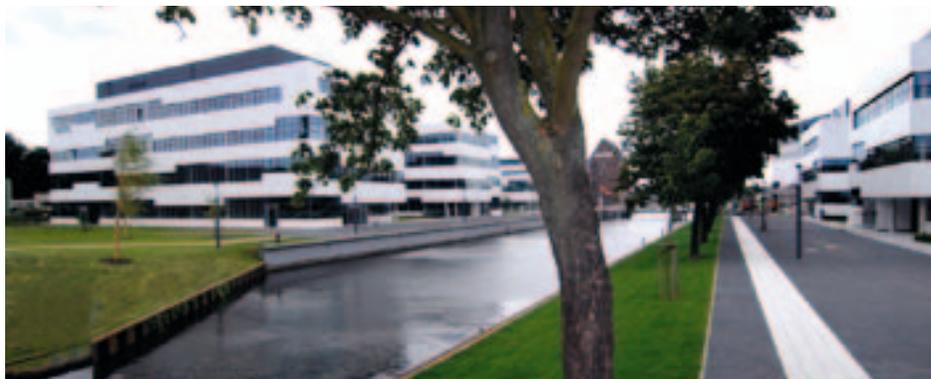
The biotechnology labs are equipped with fermentation capabilities from shake flask scale over small-scale parallel bioreactor systems up to 30 L bioreactor scale. Downstream processing, e.g. FPLC, high-pressure homogenizer, disc stack centrifuges, frame filter press, membrane filtration systems

and lyophilisation, allows the further processing of the products.

The steps are supported by corresponding analytical equipment, e.g. UPLC, Cellavista, CuBiAn and others.

Membership in local and regional Networks Bio-OWL

Research Field	Industrial Biotechnology
Keywords	Biocatalysts, Biopharmaceuticals, Downstream Processing, Enzymes, Fermentation
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Rhine-Waal University of Applied Sciences International, Interdisciplinary and Innovative

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Postal Code/City	47533 Kleve
Fon	+49 2821 80673-324
E-Mail	infor@hochschule- rhein-waal.de
Internet	<a href="http://www.hochschule-
rhein-waal.de">www.hochschule- rhein-waal.de
Founded (year)	2009

www.hochschule-rhein-waal.de

A sound education is the basis for professional life? Seventy-five per cent of degree programmes will be offered in English? The Rhine-Waal University of Applied Sciences offers this, and much more, to its approximately 5,200 students.

Open, modern and friendly appears it, the new Kleve Campus of the Rhine-Waal University of Applied Sciences. On the banks of the Spoy Canal, students can find lecture halls, research laboratories, a university library, a university refectory – and much more for their day-to-day life. Founded in 2009, the university will move to a new campus, the second campus, Kamp-Lintfort, in 2014.

International

The working world is becoming increasingly international. With students coming from 69 different nations, the Rhine-Waal University of Applied Sciences has made internationality its mission. More than 75 per cent of the degree programmes will be offered in English. Various co-operative agreements, most recently with an Indian and a Philippine university, allow students and professors to conduct international research projects.

Interdisciplinary

Not only is the working environment about to change, but also the requirements demanded of entrants: one must increasingly work across disciplines. The degree programmes offered by the Rhine-Waal University of Applied Sciences are therefore scientific, application-oriented and interdisciplinary. "Our degree programmes are the answer to a growing need for specialists - worldwide," explains Prof. Dr. Marie-Louise Klotz, President of the Rhine-Waal University of Applied Sciences. The degree programmes in Natural Sciences, Economics, Engineering, Social Sciences and Health Sciences are offered - altogether, students can choose between 25 undergraduate and three postgraduate degree programmes.

Innovative

Every innovation comes through conducting research - through numerous co-operations with global companies, the university offers excellent conditions for researchers. In many cases, students can bring in their ideas and make an active contribution to the development of new products. So, for example, students planned and organised a First Aid Post in the mountainous region of Chocruz in Guatemala.

Institute for Life Sciences

The faculty of Life Sciences at the Rhine-Waal-University of Applied Sciences covers several fields, ranging from agricultural topics, ecology and environmental science, health and hygiene, up to biotechnological aspects in the area of green, red and white biotechnology. It is well equipped with its own microscopy centre and biotech as well as molecular biology and microbiology labs up to safety level 2. Special research interests lie in nanotechnology, bionics, domestic hygiene, cleaning, soil and crop science.

International Collaborations

INRA, France
Technion, Haifa
Bangladesh Agricultural University, India

National Collaborations

University of Göttingen
University of Bonn

Membership in local and regional Networks

Bioanalytik Münster e.V.

Research Field	Biotechnology
Keywords	Agricultural Biotechnology, Bioenergy Research, Environmental Research, Food Science, Microscopy
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Technology Arts Sciences TH Köln



TH Köln – Technology, Arts, Sciences

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E-Mail	kommunikation@th-koeln.de
Internet	www.th-koeln.de
Founded (year)	1971 as Fachhochschule Köln - Cologne University of Applied Sciences
Number of employees	total number of employees: 1,700

www.th-koeln.de

The TH Köln – University of Applied Sciences offers students and scientists from Germany and abroad an inspirational study, work, and research environment in the social, cultural, societal, engineering, and natural sciences. Currently there are more than 24,000 students from about 120 countries enrolled in over 90 bachelor's and master's programs. Annually about 6,000 students start to study at TH Köln and around 2.800 students leave the university after graduation.

“We create social innovation” – with this claim TH Köln meet the challenges of our day. The interdisciplinary approach to thinking and acting, as well as the university's regional, national, and international activities, have made TH Köln both a valuable collaborative partner and a trailblazer in many areas. The TH Köln was founded as the Fachhochschule Köln in 1971 and is regarded as one of the most innovative universities of its kind.

Research-intensive and international

TH Köln - University of Applied Sciences is a research-intensive university actively engaging in a variety of research activities. We cooperate with universities and other research

institutions on a national and international level, as state-of-the-art research thrives on the exchange of expertise transcending institutional and geographic borders. Climate change, scarce resources, safety issues and demographic change are some of the major challenges mankind will be facing in the coming decades. In their application-oriented and interdisciplinary projects, TH Köln – University of Applied Sciences' experienced researchers try to solve these 'great challenges' and actively contribute to the advancement of science, the economy and society.

As one of the first institutions in Germany, TH Köln – University of Applied Sciences received the quality seal “HR Excellence in Research” for the participation in the Human Resources Strategy for Researchers (HRS4R). “HR Excellence in Research” is bestowed by the European Commission upon institutions with fair and transparent recruitment processes, concern for intellectual property rights, and stimulating work environments that provide opportunities for advanced training. The intention of the HRS4R-initiative is to foster the development of strong research cultures at universities, to create better working conditions for researchers, and to promote academic careers.

Faculty of Applied Natural Sciences – Bio-Pharmaceutical Chemistry and Molecular Pharmacology

The faculty of Applied Natural Sciences was founded in 2009 and comprises currently four courses of studies:

“Pharmaceutical Chemistry” and “Technical Chemistry” (both Bachelor of Science) “Applied Chemistry” and “Drug Discovery and Development” (both Master of Science)

Research group Bio-Pharmaceutical Chemistry and Molecular Pharmacology (Head Prof. Dr. Nicole Teusch)

Research focus is the development of innovative *in vitro* pharmacological test systems for compound characterization & identification of drug-like lead structures.

Methodologies in detail:
Pharmaceutical target expression studies
Phenotypic assay development: High content imaging platform
Screening and automation for drug candidate identification
GPCR pharmacology: Online kinetics and endpoint readouts

National Collaborations

University of Cologne
University Hospital Cologne
Heinrich-Heine University Duesseldorf
Research Center Juelich
Various industrial partners from pharma and biotech

Membership in local and regional Networks

BioRiver e. V. (Prof. Dr. Nicole Teusch)

Research Field	Multi-drug Resistance, Cancer Immunology, Cancer Cell (Re-)differentiation, High Content Imaging: 3D Cell Culture
Keywords	Drug Discovery/Delivery, Assay Development, Molecular Pharmacology, Cancer Research
Head of Group	Prof. Dr. Nicole Teusch
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Faculty of Applied Natural Sciences – Biotechnology & Green Chemistry Group

The research group Biotechnology & Green Chemistry is active in the field of White Biotechnology with a focus on the generation of biobased chemicals from renewable resources. Research comprises biocatalytical transformations and microbial fermentations from ml to 10 l scale including downstream processing utilizing distillation, chromatographic and membrane separations. Process development is accompanied by modelling utilizing e.g. Aspen and Matlab.

Biocatalysis research comprises the application of enzymes with a focus on hydrolases in reverse hydrolysis reactions under non-natural reaction conditions. A general interest is the production of (bioactive) amphiphilic molecules and functional intermediates for application in e.g. cosmetics, detergents and polymer applications. Fur-

thermore, the research group works on the optimization and development of fermentation processes for bioproduction in the fields of Industrial and Food Biotechnology as well as Biologicals. Considerable knowhow in the preparation of macroporous membranes for downstream processing is available.

International Collaborations

University of the Republic, Montevideo, Uruguay
Université Henri Poincaré, Nancy, France
German Jordan University, Amman, Jordan

National Collaborations

University of Cologne
Research Center Jülich / HHU Düsseldorf
University Hanover
Karlsruhe University of Applied Sciences

Membership in local and regional Networks

BioRiver e. V. (Prof. Dr. Ulrich Schörken)

Research Field	Biocatalysis, Biotransformation, Bioseparation
Keywords	Renewable Resources, Biocatalyst Applications, Microbial Fermentations, Membrane Technology, Process Modelling
Head of Group	Prof. Dr. Ulrich Schörken, Prof. Dr. Stephan Barbe
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Research Field	Environmental Biology/ Chemistry, Renewable Energy and Resources
Keywords	Bioenergy Research, Biomass, Environmental Research, Small Molecules
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Cologne Institute for Renewable Energy (CIRES) – Bioenergy

Bioenergy for students and research- Bachelor and Master degree in the field of renewable energies.

Bioenergy: Generation of energy carriers (biogas, biopellets) from renewable biomass and organic residues from industry, municipalities, forestry and agriculture. Optimization of end energy producing machines and plants (to produce electricity, heat, motor drive).

Research projects in the field of biogas production (optimization of microbial degradation, pretreatment, inhibitors). Combustion of biomass (pellet production from straw-like material, reduction of emissions, prevention of slagging)

International Collaborations

Ciência sem Fronteiras (DAAD, Brazil)

National Collaborations

University of Bonn
TU Munchen
Landwirtschaftskammer NRW
Fraunhofer UMSICHT
RWTH Aachen TEER

Membership in local and regional Networks

:metabolon
Biogas e.V.
NaRoTec e.V.

Research Field	Biochemistry, Renewable Energy and Resources
Keywords	Bioenergy Research, Biopharmaceuticals, Environmental Research, Fermentation, Metabolomics
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Institute of Sustainable Technologies for Environmental and Production Processes (STEPS)

The STEPs Research Institute is particularly concerned with finding solutions to complex problems of an interdisciplinary nature. This is reflected in its four research fields and in its projects. This scientific collaboration within and between research areas is a key feature of the work of the Institute.

The research interests of the institute are Biotechnology, Data Analysis, Simulation and Optimization, Energy and Resource Management, Measurement and Control Technologies, Process Analytics, Process Simulation, Membrane Processes, Sustainable Drug Discovery, Sustainable Materials, Water and Watermanagement. One of the Research Institute's key assignments is to provide the best possible support to junior scientists.

International Collaborations

Bayer AG, Covestro, Clariant
European Biotechnology Network
German Water Partnership

National Collaborations

University of Cologne
University of Duisburg-Essen
BMBF, BMWi, MIWF
Rheinenergie AG

Membership in local and regional Networks

:metabolon (BAV)





Westfälische Hochschule

Gelsenkirchen Bocholt Recklinghausen
University of Applied Sciences



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Founded (year) 1992

Number of employees scientific about 446
administrative about 190

Funding State Government
NRW 100%

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Westfälische Hochschule – University of Applied Sciences

Knowledge. That's what counts in life.

The Westfälische Hochschule was founded in 1992 under the name of its headquarter Gelsenkirchen University of Applied Sciences. As a state-managed university we consider it our responsibility to establish the necessary conditions for practical academic training at our sites in Gelsenkirchen, Bocholt and Recklinghausen in order to secure a base for qualified young talents in our region. Our study programmes are characterized by a clear technical-economic profile, which is oriented towards the needs of the economy.

This also manifests itself through our close and expanding cooperation with companies in the field of dual study programmes. With further concepts, which received multiple nationwide awards, we have made it our task to promote young people and develop their various talents. As a partner for our region, we do not only set out to support the teaching and learning but also the research. We consider strong research as an essential element of contemporary teaching oriented towards the challenges of today and tomorrow. An important pillar of our research activity is the diversity of topics. We want to further cultivate

this variety and simultaneously establish research focuses. Even with a clear commitment to our regional responsibility we are open to a globalised world. International university partnerships, students from other countries, as well as study and praxis stays of our students in all continents of the world contribute to the completion of our profile. We offer a wide range of future-oriented study programmes.

Furthermore, we not only take account for the current structure of the economy in our region with courses in the fields of engineering, science, informatics, economics, journalism and law, but we also give a new impetus to newly developing branches and, as a result, we open various opportunities for prospective students. Accompanying support services help students to orientate and solve technical problems, especially during the introductory phase. Research creates the future. Whether it is about new energy supply concepts, a safer internet, intelligent mechatronic systems or new diagnosis and therapy systems in the health care sector, we work on tomorrow's solutions. Application-orientation and close cooperation with the practical field shape our work.

Institute for Molecular Biology

A multidisciplinary approach is an important key in our Molecular Biology Department in Recklinghausen which consists of 4 different research groups actively collaborate with national and international laboratories as well as industrial partners.

The Medical Biology & Biochemistry research group sets the focus on stem cell research, protein engineering and state of the art molecular biology techniques for biomedical research.

Major topics of the Bioinformatics group are software development of algorithmic solutions, analysis of genomes and transcripts and digital image processing.

The Biomaterials group utilizes biologically inspired strategies to synthesize biomaterials for medical applications, e.g. biofunctionalization of medical implants or bioactive composite materials for reconstructive medicine.

The Bioprocess Technology group is dealing with the technical transfer of biochemical reactions in industrial biotechnology applications. For the optimization of biotechnological processes fermentation, process development strategies and metabolic engineering techniques for strain development are used.

International Collaborations

University of Edinburgh, UK
University of Western Ontario, London, Canada

National Collaborations

MKG Dept., University Medicine, Mainz
Bayer, Evonik
TaconicArtemis GmbH

Membership in local and regional Networks

BioIndustry e.V., BioLAGO

Research Field	Life Science
Keywords	Biomedical Research, Bioinformatics, Biomaterials, Biomimetics, BioNanotechnology, Drug Discovery/Delivery, Metabolic Engineering, Molecular Biology, Protein Engineering
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Fraunhofer Society

Fraunhofer Society

The research organisation “Fraunhofer-Gesellschaft zur Förderung der angewandten Forschung e. V.” (“Fraunhofer Society for the advancement of applied research”) was founded in 1949, the same year as the Federal Republic of Germany. It is named after Joseph von Fraunhofer who, as a scientist, an engineer and an entrepreneur, is said to have superbly exemplified the goals of the society. The Fraunhofer Society started out as a small office with just three employees but became one of the largest research organisations in Europe. As it stands today, it has attained a size and influence that makes it a vital element in Germany’s industrial and scientific landscape.

Organisation

The Fraunhofer Society promotes and undertakes applied research in an international context with direct application to private and public enterprises and of wide benefit to society as a whole. By developing technological innovations and novel systems solutions for their customers, the Fraunhofer Institutes help to reinforce the competitive strength of the economy in their region, throughout Germany and in Europe. Their research activities aim at promoting the economic development of our industrial society with particular regard for social welfare and environmental compatibility. As an employer, the Fraunhofer Society offers a platform that enables its staff to develop the necessary professional and personal skills that will enable them to assume positions of responsibility within

their institutes, the industry and other scientific domains.

More than 80 research units belong to the Fraunhofer Society, including 67 institutes at over 40 locations in Germany.¹ Furthermore, the Fraunhofer Society is engaged in a number of international activities, mainly in Europe, North and South America, Asia and the MENA-Region (Middle East and Northern Africa). The Fraunhofer Society operates subsidiaries in parts of Europe (Austria, Italy, Portugal, Sweden, UK) and also in North and South America (USA, Chile). Representative offices and senior advisors in Asia and the MENA-Region form a bridge between the local Asian markets and the Fraunhofer Institutes. Their activities are focused on marketing and business expansion.

All in all, the Fraunhofer Society is the largest organisation for applied research in Europe with almost 24,000 staff, the majority being scientists and engineers, and a total annual research budget of € 2.1 billion.¹ Some basic funding is provided by the federal government and the states but more than 70% of the funding is earned through contract research, either for government-sponsored projects or via cooperation with industry.

Research

Fraunhofer research activities are application- and result-oriented. The organisation pursues the implementation of innovative research findings in industrial and social applications. Its work is based on a dynamic balance between applied basic research and innovative development projects. The research activities are decentralized. The

Fraunhofer Institutes use structured processes to identify areas of technology relevant for industry and the short-term and long-term demands of the contract research market. Their choice of research fields is based on this information. A parallel approach on the part of the various institutes leads to a wide range of creative solutions. The Fraunhofer Society carries out publicly funded pre-competitive research, which forms the basis for the contract research projects conducted for customers. Private-sector earnings enable the organisation to finance a major proportion of its budget through its own means.

Fraunhofer Venture Group

Industry and government place high value on the institutes of the Fraunhofer Society in their role as a nucleus promoting the foundation or relocation of companies within their respective regions. The Fraunhofer Society supports this aspect of the institutes’ work by actively encouraging the formation of start-up companies as offshoots and supporting cooperative ventures between spin-off companies and Fraunhofer Institutes by a variety of means. Emphasis is placed on reviewing and optimizing business plans, obtaining access to equity and risk capital, providing assistance with the drawing-up of partnership agreements and direct support by the Fraunhofer Society to guarantee smooth launch of its business activities. The recently founded Fraunhofer Venture Group is a private investment fund that offers professional investment management of venture capital for the launch and initial growth phase of start-up companies. In combination with its venture group, the Fraunhofer Society offers the ideal conditions for making the leap from applied research to an independent company.

Source: ¹Fraunhofer-Gesellschaft - Jahresbericht 2015



Fraunhofer Institute for Algorithms and Scientific Computing SCAI

Fraunhofer – We Forge the Future

Name	Fraunhofer Institute for Algorithms and Scientific Computing SCAI – Department of Bioinformatics
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Internet	www.scai.fraunhofer.de/bio
Founded (year)	2001
Number of employees	140 (SCAI), 31 (Department of Bioinformatics)
Funding	in 2015, Industry 46,5% Contract Research, Federal Government, EU, and basic funding approximately 53,5%

www.scai.fraunhofer.de/bio

Technologies developed at Fraunhofer SCAI's Department of Bioinformatics are in active use in the pharmaceutical and biotech industry. A perfect blend of products on one side and professional services on the other side help our partners in the biopharmaceutical industry to extract valuable information from unstructured information sources (e.g. scientific literature, patents, electronic patient records and social media). With strong links to both, the commercial and the academic research community, we thrive at maintaining a balance between scientific excellence as defined by academic standards and innovation as required by our partners in industry.

The Department of Bioinformatics is active in research and development in the following areas:

- Information extraction and retrieval from text and images
- Disease Modelling with a focus on neurodegenerative diseases
- High Performance Computing with a focus on scalable information extraction workflows

The Bioinformatics team works closely with industrial partners – ranging from SMEs to global enterprises – to enhance their competitiveness through mediating knowledge and technology transfer from academic research to industrial application. Our academic affiliation with the Bonn-Aachen International Centre for Information Technology (B-IT) provides us with ample opportunity to do excellent academic research. The scientific quality of the work in our Department is reflected by a steadily growing number of high-impact publications.

Professionalism at software development level is a key to the commercial success of text mining solutions at SCAI. The ProMiner system, developed for the detection of a broad spectrum of biomedical named entities in text, belongs to the leading named entity recognition systems worldwide.

Our new literature-mining environment SCAIView is an easy-to-use, web-based retrieval and question – answering engine that allows biologists and clinical researchers to apply rather complicated text-mining technology in a routine mode.



Fraunhofer Institute for Applied Information Technology FIT

Our researchers work in interdisciplinary teams and combine insights from computer science with questions from other fields. Thus, the institute invents and develops applications custom-tailored to support people in their jobs and to enrich their leisure time. Our specific strength is a comprehensive system design process, from test and validation of concepts to the handover of well-implemented systems. Our research, development and consulting services for our partners in the private and public sectors are aggregated in five business areas:

- **Management of Cooperation and Innovation** develops technologies and offers research-based consulting to support digitization in companies. In addition to communication and cooperation systems, we focus on professional training and on innovative solutions for interaction and visualization using Mixed and Augmented Reality.
- **Life Science Informatics**, focusing on microsystems technology and integrated imaging systems for High Content analysis in diagnostics and drug research.
- **Internet of Things / Energy Efficiency**, focusing on cyber-physical systems for smart monitoring, optimizing and

management of systems and devices to reduce energy consumption, as well as solutions for Smart factories, Smart Cities and Industry 4.0.

- **Usability and User Experience Design**, with special emphasis on context-optimized man-machine interaction, optimal usability of applications and devices, professional usability training, Web compliance and accessibility.
- **Sustainable Finance Management** on the microeconomic as well as the macroeconomic level, focusing on micro-analytic simulation in impact assessment as well as on (risk) analysis and efficiency improvement of complex business processes, using decision support tools, among others.

Our researchers with backgrounds in Computer Science, the Social Sciences, Business Administration, Economics, Psychology and Engineering are organized in FIT's five departments Cooperation Systems, Life Science Informatics, Risk Management, User-Centered Computing, and Project Group Business & Information Systems Engineering and cooperate closely with Prof. Jarke's and Prof. Decker's Information Systems group at RWTH Aachen University.



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Internet	www.fit.fraunhofer.de
Founded (year)	1983
Number of employees	scientific 160 administrative 12
Funding	Federal Government (Germany) 29% EU 21% Contract Research 36%

www.fit.fraunhofer.de

Research Field	Bioinformatics
Keywords	Bio Processing, Cell Separation, Drug Discovery/Delivery, Microarrays, Microscopy
Head of Institute	Prof. Dr. Thomas Berlage
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Life Science Informatics

The Life Science Informatics department develops new approaches to produce highly specific information on diseases and individual patients. We build systems incorporating these technologies and validate them in biological applications.

the interaction between assay and sensor system. The BioMOS group investigates microsystems to hold and treat biomolecular assays and multi-parametric, in particular optical sensor systems.

High Content Analysis and software-intensive instruments (HCA)

Detection of structures, states and signals is a major component of automated instruments. The HCA group investigates detection methods and the information processing involved.

Biomolecular Optical Systems (BioMOS)

To build information-generating instruments you need to understand and control



Fraunhofer Institute for Environmental, Safety, and Energy Technology UMSICHT

Fraunhofer UMSICHT actively shapes the energy turnaround and the raw material shift. As a pioneer for sustainable energy and raw materials management, Fraunhofer UMSICHT aims at advancing sustainable economies, environmentally friendly technologies and innovative approaches. Our wish: to improve the standard of living and to promote the innovation capacity of the national economy.

Our customers are industrial enterprises, service companies and public authorities. Together with them Fraunhofer UMSICHT develops and researches the latest know-how and transfers it into industrial applications and marketable products.

As of 1 July 2012, Fraunhofer UMSICHT is represented in the Nuremberg metropolitan region of Bavaria by the Fraunhofer UMSICHT branch Sulzbach-Rosenberg.

We are setting strategic priorities despite the broad spectrum that is characteristic of us. Those challenges that deal with the shift in energy are at the forefront for us. The storage of energy is one of the most pressing issues that need to be addressed. Solar parks, wind turbines, biomass facilities – more and more electrical energy is coming from decentralized sources where supply can vary

dramatically. After all, wind and solar energy are dependent on the weather and the time of day. Smart grids, innovative storage solutions and energy management systems will make it possible to use renewable energy as and when it is required and keep the grid stable. We are working on this and operate a large test lab for redox flow batteries.

Another important topic of the future deals with our finite resources. The efficient use of biomass or the handling of rare earths and metals are just as important areas of work at Fraunhofer UMSICHT as the manufacturing of high-quality biofuels or the utilization of plastic waste or rubber residues as raw materials. Another overriding challenge is to reconcile food production and biomass utilization and to not create a utilization competition. We need to create compatible options for the supply of energy and raw materials and provide export technologies for a growing technology world market. With these objectives, we managed a Fraunhofer Innovation Cluster, sponsored by businesses, the Fraunhofer-Gesellschaft and the German state of North Rhine-Westphalia.

