Fraunhofer
IZI

FRAUNHOFER INSTITUTE FOR CELL THERAPY AND IMMUNOLOGY IZI

ANNUAL REPORT 2016

ANNUAL REPORT
2016

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PREFACE

DIRECTOR
PROF. DR. FRANK EMMRICH

2016 brought with it a wealth of scientific and technical achievements. Once again we saw some incredibly sharp minds that are far ahead of their time. It can takes decades or even centuries for a hypothesis to be proven or for scientific findings to lead to a technological change that impacts on the whole of society.

Take what happened with Albert Einstein's hypothesis on the existence of gravitational waves. The technical evidence supporting this theory wasn't published until last year – almost 100 years after Einstein's theoretical derivation. A milestone in physics. Likewise, the fields of medicine and biomedical research can also look back on an eventful year: researchers from Hamburg and Dresden managed to completely remove HIV from an organism for the first time. Significant progress was also made in cancer research, for instance in the advancement of the CRISPR-Cas9 technology. This acronym represents a new way of modifying DNA building blocks in the genome – simply and accurately. These so-called "genetic scissors" were incorporated into the treatment of cancer patients for the first time in 2016. Additional major advancements not expected to revolutionize biomedical research for another 100 years were reported in the fields of molecular biology and imaging: the technologies required to sequence genetic material were developed to such an extent that entire genomes are able to be sequenced within a much shorter time frame and with much lower cost implications besides being read, to a great extent, in large sections. This opens doors to completely new options in disease research and in the development of new therapeutic and diagnostic processes.

Successful research was also carried out at the Fraunhofer IZI in 2016, with numerous developments prepared for practical application. This is reflected on the one hand in over 110 scientific publications, 47 graduations and over 200 conference and meeting contributions, as well as in the acquisition of numerous new major and joint projects. For instance, an extremely successful Fraunhofer joint project was able to be completed in the field of vaccine production that is now being transferred into an initial application with support from the Bill and Melinda Gates Foundation. This incorporates technology developed by Fraunhofer to make polio vaccines much more efficient and affordable than in the past. Also in the Department of Immunology, a test was developed to specifically differentiate between dengue and other flaviviruses. This should enable a much more accurate therapy to be developed in future.

The previously mentioned advancements seen in sequencing technologies are also spurring on the major project RIBOLUTION in the Diagnostics department. The so-called next-generation sequencing procedures allow a much more effective search for biomarkers. Huge amounts of data are generated within just a short amount of time. The information contained in this data is then extracted using comprehensive bioinformatics. The foundation of the RIBOLUTION Biomarker Center and the company RIBOLUTION Health GmbH, both of which stem from within the institute, also marked two key achievements in 2016 on the path to clinical application.

The developments addressed in the field of genetic engineering are also increasingly reflected in the projects handled at the institute. One internal Fraunhofer project is specifically looking at various gene therapies, whereby various Fraunhofer Institutes are deploying oncolytic viruses in the treatment of lung cancer. Furthermore, the Department of GMP Cell and Gene Therapy is supporting a renowned pharmaceutical company in developing a gene therapy for the treatment of leukemia.

The institute is assisting in further exciting projects and developments linked to neurodegenerative diseases, in particular at the Halle site. In Rostock, 2016 saw colleagues working on new dialysis strategies, while the wanderers of the farthest "business trip" in the institute's history returned to the Bioanalytics and Bioprocesses branch in Potsdam-Golm last year. Various extremophilic algae strains spent almost two years at the International Space Station. The researchers were surprised to find that the majority of these survival specialists managed to withstand inhospitable conditions such as extreme UV radiation and cold. The molecular foundations of the adaptability demonstrated here is certain to be of great interest to the cosmetics industry and medical applications.

With an overall balance of 30.2 million euros and an industrial proportion of over 40 per cent at the Leipzig headquarters, 2016 also proved to be the institute's most successful year since being founded. In addition to the positive economic development seen at the Fraunhofer IZI, the Fraunhofer-Gesellschaft is set to receive an extra 60 million euros per year in basic government funding as of 2017. The additional funds will largely be used to bolster preliminary research.

There are therefore many reasons to look to the future with confidence and optimism.

Best wishes
Yours

Prof. Dr. Frank Emmrich

STRUCTURES AND FIGURES 2016

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

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.

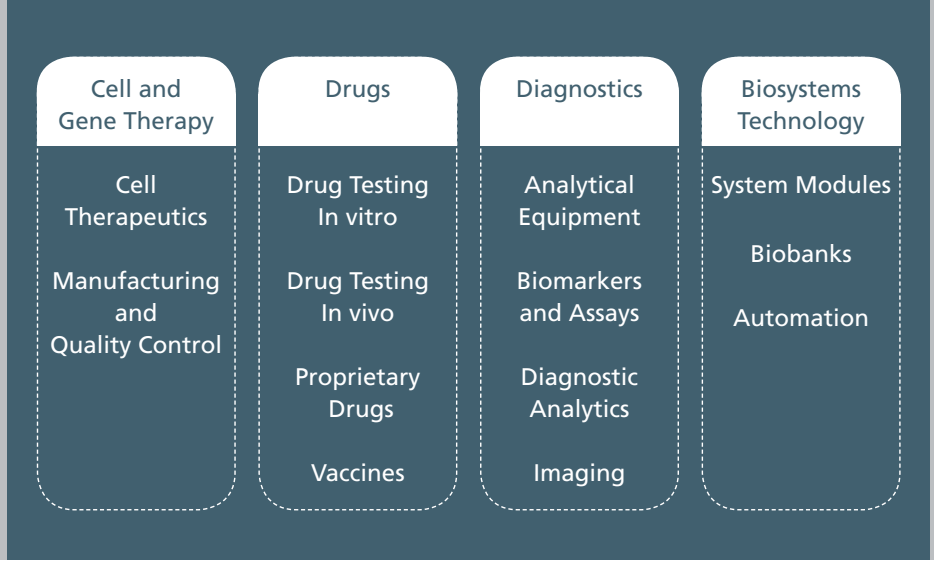
The institute's tasks

The institute operates four sites. The departments GMP Cell and Gene Therapy, Therapy Validation, Immunology, Cell Therapy and Diagnostics are based at the Leipzig headquarters. The Potsdam-Golm branch is home to the departments Biosystem Integration and Process Automation, Cellular Biotechnology, Molecular and Cellular Bioanalytics as well as Cell-free and Cell-based Bioproduction. Two additional off-site departments are located in Halle (Saale) and Rostock. Different 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 investigational medicinal products according to GMP guidelines and contracted clinical trials. In addition, we support our partners in obtaining manufacturing and marketing authorizations.



BUSINESS UNITS

From a market perspective, a business unit is defined as a compilation of services rendered for specific groups of customers within a defined technological area which gives rise to customer value. Business units therefore form a basis for strategic planning within the context of market development and were identified by pooling and analyzing connected services and corresponding development activities as outlined below. As a result, the institute has defined four business units which comprise various areas of competence.

Cell and Gene Therapy Business Unit

The Cell and Gene Therapy Business Unit is especially important to Fraunhofer IZI and comprises development activities and contract research projects to develop innovative cell and gene therapy concepts as well as their validation, testing and manufacture according to GLP and GMP standards. In this regard, the Cell Therapeutics business field comprises all of the developments relating to proprietary therapeutic concepts, while research and development services for industry partners involving the testing and manufacture of cell and gene therapy agents as commissioned by the customer stand at the fore of the Manufacturing and Quality Control business field. The institute's own future developments will be more heavily devoted to the field of tumor immunology. The Manufacturing and Quality Control business field is currently focused on approaches to fight cancer and treat cardiovascular diseases; the field is, however, generally set up to deal with all indications.

Drugs Business Unit

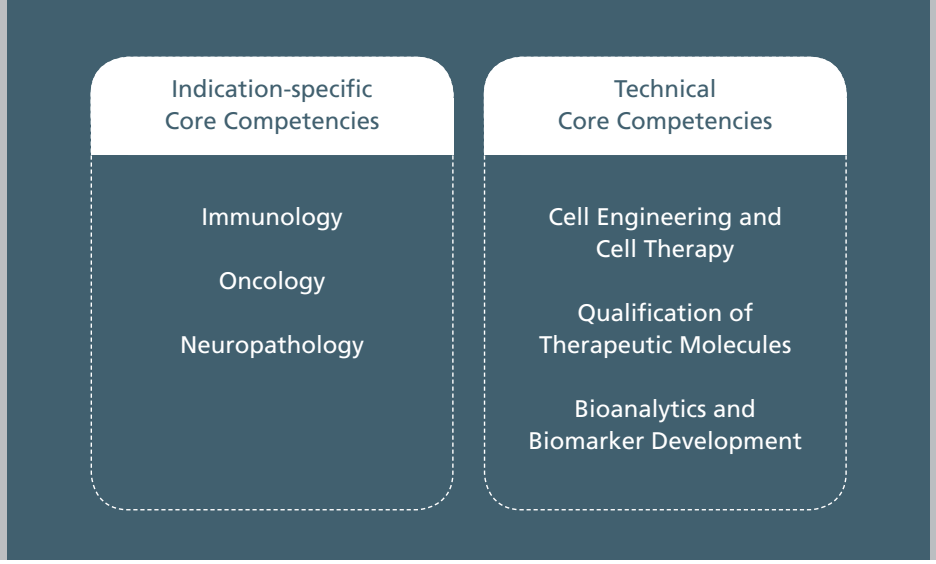
Fraunhofer IZI's Drugs Business Unit represents large parts of the preclinical value chain relating to drug and vaccine development and is subdivided into the business fields Drug Testing (in vitro and in vivo), Proprietary Drugs, and Vaccines. With regard to drug testing, development services in the form of in vitro and in vivo models are primarily offered for the detailed characterization and optimization of drug candidates with a view to their efficacy and safety. The models established in this area are adapted in close cooperation with the customer and, in many cases, completely redeveloped and validated. Moreover, Fraunhofer IZI develops proprietary drugs and vaccines for human and veterinary medicine. In this regard, the range of services and parallel proprietary developments should efficiently complement each other. The developed drug and vaccine candidates are licensed to industry partners in line with specific projects at different times, or form the basis of company spin-offs from Fraunhofer IZI.

Diagnostics Business Unit

At its four sites in Germany and its two sites abroad (Canada, South Korea), Fraunhofer IZI carries out a number of R&D projects in the field of diagnostics that range from finding biomarkers and clinical validation through to assay and test development for the areas of medicine, agricultural economics and food economics right over to the development of respective diagnostic devices and prototype construction. In this regard, the Biomarkers and Assays business field is primarily focused on identifying biomarkers and other marker structures besides using them for diagnosis and prognosis purposes in connection with assays and test systems that have been developed accordingly. By way of contrast, the Analytical Equipment business field looks first and foremost at establishing new analysis and technology platforms for diagnostic applications, which can also be based on publicly accessible, common-knowledge biomarkers or target structures supplied by cooperation partners, alongside biomarkers that the institute has developed itself. Both business fields are closely interrelated, which creates benefits in particular within the context of the demanding biomarker and diagnostics market. Moreover, this business unit includes the development, optimization and diagnostic application of imaging procedures.

Biosystems Technology Business Unit

In the Biosystems Technology Business Unit, Fraunhofer IZI brings together biomedical, engineering and process engineering expertise in order to develop system solutions in the fields of advanced manufacturing procedures, medical engineering and diagnostics. The components required to design integrative systems are developed in the System Modules business field. Furthermore, R&D activities at Fraunhofer IZI also concentrate on the automation of manufacturing and analytical processes in the business field bearing the same name, whereby the value chain consists of not only drafting, developing and optimizing equipment modules, but also their integration. Particular attention is directed here to the automation of processes that have so far required a high degree of human input and interaction in the laboratory, especially with regard to manufacturing cell therapeutic products. The Biobanks business field, which has also been allocated to the Biosystems Technology Business Unit, is currently under development.



CORE COMPETENCIES

Specific skills and resources at Fraunhofer IZI are defined as core competencies; as such they are of key importance to the development of attractive technologies and product candidates and form the basis of the long-term economic and scientific success achieved by the institute's business units. At the same time, core competencies not only make an excellent contribution to the value of our services as perceived by the customer, but are primarily distinguished by their unique characteristics. Six core competencies are defined at Fraunhofer IZI, which can be divided into indication-specific and technical core competencies depending on their nature.

Indication-specific core competencies

The core competence **Immunology** covers special competencies and technologies available at Fraunhofer IZI to develop innovative approaches for the diagnosis, treatment, monitoring and prevention of infectious, inflammatory and hematologic diseases in human and veterinary medicine. A key resource here is the excellent infrastructure at Fraunhofer IZI which features, among other things, a facility for keeping small animals in accordance with the latest standards, comprehensive imaging capabilities and state-of-the-art operating rooms besides specific areas for conducting work in line with BSL-3 and GLP.

The development of new therapeutic strategies and diagnostics platforms for various types of cancer requires special and diverse skills and resources, which are pooled under the core competence of **Oncology.** This includes, for example, special competencies in identifying and validating cellular target structures and signal paths which are of diagnostic and/or therapeutic value, competencies in developing and validating especially predictive animal models, as well as competencies in developing innovative therapeutic approaches. As a consequence, the competencies available at Fraunhofer IZI allow large parts of the early stages of the value chain to be depicted in this field in terms of diagnostics and therapy development related to oncology.

Neuropathology is the third indication-specific core competence and describes pooled expertise in the research of neuropathological and neurodegenerative diseases. A special feature of this core competence is the depth of research established at Fraunhofer IZI which, in several projects, extends to the area of internationally, surpassingly renowned, excellent fundamental research. This research hones in on the areas of stroke and neurodegenerative diseases (Alzheimer's disease). In several projects, the applied research conducted at Fraunhofer IZI into the pathogenesis of various diseases has already enabled promising, new targets to be identified for diagnosing and treating diseases in the described ranges of indication.

Technical core competencies

The core competence **Cell Engineering and Cell Therapy** is one of the institute's most important core competencies and has been ever since Fraunhofer IZI was established, as clearly expressed in the institute's name. Comprehensive expertise and an extensive special infrastructure have been established at the institute for the commissioned testing and manufacturing of cell-based therapeutic agents. The three facilities operated by Fraunhofer IZI for the GMP-compliant manufacture of ATMPs count among the largest and most profiled of their kind in Europe. At the same time, sizeable resources and outstanding regulatory experience have been established at Fraunhofer IZI with regard to reviewing the safety and tolerability of ATMPs and blood products under GLP conditions.

The core competence **Qualification of Therapeutic Molecules** pools together all of the competencies available at Fraunhofer IZI in close connection with drug development. The classes of therapeutic molecules addressed here include small, organic molecules and peptides as well as therapeutic macromolecules such as aptamers and antibodies, besides various kinds of natural products. The Molecular Drug Biochemistry and Therapy Development project group in Halle (Saale) covers a large part of the overall value chain at the preclinical drug development stage, beginning with drug design and the complete spectrum of medicinal chemistry and analytics and extending right through to establishing new animal models for investigating relevant mechanisms of action and conducting in vivo drug candidate tests.

The final technical core competence, **Bioanalytics and Biomarker Development,** addresses all of the available capabilities and resources for the development of biomarkers, assays and detection technologies / solutions for the application area of medicine and food analysis. The biomarkers identified and validated at Fraunhofer IZI often form the basis of a subsequent assay or device development. In this regard, capabilities in the technological areas of analytics, nanotechnology and electrical engineering are what primarily contribute towards the implementation of innovative development concepts.

1

2

ORGANIZATION LEIPZIG / HALLE (SAALE) / ROSTOCK*

Directors
Prof. Dr. Frank Emmrich (executive)
Prof. Dr. Hans-Ulrich Demuth

Press and Public Affairs
Jens Augustin

Business Development and Patent Management
Dr. Thomas Tradler

Information technology
Alexander Dossin

Administration
Anja Bochmann-Seidel (temp.)

Center for Experimental Medicine
Dr. Thomas Grunwald

Officers

Leipzig Headquarters

Department of GMP Cell and Gene Therapy
Dr. Gerno Schmiedeknecht / Kati Kebbel

Department of Therapy Validation
Dr. Jörg Lehmann

- **Preclinical Models** Dr. Ulla Schwertassek
- **Protein Biomarker** Prof. Dr. Stefan Kalkhof
- **Antibody Production** Maximilian Hoffmann

Department of Immunology
PD Dr. Sebastian Ulbert

- **Vaccine Technologies** PD Dr. Sebastian Ulbert
- **Immune Tolerance** PD Dr. Stephan Fricke
- **Cell-functional Image Analysis** Prof. Dr. Ulf-Dietrich Braumann
- **Ligand Development** Dr. Michael Szardenings
- **Antimicrobial Agents** Dr. Andreas Schubert
- **Preclinical Validation** Dr. Thomas Grunwald
- **Immunobiological Material Diagnostics** Dr. Juliane Pasold

Extracorporeal Immunomodulation Project Group (Rostock)
Prof. Dr. Steffen Mitzner

Department of Cell Therapy
Dr. Thomas Grunwald (temp.)

- **Immuntherapy – Oncology** Christopher Oelkrug
- **Ischemia Research** Dr. Thomas Grunwald (temp.)
- **Experimental Imaging** Dr. Alexander Kranz
- **Cognitive Genetics** Dr. Arndt Wilcke
- **Clinic-oriented Therapy Assessment** Dr. Antje Dreyer
- **OpTcell** Dr. Jana Burkhardt

Department of Diagnostics
Prof. Dr. Friedemann Horn

- **Inflammation Models and Immunodiagnostics** Dr. Franziska Lange
- **Nanotechnology** Dr. Dirk Kuhlmeier
- **Tumor Stem Cells** Dr. Peter Ruschpler
- **DNA Nanodevices** Dr. David M. Smith
- **Cardiomics** Prof. Dr. Dr. Dr. Andreas Oberbach
- **RNA Biomarker** Dr. Sophie Bartsch
- **Next-Generation Diagnostics** Dr. Conny Blumert
- **Bioinformatics** Dr. Kristin Reiche
- **Study and Quality Management** Dr. Catharina Bertram

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

1 *Leipzig*
2 *Halle (Saale)*

** January 2017*

1

ORGANIZATION BRANCH OF INSTITUTE POTSDAM-GOLM*

Bioanalytics and Bioprocesses Branch of Institute (Potsdam-Golm)
Prof. Dr. Hans-Ulrich Demuth

Strategy, Marketing and Administration
Katja Okulla

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

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

Department of Molecular and Cellular Bioanalytics
Dr. Claus Duschl /
Dr. Eva Ehrentreich-Förster

- **Microarray and Sensor Technology**
  Dr. Eva Ehrentreich-Förster
- **Biomarker Validation and Assay Development**
  Dr. Harald Seitz
- **Molecular Bio-Engineering**
  Dr. Markus von Nickisch-Rosenegk
- **Metabiobanks CRIP**
  Dr. Oliver Gros
- **Microsystems for In Vitro Cell Models**
  Dr. Claus Duschl
- **Microfluidic Cell Processing and Cell Analytics**
  Dr. Michael Kirschbaum

Department of Cell-free and Cell-based Bioproduction
Dr. Stefan Kubick

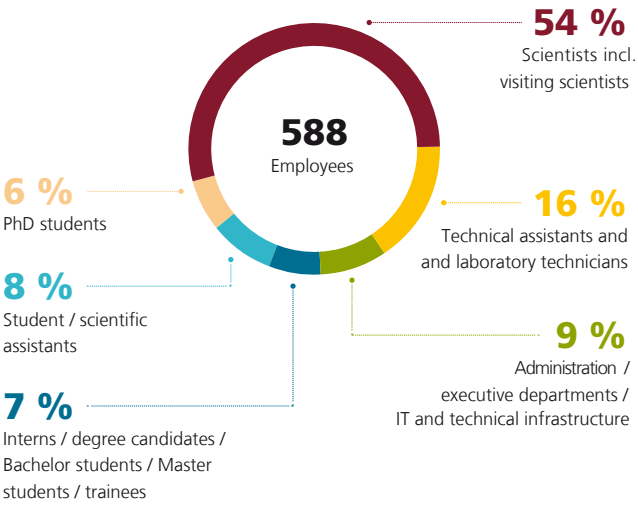
- **Functional Nucleic Acids – Aptamers**
  Dr. Marcus Menger
- **Eukaryotic Lysates**
  Doreen Wüstenhagen
- **Extremophile Research & Biobank CCCryo**
  Dr. Thomas Leya
- **Cell-free Protein Synthesis**
  Dr. Stefan Kubick

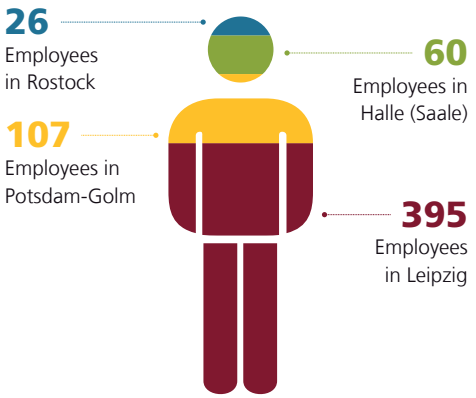
1 *Potsdam-Golm*

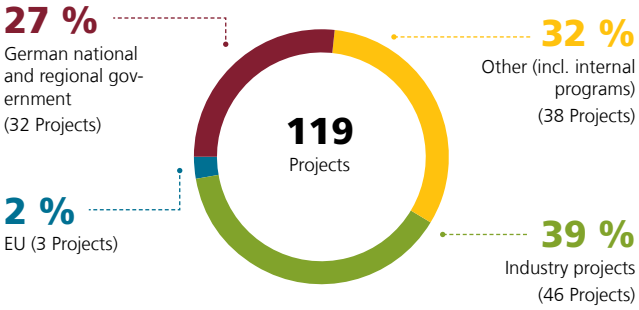
** January 2017*

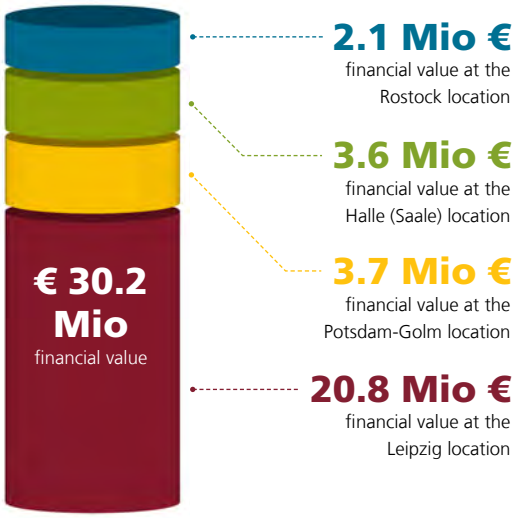
GROWTH AND PERFORMANCE

KEY INSTITUTE FIGURES 2016







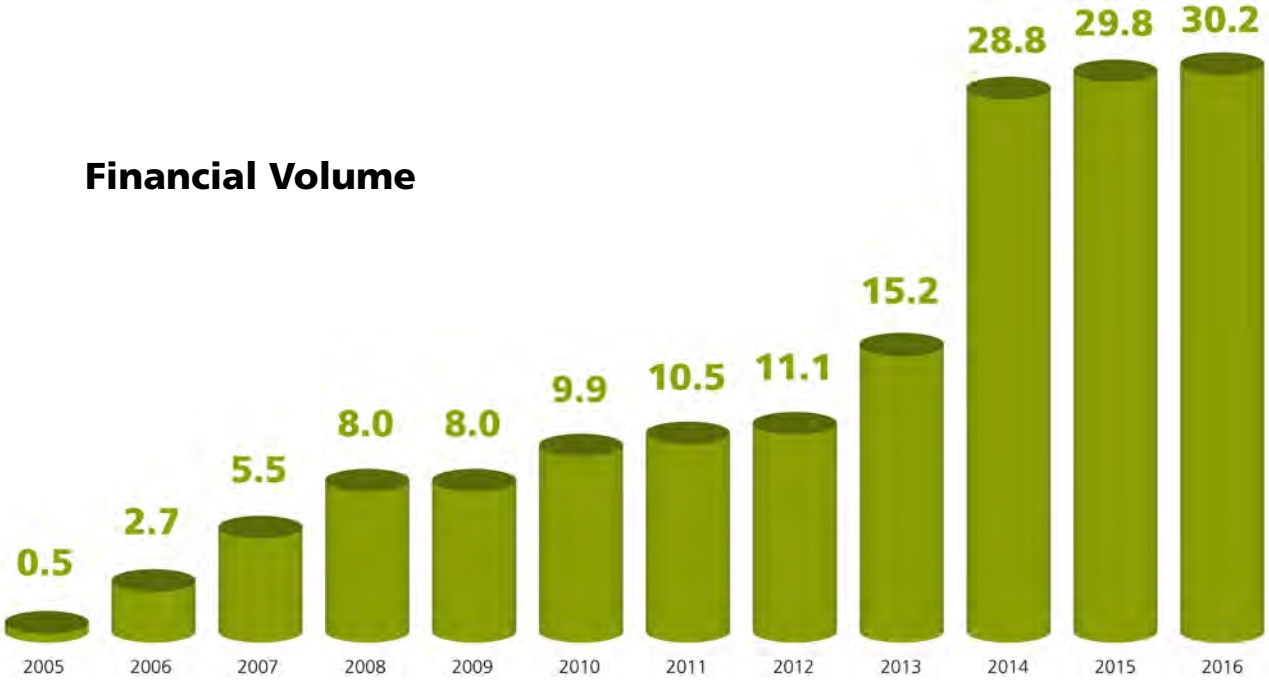


Project revenue 2016 in kEUR

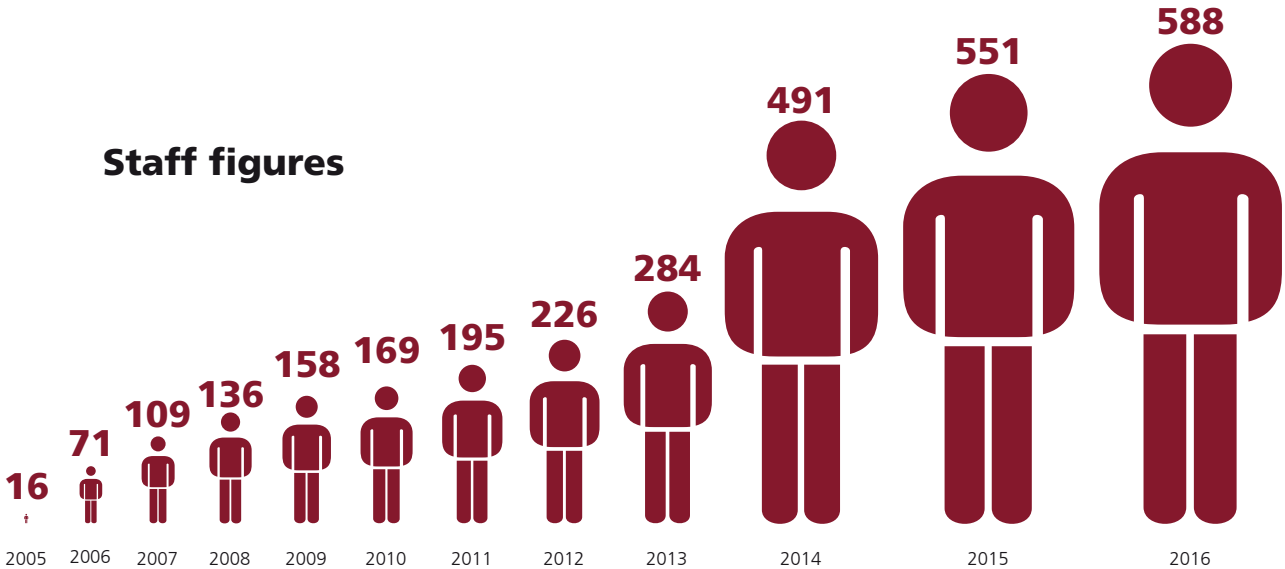
	Leipzig	Halle	Potsdam	Rostock	Total
German national and regional government	1 250	3 140	1 220	1 420	7 030
EU	0	110	250	0	360
Industry projects	10 350	210	540	560	11 660
Other (incl. internal programs)	5 160	110	1 070	0	6 340
Total	16 760	3 570	3 080	1 980	25 390

