Fraunhofer

IZI

FRAUNHOFER INSTITUTE FOR CELL THERAPY AND IMMUNOLOGY IZI

10 YEARS IZI

# ANNUAL REPORT 2014

## ANNIVERSARY ISSUE

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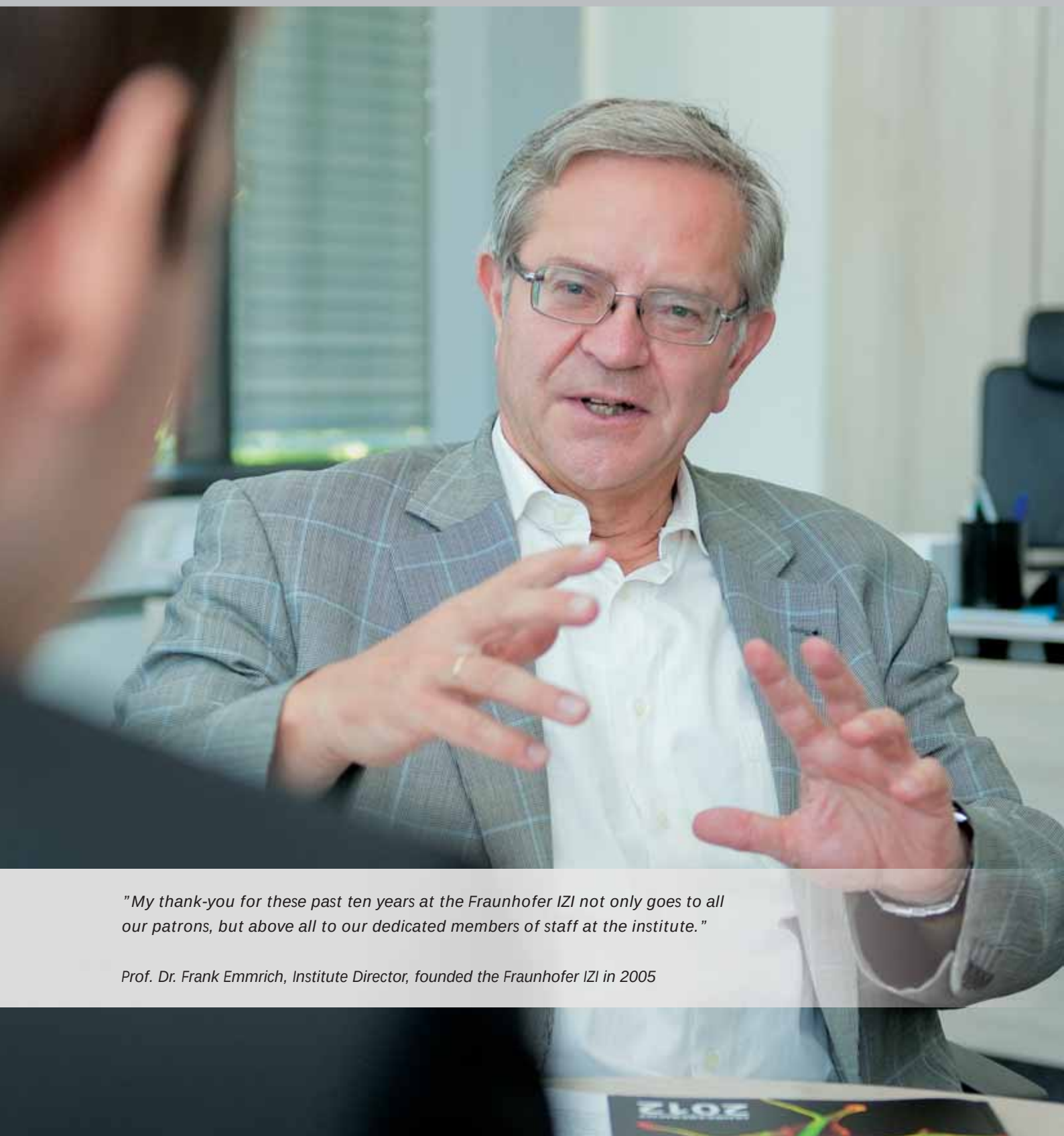


*”My thank-you for these past ten years at the Fraunhofer IZI not only goes to all our patrons, but above all to our dedicated members of staff at the institute.”*

*Prof. Dr. Frank Emmrich, Institute Director, founded the Fraunhofer IZI in 2005*

# INTERVIEW WITH THE DIRECTOR PROF. DR. FRANK EMMRICH

**Professor Emmrich, this report is surely one of great significance for you and the Fraunhofer IZI. In its 2015 year of publication, the institute is celebrating its tenth anniversary, which is why we are also using the 2014 annual report to look back over the past ten years. How have you, as initiator and founder of the institute, perceived the developments of the past ten years and what moments have you found particularly moving?**
In order to answer this question, we have to go back a little further than ten years. Setting up an institute without first having a respective research unit at the Fraunhofer-Gesellschaft was completely unheard of. However, 15 years ago there was an infectious spirit of optimism around the world in the field of biotechnology, which led to politicians prompting the rather technically oriented Fraunhofer-Gesellschaft to strengthen its expertise in this area.

A few years before the institute was set up, a competition thus took place where concepts were put forward; during this process, most members of the Fraunhofer supervisory bodies voted in favor of developing a focus on cell therapy and immunology. This was a very courageous decision at the time as it could not yet be foreseen whether cells and tissues would really gain relevance as a new form of therapy for large-scale clinical application and thus whether the field would be embraced by industry. I am extremely happy to say that the prognoses I made at the very beginning have now come to fruition. The institute's rapid growth to almost 500 members of staff across four German and two international locations, not to mention the scientific and economic successes, would certainly not have been possible without our staff's commitment and excellent teamwork. On this note, I would like to take this opportunity to say a huge thank you to all those involved.

**A further substantial boost was given to the constant growth at the Leipzig site in July 2014 through the affiliation of an existing branch in Potsdam. How did this come about and what consequences does this entail for the strategy adopted by the Fraunhofer IZI?**
After having set up a site focused on drug discovery in Halle an der Saale in 2013 with the support of the *Land* of Saxony-Anhalt, we went on to acquire a division based at the science campus in Potsdam in 2014 which deals with the research and development of biological processes and bioanalytical procedures. With the support of the Board, the Fraunhofer IZI has taken on the task of remedying the division's structural and economic problems over the next few years and combining the biomedical expertise from Leipzig with the knowledge of process engineering and device development offered in Potsdam-Golm.

**In the 2014 reporting year, the institute can also look back on many other events which have a direct influence on its future development. What were your personal highlights?**
Together with Leipzig University of Applied Sciences (HTWK), we created the specialist group "Image Analysis of Cell Function" around the middle of the year, which is headed up by Professor Ulf-Dietrich Braumann from the Faculty for

Electrical Engineering. The group aims to be able to measure and display cellular functions as continuously as possible without impairing the respective object under cell-culture conditions.

The ceremonial foundation of the group, which was witnessed by the Minister Presidents of Saxony-Anhalt and Saxony alongside the University Rectors of the Universities of Halle-Wittenberg and Leipzig and the President of the Fraunhofer-Gesellschaft, also served to present a joint initiative between the Fraunhofer Institutes from the regions of Halle and Leipzig. Together with the universities and other non-university research facilities, a high performance center is to be set up for chemical and biosystem engineering, which will be able to offer attractive R&D services to regional and national industry.

2014 was also the key year for the construction of the Fraunhofer IZI's second extension building on the former technical exhibition grounds on Perlickstrasse. The construction fills the structural gap between the main building and BIO CITY's Biocube. It is connected to the main building via a number of passages and will be home to units and departments working on drugs, new biomarkers and developments concerning sophisticated devices. On the ground floor, a demonstration area in the form of a "transparent lab" will allow procedures and new equipment to be seen and experienced in operation.

2014 also brought with it intensive discussions and negotiations with our Canadian cooperation partners at the McMaster University in Hamilton, Ontario. McMaster University belongs to the three leading universities in Canada that focus on the field of biotechnology. A jointly operated project center for "Bioengineering and Advanced Manufacturing (BEAM)" aims to drive forward project work with many biotechnology companies in Canada and the USA, to the benefit of both parties.

The intensive preparation and negotiation of a major development contract with an internationally operating pharmaceuticals company should also be mentioned here. This deals with the development and GMP manufacture of a procedure which happens naturally in the body in order to treat a special type of leukemia with the aid of T-lymphocytes, whose special receptor molecules were grafted

**A diverse range of academic events were held at the Fraunhofer IZI over the course of the year. Two of the three regular events, the Fraunhofer Life Science Symposium and the International Symposium on Neuroprotection and Neurorepair, took place in the reporting year for the eighth and third time respectively. How would you summarize the events?**
Since being founded, the Fraunhofer IZI has organized scientific workshops, symposiums and even major international conferences – often in cooperation with relevant associations specialized in the areas in question. A Fraunhofer Life Science Symposium is held at the institute itself every autumn with up to 200 attendees. With changing topics, often including some which venture into uncharted

territories, the forum provides for intensive discussions among specialists and experimenters. We held the eighth symposium in 2014, which looked into aspects of the medical application of cell products.

The International Symposium on Neuroprotection and Neurorepair was initiated in 1998 under the name "Magdeburg Meeting Series" by the Otto von Guericke University Magdeburg. The Leibniz Institute for Neurobiology and the Fraunhofer IZI later became organizers. As the event is held in different cities around Germany, it returned to Magdeburg in 2014 with a record attendance of over 400 participants. Due to the broad diversity of subjects, the symposium once again offered a great platform for scientists and clinicians to exchange views and experiences, particularly in the field of neurodegeneration and neuroregeneration. The next event will be held in Leipzig from April 19–22, 2016.

**With a view to the anniversary year 2015, what do you hope to see happen in the next ten years? Where should this journey take us and which aims now have priority after a more than successful start-up phase?**
The extraordinarily dynamic development of the Fraunhofer IZI with regard to project volumes and staff is now likely to enter a quieter, steadier stage, in which we shall look to strengthen and supplement our focal areas. The start of 2015 thus marks the start of the structured strategy process, which all Fraunhofer Institutes will go through approximately every five years. I do not expect our priorities, being our orientation towards cell therapy and immunology and the related business units, to change very much, but there will always be a need to closely monitor the research and product markets and to orient and adjust our portfolio towards any changes in good time. By following this strategy, we managed to ride out the economic slowdown in 2008/2009 and we will also manage to do this moving forward by maintaining the future-oriented scientific spirit of discovery and entrepreneurship which characterizes the Fraunhofer IZI.

On that note I would like to address all partners and friends of the institute and all members of our small and large project teams: Thank you and keep up the good work!

Prof. Dr. Frank Emmrich

# 2005 – 2015 CONGRATULATORY MESSAGES FOR OUR ANNIVERSARY

© Saxon State Chancellery/ Jürgen Jeibmann

*"The past ten years have seen extraordinary 'cell growth' at the Fraunhofer Institute for Cell Therapy and Immunology: Internally in the research laboratories and externally with the construction work at the Fraunhofer IZI. A vibrant institute in many ways which hugely enriches Saxony as a research location. All the best for your anniversary and: Continue growing!"*

Stanislaw Tillich, Minister President of the Free State of Saxony

*"In the ten years since being founded, the Fraunhofer IZI has become a respected partner for biotechnological, pharmaceutical and medical engineering companies. I offer my congratulations to all members of staff and wish everyone continued success in their research."*

Prof. Dr. Johanna Wanka, Federal Minister of Education and Research

© Federal Government / Steffen Kugler

© Götz Schleser

*"The Saxon Fraunhofer Institutes have been a mainstay of our state's innovational strength for almost 25 years now. Over the past ten years, the Fraunhofer Institute for Cell Therapy and Immunology in Leipzig has made a significant contribution here by closing the gap between excellent fundamental research and its application in business and society in the field of life sciences. It has therefore become an important location factor in terms of the non-university research landscape in Leipzig – I wish you every success in the future!"*

Dr. Eva-Maria Stange, Saxon State Minister for Science and the Arts

*"I can clearly recollect the year 2005 when we founded this institute with magnificent ideas for the future, of which many have been realized over the past few years. Congratulations!"*

Wolfgang Tiefensee, Thuringian Minister for Economic Affairs, Science and Digital Society (since 2014), Federal Minister for Transport, Building and Urban Development, ret., (2005–2009), Mayor of the City of Leipzig in the institute's foundation year (1998–2005)

*"We are extremely proud of everything that has been achieved. The institute is a gift to our city and makes a significant contribution to growth. Cell division progresses year on year. Congratulations, keep up the good work!"*

Burkhard Jung, Mayor of the City of Leipzig

*"The Fraunhofer IZI started small but has seen remarkable development and has optimally supplemented the portfolio offered by the Fraunhofer-Gesellschaft in life sciences. A huge thank you on behalf of the board for ten years of excellent work!"*

Prof. Dr. Reimund Neugebauer, President of the Fraunhofer-Gesellschaft

*"Ten years of Fraunhofer IZI represent ten years of close cooperation with Leipzig University in life sciences, promoting the transfer of expertise. Congratulations from Leipzig University!"*

Prof. Dr. Beate Schücking, Rector of Leipzig University

*© Swen Reichhold/Universität Leipzig*

*"Being able to follow the development of the Fraunhofer IZI has been nothing but impressive. I am especially pleased to see that so many young people have found an attractive workplace at the institute. I wish you all the very best for the future!"*

Dr. Henrich Guntermann, President Europe & Immunology Group Nuvo Research Inc. and Chairman of the Fraunhofer IZI Advisory Board

# 2005–2015 MILESTONES

**April 29, 2005**
The institute was founded in the BIO CITY

**September 22, 2006**
The foundation stone was laid for the main building

**2008**
Opening of the main building in Leipzig

**March 14, 2011**
The EXIM Project Group was set up in Rostock

**July 2010**
Positive evaluation and transition into basic funding

**March 28, 2013**
The "Joint Laboratory of CNUHH in Collaboration with Fraunhofer IZI" (JLCI) was set up in Gwangju, South Korea

**July 1, 2013**
The Drug Design and Target Validation Project Group was set up in Halle (Saale)

**January 23, 2013**
Opening of the first extension building

**July 2014**
Affiliation of the Bioanalytics and Bioprocesses Branch in Potsdam/Golm


**January 19, 2015**
The "Fraunhofer Project Centre for Biomedical Engineering and Advanced Manufacturing" was set up in Hamilton, Canada

**April 29, 2015**
Anniversary year and opening of the second extension building

# 2005 – 2015 **IN PUBLIC**

Summer of Science

Ceremonial opening of the main building

Graduate fair

Open day

Day of Mobility and Technology

Long Night of the Sciences

Movie talk

Children's lecture

Long Night of the Sciences

Pupils' congress

New Year's reception

Girls'Day

# 2005 – 2015 **CONFERENCES**

Fraunhofer Life Science Symposium 2006

Research Conference 2014

International Symposium on Albumin Dialysis 2013

World Conference on Regenerative Medicine 2013

International Symposium on Neuroprotection and Neurorepair 2012

International Symposium on Neuroprotection and Neurorepair 2014

Fraunhofer Life Science Symposium 2012

World Conference on Regenerative Medicine 2009

World Conference on Regenerative Medicine 2011

Science Day 2014

# 2005–2015 THE FRAUNHOFER IZI IN THE POLITICAL SPHERE

Saxon Minister President Georg Milbradt visits the institute in 2006

Visit from EU Commissioner Janez Potocnik in 2007

Bernat Soria, Spanish Minister for Health, is our guest at the World Conference on Regenerative Medicine in 2007

Thomas Jurk, Saxon State Minister for Economic Affairs and Labour, visiting in 2008


Professor Sabine von Schorlemmer, Saxon State Minister for Science and the Arts, attends the podium discussion of the Association of Research-Based Pharmaceutical Companies (vfa) in 2011

Minister President of Saxony Stanislaw Tillich when the foundation stone was laid for the first extension building in 2009

Minister President of Saxony-Anhalt Dr. Reiner Haseloff and Fraunhofer President Professor Reimund Neugebauer at the opening of the Molecular Drug Biochemistry and Therapy Development Project Group in Halle (Saale) in 2013

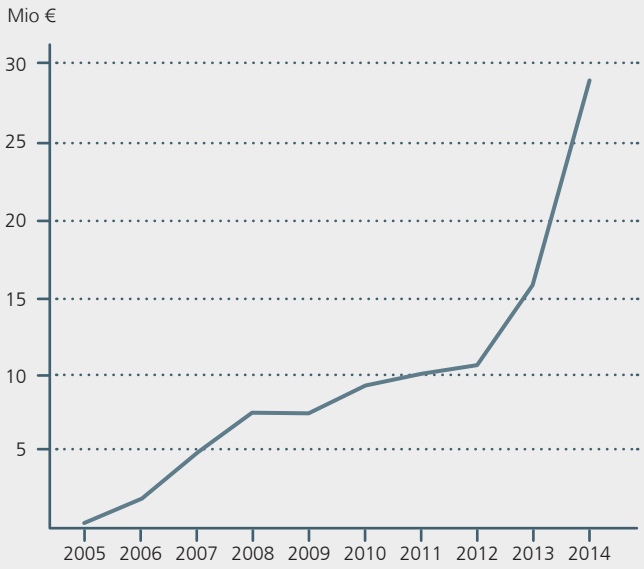
Wolfgang Tiefensee, Federal Minister for Transport, Building and Urban Development (photo left) as well as Saxon State Minister for Science Dr. Eva-Maria Stange and Mayor of Leipzig Burkhardt Jung (photo right) at the opening of the main building in Leipzig in 2008

EU Commissioner Dr. Johannes Hahn and Sven Morlock, Saxon State Minister for Economic Affairs and Labour, visiting in 2010

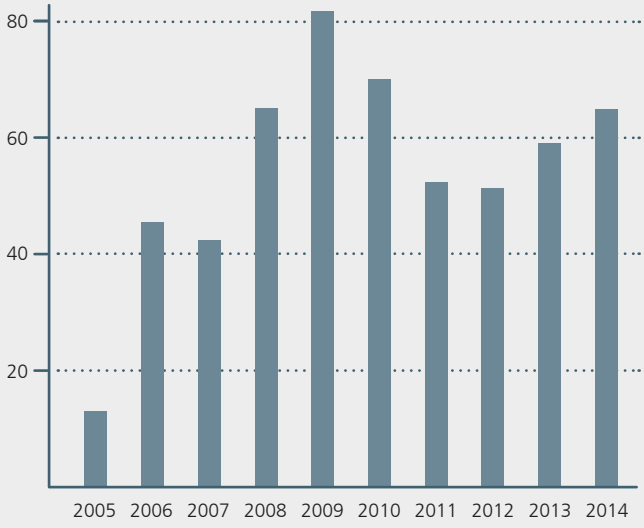

Dr. Reiner Haseloff (3rd from l.) and Stanislaw Tillich (4th from l.), Minister Presidents of Saxony-Anhalt and Saxony, together with the rectors of Halle-Wittenberg University and Leipzig University, Professor Udo Sträter (1st from l.) and Professor Beate Schücking (2nd from l.) as well as Prorector of the HTWK Leipzig Professor Markus Krabbes (3rd from r.) at a press conference in 2014

# 2005–2015 DEVELOPMENT

### Financial volume




### Number of projects



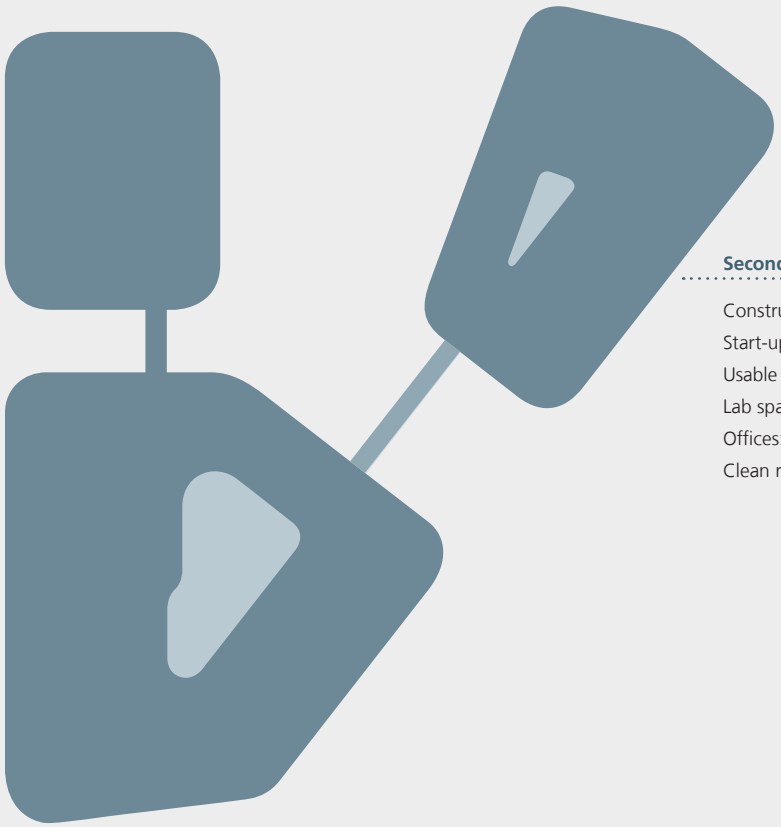

### Available usable area and lab space at the Leipzig headquarters

**First extension building**

| | |
|---|---|
| Construction period: | 30 month |
| Start-up operations: | 2012 |
| Usable area: | 1.568 m² |
| Lab space: | 856 m² |
| Offices: | 142 m² |
| Clean rooms: | 377 m² |

**Main building**

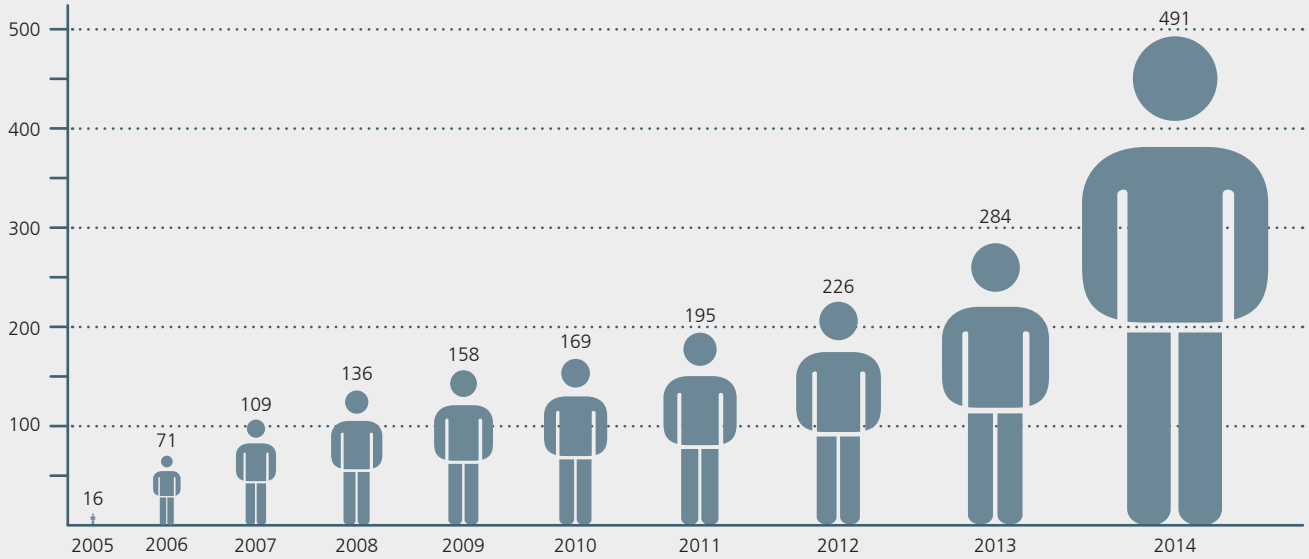
| | |
|---|---|
| Construction period: | 21 month |
| Start-up operations: | 2008 |
| Usable area: | 4.131 m² |
| Lab space: | 1.867 m² |
| Offices: | 1.615 m² |
| Seminar area: | 276 m² |



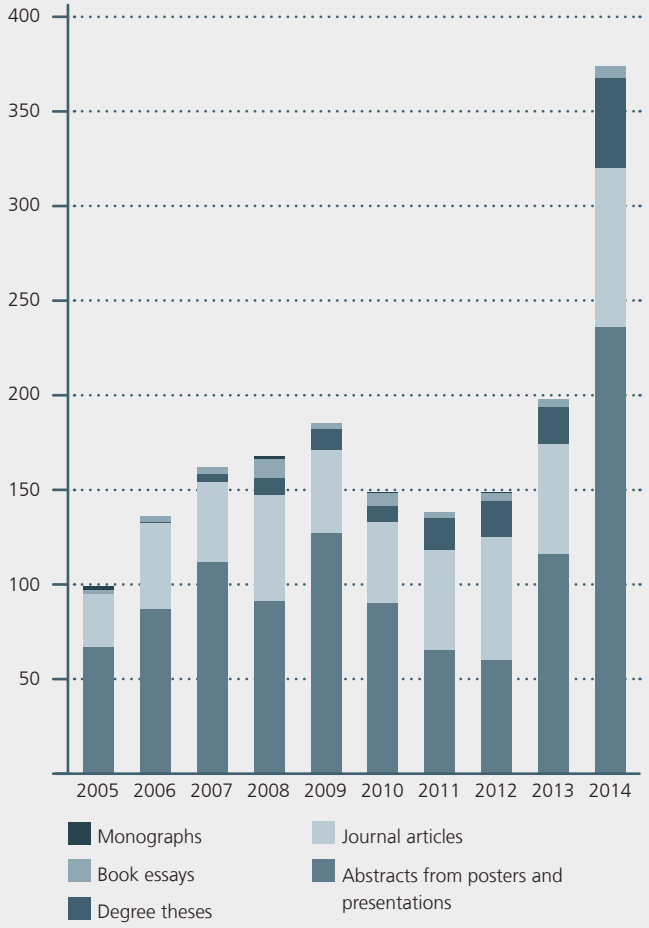
**Second extension building**

| | |
|---|---|
| Construction period: | 22 month |
| Start-up operations: | 2015 |
| Usable area: | 3.050 m² |
| Lab space: | 1.171 m² |
| Offices: | 881 m² |
| Clean rooms: | 408 m² |

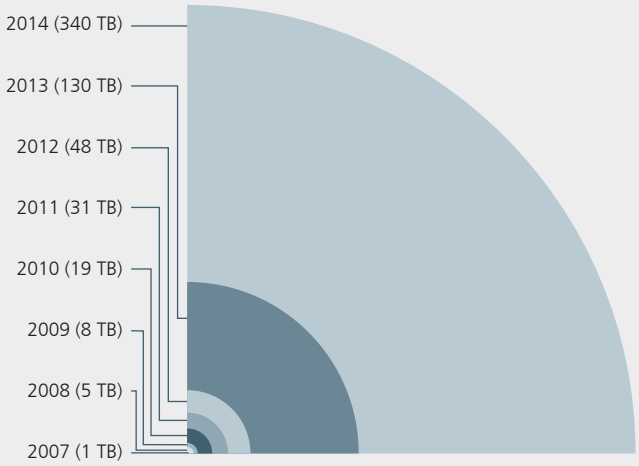
## Development of staff figures




## Publications



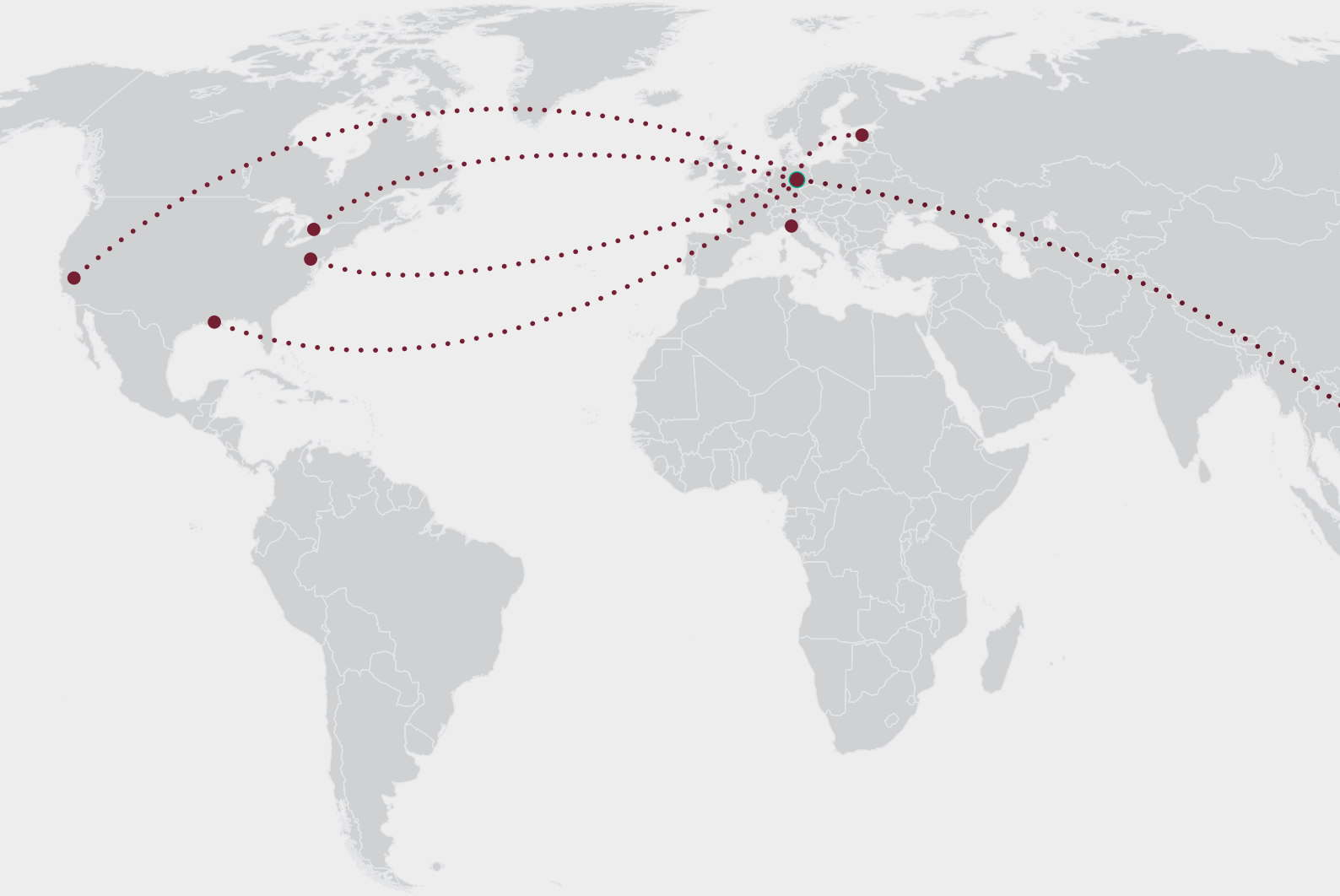

## Growth of data volume on the institute servers (in terabytes)




## Graduate papers in total

# 2005 – 2015 SPIN-OFFS AND COMPANY SETTLEMENTS

The Fraunhofer IZI strengthens the regional economy by helping international and national companies settle in Leipzig and by supporting and encouraging colleagues in starting up their own companies. Since its foundation in 2005, the Fraunhofer IZI has been substantially involved in the settlement and founding of a total of thirteen companies. The site's appeal and its local cooperation with the Fraunhofer IZI were important factors in the partners' decision to settle there.



**Nuvo Research GmbH (settled in 2009)***

- Origin: Canada, Nuvo Research Inc.
- Business model: Developing immunomodulatory drugs to treat inflammatory diseases such as rheumatoid arthritis and allergic rhinitis

**Northwest Biotherapeutics GmbH (settled in 2011)***

- Origin: USA, Northwest Biotherapeutics, Inc.
- Business model: Developing an immunotherapeutic to treat glioblastomas

**InnovaStem GmbH (settled in 2009)***

- Origin: Italy, I.M.S. Innovative Medical Solutions S.r.l.
- Business model: Establishing a stem cell bank to store adult stem cells from various neonatal tissues

**Sonovum AG (founded in 2011)**

- Origin: Germany, Fraunhofer IZI
- Business model: Developing diagnostic procedures on the basis of ultrasounds

**Bioville GmbH (settled in in 2010)***

- Origin: Germany, Fraunhofer IZI
- Business model: Developing and managing projects with a focus on the former trade fair grounds

**MD-5 GmbH / Nervive (settled in 2012)***

- Origin: USA
- Business model: Medical device for stroke therapy

**Magna Diagnostics GmbH (founded in 2010)***

- Origin: Germany, Fraunhofer IZI
- Business model: Developing an innovative diagnostics platform for the rapid diagnosis of infectious diseases based on a lab-on-a-chip system

**Oncotrition GmbH (founded in 2012)***

- Origin: Germany, Fraunhofer IZI
- Business model: Nutritional supplement concepts for the prevention of cachexia and the development of tumor-preventative strategies

**Prima BioMed GmbH (settled in 2010)***

- Origin: Australia, Prima BioMed Ltd.
- Business model: Developing an immunotherapeutic to treat ovarian cancer

**SelfD Technologie GmbH (settled in 2012)***

- Origin: Estonia, Selfdiagnostics, OÜ
- Business model: In vitro diagnostics

**Cognate Bioservices GmbH (settled in 2011)***

- Origin: USA, Cognate BioServices, Inc.
- Business model: Providing development services for cell therapy products

**ApoCell (settled in 2013)***

- Origin: USA, ApoCell Inc.
- Business model: Development of a procedure to improve cancer diagnostics

**Tutelacell GmbH (founded in 2014)**

- Origin: Germany, Fraunhofer IZI
- Business model: Project development and project management

*Spin-off and settlement projects overseen by the Fraunhofer IZI were supported by the SMILE start-up network.

# STRUCTURES AND FIGURES 2014

*”The continuous growth of our institute has always posed an ever-growing challenge to the Administration team. I am proud of the entire team for always mastering these challenges.”*

*Patric Nitz, Head of Administration, at the Fraunhofer IZI since 2005*

# PORTRAIT OF THE INSTITUTE

In light of an aging society and an increasing number of chronic diseases, modern medicine is facing exceptional challenges. The Fraunhofer Institute for Cell Therapy and Immunology IZI is working on meeting the demands of health and quality of life through new developments in the fields of diagnostics and therapy. Our body's immune detection and defense system are of particular interest here, as well as cell-biological assay and treatment methods.

Over the past years, biotechnology and regenerative medicine have taken on greater significance. Of these specialized fields the public expects new therapies for the treatment of diseases which lead to the irreversible damage of tissue and organs; these invariable include chronic, autoimmune and tumor diseases.

The goal is to systematically repair the damages caused by diseases associated with the destruction of cells or tissue and to correct dysfunctions by means of cell therapies, tissue engineering or targeted modulation of the immune system. This goal can be achieved by stimulating the body's own regeneration processes or by means of biological substitutes in form of extracorporeally cultivated tissues.

**General topic: Cell therapy and immunology**

In the narrow sense of the word, cell therapy denotes the transfer of cells that provide a substitute for lost functions however are also capable of taking over advanced active functions and additionally the term describes the repairing of defects by means of treatment with cells. Stem cells can be transferred in order to induce the formation or repair of tissue.

This builds a bridge to immunology, which is concerned with cellular defense and control mechanisms. It is expected that cell therapeutic methods for targeted enhancement, suppression or regeneration of the immune system will soon be available, e. g. for stimulating the defense mechanisms of degenerate cells or for suppressing undesired graft-versus-host reactions against grafted tissue. In addition, the further development of immunomodulatory techniques, e. g. vaccination, is of particular importance.

**The institute's tasks**

The institute operates four sites. The four departments Cell Engineering, Immunology, Cell Therapy and Diagnostics are based at the Leipzig headquarters. The Potsdam-Golm branch is home to the four departments Biosystem Integration and Automation, Cellular Biotechnology, Cell-free Bioproduction as well as Bioanalytics and Biosensors. Two additional off-site departments are located in Halle (Saale) and Rostock. A total of 37 units thus represent a broad spectrum of expertise and qualifications.

The institute's spectrum of services is aimed at specific problem solutions at the interfaces of medicine, biosciences and engineering. With this, the Fraunhofer IZI addresses not only the biomedical industry, including pharmaceutical and biotechnological companies and diagnostic laboratories, but also hospitals and research facilities.

The institute's core competences lie in the fields of cell biology, immunology, drug biochemistry, bioanalytics, bioproduction, process development and automation as well as in regenerative medicine. Besides developing and testing new drugs, this also primarily entails cell-therapeutic approaches to restoring dysfunctional tissue and organs right through to biological replacement by means of tissue cultivated in vitro (tissue engineering). For an unproblematic engraftment of these tissues it is necessary to detect cellular and immunological mechanisms of defense and control and to integrate them into the development of methods and products. Around these core competencies a large variety of tasks for new products and methods arises. The institute is strongly oriented towards the hospitals and takes on quality testing, the production of clinical test samples according to GMP guidelines and contracted clinical trials. In addition, we support our partners in obtaining manufacturing and marketing authorizations.

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# ORGANIZATION

**Bioanalytics and Bioprocesses Branch of Institute (Potsdam-Golm)**
Prof. Dr. Ulrich Buller

**Strategy, Marketing and Administration**
Katja Okulla

**Department of Biosystem Integration and Automation**
Prof. Dr. Frank Fabian Bier

- **iVD-Platform**
  Prof. Dr. Frank Fabian Bier
- **Biomolecular Nanostructures and Measurment Technology**
  PD Dr. Ralph Hölzel
- **Biomimetic Functional Materials**
  Dr. Nenad Gajovic-Eichelmann
- **Laboratory and Process Automation**
  Jörg Henkel

**Department of Cellular Biotechnology**
Dr. Claus Duschl

- **Lab-On-Chip Technology**
  Dr. Claus Duschl
- **Miniaturized Cell Assays**
  Dr. Michael Kirschbaum
- **Extremophile Research and Biobank CCCryo**
  Dr. Thomas Leya
- **Biofunctional Coatings**
  Dr. Dmitry Volodkin

**Department of Cell-free Bioproduction**
Dr. Stefan Kubick

- **Cell-free Protein Synthesis**
  Dr. Stefan Kubick
- **In Vitro Protein Labeling**
  Dr. Stefan Kubick
- **Eukaryotic Lysates**
  Doreen Wüstenhagen

**Department of Bioanalytics and Biosensors**
Dr. Eva Ehrentreich-Förster

- **Microarray and Sensor technology**
  Dr. Eva Ehrentreich- Förster
- **Biomarker Validation and Assay Development**
  Dr. Harald Seitz
- **Molecular Bioengineering**
  Dr. Markus von Nickisch-Rosenegk
- **Metabiobanks CRIP**
  Dr. Christina Schröder

1 *Potsdam-Golm*
2 *Halle (Saale)*
3 *Leipzig*

2


3

**Directors**
Prof. Dr. Frank Emmrich (executive)
Prof. Dr. Ulrich Buller

**Press and Public Affairs**
Jens Augustin

**Administration**
Patric Nitz

**Business Development and Patent Management**
Dr. Thomas Tradler

**Preclinical Validation**
Dr. Thomas Grunwald

**Officers**

**Leipzig Headquarters**

**Department of Cell Engineering**
Dr. Gerno Schmiedeknecht

**Cell Engineering / GMP**
Dipl.-Ing. Kati Kebbel

**Cell Engineering / GLP**
Dr. Jörg Lehmann

**Department of Immunology**
Prof. Dr. Frank Emmrich

**Vaccine Technologies**
PD Dr. Sebastian Ulbert

**Immune Tolerance**
Dr. Stephan Fricke

**Antimicrobial Agents**
Dr. Andreas Schubert

**Ligand Development**
Dr. Michael Szardenings

**Extracorporeal Immunomodulation Project Group**
Prof. Dr. Steffen Mitzner

**Cell Functional Image Analysis**
Prof. Dr. Ulf-Dietrich Braumann

**Department of Cell Therapy**
Dr. Dr. Johannes Boltze

**Immunotherapy – Oncology**
Christopher Oelkrug M.Sc.

**Ischemia Research**
Dr. Daniel-Christoph Wagner

**Experimental Imaging**
Dr. Alexander Kranz

**Clinic-oriented Therapy Assessment**
Dr. Antje Dreyer

**Cognitive Genetics**
Dr. Arndt Wilcke
Dr. Holger Kirsten

**Department of Diagnostics**
Prof. Dr. Friedemann Horn

**Inflammation Models and Immunodiagnostics**
Dr. Franziska Lange

**Tumor Stem Cells**
Dr. Peter Ruschpler

**Nanotechnology**
Dr. Dirk Kuhlmeier

**DNA Nanodevices**
Dr. David M. Smith

**RNA Biomarker**
Dr. Sabina Christ-Breulmann

**Analysis Strategies**
Prof. Dr. Friedemann Horn

**Department of Drug Design and Target Validation (Halle / Saale)**
Prof. Dr. Hans-Ulrich Demuth

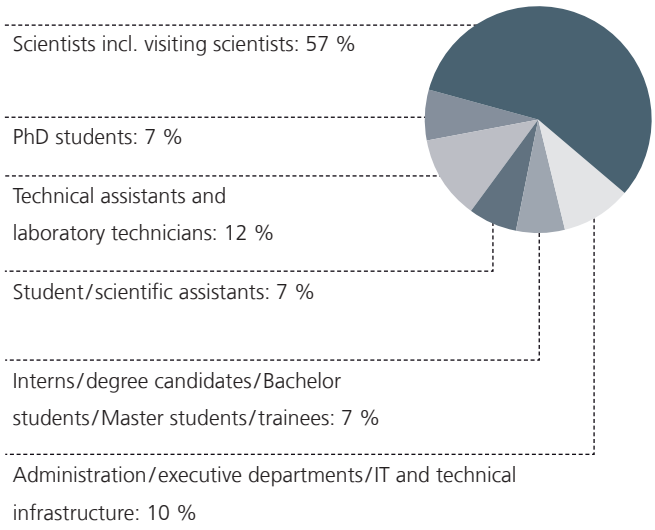
**Molecular Biotechnology**
Dr. Holger Cynis

**Protein and Drug Biochemistry**
Dr. Stephan Schilling

**Drug Design and Analytical Chemistry**
Dr. Mirko Buchholz

# KEY INSTITUTE FIGURES 2014

### Workforce composition



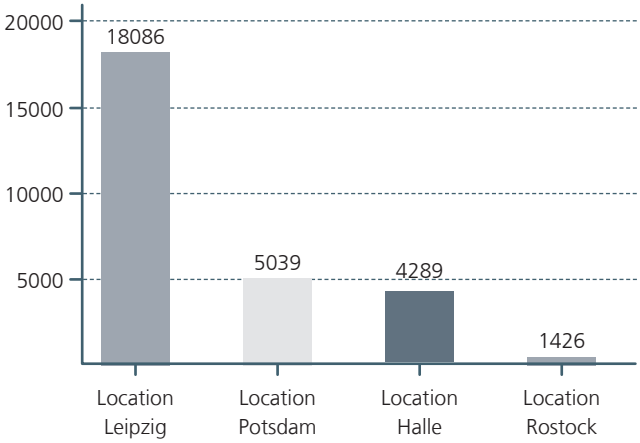

### Staff distribution (as at 12/31/2014)

| | |
|---|---|
| Leipzig | 304 |
| Potsdam | 119 |
| Halle | 49 |
| Rostock | 19 |
| **Total** | **491** |

### Project revenue 2014 in kEUR

| | Leipzig | Halle | Potsdam | Total |
|---|---|---|---|---|
| German national and regional government | 10851 | 4135 | 2746 | 17732 |
| EU | 5 | 119 | 211 | 335 |
| Industry projects | 2387 | 6 | 566 | 2959 |
| Other (incl. internal programs) | 3851 | 29 | 632 | 4512 |
| **Total** | **17094** | **4289** | **4155** | **25538** |

### 2014 financial values in kEUR (total €28.84 million)




### Number of projects in 2014

**Financial value**

Financial value was able to be increased to 28.84 million euros in the reporting year, thus reaching almost twice the previous year's value. Included in this amount are financial resources from internal programs, special allowances from strategic investments and special funding for the off-site departments. The institute's overall financial value thus comprises 18.1 million euros at the Leipzig headquarters, 4.3 million euros at the Halle site, 1.4 million euros at the Rostock site and 5.04 million euros through the Potsdam-Golm branch which was affiliated in July 2014. Not included are expenses for the construction work on the third construction phase at the Leipzig branch: This work is being funded by the European Union, the Free State of Saxony and the Fraunhofer-Gesellschaft.