As one of the 67 institutes and research units of the Fraunhofer-Gesellschaft we are networked world-wide and promote cooperations.



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Internet	www.umsicht.fraunhofer.de
Founded (year)	1990
Number of employees	scientific 184 (Oberhausen), 57 (Sulzbach-Rosenberg) administrative 53 (Oberhausen), 20 (Sulzbach-Rosenberg)
Funding	Returns Operational Budget 2015 (in Mio. €) Basic Funding: 7,9 Public Returns: 14,8 Industrial Returns: 13,1 Others: 3,3

www.umsicht.fraunhofer.de

Research Field	Renewable Energy and Resources, Process Development
Keywords	Bioenergy Research
Head of Unit	Dipl.-Phys. Thorsten Wack
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Business Unit Biomass

Provision of bioenergy and biogas, utilization of residues, nutrient management and recovery as well as decentralized production and marketing of bio-based conversion products (biochar, synthesis gas, and pyrolysis condensate) are among our focal points. We develop and optimize thermochemical and biological conversion and distribution processes and the corresponding plant technology. With the objective to recover nutrients from municipal and industrial process chains and the conversion processes, we develop concepts and methods for nutrient management in biomass management. In this, we take into consideration raw materials potentials as well as logistic issues and integrate the technologies developed into established or novel value added chains.

Research Field	Chemical Engineering
Keywords	Analytics, Biocatalysts, Bio Processing, Downstream Processing
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Business Unit Chemistry

We offer research on process engineering as well as on products and processes incl. intellectual property rights. These help to meet the increasing demands for affordable sustainability and innovation in chemistry, petrochemistry and refinery. Our know-how encompasses the areas of fine and specialty chemicals (organic acids, peptides, sugars, surfactants), polymers (monomer syntheses, polymerization, polycondensation) as well as chemical commodities like higher alcohols, naphtha and biofuels (diesel, kerosene). Biomass, synthesis gas and selected residues constitute the portfolio of raw materials from which we develop process-specific solutions. Know-how regarding the upstream and downstream processing as well as product formulation complete our expertise.

We are points of contact for the whole value and logistics chains and develop sustainability assessments and strategies.

We are glad to bundle internal and external competences to make them fit to projects.

Membership in local and regional Networks
CLIB²⁰²¹



Fraunhofer Institute for Molecular Biology and Applied Ecology IME

The Fraunhofer Institute for Molecular Biology and Applied Ecology conducts interdisciplinary research in the field of applied life sciences. The IME has six facilities in Germany: a Molecular Biology Division in Aachen with a project group in Münster, an Applied Ecology Division in Schmallenberg, a Bioresources Group in Gießen, a Translational Medicine and Pharmacology Group in Frankfurt and a Sreening Group in Hamburg, each with close university links (the Institute for Molecular Biotechnology to RWTH Aachen University; the Plant Biotechnology Department, WWU Münster; the Bioresources Department, JLU Gießen). The IME also has two international subsidiaries: the Center for Molecular Biology (CMB) in Newark, Delaware, and the Center for Systems Biotechnology (CSB) in Santiago, Chile (not accounted under “Number of employees”). It collaborates with other Fraunhofer institutes in Germany to form strategic alliances such as the Fraunhofer Group for Life Sciences, the Fraunhofer Food Chain Management Alliance, the Fraunhofer Big Data Alliance and the principal project “Research for Sustainability”. The IME also collaborates

with multiple government departments and industry partners.

The Molecular Biology Division uses its diverse, interdisciplinary collaboration network to facilitate highly ambitious projects, including the development of novel vaccine candidates and diagnostic/therapeutic antibodies that can be produced in microbial fermenters or in plant-based production platforms complete with pilot scale GMP manufacturing for clinical trials. Other projects use genetic engineering or smart breeding to develop plants that produce natural polymers and metabolites, which can be used as drugs, plant protection products, intermediates or fine industrial chemicals.

The Applied Ecology Division carries out measurements, complex experimental tests and model calculations for assessing the risk of substances for ecosystems or the consumer by contamination of food, feed and consumer products. It is GLP-certified and has accreditations for sample preparation and all state-of-the-art detection systems.



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Founded (year)	1959
Number of employees	scientific 418 administrative 59
Funding	Federal Government (Germany) 19.6% Fraunhofer Society 2.9% Others 23.7% EU 6.7% Industry 47.1%

www.ime.fraunhofer.de

Research Field	Environmental Biology/ Chemistry, Monitoring, Food Safety, Ecotoxicology
Keywords	E-Fate, Hazard Identification, Risk Assessment, Trace Analysis, Substance Regulation
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Applied Ecology Division

The Applied Ecology division of the Fraunhofer IME is explicitly dedicated to ecological issues and thematically routed in agricultural production. The overall aim of the division is to determine, assess and finally minimize the risk of synthetic and natural substances for ecosystems, and for humans via contamination of food, feed and consumer products.

Our analytical and ecotoxicological activities focus on the characterization and assessment of the environmental safety of plant protection products, biocides, veterinary medicinal products, industrial chemicals and, e.g., nanomaterials and include project work aiming to ensure food safety and quality.

We carry out a large part of our contract research projects for clients from industry and medium sized enterprises in different chemical sectors, the food manufacturing

and processing industries. With projects performed for governmental agencies, consultancy services and expert memberships in regulatory boards the institute also takes considerable influence on environmental policy.

International Collaborations

Chemical industry, plant protection producers, research Institutes and universities

National Collaborations

RLP AgroScience,
Mesocosm GmbH,
gaiaC, ECT

Membership in local and regional Networks

Fraunhofer Life Science, Fraunhofer Alliance Food Chain Management, Fraunhofer Alliance Photocatalysis, SETAC, GdCh

Research Field	Biotechnology, Plant Biology/Physiology
Keywords	Agricultural Biotechnology, Biomass, Genetic Engineering, Plant Breeding, Plant Produced Products
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Department of Functional and Applied Genomics

The Department of Functional and Applied Genomics (DFAG) has capitalized on the rapidly accumulating catalogue of genome sequence data to fuel a discovery engine that takes us from gene to function to target to useful products. In the context of plant-based research, the major aim of the DFAG is to develop new traits that allow the sustainable production of biopolymers, which are the most abundant organic compounds in the world and the major constituent of plant cells. DFAG has active research projects underway into the biopolymers starch, natural rubber and a particular type of protein-based polymer (forisomes). In addition, DFAG further research interests are to improve plant biomass by utilization of the tobacco forever young effect.

International Collaborations

Neiker, Spain
Wageningen University, The Netherlands
Lethbridge Research Centre, Canada

National Collaborations

Continental Reifen, Hannover
Westfälische Wilhelms-Universität Münster
BioPlant, Ebstorf

Membership in local and regional Networks

CLIB ²⁰²¹

Department of Industrial Biotechnology

Many microbes and plants can synthesize complex natural products that are difficult to produce chemically. In this respect, nature has provided elaborate biochemical factories often involving biochemical reactions that are unparalleled by modern chemical synthesis methods. Humans use these complex molecules in many ways, e. g. as spices, flavors, fragrances and pharmaceuticals. However, the molecules are produced naturally in tiny amounts, often among many similar molecules, making them expensive and difficult to isolate.

These challenges can be addressed by metabolic engineering (using recombinant cells) and bioorganic synthesis (using isolated enzymes). The Industrial Biotechnology group focuses on the production of natural products and other valuable molecules using metabolically engineered microbes and

isolated enzymes, helping to reduce the cost and increase the availability of useful and valuable compounds.

International Collaborations

Sekisui Chemicals, Japan

National Collaborations

Max-Planck Institut Jena
Max-Planck Institut Dortmund
Fraunhofer ICT Karlsruhe

Research Field	Biotechnology
Keywords	Bioenergy Research, Biomass, Bio Processing, Enzymes, Genomics, Metabolomics, Microbial Genomics
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Department of Immunotherapy

Over the last decades, remarkable progress has been made to transform monoclonal antibodies (mAbs) from scientific tools at the lab bench to potent immunodiagnostic reagents and life-saving immunotherapeutics at the bedside. Our department has solid expertise in engineering novel or optimized mAbs for immunodiagnostic and immunotherapeutic approaches with a main focus on oncological diseases. Disease-specific, therapeutically relevant human antibodies are being isolated by targeting antigen-specific B lymphocytes. The wide array of methodologies includes hybridoma technology, phage display libraries, production of antibody fragments custom-tailored to derived sequence information, rational recombinant protein design, and innovative fusion proteins. The rationale is that the inclusion of human mAbs in optimized

treatment modalities has the potential to significantly increase the survival of patients and/or even the probability to cure difficult-to-treat diseases.

International Collaborations

Harvard Medical School, Boston, USA
Duke University Medical Center, Durham, USA
University of Innsbruck, Austria

National Collaborations

Fraunhofer MEVIS, Bremen
University Hospital of Aachen

Membership in local and regional Networks

German Society for Immunology, German Society for Virology, American Society for Microbiology, Deutscher Hochschulverband

Research Field	Medical Biotechnology
Keywords	Animal Models, Antibody, Immune Modulation, Infectious Diseases, Oncology
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Research Field	Biotechnology
Keywords	Antibody, Crop Research, Downstream Processing, Plant Produced Products, Recombinant Proteins
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Department of Plant Biotechnology

Biotechnology can be used to modify plants to improve their agronomic performance. The same techniques can be used to modulate metabolic pathways so that specific plant metabolites are produced in large quantities and can improve the nutritional value of foods. Plants and plant cell cultures can also be used as biofactories to produce pharmaceutical and industrial proteins in large amounts. We also focus on the establishment of new strategies to increase the production and stability of recombinant proteins in plant cells through novel molecular biology approaches, improved cultivation conditions based on statistical experimental design, and the high-content screening of plant lines. In this context, we aim to determine the molecular and cellular mechanisms affecting protein production using transcriptomics,

proteomics and metabolomics. Finally, the department focuses on the establishment of novel techniques to enhance plant growth and the development of plant stem cell lines for the cosmetics industry.

Membership in local and regional Networks

CLIB²⁰²¹



Fraunhofer Institute for Production Technology IPT

With its broad range of skills in all fields of production technology and its many years of practical experience, the Fraunhofer IPT provides its clients and project partners with applied research and development services for a connected, adaptive production. For this purpose, we generate marketable results in the areas of process technology, production machines, production quality and metrology as well as technology management. We understand the production process not as a mere sequence of isolated events. Our work has always taken into account the many ways in which the individual elements of the process chain are interconnected and interlinked, integrating the early and advanced stages of product development with the planning and preproduction processes as well as the production itself and the subsequent assembly into a single functional whole.

We develop and optimize new and existing methods, technologies and processes to create the connected, adaptive production environment of the future. Using an integrated perspective, we analyze production technology challenges of our clients in the context of the process chains involved. This

allows us to go beyond the development of individual technologies which are capable of performing highly specific tasks, designing customized system solutions for our clients' production requirements.

Our business units combine the skills and the knowledge of the individual departments, the Fraunhofer CMI and our partner institute at the RWTH Aachen University, the Laboratory for Machine Tools and Production Engineering WZL. This interdisciplinary view allows us to approach and develop solutions which require thinking beyond the narrow confines of any particular discipline.

We put great importance on our continuous contacts and exchanges with industrial corporations and the permanent updating of our equipment. This allows us to ensure that we always remain abreast of the latest technological trends and developments – and that we can provide you with that all-important competitive edge in your production technologies. Our laboratories and production facilities feature state of the art technology and cover an area of 5,000 m². The entire Fraunhofer IPT occupies an area of app. 9,000 m².



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Founded (year)	1980
Number of employees	scientific 121 administrative 93

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Research Field	Life Sciences Engineering
Keywords	Chip Technology, Diagnostic Systems, MSC, Personalized Medicine, Stem Cell Research
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Life Sciences Engineering

As a research institute specialized in production technology, the Fraunhofer IPT offers years of experience in manufacturing techniques, medical engineering, metrological systems, and process automation. In the "Life Sciences Engineering" business area, we use our expertise for the development and manufacturing of highly integrated diagnostic products and innovative medical devices as well as for the transfer of manual laboratory processes to automated process chains. Within these different fields, we are specialized in the build-up of adaptive platform technologies which ensure flexible production of individual products. Examples of such platforms are roll-to-roll production for multifunctional diagnostic systems (microfluidic structures, optical waveguides, printed electronics), the automated StemCellFactory

for the generation of induced pluripotent stem cells (www.stemcellfactory.de), and our production facility for the on-demand production of entirely customized devices for minimally invasive medical procedures.

International Collaborations

Fraunhofer CMI, Boston
Dublin City University
National University of Ireland, Galway

National Collaborations

Universitätsklinikum Aachen
Universitätsklinikum Bonn

Membership in local and regional Networks

German Stem Cell Network (GSCN)
Stem Cell Network NRW, MedLife e.V.,
StemCellFactory – Automated derivation, expansion and differentiation of iPS cells





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Helmholtz Association

Helmholtz Association

The “Helmholtz-Gemeinschaft Deutscher Forschungszentren e. V.” (“Helmholtz Association of German Research Centres”) is Germany’s largest scientific research organisation with a total of 38,000 employees, which work in 18 scientific-technical and biological-medical research centres. About 70 % of the annual budget of more than € 4.2 billion is raised from public funds provided by the federal government (90 %) and the states (10 %). The remaining 30 % of the budget is acquired by the individual Helmholtz Centres in the form of contract funding.¹ The namesake of the association is the German physiologist and physicist Hermann von Helmholtz.

The official mission of the Helmholtz Association is “solving the grand challenges of science, society and industry” and it therefore focuses on research which contributes substantially to solving these challenges. Scientists at Helmholtz perform cutting-edge research on complex systems which affect human life and the environment. For example, ensuring that society remains mobile and has a reliable energy supply, that an intact environment is passed on to future generations or that treatments for previously incurable diseases are found. The activities of the Helmholtz Association focus on securing the foundations of human life into the future and on creating the technological basis for a competitive economy. These goals are achieved by the outstanding scientists working at the research centres, a high-performance infrastructure and modern research management.

In order to succeed in achieving the aforementioned responsibilities, the Helmholtz Association concentrates its work in six research fields:

- Aeronautics, Space and Transport
- Energy
- Earth and Environment
- Health
- Key Technologies
- Structure of Matter

Scientists develop research programmes for each of these fields and international experts review these programmes. Their evaluation forms the basis for the programme-oriented funding given to Helmholtz research. Within the six research fields, Helmholtz scientists cooperate with each other and with external partners – working across disciplinary, organisational and national borders. Indeed, the name Helmholtz stands for concerted research in which networks form the key principle behind inquiring thought and action. Because concerted research is efficient and flexible, the Helmholtz Association creates an effective platform for shaping the future.

Research Infrastructure

Scientists and researchers from the Helmholtz Association develop and operate large-scale facilities of international significance, such as particle accelerators, synchrotron beams, neutron and ion sources, research vessels and aircrafts. These facilities appeal greatly to the best researchers around the world as well as for

young scientists. Each year, several thousand researchers from home and abroad use these large-scale facilities, some of which are the only ones of their kind.

Research Programmes

No other research organisation can compare to the way the Helmholtz Association has engaged in reforms in recent years and, in doing so, has successfully put these into practice. Since the Helmholtz Association’s foundation in autumn 2001, all the research has been strategically restructured. Programme-oriented funding is the centrepiece of these reforms. They no longer invest their resources in individual institutions but rather fund centre-embracing research programmes that compete with each other for funding. In accordance with the core objectives of the “Pact for Research and Innovation”, activities now concentrate primarily on achieving top-flight results through cooperation and competition. The scientists and researchers working at the 18 Helmholtz Centres have developed a total of 28 research programmes whose scientific excellence and strategic relevance are evaluated by internationally renowned peers once every five years. This in turn helps to ensure that the results of Helmholtz research can compete with the work of leading institutes worldwide.

Source: ¹Helmholtz-Gemeinschaft - Geschäftsbericht 2015



Forschungszentrum Jülich

Future is our Mission

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Internet	www.fz-juelich.de
Founded (year)	1956
Number of employees	5,770
Funding	Federal Government (Germany) 90% State Government NRW 10%

www.fz-juelich.de

How will we live longer in future while remaining healthy as we age? How will we ensure our energy supply and protect the environment at the same time? What does our future as a knowledge society look like? In order to answer these pressing questions, society needs solutions from research – solutions based on completely new ways of thinking that can only be achieved with cutting-edge research tools.

Forschungszentrum Jülich is concerned with these kinds of key technologies, whose benefits are not restricted to the specific needs of isolated disciplines, but instead open new doors for research as a whole. Jülich, one of Europe's largest interdisciplinary research centres works with the best partners in science and industry to develop and build these key technologies, to use them for their own research, and make them available to science.

Our potential for meeting the objective of "key technologies for tomorrow" lies in 5,770 employees who work together in an interdisciplinary manner, over 200 cooperation partners in Germany and abroad, a unique infrastructure, and our special expertise in physics, materials science, nanotechnology, life science, and information technology.

We harness this potential to generate new solutions for the areas of health, energy and environment, and information.

Excellent researchers who cooperate across the borders of institutes, research centres and even countries are Jülich's greatest strength. In order to allow them to collaborate with the best partners throughout the world, Jülich participates in strategic alliances both in Germany and abroad. The young scientists, students, and PhD candidates make an especially vital contribution to the intellectually stimulating environment and energy at the campus. Jülich offers them a working environment with state-of-the-art instruments and global contacts, as well as the opportunity to do independent research early on in their careers.

Forschungszentrum Jülich is proud of the tools it provides for its researchers to do their work: simulation with supercomputers, research with neutrons, imaging techniques for medicine and plant science, nanotechnology tools – these modern instruments allow science to break through to new horizons of knowledge. This infrastructure, valued and used by researchers throughout the globe, characterizes Jülich the home of key technologies.

IBG-1: Institut für Bio- und Geowissenschaften/Biotechnology

IBG-1: Biotechnology performs research in White Biotechnology, a key field in knowledge-based bioeconomy. A major focus is the development and characterization of microbial production strains, enzymes and technical production processes for the synthesis of chemicals and pharmaceuticals (e.g. amino acids, organic acids, phenylpropanoids, aminoalcohols, proteins) based on renewable carbon sources. A comprehensive bioanalytical platform (transcriptomics, proteomics, metabolomics, fluxomics) forms the basis of a systems biological approach for microbial strain development via metabolic engineering. Bacterial single-cell analysis using biosensors, fluorescence-activated cell sorting (FACS) and novel microfluidic devices has been established, offering outstanding new opportunities for the analysis

and development of production strains. All these research areas use methods of synthetic biology, modeling and simulation.

International Collaborations

Novo Nordisk Biosustainability Center, Lyngby, Denmark
 University of Delft, The Netherlands
 University of British Columbia (UBC), Canada
 University College London, UK

National Collaborations

Universities of Aachen, Düsseldorf, Bielefeld, Ulm
 EVONIK Industries
 Sartorius Stedim

Membership in local and regional Networks

CLIB²⁰²¹, Bioeconomy Science Center

Research Field	Biotechnology
Keywords	Enzymes, Flow Cytometry, Microbial Genetic Engineering, Metabolomics, Microarrays, Metabolic Engineering, Systems Biology, Synthetic Biology
Head of Institute	Prof. Dr. Michael Bott Prof. Dr. Wolfgang Wiechert
Internet E-Mail	www.fz-juelich.de/ibg/ibg-1/ m.bott@fz-juelich.de w.wiechert@fz-juelich.de
Address Postal Code/City	Wilhelm-Johnen-Strasse 52425 Jülich
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IBG-2: Institut für Bio- und Geowissenschaften/Plant Sciences

Based on molecular, physiological and ecological expertise IBG-2: Plant Sciences develops integrated concepts of sustainable intensification of plant production towards a knowledge based bioeconomy. Major topics are Integrative Plant Research (biodiversity, resource use efficiency, non-invasive analytics), Sustainable & Innovative Plant Production (Bioeconomy Science Center, resource-friendly & integrated production systems), Science Policy and Political Consultants. Non-invasive phenotyping methods are used to quantify the dynamics of plant traits by studying growth and transport as well as exchange processes between plants and their environment. Imaging approaches are used to quantify plant structure and function from single organs (leaves or roots) to the ecosystem. Techniques are applied in green houses and outdoor facilities, thereby

using various sensor-platforms covering near-ground techniques like (non-)flexible operating platforms as well as airborne platforms including airships and helicopters.

International Collaborations

Universities of Bologna, Gent, British Columbia, PennState
 Major plant breeders: INRA (France), CSIR (India), CSIRO (Australia), EMBRAPA (Brasilien)

National Collaborations

Universities of Bonn, Düsseldorf & RWTH Aachen
 Competence centre for horticulture (KoGa)
 Helmholtz, Fraunhofer, Max Planck

Membership in local and regional Networks

CLIB²⁰²¹, Bioeconomy Science Center (BioSC); Deutsches Pflanzen Phänotypisierung Netzwerk (DPPN)

Research Field	Plant Biology/Physiology
Keywords	Biodiversity, Biomass, Crop Research, Plant Breeding, Phenotyping, Plant Technology
Head of Institute	Prof. Dr. Ulrich Schurr Prof. Dr. Björn Usadel Prof. Dr. Michelle Watt
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Fon Fax	+49 2461 61-4819 +49 2461 61-2492

Research Field	Biochemistry
Keywords	Alzheimer's Disease, Infectious Diseases, Neurodegenerative Diseases, Structural Biology, Biomolecular NMR Spectroscopy, Protein-Ligand Interactions, Autophagy, X-Ray Crystallography
Head of Institute	Prof. Dr. Dieter Willbold
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ICS-6: Structural Biochemistry

Research at the ICS-6: Structural Biochemistry focuses on the development and application of methods to precisely investigate three-dimensional structures and dynamics of biologically and medically relevant macromolecules. We are particularly interested in the misfolding and subsequent aggregation of proteins in neurodegenerative diseases like Alzheimer's and Parkinson's disease. A defining characteristic of our approach to neurodegeneration is the combination of basic research in structural biology and applied research, which is carried out in both diagnostics and therapy. Beyond that, we also investigate proteins involved in infectious diseases, e.g. AIDS and Hepatitis C, as well as in basic cellular processes like autophagy. Important areas of methodological development are nuclear magnetic resonance (NMR) spectroscopy,

X-ray crystallography and computational structural biology.

International Collaborations

Institut de Biologie Structurale, CEA, Grenoble, France
University of Alabama at Birmingham, USA
Tel-Aviv University, Israel

National Collaborations

Heinrich Heine University Düsseldorf
Caesar, Bonn
Universities of Erlangen-Nuernberg and
Duisburg-Essen

Membership in local and regional Networks

BioStruct GRK1033, IHRS BioSoft, Bio-N3MR Network NRW, BMFZ, Competence Network Degenerative Dementias, CLIB²⁰²¹, Graduate Cluster, SFB 974, SFB 1208

Research Field	Biophysics/ Neurotechnology
Keywords	Chip Technology
Head of Institute	Prof. Dr. Andreas Offenhäusser
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ICS-8/PGI-8: Institute of Complex Systems & Peter Grünberg/ Bioelectronics

In our research we focus on the functional connection of biological and electronic systems where we in particular examine the molecular, cellular and electronic and electro-chemical processes at this interface. This enables the development of electronic sensors for the detection of minute amounts of biochemicals in the environment and in body fluids or even exchange signals with cells.

We operate onsite facilities for method developments, prototyping and testing bio-electronic systems, fabricating and measuring the performance of devices, and testing the interaction with biological materials. We have access to micro- and nanofabrication (1000 sqm cleanroom with state of the art micro- and nanoelectronics equipment) in the Helmholtz Nanoelectronics Facility (HNF).

International Collaborations

Shanghai Institute of Microsystem and Information Technology, China
ETRI, Daejeon, Korea
UMPC, France

National Collaborations

RWTH Aachen
Universität Bonn

INM-1: Institute of Neuroscience and Medicine/Structural and Functional Organisation of the Brain

The structural and functional organisation of the human brain can only be understood from an integrative systems perspective. Thus, a highly multimodal approach is taken, using *in-vivo* and post-mortem structural and functional imaging as well as genetic methods.

The main aim is to create a realistic 3D model of the normal human brain from a systems perspective which is informed by knowledge on the different levels of structure and function of brain areas and the connections between them. The structural delineation of brain areas by means of cyto- and receptorarchitecture provides a thorough anatomical basis for analyses of structure-function relationships in the brain. In addition to *in-vivo* characterization of connections between brain areas, these connections are

analyzed with ultra-high resolution using polarized light. All these modalities are combined with genetic marker and genome wide association analyses to identify heritable traits and gene-environment interactions in the healthy and diseased human brain.