** 31.12.2016*

Financial Volume

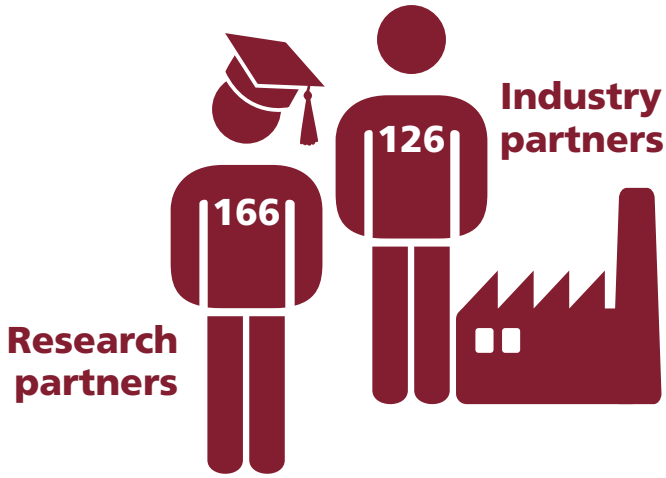


Staff figures

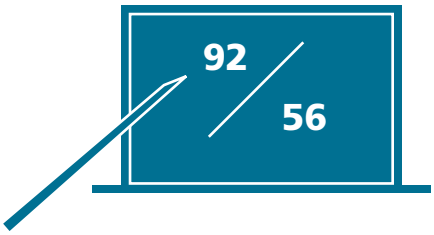


SCIENTIFIC PRESENCE AND NETWORK 2016

Conventions and conferences



Advanced vocational training



Teaching activities

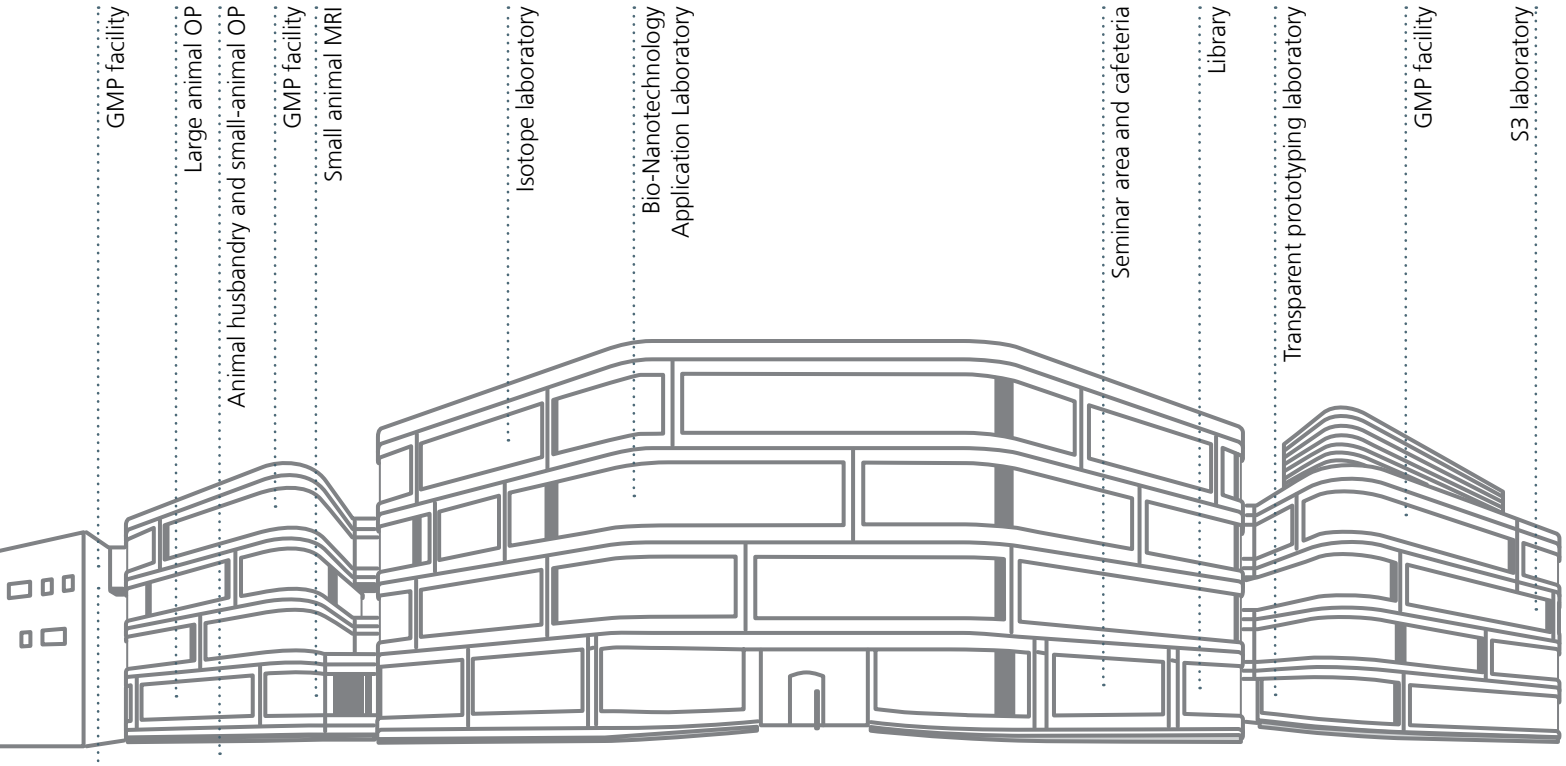
Evaluator activities

Association memberships

Patent families with 127 Patents

OUTSTANDING
INFRASTRUCTURE

RESEARCH INFRASTRUCTURE AT THE LEIPZIG SITE



First extension building

- Start-up operations: 2012
- Usable area: 1568 m²
- Lab space: 470 m²
- Offices: 142 m²
- Clean rooms: 377 m²

Rental area at Bio City Leipzig

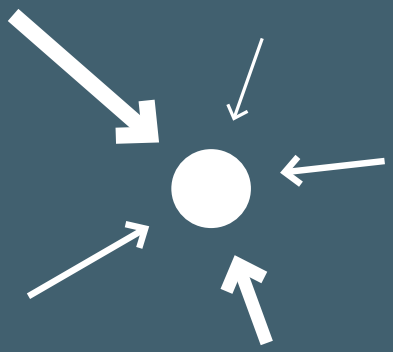
- Start-up operations: 2006
- Clean rooms: 450 m²

Main building

- Start-up operations: 2008
- Usable area: 4131 m²
- Lab space: 1867 m²
- Offices: 1615 m²
- Seminar area: 276 m²

Second extension building

- Start-up operations: 2015
- Usable area: 3050 m²
- Lab space: 1171 m²
- Offices: 881 m²
- Clean rooms: 408 m²



APPEALING TO INDUSTRY

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 seventeen companies. The site's appeal and its local cooperation with the Fraunhofer IZI were important factors in the partners' decision to settle there.

Anti-tumor cell vaccines und cell therapeutics
- CellProTec GmbH (Settlement 2015)
- Cognate Bioservices GmbH (Settlement 2011)*
- Northwest Biotherapeutics GmbH (Settlement 2011)*
- Prima BioMed GmbH (Settlement 2010)*

Developing
- Bioville GmbH (Spin-Off 2010)*
- Tutelacell GmbH (Spin-Off 2014)

Diagnostics
- ApoCell (Settlement 2013)*
- epitopic GmbH (Spin-Off 2016)
- Magna Diagnostics GmbH (Spin-Off 2010)*
- RIBOLUTION Health GmbH (Spin-Off 2016)
- SelfD Technologie GmbH (Settlement 2012)*
- Sonovum AG (Spin-Off 2011)

Drugs R&D
- Nuvo Research GmbH (Settlement 2009)*

Natural remedies R&D
- Oncotrition GmbH (Spin-Off 2012)*

Stem cell bank
- InnovaStem GmbH (Settlement 2009)*

Therapy devices
- IPDx Immunoprofiling Diagnostics GmbH (Settlement 2015)
- MD-5 GmbH/Nervive (Settlement 2012)*

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

APOCELL
molecular profiling
& diagnostics

BIOVILLE

Cell
Pro
Tec

Cognate
BioServices, Inc.

EPITOPIC

InnovaStem
Innovation for Life

magna
DIAGNOSTICS

MD5

NORTHWEST
BIOTHERAPEUTICS

NUVO

oncotrition

PRIMA BIOMED LTD
Australian Cancer Treatment Company

RIBOLUTION

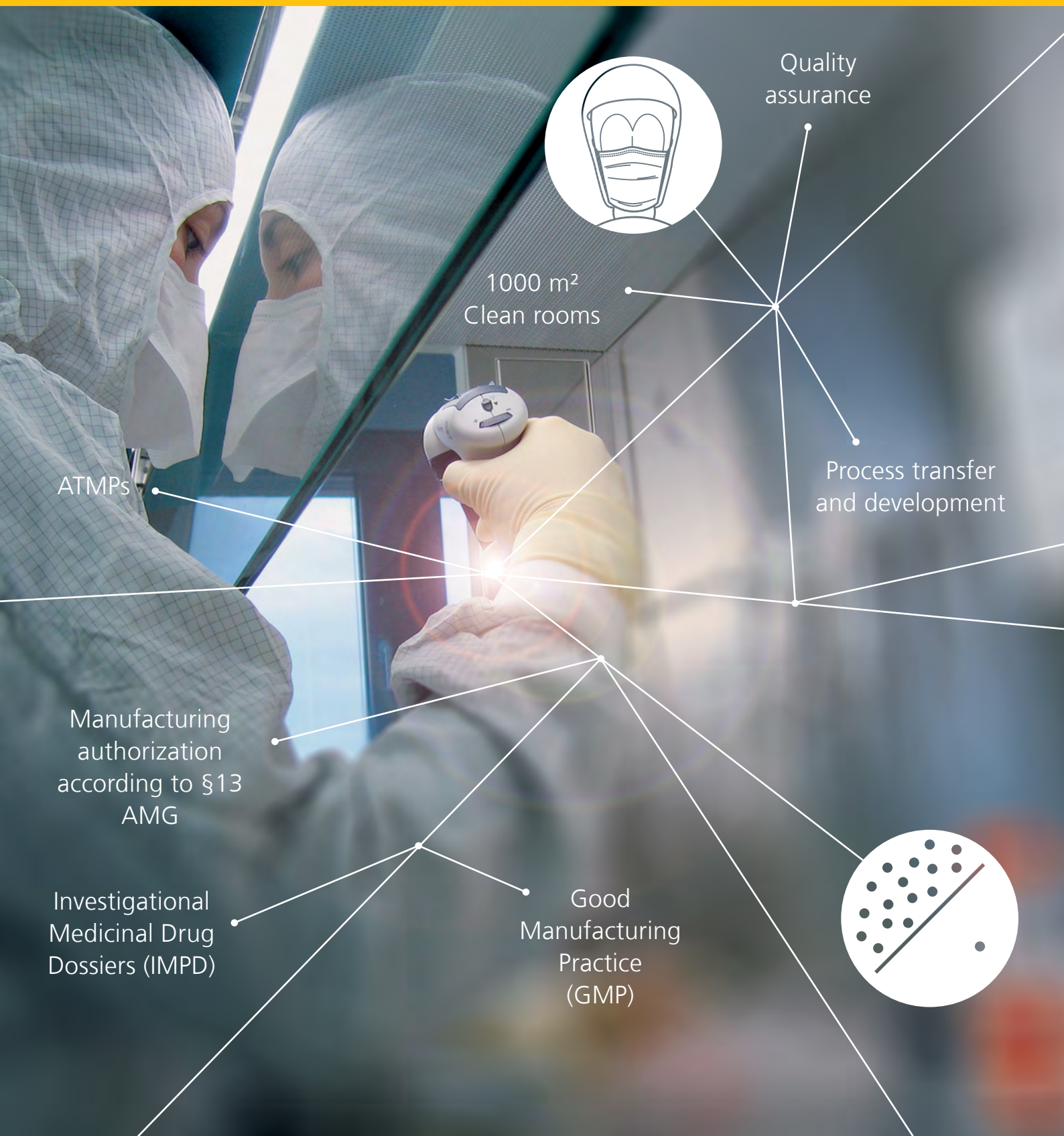
SelfD
Technologie
GmbH

SoNovum
Cerebrum protego

Tutelacell

DEPARTMENT OF GMP CELL AND GENE THERAPY

Location Leipzig, Germany



THE DEPARTMENT AT A GLANCE

The Department of GMP Cell and Gene Therapy operates Fraunhofer IZI's three modern GMP facilities consisting of ten separate clean room suites (altogether 21 clean room grade B manufacturing rooms) which have been specially optimized for manufacturing of cell and gene therapy products, so called Advanced Therapy Medicinal Products – ATMP. The particular specialty of the about 90 highly qualified staff members is the GMP-compliant manufacturing and quality control of investigational medicinal products.

GMP-compliant process and quality control development as well as the creation of Standard Operating Procedures (SOPs) are intensively discussed with the project partner before being implemented. The leading staff in charge has many years of experience in designing GMP-processes in the cell therapy area.

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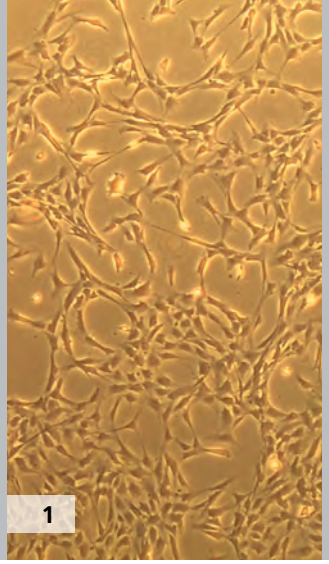

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PROJECT EXAMPLES

autoCard study

Cardiovascular diseases still represent the main cause of death in Europe, with around 50,000 people dying from myocardial insufficiency every year in Germany. The relatively new field of regenerative medicine is, however, showing a great deal of promise.Clinical investigational drugs called "CardAPcells" (cardiac-derived adherent proliferating cells) are being manufactured at the Fraunhofer IZI in cooperation with Charité - Universitätsmedizin Berlin. The therapeutic agent contains myocardial cells that are isolated from biopsy samples taken from the patient's own heart muscle and expanded over the course of a cell cultivation process lasting several weeks. Once the required cell concentrations have been reached (usually after four to six weeks), the cells are then to be applied as a suspension in their final formulation - intravenously (IV) through a drip on the one hand and intramyocardially, i.e. directly into the heart muscle, using the MYOSTAR™NOGA system on the other. The manufacturing process includes numerous sampling points for in-process and end-product control testing of the cultivated cells. Several test batches have already been produced in the project within the context of technology transfer; these batches were used to adapt and optimize the process with an eye to the stringent production requirements under GMP conditions. The suitability of newly introduced GMP-compliant materials and reagents was also reviewed here and the respective specifications were compiled in order to guarantee the consistent quality of these base substances and materials. The "CardAPcells" investigational drug is to become established as routine patient treatment. There is no risk of rejection as the study uses the patient's own heart cells. Fibrosis formation (scar tissue) is also reduced. This gives patients a chance to recover and enjoy a better quality of life.

Plans are in place to validate the process, which is to be conducted in the clean room at the Fraunhofer IZI, at the beginning of 2017. The analytical methods applied as part of the so-called safety parameters to check for mycoplasma, sterility and bacterial endotoxins are also planned to be validated at the same time. An application is to be sent to the responsible state authority, i.e. Landesdirektion Sachsen (Saxony Land authorities), simultaneously for the manufacturing permit pursuant to Section 13 of the German Drug Act (Arzneimittelgesetz, AMG). The first "CardAPcells" product cannot be manufactured for patient treatment until the manufacturing permit pursuant to Section 13 AMG has been received, a favorable opinion has been issued by the competent ethics committee of the state of Berlin and the autoCard study has received official approval from the Paul Ehrlich Institute

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1 *Adherent CardAPcells in culture*

2 *A member of staff examines the cells through the microscope*

DEPARTMENT OF THERAPY VALIDATION

Location Leipzig, Germany

THE DEPARTMENT AT A GLANCE

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The department was founded in January 2016 as a direct replacement of the former Cell Engineering/GLP unit. The main goal of the new department is the concentration of expertise for the preclinical validation of novel therapeutic approaches at IZI, to maximize the efficiency in developing new in vitro or in vivo models and their application in preclinical studies. Since the department manages the GLP test facility of Fraunhofer IZI, all preclinical studies (even those in other IZI departments) can be performed under GLP.

The department covers the following topics:
1) Planning and execution of preclinical efficacy and safety studies for new drug candidates (especially ATMPs) and medical devices (ISO 10993) under GLP or GLP-analogous conditions. This includes the development and validation of suitable in vitro and in vivo models.
2) Developing procedures for the diagnostic analysis of secretory and cellular protein biomarkers, including the development and production of specific monoclonal antibodies for their detection and finally the development and validation of the respective diagnostic assays (e.g. ELISA, Luminex®, flow cytometry).
3) Identifying and validating new protein biomarkers for diagnosis and therapy of chronic-inflammatory and tumor diseases, as well as for the sector of veterinary medicine / farm animal husbandry.
4) Developing human therapeutic monoclonal antibodies for the treatment of tumor and autoimmune diseases, as well as for passive vaccination against bacterial toxins and pathogenic viruses, and their advancement to drug candidates.
5) Small-scale GMP manufacturing of therapeutic monoclonal antibodies for preclinical animal studies or clinical trials (Phase I and II).

- GLP-certified since 2009
- Immunotoxicity / immunogenicity in vitro / in vivo
- Safety tests for ATMPs – biodistribution, tumorigenicity and immunogenicity / immunotoxicity

UNITS

Preclinical Models Unit

The Preclinical Models Unit is concerned with the design and implementation of preclinical efficacy and safety studies for new drug candidates under GLP or GLP-analogous conditions. This includes the development, establishment and validation of in vitro and in vivo models for inflammatory and tumorigenic diseases. The main focus of research is on the development and optimization of humanized mouse models for developing and testing patient-specific therapies.

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Protein Biomarker Unit

The Protein Biomarker Unit focuses on the identification and validation of proteins to be used as diagnostic biomarkers or representing therapeutic targets. Moreover, the unit aims at the development of single and multiplex assays for their detection. Multi-omics strategies (especially LC-MS based proteomics) are applied for identification. ELISA, western blot, and peptide or bead arrays (Luminex) are utilized for validation. High-affinity monoclonal antibodies, which are usually developed in the group, are key tools for these immunochemical assays.

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Antibody Production Unit

"From research to clinical development." - The Antibody Production Unit at Fraunhofer IZI provides the facilities for a GMP-compliant production of monoclonal antibodies on the basis of, for example, CHO cell lines. The production facility provides all clean room classes from D to A and is characterized by its high flexibility, achieved by the use of single-use material. The spectrum of manufacturing activities ranges from process establishment and validation to bulk preparation and aseptic filling for preclinical and early- stage clinical trials (up to Phase II).

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1

PROJECT EXAMPLES

Preclinical safety study for the evaluation of biodistribution and tumorigenicity of a human stem cell therapy for cartilage regeneration in a mouse model

The development of novel therapies, such as the somatic cell therapy or the transplantation of tissues generated from stem cells, requires new preclinical strategies as to the safety of these products. Conventional efficacy and safety studies, e.g. for biopharmaceuticals, are not suitable for these cell-based products (cell-based advanced therapy medicinal products; ATMPs). The application of cell-based ATMPs thus requires clearly defined safety studies under GLP (Good Laboratory Practice) conditions that are in line with regulatory requirements of the national and European authorities. Here, the interest mainly focusses on biodistribution, i.e. distribution of the applied cell-based ATMPs within the tissue, as well as tumorigenicity, i.e. propensity of the applied cells to undergo transformation, and thus have to be appropriately addressed in preclinical studies.

The aim of this project is the realization of preclinical efficacy and safety studies for a cartilage therapy on the basis of mesenchymal stem cells (MSC). For this ATMP, MSC are isolated in an out-patient bone marrow aspiration and further treated for the production of a patient-specific cartilage therapy (MSC-based Matrix-associated Autologous Chondrocyte Transplantation; MSC-MACT). In the preclinical GLP studies, both biodistribution and tumorigenic potential of the human MSC-MACT are tested in immunodeficient mice. Due to the immunodeficiency of the animals, the implanted human cells are tolerated without graft rejection, and the migration and/or transformation of the human cells can be analyzed. For an optimal function of the ATMPs, the MSC should remain at the site of implantation and not migrate into the surrounding tissue. Thus, in the experimental part "biodistribution", it is clarified whether cells migrate from the site of implantation and where they settle in the case of migration. This simultaneously identifies potential sites of tumorigenesis that can arise from the implanted cells. In the subsequent experimental part, tumorigenicity of the MSC from the implanted ATMP is tested.

The non-clinical safety studies for MSC-MACT are an important regulatory building block on the way to a clinical application, which may significantly reduce the risks of a therapy with MSC-MACT for patients with cartilage defects.

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1 *The stem cell therapeutic agent MSC-MACT is transplanted into immunodeficient mice to test its safety as part of a GLP study - this includes the analysis of the tumorigenic potential as well as a possible migration into other tissues.*

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Establishment of a flexible small-scale manufacturing facility for the GMP production of therapeutic human monoclonal antibodies

In recent years, the increasing number of therapeutic monoclonal antibody (mAb) candidates under preclinical and clinical development require new flexible, efficient, and economic opportunities for the GMP production of therapeutic antibody candidates. Small-scale batch production of test samples for late preclinical GLP animal studies or for phase I and phase II clinical studies is often not appropriate for large-scale manufacturing facilities in industry. The Fraunhofer IZI, founded in 2005, investigates and develops solutions for such specific problems at the interfaces of medicine, life sciences and engineering.

In January 2017 the newly constructed GMP antibody production facility of the therapy validation department will be completely qualified. Our facility has a size of 180 m² and involves all clean room classes from D to A. A pilot manufacturing process of the MAX.16H5 IgG4 anti-CD4-antibody using a CHO cell line will be started in spring 2017. The use of single-use equipment and materials enables an easy adaption to new process requirements. The GMP facility can be used for different contract manufacturing processes for preclinical and clinical (Phase I/II) test samples as well as for process or instrument validation projects under the consideration of special customer requests. The standard equipment can be easily extended for new products.

In summary the main advantages are:

- high flexibility
- easy switch to different products
- fast implementation of technology changes
- customized production
- ideal batch size for preclinical and early clinical trials
- possibility to obtain ready-to-use GMP-compliant products with integrated sample

Later projects could include:

- transfer promising biopharmaceutical candidate from research to clinical development
- design a user-specific process with single-use-materials
- the production of e.g. human monoclonal antibodies in 200-L scale for GMP-compliant products

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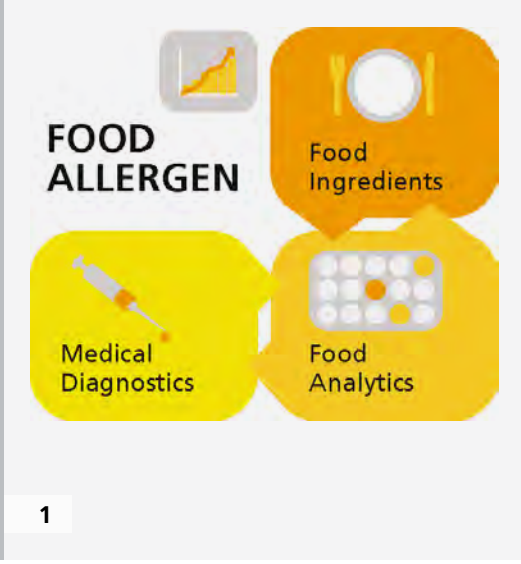
1 *The Sartorius BIOSTAT® STR Plus 200L stirred-tank bioreactor (left) and Flex Act Cell Harvest incl. depth filter (right). These devices constitute the final stage of cell cultivation in the upstream area of the clean room facility.*

2 *At work in the isolator to cultivate a master cell bank. Establishing a master and working cell bank is the prerequisite to the later production of a therapeutic antibody.*



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2

FoodAllergen

Eating habits have been rigorously changed towards a consumer preference of vegan and vegetarian food in the last few decades. So, vegetarians, vegans and so-called flexitarians, who voluntarily stop eating animal source foods temporarily, have risen to a record level. Frequent ingestion of plant protein in pure form and higher amounts, however, might increase allergy risk to a certain degree.

European guidelines strictly regulate the declaration of ingredients in foods. According to EU law on food information to consumers, 14 allergenic commodities must be declared in ingredient lists, among them eight food plants.

Testing allergenic ingredients in food is necessary and in the interest of both public authorities to assure the compliance with regulation as well as manufacturers to protect themselves against accidental entry of allergens into products by cross-contact and hence against expensive product recalls. As a consequence there is an increasing demand for specific assays with high sensitivity.

Currently general labelling lists specify ingredients using intelligible to all terms like soy, lupine or peanuts. However, each of these crops in turn represents a complex mixture of substances, yet only a few of them are responsible for allergic reactions in sensitized people.

Recent research in allergology has mainly identified proteins as being responsible for allergic reactions. Thus, the intention of modern food technology is to modify proteins to destroy their allergenic epitops, which are the critical protein components that react with an allergic person's immune system. Mitigating the allergenic potential of food with consistent or even improved functionality is the major goal. The development of processes targeting allergen-reduced protein production requires appropriate assays for in-process quality control. For this purpose we develop sensitive assays based on monoclonal antibodies for detecting allergenic vegetable ingredients. Together with our partners in the FoodAllergen-project we generate the complete workflow from immunization with appropriate antigen to final test validation.

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1 *Topic areas addressed as part of the joint project FoodAllergen*

2 *Many plant-based foodstuffs such as peanuts (above) and soy (below) can trigger allergies*

DEPARTMENT OF IMMUNOLOGY

Locations Leipzig and Rostock, Germany

THE DEPARTMENT AT A GLANCE

Procedures to stimulate or suppress the immune system are developed in the Department of Immunology. These include vaccines on innovative technology platforms, e.g. novel inactivation methods or plasmid DNA. As such, efficient vaccines can be produced quickly and inexpensively. A further topic is improving the problem-free healing of transplants by the induction of specific tolerance. Furthermore, procedures are being developed to monitor immunoreactivity and to control dysfunctions such as graft-versus-host disease (GvHD). Bacteriostatic peptides and peptide banks for the analysis of immune reactions in food allergies are a further focus. The potential of extracorporeal therapeutic treatments of blood or blood components and of the immune system is investigated by the EXIM project group EXIM in Rostock.

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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, microbiology, 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). Besides this, strategies are being developed to combat ectoparasites. 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 the interaction of biomolecules, in particular the identification of peptides for tumor targeting and antibody characterization. A new peptide phage display method is combined with modern devices and measurement methods. This allows in silico data evaluation for epitope mapping as well as the immunome of patient sera (e. g. allergy research) and the identification of peptide ligands for characterizing 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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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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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 models.

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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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Extracorporeal Immunomodulation Project Group

The project group focuses on the development and evaluation of extracorporeal (outside the body), organsupporting 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, 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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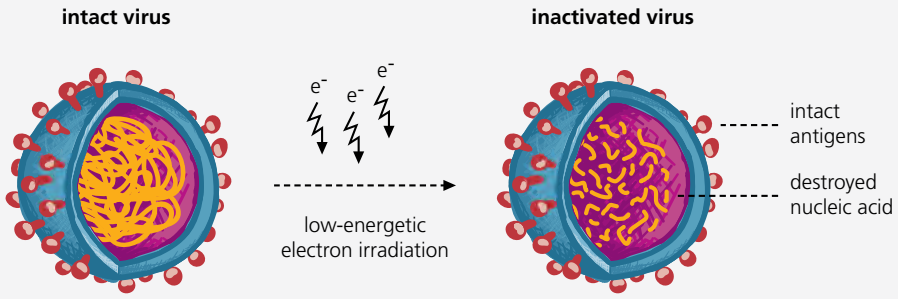

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PROJECT EXAMPLES

New process for manufacturing safe and effective vaccines

Many vaccines against viral or bacterial infections are based on so-called killed vaccines in which the pathogens have been inactivated yet are still identified by the immune system. The immune system, in turn, generates respective antibodies and thus provides effective protection. Until now, pathogens have been inactivated using chemicals, usually formaldehyde. However, like other chemicals used for the same purpose, formaldehyde is toxic. In order to minimize the risks posed to humans and the environment, such substances can only be used in an extremely diluted form. The pathogens therefore have to be exposed to the chemical for a long time before they are destroyed. Formaldehyde, for instance, needs around two weeks to inactivate polioviruses, which trigger infantile paralysis. Furthermore, formaldehyde also attacks the proteins in the viruses against which the immune system forms antibodies. In doing this, it modifies the viruses, making the vaccine less effective.

A new method of manufacturing safe and effective vaccines is currently being developed as part of a joint project involving the Fraunhofer Institutes for Cell Therapy and Immunology IZI, for Interfacial Engineering and Biotechnology IGB, for Organic Electronics, Electron Beam and Plasma Technology FEP and for Manufacturing Engineering and Automation IPA. With this method, pathogens are no longer made inactive using chemicals but through electron irradiation. The process of irradiation destroys the genetic substance required for the viruses or bacteria to reproduce. As opposed to chemical inactivation using formaldehyde, however, structural proteins (antigens) that are essential to immune response remain mostly intact. While attempts have long been made to kill pathogens using irradiation, the experimental effort involved here has so far been immense. By contrast, low-energy electron irradiation is possible in a normal laboratory. The technique is already proven to be error free at the laboratory scale. The pathogens are verifiably eliminated and the vaccine was shown to provide comprehensive protection in initial experiments on the animal model. In the next step, viruses are to be inactivated in large volumes. Two suitable prototypes are being developed that will inactivate pathogens automatically. USD 1.85 million in funding has been awarded by the Bill & Melinda Gates Foundation to help support this step (Grant Agreement Investment ID: OPP1154635).

The new technology is, however, not restricted to vaccines alone. Highly infectious material can also be inactivated using electron irradiation without it being destroyed. This could, for instance, allow blood samples taken from people infected with the Ebola virus to be handled and examined safely in ordinary laboratories.

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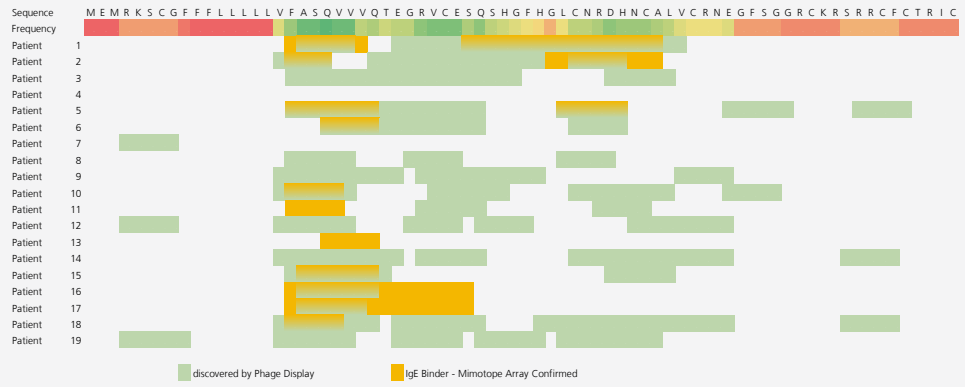
BILL & MELINDA GATES foundation

1 *Viral inactivation by means of low-energy electron irradiation*



1

Mapping patient antibodies in sera

Antibodies recognize parts of antigens, so-called epitopes. These are only small portions or peptides, of a larger protein. For procedures based on antigen recognition, it is extremely important to know these in detail. This applies not only to antibodies used in diagnostics but also to the detection of antibodies against foreign proteins in the patient serum.

For the determination of antibody binding sites in antigenic proteins, where they are known e.g. virus proteins or allergens, these antigen proteins are usually broken down into or synthesized as short peptides. This process is extremely time consuming and associated with high costs, for example when synthesizing hundreds of peptides.

Peptide phage display could be considered a long-established method that allows to reverse this principle. From millions of different bacterial viruses, each with a defined peptide, those which bind to an antibody are sought and fished out. An antibody binding site can at least approximately be recognized from the extracted peptide sequences. However, this approach remains extremely expensive and time consuming in its current form and generally requires hundreds or thousands of viruses (bacteriophages) to be isolated and the binding capacity of its peptide variants to the antibody to be tested.

Large efforts have been spent on the construction of an improved bacteriophage library at the Fraunhofer IZI consisting of more than five billion peptide sequences. This allows the use of specially developed algorithms and high-throughput sequencing (NGS), to find within pool of binding sequences those which give information of the antibody binding site.