**Projects**

With an overall sum of 25.54 million euros, project revenue almost doubled compared with the previous year (12.4 million euros). The number of projects also increased to a total of 65 in the reporting period, up from 52 in 2013. The majority of these projects – 22 in total with overall revenue of 17.7 million euros – is funded by the government and *Länder*. The industrial proportion is made up of 20 projects and overall revenue of almost three million euros.

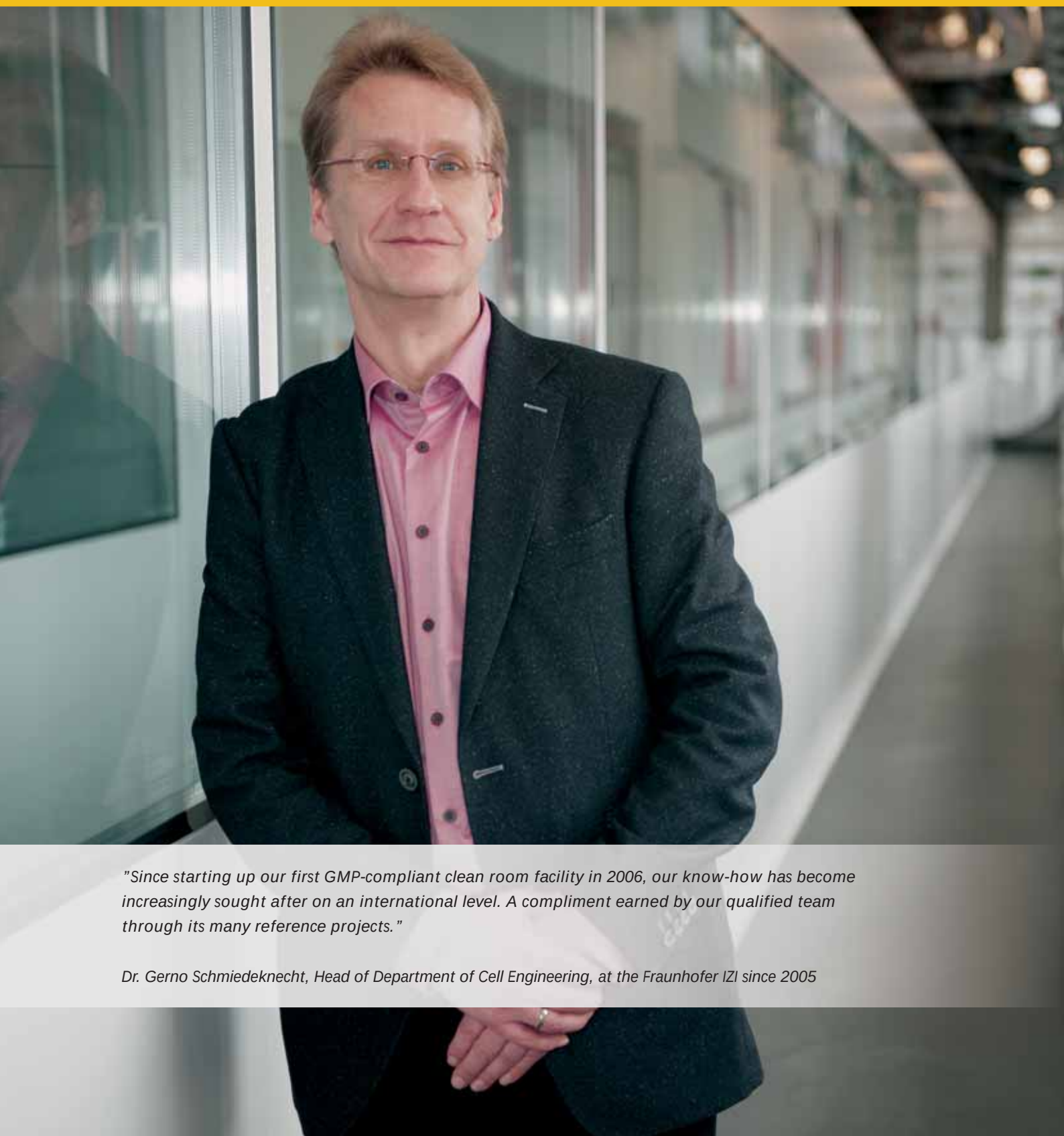
Besides traditional industrial projects, the Fraunhofer IZI provides significant assistance to industrial cooperations, which are funded through the Sächsische Aufbaubank (Saxon Development Bank, SAB) using means provided by the EU. In many cases, these cooperations have given way to follow-up projects and settlements. As partner companies have to contribute co-financing of 40 to 70 %, these projects take up a special position among the projects funded by the government and *Länder*. Large EU collaborative projects have, in the meantime, become much less attractive due to the associated accounting procedures which are unfavorable for the Fraunhofer Institute. The overall value of SAB projects for the Fraunhofer IZI amounted to approx. nine million euros in the reporting period. These projects primarily support medium-sized industry in Saxony.

**Members of Staff**

In 2014, the institute once again saw a huge increase in staff numbers. The overall number of employees increased from 284 to a total of 491. This was mainly due to the interim affiliation with the Potsdam branch, which accounted for a total of 119 people. At the Leipzig headquarters, a total of 304 people were employed on the reference date (12/31/2014), while 49 people were employed in Halle and 19 in Rostock. Research fellows make up the majority of employees. At just 10 %, Administration remains small and efficient.

This dynamic development forms the basis of the institute's scientific excellence, the continuous promotion of young scientists, and the sustainable consolidation of partnerships both in Germany and abroad. Interdisciplinary and intercultural teams help maintain high-quality results. With over 20 branches of study, our staff's qualifications are as diverse as their cultural backgrounds. Female employees make up over 60 % of staff at the Fraunhofer IZI; the institute therefore ranks highly within the entire Fraunhofer-Gesellschaft in terms of employing women.

# DEPARTMENT OF CELL ENGINEERING



*”Since starting up our first GMP-compliant clean room facility in 2006, our know-how has become increasingly sought after on an international level. A compliment earned by our qualified team through its many reference projects.”*

*Dr. Gerno Schmiedeknecht, Head of Department of Cell Engineering, at the Fraunhofer IZI since 2005*

# IN CONVERSATION WITH DR. GERNO SCHMIEDEKNECHT

**Which of the department's areas of competence / technologies are particularly impressive and which R&D services have emerged as a result?**

Of particular note are our many years of experience with the GMP-compliant manufacture of cell-based drugs – referred to as advanced therapy medicinal products – for use in clinical trials. With the Cell Engineering/GMP Unit, we cover the entire spectrum here, from process development and validation, development and validation of quality controls, international technology transfer through to the manufacture of investigational medicinal products for all study phases or alternatively for individual use pursuant to Section 4b of the German Drug Act within the scope of "hospital exemption". The high-quality R&D services offered by our GLP testing facility operated by the Cell Engineering/GLP Unit are especially important here. Preclinical trials on the safety and efficacy of advanced therapy medicinal products and other drugs are conducted here, besides accompanying investigations within the context of clinical trials, e. g. immune monitoring in the clinical testing of innovative immunotherapies.

**What were the department's main challenges and highlights in the 2014 reporting year?**

One of the main challenges facing the Cell Engineering/GMP Unit was further developing the successful collaboration with our major project partners Northwest Biotherapeutics/ Cognate BioServices and Prima BioMed. The clinical trials conducted here were continuously supplied with high-quality investigational medicinal products and the number of clinical investigational sites in Germany and other European countries was steadily increased. In addition, the first patients received the therapeutic agent under the authorization granted in 2014 for the autologous immunotherapy DCVax®-L, which is based on dendritic cells. This authorization was issued in accordance with Section 4b of the German Drug Act within the scope of so-called "hospital exemption". In 2014, the Cell Engineering/GLP Unit excelled not only in terms of its huge number of scientific publications, but also through the brilliant support it lent young scientists, as reflected in several graduate papers. The three-day reinspection of the GLP testing facility in September 2014, which once again managed to ascertain the unit's high quality standards, posed a huge challenge, but one that was successfully mastered. Besides this, the Cell Engineering/GLP Unit attracted numerous new projects with various partners from the biotechnology and pharmaceuticals industry.

**Please give us a brief outlook over the department's key tasks and plans for the 2015 anniversary year and beyond.**

The 2015 anniversary year will be characterized not only by further staff growth in the department due to upcoming, new projects, but also by the expansion of methodological, scientific and technical expertise and the development of the infrastructure. Special focus will be placed here on finishing the Fraunhofer IZI's second extension building. This will involve putting an additional pharmaceutical clean room facility into operation for the manufacture of advanced therapy medicinal products and qualifying this facility to GMP standards. The facility will comprise a 200 $m^2$ clean room area and five manufacturing rooms meeting the requirements of clean room classification B. The first projects are expected to be processed here in the first quarter of 2016, once the facility has been qualified and has successfully completed the necessary official inspection. The Cell Engineering/GLP Unit will also move into new, state-of-the-art laboratories in the second extension building, which are better equipped for the unit's needs and quality requirements.

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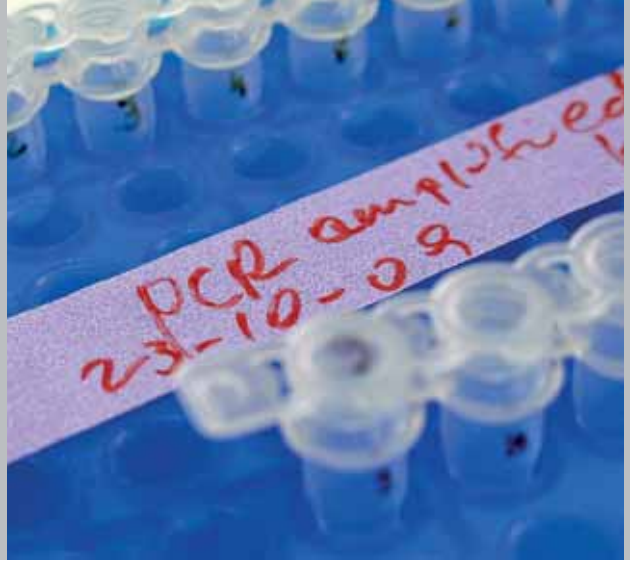


# UNITS

### Cell Engineering / GLP Unit

The unit focuses on three main topics: 1) Planning and conducting preclinical efficacy and safety studies for new drug candidates, in particular ATMPs, (in vitro and in vivo) under GLP and GLP-analogous conditions. This also includes the development, establishment and validation of new in vitro and in vivo models. 2) Identification and validation of new protein biomarkers for application in diagnostics and in the treatment of chronic inflammatory and tumor diseases as well as for veterinary medicine/animal breeding. 3) Developing and optimizing methods and techniques for the diagnostic detection of protein biomarkers and for the separation of cells. This includes the development, manufacturing and modification of monoclonal antibodies as well as participation in the development of analytical equipment and cell separation robots.

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### Cell Engineering / GMP Unit

The Cell Engineering/GMP Unit operates Fraunhofer IZI's two modern GMP clean room facilities consisting of eight separate clean room suites (altogether 16 clean room grade B manufacturing rooms) which are optimal for manufacturing Advanced Therapy Medicinal Products (ATMPs). The 60 highly qualified staff members specialize in the GMP-compliant manufacturing and quality control of investigational medicinal products. Transfering and establishing GMP-compliant processes and quality controls as well as creating Standard Operating Procedures (SOPs) are discussed in detail with the partner at the start of the project and then implemented in practice, with a strong emphasis on quality. Project leaders have many years of experience in designing GMP-processes in the cell therapy area.

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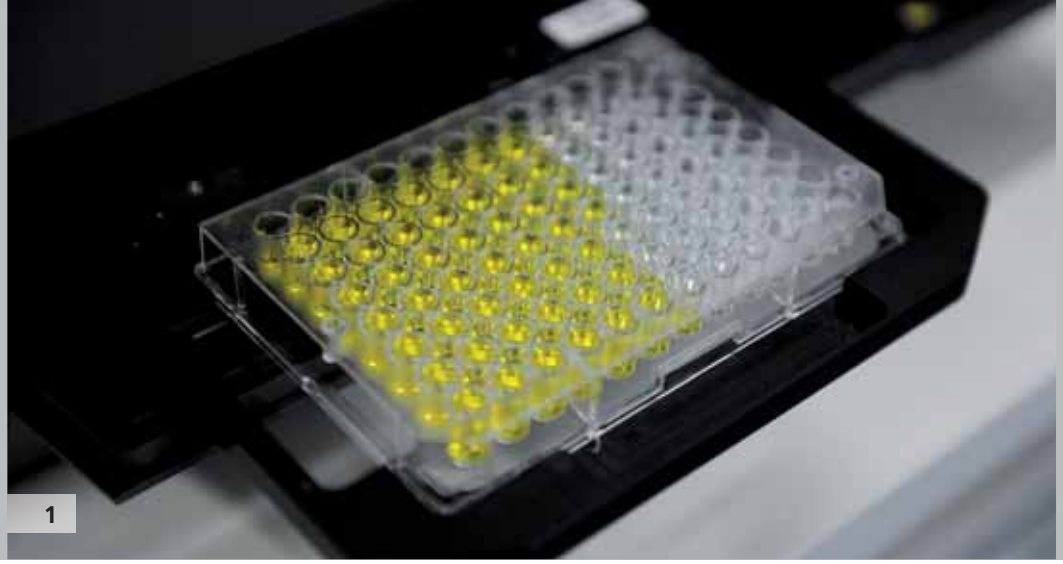

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# PROJECT EXAMPLES

**Development of diagnostic tests for the somatic cell therapy CVac™**

CVac™ is a cell therapeutic based on the body's own immune cells that is to be used to treat tumor diseases following tumor regression (so-called maintenance therapy). The therapy is based on immune cells from peripheral blood, that are differentiated in vitro into specialized antigen-presenting cells known as dendritic cells (DCs). The immature DCs are then brought into contact with a recombinant form of the tumor antigen mucin 1 (MUC1) and thus "trained" to identify tumor cells. The DCs matured in this way are injected into the patient and can now trigger an immune response against remaining tumor cells. The special structure of the recombinant protein thereby induces a particularly effective activation of MUC1-specific cytotoxic T cells. This is intended to prevent new tumor growth and/or the formation of metastases.

As part of a joint project which aims to prepare the commercial availability of CVac™ for clinical development in Europe, tests were designed for accompanying diagnostics. This involved establishing and validating tests for MUC1-specific antibodies and for the reactivity of MUC1-specific T cells. In order to detect MUC1-specific antibodies in the serum, an ELISA (Enzyme-Linked Immunosorbent Assay) was developed where antibodies are bound by recombinant MUC1 and can be quantified using a detection system for human antibodies. The ELISA can thus help to determine the CVac™-specific immune response mediated by antibodies. Reactive MUC1-specific T cells were to be detected by flow cytometry analysis of secreted inflammatory mediators (cytokines) following the restimulation of blood cells with MUC1 peptides. As no MUC1-reactive T cells were expected to be found in the blood taken from healthy donors, the assay was established using peptides of various antigens (e. g. tetanus toxoid). The developed test format allows the simultaneous analysis of T cells and of the cytokines produced by these cells and thus serves to precisely characterize the cell-mediated immune response. In order to make the test format applicable to clinical trials, the test was also established and validated for cryopreserved blood cells.

Both tests are to be used in future as accompanying diagnostics in a phase IIb clinical trial investigating the efficacy of CVac™ in patients with ovarian carcinoma. The simultaneous analysis of antibodies and reactive T cells will thereby allow for a detailed characterization of the immune response induced by CVac™.


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1 *ELISA – Enzyme Linked Immunosorbent Assay – refers to an antibody-based detection procedure.*


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**Development of a test for hypoallergenic nutrition, taking soy as an example**

More and more people are proving to be intolerant or allergic to different foodstuffs. This is connected with symptoms which highly impair affected individuals. Once those affected have identified a certain food as the trigger of their complaints, the ingestion of this foodstuff is strictly avoided where possible. This, in turn, leads to restrictions in everyday life: For instance, more time is spent in supermarkets as ingredients lists first have to be checked for processed foodstuffs or loose products from the weekly market initially have to be avoided. Beyond this, other valuable components of the respective foodstuff can also no longer be ingested. It would therefore be preferable to change food in such a way that the components which trigger intolerances or allergies are either contained in extremely reduced quantities (threshold value) or as a modified, harmless form.

The joint project "Low Allergen" is dedicated to this idea of improving and modifying foodstuffs, using the example of soy. As part of this project, the Cell Engineering/GLP Unit is entrusted with the task of developing a testing procedure to detect food components which trigger allergies. In order to do this, polyclonal and monoclonal antibodies were manufactured and used in different formats. The next stage involves giving a detailed description of the binding properties of selected antibodies. To this end, antibodies from different species are analyzed which identify the same epitopes. The test procedure is then to be optimized based on the resulting findings.

Processed soy is to be analyzed in detail using the developed detection procedure. The aim is to design a certified user kit for soy-based source and/or raw materials for foodstuffs. A relevant label for the processed foodstuff aims to give the consumer a higher level of assurance.

The project is being jointly handled by the Fraunhofer IME, Fraunhofer ITEM and Fraunhofer IZI and is coordinated by the Fraunhofer IVV.

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1 *Soybean plant*

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**Manufacture of the immunotherapeutic DCVax®-L for brain tumor patients**

The US biotechnology company Northwest Biotherapeutics Inc. is conducting a phase III clinical trial in Europe to examine the efficacy of its immunotherapeutic DCVax®-L, whereby the Fraunhofer IZI is responsible for manufacturing the investigational medicinal products. DCVax®-L is an advanced therapy medicinal product (ATMP) based on autologous dendritic cells to treat glioblastomas, a particularly aggressive type of brain tumor. The therapeutic agent has already been successfully used in clinical trials in the USA. After transferring the process in 2011/2012 together with US manufacturing company Cognate BioServices Inc., and after establishing and validating the process and the analytical methods at the Fraunhofer IZI, a manufacturing authorization was acquired through the Landesdirektion Sachsen (Saxony Land local competent authority) and the higher federal authority Paul Ehrlich Institute for DCVax®-L and DCVax® placebo in accordance with Section 13 of the German Drug Act (AMG). Furthermore, the leukapheresis collection facilities and neurosurgical tumor procurement centers had to be qualified in order to guarantee the high-quality procurement of patients' base materials. Obtaining the required authorization for the procurement of tissues in accordance with Section 20b (2) AMG for the removal of tumors has presented and continues to present a particular challenge for various hospitals.

After the clinical trial was approved in the UK and following capacity increases at the Fraunhofer IZI (concerning clean rooms and staff), patient batches for use in British hospitals have been produced since June 2013. In addition, both the clinical trial and a special permit pursuant to Section 4b AMG ("hospital exemption") were authorized by the Paul Ehrlich Institute. The authorization pursuant to Section 4b AMG permits the manufacture of advanced therapy medicinal products as an individual preparation for individual patients who are not able to be included in a clinical trial due to their indication or other exclusion criteria. Batches for German patients have been manufactured in the clean rooms and administered to patients as part of the clinical trial since August 2014; patient batches for treatment pursuant to Section 4b AMG have been manufactured and administered to patients since October 2014. The production, quality control and shipment for the patients and administration to the patient as well as the supervision of the involved hospitals still form the focus of the coming year. Furthermore, additional hospitals in Germany and the UK are to become involved in the clinical trial and treatment pursuant to Section 4b AMG over the next few months.


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1 *Leukapheresis processing for DCVax®-L in the category A clean room*

2 *Cell harvest from the cell culture vessels for the production of DCVax®-L in the clean room*

# DEPARTMENT OF IMMUNOLOGY

*”The immune system spends its whole life learning new things. The same principle applies to science.”*

*PD Dr. Sebastian Ulbert, Deputy Head of Department of Immunology, at the Fraunhofer IZI since 2006*

# IN CONVERSATION WITH PROF. DR. FRANK EMMRICH

**Which of the department's areas of competence / technologies should be especially highlighted and which R&D services have emerged as a result?**
The department offers a wide range of expertise on the modulation and characterization of the immune system. For example, we are looking at ways of thwarting immune defense measures during organ transplantation and have developed far-reaching expertise with antibody-based therapies for this purpose. Furthermore, we are working on techniques to boost the specific immune response to infectious pathogens using vaccines. Manufacturing recombinant vaccine antigens plays a pivotal role here. In a parallel approach, we are developing innovative methods to deactivate viral and bacterial pathogens in such a way that they are particularly well suited to immunization.

Besides this, antibody-based diagnostics also represents an important topic in the department. We have access to state-of-the-art gene libraries, which can be used to identify critical epitopes, for instance in the case of allergies. Through its platforms to manufacture recombinant proteins and its contact to medical partner institutions around the world, the department is able to develop all kinds of serological tests.

**What were the department's main challenges and highlights in the 2014 reporting year?**
As part of an internal Fraunhofer joint project, we managed to conduct a global examination of antibody target structures in the serums of soy allergy sufferers. With the help of a novel peptide phage display procedure in connection with next-generation sequencing, hundreds of these types of epitopes were able to be discovered, the majority of which we had not been familiar with. This procedure proved to be greatly superior to traditional methods in terms of time and expense, especially in the case of this complex antigen.

Moreover, additional competences and skills were called on from our EXIM Project Group in Rostock, which will both intensify work on the existing projects and further supplement the group's range of activities through newly planned projects. Within this context, we are pleased that the project group was given a highly positive assessment by a committee consisting of representatives from politics, science, industry and the Fraunhofer headquarters, which recently examined the group's state of development.

**Please give us a brief outlook over the department's key tasks and plans for the 2015 anniversary year and beyond.**
In collaboration with our academic partners, we are preparing for the clinical testing of our treatment methods for transplant rejection. This is an important milestone for the institute as it is the first time that a development worked on solely by the institute is to be transferred into a clinical trial. The opening of the institute's third extension building will also be incredibly important. Among other things, the possibilities of working with infecting agents will be greatly increased through special laboratories. This will be especially beneficial for the research fellows in the department dealing with the development of vaccines and infection diagnostics. Furthermore, the new construction will also be home to the Bionanotechnology Application Center, a cooperation with the Fraunhofer IKTS which is intended to further develop the interdisciplinary research area of nanotechnology and also make it applicable to research areas in immunology.

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# UNITS

### Vaccine Technologies Unit

The unit develops diagnostic techniques and prevention strategies for infectious diseases in human and veterinary medicine. The main research focus is on viral infections affecting livestock and zoonotic diseases. Pathogens up to biosafety level 3 can also be processed. Marker vaccines are developed which enable differentiation between infected and vaccinated animals (DIVA strategy). All state-of-the-art methods in virology, molecular biology and immunology are well established in the unit. Viruses currently being focussed on include West Nile Virus, influenza, and PRRS Virus (Porcine Reproductive and Respiratory Syndrome). In addition, large-animal models can be provided through the collaboration with the Faculty of Veterinary Medicine at the Leipzig University.

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### Ligand Development Unit

The unit focuses on developments for detecting biomolecules. A new peptide phage display method (patent filed) is combined with modern devices and measurement methods. This allows peptide phage display for epitope mapping as well as the immunome of patient sera (e. g. allergy research) and the identification of peptide ligands for the characterization of complex structures (e. g. cell surfaces) as an alternative to antibodies. These applications range from the labeling of cancer cells/tissues to the characterization of (stem) cells in different culture and storage conditions.

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**Immune Tolerance Unit**

The goal of this unit is to develop cell and antibody-based therapeutic strategies to treat complications following hematopoietic stem cell transplantation. Novel concepts of immunological tolerance which take into account immunological and therapy-associated complications (e. g. GvHD) are being tested in new, in-house developed animal models.


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**Antimicrobial Agents Unit**

The aim of this unit is to develop peptides which have an antimicrobial effect to fight multiresistant germs, such as staphylococcus aureus, vancomycin-resistant enterococci, candida albicans, etc., as well as their evaluation in respective animal models. The main focus here is on applications in the field of dentistry and oral hygiene. A further key focus is placed on identifying and evaluating plant compounds for applications in the fields of immunomodulation, inflammation inhibition, concomitant tumor therapy and antibiosis.


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**Extracorporeal Immunomodulation Project Group**

The project group focuses on the development and evaluation of extracorporeal (outside the body), organ-supporting technologies with a particular emphasis on supporting the immune system. We offer the full range of preclinical and clinical analyses of extracorporeal technologies based on a broad spectrum of in vitro simulations, small and large animal models, as well as a powerful clinical study network for in and out-patients. Moreover, we offer self-developed unique analytic and diagnostic devices including an ex situ intestinal model, a cell sensor and novel protein assays.


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### Preclinical Validation Unit

This unit develops and examines new vaccines and drugs in preclinical trials. Drugs and vaccine candidates are tested in vitro in cell culture systems and in vivo in preclinical trails involving different animal species, also under GLP conditions. This research is focused in part on the development and efficacy testing of innovative vaccines for humans and animals.

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### Image Analysis of Cell Function Unit

This unit develops new methods for the non-destructive, microscopy-based quantification of physiological and pathological processes. The aim is to support research into fundamental biological connections and to test new therapy procedures by analyzing cells and tissue without their modification or destruction. As this objective requires interdisciplinary cooperation in the fields of electrical engineering, optics, imaging, software development and biology, the specialist group has close ties to the Chair for Biotronic Systems at Leipzig University of Applied Sciences.

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# PROJECT EXAMPLES

**Development of methods for the antibody-based detection of dengue infections**

Dengue fever is one of the most dangerous and widespread insect-borne viral infections. The affected patients normally suffer from high fever, however serious, even fatal, disease progression may also occur. Up to 100 million people are reported to be infected around the world. Dengue fever especially affects the regions of Africa, the eastern Mediterranean area and the Western Pacific. However, the virus has long since spread beyond these areas. Europe has also seen localized epidemics and it is to be assumed that the spread of the disease will intensify in future: The carriers of the virus (e. g. the Asian tiger mosquito) are becoming increasingly endemic to southern Europe, which means that new outbreaks of the disease are also reckoned upon in Europe.

Dengue viruses belong to the family of flaviviruses, which also include other important pathogens such as yellow fever, TBE or West Nile Virus. A major problem in the serological diagnosis of dengue infections is the fact that antibodies demonstrate a high level of cross-reactivity with these other flaviviruses, making it extremely difficult to differentiate between individual infections.

A satisfactory antibody test which is completely specific to dengue is yet to be found. The demand for such a product is, however, extremely high due to the need for reliable diagnosis, particularly as several different types of flavivirus circulate at the same time in many regions around the world. At the Fraunhofer IZI, a system for identifying specific antibody targets, so-called B cell epitopes, of the West Nile Virus (WNV) was developed as part of the EU WINGS project. This principle has now been applied to dengue viruses. The proteins found in the dengue virus were divided into many smaller protein fragments and then incubated with different human serums. This enabled peptides to be identified, which were specifically recognized based on dengue antibodies. Together with diagnostics company Analytik Jena, these results will now be further developed to create a test that will be able to sensitively and accurately diagnose respective infections.

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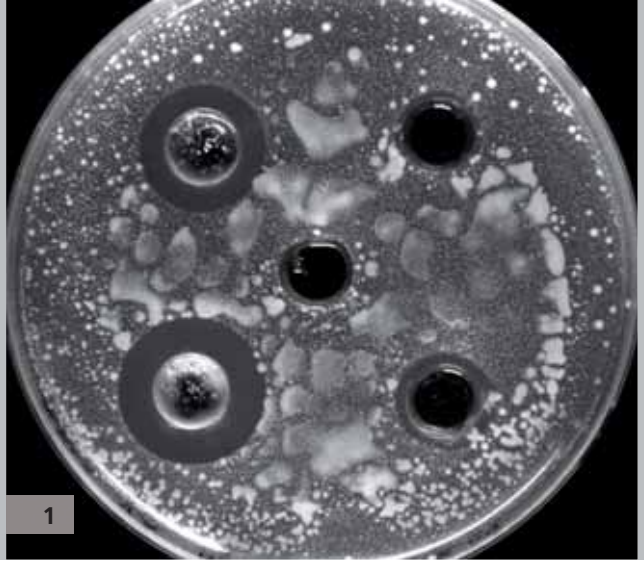
Europa fördert Sachsen.
EFRE
Europäischer Fonds für regionale Entwicklung

1 *Asian tiger mosquito*



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**The development of antimicrobial peptides for use in medicine and food production**

The need for new antibiotic drugs based on bioactive substances has greatly risen in recent years due to the increased resistance of human pathogenic germs. Strong growth is also predicted for the future of this segment. In the Antimicrobial Agents Unit, antimicrobial peptides are being developed to fight multiresistant hospital germs and oral, human pathogenic germs with the aid of a specially established technology platform. This DNA-based technology facilitates the development of an appropriate, antibiotic peptide against, in principle, every type of hospital germ by using a high-throughput technique. Some of these antimicrobial peptides have a broad-spectrum effect and could thus be applied against several different types of bacteria or even pathogenic fungi (e. g. candida albicans). Over the course of the past five years, more than ten sequence libraries were established with partly differing ranges of efficacy, e. g. against human-pathogenic oral germs (cariogenic germs such as streptococcus mutans, streptococcus sobrinus or pathogens associated with periodontitis such as actinobacillus actinomycetemcomitans or porphyromonas gingivalis), germs found in the gastrointestinal tract (helicobacter pylorii) and also against germs found in the respiratory tract (haemophilus influenzae).

Special emphasis is currently being placed on developing antimicrobial peptides against periodontitis and/or caries pathogens. Although the incidence for caries has decreased thanks to improved prophylaxis, oral hygiene and the extensive availability of fluorinated drinking water, contagious diseases in the field of oral health cost Germany billions of euros every year.

In 2014, among other things, five antimicrobial peptides were developed in the unit which are extremely selective in destroying the two most significant caries pathogens (streptococcus mutans and streptococcus sobrinus), yet without negatively impairing the commensal flora, which is important for the integrity of the oral cavity. Besides this, these peptides do not have a negative impact on epithelial cells, which means they can be used in the areas of restorative treatment, caries prophylaxis and dental implantology. On the surface of teeth, both peptides were proven to substantially delay the formation of biofilms, prompting their further use in dental hygiene products (mouthwashes, toothpastes). The structure of other peptides renders them chemically inert to reactive oxygen. This makes them optimally suited to be used, for example, as an extra additive in ozone-based periodontitis treatments. Applications involving antimicrobial peptides in the field of dentistry and in the production of foodstuffs are planned for the next stage of research.

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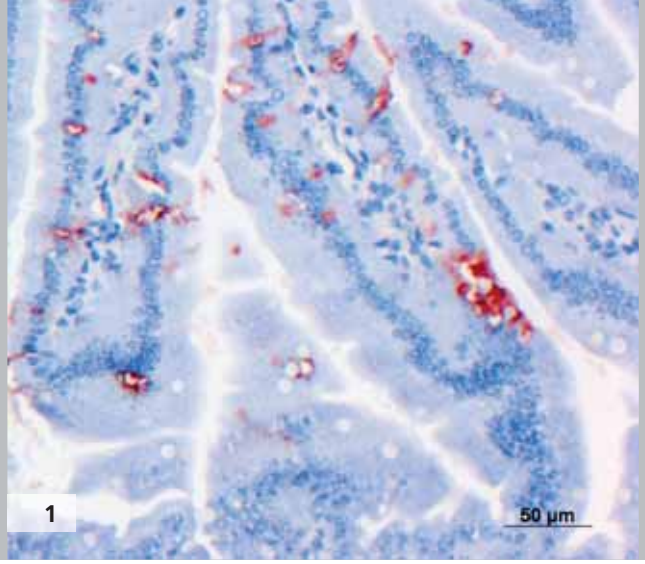
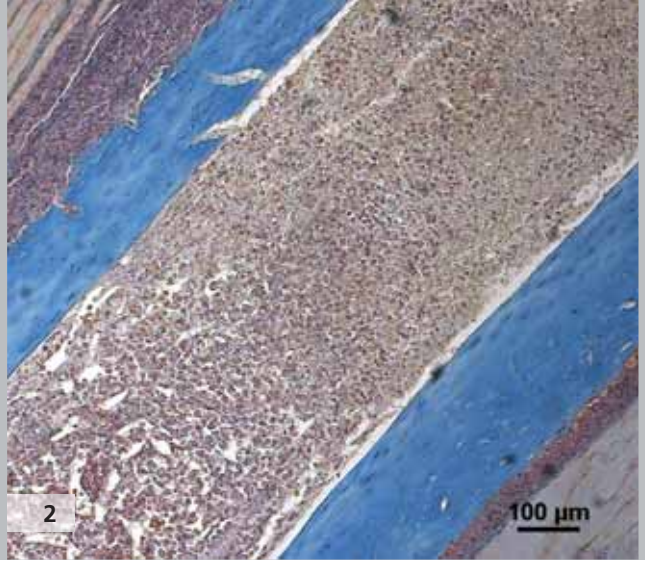
1 *Agar diffusion test to determine the antibacterial efficacy of peptides*




**Prevention of adverse immunological complications while retaining anti-tumor effect following stem cell transplantation using anti-human CD4 antibodies**

The main complication following an allogeneic hematopoietic stem cell transplant is acute graft-versus-host-disease (aGvHD). The conventional treatment methods are frequently associated with low long-term success and toxicities. This necessitates the development of treatment alternatives which are less burdensome.

A new approach involves the use of a specific anti-human CD4 antibody. The antibody specifically reduces adverse immune reactions, thus minimizing the chances of aGvHD emerging following stem cell transplantation. The influence of this anti-human CD4 antibody with regard to the prevention of GvHD and under consideration of the graft-versus-leukemia (GvL) effect in a clinically relevant, humanized leukemia model is currently being investigated. Models are being used for this purpose which are particularly well suited to the transplantation of human hematopoietic stem cells and human leukemia cells. The findings are essential in applying the antibody and other new drugs in the hospital environment. Existing leukemia models are being further developed and the anti-human CD4 antibody and other drugs are being evaluated.

Through the use of humanized models, it may be possible to achieve new findings concerning immunological processes in the emergence of GvHD and regarding the GvL effect. The models and findings are not only extremely valuable for hematopoietic stem cell transplantation and leukemia treatment, but also for stem cell transplantation in other indications (e. g. autoimmune diseases).

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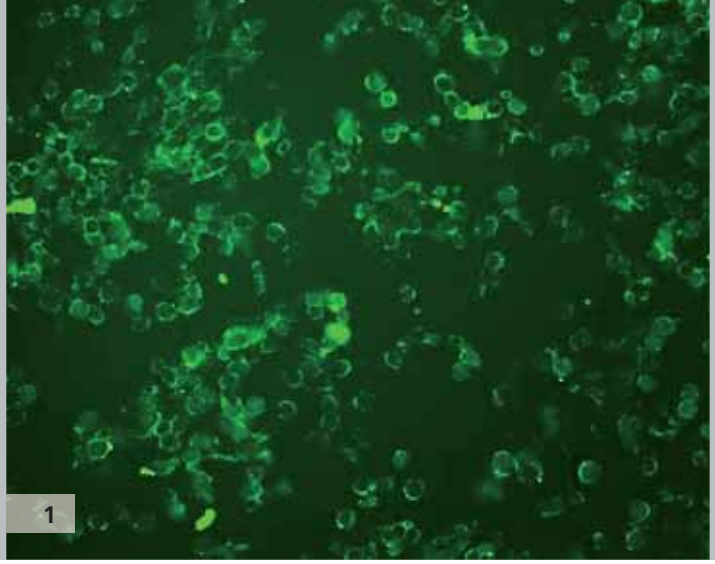
1 *Apoptosis examination of the intestine (TUNEL staining)*
2 *Tumor cell migration in murine bone marrow (KAO staining)*



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## Peptides for tumor targeting

Targeted treatment of tumors and being able to differentiate between healthy and aberrant cells in therapeutic applications are just some of the most recent developments in medical science. Antibodies prevail in today's clinical applications, however their use is often limited by production costs and the quantities required for treatment due to the size of the molecules. Small, synthetic peptides have many practical advantages, especially for imaging and novel tumor targeting drugs, provided they have sufficient selectivity and affinity to bind their target structures.

In several projects, the unit aims to identify peptides which are able to characterize different cell and tissue types, e. g. tumor-specific ligands. One of these projects started back in 2012 in collaboration with a large tumor hospital in South Korea, and another started more recently in 2014 with Spanish and German companies primarily focused on the development of a novel type of tumor-specific nanoparticle which targets kidney tumors.

Peptides are selected using a newly developed procedure for peptide phage display based on a novel library design. This avoids repeated selection rounds: Based on the read-out of all bound phage with next-generation sequencing (NGS), it facilitates analysis in silico. For this purpose, a large database has been built which contains data sets obtained from many different cell and tissue types. New data sets can be compared and analyzed based on the existing data. The analysis for tissue specific targeting peptide motifs is carried out with special software on millions of sequences. This is similar to a procedure we currently use to characterize the antibody repertoire in the serum of allergy patients.

The identified peptides are synthesized and their binding behavior and specificity determined on human cells and tissues. This process is carried out with established cell lines as well as human patient material, the latter in collaboration with our project partners. Many different methods are available for cell analysis at the Fraunhofer IZI. Direct protein-peptide or even cell-peptide interactions on surfaces can be measured using a Biacore. The binding of peptides to cells in suspension can be determined by means of flow cytometry with both standard and high-throughput instruments (Intellicyt iQue®, Intellicyt) or by means of sorting (Influx®, BD Biosciences).

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Sponsored by:

Federal Ministry of Education and Research

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thanks to a resolution passed by the German Bundestag

1 *Labeling living renal cancer cells (RCC04, P. Ruschpler, Fraunhofer IZI) with a tumor-specific peptide selected in collaboration with CNUHH/JLCI (Hwasun, Korea)*

**ECOS study center**

Clinical trials form an extremely important part of medical research as they usually represent the final stage before a broad clinical application of new therapy procedures. The organization and conduct of such clinical trials demand special knowledge in terms of study design and regulatory requirements, as well as experience of the statistical and clinical assessment of study results.

The relatively new, integrated Study Center for Extracorporeal Methods and Biosimulation (ECOS) belonging to the EXIM Project Group essentially pursues two target courses: On the one hand, it is dedicated to the implementation of the group's own scientific concepts and developments in practice. On the other hand, it conducts preclinical and clinical trials in close cooperation with the University of Rostock's Department of Medicine and local hospitals in the field of medical extracorporeal therapies and systems for industry partners.

The object of our research includes both interventional and non-interventional trials with drugs and medical products. It is primarily focused on testing dialyzers and accessories, extracorporeal blood treatment, purification and detoxification besides extracorporeal immune cell therapy. The chain of competence here covers all aspects of clinical trials, from planning over to conduct and monitoring through to biometric evaluation and publication.

At present, ECOS is involved in a multicenter clinical trial investigating the efficacy and safety of the Extracorporeal Liver Assist Device (ELAD®) in patients with severe alcoholic hepatitis. Two additional observational studies will investigate the effectiveness of using different adsorbers in albumin dialysis and/or for the treatment of patients with severe sepsis.

Another key area of our work lies in analyzing the spread, causes and processes as well as the influencing factors and interactions of diseases in the field of nephrological diseases, based on clinical and representative population data. In a cooperation project with the Chair of Empirical Social Research at the Institute for Sociology and Demography at the University of Rostock, research is currently under way based on a representative sample of people insured with the AOK health insurance company to see how many patients currently suffer from renal disease in Germany and to pinpoint the proportion of patients who come to depend on renal replacement therapy. Disease progression is also analyzed; this means looking at how long it takes to reach the different degrees of severity of renal failure until the patient is ultimately dependent on dialysis.

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**1** *Case series of an extra-corporeal blood purification procedure*

1

**Characterizing the technical and physical parameters of components of extracorporeal therapy procedures**

When treating different diseases such as kidney or liver failure, sepsis, lipid metabolic disorders, or even in the case of several immunological diseases, medical engineering products are used to remove certain substances from the blood outside of the patient (i. e. extracorporeal removal). The most established blood purification procedure is probably dialysis, which is routinely used to purify the blood of patients suffering from kidney failure in which metabolic toxins are removed from the blood. In other procedures, on the other hand, the aim might be to remove cytokines, cholesterol or even fragments of bacterial cells. Each application has extremely specific technical requirements to help achieve the most optimal level of blood purification possible.