International Collaborations

Montreal Neurological Institute/McGill University, Montreal, Canada
 Neurospin CEA, Paris, France
 University of California-San Diego, UCLA, USA

National Collaborations

JARA-BRAIN, Jülich-Aachen Research Alliance, The Human Brain Project, HBP
 Heinrich-Heine-University, Düsseldorf
 Max-Planck-Institute, Leipzig
 Helmholtz Zentrum München

Research Field	Neuroscience, Neuroanatomy
Keywords	Ageing, Genomics, Connectivity, Microscopical Brain Models, Systems Biology
Head of Institute	Prof. Dr. med. Karin Amunts
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INM-3: Institute of Neuroscience and Medicine/Cognitive Neuroscience

The Department of Cognitive Neuroscience (INM-3) uses behavioral, pharmacological and neuromodulatory methods to elucidate pathomechanisms of neurological, neuropsychological or psychological deficits, with the aim to develop innovative diagnostic and therapeutic strategies/procedures.

Functional imaging (PET and MRI), both systemic (neural networks) and molecular (neurotransmission) approaches and mathematical models (such as dynamic causal modeling) are combined, in order to arrive at a holistic understanding of the development of normal functions in the healthy brain (across the entire life span) as well as the diseased brain of neurological and psychiatric patients.

These aims are pursued in close collaboration with the Department of Neurology, University Hospital Cologne (stroke-induced

deficits and neurorehabilitation, memory disorders in normal aging and dementias), the Department of Psychiatry, University Hospital Cologne (disorders of social cognition in autism and schizophrenia) and the Department of Child and Adolescent Psychiatry, University Hospital of the RWTH Aachen (disorders of attention and empathy in ADHD).

International Collaborations

SISSA, Trieste, Italien
 Institute of Cognitive Neuroscience, London, UK
 Department of Psychology, University Cardiff, UK

National Collaborations

University Hospital Cologne
 RWTH Aachen
 Universityhospital Kiel

Membership in local and regional Networks

KFO 219, NeuroNRW

Research Field	Health, Cognitive Neuroscience, Neurobiology
Keywords	Neurology, Alzheimer's Disease, Neurodegenerative Diseases, Parkinson Disease, Stroke
Head of Institute	Prof. Dr. Gereon R. Fink
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Research Field	Health, Medical Physics
Keywords	Ageing, Alzheimer's Disease, Diabetes, Diagnostic Systems, Neurodegenerative Diseases, Parkinson Disease
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INM-4: Institute of Neuroscience and Medicine/Medical Imaging Physics

The research and development activities of the Medical Imaging Physics division (INM-4) of the Institute of Neuroscience and Medicine concentrate on the development, experimental validation and the clinical implementation of novel brain imaging methods. The focal points comprise the development of novel methods in the area of ultra-high field Magnetic Resonance Imaging (MRI), Magnetoencephalography (MEG) and the development of hybrid imaging combining MRI with Positron Emission Tomography (PET). Such combinations present unique opportunities for the simultaneous acquisition of structural changes, physiological and biochemical data and provide excellent perspectives for clinical application to neurological diseases. In cooperation with our partner institutes, novel tracers for MR-PET imaging are investigated in animal experiments and validated by means

of autoradiography, immunofluorescence imaging and histological methods. With MEG, patterns of neuronal activities are detected with high temporal resolution. The analysis of such signals provides new insights which contribute to the basic understanding of physiological and pathophysiological activity in the human brain.

International Collaborations

Maastricht University, The Netherlands
NCVC, Osaka, Japan
Neurospin, Paris, France

National Collaborations

Siemens Healthcare
RWTH Aachen University
HHU Düsseldorf
MPI Tübingen and Leipzig

Membership in local and regional Networks

JARA-BRAIN

Research Field	Philosophy of Neuroscience
Keywords	Ageing, Alzheimer's Disease, Neurodegenerative Diseases, Bioethics
Head of Institute	Prof. Dr. Dieter Sturma
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INM-8: Institute of Neuroscience and Medicine/Ethics in the Neurosciences

The department Ethics in the Neurosciences (INM-8) investigates philosophical, psychological, ethical and social issues resulting from neuroscientific research.

It subscribes to an integrative conception of ethics that includes legal and social issues. The disciplines represented in the INM-8 are ethics, philosophy of mind, philosophy of psychology and social sciences.

Key topics of research are Person and Personality, Representation and Psychophysical Correlations, and Modeling in the Neurosciences.

The INM-8 applies methods of philosophy of science, epistemology, philosophy of mind, conceptual analysis, normative evaluation. It conducts empirical social research in the field of science communication.

International Collaborations

University of Wisconsin-Madison, School of Journalism & Mass Communication, USA

National Collaborations

Institut für Wissenschaft und Ethik, Universität Bonn
Deutsches Referenzzentrum für Ethik in den Biowissenschaften, Bonn
Institut für Technikfolgenabschätzung und Systemanalyse, Karlsruhe
Institut für Philosophie, Karlsruhe
Institut für Technologie (KIT)

Membership in local and regional Networks

JARA-BRAIN



German Aerospace Center (DLR) DLR – Research for the Earth

DLR is the national aeronautics and space research centre of the Federal Republic of Germany. Its research and development work in aeronautics, space, energy, transport and security is integrated into national and international ventures. In addition to its own research, as Germany’s space agency, DLR has been given responsibility by the federal government for the planning and implementation of the German space programme. DLR is also the umbrella organisation for the nation’s largest project management agency.

DLR has approximately 8,000 employees at 16 locations in Germany: Cologne, Augsburg, Berlin, Bonn, Braunschweig, Bremen, Goettingen, Hamburg, Juelich, Lampoldshausen, Neustrelitz, Oberpfaffenhofen, Stade, Stuttgart, Trauen, and Weilheim. DLR also has offices in Brussels, Paris, Tokyo and Washington D.C.

DLR’s mission comprises the exploration of Earth and the Solar System and research for protecting the environment. This includes the development of environment-friendly technologies for energy supply and future mobility, as well as for communications and security. DLR contributes the scientific and technical expertise that it has

acquired to the enhancement of Germany as a location for industry and technology.

In Cologne, the headquarters of DLR are located; here, also the Institute of Aerospace Medicine is settled: Together with its Hamburg-based Aviation and Space Psychology division the Institute of Aerospace Medicine as well as its new research facility :envihab is part of the DLR. Within DLR, the Institute of Aerospace Medicine is the only research center focusing on life science questions with regard to aviation, space flight, and traffic.

In the highly technological environment of the future, people will be even more mobile – both on Earth and in space. And they must remain equally healthy and effective. The Institute of Aerospace Medicine develops long-term solutions aimed at increasing the effectiveness and efficiency of the system of interdependent effects between humans, machines, and the environment. The institute makes important contributions to the medical areas of prevention, individualization and remote care so as to meet the demands people face, both in today’s society and that of the future.



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Founded (year)	1907
Number of employees	8,000 all together

www.dlr.de

Research Field	Health
Keywords	Sleep and Performance Research, Noise Effects Research, Baromedicine, Biomedical Systems and eHealth
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Institute of Aerospace Medicine/Flight Physiology

The Division aims at improving human health, performance, and wellbeing through basic and applied research in operators (e.g. pilots) and passengers, as well as residents that are affected by air, rail and road traffic systems. The stressors whose effects are investigated both in the laboratory as well as in comprehensive field studies include sleep loss, shift work, jet lag, workload, atmospheric pressure changes, noise and vibrations. The results of our examinations render a better understanding of the foundations and conditions of human health, performance and wellbeing in the modern mobile society. Moreover, they serve the development of models, criteria, standards and countermeasures, and enable recommendations to operators and policy makers.

International Collaborations

Federal Aviation Administration, USA
Harvard Medical School, Boston, USA
University of Pennsylvania, USA

National Collaborations

Germanwings/Eurowings
Zodiac Aerospace
Forschungszentrum Jülich

Research Field	Artificial Gravity, Bioregeneration, Cell Biology, Gravitational and Space Biology, Health, Space Life Sciences
Keywords	Agriculture, Environmental Research, Immune Modulation, Signal Transduction, Stem Cell Research
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Institute of Aerospace Medicine/Gravitational Biology

Gravity has been the only environmental stimulus which always has remained constant and thus has influenced life on Earth during evolution. Consequently, it is of great interest to understand how gravity is being perceived by organisms and which impacts altered gravitational conditions effect biosystems, from the single cell to a human, including health relevant issues to develop countermeasures. Our expertise is constructing and operating ground-based facilities which provide altered gravity conditions ranging from simulated microgravity (functional weightlessness) to hypergravity. Data achieved are being validated in the course of experiments under real microgravity conditions (drop tower, parabolic aircraft, sounding rockets or aboard the ISS). Topics in bioregeneration such as the development of biofilters with

respect to urine degradation and nitrate reduction as part of a life support system and also the degradation of xenobiotics and micro-pollutions for closed habitats complete our portfolio.

International Collaborations

Aarhus University, DK
Chinese Academy of Sciences Wuhan, China

National Collaborations

Rheinische Friedrich-Wilhelms-University Bonn
University of Erlangen
University of Cologne

Institute of Aerospace Medicine/Space Physiology

Space physiology is foremost gravitational physiology and mechano-physiology: weightlessness during spaceflight, hypogravity during journeys on Mars and on the Moon, as well as rotational gravitational fields in human centrifuges all deviate significantly from the 1-g conditions on Earth. It is our aim to understand how humans can tolerate these altered gravitational fields, how these fields will affect our movements, and how our tissues biologically react to their altered mechanical environment.

Non-gravitational research questions of space physiology relate to exploration atmospheres, nutrition and energy metabolism, isolation and psychological stressors.

The ultimate goal is to scientifically support human long-term presence in space. Investigations are performed in an integrative approach – from the cell to the whole

organism – on ground and in space. In silico models play a crucial role for digestion of experimental results, for generating critical hypotheses, and for optimizing the experimental set-up for future studies.

International Collaborations

Baylor College of Medicine, Houston, USA
Astronaut Center of China, Beijing, China
University Hospital Balgrist, Zürich, Switzerland

National Collaborations

German Sports University, Cologne
RWTH Aachen
Technical University Munich

Research Field	Human, Biology, Physiology
Keywords	Environmental Research, Nutrition, Systems Biology, Immobilization, Training
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Institute of Aerospace Medicine/Radiation Biology

The Radiation Biology Department investigates the effects of radiation on humans and the biosphere as related to exposure in space, in aviation and on Earth. The radiation risk in space and in civil aviation is assessed by investigation of the radiation environment onboard the International Space Station (ISS), measuring and modelling of the radiation climate on Moon and Mars and measurement and calculation of the radiation exposure of aircrew.

The biological effects of space radiation and other environmental factors are assessed in cell and organ cultures. The repair capacity, gene expression changes and the outcome of the cellular radiation response give important information for the estimation of radiation risk and countermeasure development. The astrobiology working group studies the origin, distribution and

evolution of life and investigates the adaptation mechanisms to 'extreme' environmental conditions. The group determines the microbial diversity investigations on spacecraft and develops planetary protection measures.

International Collaborations

NASA Jet Propulsion Laboratory, JPL, Pasadena, USA
National Institute of Radiological Sciences (NIRS), Chiba, Japan
Institute of Biomedical Problems, Moscow, Russian Federation

National Collaborations

Christian-Albrechts-University Kiel
University of Regensburg
Rheinische Friedrich-Wilhelms-University Bonn

Research Field	Health, Radiation Biology and Astrobiology
Keywords	Antibiotic, Cancer, DNA, Flow Cytometry, Signal Transduction
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Postal Code/City	53127 Bonn
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Fon	+49 228 43302-260
E-Mail Internet	dirk.foerger@dzne.de www.dzne.de
Founded (year)	April 2009
Number of employees	900
Funding	Federal Government (Germany) 90% State Government NRW 10% The DZNE receives 10% funding from every state in which a DZNE site is located.

www.dzne.de



German Center for Neurodegenerative Diseases – DZNE

The mission of the German Center For Neurodegenerative Diseases (DZNE) is to study neurodegenerative diseases: Their causes and novel approaches to their prevention and therapy, including new health care strategies. DZNE research ranges from the study of molecular processes in simple organisms and brain cells to human clinical trials, population studies and health care research.

DZNE was founded in 2009 as a new type of research institute within the Helmholtz Association. It is the first of a total of six German Centres of Health Research (DZG) that were established by the German Federal Ministry of Education and Research (BMBF) to combat the most significant diseases affecting the population. DZNE's organisational structure integrates the best scientific resources across different locations in Germany into a single research institute with an interdisciplinary approach. DZNE scientists are located at nine sites in Berlin, Bonn, Dresden, Göttingen, Magdeburg, Munich, Rostock/Greifswald, Tübingen and Witten – and work closely with universities, university hospitals and other partner institutes. This fosters

translational research and brings together a critical mass of scientists to strategically coordinate their efforts to find solutions for brain diseases. DZNE also has close collaborative partnerships with industry and patient organisations.

As a member of the Helmholtz Association, DZNE receives 90% of its funding from the BMBF and 10% from the state in which each DZNE site is located.

German Center for Neurodegenerative Diseases/Bonn-Cologne-Jülich

Bonn is home of the the largest DZNE-site and of the national administrative office. With the support of basic research, DZNE scientists aim to develop new therapeutic approaches for neurodegenerative diseases. The Bonn researchers strive to understand the mechanisms of neuronal impairment. This includes investigating neural dysfunction, synaptic loss, synaptic regeneration, inflammation, and modified proteins. The role infection and modified proteins play is another important question studied in Bonn. Clinical research at DZNE Bonn seeks to improve diagnostic procedures and develop effective therapies. State-of-the-art imaging technology and biochemical methods are used to facilitate early diagnosis.

We also look into the impact that vascular and infectionrelated processes have

on the development of neurodegenerative diseases. Laboratory findings are promptly translated into clinical research and in a reciprocal manor, results from clinical research inspire new experimental directions to explain molecular disease mechanisms.

International Collaborations

Medical Research Council, UK
 Canadian Institutes of Health Research, Canada
 Gladstone Institute, USA

National Collaborations

University of Bonn
 Federal Institute for Drugs and Medical Devices
 Forschungszentrum Jülich
 Forschungszentrum caesar

Research Field	Neurodegenerative Disease
Keywords	Ageing, Alzheimer's Disease, Biomarker, Neurodegenerative Diseases, Parkinson Disease
Head of Institute	Prof. Dr. Dr. Pierluigi Nicotera (Scientific Director) Prof. Dr. Thomas Klockgether (Director for Clinical Research)
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German Center for Neurodegenerative Diseases /Witten

Health Care Research on demetia care means to develop novel strategies that help to maintain quality of life and functioning of people with dementia. Moreover, the aim is to minimize disability-related suffering and support caregivers. This includes psychosocial interventions, education, support and counselling and is related to different settings. These settings are community based care, nursing homes, day care and hospitals. Research in this area is not only required to improve individual quality of life. The goal is also to develop strategies that ensure effective, sustainable and cost-effective improvement. The development of health care structures and ways of knowledge circulation and implementation strategies is from greater social importance.

International Collaborations

InterDem (early detection and timely intervention in dementia – a european research association)
 University of Bradford, DCM, UK
 Bournemouth University, UK
 University of Leiden, NL
 University of Applied Science St. Gallen, Switzerland
 University of Vienna, Austria

National Collaborations

Most German universities and some universities of Applied Sciences with nursing science and research

Research Field	Neurodegenerative Disease
Keywords	Dementia Care, Alzheimer's Disease, Quality of Life, Challenging Behavior, Pain
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Helmholtz Institute for Biomedical Engineering Aachen

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Internet	www.hia.rwth-aachen.de www.meditec.rwth-aachen.de
Founded (year)	1971
Number of employees	scientific 210 administrative 23
Funding	Federal Government Germany 45% State Government NRW 15% EU 20% Industry 20%

www.hia.rwth-aachen.de

Helmholtz Institute for Biomedical Engineering is one of the multidisciplinary institutions of Rheinisch-Westfälische Technische Hochschule (RWTH) Aachen.

Helmholtz Institute was founded in 1971 and has since then been acting as a bridge between the Faculties of Engineering, Sciences and Medicine of RWTH Aachen University.

At present the Helmholtz Institute is being sustained by the Faculty of Medicine, Faculty of Electrical Engineering and Information Technology, Faculty of Mechanical Engineering and Faculty of Mathematics, Computer Sciences and Natural Sciences.

The mission of the Helmholtz Institute is a close interconnection of interdisciplinary basic research and application-oriented research in biomedical engineering. Research topics include modeling, design, prototyping, experimental validation and preclinical testing of medical devices, molecular imaging, biomaterials and biointerface science, glyco biochemistry, tissue engineering and stem cell biology.

The common intention of all initiated projects, activities and tasks is the invention and development of new biomedical technolo-

gies. The application of new methods should contribute to the best possible medical therapy of patients and their rehabilitation.

Institute of Applied Medical Engineering AME

The defining feature of our institute is the pursuit of a future-oriented biomedical engineering research profile, combining conventional medical engineering with natural sciences, and especially with biosciences. Our team consists of medical scientists, engineers, physicists, information scientists and chemists, working closely together in more than 60 R&D projects. Our R&D-projects comprise of modelling, construction, prototyping, experimental validation and preclinical testing of biomedical products and also the technical support of innovative methods and products for the clinical environment. Our co-operations include a great variety of national and international industrial and academic partners.

International Collaborations

Tampere University (Finland)
Zurich University Schweiz
Valladolid University Spain

National Collaborations

Medizinische Hochschule Hannover
Würzburg University
Rostock University

Membership in local and regional Networks

MedLife e.V.,
Cluster Innovative Medizin

Research Field	Medical Devices, Tissue Engineering, Regenerative Medicine
Keywords	Biomaterials, Cardiovascular Research, Personalized Medicine, Regenerative Medicine, Tissue Engineering
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Biointerface Laboratory

The Biointerface group studies two major topics – the biology of fetuin family proteins, and (stem) cell-material interactions. Fetuin biology involves tissue development and remodeling ranging from mineralized tissue metabolism, lipid metabolism, blood clotting, and tissue modifications regulating reproductive biology. We develop in genetically altered mouse strains to study aspects of tissue remodeling involved in human disease. Over the years we have thus developed expertise in pathological calcification, atherosclerosis, fibrosis and thrombotic disease.

Our second line of research deals with cell-material interactions including toxicity studies with (nano-) materials, cell sources and cell-scaffold interactions up to implantation models in experimental tissue engineering. Tissue engineering approaches address wound healing and bone tissue engineering.

We study cell sources and precursors of cells required for new tissue formation and homeostasis. This involves mesenchymal stem cells as precursors of major tissue types as well as immune cell precursors as the regulators of tissue function.

International Collaborations

Mc Gill University, Montreal, Canada
Institute for Systems Biology, Seattle, WA, USA
Maastricht University, Netherlands

National Collaborations

RWTH Aachen University
University Clinics Hamburg Eppendorf
MPI of Molecular Plant Physiology, Potsdam

Membership in local and regional Networks

Life Tec Aachen Jülich e. V.

Research Field	Biochemistry
Keywords	Animal Models, Biomarker, Biomaterials, Diagnostic Systems, Tissue Engineering
Head of Institute	Univ.-Prof. Dr. Wilhelm Jahnen-Dechent
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Address	Pauwelsstr. 30
Postal Code/City	52074 Aachen
Fon	+49 241 80-80163
Fax	+49 241 80-82573

Research Field	Biotechnology
Keywords	Biocatalysts, Biomaterials, Carbohydrates, Enzymes, Platform Technology, Recombinant Proteins, Synthetic Biology
Head of Institute	Prof. Dr. rer. nat. Lothar Elling
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E-Mail	l.elling@biotec.rwth-aachen.de
Address Postal Code/City	Pauwelsstr. 20 52074 Aachen
Fon	+49 241 80-28350
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Laboratory for Biomaterials

We have a profound expertise in the development of multi-enzyme cascade reactions for the synthesis of (neo)glycoconjugates. The combinatorial modules include enzymes from our tool box including biocatalysts for the synthesis of nucleotide sugars, glycosyltransferases, and galactosidases / glycosynthases. We create novel synthetic routes towards natural and modified glycoconjugates by optimization of multi-enzyme reactions cycles. Current research projects include the enzymatic synthesis of native and modified glycan structures and their interaction with glycan binding proteins (lectins). In cooperation with partners we utilize these carbohydrate-protein interactions for the biofunctionalization of biomaterial surfaces and for targeting toxins and cancer cells.

International Collaborations

Czech Academy of Sciences, Prague
Osaka University, Japan

National Collaborations

DWI - Leibniz-Institute for Interactive Materials, Aachen
Research Center Jülich (FZ Jülich)
RWTH Aachen

Membership in local and regional Networks

Bioeconomy Science Center, SFB 985,
GRK 1628-2 "Seleca"

Research Field	Health, Medical Devices
Keywords	Regenerative Medicine, Stem Cell Research, Tissue Engineering
Head of Institute	Prof. Dr. rer. nat. Martin Zenke
Internet	www.molcell.rwth-aachen.de
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Address Postal Code/City	Pauwelsstr. 20 52074 Aachen
Fon	+49 241 80-80760
Fax	+49 241 80-82008

Cell Biology

The institute has a long standing interest in stem cells and cellular engineering. A particular focus is on blood stem cells, mesenchymal stem cells and embryonic stem cells (ES cells), and their differentiated progeny. Additionally, efforts are directed towards enlarging the developmental potential of somatic cells, for example by employing induced pluripotent stem (iPS) cell technology, referred to as cellular engineering. Further activities are on the development of biohybrid systems, comprising of cells and engineered materials. In this context the institute investigates the impact of natural and synthetic biomaterials on cell growth, differentiation and function.

International Collaborations

Ludwig Boltzmann Institute, Vienna,
Austria

Tsinghua University and Peking Union Medical School (PUMC), Beijing, China

National Collaborations

Max Planck Institute for Molecular Biomedicine, Münster
Bonn University
Würzburg University
Life & Brain, Bonn
Bayer, Leverkusen

Membership in local and regional Networks

Stem Cell Network NRW
DFG Priority Program "Pluripotency and Cellular Reprogramming"
StemCellFactory – Automated derivation, expansion and differentiation of iPS cells

Experimental Molecular Imaging

ExMI develops and applies novel contrast agents, imaging techniques and therapeutic approaches to characterize and treat cancer, cardiovascular and inflammatory disorders.

International Collaborations

Department of Pharmaceutics, Utrecht University, The Netherlands
 Department of Biological Regulation, Weizmann Institute of Science, Israel
 Bordeaux University, Pessac, France

National Collaborations

Institute for Medical Engineering, Ruhr-University Bochum
 Institut for Cardiovascular Prevention, LMU Müncheng
 Institute of Organic Chemistry, Johannes Gutenberg-University Mainz

Research Field	Health, Medical Devices
Keywords	Cancer, Cardiovascular Research, Companion Diagnostic, Colon Cancer, Oncology, Personalized Medicine
Head of Institute	Univ.-Prof. Dr. med. Fabian Kiessling
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mediTEC – Chair of Medical Engineering

The mediTEC team is engaged in basic research issues as well as in application-oriented aspects of the development and evaluation of computer assisted and model driven therapy systems. The effective development of these systems is based on the successful interdisciplinary cooperation of medical and engineering sciences. Our activities cover a wide range of subjects from feasibility studies to usability testing and clinical trials e.g. in orthopaedics, traumatology, neurosurgery, general surgery, interventional radiology and cardiology in close cooperation with international academic, clinical and industrial partners. The research field consists of six research areas:

- Image Processing & Morphology Modelling
- Biomechanical Modelling & Simulation
- Model Based Surgical Planning & Navigation

- Sensorintegrated Instruments & Robotics
- Ultrasound Technology & Shockwaves
- Risk Management & Usability Engineering

International Collaborations

Imperial College
 Delft University
 Industrial Cooperations

National Collaborations

Charité Berlin
 Lübeck University
 Leipzig University

Membership in local and regional Networks

CeMPEG e.V.
 OR.NET e.V.

Research Field	Computer Assisted Therapy, Health, Medical Devices
Keywords	Image Processing, Biomechanics, Platform Technology, Robotics, Ultrasound and Shockwaves
Head of Institute	Univ.-Prof. Dr.-Ing. Klaus Radermacher
Internet E-Mail	www.meditec.rwth-aachen.de radermacher@hia.rwth-aachen.de
Address Postal Code/City Fon Fax	Pauwelsstr. 20 52074 Aachen +49 241 80-23873 +49 241 80-23870

Research Field	Health, Medical Devices
Keywords	Ageing, Cardiovascular Research, Diabetes, Neurodegenerative Diseases, Parkinson Disease, Personalized Medicine
Head of Institute	Univ.-Prof. Dr. med. Dr.-Ing. Steffen Leonhardt
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Address	Pauwelsstr. 20
Postal Code/City	52074 Aachen
Fon	+49 241 80-23211
Fax	+49 241 80-623211

MedIT – Philips Chair for Medical Information Technology

The Philips Chair for Medical Information Technology is concerned with biomedical measurement instrumentation, automation of therapy and medical care outside the hospital. We develop both algorithms and device prototypes and test them in appropriate experimental or human trials.