In the case of individual antibodies this results in detailed pictures of which amino acids are recognized and/or also accepted. This renders a kind of fingerprint showing the antibody binding site in the format of a photo negative. It also allows to differentiate between specific and unspecific antibodies without complex experiments.

Moreover, it is even possible to identify epitopes from serum, although it comprises a mixture of hundreds of antibodies. In one successful project, over 300 largely unknown epitopes of allergenic soy proteins in patient sera could be identified (see image). Based on this results we received a novel grant to examine the most common and frequent food allergens.

In further projects epitopes could be identified which are recognized by antibodies after viral infections, autoimmune diseases or even vaccinations. Such peptides will enable new methods in diagnostics and vaccine development.

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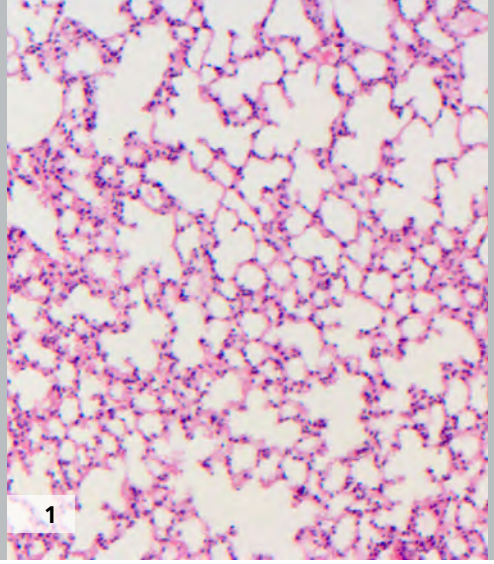
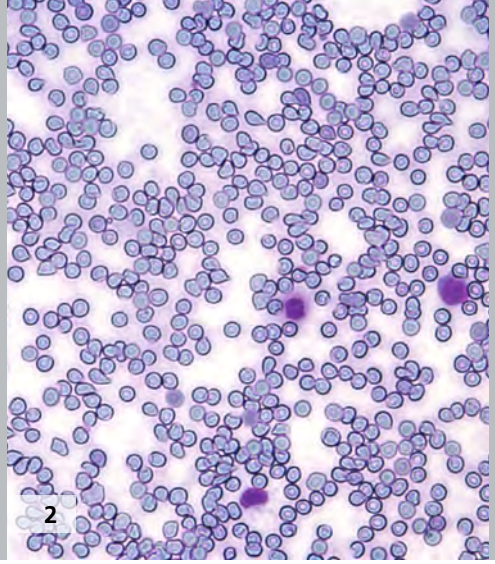
1 *Epitope map: Gly m 2 is a major allergen of the soybean. For the protein sequence in the first row, this epitope map shows based on data from 19 patients which amino acids belong to epitopes according to phage display analysis (green) and which have been meanwhile verified in the individual serum as potentially allergenic IgE epitopes (yellow). Not all Patient sera were mapped and only the most frequent epitopes were tested for IgE binding.*
(Karolin Kern, unpublished)





Prevention of adverse immunological complications while retaining the 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 a GvHD 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. For this purpose Models are being used 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 a hospital environment. Existing leukemia models are being further developed and the anti-human CD4 antibody and other drugs are being evaluated.

Using 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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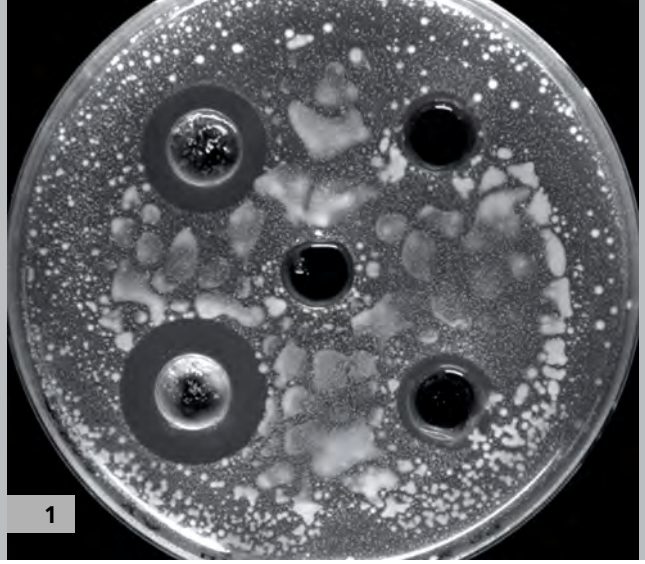
1 *Lung tissue, magnification x10 (HE)*
2 *Blood smear, magnification x100 (Pappenheim)*



1

Evaluation of effective antimicrobial substances taken from plant tissue for the treatment of human pathogenic bacteria and fungal infections in preclinical immunotoxicological models

The incidence of systemic infections caused by human pathogenic and often multiresistant bacteria and fungi has risen considerably over the past two decades among older and immunosuppressed patients and is associated with high morbidity and mortality. Infections are already the main cause of death today, especially among patients with hematological diseases. It is extremely difficult to develop new drugs, especially those with an antimycotic effect, as active substances aimed at countering fungal pathogens are usually toxic to humans.

This project aims to identify new active ingredients in food crops and medicinal plants that demonstrate low human toxicity, substantially reduce the side effect profile, improve efficacy either alone or when combined with previously established active ingredients and, as the case may be, that only take effect in very specific parts of the body. The ingredients to be evaluated should exhibit both antimicrobial and immunomodulatory properties. Potential products include, for instance, phytopharmaceuticals, nutraceutics and biodegradable fungicides for fruit, wine and vegetable cultivation.

Peptide sequences that were able to be ascribed an antimicrobial effect based on their structure were first identified by means of in-silico investigations. Experiments were conducted whereby peptides and other microbicidal active ingredients (alkaloids, triterpenes, etc.) and total dry extracts were isolated from different plant tissues provided by the company Vita34 AG and tested on different human pathogenic germs and human immune cells. At the same time, plant tissues taken from wild collections (leaves, bark) were tested with regard to their antimicrobial effect. Here it became apparent that the potency and spectrum of active ingredients varied hugely between plants cultivated under in vitro conditions and those originating from a soil culture in a greenhouse compared with the wild collection.

As part of the project, several plant compounds with an antimicrobial effect have been identified that also demonstrate wide-ranging areas of efficacy against human-pathogenic germs and extraction algorithms for accumulating hydrophilic and lipophilic micro-biocidal ingredients have been developed and tested.

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

Test and advice center for health apps in Mecklenburg-Western Pomerania

As part of the further expansion of the clinical study center belonging to the EXIM Project Group, new project activities have now also evolved in the field of eHealth. In 2015, the Fraunhofer IZI's Rostock project group submitted a successful application to the ideas competition on the topic of health economy, in which it proposed to set up a central test and advice center for health apps in Mecklenburg-Western Pomerania. Issued through the Ministry for Economic Affairs, Construction and Tourism of Mecklenburg-West Pomerania, the grant highlights the importance of this topic.

Health apps are popular and highly present in our society. Almost every third German has a smartphone and is therefore able to use various apps and self-trackers (e.g. pedometers). Health apps provide information and assistance on everything from specific symptoms, lifestyle assistance, risk assessment, nutritional advice and medicines right through to supporting with sports and fitness activities. More and more people are also turning to these applications with regard to health issues. If they are to have a positive effect, however, health apps need to ensure that their systems are absolutely flawless and they have a well-founded scientific and medical foundation.

It is therefore essential in this rapidly growing market that developers and users are able to receive independent advice and support when it comes to evaluating health apps. On the initiative of the Fraunhofer EXIM Project Group, the state of Mecklenburg-Western Pomerania is supporting the establishment of an independent institution that will advise health app developers, liaise with experts and develop homogeneous quality criteria for health apps, which will then be available in the market. The close involvement of respective players at state and national levels ensures the safe use of health apps far beyond the state borders of Mecklenburg-Western Pomerania. Moreover, a network is already in place which draws on experts from a range of backgrounds: IT specialists, medics, engineers, legal professionals, QA managers, usability experts and many more. The test and advice center for health apps is to be set up in 2017.

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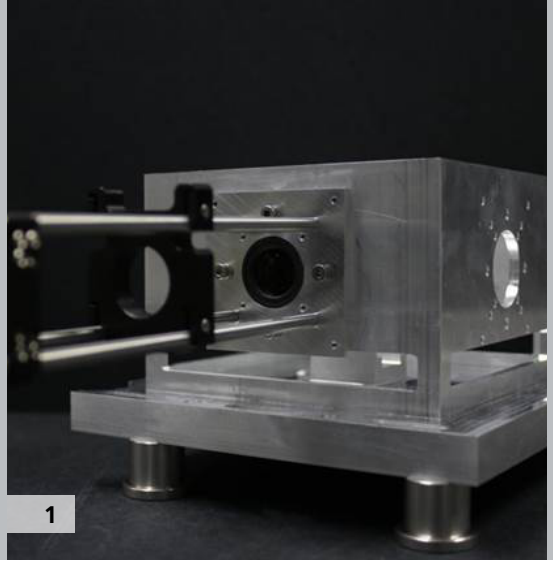
funded by:
Mecklenburg Vorpommern
Ministerium für Wirtschaft, Bau und Tourismus

1 / 2 *Health apps collect data and interact with users in a number of ways*



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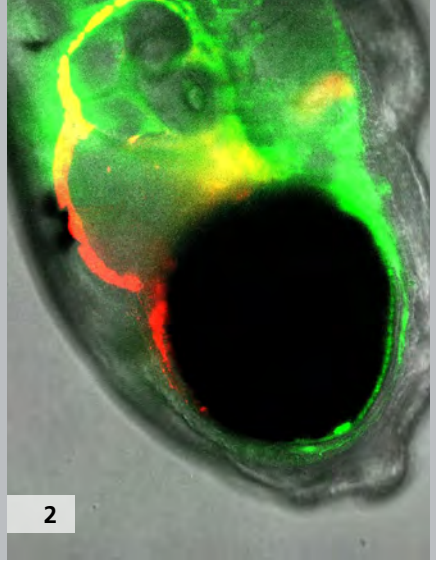

2

Design, Setup and Commissioning of a Light-Sheet Microscopy Platform

A key part of the work carried out by the joint specialist group made up of the Fraunhofer IZI and Leipzig University of Applied Sciences concentrates on building a modular light sheet microscope that is particularly suited to long-term observations of live samples. The project thus seizes on a technology that is currently undergoing active development, advancing it with a view to applications in biomedical research.

So-called Single Plane Illumination Microscopy (SPIM) is a fluorescence microscopic procedure which involves just a thin layer being illuminated in the sample (usually only a couple of micrometers). Compared with other fluorescence microscopy procedures, the light sheet microscope therefore achieves a higher resolution while greatly reducing the background of the image. Furthermore, the biological samples are not burdened or distorted by bleaching or light-induced stress.

The developed microscope is unique within the Fraunhofer-Gesellschaft in its current form. It was designed, constructed and commissioned from scratch by the group as an experimental platform. The light sheet microscope and related services will be available from 2017 not only to in-house units but also to customers and partners.

The 3D fluorescence microscopy platform is especially gentle on samples and therefore well suited, among other things, to observe the growth of organoids or the fine-tissue architecture of organotypic cultures as a long-term process over the course of days or even weeks based on 3D imaging.

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1 *Adapted lens mount featuring a modular sample chamber for the light sheet microscope*
2 *Recorded image of a zebrafish embryo*

DEPARTMENT OF CELL THERAPY

Location Leipzig, Germany

THE DEPARTMENT AT A GLANCE

Cell therapeutic procedures are developed and validated in terms of their safety, feasibility and efficacy in the department. To this end, numerous model systems are maintained which enable the preclinical testing of innovative concepts under the strictest quality criteria. This ensures that the obtained results have a high predictive power with regard to their clinical application. Cell therapeutic procedures in the case of ischemic diseases such as stroke and myocardial infarction form a special focal area, while attention is also given to processes that might prevent cell degeneration and aging. Moreover, the "sleeping" potential of stem cells is also being investigated. The department offers isolation and purification procedures for cells derived from blood and tissue. Furthermore, special treatment procedures are being developed using T cell clones and natural killer cells as well as for tumor treatment.

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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 focuses on two key subject areas. Firstly, new cancer treatment strategies are being tested and developed based on innovative tumor models. Promising results are being seen in the fields of tumor immunology and immune system remodeling compared with the treatment options available at present. Secondly, the unit is developing preventive and therapeutic strategies based on chicken antibodies (IgYs) and their immunomodulatory capabilities.

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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 ischemic stroke. As the possibility of being able to transfer findings from current laboratory rodent models to human patients is sometimes only very limited, a globally unique large-animal model was established for the translational approach. Tests can be carried out using this model under clinically relevant and patient relevant conditions. Both the gyrencephalic brain structure and the size of the brain much more closely resemble the human situation in the sheep model as opposed to in the small animal.

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OpTcell Unit

The OpTcell Unit is primarily focused on cancer immunotherapy. Both patients and science have high hopes for this field in terms of modern cancer therapies. Particularly relevant aspects of cancer immunotherapy are dealt with under three core areas of activity. The aim is to create technological innovations which will potentially increase the efficacy of cancer immunotherapeutics and which may also be used to treat solid tumors.

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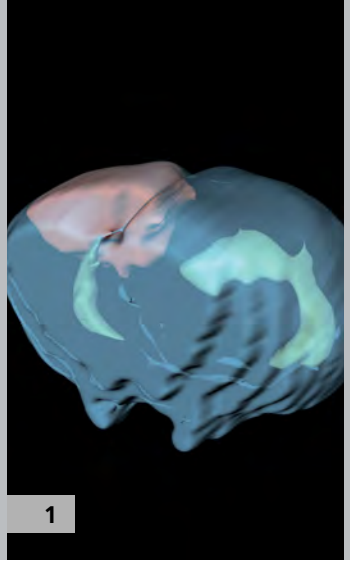

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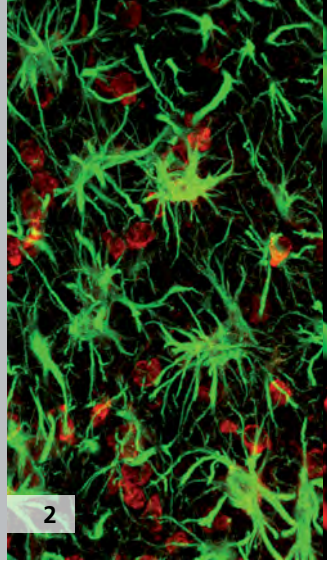

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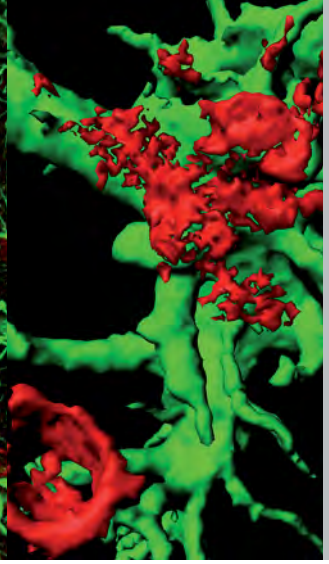

PROJECT EXAMPLES

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 x-ray (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*

LEGASCREEN - Development of an early screening test for dyslexia

Dyslexia is a severe reading and writing disorder affecting about 5% of all German schoolchildren. It is one of the most common developmental disorders in childhood and youth. Dyslexia is unrelated to a child's intelligence. It results in tremendous problems in school, education, and job. One of the main problems hampering successful therapy is the late diagnosis: With current methodology, dyslexia can be reliably diagnosed earliest at the end of the 2nd grade. At this time, a large part of speech development has already passed, and a lot of precious time for early therapy is inevitably lost.

Benefiting from our previous research on the genetics of dyslexia, this project aims to overcome these limitations. The earlier risk for dyslexia is diagnosed, the earlier therapy can be initiated to reduce later problems. The project is a joint project between the Fraunhofer Society and the Max Planck Society. It integrates different research areas: Genetics as well as specific measures of brain activation (EEG).

Heritability of dyslexia is estimated between 50% and 70%. Genetic information basically does not change during the life span. Consequently, specific genetic variants can be measured long before reading and writing is taught. Our project will leverage known genetic risk variants as well as further optimize those genetic markers.

The other important part of the test is based on electroencephalography (EEG). Here, brain activation is analyzed, even without drawing attention to a stimulus. It is known that children at risk for dyslexia, even as infants, have specifically altered brain activation patterns in response to specific language stimuli.

Finally, our project includes magnetic resonance imaging (MRI). MRI assessments will not be part of the final test, however, they are very helpful during assay development. Information about brain structure provided by MRI can hint to connections between genetics and activation patterns seen in the EEG measures.

To summarize, the aim of this project is to develop an early screening test for dyslexia. This test should be applicable long before conventional testing is conducted. We believe, that early testing will improve access to as well as the success of dyslexia therapy.

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1 *EEG examination*
2 *MRI examination*

DEPARTMENT OF DIAGNOSTICS

Location Leipzig, Germany

THE DEPARTMENT AT A GLANCE

Within the Department of Diagnostics, the project RIBOLUTION - funded by the Fraunhofer Future Foundation - offers a comprehensive platform for the systematic identification and validation of novel diagnostic or prognostic biomarkers. Here, a particular focus is placed on the novel field of the so far underestimated noncoding RNAs that represent the majority of RNA molecules in human cells and exhibit high biomarker potential. For molecular diagnostics, a variety of state-of-the-art techniques are established, including genome-wide transcriptome, genome, and epigenome analyses (e.g. by next-generation sequencing or microarrays) as well as innovative immunoassays. Furthermore, a strong bioinformatics competency and a proprietary data management system are offered.

A wide variety of cell culture and animal models serve to study novel therapeutic approaches. In this context, the fields of tumor stem cells shows a high perspective for developing and testing novel cancer therapies in vitro or in preclinical models. Animal models for rheumatoid arthritis, asthma, and other chronic -inflammatory diseases allow studying the innovative therapy options. All in vitro and in vivo models are adaptable to the individual applications. In addition, xenogenous transplantation models are used to close the gap between model and patient.

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The department develops novel molecular -diagnostic assay systems, e.g. on the basis of lab-on-the-chip platforms or strip-based rapid assays. In a market-oriented manner, these systems address companies that intend to simplify and integrate their (bio-)analytical competencies. Furthermore, we offer know-how for the development and approval of point-of-care laboratory diagnostic systems, which allow an autonomously operating health system.

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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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 (nextgeneration 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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Next-Generation Diagnostics Unit

This unit develops and establishes analysis strategies for discovering novel biomarkers to diagnose and anticipate diseases. The focus here is placed on the detection and characterization of RNAs, especially of non-protein-coding RNAs (ncRNAs), which possess a great deal of potential in terms of their use as biomarkers. The latest nucleic acid analysis techniques are employed here based on next-generation sequencing and microarrays. These procedures are being optimized to analyze various base materials (cryo tissue, FFPE tissue, urine, blood).

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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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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 biochips, 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.

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Nanotechnology Unit

This unit develops molecular diagnostic test systems for the food and medicine/clinical practice sectors. A major focus is rapid tools to detect infectious agents or diseases-specific biomarkers including methods for bioanalytical sample preparation. Work is being done with customers to create novel reagent-free cell lysis methods and lab-on-a-chip diagnostics platforms, e. g. to detect sexually transmitted pathogens in a home-testing format. The field of immunomic and oncological exosome analytics form a further focus. The unit has access to hot embossing methods.

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Bioinformatics Unit

The Bioinformatics Unit develops and establishes computer aided ways of identifying and verifying new biomarkers for the personalized diagnosis and prognosis of diseases and for the detection of novel therapeutic targets. The fact that a vast number of RNA molecules are not translated into proteins has only been known for a few years. The latest scientific findings show that these non-coding RNAs (ncRNAs) perform fineregulatory tasks in gene regulation and are therefore suitable as markers for individual disease patterns and progression. The unit develops strategies for efficient processing and (statistical) analyzing molecular biological data gained from extensive clinical cohorts based on next-generation sequencing, microarrays, and DNA, RNA, and epigenetic analytics in order to detect disease-relevant ncRNAs. The gene regulatory mechanisms of ncRNAs are modeled using methods from systems biology and RNA bioinformatics. The objective of the unit is to analyze the potential of these innovative RNA molecules as biomarkers or therapeutic targets and to establish them as appropriate clinical markers or targets.

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Study and Quality Management Unit

The Study and Quality Management Unit develops and implements processes for establishing a quality management system according to DIN EN ISO 13485. The unit's activities here focus in particular on quality assurance in the design and development of in vitro diagnostics (IVDs). A specifically designed and in-house developed data management system supports quality-compliant documentation and sample management. It captures a sample's underlying clinical data and enables every lab processing stage to be recorded in detail. The unit helps plan screening and validation studies, which are then carried out in close consultation with clinical Key Opinion Leaders (KOLs).

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CardiOmics Unit

The unit carries out research into infectious diseases relevant to cardiac surgery using state-of-the-art OMICS technology platforms. Infective endocarditis and the development of molecular biological diagnostic procedures are of particular scientific interest here, as is the translation of such procedures into routine clinical practice. Based on improved diagnostics, alternative treatment methods are evaluated and new interventional procedures taken to clinical maturity.

The unit will concentrate on the connection between infectious diseases and molecular regulatory mechanisms associated with haemostasis. In the interdisciplinary field of intervention strategies relating to cardiac surgery, the diagnosis and therapeutic intervention of the coagulation system play a vital role. The unit primarily develops diagnostic procedures to determine the effect of factor X inhibitors and /or coagulation diagnostics during the final stages of plasma coagulation.

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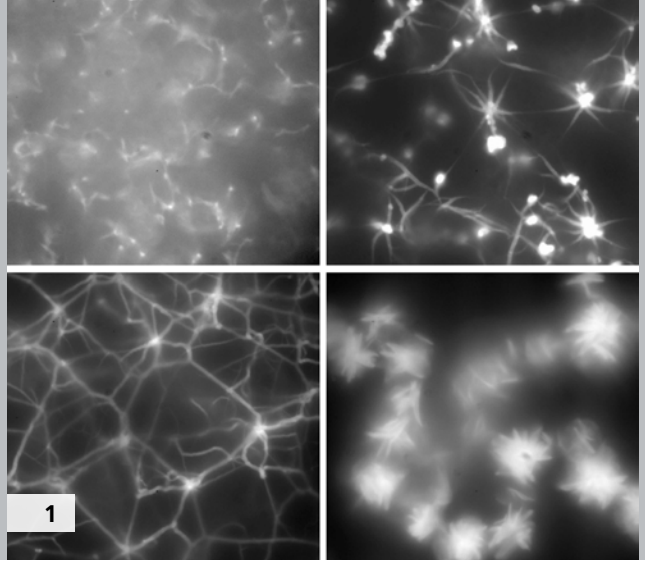

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PROJECT EXAMPLES

Programming biomaterial mechanics with DNA

Beyond its standard role as the carrier of genetic information in living organisms, DNA has also emerged has highly versatile construction material for fabricating nanometer-sized particles and machines. By carefully designing the sequences of DNA strand collections, complementary base pairing can be used to fully control the size, shape and mechanical properties of single, DNA-based nanoparticles or larger DNA-based materials.

An example includes materials formed from DNA nanotubes. A small collection of DNA strands is designed to self-assemble into micrometer-length filaments. Their nanometer-sized diameters can be precisely controlled in order to "program" their nanoscale mechanical properties. These can act as synthetic mimics of biologically derived structures such as actin or collagen filaments. However, the programmable nature of DNA strands provides the ability to selectively control parameters such as the stiffness of the individual nanotubes, which is not possible with biologically derived materials such as actin or collagen.

By forming the DNA nanotubes in a crowded molecular environment, similar to what is found inside cells, they can be made to spontaneously assemble large microstructures that are dependent upon their stiffness and volume fraction (Figure 1). These star-like or bundled structures resemble cellular structures such as stress fibers, filopodia or the mitotic spindle, and are tools to provide insight into the basic mechanism behind their formation in biological systems.

Additionally, DNA nanotubes at lower volume fractions form entangled, elastic hydrogels. Here, the elastic plateau shear modulus (G') can be adjusted over a wide range by changing either the network density or the stiffness of the individual DNA nanotubes. This enables a fine-tuning of the hydrogel stiffness while being able to independently maintain factors such as porosity. This ability to control macroscale properties through programmable nanoscale building blocks can be applied more broadly to develop functional materials for cell-based applications such as 3D cell culture or nutrient repositories in long-term bioreactors.

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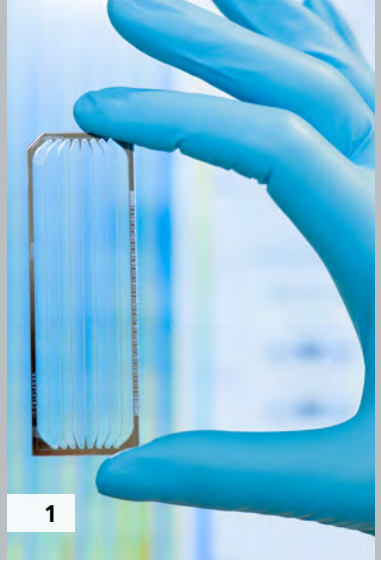
1 *Examples of bundled, star-like, connected and compact microparticle structures formed from DNA tubes. (from New J. Phys. 18 (5), 055001)*



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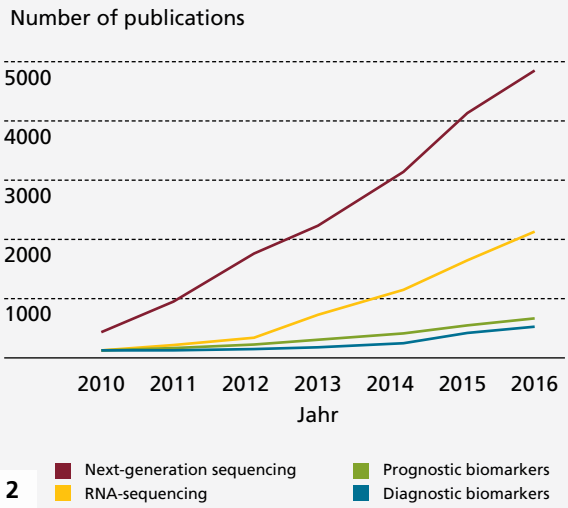

2

Development of an NGS-based prognostic test for prostate cancer

Prostate cancer is one of the most common forms of cancer and the third-highest cause of cancer-related death among men in Germany. Although a large proportion of prostate cancer cases has a positive prognosis and does not require further treatment, some tumors are highly aggressive. The course of the disease cannot be reliably predicted at present - a fact which can lead to unsuitable treatment decisions. This usually results in overtreatment and, in turn, health risks for the patient and unnecessary costs for the health care system.

As part of the RIBOLUTION project, an R&D consortium funded by the Fraunhofer Future Foundation, a molecular diagnostic test is being developed to address this problem with the goal of facilitating more targeted therapy in future. The identification of novel, promising biomarkers by means of transcriptome-wide analyses (microarray studies, next-generation sequencing) formed the basis of the project. This included both the coding and non-coding parts of the transcriptome. As a result, RNAs were able to be identified - some of which were previously unknown - that are highly promising in terms of their use as biomarkers.

High-quality cryo tissue taken from the prostate formed the starting point for biomarker screening. The technical challenge here lay in transferring the identified biomarkers into verifiable evidence in formalin-fixed biopsy material, the test material used in clinical practice. The formalin treatment is associated with extremely high RNA fragmentation and therefore requires various optimization steps to be able to carry out RNA isolation and sequencing in a way that is reproducible and that conforms to quality management conditions. These technical adjustments provide the basis for specifying the markers in further clinical cohorts. Resulting from these studies is a biomarker signature that will be validated in multicentre trials and is to be introduced onto the market as a prognostic test.

The procedure, which was developed at the RIBOLUTION Biomarker Center and looked at prostate cancer by way of example, addresses the rising demand for innovative biomarkers which will permit personalized health care in the future. The effective biomarker screening process and subsequent test development can be transfered to other indications. Moreover, the applied analyses are grounded in a rapidly growing field, as NGS and RNA sequencing in particular are shifting more and more into the focus of scientific studies (see Figure 2).

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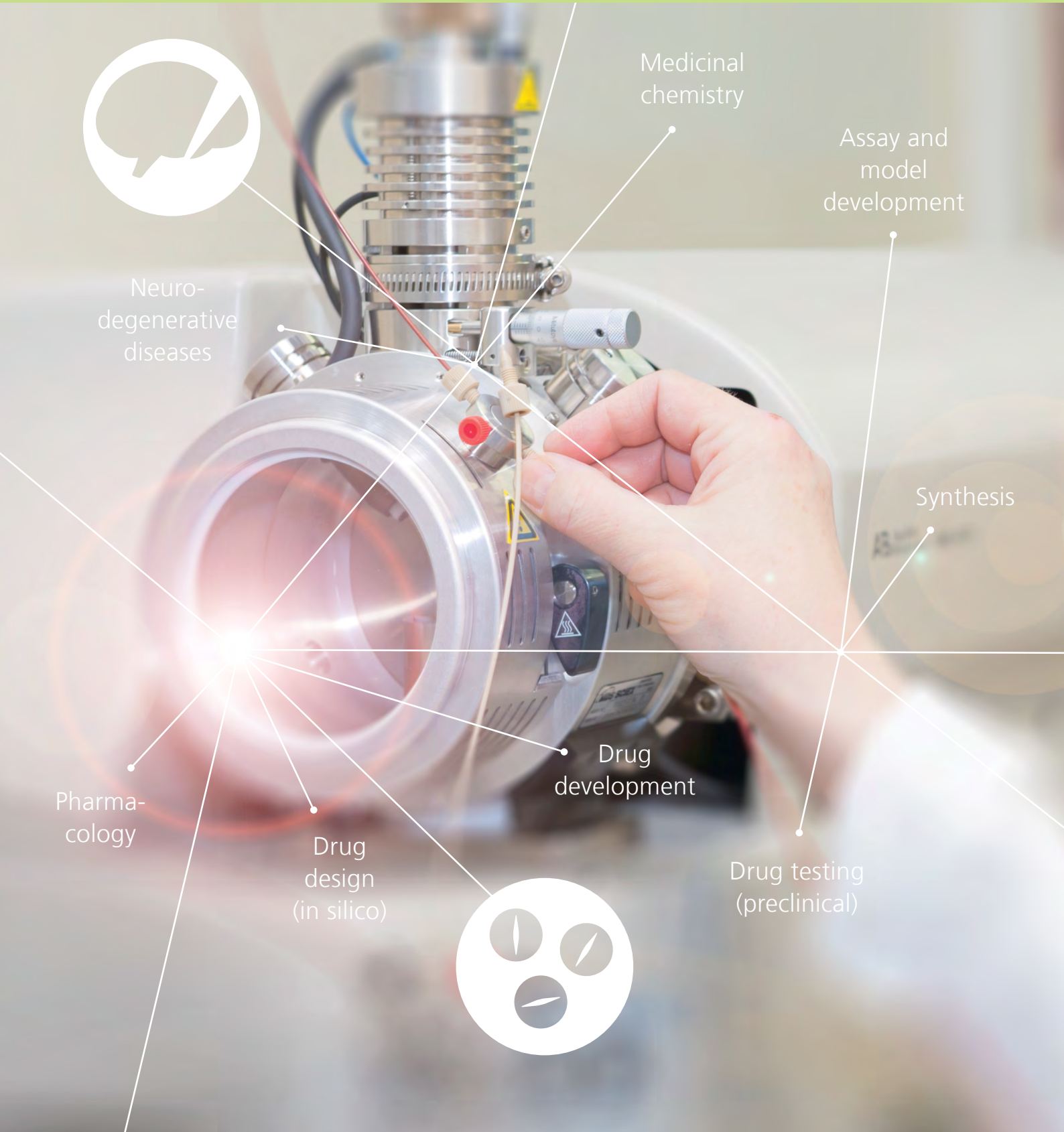
1 *Flow cell for use with the Illumina HiSeq 2500 platform*

2 *Number of publications recorded in the PubMed database over the past six years on the topics of next-generation sequencing and biomarkers*

DEPARTMENT OF DRUG DESIGN AND TARGET VALIDATION

Location Halle (Saale), Germany



THE DEPARTMENT AT A GLANCE

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.