Interest in the further technological development of such medical products is huge, not least because the number of patients treated with extracorporeal therapies is on the rise. In addition, novel therapeutic approaches are constantly being developed which require a new form of technical implementation. An important prerequisite here is the option to be able to specifically characterize such medical products with respect to physical properties as well as the performance parameters. In order to do this, the EXIM Project Group has started to develop a specialized measuring unit which can be used to record and evaluate a range of different technical parameters such as flow rate, pressure and temperature change. This would typically be used to examine damage to blood cells when flowing through a technical component. The respective clinical application is then simulated, for instance in circulation mode with human or animal blood. In addition, there is a broad spectrum of methods which can be used to quantitatively analyze a range of substances dissolved in the blood.

This modularly structured measuring unit is of key significance to several currently ongoing cooperation projects with industrial companies, whereby different medical products are being further developed or characterized in more detail. As the metrological facility is to be further expanded in the coming year, additional applications are also on the horizon.

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1 *Technical components of a dialysis machine*


1

**Development of a vaccine against respiratory syncytial virus**

The human respiratory syncytial virus (RSV) normally only leads to mild complaints such as cold, cough or hoarseness. However, RSV leads to the highest risk for severe diseases of the respiratory tract in premature babies and infants in the first 6 month of life. Neither a therapy nor a vaccine are currently available which effectively protect against the RSV infection. A vaccine trail in the early 1960s using a chemically inactivated vaccine had a detrimental effect. A natural RSV infection lead to an enhanced disease in the vaccinated children with two fatal infections.

Genetic vaccines are currently being tested to be developed for a series of indications. An innovative vaccination method is being investigated as part of preclinical trails. This involves a circular DNA molecule being administered as a vaccine, followed by a mucosal spray application on the tonsils of the vaccinee. This prime-boost vaccination strategy has demonstrated a surprisingly complete protection against experimental infection with this virus. This promising preclinical success is translated to further clinical trails in humans and is expanded to other vaccine candidates.

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**1** *Vaccinations serve to activate the immune system against specific pathogens*

# DEPARTMENT OF CELL THERAPY


*”After ten years of stroke research and profound insights into the nervous system which warranted our work, we are more motivated than ever to really get to grips with the key mechanisms of brain damage.”*

*Dr. Dr. Johannes Boltze, Head of Department of Cell Therapy, at the Fraunhofer IZI since 2006*

# IN CONVERSATION WITH DR. DR. JOHANNES BOLTZE

**Which of the department's areas of competence / technologies are particularly impressive and which R&D services have emerged as a result?**

We want to continue developing the skills gained in the fields of neuroimmunology and system immunology and offer them to academic and industrial cooperation partners as key platform expertise. Especially in the field of immunophenotyping, we were able to develop a range of methods which is capable of competing at a high, global level and is valuable for partners. As part of the institute's own research, we are deriving ideas for potential new therapies from the knowledge we have already gained. Furthermore, we managed to establish an animal model for vascular dementia, which is expected to give rise to additional research impulses.

**What were the department's main challenges and highlights in the 2014 reporting year?**

A special highlight of 2014 was the 8th International Symposium on Neuroprotection and Neurorepair (ISN&N). The 8th ISN&N took place in its founding city of Magdeburg and was by far the largest event of the series with 400 attendees. Representatives from research, medicine and industry held intensive discussions on the latest developments in the field over four days. Moreover, scientific productivity, measured by publications and patents, reached its climax in 2014. Coordinating and organizing numerous complicated, simultaneously running, major research projects while concentrating on the ongoing strategic process proved to be rather challenging. Another important challenge came in structuring the institute's internal advanced training program, besides designing, structuring and finding initial funding for our Biomedical Engineering and Advanced Manufacturing (BEAM) project center together with the McMaster University in Hamilton, Canada. We were able to successfully overcome all challenges and learn a great deal from them.

**Please give us a brief outlook over the department's key tasks and plans for the 2015 anniversary year and beyond.**

In future, the department would like to concentrate on developing specific products, which, however, presents a challenge not to be underestimated due to the enormous yet necessary lead time and the associated resources in the area of clinically oriented life sciences. Furthermore, we want to more specifically develop our research activities in the clinical sphere. An important task in 2015 will also lie in the continuation and more in-depth implementation of our internal advanced training program, which offers PhD, Bachelor and Master students a very competitive training and further education opportunity at a high level.


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# UNITS

**Experimental Imaging Unit**

Experimental imaging stands at the interface between engineering and life sciences. It is dedicated to research activities where the acquisition and processing of images are required before implementation is possible. This draws on different technical devices and software. As the methods used in the applied procedures are constantly being developed, the field of work is always adjusting to reflect the latest developments. The focus here lies on applying state-of-the-art imaging techniques as part of the task assigned to us by our respective project partners.

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**Ischemia Research Unit**

The common conditions stroke, myocardial infarction and vascular dementia are caused by an acute or chronic lack of supply of blood and oxygen. This ischemic tissue damage results in an inflammatory response which is important for the healing process, but may also exacerbate the initial damage. Comorbidities such as hypertension, hyperlipidemia and chronic inflammation especially determine the relationship between protective and damaging influences.

The unit explores the foundations of these correlations with the aim of identifying and preclinically validating novel therapy options.

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**Immunotherapy – Oncology Unit**

The unit encompasses two major areas of interest. New strategies for treating cancerous diseases are developed and tested with the aid of innovative tumor models. The unit also focuses on optimizing therapeutic cancer vaccines, e. g. through different administration strategies, in view of the fact that tumor immunology and re-engineering of the immune system show promising results compared with current types of treatment.

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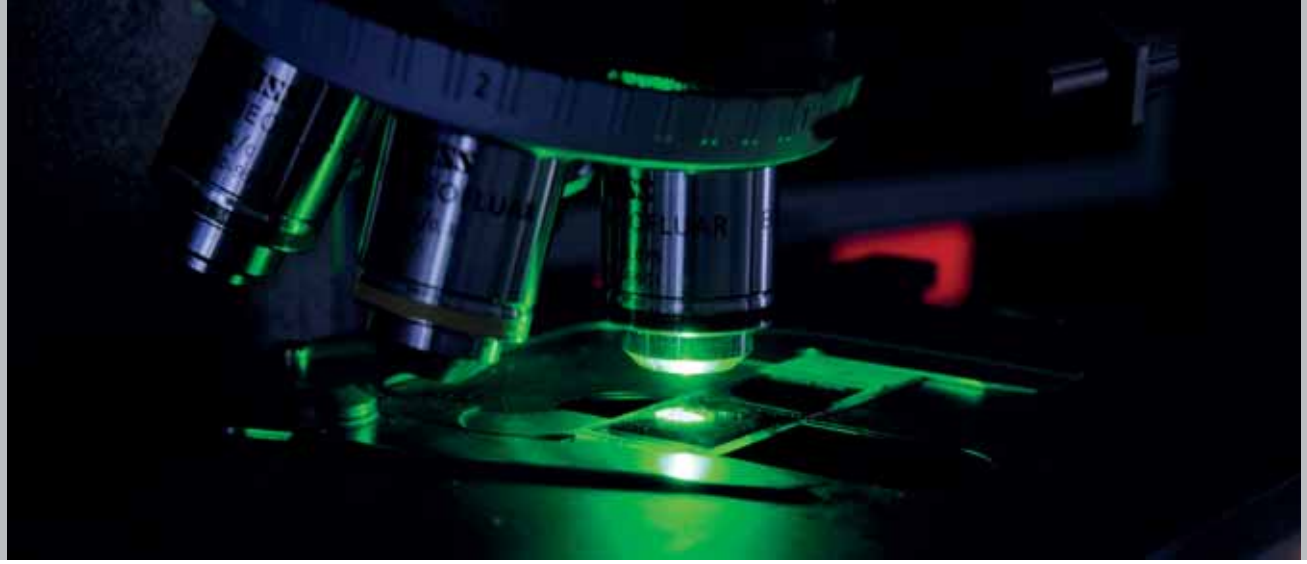

**Cognitive Genetics Unit**

The Cognitive Genetics Unit investigates the foundations and application possibilities for the genetics involved in cognitive processes. The main focus of our work is on the genetics of dyslexia. Our main aim is to develop an early screening test which will effectively facilitate the functional regeneration of dyslexia-related cellular deficits in the future.

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**Clinic-oriented Therapy Assessment Unit**

The unit tests and develops innovative diagnosis and therapy procedures for stroke. As the possibility of being able to transfer findings from small-animal models to human patients is sometimes only very limited, a globally unique, large-animal model was established for the translational approach. Using this model means that tests can be carried out under conditions which come close to patient treatment in a clinical setting. Both the gyrencephalic brain structure and the size of the brain in the human situation are much more similar in the sheep model than they are in the small animal.

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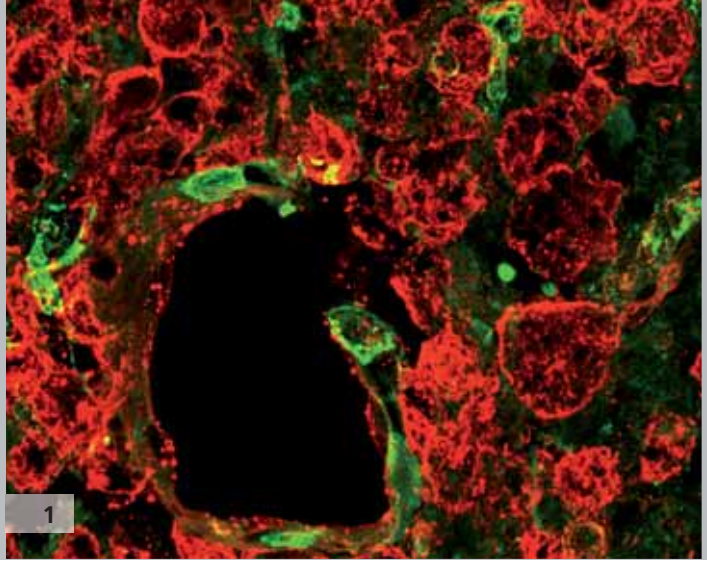

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# PROJECT EXAMPLES

**Immunotolerance following a stroke**

The dying off of nerve cells following a stroke leads to the activation of the immune system and to a huge influx of immune cells in the damaged brain. Certain immune cells, for instance granulocytes, can damage healthy brain tissue in the early phase of the stroke and thus have a negative effect on disease progression. Other immune cell populations such as macrophages convey the resorption of dead cells and initiate tissue repair. It is extremely important during this phase that the immune system does not perceive the brain tissue to be foreign matter, consequently fighting against it; this process is referred to as immunotolerance and is, among other things, conveyed by dendritic cells. Depending on the concomitant immunological signals, these cells are able to trigger immune tolerance or an immune response from the adaptive immune system. Mismanagement of this system following a stroke, e. g. due to the simultaneous presence of pneumonia, may lead to an immune reaction which works against the person's own brain tissue. Possible consequences include, among other things, insufficient rehabilitation capacities and cognitive disorders through to dementia.

The aim is to better understand the process of immunotolerance development following a stroke and to potentially develop new therapeutic approaches that can be applied here. In order to do this, the infiltration, eating behavior and migration movement of macrophages and dendritic cells are analyzed after an experimental stroke has been triggered. It is presumed that dendritic cells exit the brain via a range of pathways and encounter the effector cells of the adaptive immune system in the cervical lymph node, which is where they determine their functional status.

This idea is being investigated by introducing different kinds of therapy which stimulate the immune system and increase tolerance and by monitoring whether they have an impact on the functional status of the migrated dendritic cells and on the activity of the adaptive immune system.

In a possible clinical application, patients who suffer from an inflammatory reaction after a stroke could be treated. A type of therapy which generates immunotolerance could limit the emergence of an autoimmune reaction to the brain caused by stroke and thus improve the healing process following a stroke. However, numerous investigations are required before any type of clinical application is possible.

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1 *Besides macrophages (red), dendritic cells (green) also determine disease progression.*

1

2

3

**LEGASCREEN – development of a multi-modal early screening test for diagnosing dyslexia**

Dyslexia is a severe disorder in acquiring reading and writing skills, affecting about five percent of all German schoolchildren. It is one of the most common developmental disorders in childhood and youth. Dyslexia is unrelated to the child's intelligence. It results in tremendous problems in school, education, and at work.

One of the main problems hampering successful therapy is late diagnosis: With the current methods, dyslexia cannot be reliably diagnosed until the end of the 2nd grade. By this time, a large part of speech-development has, however, already taken place, and a lot of precious time for providing support and therapy is inevitably lost.

Our project, a joint venture between the Fraunhofer-Gesellschaft and the Max Planck Society, is based on our previous research into the genetics of dyslexia. The earlier a disposition towards dyslexia can be recognized in a child, the more likely it is that this disorder can be counteracted by providing a targeted form of language support, and the greater the chance of reducing later problems. To do this, different research approaches are combined: Genetics together with specific brain activity measurements (EEG).

The heritability of dyslexia is estimated at 50–70%. Genetic material (DNA) practically stays the same during a person's life span. Consequently, respective genetic risk variants can already be used for diagnostic purposes at an early stage, irrelevant of whether or not the child is yet able to read and write. Previously identified genetic variants which contribute towards the emergence of dyslexia will be used and optimized as a starting point for the project.

The other key part of our test is based on electroencephalography (EEG) – a procedure which allows brain activity to be measured without demanding the attention of the child. Research has shown that children who go on to develop dyslexia already demonstrate distinctive features in brain activity at an early age in response to specific language stimuli.

Magnetic resonance imaging (MRI), which is also involved in our study, is used as a link between genetics and EEG. It allows us to better understand structural features in the brain, however it will not form part of the test procedure which is to be developed.

To summarize, the aim of this project is to develop an early screening test for dyslexia which recognizes the respective disposition towards dyslexia long before this can be seen using conventional testing methods. This type of early warning test will be able to considerably improve access to therapy at an early stage in the future.

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1 *Our aim: Taking pleasure in successful learning*
2 *EEG examination*
3 *MRT examination*


1

**Identifying tumoricidal peptides**

The project aims to identify new peptide connections with a tumoricidal effect for the treatment of cancer.

Demographic shifts have led to an increased risk of developing cancer. As human life expectancy is on the rise and cancer is thus even more prevalent, the pharmaceuticals industry has spent many years conducting research into the causes of the disease and new, potential treatment options. Tumor diseases count among the most common cause of death around the world. Every fourth death in Germany in 2014 was caused by cancer or side effects of tumor treatment. The development of new and targeted medication for the treatment of tumors is therefore of great importance.

Chemotherapeutics now belong to the most frequent applications to fight cancer, however they are associated with strong side effects. Beyond this, cancer cells often build up resistances against this type of medication. Furthermore, chemotherapeutics do not only have an inhibiting effect on degenerative cells; the cell division of healthy tissue is also influenced by the medication. If healthy cells and bone marrow are impaired by chemotherapy, the immune system is no longer able to function properly.

There is therefore a huge amount of interest in finding alternative treatment options for malignant tumors; selective medication to combat tumor cells is constantly being researched. Among other things, synthetic, membrane-active peptides with selective tumoricidal effect could become more significant in future.

The tumoricidal properties of frog secretion (peptides) and synthetic peptides were investigated in more detail in this project. Secretion from the Phyllomedusa bicolor and Rana chensinensis species, which have already been described in the literature, were useful here as reference secretion and/or reference peptides and were evaluated. In doing so, potential candidates were identified which would be eligible for treating tumors. The tumoricidal peptides were developed together with Dr. Andreas Schubert (Antimicrobial Agents Unit).

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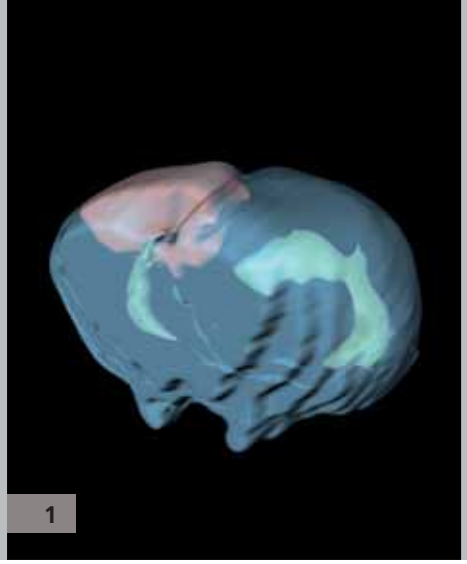
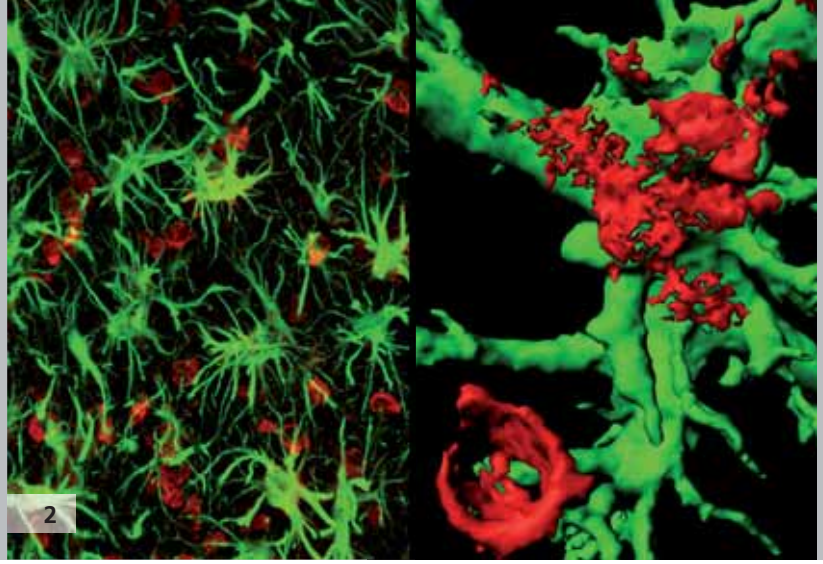
1 *Phyllomedusa bicolor*





**Use of 3D rendering in modern imaging procedures**

The field of life sciences presents us with a variety of diagnostic options. The procedures applied in this field harness the entire span of the electromagnetic spectrum, ranging from short-wave roentgen radiation (computer tomography) and light which is visible to humans (microscopy) right over to high frequency magnetic resonance imaging. Each one of these procedures pinpoints and visually illustrates structures or biological processes in the living organism. Thanks to the increased resolution of devices, sufficient data can now be gathered to create a virtual reproduction of the examined structures. Calculations can be made and biological processes visualized based on the computer models rendered from these devices. This is made possible due to the use of sophisticated computer systems and special software applications.

Pathological processes which emerge, for example, in the case of the widespread condition stroke can thus be precisely quantified. It is not possible to depict the affected structures directly without surgery as they are shielded in the cranium. With the aid of MRI scanners with extremely high field strengths (up to 140,000 times the strength of the earth's magnetic field) and special algorithms which are used to segment these structures, the damaged region can simply be depicted "in vivo". By using different contrast methods, macroscopic pathologies are made visible on the screen as 3D objects (image 1).

Far-reaching microscopic reconstruction processes take place in the affected areas of the brain following brain tissue damage caused by trauma or hypoxia, which cannot be seen using MRI scanners. The brain's connective and supportive tissue (glial cells) reacts to this by enlarging the cells (hypertrophy) and increasing the number of cells (hyperplasia). In order to be able to depict regeneration, the affected region is immunohistochemically stained and scanned using a confocal laser scanning microscope. The resulting data record is processed and transformed into a 3D structure. This makes it possible to precisely describe the number and morphology of cells, their interaction with other cells, and their changes over the course of time (image 2).

Both processes facilitate the evaluation of pathological changes following brain damage and are therefore suitable for verifying the effectiveness of new therapeutic procedures. The methods used to segment, evaluate, and assure quality are hugely similar here in spite of the different processes. Combining these competencies into one unit thus facilitates various synergies.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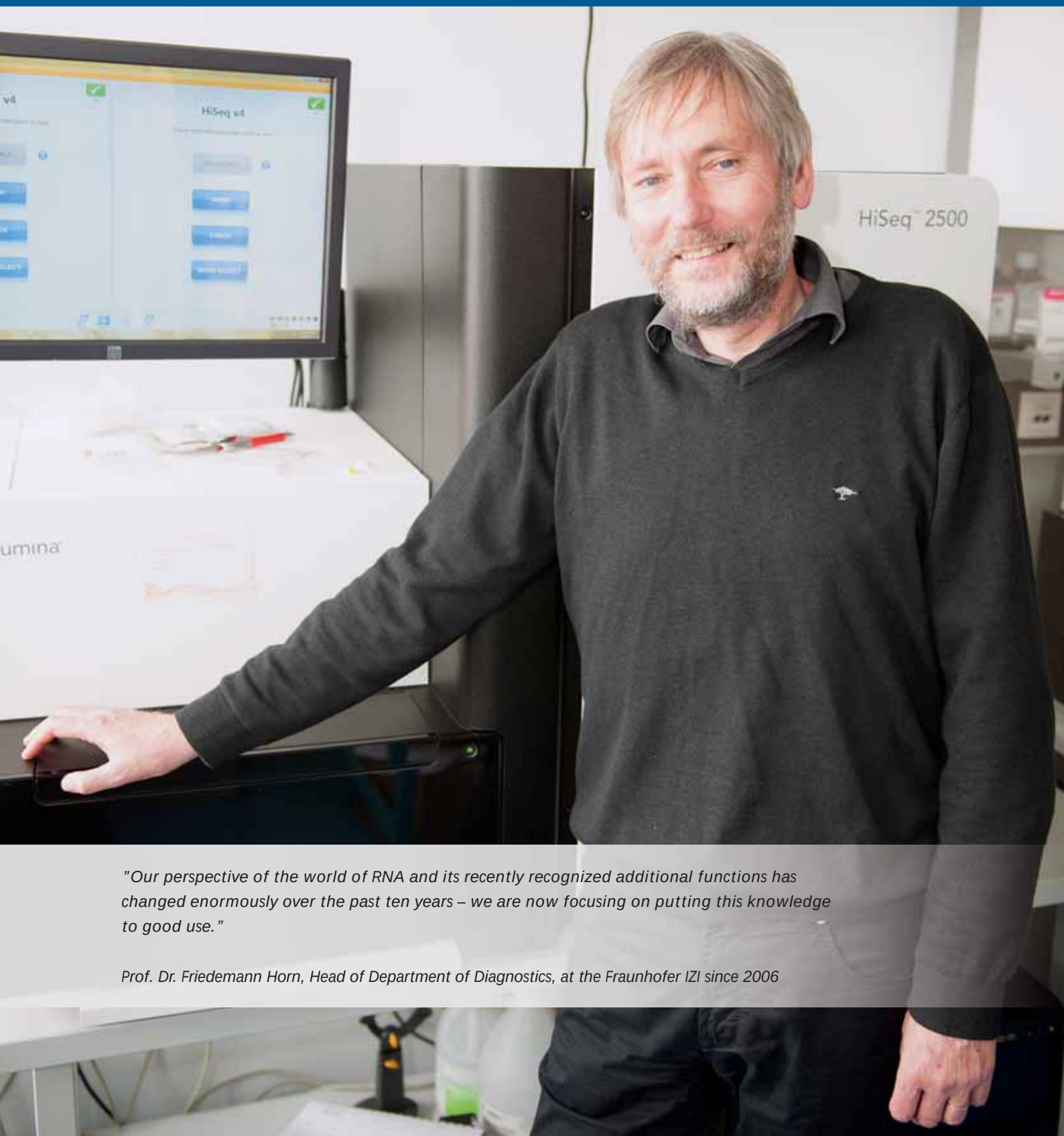
**1** *Visualization of a stroke in a 3D model of a rat's brain*
**2** *3D model of astrocytes based on immunohistochemical staining*

# DEPARTMENT OF DIAGNOSTICS




*”Our perspective of the world of RNA and its recently recognized additional functions has changed enormously over the past ten years – we are now focusing on putting this knowledge to good use.”*

*Prof. Dr. Friedemann Horn, Head of Department of Diagnostics, at the Fraunhofer IZI since 2006*

# IN CONVERSATION WITH PROF. DR. FRIEDEMANN HORN

**Which of the department's areas of competence / technologies should be especially highlighted and which R&D services have emerged as a result?**
Identifying and validating new diagnostic and prognostic biomarkers forms an important focus in the Department of Diagnostics. A huge amount of attention is given here to the R&D consortium RIBOLUTION, which is funded by the Fraunhofer-Zukunftsstiftung (Fraunhofer Future Foundation) and is currently in its second phase of funding. This phase sees the knowledge previously developed by all partners being combined into one local "RIBOLUTION Unit for Biomarker Development". The platform offers an especially efficient biomarker development process, whereby special attention is given to RNA molecules. This results in exciting proposals for services in the field of genome-wide transcriptome, genome and epigenome investigations, also by means of next-generation sequencing and microarrays. Partnerships are able to take root here with the diagnostics and pharmaceuticals industries in order to establish new diagnostic tests and to develop companion diagnostics.

A second focus is on the innovative, preclinical, in vitro and in vivo models established in the department. Mouse models with humanized immune systems, xenogeneic transplantation models or models for tumor stem-cell research facilitate excellent basic approaches for investigating molecular causes of disease as well as for testing innovative therapy strategies in cooperation with the pharmaceuticals industry and research institutions.

Furthermore, the technical development of intelligent, new diagnostic test procedures, especially (but not limited to) point-of-care diagnostics, forms a key strength in the department. In this regard, companies are approached which are looking to simplify and integrate their (biological) analytical procedures. However, completely new approaches on the nano scale, such as DNA origami technology, also offer diverse development and cooperation opportunities for a new generation of diagnostic and therapy-supporting procedures. With this new field of "DNA nanotechnology", biomolecules can be arranged with nanometer precision onto structures which are created through the programed assembly of DNA strands. These are used in the development of diagnostic instruments for pathogen detection, in the molecular evaluation of new therapies and in order to design bioactive materials as sensors, to name a few examples.

**What were the department's main challenges and highlights in the 2014 reporting year?**
Many projects in the department have now been successfully conducted over a number of years. In 2014, based on this extremely successful result, we took on the task of developing long-term cooperations and attractive offers for our partners and industry over the next few years. Benchmarks were able to be set here – for instance, a new funding phase was acquired for RIBOLUTION, which primarily aims to bring the achieved results into one successful application.

**Please give us a brief outlook over the department's key tasks and plans for the 2015 anniversary year and beyond.**
In 2015 and the years to come, a lot of time and work will be dedicated to further expanding our range of attractive proposals through innovations and by intelligently developing our know-how in the field of diagnostics. The department's competitive edge and excellence are therefore to be further strengthened. In this regard, the previously established quality management system (especially regarding RIBOLUTION) will be further developed and preparations will be made to acquire certification in accordance with ISO-9001 at a later stage, which will make the processes offered by the department even more appealing. Moreover, we are planning at least one spin-off in order to transfer our results to the market as efficiently as possible.

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# UNITS

### Inflammation Models and Immunodiagnostics Unit

This unit develops rapid, straightforward, immunological, cell biological and genetic analysis and model systems for the areas of graft rejection, inflammation research and tumor biology, in particular for joint and pulmonary diseases. This involves the use of innovative immunoassays, genetic analyses, complex cell culture models and animal experimental approaches.

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### DNA Nanodevices Unit

This unit focuses on exploring and developing DNA-based tools for biomedical research. In doing this, DNA molecules and their characteristics are used to arrange and structure biomaterials on the nanometer scale. This type of technology is applied to develop biosensors and nanocircuitry for bio-chips, in addition to being used to develop new procedures to specifically transport molecules in vivo and in vitro. To this end, the unit investigates the biochemical and biophysical characteristics of specific DNA molecules and composite materials in order to deduce concrete applications. The unit has been funded by the Fraunhofer-Gesellschaft's Attract program since 2013.

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### Analysis Strategies Unit

This unit develops and establishes analysis strategies for the discovery of novel biomarkers to diagnose and predict diseases as well as of novel therapeutic targets. State-of-the-art approaches relating to DNA, RNA, and epigenetic analyses – based on next-generation sequencing and microarrays – are optimized for applications concerning large clinical cohorts and for the study of DNA, RNA and protein interactions. Furthermore, the unit offers comprehensive bioinformatic competence with a particular focus on the analysis of large sequencing data sets as well as on a proprietary data management system.

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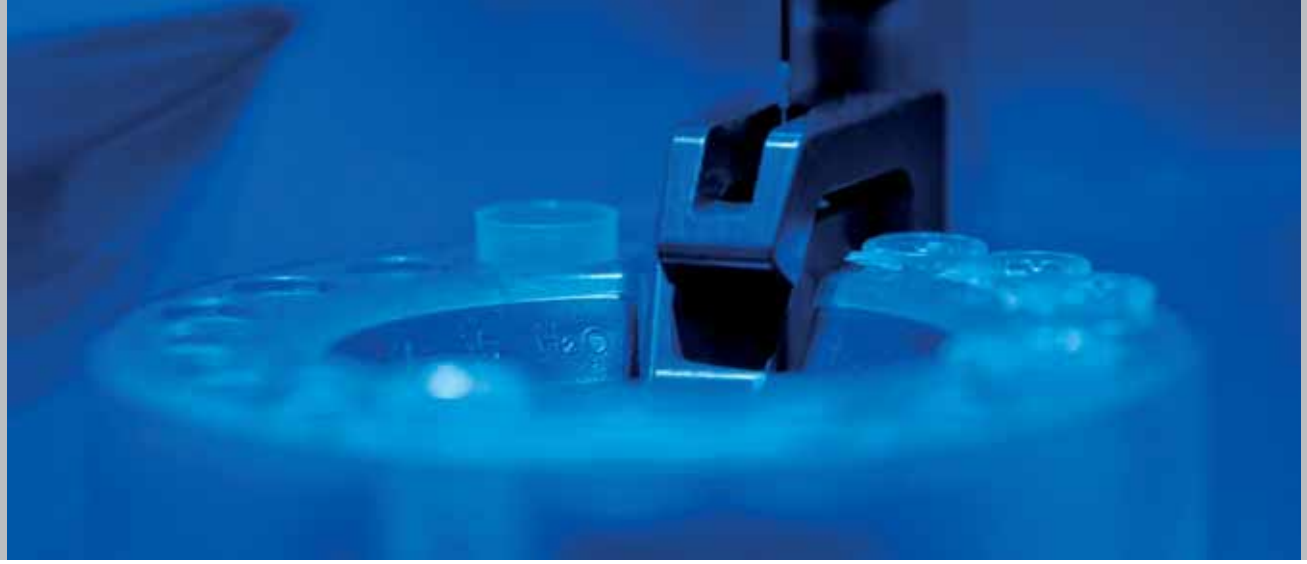

**Tumor Stem Cells Unit**

This unit's objective is to develop therapeutic strategies based on cells and agents for the treatment of neoplastic diseases based on the elimination or modification of tumor stem cells in the relevant malignant tumor. This concept is to be used to describe the tumor stem cells of further tumor entities and to facilitate therapeutic innovations in the field of internal oncology.

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**Nanotechnology Unit**

This unit works on the development of molecular diagnostic test systems for the food and medicine/clinical practice sectors. The unit focuses on the development of test-strip based rapid tests to detect infecting agents, bioanalytical sample preparation and the application of nucleic acid-binding proteins. Work is being done with customers to develop novel Lab-on-a-Chip diagnostics platforms, e. g. to detect sexually transmitted pathogens in a home-testing format.

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**RNA Biomarker Unit**

Our focus is on the identification and validation of new diagnostic and prognostic RNA biomarkers for various diseases. We use a wide range of molecular methods (next-generation sequencing, microarrays, PCR-based methods) for the GLP-oriented screening and validation process. We also focus on companion diagnostics, which is an important step towards personalized health care. With the development of specific tests (e. g. cancer diagnostics), we are constantly moving towards the optimal goal.

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# PROJECT EXAMPLES

**World-wide innovation: Molecular biology mini laboratory for home use**

The general public holds the topic of pathogens in high regard. Alongside multiresistant germs and food contaminants, sexually transmitted infections (STIs) also receive a great deal of attention and require better therapeutic and diagnostic strategies the world over. Every year, over 100 million people around the world become infected with the Chlamydia trachomatis bacteria alone. Chlamydia species are thus responsible for a fifth of all cases of illness caused by sexually transmitted pathogens.

A particular problem linked to STIs in the western industrialized nations is the reluctance of those affected to consult a doctor and receive treatment as soon as they suspect an infection. Third world countries have a considerably poorer health care system, a fact which increases the risk of carrying an infection.

This project aims to create a diagnostic platform which integrates highly specific and sensitive nucleic acid amplification on a chip and allows the user to discretely test for the infection in the comfort of their home. Together with the Leipzig-based company SelfD Technologie and with the support of the Sächsische Aufbaubank (Saxon Development Bank, SAB), a global novelty is therefore being developed which addresses the home care market.

This is based on a molecular biology laboratory with the dimensions of a credit card, which absorbs the sample and releases the nucleic acids from the cells of the pathogen. The nucleic acid, which may exist in extremely low concentrations, will be specifically reproduced a million times in a miniaturized reaction chamber before being detected. Detection takes place using a visible strip which displays the outcome of the test after approx. 30 minutes: Similar to a pregnancy test, a control strip will be visible which shows whether the test has, in principle, been successfully executed. A specific detection field appears in color if the sexually transmitted pathogen is present in the user's urine. In this case, the only option available is to consult a doctor, who will have to treat the infection using an antibiotic therapy in order to avoid late sequela such as infertility or even blindness.

The HomeCare diagnostic system is a simple, molecular biological test platform which can easily be adjusted to address different issues in the field of medical, environmental or nutritional analytics. It serves as an innovative basis for further applications.

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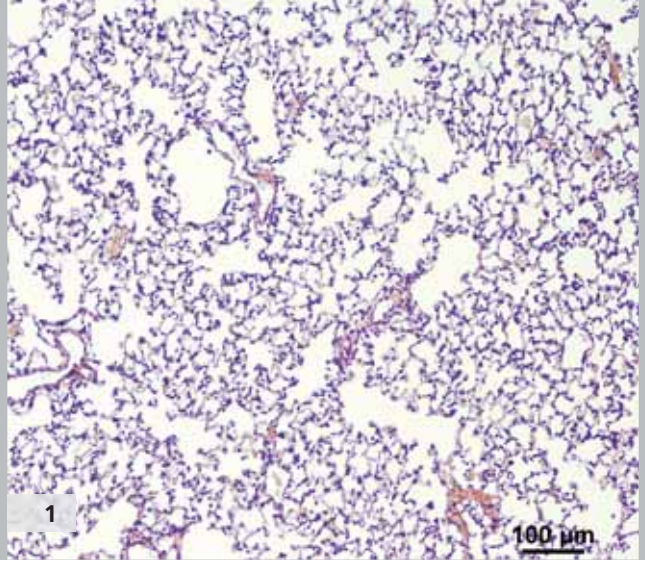
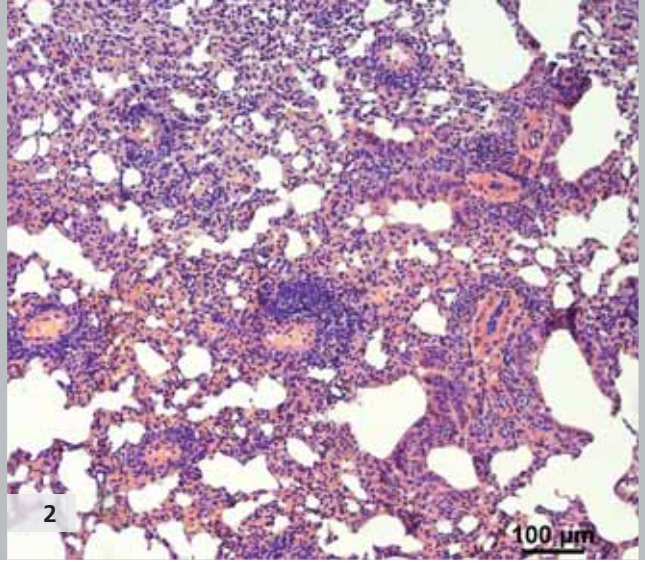
Europa fördert Sachsen.
EFRE
Europäischer Fonds für regionale Entwicklung

1 *Molecular biological mini laboratory*




**Proof-of-concept study for a new drug for allergic asthma**

Over the past few years, the number of patients with chronic, allergic airway diseases has increased. The continuous increase in patients with asthma bronchiale is especially noteworthy. The incidence and prevalence of this immunological disease has seen a particular rise in industrialized countries over the past 20 years. According to the World Health Organization (WHO), 235 million people suffer from asthma bronchiale. Approximately five per cent of the German adult population is affected.

Due to these enormous numbers of patients and the fact that the treatment of asthma is only symptomatic at present, intensive research is necessary to identify new drugs suitable for treating the disease.

The company Nuvo Research develops an immune modulator which has already proven to be effective in different clinical studies, e. g. in the indication allergic rhinitis. This immune modulator was tested at the Fraunhofer IZI in a murine model of allergic asthma bronchiale. Dexamethasone – a standard drug for the treatment of allergic asthma – was used as a comparative drug.

House dust mite extract was used to induce allergic asthma in a murine model. During the experiment, several non-invasive lung function tests were performed, and blood and tissue samples were analyzed.

The study showed that the tested immune modulator tended to have a positive effect on the lung function of asthmatic mice similar to dexamethasone. Therefore, the immune modulator is a potential candidate for further preclinical and clinical studies.

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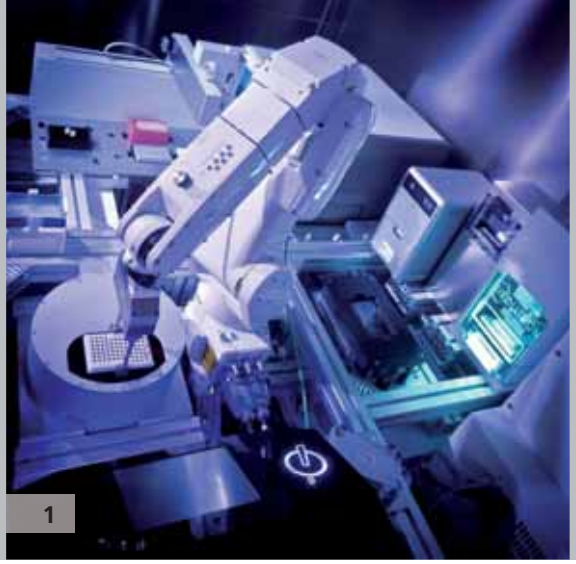
1 *Healthy lung tissue*
2 *Lung tissue of an asthma sufferer*



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**RIBOLUTION**

Complex diseases present medicine and the health care system with immense problems. Oncological, chronic inflammatory and degenerative diseases are on the up due to the demographic transition. Despite a growing number of treatment options, the therapeutic situation continues to be unsatisfactory in many ways. Precision medicine is expected to bring about fundamental advances through a choice of therapies which is adjusted to the individual. However, this requires the molecular basis of a disease and of the individual disease progression as well as the response to therapy to firstly be determined in detail. New biomarkers which make this possible are therefore a key requirement for the success of precision medicine.

Research into the human genome has made vital progress for biology since being completely sequenced in 2001. Decoding many disease-relevant genes also opens up a new clinical horizon for the development of tailor-made therapeutic approaches. On a diagnostic level, however, many expectations have not been met, despite comprehensive studies. It is only possible to predict predispositions to certain diseases with a high level of probability in limited cases based on purely genetic methods.

In 2007, a fundamental discovery was made which had a profound impact on biology. Before then, most sections (>95 %) of our genome were considered insignificant as they do not encode proteins. It has now been shown that these non-coding genome sections are translated (transcribed) into a large number of so-called "non-coding RNAs (ncRNAs)". ncRNAs play an outstanding regulatory role and form a key platform for processing and managing information in the cell, which enables precise conclusions to be drawn on the cell's condition. This finding has generated a new understanding of the biology of complex organisms and, at the same time, demonstrates direct repercussions on medicine: ncRNAs hold a great deal of potential as highly specific biomarkers for diagnostics and as therapeutic targets, besides revealing promising clinical perspectives. With the dramatically reduced cost of so-called next-generation sequencing (NGS), new dimensions of state-of-the-art diagnosis and therapy development are presented here.

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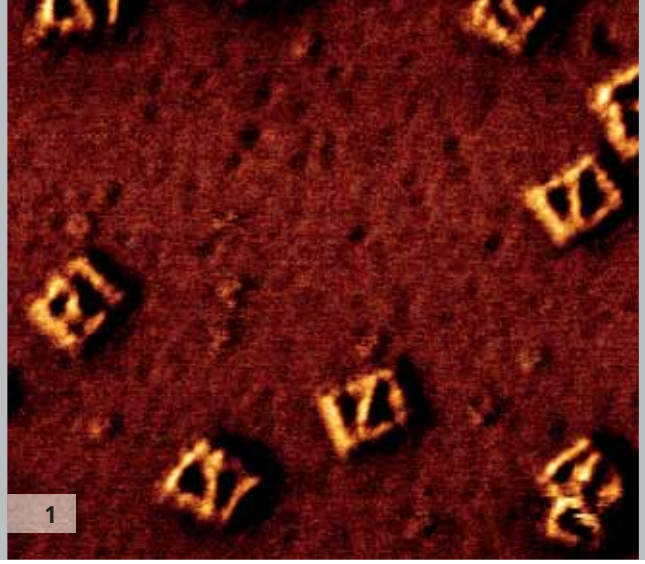
SMILE (Self Management Initiative Leipzig) is helping the founding team to create a spin-off from the RIBOLUTION consortium.