Topics include

- theory and applications of feedback control in medicine
- noncontact monitoring of vital signs
- bioimpedance spectroscopy and tomography
- wearables and textile integration

International Collaborations

Imperial College London, UK
 Bauman Moscow State Technical University
 Philips Research, Eindhoven

National Collaborations

Charite Berlin
 University of Bonn
 Ford Research, Aachen

Membership in local and regional Networks

Smart Care Unit (ZIM/AiF)





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Leibniz Association

Leibniz Association

The Leibniz Association (“Wissenschaftsgemeinschaft Gottfried Wilhelm Leibniz e. V.”) employs more than 18,000 individuals and connects 89 independent research institutions.¹ These range from the natural, engineering and environmental sciences via economics, spatial and social sciences to the humanities. Leibniz Institutes address issues of social, economic and ecological relevance. They conduct knowledge-driven and applied basic research, maintain scientific infrastructure and provide research-based services. The Leibniz Association is named after the German philosopher, mathematician, scientist and inventor Gottfried Wilhelm Leibniz.

The Leibniz Association identifies focus areas for knowledge transfer to policy-makers, academia, business and the public. Leibniz Institutes collaborate intensively with universities – for example in the form of “WissenschaftsCampi” (thematic partnerships between university and non-university research institutes) – as well as with industry and other partners at home and abroad. They are subject to an independent evaluation procedure that is unparalleled in its transparency. Due to the importance of the institutions for the country as a whole, they are mainly funded by the federal government and the states. The total annual budget of all the institutes exceeds € 1.6 billion and today, more than 30 % is acquired through third-party funds.¹ In 2012, the general assembly of the Leibniz Association pledged itself to the guiding principle of a coordinated, decentralised structure. At the same time, it decided to strengthen the central service

functions of the Leibniz Association and to expand its headquarters.

Scientific profile

The 89 Leibniz Institutes are divided up into five sections with different focus areas. Active knowledge sharing takes place both within and between the sections which provide an initial overview of the Leibniz Association’s scientific profile:

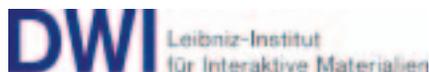
- Section A: Humanities and History of Education
- Section B: Economics, Social Sciences, Regional Infrastructure Research
- Section C: Life Sciences
- Section D: Mathematics, Natural Sciences & Engineering
- Section E: Environmental Science

The latter three sections are most relevant for research disciplines from the life sciences. The Leibniz Institutes in section C concentrate on research in the life sciences with a focus on health and biodiversity. Health themes include immune diseases, infection, obesity and related complications (diabetes, heart and vascular disease) as well as diseases of the central nervous system. The main directions in biodiversity research are species diversity, ecosystems, the role of biodiversity and the impact of anthropogenic change, sustainable use of biodiversity and the development of methods for meaningful biodiversity management.

Section D comprises the institutions and infrastructure facilities in the Leibniz Association which research into mathematics, natural sciences and engineering. These Leibniz Institutes ideally combine knowledge-driven research in mathematics, astrophysics and atmospheric physics with application related investigations into innovative semi-conductor devices, new materials, medical diagnostics and environmental analysis. Modelling and simulating complex processes allow reliable predictions to be made in areas that are inaccessible or in which experimentation is difficult. New approaches to technology transfer and the presentation of outcomes reach out beyond the individual sections but are actively embraced by the scientific infrastructure facilities and the international meeting centres for mathematics and computer science.

Section E focuses on environmentally-relevant issues in the natural sciences, engineering and social sciences. With the aid of laboratory and field work, the development of analytical procedures and mathematical modelling, ecosystems and biotic communities are studied, particularly against the backdrop of global change. These Leibniz Institutes investigate the interdependency between the natural environment and human activity and provide the basis for decision making on securing sustainable resources in the political, economic and social arenas.

Source: ¹ Leibniz-Gemeinschaft - Jahrbuch 2014



DWI – Leibniz Institute for Interactive Materials

Name	DWI – Leibniz Institute for Interactive Materials
Address	Forckenbeckstraße 50
Postal Code/City	52074 Aachen
Contact Person	Prof. Dr. Martin Möller
Fon	+49 241 80-23300
E-Mail	contact@dwi.rwth-aachen.de
Internet	www.dwi.rwth-aachen.de
Founded (year)	1952
Number of employees	scientific 90 administrative 17
Funding	Leibniz Association 60% Federal Government (Germany) 12% State Government NRW 4.4 % others (EU, DFG, AiF, VW Fondation, Industry)

www.dwi.rwth-aachen.de

Research at DWI – Leibniz-Institut für Interaktive Materialien e.V. (DWI – Leibniz Institute for Interactive Materials) focuses on the development of materials with active and adaptive properties, after being founded in 1952 with an original emphasis on keratin research and protein chemistry. The capability for active adaptation and interactivity is one of the most profound challenges of today's materials research and will ultimately lead to the evolution of structural via functional to intelligent materials. At DWI scientists with backgrounds in polymer sciences, biotechnology and chemical engineering closely collaborate on mastering this challenge.

The research approach at DWI is based on integrating molecular components, whose structure and dynamics are orchestrated by complex interactions on various length scales, into macroscopic materials, devices and in the end systems. For exceeding the passive functionalities of existing materials, DWI researches on switchable material properties, the application of memory effects, the integration of energy conversion systems, as well as on internal feedback mechanisms. Beyond materials aspects

the DWI team aims at an integration of active characteristics into interacting material systems. The fields of application are diverse, dealing with surface finishing, biomedical technology, biotechnology and sustainable chemical engineering.



German Diabetes Center – Leibniz Institute for Diabetes Research at the Heinrich Heine University

The German Diabetes Center (DDZ) is an interdisciplinary research center which combines molecular, clinical, and epidemiological work to improve prevention, early detection, diagnosis, and therapy of diabetes mellitus and its associated secondary complications.

The DDZ contributes to an improved quality of epidemiological data regarding diabetes in Germany. Moreover, the DDZ conducts clinical studies in order to analyze onset and development of diabetes, and to develop new prevention therapies. It represents the national reference center for diabetes research of the Leibniz-Association. As a result, the DDZ provides accurate scientific information related to diabetes mellitus for the public and for experts within the health care system.

The organizational units are the Institute for Clinical Diabetology, the Institute for Clinical Biochemistry and Pathobiochemistry, the Institute for Biometrics and Epidemiology, the Institute for Beta Cell Biology, the Paul-Langerhans-Group for Integrative Physiology, the Paul-Langerhans-Group for Health Services Research and Health Economics and the National Diabetes Information Center.

The DDZ is operated through the non-profit German Diabetes Research Foundation (Deutsche Diabetes Forschungsgesellschaft e.V.) and affiliated with the Heinrich Heine University Düsseldorf. The DDZ is also partnered with the German Center for Diabetes Research (DZD), a research cluster funded by the Federal Ministry of Education and Research.

DDZ
Deutsches Diabetes-Zentrum

Name	German Diabetes Center – Leibniz Institute for Diabetes Research at the Heinrich Heine University
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Internet	www.ddz.uni-duesseldorf.de
Founded (year)	1965
Number of employees	210
Funding	Federal Government (Germany) 50% State Government NRW 50%

www.ddz.uni-duesseldorf.de

Research Field	Beta Cell Biology, Cell Biology/Physiology
Keywords	Diabetes, Platform Technology, Therapeutics
Head of Institute	Prof. Dr. rer. nat. Eckhard Lammert
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Institute for Beta Cell Biology

The institute investigates the pathomechanisms in pancreatic beta cells and endothelial cells in type 2 diabetes. The underlying hypothesis is that blood vascular changes support the development of type 2 diabetes. To analyze blood vessels and vascular changes systematically, an imaging platform has been developed to qualitatively and quantitatively analyze blood vessels in tissues *in vivo* and in a 96-well screenable format *in vitro*. The platform is based on state-of-the-art fluorescence and laser scanning microscopes in combination with image analyses programs. Moreover changes in mitochondria of pancreatic beta cells in diabetic and pre-diabetic mice are analyzed. The molecular pathomechanisms in mitochondria are analyzed during development of type 2 diabetes and glucose intolerance in mice.

International Collaborations

Swiss Federal Institute of Technology in Zurich, Switzerland
Science and Engineering, Basel, Switzerland
Wihuri Research Institute and Translational Cancer Biology Program, Biomedicum Helsinki, University of Helsinki
Friedrich-Miescher Institute for Biomedical Research, Basel, Switzerland

National Collaborations

Clinic for General Pediatrics, Neonatology and Pediatric Cardiology, University Children's Hospital Düsseldorf
Institute of Neuro- and Sensory Physiology, University Hospital Düsseldorf
Profil Institute for Clinical Research, Neuss

Research Field	Biometrics and Epidemiology
Keywords	Diabetes, Epidemiology, Biometry, Health Service, Health Economics
Head of Institute	Prof. Dr. sc. hum. Oliver Kuß
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Address Postal Code/City	Auf'm Hennekamp 65 40225 Düsseldorf
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Institute for Biometrics and Epidemiology

The Institute for Biometrics and Epidemiology conducts population-based studies on the descriptive epidemiology of the two types of diabetes and its complications to improve prevention and early detection, as well as medical care of patients with diabetes.

Analytical epidemiological studies are focused on the detection of Public Health-related risk factors of diabetes. These studies are carried out in close cooperation with other national and international epidemiological centers, clinical partners and research scientists. The studies are conducted in accordance to international epidemiological standards. The Institute also contributes to the further development of biometrical-epidemiological methods.

The Institute for Biometrics and Epidemiology at the German Diabetes Center is the only institution in Germany, which sees its

main objective in creating up-to-date epidemiological data on diabetes.

International Collaborations

Queen's University Belfast, Department of Epidemiology and Public Health, UK
National Public Health Institute, Helsinki, Finland
Institute for Public Policy, Rice University, Houston, USA

National Collaborations

Helmholtz Center Munich
Westphalian Wilhelms-University, Münster
University Duisburg-Essen
University of Greifswald
Leibniz Institute for Environmental Research (IUF), Düsseldorf

Membership in local and regional Networks

German Delegate, OECD Expert Group
Deputy Speaker

Institute for Clinical Biochemistry and Pathobiochemistry

The Institute for Clinical Biochemistry and Pathobiochemistry investigates the molecular basis of onset and progression of obesity, insulin resistance and type 2 diabetes. The aim is to gain insights that may lead to improvements in prevention, prediction and therapy of diabetes.

Therefore, several research strategies are pursued, including experimental mouse genetics to identify novel risk genes, gene/gene and gene/environment interactions, molecular and cell biology studies and mass spectroscopy-based proteome mapping to investigate regulatory networks and to identify novel predictive biomarkers for diabetes mellitus and secondary complications.

International Collaborations

Ghent University Hospital, Ghent, Belgium
 Karolinska Institut, Stockholm, Sweden
 National Institutes of Health, Bethesda MD, USA
 University of Bath, UK
 VU University Medical Center, Amsterdam, The Netherlands

National Collaborations

German Institute for Human Nutrition, Potsdam-Rehbruecke
 Charité - Berlin Medical University
 Max Planck Institute for Molecular Genetics, Berlin

Research Field	Genetics/Molecular Biology
Keywords	Animal Models, Biomarker, Diabetes, Proteomics, Signal Transduction
Head of Institute	Prof. Dr. rer. nat. Hadi Al-Hasani
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Institute for Clinical Diabetology

Diabetes mellitus comprises heterogeneous metabolic disorders, which are characterized by hyperglycemia. Various factors contribute to the pathogenesis and development of these disorders.

Identification of these factors and integration into pathophysiological concepts are key to novel therapeutic approaches to diabetes mellitus, including prediabetic states and associated diseases.

Researchers of four research groups and the staff unit "Technical Lab" of the Institute for Clinical Diabetology study the mechanisms of the natural course of LADA, type 1 or type 2 diabetes and perform studies on the prevention, novel forms of treatment of diabetes and its late complications.

International Collaborations

Howard Hughes Institute at Yale University, USA
 Steno Diabetes Center, Gentofte, Denmark;
 University College London, UK
 National Institute for Health and welfare, Helsinki, Finland

National Collaborations

Helmholtz Zentrum Muenchen
 Institute for Diabetes Research and Metabolic Diseases at Eberhard-Karls-University of Tuebingen
 German Institute of Human Nutrition
 Potsdam-Rehbruecke

Membership in local and regional Networks

German Council of Science and Humanities
 Board Member/Honorary Treasurer EASD
 Speaker of the German Center for Diabetes Research (DZD)

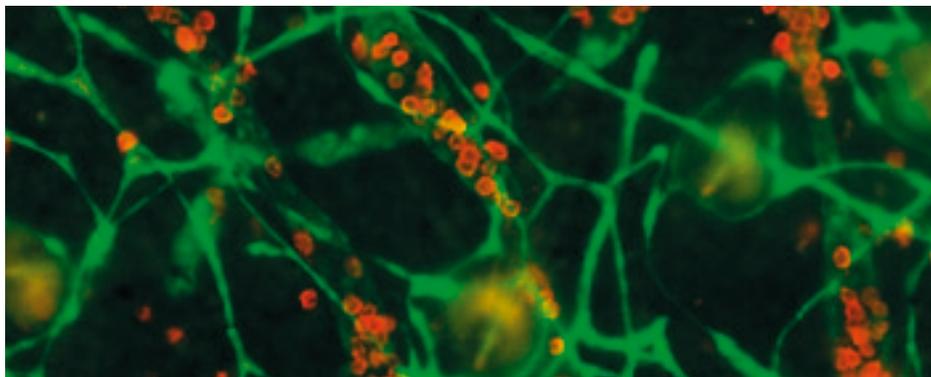
Research Field	Diabetes
Keywords	Biomarker, Energy Metabolism, Inflammation, Neuropathy, Metabolic Imaging, Clinical Studies
Head of Institute	Prof. Dr. Michael Roden
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IUF

LEIBNIZ-INSTITUT
FÜR UMWELT-
MEDIZINISCHE
FORSCHUNG

Name	IUF - Leibniz Research Institute for Environmental Medicine
Address Postal Code/City	Auf'm Hennekamp 50 40225 Düsseldorf
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Fon	+49 211 3389-216
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Internet	www.iuf-duesseldorf.de
Founded (year)	2001
Number of employees	scientific 118 administrative 22
Funding	Federal Government (Germany) 50% State Government NRW 50%

www.iuf-duesseldorf.de



IUF – Leibniz Research Institute for Environmental Medicine Molecular Preventive Medicine

The IUF's major task is to carry out molecular preventive medical research of environmentally-induced disorders. The main objective is to improve health care with regards to environmental pollution and to develop preventive strategies. The IUF carries out research projects addressing the biological effects that pollutants (in particular particles, non-ionizing radiation and chemicals) have on humans. Environmentally-induced ageing processes of the cardiovascular system and the skin as well as environmentally-induced disturbances of the immune system and damages to the brain are in focus. Based on the scientific competence in the institute these investigations are carried out interdisciplinarily. The IUF bundles scientific expertise in the fields of toxicology, immunology, molecular ageing research and epidemiology. This interdisciplinary research approach needs experimental models of one or more barrier organs. The impact of environmental factors is mainly investigated in the organ systems skin, lung, cardiovascular system, and brain. Besides *in vitro* examinations on cultured cells and (partly genuinely at the

IUF developed) human 3 dimensional organic model systems, *in vivo* examinations are conducted in animal models as well as in humans using a specially established research unit for this purpose.

Group: Environmentally-induced Skin and Lung Ageing

The Krutmann research group investigates the molecular mechanisms that underlie environmentally-induced skin aging and associated skin diseases. Insights obtained hereby are translated into the development of novel preventive strategies, if possible. Main topics of the last years are: (1) the discovery of the promoting effects of solar IRA radiation on skin aging and the development of corresponding skin protection products, (2) studies on the functional relevance of UV-induced mitochondrial mutagenesis in skin aging, (3) system biology investigations regarding UV-induced stroma aging of the skin, (4) and the discovery of the first curative therapeutic approach for the UV-sensitive progeroid syndrome Cockayne syndrome. Together with PD Dr. K. Unfried the development of an Ectoin-based medical prod-

uct for the prevention of airborne particle (PM) induced lung ageing was recently achieved. In IUF internal cooperation on epidemiological studies, an association between PM-exposure and skin aging was described for the first time. This finding is currently further investigated in a large Chinese cohort and moreover mechanistically investigated. In cooperation with the toxicological working groups, the role of the aryl hydrocarbon receptor in PM- and UV-induced skin aging and carcinogenesis is respectively analyzed. In cooperation with the immunological working groups the role of the innate immune system in extrinsic skin aging is being investigated.

Research Field	Health, Medical Devices, Molecular Aging Research, Dermatology
Keywords	Ageing, Environmental Research, Signal Transduction, Molecular Aging Research
Head of Group	Prof. Dr. Jean Krutmann
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Fon Fax	+49 211 3389-224 +49 211 3129-76

Group: Influence of Xenobiotics on the Cell Nucleus

The research group von Mikecz investigates the effects of environmental noxae/pollutants on the structure and function of the cell nucleus. Here, the ubiquitin-proteasome system fulfills a prominent role by maintaining cellular quality control and protein homeostasis. The research group contributed to define a nuclear ubiquitin-proteasome system and characterize its role in nuclear processes such as transcription. Consistent with this it could be shown that pollutants such as certain trace metals and nanoparticles modify proteasome-dependent proteolysis and promote the formation of amyloid-like protein aggregates in the nucleus. These amyloid-aggregates represent proteolytic centers that recruit components of the ubiquitin-proteasome system, heat shock proteins and RNA processing factors dur-

ing pollutant-induced stress responses. The pollutant-stress-induced nuclear aggregates resemble neuronal nuclear inclusions that occur in neurodegenerative aggregation diseases. Thus, the characterization of nuclear protein fibrillation mechanisms serves both, a better understanding of molecular effects of noxae and the cellular pathways of neurodegenerative diseases. Consistently, the von Mikecz group demonstrates in cell culture and in the nematode *C. elegans* that silica nanoparticles and the trace metal mercury induce amyloid protein aggregation in neural cells that inhibits neural transmission and promotes neurodegeneration. Such neurotoxicity manifests in *C. elegans* by impairment of neuromuscular behavior phenotypes that are otherwise associated with organismal aging processes.

Research Field	Cell Biology, Neurobiology, Nanotoxicology
Keywords	Ageing, Environmental Research, Nanotoxicology, Neurodegenerative Diseases, Proteomics
Head of Group	Prof. Dr. Anna von Mikecz
Internet	www.iuf-duesseldorf.de
E-Mail	mikecz@uni-duesseldorf.de
Address Postal Code/City	Auf'm Hennekamp 50 40225 Düsseldorf
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Research Field	Health, Nanotechnology, Risk Assessment
Keywords	Animal Models, Cell Lines/Banks, DNA, Nanotoxicology, Neurodegenerative Diseases, Risk Assessment, Toxicology
Head of Group	Dr. Roel Schins
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Address Postal Code/City	Auf'm Hennekamp 50 40225 Düsseldorf
Fon Fax	+49 211 3389-269 +49 211 3389-331

Group: Particles, Inflammation and Genome Integrity

The group focuses on the investigation of acute and chronic health effects of inhaled and ingested particles. The key aims of the group's research are: (1) to identify potential tools that may contribute to the prevention or treatment of particle-induced health effects, and (2) to provide data for risk assessment in the fields of particle toxicology and nanotoxicology.

Research Field	Immunology, Toxicology
Keywords	Cell Separation, Environmental Research, Genomics, Immune Modulation, Microbial Genomics
Head of Group	Prof. Dr. Charlotte Esser
Internet E-Mail	www.iuf-duesseldorf.de charlotte.esser@uni-duesseldorf.de
Address Postal Code/City	Auf'm Hennekamp 50 40225 Düsseldorf
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Group: Role of AhR in Immunotoxicology

The Esser lab studies the role of the aryl hydrocarbon receptor (AhR) in immunotoxicology, in particular in differentiation, function and mobility of lymphoid cells in the barrier organs skin and gut. AhR is a transcription factor, which senses certain small molecular weight chemicals in the environment and thereby mediates an adaptive response of cells to such signals. For instance, cells can respond to chemicals with upregulation of relevant metabolizing enzymes. In addition, many immune (and other) cells use AhR signaling in normal differentiation.

The Esser lab showed for the first time in mice that AhR is necessary for the maturation and function of two distinct immune cell types of the skin, the Langerhans cells and dendritic epidermal T cells. Also AhR was shown to influence oral

tolerance, an important immunological feature of the gut, which ensures that food proteins are ignored by the immune system. Building on these results, the lab focusses currently on (i) the role of AhR for skin barrier functions and skin T cells, and (ii) immunostimulation versus immunosuppression by AhR. Depending on the organ studied, either UV (which generates a high-affinity AhR ligand in the skin), or AhR activating food constituents such as indole-3-carbinol are used. A number of mouse models were developed which are used to study immunological functions and the preventive and therapeutic potential of AhR in depth.

Group: Toxicological Risk Assessment and Sphere Models

A major issue in developmental neurotoxicity (DNT) risk assessment is the lack of toxicological hazard information for most compounds. Therefore, new approaches are needed to provide adequate experimental data that allow regulatory decisions. The Fritsche lab has developed a 3D method for DNT hazard assessment based on human, rat and mouse neurospheres that mimic early neurodevelopmental processes like neural progenitor cell (NPC) proliferation, migration, differentiation into neurons and glial cells as well as apoptosis *in vitro*. This system is thus suited to perform pathway-to-function analyses in a species-specific context. Such data is also valuable to translate rodent *in vivo* data to humans on a mechanistic basis within the Adverse Outcome Pathway (AOP) concept. The Fritsche lab currently

focuses on the assay's scientific validation in order to define its biological application domain. Furthermore, algorithms are developed for the analysis of neurospheres in medium-throughput High Content Imaging Analyses (HCA).

In addition, hiPSC (human induced pluripotent stem cell)-based assays are currently developed that will be able to identify embryotoxicity as well as neurotoxicity of compounds by pathway-to-function analyses.

Research Field	Developmental Biology, Neurobiology, Neurotoxicology
Keywords	Environmental Research, iPS, Signal Transduction, Stem Cell Research, Toxicology, Risk Assessment
Head of Group	Prof. Dr. Ellen Fritsche
Internet	www.iuf-duesseldorf.de
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Address Postal Code/City	Auf'm Hennekamp 50 40225 Düsseldorf
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Fax	+49 211 3190-910

Heisenberg Group – Environmentally-induced Cardiovascular Degeneration

The major focus of the Haendeler lab is to elucidate environmentally-induced molecular mechanisms of aging processes and age-associated diseases of the cardiovascular and cardiopulmonary system. Within this context we work on the following four subprojects:

1. the function and regulation of Telomerase Reverse Transcriptase (TERT) in the nucleus and in the mitochondria *ex vivo* and *in vivo*,
2. the regulation of Thioredoxin (Trx-1), identification of new binding partners of Trx-1 and their functions in the cardiovascular system,
3. the function and regulation of transcription factors, especially Grainyhead-like 3

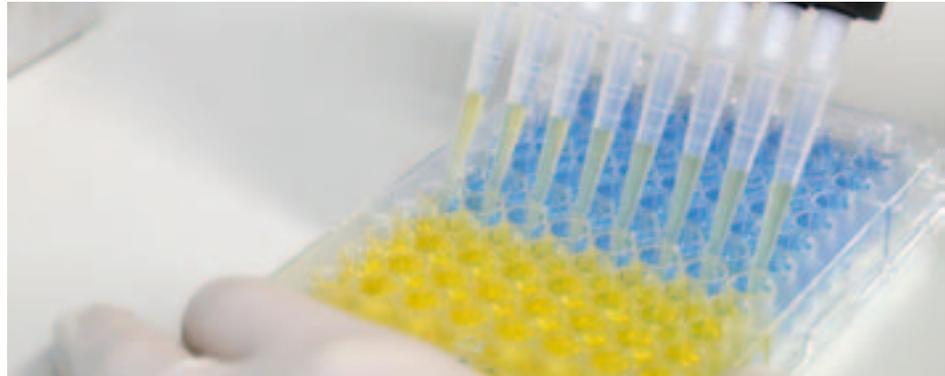
(GRHL3) and Arylhydrocarbon Receptor (AhR), in the cardiovascular system,

4. the impact of exercise, diet and carbon nanoparticles on the cardiovascular and cardio-pulmonary system.