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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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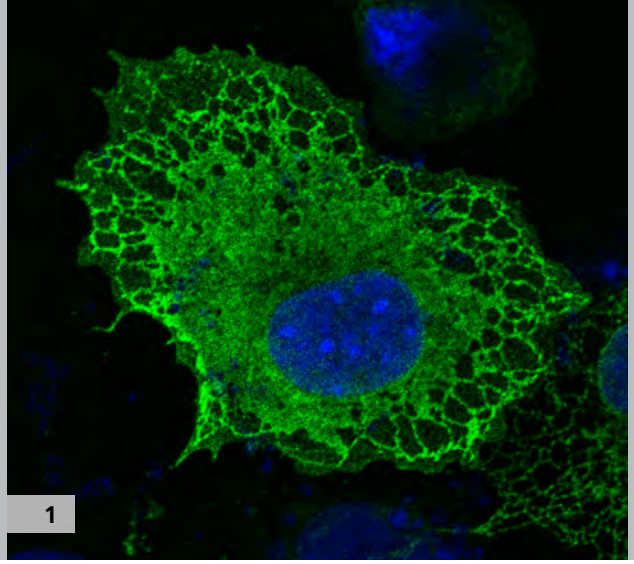

1

PROJECT EXAMPLES

Envelope proteins of endogenous retroviruses as novel targets for drug development

Endogenous retroviral elements (ERVs) are relicts of past germ cell infection by exogenous retroviruses. These sequences make up approx. 8 % of the human genome, which is an impressive figure compared to protein coding sequences, which only account for approx. 1 % of the human genome. Although these sequences are inactivated by mutations, deletions or silenced by epigenetic mechanisms, a number or open reading frames (ORFs) remain intact. Through activation by endogenous or exogenous factors, these ORFs might lead to the formation of retroviral proteins. Especially in the context of autoimmune disorders and cancer, these pathologically formed proteins are interesting targets for drug development since they have been shown to be upregulated in such disease conditions.

For a better understanding of the contribution of endogenous retroviral sequences to the initiation of human disorders, we are investigating the formation of retroviral envelope proteins in mammalian cells and their effect on cellular physiology. In this regard, a long-term collaboration with the Department of Neurology and the Department of Pediatrics and Adolescent Medicine at the university hospital of the Martin-Luther-University Halle-Wittenberg is key for realizing the project. Among a number of biological properties of the envelope proteins, their immunological function is analyzed and therapeutic antibody molecules are generated. As a basis for these experiments, the proteins are generated by recombinant expression in different prokaryotic and eukaryotic host systems.
The involvement of endogenous retroviral envelope proteins in the initiation of a number of human disorders is a developing topic. It might be a missing link for, e.g. autoimmune disorders such as Multiple Sclerosis, type I Diabetes mellitus, Lupus erythematodes or Rheumatoid Arthritis. In this regard, a competitor is already testing a therapeutic antibody directed against the envelope protein of calls HERV-W for the treatment of Multiple Sclerosis. Own antibody developments should open novel therapy options for the above mentioned indications and beyond.

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1 *Expression of an endogenous retroviral envelope protein in the COS-7 mammalian cell line. Green: envelope protein; blue: cell nuclei*

Interaction of amyloid peptides in the case of neurodegenerative diseases: JPND CrossSeeds

A characteristic feature of neurodegenerative diseases is the misfolding and deposit of proteins and/or protein fragments in the patient's brain. This leads to progressive tissue damage and the destruction of nerve cells as well as the emergence of cognitive limitations and dementia. There are no therapy options for these diseases at present. Although the misfolded proteins differ greatly with regard to Alzheimer's disease (Aβ and tau) and Parkinson's disease (alpha-synuclein), the mechanisms behind the tissue damage are presumed to be based on similar principles. Furthermore, the protein aggregates often emerge together in a patient. It is precisely these mixed forms, however, that are relevant to drug discovery as the failure of many new therapeutic approaches in clinical practice may well be due to multiple pathophysiological processes.

The CrossSeeds project is therefore dedicated to exploring the question of whether the different peptides interact with each other during aggregation, i.e. whether the deposit of one of the peptides incites the others to follow suit. This question is being investigated in a JPND consortium also made up of scientists from research institutes based in Oslo, Paris, Leipzig and Erlangen. Besides coordinating the project, the Fraunhofer IZI in Halle (Saale) has also been handed the task of examining the co-aggregation of the amyloid peptides Aβ (typical of Alzheimer's disease), alpha-synuclein (Parkinson's disease) and huntingtin (Huntington's disease) in vitro.

By drawing on electron microscopy and Immunogold labeling, evidence will be collected to show that these peptides form aggregates together and also isolate these aggregates. Together with partners, we plan to investigate the toxicity of the mixed aggregates on cultivated nerve cells. The peptides, or even these aggregates, will then be used at a later stage in order to facilitate new treatment strategies, e.g. the development of therapeutic antibodies.

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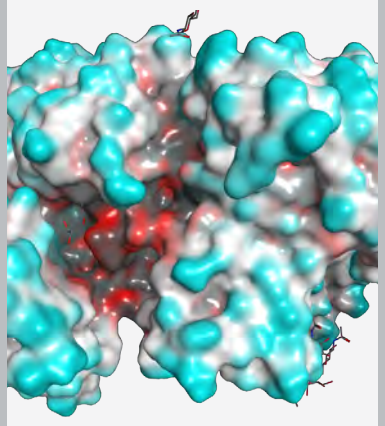
project-website:
www.crossseeds.eu



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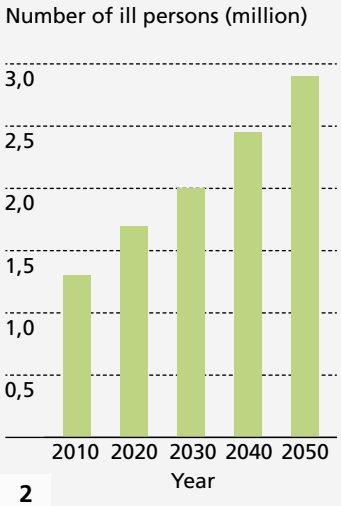

2

Development of small molecules as innovative medicines to combat Alzheimer's disease

In today's ageing society, dementia, especially Alzheimer's disease, plays an ever more significant role in health care policy: It is estimated that every third person over the age of 85 suffers from dementia. This constantly increasing number of patients, however, does not have access to adequate treatment options. To date, it has not been possible to delay disease progress.

The disease is triggered by the accumulation of different proteins in the brain which damage the tissue and lead to the nerve cells dying off. It is evident that one of these protein molecules, the amyloid beta peptide (Aβ), initiates this cascade of changes. In recent years it has been successfully demonstrated that various other proteins (enzymes) are responsible for the formation of Aβ. It has also become apparent that particularly toxic forms of Aβ exhibit changes at their N-terminal end. These types of Aβ and, in particular, their formation, are the basis of the project presented here.

The aim is to develop pharmaceutical substances that inhibit the so-called alternative beta-secretase meprin and thus prevent the toxic protein molecules from being produced. The project will be conducted across all units as it contains many partial aspects that can only be effected using special technologies.

The Protein and Drug Biochemistry Unit has successfully redeveloped a test system that can detect enzyme activity quickly and precisely, allowing potential new drugs to be characterized for the first time. Drug design, synthesis and analytics are being handled by the Drug Design and Analytical Chemistry Unit. In the reporting year, targeted design allowed molecules to be synthesized which specifically inhibit the alternative beta-secretase with an extremely high level of activity. These innovative molecules now have to demonstrate whether they are ready for the next stages of development. The aim of the project is to characterize molecules to such an extent that a "proof of principle", i. e. efficacy in the animal disease model, can be shown. Subsequent development will then take place in close collaboration with pharmaceutical companies. Alzheimer's disease is, however, just one target area: The drugs may also bear significance on the treatment of nephropathy.

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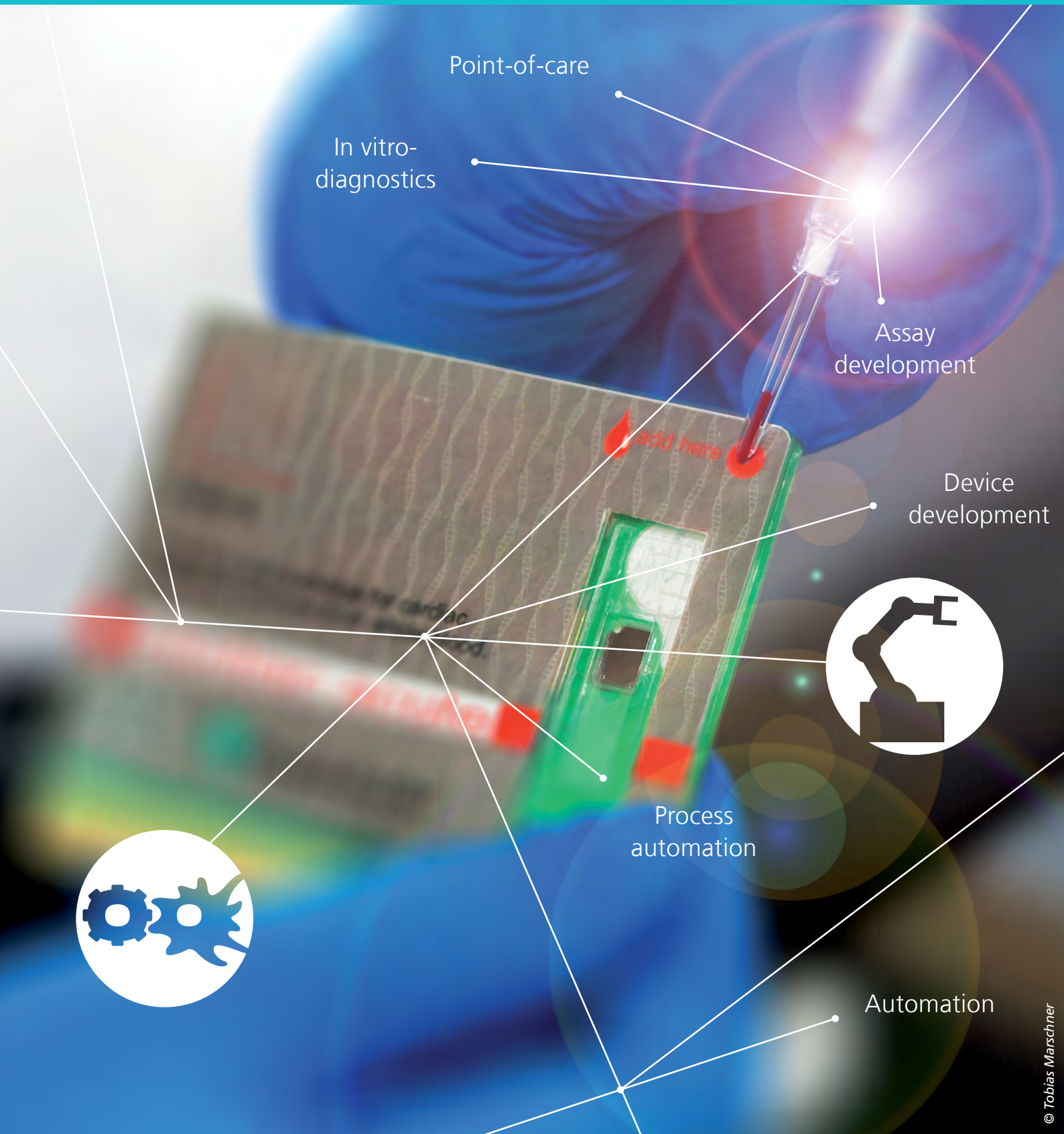
1 *View of the catalytic center of the alternative beta-secretase meprin beta*

2 *Predicted development of Alzheimer's disease in Germany up to the year 2050 (source: German Alzheimer Association)*

DEPARTMENT OF BIOSYSTEM INTEGRATION AND PROCESS AUTOMATION

Location Potsdam-Golm, Germany



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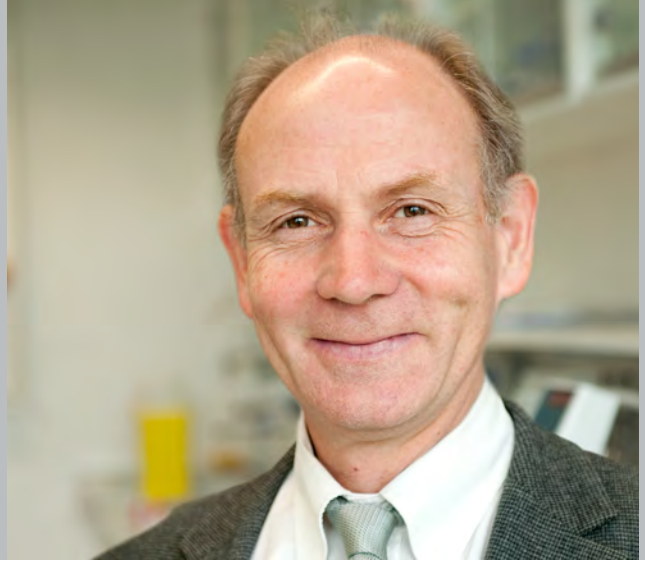

THE DEPARTMENT AT A GLANCE

The department delivers solutions for complex laboratory automation tasks in biotechnology. Work here focuses on processes related to cell culture, expansion and monitoring and aims at increasing the efficiency, quantity and quality of cell products.

A further focal area is found in developing procedures and devices for a broad range of point-of-care applications. Among other things, an in vitro diagnostics (ivD) platform is available for this purpose, which can be adapted to different diagnostic tests depending on the task at hand. Furthermore, procedures and devices are also available for analyzing and using molecular interfaces and higher-order electronic effects.

Special importance is also assigned to developing procedures to gently dehydrate and fix dry reagents, which are used in all kinds of ways in diagnostics and analytics.

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UNITS

ivD Platform Unit

The unit develops procedures and devices for various point-of-care applications. Based on miniaturized lab automation using microfluidics and biosensors, application-related, on-site solutions are developed for use in medical and non-medical fields. Among other things, 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 customers 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 with an affordable electrochemical readout system for point-of-care, food and environmental analytics. "Smart" dry reagents tailored to the customer offer not only a high level of storage stability, but also added functionalities such as adhesion, transparency, slow-release kinetics or desiccation protection. Biomimetic electrochemical sensors, functionalized with artificial binding molecules (MIPs, "plastic antibodies"), offer new analytical options if antibodies are not available or desired.

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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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1

2

PROJECT EXAMPLE

Peptide-based subtyping of Influenza virus (FluType)

Virus-borne diseases are a worldwide challenge for healthcare systems. Avian flu, SARS, Ebola, dengue fever and, most recently, the Zika virus are examples from the recent past, showing the quick spread of virus-borne epidemics in the globalized world. The influenza virus has been the cause for annual flu epidemics for many centuries and can lead to grave pandemic waves like the so- called "Spanish flu" from 1918 with between 20 and 100 million casualties. The only efficient and cost-effective protection from flu is vaccination. The circulating virus strains must be exactly analyzed for an effective vaccination recommendation by the WHO (subtyped).

In Germany this task is performed by the Robert-Koch-Institute in Berlin. Current best practice of virus analysis from patient samples comprises tedious animal experiments: Blood serum obtained from ferrets, that have been previously infected with human flu, is used as the test reagent. Based on specific recognition elements (peptides), a new system for influenza subtyping has been developed at Fraunhofer IZI-BB and the University of Potsdam. Instead of serum from ferrets, synthetic protein fragments, so-called peptides, are used as test reagents. When several different peptides are applied, a characteristic binding pattern is obtained with different flu strains, allowing the identification of the strain in question.

In the framework of the "FluType" project we seek to validate the new, patented method for its application in routine diagnostics. The ultimate goal is the safe discrimination of the relevant virus strains by an automated molecular test method without the need for animal experiments.

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1 *The influenza virus has been the cause of annual flu epidemics for centuries*

2 *Influenza A virus of sub-type H3N2 A/Aichi/2/68 (X31) (c/o Thorsten Wolff, RKI Berlin) bind to a peptide-decorated polymer surface (image taken using scanning electron microscope c/o Xenia Knigge, Fraunhofer IZI, Potsdam / Golm)*

DEPARTMENT OF MOLECULAR AND CELLULAR BIOANALYTICS

Location Potsdam-Golm, Germany

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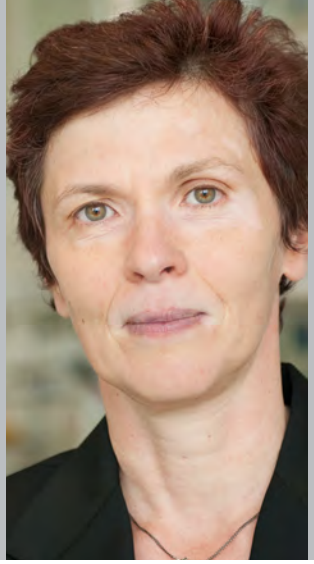

THE DEPARTMENT AT A GLANCE

This department is responsible for developing systems to detect, analyze and process demanding biological samples. These systems address problem areas in the fields of biomedicine, diagnostics, biotechnology, process control as well as environmental analytics, food safety and animal husbandry. The spectrum of solutions ranges from stand-alone sensor and fluidic components to integrated analysis systems and comprehensive database tools. The development of point-of-care tests, e.g. for drugs and serum screenings, forms as much a part of the unit's scope of duties as establishing assays for the validation of biomarkers. Lab-on-a-Chip systems for cultivating, processing and analyzing cell samples present a further focus. They can be depended upon for carrying out long-term cultivation and toxicity tests on suitable cell clusters and for positioning solitary cells to the micrometer or for sorting heterogeneous cell populations. All of the department's tasks are based on its profound expertise in sensor technology, spotting and dispensing technologies, surface coatings, microfluidics and the integration of functional units into all-in-one solutions. Solid molecular and cell biology expertise enable the targeted use of these technological capacities. Work can be carried out efficiently using the state-of-the-art instruments and facilities available in the department's well-equipped laboratories.

By integrating biobanks into so-called metabiobanks, the department also facilitates and supports the web-based case-by-case and sample-by-sample search for human biospecimens and associated data across institutional and national borders.

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UNITS

Microarray and Biosensor Technology

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 as well as 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

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 most suitable technique 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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Metabiobanks Unit

The unit develops ICT infrastructure for and solutions around 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 meta-biobanks, 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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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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Microsystems for In Vitro Cell Models

This unit offers the application-related and customer-specific development of procedures and prototypes for cultivating, characterizing and processing demanding cell samples. Our expertise in microreactors, microfluidics, sensor technology and functional polymer coatings forms the basis for innovative solutions, which are complemented by our knowledge in the fields of cell biology, toxicology and bioanalytics. The unit's interdisciplinary orientation enables us to provide well-founded, targeted advice and to efficiently cater to your specific needs. Our work focuses on (i) developing in vitro test procedures for the assessment of the toxicity of drugs and chemicals based on highly functional microbioreactors and relevant cell models, as well as (ii) establishing intelligent polymer coatings which allow the behavior of adherent cells to be controlled on technical surfaces.

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Microfluidic Cell Processing and Cell Analytics

This unit offers the application-related and customer-specific development of procedures and prototypes to process and manipulate demanding biological samples. It focuses in part on manipulating individual objects, e.g. the gentle and versatile handling of single cells and particularly small cell samples in microfluidic chips. This usually involves the use of electric fields in the radio frequency range. For more complicated tasks, this is combined with complementary manipulation procedures involving optical tweezers or microfluidic processes. In addition, the unit deals with the integration of sensor technology in microfluidic components to record key parameters relating to cells and other complex biological samples.

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PROJECT EXAMPLES

Development of a multiparametric rapid test for germ load and/or resistance monitoring

The emergence of bacterial strains that are resistant to almost all known antibiotics is putting patients and consumers at an ever growing risk in the 21st century. This increased threat caused by bacterial pathogens requires innovative solutions that allow a quick and easy analysis to be carried out and the relevant countermeasures to be initiated in good time as necessary. To this end, the physical and chemical antibacterial procedures currently in use have to be supplemented and supported by a robust, rapid detection procedure. A preventive, non-toxic, sensory element coupled with a reduction in germ load and/or antibiotic treatment would significantly raise the efficiency of countermeasures and treatments universally, flexibly and as required.

The aim of the project is to develop a multiparametric rapid test for germ load and/or resistance monitoring. There are a number of different fields of application relevant not only to preventive and general health care but also animal husbandry and exploitation and even the food sector. The procedure described here therefore has an integrative effect, bringing together all fields and topics relevant to health care from across all kinds of departments. The subsequent findings allow new strategies to be developed in the area of bacterial infections that will increase the effectiveness of preventive health care besides promoting fit and healthy living.

The test will potentially be used in hospitals (e.g. in the reception area), in public areas (e.g. in airports) and in the tourism industry (e.g. cruise ships), as well as among livestock populations and at various stages of the manufacturing process. The aim is to create an expanded, faster and more efficient way of detecting the presence of relevant pathogens and resistance genes. Moreover, the test can be used as a second, independent verification method alongside existing procedures.

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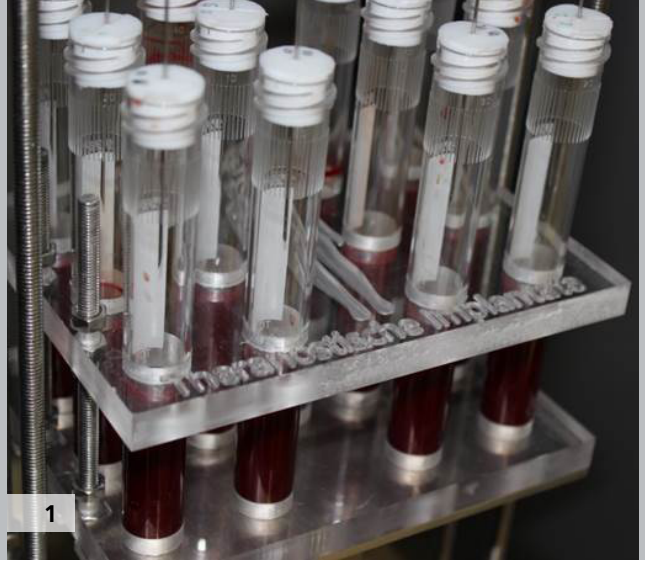
1/2/3 *Possible areas of application for a multiple rapid test for germ load monitoring (hospitals, airports, tourism)*



1

Innovative test stations for dynamic hemocompatibility testing

In the course of the development of biocompatible implant surfaces, cell-culture-based testing systems present an important diagnostic tool when it comes to assessing how new materials interact with living tissue in a way that involves little effort and reproducible test conditions. In the case of cardiovascular implants, flow-dependent reactions, e.g. of the coagulation system in blood, pose particular challenges to these test systems as parameters such as specimen geometry, flow rates and flow conditions have to be taken into consideration. The use of dynamic procedures to determine hemocompatibility (i.e. under real flow conditions) continues to present a problem within medical technology that is yet to be adequately solved. Test systems available until now (especially "Chandler Loop") are not able to sufficiently depict physiological flow conditions in the blood vessel and often fail to form controlled flow profiles.

As part of the main project "Theranostic Implants", funded by the Fraunhofer-Gesellschaft with just short of nine million euros, innovative in vitro test systems are being developed at the Fraunhofer IZI in Potsdam / Golm that can be used to assess the hemocompatibility of cardiovascular implants and their coatings under controlled shear and flow conditions. The problem-solving approaches developed so far in the project, which are based on sample chambers that are filled with blood and move around a fixed test object , are already making for an innovative test system which can be used to carry out dynamic hemocompatibility testing under highly controlled flow conditions for the first time, with flow rates of up to 400mm/s. The flexibility of the sample chamber size here facilitates the dynamic hemocompatibility determination of even the smallest cardiovascular medical devices and implants. This is no easy feat using the technology available at present. In order to asses the hemocompatibility of the test objects, both their hemolytic activity and, in future, the activation conditions of the coagulation cascade, complement pathway and thrombocytes are to be recorded based on immunobiochemical processes.

Besides integrating the different immunobiochemical processes, the ongoing projects also aim to fine-tune test system performance in line with the specific requests of implant manufacturers, thus optimizing the system for later use in industrial laboratories.

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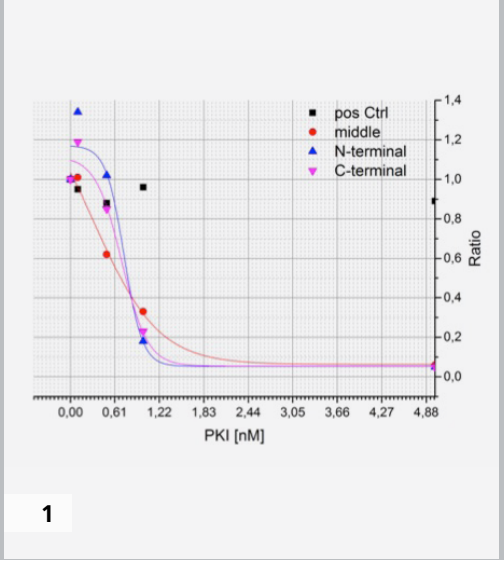
1 *Test station for dynamic hemocompatibility testing on human blood. Twelve sample chambers of adjustable dimensions allow even the smallest cardiovascular implants to be measured in parallel.*



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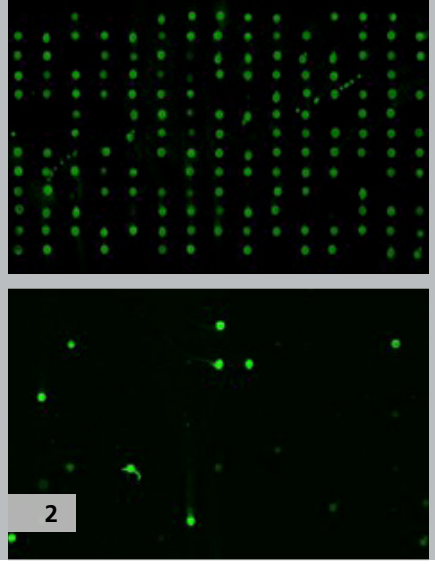

2

Tools for the analysis of posttranslational modifications (phosphorylations) of proteins / peptides

In this project, technologies were developed to investigate signal transduction mechanisms in cells and were tested on specific issues in a systems biology context. The focus here was on analyzing posttranslational modifications (phosphorylations). These technologies should be capable of screening both for potential target molecules (proteins and peptides) and for chemical compounds in order to identify special inhibitors associated with the involved enzymes.

Kinases and their targets were selected as model systems which had been involved in the sensitization of pain, while data from in vivo experiments was used in which signaling pathways were molded. Taking an experimental approach, peptide microarrays and a beads-based system were also used and various specific fluorescence-based detection systems were established. Quality assurance measures were put in place for all reagents which, for example, allow a quick and easy analysis of the enzymatic activity of kinases or test the specificity of the antibodies. By standardizing the individual, experimental steps, the same source reagents are able to be used with both technologies. Besides reducing costs, this leads to a high level of comparability between the two technologies. The combination of peptide microarrays and a beads-based system enables several thousand peptides (peptide microarrays) to be screened in parallel besides facilitating a more detailed analysis of selected peptides (beads-based system). There are currently two ways in which phosphorylations can be analyzed using the established technologies; these methods can also be applied to analyze other posttranslational modifications. The newly developed approach could be applied, for instance, to examine kinases whose target sequence already comprises phosphorylation.

The technologies are suitable for analyzing posttranslational modifications, for characterizing enzymes and compounds that lead to the activation / inhibition of these enzymes, for determining the specificity of antibodies and other binders and for serum screening in order to identify and validate potential biomarkers.

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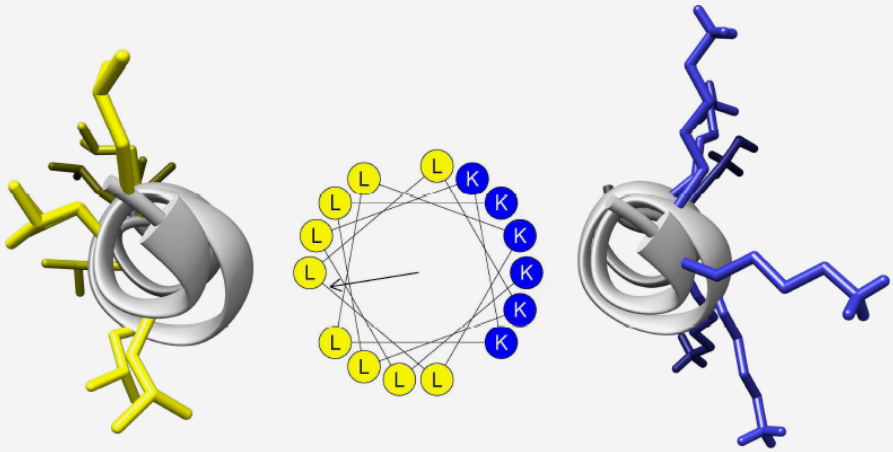
1 *Peptide microarray with 189 different peptides. A) Controlling peptide immobilization B) Following incubation with PKA and detection with a phosphospecific antibody*

2 *Beads assay. Red circle: the kinetics of phosphorylation of a known peptide through the PKA. Black square: phosphorylated control peptide.*



1

Pepetide-based antimicrobial surfaces in dairy production

One of the most important procedures to decrease germ burden at dairy plants is an antimicrobial intervention at the significant surfaces such as dairy equipment, resting areas or skin of dugs.