*1 A fully automated facility for biomarker validation enables the tiniest volumes of RNA to be accurately analyzed in a high-throughput process.*



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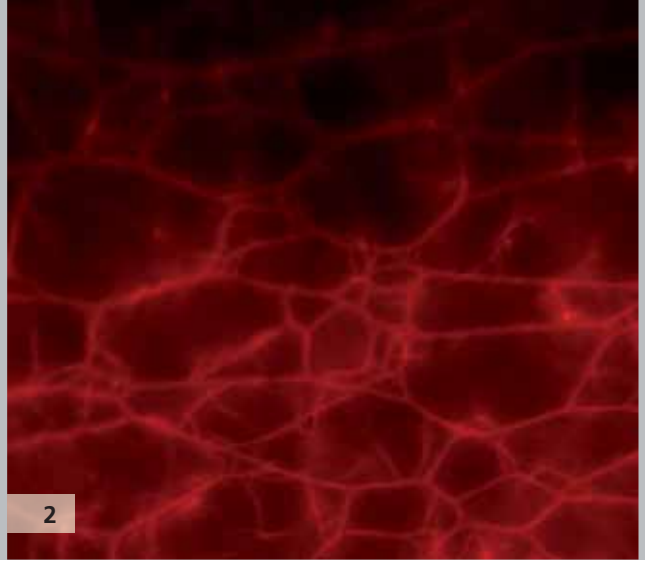

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**DNA self-assembly and molecular programming**

Currently, the design and construction of tiny objects through the programmed assembly of complementary DNA strands is the most precise and advanced method available for creating arrangements of molecules on the nanometer scale. Through established methods such as the so-called "DNA origami" technique or the assembly of "DNA bricks", lattice-like structural scaffolds can be assembled from DNA strands and used for the placement of nearly any type of molecule on the nanometer scale. This concept of "molecular nanotemplating" using DNA is a powerful technique which has many promising applications in the biomedical fields. The DNA Nanodevices Unit was established at the Fraunhofer IZI in 2013 within the Fraunhofer ATTRACT program to develop applications for these techniques in the areas of therapeutics and diagnostics.

The "DNA origami" technique utilizes a long, single-stranded DNA scaffold strand of several thousand bases in length, which is folded into a desired shape by hundreds of shorter DNA strands. This is used to create two and three-dimensional structures with an exact shape and size on the nanometer scale. Individual molecules or molecule patterns can be positioned to the nanometer on each of these short DNA strands. This is used to connect tiny carrier molecules, which are able to bind therapeutic anti-cancer drugs, for example, to DNA nanostructures. Other molecules such as aptamers or peptides can be attached to specifically locate diseased cells. The goal is both to increase the efficiency of drugs, as well as to reduce unwanted side-effects on healthy cells.

Another technique for the assembly of nanoscale structures uses a collection of short, synthetic DNA strands as "bricks". Using this technique, a nearly infinite number of three-dimensional shapes can be constructed from one common collection of DNA strands. The process, from design to final assembly of the nanostructures, has been streamlined and automated with the help of custom software and a liquid-handling robot, so that nearly any shape can be generated within different time frames. An initial application is to use these tiny objects for creating large surfaces of specific topology, upon which arrays of single-walled carbon nanotubes can be precisely arranged. This will enable the creation of DNA-based nano networks, which will form the foundation of miniaturized, ultra-sensitive diagnostic biosensors.

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1 *Atomic Force Microscope (AFM) image of Fraunhofer IZI Logo drawn onto flat DNA origami by immobilized proteins*
2 *Micro-structure of a porous, elastic gel, which was created by bundling DNA nanotubes – recorded using fluorescence microscopy*

# DEPARTMENT OF DRUG DESIGN AND TARGET VALIDATION

*”The development of new drugs is a multi-layered process – it can only be mastered with a strong team that does not lose sight of the common goal.”*

*Prof. Dr. Hans-Ulrich Demuth, Head of Department of Drug Design and Target Validation, at the Fraunhofer IZI since 2013*

# IN CONVERSATION WITH PROF. DR. HANS-ULRICH DEMUTH

**Which of the department's areas of competence / technologies are particularly impressive and which R&D services have emerged as a result?**

The project group is structured in such a way that the drug development process, from the discovery and characterization of pathophysiological conditions over to the validation of potential target proteins, depicts the early pharmaceutical development process in an integrated format. This means that the three units operate in synergy across horizontally structured projects, allowing the respective expertise to be fully exploited. Topics range from molecular biology/ biochemistry and cell biology issues through to the synthesis of low-molecule, potential drug candidates, which are first tested in representative cell assays with regard to their efficacy. If the results are promising at this stage of development, pharmacological testing then begins in the respective disease-specific animal model. In doing this, the focus is not only on "small molecules", but also on the development of specific antibodies, directed at previously unknown neo-epitopes. The team is therefore versed in both bioorganic and medicinal chemistry, besides protein chemistry, molecular biology and cell biology, as well as in animal pharmacology. This range of expertise is offered to potential partners through cooperation projects and is currently being implemented together with various organizations in national and international research alliances.

**What were the department's main challenges and highlights in the 2014 reporting year?**

Since setting up the project group on October 10, 2013 with around 20 members of staff, personnel capacity more than doubled in 2014. A large proportion of this growth is attributed to interns, Master students and PhD students, who are involved in the demanding projects carried out in the department.

This called for a well-functioning, internal reporting structure to be set up alongside the ongoing investments in laboratories and the relational structure evolving between the units.

Another important task in 2014 came in implementing the administrative duties typical of the Fraunhofer Institute. This goal was achieved together with the project group members who work with the headquarters' administration with regard to organization, purchasing and HR activities.

**Please give us a brief outlook over the department's key tasks and plans for the 2015 anniversary year and beyond.**

We see 2014 as a phase of initiation and consolidation: We were able to launch research projects with academic institutes and cooperation projects with industrial partners which went above and beyond the basic funding. Our aim for 2015 is to at least double the additional revenue generated thus far and to expand our academic and industrial network accordingly. Within the institute, we want to continue expanding the new and long-standing cooperation partnerships between the Department of Cell Therapy and the Preclinical Validation Unit in Leipzig and the Department of Cell-free Bioproduction in Potsdam-Golm. Furthermore, we would also like to transfer ongoing projects into the corresponding drug development stage.

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# UNITS

**Molecular Biotechnology Unit**

The Molecular Biotechnology Unit develops and establishes cellular and molecular biology analysis and model systems. This involves cell-based assays, gene expression analysis, immunological and protein chemistry methods, sophisticated cell culture and animal models. The unit conducts a series of cell-based tests for characterizing substances with regard to effectiveness, toxicology and transport. Its service portfolio also includes establishing new animal models for investigating enzyme functions in vivo.

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**Protein and Drug Biochemistry Unit**

The Protein and Drug Biochemistry Unit has in-depth experience in the purification of target proteins as well as their enzymatic characterization. Besides classic protein chromatography procedures, protein chemistry methods are also used, such as the spectroscopic analysis of structure and enzyme-kinetic mode of action. The unit specializes in the humanization of antibodies for the manufacture of protein drugs and their semi-preparative extraction. The subsequent structure-activity-analysis as well as structure-based molecular optimization round off the unit's portfolio.

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**Drug Design and Analytical Chemistry Unit**

The service portfolio offered by the unit comprises the entire spectrum of medicinal chemistry and analytics required to identify potential, new drug candidates from within the field of "small molecules" and develop them into clinical candidates. New target molecules can be generated in silico with the aid of computational procedures, besides being evaluated, synthesized and tested in terms of their effectiveness on the target protein. Moreover, the unit also offers analytical support as part of drug development in both preclinical and clinical trials.

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# PROJECT EXAMPLES

**Antibodies for the treatment of neurodegenerative diseases**

Neurodegenerative diseases are characterized by the progressive loss of brain substance. The degeneration of nerve cells coincides with the development of dementia, i. e. a qualitative and quantitative decline of brain cognitive performance. Due to the rise of life expectancy, dementia, especially Alzheimer's Disease (AD), will pose a major challenge to our health systems in the decades to come. Despite the fact that some medication is available to relieve the symptoms of such diseases, no curative therapy is currently available.

The majority of neurodegenerative diseases is caused by a misfolding of proteins. This structural modification results in an aggregation that damages the surrounding tissue and nerve cells, causing them to die off. An effective therapy has to prevent the peptides from aggregation and/or to accelerate the decomposition of these proteins. One way of triggering the degradation of the misfolded proteins is to apply antibodies which specifically target these non-natural proteins. The antibodies and misfolded amyloid peptides form complexes which are recognized and degraded by immune cells. One key aim of such approaches is to identify antibodies which only bind to misfolded, toxic material and which do not display any side activity to bind physiologically active peptides or proteins.

Therefore, our research focuses on so-called posttranslational modifications that are causally related to the development the disease. Such modifications include, for instance, nitration, phosphorylation and the formation of isoaspartate. The project aims to generate and test antibodies which are highly specific to modified amyloid peptides. The most promising candidates will be selected from several different molecules and prepared for human use.

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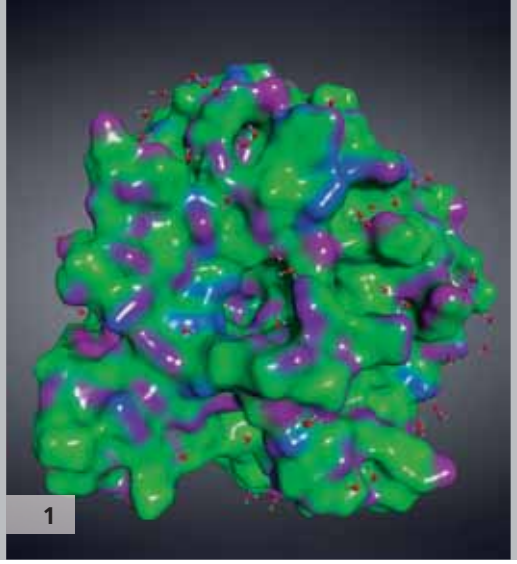
1 *Alzheimer's Disease is associated with a progressive deterioration of cognitive ability. It almost always affects the elderly.*



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**Periodontal pathogens as etiologic factor in RA, CVD and COPD and their impact on treatment strategies**

Extensive clinical and epidemiological data clearly show that chronic periodontal disease, one of the most prevalent infectious inflammatory diseases among human beings, is strongly linked to systemic inflammatory diseases such as cardiovascular diseases (CVD), rheumatoid arthritis (RA), and chronic obstructive pulmonary disease (COPD). Taking into account that up to 30 % of the adult population worldwide suffers from severe periodontitis, the impact of this disease on human health is immense – an opinion shared by the World Health Organization. Nevertheless, in many European countries periodontitis is a neglected disease, both by the population in general and by health-care personnel. In some cases, this ignorance reaches the stage that hair and tooth loss caused by periodontitis are still considered to be normal, inevitable events associated with aging. To combat this misconception and to research novel ways of treating CVD, RA, and COPD we are exploring the highly innovative idea that these non-infectious diseases are at least aggravated, and maybe even initiated, by periodontal infections.

The project aims to elucidate a relationship between the presence of specific periodontal pathogens and the severity of systemic diseases. Furthermore, it aims to show that extensive periodontal treatment improves the clinical parameters of the investigated systemic diseases. In order to elicit this, specific active agents are to be developed to combat periodontal pathogens, based on bacterial glutaminyl cyclases.

This will reduce mortality while at the same time ameliorating the quality of life of CVD, RA, and COPD patients.

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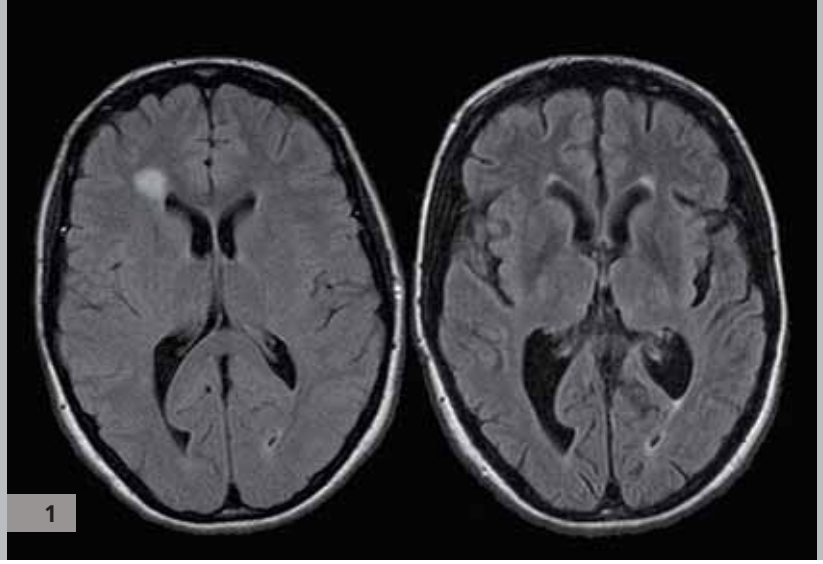
1 *View of the catalytically active center of a bacterial glutaminyl cyclase, a potential target enzyme for the treatment of periodontitis*



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**Role of human endogenous retroviruses in the development of multiple sclerosis**

Multiple Sclerosis (MS) is a progressive and chronic inflammatory disorder of the central nervous system. MS is characterized by a pathological demyelination of axons. Depending on the site of inflammation, symptoms vary greatly and include paralysis or numbness of extremities, impaired vision and speech, dizziness, cognitive impairment, and fatigue. An underlying cause for the development of MS has not yet been identified. A widely accepted theory of MS pathology focuses on autoreactive T-cells acting against axonal myelin. This simplistic view is challenged by a number of clinical observations, which argue against a sole autoimmunological process.

Firstly, newly emerging MS lesions are devoid of immune cells; secondly, MRI imaging suggests alterations in affected areas before the appearance of signs of inflammation. Furthermore, relapses during disease progression do not correlate with the disability that patients face in the later stages of MS and standard therapy using immune modulatory and/or immune suppressive drugs has no influence on primary or secondary progressive forms of MS. Consequently, MS consists of two arms: An inflammatory part (relapses) on the one side and a slowly progressive neurodegenerative part on the other.

The less understood second arm might correlate with the expression of human endogenous retroviruses (HERVs). HERVs are remnants of a previous retroviral infection which integrated viral DNA into the human genome. A number of HERVs still possess open reading frames, e. g. coding for the former viral envelope protein. These proteins could demonstrate superantigenic properties.

The project therefore focuses on the immunological properties of HERV-derived viral envelope proteins and the development of humanized monoclonal antibodies as alternative therapies for the treatment of MS.

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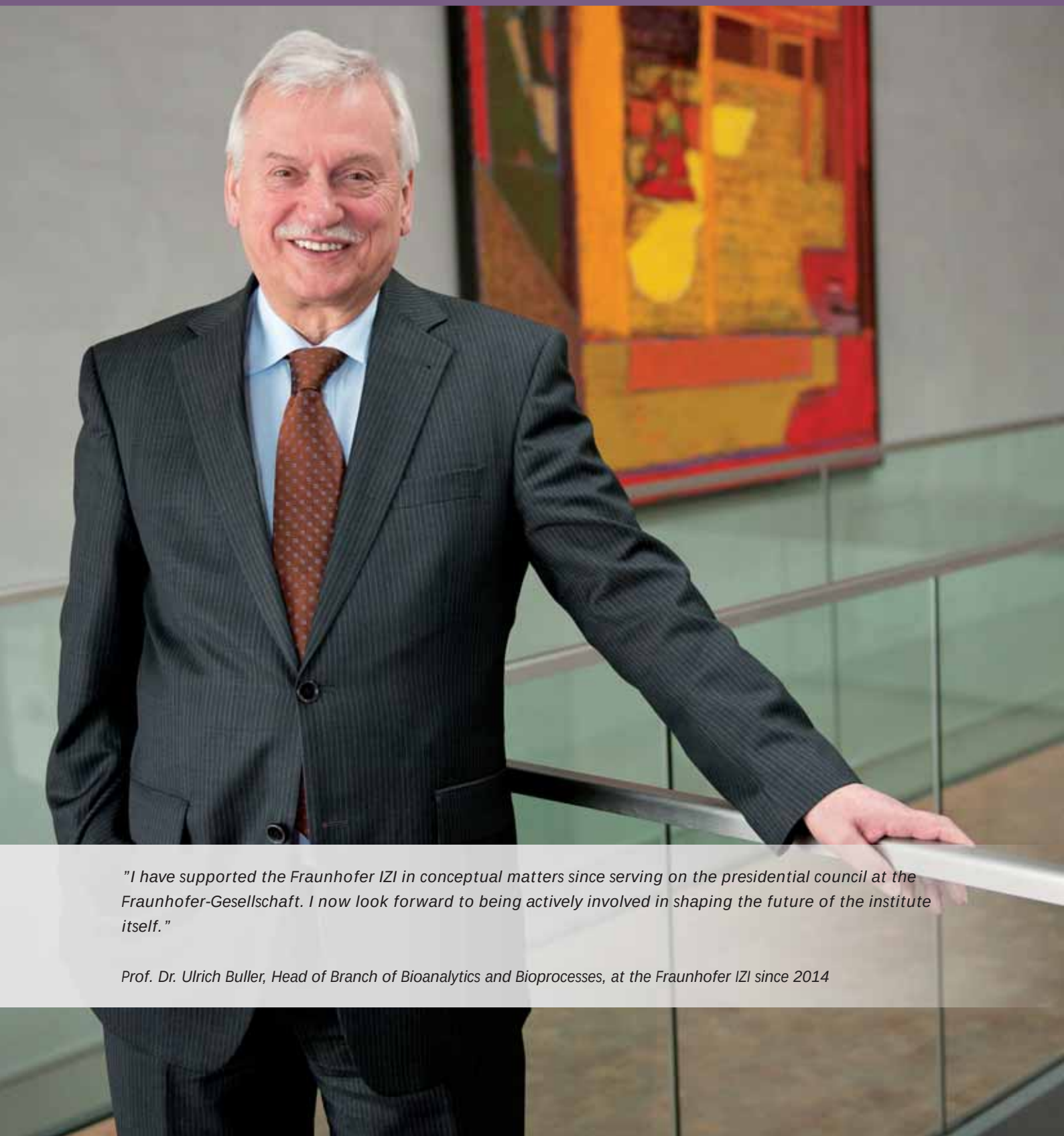
**1** *MRI images of primarily progressive MS following diagnosis (left) and after a one-year period (right). A huge cerebral atrophy is noticeable within a very short space of time. It is assumed that human, endogenous retroviruses are involved in the neurodegenerative components of MS.*

# BIOANALYTICS AND BIOPROCESSING BRANCH OF INSTITUTE



*”I have supported the Fraunhofer IZI in conceptual matters since serving on the presidential council at the Fraunhofer-Gesellschaft. I now look forward to being actively involved in shaping the future of the institute itself.”*

*Prof. Dr. Ulrich Buller, Head of Branch of Bioanalytics and Bioprocesses, at the Fraunhofer IZI since 2014*

# INTERVIEW WITH DIRECTOR PROF. DR. ULRICH BULLER

**The Bioanalytics and Bioprocesses Branch in Potsdam-Golm has been affiliated with the Fraunhofer IZI since July 1, 2014. How will the expertise of the almost 120 members of staff at the new site complement the service portfolio already offered by the institute?**
A branch has been built up over the past few years in Potsdam which has a broad range of expertise in the areas of bioanalytics and bioprocessing. Under the management of Professor Bier, we have been able to put together interdisciplinary teams which boast knowledge and experience in areas ranging from molecular biology over to cellular biophysics and from surface chemistry through to software development, all of which can be applied to work on problems affecting modern biomedicine. In all, we have a technological orientation which thus complements the medical and biological expertise provided by the parent institute in Leipzig as well as the pharmaceutical and biochemical focus offered in Halle.

This is reflected in the following two examples. Firstly, the automation of cell culture management is an important topic in regenerative medicine as the introduction of regenerative treatment methods can only be expanded upon with the aid of highly standardized processes. The technical implementation of laboratory processes is, however, complex and requires both the suitable hardware and a form of management which is programed with an informed view to the pertinent biological processes; the Potsdam-based Bioanalytics and Bioprocesses Branch is able to supply both these things on a micro and macro level. Moving on to the second example, the area of drug discovery focused upon at the Halle site requires functional targets, which will be available through the cell-free protein synthesis methods established and developed in Potsdam over the past few years.

**The branch was set up 15 years ago in Golm's Science Campus. What outstanding products and services have been developed since?**
I have had the opportunity to follow the development of the Potsdam branch since it came into being. Founded in 1998 with the Biofuture Prize awarded by the Federal Ministry of Education and Research, the unit has brought over 100 million euros into the region over the past 15 years and has become an integral part of the biotechnology cluster in the capital city region. Its products are not only of a biomedical nature – for example, a sensor was also developed to determine hormones in fresh milk which farmers can use to verify fertility, thus supporting herd management. This particular product has enjoyed market success for a number of years.

A patent for a high-speed immunoassay was recently issued to us in a different field of research. Negotiations are currently under way on how to market this patent, which is to become one of the first products to connect the new app world of smartphones with the biochemistry of wet samples. This indicates the direction in which we are moving here: Linking biochemical and biological laboratory work with new technologies.

# BIOANALYTICS AND BIOPROCESSING BRANCH OF INSTITUTE

The automation of laboratory processes, for instance for innovative peptide syntheses, forms another important focus. Over the past few years, the Federal Ministry of Education and Research and the Fraunhofer-Gesellschaft Executive Board have funded the major project "Cell-free Bioproduction", which is managed by Professor Bier and Dr. Kubick. These results will now be utilized in our new Department of Cell-free Bioproduction in a contract research capacity. The thermally switchable surfaces, which emerged at the Golm research campus out of the cooperation with the Max Planck Institute of Colloids and Interfaces, the Fraunhofer IAP (our Fraunhofer neighbors) and the department run by Dr. Duschl form an important basis for next-generation cell assay – for instance, for a migration assay in microfluidic environments. The recently concluded Federal Ministry of Education and Research project "Handkerchief Lab" should also be touched upon here: The new pathways to surface determinants of pathogens discovered by Dr. Ehrentreich-Förster's department will not only lead to the quick detection of pathogens, but also to new approaches to vaccine development. We want to expand on all these things.

**Which areas of focus are to be further developed in the coming years at the Potsdam site?**
Bioanalytics which go beyond medical applications will open up new industries. Steps towards food production and agricultural engineering have already been taken and will be intensified, as will medical diagnostics, which will also be strengthened in terms of cell analytics and characterization with a view to the Leipzig branch of the institute. The site is well equipped for industry-relevant research and development concerning biotechnological production processes thanks to state investments. The scale-up of cell-free protein production is just as relevant here as the development of gentle dehydration procedures for active biomolecules for shipment and use in medical practice. In addition to these topics, the Fraunhofer IZI-BB will address other application-relevant research fields which will be introduced to the contract research market with high hopes.

**Which current projects and developments do you believe have an especially high exploitation potential for both industrial and clinical settings?**
Being able to launch onto the market the comprehensive, promising scientific results from numerous public funded projects, which have yielded over 400 publications and more than 50 patent registrations in Potsdam, is our main task in the coming years. Here it is necessary that we use the pilot facilities for automation in order to establish standardized processes in cell culture management together with industry as part of contract research.

The bioactive surface coatings from the Department of Cellular Biotechnology should also be mentioned here, as they allow us to manage cell behavior in a targeted way. This is not only able to significantly increase the functionality of substrates for tissue engineering or cell cultivation; it is also able to make the further use and handling of cells considerably easier. Various cell-free systems manufactured at the Fraunhofer IZI-BB based on lysates from E. coli and eukaryotic resources allow the manufacture of a broad spectrum of diversely structured and modified proteins. Easily comparable in vitro translation reactions facilitate automated screening approaches, which are characterized by an excellent scalability from the submicroliter area through to high-volume reactions in the liter range. The possibility to be able to generate linear DNA matrices using PCR and to use these straight away for protein synthesis in cell-free pro and eukaryotic systems in equal measure renders elaborate cloning, selection, transformational and cell culture procedures obsolete. The Department of Bioanalytics and Biosensors was able to produce excellent results and laboratory samples over the past few years in connection

with antimicrobial peptides (AMPs). Different surfaces were grafted with AMPs, which are relevant in the household, industry and, in particular, medicine – an area often burdened with microbiological germs or pathogens.

**As former member of the executive board at the Fraunhofer-Gesellschaft, you retired almost a year ago. What motivated you to return to active work and to take on this task?**

I took over management of the Fraunhofer Institute for Applied Polymer Research IAP on June 1, 1997. At the time, the institute was still located in Teltow-Seehof. One of my first tasks was to plan our new institute premises in Potsdam-Golm, which was still a standalone, little village on the outskirts of the state capital at the time. The university had already moved into the rather dog-eared former University for State and Law, yet the Science Campus for the Max Planck and Fraunhofer Institutes was still an expanse of green. In short, I have accompanied the development of this science campus from day one and witnessed a number of transformations:

- New construction of the Max Planck Institute;
- Construction of the new building for the Fraunhofer IAP;
- Expansion of the Golm branch of the Fraunhofer Institute for Biomedical Engineering, now known as the Fraunhofer IZI-BB;
- Expansion of the GO-IN technology center;
- Construction of a railway underpass in order to extend the street connection between the university and science campus;
- Improved access to Golm Train Station; and
- Planning and constructing the extension to the Fraunhofer IAP.

This list underlines how closely connected I feel to the site, which is why I was happy to fulfil the wish, voiced by the President of the Fraunhofer-Gesellschaft, to help shape the Golm site of the Fraunhofer IBMT and to help create the new orientation and associated administrative restructuring during this special time as a Director of the Fraunhofer IZI.

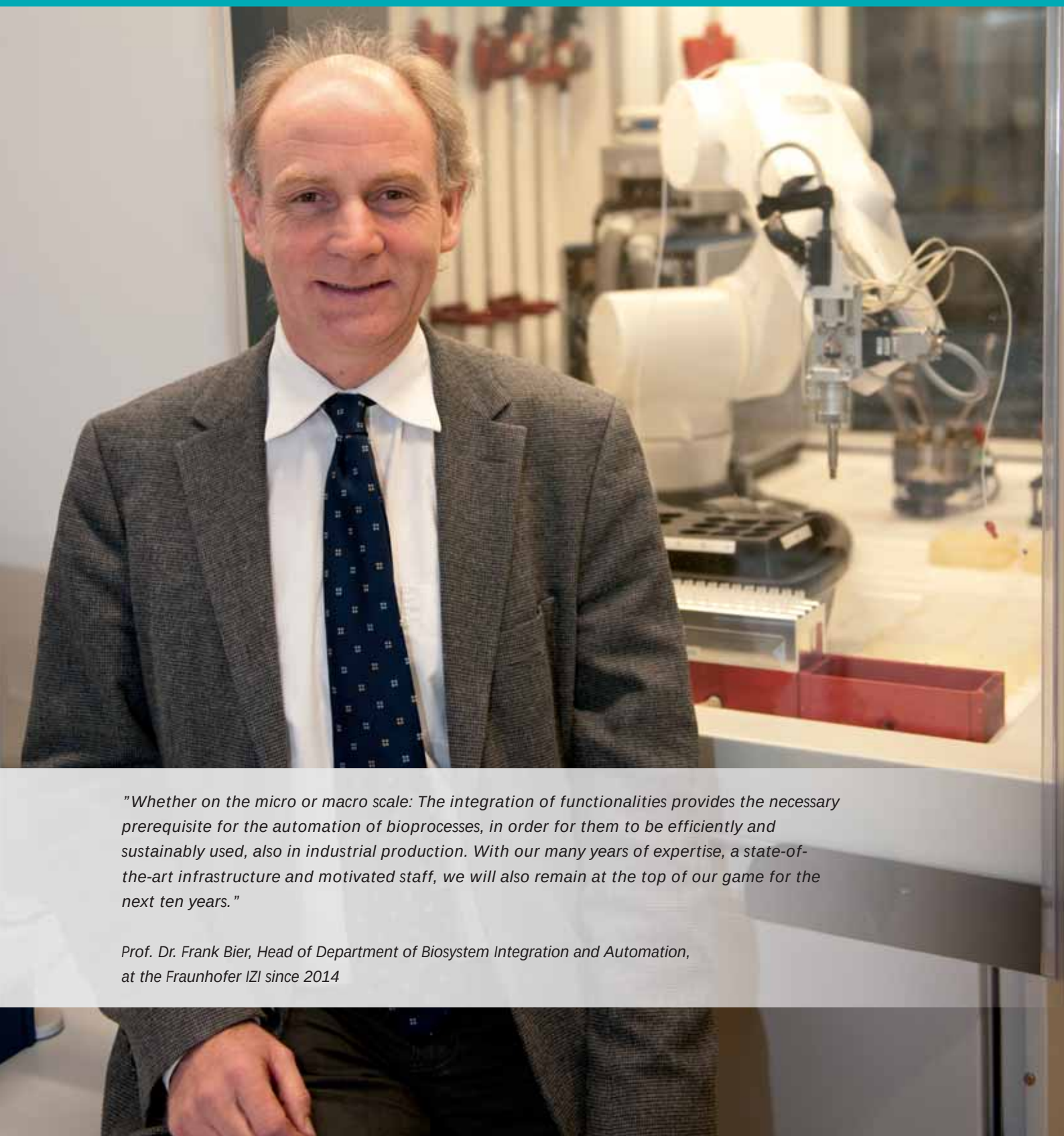
**How did you perceive the foundation and development of the Fraunhofer IZI during your time as Executive Board Member of the Fraunhofer-Gesellschaft and what are your hopes for the institute's future?**

When the Fraunhofer IZI was founded, I was Chairman of the Fraunhofer Group Materials and thus member of the presidential council. Two things stands out for me from the discussions: The Fraunhofer IZI has enabled the Fraunhofer-Gesellschaft to significantly expand its research portfolio in the field of medical research; this has created an additional focal area alongside the activities in the fields of information and production technology, microelectronics, and optical and material research. A further aspect was acknowledged with a great deal of interest: The large and also financial commitment of the City of Leipzig. I have the impression that this cooperation is still effective today.

I am certain that the Fraunhofer IZI will also be active and successful with new, attractive research and development fields in years to come.

Prof. Dr. Ulrich Buller

# DEPARTMENT OF BIOSYSTEM INTEGRATION AND AUTOMATION



*”Whether on the micro or macro scale: The integration of functionalities provides the necessary prerequisite for the automation of bioprocesses, in order for them to be efficiently and sustainably used, also in industrial production. With our many years of expertise, a state-of-the-art infrastructure and motivated staff, we will also remain at the top of our game for the next ten years.”*

*Prof. Dr. Frank Bier, Head of Department of Biosystem Integration and Automation, at the Fraunhofer IZI since 2014*

# IN CONVERSATION WITH PROF. DR. FRANK BIER

**Which of the department's competences are especially outstanding?**

The department encompasses an extremely broad range of competences in the field of bioassay development and hardware design for point-of-care testing (POCT). This example of POCT and the integrated lab-on-a-chip technologies illustrate two typical characteristics of our industry: On the one side, such advances require interdisciplinary teams, which we are lucky to have in our department. On the other side, production conditions are often not taken into consideration for bioanalytics and diagnostics projects. This is a shortcoming we see through our own product demonstrators, which allows us to tell the customer at an early stage how their products can be made and adapted to suit the market. In doing so, we deploy our automation expertise, which is also applied in other departments, for example for cell culture and autologous cell therapy. In addition, we have also focused on observing and manipulating single molecules and nano-objects in recent years, from which we have deduced industry-relevant processes. Furthermore, the results from the "Handkerchief Lab" project form an important basis for further developments in terms of diagnosing infectious diseases, which we are now looking to integrate into early warning systems.

**What were the main challenges and highlights in the 2014 reporting year?**

2014 was, without doubt, characterized by internal restructuring. However, we managed to maintain continuity, retain existing customers and attract new ones besides all of the additional work the restructuring brought with it. Ongoing projects had to be brought to an end: We hosted the closing event for the 30-million-euro project "TheraDiagnostics" in March and were able to show investors and partners that the vision of implantable sensors may become a reality in the not-too-distant future – to this end, we shall continue to work together with the Leibniz Institute IHP in Frankfurt/Oder at the same level of intensity. Together with the University of Potsdam, we invited Stefan Hell, who went on to become a Nobel Prize winner, to the Leibniz Kolleg academy in May; Dr. Ralph Hölzel presented the introductions to microscopy and demonstrated how we use this in the field of nanostructures. In June we introduced our ivD platform at the Capital City Congress of Medicine and Health. At the same time, we held the closing seminar on cell-free bioproduction as part of the Fraunhofer Forum, the president's key project, for which I took on the scientific coordination with the involvement of international guests – including Nobel Prize winner Ada Yonath from the Weizmann Institute of Science, who was honored in 2009 for her explanation of ribosome activity. Our open day was held on September 6 together with our neighboring institutes at the Science Campus, in which many of our dedicated staff were involved. As part of the Handkerchief Lab project, we organized a workshop and invited representatives from industrial branches with whom we have had less contact until now. Initial industry contracts have already been concluded on the back of this and others are under discussion. The results of the project were presented in the closing seminar as part of the traditional "Potsdam Days of Analysis". The extraordinarily close-knit, interdisciplinary cooperation on the campus, especially that of the Fraunhofer Institutes, on the topic of infection detection and on polymer research, was highly valued by participants. Finally, the MEDICA, held in November and excellently prepared by Dr. Ehrentreich-Förster, has provided a significant platform to showcase achievements for many years now.

**Please give us a brief outlook over the department's key tasks and plans for 2015 and beyond.**

The fact that, despite adverse conditions, we have managed to transform the entire Potsdam branch from a strongly research-driven to an industry-relevant R&D unit, a transformation which I kick started three years ago, is largely thanks to the decisiveness of the institute's management team and especially Professor Buller, who followed through with the "PILOT" investment project. Our task is now to put these resources to work in the pilot production facilities and use them to attract new customers. We are well positioned here; initial customers have already shown an interest in our rapid prototyping facilities and our scale-up options are also already sought-after. The application of the patented high-speed immunoassay in new areas is also on the agenda for 2015.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# UNITS

**ivD Platform Unit**

This unit develops procedures and devices for various point-of-care applications. An in vitro diagnostics platform (ivD platform) is available for this purpose, which can be adapted to different diagnostic tests depending on the matter at hand. Besides developing new diagnostic procedures, the unit offers customers and partners the opportunity to transfer existing tests (e. g. ELISAs, DNA microarrays, etc.) to the ivD platform. It also offers test optimization and technical verification, right through to authorization. The platform is open to numerous biomarkers and offers the customer a fast way of moving from the biomarker to the actual product.

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**Biomolecular Nanostructures and Measurement Technology Unit**

The unit carries out research and development for the analysis of biomolecular interfaces and higher-order electronic effects. At the center of our activities are applications for point-of-care testing, however applications in a laboratory environment are also included. The methods used cover a broad range of microscopies including high-resolution optics, electronic and atomic forces microscopy, as well as THz spectroscopy.

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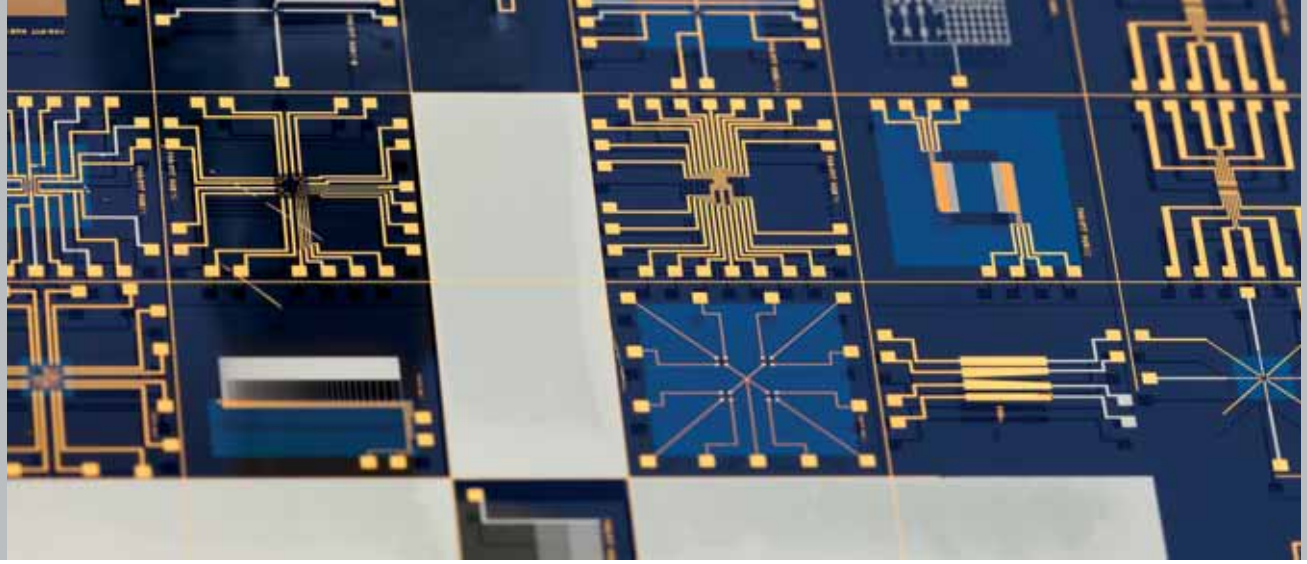

**Biomimetic Functional Materials Unit**

The unit develops technologies and solutions for fast homogeneous immunoassays and novel electrochemical and colorimetric detection systems for binding assays. Our mission is to create quantitative tests with easy handling and affordable readout for the point of care, food safety and environmental control. "Smart" customer-specific dry reagents for diagnostic and analytical applications are our second focus. Our transparent, gel-like dry reagents, for instance, offer superior storage stability, protection against desiccation and excellent adhesion on all materials.

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**Laboratory and Process Automation Unit**

This unit provides solutions for the automation of complex processes in biomedicine and biotechnology. The workflow in cell culture, cell expansion and monitoring, as usually done in the lab, forms the basis of analysis. The aim of all automation approaches is to standardize complex workflows and enhance efficiency as well as the quality of cell products.

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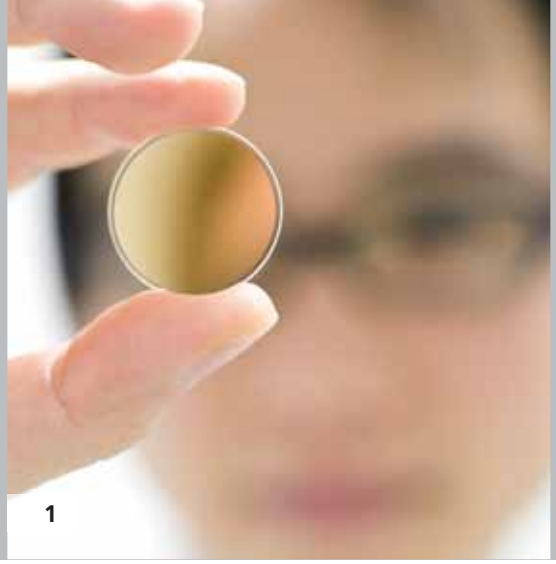

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# PROJECT EXAMPLES

**Redox displacement assay for the detection of protein-sugar interactions**

In light of a worldwide increase in infectious diseases, there is a growing demand for affordable rapid tests for pathogenic bacteria and viruses. Besides viral epidemics, as we are seeing at present with Ebola, flu and SARS, bacterial zoonoses also play an increasingly significant role. These are diseases caused by bacterial pathogens that can be transmitted from animals to humans. A notorious example is EHEC, a pathogenic E. coli strain that causes potentially fatal intestinal inflammation. On the other hand, the prevalence of multiresistant bacterial strains (especially in hospitals) requires efficient and quick screening tests to identify infected individuals immediately.

The aim of this project was to develop a sensitive electrochemical assay for bacteria, viruses and saccharide-binding proteins through their binding capacity to saccharide- or glycan-modified sensing surfaces. The specific molecular interaction between a surface protein and the immobilized saccharide or glycan replaces the typically required antibodies or other binding proteins. During its adsorption, the pathogen displaces a reporter molecule (a ferrocene benzoboroxol conjugate) that was previously chemically bound by the saccharide layer. This produces an electrochemical signal. The new redox binding assay was realized, characterized and optimized using a sugar-binding protein (concanavalin A) and the monosaccharide mannose as the model system. It was also used for the sensitive detection of a facultative pathogenic E. coli strain. Between 600 and 600,000 cells/mL were able to be detected within 15 minutes.

The new assay format is label-free, miniaturizable and suited to multiplexing. It requires no added reagents ("dip and measure") and can be realized using minimal amounts of saccharide or glycan. Electrochemical read-out by squarewave voltammetry provides a sensitive and low-cost method for real-time detection. As no antibodies or proteins are included, the functionalized sensor surface is stable in the long term and can be stored dry.

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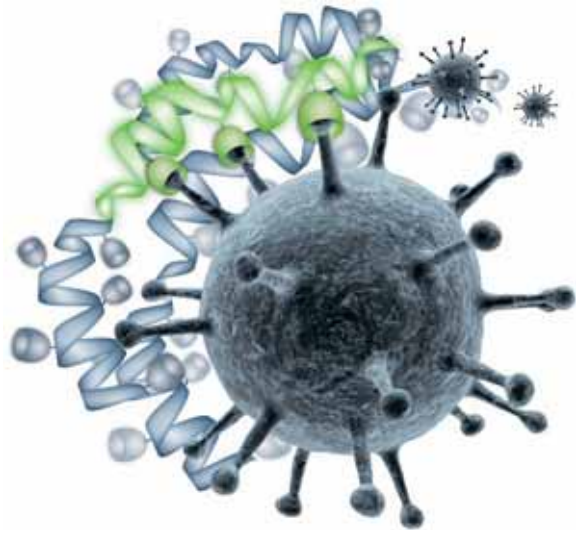
1 *Saccharide-functionalized gold sensor surface for E. coli detection*



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**Handkerchief Lab**

Chemical analysis and medical diagnostics are currently performed in highly specialized laboratories. For many years now, work has been ongoing to miniaturize and automate laboratory workflows in order to bring analysis to the point of need. Such Lab-on-a-Chip systems are not yet available on the market, however the Fraunhofer IZI has already commenced with the next step of integration in bioanalysis: Next-generation bioanalysis will make use of molecularly integrated devices, comprising all analytical components in one single molecular structure. Such molecules or molecular structures will be able to be integrated into everyday commodities, for instance into textiles and hygiene products. This vision gave the project the name "Handkerchief Lab". Fourteen partners from universities, research laboratories and industry worked together to gain insights into new mechanisms of molecular recognition and to discover how to manipulate molecules for analytical purposes in order to detect infectious germs. By doing so, biomolecular interactions will be made directly visible and applicable to diagnostics. With the new knowledge of how to gain identification patterns from any kind of germ, novel molecular identification methods for all kinds of germs have been found, for example for salmonella, MRSA (methicillin-resistant Staphylococcus aureus) klebsiella and campylobacter jejuni. Novel binding molecules, e. g. peptides, have been identified to detect flu and also patented. Fast detection methods for malaria and Ebola viruses have been found and published. Novel ways of generating signals on a molecular level have also been discovered. This knowledge opens the door to access a new era of diagnostics. The results were presented to the public during the "6th Potsdam Days of Bioanalysis", organized by the ZMDB and held by the Fraunhofer IZI in Potsdam; more information can be found at www.taschentuchlabor.de.