Research Field	Ageing Research, Cell Biology
Keywords	Age Related Diseases, Ageing, Animal Models, Cardiovascular Research, Environmental Research, Signal Transduction
Head of Group	Prof. Dr. Judith Haendeler
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LEIBNIZ RESEARCH CENTRE
FOR WORKING ENVIRONMENT
AND HUMAN FACTORS



IfADo – Leibniz Research Centre for Working Environment and Human Factors

Research for the benefit and welfare of the working human

Name	Leibniz Research Centre for Working Environment and Human Factors (IfADo - Leibniz-Institut für Arbeitsforschung an der TU Dortmund)
Address	Ardeystr. 67
Postal Code/City	44139 Dortmund
Contact Person	Prof. Dr. med. Jan G. Hengstler
Fon	+49 231 1084-0
Internet	www.ifado.de
Founded (year)	1969
Number of employees	204 in total
Funding	Federal Government Germany 50% State Government NRW 50%

www.ifado.de

The IfADo investigates potentials and risks of modern work on the basis of behavioral and life sciences. The results lead to principles of beneficial and healthy design of the working environment.

The IfADo is a cross-disciplinary institute for integrated applied and basic research related to occupational health and human performance. Its research groups combine different academic subjects such as ergonomics, psychology, toxicology, immunology, neurosciences and occupational medicine/biology. The broad spectrum of scientific competences is an unique feature of this Leibniz institution and allows to investigate working humans from the cell to the workplace.

In the field of life sciences the institute has a strong background in immunology, neurosciences, and toxicology. Major topics are neurostimulation, natural killer cells, hepatotoxicity and liver regeneration as well as carcinogenesis. Routinely applied techniques include hepatocyte, natural killer cell and neuronal *in vitro* systems, FACS, confo-

cal and two photon microscopy, time lapse microscopy and calcium imaging. Besides, the IfADo applies tDCS, EEG, and TMS-EEG.

The institute is associated with the TU Dortmund University and therefore actively involved in teaching and training of young scientists. Moreover the institute is a WHO Collaborating Centre for Occupational Health.

The research findings are not only communicated to the scientific community, but in addition they form the basis for contributions to regulatory bodies such as the Scientific Committee on Occupational Exposure Limits (SCOEL) of the EU or standardization bodies such as the European Committee for Standardization (CEN). Besides political consulting the findings are also communicated to practitioners in the field of occupational health and ergonomics.

Department of Immunology

The Department of Immunology focuses on the investigation of inborne Natural Killer (NK) cells. NK cells represent a third subset of lymphocytes that can kill tumor and virally infected cells without prior sensitization, a process called natural killing. They can also regulate immune responses by the secretion of cytokines such as interferon-gamma, tumor necrosis factor, and granulocyte/macrophage colony-stimulating factor. The activity of NK cells is controlled by a balance of positive and negative signals that NK cells receive through different surface receptors. The protection of normal, healthy cells from natural killing is assured by inhibitory receptors, most of which are specific for major histocompatibility complex class I molecules.

Recent research

- Signal transduction of SLAM related receptors
- Integration of positive and negative signals during NK cell activation
- Role of membrane micro domains in NK cells
- Contribution of different activating ligands to NK cell activity

Research Field	Immunology
Keywords	Antibody, Cancer, Cell Lines/ Banks, Immune Modulation, Natural Killer Cells, Signal Transduction
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Department of Neurosciences

The Department of Neurosciences aims to understand the physiological and psychological underpinnings of performance-relevant processes, from basic research to application in real-life work scenarios. Improved understanding of factors which influence the respective processes will help to identify, and implement beneficial and to avoid aversive work conditions on a rational basis, help to optimize performance, and avoid work-related diseases. The research projects of the department are therefore organized along the following topics, which are highly interconnected:

1. Determinants and modulators of cortical activity, and neuroplasticity in the human brain
2. Physiological basis, and psychological mechanisms of cognition, motor functions and emotion
3. Physiology-based improvement of work conditions

Research Field	Neurobiology
Keywords	Diagnostic Systems, Neurostimulation, tDCS (transcranial direct-current stimulation), Neural Plasticity, Cognition
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Research Field	Genetics/Molecular Biology
Keywords	Cancer, Cell Lines/Banks, Signal Transduction, Stem Cell Research, Liver Regeneration, Novel Toxicity Tests
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Department of Toxicology

The research group Systems Toxicology develops novel toxicity tests and investigates *in vitro* systems with hepatocytes, spatial-temporal modeling of tissue toxicity and regeneration as well as carcinogenesis and tumor development.

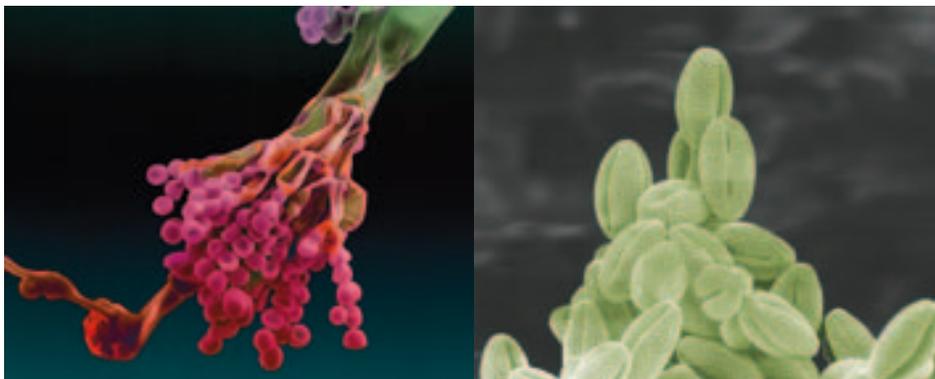
The junior group Liver Toxicology identifies key molecular mechanisms mediating hepatocyte behavior *in vitro* and improves methods for the evaluation of toxic substances which will spare experimental animals.

The junior group Visualizing Toxicology identifies interfaces of toxic substances and cellular targets of the early signaling networks in order to understand certain activation states.

The junior group Cellular Toxicology focuses in particular on pro-survival mechanisms in various stress situations, and

analyzes gene expression, metabolism and signal transduction pathways in several cell lines.

The research group Neurobehavioural Toxicology and Chemosensation investigates current issues regarding chemosensory effects and neurotoxicity and provides data for the setting of health based threshold limit values.



Leibniz-Institut für Analytische Wissenschaften – ISAS – e.V.

ISAS is a research organization dedicated to advancing the development of analytical technologies through combining knowledge from chemistry, biology, physics, and computer sciences. Our research focuses on providing methods for the multi-parameter analysis of bio materials. With our innovations we aim to enable an earlier detection of diseases and their associated risk factors, and a faster and more precise therapy. Excellent interdisciplinary research, scientific qualification, and the transfer of our research findings to science, economy and society at large are our key objectives to implement our mission.

Analytical methods and strategies need to be developed in order to gain new insights into the structure and the dynamics of new materials and biological systems. The fundamental approach deployed to understand and explain complex systems is similar in materials and life sciences: both require suitable methods, the right model systems for investigations and appropriate modelling and simulation processes. Moreover, the continuous optimization and validation of ground-breaking technologies is essential in both disciplines, in order to measure molecu-

lar structures, components and processes in real-world samples and to develop the technologies for use in practical applications.

In this context, ISAS concentrates on developments which combine knowledge from both these branches of science to provide tailor-made analytical processes. Modern analytics requires that complementary methods be coupled for qualitative and quantitative analyses as well as for investigations with spatial and temporal resolution in order to produce a complex analytical strategy. Brought together, these new techniques should help to answer the question of which quantities of what substance are in a particular place at any particular time.

isas

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Internet	www.isas.de
Founded (year)	1952
Number of employees	scientific 79 administrative 91
Funding	Federal Government Germany 50% State Government NRW 50%

www.isas.de

Research Field	Bioanalytics
Keywords	Analytics, Chip Technology, Metabolomics, Microarrays, Peptide Synthesis, Proteomics Systems Biology
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Bioanalytics

Bioanalytics deals with different molecules and biological systems of varying complexity. To understand and describe those systems, it is necessary to measure as many of their components as possible. Therefore, the Bioanalytics department at ISAS concentrates on quantitative and qualitative descriptions of biologic systems. Also, bioanalytics often means trace analysis, because many biomolecules are transient, posttranslationally modified or simply low-abundant. In addition, the Bioanalytics department deals with the miniaturization of measuring systems to make analysis smaller, faster and cheaper.

International Collaborations

University of Ghent, Belgium
University of Aberdeen, UK
La Trobe University Melbourne, Australia

National Collaborations

Albert-Ludwigs-Universität Freiburg,
Julius-Maximilians-Universität Würzburg,
TU Berlin

Membership in local and regional Networks

bio.dortmund,
windo e.V.
Wissenschaftsforum Ruhr
bioindustry e.V.

Research Field	Biomedical Research
Keywords	Cardiovascular Diseases, Alzheimer's Disease, Neurodegenerative Disorders
Head of Department	Prof. Dr. Kristina Lorenz
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Biomedical Research

Biomedical research is an interdisciplinary area between biology, chemistry and medicine. The Biomedical Research department at ISAS aims to investigate the molecular background of pathological changes to causally treat or prevent them. Research mainly focuses on lifestyle diseases such as cancer, cardiovascular diseases or psychological, neurodegenerative or neurological disorders: They are often diagnosed too late to stop their progression or to efficiently prevent their chronification. Therefore new methods and technologies are required to detect lifestyle diseases at an early stage when affected persons do not show any symptoms although pathological processes have already started.

International Collaborations

University of Adelaide, Australia
University of Victoria, Canada
Maria Skłodowska Curie Memorial
Cancer Center, Gliwice, Poland

National Collaborations

Universitätsklinikum Münster
Universitätsklinikum RWTH Aachen
Universitätsklinikum Bonn
Justus-Liebig-Universität Gießen
Universitätsklinikum Carl Gustav Carus

Membership in local and regional Networks

bio.dortmund
windo e.V.
Wissenschaftsforum Ruhr
bioindustry e.V.

Interface Analytics

The Interface Analytics department at ISAS develops spectroscopic methods to analyse interfaces, nanostructures and minimal amounts of materials. They are the building blocks of “new” materials with “new” physical and chemical properties. In addition to inorganic nanostructures, organic molecules become increasingly important as defined units of functional layers used in optoelectronics, photovoltaics and sensor technology. Spectroscopic methods covering the spectral range from X-ray to far infrared provide information on composition, structure and electronic properties of a material, no matter if it is inorganic or organic, in a solid, liquid or gaseous state. Those methods – combined with electron spectroscopy and NMR methods – can be used in life sciences as much as in material sciences.

International Collaborations

Clemson University, SC, USA
Clarkson University, NY, USA

National Collaborations

Leibniz-Institut für Polymerforschung,
Dresden
Ruhr Universität Bochum
TU Dortmund

Membership in local and regional Networks

Optik Cluster Berlin-Brandenburg
windo e.V.
Wissenschaftsforum Ruhr

Research Field	Material Sciences / Biophysics
Keywords	Analytics, Optical Spectrometry, X-Ray Spectroscopy, NMR
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Zoological Research Museum Alexander Koenig

Name	Zoologisches Forschungsmuseum Alexander Koenig - Leibniz-Institut für Biodiversität der Tiere
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Postal Code/City	53113 Bonn
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Internet	www.zfmk.de
Founded (year)	1912
Number of employees	scientific 105 administrative 37
Funding	Federal Government Germany 50% State Government NRW 50% Small amount from all countries of Germany

www.zfmk.de

The Zoological Research Museum Alexander Koenig (ZFMK) is one of the largest natural-history-research museums in Germany. The museum has earned its reputation as a leader in the documentation, research and interpretation of biodiversity.

The important scientific collections which focus on terrestrial vertebrates and insects, constitute the "heart of the museum".

These collections form the basis for the diversity of research performed in the museum. The permanent exhibition presents only parts of these rich resources. The ZFMK is a foundation under public law. The official authority to which it reports is the Ministry for Innovation, Science and Research of the State of North Rhine-Westphalia in Düsseldorf. As a member of the Leibniz-Gemeinschaft (wgl) the ZFMK is jointly funded by the state of North Rhine-Westphalia, the other states of Germany and the Federal Government. Research fields exercised at a worldwide scale are biodiversity in terrestrial habitats, taxonomy and systematics of terrestrial vertebrates and arthropods (including the limnetic fauna) and evolutionary biology.

As general data bases, the collections of biological research museums are the basis of scientific research in these institutions. The biological species is the key entity of material documentation and the level of primary approach to study biodiversity. Research questions of biological museums are primarily taxon-specific. Accordingly their research profile differs from that of universities and other types of scientific institutes. Species-focused research is regaining considerable importance again after a longer phase of main emphasis on other research fields. It has become increasingly clear that on most continents and for many taxonomic groups our knowledge of the biological inventory of the earth is very insufficient. Temperate eurasia (palaeartic region), tropical and subtropical africa (afrotropical region) and central and south america (neotropical region) are the regional focuses. Many research projects also include specific aspects of the ecology of vertebrates and insects, with special reference to proximate and ultimate factors.

Centre of Molecular Biodiversity Research (zmb)

Scientists of the Centre of Molecular Biodiversity Research (ZMB) of the Museum Konig (ZFMK) work on various aspects of molecular biodiversity research driven by bioinformatics and covering biodiversity genomics, molecular taxonomy and barcoding as well as bio banking. In the area of biodiversity genomics the ZMB as a partner in large international projects is trying to map the biodiversity developed over the course of evolution. Furthermore, the centre holds an important national and international position in the fields of bar coding and bio banking as it coordinates the German national biodiversity research in a centralized approach especially by exploring data generated by the use of molecular markers.

The ZFMK is also investing into in a main-frame computing system, maintained and

supported by bioinformatic specialists of the ZMB to give answers to specific questions and hypotheses arising from genomics research and to perform modelling like eg. for area dislocations or territory shifts

International Collaborations

Arizona State University, USA
University of Memphis, USA

National Collaborations

University of Münster
University of Jena
University of Leipzig

Research Field	Zoology
Keywords	DNA, Environmental Research, Genomics, Molecular Library, Systems Biology
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Department of Arthropoda

ZFMK, Centre of Taxonomy and Evolutionary Research: Based on large collections of biological specimens (Arthropods) the centre uses morphological, genetic and computer-based methods for biodiversity research which includes the systematics and classification of organisms, the exploration of their evolution and of patterns of biodiversity.

Major topics are DNA-barcoding and integrative taxonomy using various lines of evidence (morphology, morphometrics, bioacustics, DNA sequences) for species delineation. With the curation of the specimen collections the centre has an important role in networking as a scientific service institution that makes accessible their archives of biodiversity in time and space to national and international scientific users.

International Collaborations

Natural History Museum London, UK
Chinese Academy of Sciences, China

National Collaborations

University Bonn

Membership in local and regional Networks

GBOL

Research Field	Zoology, Biodiversity Research
Keywords	DNA, Environmental Research, Genomics, Molecular Library, Systems Biology
Head of Department Internet	Dr. Dirk Ahrens www.zfmk.de/en/research/research-centers-and-groups/abteilung-arthropoda
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Research Field	Zoology, Biodiversity Research
Keywords	DNA, Environmental Research, Genomics, Molecular Library, Systems Biology
Head of Department	Dr. Fabian Herder
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Department of Vertebrates

Research in the Department of Vertebrates concentrates on specimen-based analyses of the biodiversity of mammals, birds, reptiles, amphibians, and fishes of the World. This includes aspects of taxonomy, morphology, ecology, phylogeny and evolution of vertebrates. Our work is conducted in collaboration with national and international specialists in other zoological museums, universities, and conservation societies. Research results range from basic studies and new species descriptions to more applied work such as handbooks, identification keys, Rapid Assessment Surveys, or IUCN species profiles. Teaching zoology and biodiversity research to university students is part of our work. Research projects regularly involve post docs and students on all levels (BSc, MSc, PhD), mainly from

Rheinische Friedrich-Wilhelms-University Bonn. Honorary and visiting scientists support research and collection work.

International Collaborations

Field Museum, Chicago, USA
Muséum National d'Histoire Naturelles, Paris, France
Natural History Museum, London, UK

National Collaborations

Universities Bonn, Trier, TU München
Natural History Museums of Leibniz Society

Membership in local and regional Networks

GBOL, FREDIE, Angel Shark Project





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Max Planck Society

Max Planck Society „Insight must precede application.“ (Max Planck)

The “Max-Planck-Gesellschaft zur Förderung der Wissenschaften” (“Max Planck Society for the Advancement of Science”) is an independent, non-profit research organisation. It is the successor organisation to the “Kaiser Wilhelm Society”, which was already founded in 1911 and was renamed “Max Planck Society” in 1948 in honor of its former president, German theoretical physicist Max Planck. Today, the Max Planck Society is Germany’s most successful research organization. Since its establishment, no fewer than 18 Nobel laureates (33 including the Kaiser Wilhelm Society) have emerged from the ranks of its scientists, putting it on a par with the best and most prestigious research organisations worldwide. The more than 15,000 publications each year in internationally renowned scientific journals are proof of the outstanding research work conducted at Max Planck Institutes – especially considering many of those articles are among the most cited in their respective fields.

Organization

The primary goal of the Max Planck Society is to promote research at its own institutes. It is not a governmental institution although it is funded to a large extent by the federal and state governments. Instead, it is a registered association and has its seat in Berlin, while the administrative headquarter and office of the president are located in Munich. Max Planck Institutes are organized into research departments

headed by scientific members as directors. Individual governing bodies within the society make the decisions required to ensure that the Max Planck Society functions efficiently as a large research organisation.

As of now, there are 83 institutes and research facilities, five institutes and one research facility being situated abroad. The Max Planck Society employs a total of about 18,000 staff including approximately 6,000 scientists.¹ During 2015, a total of more than 15,000 bachelor students, fellows of the International Max Planck Research Schools (IMPRS), PhD students, postdoctoral students, research fellows and visiting scientists worked at the Max Planck Society.

The annual budget of the Max Planck Society amounts to approximately € 1.7 billion and 80 % is made up of basic financing from the public sector. In addition, third-party funding and donations contribute to the budget.¹ The funding is used by the Max Planck Institutes to conduct basic research in the service of the general public in the natural sciences, life sciences, social sciences and the humanities.

Max Planck Institutes focus on research fields that are particularly innovative or that are especially demanding in terms of funding or time requirements. Furthermore, their research spectrum is continually evolving: new institutes are established to find answers to seminal, forward-looking scientific questions, while others are closed when, for example, their research field has been widely established

at universities. This continuous renewal process preserves the scope the Max Planck Society needs to quickly react to pioneering scientific developments.

Fostering Creative Potential

As a result of demographic change, Europe will soon have a shortage of young talent: as early as 2030, there will be an estimated 50,000 fewer university graduates than in 2005. Particularly the natural and engineering sciences are already experiencing a shortage of junior researchers, making it all the more important to encourage young people’s interest in studies in these areas early on. Teachers play an important role in this process. That is why the Max Planck Society supports them with informative journals, which present current research issues in such a way that they can easily be used in natural sciences courses for secondary level students. But despite this, the number of talented junior scientists from Germany will never fully meet the demand in science and research. That is why, in 1998, the Max Planck Society developed a programme in collaboration with the universities to motivate talented young PhD students from all over the world to come to Germany for their studies: the International Max Planck Research Schools (IMPRS). These schools offer junior scientists excellent research opportunities, providing them with extensive support and special offers to foster their development.

Source: ¹Max-Planck-Gesellschaft - Jahresbericht 2015



MAX PLANCK INSTITUTE FOR
BIOLOGY OF AGEING



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Contact Person	Dr. Maren Berghoff, Press and Public Relations Executive
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E-Mail	maren.berghoff@age.mpg.de
Internet	www.age.mpg.de
Founded (year)	28.06.2007 (Foundation) 01.01.2008 (Work commenced)
Number of employees	scientific 190 administrative 40
Funding	Federal Government Germany 45 %, State Government NRW 45 % Other 10% (ERC, DFG, Europ. Structural Funds, misc. third-party funds)

www.age.mpg.de



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Max Planck Institute for Biology of Ageing

The Max Planck Institute for Biology of Ageing is one of more than 80 independent and non-profit research institutions under the umbrella of the Max Planck Society. Understanding the natural ageing process as well as the nature of longevity and age-related diseases is at the center of the basic research carried out at the Institute. Its aim is to make fundamental discoveries into the underlying molecular, physiological and evolutionary mechanisms, by using mice, flies and worms as model organisms. The long-term goal is to pave the way towards increasing health during ageing in humans. Thus, a key line of research is to investigate interventions that can ameliorate the ageing process. A ground-breaking discovery of recent years is that mutations in single genes in the simple, single-celled yeast, in multicellular animals such as worms and flies as well as in mice, can extend lifespan and produce a broad-spectrum improvement in health during ageing. The mechanisms involved seem to be similar in these very different organisms, and the same kinds of genes are turning out to be associated with human lifespan.

Hence, there is an unprecedented opportunity to use simpler organisms to make

discoveries of relevance to the amelioration of human ageing – and thereby to meet the challenges of global changes associated with ageing and longer lifespan.

In particular, the Institute's research focuses on the roles of

- insulin/IGF and steroidal hormones,
- cellular components involved in growth control and nutrient sensing,
- factors regulating metabolism and function of mitochondria and
- various molecular signaling pathways in ageing, neurodegeneration and other ageing-related diseases.

Founded in 2008 the MPI for Biology of Ageing is one of Europe's first scientific facilities of this kind and as such is at the forefront of basic biomedical science.

It is part of a developing life science cluster focusing on ageing research that will have global impact (partner organisations being the Max Planck Institute for Metabolism Research, the Cologne Cluster of Excellence in Cellular Stress Responses in Aging-associated Diseases, the DZNE, the caesar and the University of Cologne).

Department Antebi: Molecular Genetics of Ageing

Adam Antebi has focused on a nuclear hormone receptor (NHR) signalling pathway that couples environmental cues such as nutrient availability to development, growth and ageing. *C. elegans* DAF-12 is an NHR transcription factor receptor most related to vertebrate vitamin-D and liver-X receptors, which regulates metabolism, dauer diapause, developmental progression, and life span. Our studies reveal that DAF-12 works as part of a hormone regulated switch: The liganded receptor promotes reproductive growth and rapid ageing, while the unliganded receptor specifies a long-lived, developmentally arrested larval stage called dauer diapause, as well as longevity in adults. The endogenous ligands of DAF-12 have been identified as bile acidlike steroids, providing critical evidence that such molecules regulate animal longevity.

We are now exploring the molecular mechanisms by which ligand, receptor complexes, and target genes determine organismal physiology.

International Collaborations

Baylor College of Medicine, Houston, TX, USA
 Cornell University, Ithaca, NY, USA
 UT Southwestern Medical Center, Dallas, TX, USA

National Collaborations

University of Cologne & Cologne Cluster of Excellence in Cellular Stress Responses in Aging-associated Diseases (CECAD)
 Max Planck Institute for Metabolism Research

Membership in local and regional Networks

Systems Biology of Ageing, Cologne (SyBACol)
 EndoProtect, Cologne-Bonn-Dortmund

Research Field	Genetics/Molecular Biology, Developmental Biology
Keywords	Ageing, Animal Models, Metabolomics, Systems Biology
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Department Larsson: Mitochondrial Biology

The group of Nils-Göran Larsson focuses on mitochondrial genetics and the impact of mitochondrial dysfunction on disease and ageing. Mitochondrial dysfunction is heavily implicated in the ageing process. Ageing humans have increased levels of somatic mutations in the mitochondrial genome that tend to undergo clonal expansion to cause mosaic deficiencies in the respiratory chain. The oxidative phosphorylation system produces adenosine triphosphate (ATP), the universal source of energy in all tissues. Respiratory chain dysfunction, and thus insufficient supply of ATP, can cause a variety of phenotypes associated with ageing, age-related and mitochondrial diseases. In the department of Nils-Göran Larsson, we use different model organisms to investigate the regulation of the mitochondrial genome and the accumulation of somatic mutations in mtDNA.

International Collaborations

Karolinska Institutet, Stockholm, Sweden
 University of Western Australia, Perth, Australia
 University of Gothenburg, Sweden
 University of Newcastle, UK

National Collaborations

MPI for Biophysical Chemistry, Göttingen
 University of Frankfurt

Membership in local and regional Networks

MPI for Metabolism Research, Cologne
 Lead Discovery Centre, Dortmund
 Cologne Cluster of Excellence in Cellular Stress Responses in Ageing-associated Diseases (CECAD)
 University of Cologne – SFB 829

Research Field	Genetics/Molecular Biology
Keywords	Ageing, Animal Models, DNA, Genomics, Neurodegenerative Diseases, Parkinson Disease
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Research Field	Genetics/Molecular Biology
Keywords	Ageing, Animal Models, Neurodegenerative Diseases, Nutrition, Signal Transduction
Head of Department	Prof. Linda Partridge
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Department Partridge: Biological Mechanisms of Ageing

Our aim is to discover evolutionarily conserved dietary, genetic and pharmacological interventions that can improve health and function during ageing. We investigate the mechanisms at work using an experimental approach that takes advantage of interplay between the fruit fly *Drosophila* and the mouse. It paves the way for development of a broad spectrum of preventative medicine for diseases associated with human ageing. Dietary restriction (DR) can extend healthy lifespan in diverse animal species. DR also improves aspects of human health, but most humans find the regime impossible to maintain. We are therefore investigating mechanisms mediating the health benefits of DR, to identify potential drug targets, by identifying nutrients that induce DR, the mechanisms by which they are sensed, the consequent changes in physiology,

and the mechanisms involved in long-term memory of diet.