Currently there is either no reduction of burden or in the case of equipment there is an extensive disinfection by germicides which is finally unsatisfactory, regarding the relevant pathogens.

For an effective reduction it is necessary to identify the germs followed by a targeted and lasting disinfection by appropriate agents. Therefore the consortium of RemuNa seeks two procedures for the identification of bacterial biofilms by using sensor-driven pen-side monitoring and MALDI-TOF for a specific on-site analysis or in the lab. There is no longer a need for laborious screening and cultivation. Thus the consortium of RemuNa is able to elucidate the germ reduction by using these two developed techniques.

The mentioned reduction of germ burden will be facilitated by so-called antimicrobial peptides (AMPs), which are to be developed within this consortial work. AMPs are known to avoid multiple resistances like antibiotics. AMPs represent an effective control measure and do not require any recognition sites on cell membranes. To prevent AMP action, cells have to reconstruct their membrane architecture. This is hard to be permuted and hence the initiation of resistances is implausible. AMPs are presumed an effective alternative to antibiotics and can decrease infections caused by pathogenic bacteria.To avoid the development of bacterial biofilms, which cause source of germ contamination, the design of new biological germicides based on dissolved AMPs or AMPs immobilized on surfaces is a promising attempt. This is an effective possibility to minimize biofilms and germ burdens by inactivating of bacterial contaminations, which is the focus of the cooperative project.

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1 *Schematic depiction of an amphipathic, a-helical peptide.*

1

2

CRIP.CodEx: Knowledge extraction from free-text medical records

Biobanks represent key resources for translational research and personalized medicine. Knowledge corresponding to the stored human biospecimens is contained in free-text records. To be a valuable resource for translational biomedical research, the samples have to be annotated with clinical data, often only available from free-text records. Access to these biospecimens and data, is provided e.g. over via platforms like Arevir (Roomp et al., 2006), or the trans-institutional meta-biobank CRIP (Schröder et al., 2011) or p-BioSPRE (Weiler et al., 2014). To enable stratified, parameterized project queries, integration of knowledge from various sources, including free- text records, into harmonized and structured data is mandatory (Abert & Cohen, 2009).

The automated knowledge extraction software CRIP.CodEx was designed to identify and extract diagnostic information in free-text medical records and assign corresponding codes (e.g. ICD, ICD-O, TNM). CRIP.CodEx runs automatically, fast and efficiently, identifies word relations and negation, handles extended negation scopes (Gros & Stede, 2013), but does not require access to databases or other external resources. By tapping complementary data sources, e.g. free-text pathology reports or diagnoses, we have delivered a system to provide biobanks with information out of previously unstructured – and therefore hidden data. We have thereby enriched parameterized annotation of stored biospecimens, increased the visibility of the samples and data and enhanced their availability for translational research.

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1 *Knowledge extraction from free text using CRIP.CodEx*
2 *CRIP.CodEx online demonstrator website*

DEPARTMENT OF CELL-FREE AND CELL-BASED BIOPRODUCTION

Location Potsdam-Golm, Germany

© Tobias Marschner

THE DEPARTMENT AT A GLANCE

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Conservation of resources and creating more efficient material flows are the current challenges facing the economy and technological development. Particularly in the field of health, a sufficient and cost-effective availability of high-quality synthetic products is an important basis for progress. For instance, highly complex proteinogenic active ingredients are the basis for vaccine and antibody development. But in food technology as well as in the agricultural, cosmetics and detergent industries, requirements are continuously increasing on enzymes, complex peptides and proteins or on synthetic biomolecules in general. Currently, these substances are often manufactured with the help of living cells or organisms. However, these systems are subject to considerable limitations. A large material and energy input must be spent to maintain the metabolism of the microorganisms or cell cultures themselves, thus limiting the cost effectiveness of this approach. In addition, many metabolites and final products are toxic, or have a toxic effect on cells or organisms in higher concentrations necessary for economical production . Therefore many important substances cannot be manufactured at all or only in small quantities.

The development of cell-free production of high-quality biomolecules offers completely new possibilities. The exclusive use of subcelluar components of the organisms necessary for the synthesis makes it possible to efficiently produce biomolecules with complex and also completely new characteristics in suitable reaction environments. The technologies established at the Golm site allow an economically efficient use of these processes, thereby creating a new foundation for the economic production of active proteins.

The department's extremophile research is engaged with cold-adapted snow algae. We focus on their use for extracting high-quality substances such as antioxidants or fatty acids. Accompanying product-optimised photobioreactors are also being developed. The culture collection CCCryo is a unique bio-resource that can be used by interested academic and private enterprise groups.

UNITS

Functional Nucleic Acids – Aptamers

The Functional Nucleic Acids – Aptamers Unit aims at developing new innovative products on the basis of aptamers. This goal comprises the generation, synthesis and functionalization of aptamers as well as the integration in diverse applications. The unit thereby seeks a close collaboration with the industry and academic institutes. Primarily, aptamers are short, single-stranded DNA and RNA molecules with the particular feature of binding high-affine and high-specific a target molecule such as antibodies. The very broad capabilities of aptamers as binding molecules are used in analytical, diagnostic and therapeutic applications. A focus is on the generation of new aptamers by using an automatic in vitro selection process as well as a monitoring and managing process. Additionally, the unit develops of aptamer-based detection methods such as lateral flow assays or so-called aptasensors.

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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 cellfree 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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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 by which they oppose 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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Cell-free Protein Synthesis Unit

The unit researches and develops systems for the cell-free synthesis of recombinant proteins. A special focus here lies on characterizing, modifying and examining the functions of cell-free manufactured membrane proteins, with particular emphasis on ion channels, glycoproteins and antibody formats. Quick and affordable target-protein synthesis is ensured as only the constituents of the cells are used. The use of eukaryotic cell lysates also allows the synthesis of posttranslationally modified proteins. Beyond this, position-specific labeling enables proteins to be specifically modified, changing and optimizing their properties, e.g. through the introduction of polymeric groups. By introducing fluorescent groups at selected positions, membrane proteins in particular can be measured, functionally characterized and analyzed with an eye to identifying new binding molecules.

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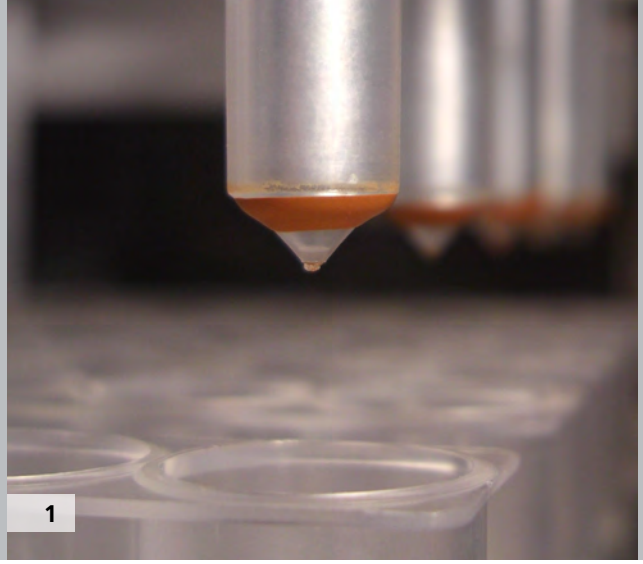

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PROJECT EXAMPLES

APTAMASTER: development of an automated system to monitor wastewater from sewage disposal facilities in terms of drug residues and organic trace elements following the fourth treatment stage

The existence of drug residues in wastewater has become a socially relevant topic due to its increased prevalence and previously incalculable risks to humans and the environment. Besides hospitals and care homes, private households are also largely to blame for the contamination of wastewater with active pharmaceutical ingredients, or APIs for short. The number of detected substances is on the rise and the diverse chemical compositions of the pharmaceuticals point to a clear need for fast and universal on-site analyses. One consequence of such wastewater contamination is seen in a number of undesirable and unpredictable effects on biological systems. Before the environmental stress, impact and course of the process can be accurately assessed and, in turn, limit values determined and tested, it is essential that detailed knowledge of the concentrations of relevant substances and substance classes is first acquired. Determining such concentrations, however, is currently only possible in the laboratory and is associated with a considerable effort in terms of time, technology and funding.

The project therefore aims to develop a modular device solution that automatically measures these substances on site - quickly, reliably and with little economic effort - and prepares the findings in a visual way for a range of terminal devices. To this end, scientific-methodological principles are to be researched in the APTAMASTER project and new kinds of sensors based on specific aptamers involving ceramic carriers, innovative electrochemical analytics, intelligent self-learning software and a new type of device concept are all to be developed that can be integrated into "Industry 4.0".

The project explicitly entails the development of new types of specific DNA aptamers to counter pharmaceuticals of environmental relevance using a new procedure. In order to do this, chemical bonds (organic molecules) from different substance classes, such as hormones, painkillers, psychotropic drugs and antibiotics, are to be drawn on as part of the aptamer generation. Aptamers (short, single-stranded nucleic acids) are highly affine and extremely specific binding molecules which can be developed against pretty much all molecule classes and are therefore perfectly suited to detect drug residue such as small organic molecules or peptides. Furthermore, an aptasensor based on electrical impedance spectroscopy (EIS) is being developed at the same time with the help of a previously existing pharmaceutical aptamer.

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Bundesministerium für Wirtschaft und Energie

aufgrund eines Beschlusses des Deutschen Bundestages

ZIM Zentrales Innovationsprogramm Mittelstand

1 *Transfer of magnetic particles using the magnetic robot during aptamer generation*

1

CCCryo-Algae in Space

"Does life exist or is life possible beyond our Earth?" is an eternal question of mankind. In the framework of the BIOMEX project (Biology and Mars Experiment) coordinated by the German Aerospace Center (DLR) in Berlin, many diverse organisms isolated from extremophilic habitats are being investigated as to whether they can withstand space- or Mars-like conditions. Indications of their survivability under strong temperature fluctuations, vacuum, dryness and UV-A, -B, -C as well as cosmic radiation may prove that such extremophilic organisms may survive a voyage through space (panspermia).

Two organisms from the biobank CCCryo (Culture Collection of Cryophilic Algae) at Fraunhofer IZI in Potsdam participated in a trial journey through space: The cyanobacterium Nostoc sp., a blue-green alga from Antarctica and strain CCCryo 101-99 of a green alga, which was isolated from Spitsbergen during one of our earlier expeditions. Since 2011 many preliminary tests had been performed at DLR in Cologne simulating a series of different levels of irradiation, vacuum and temperature. Finally, in July 2014 it was «lift-off» for the transport to the International Space Station (ISS). On the ISS the organisms, especially prepared in a desiccated stage, were installed on the outside of the space station and remained there in space for more than 450 days and approximately 400 km above the Earth's surface. This allowed two conditions to be studied: Mars-like under a gas atmosphere with >95 % CO2 and a partial vacuum of 1000 Pa (= 10 mbar) at radiations of >200 nm (from far UV-C) and space-like under a vacuum of <0.0014 Pa and at radiations >110 nm (vacuum-UV-C).

On 18 June 2016 the samples returned from the ISS and both strains showed a remarkable ability of survival. As metabolically reduced cell stages they withstood temperature fluctuations between 20 and +47 °C. Space vacuum had no negative effects either. As we knew from earlier simulations experiments, radiation would have the most impact on survivability. However, only one single sample, in which the green alga was prepared on its natural culture medium and which was exposed directly to radiation did not survive. Growing populations developed from all the other samples within a few days. They showed their typical morphology and in the case of the green alga, also the different cell stages – green young swarmers and adult cells as well as resting stages coloured orange due to carotenoids - could be observed. No immediate damage was apparent, though long-term defects might only become apparent after some time. Further tests on the DNA level will be performed in cooperation with the DLR in Berlin and the TU-Berlin.

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1 *The different organisms contributed by all project partners were mounted to the outside of the ISS space station and exposed to the conditions of space for a year and a half.*

CENTRAL FACILITIES AND SERVICES

IMAGING AND IMAGE EVALUATION

Phenotyping biological samples using multiple imaging methods forms a core competence of preclinical research. This enables thorough depiction, from the smallest structures (cell organelles) right through to entire organ systems, both in spatial and temporal resolution (4D). Fraunhofer IZI has access to a comprehensive, state-of-the-art equipment pool that enables the acquisition and evaluation of various (also correlative) image data. Partners and customers are advised on biological, technical and economic matters and supported in carrying out and evaluating experiments. Furthermore, experimental procedures and equipment can be used, adapted and developed.

In vivo imaging

Magnetic resonance imaging (7 Tesla high-field small animal MRI) (A)

- Examination of soft tissues and organs, use of contrast agents and cell labeling possible, long-term measurements in single individuals
- Depiction of anatomical changes, MRS, diffusion methods, functional imaging

Computer tomography (CT and X-Ray for small animals) (B)

- Depiction of dense (bone, cartilage) and contrast-enhanced (soft tissue) structures
- Rendered 3D data sets can be used for conformal radiation treatment planning

Fluorescence and bioluminescence imaging for small animals

- Monitoring tumor growth and progression of inflammation, tracking cell movements following transplantation (cell tracking)
- Complex reconstruction of in vivo parameters using Diffuse Light Imaging Tomography (DLIT) and spectral unmixing

A

B

Bedside imaging for small animals

- Various ultrasound units with a number of transducers and an implemented Color Doppler
- Flexible miniature cameras for the routine endoscopic examination of small animals and for the development of new lens attachments

In vitro / ex vivo imaging

Confocal laser scanning microscope with live cell imaging

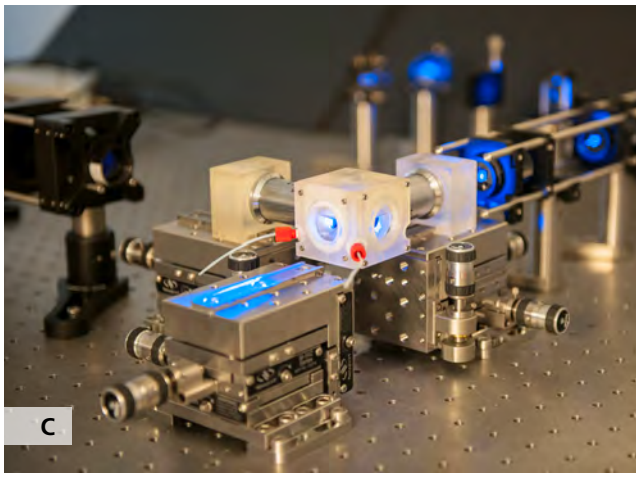
- Analysis of cell cultures and tissues in 4D, localizing target structures inside cells
- Standard laser lines from blue to red, water immersion lenses, real-time rendering and quantification of results

Light sheet microscopy (C)

- Flexible light sheet microscope with modular sample chamber for sample sizes from just a few µm to 2cm
- For the study of light-sensitive live-cell samples in high temporal resolution

Atomic force microscopy (D)

- Nanometer-scaled, micro-mechanical sampling of surfaces using a cantilever measuring needle and measurement of the occurring atomic forces



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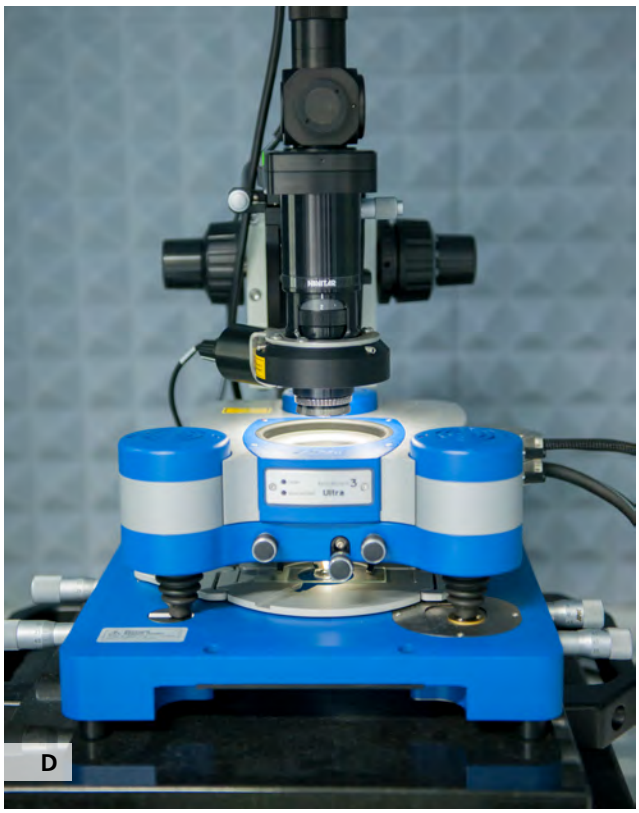

D

MALDI Mass Spectrometry Imaging (MALDI-MSI)

- Label-free methods of depicting the distribution of macro molecules in histological samples based on their degree of ionization and time of flight (TOF) in the electric field; special sample preparation and matrix application required, statistical evaluation of distribution patterns

Laser capture microdissection

- Isolating individual cells or tissue structures by means of microscopic laser cuts, analyzing samples using molecular biology methods (RT-PCR, proteomics)

Hardware-linked evaluation process

- Stereological quantification using the upright fluorescence and reflected-light microscope for unbiased histological evaluations
- Virtual microscopy in order to create completely virtual tissue sections for digital post-processing, high-throughput technique

Individual image evaluation and analysis

With increasing automation and associated quantitative imaging comes a rise in the demand for image analysis which is just as automated and robust. Fraunhofer IZI is highly experienced in the fields of cytometry and histometry (especially using mathematical morphometry), as well as statistical classification procedures in the quantitative microscopy segment. In this regard, our portfolio comprises individually tailored 2D and 3D image analysis methods, shape analyses (eigenshapes, various shape descriptors, topological descriptors), motility / vitality analyses (e. g. by means of fluid registration), topological tissue analyses (speckle pattern statistics) besides biostatistical analyses. Procedures taken from machine learning are used here, for example to detect cells in 3D fluorescent images.

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BIO-NANOTECHNOLOGY APPLICATION LABORATORY (BNAL)

The Bio-Nanotechnology Application Laboratory (BNAL) in Leipzig represents a research infrastructure jointly run by Fraunhofer IZI and Fraunhofer IKTS. With this laboratory, both institutes are opening up new fields of application in biomedicine related to various nanotechnologies.

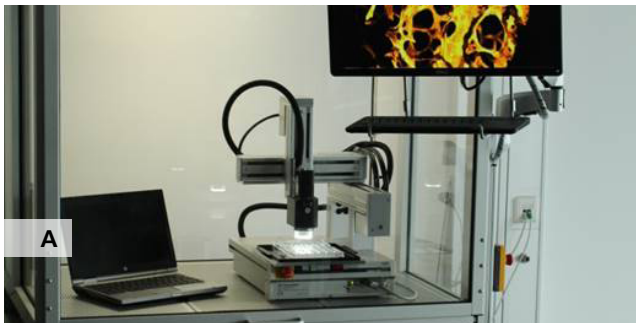
State-of-the-art equipment allows biological and medical issues to be handled in an interdisciplinary manner. BNAL provides research and development services from fundamental biomedical research by process development up to the development and validation of innovative technologies and system solutions.

Biological and medical expertise at Fraunhofer IZI (e.g. oncology, chronic inflammatory diseases and neuro-degenerative diseases) in combination with established analysis methods for material diagnostics at Fraunhofer IKTS enable the development of new diagnostic and therapeutic technologies and procedures.

Imaging procedures

Optical coherence tomography (A): Uses near-infrared light to depict the internal and surface structures of various materials in high resolution.

Multi-acousto-scope: The combination of three microscopy techniques paves the way to innovative new examination strategies.



Cell characterization and classification

Diagnosis and mapping for cell biology studies: Non-intrusive way of delivering high-resolution, geometric information from the inside of test objects.

Spectrometer for time-resolved fluorescence spectroscopy: Procedure to characterize cells based on electromagnetic radiation.

Ultrasound broadband spectroscopy system: This procedure has long been used in the medical diagnosis of cell tissues, biological materials and in the analysis of fluid media. It mainly identifies acoustic and mechanical properties of substances.

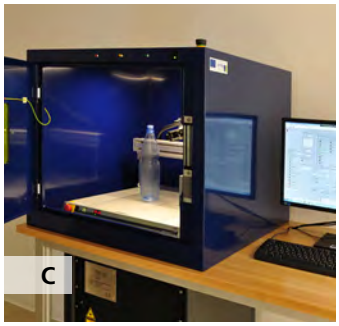
High-throughput flow cytometry (B): Rapid, multiplex, high-throughput screening of cells and beads in suspension.

B

Surface sterilization and modification

Electron beam dosimeter (C): Dose measurement of highenergy radiation (e. g. gamma or electron radiation) on even on the different positions of bent 3D free-form surfaces.

System for electron irradiation of surfaces (D): Sterilization of package / surfaces, inactivation of microorganisms for vaccine production or targeted adjustment of material properties by means of electron irradiation.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D

Nanotechnology

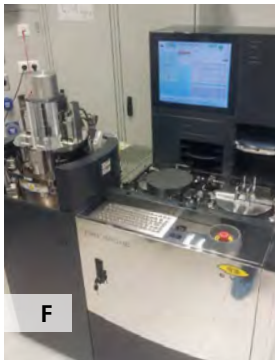
Droplet digital PCR system: PCR-based, absolute quantification of microbial / viral or eukaryotic DNA / RNA as well as precise detection of low genome copy numbers.

Zetasizer: Determination of particle and molecule sizes, e. g. for characterizing recombinant proteins, micelles and nanoparticles.

Micro-spotter unit (E): Automated dosing of tiny quantities of liquid (e. g. biological or organic solutions, or solutions containing nanoparticles) on a broad range of different surfaces for the production of microarrays.

Hot-embossing system (F): Production-relevant manufacturing of nanostructured surfaces on glass and polymer surfaces.

E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CENTER FOR EXPERIMENTAL MEDICINE

The development of new drugs entails testing using suitable animal models. Animal experiments are therefore an integral component in the development of new drugs, therapies and diagnostic procedures. The institute's Centre for Experimental Medicine (TEZ) is a central unit which facilitates important steps in translating research findings into a clinical application for human subjects.

Moreover, the institute has access to one of the most state-of-the-art animal houses in Germany. The TEZ is distinguished by its highly technical facilities, which are optimized to handle preclinical research projects. These facilities include modern rooms in which the animals are kept, featuring standardized hygiene levels and individually ventilated cage systems that are monitored via the building management system.

The health and care of the animals is of the highest priority. Highly qualified personnel support the scientific staff in daily care, health monitoring and breeding activities, and in administering treatments.

All experimental work can be carried out under practically sterile conditions. Several fully fitted operating suites allow small and large animals to be examined and treated. The comprehensive, state-of-the-art equipment guarantees correct anesthesia, analgesia and species-relevant blood analyses.

An expansive equipment pool for imaging technologies at the institute enables partly non-invasive analysis methods and also contributes towards reducing the need for animal experiments. This means, for example, that in vivo imaging analyses can be carried out using, for instance, 7 Tesla magnetic resonance imaging, bioluminescence imaging or small-animal CT.

In order to work on a range of issues, the TEZ has access to areas approved for genetic engineering safety levels S1 to S3; it may also conduct in vivo studies in line with GLP (Good Laboratory Practice).

The TEZ forms the central interface at the institute for processing preclinical development projects. Furthermore, cooperation projects with external clients and other research institutes are also carried out. At the same time, the TEZ acts as a training facility for animal care supervisors in a research and clinical setting, also offering advanced training courses for experimenters.

Adherence to the animal welfare guidelines is strictly monitored by the institute's animal welfare officer and regularly controlled by the regional animal welfare authority

Equipment and services:

- Small animals are kept under state-of-the-art standards and permanently monitored
- Animal husbandry under GLP standards
- Animal husbandry with the option to use infecting agents for experimental infection

- Quarantine services
- Standard in-breeding and breeding transgenic lines
- Operation units in various areas including provision of inhalation anesthesia for small and large animals

- Large-animal OP area with intensive care capacity
- C-arm
- Option for individual stereotactic brain surgery
- Autopsy room for large animals
- Intraoperative blood gas analyses

- Small animal endoscope
- Blood cell meter
- Surgical microscope
- Stereotactic manipulation
- Temperature control during operations

- In vivo bioluminescence
- Small animal magnetic resonance imaging
- Small animal computer tomography
- X-ray unit for whole-body irradiation and pinpointed radiation therapy
- Large capacity autoclave
- Sterilization units using hydrogen peroxide fumigation
- Cryopreservation of spermatozoa and embryos
- Tissue bank

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RIBOLUTION BIOMARKER CENTER

Over the past few years, the Fraunhofer Future Foundation has supported the RIBOLUTION project consortium, which takes an innovative approach to identifying new biomarkers for modern diagnostic solutions. The RIBOLUTION Biomarker Center was set up as part of a close cooperation involving five Fraunhofer institutes and several universities. It was opened on April 26, 2016, at the Fraunhofer Institute for Cell Therapy and Immunology IZI in Leipzig.

At the RIBOLUTION Biomarker Center, novel biomarkers are identified based on ribonucleic acids and developed through to clinical "proof of concept" with the aid of selected patient cohorts. At present, activities are primarily focused on development programs in the areas of prostate cancer, chronic obstructive pulmonary disease (COPD) and infectious diseases.

A

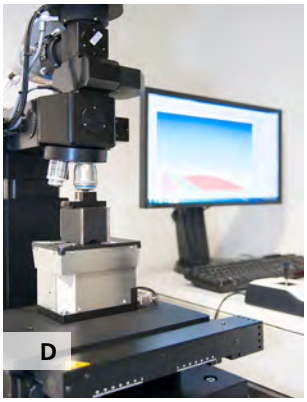
B

Biomarker screening and validation

By integrating state-of-the-art genomic analysis methods such as next-generation sequencing (NGS) using our own bioinformatical data analysis methods developed in house, the RIBOLUTION Biomarker Center is able to identify biomarkers and develop new diagnostic tests at the **highest technological level**:

- Illumina HiSeq and Miseq (A): Ultra-high-throughput sequencing platforms
- Hamilton Microlab STARlet/STARplus (B): Fully automated preparation of samples for sequencing and fully automated extraction and purification of nucleic acids

C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F

- Agilent microarray scanner (C)
- EMD (D): Quality and quantity analyses of minimal amounts of nucleic acids with high sensitivity; developed by Fraunhofer FIT
- QIAcube (E): Semi-automated extraction and purification of nucleic acids
- RiBOT (F): Novel procedure for the automated validation of biomarkers in high-throughput based on complex interactions between actuator engineering and media to be dispensed; developed by Fraunhofer IPA

The highest quality standards are defined and implemented from start to finish, which increases the intrinsic value of the obtained data and lays the foundations for the implementation of a quality management system pursuant to DIN ISO 13485, which will become necessary as the project progresses.

New biomarkers are identified and validated using bioinformatical methods. This includes designing custom expression microarrays and analyzing expression microarray data. A proprietary data management system has been developed to store and supply all clinical and experimental data and is used to manage the extensive biobank which has emerged in the RIBOLUTION project.

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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.

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GMP – "Good Manufacturing Practice"

The Fraunhofer IZI maintains three 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).

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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-Institut) 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 preclinical 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 co operation 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.

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LOCATIONS

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HALLE
ROSTOCK
GERMANY
HAMILTON
CANADA
GWANGJU
SOUTH
KOREA

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Bioanalytics and Bioprocesses Branch of Institute in Potsdam/Golm, Brandenburg

Am Mühlenberg 13
14476 Potsdam-Golm
Germany

Department of Drug Design and Target Validation in Halle (Saale), Saxony-Anhalt

Weinbergweg 22
06120 Halle (Saale)
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Extracorporeal Immunomodulation (EXIM) Project Group in Rostock, Mecklenburg-Western Pomerania

Schillingallee 68
18057 Rostock
Germany

Fraunhofer Project Center for Biomedical Engineering and Advanced Manufacturing (BEAM) at McMaster University, Hamilton, Ontario, Canada

JLCI – Joint Laboratory of Chonnam National University Hospital Hwasun in collaboration with Fraunhofer IZI in Gwangju, Jeollanam-do, South Korea

LEIPZIG HEADQUARTERS, SAXONY

Usable area: 8 749 m²
Employees: 395
Focal areas: Cell engineering, cell therapy, drugs, diagnostics, immunology

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 buildings, which were opened in 2013 and 2015 (e. g. imaging units, laboratories for experimental medicine, a S3 laboratory, and clean-room facilities).

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 and Gene 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 1000 m².

Management

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BIOANALYTICS AND BIOPROCESSING BRANCH OF INSTITUTE IN POTSDAM-GOLM, BRANDENBURG

Usable area: 4 096 m²
Employees: 107
Focal areas: Biotechnology, bioproduction, bioanalytics, automation

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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DEPARTMENT OF DRUG DESIGN AND TARGET VALIDATION IN HALLE (SAALE), SAXONY-ANHALT

Usable area: 1 300 m²
Employees: 60
Focal areas: Biochemistry, pharmacology, drug development, analytics

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.

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EXTRACORPOREAL IMMUNOMODULATION PROJECT GROUP IN ROSTOCK, MECKLENBURG-WESTERN POMERANIA

Usable area: 700 m²
Employees: 26
Focal areas: Organ-supporting technologies, clinical trials

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

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FRAUNHOFER PROJECT CENTER FOR BIO-MEDICAL ENGINEERING AND ADVANCED MANUFACTURING (BEAM) AT MCMASTER UNIVERSITY, HAMILTON, ONTARIO, CANADA

The founding team at Fraunhofer IZI started looking for suitable Canadian cooperation partners back in 2011. On the back of these efforts, initial joint research projects were set up with McMaster University in Hamilton (Ontario, Canada). With approximately 29,000 students, the university is among the leading universities in Canada, with exceptional strengths in health sciences, engineering and natural sciences.