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Taschentuchlabor
SPITZENFORSCHUNG & INNOVATION IN DEN NEUEN LÄNDERN

Sponsored by the Federal Ministry of Education and Research (BMBF)

1 *The creatively processed vision emphasizes the mechanism: Specific binding molecules recognize the surface structures of a pathogen (a simulated virus in this case) and amend the structure, creating a signal (in this case the green stain on the backbone molecule).*

# DEPARTMENT OF CELLULAR BIOTECHNOLOGY

*”The next ten years are sure to bear witness to new therapeutic and diagnostic, cell-based procedures. Using our microreactors and biochips, we will actively support this development.”*

*Dr. Claus Duschl, Head of Department of Cellular Biotechnology, at the Fraunhofer IZI since 2014*

# IN CONVERSATION WITH DR. CLAUS DUSCHL

**Which of the department's areas of competence / technologies are particularly impressive and which R&D services have emerged as a result?**

For many years now, the European Commission has gone to great lengths to support the development of alternatives to toxicity tests on animals. One of the most important elements of this strategy is the SEURAT-1 program (Safety Evaluation Ultimately Replacing Animal Testing), which is funded together with the European Cosmetic Association (Colipa). Within this context, we are involved in a large consortium working on the HemiBio project, which aims to develop a microbioreactor that will be able to imitate the key structures and functions of the human liver. Our role in this project is to integrate sensor elements into the reactors in order to continuously determine a series of parameters over the course of several weeks, which will allow reliable conclusions to be drawn on the vitality of the extremely small cell samples. Through the combination of cleverly automated sample management and integrated optical microsensors, we are able to track the oxygen concentration, pH value and the lactate and glucose concentration of the cell medium over four weeks. The expertise gained in this project will allow us to establish novel microreactor systems whose formats will be more easily adaptable to the various requirements of demanding cell cultivation procedures. Beyond this, we hope to be able to offer a series of toxicity tests in the medium term using these systems.

**What were the department's main challenges and highlights in the 2014 reporting year?**

We want to use the start of the Fraunhofer-Gesellschaft's main project "Theranostic Implants", which will see us developing novel testing procedures to assess the hemocompatibility of implants, to also be able to offer this type of testing procedure as a service to industry partners. To this end, we have identified future challenges in this field over the past year together with a number of potential interested parties from industry and test laboratory representatives. This is to be viewed from the perspective that the requirements for the approval of implants are currently being dramatically rethought and discussed, and that considerable changes are to be expected in terms of approval criteria. With our decision to strive after accreditation as a testing laboratory for implants, we are currently moving within new territory as this is the first time such a process has been prepared at the Fraunhofer IZI-BB. We also hope that, in doing this, we will be able to profit from the relevant experience the Leipzig site has gained with qualification procedures.

**Please give us a brief outlook over the department's key tasks and plans for the 2015 anniversary year and beyond.**

Over the past few years, we have established novel coatings for the non-invasive detachment of adherent cells from their cultivation substrates in several partner projects. Three patent registrations have so far been filed during this process. From our point of view, the thermoresponsive polymer and microgel coatings are now robust and dependable enough to be used as an important tool to substantially improve the quality of numerous protocols for the handling of adherent cells. Moreover, together with industrial partners we were able to show that novel cell assays can be developed using these responsive polymers. In our view, proof now has to be furnished over the next year as to whether or not these systems are received with enough interest from business customers.

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# UNITS

### Lab-on-a-Chip Technology Unit

The unit develops customer-specific processes and prototypes based on Lab-on-a-Chip systems for the analysis and manipulation of complex biological samples. In this context, we focus on the noninvasive handling and characterization of sensitive cell samples right down to the single-cell level, employing microfluidic chips. The integration of sensor units in microfluidic devices to monitor crucial parameters of complex samples including cell lysates and cell clusters represents another important activity within the unit.

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### Miniaturized Cell Assays Unit

The unit aims to develop powerful techniques for the highly controlled processing of cells and their cultivation under defined experimental conditions. In order to do this, the unit develops microfluidic systems and microstructured substrates that are coated with smart biopolymers and allow the natural microenvironment of cells to be mimicked as far as possible in vitro. The miniaturized assay formats enable us to process even the smallest sample quantities in a parallelized and automated fashion.

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**Extremophile Research & Biobank CCCryo Unit**

The unit studies the adaptation strategies and industrial usability of cryophilic (= cold-loving) freshwater microalgae. The aim is to characterize these so-called snow and permafrost algae with regard to the various strategies in which they withstand extreme environmental parameters such as cold, UV radiation, drought and osmotic stress, before transferring these natural adaptation strategies into industrial applications. The CCCryo culture collection is unique in its diversity and scope and forms the basis of this work. Furthermore, the unit develops optimized photobioreactors for a sterile mass bioproduction of these autotrophic organisms on an industrial scale.


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**Biofunctional Coatings Unit**

The unit develops novel substrates for cell culture and tissue engineering. The behavior of biological cells is controlled using multilayer films made of biopolymers, which are also externally activated. Planar films and also microcapsules with encapsulated biomolecules are employed. Microcapsules are assembled as templates on porous CaCO3. The porous CaCO3 particles, which allow encapsulation in mild conditions, are also employed for bio-applications such as drug delivery and separation as well as polymer scaffold fabrication.


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# PROJECT EXAMPLES

**Microfluidic devices for hemocompatibility testing**

Cell-culture-based test systems are an important low-cost and reproducible diagnostic tool for assessing the interaction of new materials with living tissue. The established methods for assessing the biocompatibility of cardiovascular medical devices and implants are currently being reviewed and discussed in terms of their significance in pivotal safety tests. Through discussions with a number of potential buyers from the industry and testing laboratory representatives in the past half year, we have identified the future challenges in this field. These discussions revealed that conventional testing methods are unable to reproduce the complex flow conditions in vivo, although flow-dependent reactions, for example of the coagulation system, represent an important parameter that cannot be ignored in the context of safety tests.

In addition, the high number of human and material resources necessary for the biochemical analyses associated with conventional testing schemes considerably limit the achievable data density. As a consequence, important information on time-dependent processes cannot be gained. However, including test parameters such as sample geometry, flow rates and flow conditions makes the development of a suitable test environment challenging. In combination with a multiparameter analysis of the blood samples used, the complexity of such test environments can only be met with microfluidic devices.

Therefore, the aim of the current project is to develop a microfluidic test environment that allows the in vitro evaluation of the hemocompatibility of cardiovascular medical devices and implants and their coatings, respectively. This evaluation will take place in the form of controlled experiments, be more efficient and consume less material than before. Our many years of experience in the field of processing and characterizing biological samples in Lab-on-a-Chip systems enable us to draw on concepts and partial solutions that form a solid foundation for this exciting and challenging task.

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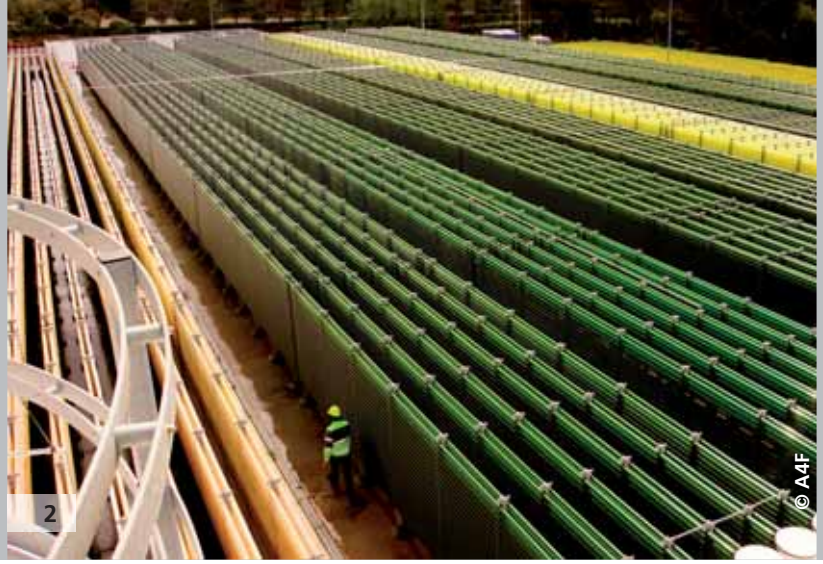
**1** *Microfluidic system to precisely control the cellular microenvironment. These kinds of systems form a basis for establishing fluidic testing environments to judge the hemocompatibility of cardiovascular implants.*




**PUFAChain – Microalgae as production strains for omega-3 fatty**

Polyunsaturated fatty acids (PUFA), especially omega-3 fatty acids such as eicosapentaenoic (EPA) or docosahexaenoic acid (DHA), are essential constituents of the human diet. Until now, certain saltwater fish have been the only natural source of these substances in the human diet. However, this natural resource is becoming increasingly rare and there is growing demand for supplements containing EPA and DHA. This also applies to capsules or food enriched with EPA and DHA: The fishing industry with its by-catch or fish scraps provides the only biological source, yet this source is diminishing.

Microalgae are important primary producers of EPA and DHA; they pass them on to shellfish, fish, and finally the human within the food chain. Thus, they are a valuable alternative source, also because they can be produced in large quantities in industrial-scale photobioreactors under controlled conditions and are therefore also free from pollutants. The feasibility of such a process is being investigated within the framework of the EU-funded project PUFAChain. The project partners cover all the relevant steps along the value-added chain and investigate the process from the market back to the start: The rising demand for highly purified EPA and DHA for food and pharmaceutical applications primarily defines the quality of all downstream processes such as algal harvest, cell disruption, extraction and purification of the desired fatty acids. Prior to this, the mass production of suitable algal strains to be cultured under natural ambient light and temperature conditions first has to be managed. In order to identify the most suitable algal production strains, a preselection of strains is tested for optimal PUFA content and yield with two bioresources of microalgal cultures – the Culture Collection of Algae at the University of Göttingen (SAG) and the Culture Collection of Cryophilic Algae (CCCryo) at the Fraunhofer IZI-BB in Potsdam.

The Fraunhofer IZI-BB primarily focuses on cold-adapted algae from the polar permafrost regions of our earth. They offer acceptable growth rates even at low temperatures and under low irradiation. During the production process, these CCCryo algal strains will be favored during the cold seasons over the algal strains from the SAG, which are more suitable during the warm seasons. By choosing algal strains which are always best suited for the respective ambient production conditions over the course of the year while also bearing in mind optimized downstream processes, an overall economic production process can be achieved. A conclusive sustainability assessment, which includes a life-cycle assessment on environmental, economic and social implications, forms an integral part of the project.

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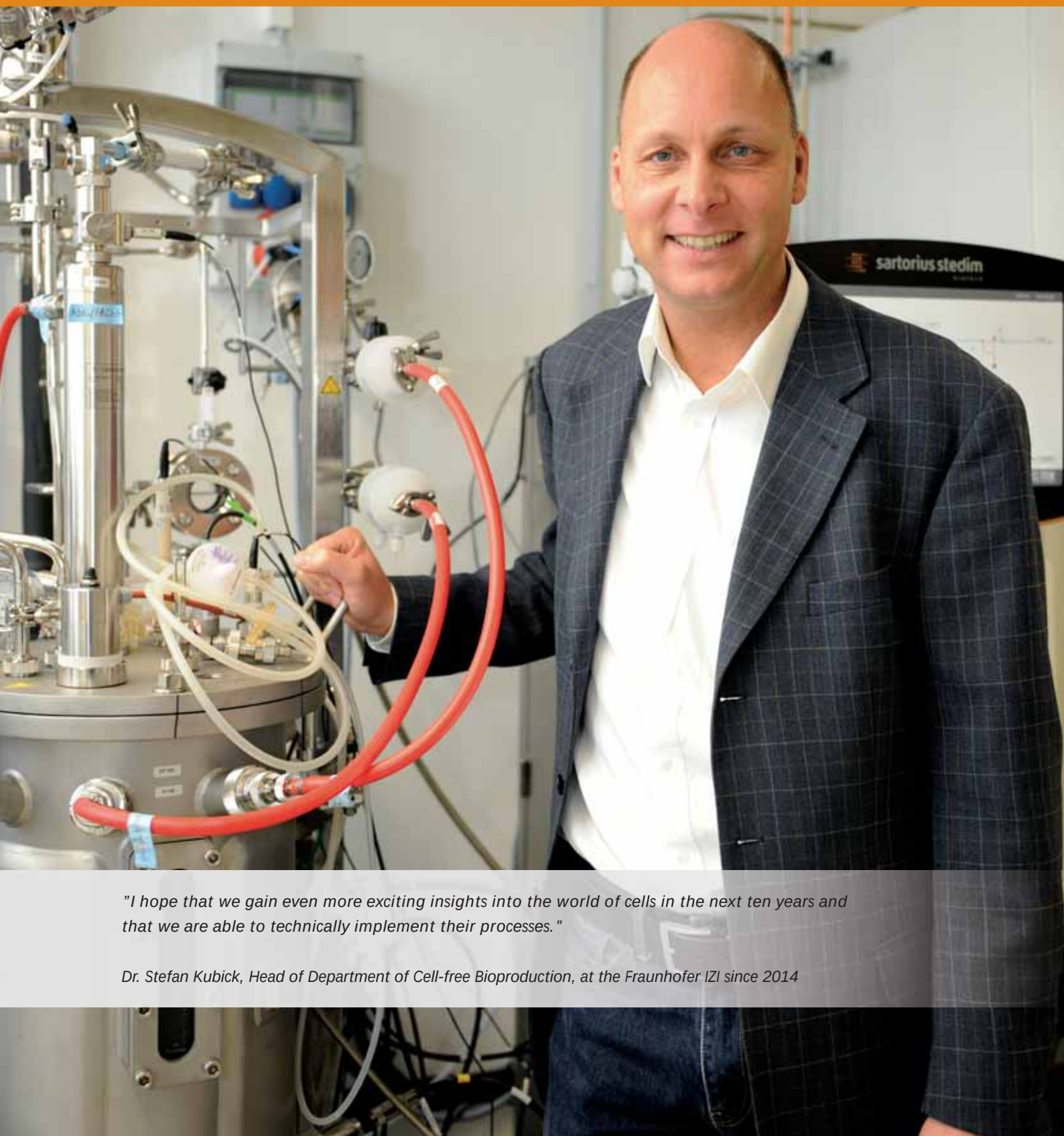
**1** *Precultures from the CCCryo algae collection to determine fatty acid pattern*
**2** *Algafarm photobioreactor system in Leiria, Portugal*

# DEPARTMENT OF CELL-FREE BIOPRODUCTION




*”I hope that we gain even more exciting insights into the world of cells in the next ten years and that we are able to technically implement their processes.”*

*Dr. Stefan Kubick, Head of Department of Cell-free Bioproduction, at the Fraunhofer IZI since 2014*

# IN CONVERSATION WITH DR. STEFAN KUBICK

**Which of the department's areas of competence / technologies should be especially highlighted and which R&D services have emerged as a result?**
The Department of Cell-free Bioproduction has comprehensive expertise in the area of eukaryotic cell cultivation and in the manufacture of translationally active cell lysates from these cells, which are serum-free and have been fermented in a chemically defined medium, as well as in further developing these cell lysates into efficient, cell-free protein synthesis systems. These systems will, in turn, be adapted in our department to the specific requirements of cell-free membrane protein synthesis, the production of antibody fragments and the cotranslational introduction of non-canonical amino acids, for instance fluorescent amino acids, in proteins synthesized in a cell-free way.

This expertise gives rise to a variety of possible R&D services. A particular focus lies on synthesizing active membrane proteins under individually optimized conditions in order to retain their specific properties for advanced analytical procedures. In this context, among other things, electrophysiological measurements are carried out in the Department of Cell-free Bioproduction on ion channels which have been synthesized in a cell-free way. Both for analytical purposes and for the generation of proteins with completely novel properties, relevant for technical purposes and pharmacological applications, so-called non-canonical amino acids are introduced in a targeted manner into cell-free synthesized proteins. In this way, for instance, fluorescent membrane proteins and enzymes immobilized on surfaces can be manufactured in cell-free systems.

The open design of cell-free systems allows components which influence the quality and quantity of the target protein to be introduced externally. For example, folding assistants, so-called chaperones, or membrane structures, so-called microsomes, can be added to the cell-free system in order to retain a high proportion of the functional protein in the result. Finally, cytotoxic proteins can also be produced in cell-free production systems; these proteins are of great use from a technological and pharmaceutical perspective, yet they cannot be portrayed in living cells.

Cell-free protein synthesis systems generally present a future-oriented technology platform, which allows the variety of identified gene sequences to be efficiently translated into proteins in a way that saves time and resources, and allows defined functions to be assigned to these proteins.

**What were the department's main challenges and highlights in the 2014 reporting year?**
One of the greatest challenges was in generating a new type of cell-free protein synthesis system based on cell lysates from cultivated CHO cells. These cells are frequently used in biotechnological procedures in order to produce therapeutic proteins. The aim was to combine the efficiency and economy of in vivo protein production in CHO cells with the advantages and unique criteria of cell-free protein synthesis. As a result, a robust, cell-free CHO system was successfully manufactured which is able to synthesize complex, post-translationally modified eukaryotic proteins in less than 90 minutes. Signal peptide cleavage, phosphorylations, lipid modifications and also glycoprotein synthesis was demonstrated in this new cell-free system. Through the especially gentle lysate manufacturing methods, endogenous microsomes derived from the endoplasmatic reticulum are retained in the system, which facilitate the cotranslational embedding of membrane proteins in lipid layers. This system is therefore especially suitable for the time-saving and highly parallel, cell-free synthesis of membrane proteins.

This gives rise to an important task for the coming years: Linking laboratory automation technologies with robust, cell-free systems in order to manufacture proteins for structural and functional analysis and for pharmaceutical use.

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# UNITS

### Cell-free Protein Synthesis Unit

The unit focuses on the synthesis of recombinant proteins in cell-free systems. In this context, special emphasis is placed on the cell-free synthesis of antibodies and antibody fragments, followed by their characterization, modification and functional analysis. By using cell-free protein synthesis, a given target protein is produced using the translational machinery without the living cell. Thus, protein synthesis is disconnected from cell fate. Eukaryotic lysates offer the particular advantage of being able to produce posttranslationally modified proteins.

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### In Vitro Protein Labeling Unit

Functional characterization of membrane proteins and the development of novel protein labeling technologies form the focus of the In Vitro Protein Labeling Unit. The incorporation of modified and non-canonical amino acids into the growing nascent peptide chain is facilitated by chemically or enzymatically preacylated tRNAs. Defined protein conjugates with biotinylated or fluorescent-labeled groups are prepared using prokaryotic and eukaryotic cell-free systems. Site-specific protein labeling serves as a gentle and easy way of characterizing and detecting the functionality of the synthesized proteins.

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**Eukaryotic Lysates Unit**

The unit is developing cultivation systems for eukaryotic cell lines in order to obtain translationally active lysates for cell-free protein synthesis. In this respect, testing new cell lines for their in vitro expression capabilities is of highest interest. Furthermore, the unit develops and optimizes eukaryotic cell-free translation systems. The influence of fermentation conditions, cell disruption as well as transcription and translation components are of special interest for the translational productivity of the generated lysates.


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# PROJECT EXAMPLES

**Production and functional characterization of membrane proteins using cell-free systems**

Membrane proteins constitute more than 30 % of all human encoded proteins. They are essential pharmaceutical targets due to their involvement in vital cellular processes such as transport, signal transduction, cell-cell recognition and adhesion to the cytoskeleton. Expression of membrane proteins in vivo is challenging due to low yields, solubilization and purification problems, while overexpression often leads to toxicity. An alternative for in vivo methods is the cell-free synthesis of proteins. This method is simple, has a high degree of controllability and provides a completely open system allowing direct manipulation of the reaction conditions to optimize protein folding, disulfide bond formation, incorporation of non-canonical amino acids and the expression of toxic proteins. In comparison to conventional cell-based expression systems, cell-free systems offer rapid protein expression, purification and functional analysis.

The most common way of analyzing ion channel activity is by measuring the currents caused by the ion flow. In this context, the bacterial potassium channel KcsA was chosen for our studies. The cell-free synthesized potassium channel was fluorescently labeled by random cotranslational incorporation of BODIPY-TMR lysine. The functional analysis of the synthesized protein was verified to check whether the modified protein retains its native gating activity. Therefore, KcsA was synthesized in a vesicle-based, eukaryotic, cell-free system. Protein functionality was subsequently demonstrated by means of electrophysiological analysis after fusing microsomes harboring KcsA onto a planar lipid bilayer. Patch clamp experiments were performed with the automated system "Port-a-Patch" (NanionTechnologies).

The assay explained above dramatically speeds up the downstream application of synthesized membrane proteins. The whole process starting from protein expression directly from a PCR product to its functional monitoring could be done within two hours. The microsomes present in the cell-free system incorporate the expressed protein in their membrane and no extra purification or addition of membrane supplements is necessary. Moreover, no extra time has to be spent on cloning steps as the protein can be synthesized directly from the linear PCR templates. The entire cell-free procedure is devoid of the generation of genetically modified organisms.

Cell-free systems will enable the synthesis of more complex membrane proteins and their subsequent, detailed functional characterization through a combination of biophysical and molecular biological methods based on translationally active cell-lysates derived from cultured eukaryotic cells.

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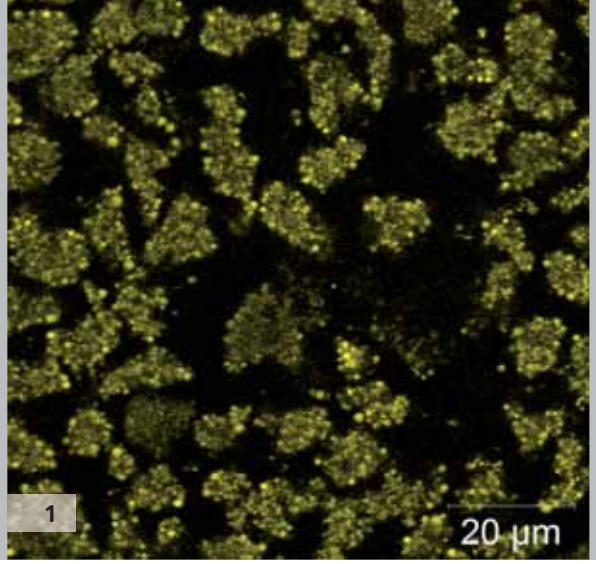


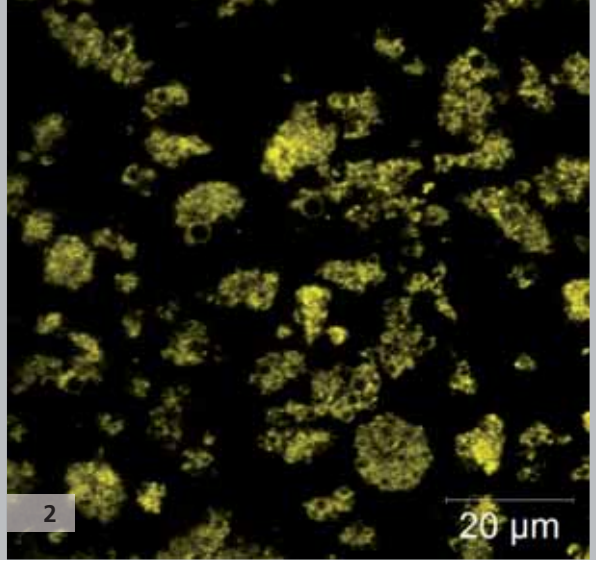


**Cell-free systems for the synthesis of antibodies**

Antibodies recognize their corresponding antigens with high affinity and specificity. This property makes engineered antibodies indispensable to key players in research, diagnostics and therapy. Thus, it is of utmost interest to develop novel production strategies for antibodies which are time-saving and cost-effective, yet also flexible and reliable. In this context, an efficient alternative to cell-based production systems has emerged in the last decade, termed as "cell-free protein synthesis".

Cell-free protein synthesis, also referred to as in vitro translation, facilitates the production of a given target protein by using translational machinery without maintaining the integrity of the living cell. In contrast to cell-based expression, reaction conditions can directly be adjusted according to the needs of the individual target protein. The use of eukaryotic cell lysates offers particular advantages for the synthesis of complex and posttranslationally modified proteins. Thanks to these positive characteristics, an eukaryotic, cell-free translation system based on cultured insect cells (Spodoptera frugiperda, Sf21) has been used to synthesize antibody fragments featuring various specificities. In these experiments, fusion of the gene sequence to an ER-specific signal sequence was shown to enable an efficient translocation of antibody fragments into the lumen of microsomal vesicles. These vesicles originate from the endoplasmic reticulum of the insect cells used in the preparation of the cell lysate. This "translocation" step provides optimal reaction conditions for protein folding, posttranslational modification as well as concentration in microsomal vesicles.

In general, cell-free systems offer the advantage of synthesizing recombinant antibody formats for production and screening purposes in a highly parallel and therefore time-saving manner. The co-translational labeling of proteins is another advantage of cell-free systems. Using co-translational labeling techniques, antibody fragments can be equipped with fluorescent dyes, biotin or other low-molecular weight substances. Moreover, antibody fragments and antibodies can be conjugated with cytotoxic proteins and peptides which cannot be synthesized in vivo due to their cytotoxicity. This application is of particular interest to the generation of therapeutic antibodies.

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**1** *Fluorescence microscopy image of antibody fragments, which were merged with a yellow-fluorescent protein (eYFP)*

**2** *Fluorescence microscopy image of a membrane protein which has been synthesized in a cell-free way and is also fluorescently labelled*

# DEPARTMENT OF BIOANALYTICS AND BIOSENSORS

*”As scientists, we are able to predict the behavior of cells and molecules. It would be great if the same could be said of all parts of life!”*

*Dr. Eva Ehrentreich-Förster, Head of Department of Bioanalytics and Biosensors, at the Fraunhofer IZI since 2014*

# IN CONVERSATION WITH DR. EVA EHRENTREICH-FÖRSTER

**Which of the department's areas of competence / technologies should be especially highlighted and which R&D services have emerged as a result?**
The department is able to deliver a complete solution to analytical problems in a short amount of time and subject to constant quality controls. This begins with sampling biological, biochemical or purely chemical materials and, besides the minimal preparation required, encompasses the selection of suitable methods from a large instrumental pool and the analysis itself, as well as evaluation and data processing through to incorporating our methods and findings in "big data" platforms.

**What were the department's main challenges and highlights in the 2014 reporting year?**
The internal change in responsibilities and structures, the resulting challenges and the new synergies and areas of activity which have emerged in consequence.

**Please give us a brief outlook over the department's key tasks and plans for the 2015 anniversary year and beyond.**
The most important task for our department is to stabilize and continue our previous work and to tap new fields.


Contact

Dr. Eva Ehrentreich-Förster
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# UNITS

### Microarray and Sensor Technology Unit

The unit develops and modifies the surfaces of biological materials with the aim of also analyzing and characterizing the smallest sample quantities in as much detail as possible. The technological implementation takes place both on geometric materials, such as fibers, and on planar carriers, such as plates or chips. The surfaces themselves vary from glass containers and wafer materials through to plastics.

The products developed by the unit include independent sensor elements (e. g. test strips) or analysis and database tools (cell and peptide chips) and can be applied to the various issues in the fields of environmental analysis, food control, herd management, process control and diagnostics.

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### Biomarker Validation and Assay Development Unit

The unit develops specific assays to validate biomarkers and adapt assays. In order to selectively immobilize biomolecules on a variety of surfaces such as microtiter plates, slides or membranes, the unit has a variety of spotting and dispensing techniques and can select the best one for each specific problem. All kinds of interactions can also be characterized on the basis of kinetic and thermodynamic measurements. Applications include system biology projects, the kinetic analysis of antibodies and the development of point-of-care applications e. g. for drugs and serum screening.

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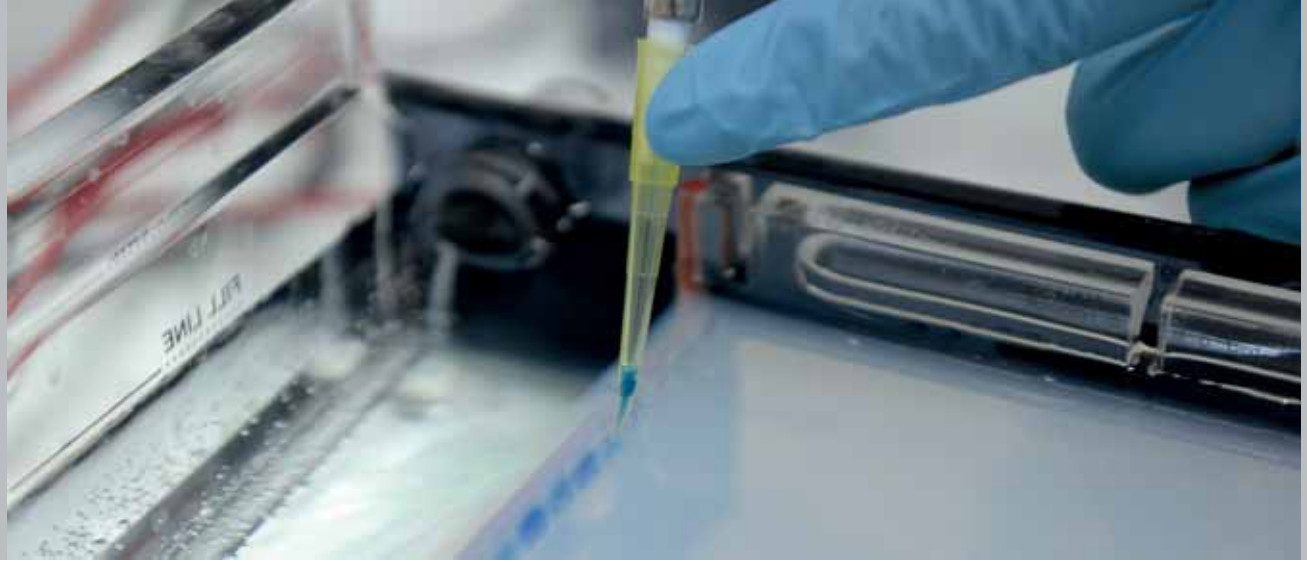

**Molecular Bio-Engineering Unit**

This unit converts natural biological processes into isolated artificial architectures and strategies which utilize new perspectives in applications of cellular structures, mechanisms and metabolisms. In former studies, for example, modified synthetic membrane proteins were used to fix extracellular entities.

More recent studies deal with innovative immunodominant antigens taken from cDNA libraries of prokaryotic transcriptomes, which mainly consist of pathogens, besides the development and construction of antimicrobial peptides, especially synthetic and artificial peptides, within the scope of antibiotic resistances.


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**Metabiobanks CRIP Unit**

The unit develops ICT infrastructure for networked biomedical research: Based on the CRIP Privacy Regime (which was approved by German data protection authorities in 2006), remote biobanks are integrated into so-called metabiobanks, facilitating cross-institutional and transnational queries concerning human specimens on a case-by-case and sample-by-sample basis. Thus, material and data originally collected for health care (e. g. blood, serum, tissue) are swiftly made accessible through stratified, statistically relevant "clinical cohorts" to support research in personalized medicine and disease biomarkers.


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# PROJECT EXAMPLES

**Telediagnosis**

Autonomous sensors repeatedly shift into the spotlight with regard to the continuous process control and acquisition of measurement data in poorly accessible areas.

This is why the development of encapsulated sensor elements as part of the advancing miniaturization of complex, technical applications has increasingly gained in significance in recent years. Such systems can be used flexibly and applied to the field of medical diagnosis and local patient monitoring (point-of-care testing, POCT) just as well as in the bioprocess control of fermentation processes or in the cultivation of microorganisms in bioreactors.

Crucial to these developments, however, is the successful transfer of established "traditional" measurement systems. In order for this to happen, the biosensor has to be made from biocompatible materials. The established sensors are, however, largely based on the use of electrochemical measurement techniques, which greatly eliminate the complete abandonment of non-biocompatible materials in advance at present. The alternative lies in a protective system which separates the sensor. This was accomplished with the development of a semi-permeable encapsulation system for the controlled use of autonomous biosenors in the area of bioprocess optimization and medical diagnostics.

The autonomous sensor system is manufactured using a sinter procedure, in which a fine-grained composite consisting of a polymer and a water-soluble porogen is processed. Biocompatible (co-)polymers with variable material properties, which are already utilized in the field of medicine, are used as the base material. With their intended use to optimize bioprocesses in less demanding systems, sensor capsules may, on the other hand, be manufactured from more affordable polymers.

The targeted release of specific reagents inside the capsule enables individual maintenance processes to be carried out on the sensor system. The range of stated targets is to be amalgamated using minimal technical and economical efforts. Moreover, the combination of modules to be developed is intended to facilitate a qualitative and quantitative expansion of the application spectrum of current biosensor encapsulation systems.

The sensor system in its present state has been used in functionality studies to monitor growth and culture conditions of algae cultures in photobioreactors. The pH value, glucose concentration and conductivity were continuously monitored in parallel.

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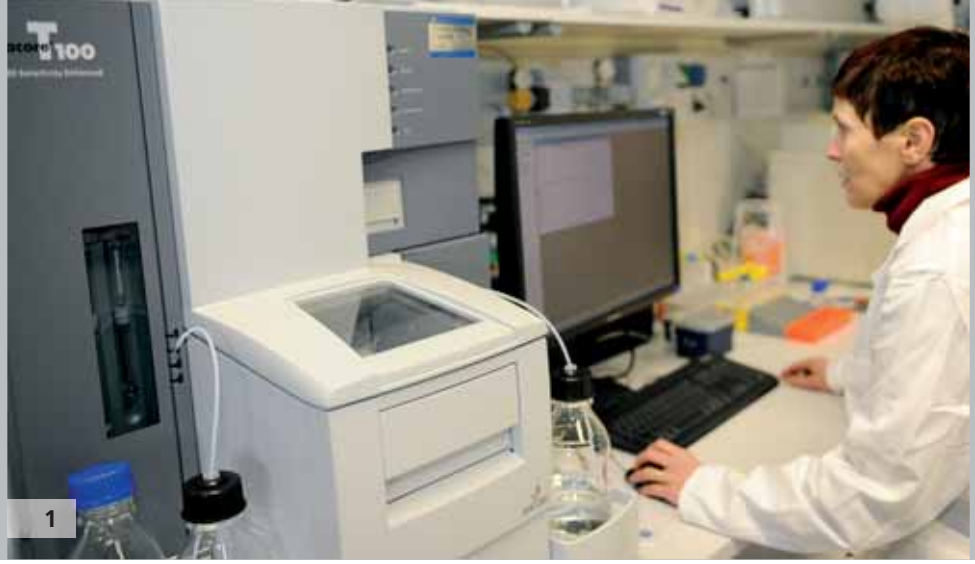
Funded by the *Land* of Brandenburg using means from the European Regional Development Fund (ERDF).



**Impulse center for integrated bioanalytics – the handkerchief lab**
**Sub-project: SPR characterization of the 1:1 and multiple interactions of binder peptides and pathogen target structures**

Patient-relevant, on-site analysis (point of care) plays an ever more significant role in disease diagnosis and also in monitoring physiological status. Self tests which can be carried out quickly save time and money compared with a laboratory examination, making initial disease diagnosis or the examination of physiological parameters more effective.

The Lab-on-a-Chip idea is being further advanced in the "Handkerchief Lab" collaboration project. Sensor-actor molecules, which link biomolecular detection and signal generation, could thus be woven into textiles or sanitary tissues and used to directly detect pathogenic germs. The three pillars of the project are pathogen detection, scaffold structure construction (switchable polymers) and signal recognition (incl. strengthening).

Small binding molecules will be developed to detect pathogens, especially peptides and oligosaccharides, which only slightly influence the properties of switchable scaffold polymers compared with large binders such as antibodies. The experiments are focused on gaining and characterizing peptides and antibodies to fight influenza viruses and methicillin-resistant Staphylococcus aureus (MRSA) as well as candida albicans. Binding peptides are gained through the paratope mapping of known and newly isolated antibodies. Peptides are characterized by means of surface plasmon resonance spectroscopy (SPR) and involves the optimization of spacers (which maintain distance from the sensor surface) and linkers (end groups for immobilization). In order to gain peptide variants which are better at binding to the pathogenic target structures, substitution analysis is used with the help of microarray techniques. This technique is also applied to trials differentiating between influenza strains.

Initial results with peptides coupled to PDA polymers verify the concept of the autonomous biosensor, in that binding a pathogen through a change made to polymer structure directly leads to a visually measurable signal. The peptides fighting influenza peptides not only possess sensory but also therapeutic potential and are being further investigated by different institutes, especially in the Berlin-Brandenburg region.

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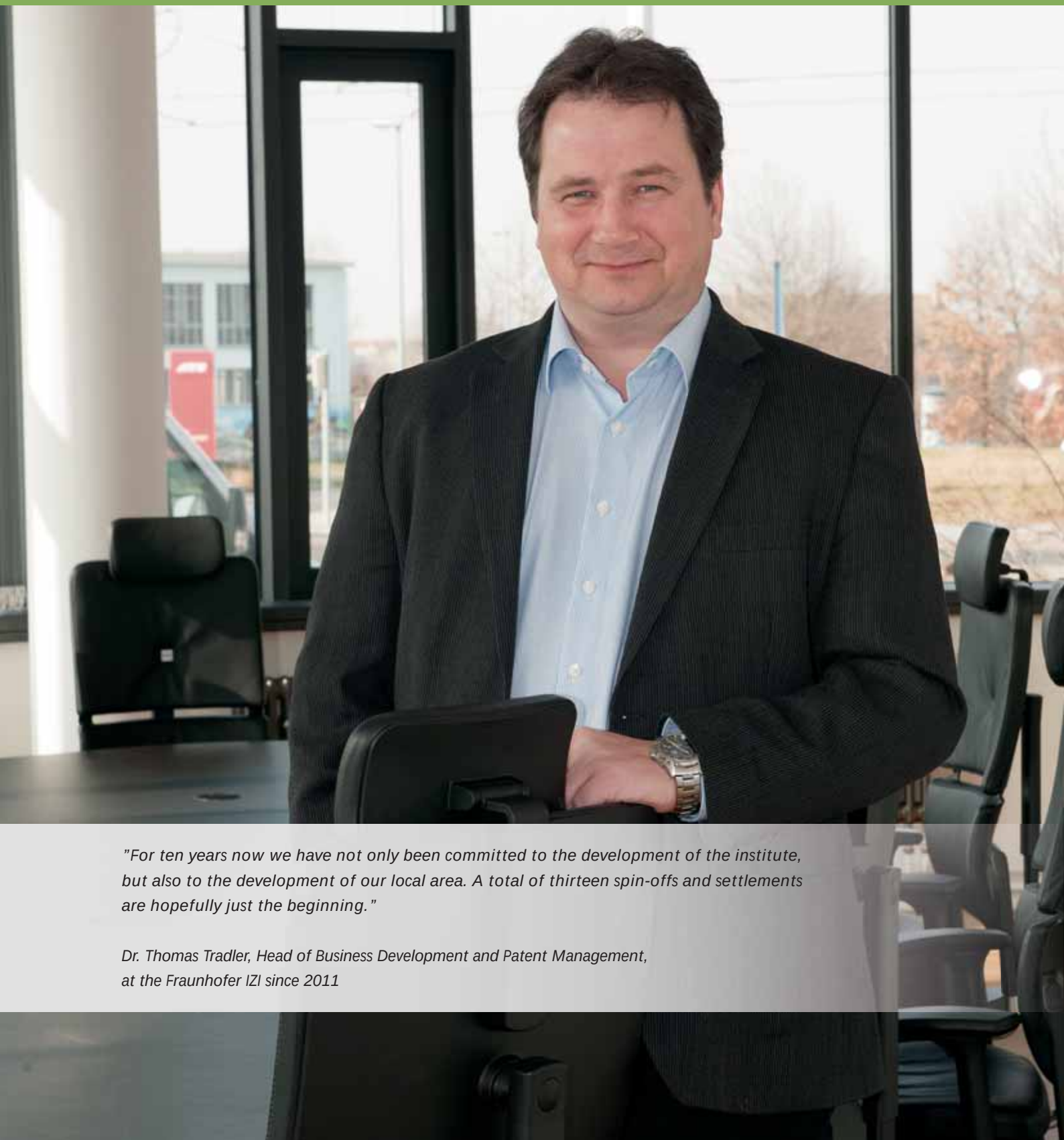
Taschentuchlabor
SPITZENFORSCHUNG & INNOVATION IN DEN NEUEN LÄNDERN

Sponsored by the Federal Ministry of Education and Research

1 *Investigating the interactions of binder peptides and pathogen target structures in the laboratory*

# PRODUCTS AND SERVICES



*”For ten years now we have not only been committed to the development of the institute, but also to the development of our local area. A total of thirteen spin-offs and settlements are hopefully just the beginning.”*

*Dr. Thomas Tradler, Head of Business Development and Patent Management, at the Fraunhofer IZI since 2011*

# BUSINESS UNITS

The Fraunhofer Institute for Cell Therapy and Immunology IZI explores and develops solutions to specific problems at the interfaces of medicine, life sciences and engineering. To its clients and partners the institute offers complete solutions ranging from market studies right down to the development of a market-ready product and its marketing authorization. In the business units of drugs, cell therapy, diagnostics / assays and biobanks the Fraunhofer IZI develops, optimizes and validates methods, materials and products for medical, biotechnological and pharmaceutical companies as well as for diagnostic laboratories, hospitals and research facilities. On the following pages please find a list of our special competencies, sorted by departments.

**Business Unit Drugs**

The development of new therapeutic agents is a time- and cost-intensive process. In many cases there is a gap in the transfer of fundamental research results to clinical practice. The Fraunhofer IZI bridges this gap by means of its special know-how in the field of preclinical development. Our range of services already starts with development services and extends over characterization, optimization and preclinical studies right down to clinical trials. Particular priorities are the development of agents in the fields of oncology, infection biology, autoimmune and inflammatory diseases as well as ischemia.