International Collaborations

University College London, UK
University of Michigan, MI, USA
Babraham Institute, Cambridge, UK
University of Sydney, Australia

National Collaborations

CECAD & University of Cologne
Systems Biology of Ageing, Cologne
Max Planck Institute for Biochemistry, Martinsried
Max Planck Institute for Metabolism Research, Cologne
DZNE & caesar, Bonn

Membership in local and regional Networks

Cologne Cluster of Excellence in Cellular Stress Responses in Aging-associated Diseases (CECAD)



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Max Planck Institute for Metabolism Research

The balance between caloric intake and energy expenditure has to be maintained in a tight range to ensure metabolic homeostasis, health, and survival. A sophisticated neuronal network integrates information from the periphery of the organism about the energy availability and enables the body to adapt a wide range of behavioural responses to precisely control food intake, energy expenditure, and substrate flux across different peripheral organs. Even small deviations in this homeostatic regulatory network can result in either massive weight loss or weight gain, as well as associated metabolic disturbances. Worryingly, the incidence of increased body weight, i.e. obesity, has reached epidemic proportions with more than 30% of the population of industrialized countries being overtly obese and close to 10% developing obesity associated type 2 diabetes mellitus. Altered energy homeostasis and obesity not only represent a major risk factor for the development of type 2 diabetes mellitus, but also for cardiovascular disease, neurodegenerative disorders, and certain types of cancer.

The research goal of the MPI for Metabolism Research is to define the physiological regulatory principles in energy and glucose

homeostasis, the genetic and environmental factors that alter energy and glucose homeostasis in disease, and to ultimately identify novel therapeutic targets as a first step to developing new treatments for obesity and obesity-associated diseases.

Researchers of the Institute employ state-of-the-art methodologies and technologies to pursue translational research approaches ranging from studies on underlying molecular mechanisms in cells to defining regulatory mechanisms in model organisms. Hypotheses derived from these approaches are tested and validated through functional imaging in control human subjects and patients suffering from obesity and obesity-associated diseases.

The Institute is located in the heart of the medical and natural sciences campus of the University in Cologne. Our immediate neighbours are the natural science and medicine faculties of the University of Cologne, the Cologne Excellence Cluster on Cellular Stress Responses in Aging-Associated Diseases (CECAD), the Max Planck Institute for Biology of Ageing, as well as the Centre for Advanced Studies (CAESAR) in Bonn.



Max-Planck-Institut
für Stoffwechselforschung

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Number of employees	scientific 67 administrative 77, including technicians

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MAX-PLANCK-GESELLSCHAFT

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Founded (year)	2001
Number of employees	scientific 161 administrative 35
Funding	Max Planck Society 82% Other 18% Third-party funding

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Max Planck Institute for Molecular Biomedicine

The Max Planck Institute (MPI) for Molecular Biomedicine is devoted to basic science involving cell biology of the endothelium, developmental biology and cell-renewal, development of the vascular system, and structural biology. How can a complete human being develop from a single fertilized egg cell? How do the cells of an embryo “know” when and where they should form arteries, nerves or muscles? And: What tricks do immune cells use to migrate from the blood into the infected tissue – although the arteries are impermeable? In our various research teams, we are seeking answers to these and other questions about important life processes. Using gene technology, molecular biology, and electron and laser microscopy, the researchers are investigating how cells exchange information, which molecules regulate their behavior and which crosstalk errors between cells lead to diseases like cancer and multiple sclerosis.

The internationally staffed teams are subdivided into three departments and several research and project groups. As in all 80 institutes of the Max Planck Society, the MPI for Molecular Biomedicine is fully committed to educating and promoting the next generation of scientists. Together with the Westphalian

Wilhelms University in Münster the institute runs the joint CiM Graduate School of the “Cells in Motion” Cluster of Excellence and International Max Planck Research School for Molecular Biomedicine, allowing 16 talented German and foreign junior scientists each year to complete a well-structured doctoral studies program under excellent conditions. Promising junior scientists with a doctoral degree obtain an excellent opportunity to qualify for a further career at a high level as Max Planck Research Group leaders.

Life science is a core theme of research in Münster, with a strong emphasis on molecular medicine and optical imaging, and distinctly benefits from the vicinity and cooperations between the MPI for Molecular Biomedicine, the Technology Park Münster GmbH, the University Hospital and of course the University of Münster. Especially to the latter, the institute tightly connects at several scientific and organizational levels. All these conditions make a unique scientific framework for the internationally oriented MPI for Molecular Biomedicine, which enables the institute to pioneer in the modern, medically relevant research of organ system development, like that of the vascular system.

Department Cell and Developmental Biology

Pluripotency – the ability of a cell to become any type of body cell – is a key feature of embryonic stem cells. We aim to identify the molecular mechanisms that are involved in the establishment and maintenance of pluripotency in development. The conversion of somatic cells to pluripotent cells, also called reprogramming, is of great therapeutic interest in regenerative medicine. Unravelling the transcriptional network that is involved in the conversion process is therefore another focus of our department.

Induced pluripotent stem cells from patients with a genetically based degenerative disorder allow for a novel type of disease modeling and drug discovery: specialized cells with the genetic error can be used for in-vitro modeling of many types of disease afflicting humans. The ultimate goals of this research are to support detailed studies

into the underlying mechanisms of human pathophysiology and the development of new drugs that target specific phenotypes and novel pathways and that are more likely to be effective in the clinic.

International Collaborations

Institute of Science and Technology (UNIST), Korea
Konkuk University, Korea
Guangzhou Institutes of Biomedicine and Health (GIBH), China

National Collaborations

Hannover Medical School (MHH)
Dresden University of Technology (TU),
University Hospital Tübingen

Membership in local and regional Networks

REBIRTH and “Cells in Motion” Cluster of Excellence

Research Field	Developmental Biology
Keywords	Drug Discovery/Delivery, ESC, iPS, Regenerative Medicine, Stem Cell Research
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Department Tissue Morphogenesis

Tissue morphogenesis involves complex and interdependent processes such as the coordinated generation of different cell types and their assembly into functional structures. “How cells make tissues” is the central research interest in our department.

We mainly focus on the vertebrate vascular system, in which blood vessels need to integrate precisely into different organ environments and retain plasticity allowing them to adapt to changing local requirements and cues. Angiogenesis in the adult organism is critical for tissue repair and regeneration, but also plays important roles in pathological processes. Angiogenesis in cancer promotes tumor growth and metastasis. By understanding the cellular mechanisms and the molecular regulation of physiological and pathological angiogenesis, we can identify potential targets for future therapies.

We are combining genetic approaches in the mouse with high resolution imaging by confocal and multiphoton microscopy, time-lapse microscopy, cell biology, biochemistry and expression profiling.

International Collaborations

Nagoya University, Nagoya, Japan
Karolinska Institute, Stockholm, Sweden
School of Sciences, University Milan, Italy

National Collaborations

Institute for Molecular Biology, Hannover Medical School
Interfaculty Institute for Cell Biology, University of Tübingen

Membership in local and regional Networks

“Cells in Motion” Cluster of Excellence

Research Field	Genetics/Molecular Biology
Keywords	Angiogenesis, Cardiovascular Research, Microscopy, Signal Transduction, Tissue Morphogenesis
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Research Field	Cell Biology
Keywords	Animal Models, Antibody, Anti-infective Research, Cardiovascular Research, Signal Transduction
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Department Vascular Cell Biology

Research in our department is focused on various aspects of vascular cell biology. We concentrate mainly on the molecular mechanism of leukocyte extravasation as the basis for inflammatory reactions. In addition, we work on novel molecular mechanisms involved in the formation of the cardiovascular system.

A major goal of our studies is to reveal the mechanisms by which endothelial cell layers control leukocyte extravasation. After analyzing for many years the molecular components that control and mediate the docking of leukocytes to the endothelium, we focus now on the question how leukocytes actually move through the barrier of the blood vessel wall. Leukocyte-triggered opening of endothelial junctions is a key event during this process.

The regulation of endothelial junctions is also studied in our department in the context of other processes. Various pathological stim-

uli induce vascular permeability by destabilizing endothelial junctions and this is a major cause of death in sepsis patients. In addition, the formation and plasticity of endothelial junctions is an important aspect in blood vessel development. Adhesion and signaling mechanisms that modulate junctional integrity of endothelial cells in the context of these processes is a major focus of the lab.

International Collaborations

Karolinska Institute, Stockholm, Sweden
Yale University, New Haven, Connecticut, USA

University of California, San Diego, USA

National Collaborations

Ludwig Maximilians University München
Heinrich Heine University Düsseldorf

Membership in local and regional Networks

DFG SFB 1009, DFG SFB 629, DFG SFB/TR 128, "Cells in Motion" Cluster of Excellence





MAX-PLANCK-GESELLSCHAFT

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Founded (year)	1913

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Max Planck Institute of Molecular Physiology From Molecule to Man

The Max Planck Institute of Molecular Physiology in Dortmund conducts basic biomedical research in line with a scientific mission that aims to understand the molecular basis of cell physiology in living beings. The institute's scientists pursue interdisciplinary research approaches founded on a unique liaison between structural biology, molecular cell biology, and chemical biology. This liaison is exemplified in the institute's concept of bridging the physical scales in a range that starts with small bioactive molecules – the interest of chemists – and ends with the cell, the fundamental principle of biological organization – the interest of cell and systems biologists. In between these two extremes are the macromolecules, which self-organize to generate dynamic sub-cellular structures and reaction networks, which are the targets of the structural biologists. Thus the institute aims to building an integrative and creative description of cell function that combines reductionist and holistic views of biological networks and their dynamics. Ultimately, this approach to studying biological self-organization will likely shed light on the

perturbations occurring in devastating diseases such as cancer.

Department of Chemical Biology

Research in the Department of Chemical Biology is focused on the interface between organic chemistry and biology. We develop new synthesis methods and strategies and employ them for the synthesis of compounds which then are used as probes for the study of biological phenomena.

The synthesis and chemistry of proteins, in particular with a view to biological signaling and vesicular trafficking are one major area of activity of the Department.

The Department has intense activities in small molecule development for chemical biology research in particular based on natural products and compound collections derived therefrom. These activities include the establishment of screening capacity employing both isolated proteins and cell-based screens and the identification of cellular target proteins and the

development of new phenotype-based screening methods.

Membership in local and regional Networks

Bio.NRW2 consortium "NRW Drug Discovery Engine (DDE) based on natural products screening data"

Research Field	Chemical Biology
Keywords	Cancer, Drug Discovery/Delivery, Lead Discovery, Molecular Library, Oncology
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Department of Mechanistic Cell Biology

The mechanisms subtending to the replication of chromosomes in the mother cell and their subsequent segregation to the daughter cells remain poorly understood. We are interested in the feedback control mechanisms that allow a mother cell to distribute its chromosomes seamlessly to its two daughters. Such feedback mechanisms operate on complex molecular structures named kinetochores, large assemblies containing over 100 different proteins, each in multiple copies.

The kinetochore's main role is to form stable contacts with microtubules, cellular cables that are used to align and transport the chromosomes to the daughter cells. The kinetochore is also able to monitor the quality of the contacts, halting cells in mitosis until proper contacts are established. Deviations from the typical number of

chromosomes is one of the main features of human tumors. Our investigations, which are based on a combination of structural, chemical and cell biology, aim to unveil the mechanisms that insure genetic stability and their perturbations in tumors.

International Collaborations

University of North Carolina at Chapel Hill, USA

University of California at Berkeley, USA

University of Manchester, UK

National Collaborations

University of Konstanz

Max Planck Institute of Molecular Cell Biology and Genetics, Dresden

Research Field	Biochemistry
Keywords	Cancer, Small Molecules, Structural Biology, Systems Biology, Synthetic Biology
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Research Field	Biochemistry
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Department of Structural Biochemistry

The primary aim of the Department of Structural Biochemistry is to understand biological processes in molecular detail. In particular, we intend to reveal the molecular mechanisms of muscle contraction, bacterial infection and cellular cholesterol homeostasis. We want to understand how malfunction of these processes results in human diseases, such as cardiomyopathies, arteriosclerosis and infectious diseases. Ultimately, we aim at providing a strong foundation for the targeted development of drugs.

Our studies involve heterologous expression of soluble and transmembrane protein complexes, their biochemical reconstitution and biophysical, biochemical and structural analysis. The department's main area of expertise is in high-resolution electron cryo microscopy (cryo-EM), but

we also successfully use X-ray crystallography to determine the structure of macromolecular protein complexes.

International Collaborations

ETH Zurich, Switzerland
University of Texas Houston, USA
Umeå Universitet, Sweden

National Collaborations

University of Osnabrück
MHH Hannover

Research Field	Cell Biology/Physiology
Keywords	Microscopy, Oncology, Signal Transduction, Systems Biology
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Department of Systemic Cell Biology

Our main objective is to elucidate how intracellular signaling networks process extracellular information thereby determining cellular phenotype.

We develop quantitative experimental and theoretical approaches to derive and conceptualize physical principles that underlie the signaling dynamics and cellular organization and use functional microscopic imaging approaches to study the localization of protein reactions.

We investigate the spatial distribution of activities that transmit signals from cell surface receptors and ask how spatial partitioning of intracellular signaling activities is achieved, and how this partitioning affects signal strength and duration. We also investigate if specific logical topologies within reaction networks occur and how these give rise to specific responses to input

signals. This also entails a strong recursion between modeling of network dynamics and experiments that reveal dynamic properties of networks in living cells.

International Collaborations

University College Dublin, Ireland
New York University, School of Medicine, NY, USA
MRC Laboratory of Molecular Biology, Cambridge, UK

National Collaborations

Fraunhofer Institute for Biomedical Engineering, St. Ingbert
Universitätsklinikum Düsseldorf
University of Bochum

Membership in local and regional Networks

Bioband Dortmund



Max Planck Institute for Plant Breeding Research

The Max Planck Institute for Plant Breeding Research conducts basic molecular biological research on plants with the goal of developing more efficient breeding techniques and environmentally sound plant protection strategies for agricultural crops. We wish to determine whether and how a detailed understanding of molecular mechanisms defined in model plant species can be used to rationally manipulate selected traits in crop plants.

The primary scientific goal of the **Department of Plant Developmental Biology** is to study molecular mechanisms that regulate the responsiveness of plant development to environmental cues. In particular, a strong emphasis is placed on understanding the mechanisms controlling the transition to flowering in response to environmental signals and in explaining the diversity in flowering responses observed between species. Related programmes study sugar signaling pathways, temporal control of gene expression by the circadian clock and effects of protein modification by ubiquitin or ubiquitin-like proteins.

Research in the **Department of Plant Microbe Interactions** concentrates on fun-

damental molecular processes underlying interactions between plants and pathogens. The innate immune system of plants and mechanisms of microbial pathogenesis have a central role in the discovery programme. The establishment of plant-associated microbial communities with healthy plants, called the plant microbiota, defines a second major research theme. Researchers are pursuing an integrated approach that connects traditionally separate research territories like genetics, molecular biology, biochemistry, and cell biology.

The **Department of Comparative Development and Genetics** seeks to address two fundamental questions in biology: how do biological forms develop and what is the basis for their diversity? To address these questions we first aim to elucidate how genotypes are translated into organismal forms through the process of morphogenesis. Secondly, we seek to conceptualize how the balance of conservation versus divergence in morphogenetic regulatory networks yields different organismal forms during evolution. We approach these problems using genetics, while also employing biological imaging, genomics and computational modelling.



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Number of employees	scientific 220 administrative 160
Funding	Federal Government Germany 41% State Government NRW 40% others (DFG, EU) 19%

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caesar



center of advanced
european studies
and research



caesar – an Institute of the Max Planck Society

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Founded (year)	1995
Number of employees	scientific 167 infrastructure 20 administrative 7
Funding	Federal Government (Germany) 92% State Government NRW 8%

www.caesar.de

Caesar is a Neuroscience research institute of the Max Planck Society (Max-Planck-Gesellschaft; MPG). Caesar's research is interdisciplinary with scientists from various research areas working together on the topics of cellular signal processing and the neural foundations of behavior. To unravel submolecular structures as well as to understand the neural underpinnings of sensory based behavior, the scientists use a broad set of techniques ranging from cryo-TEM, holographic microscopy, and optogenetics to development of miniaturized multiphoton microscopes and computational approaches for measuring activity in the freely behaving mammal. Caesar directors are Scientific Members of the MPG and scientifically caesar adheres to the principles and structure set forth by the MPG. Conceptually research at caesar is concerned with understanding the neural mechanisms underlying behavior. This ranges from studying the behaving single celled organism to studying one of the core questions of mammalian neurobiology: how do patterns of neuronal activity give rise to complex but coherent and goal-directed behavior? As of 2016, caesar hosts two departments: the Department of Behavior and Brain Organization (Jason Kerr)

and the Department of Molecular Sensory Systems (U. Benjamin Kaupp). In addition, six research groups have been established: the Max Planck Fellow Group Chemical Biology (Michael Famulok), the Max Planck Research Groups Neural Systems Analysis (Jakob Macke), Neuroimmunology (Annett Halle), Molecular Physiology (Dagmar Wachten), and Neural Circuits (Johannes Seelig), as well as the FreiGeist Research Group Dynamics of Proteins (Elmar Behrmann). Caesar is part of a cluster for neurosciences in the Bonn-Cologne region and has multiple ties with the University of Bonn. Caesar is involved in several collaborative research centers (Sonderforschungsbereiche) and in the Excellence Cluster "ImmunoSensation". In collaboration with the Max Planck Florida Institute for Neuroscience (MPFI), the University of Bonn and Florida Atlantic University, caesar established an International Max Planck Research School Graduate Program (IMPRS) based on Brain and Behavior. This first transatlantic IMPRS aims to train students in a large range of cutting-edge techniques which are currently instrumental in the quest for understanding brain circuit function in the whole animal and its role in defining behavior.

Department of Behavior and Brain Organization

The primary aim of the department BBO is to understand how mammals use vision to make decisions and what the underlying neural processes are. BBO combines imaging, computation, behavioral analysis, electrophysiological recordings, and anatomical mapping to explore the connection between behavior and neuronal activity. The research can be divided into two broad regions. The first develops tools and techniques for recording and analyzing neuronal activity, with single-cell and single action-potential resolution, from large populations of cortical neurons in awake and freely moving mammals. The second is focused on understanding the neuronal mechanisms underlying vision-based decision making in freely moving mammals. This involves the development of special multiphoton microscopes and of optics-based head and eye-tracking

techniques. The overall aim of this approach is to generate a thorough understanding of mammalian vision and the organization of the circuits that underlie it.

International Collaborations

Max Planck Florida Institute for Neuroscience, Jupiter, USA
 Howard Hughes Medical Institute, Janelia Research Campus, USA
 OIST, Japan

National Collaborations

Max Planck Institute for Brain Research, Frankfurt
 Max Planck Institute for Biological Cybernetics, Tübingen, University of Bonn

Membership in local and regional Networks

IMPRS for Brain and Behavior
 Society for Neuroscience
 Nationales Bernstein Netzwerk
 Computational Neuroscience

Research Field	Biophysics, Behavior Research, Neurobiology
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Department of Molecular Sensory Systems

The Department of Molecular Sensory Systems studies the mechanisms of cellular signaling. The Department wants to understand how a stimulus is detected by a cell and converted to a cellular response. A long-term goal is to unravel in quantitative terms, selected signaling pathways in photoreceptors, olfactory neurons, and sperm.

A unique feature of the Department is the ability to study signaling mechanisms at all levels – from single molecules to the behavioral response. For example, the Department studies the structure of membrane receptors and ion channels that furnish cAMP- and cGMP-regulated pathways – at the molecular or even atomic level. At the same time, a major research area has become sperm motility.

To support these various projects, the Department acquired a panoply of bio-

physical techniques, including various imaging techniques, patch-clamp techniques, electron microscopy and tomography, and ultra-fast hyper-quenching techniques for timeresolved double-electron-electron resonance (DEER) – to name a few. Another emphasis is on the development of various chemical tools, including fluorescent ligands, caged compounds, and novel photo-affinity labels.

International Collaborations

Jules Stein Eye Institute, UCLA, USA
 University Utrecht, The Netherlands
 Harvard Medical School

National Collaborations

University of Bonn; German Center for Neurodegenerative Diseases, Bonn
 MPI for Biophysical Chemistry, Göttingen

Research Field	Molecular Sensory Systems, Biophysics
Keywords	Cellular Signaling, Development of Chemical Tools, Membrane Receptors and Ion Channels, Sperm Motility
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Research Field	Biophysics
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Freigeist Group: Structural Dynamics of Proteins

Proteins are by no means rigid objects, but dynamic - just like life itself. However, structural knowledge of proteins is largely limited to static snapshots. The Structural Dynamics of Proteins group headed by the Freigeist Fellow Elmar Behrmann uses electron microscopy (EM) to visualize proteins in native-like environments, trying to capture their dynamics. The group is advancing two methods of sample preparation, namely timed-vitrification and in situ-EM, both allowing complementary insights into the conformational space sampled by a protein. This is supplemented by sophisticated reconstruction techniques enabling the researchers to decipher conformational changes using computational approaches.

By applying these methods the group is investigating how proteins interact with

lipid membranes, and how this affects both the shape of the membrane as well as that of the protein. Another emphasis is on determining how membrane proteins transmit information across a lipid membrane, which allows cells to react to external queues.

International Collaborations

University of Texas Medical School, USA
Umeå University, Sweden

National Collaborations

Institute for Experimental Virology, Universität Tübingen
Department of Chemical Biology, University Bonn/Limes

Membership in local and regional Networks

Young ZiF, BFB

Research Field	Neuroimmunology
Keywords	Alzheimer's Disease, Immune Modulation
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Max Planck Research Group: Neuroimmunology

The Max Planck Research Group Neuroimmunology has been jointly appointed by a committee of Boehringer Ingelheim, the Max Planck Society, and caesar.

Microglia are the resident immune cells in the brain and mediate the primary inflammatory response to potentially harmful microbiological and foreign agents. The scientific focus of the group is to understand how microglial cells react to aggregated substances such as β -amyloid ($A\beta$). $A\beta$, a cleaved peptide especially prone to form fibrillar aggregates, is found in senile plaques in brains of patients with Alzheimer's disease (AD).

The Research Group is interested in the question whether and how the microglia-mediated immune reaction to $A\beta$ contributes to the progression of Alzheimer's disease.

To study these mechanisms, the scientists use cell culture systems, acute brain slices and transgenic mouse models of Alzheimer's disease.

The identification of mechanisms responsible for the interaction between $A\beta$ plaques and microglia may lead to new options in the treatment of Alzheimer's disease.

International Collaborations

University of Massachusetts Medical School, Worcester, USA

National Collaborations

University of Bonn
Charité – Universitätsmedizin Berlin
Max-Delbrück-Zentrum für Molekulare Medizin, Berlin

Max Planck Research Group: Neural Systems Analysis

The Max Planck Research Group “Neural Systems Analysis” lead by Jakob Macke develops machine learning algorithms and statistical methods for analyzing high-dimensional neural and behavioural data. The group uses these tools in to understand how populations of neurons collectivity process sensory input, perform computations and control behavior.

Modern experimental techniques allow unprecedented insights into the structure and function of neural circuits. These advances open the possibility of studying neural activity and connectivity in large populations of neurons, and of using these insights in clinical applications such as neural prosthetics. Understanding the complex, high-dimensional data generated by modern experimental techniques experiments is a challenging task that

requires powerful statistical methods. Using techniques from machine learning and Bayesian statistics, we develop analysis techniques which are adapted to the specific characteristics of biological and behavioural measurements.

International Collaborations

HHMI Janelia Research Campus, Ashburn, USA
University College London, UK

National Collaborations

Max Planck Institutes
University of Tübingen
University of Bonn

Membership in local and regional Networks

Bernstein Network for Computational Neuroscience
Smart Start - Joint Training Program in Computational Neuroscience

Research Field	Bioinformatics, Machine Learning and Computational Neuroscience
Keywords	Analytcs, Neurodegenerative Diseases, Analysis of Biological Data, Machine Learning, Computational Neuroscience
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Minerva Max Planck Research Group: Molecular Physiology

In my group, we analyze ciliary signaling to understand the physiological function of cilia and flagella. Here, we use an array of biochemical, cell biological, genetic, fluorescent, and optical techniques to study signaling pathways. Our model system is the mouse.