Based on the success of ongoing cooperation projects, the Fraunhofer-Gesellschaft took the decision in 2014 to set up a Fraunhofer Project Center (FPC) at McMaster University. The FPC is jointly managed by McMaster and Fraunhofer senior managers and is devoted to applied research in the business units Diagnostics, Automation, Cell Therapeutics and Biomaterials. In setting up the FPC, both partners aim to collectively develop innovative products and technologies by combining specific technological strengths from both sides. In addition, the FPC helps establish German and Canadian companies and supports the development of business activities in the respective partner country.

Since 2014, the FPC managed to attract significant funding on both the German and Canadian side as well as a series of industry collaboration projects. The total funding acquired from 2014 to 2016 was about 25 million CAD.

This is including FedDev funding in the sum of approx. 12 million CAD for the construction of a joint research building in the McMaster Innovation Park. The building is due to open at the start of 2018. Covering a usable area of approx. 2,000m² it will provide joint German-Canadian research units and research subsidiaries of industrial companies with an outstanding, state-of-the-art research infrastructure.

In the second half of 2016, the FPC successfully passed its mid-term evaluation with excellent results. Subsequently and in a stepwise process, the founding team and BEAM management (Dr. Thomas Tradler and Christopher Oelkrug) handed over responsibility to a new management team.

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JLCI – JOINT LABORATORY OF CHONNAM NATIONAL UNIVERSITY HOSPITAL HWASUN IN COLLABORATION WITH FRAUNHOFER IZI IN GWANGJU, JEOLLANAM-DO, SOUTH KOREA

Since 2010, Fraunhofer IZI has maintained a close cooperation with Chonnam National University Hospital Hwasun (CNUHH) in several areas. With 700 beds, the CNUHH is one of the largest university hospitals specialized in the treatment of cancer in South Korea. The hospital is accredited by the Joint Commission International and specializes in cancer and joint diseases.

The JLCI facilitates the collaboration with external partners from academia and industry in Asia. For example the Fraunhofer IZI's ligand development group is using the regular access to fresh tumor materials from patients to identify tumor binding peptides, which already have been validated in tumor models.

The laboratory management is oriented at the standards and rules of the Fraunhofer-Gesellschaft. This shall guarantee a common basis when dealing with patents and contractual matters. The JLCI is financed by the Korean Ministry of Education, Science and Technology (NRF) as part of an initiative to strengthen international cooperation run by the GRDC. Respective funding on the part of the Korean government has been granted to the CNUHH for the collaboration between both institutes since June 2011. Since then, several delegations from Fraunhofer IZI have travelled to Korea for conferences and scientists have stayed there for up to two months as well as a number of Korean colleagues have also worked at Fraunhofer IZI. Many joint publications have also been written. German-Korean symposiums take place on an annually rotating basis.

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SCIENCE LOCATION LEIPZIG

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LEIPZIG AND THE FORMER TRADE FAIR

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 Uni-versity 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 Bio technological-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 of the University Leipzig.

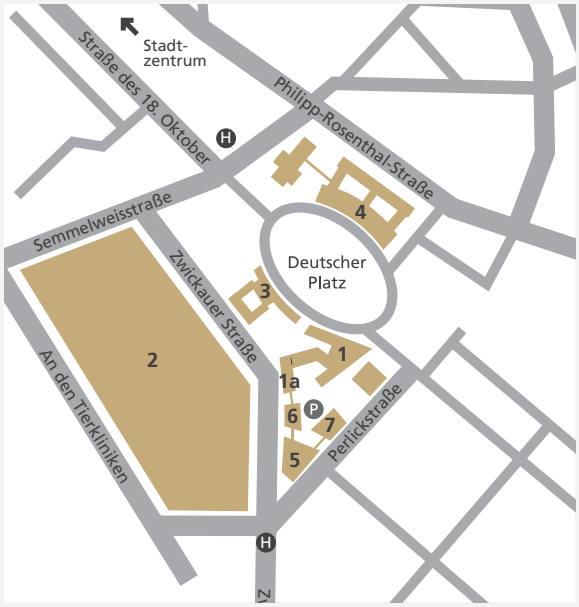
The outstanding collaboration work with the Faculty of Veterinary Medicine and its institutes and clinics directly opposite the Fraunhofer IZI building deserves special mention. Research involving animal experiments does not only serve the development of new products for human medicine, but also contributes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

Numerous partners in the immediate vicinity

The neighboring partners of the Leipzig University are, among others, the Medical Faculty, the Veterinary Medicine Faculty, and the University Hospital. 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 Institute for Clinical Immunology, the Center for Biotechnology and Biomedicine (BBZ), and the Max Planck Institute for Human Cognitive and Brain Sciences. Moreover, there are numerous interfaces with different special research areas 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), Fraunhofer IZI (5), first extension building Fraunhofer IZI (6), second extension building Fraunhofer IZI (7).

EVENTS

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 2016.

January 21, 2016: Leipzig Fraunhofer Institutes' Joint New Year's Reception

Together with the Fraunhofer IZI, the Fraunhofer Center for International Management and Knowledge Economy (IMW) held a New Year's reception at the Fraunhofer IMW in Leipzig's Städtisches Kaufhaus. The reception began with the two directors Professor Thorsten Posselt (Fraunhofer IMW) and Professor Frank Emmrich (Fraunhofer IZI) once again welcoming around 100 guests from politics, business and science, including Dr Johannes Beermann, Executive Board member of the Deutsche Bundesbank, and Jürgen Chrobog, retired Minister of State. The spotlight was placed on the ten-year anniversary of the two institutes at the Leipzig science hub. While Fraunhofer IZI already celebrated this milestone in 2015, the socio-economic Fraunhofer center entered its anniversary year in 2016. Guest speaker at the event was Professor Hans Wiesmeth, President of the Saxon Academy of Sciences. 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 on January 19, 2017, hosting guests from politics, business and science.

January 26, 2016: Immunology Workshop together with the University of Potsdam

Professors and lecturers from the University of Potsdam came together on January 26, 2016, to discuss various areas of immunology research. Our Potsdam colleagues presented their work on tumor targeting, cell factories with artificial chromosomes and new approaches in the area of antibody production. Members of staff from the Fraunhofer IZI contributed to the discussion with topics such as epitope fingerprinting, the serological diagnosis of viral infections and vaccine development.

April 14–15, 2016: Fraunhofer Life Science Symposium

The 2016 Fraunhofer Life Science Symposium was held at the Fraunhofer IZI in cooperation with the German Society of Laboratory Animal Science's IGTP Conference. Together with the Experimental Centre of the Faculty of Medicine at Leipzig University and the Max Planck Institute for Evolutionary Anthropology, talks and workshops were offered on the topics of laboratory animal science and working with laboratory animals. Viewed as the founder of paleogenetics, Professor Svante Pääbo, Max Planck Institute for Evolutionary Anthropology, gave the opening talk on the subject of the

Neanderthals, addressing around 200 animal care supervisors, experimenters, animal facility directors, veterinarians and animal protection advocates. He presented the DNA evidence showing that early forms of modern-day humans mated with Neanderthals after migrating out of Africa. Dr Vera Koch, Landesdirektion Leipzig, spoke about reforms affecting the German Animal Protection Act.
www.fs-leipzig.com

April 19–22, 2016: 9th International Symposium on Neuroprotection and Neurorepair

The 9th International Symposium on Neuroprotection and Neurorepair was held from April 19–22, 2016, at the conference venue Kongresshalle am Zoo Leipzig. The symposium is held every two years. Dr Johannes Boltze, who moved from the Fraunhofer IZI to the Lübeck-based Fraunhofer Research Institution for Marine Biotechnology and Cell Technology in 2015, has helped organize the event since 2010. 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 today. Above all, new therapeutic and diagnostic approaches were presented alongside the latest findings on the molecular foundations of such diseases. Transferring research findings into clinical application is a subject especially dear to Fraunhofer researcher Dr Boltze and was therefore discussed at length. Around 400 international guests from the fields of research, medicine and business took part in the event in Leipzig. The 10th International Symposium on Neuroprotection and Neurorepair will take place in Dresden in 2018.
www.neurorepair-2016.de

April 28, 2016: Girls' Day at the Fraunhofer IZI

April 28, 2016, marked the 16th Girls' Day to be held across Germany. Girls' Day is an annual day of action that aims to encourage women and girls in particular to take up technical and scientific careers. The Fraunhofer IZI took part in 2016 for the fifth time. 17 female participants were given the chance 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 at the Fraunhofer IZI and career opportunities within the Fraunhofer-Gesellschaft. By taking part in Girls' Day, the Fraunhofer IZI aims to address mainly 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 27, 2017.
www.girls-day.de

June 16, 2016: Science Day

When the Fraunhofer IZI was set up back in 2015, it had a grand total of 16 members of staff; since then, it has grown to accommodate over 580 employees. While it was easy to become acquainted with one other and know what your colleagues were working on in the early years, such familiarity proves a little trickier with over 500 members of staff spread across three sites. Hence the introduction of the Fraunhofer IZI Science Day, which was held on June 16, 2016. The Science Day intends to give all members of staff the opportunity to really get to grips with the various research topics and available technologies at the institute. The event also provides the perfect setting for colleagues to discuss their work and to give and receive ideas for new projects. The Science Day is accompanied by a poster exhibition organized by our PhD students, where they can

present their latest research findings. Prizes are handed out to honor the posters with the best content and design. The next Science Day will be held on June 20, 2017.

June 24, 2016: Long Night of the Sciences – bringing light into the darkness

The Long Night of the Sciences was held once again in Leipzig for the fifth time on June 24, 2016. Scientific institutions opened their doors between 6pm and midnight to present their work to the general public. The Fraunhofer Institute for Cell Therapy and Immunology also took part in the event, showcasing its projects late into the night to the approximately one-thousand visitors. The institute's research topics were demonstrated through playful initiatives, hands-on booths, interesting project presentations and tours around the clean-room laboratories. The star attraction came from the field of immunology, where visitors could learn all about allergies and vaccinations. At the stand "Dyslexia – what's it all about? How clever am I really?", the causes of dyslexia (poor reading and writing skills) were explained in a playful way and visitors were told about the development of a new early warning test to recognize the disorder at an early stage. The stand "Cunning chlamydia – recognize, test, treat" introduced a miniaturized laboratory with the dimensions of a credit card that can be used to diagnose sexually transmitted diseases at home. The next Long Night of the Sciences will be held on June 29, 2018.
www.wissenschaftsnacht-leipzig.de

April 26–27, 2016: German Biotechnology Days (DBT)

The German Biotechnology Days were held from April 26 to 27, 2016, in the Leipzig-based conference venue Kongresshalle am Zoo. Every year since 2010, the conference has taken a look at the basic conditions and diverse fields of application in biotechnology, delivered as plenary addresses, podium discussions and round-table breakfast talks. The BIO Deutschland Council of BioRegions in Germany organizes the annual event, which sees companies from different stages of development introduce their work. This year, the Fraunhofer IZI project Ribolution (Ribonucleic Acid-Based Diagnostic Solutions) was also presented. The project "RIBOLUTION – integrated platform for the identification and validation of innovative RNA-based biomarkers for personalized medicine" is carried out by a research alliance. New RNA-biomarkers are identified and their diagnostic application validated for selected diseases using comprehensive, genome-spanning screening techniques. RIBOLUTION also includes so-called noncoding RNAs, which were recently discovered as a large reservoir of biomarkers of potential value to the field of medicine. Biomarkers are being sought that function as diagnostic indicators in terms of detecting diseases and predicting their course or response to therapy. In addition, the process of biomarker screening will be optimized and perfected by RIBOLUTION with the aid of technical innovations. The 2018 German Biotechnology Days will be held in Hanover on April 5 and 6.
www.biotechnologietage.de

October 1–3, 2016: German Unification Day in Dresden

In 2016, German Unification Day was held in the federal state where everything began with the peaceful revolution back in 1989: in Saxony. The public celebration was held in Dresden from October 1 to 3 under the motto "Building bridges". 450,000 visitors joined the celebrations and took up the opportunity to hold discussions and find out about the latest topics. The Fraunhofer IZI presented its work to the general public at a stand run together with the Fraunhofer IMW located along the science mile, right by the Frauenkirche. The Fraunhofer tent attracted the interest of Stanislaw Tillich, Minister President of the Free State of Saxony, and Dr Eva-Maria Stange, State Minister for Science and the Arts, besides that of the general public.
www.tag-der-deutschen-einheit.sachsen.de

LOOKING TO 2017

January 19, 2017
New Year reception

April 27, 2017
Girls'Day 2017
www.girls-day.de

June 22, 2017
Science Day

September 8–10, 2017
18th International Symposium on Albumin Dialysis (ISAD)
www.albumin-dialysis.org

November 8–9, 2017
Fraunhofer Life Science Symposium
www.fs-leipzig.com

SCIENTIFIC PRESENCE

CONVENTIONS AND CONFERENCES

»mHealth trifft Diagnostik« – Ein Symposium des mHealth-Dx Network, 20.–21.6.2016, Berlin

10. Mitteldeutsches IVU-Trauma-Update (MTU) 2016, 3.6.2016, Halle (Saale)

10th European Mucosal Immunology Group Meeting, 19.–21.10.2016, Kopenhagen, Dänemark

10th FENS – Forum of Neuroscience, 2.–6.7.2016, Kopenhagen, Dänemark

10th International Congress on Autoimmunity, 6.–10.4.2016, Leipzig

11th International Conference on Protein Stabilisation, 9.–11.5.2016, Istanbul, Türkei

12. Nationale Branchenkonferenz Gesundheitswirtschaft 2016, 13.–14.7.2016, Rostock

12th Annual European Antibody Congress, 14.–16.11.2016, Basel, Schweiz

12th German Conference on Chemoinformatics, 6.–8.11.2016, Fulda

12th International Congress of Cell Biology, 21.–25.7.2016, Prag, Tschechien

14. Herbstforum der GRM, 11.11.2016, Berlin

14th International Athens / Springfield Symposium on Advances in Alzheimer Therapy, 9.–12.3.2016, Athen, Griechenland

15th Annual PepTalk: The Protein Science Week, 18.–22.1.2016, San Diego, USA

15th European Conference on Computational Biology, 3.–7.9.2016, Den Haag, Niederlande

15th Workshop on »Pathogenicity and Immune Control of Viral Infections«, 28.–30.9.2016, Tauberbischofsheim

16th EANA Astrobiology Conference, 27.–30.9.2016, Athen, Griechenland

16th Scientific Conference of the Phycological Section of the German Botanical Society, 6.–9.3.2016, Leipzig

18. Heiligenstädter Kolloquium, 19.–21.9.2016, Heilbad Heiligenstadt

19th Annual Conference on Vaccine Research, 18.–20.4.2016, Baltimore, USA

19th International Congress on In Vitro Toxicology ESTIV 2016, 17.–20.10.2016, Juan-les-Pins, Frankreich

1st European Drug Discovery for Neurodegeneration Conference, 15.–17.5.2016, Budapest, Ungarn

2016 BIO International Convention, 6.–9.6.2016, San Francisco, USA

22nd International Conference on DNA Computing and Molecular Programming, 4.–8.9.2016, München

23. Essener Informationstreffen für Tierschutzbeauftragte, Tierexperimentatoren und mit Tierversuchen befasste Behördenmitglieder, 9.3.2016, Essen

23. Innovationstag Mittelstand des BMWi, 2.6.2016, Berlin

252nd American Chemical Society National Meeting & Exposition, 21.–25.8.2016, Philadelphia, USA

30th EFFoST International Conference, 28.–30.11.2016, Wien, Österreich

33rd Winterschool on Proteainases and Inhibitors 2016, 24.–28.2.2016, Tiers, Italien

34th European Peptide Symposium, 4.–9.9.2016 Leipzig

3rd International Conference & 5th International Macro-Nano-Colloquium on the Challenges and Perspectives of Functional Nanostructures, 20.–22.6.2016, Ilmenau

3rd Light Sheet Fluorescence Microscopy International Conference, 31.8.–3.9.2016, Sheffield, Großbritannien

47. Jahrestagung der Deutschen Gesellschaft für Medizinische Physik, 7.–10.9.2016, Würzburg

49. Jahrestagung der Deutschen Gesellschaft für Massenspektrometrie (DGMS), 28.2.–2.3.2016, Hamburg

4th Annual GSCN Conference, 12.–14.9.2016, Hannover

4th Annual Immuo-Oncology Summit, 29.8.–2.9.2016, Boston, USA

4th BioProScale Symposium »Bioprocess intensification through Process Analytical Technology (PAT) and Quality by Design (QbD)«, 6.–8.4.2016, Berlin

4th Dresden International Symposium on Therapeutic Apheresis, 17.–19.3.2016, Dresden

4th International Conference on Bioprocess and Biosystems Engineering, 20.–21.10.2016, Houston, USA

5. Hightech Transfertag 2016, 11.10.2016, Potsdam

5th Chinese-German Symposium on Immunology, 4.–8.12.2016, Dresden

6. Dresdner Medizintechnik-Symposium, 5.–6.12.2016, Zwickau

68. Kongress der Deutschen Gesellschaft für Urologie e. V., 28.9.–1.10.2016, Leipzig

6th European Congress of Virology, 19.–22.10.2016, Hamburg

6th Korea-Germany JLCI Symposium, 26.9.2016 Hwasun, Südkorea

7th Annual Community Meeting of German Bio-Imaging, 11.–13.7.2016, Fulda

7th Annual Symposium Physics of Cancer, 4.–6.10.2016, Leipzig

7th International Conference and Expo on Molecular & Cancer Biomarkers, 15.–16.9.2016, Berlin

7th International Symposium on Semantic Mining in Biomedicine (SMBM), 4.–5.8.2016, Potsdam

7th World Congress on Microbiology, 28.–29.11.2016, Valencia, Spanien

8. Leipziger Tierärztekongress, 14.–16.1.2016, Leipzig

8th Autumn School Current Concepts in Immunology, 9.–14.10.2016, Merseburg

9th International Symposium on Neuroprotection & Neurorepair, 19.–22.4.2016, Leipzig

9th Seeon Conference, Microbiota, Probiota and Host, 24.–26.6.2016, Seeon-Seebruck

9th Senftenberg Innovation Forum on Multiparametric Analytics, 1.–2.6.2016, Senftenberg

AbGradE symposium 2016, 25.–27.9.2016, Athen, Griechenland

AHR Conference 2016, 3.–6.8.2016, Rochester, USA

AlgaeEurope 2016, 13.–15.12.2016, Madrid, Spanien

Alzheimer's Association International Conference® 2016, 24.–28.7.2016, Toronto, Kanada

Americas Antibody Congress 2016, 19.–20.5.2016, San Diego, USA

analytica conference 2016, 10.–12.5.2016, München

Annual BuildMoNa Conference, 14.–15.3.2016, Leipzig

Annual International Meeting on Antimicrobial Resistance in Microbial Biofilms and Options for Treatment, 5.–7.10.2016, Ghent, Belgien

Annual Meeting of The American Association of Genitourinary Surgeons, 6.–9.4.2016, San Antonio, USA

Annual Meeting of The American Urological Association, 6.–10.5.2016, San Diego, USA

APS March Meeting 2016, 14.–18.3.2016, Baltimore, USA

Aptamers 2016, 4.–5.4.2016, Oxford, Großbritannien

Aptamers in Bordeaux 2016, 24.–25.6.2016, Bordeaux, Frankreich

Bio meets Materials, Fraunhofer IKTS, 8.12.2016, Dresden

Bio Taiwan 2016, 20.–24.7.2016, Taipeh, Republik China (Taiwan)

BioBilanz 2016, 1.12.2016, Berlin

BioJapan 2016, 12.–14.10. 2016, Yokohama, Japan

Biomarkerentwicklung in Prävention & Ernährung – Herausforderungen und aktuelle Trends, 6.12.2016, Potsdam

Bionection, 18.–19.10.2016, Halle (Saale)

Bionnale 2016, 25.5.2016, Berlin

BioPharma Asia Convention 2016, 22.–24.3.2016, Singapur, Singapur

BioTrinity 2016, 25.–27.4. 2016, London, Großbritannien

BIT's 9th World Congress of Regenerative Medicine & Stem Cell-South Korea 2016, 16.–18.3.2016, Seoul, Korea

BMT2016 »Dreiländertagung« of the Swiss, Austrian and German Societies for Biomedical Engineering, 4.–6.10.2016, Basel, Schweiz

Cell & Gene Therapy Europe, 21.–22.9.2016, Berlin

ChinaBio® Partnering Forum 2016, 18.–19.5.2016, Suzhou, China

Clusterkonferenz Gesundheitswirtschaft HealthCapital Berlin Brandenburg 2016, 13.10.2016, Berlin

conhIT 2016, 19.–21.4.2016, Berlin

Cross-Innovation-Workshop: Oberflächentechnologien für Analytik und Medizin, 14.12.2016, Berlin

Cross-Innovation-Workshop: Polymere – Neue Perspektiven für IVD, Bioanalytik und Medizin, 23.6.2016, Wildau

Defense Innovation Technology Acceleration Challenges, 29.11.–1.12.2016, Austin, USA

DELAB Fachtagung, 17.7.2016, Mainz

Deutsche Biotechnologietage, 26.–27.4.2016, Leipzig

Deutsch-Kanadisches Symposium, 26.10.2016, Leipzig

DIAGNOSTICS 6.0 – Precise Innovative Diagnostics: Development, Regulatory Affairs & Manufacturing, 15.–16.9.2016, Berlin

Diagnostics within Microfluidics & Multiplexing Microarrays (MMM), 20.–21.4.2016, Potsdam

DiagnostikNet-Arbeitskreistreffen »Immunoassays für Lebensmittelanalytik«, 29.6.2016, Berlin

DiPIA 2016, 12.–15.6.2016, Berlin

DNA Nanotechnology Mitteldeutschland, 19.–21.5.2016, Jena

DNA Nanotechnology Mitteldeutschland, 16.9.2016, Potsdam

DNA Nanotechnology Mitteldeutschland, 12.12.2016, Leipzig

DPG-Arbeitstagung Forschung – Entwicklung – Innovation, 6.–8.11.2016, Bad Honnef

e:MED Meeting 2016, 4.–6.10.2016, Kiel

e:Med Meeting on Systems Medicine, 4.–6.10.2016, Kiel

ECCB 2016 – 15th European Conference on Computational Biology, 3.–7.9.2016, Den Haag, Niederlande

EIPC Workshop on PCB Bio-MEMs, 8.12.2016, London, Großbritannien

EnFi 2016 – 9th Meeting »Engineering of Functional Interfaces«, 3.–5.7.2016, Wildau

ESMRMB 2016 Congress, 29.9.–1.10.2016, Wien, Österreich

Europe Biobank Week – Biobanking for Health Innovation, 13.–16.9.2016, Wien, Österreich

European Association of Urology Congress, 11.–15.3.2016, München

European Congress of Virology, 19.–22.10.2016, Hamburg

European Digital Health Day, 28.4.2016, Berlin

European Population Conference, 31.8.–3.9.2016, Mainz

European Roadmap for an Algae-based industry, 6.–8.4.2016, Olhão, Portugal

EuroTox 2016, 4.–7.9.2016, Sevilla, Spanien

Fachtagung »Exzellente Wissenschaft«, 19.5.2016, Dresden

FNANO16, 13th Annual Conference on Foundations of Nanoscience, 11.–14.4.2016, Snowbird, USA

Fraunhofer IZI Attract Day, 3.1.2016, Leipzig

Fraunhofer IZI Science Day, 16.6.2016, Leipzig

Frontiers in Medicinal Chemistry, 13.–16.3.2016, Bonn

Funktionsintegration in Kunststoffe, 17.11.2016, Potsdam

Future Medicine Science Match, 7.11.2016, Berlin

Girls'Day 2016, 28.4.2016, Leipzig

Gordon Research Conference – Computational Chemistry 2016, 24.–29.7.2016, Girona, Spanien

Hwasun International Vaccine Forum, 10.–11.6.2016, Hwasun, Südkorea

ICI 2016 – International Congress of Immunology, 21.–26.8.2016, Melbourne, Australien

IGSTC Conference, 12.10.2016, Neu Delhi, Indien

IGSTC Midardi Symposium, 27.6.2016, Potsdam

IntelliCyt European User Group Meeting, 26.–27.10.2016, London, Großbritannien

Intelligent Systems for Molecular Biology (ISMB), 8.–12.7.2016, Orlando, USA

Interdisziplinärer Workshop »Organisches Reststoffrecycling – Integrierte Bioanalytik«, 21.9.2016, Leipzig

International Symposium on Computational Biology and DNA Computing, 26.11.2016, Gandhinagar, Indien

International Symposium Salmonella and Salmonellosis, 6.–8.6.2016, Saint Malo, Frankreich

International Technology Forum »In vitro-Diagnostics and Bioanalysis« 2016: Diagnostics in the Era of Big Data and Systems Biology, 5.–6.10.2016, Potsdam

ISBER 2016 Annual Meeting & Exhibits, 5.–8.4.2016, Berlin

ISMRM 24th Annual Meeting & Exhibition, 7.–13.5.2016, Singapur, Singapur

IWHM5 – International Workshop on Humanized Mice, 28.–30.1.2016, Zürich, Schweiz

Jahreskongress Biotechnologie 2020+, 11.–12.10.2016, Jena

Jahrestagung der Deutschen Gesellschaft für Virologie, 6.–9.4.2016, Münster

Keystone Symposia »Exosomes / Microvesicles: Novel Mechanisms of Cell-Cell Communication (E4)«, 19.–22.6.2016, Keystone, USA

Kick-Off Meeting glyconet Berlin-Brandenburg e. V., 5.12.2016, Berlin

Korean-German Joint Symposium, CNUHH, 26.9.2016, Gwangju, South Korea

Life Science Conference, 14.–15.6.2016, Jena

MacoBio Summer School 2016 »Biomaterial Interfaces – Where Biology meets Chemistry«, 19.–23.9.2016, Potsdam

MEDICA 2016, 12.–15.11.2016, Düsseldorf

Medizin Innovativ – MedTech Summit 2016, 15.–16.6.2016, Nürnberg

Meet and Leap – Bridging Biotech and biodiv Research: Joint poster session of BBZ and iDiv, 2.12.2016, Leipzig

Microbiome Science Day, 7.–8.10.2016, Berchtesgarden

Microfluidics 2016, 24.–26.7.2016, Heidelberg

Micropscopy symposium »Imaging Techniques in Cell Biology – From single molecules to subcellular departments«, 30.9.2016, Magdeburg

microTAS 2016 Conference, 9.–13.10.2016, Dublin, Irland

Mobile Diagnostik am Point-of-Care 2016, 1.6.2016, Frankfurt am Main

Molecular Med TRI-CON 2016, 6.–11.3.2016, San Francisco, USA

NCBS Annual Postdoctoral Symposium, 18.11.2016, Bangalore, Indien

Neuroscience 2016, 12.–16.11.2016, San Diego, USA

Next Generation Microarrays Live Tour 2016, 22.11.2016, Potsdam

PEGS Boston, the essential protein engineering summit, 25.–29.4.2016, Boston, USA

PEGS Europe, Protein & Antibody Engineering Summit, 31.10.–4.11.2016, Lissabon, Portugal

PerMediCon, 30.11.–1.12.2016, Köln

Point-of-Care Diagnostics & Global Health World Congress 2016, 26.–28.9.2016, San Diego, USA

Potsdam Colloquium 2016: Current developments in viral diseases and virus diagnostics, 30.11.2016, Potsdam

ProcessNet-Jahrestagung und 32. DECHEMA-Jahrestagung der Biotechnologen 2016, 12.–15.9.2016, Aachen

Proteolytic Enzymes & Their Inhibitors, Gordon Research Conference, 26.6.–1.7.2016, Lucca, Italien

RNA Biochemistry Meeting 2016 & Workshop »Extracellular RNA«, 6.–9.10.2016, Bonn

Science Word 2016, 1.6.2016, Berlin

Single Cell Technologies 2016, 3.–6.6.2016, Frankfurt am Main

Snow Algae Meeting (SAM) 2016, 18.–19.5.2016, Potsdam

Soft Matter Day 2016, 10.6.2016, Leipzig

Summer course »Volcanism, Plate Tectonics, Hydrothermal Vents and Life«, 23.8.–1.9.2016, Angra do Heroismo, Azores (Portugal)

Tag der offenen Tür, Zahnklinik Leipzig, 5.11.2016, Leipzig

The Oxford Chemical Immunology Conference, 4.–5.4.2016, Oxford, England

Treffen der Tierärztlichen Vereinigung für Tierschutz e.V., 3.6.2016, Fulda

Tumor Immunology Meets Oncology XII, 28.–30.4.2016, Halle (Saale)

RESEARCH PARTNERS

UGM & Conference 2016 Europe, 17.–20.5.2016, Wien, Österreich

Workshop »An ANTIDotE for tickborne diseases«, 3.6.2016, Potsdam

Workshop on Arthropod-Borne Diseases 2016, 29.–30.9.2016, Jena

World Preclinical Congress Europe, 14.–16.11.2016, Lissabon, Portugal

xMAP Connect 2016, 16.–17.11.2016, Amsterdam, Niederlande

XVth International Symposium on Proteases, Inhibitors and Biological Control, 17.–21.9.2016, Portorož, Slovenien

XXIV EFMC International Symposium on Medicinal Chemistry (EFMC-ISMC 2016), 28.8.–1.9.2016, Manchester, UK

AIT Austrian Institute of Technology, Wien, Österreich

Albert-Ludwigs-Universität Freiburg, Freiburg

Alfred-Wegener-Institut, Helmholtz-Zentrum für Polar- und Meeresforschung, Helgoland

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Biomedical Primate Research Centre, Rijkswijk, Niederlande

Brandenburgische Technische Universität Cottbus-Senftenberg, Senftenberg

Brigham & Women's Hospital, Harvard Medical School, Boston, USA

Bundesanstalt für Materialforschung und -prüfung, Berlin

Bundesinstitut für Risikobewertung, Berlin

Caritas Hospital St. Josef, Universität Regensburg, Regensburg

Centre for advanced molecular imaging, Melbourne, Australien

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Centro Tecnológico L'Urederra, Navarra, Spanien

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Chonnam National University Medical School, Hwasun, Südkorea

CIDEIM Centro Internacional de Entrenamiento e Investigaciones Medicas, Cali, Kolumbien

Competence Center for scalable data services and solutions ScaDS, Dresden / Leipzig