**Business Unit Cell Therapy**

Cell therapy is the application of cells or cell suspensions. It is the aim of a cell therapy to induce regenerative processes and to replace dysfunctional or defective cells in the patient, respectively. In order to clinically apply cell therapeutics it is required to demonstrate their safety and effectiveness, which is done in extensive preclinical examinations and clinical trials. The Fraunhofer IZI conducts contract development and testing of cell therapeutic methods. The institute offers all developmental steps from one source, from the design of studies over preclinical development right down to the grant of a manufacturing authorization and the production of test preparations for clinical trials.

**Business Unit Diagnostics / Assays**

In order to promote the development of regenerative therapy strategies innovative diagnostic methods are required. From the characterization of individual cells to the imaging in living organisms, methods and processes must continuously be adapted and adjusted. The Fraunhofer IZI develops, tests and validates new and adapted diagnostic methods and accompanies its partners until a product has reached market maturity. With innovative methods and new classes of biomarkers (e. g. ncRNA) the institute seeks to develop more sensitive, rapid and cost-effective methods and to transfer them to clinical application.

**Business Unit Biobanks and Biosystems Technology**

Biobanks are collections of biological material that are stored and optionally preserved in a special manner while providing additional information, e. g. about their origin. Biobanks are established for research and other purposes, e. g. as supply for diagnostic or therapeutic methods or, in the field of biology, for the conservation of biodiversity. As far as human materials are concerned, the donators' consent and specific handling regulations are required.

At the Fraunhofer IZI there are biobanks for various inflammatory and tumor tissues as well as for various types of stem cells, also including tumor stem cells, that serve for the processing of research contracts. The units at the Fraunhofer IZI also develop individual components themselves, like for example new cryoprotectors, and are very experienced in conceiving, establishing, documenting and operating biobanks, which are readily utilized within the scope of contracts.

# PRODUCTS AND SERVICES

**Department of Cell Engineering**

- GMP-compliant development and validation of manufacturing processes
- GMP-compliant development and validation of quality controls
- GMP-compliant production of cell and gene therapeutics
- Application for tissue procurement permissions according to Section 20b of the German Drug Act
- Application for import permissions
- Assistance in writing the Investigational Medicinal Product Dossier (IMPD)
- Regulatory consultancy
- Process and method transfer (international, national)
- Antibodies – monoclonal / polyclonal
- GLP studies (in vitro) – immunotoxicology, immunogenicity
- GLP studies (in vivo) – biodistribution, tumorigenicity, immunotoxicology, immunogenicity
- Customized development and validation of immunological in vitro test systems
- Customized development and validation of animal models for efficacy and safety studies (predominantly ATMPs)
- Therapy model (mouse) of salmonellosis (Salmonella enterica)
- Therapy models (mouse) of chronic inflammatory bowel diseases
- Validation and beta-evaluation of cell technological procedures/instruments

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**Department of Immunology**

- Development of vaccines (antigen, expression systems, adjuvants) for human/veterinary medicine
- Development of diagnostic tests for infectious diseases
- Models of Graft-versus-Host-Disease (in vivo/in vitro)
- Leukemia models (mouse)
- Skin transplantation model (mouse)
- Human immune system in the animal model (mouse)
- Innovative phage-display libraries
- Enzymatically activatable linker
- Activation of surfaces
- Development of diagnostics and therapeutics from peptides
- Epitope mapping of antibodies and mixtures
- Development and manufacture of cell-specific peptides
- Determination of the hepatotoxicity of drugs
- Biosensor technology: Cell-based early detection of liver failure
- Function and performance tests of hemodialyzers, filters and adsorbers
- Preclinical and clinical trials
- Assay system to isolate biomarkers in the case of arteriosclerosis/development of plaque
- Defensins and antimicrobial peptides
- Biofunctionalization of surfaces
- Preclinical testing of drugs and vaccines
- Establishing animal models
- Preclinical trials under GLP conditions

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**Department of Cell Therapy**

- T-cell infiltration patterns in vitro and in vivo
- Cell sorting
- Cytotoxicity assays
- CAM (chorio-allantoic membrane) assay angiogenesis and tumor
- Dye transfer assay
- Large-animal treatment model for cerebral ischemia (sheep)
- Histology of the mammal brain
- Large-animal model for acute cerebral hemorrhage (sheep)
- Neuronavigation and stereotaxic application in large animals
- Intensive medical attendance of large animals
- Genetic-epidemiological analyses
- Development of nucleic acid-based assays
- SNP analysis in the human genome
- Combination of genetics and EEG (e. g. MMN)
- Differential allelic RNA expression analysis
- IImaging genetics (combination of (f)MRI and DTI)
- Statistical analyses
- Psychometric testing
- Morphological, functional and spectroscopic examinations in high-field magnetic resonance imaging
- Quantification of in vivo fluorescence and bioluminescence signals
- Stereological cell and object analyses
- Acquisition and evaluation of 3D stacks using confocal laser scanning microscopy
- Development of software-supported evaluation routines (e. g. in MATLAB)
- Laser microdissection and molecular biological analyses
- Animal models of myocardial ischemia
- Model systems of stroke (murine/humanized)
- Vascular dementia models
- Multi-dimensional flow-cytometric characterization of organ lysates
- Sensorimotor and cognitive behavioral tests

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**Department of Diagnostics**

- Model for acute and chronic arthritis (mouse, rat)
- Cartilage destruction models (mouse)
- Cellular functional testing for tissue-destructive fibroblasts
- Allergic rhinitis model (mouse)
- Scleroderma model (mouse)
- Humanized NSG mouse
- Model of chronic and acute allergic asthma (mouse)
- Model of chronic obstructive lung disease (COPD)
- Model of sepsis in the humanized NSG mouse
- Model of xenogeneic Graft-versus-Host-Disease in the NSG mouse
- Cytostatics and cell therapeutics
- Testing of cytostatics on tumor stem cells (in vitro & in vivo)
- Personalized tumor killer cells
- Nanostructuring of surfaces
- Optimization of pathogen isolation methods
- Development of molecular diagnostic detection procedures
- Functional nanoparticles in diagnostics and therapy
- Development of diagnostic rapid tests

- Sepsis diagnostics
- Design of custom 2D or 3D nanoscale objects via the "DNA Origami" method
- Custom single-stranded DNA scaffold production
- Molecular (e. g. peptide) patterning on biocompatible scaffolds
- Transcriptomic analyses by tilling arrays and ultra high throughput sequencing
- Microarray analytics
- MicroRNA analytics (expression, localization, targets)
- Noncoding RNA (ncRNA) studies (expression, functions)
- Chromatin Immunoprecipitation ChIP
- Capture Sequencing
- Chromatin Isolation by RNA Purification (ChIRP)
- Bioinformatics, particularly analyses of next-generation sequencing and microarray data
- Prgramming of data management systems
- Biomarker screening
- Biomarker validation
- Assay development for diagnostic tests

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**Department of Drug Design and Target Validation**

- Development and phenotyping of transgenic animal models
- Behavioral analysis
- Stereotactic CNS injections
- Neuronal primary cell culture
- Compound analysis in vitro
- ADME analysis in vivo
- Manufacture (cloning) of expression vectors
- Heterologous expression of proteins in E. coli, yeast, insect cells and mammalian cells
- Protein purification using column chromatography
- Spectroscopic analysis of enzyme structure and function in vitro (UV-Vis, CD, and fluorescence spectroscopy)
- Structure-based optimization of antibodies (protein engineering)
- Rational drug design in silico
- Synthesis, purification and analysis of small molecules
- Synthesis, purification and analysis of peptides/proteins
- MALDI-TOF/TOF
- Physico-chemical analysis of protein-ligand interactions
- Identification of biomarkers
- Biological analysis and assay development
- Computational chemistry and bioinformatics

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**Department of Biosystem Integration and Automation**

- Assay development for biological samples
- Multiplex assays
- DNA-based assays (microarray)
- PCR and RT-PCR development
- Dispensing biological samples
- Coupling DNA, RNA, proteins and peptides to modified surfaces
- Aptamers for in vitro diagnostics / aptamer assays
- Biomolecular interaction analysis, kinetic analysis
- Characterization and validation of antibodies (cross-reactivity, specificity)
- Serum screening
- Biochips
- Alternative detection systems
- High-resolution lateral structuring of immobilisates ("nanostructures")
- Composition of 2D and 3D nanostructures
- Direct printing and writing of nanoscale structures
- Nanotechnology with biomolecules
- Development of nanoarrays
- Impedance spectroscopy
- Molecular dielectrophoresis
- Microscopy (fluorescence, atomic force, electron)
- Coatings (evaporation, sputtering), plasma purification, laser structuring
- Optoelectronics
- Simulation of electronic analogue circuits
- Calculation of electric fields in three-dimensional geometry
- Homogeneous immunoassays with electrochemical detection
- Customer-specific formulations of dry reagents for POCT
- Customer-specific synthesis of bioconjugates and functional polymers
- Molecularly imprinted polymers (MIPs) for sensor technology and chromatography
- Electrochemical examination techniques
- Analysis of laboratory processes / development of automation strategies
- Designing automation facilities
- Rapid prototyping
- Peptide syntheses (complex libraries)
- Automation solutions for pre-analytics
- Software development and programming

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**Department of Cellular Biotechnology**

- Design and development of microfluidic systems
- Manufacture of microfluidics (incl. periphery and integration of functional elements)
- Non-contact cell handling by means of dielectrophoretic field cages
- Loading cells with signal molecules or drugs
- Characterizing mechanical and dielectric cell properties
- Examining cell-cell interactions
- Cell sorting
- Microbioreactors
- Integration of sensor technologies
- Cell cultivation and cryoconservation
- Functional cell assays and cell analytics

- Expression analyses
- Fluorescence, TIRF, super resolution and confocal microscopy
- Binding studies of receptor-ligand interactions in microchannels
- Biofunctionalization of cell culture substrates
- Manufacture of micro-contact stamping
- Cell arrangement on surfaces
- Chemical surface modification
- Surface analytics
- Determining adsorption kinetics and coating thicknesses
- Metallization of surfaces
- Micromanipulation, microdissection, laser-microdissection
- Isolation as well as taxonomic and phylogenetic characterization of extremophilic microorganisms
- Analysis of primary and secondary metabolites of extremophilic microorganisms in terms of industrial applicability
- Photobioreactor development for production on an industrial scale

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**Department of Cell-free Bioproduction**

- DNA templates for cell-free protein synthesis
- RNA synthesis
- Cell-free synthesis and characterization of recombinant antibody formats
- Protein expression and analysis
- Directed protein evolution
- Labeling and functional analysis of antibody fragments
- Optimization of in vitro translation systems
- Cell-free synthesis and characterization of membrane proteins
- Functional protein analyses
- Specific protein labeling methods
- Synthesizing exogenous tRNAs
- Fermenting eukaryotic cell lines
- Manufacturing translationally active lysates
- Cell-free eukaryotic translation systems
- Expression analysis of cell lines
- Validating DNA and mRNA templates
- Cell-free synthesis of difficult to express proteins (e. g. toxic proteins and membrane proteins)
- MS analyses of peptides
- Qualitative and quantitative analysis of protein synthesis

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**Department of Bioanalytics and Biosensors**

- Activation, modification and (polymer) synthesis of different surfaces
- Customer-specific DNA, peptide and protein chips
- Transfer/miniaturization of existing analyses in alternative (sensor) systems
- Physicochemical and biochemical analytics
- Development and characterization of bioanalogous receptors
- Probe design
- Development of rapid tests
- Characterization of permeation properties of thinner layers
- Surface characterization
- Surface-modified micro and nano particles
- Assay development
- Manufacture of customer-specific DNA, peptide and protein microarrays
- Spotting on various materials
- Reference laboratory for liquid dispensing systems
- Microarray analyses
- Transferring other assay formats to microarrays
- Assay development for ELISA and microarrays
- Colorimetric, fluorescent and electrochemical detection systems
- Serum screening to identify disease-associated antibody profiles
- Detecting and validating biomarkers in body fluids
- Antibody epitope mapping
- Bead-based assays
- Antimicrobial peptides
- Antibody optimization
- Prokaryotic cDNA libraries
- Detecting pathogenic germs
- Gentle extraction of antigens from (pathogenic) germs
- Design, generation and modification of multimeric zinc fingers
- Nucleic acid structures (self-assembly) on surfaces
- Biological processes on surfaces
- SNP detection on surfaces
- Pathogen detection on surfaces
- PCR analyses
- C2H2 zinc finger applications
- Strategy development for biochip analysis/diagnosis
- Nucleic acid and amino acid template design for in vitro applications
- CRIP Toolbox: Modular software portfolio for structuring metabiobanks
- CRIP.CodEx: Software for extracting information from texts on medical findings
- CRIP.Anon: Configurable software tool for anonymizing personal data

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# LEIPZIG HEADQUARTERS

Usable area: 8.749 m²
Employees: Approx. 304
Focal areas: Cell engineering, cell therapy, drugs, diagnostics, immunology

Address: Perlickstraße 1, 04103 Leipzig, Germany

Completed in April 2008, the main building boasts extensive laboratory capacities for conducting molecular and cell-biological work. An extensive immunohistochemistry laboratory, an isotope laboratory, a quality control laboratory with qualified equipment, as well as cyro-storage capacities also make up the institute's facilities.

The research infrastructure at the headquarters is complemented by various special facilities found in the extension building, which was opened in 2013 (e. g. imaging units, laboratories for experimental medicine and a clean-room facility).

All of the Fraunhofer IZI's laboratories are certified according to S2 standards and therefore suitable for carrying out work in the fields of genetic engineering and infection biology. A flexible cluster structure allows laboratory sections to be adapted and fitted out in line with the specific requirements of a broad range of projects.

The business units Cell Therapy, Drugs and Diagnostics are primarily based in Leipzig. Biopharmaceutical products for clinical trials are manufactured in line with Good Manufacturing Practice (GMP) in the institute's clean-room facilities, which cover a total area of 750m².

The construction measures for the second extension building, which is set to open on April 29, 2015 just in time for the tenth anniversary, have been ongoing since spring 2013.

**Management**

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# BIOANALYTICS AND BIOPROCESSING BRANCH OF INSTITUTE IN POTSDAM-GOLM

Usable area: 4.096 m²
Employees: Approx. 119
Focal areas: Biotechnology, bioproduction, bioanalytics, Automation

Address: Am Mühlenberg 13, 14476 Potsdam-Golm, Germany

The Bioanalytics and Bioprocesses Branch in Potsdam-Golm was affiliated with the Fraunhofer Institute for Cell Therapy and Immunology on July 1, 2014. The site was initially founded in 2005 as a branch of the Fraunhofer IBMT and has since worked on technological solutions for biomedicine and diagnostics as well as for biotechnology and bioproduction.

The interdisciplinary team comprising natural scientists, engineers and technicians develops powerful, analytical methods for the detection and validation of pathogens and biological markers besides processes to obtain, handle and manipulate cells and biomolecules. In this context, the team develops applications for personalized medicine, as well as biosensors and detection procedures for the areas of agriculture and the environment, for a broad spectrum of substance classes.

The site has the state-of-the-art infrastructure required for miniaturizing and automating biological processes. This includes various biosensor and biochip technologies, pipetting robots and micro and nano-dispensers, besides many different rapid-prototyping procedures.

A further special feature of the branch's facilities is the life culture collection of cryophilic algae (CCCryo), which serves as a resource for developing production processes for novel, industrial bioproducts.

**Management**

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**Katja Okulla**
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# DEPARTMENT OF DRUG DESIGN AND TARGET VALIDATION IN HALLE (SAALE)

Usable area: 1.300 m²
Employees: Approx. 49
Focal areas: Biochemistry, pharmacology, drug development, analytics

Address: Weinbergweg 22, 06120 Halle (Saale), Germany

The Department of Drug Design and Target Validation develops new molecular therapies for neurodegenerative and inflammatory diseases. The department's expertise is based on an in depth pharma-like understanding of scientific work and a long-lasting experience in the field of drug development.

This profile encompasses the identification of new target proteins by analyzing putative pathologic post-translational modifications, the misfolding of proteins and the formation of pathological aggregates. Based on these new strategies the department develops and tests small molecules as well as biological agents (biologicals). This research is complemented by the design of new assays for the identification and diagnostic application of biomarkers aiming at monitoring the course of the disease and its therapy.

The department's expertise also expands to the generation of pharmacologically relevant in vitro and in vivo models. Besides state-of-the-art methods for peptide synthesis and protein analytics (MALDI-TOF and LC-MS), the department commands a wide range of biophysical methods to characterize therapeutically relevant physiological pathways, their key proteins as well as cell-based and pharmacologic models for the characterization of new chemical and biological drug candidates.

**Management**

**Prof. Dr. Hans-Ulrich Demuth**

Phone +49 345 131428-00
hans-ulrich.demuth@izi.fraunhofer.de


# EXTRACORPOREAL IMMUNOMODULATION PROJECT GROUP IN ROSTOCK

Usable area: 700 m²
Employees: Approx. 19
Focal areas: Organ-supporting technologies

Address: Schillingallee 68, 18057 Rostock, Germany

The group focuses on the development and evaluation of extracorporeal (outside the body) organ-supporting technologies with a particular emphasis on supporting the immune system.

The group offers the full range of preclinical and clinical analyses of extracorporeal technologies on the basis of a broad spectrum of in vitro simulations, small and large animal models as well as a powerful clinical study network for in- and outpatients. Moreover, the group offers self-developed unique analytic and diagnostic devices including an ex situ intestine model, a cell sensor and novel protein assays.

**Management**

**Prof. Dr. Steffen Mitzner**

Phone +49 381 494-2600
steffen.mitzner@izi.fraunhofer.de

# QUALITY MANAGEMENT

With a highly successful quality management the Fraunhofer IZI fulfills its clients' and partners' sophisticated demands and thus guarantees research services at the highest level.

**GLP – "Good Laboratory Practice"**

"Good Laboratory Practice" (GLP) is a quality system concerned with the organizational process and the conditions under which non-clinical health and environmental safety studies are planned, performed, monitored, recorded, archived and reported. This is the definition of Good Laboratory Practice in the GLP principles of the Organization for Economic Co-operation and Development (OECD) that were devised following the EC-Directive, which was incorporated into German legislation for chemical compounds ("Chemikaliengesetz"). Good Laboratory Practice, as almost no other quality system, has contributed to health, environmental and animal protection through its worldwide implementation and the consequent widely reciprocal recognition of study data.

Fraunhofer IZI holds a separate GLP laboratory and trained personnel. These resources are fully equipped to provide integrated solutions for research and development.

*Contact: Dr. Jörg Lehmann | Head of Cell Engineering/GLP Unit*
*Phone +49 341 35536-1205 | joerg.lehmann@izi.fraunhofer.de*

**GMP – "Good Manufacturing Practice"**

The Fraunhofer IZI maintains two GMP-compliant clean room facilities. Through the flexible design, the facilities are especially attractive for new biotechnology companies that seek to bring newly developed medicinal products into clinical application via clinical trials. The facilities are divided into different independent suites. Each has its own grade C clean rooms (preparation), own air locks from grade C to B (personnel and materials transport) and two grade B rooms (aseptic manufacturing). The clean room grade A is provided via laminar airflow cabinets that are installed in the B-rooms. The available clean room suites are specialized in conducting processes for manufacturing human autologous and/or allogeneic cell-based therapeutics (advanced therapy medicinal products). In addition to the clean rooms and the technical infrastructure, the Fraunhofer IZI offers assistance for the set-up and validation of GMP-compliant manufacturing processes as well as for obtaining a manufacturing authorization according to § 13 of the German Drug Act (AMG).

*Contact: Kati Kebbel | Head of Cell Engineering/GMP Unit*
*Phone +49 341 35536-9712 | kati.kebbel@izi.fraunhofer.de*

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**Why are GMP and GLP important?**

The clinical trial of new drug candidates is an essential step on the way to approval. Since the 12th revision of the "Arzneimittelgesetz AMG" (German Drug Act) every clinical drug trial must be approved of by the responsible higher federal authority ("Bundesinstitut für Arzneimittel und Medizinprodukte", Federal Institute for Drugs and Medical Devices, Paul-Ehrlich-Institute) and by the responsible ethics commission prior to the initiation of the clinical study. In order to obtain this authorization, the efficacy and safety of the investigational medicinal product must first be verified within the framework of GLP-compliant pre-clinical investigations (e. g. toxicological testing procedures). Furthermore, the quality of manufacture of the investigational medicinal products must be verified by a GMP manufacturing authorization pursuant to § 13 AMG. Relevant trial results from GLP-certified trial institutions and a GMP manufacturing authorization are thus absolutely prerequisite when applying for the clinical trial of a new medication.

**GCP – "Good Clinical Practice"**

GCP describes internationally accepted regulations which govern the execution of clinical trials. These regulations encompass ethical as well as scientific aspects. Clinical trials are divided into three phases.

- Phase I: Establishment of safety of the new medication/therapeutic
- Phase II: Establishment of the efficacy of the new medication/therapy (Phase IIa) and dose curve (Phase IIb)
- Phase III: Establishment of a significant proof of efficacy (also known as Pivotal-trial).

Only after successful completion of phase III can new substances register for marketing approval. All phases of clinical development must be carried out under the above described GCP-guidelines. The protection of the patient or volunteer must always remain in the foreground. Important aspects of this include the patient consent form, patient trial insurance as well as the exact documentation of the trial results. Additionally GCP regulates the roles of the essential entities involved in the trial including the sponsor, monitor, CRO, primary investigator and ethics committee or intuitional review board and also regulates quality management and adverse event reporting.

The Fraunhofer IZI carries out in cooperation with doctors and SMO's (site management organizations) clinical trials as requested by Sponsors. The Fraunhofer IZI is a reliable partner in the area of clinical trial planning, composition of trial protocols and all other necessary documents required for submission to the regulatory authorities including the ethics committee. Private physicians and SMOs carry out on-site patient visits.

*Contact: Prof. Frank Emmrich | Director*
*Phone +49 341 9725-500 | frank.emmrich@izi.fraunhofer.de*

# SCIENCE LOCATION LEIPZIG


*”I was the first member of staff to help shape the institute in terms of technology. I hope our state-of-the-art infrastructure will always function smoothly and that we are able to continue offering our scientists optimal research conditions.”*

*Dirk Peisker, Instrument Engineering and Procurement, at the Fraunhofer IZI since 2005*

# LEIPZIG AND THE FORMER TRADE FAIR GROUNDS

The Fraunhofer Institute for Cell Therapy and Immunology IZI is located on the former trade fair grounds in the south-east of the city of Leipzig. Close cooperation with the nearby facilities of the Leipzig University and the companies of the BIO CITY Leipzig is maintained.

**Location: Central for interface partners**

The Fraunhofer Institute for Cell Therapy and Immunology IZI is located on the former trade fair grounds in the south-east of the city of Leipzig. The institute's premises are only about a ten-minute drive away from the city center and can easily be reached with public transport. Moreover, many of the already established and potential future cooperation partners are located in the immediate vicinity. Among these are, for example, the BIO CITY Leipzig, the Max Planck Institute for Evolutionary Anthropology, the clinics and institutes of the Medical Faculty, the Chemistry Faculty, the Physics Faculty, the Veterinary Medicine Faculty, as well as the Faculty of Life Sciences, Pharmacy and Psychology.

**BIO CITY Leipzig: A potent neighbor**

The BIO CITY Leipzig unites university and industry-related research under one roof. It houses, for instance, the Biotechnological-Biomedical Center (BBZ) of the Leipzig University and has available space for industrial settlements in the vicinity. More than 25 cell technology companies including VITA34 International AG, Haemabank AG and Curacyte AG are already located there. Cooperations with the Fraunhofer IZI have been established in the fields of cell engineering and applied stem cell biology, bioprocess engineering, protein structure analysis, mass spectroscopy, molecular cell therapy and molecular pathogenesis.

**Integrated universities**

The academic landscape within Leipzig also benefits from cooperation with the Fraunhofer IZI: The Leipzig University, the Leipzig University of Applied Science (HWTK) and the Graduate School of Management (HHL) have found in the Fraunhofer IZI a strong partner for research cooperations and the development of joint programs for teaching and advanced vocational training, which enhance local attractiveness from an economic and scientific point of view. Thus, for example, students of business administration from the HHL have already been successfully involved in practical scientific projects with their development of business plans or marketing concepts. A particularly intensive cooperation connects the Fraunhofer IZI and the Institute for Clinical Immunology and Transfusion Medicine (IKIT) of the University Leipzig.

The outstanding collaboration work with the Faculty of Veterinary Medicine and its institutes and clinics directly opposite the Fraunhofer IZI building deserves special mention. Research involving animal experiments does not only serve the development of new products for human medicine, but also contributes to the development of new diagnostic and therapeutic procedures in veterinary medicine.

The Faculty of Medicine has traditionally been an extremely important partner with many interactions, also in teaching and advanced education. The Fraunhofer IZI has been working closely together with institutional and clinical areas of radiology, nuclear medicine and diagnostics for several years now in order to develop sophisticated imaging procedures for large animal models.

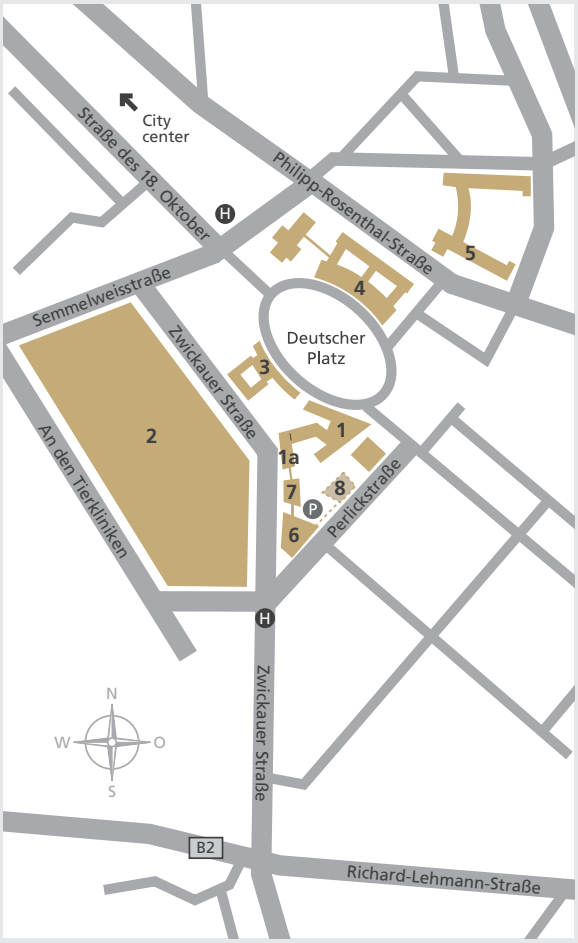
**Excellence partner: Translational Center for Regenerative Medicine**

One of the most important partners of the Fraunhofer Institute for Cell Therapy and Immunology IZI is the Translational Center for Regenerative Medicine (TRM), which was founded within the framework of the Excellence Initiative 2006 by the German Federal Ministry of Education and Research and the Free State of Saxony. Under the auspices of the renowned immunologist Prof. Dr. Frank Emmrich, institutes from five faculties established the TRM in order to start conceptional, pre-clinical and clinical research projects focused on Tissue Engineering and Materials Sciences (TEMAT), Cell Therapies for Repair and Replacement (CELLT), Regulatory Molecules and Delivery Systems (REMOD), Imaging, Modeling, and Monitoring of Regeneration (IMONIT). In 2010, the TRM received a very

positive evaluation by the consulting firm Capgemini Deutschland Holding GmbH and international consultants, so that funding was granted by the BMBF and Saxony for further support.

**Numerous partners in the immediate vicinity**

The neighboring partners of the Leipzig University are, among others, the Translational Center for Regenerative Medicine (TRM) and the University Hospital (special field of transplantation). Further institutions relevant for cooperation are the Heart Center Leipzig GmbH, the Helmholtz Center for Environmental Research (UFZ), the Leibniz Institute for Surface Modification (IOM), the Interdisciplinary Center for Bioinformatics (IZBI), the Center for Clinical Trials Leipzig GmbH (ZKS), the Center for Therapeutic Studies (ZET) and the Leipzig Interdisciplinary Research Cluster of Genetic Factors, Clinical Phenotypes and Environment. Moreover, there are numerous interfaces with different special research areas and so-called Transregios (transregional research projects) that are located in Leipzig.




*BIO CITY (1) with hired Fraunhofer IZI area (1a), Faculty of Veterinary Medicine, institutes and hospitals (2), Max Planck Institute for Evolutionary Anthropology (3), German National Library (4), Translational Centre for Regenerative Medicine (5), Fraunhofer IZI (6), 1. extension Fraunhofer IZI (7), 2. extension Fraunhofer IZI (8).*

Translational Centre for Regenerative Medicine (TRM)
Philipp-Rosenthal-Str. 55 | 04103 Leipzig
www.trm.uni-leipzig.de

Interdisciplinary Centre for Clinical Research (IZKF)
Liebigstr. 21 | 04103 Leipzig | www.izkf-leipzig.de

Center for Biotechnology and Biomedicine (BBZ)
Leipzig University | Center for Biotechnology and Biomedicine | Deutscher Platz 5 | 04103 Leipzig
www.bbz.uni-leipzig.de

University Hospital Leipzig AöR
Liebigstr. 18 | 04103 Leipzig | www.uniklinik-leipzig.de

Heart Center Leipzig GmbH – University Hospital
Strümpellstr. 39 | 04289 Leipzig
www.herzzentrum-leipzig.de

Coordination Center for Clinical Trials Leipzig (ZKS)
Leipzig University | Härtelstr. 16–18 | 04107 Leipzig
www.kks.uni-leipzig.de

Interdisciplinary Center for Bioinformatics (IZBI)
Leipzig University | Härtelstr. 16–18 | 04107 Leipzig
www.izbi.uni-leipzig.de

Max Planck Institutes (MPI)
Max Planck Institute for Human Congnitive and Brain Sciences | Post office box 500355 | 04303 Leipzig
www.cbs.mpg.de

Max Planck Institute for Mathematics in the Sciences
Inselstr. 22 | 04103 Leipzig | www.mis.mpg.de

Max Planck Institute for Evolutionary Anthropology
Deutscher Platz 6 | 04103 Leipzig | www.eva.mpg.de

Helmholtz Center for Environmental Research GmbH – UFZ
Permoserstr. 15 | 04318 Leipzig | www.ufz.de

Leibniz Institute for Surface Modification e.V.
Permoserstr. 15 | 04303 Leipzig | www.iom-leipzig.de

Association for the Advancement of the Health Economics of the Region Leipzig (VGF) e.V.
Deutscher Platz 5a | 04103 Leipzig | www.med-in-leipzig.de

Leipzig University
Ritterstr. 26 | 04109 Leipzig | www.uni-leipzig.de

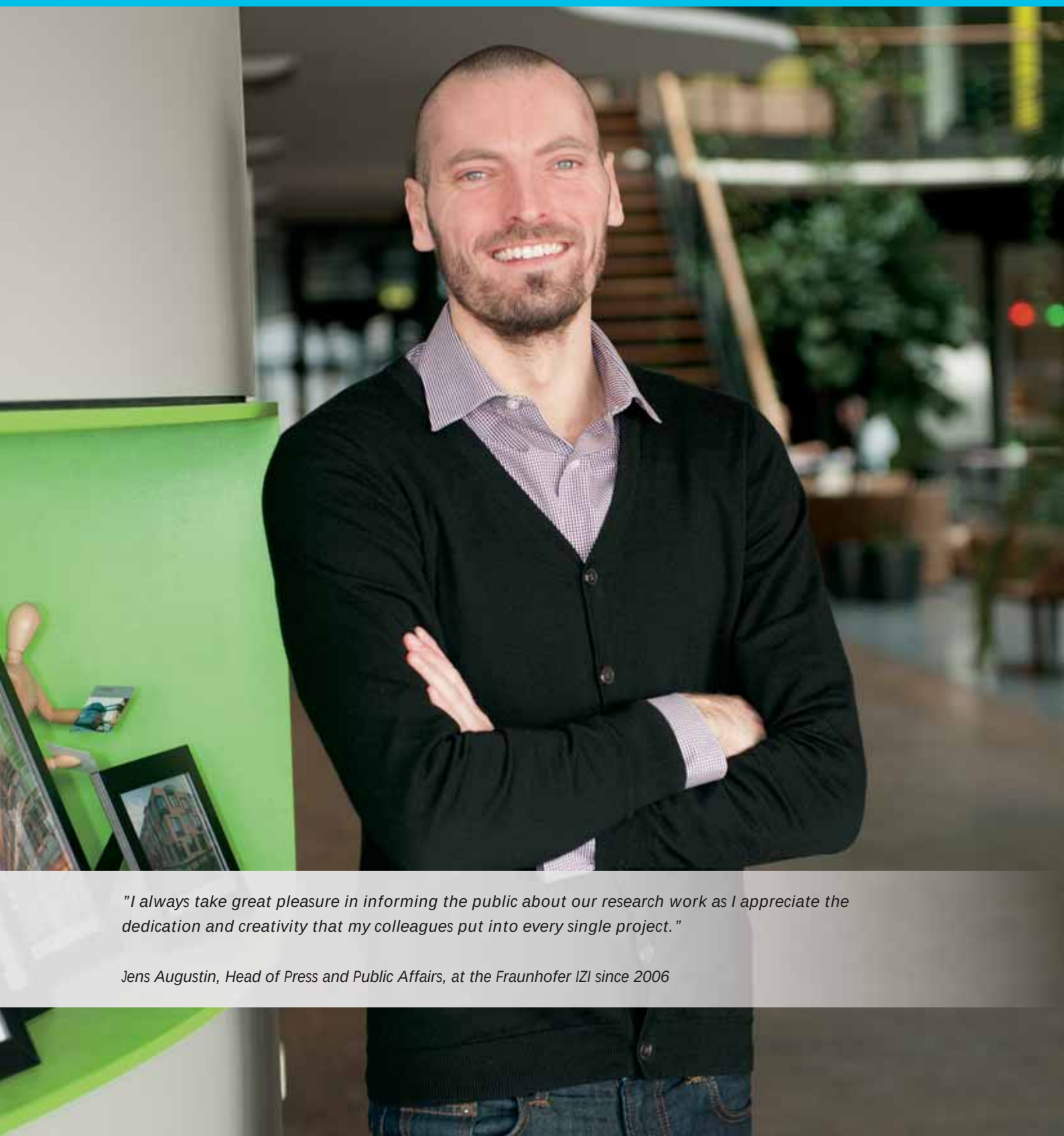
Faculty of Medicine
Liebigstr. 27 | 04103 Leipzig | www.medizin.uni-leipzig.de

Faculty of Biosciences, Pharmacy and Psychology
Brüderstr. 32 | 04103 Leipzig | www.uni-leipzig.de/~biowiss

Leipzig University of Applied Sciences (HTWK)
Karl-Liebknecht-Str. 132 | 04277 Leipzig
www.htwk-leipzig.de

Graduate School of Management (HHL)
Jahnallee 59 | 04109 Leipzig | www.hhl.de

# EVENTS



*”I always take great pleasure in informing the public about our research work as I appreciate the dedication and creativity that my colleagues put into every single project.”*

*Jens Augustin, Head of Press and Public Affairs, at the Fraunhofer IZI since 2006*

# THE FRAUNHOFER IZI IN PUBLIC

Events are the key ingredient of the institute's communication strategy. The Fraunhofer IZI once again organized and supported various scientific and public events in 2014.

**January 15, 2014: Leipzig Fraunhofer Institutes' joint New Year's reception**

This year, together with the Fraunhofer IZI, the Fraunhofer Center for Central and Eastern Europe MOEZ invited guests to a New Year's reception in the "Max Enk" café in Leipzig's Städtisches Kaufhaus. Over 100 guests from both institute networks were brought together in an informal setting.

They were welcome by Mayor Burkhardt Jung, who was intent on opening the event, first held by the two science institutes in 2013, despite his tight schedule. Directors Professor Frank Emmrich (Fraunhofer IZI) and Professor Thorsten Posselt (Fraunhofer MOEZ) gave an overview of the past year's achievements and an outlook of future projects. The event, held in the relaxed coffee house ambience, once again offered guests many an opportunity to chat about their plans and visions for the future. The evening came to a tasteful close with a smooth jazz musical accompaniment. The event location alternates every year between the Fraunhofer Institutes, meaning the Fraunhofer IZI will once again open its doors for the New Year's celebration in 2015, welcoming guests from politics, business and science.

**April 9–12, 2014: 8th International Symposium on Neuroprotection and Neurorepair**

The 8th International Symposium on Neuroprotection and Neurorepair was held from April 9–12, 2014 at the Maritim Hotel in Magdeburg. The symposium takes place every two years. Since 2010, Dr. Dr. Johannes Boltze, Dr. Alexander Kranz and Dr. Daniel-Christoph Wagner have helped organize the event, together with colleagues from the Otto von Guericke University Magdeburg and the Leibniz Institute for Neurobiology. This year, the event's scientific focus was again placed on the field of neurodegenerative diseases such as stroke, Alzheimer's, dementia and Parkinson's disease, for which there still remains a lack of satisfactory treatment options. Besides the latest findings into the molecular foundations of such diseases, attention was primarily given to the presentation of new therapeutic and diagnostic approaches.

Transferring research findings into clinical application is a subject especially dear to the organizers at the Fraunhofer IZI and was therefore intensively discussed. Around 400 international guests from the fields of research, medicine and business took part in the event in Magdeburg. Discussions between renowned, great minds of science and up-and-coming researchers were especially encouraged. In a special session organized for junior scientists, Marc Fischer (editor-in-chief of the specialist journal "Stroke") and Ulrich Dirnagl (editor-in-chief of the specialist journal "Cerebral Blood Flow & Metabolism") reported how research findings can be published in high-ranking journals.

The 9th International Symposium on Neuroprotection and Neurorepair will take place from April 19 to 22, 2016 in Leipzig.

1

**April 27, 2014: Girls'Day at the Fraunhofer IZI**

Girls'Day in took place across Germany for the 14th time on April 27, 2014. Girls' Day is an annual day of action which aims to encourage women and girls in particular to take up technical and scientific careers. The Fraunhofer IZI took part in 2014 for the third time.

15 female participants were given the opportunity to gain an insight into the scientific world of work during a spot of practical training in the laboratory, while at the same time finding out about the research topics covered by the Fraunhofer IZI as well as career opportunities within the Fraunhofer-Gesellschaft.

By taking part in Girls'Day, the Fraunhofer IZI aims to mainly address girls in the upper stage of grammar school in the hope that more women will fill executive roles in scientific enterprises in future. The next Girls'Day will be held on April 23, 2015.

**June 27, 2014: Long Night of the Sciences – "Playfully Expanding Horizons"**

On June 27, 2014, over 40 scientific establishments in Leipzig opened their doors for the fourth Long Night of the Sciences. With over 200 events, members of the general public were offered insights into science which are otherwise only rarely possible. The Fraunhofer IZI also took part in the event with the motto "Playfully expanding horizons". Around 800 visitors were enthralled by the research conducted by members of the institute.

The institute's research topics were showcased through playful initiatives, a whole host of booths where guests could get hands on, interesting project presentations and tours around the clean-room laboratories. The tour around the institute led, among other things, to the computer game "Virus X" which explains the foundations of viral infections and the strategies employed to fight them. West Nile Virus was used as an example to demonstrate how the institute is developing new vaccines and diagnostic methods to combat viruses. The next Long Night of the Sciences will take place on June 24, 2016.

**July 10, 2014: Science Day**

On July 10, 2014, members of staff at the Fraunhofer IZI in Leipzig organized a day completely dedicated to science. Besides informative presentations given by the different units from all the various sites (Leipzig, Halle, Rostock, Potsdam-Golm), there was also a poster exhibition. The PhD students at the Fraunhofer IZI were asked to present their doctorate work including initial findings in the form of a poster. This gave members of staff from all sites the opportunity to find out about the work being done at the institute and to chat to other staff members.

1 *Long Night of the Sciences*



**August 12, 2014: Press conference introducing new forms of cooperation**

On August 12, 2014, Minister Presidents of the *Land* of Saxony, Stanislaw Tillich, and of the *Land* of Saxony-Anhalt, Dr. Reiner Haseloff, attended a press conference at the Fraunhofer IZI to show their support for new cooperation projects planned by the Fraunhofer-Gesellschaft concerning science and business in the Leipzig and Halle region.

On the one hand, Fraunhofer President Professor Reimund Neugebauer presented the plans for a National High Performance Center for Chemistry and Biosystems Engineering in the Leipzig/Halle region. This will see excellent research combined with teaching and training opportunities and will create a close-knit transfer and business network. The national high performance centers initiated by the Fraunhofer-Gesellschaft are intended to stand out through their thematic profile, international unique selling points and efficient transfer into the economy. In the region of central Germany, we are looking to build upon the chemicals industry, which has been deeply rooted in the area for over a hundred years. In the region of Halle and Leipzig, procedural process chains in the polymer processing, chemical, biotechnological and biomedical industries are to be researched and optimized from the raw material to the end product. Eight institutes belonging to the Fraunhofer-Gesellschaft and six universities as well as numerous companies are already involved in discussions here.

Furthermore, a new cooperation format between the Fraunhofer Institutes and the universities was presented. The exchange between application-oriented teaching and research is to be intensified through a newly created unit at the Fraunhofer IZI, which has long since been linked to a Chair at Leipzig University of Applied Sciences (HTWK). Together with the joint Fraunhofer specialist group "Image Analysis of Cell Function", headed up by Professor Ulf-Dietrich Braumann, the focal research area of regenerative medicine is to be further expanded in Leipzig. Fraunhofer is putting a total of 1.5 million euros into these plans over the next five years.

**1 / 2** *Press conference: Dr. Reiner Haseloff (Minister President of Saxony-Anhalt), Stanislaw Tillich (Minister President of Saxony), Professor Reimund Neugebauer (President of the Fraunhofer-Gesellschaft) (f. l. t. r.)*

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**September 2, 2014: Parliamentary day to mark the first anniversary of the off-site department in Halle**

As part of a parliamentary day on September 2, 2014, the Fraunhofer IZI's Molecular Drug Biochemistry and Therapy Development Project Group gave an initial, positive summary of the first year. The researchers from Halle spoke to guests from politics, business and academia about what had been achieved in the first twelve months with the support of the start-up funding from the *Land* of Saxony-Anhalt and which targets were to be achieved next.

The event was opened by Hartmut Möllring, Minister for Sciences and Economic Affairs in the *Land* of Saxony-Anhalt. Director Professor Frank Emmrich and Professor Hans-Ulrich Demuth, Head of the off-site division, then went on to host an event in which the three units introduced their projects and fields of activity. This included, above all, the detailed characterization, analysis, modification and manufacture of peptides, proteins and small molecules. The aim of the project group is to investigate molecular disease mechanisms and the related development of new drugs. A special focus is placed here on the area of neurodegenerative diseases such as Alzheimer's and Parkinson's disease.