Cilia are subcellular compartments that protrude from the surface of almost every mammalian cell. Cilia can be grouped into primary cilia, which are immotile and motile cilia, also called flagella. We investigate ciliary signaling using optogenetics in combination with genetically-encoded biosensors.

Furthermore, we are analyzing the molecular mechanisms how sperm flagella form, in particular, which role glycosphingolipids play during sperm development.

Last but not least, we are investigating the molecular mechanisms underlying the separation of the heart into four chambers –

a process that relies on primary cilia function. We have identified Creld1 (Cysteine-rich with EGF-like domains 1) as a new key player that regulates the formation of atrioventricular septa and, thereby, the development of a four-chambered heart.

International Collaborations

Max Nachury, Stanford University, USA
Kent Hill, UCLA, USA

National Collaborations

Humboldt University Berlin
University of Münster
DZNE, Bonn

Membership in local and regional Networks

Bonner Forum für Biomedizin
Bonn Excellence Cluster
“ImmunoSensation”

Research Field	Cell Biology, Physiology, Biophysical Imaging
Keywords	Animal Models, Cardiovascular Research, Microscopy, Pathology, Signal Transduction, Optogenetics
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Research Field	Electron Microscopy and Analytics
Keywords	Analytics, Microscopy, Tomography
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Scientific Facility: Electron Microscopy and Analytics

The Group Electron Microscopy and Analytics (EMA) runs caesar's electron microscopy facility. The scientists work on high-resolution and analytical electron microscopy in the areas of biomolecular structure, spectroscopy, and nanostructuring.

In biology, analysis of 3-dimensional structure of cell organelles and macro molecules is of particular interest. To closely meet *in vivo* conditions, biological specimen are frozen by a special process and sliced into ultrathin sections. In order to avoid artifacts, EMA is developing a new method to prepare such samples without distortions.

Biological samples are virtually transparent in a transmission electron microscope. EMA is developing a special optical component, a so-called phase contrast

analysis of biological material at high resolution.

EMA makes its equipment available to external users from research and Industry. EMA assists the users in solving their analytical problems.

National Collaborations

University of Bonn
University of Koblenz
University of Heidelberg

Membership in local and regional Networks

Deutsche Gesellschaft für
Elektronenmikroskopie
Arbeitskreis EELS & EFTEM





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Other Research Institutions

Other Research Institutions and Clusters of Excellence

In addition to the universities, the universities of applied science and the scientific organisations mentioned before, there are further research institutions and several clusters of excellence active in the field of life science. As a whole, this network of institutions emphasises the outstanding NRW academic environment. The **Bioeconomy Science Center (BioSC)** was founded in 2010 by the RWTH Aachen University, the Universities of Bonn and Düsseldorf and the Jülich Research Centre. It is based on a joint strategy involving numerous pre-existing scientific networks and collaborations for a sustainable supply of biomass and bio-based products or processes focusing on four key research areas: sustainable plant production, microbial/molecular transformation, process engineering of renewable resources as well as economic and social implications.

The **West German Cancer Center (WTZ)**, founded in 1977 as a registered association, originally started in 1967 as the “Essen Tumour Hospital”. It was the first cooperative institution exclusively dealing with diagnostics and therapy of tumour patients. In 2009, the WTZ was awarded the title “Oncology Center of Excellence” by the non-profit-organisation Deutsche Krebshilfe e. V. (German Cancer Aid), which is comparable to the American Comprehensive Cancer Centers. One and a half years later, the WTZ became part of the “German Consortium of Translational Cancer Research” and belongs to a network of 13 “Top Oncology Centres” by now. Today, more than 650 physicians and medical scientists coming from different clinics and institutions are working at the WTZ.

In a similar integrated approach the **Center of Integrated Oncology (CIO Cologne-Bonn)** started as a virtual center in 2007 and is currently being transformed into a new university hospital oncology center at the Cologne campus – an investment of € 80 M. The CIO is embedded in an extraordinary rich life science landscape with the Universities of Cologne and Bonn, the **Center for Molecular Medicine (ZMMK)**, the **Cologne Center for Genomics (CCG)**, the excellence cluster **Cellular Stress Responses in Aging-Associated Diseases (CECAD)** the two Max-Planck-Institutes for “Biology of Ageing” and “Metabolism Research” and the “Life and Medical Science Institute” all around the corner.

The **Protein Research Unit Ruhr within Europe (PURE)**, see Page 55) launched in 2010 serves as a platform for protein researchers and clinical researchers from Bochum’s Ruhr-University as well as Duisburg-Essen’s University to pool their resources in the search of biomarkers for the early detection of diseases such as cancer, Parkinson, Multiple Sclerosis or Alzheimer’s. Currently, an investment of € 48 M supports PURE by the construction of “ProDi” – a new center for molecular protein diagnostic.

Clusters of Excellence are part of the Excellence Initiative of the German Federal Ministry of Education and Research and the German Research Foundation. The Excellence Initiative provides funding for graduate schools, Clusters of Excellence and institutional strategies. In June 2012, the Grants Committee decided to support 45 graduate schools, 43 Clusters

of Excellence and 11 institutional strategies in the second phase from 2012 until 2017.

In total, 39 universities received € 2.4 billion. Each Cluster of Excellence receives between € 3.6 and € 9.6 M per year. Clusters of Excellence aim to promote cutting-edge research and to create outstanding training and career conditions for young scientists at universities. They intend to deepen cooperation between disciplines, institutions and the business sector to enhance the international appeal of excellent German universities. Ten out of 43 cluster projects all over Germany are located in North Rhine-Westphalia and half of these clusters are clearly associated with biotechnology and life sciences:

- Cellular Stress Responses in Aging-associated Diseases (CECAD), Köln
- Cells in Motion (CiM), Münster
- ImmunoSensation, Bonn
- Cluster of Excellence on Plant Sciences (CEPLAS), Düsseldorf and Cologne
- Tailor-Made Fuels from Biomass (TMFB), Aachen



Bioeconomy Science Center – BioSC

Competence, Knowledge and Technology for a Sustainable Bioeconomy

Name	Bioeconomy Science Center – BioSC
Address	BioSC Office c/o Forschungszentrum Jülich/IBG-2
Postal Code/City	52425 Jülich
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E-Mail	h.slusarczyk@fz- juelich.de
Internet	www.biosc.de
Founded (year)	2010
Number of employees	1,500

www.biosc.de

The generation and integration of knowledge about biological systems for the sustainable production of biomass and bio-based raw materials and its use for food, feed, bio-based materials and energy is an essential and emerging field of research and development within the development of the bioeconomy. Based on broad and excellent competencies in bioeconomy related research fields, the RWTH Aachen University, the University of Bonn, the Heinrich Heine University Dueseldorf and the Forschungszentrum Juelich have established the so-called Bioeconomy Science Center (BioSC).

The aim of the BioSC as a competence center for research for a sustainable bioeconomy is to synergistically align existing scientific expertise and infrastructures of the partners in the fields of biotechnology, bio- and chemical science, plant and agro science, engineering science, and socio-economics along a common strategy in order to develop innovative concepts in the research fields as well in their interaction. The scientific and technological expertise in BioSC ranges from the sustainable production of plants

for food/feed and as renewable feedstock, its molecular and microbial transformation to bio-based products (i.e. fine chemicals, biopolymers, pharmaceuticals, enzymes, proteins, biofuels, bioenergy) in innovative processes (i.e. biorefinery concepts, cascade use) under consideration of the economic impact and social implication for and of the bioeconomy. BioSC encompasses more than 1,500 staff members working at 51 member institutes of the BioSC. A multi- and interdisciplinary education within different topics and disciplines of a sustainable bioeconomy is another aim of the BioSC.

The BioSC is also designed as a regional hub for national and international scientific cooperation with e.g. European technology platforms and network projects with industry. It is intended to expand the bioeconomy network of the BioSC by further national as well as international cooperation with academia and industry.



West German Cancer Center – WTZ

Medical excellence with a human touch

As Germany's first and one of Germany's largest comprehensive cancer center, the WTZ is based on the visionary concepts of C. G. Schmidt and E. Scherer, who strove to integrate Medical and Radiation Oncology, creating interdisciplinary facilities in the "Essen Tumor Hospital" as early as 1967. This was further developed into a "comprehensive" cancer center by establishing the Dept. of Cell Biology (Cancer Research) led by M. F. Rajewsky in 1975. A dedicated bone marrow transplantation (BMT) program was established by U. Schäfer in 1975, which quickly evolved into the top European BMT center and one of the largest BMT centers worldwide. The WTZ was formally founded in 1977, and had strong impact as a model for other cancer centers in Germany. In 1995, the Medical Faculty of the University of Essen and the University Hospital (UH Essen) focused their research on three areas of specialization: Oncology, Transplantation and Cardiovascular Medicine. These efforts were acknowledged by the designation as an "Oncology Center of Excellence" of the German Cancer Aid (Deutsche Krebshilfe) in 2009, which was renewed in 2013. In 2010, the WTZ was selected as one of 7 university partner sites to form the German Cancer Consortium (DKTK), which was estab-

lished as a long-term investment of the Federal and State Governments to foster translational cancer research to the benefit of the patients.

The WTZ is devoted to the multidisciplinary care of more than 30,000 patients per year and closely connected with research and education in cancer. Early detection, precise diagnosis, individually tailored treatment, participation in clinical studies and concern for the patient's needs are the hallmarks of care provided at the WTZ. The Center's mission – the progressive understanding, control and cure of cancer – as well as its continued efforts to develop innovative cancer therapies place it at the forefront of scientific research.

Integrated cancer care requires an integrated infrastructure, for which the WTZ receives major support from the UH Essen and Medical Faculty. The interdisciplinary WTZ Outpatient Facility is the central entry port for all cancer patients since its opening in 2008, concentrating clinical core activities in one building. A new WTZ Inpatient Building and a renovated central WTZ Research Building harboring research laboratories opened in 2012. As a flagship for innovative radiation technologies, a Proton Therapy Center was added to the WTZ, and is accepting patients since 2013.



Name	West German Cancer Center – WTZ – University Hospital Essen
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Contact Person	Univ. Prof. Dr. med. Dirk Schadendorf
Fon	+49 201 723-1614
E-Mail	dirk.schadendorf@uk-essen.de
Internet	www.wtz-essen.de
Founded (year)	1967 (Essen Tumor Hospital)
Number of employees	University Hospital Essen: 660 (Physicians, approx. value) 4,340 (Other professions approx. value)
Funding	State Government NRW 50% Federal Government (Germany) 20% Other 30% (Deutsche Krebshilfe Program "Oncology Centers of Excellence", NRW, other Peer reviewed funding org.)

www.wtz-essen.de



West German Heart and Vascular Center – WHGZ

Name	West German Heart and Vascular Center University Duisburg-Essen
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Contact Person	Prof. Dr.med. Dr.h.c. Gerd Heusch
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E-Mail	gerd.heusch@uk-essen.de
Internet	www.whgz.de
Founded (year)	2014
Number of employees	scientific 167 administrative 77
Funding	State Government NRW 80% Federal Government (Germany) 10% Other 10% Leducq, Deichmann, Fischer Foundations, Else Kröner Fresenius Foundation, MARS Symbioscience Foundation

www.whgz.de

The West German Heart and Vascular Center (WHGZ) was founded in 2014 and has evolved from the former West German Heart Center. The WHGZ comprises all clinics and institutes of the University of Essen Medical School which are involved in cardiovascular patient care and cardiovascular research (Clinics of Angiology, Cardiology, Neurology, Pediatric Cardiology, Thoracic and Cardiovascular Surgery, Vascular Surgery, Institutes of Molecular Cardiology, Pathophysiology, Pharmacology) as well as the associated chair on Mechanisms of Cardiovascular Disease at the ISAS Leibniz Institute Dortmund and the Herzzentrum Huttrop. The main purpose of the WHGZ is to provide the best possible patient care and to translate innovations as quickly as possible to patients' benefit. Research at the WHGZ is supported by the German Research Foundation and several other funding agencies. Research focusses on myocardial ischemia and reperfusion injury, arrhythmias, heart failure, stroke and protective interventions. In patients with structural heart diseases, interventional strategies to treat valve and congenital heart diseases are developed and evaluated. Aging, including subclinical atherosclerosis and aortic diseases, but also atrial fibrillation is a clinical

focus and research topic. Heart failure as the terminal state of most cardiac diseases is a focus of both basic research and clinical care, including biotechnical support and ultimately transplantation.

At the WHGZ, researchers benefit from an excellent infrastructure, combining mechanistic basic research, interdisciplinary core facilities and an active university clinic, which offers maximum medical care for its patients. Close communication between research and clinical facilities enhances the interaction of scientists in all fields of the WHGZ, thus facilitating translational projects. Training of young scientists and continuous education are a key mission of the WHGZ, which is reflected by the high number of evolving highly productive working groups. By its interactive basic science and clinical research, the WHGZ will break new ground in cardiovascular medicine and improve patient care.



Cellular Stress Responses in Aging-associated Diseases (CECAD)

Excellent in Aging Research

In the past years CECAD has been established as a center of the growing scientific community addressing the research of aging and aging associated diseases. Together with the two Max Planck Institutes (Biology of Ageing and Metabolism Research) and the DZNE an important progress in scientific output and visibility of this rather new research field has been achieved. The aim of CECAD is to understand the basic concepts of aging processes to develop strategies how people can get old staying healthy and vital. The fundamental research of the aging process and diseases has a great social impact on a society of an increasing number of elderly people.

The interdisciplinarity will facilitate communication processes between researchers and reveal cross-over points from basic research into clinical applications. Translational medicine provides the connection between basic research (bench) and clinical applications (bedside) and accelerates the transfer of knowledge. Demographic changes will continue and speed up. Because of that research into the aging process and associated diseases is of high relevance. The goal of CECAD is “not

to only add more years to our lives, but also more life to our years”. This implies to ensure a greater quality of life during those last years. Thus, the research of the Cologne Cluster of Excellence in Cellular Stress Responses in Aging-associated Diseases embraces both natural scientific and societal aspects.

CECAD is supported equally by the Medical Faculty and the Faculty of Mathematics and Natural Sciences and offers the opportunity to be in the lead of aging research in the future. Some facts:

- Funded by the DFG as part of the federal and state Excellence Initiative since November 1, 2007, the second five-year funding period began in November 2012
- 50 Principal investigators (2011: 32, Pls 2016: 53 Pls)
- May 2013: new CECAD Research Center opened
- Central office for scientific administration
- Three central platforms to support research:
 - Technology Platform with five facilities
 - Translational Platform
 - Platform for Career Development & Gender Equality



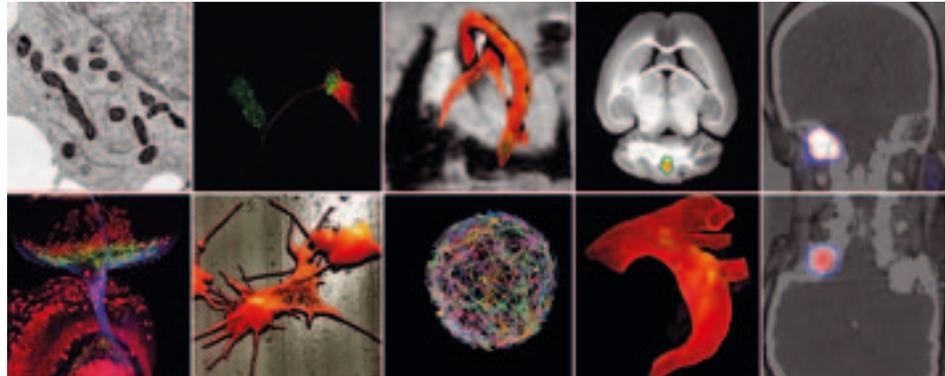
Name	Cellular Stress Responses in Aging-associated Diseases (CECAD)
Applicant	Josef-Stelzmann-Str. 26
Postal Code/City	50931 Köln
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E-Mail	bruening@sf.mpg.de
Internet	www.cecad.uni-koeln.de
Funding	2007

www.cecad.uni-koeln.de



CELLS IN MOTION

Cluster of Excellence



Cells in Motion (CiM)

Imaging to understand cellular behaviour in organisms

Name	Cells in Motion (CiM) Cluster of Excellence EXC 1003
Applicant	Westfälische Wilhelms-Universität Münster Schlossplatz 2 48149 Münster
Postal Code/City	48149 Münster
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Fon	+49 251 83-49311
E-Mail Internet	cim@uni-muenster.de www.cells-in-motion.com
Funding Period	I. 11.2012 – 10.2017

www.cells-in-motion.com

The Cells-in-Motion Cluster of Excellence (CiM) is a joint undertaking of the Westfälische Wilhelms-Universität Münster and the Max Planck Institute for Molecular Biomedicine. CiM's aim is to understand the dynamic behaviour of a defined set of cells or cellular processes that are relevant for the development, homeostasis and pathologies of the vascular and nervous systems using imaging as the common and bridging strategy. This ambitious project is driven by a large interdisciplinary consortium of more than 90 scientists with broad expertise in medicine, biology, chemistry, pharmacology, physics, mathematics and computer sciences.

Optical live imaging strategies have revolutionized the perception of cellular behaviour and have emphasized their dynamic nature. However, current analyses of cellular behaviour are often one-dimensional, and imaging-based approaches are limited to a single temporo-spatial event. High resolution optical imaging offers nanometre resolution but has intrinsic limitations in whole organs, mice and patients, and requires staining or genetic manipulation

for the identification of cells or molecular processes. On the other hand molecular whole-body technologies permit high sensitivity dynamic imaging but have low spatial resolution. No single imaging modality can effectively combine the features of sensitivity, specificity, temporal and spatial resolution and ultimately quantification.

CiM promotes a combination of microscopic and whole-body techniques that has not been systematically attempted before. The cluster encourages interdisciplinary collaboration and has set up a new interfaculty educational structure that promotes diversity and includes a novel Master in 'Experimental Medicine' allowing medical students to enter into a structured PhD programme. This will endorse the translation of basic science into the clinic.

Participating institutions:

- Westfälische Wilhelms-Universität Münster
- Max Planck Institute for Molecular Biomedicine



Cluster of Excellence on Plant Sciences CEPLAS

From complex traits towards synthetic modules – a second green revolution

Plants are the basis of all human life; they provide food and feed, medicine and drugs, and raw materials for clothing, housing and energy production. Due to global change, the role of crop plants as the foundation of human civilisation becomes threatened. CEPLAS – Cluster of Excellence on Plant Sciences – is pursuing innovative strategies for a sustainable plant production. Our goal is to improve crop productivity while minimising resource requirements. Therefore, a fundamental understanding of how plant species adapt to environmental conditions and constraints is needed.

With our research programme we aim to understand the mechanistic basis of the following complex plant traits using an evolutionary approach combined with modern genomic technologies:

- Annual and perennial life histories
- C_4 photosynthesis
- Plant-microbe interaction
- Metabolic interaction

This knowledge will be used to facilitate engineering of these traits in heterologous species. By engineering new generations

of crop plants harbouring these complex traits, we seek to increase crop yield but not at the expense of an increased use of water, nutrients and soil resources or of disease resistance.

CEPLAS focuses on cutting edge science as well as on the promotion of young scientists by novel study modules and individual training programmes.

Participating institutions:

- Max Planck Institute for Plant Breeding Research
- Forschungszentrum Jülich GmbH (IBG-2)



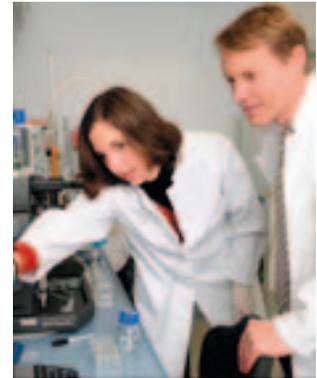
CEPLAS

Name	Cluster of Excellence on Plant Sciences (CEPLAS) - EXC 1028
Applicant	Heinrich-Heine-Universität Düsseldorf Universitätsstrasse 1 Universität zu Köln Albert-Magnus-Platz 1
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Fon	+49 211 81-12347
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Internet	www.ceplas.eu
Funding Period	I. 11.2012 – 10.2017

www.ceplas.eu



ImmunoSensation
the immune sensory system Bonn cluster of excellence



Name	ImmunoSensation Cluster of Excellence - EXC 1023
Applicant	Rheinische Friedrich- Wilhelms-Universität Bonn Regina-Pacis-Weg 3 53175 Bonn
Postal Code/City	53175 Bonn
Contact Person	Speaker: Prof. Dr. Gunther Hartmann Cluster Manager: Dr. Catherine Gottschalk Cluster Coordination Office ImmunoSensation Cluster of Excellence Sigmund-Freud-Str. 25 53127 Bonn Fon +49 228-28751288 E-Mail immunosensation@ uni-bonn.de Internet Funding Period I. 11.2012 – 10.2017

www.immunosensation.de

ImmunoSensation The Immune Sensory System

The ImmunoSensation Cluster of Excellence is a joint collaborative project of the Medical Faculty and the Faculty of Mathematics and Life Sciences of the University of Bonn, the Max-Planck associated Institute caesar (center of advanced european studies and research) and the DZNE (German Center for Neurodegenerative Diseases) of the Helmholtz-Society. The discipline of innate immunity is one of the most dynamic fields in life sciences. Immune sensing receptors represent the core of innate immunity. These receptors detect foreign microbial molecules or altered self-molecules from tissue damage. The activation of immune sensing receptors initiates defense and repair mechanisms that normally protect the host. Dysregulation of these responses can cause a range of inflammatory and life-style associated diseases like atherosclerosis, metabolic syndrome and diabetes, neurodegeneration, autoimmune diseases and cancer. With the recent discoveries that particular immune sensing receptors are present in most somatic cells and that the metabolic state and neuronal inputs are tightly integrated, innate immunity has developed beyond the boundaries of classical immunology. This has led the ImmunoSensation Cluster of Excellence to

the concept of the immune sensory system, linking the research fields of innate immunity, sensory systems, neurobiology and mathematics. To promote young researchers, the International Immunology Training Program Bonn (IITB) was established. The IITB offers first-class training in biological and medical sciences in a structured 3-years PhD program. With the recruitment of excellent scientists and the establishment of cross-institutional technological platforms, the ImmunoSensation Cluster of Excellence contributes to a better understanding of immune sensing receptors, their ligands, their regulation by the local and systemic environments, the integration of sensory input and its consequences for inflammation *in vivo*.

Participating institutions:

- Medical Faculty, University of Bonn
- Faculty of Mathematics and Life Sciences, University of Bonn (Life and Medical Sciences Institute, Institute for Applied Mathematics)
- German Center for Neurodegenerative Diseases (DZNE)
- center of advanced european studies and research (caesar)



Tailor-Made Fuels from Biomass (TMFB)

Biofuel for the future

Achieving independence from fossil energy resources is one of the major challenges for society in the future. The Cluster of Excellence Tailor-Made Fuels from Biomass (TMFB) aims to develop fuels on the basis of renewable raw materials in which all of the plant can be converted into tailor-made fuel components. Furthermore, these new fuels will not compete with the food production process. Aside from the research topic on new synthetic fuels and fuel components, the cluster is focused on efficient low-temperature combustion engines and low pollutant emissions. The overall aim is paving the way to the third generation of biomass based fuels.

To cover and connect all the fields of research and interactions an interdisciplinary science structure was set up. The “Core Interaction Field” (CIF) “Fuel Design” is linked to the two major “Integrated Research Fields” (IRF): IRF-A, “From Biomass to Biofuels”, deals with molecular transformation and targets the conversion of biogenous substrates derived from renewable feedstocks. Moreover, it covers reaction and process engineering for biorenewables and addresses the key issues in transition of biorenewable feedstock

in fuel production. IRF-B, “From Biofuels to Propulsion”, is focused on the development of new engine combustion concepts by using fuel as one design parameter.

The “Supplementary Cluster Activities” (SCA) reflect the networking activities of all participants of TMFB. SCA ongoing measures are implementation and analysis of fields like strategy, controlling, education, lifelong learning or working atmosphere.

Scientists from the Faculty of Natural Sciences, Mathematics and Information Technology, and the Faculty of Mechanical Engineering at the RWTH Aachen University are collaborating with the Fraunhofer Institute for Molecular Biology and Applied Ecology and the Max Planck Institute for Coal Research in the jointly founded “Fuel Design Center”.