Dalian Muncipal Hospital, Dalian, China

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Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR) in der Helmholtzgemeinschaft, Berlin

Deutsches Zentrum für Neurodegenerative Erkrankungen e. V. (DZNE), Berlin

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ETH Zurich, Basel, Schweiz

Fachhochschule Aachen, Jülich

Fachhochschule Brandenburg, Brandenburg

Fachhochschule Hannover, Hannover

Fachhochschule Nordwestschweiz, Hochschule für Life Sciences FHNW, Muttenz, Schweiz

Fachhochschule Potsdam, Potsdam

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Helmholtz-Zentrum Potsdam, Deutsches Geoforschungszentrum GFZ, Potsdam

Herzzentrum Leipzig - Universitätsklinik, Leipzig

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Hochschule Bremerhaven, Bremerhaven

Hochschule für angewandte Wissenschaften Coburg, Coburg

Hochschule für Technik, Wirtschaft und Kultur Leipzig, Leipzig

Hochschule Furtwangen, Villingen-Schwenningen

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Innovations for High Performance Microelectronics, Leibniz-Institut für innovative Mikroelektronik, Frankfurt (Oder)

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Institut für Bioprozess- und Analysenmesstechnik (iba) e.V., Heilbad Heiligenstadt

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Makerere University Kampala, Kampala, Uganda

Martin-Luther-Universität Halle-Wittenberg, Halle (Saale)

Max-Delbrück-Center für Molekulare Medizin MDC, Berlin

Max Planck Institute for Chemical Ecology, Jena

Max-Planck-Institut für evolutionäre Anthropologie, Leipzig

Max-Planck-Institut für Kognitions- und Neurowissenschaften, Leipzig

Max-Planck-Institut für Molekulare Zellbiologie und Genetik, Dresden

Max-Planck-Institut für Psychiatrie, München

McMaster University, Hamilton, Kanada

McMaster University and St. Joseph's Healthcare, Hamilton, Kanada

Medizinische Universität Graz, Graz, Österreich

Monash University, Melbourne, Australien

Multitel, Mons, Belgien

National Centre for Scientific Research »Demokritos«, Athen, Griechenland

National Institute for Standards and Technology (NIST), Gaithersburg, USA

North German Tumor Bank of Colorectal Cancer, Lübeck

Nottingham Trent University, Nottingham, Großbritannien

Oslo University Hospital, Oslo, Norwegen

Ospedale San Raffaele, Mailand, Italien

Otto-von-Guericke Universität Magdeburg, Magdeburg

Paul-Flechsig-Institut für Hirnforschung, Leipzig

Pilot Pflanzöltechnologie Magdeburg e.V., Magdeburg

Potsdam Institut für Klimafolgenforschung, Potsdam

Rheinische Friedrich-Wilhelms-Universität Bonn, Bonn

Rheinisch-Westfälische Technische Hochschule (RWTH) Aachen, Aachen

Robert Koch Institut, Berlin

Rudolf-Boehm-Institut für Pharmakologie und Toxikologie, Leipzig

Ruhr-Universität Bochum, Bochum

Sächsisches Landesamt für Umwelt, Landwirtschaft und Geologie, Köllitsch

Skåne University Hospital, Malmö, Schweden

St. Elisabeth-Krankenhaus Leipzig, Akademisches Lehrkrankenhaus der Universität Leipzig, Leipzig

Technische Universität Berlin, Berlin

Technische Universität Carolo Wilhelmina zu Braunschweig, Braunschweig

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Università degli studi di Padova, Padua, Italien

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Universität Zürich, Zürich, Schweiz

Universitätsklinikum Carl Gustav Carus an der Technischen Universität Dresden, Dresden

Universitätsklinikum des Saarlandes, Homburg

Universitätsklinikum Erlangen, Erlangen

Universitätsklinikum Essen (AöR), Essen

Universitätsklinikum Halle (Saale), Halle (Saale)

Universitätsklinikum Hamburg-Eppendorf (UKE), Hamburg

Universitätsklinikum Jena, Jena

Universitätsklinikum Leipzig AöR, Leipzig

Universitätsklinikum Regensburg AöR, Regensburg

Universitätsklinikum Schleswig-Holstein, Kiel

Universitätsmedizin Göttingen, Göttingen

Université Paris 13, Paris, Frankreich

Universiteit Gent, Gent, Belgien

Universitetet i Bergen, Bergen, Norwegen

Universitetet i Oslo, Oslo, Norwegen

University of Belgrade, Belgrad, Serbien

University of California, Los Angeles / San Diego, USA

University of Cambridge, Cambridge, Großbritannien

University of Illinois at Chicago, Chicago, USA

University of Oxford, Oxford, Großbritannien

University of Texas, Houston, TX, USA

Wageningen UR, Wageningen, Niederlande

Washington University School of Medicine, St. Louis, USA

Western University, London, Kanada

INDUSTRY PARTNERS

2bind GmbH, Regensburg

3B Pharmaceuticals GmbH, Berlin

A4F, AlgaFuel, SA, Lissabon, Portugal

Affimed GmbH, Heidelberg

AJ Roboscreen GmbH, Leipzig

AKT Angewandte Kommunikationstechnik GmbH, Beucha

ALS Automated Lab Solutions GmbH, Jena

AMSilk GmbH, Planegg

Analytik Jena AG, Jena

AnaPath GmbH, Oberbuchsiten, Schweiz

ANT Neuro HQ, Enschede, Niederlande

APC AG, Nürnberg

AptaIT GmbH, München

ASA Spezialenzyme GmbH, Wolfenbüttel

Baxter Deutschland GmbH, Unterschleißheim

Bayer AG, Monheim

Becit GmbH, Bitterfeld-Wolfen

Befort Wetzlar OD GmbH, Wetzlar

BellaSeno GmbH, Leipzig

Berthold Technologies GmbH & Co.KG, Bad Wildbad

BEST-Sabel-Bildungszentrum GmbH, Berlin

Biametrics GmbH, Tübingen

Bill and Melinda Gates Foundation, Seattle, USA

BioGenes GmbH, Berlin

BIOSYNTAN GmbH, Berlin

BioTeZ Berlin Buch GmbH, Berlin

Bombastus-Werke AG, Freital

BRUKER DALTONIK GmbH, Bremen

BST Bio Sensor Technology GmbH, Berlin

Cellavent GmbH, Düsseldorf

CellTrend GmbH, Luckenwalde

C-Lecta GmbH, Leipzig

co.don AG, Teltow

Cognate Bio Services, Inc., Memphis, USA

Cognate Bioservices GmbH, Leipzig

Compart Umwelttechnik GmbH, Weißenfels

CONGEN Biotechnologie GmbH, Berlin

DMCE GmbH & Co KG, Linz, Österreich

DOKAtec GmbH, Sömmerda

Dr. Michael Himmelhaus – NanoBioAnalytics, Berlin

Enzo Life Sciences (ELS) AG, Lausen, Schweiz

Epiontis GmbH, Berlin

Erdmann Technologies GmbH, Berlin

ERT-OPTIK Dr. Thiel GmbH, Ludwigshafen

EurA Consult AG, Ellwangen

Experimental Pharmacology & Oncology Berlin-Buch GmbH, Berlin

First Sensor AG, Berlin

Fresenius Kabi Deutschland GmbH, Bad Homburg

GATTAquant GmbH, Braunschweig

Geräte- und Vorrichtungsbau Spitzner OHG, Leipzig

GESA Automation GmbH, Teuchern

GeSiM – Gesellschaft fuer Silizium-Mikrosysteme mbH, Radeberg

Grünenthal GmbH, Aachen

GVG Diagnostics GmbH, Leipzig

Hybrotec GmbH, Potsdam

IBA GmbH, Göttingen

Idifarma Desarrollo Farmacéutico, S.L., Navarra, Spanien

IDT Biologika GmbH, Dessau-Roßlau

ifeu - Institut für Energie- und Umweltforschung Heidelberg GmbH, Heidelberg

ILBC GmbH, Potsdam

Immunic GmbH, Halle (Saale)

IMT Masken und Teilungen AG, Greifensee, Schweiz

in.vent DIAGNOSTICA GMBH, Hennigsdorf

Institut für Systemisch-Integrative Lerntherapie, Leipzig

InVivo Biotech Services GmbH, Berlin

IOI Oleochemicals GmbH & Co. KG, Witten

Ionera Technologies GmbH, Freiburg

IPDx GmbH, Leipzig

Ipratech SA, Mons, Belgien

KET Kunststoff- und Elasttechnik GmbH, Radeberg

Lipocalyx GmbH, Halle (Saale)

M2-Automation, Berlin

MAHLE InnoWa GmbH, Schwaikheim

Medichema GmbH, Chemnitz

Medipan GmbH, Dahlewitz / Berlin

Mibelle Biochemistry, Mibelle AG, Buchs, Schweiz

MicroDiscovery GmbH, Berlin

microfluidic ChipShop GmbH, Jena

Micro-Hybrid Electronic GmbH, Hermsdorf

nal von minden GmbH, Regensburg

Nanion Technologies GmbH, München

NATEX Prozesstechnologie GesmbH, Ternitz, Österreich

Nomad Bioscience GmbH, Halle (Saale)

Northwest Biotherapeutics GmbH, Leipzig

Northwest Biotherapeutics, Inc., Bethesda, USA

Novavax AB, Uppsala, Schweden

NTG Neue Technologien GmbH & Co. KG, Gelnhausen

Nuvo Research GmbH, Leipzig

opTricon – Entwicklungsgesellschaft für Optische Technologien mbH, Berlin

PharmGenomics GmbH, Mainz

pluriSelect Life Science UG (haftungsb.) & Co.KG, Leipzig

PolyAn GmbH, Berlin

PolyBatics, Ltd., Palmerston, Neuseeland

PolyQuant GmbH, Bad Abbach

Praxis Pharmaceutical S.A., Miñano, Spanien

preclinics GmbH, Potsdam

Probiodrug AG, Halle (Saale)

qpa bioanalytics GmbH, Berlin

quartett Immunodiagnostika, Biotechnologie + Kosmetik Vertriebs GmbH, Berlin

Quimatryx S.L., San Sebastian, Spanien

Rathenower Optik GmbH, Rathenow

RedHill Biopharma Ltd., Tel Aviv, Israel

ReliaTech Receptor Ligand Technologies GmbH, Wolfenbüttel

RESprotect GmbH, Dresden

RIPAC-LABOR GmbH, Potsdam

Roche Glycart AG, Schlieren, Schweiz

RS Zelltechnik GmbH, Leipzig

Sabel-Schülerzentrum, Dresden / Freital

Sartorius Stedim Biotech AG, Göttingen

SB ScienceManagement UG haftungsbeschränkt (SBSM), Berlin

SCIENION AG, Berlin

scienova GmbH, Jena

Secopta GmbH, Berlin

Securetec Detektions-Systeme AG, München

SelfDiagnostics Deutschland GmbH, Leipzig

Seramun Diagnostica GmbH, Heidesee

Siemens AG, München / Erlangen

Surflay Nanotec GmbH, Berlin

Syngenta International AG, Basel, Schweiz

VacCell-Bio, Hwasun, Südkorea

Vita 34 AG, Leipzig

Vita 34 AG, Geschäftsbereich BioPlanta, Leipzig

We love apps, Erfurt

Wrig Nanosystems GmbH, Leipzig

Yumab GmbH, Braunschweig

ZELLMECHANIK DRESDEN GmbH, Dresden

ADVANCED VOCATIONAL TRAINING

3rd Amnis Imaging Flow Cytometry User Meeting & Workshop, Merck KGaA, Berlin

3rd PEI-DKTK Workshop »Regulatory issues relating to the development and clinical application of CAR and TCR gene-modified ATMPs«, Paul-Ehrlich-Institut, Langen

45. Seminar über Versuchstiere und Tierversuche, Bundesinstitut für Risikobewertung, Berlin

9. Fortbildungsveranstaltung der GV-SOLAS für Tierschutzbeauftragte und Behördenmitglieder, Gesellschaft für Versuchstierkunde, Leipzig

Abweichungen und CAPA, gmp-experts Dipl.-Ing. Rudloff, Dr. Volkland GmbH, Karlsruhe

Adoptive T cell therapy, SFB TR36 - Charité-Universitätsmedizin Berlin, München

Application User Meeting iQue, IntelliCyt Corp., London, Großbritannien

Arbeitsschutz, Fraunhofer-Gesellschaft, Potsdam

Autumn School, Deutsche Gesellschaft für Immunologie e. V., Merseburg

Basiswissen GxP (GMP; GLP), Klinkner & Partner GmbH, Potsdam

BD on the road »Next generation Flow Cytometry«, BD (Becton, Dickinson and Company), Leipzig

Bilaterale ZIM-Programme. Eine Fördermöglichkeit für internationale Forschungskooperationen, Berlin Partner für Wirtschaft und Technologie GmbH, Berlin

Bildungskongress für Technische Assistentinnen und Technische Assistenten, BBB Management GmbH Campus Berlin-Buch, Berlin

Challenges, Insights, and Future Directions for Mouse and Humanized Models in Cancer Immunology and Immunotherapy, Society for Immunotherapy of Cancer, National Harbor, USA

Clinical Immunology Course, International Congress of Immunology, Melbourne, Australien

Committee for Advanced Therapies (CAT) workshop: scientific and regulatory challenges of genetically modified cell-based cancer immunotherapy products, European Medicines Agency (EMA), online

Computational Tools for Single-Cell Transcriptomics, Helmholtz-Zentrum München GmbH, München

Computervalidierung Modul 1: Grundlagen, Regeln, GAMP 5, PTS Training Service, Unna

DAB-Färbungen, Paul-Flechsig-Institut für Hirnforschung, Leipzig

Data Integrity: Aktuelle Anforderungen an den GMP gerechten Daten-Lebenszyklus (CV29), Concept Heidelberg GmbH, Mannheim

Datenschutzschulung – Datenschutzgrundwissen, Fraunhofer-Gesellschaft, Leipzig

DFG-Projektakademie Ingenieurwissenschaften, Deutsche Forschungsgemeinschaft, Göttingen / Bonn

Die Leitung der Herstellung, Concept Heidelberg GmbH, Berlin

Die Leitung der Qualitätskontrolle, Concept Heidelberg GmbH, Heidelberg

Die Maus als Versuchstier, Das Schwein im Tierversuch (inkl. Xenotransplantation), Universität Leipzig, Leipzig

Dokumentenmanagement: GMP-konforme Konzepte und Systeme (D8), Concept Heidelberg GmbH, Mannheim

Durchflusszytometrie, PromoCell GmbH, Heidelberg

Effiziente Lieferantenqualifizierung (QS 9), Concept Heidelberg GmbH, Hamburg

EMBL Course »Next Generation Sequencing: RNA Sequencing Library Preparation«, EMBL, Heidelberg

EMBO Kurs Lichtblattmikroskopie, EMBO, Dresden

Erste Hilfe (Grundlehrgang / Fortbildung), Deutsches Rotes Kreuz e. V., Halle (Saale) / Potsdam / Weißenfels

Ethische Aspekte von Tierversuchen, Universität Leipzig, Leipzig

Ethische Aspekte von Tierversuchen, Universität Leipzig, Leipzig

Fach- & Sachkunde Laserschutz, Akademie für Lasersicherheit Berlin, Berlin

Fachkunde Gefahrstoffe (Gefahrstoffbeauftragter) – Einstufung, Kennzeichnung, Lagerung und innerbetrieblicher Transport, TÜV SÜD Akademie GmbH, Leipzig

FACS-Kurs FC500, Beckman Coulter GmbH, Krefeld

FELASA-B Kurs, Martin-Luther-Universität Halle-Wittenberg, Halle (Saale)

Fortbildung zum Projektleiter und Beauftragten für die biologische Sicherheit gem. §15 GenTSV, Universität Leipzig, Leipzig

Fortbildungsveranstaltung nach §15 GenTSV, BioMedConcept GmbH, Berlin

Führen mit Erfahrung – Baustein Leadership, Fraunhofer-Gesellschaft, Hamburg

Führen mit Erfahrung – Baustein Selbststeuerung, Fraunhofer-Gesellschaft, Köln

Funktionelle und neuartige Lebensmittel, Dechema Gesellschaft für Chemische Technik und Biotechnologie e.V., Frankfurt am Main

GCP-Kurs, Prüfarzt, Universitätsmedizin Rostock, Rostock

Gentechnik und Biologische Sicherheit, Universität Leipzig, Leipzig

GLP-Schulung, Fraunhofer IZI, Leipzig

GMP für pharmazeutische Entwicklung und Herstellung klinischer Prüfpräparate, PTS Training Service, Baden-Baden

GMP in der Qualitätskontrolle, Concept Heidelberg GmbH, Heidelberg

GMP-gerechte Wartung / Instandhaltung (PT3), Concept, Heidelberg GmbH, Heidelberg

Grundkurs der ICAO/IATA DRG Gefahrgutvorschriften der Personalkategorie Pk1, Gefahrgut Service Nord, Leipzig

Grundkurs der Versuchstierkunde mit den Schwerpunkten Maus und Ratte, Universität Leipzig, Leipzig

Grundkurs für Auditoren, Klinkner & Partner GmbH, Potsdam

Grundlagenseminar Medizinprodukte, BIO-NET LEIPZIG Technologietransfergesellschaft mbH, Leipzig

HIV in humanized mice, Taconic Biosciences, GmbH, online

HIV Persistence, Elsevier B.V., online

Hygienebeauftragte Block 1 (H1), Concept Heidelberg GmbH, Karlsruhe

IATA DGR Gefahrgut Lufttransport P1/2 mit Radioaktivität, AFK - International GmbH, Berlin

Immunhistochemische Färbemethoden, PromoCell GmbH, Heidelberg

Industrieakquise, Fraunhofer-Gesellschaft, Berlin

Informationstreffen für Tierexperimentatoren, Martin-Luther-Universität Halle-Wittenberg, Halle (Saale)

Inhouse Schulung Audit/SI, PTS Training Service, Leipzig

IP Management – Rechtssichere Gestaltung, Fraunhofer-Gesellschaft, Dresden

ISCT 2016 Annual Meeting, International Society for Cellular Therapy, Singapur, Singapur

IT-Sicherheitsbeauftragten (ITSiBe) / Information Security Officer (ISO) gemäß ISO/IEC 27001 und BSI IT-Grundschutz, Akademie der DGI Deutsche Gesellschaft für Informationssicherheit AG, Berlin

Jahrestagung der Arbeitsgemeinschaft Akkreditierter Laboratorien, Arbeitsgemeinschaft Akkreditierter Laboratorien, München

Klinisches Seminar – Mammakarzinom, Universitätsklinikum Leipzig, Leipzig

Kryokonservierung und In vitro-Fertilisation, Berliner Kompaktkurse, Berlin

QM-Basiskurs für Labormitarbeiter/innen, Klinkner & Partner GmbH, Potsdam

Qualifizierung von Analysegeräten, Klinkner & Partner GmbH, Potsdam

Qualität im Dialog, Testo industrial services GmbH, Hamburg

Qualitätsaspekte bei der Herstellung von ATMP, Beuth Hochschule für Technik Berlin, Berlin

Regulatorische Aspekte bei der Entwicklung Therapeutischer Impfstoffe gegen Krebs, Paul-Ehrlich-Institut, Langen

Reinigungsvalidierung – aktuelle Aspekte im Kontext der Revision des EU GMP Annex15, CUP Laboratorien Dr. Freitag GmbH, Dresden

Richtig sterilisieren im Labor, Fraunhofer-Gesellschaft, Leipzig

Risikomanagement und Technische Dokumentation für In vitro-Diagnostika, mdc medical device certification GmbH, Berlin

Schleyer Seminar Medizinethik, Hanns Martin Schleyer-Stiftung, Berlin

Science on Stage Festival 2016, Science on Stage Deutschland e.V., Berlin

Sicherheitsbeauftragte in technisch ausgestatteten Unternehmen: Einführungsseminar, Verwaltungs-Berufsgenossenschaft (VBG), Tangermünde

Single-Use Disposables 2016, Concept Heidelberg GmbH, Heidelberg

Softwarekurs Aspect UV, Analytik Jena AG, Jena

Sommersymposium der Brustzentren Halle/Weißenfels, Brustzentren Weißenfels / Halle, Halle

SOPs und QM-Dokumentation im Labor, Klinkner & Partner GmbH, Potsdam

Sprachkurs Englisch, LSI World of Languages GmbH, Leipzig

Tierversuchsplanung und das 3R-Prinzip, Fraunhofer IZI, Leipzig

Tumor immunology, Deutsche Gesellschaft für Immunologie e. V., Halle (Saale)

Ultraschall-Trächtigkeitsuntersuchung Maus, Universitätsklinikum Frankfurt, Frankfurt am Main

Vertragsgestaltung bei Forschungs- und Entwicklungsprojekten, Fraunhofer-Gesellschaft, Leipzig

Vorlesung Labortierkunde, Universität Leipzig, Leipzig

Wissenschaftliches Schreiben und Publizieren, Fraunhofer IZI, Leipzig

Workshop Dialyse 2.0, Fraunhofer IZI, Berlin

Workshop Gen-basierte Therapien, Paul Martini Stiftung, Berlin

Workshop Nahtkurs, Gesellschaft für Versuchtstierkunde, Leipzig

Workshop Pre-clinical models for immuno-oncology research, The Jackson Laboratory, Heidelberg

TEACHING ACTIVITIES

Beuth Hochschule für Technik Berlin

Ausgewählte Kapitel der Biotechnologie: Zellfreie Proteinsynthese (Vorlesung), Dr. Stefan Kubick

Ernst-Abbe-Hochschule Jena

Datenbanken (Vorlesung), B.Eng. Thomas Fritzsche

Grundlagen der Elektrotechnik (Praktikum), B.Eng. Thomas Fritzsche

Fraunhofer IZI

Tierexperimenteller B-Kurs nach Vorgaben der FELASA (Kurs), Dr. Thomas Grunwald

Tierversuchsplanung und das 3R-Prinzip (Seminar), Dr. Thomas Grunwald, Dr. Franziska Lange, Dr. Thomas Keller

Freie Universität Berlin

Membranproteine: Klassifizierung, Struktur und Funktion (Vorlesung, Seminar), Dr. Stefan Kubick

Zellfreie Synthese von Membranproteinen (Seminar, Praktikum), Dr. Stefan Kubick

Hochschule Anhalt

Entwicklung und Herstellung therapeutischer monoklonaler Antikörper (im Rahmen der VL Trends in der Biotechnologie) (Vorlesung), Dr. Jörg Lehmann

Proteinbiotechnologie (Vorlesung), Prof. Dr. Hans-Ulrich Demuth

Tiermodelle in nicht-klinischen Prüfungen von zellbasierten Therapeutika (im Rahmen der VL Trends in der Biotechnologie) (Vorlesung), Dr. Jörg Lehmann

Hochschule für Technik, Wirtschaft und Kultur Leipzig

Biometrische Planung und Analyse Biomedizinischer Experimente (Vorlesung, Praktikum), Prof. Dr. Ulf-Dietrich Braumann

Bioreaktoren (Vorlesung, Praktikum), Prof. Dr. Ulf-Dietrich Braumann, Dr. Dirk Kuhlmeier, Dr. Claire Fabian, Lukas Rositzka

Digitale Bildverarbeitung (Vorlesung, Praktikum), Prof. Dr. Ulf-Dietrich Braumann

Mikroskopische Bildgebung (Vorlesung, Praktikum), Prof. Dr. Ulf-Dietrich Braumann

Mikroskopische Bildverarbeitung (Vorlesung, Praktikum), Prof. Dr. Ulf-Dietrich Braumann

Mikroskopische Bildgebung (Vorlesung), Dr. Alexander Kranz

Martin-Luther-Universität Halle-Wittenberg

Biochemie für Mediziner und Zahnmediziner (Praktikum), Dr. Holger Cynis

Vector Construction (Praktikum), Dr. Stephan Schilling

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

Molekularbiologie / Biochemie (Seminar), Dr. Holger Cynis

Projektmodul Pflanzenbiochemie für Bachelor (Praktikum), Dr. Holger Cynis

Ruhr-Universität Bochum

Immuntherapie und Prophylaxe von Infektionserkrankungen (Vorlesung), Dr. Thomas Grunwald

Virologie für Naturwissenschaftler (Vorlesung), Dr. Thomas Grunwald

Technische Universität Berlin

Membranproteine: Klassifizierung, Struktur und Funktion (Vorlesung), Dr. Stefan Kubick

Zellfreie Synthese von Membranproteinen (Praktikum), Dr. Stefan Kubick

TMF Berlin

Diskussionsforum zur Harmonisierung von S3 Anlagen von Sicherheitsstandards für S3 Laboratorien (Seminar), Dr. Thomas Grunwald

Universität Leipzig

Arzneimittelanalytik – Drug Monitoring II (Vorlesung), Dr. Mirko Buchholz

Geschichte der Naturwissenschaften unter besonderer Berücksichtigung der Pharmazie (Vorlesung), Dr. Mirko Buchholz

Gewebetypisierung / Transplantationimmunologie für Medizinstudenten (Modul QSB 4) (Kurs), Dr. Peter Ruschpler

Grundlagen der Immunologie (im Rahmen der VL Pharmazeutische Biologie) (Vorlesung), Dr. Jörg Lehmann

Immunologische Methoden (im Rahmen der VL Pharmazeutische Biologie) (Vorlesung), Dr. Jörg Lehmann

Immunologisches Praktikum, 6. Semester Humanmedizin, Immunologie Teil 3 (Praktikum), Dr. Conny Blumert

Medizinische Biotechnologie / Regenerative Medizin (Vorlesung), Prof. Dr. Frank Emmrich

Medizinische Mikrobiologie (Vorlesung), Dr. Thomas Grunwald

Molecular Nanotechnology (Seminar), Dr. David M. Smith

Molekulare Medizin (Vorlesung), Dr. Thomas Grunwald

Molekulare Medizin (Praktikum), Dr. Thomas Grunwald, Lea Bayer

Molekulare Medizin / Virologie (Praktikum), PD Dr. Sebastian Ulbert, Dr. Jasmin Fertey

Molekulare Medizin / Virologie (Vorlesung), PD Dr. Sebastian Ulbert

Neue Technologien in der Impfstoffentwicklung (Vorlesung), PD Dr. Sebastian Ulbert

Pharmazeutische Chemie für Biochemiker (Praktikum), Dr. Mirko Buchholz

Pharmazeutische und Medizinische Terminologie (Seminar), Dr. Daniel Ramsbeck

Prinzipien der Gentherapie (Vorlesung), Dr. Jana Burkhardt

QSB: Autoimmunität (Seminar), Nadja Hilger

QSB: Gewebetypisierung (Seminar), Nadja Hilger

Statistisches Lernen (Vorlesung), Dr. Kristin Reiche

Vektorübertragene Virusinfektionen (Vorlesung), PD Dr. Sebastian Ulbert

Universität Potsdam

Einführung in das Qualitätsmanagement bei der Diagnostika-Entwicklung (Vorlesung), Dr. Nenad Gajovic-Eichelmann

Schneealgen als interessante Bioressource für die Grundlagenforschung und eine industrielle Bioproduktion von Algenmetaboliten (Vorlesung), Dr. Thomas Leya

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

Zellfreie Synthese von Membranproteinen (Praktikum), Dr.Stefan Kubick

Universität Rostock

Anästhesiologie und Notfallmedizin für Zahnmediziner (Vorlesung), PD Dr. Martin Sauer

Anästhesiologie, Intensivmedizin und Schmerztherapie (Praktikum), PD Dr. Martin Sauer

Fachbegeleitendes Seminar Innere Medizin (Seminar), Prof. Dr. Steffen Mitzner

Innere Medizin I (Vorlesung), Prof. Dr. Steffen Mitzner

Wahlpflichtfach: Nephropharmakologie (Seminar), Prof. Dr. Steffen Mitzner

EVALUATOR ACTIVITIES

Acta Neuropathologica Communications, Dr. Stephan Schilling

Alzheimer Association Research Grant (AARG), Dr. Holger Cynis

Alzheimer's Association, Prof. Dr. Hans-Ulrich Demuth

American Journal of Respiratory and Critical Care Medicine, Dr. Claire Fabian

Analytical Chemistry, Dr. Eva Ehrentreich-Förster

Bioanalysis, Dr. Harald Seitz

Biochimica et Biophysica Acta (BBA), Prof. Dr. Hans-Ulrich Demuth

Biosensors and Bioelectronics, Dr. Eva Ehrentreich-Förster

BMC Bioinformatics, Dr. Kristin Reiche (Member of Editorial Board, Associated Editor)

Brain and Behaviour, Dr. Holger Kirsten

Case Reports in Oncology, PD Dr. Sebastian Ulbert

Cellular and Molecular Life Sciences, Prof. Dr. Frank Emmrich

Clinical & Experimental Immunology, Dr. Thomas Grunwald

Convergent Science Physical Oncology, Dr. David M. Smith

Cytometry Part A, Prof. Dr. Attila Tárnok (Editor-in-Chief)

DECHEMA, Temporärer Arbeitskreis »Neue Bioproduktionsmethoden«, Dr. Stefan Kubick

Deutsche Forschungsgemeinschaft, Dr. Eva Ehrentreich-Förster, Prof. Dr. Hans-Ulrich Demuth

Drug Discovery Today, Dr. Holger Cynis

Emmy Noether-Programm des Deutsche Forschungsgemeinschaft e. V., Prof. Dr. Hans-Ulrich Demuth

Engineering in Life Sciences, Dr. Stefan Kubick

Faculty 1000, Dr. Jörg Lehmann

FWF – Austrian Science Fund, PD Dr. Sebastian Ulbert

Gene Regulation and Systems Biology, Dr. Harald Seitz

glyconet Berlin-Brandenburg, Dr. Stefan Kubick

GSCN Scientific Awards, Prof. Dr. Frank Emmrich

High-Tech Gründerfonds Bonn, Dr. Mirko Buchholz, Prof. Dr. Hans-Ulrich Demuth

HSOA Journal of Forensic, Legal & Investigative Sciences, Dr. Harald Seitz

IQ Innovationspreis Mitteldeutschland, Prof. Dr. Hans-Ulrich Demuth

Journal of Alzheimer's Disease, Prof. Dr. Hans-Ulrich Demuth

Journal of Mechanical Design, Dr. David M. Smith

Journal of Medical Imaging, Prof. Dr. Ulf-Dietrich Braumann

Journal of Nanomedicine & Nanotechnology, Dr. Eva Ehrentreich-Förster

Journal of Neuroscience Research, Dr. Alexander Kranz

Journal of Proteomics & Bioinformatics, Dr. Harald Seitz

Lung Foundation Netherlands, Dr. Claire Fabian

Nature Communications, Prof. Dr. Hans-Ulrich Demuth

Neurodegenerative Disorders, Prof. Dr. Hans-Ulrich Demuth

Oncology Letters, Dr. Holger Cynis

Parasites & Vectors, PD Dr. Sebastian Ulbert, Dr. Gustavo Makert dos Santo

PeerJ, Dr. Holger Cynis, Dr. Stephan Schilling

PLoS One, Dr. Alexander Kranz, Dr. Thomas Grunwald, PD Dr. Sebastian Ulbert, Dr. Gustavo Makert dos Santo, Prof. Dr. Hans-Ulrich Demuth