**October 9–10, 2014: Fraunhofer Life Science Symposium**

From October 9–10, 2014, around 200 scientists came together at the Fraunhofer IZI for the ninth "Fraunhofer Life Science Symposium". This year, the event was held on the topic of medical cell products and stem cells for medical application. The scientific program thus covered three vast subject areas: Production, manufacture and application. Among other people, Robert Zweigerdt (Hannover Medical School, Hanover), Sarah Ferber (Orgenesis Inc., New York, USA) and Nicole zur Nieden (University of California Riverside, Riverside, USA) were welcomed to the event as keynote speakers.

Every year, the Fraunhofer Life Science Symposium brings together representatives from industry, academia and clinical institutes to exchange views on the latest technologies, trends and developments, with a different topic every year.

www.fs-leipzig.com

1 / 2 *Fraunhofer Life Science Symposium*

2

**November 6–7, 2014: Closing seminar of the collaboration project "Handkerchief Lab"**

On November 6 and 7, 2014, the Bioanalytics and Bioprocesses Branch of the Fraunhofer IZI held the "6th Potsdam Days on Bioanalysis" together with the Center for Molecular Diagnostics and Bioanalysis (ZMDB). At the event, the results of the collaboration project "Handkerchief Lab – Impulse Center for Integrated Bioanalytics" were presented to the approx. 200 guests. The project was funded between 2009 and 2014 by the Federal Ministry of Education and Research as part of the initiative Cutting-Edge Research and Innovation in East German Regions.

In the project, fourteen partners from science and business searched for new binding molecules for topical pathogens (incl. MRSA, influenza) and developed new ways of quickly identifying surface antigens. The detection procedure was intended to be as simple and convenient as a handkerchief. The work carried out on the sensor-actuator molecule, from discovering new binding molecules through to the rapid detection of the analyte and the related fundamental concepts, was presented in the closing seminar within the program blocks "Host-Pathogen Relationship", "Detection Systems" and "Pathogens and Artificial Surfaces".

# LOOKING TO 2015

January 21, 2015
**New Year reception**

April 23, 2015
**Girls'Day 2015**
www.girls-day.de

April 29, 2015
**Anniversary event to mark ten years of the Fraunhofer IZI**

September 29–30, 2015
**Arthropod-Borne Diseases – diseases transmitted by ticks, mites, fleas and lice**

October 21–23, 2015
**World Conference on Regenerative Medicine**
www.wcrm-leipzig.com

# SCIENTIFIC PRESENCE


*”Research requires information and exchange: With over 1,000 publications and presentations over the past ten years, the community was presented with exciting developments and results. As a facilitator to research, the specialist info team is happy to be able to assist our colleagues in their work.”*

*Cornelia Gruhle, Specialist Information Management, at the Fraunhofer IZI since 2008*

# CONVENTIONS AND CONFERENCES

**10th European Antibody congress,** November 10–12, 2014, Geneva, Switzerland

**10th German Conference on Chemoinformatics,** June 1–5, 2014, Noordwijkerhout, The Netherlands

**11th Annual Conference on Foundations Of Nanoscience: Self-assembled Architectures and Devices (FNANO14),** April 14–17, 2014, Snowbird, USA

**13th Research Festival,** December 18, 2014, Leipzig, Germany

**13th International Geneva / Springfield Symposium on Advances in Alzheimer Therapy,** March 26–29, 2014, Geneva, Switzerland

**19th DGGF International Meeting,** September 18–19, 2014, Magdeburg, Germany

**2nd Munich Point-of-care Testing Symposium,** September 15–17, 2014, Munich, Germany

**248th ACS National Meeting & Exposition,** August 10–14, 2014, San Francisco, USA

**31st Winter School on Proteases and Inhibitors,** February 26–March 2, 2014, Tiers, Italy

**43rd Seminar on Experimental Animals and Animal Experiments,** May 6–7, 2014, Berlin, Germany

**44th Annual Meeting of German Society of Immunology (DGfI),** September 17–20, 2014, Bonn, Germany

**47th Annual Meeting of the German Society for Mass Spectrometry,** March 2–5, 2014, Frankfurt/Main, Germany

**6th CIT Workshop,** November 13–14, 2014, Hamburg, Germany

**6th International Technology Forum Berlin,** June 12–13, 2014, Berlin, Germany

**7th Annual Proteins & Antibodies Congress,** April 3–4, 2014, London, UK

**7th Leipzig Veterinary Congress,** January 16–18, 2014, Leipzig, Germany

**8th International Symposium on Neuroprotection and Neurorepair,** April 9–12, 2014, Magdeburg, Germany

**8th Senftenberg Innovation forum on Multiparametric analysis: Autoimmune Diagnostics,** May 7–8, 2014, Senftenberg, Germany

**9th Fraunhofer Life Science Symposium: Medicinal Cell Products,** October 9–10, 2014, Leipzig, Germany

**9th German Allergy Congress 2014,** October 2–4, 2014, Wiesbaden, Germany

**9th International Congress on Autoimmunity,** March 26–30, 2014, Nice, France

**Alzheimer's Association International Conference,** July 12–17, 2014, Copenhagen, Denmark

**Analytica,** April 4, 2014, Munich, Germany

**Annual Fraunhofer Conference 2014,** May 21–22, 2014, Freiburg im Breisgau, Germany

**Automation of GMP Cell Production Workshop,** April 15, 2014, Hamilton, Canada

**BIO International Convention,** July 23–26, 2014, San Diego, USA

**Bioelectronics and Life Sciences Symposium of the IHP and TUB Joint Lab Bioelectronics,** September 18–19, 2014, Berlin, Germany

**Biologized Medical Engineering,** September 25, 2014, Berlin, Germany

**BMBF Half-Time Conference BioEconomy,** June 5, 2014, Berlin, Germany

**CCG UGM & Conference,** April 22–25, 2014, Strasbourg, France

**COMPAMED,** November 12–14, 2014, Dusseldorf, Germany

**DFG Kick-Off Event,** February 19–20, 2014, Rheinfelden, Germany

**Diagnostics 4.0 – Miniaturized Assays: Technologies, Applications & Markets,** September 11–12, 2014, Berlin, Germany

**Downstream "Down the Road" – Future Technologies in Purification,** June 19, 2014, Berlin, Germany

**DZNE Colloquium,** November 12, 2014, Magdeburg, Germany

**DZNE Meeting,** February 25, 2014, Magdeburg, Germany

**Essen Information Meeting for Animal Welfare Officers,** April 12, 2014, Essen, Germany

**Federal Congress of the Federal Association of Dyslexia and Dyscalculia,** May 9–11, 2014, Erfurt, Germany

**Fraunhofer IAP Colloquium: Bioeconomy Quo Vadis?,** May 9, 2014, Potsdam, Germany

**Fraunhofer IZI Strategy Meeting,** May 15–16, 2014, Belgern, Germany

**German-Latin American Conference,** June 1–4, 2014, Potsdam, Germany

**Gum & Joints,** March 4–8, 2014, Ustron, Poland

**High-Tech Transfer Day,** October 7, 2014, Potsdam, Germany

**Human Antibodies & Hybridomas,** March 30–April 2, 2014, Vienna, Austria

**International Technology Forum: In Vitro Diagnostics and Bioanalytics,** June 12–13, 2014, Berlin, Germany

**ISAD (International Symposium on Albumin Dialysis,** August 29–31, 2014, Rostock-Warnemünde, Germany

**Kongress Frontiers in Medicinal Chemistry,** March 16–19, 2014, Tübingen, Germany

**Lab-on-a-chip European Congress,** March 10–11, 2014, Berlin, Germany

**Lab Supply,** May 28, 2014, Berlin, Germany

**Leibniz Kolleg Academy of the University Society Potsdam: Talks on the Topic "High Resolution Microscopy" with Stephan Hell,** May 21–22, 2014, Potsdam, Germany

**MEDICA,** November 12–15, 2014, Dusseldorf, Germany

**NanoTOES Meeting and International Conference,** April 2–4, 2014, Vagliagli (Siena), Italy

**National Industry Conference on Health Science,** July 15–16, 2014, Rostock-Warnemünde, Germany

**Potsdam Days on Bioanalysis 2014,** November 6, 2014, Potsdam-Golm, Germany

**Presentation of Animal Models Established in the Unit for Chronic Diseases,** September 16, 2014, Grünenthal GmbH, Aachen, Germany

**Public Closing Seminar "T(h)eraDiagnostics",** March 26, 2014, Potsdam, Germany

**Science World 2014,** September 2, 2014, Berlin, Germany

**Scientific Symposium of the Fraunhofer IZI Off-Site Department,** April 8, 2014, Halle (Saale), Germany

**Sepsis Summit,** September 11, 2014, Berlin, Germany

**Sony DADC, SCIENION & Invetech Symposium "Bringing Ideas to Market 2.0",** March 30, 2014, Salzburg, Austria

**South African Biomedical Engineering and Technology Conference,** April 2–4, 2014, Stellenbosch; South Africa

**TMF – IT/QM Working Group Meeting,** May 13 / September 17, 2014, Berlin, Germany

**Transfer Meeting "Biosensor Systems",** March 26, 2014, Leipzig, Germany

**Translational Regenerative Medicine Congress,** October 21–22, 2014, Leipzig, Germany

**Upstream & Downstream-Technology Forum 2014,** September 8–10, 2014, Göttingen, Germany

**Workshop "IHE – Applicability in Medical Research",** July 2, 2014, Berlin, Germany

**Workshop "Life Science Technologies" New Technology Developments for Kuwait nad GCC Region – R&D Opportunities for Kuwaiti Compani,** April 6–8, 2014, Kuwait-City, Kuwait

**Workshop "Use of EPR in Clinical Research",** November 20–21, 2014, Erlangen, Germany

## RESEARCH PARTNERS

**Aachen University of Applied Sciences,** Jülich, Germany

**AIT Austrian Institute of Technology,** Department of Health and Environment, Vienna, Austria

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**Center for Neurologic Diseases,** Harvard Medical School, CND, Boston, USA

**Center for Physiology and Pharmacology**, Vienna, Austria

**Centre Suisse d'Electronique et Microtechnique,** Neuchâtel, Switzerland

**Centro Tecnológico L'Urederra,** Navarra, Spain

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**Fraunhofer Institute for Toxicology and Experimental Medicine,** Hanover/ Braunschweig, Germany

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**Helmholtz Centre for Environmental Research – UFZ,** Department of Proteomics | Department of Environmental Immunology | Department of Environmental Microbiology, Leipzig, Germany

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**Helmholtz-Zentrum München,** Institute of Epidemiology, Munich, Germany

**Hochschule Darmstadt University of Applied Sciences,** Department of Chemistry and Biotechnology, Darmstadt, Germany

**Humboldt-Universität zu Berlin,** Institute of Biophysics | Systems Immunology Lab | Molecular biophysics group, Berlin, Germany

**Imperial College London,** Department of Mathematics, London, UK

**Institute for Thin Film and Microsensoric Technology,** Teltow, Germany

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**Jena University Hospital,** Department of Child and Adolescent Psychiatry, Psychosomatic Medicine and Psychotherapy | Clinical Chemistry and Laboratory Diagnostics, Jena, Germany

**Johannes-Keppler-University Linz,** Research Group Membrane Transport, Linz, Austria

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**Klinikum St. Georg gGmbH,** Robert Koch Clinic, Leipzig, Germany

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**Leibniz Institute for Neurobiology,** Magdeburg, Germany

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**Max Planck Institute of Colloids and Interfaces,** Potsdam, Germany

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**Technische Universität Dresden,** Biotechnology Center (BIOTEC), Cellular Machines | cfaed, DNA Chemistry, Dresden, Germany

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**Universitätsklinikum Erlangen,** Urology, Erlangen, Germany

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**A4F – AlgaFuel, SA,** Lissbon, Portugal

**ACOMED Statistik,** Leipzig, Germany

**Affimed GmbH,** Heidelberg, Germany

**AJ Roboscreen GmbH,** Leipzig, Germany

**Albutec GmbH,** Rostock, Germany

**ALS Automated Lab Solutions GmbH,** Jena, Germany

**Analytik Jena AG,** Jena, Germany

**AnaPath GmbH,** Oberbuchsiten, Switzerland

**Angewandte Kommunikationstechnik GmbH,** Beucha, Germany

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**Apraxon GmbH,** Hofbieber, Germany

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**Artcline GmbH,** Rostock, Germany

**ASA Spezialenzyme GmbH,** Wolfenbüttel, Germany

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**IkerChem S.L.,** San Sebastian, Spain

**ILBC GmbH,** Potsdam, Germany

**IMT Masken und Teilungen AG,** Greifensee, Switzerland

**in.vent diagnostica GmbH,** Hennigsdorf, Germany

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**InstrAction GmbH,** Mannheim, Germany

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**microfluidic ChipShop GmbH,** Jena, Germany

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**RESprotect GmbH,** Dresden, Germany

**RiNA GmbH,** Berlin, Germany

**Sabel-Schülerzentrum,** Dresden/ Freital, Germany

**Scancell Limited,** Nottingham, UK

**Scienion AG,** Berlin/Dortmund, Germany

## ADVANCED VOCATIONAL TRAINING

**Scil Proteins GmbH,** Halle (Saale), Germany

**SECOPTA GmbH**, Berlin, Germany

**Securetec Detektions-Systeme AG,** Neubiberg/Munich, Germany

**SensLab GmbH,** Leipzig, Germany

**Seramun Diagnostica GmbH,** Heidesee, Germany

**Siemens AG Corporate Technology,** Munich/Erlangen, Germany

**Sonovum AG,** Leipzig, Germany

**Sportklinik Halle,** Halle (Saale), Germany

**Syngenta,** Jeallott's Hill, UK

**Thermo Fisher Scientific BRAHMS GmbH,** Hennigsdorf, Germany

**Twincore,** Experimentelle Virologie, Hanover, Germany

**Vita 34 AG,** Leipzig, Germany

**Vivotecnia Research S.L.,** Tres Cantos/Madrid, Spanin

**Wrig Nanosystems,** New Dehli, India

**Yumab GmbH,** Braunschweig, Germany

**3rd Translational Immunology School,** DGfI, Potsdam

**33rd Meeting of the DGGF GLP Working Group: Quality Assurance / Monitoring,** DGGF, Frankfurt/Main

**44th Annual Meeting of the German Society for Immunology,** DGfI, Bonn

**52nd Annual Meeting of the Society for Laboratory Animal Science GV-SOLAS and 15th Advanced Training Course of the GV-IGTP,** Society for Laboratory Animal Science, Frankfurt/Main

**6th Autumn School of Immunology,** DGfI, Merseburg

**7th Advanced Training Event for Animal Welfare Officers,** BfR, Berlin

**7th Leipzig Veterinary Congress 2014,** Faculty of Veterinary Medicine at Leipzig University and the Chambers of Veterinary Surgeons in Brandenburg, Mecklenburg-Western Pomerania, Saxony, Saxony-Anhalt and Thuringia

**Acquiring Knowledge on Radiation Protection in accordance with the Radiation Protection Act (modules GG + FA),** Hemholtz-Zentrum Dresden Rossendorf, Forschungsstelle Leipzig, Leipzig

**Advanced First Aid Training,** German Red Cross, Weißenfels

**Advanced Training Event in accordance with Section 2 No. 11 of the Biological Agents Ordinance,** BioMed Concept GmbH, Berlin

**Advanced Training to Become a Specialized Immunologist,** German Society for Immunology (DGfI), Leipzig

**Advanced Training to Become a Tutor (Ordinance on Trainer Aptitude, AEVO),** IHK Leipzig, Leipzig

**Agilent Chromatography Forum,** Agilent, Berlin

**Agilent User Training LC and OpenLab CDS Version ChemStation (3D),** Agilent, Waldbronn

**Air Safety Training (in line with number 11.2.3.9 of Regulation (EU) no. 185/2010),** Fraunhofer IZI, Leipzig

**Analyzing Solid Matter – From Lab Sample to Analysis Result,** Retsch GmbH, CEM GmbH, Agilent Technologies, Berlin

**Animal Experimentation Course, Foundation Course,** Leipzig University, Leipzig

**Autumn School – Current Concepts in Immunology,** German Society for Immunology (DGfI), Merseburg

**BacT / Alert 3D Intensive Course,** Biomerieux, Nürtingen

**Basic Course Laboratory Animal Science,** MEZ, Leipzig

**Basic Operator Course – Proteomics,** Bruker, Bremen

**Biacore Assay Design, Application Overview and Determination of Kinetic and Affinity Constants using the Biocore 3000 instrument platform,** GE Healthcare Europe GmbH, Halle (Saale)

**Biacore Basics,** GE Healthcare Europe GmbH, Munich

**Biological Working Materials Seminar,** VBG, Tangermünde

**Biomolecular Interaction Analysis employing Micro-Scale Thermophoresis,** NanoTemper Technologies GmbH, Munich

**Brain Cannulation on a Mouse or Rat using the ALZET Brain Infusion System,** Charles River, Heidelberg

**Briefing on the Operation of the BD FACSCanto II Flow Cytometer,** BD Biosciences, Heidelberg

**Briefing: Reprogramming the Airnet,** PMS, Leipzig

**Cell Culture and Laboratory Compact Course,** Bio & Sell e.K., Heidelberg

**Cell Culture under GMP,** PromoCell, Heidelberg

**CML / MPN Discussion Forum of the ONKO-NET MVP,** ONKO-NET MVP, Dierhagen

**Contract Design Workshop,** Fraunhofer IZI, Leipzig

**Course, "Certified QM Experts, Part 1: Basic GMP/ GLP Knowledge",** Klinkner & Partner, Potsdam

**Course, "Certified QM Experts, Part 2: Qualification of Analysis Equipment",** Klinkner & Partner, Potsdam

**Course, "Certified QM Experts, Part 3: Audits and Part 4: SOPs",** Klinkner & Partner, Munich-Freising

**Current Information on Animal Protection Law: EU Guideline, Animal Welfare Act and Experimental Animal Protection Regulation,** Leipzig University, MEZ, Leipzig

**D1-GMP / FDA-Compliant Documentation in Manufacturing,** Concept Heidelberg, Heidelberg

**Discussion of Enode Components,** PMS, Leipzig

**ECA-Environmental Monitoring,** ECA Academy, Heidelberg

**English Course,** Fraunhofer IZI, Leipzig

**Enquire Within – Symposium,** Max-Planck-Institut für Kognitions- und Neurowissenschaften, Leipzig

**External GLP Training: Modern Trends in Histopathology,** GLP Testing Facility, Fraunhofer IZI / AnaPath GmbH, Leipzig

**Factory Course Basic Operator MALDI-Autoflex,** Bruker, Bremen

**Factory Course ClintProt MALDI TOF + Imaging,** Bruker, Bremen

**Factory Course MALDI Molecular Imager,** Bruker, Bremen

**FELASA B,** Fraunhofer IZI, Leipzig

**FELASA C,** Berliner Kompaktkurse, Berlin

**First Aid Training,** German Red Cross, Halle (Saale)

**Foundation Course in Animal Welfare and Animal Experimentation,** Heart Center Leipzig, Leipzig

**Fundamental Assay Techniques-Protein,** Luminex Cooperation, s' Hertogenbosch

**GLP Training,** Fraunhofer IZI, Leipzig

**GMP Auditor Training,** Haema AG, Leipzig

**GMP Course,** Student Funding Initiative for Natural Sciences, Halle (Saale)

**GMP in the Test Laboratory,** BB LIFE, Berlin

**Hemocompatibility Training,** Steinbeis Transfer Center Hemocompatible Medical Devices, Tübingen

**Horizon 2020 Launch Event,** BMBF, Magdeburg

**Humanization of NSG Mice,** Universität Regensburg, Leipzig

**IGTP Meeting,** GV-Solas, Frankfurt / Main

**Industry Acquisition,** Fraunhofer-Gesellschaft – Marketing Network, Berlin

**In-House Training: Auto Set-Up and Compensation using Navios,** Beckman Coulter, Leipzig

**In-House Training: IDEAS Software for Analyzing Amnis Measurements, Use of Masks,** Merck Millipore / Fraunhofer IZI, Leipzig

**In-House Training: Intricacies concerning Measurement using Navios,** Beckman Coulter / Fraunhofer IZI, Leipzig

**Interdisciplinary Symposium "Latest Findings from Dermatology, ENT Medicine, Pediatrics and Pneumology",** Prof. Dr. Georg Hoheisel, Leipzig

**Internal Seminar Series (cross-institute),** Leipzig

**Interphase Fluorescence In Situ Hybridization (I-FISH),** TRM, Leipzig

**Introduction to HPLC,** German Chemical Society, Nürnberg

**Introduction to SPSS,** University of Rostock, Rostock

**Introduction to the German Medical Devices Act,** TRM, Universität Leipzig, Leipzig

**Journal Club: Hematology Department,** Leipzig University, Leipzig

**Lab Course on Microbiology and Germ Identification,** Concept Heidelberg, Heidelberg

**Lab Faults and CAPAs in Quality Control,** Concept Heidelberg, Heidelberg

**Legal Foundations, Social Act V,** Saxon Association of Statutory Health Insurance Physicians, Dresden

**LOV Training: Performance-Based Remuneration Procedure at the Fraunhofer-Gesellschaft,** Fraunhofer-Gesellschaft e.V., Dresden / Potsdam

**M4 – Test for Sterility,** Concept Heidelberg, Bad Kissingen

**MACSQuant User Day,** Miltenyi Biotec, Bergisch-Gladbach

**Management training on the topic "Conducting Staff Appraisals and Agreeing upon Targets within the Context of Performance-Related Remuneration at the Fraunhofer-Gesellschaft",** Fraunhofer-Gesellschaft, Leipzig/ Potsdam-Golm

**Medical English Language Course,** University of Rostock, Rostock

**NMR Spectra Analysis,** Gesellschaft Deutscher Chemiker (GDCh – German Chemical Society), Frankfurt/Main

**Oncology Working Group – Autumn Symposium of the NIO Saxony,** NIO Sachsen e.V., Leipzig

**Preparation for Apprenticeship Suitability Test,** ZAW Leipzig, Leipzig

**Primary and Secondary Immune Defects – Established and New Products from Science and Practice,** Prof. Dr. Borte, Leipzig

**Principles of Animal Experimentation Projects,** Fraunhofer IZI, Leipzig

**Project Management – Methods and Instruments,** University of Rostock, Rostock

**Protein and Peptide Analytics using MALDI-TOF MS,** Bio & Sell e.K., Heidelberg

**Psychosomatic Primary Care,** Seminare Dr. Scheib, Campanet, Spain

**Quality Aspects in the Manufacture of ATMP,** Beuth Hochschule für Technik Berlin, University of Applied Science Berlin

**Quality Control Management,** Concept Heidelberg, Mannheim

**Quality Management Customer Forum,** TÜV SÜD Management Service GmbH, Dresden

**Real Time in the Real, Everyday Laboratory, Successfully Amplify and Quantify – Foundations of qPCR and a Guide to Successful Planning, Conduct and Evaluation,** Promega GmbH, Mannheim

**Regression Models,** coursera, online

**Safety in Genetic Engineering,** Leipzig University, Leipzig

**Safety in Genetic Engineering – Biological Safety,** Research Academy Leipzig, Leipzig

**SARRP Basic Training,** Fraunhofer IZI, Leipzig

**Science Career Day,** Graduate School Potsdam, Potsdam

**Seminar Series – Biomedical Lectures Leipzig (2013 / 2014),** Leipzig University, TRM, Leipzig

**Seminar Series – Biomedical Lectures Leipzig (2014 / 2015),** Leipzig University, TRM, Leipzig

**Sending Air Freight pursuant to number 11.2.3.9 of Regulation (EU) no. 185/2010 and the national requirements which supplement this regulation in terms of time and content,** Human Reliability Institute Berlin, Leipzig/Eichwalde

**Serva Electrophoresis Days 2014, Theoretical Foundations and Practical Aspects of Protein Electrophoresis,** SERVA Electrophoresis GmbH, Berlin

**Slide Scanner Microscope,** Leipzig University, TRM, Leipzig

**Slimline GMP Systems, Efficiency in QA,** Concept Heidelberg, Mannheim

**Specialist Immunology,** German Society for Immunology (DGfI), Berlin

**Strategy Seminar,** Fraunhofer Marketing Network, Berlin

**Successful Negotiation Based on HARVARD,** SMILE – the University Start-Up Network, Leipzig

**Talks and presentations,** SMILE – the University Start-Up Network, Leipzig

**Team Management,** University of Rostock, Rostock

**Tecan Gemini Software Training,** Tecan Trading AG, Halle (Saale)

**The Doctor and the Dear Cattle,** Evangelical Academy of Saxony-Anhalt, Wittenberg

**Training in line with 11.2.3.9 of regulation (EU) no. 185/2010,** Human Reliability Institute Berlin, Berlin

**Translational Immunology School,** German Society for Immunology (DGfI), Potsdam

**Transport of Hazardous Materials Training,** Fraunhofer-Gesellschaft, Halle

**Tumor Biology Course,** Charles River, Frankfurt/Main

**Turbomole/TmoleX Training,** COSMOlogic, Leverkusen

**Ultrahigh Field Magnetic Resonance,** Max Delbrück Center for Molecular Medicine, Berlin-Buch

## TEACHING ACTIVITIES

**Various GLP Training Courses,** GLP Testing Facility, Fraunhofer IZI, Leipzig

**World Immune Regulation Meeting VIII,** Swiss Institute of Allergy and Asthma Research (SIAF), Davos, Switzerland

**Workshop "From research to publications",** Research Academy Leipzig – Competence School ELSYS, Leipzig

**xCELLigence User Meeting,** ACEA/OLS, Munich

**Young Leaders in Science – Part 1,** Zentrum für Wissenschaftsmanagement e.V/ Schering Stiftung, Langwedel

**Young Leaders in Science – Part 2,** Zentrum für Wissenschaftsmanagement e.V/ Schering Stiftung, Langwedel

**Young Leaders in Science – Part 3,** Zentrum für Wissenschaftsmanagement e.V./ Schering Stiftung, Berlin

**Anhalt University of Applied Sciences:**

Protein Biotechnology (lecture), Prof. Dr. Hans-Ulrich Demuth

**Beuth University of Applied Sciences Berlin:**

Cell-free Protein Synthesis (lecture), Dr. Stefan Kubick

Proteomics/Biosensors (lecture), Dr. Eva Ehrentreich-Förster

**Brandenburg University of Technology Cottbus–Senftenberg:**

Neuraminidase Test Development (practical training), Henry Memczak

**Fraunhofer IZI Leipzig:**

Animal Experimental Category B Course in line with the specifications of the FELASA (course), Dr. Thomas Grunwald

FELASA Category B Course – Talk and Practical Demo "Bioimaging" (seminar), Dr. Alexander Kranz

**Freie Universität Berlin:**

Cell-free Synthesis of Membrane Proteins (practical training, seminar), Dr. Stefan Kubick

Membrane Proteins: Classification, Structure and Function (lecture, seminar), Dr. Stefan Kubick

Microscopy Techniques (practical training), PD Dr. Ralph Hölzel

**Leipzig University:**

Active Ingredient Analytics – Drug Monitoring I (seminar), Dr. Mirko Buchholz

Active Ingredient Analytics – Drug Monitoring II (seminar), Dr. Daniel Ramsbeck

Build MoNa module on smart molecules (lecture), Jessica Lorenz

Environmental Medicine for Adults 1 (course), Dr. Ingo Bäcker, Veronika Storbeck

Environmental Medicine for Adults 2 (course), Anja Rodewohl, Anne Kühlmann

Foundations of Immunology (as part of the lecture on pharmaceutical biology; lecture), Dr. Jörg Lehmann

Hematopoietic Stem Cell Transplantation (lecture), Nadja Hilger

History of Natural Sciences: Spotlight on Pharmacy (lecture), Dr. Mirko Buchholz

Immunological Methods (as part of the lecture on pharmaceutical biology; lecture), Dr. Jörg Lehmann

Immunological Practical Training (practical training), Dr. Anna Leichsenring, Eva Kendzia, Dr. Ingo Bäcker, Tamara Shahmary

Immunology / Tissue Typing (seminar), Dr. Peter Ruschpler

Infectiology and Immunology (problem-oriented learning), Dr. Alexander Kranz, Dr. Daniel-Christoph Wagner

Medicinal Chemistry for Biochemists and Chemists (seminar), Dr. Mirko Buchholz

Medicinal Microbiology (lecture), Dr. Thomas Grunwald

Model Organisms in Research – Arthritis Models (lecture), Dr. Fransziska Lange

Molecular Medicine (lecture), Dr. Thomas Grunwald

Molecular Medicine (practical training), Dr. Thomas Grunwald, Lea Wierich

Molecular Medicine / Virology (practical training, lecture), Dr. Sebastian Ulbert

Molecular Oncology and Immunology for Biochemists (practical training, seminar, lecture), Prof. Dr. Friedemann Horn

New Technologies in the Development of Vaccines (lecture), Dr. Sebastian Ulbert

QSB Seminar for Medical Practitioners "Autoimmunity" (seminar), Dr. Stephan Fricke, Nadja Hilger

QSB Seminar for Medical Practitioners "Tissue Typing" (seminar), Dr. Stephan Fricke, Nadja Hilger

QSB Seminar: Transplantation Immunology (seminar), Christopher Oelkrug

Response Mechanisms in Organic Chemistry (seminar), Dr. Daniel Ramsbeck

Terminology for Pharmacists (seminar), Dr. Daniel Ramsbeck

Vector-Transferred Viral Infections (lecture), Dr. Sebastian Ulbert

**Leipzig University of Applied Sciences:**

Digital Image Processing (lecture), Prof. Dr. Ulf-Dietrich Braumann

Microfluidics and Dosing Systems (lecture), Dr. Dirk Kuhlmeier

Microscopic Image Processing (lecture), Prof. Dr. Ulf-Dietrich Braumann

Microscopic Imaging (lecture), Dr. Alexander Kranz, Prof. Dr. Ulf-Dietrich Braumann, Dr. Daniel-Christoph Wagner

**Martin Luther University Halle-Wittenberg:**

Lab Course on Vector Construction (practical training), Dr. Stephan Schilling

Molecular Biotechnology: Construction of Hosts and Vectors (lecture), Dr. Stephan Schilling

Project Module on Plant Biochemistry for Bachelor Students (practical training), Dr. Holger Cynis

**Ruhr-Universität Bochum:**

Immunotherapy and Prophylaxis of Infectious Diseases I (lecture), Dr. Thomas Grunwald

Virology for Natural Scientists (lecture), Dr. Thomas Grunwald

**Technische Universität Berlin:**

Cell-free Synthesis of Membrane Proteins (practical training, seminar), Dr. Stefan Kubick

Membrane Proteins: Classification, Structure and Function (lecture), Dr. Stefan Kubick

Polymer self-assembly: multilayer films (lecture), Dr. Dmitry Volodkin

**University Medicine Rostock:**

Anesthesiology and Emergency Medicine for Dental Specialists (lecture), PD Dr. Martin Sauer

Anesthesiology, Intensive-Care Medicine and Pain Therapy (practical training), PD Dr. Martin Sauer

Internal Medicine I (lecture), Prof. Dr. Steffen Mitzner

Seminar on Nephrology (seminar), Prof. Dr. Steffen Mitzner

Subject-Specific Seminar on Internal Medicine (seminar), Prof. Dr. Steffen Mitzner

**University of Kassel:**

Biochemistry II (lecture), Dr. Harald Seitz

Work-Oriented Practical Training (practical training), Sandra Mükusch

**University of Potsdam:**

Analytical Biochemistry II (lecture), Prof. Dr. Frank Bier

Analytical Biochemistry II (practical training), Dr. Eva Ehrentreich-Förster

From Western Blot to Microarray (practical training, seminar), Dr. Harald Seitz, Sandra Mükusch, Sarah Schumacher, Isabelle Relling

Interaction Analyses with SPR and Thermophoresis (practical training), Dr. Walter Stöcklein

Introduction to Quality Management in Diagnostic Agents Development (lecture), Dr. Nenad Gajovic-Eichelmann

New Papers in Nano-Biotechnology (seminar), Prof. Dr. Frank Bier

Practical Training for the Module: "Cell-free Protein Synthesis" (lecture), Dr. Stefan Kubick

Practical Training for the Module: "Cell-free Protein Synthesis" (practical training), Dr. Stefan Kubick

Practical Training in Cell Biology (practical training), Dr. Michael Kirschbaum, Dr. Katja Uhlig, Laura Behm

Practical Training Module on Analytical Biochemistry (practical training), Dr. Cornelia Hettrich

Seminar for the "Cell-free Protein Synthesis" Module (seminar), Dr. Stefan Kubick

Snow Algae as a Bioresource & Aspects of its Distribution and Dispersal (lecture), Dr. Thomas Leya

## EVALUATOR ACTIVITIES

**Abstracts: 8th International Symposium on Neuroprotection and Neurorepair,**
Dr. Alexander Kranz,
Dr. Daniel-Christoph Wagner,
Dr. Dr. Johannes Boltze

**ACS Nano,** Dr. Dmitry Volodkin

**Advanced Materials,**
Dr. Claus Duschl,
Dr. Dmitry Volodkin

**Alzheimer's Association,**
Prof. Dr. Hans-Ulrich Demuth

**Am. J. Physiology,**
Prof. Dr. Hans-Ulrich Demuth

**Anal. Biochem.,**
Dr. Harald Peter

**Analyst,** Dr. Dirk Kuhlmeier

**Analytical Chemistry,**
Dr. Dirk Kuhlmeier,
Dr. Eva Ehrentreich-Förster

**Annals of Vaccines and Immunization,**
PD Dr. Sebastian Ulbert

**Applied Physics Letters,**
Dr. Dirk Kuhlmeier

**Berlin-Brandenburg Innovation Award 2014,**
Christopher Oelkrug,
Dr. Christina Schröder

**Biochimica Biophysica Acta,**
Prof. Dr. Hans-Ulrich Demuth

**Biological Chemistry,**
Prof. Dr. Hans-Ulrich Demuth

**Biomacromolecules,**
Dr. Claus Duschl

**Biomarker Insights,**
Dr. Harald Seitz

**Biomaterials,**
Dr. Dmitry Volodkin

**Biopreservation & Biobanking,**
Dr. Christina Schröder

**Biosensors Bioelectronics,**
Dr. Eva Ehrentreich-Förster,
Prof. Dr. Frank Bier

**BMBF,**
Prof. Dr. Hans-Ulrich Demuth

**Brain Research,**
Dr. Daniel-Christoph Wagner

**Cell Biology International,**
Dr. Claire Fabian

**Clinical Microbiology and Infection,**
PD Dr. Sebastian Ulbert

**Coordination Group "New Procedures in Biotechnology – Biotechnology 2020-Plus", awarded by the BMBF,**
Prof. Dr. Frank Bier

**Crystal Growth,**
Dr. Dmitry Volodkin

**Dechema, New Bioproduction systems, Conference "Non-canonical amino acids in proteins: structural investigations and biocatalysis",** Dr. Stefan Kubick

**Dentistry: Current Research (OMICS Publishing Group),**
Dr. Natalia Sandetskaya

**DFG,** Dr. Eva Ehrentreich-Förster,
Dr. Stefan Kubick

**Drug Design Reviews,**
Prof. Dr. Hans-Ulrich Demuth
(Editorial Advisory Board Member)

**Electophoresis,**
Dr. Claus Duschl

**Electroanalysis,**
Dr. Nenad Gajovic-Eichelmann

**Engineering in Life Sciences, Special Issue: New and synthetic bioproduction systems,** Dr. Stefan Kubick
(Editor)

**Eur. J. Biochemistry,**
Prof. Dr. Hans-Ulrich Demuth

**Experimental Neurology,**
Dr. Daniel-Christoph Wagner

**FEBS Journal,** Dr. Harald Peter

**FEBS-Letters,**
Prof. Dr. Hans-Ulrich Demuth

**German Society for Proteome Research, Proteomic Forum Meeting 2015,**
Dr. Stefan Kubick

**High-Tech Gründerfonds Bonn on the Steinbeis Transfer Centre, Mannheim,**
Prof. Dr. Hans-Ulrich Demuth

**Innovation Management – Life Science and Medical Technology, Technology Transfer and Law at the Helmholtz Association,**
Prof. Dr. Hans-Ulrich Demuth

**Intervirology (Journal),**
Dr. Thomas Grunwald

**J. Alzheimer's Disease,**
Prof. Dr. Hans-Ulrich Demuth
(Handling Editor)

**J. American Chemical Society,**
Prof. Dr. Hans-Ulrich Demuth

**J Nanotechnology,**
Prof. Dr. Frank Bier

**Journal "Future Drugs – Expert Reviews Vaccines",**
Dr. Jörg Lehmann

**Journal Biological Chemistry,**
Prof. Dr. Hans-Ulrich Demuth

**Journal for Biological Macromolecules,**
Dr. Harald Seitz

**Journal of Alzheimers Disease,** Dr. Stephan Schilling

**Journal of Chromatography B,** Prof. Dr. Hans-Ulrich Demuth

**Journal of Medical Virology,** PD Dr. Sebastian Ulbert

**Journal of Nanomedicine & Nanotechnology,** Dr. Eva Ehrentreich-Förster

**Journal of Neurochemistry,** Dr. Daniel-Christoph Wagner, Prof. Dr. Hans-Ulrich Demuth

**Journal of Proteomics & Bioinformatics,** Dr. Harald Seitz

**Journal "The Open Veterinary Science Journal",** Dr. Jörg Lehmann (Evaluator, Editorial Board)

**Journal "Veterinary Immunology and Immunopathology",** Dr. Jörg Lehmann (Evaluator)

**Journals (ACS Nano, Journal of Physical Chemistry), Funding Applications (National Science Foundation, USA),** Dr. David M. Smith

**Jury for the Fraunhofer Prize 2014 and for the "Technology for the People" Prize,** Prof. Dr. Frank Bier

**Jury for the Berlin-Brandenburg Innovation Award 2014,** Prof. Dr. Frank Bier

**LA Press,** Dr. Harald Seitz

**Life Sciences,** Prof. Dr. Hans-Ulrich Demuth

**Member of the Reviewer Committee, Statuskolloquium and Winter School of the Competence Network of Degenerative Dementia,** Prof. Dr. Hans-Ulrich Demuth

**Member of the Reviewer Panel for Doctorate Students at the University of Ulm,** Dr. Thomas Grunwald

**Monoclonal Antibodies in Immunodiagnosis and Immunotherapy,** PD Dr. Sebastian Ulbert

**Neurodegenerative Disorders,** Prof. Dr. Hans-Ulrich Demuth

**NRF Program: South African and Japan Joint Science and Technology Research Collaboration,** Dr. Harald Seitz

**Nutrients (ISSN 2072-6643; CODEN: NUTRHU),** Christopher Oelkrug

**OMICS eBooks Group,** Dr. Harald Seitz

**Organizing Committee for the BTU Cottbus-Senftenberg Innovation Forum,** Prof. Dr. Frank Bier

**Organizing Committee for the German BioSensor Symposium (every two years),** Prof. Dr. Frank Bier

**Organizing Committee Potsdam Days of Bioanalysis,** Prof. Dr. Frank Bier

**Österreichische Forschungsförderungsgesellschaft mbH (FFG),** Dr. Franziska Lange

**Parasitology (Special Issue) (Cambridge University Press),** Dr. Natalia Sandetskaya

**Phycologia,** Dr. Thomas Leya

**Physiology and Behavior (Journal),** Dr. Stephan Schilling

**PLoS One (Journal),** Dr. Alexander Kranz, Dr. Daniel-Christoph Wagner, Dr. Stephan Schilling, Dr. Thomas Grunwald

**Polymers,** Dr. Dmitry Volodkin

**Post-Doctoral Qualification (Habilitation) Committee at Ilmenau University of Technology,** Prof. Dr. Frank Bier

**Prima BioMed, Scientific Advisory Board,** Dr. Michael Szardenings

**Reviewer Clinical and Experimental Immunology,** Dr. Stephan Fricke

**Reviewer in Appeal Proceedings at the University of Lübeck,** Prof. Dr. Frank Bier

**Reviewer Research Prize New Procedures in Biotechnology, awarded by BMBF,** Prof. Dr. Frank Bier

**Sensors & Actuators B,** Dr. Nenad Gajovic-Eichelmann

**Small,** Dr. Claus Duschl

**Special learning module at Wilhelm-Ostwald-Gymnasium Leipzig,** Dr. Stephan Fricke

**Stroke (Journal),** Dr. Alexander Kranz, Dr. Daniel-Christoph Wagner

**Vaccine (Journal),** Dr. Thomas Grunwald

**Weston Garfield Family Funds, Canada,** Prof. Dr. Hans-Ulrich Demuth

**World Journal of Gastroenterology,** Dr. Holger Cynis

## ASSOCIATION MEMBERSHIPS

**Academy for Advanced Veterinary Training,** Dr. Antje Dreyer

**Alumni of the Faculty of Medicine at Leipzig University,** Dr. Stephan Fricke

**American Chemical Society,** Dr. Daniel Ramsbeck, Dr. Mirko Buchholz, Prof. Dr. Hans-Ulrich Demuth

**American Diabetes Association (ADA),** Prof. Dr. Hans-Ulrich Demuth

**American Heart Association,** Dr. Alexander Deten

**American Physical Society,** Dr. David M. Smith

**American Society of Biochemistry and Molecular Biology (ASBMB),** Dr. Claus Kerkhoff

**Association for the Advancement of Immune Diagnostics (GfID),** Prof. Dr. Ulrich Sack

**Australian Neuroscience Society,** Dr. Antje Dreyer

**Biohybrid Technologies,** Prof. Dr. Frank Bier

**BSRT – Berlin School of Regenerative Therapies,** Prof. Dr. Frank Bier

**Center for Molecular Diagnostics and Bioanalysis / Speaker Technology,** Prof. Dr. Frank Bier

**Central Committee for Animal Protection, Directorate Leipzig,** Dr. Jörg Lehmann

**CIMT,** Christopher Oelkrug

**DECHEMA – Society for Chemical Engineering and Biotechnology,** Dr. Mirko Buchholz

**Dechema, Temporary Working Group "New Bioproduction Systems",** Dr. Stefan Kubick

**DiagnostikNet Berlin-Brandenburg,** Prof. Dr. Frank Bier

**DIN German Institute for Standardization,** Dr. Christina Schröder

**DPG,** Prof. Dr. Frank Bier

**Editorial Board, Advances in Biochemical Engineering / Biotechnology,** Dr. Harald Seitz

**ESBB European, Middle-Asian and African Society for Biopreservation and Biobanking,** Dr. Christina Schröder

**European Autoimmunity Standardization Initiative (EASI),** Prof. Dr. Ulrich Sack

**European Macrophage and Dendritic Cell Society (EMDS),** Dr. Claus Kerkhoff

**European Molecular Biology Laboratory (EMBL) Alumni Association,** PD Dr. Sebastian Ulbert

**European Renal Association / European Dialysis and Transplantation Association (ERA-EDTA),** Prof. Dr. Steffen Mitzner

**European Society for Advances to Study Diabetes (EASD),** Prof. Dr. Hans-Ulrich Demuth

**European Society for Artificial Organs (ESAO),** Prof. Dr. Steffen Mitzner

**European Society for Clinical Cell Analysis (ESCCA),** Prof. Dr. Ulrich Sack

**European WNV Research Platform,** PD Dr. Sebastian Ulbert

**FIND Foundation Innovative Diagnostics – Scientific Advisory Board, Genf,** Prof. Dr. Frank Bier

**Friends of Veterinary Medicine Faculty of the Leipzig University,** Dr. Jörg Lehmann

**German Association of University Professors and Lecturers (DHV),** Dr. Alexander Deten

**German Chemical Society (GDCh),** Dr. Michael Szardenings

**German Chemical Society / Biochemistry Technical Unit, Analytical Chemistry Technical Unit,** Prof. Dr. Frank Bier

**German Interdisciplinary Association for Intensive Care and Emergency Medical Aid (DIVI),** Prof. Dr. Steffen Mitzner

**German Neuroscience Society (NWG),** Dr. Anna Leichsenring

**German Pharmaceutical Society,** Dr. Daniel Ramsbeck, Dr. Mirko Buchholz

**German Physical Society,** Dr. Claus Duschl

**German Physiologic Society (DPG),** Dr. Alexander Deten

**German QP Association,** Dr. Gerno Schmiedeknecht, Kati Kebbel

**German Sepsis Society (DSG),** Prof. Dr. Steffen Mitzner, PD Dr. Martin Sauer

**German Society for Allergology and Clinical Immunology (DGAKI),** Dr. Elke Ueberham

**German Society for Anesthesiology and Intensive Care (DGAI),** PD Dr. Martin Sauer

**German Society for Cardiology – Cardiovascular Research (DGK),** Dr. Alexander Deten

**German Society for Clinical Chemistry and Laboratory Medicine (DGKL),** Prof. Dr. Ulrich Sack

**German Society for Clinical Neurology,** Dr. Gesa Weise

**German Society for Clinical Neurophysiology,**
Dr. Gesa Weise

**German Society for Epidemiology (DGEpi),** Dr. Holger Kirsten

**German Society for Good Research Practice (DGGF),**
Stefanie Jahr

**German Society for Immunology (DGfI),**
Christopher Oelkrug,
Dr. Franziska Lange,
Dr. Stephan Fricke,
Prof. Dr. Ulrich Sack,
Aleksandra Seydel,
Dr. Christiane Füldner,
Dr. Jörg Lehmann,
Dr. Ulla Schwertassek,
Janine Kohlschmidt,
Katharina Zoldan,
Sina Riemschneider