Participating institutions:

- Fraunhofer Institute for Molecular Biology and Applied Ecology - IME
- Max Planck Institute of Coal Research, www.mpi-muehlheim.mpg.de
- Öko-Institut e.V. - Institute for Applied Ecology, www.oeko.de

 	
Name	Tailor-Made Fuels from Biomass @ RWTH Aachen University
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Fon	+49 241 80-48000
E-Mail	office@vka.rwth-aachen.de
Internet	www.fuelcenter.rwth-aachen.de
Founded (year)	2007
Number of employees	scientific 92 administrative 4
Funding	Federal Government Germany 100 %,
www.fuelcenter.rwth-aachen.de	

Graduate Programmes in North Rhine-Westphalia (Life Sciences)

DFG Research Training Groups	Institution(s)	Since	
The Neuroscience of Modulating Aggression and Impulsivity in Psychopathology	University of Aachen, Jülich Research Centre, University of Pennsylvania	2016	
Computational Methods for the Analysis of the Diversity and Dynamics of Genomes (MADD-Gen)	Universities of Bielefeld, Burnaby & Vancouver	2013	
Pharmacology of 7TM-receptors and Downstream Signaling Pathways	University of Bonn	2013	
Water Use Efficiency and Drought Stress Responses: From Arabidopsis to Barley	University of Bonn & MPI for Plant Breeding Cologne	2015	
Neural Circuit Analysis on the cellular and subcellular level	University of Cologne, Jülich Research Centre	2014	
The Dynamic Response of Plants to a Changing Environment	University of Düsseldorf, Jülich Research Centre, Michigan State University	2009	
Intra- and Interorgan Communication of the Cardiovascular System	University of Düsseldorf, University of Virginia	2013	
Molecular Determinants of the Cellular Radiation Response and Their Potential for Response Modulation	University of Duisburg-Essen	2012	
Immune Response in Infectious Diseases – Regulation between Innate and Adaptive Immunity	Universities of Duisburg-Essen, Bochum & Düsseldorf	2014	
Biomedicine of the Acid Sphingomyelin/Acid Ceramide System	University of Duisburg-Essen	2015	
NRW Graduate and Research Schools			
International Graduate School of Neuroscience (IGSN)	University of Bochum	2001	
Bonn International Graduate School of Drug Sciences (BIGS)	University of Bonn	2008	
International Graduate School From Embryo to Old Age: The Cell Biology and Genetics of Health and Disease (IGS DHD)	University of Cologne	2009	
NRW Research School Biostruct	University of Düsseldorf	2008	
NRW Research School Molecules and Materials – A Common Design Principle	University of Münster	2009	

Aims & Topics	Website
Neurobiology of pathological aggression and impulsivity; circuit models based on imbalance among striatal, limbic and frontal networks; neuroimaging and behavioural research with neuropsychological, electrophysiological, neuroendocrinological and molecular approaches	www.irtg2150.rwth-aachen.de
Next generation research in computational genomics, especially big data	www.didy.uni-bielefeld.de
Pharmacology, toxicology, pharmaceutical biology, pharmaceutical/medicinal chemistry, physiology and bioinformatics	www.grk1873.uni-bonn.de
Understanding of drought responses and water efficiency in plants, identifying factors and strategies to improve drought tolerance	www.imbio.uni-bonn.de/GRK2064
Integrate data from the molecular to the neural network level to obtain a deeper understanding of nervous system function, sensory processing, control of energy homeostasis and motor control	www.rtg-nca.uni-koeln.de/12636.html
Molecular plant sciences, genetics, quantitative biology & bioinformatics	www.igrad-plant.hhu.de
Investigation of functional and molecular mechanisms underlying intra- and inter-organ communication as a means to understand normal and pathological cell and organ function	www.irtg1902.hhu.de
Better mechanistic understanding of the key molecules that determine the cellular response to ionizing radiation and thus radiation sensitivity with the goal of providing a scientific basis for effective response modulation	www.uni-due.de/med/forschung/grk1739
Interaction between innate and adaptive immunity, modulation of the adaptive immune response against pathogens by the innate immune response	www.uni-due.de/grk1949
Biomedicine of sphingolipids, significance of the sphingolipid pathway in inflammatory disorders, infectious diseases, cystic fibrosis, cancer and cardiovascular disease	www.uni-due.de/grk2098
All aspects of neuroscience, from the molecular level to higher cognitive functions	www.rub.de/igsn
Various aspects of drug research; pharmacy, chemistry, biology, molecular medicine and life sciences	www.bigs-drugs.uni-bonn.de
Microbial, plant and animal model systems to investigate cell biological and genetic mechanisms whose perturbation during the life cycle of an organism results in disease	www.igsdhd.uni-koeln.de
Structural biology, molecular medicine and biotechnology	www.biostruct.uni-duesseldorf.de
A broad and interdisciplinary research program in all fields of chemistry	www.uni-muenster.de/GSC-MS/RS

International Helmholtz Research Schools	Institution(s)	Since	
Helmholtz Space Life Sciences Research School	German Aerospace Center Cologne	2009	
International Helmholtz Research School of Biophysics and Soft Matter (IHRS BioSoft)	Jülich Research Centre, Universities of Aachen, Cologne & Düsseldorf, caesar Bonn	2006	
Leibniz Graduate Schools			
Leibniz Graduate School on Genomic Biodiversity Research (GBR)	ZFMK Bonn, Universities of Bonn & Münster	2010	
International Max Planck Research Schools (IMPRS)			
International Max Planck Research School in Chemical Biology (IMPRS-CMB)	MPI of Molecular Physiology Dortmund, Universities of Bochum, Dortmund & Duisburg-Essen	1999	
International Max Planck Research School on Understanding Complex Plant Traits Using Computational and Evolutionary Approaches	MPI for Plant Breeding Cologne, Universities of Cologne & Düsseldorf	2001	
Other Graduate Schools and Programmes			
CLIB-Graduate Cluster Industrial Biotechnology	Universities of Bielefeld, Dortmund & Düsseldorf	2009	
Graduate School of Chemistry and Biochemistry (GSCB)	University of Bochum	2003	
International Graduate School of Biosciences (IGB)	University of Bochum	2004	
Graduate School for Biological Sciences	University of Cologne	2006	
Cologne Graduate School of Ageing Research	CECAD Cologne, MPI Age Cologne, caesar Bonn, MPI of Molecular Physiology Dortmund	2013	
CEPLAS Graduate School	Universities of Düsseldorf & Cologne, MPI for Plant Breeding Cologne & Jülich Research Centre	2012	
Manchot Graduate School Molecules of Infection	University of Düsseldorf	2009	
CiM-IMPRS	CiM Münster, MPI for Molecular Biomedicine Münster	2010	
Münster Graduate School of Evolution	University of Münster	2011	

Aims & Topics	Website
Health issues in human spaceflight and in related disease patterns on Earth, requirements for life in extreme environments and the search for life on other planets in manned and unmanned missions	www.dlr.de/me/desktopdefault.aspx?tabid=4960
Cell biophysics, structural biology and cellular signaling pathways	www.ihrs-biosoft.de
Genome evolution within holometabolous insects in regard to their agricultural, medical, ecological and economic importance	www.zfmk.de/en/research/research-centres-and-groups/graduate-school-gbr
Studies of the fundamental chemical principles that govern biological systems; bioinorganic and bioorganic chemistry, biophysics and biochemistry, nanobiotechnology, structural biology, molecular- and cell biology, molecular physiology and molecular informatics	www.rwth-aachen.de/go/id/zhb/
Molecular plant biology; reverse genetics, gene isolation, advanced microscopy, 3D-structural analysis of proteins, bioinformatics and novel mass spectrometry-based protein biochemistry	www.mpipz.mpg.de/imprs
Polyomics, expression, biocatalysis & downstream processing	www.clib-graduatecluster.de
Molecular chemistry, biological chemistry, life sciences	www.chemie.rub.de/gscb
Biology, biotechnology, chemistry, biochemistry and medicine	www.biologie.ruhr-uni-bochum.de/promotion/igb
Biological sciences from ecology and evolution to medicine, centred on molecular analysis of biological processes, including all major microbial, plant and animal model organisms	www.gs-biosciences.uni-koeln.de
Genetic determinants of longevity, protein quality control, DNA damage and repair, mitochondria regulation, immunosenescence and inflammation, stem cell and tissue maintenance, organellar and cellular architecture, endocrine control of metabolism as well as their research into age-related diseases such as neurodegeneration, cancer, diabetes, obesity, kidney dysfunction and others	www.ageing-grad-school.de
Combination of evolutionary analysis and synthetic biology, genetic architecture and regulatory networks of four important complex traits: annual & perennial life histories, C4 photosynthesis, plant-microbe interactions and metabolic interaction	www.ceplas.eu/en/young-researchers/ceplas-graduate-school
Mechanistic aspects of viral infections, bacterial proteins in infection and infection control, mechanisms of morphogenetic change in dimorphic fungal pathogens and immunological control of infection	www.moi.hhu.de
Molecular and cellular life sciences (biological sciences, chemistry, mathematics, computer sciences and physics), analysis of basic cellular processes to clinical translation with a strong focus on state-of-the-art imaging	www.imprs-mbm-cedad.mpg.de
Bology, medicine, geosciences, mathematics and philosophy; the unifying concept of evolution will provide a strong theoretical and philosophical foundation	www.uni-muen-ster.de/Evolution/mgse

Research Fields

Ageing Research	151	Chemical Engineering	60, 64, 116
Analytical Chemistry	27	Cognitive Neuroscience	129
Angiogenesis	35	Computer Assisted Therapy	139
Anti-Doping Research	27	Dermatology	149
Artificial Gravity	132	Developmental Biology	35, 151, 165, 169
Behavioral Biology & Ecology	73	Diabetes	147
Behavior Research	177	Diabetes Mellitus	35
Beta Cell Biology	146	Downstream Processing	64
Bioactive Natural Products	39	Drug Development	35
Bioanalytical Chemistry	76	Ecology	51
Bioanalytics	156	Ecotoxicology	95, 118
Biocatalysis	32, 33, 105	Electron Microscopy and Analytics	180
Biochemistry	31, 32, 33, 39, 40, 49, 57, 70, 71, 78, 95, 106, 128, 173, 174	Environmental Biology/Chemistry	51, 58, 106, 118
Biodiversity	51	Environmental Chemistry	95
Biodiversity Research	159, 160	Environmental Science	19
Bioengineering	89	Evolution	51
Bioinformatics	22, 24, 32, 114, 179	Food Safety	118
Biointeractive Materials	58	Formulation	93
Biointerface Chemistry and -Physics	75	Functional Materials	73
Biomaterials	87	Genetica	53
Biomathematics	63	Genetics	43, 53, 80
Biomechanics	89	Genetics/Molecular Biology	34, 40, 54, 147, 154, 165, 166, 169
Biomedical Products	95	Good Manufacturing Practice	97
Biomedical Research	69, 156	Gravitational and Space Biology	132
Biometrics and Epidemiology	146	Health	78, 129, 130, 132, 138, 139, 140, 149, 150
Biophysical Imaging	179	High Content Imaging: 3D Cell Culture	105
Biophysics	31, 51, 76, 89, 177, 178	Human Biology	27, 35
Biophysics/Neurotechnology	128	Human Biology/Physiology	133
Bioregeneration	132	Imaging	51
Bioseparation	105	Immunology	87, 150, 153
Biotechnology	21, 22, 24, 25, 36, 37, 39, 40, 50, 57, 58, 59, 60, 61, 63, 69, 78, 80, 89, 90, 93, 97, 103, 118, 119, 120, 127, 138	Immunosciences	44
Biotransformation	105	Industrial Biotechnology	101
Botany	36	Infection	44
Cancer Cell (Re-)differentiation	105	Inorganic Chemistry	41
Cancer Immunology	105	Integrated Water and Environmental Research	67
Cell Biology	34, 50, 52, 78, 132, 149, 151, 170, 179	Life and Medical Sciences	46
Cell Biology/Physiology	52, 146, 174	Life Science	109
Chemical Biology	173	Life Sciences Engineering	122
		Machine Learning and Computational Neuroscience	179

Material Sciences/Biophysics	157	Plant Pathology	57
Mathematical Modelling	89	Polymer Chemistry	38
Medical Biotechnology	67, 119	Process Development	60, 61, 116
Medical Devices	78, 89, 97, 137, 138, 139, 140, 149	Process Dynamics and Operations	65
Medical Physics	89, 130	Protein Engineering	32
Metabolic Engineering	57	Public Health	54
Metabolite Analysis	36	R egenerative Medicine	137
Micro- and Nanochemistry	73	Renewable Energy and Resources	106, 116
Microbiology	36, 38, 44, 45, 53, 57, 80	Renewable Resources	87
Microfluidics	59	Risk Assessment	150
Modeling of Downstream Processing	64	RNA Biology	40
Molecular Aging Research	149	S ensors	90
Molecular Biology	43, 53, 78, 80	Solid-state NMR Spectroscopy of Biopolymers	31
Molecular Evolution	37	Space Life Sciences	132
Molecular Medicine	54	Stem Cell Biology	52
Molecular Neuroscience	49	Structural Biology	31
Molecular Physiology	74	T heoretical Biology	32
Molecular Sensory Systems	177	Tissue Engineering	137
Monitoring	118	Toxicology	54, 150
Movement and Neuroscience	28	Translational Imaging	78
Multi-drug Resistance	105	V arious Biological Fields of Research	21
N anotechnology	41, 73, 90, 150	Viroids	89
Nanotoxicology	149	W hite Biotechnology	63
Natural Product	63	Z oology	159, 160
Natural Product Chemistry	81		
Neuroanatomy	129		
Neurobiology	28, 35, 50, 52, 70, 71, 80, 129, 149, 151, 153, 177		
Neurodegenerative Disease	135		
Neuroimmunology	178		
Neuroscience	129		
Neurotoxicology	151		
O ptogenetics	50		
Organic Chemistry	21, 33, 38, 39, 74, 75, 76		
Organ-on-a-Chip	89		
P harmacology	46		
Philosophy of Neuroscience	130		
Physiology	27, 28, 35, 37, 43, 82, 179		
Plant Biology/Physiology	33, 34, 36, 40, 43, 45, 50, 54, 57, 81, 118, 127		

Keywords

A geing	28, 70, 71, 129, 130, 135, 140, 149, 151, 165, 166	Biomaterials	31, 61, 63, 73, 74, 75, 80, 87, 97, 109, 137, 138
Age Related Diseases	151	Biomechanics	89, 139
Agricultural Biology	74	Biomedical Research	109
Agricultural Biotechnology	33, 43, 45, 54, 57, 69, 81, 93, 103, 118	Biomedical Systems and eHealth	132
Agriculture	132	Biometry	146
Alzheimer's Disease	28, 39, 128, 129, 130, 135, 156, 178	Biomolecular NMR	39, 128
Analysis of Biological Data	179	BioNanotechnology	109
Analytics	22, 27, 31, 36, 39, 61, 93, 116, 156, 157, 179, 180	Bioorganic Chemistry	73, 75
Angiogenesis	169	Biopharmaceuticals	22, 36, 59, 60, 64, 81, 101, 106
Animal Facility	87, 177	Biopolymers	80
Animal Models	43, 49, 50, 73, 79, 80, 119, 137, 147, 150, 151, 165, 166, 170, 177, 179	Bio Processing	60, 61, 64, 114, 116, 119
Antibiotic	39, 44, 45, 53, 133	Biorefinery	60, 61
Antibody	36, 52, 64, 87, 119, 120, 153, 170	Biotechnology	89
Anti-infective Research	38, 39, 45, 75, 97, 170	Biotransformations	44
Applied Immunology	90	Body Fat Regulation	46
Aquatic Ecology	67	C ancer	38, 39, 51, 54, 71, 78, 133, 139, 153, 154, 173
Assay Development	105	Cancer Biology and Clinical Trials	67
Atmospheric Chemistry	19	Cancer Research	105
Atmospheric Physics	19	Carbohydrates	138
Autophagy	39, 128	Carbon Monoxide Releasing Molecules	41
B acterial Cell Biology	45	Cardiovascular Diseases	156
Bacterial Cell Wall	45	Cardiovascular Research	28, 35, 69, 71, 78, 89, 137, 139, 140, 151, 169, 170, 179
Baromedicine	132	Cartilage Biology	71
Behavioral Biology	73	Cell Lines/Banks	22, 150, 153, 154
Behavioural Biology	21	Cell Separation	87, 114, 150
Biocatalysis	63, 90	Cell Therapy	89
Biocatalyst Applications	105	Cellular Signaling	177
Biocatalysts	32, 37, 38, 50, 57, 59, 60, 93, 101, 116, 138	Challenging Behavior	135
Biodiversity	51, 127	Chemical-/Biosensors	90
Bioelectrochemistry	76	Chemical Ecology	51
Bioenergy Research	24, 37, 50, 57, 60, 61, 81, 93, 103, 106, 116, 119	Chip Technology	59, 97, 122, 128, 156
Bioengineering	63	Clinical Studies	147
Bioethics	130	Cognition	153
Bioinformatics	22, 24, 37, 109	Colon Cancer	38, 139
Biointerface Fabrication and Characterization	75	Companion Diagnostic	139
Biologicals	57, 79	Comparative Genomics	37
Biomarker	39, 51, 54, 97, 135, 137, 147	Computational Neuroscience	179
Biomass	24, 34, 40, 41, 57, 59, 60, 61, 69, 106, 118, 119, 127	Connectivity	129

Conservation Biology	73	GPCR	52
Crop Research	34, 54, 120, 127	Hazard Identification	118
D ata Integration	24	Health Economics	146
Dementia Care	135	Health Service	146
Development of Chemical Tools	177	Hybrid-Catalysts	58
Diabetes	35, 46, 70, 89, 130, 140, 146, 147	I mage Processing	139
Diabetes, Metabolomics	28	Imaging	51, 95, 177
Diagnostic Systems	59, 78, 95, 97, 122, 130, 137, 153	Immobilization	133
Directed Evolution	58	Immune Modulation	27, 43, 46, 79, 87, 119, 132, 150, 153, 178
DNA	37, 73, 75, 76, 133, 150, 159, 160, 165	Immunology	44, 67
DNA-Sensors	90	Industrial Microbiology	90
Downstream Processing	60, 64, 93, 101, 116, 120	Infectious Diseases	39, 44, 45, 67, 69, 79, 81, 82, 119, 128
Drug Discovery/Delivery	35, 41, 45, 46, 52, 73, 81, 82, 105, 109, 114, 169, 173	Inflammation	44, 147
Dynamic Flux Analysis	65	iPS	151, 169
E cology	21, 51, 73	L ead Discovery	35, 39, 81, 173
Ecophysiology	73	Life Cycle Assessment	95
Ecotoxicology	73, 95	Lipid Metabolism	46
E-Fate	118	Liver Regeneration	154
Electron Cryo Microscopy (cryo-EM)	174	M achine Learning	179
Electron Microscopy	178	Mammalian Cell Culture Technology	90
Energy Metabolism	147	Marine Biology	51
Environmental Research	69	Mathematical Analysis and Simulation	63
Environmental Chemistry	95	Medical Immunosciences	44
Environmental Research	43, 45, 54, 58, 74, 82, 103, 106, 132, 133, 149, 150, 151, 159, 160	Membrane Proteins	74, 178
Enzymes	21, 31, 32, 33, 36, 37, 38, 44, 53, 60, 70, 80, 101, 119, 127, 138	Membrane Receptors and Ion Channels	177
Enzyme Technology	90	Membrane Technology	105
Epidemiology	146	Metabolic Engineering	63, 109, 127
ESC	169	Metabolic Flux Analysis	65
Evolution	51	Metabolic Imaging	147
Evolutionary Biology	21	Metabolomics	21, 25, 27, 28, 36, 40, 106, 119, 127, 156, 165
Exercise Physiology	28	Microalgae	69
F ermentation	22, 24, 50, 57, 60, 80, 93, 101, 106	Microarrays	25, 59, 74, 81, 114, 127, 156
Fertility	52	Microbial Fermentations	105
Flow Cytometry	81, 87, 127, 133	Microbial Genetic Engineering	127
Food Science	44, 103	Microbial Genomics	25, 32, 37, 53, 80, 119, 150
Formulation Technology	93	Microbial Pathogenicity	79
Fresh Water	51	Microbial Pathways	80
Fungal Biotechnology	38	Microbial Physiology	44
G asotransmitters	41	Microscopical Brain Models	129
Genetic Engineering	22, 34, 37, 38, 40, 43, 44, 50, 53, 79, 80, 82, 118	Microscopy	34, 35, 43, 52, 53, 70, 73, 79, 95, 103, 114, 169, 174, 177, 179, 180
Genomics	21, 24, 25, 32, 34, 40, 43, 45, 46, 51, 54, 74, 97, 119, 129, 150, 159, 160, 165	Microsystems	59
GMO	43	Model Development	65
		Modeling	63
		Model Predictive Control	65
		Molecular Ageing Research	149

Molecular Biology	51, 109	Platform Technology	31, 59, 75, 95, 97, 138, 139, 146
Molecular Cell and Chemical Biology	67	Population Dynamics and Synchronization	65
Molecular Imaging	78	Population Genetics	51
Molecular Library	159, 160, 173	Postgenomics	24
Molecular Neurobiology	49	Process Design	61
Molecular Pharmacology	105	Process Modelling	105
Molecular Scaffolds	178	Process Optimization	61
MSC	122	Process Studies	19
N anotoxicology	149, 150	Protein Chemistry	78
Natural Killer Cells	153	Protein Engineering	58, 109
Natural Products	33, 63	Protein-Ligand Interactions	39, 128
Neural Networks	70	Protein Protein Interaction	71
Neural Plasticity	153	Proteomics	21, 27, 25, 45, 50, 52, 70, 81, 147, 149, 156
Neurobiology	21	Q uality of Life	135
Neurodegenerative Diseases	28, 35, 39, 43, 46, 49, 50, 51, 69, 70, 71, 128, 129, 130, 135, 140, 149, 150, 165, 166, 179	R ecombinant Proteins	21, 22, 31, 33, 37, 38, 59, 70, 71, 74, 78, 79, 93, 95, 120, 138, 174
Neurodegenerative Disorders	156	Regenerative Medicine	27, 52, 87, 137, 138, 169
Neurology	129	Regulatory Toxicology	95
Neuropathy	147	Renewable Energy and Resources	58
Neuroscience	49	Renewable Resources	105
Neurotransmitter	28	Rheumatology	44
Neurotransmitter Receptors	49	Risk Assessment	95, 118, 150, 151
Neurotrophic Factors	28	RNA (Bio)Chemistry	78
Next-Generation Sequencing	54	RNA/RNAi/Antisense RNA	35, 36, 40, 46, 53, 74
NMR	157	Robotics	139
Noise Effects Research	132	S afety Engineering	19
Novel Toxicity Tests	154	Sensing of Ions and Molecules	74
Nutrition	28, 46, 133, 166	Signal Transduction	33, 34, 36, 45, 46, 49, 50, 52, 53, 63, 79, 80, 81, 132, 133, 147, 149, 151, 153, 154, 166, 169, 170, 174, 178, 179
O besity	46	Simulation Experiments	19
Olfaction and Taste	52	Skin Biology	71
Oncology	44, 52, 69, 78, 95, 119, 139, 173, 174	Sleep and Performance Research	132
Ophthalmology	89	Small Molecules	21, 27, 33, 36, 38, 41, 64, 73, 78, 81, 106, 173
Optical Micro- and Nanosystem Technology	90	Space Physiology	28
Optical Spectrometry	157	Spectroscopy	39, 51, 128
Optogenetics	179	Sperm Motility	177
P ain	135	Sports Drug Testing/Doping Controls	27
Parkinson Disease	31, 49, 129, 130, 135, 140, 165	Stem Cell Research	21, 27, 49, 52, 122, 132, 138, 151, 154, 169
Pathology	36, 179	Stroke	129
Peptide Synthesis	21, 70, 156	Structural Biology	31, 39, 70, 128, 173, 174, 178
Personalized Medicine	75, 89, 122, 137, 139, 140	Substance Regulation	118
Phenotyping	127	Sustainable Water Management	67
Photochemistry	75	Synthetic Biology	32, 40, 50, 53, 57, 127, 138, 173
Plant Breeding	43, 45, 46, 54, 118, 127	Systems Biology	32, 37, 40, 57, 63, 82, 127, 129, 133, 156, 159, 160, 165, 173, 174, 177
Plant Produced Products	36, 39, 60, 69, 81, 118, 120	Systems Biotechnology	63
Plant Stress Resistance	57		
Plant Technology	127		

t DCS (transcranial direct-current stimulation)	153
Therapeutics	35, 146
Tissue Engineering	52, 87, 89, 137, 138
Tissue Morphogenesis	169
Tomography	180
Tool Development	177
Total Synthesis	33
Toxicology	150, 151
Trace Analysis	118
Training	133
U ltrasound and Shockwaves	139
W ater and Environmental Research	67
Water Quality/Technologies	67
Workflows	24
X -Ray Crystallography	128
X-Ray Spectroscopy	157

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