**German Society for Parasitology (DGP),** Dr. Markus von Nickisch-Rosenegk

**German Society for Proteome Research (DGPF),**
Dr. Stefan Kubick

**German Society for Regenerative Medicine (GRM),** Dr. Stephan Fricke

**German Society for Veterinary Medicine (DVG),**
Anne Kühlmann

**German Society for Virology (GfV),** PD Dr. Sebastian Ulbert

**German Society of Mass Spectrometry (DGMS),**
Prof. Dr. Hans-Ulrich Demuth

**German Zoologic Society (DZG),** Dr. Gustavo Makert dos Santos

**GdCh,** Dr. Eva Ehrentreich-Förster, Dr. Walter Stöcklein

**GLP-Commission,**
Prof. Dr. Ulrich Sack

**glyconet Berlin-Brandenburg,**
Dr. Stefan Kubick

**GV-Solas,** Dr. Thomas Grunwald

**International Dyslexia Association,** Dr. Arndt Wilcke

**International Proteolysis Society (IPS),**
Prof. Dr. Hans-Ulrich Demuth

**International Society for Heart Research (ISHR),**
Dr. Alexander Deten

**International Society for Magnetic Resonance in Medicine,** Dr. Alexander Kranz

**International Society for Nanoscale Science, Computation and Engineering,**
Dr. David M. Smith

**International Society of Psychiatric Genetics,**
Bent Müller

**International Union for the Study of Social Insects,**
Gustavo Makert dos Santos

**Joint Technical Unit for Chemical Biology,**
Prof. Dr. Hans-Ulrich Demuth

**Junior GBM,** Sandra Mükusch

**LAUF e.V. – State Association of Non-University Research Institutions in Brandenburg,**
Prof. Dr. Frank Bier

**Molecularbiology Cluster Potsdam,** Prof. Dr. Frank Bier

**National Research Platform for Zoonoses,**
Alexandra Kerzhner,
Gustavo Makert dos Santos,
PD Dr. Sebastian Ulbert

**New York Academy of Sciences,**
Prof. Dr. Hans-Ulrich Demuth

**PerMediCon Messe Köln,**
Prof. Dr. Frank Bier

**Phycology Section of the German Botanical Society,**
Dr. Thomas Leya

**Processnet / DECHEMA,**
Prof. Dr. Frank Bier

**Protein Society (PS),**
Prof. Dr. Hans-Ulrich Demuth

**Regional Advisory Body to the Brandenburg Economic Development Board,**
Prof. Dr. Frank Bier

**Research Association for Measurement and Sensor Technology / Executive Board,**
Prof. Dr. Frank Bier

**SAB of the BMBF-NWG "Cell2Fab",** Prof. Dr. Frank Bier

**Society for Biochemistry and Molecular Biology (GBM),**
Dr. Holger Cynis,
Dr. Christina Schröder,
Dr. Claus Kerkhoff,
Dr. Harald Seitz,
Dr. Markus von Nickisch-Rosenegk,
Dr. Michael Szardenings,
Dr. Stefan Kubick,
Dr. Stephan Schilling,
Dr. Walter Stöcklein,
Prof. Dr. Frank Bier,
Prof. Dr. Hans-Ulrich Demuth

**Society for Laboratory Animals (GV-SOLAS),**
Dr. Jörg Lehmann

**Society for Nephrology (GfN),**
Prof. Dr. Steffen Mitzner

**Society for Neuroscience,**
Dr. Alexander Kranz,
Dr. Holger Cynis,
Dr. Björn Nitzsche,
Dr. Daniel-Christoph Wagner,
Vilia Zeisig,
Prof. Dr. Hans-Ulrich Demuth

**Society for Virology,**
Dr. Thomas Grunwald

**Society of Biological Systematics (GfBS),** Dr. Markus von Nickisch-Rosenegk

**Study-group for experimental stem cell transplantation,**
Dr. Stephan Fricke

**VAAM,** Dr. Walter Stöcklein

## PUBLICATIONS


Arnold C, Externbrink F, Hackermüller J, Reiche K. **CEM-Designer: Design of custom expression microarrays in the post-ENCODE Era.** Journal of Biotechnology. 2014 Nov 10;189:154-6. DOI http://dx.doi.org/10.1016/j.jbiotec.2014.09.012.

Backofen R, Amman F, Costa F, Findeiß S, Richter AS, Stadler PF. **Bioinformatics of prokaryotic RNAs.** RNA Biology. 2014 May;11(5):470-83. DOI http://dx.doi.org/10.4161/rna.28647.

Balseanu AT, Buga AM, Catalin B, Wagner DC, Boltze J, Zagrean AM, Reymann K, Schaebitz W, Popa-Wagner A. **Multimodal approaches for regenerative stroke therapies: combination of granulocyte colony-stimulating factor with bone marrow mesenchymal stem cells is not superior to G-CSF alone.** Frontiers in Aging Neuroscience. 2014 Jun 23;6:130. DOI http://dx.doi.org/10.3389/fnagi.2014.00130.

Barzon L, Pacenti M, Franchin E, Squarzon L, Sinigaglia A, Ulbert S, Cusinato R, Palù G. **Isolation of West Nile virus from urine samples of patients with acute infection.** Journal of Clinical Microbiology. 214 Sep;52(9):3411-3. DOI: http://dx.doi.org/10.1128/JCM.01328-14.

Boldt A, Borte S, Fricke S, Kentouche K, Emmrich F, Borte M, Kahlenberg F, Sack U. **Eight-color immunophenotyping of T-, B-, and NK-cell subpopulations for characterization of chronic immunodeficiencies.** Cytometry B Clinical Cytometry. 2014 May;86(3):191-206. DOI: http://dx.doi.org/10.1002/cyto.b.21162.

Boldt A, Kahlenberg F, Fricke S, Rasche FM, Sack U. **Flow cytometric phenotyping of lymphocytes in patients with systemic lupus erythematosus.** Cytometry A. 2014 Jul;85(7):567-9. DOI: http://dx.doi.org/10.1002/cyto.a.22477.

Boldt A, Kentouche K, Fricke S, Borte S, Kahlenberg F, Sack U. **Differences in FOXP3 and CD127 expression in Treg-like cells in patients with IPEX syndrome.** Clinical Immunoloy. 2014 Jul;153(1):109-11. DOI: http://dx.doi.org/10.1016/j.clim.2014.04.001.

Boltze J, Ayata C, Wagner DC, Plesnila N. **Preclinical phase III trials in translational stroke research: call for collective design of framework and guidelines.** Stroke. 2014 Feb;45(2):357. DOI http://dx.doi.org/10.1161/STROKEAHA.113.004148.

Boltze J, Lukomska B, Jolkkonen J; MEMS–IRBI consortium. **Mesenchymal stromal cells in stroke: improvement of motor recovery or functional compensation?** Journal of Cerebral Blood Flow and Metabolism. 2014 Aug;34(8):1420-1. DOI http://dx.doi.org/10.1038/jcbfm.2014.94.

Burkhardt J, Blume M, Petit-Teixeira E, Hugo Teixeira V, Steiner A, Quente E, Wolfram G, Scholz M, Pierlot C, Migliorini P, Bombardieri S, Balsa A, Westhovens R, Barrera P, Radstake TR, Alves H, Bardin T, Prum B, Emmrich F, Cornelis F, Ahnert P, Kirsten H. **Cellular adhesion gene SELP is associated with rheumatoid arthritis and displays differential allelic expression.** PLoS One. 2014 Aug 22;9(8):e103872. DOI http://dx.doi.org/10.1371/journal.pone.0103872.

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Hettrich C. **Development of a β-lactamase inhibitor screening assay.** 6th Potsdam Days on Bioanalysis, 6.–7.11.2014, Potsdam

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Kranz A. **Bioluminescence Imaging in neuroscience research.** IBRO NERKA Biophysics School on Neurophotonics, 28.11.–5.12.2014, Belgrade, Serbia

Kranz A. **Image analysis – colocalization and pitfalls in biological image processing.** IBRO NERKA Biophysics School on Neurophotonics, 28.11.–5.12.2014, Belgrade, Serbia

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Kubick S. **Cell-free protein expression based on extracts from eukaryotic cells.** PEGS 2014, 5.–9.3.2014, Boston, USA

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Kubick S. **Eukaryotic cell-free systems: Novel strategies for the synthesis of membrane proteins.** SFB1078-Seminar am Institut für Physik der Freien Universität Berlin, 2.6.2014, Berlin

Kubick S. **Eukaryotic in vitro translation systems: Cell-free synthesis of posttranslationally modified membrane proteins.** PepCon-Konferenz, 26.4.2014, Dalian, China

Kubick S. **Eukaryotic in vitro translation systems: Cell-free synthesis of posttranslationally modified membrane proteins.** Seminarvortrag am Max-Planck-Institut für Kolloid- und Grenzflächenforschung, Freie Universität Berlin (Prof. Seeberger), 26.8.2014, Berlin

Kubick S. **Perspectives in cell-free protein synthesis: Eukaryotic in vitro translation systems.** International Symposium Cell-free Protein Synthesis and 3rd Status Seminar Cell-free Bioproduction, 27.6.2014, Fraunhofer Forum Berlin

Kubick S. **Synthesis of membrane proteins in eukaryotic cell-free systems.** Vortrag anlässlich des SFB35-Seminars am Institut für Pharmakologie der Universität Vienna (Prof. Sitte), 28.5.2014, Vienna, Austria

Kubick S. **Zellfreie Proteinsynthese.** Ringvorlesung "Biochemie" der Freien Universität Berlin, 11.7.2014, Berlin

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Lehmann J, Schulz RM. **Non-clinical testing strategies for the approval of cell-based medicinal products – state of the art.** Fraunhofer Life Science Symposium, 9.–10.10.2014, Leipzig

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Lorenz J. **Modulation of cellular uptake using CPP-functionalized DNA tetrahedra.** PMW Winterschool 2014, 17.–23.3.2014, Špindlerův Mlýn, Czech Republic

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Makert G. **Development of an immunological strategy to combat the poultry red mite Dermanyssus gallinae.** Jahrestagung der Deutschen Zoologischen Gesellschaft, 11.–14.9.2014, Göttingen

Makert, G. **An immunological strategy for the control of poultry mites.** Workshop on Ticks and Tick-Borne Diseases, 30.9.–2.10.2014, Berlin

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Memczak H. **Virus-binding peptides for influenza detection and inhibition.** 6th Potsdam Days on Bioanalysis, 6.–7.11.2014, Potsdam

Möser C, Lorenz J, Smith D. **DNA-Based Functional Materials.** 2014 Symposium, 17.5.2014, Leibniz-Institut für Photonische Technologien IPHT, Jena

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Müller B, Wilcke A, Schaadt G, Boltze J, Kirsten H. **Genetic modulators of dyslexia related MMR.** XXIInd World congress of psychiatric genetics, 12.–16.10.2014, Copenhagen, Denmark

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Paulraj T, Feoktistova N, Velk N, Uhlig K, Duschl C, Volodkin DV. **LbL assembled hollow polymeric 3D scaffolds.** Layer-by-Layer Assemblies: Science and Technology Conference, Stevens Institute of Technology, 23.6.2014, Hoboken, USA

Prill S, Jäger M. **Sensor validation and integration into the microfluidic bioreactor.** HeMiBio Annual Meeting, 23.1.2014, Leuven, Belgium

Prill S, Jäger M. **Valproic acid toxicity measurement in the microbioreactor.** HeMiBio Progress Meeting, 1.7.2014, Oslo, Norway

Prohl A, Lohr M, Ostermann C, Kühnert C, Zoldan K, Lehmann J, Menge C, Liebler-Tenorio E, Reinhold P, Berndt A. **Changes in bovine blood leukocyte surface markers after intrabronchial inoculation with Chlamydia psittaci.** 3rd Annual Meeting "Veterinärimmunologischer Arbeitskreis" (VIA) of the German Society for Immunology (DGfI), 2.–3.5.2014, Jena

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## GRADUATION (CLASS OF 2014)

Aydin, Yasemin. **Development of Packaging for Dry Reagents which is Impervious to Water Vapour and Light.** Beuth University of Applied Sciences Berlin. Master's degree

Bader, Denise. **Synthesis and Characterization of Modularly Arrangeable Biomimetics for Biosensory Application.** University of Potsdam. Doctorate degree

Beckert, Sophie. **Therapeutic effect of mesenchymal stem cells after systemic application in Alzheimer's disease mouse model.** Brandenburg University of Technology Cottbus–Senftenberg. Master's degree

Bernau, Madlin. **Fractionation of the Protein Extract from the Red Fowl Mite by Means of Gel Chromatography besides its Antigen Characterization.** Anhalt Köthen University of Applied Sciences. Master's degree

Binder, Stefanie. **STAiR18 – a STAT3-Induced Non-Coding RNA Regulates the Survival of Multiple Myeloma Cells.** Leipzig University. Doctorate degree

Blüher, Anja. **The therapeutic effect of systemically transplanted microglia in aged and Alzheimer mice.** Brandenburg University of Technology Cottbus–Senftenberg. Master's degree

Bosserdt, Maria. **Development of Innovative Biomimetic Sensors: 2D Molecularly Imprinted Polymers to Detect Ferrous Proteins.** University of Potsdam. Doctorate degree

Brödel, Andreas. **Novel cell-free systems for increasing efficiency and versatility of protein synthesis.** University of Potsdam. Doctorate degree

Chabierski, Stefan. **Investigation of Two Different Approaches to the Potential Structuring of a Specific West Nile Virus Diagnosis.** Leipzig University. Doctorate degree

Dähne, Martin. **Effect of a Colocynth and Sage-Based Phytopharmaceutical on the Gene Expression of Human Immune Cells.** Anhalt Köthen University of Applied Sciences. Master's degree

Dechtrirat, Decha. **Combination of Self-Assembled Monolayers (SAMs) and Molecularly Imprinted Polymers (MIPs) in Biomimetic Sensors.** University of Potsdam. Doctorate degree

Drees, Britta. **Examination of the Immunogenic Properties of VLPs using RSV-F and Influenza HA on the Surface and their Protective Properties against RSV and Influenza-A Viruses in the Mouse Model.** Ruhr University Bochum. Master's degree

Füldner, Christiane. **The Influence of Benzo[a]pyrene on the Innate Immune Response of the Mouse against Salmonella Enterica.** Leipzig University. Doctorate degree

Galiazzo, Vanessa. **Characterisation and optimisation of isothermal methods for application on a diagnostic home-care device.** Furtwangen University Villingen-Schwenningen. Bachelor's degree

Gros, Oliver. **Computer-Aided Knowledge Extraction from Texts on Pathological Findings.** University of Potsdam. Doctorate degree

Hartke, Martin. **A developmental pipeline for synthetic temporin-1CEa analogs, antimicrobial and anticancer peptides.** FH Aachen University of Applied Sciences. Master's degree

Hartwig, Carolin. **Surrogate development and characterization for the performance check of ApoStream.** TU Dresden. Diploma

Hermann, Claudia. **Investigation into the Packaging for POCT Use.** Beuth University of Applied Sciences Berlin. Master's degree

Hüttl, Christine. **Synthesis and Characterization of Multivalent, Peptide-Based Ligands as a Biomolecular Detection Unit for Influenza Viruses.** University of Potsdam. Doctorate degree

Kramer, Toni. **Detection of new antigens from Neisseria gonorrhoeae.** Brandenburg University of Technology Cottbus–Senftenberg. Master's degree

Kreische, Marco. **Influence of Temperature and Nitrate Availability on the Formation of EPA and other Fatty Acids in the Arctic Freshwater Algae Hormidiospora Verrucosa, CCCryo 198-05.** Brandenburg University of Technology Cottbus-Senftenberg. Bachelor's degree

Kuhrau, Julia. **Development of a Rapid Test to Detect MRSA with the Aid of Isothermal Amplification.** University of Furtwangen. Bachelor's degree

Kunath, Nicole. **Inhibition of DNA methyltransferase as an epigenetic intervention in cancer and cancer stem cells of ovarian cancer.** University of Rostock. Master's degree

Kunert, Maria. **Synthesis of functional Potassium crystallographically-sited activation channel (KcsA) with chemo-selective and bio-orthogonal modifications in a eukaryotic cell-free system.** University of Potsdam. Master's degree

Kunze, Sascha. **Design and Implementation of an Efficient Pool Index.** Brandenburg University of Applied Sciences. Master's degree

Lehnort, Sascha. **Detection of ATP Using a Homogeneous DNA-Aptamer Assay.** University of Potsdam. Master's degree

Leovsky, Christiane. **Biodistribution of Cells – Effects of Aging.** Friedrich Schiller University Jena. Diploma

Memczak, Henry. **Development of Influenza-Binding Peptides for Biosensor Technology.** University of Potsdam. Doctorate degree

Naaldijk, Yahaira. **Cryopreservation of cells with sugars and starches.** Friedrich Schiller University Jena. Doctorate degree

Niemann, Katja. **Development of a Strategy to Detect Sepsis-Pathogenic Fungi by Means of Isothermal Amplification via a Point-of-Care System.** Beuth University of Applied Sciences Berlin. Master's degree

Nitsche, Sandra. **Development and Preclinical Testing of Novel Virus-Like Particles as Vaccine Candidates against Respiratory Tract Viruses.** Ruhr University Bochum. Doctorate degree

Odimegwu, Damian Chukwu. **Interventions against the Respiratory Syncytial Virus Infection.** Ruhr-Universität Bochum. Doctorate degree

Paul, Christian Gerhard. **Characterization of the Substrate Specificity of Glutaminyl Cyclase from Porphyromonas Gingivalis.** Martin Luther University of Halle-Wittenberg. Master's degree

Petrausch, Maik. **Establishing a Fluorescence-Based Method to Measure Near-Surface Temperature Gradients on Micropatterned Cell Culture Substrates.** Technical University of Applied Sciences Wildau. Bachelor's degree

Pille, Christina. **Comparison of Different Isolation Methods for Microglial Cells from the Brain Tissue of Mice besides the Stimulation of Microglial Cells using Different Aß Species.** Martin Luther University of Halle-Wittenberg. Bachelor's degree

Reimann, Hauke. **Production and Validation of Immunogens from Neisseria Gonorrhoeae.** University of Potsdam. Bachelor's degree

Römer, Petra. **Studies on the Effect of Short Interfering RNA in Cell-free Eukaryotic Systems.** Free University of Berlin. Diploma

Rudolph, Silvia. **DNA Methyltransferase Inhibition for the Epigenetic Intervention against Tumor and Tumor Stem Cells of Ovarian Carcinoma.** Otto von Guericke University Magdeburg Master's degree

Ruländer, Maik. **Cultivation of Human Enterocytes for the Future Testing of Plant Compounds.** Zittau/Görlitz University of Applied Sciences. Bachelor's degree

Schlenther, Ilka. **Examinations on Rhodamine-B-Coupled Self-Assembling Monolayers as the Foundation of Fluorescence-Based Temperature Determination on Gold Surfaces.** Technical University of Berlin. Diploma

Schmidt, Franziska. **Morphology of Microglial Cells in Association with Amyloid Deposits and Tau Pathologies in the Canine Brain.** Leipzig University. Doctorate degree

Schneider, Josephine. **Validation of Protein Biomarkers to Monitor the Health of Dairy Cows.** Friedrich Schiller University Jena. Diploma

Schulz, Sebastian. **Development and Evaluation of Quantification Strategies and Process Control for Protein Microarrays.** University of Potsdam. Bachelor's degree

Schulze, Corina. **Functionality Studies on Antibody Fragments Synthesized in a Cell-free Manner.** Beuth University of Applied Sciences Berlin. Master's degree

Ulbert, Sebastian. **Development of Methods also for the Detection of Viral Infections Based on the West Nile Virus Example.** Leipzig University. Post-doctoral qualification

Wehrmann, Dorothé. **Mapping Tumor Tissue Using Phage Display.** Otto von Guericke University Magdeburg. Bachelor's degree

Weisbach, Niels. **Cell-free Protein Synthesis Based on Translationally Active Lysates from Dictyostelium Discoideum.** University of Potsdam. Master's degree

Zemella, Anne. **Cell-free Synthesis of Active Human Telomerase.** Free University of Berlin. Diploma

## PRIZES

**Biotechnology Prize awarded by Anhalt University of Applied Sciences, Department of Applied Biosciences and Process Engineering,** to Janine Kohlschmidt from the Cell Engineering/GLP Unit on the topic "Influence of Benzo[a]pyrene on the Functional Properties of Murine Bone Marrow Macrophages"

**Jackstädt DGHO PhD Scholarship** awarded to Christoph Halbich from the Immune Tolerance Unit on the topic "Examination and Influence of GvHD and of the GvL Effect in a Murine Haploidentical Transplantation Model"

**Scholarship awarded by the Translational Centre for Regenerative Medicine (TRM) at Leipzig University** to Nadja Hilger from the Immune Tolerance Unit on the topic "GvHD in Humanized Mice"

**Research Prize awarded by the Federal Association of Dyslexia and Dyscalculia** to Dr. Holger Kirsten from the Cognitive Genetics Unit on the topic "Imaging Genetics of FOXP2 in Dyslexia"

**C-3 Saxony Innovation Award (a society of the Chamber of Industry and Commerce)** presented to Dr. Arndt Wilcke from the Cognitive Genetics Unit on the topic "LEGATEST – Development of an Early-Screening Text for Dyslexia"

**Further education scholarship in science management "Young Leaders in Science", awarded by the Ernst Schering Foundation** to Dr. Holger Cynis from the Molecular Biotechnology Unit

**TALENTA Excellence awarded by the Fraunhofer-Gesellschaft** to Dr. Franziska Lange from the Inflammation Models and Immunodiagnostics Unit on the topic "Career Enhancement"

**TALENTA awarded by the Fraunhofer-Gesellschaft** to Claudia Hohaus from the ivD Platform Unit on the topic "Packaging of POCT Products"

**TALENTA awarded by the Fraunhofer-Gesellschaft** to Elena Ermilova from the Biomolecular Nanostructures & Measurement Technology Unit on the topic "Impedance Measurement on DNA"

**Best poster presentation, bronze medal at the conference: "Bio-Based Polymers and Composites (BiPoCo)"** awarded to Alena Sergeeva from the Biofunctional Coatings Unit on the topic "Development of Alginate Gels with Controlled Patterning and Encapsulation Performance"

**Best poster presentation, bronze medal at the conference: "Bio-Based Polymers and Composites (BiPoCo)"** awarded to Alena Sergeeva from the Biofunctional Coatings Unit on the topic "CaCO3 Microparticles as Templates to Fabricate Alginate Gels with Hollow Micropores"

**Award presented by the Association of German Engineers in recognition of the outstanding degree granted by the Technical University of Berlin** to Lena Thoring, qualified engineer, from the In Vitro Protein Labeling Unit for the degree in the field of biotechnology including thesis topic in the area of cell-free eukaryotic protein synthesis of WNT signal transduction proteins

**Clara von Simson Award presented by the Technical University of Berlin** to Victoria Schuldt, certified engineer, from the In Vitro Protein Labeling Unit for her thesis as part of the Fraunhofer's main project "Cell-free Bioproduction" with the title "Immobilization of mRNA and Magnetic Force Actuated Particle Transfer for On-Chip Automation of Cell-free Protein Synthesis"

**Travel grant awarded by the GlaxoSmithKline Foundation** to Sarah Schumacher from the Biomarker Validation and Assay Development Unit to participate in the ICID in Cape Town

**PhD scholarship awarded by CAPES / Brazilian Ministry of Education** to Harry Freitas da Cruz from the Metabiobanks CRIP Unit on the topic "Telehealth Monitoring for Risk Assessment and Triage Based on Multi-Parameter In Vitro Diagnostics Findings"

# PATENTS

The patent portfolio of the Fraunhofer IZI currently holds 52 patent families which are available for use in cooperation projects as well as for direct commercialization and licensing.

**Fraunhofer IZI holds patents in the following fields of technology:**

- Technologies for generating pluripotent stem cells
- Procedures for diagnosing infecting agents
- Procedures for diagnosing cancerous diseases
- New treatment procedures for cancer and other diseases
- New procedure for preventing Graft-versus-Host-Disease (GvHD)
- Method for immobilizing cells on surfaces
- Procedure for diagnosing dyslexia
- Methods for ascertaining liver function and regeneration
- Methods for targeted isolation of nucleic acids
- Mineral compounds for the prevention / treatment of kidney and bowel diseases
- Methods of treating neurological and neuropsychological diseases
- Substrate, cultivation facility and cultivation procedures for biological cells
- Electrochemical detection methods for binding reactions
- Procedure for manufacturing zinc fingers and concatemers
- Coimmobilization of several chemical species
- Procedure for manufacturing transparent films from cellulose dispersions and their use as multifunctional ligand carriers
- Device for measuring luminescence

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# FURTHERANCE


*”We have been optimizing quality management at the institute for ten years now, a fact which is not only expressed in the trust of our customers.”*

*Kati Kebbel, Head of Cell Engineering/GMP Unit, at the Fraunhofer IZI since 2006*

# SPONSORS AND ADVISORY BOARD OF THE FRAUNHOFER IZI

The support and commitment of active institutions and individuals enable the Fraunhofer IZI to experience continuous and successful development as well as dynamic growth.

**Sponsors**

The Fraunhofer IZI would like to thank the European Union, the Federal Ministry of Education and Research, the Free State of Saxony and the City of Leipzig via the Leipzig Foundation for Innovation and Technology Transfer for their financial support.

The European Union sponsors through the programs EFRE and ESF. The building projects of the Fraunhofer IZI are sponsored 60 percent by the European Union and 20 percent each by the Federal Ministry of Education and Research and the Free State of Saxony. In the same manner, the expenses of about 11 million Euros for construction and equipment of the extension building were covered. The plot of land is provided by the City of Leipzig in hereditary leasehold and free of charge.





**Advisory board**

The advisory board functions as the external expert committee for strategic questions regarding the institutional direction and the Fraunhofer-Gesellschaft. Its members are invited and appointed by the president of the Fraunhofer-Gesellschaft. The advisory board includes representatives from industry and research as well as from authorities, ministries and foundations. The board meets once a year and evaluates the performance and image of the institute.

Members of the advisory board:

- Dr. Knut Bartl (emeritus Roche Diagnostics GmbH, CSO Werk Penzberg)
- Dr. Annerose Beck (Saxon State Ministry of Science and the Arts (SMWK), Deputy Head of National-Regional Research Centers Administration)
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- Prof. Dr. Gerhard Oechtering (Leipzig University, Director of the Small Animal Hospital)
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- Prof. Dr. Andreas Pinkwart (HHL Leipzig Graduate School of Management, Dean)
- Prof. Dr. Thomas Skutella (University of Heidelberg, Head of Department at the Institute for Anatomy and Cell Biology)
- Dr. Christina de Wit (Federal Ministry of Education and Research (BMBF), Desk Officer for Health Care Management)
- Klaus Berka (Analytik Jena AG, CEO)

# FRAUNHOFER-GESELLSCHAFT

*”It is great to be able to work alongside fantastic colleagues in an environment which features state-of-the-art laboratory technology – I look forward to the next ten years at the Fraunhofer!”*

*Ulrike Scholz, Medical and Technical Assistant in the Cell Engineering /GLP Unit, at the Fraunhofer IZI since 2006*

# THE FRAUNHOFER-GESELLSCHAFT IN PROFILE

Research of practical utility lies at the heart of all activities pursued by the Fraunhofer-Gesellschaft. Founded in 1949, the research organization undertakes applied research that drives economic development and serves the wider benefit of society. Its services are solicited by customers and contractual partners in industry, the service sector and public administration.

At present, the Fraunhofer-Gesellschaft maintains 66 institutes and independent research units. The majority of the more than 24,000 staff are qualified scientists and engineers, who work with an annual research budget of 2 billion euros. Of this sum, more than 1.7 billion euros is generated through contract research. More than 70 percent of the Fraunhofer-Gesellschaft's contract research revenue is derived from contracts with industry and from publicly financed research projects. Almost 30 percent is contributed by the German federal and state governments in the form of base funding, enabling the institutes to work ahead on solutions to problems that will not become acutely relevant to industry and society until five or ten years from now.

Affiliated international research centers and representative offices provide contact with the regions of greatest importance to present and future scientific progress and economic development.

With its clearly defined mission of application-oriented research and its focus on key technologies of relevance to the future, the Fraunhofer-Gesellschaft plays a prominent role in the German and European innovation process. Applied research has a knock-on effect that extends beyond the direct benefits perceived by the customer: Through their research and development work, the Fraunhofer Institutes help to reinforce the competitive strength of the economy in their local region, and throughout Germany and Europe. They do so by promoting innovation, strengthening the technological base, improving the acceptance of new technologies, and helping to train the urgently needed future generation of scientists and engineers.

As an employer, the Fraunhofer-Gesellschaft offers its staff the opportunity to develop the professional and personal skills that will allow them to take up positions of responsibility within their institute, at universities, in industry and in society. Students who choose to work on projects at the Fraunhofer Institutes have excellent prospects of starting and developing a career in industry by virtue of the practical training and experience they have acquired.

The Fraunhofer-Gesellschaft is a recognized non-profit organization that takes its name from Joseph von Fraunhofer (1787–1826), the illustrious Munich researcher, inventor and entrepreneur.

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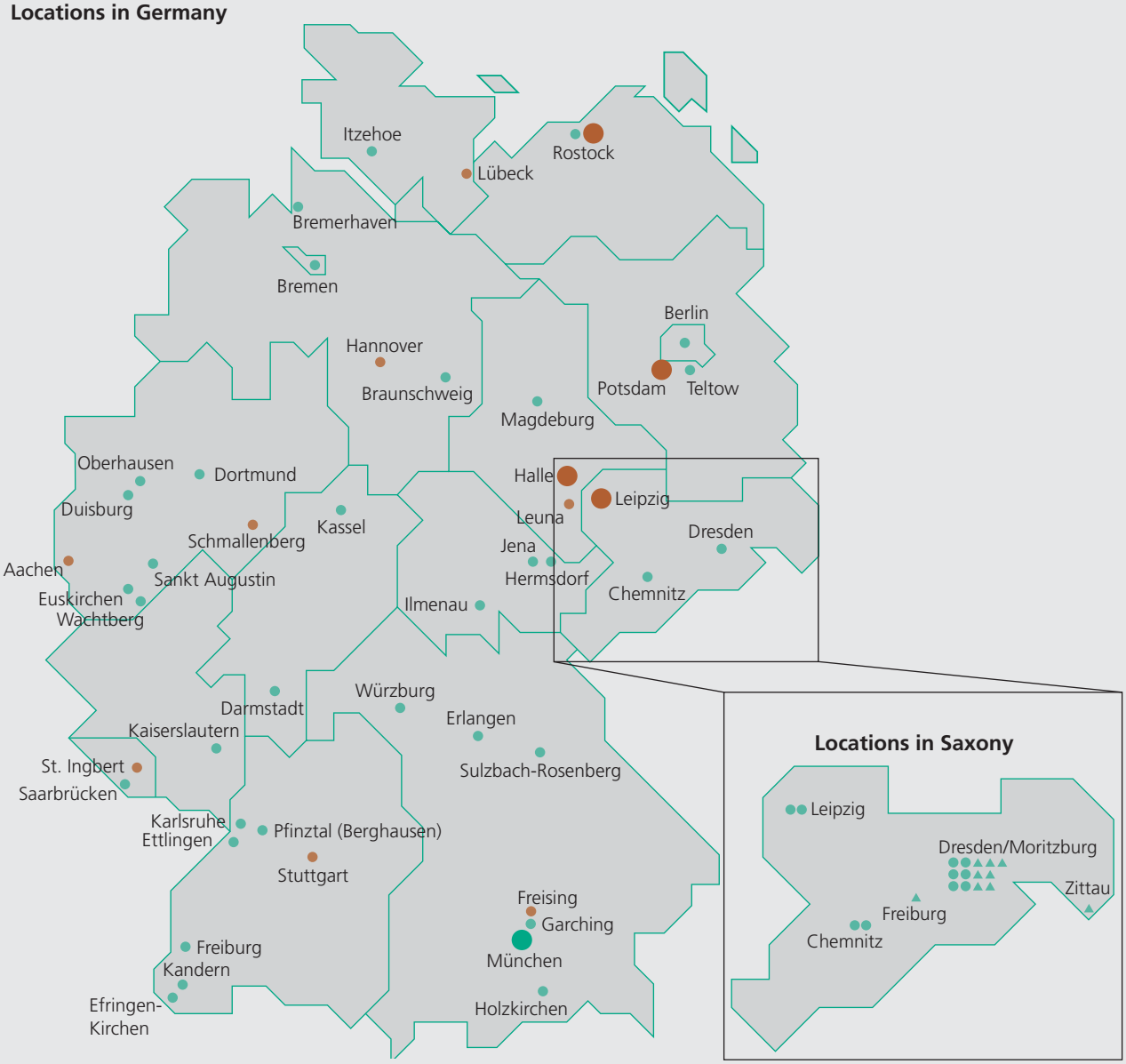
## Locations in Germany



# FRAUNHOFER GROUP FOR LIFE SCIENCES

The Fraunhofer Group for Life Sciences was founded in 2001 to strengthen the fields of life sciences, biomedicine and biotechnology. It currently comprises seven institutes.

In terms of expanding research revenue as well as business spin-offs, the Fraunhofer Group for Life Sciences is one of the Fraunhofer-Gesellschaft's most dynamic areas of research.

Business units of the Fraunhofer Group for Life Sciences:

- Medical translational research and biomedical technology: The challenge of innovative diagnostics and personalized therapy
- Regenerative medicine: The challenge of qualified biobanking and controlled self-healing
- Healthy foods: The challenge of high consumer acceptance and disease prevention
- The new potential of biotechnology: The challenge to learn from nature for industrial exploitation
- Process, chemical, and herbicide safety: The challenge of environmental and consumer protection

The elected spokesman of the Fraunhofer Group for Life Sciences is Prof. Dr. Thomas Hirth, who heads the Fraunhofer Institute for Interfacial Engineering and Biotechnology IGB in Stuttgart. Since 2008, Prof. Dr. Frank Emmrich (head of the Fraunhofer IZI) is deputy spokesman.

**Institutes of the Fraunhofer Group for Life Sciences**

- Fraunhofer Institute for Biomedical Engineering IBMT
- Fraunhofer Institute for Interfacial Engineering and Biotechnology IGB
- Fraunhofer Institute for Molecular Biology and Applied Ecology IME
- Fraunhofer Institute for Toxicology and Experimental Medicine ITEM
- Fraunhofer Institute for Cell Therapy and Immunology IZI
- Fraunhofer Institute for Process Engineering and Packaging IVV
- Fraunhofer Research Institution for Marine Biotechnology EMB

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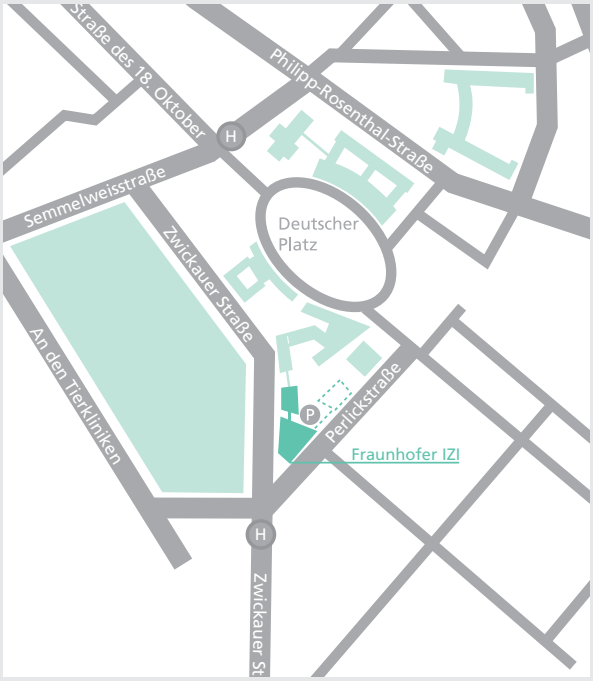
# FRAUNHOFER IZI CONTACT INFORMATION

*”I enjoy working at the Fraunhofer IZI because I have the chance to meet new people every day. In the future, I hope to continue receiving interesting insights into my colleagues‘ research topics.”*

*Mike Eichler, Reception, at the Fraunhofer IZI since 2008*

# HOW TO REACH US


**By car**

A9 – Exit Leipzig-West: Take the B181 in the direction of the city center ("Zentrum") and follow the B87 (Merseburger Straße, Lützner Str., Jahnallee). After passing the central station, turn right towards Augustusplatz (Leipzig Opera House). At Augustusplatz turn left and keep to the right, then follow Prager Straße. Turn right at Semmelweissstraße, follow the road and then turn left onto Zwickauer Straße. Follow this road until you turn left into Perlickstraße.

A14 – Exit Leipzig-Mitte: Take the B2 (via Maximilianallee) in the direction of the city center ("Zentrum") and follow the B2 (via Gerichtsweg). Turn left onto Prager Straße (B2) in the direction of "Alte Messe", then turn right onto "Alte Messe". Turn right at Semmelweissstraße, follow the road and then turn left onto Zwickauer Straße. Follow this road until you turn left into Perlickstraße.

A38 – Exit Leipzig-Süd: Take the B2 in the direction of the city center ("Zentrum") and turn off at exit "Richard-Lehmann-Straße". Follow Richard-Lehmann-Straße and turn off before the BMW car dealership onto Zwickauer Straße in the direction of "Alte Messe", then turn right onto Perlickstraße.

The car park is accessible from Perlickstraße. You will find visitors' parking right in front of the façade of the institute.

**By train and public transport**

Take the train to Leipzig Hauptbahnhof central station, and then continue with tram line 16 towards Lößnig. Get off at the stop "An den Tierkliniken", directly opposite the institute. The closest S-Bahn train station is "Leipzig MDR" and all S-Bahn trains stop there (10–15 minute walk to the institute).

**From the airport**

With the overground Train ("S-Bahn") towards Leipzig Central Station, then follow the directions given under "Train and Public Transport".

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# INFORMATION SERVICE

**Service Catalog** (English)

Our service catalog gives you a comprehensive insight into the products and services offered by the Fraunhofer IZI. On the basis of a sorting according to work units you will quickly find your appropriate contact person at our institute and gain insight into reference projects or applicabilities.


**Annual Report** (German/English)

In combination with past years' issues, our current annual report gives you an insight into the structure of the Fraunhofer IZI, our services, important events and publications, offers, as well as selected project examples.

**Homepage** (German/English)

An overview of interesting events held at the Fraunhofer IZI as well as further information on our institute can be found on our homepage www.izi.fraunhofer.de.

All our brochures and publications as well as current announcements made by the Fraunhofer IZI can be found on our homepage **www.izi.fraunhofer.de**. You can also mail to **presse@izi.fraunhofer.de** and order our brochures as hard copies.

***Editorial notes***

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***Cover picture***

*electron-microscope image of immobilized proteins on a DNA molecule base, arranged to form the letters "IZI".*

*This work was conducted in the Attract Group by Dr. David Smith using DNA origami technology (see also page 63).*

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## NOTES