Psychiatric Genetics, Dr. Holger Kirsten

Scandinavian Journal of Immunology, PD Dr. Sebastian Ulbert

Scientific Reports, Dr. Alexander Kranz

SPIE Medical Imaging: Digital Pathology Conference, Prof. Dr. Ulf-Dietrich Braumann

The Leverhulme Thrust, Dr. Thomas Leya

The Open Veterinary Science Journal, Dr. Jörg Lehmann (Editorial Board)

Toxicology in Vitro, Dr. Harald Seitz

Vaccine, Dr. Thomas Grunwald, PD Dr. Sebastian Ulbert

Vaccine Reports, PD Dr. Sebastian Ulbert

Veterinary Immunology and Immunopathology, Dr. Jörg Lehmann

ASSOCIATION MEMBERSHIPS

Alumni der Leipziger Medizinischen Fakultät e. V. – ALM, PD Dr. Stephan Fricke

Alzheimer's Association International Society to Advance Alzheimer's Research and Treatment (ISTAART), Dr. Holger Cynis

American Chemical Society (ACS), Dr. Daniel Ramsbeck, Dr. Mirko Buchholz, Prof. Dr. Hans-Uirich Demuth

American Diabetes Association (ADA), Prof. Dr. Hans-Uirich Demuth

American Physical Society (APS), Dr. David Smith

Arbeitskreis experimentelle Stammzelltransplantation, PD Dr. Stephan Fricke

Ärzte für Madagaskar e. V., Prof. Dr. Frank Emmrich

Association for Cancer Immunotherapy (CIMT), Christopher Oelkrug, Julia Zajac

biosaxony e. V., Dr. Thomas Tradler, Prof. Dr. Frank Emmrich (Vorstandsmitglied)

Biotechnologieverbund Berlin-Brandenburg e. V., Dr. Thomas Tradler

DECHEMA Gesellschaft für Chemische Technik und Biotechnologie e. V., Dr. Mirko Buchholz, Prof. Dr. Frank Emmrich, Dr. Stefan Kubick (Gründungsmitglied und stellv. Vorsitzender)

Deutsche Botanische Gesellschaft (DBG) e. V., Dr. Thomas Leya (Sektion Phykologie, Mitglied und Kassenprüfer)

Deutsche Gesellschaft für Allergologie und Klinische Immunologie (DGAKI) e. V., Dr. Elke Ueberham

Deutsche Gesellschaft für Anästhesiologie und Intensivmedizin e. V. (DGAI), PD Dr. Martin Sauer

Deutsche Gesellschaft für Biomedizinische Technik (DGBMT), Thomas Fritzsche

Deutsche Gesellschaft für Epidemiologie e. V., Dr. Holger Kirsten

Deutsche Gesellschaft für Geschichte der Pharmazie (DGGP), Dr. Mirko Buchholz

Deutsche Gesellschaft für Gute Forschungspraxis e. V. (DGGF), Martin Dähne

Deutsche Gesellschaft für Immunologie e. V. (DGfI), Aleksandra Seydel, Christopher Oelkrug, Dr. Andreas Grahnert, Dr. Franziska Lange, Dr. Jörg Lehmann (Mitarbeit im AK T-Zell-Funktionen und im AK Veterinärimmunologie), Dr. Ulla Schwertassek, Janine Kohlschmidt, Dr. Katharina Zoldan (Mitarbeit im AK Veterinärimmunologie), Lea Bayer, PD Dr. Stephan Fricke, Prof. Dr. Frank Emmrich (Vertreter der DGfI in der AWMF), Sina Riemschneider

Deutsche Gesellschaft für Massenspektrometrie e. V. (DGMS), Prof. Dr. Hans-Uirich Demuth

Deutsche Gesellschaft für Medizinische Physik (DGMP), Prof. Dr. Ulf-Dietrich Braumann

Deutsche Gesellschaft für Nephrologie e. V. (GfN), Prof. Dr. Steffen Mitzner

Deutsche Gesellschaft für Parasitologie e. V. (DGP), Dr. Markus von Nickisch-Rosenegk

Deutsche Gesellschaft für Regenerative Medizin e. V. (GRM), PD Dr. Stephan Fricke, Prof. Dr. Frank Emmrich (Vorstandsmitglied)

Deutsche Gesellschaft für Rheumatologie e. V. (DGRh), Prof. Dr. Frank Emmrich

Deutsche Gesellschaft für Stammzellforschung e. V., Prof. Dr. Frank Emmrich

Deutsche Gesellschaft für Virologie e. V. (GfV), Dr. Jasmin Fertey, PD Dr. Sebastian Ulbert

Deutsche Interdisziplinäre Vereinigung für Intensiv- und Notfallmedizin e. V. (DIVI), Prof. Dr. Steffen Mitzner

Deutsche Nucleinsäurechemiegemeinschaft e. V. (DNG), Dr. Marcus Menger

Deutsche Pharmazeutische Gesellschaft e. V. (DPhG), Dr. Daniel Ramsbeck, Dr. Julia Stäker, Dr. Mirko Buchholz

Deutsche Physikalische Gesellschaft e. V. (DPG), Carsten Schuldt, Dr. Claus Duschl, Dr. Jörg Schnauß, Martin Glaser, PD Dr. Ralph Hölzel, Tina Händler

Deutsche Sepsis-Gesellschaft e. V. (DSG), PD Dr. Martin Sauer, Prof. Dr. Steffen Mitzner

Deutsche Vereinte Gesellschaft für Klinische Chemie und Laboratoriumsmedizin e. V. (DGKL),
Prof. Dr. Frank Emmrich

Deutsche Veterinärmedizinische Gesellschaft e. V. (DVG), Anne Kühlmann

Deutsche Zoologische Gesellschaft e. V. (DZG),
Dr. Gustavo Makert dos Santo

Deutsches Institut für Normung e. V. (DIN),
Dr. Christina Schröder (autorisierte Expertin; Sprecherin AK 2 »Biobanken« des AA »Biotechnologie«)

Deutsch-Kanadische Gesellschaft e. V., Dr. Thomas Tradler

DiagnostikNet Berlin-Brandenburg e. V.,
Dr. Marcus Menger

Europäische WNV Forschungsplattform,
PD Dr. Sebastian Ulbert

European Molecular Biology Laboratory (EMBL) Alumni relations program,
PD Dr. Sebastian Ulbert

European QP Association,
Dr. Gerno Schmiedeknecht, Kati Kebbel

European Renal Association / European Dialysis and Transplantation Association (ERA-EDTA),
Prof. Dr. Steffen Mitzner

European Society for Artificial Organs (ESAO),
Prof. Dr. Steffen Mitzner

European Society for the Study of Diabetes (EASD),
Prof. Dr. Hans-Uirich Demuth

European Society for Virology (ESV), Dr. Jasmin Fertey

European, Middle-Asian and African Society for Biopreservation and Biobanking (ESBB), Dr. Christina Schröder (Councilor), Oliver Gros (Delegate)

FluType Verbundprojekt, BMBF, Prof. Dr. Frank Bier (Koordinator)

Förderverin für Medizinische Ausbildung e. V.,
Prof. Dr. Frank Emmrich

Freunde der Veterinärmedizinischen Fakultät der Universität Leipzig e. V.,
Dr. Jörg Lehmann

German QP Association,
Dr. Jörg Lehmann, Maximilian Hoffmann

German Stem Cell Network (GSCN), Prof. Dr. Frank Emmrich (Vorstandsmitglied)

Gesellschaft Deutscher Chemiker e. V. (GDCh),
Dr. Eva Ehrentreich-Förster, Dr. Marcus Menger, Dr. Michael Szardenings, Dr. Mirko Buchholz, Dr. Walter Stöcklein, Prof. Dr. Hans-Uirich Demuth (Gemeinsame Fachgruppe Chemische Biologie)

Gesellschaft für Biochemie und Molekularbiologie e. V. (GBM), Lilly Stahl, Dr. Christina Schröder, Dr. Harald Seitz, Dr. Holger Cynis, Dr. Marcus Menger, Dr. Markus von Nickisch-Rosenegk, Dr. Michael Szardenings, Dr. Stefan Kubick, Dr. Stephan Schilling, Dr. Walter Stöcklein, Prof. Dr. Frank Emmrich, Prof. Dr. Hans-Uirich Demuth

Gesellschaft für Biologische Systematik e. V. (GfBS),
Dr. Markus von Nickisch-Rosenegk

Gesellschaft für Versuchstierkunde e. V. (GV-SOLAS),
Dr. Jörg Lehmann, Dr. Thomas Grunwald, Sarah Leitenroth

Gesellschaft für Virologie e. V. (GfV), Dr. Thomas Grunwald

glyconet Berlin-Brandenburg e. V., Dr. Stefan Kubick (Gründungsmitglied und Vorstandsvorsitzender)

Institute of Electrical and Electronics Engineers (IEEE),
Prof. Dr. Ulf-Dietrich Braumann

International Dyslexia Association, Dr. Arndt Wilcke

International Proteolysis Society (IPS),
Prof. Dr. Hans-Uirich Demuth

International Society for Cellular Therapy (ISCT),
Dr. Gerno Schmiedeknecht (Mitglied EU LRA Committee)

International Society for Magnetic Resonance in Medicine (ISMRM),
Dr. Alexander Kranz

International Society for Nanoscale Science, Computation and Engineering (ISNSCE), Dr. David Smith

International Society for Optics and Photonics (SPIE),
Prof. Dr. Attila Tárnok (Ernennung zum Fellow)

International Society of Psychiatric Genetics (ISPG),
Bent Müller

International Society on Aptamers (INSOAP),
Dr. Marcus Menger (Direktor im Executive Committee)

International Union for the Study of Social Insects,
Dr. Gustavo Makert dos Santo

Leipziger Inititative für Biotechnologie e. V.,
Prof. Dr. Frank Emmrich (Vorstandsvorsitzender)

Leipziger Stiftung für Innovation und Technologietransfer,
Prof. Dr. Frank Emmrich

MEDICA Deutsche Gesellschaft für Interdisziplinäre Medizin e. V.,
Prof. Dr. Frank Emmrich

mHealth-Dx Netzwerk, BMWi,
Prof. Dr. Frank Bier (Koordinator)

Nationale Forschungsplattform für Zoonosen,
Alexandra Rockstroh, Dr. Gustavo Makert dos Santo, PD Dr. Sebastian Ulbert

Neurowissenschaftliche Gesellschaft e. V. (NWG),
Dr. Anna Leichsenring

Regenerative Medicine Initiative Germany (RMIG),
Prof. Dr. Frank Emmrich (Sprecher)

Rotary Club Leipzig,
Prof. Dr. Frank Emmrich (Incoming President)

Society for Neuroscience (SfN), Dr. Holger Cynis, Prof. Dr. Hans-Uirich Demuth

The New York Academy of Sciences,
Prof. Dr. Hans-Uirich Demuth

The Protein Society (PS),
Prof. Dr. Hans-Uirich Demuth

Verband der Elektrotechnik Elektronk Informationstechnik e.V. (VDE), Thomas Fritzsche

Verein zur Förderung der Gesundheitswirtschaft in der Region Leipzig e. V. (VfG),
Prof. Dr. Frank Emmrich (Vorstandsmitglied)

Vereinigung für Allgemeine und Angewandte Mikrobiologie (VAAM),
Dr. Walter Stöcklein

Vereinigung von Freunden und Förderern der Univeristät Leipzig e. V.,
Prof. Dr. Frank Emmrich

Zentrale Tierschutzkommission der Landesdirektion Sachsen in Leipzig,
Dr. Jörg Lehmann

Zentrum für Molekulare Diagnostik und Bioanalytik (ZMDB), Prof. Dr. Frank Bier (Vorstand, Sprecher Technologie)

PUBLICATIONS

Bader D, Klier DT, Hettrich C, Bier FF, Wessig P. **Detecting carbohydrate-lectin interactions using a fluorescent probe based on DBD dyes.** Analytical methods. 8 (2016), 6, S. 1235-1238. doi: 10.1039/C5AY02991K

Bavli D, Prill S, Ezra E, Levy G, Cohen M, Vinken M, Vanfleteren J, Jaeger M, Nahmias Y. **Real-time monitoring of metabolic function in liver-on-chip microdevices tracks the dynamics of mitochondrial dysfunction.** Proceedings of the National Academy of Sciences of the United States of America : PNAS. 113 (2016), 16, S. E2231-E2240. doi: 10.1073/pnas.1522556113

Becker A, Eichentopf R, Sedlmeier R, Cynis H, Koch B, Stephan A, Bäuscher Ch, Kohlmann S, Hoffmann T, Kehlen A, Berg S, Freyse EJ, Osmand A, von Hörsten St, Graubner S, Demuth HU, Schilling S. **IsoQC (QPCTL) knock out mice suggest differential substrate conversion by glutaminyl cyclase isoenzymes.** Biological Chemistry. 397 (2016), 1, S. 45-55. doi: 10.1515/hsz-2015-0192

Boltze J, Wagner DC, Barthel H, Gounis M. **Academic-industry collaborations in translational stroke research.** Translational Stroke Research. 7 (2016), 4, S. 343-353. doi: 10.1007/s12975-016-0475-5

Boltze J, Ayata C. **Challenges and controversies in translational stroke research : An introduction. Editorial.** Translational Stroke Research. 7 (2016), 5, S. 355-357. doi: 10.1007/s12975-016-0492-4

Boltze J, Wagner DC, Henninger N, Plesnila N, Ayata C. **Phase III preclinical trials in translational stroke research : community response on framework and guidelines.** Translational Stroke Research. 7 (2016), 4, S. 241-247. doi: 10.1007/s12975-016-0474-6

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Bier FF. **Biosystems integration and process automation.** Institutskolloquium Fraunhofer IMPS, Dresden, 15.9.2016

Bier FF. **Digitalisierung und konvergente Technologien in der Bioökonomie.** Workshop BioÖkonomie BMBF, Berlin 13.7.2016

Bier FF. **Immunodiagnostics meets mobile-Health - Connecting Immunoassays with mobile-Health technology – challenges and opportunities.** ANALYTICA Confernce 2016, München 11.5.2016

Bier FF. **Integration in der Bioanalytik – Neue Wege für Biosensoren und Perspektiven für die Lab-on-Chip Technologien.** TKoR-Workshop, Leipzig 21.9.2016

Bier FF. **Mobile Health trifft Diagnostik - Weiterentwicklung der Diagnostik zum Baustein der Systemmedizin im Rahmen der Digitalisierung.** mHealth-Dx Netzwerk Forum, FraunhoferForum Berlin, 20.-21.6.2016

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Demuth HU. **Session Chair: Protein Expression and post-translational modifications in neurodegeneratives disorders.** 9th International Symposium on Neuroprotection Neurorepair, 19.-22.04.2016, Leipzig, Deutschland

Demuth HU. **Vortrag: Die Saphir-Studie - Neue Behandlungsansätze in der Demenz.** Treffen der psychiatrischen Ärzte des Universitätsklinikums Halle (S.), 11.05.2015, Halle (S.), Deutschland

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Demuth HU. **Vortrag: Therapie der Alzheimer-Demenz - eine große Hoffnung kommt aus Halle.** 10. Deutsches Trauma-Update (Interessenverband der Unfallchirurgen Sachsen-Anhalt), 03.06.2016, Halle (S.), Deutschland

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Doss S, Potschka H, Mitzner S, Sauer S. **Human hepatocytes as a tool for hepatotoxicity-testing.** EuroTox 2016, 4.-7.09.2016, Sevilla, Spanien

Duschl C. **Methoden zur schonenden Prozessierung und Charakterisierung von Zellen.** Tagung »Forschung-Entwicklung – Innovation" der DPG, 6.-8. November 2016, Bad Honnef.

Duschl C. **Novel approaches for the noninvasive processing and monitoring of cells.** Konferenz »Challenges and Perspectives of Functional Nanostructures", 20.-21. Juni 2016, Ilmenau.

Duschl C. **Novel approaches for the noninvasive processing and monitoring of cells.** Helmholtz Graduate School for Macromolecular Bioscience, 19.-23. September 2016, Potsdam.

Duschl C. **Werkzeuge für die nichtinvasive Analyse, Kultivierung und Prozessierung von lebenden Zellen.** Kolloquium, 26. Januar, Ilmenau.

Emmrich F. **Perspectives and new process developments in cell therapy.** 4th International Conference on Bioprocess and Bio Therapeutics; 20.-21.10.2016, Houston, USA

Emmrich F. **Prevention of Graft versus Host Disease (GvHD) by extracorporeal immunomodulation of cellular graft.** The 6th Korea-Germany JLCI-Symposium; Sept 26, 2016; Hwasun (South Korea)

Emmrich F. **Translational perspectives for immunotherapy of cancer.** 5th Chinese-German Symposium on Immunology, 4.-8.12.2016, Dresden

Fabian C. **Cell-based therapy in age and disease.** Korean-German Joint Symposium, CNUHH, Gwangju, South Korea, 26.09.2016

Fabian C. **Zähne aus Stammzellen?** Tag der offenen Tür, Zahnklinik, Leipzig, 05.11.2016

Fertey J, Bayer L, Grunwald T, Hiller E, Bailer S, Rupp S, Pohl A, Wetzel C, Ulbert S. **Immunization with Low-Energy Electron Irradiation Inactivated Viruses Protects Mice from Influenza A Virus Infection.** GfV Workshop »Pathogenicity and Immune Control of Viral Infections«, 28.09.2016 - 30.09.2016, Tauberbischofsheim

Fertey J. **Generation of inactivated influenza virus vaccines using low-energy electron irradiation.** Jahrestagung der Gesellschaft für Virologie, 06.-09.04.2016, Münster

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Fertey J. **Pathogens inactivated by low-energy-electron irradiation maintain antigenic properties and induce protective immune responses.** 6th European Congress of Virology, 19.-22.10.2016, Hamburg

Freitas Da Cruz H. **Early detection of acute kidney injury with Bayesian networks.** 7th International Symposium on Semantic Mining in Biomedicine SMBM 2016, 4.-5.8.2016, Potsdam

Gajovic-Eichelmann N, Bier FF. **Neue elektrochemische Verfahren in der Bio- und Immunanalytik.** NEMO workshop Integrierte Bioanalyse, 3.11.2016

Gajovic-Eichelmann N. **Molecular imprinting of whole virus particles.** Potsdam Colloquium on Bioanalysis 30.11.2016

Glaser M. **Actin – one of the fundamentals of life.** Cellular Machines II: Lecture, 22.11.2016, Dresden

Glaser M, Mollenkopf P, Möser C, Schuldt C, Schnauß J, Händler T, Käs J, Smith D. **Altering Synthetic Semiflexible DNA Nanotube Networks by Tunable Cross-linking.** Meet and Leap – Bridging Biotech and biodiv Research: Joint poster session of BBZ and iDiv, 2.12.2016, Leipzig

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Glaser M. **Rheology on (cross-linked) DNA nanotube networks.** DNA Mitteldeutschland Workshop, 16.09.2016, Potsdam

Glaser M. **Self-assembly of hierarchically ordered structures in DNA nanotube systems.** PWM - Winterschool 2016, 14.3.2016, Kleinwalsertal, Austria

Greim T, Braumann UD, Muders M. **Detection and Classification of Prostate Cancer.** HEC 2016, 28.8.-2.9.2016, München

Gröger V, Niemeyer M, Wermann M, Kornhuber M, Emmer A, Staege MS, Schilling S, Demuth HU, Cynis H. **Putative role of envelope proteins from human endogenous retroviruses (HERV) in neurodegenerative diseases.** 9th International Symposium on Neuroprotection & Neurorepair, 19.-22.04.2016, Leipzig

Gros O, Thasler R, Müller TH, Schiergens TS, Schröder C. **Diagnostic free text analysis in Biobanks with CRIP.CodEx: Automated Matching of Classifications.** ISBER 2016 Annual Meetings, 5.-8.4.2016, Berlin

Gros O. **CRIP.CodEx: Knowledge extraction from free text medical records.** Europe Biobank Week 2016, 13. -16.9.2016, Wien

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Gros O. **Textmining und Datenintegration, CRIP und Fraunhofer Metabiobank.** mHealth trifft Diagnostik"-Symposiums in Berlin, 20. 21.6.2016

Gros O. **The Metabiobank CRIP and the CRIP Toolbox".** Vortrag im Forschungsseminar Wissensmanagement in der Bioinformatik – Neue Entwicklungen im Datenbankbereich und in der Bioinformatik HU Berlin, 5.7.2016

Guernth-Marschner C, Olszyna M, Daehne G, Kirschbaum M, Himmelhaus M, Daehne L and Duschl C. **A microfluidic protocol for label-free biomolecule interaction analysis by tracing whispering gallery modes in optical microresonators.** Microfluidics 2016, 24.7.-26.7.2016, Heidelberg

Habaza M, Kirschbaum M, Guernth-Marschner C, Barnea I, Korenstein R, Duschl C, and Shaked NT. **Dielectrophoretic cell rotation for label-free three-dimensional imaging of live cells in a flow-through system.** Microfluidics 2016, 24.7.-26.7.2016, Heidelberg

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Händler T, Glaser M, Golde T, Schuldt C, Schnauß J, Smith D, Käs J. **Reptation in semiflexible polymer networks.** Soft Matter Day, 10.6.2016, Leipzig

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Hettrich C, Ehrentreich-Förster E. **Rapid on-site test of ESBL-producing bacteria.** BMT2016 »Dreiländertagung« of the Swiss, Austrian and German Societies for Biomedical Engineering, 4. 6.10.2016, Basel

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Hettrich C, Rapsch K, Ehrentreich-Förster E. **Vor-Ort-Nachweis von Antibiotikaresistenzen.** 18. Heiligenstädter Kolloquium, 19. – 21.9.2016, Heilbad Heiligenstadt

Hoffmann M, Brandl M, Riemschneider S, Kohlschmidt J, Weber K, Lehmann J, Schwertassek U. **Efficacy of aryl hydrocarbon receptor-activating phytochemicals in a chronic Colitis model.** 10th European Mucosal Immunology Group Meeting, 19.-21.10.2016, Kopenhagen

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Hölzel R. **Ultra-broadband dielectric spectroscopy of biomolecules.** Kick-Off-Meeting zum DFG-Schwerpunktprogramm SPP 1857: Elektromagnetische Sensoren für Life Sciences (ESSENCE), Darmstadt 27.9.2016

Horn F, Christ-Breulmann S, Puppel S, Buschmann T, Reiche K, Specht M, Bertram C, Friedrich M, Binder S, Blumert C, Hackermüller J, Kreuz M, Löffler M, Toma M.I, Muders M, Baretton G.B, Fröhner M, Füssel S, Wirth M. **Next-generation sequencing reveals transcript clusters with prognostic potential for prostate cancer.** Annual Meeting of The American Urological Association, 06.-10.05.2016, San Diego, USA

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Jäger C, Wieczorek V, Demuth HU, Buchholz M. **The use of force field and quantum chemistry based methods to overcome the lack of structural information in PDB structures with very low resolution.** Gordon Research Conference – Computational Chemistry 2016, 24.07.- 29.07.2016, Girona, Spanien

Jérôme V, Thoring L, Salzig D, Blum S, Gruber F, Nack J, Kubick S, Freitag R. **Investigation of Factors Influencing Recombinant Human BMP2 Expression in Mammalian cells.** Dechema Jahrestagung, 20.9.2016-22.9.2016, Aachen

Kern K, Delaroque N, Fischer M, Ueberham E, Lehmannn J, Treudler R, Szardenings M. **Mapping of immunogenic and allergenic soybean protein epitopes.** PEGS Boston, the essential protein engineering summit, 25.-29.04.2016, Boston, USA

Kersting S, Grafe M, von Nickisch-Rosenegk M, Bier FF. **Highly adaptable and easy implemented multiplex loop-mediated isothermal amplification (LAMP) microplate assay for the rapid and specific detection of bacteria and viruses.** Innovation Forum Senftenberg 2016

Kirschbaum M, Guernth-Marschner C, Duschl C. **Dielectrophoresis-based microfluidic systems for live cell processing at the single-cell level.** Single Cell Technologies 2016, 2.6.-3.6.2016, Frankfurt

Kleinschmidt M, Schönfeld R, Bittner D, Metzner J, Leplow B, Demuth HU. **Combination of blood-based biomarkers and neuropsychological assess-**

ment enables reliable classification of tested subjects by controls, mild cognitive impairment and Alzheimer's disease. Molecular Biomarkers 2016, 15.-16.09. 2016, Berlin, Deutschland

Kohlschmidt J, Riemschneider S, Fueldner C, Lehmann J. **Activation of aryl hydrocarbon receptor alters differentiation and affects the immune response of bone marrow-derived macrophages.** AHR-Conference, 03.-06.08.2016, Rochester

Kubick S. **Cell-free Synthesis of Glycoproteins.** 2nd Glycobiology World Congress, Atlanta, USA, 29.8.2017

Kubick S. **Cell-free Bioproduction: Engineering Proteins for Therapy, Diagnostics and Biotechnological Applications.** Jahreskongress 2016 der Initiative »Nächste Generation biotechnologischer Verfahren – Biotechnologie 2020+«; Jena,12.10.2016

Kubick S. **Das Netzwerk Glyconet Berlin Brandenburg e.V.** BioBilanz 2016, Berlin, 1.12.2017

Kubick S. **Zellfreie Bioproduktion: Eine zukunftsweisende Technologieplattform für die Darstellung und Funktionsanalyse von Membranproteinen.** 18. Heiligenstädter Kolloquoium 19.9.-21.9.2016, Heilbad Heiligenstadt

Kubick S. **Von der Sequenz bis zur Funktion: Zellfreie Synthese von Membranproteinen.** Science World 2016, Berlin, 1.6.2016

Lenich T., Pampel A., Kranz A., Möller HE. **Towards High-Resolution Mapping of Lactate via NOE.** ESMRMB 2016; 29.09-01.10.2016; Wien, Österreich

Leya T. **The Who's Who in snow algae: Snow algal strains in current algal collections and their unresolved taxonomy.** Snow Algae Meeting 2016; 18.-19.05.2016; Potsdam (Germany)

Leya T, Jorde F, Teufelhart C, Wenzel D, Kryvenda A, Santos E, Verdelho Vieira V. **The Culture Collection of Cryophilic Algae CCCryo as a bioresource for an industrial-scale production of omega-3-fatty acids within the EU-funded project PUFAChain.** Scientific Conference of the Phycological Section of the German Botanical Society; 06.-09.03.2016; Leipzig (Germany).

Lorenz JS, Schnauß J, Glaser M, Sajfutdinow M, Schuldt C, Neundorf I, Käs JA, Smith DM. **Synthetic actin cross-linkers for control of cell dynamics.** DNA-Mitteldeutschland Symposium, 19.-21.5.2016, Jena

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Lorenz JS. **Non-genetic programming of biology by DNA.** Workshop-DNA Nanotechnology Mitteldeutschland, 12.12.2016, Leipzig

Lorenz JS. **Synthetic cross-linkers modulate mechanical dynamics of actin structures.** DNA22 International Conference 2016, September 4-8 2016, Munich, Germany

Makert GR. **An immunological strategy for the control of the poultry mite Dermanyssus gallinae.**. Vortragseinladung am FLI Jena, 15.3.2016

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Obasi CC, Sajfutdinow M, Schilling S, Smith D. **Role of enabled surface diffusion in ordering DNA Origamis on surfaces.** DNA-Mitteldeutschland Symposium, 19.-21.5.2016, Jena

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Schnauß J. **Programming the Mechanical Properties of Bionic Networks.** 7th Annual Physics of Cancer Symposium, 4-6.10.2016, Leipzig

Schnauß J. **Rheology of DNA and Actin Networks.** Soft Matter Day 2016, 10.6.2016, Leipzig, Germany

Schnauß J. **Untersuchung und Beeinflussung von Zellmigration mittels Bionischer Legosysteme.** Vorstellungsvortrag Juniorprofessur – Biophysik, 23.11.2016, Homburg

Schröder C. **How to Navigate the European (and Global) Biobanking Landscape Best?** Europe Biobank Week 2016, 13. -16.9.2016, Wien

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Smith D. **Bottom-up engineering of nanoscale devices to program biological systems.** DNA Nanotechnology 2016, 20.5.2016, Jena

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Szardenings M. **Bio meets Material.** IKTS Dresden

Szardenings M. **Cell binding peptides from statistical analysis of random peptide phage display libraries.** Physicy of Cancer, Leipzig, 4.-6.10.2016

Szardenings M. **Fingerprinting antibody epitopes: Identifying even minor variations for QC and IP.** PEGS Europe, Protein & Antibody Engineering Summit, 31.10-04.11.2016, Lisbon, Portugal

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Tradler T. **Commercialization of applied research derived IP at Fraunhofer-Gesellschaft.** Bio Taiwan 2016, 20.-22.7.16, Taipeh,

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Wilcke A. **Genetische Grundlagen der Legasthenie.** Weiterbildung des Landesverbands Sachsen Legasthenie und Dyskalkulie, 16.-18.09.2016

Wilcke A. **The genetics of dyslexia and their application in an early multimodal test.** 50. Kongress der Deutschen Gesellschaft für Psychologie, 18.-22.09.2016, Leipzig

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Wüstenhagen DA, Thoring L, Kubick S. **Fast Production of Membrane Proteins in a native like Environment using Cell-Free System based on CHO Cell Lysate.** PepTalk Tagung, 18.und 19.01.16, San Diego, USA

Zemella A, Thoring L, Kubick S. **Cell-free synthesis meets protein engineering: Current prospects in labeling of difficult-to-express-proteins.** Chemical Biology, Heidelberg, Deutschland 31.8.-3.9.2016

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BOOK ARTICLES

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GRADUATION (CLASS OF 2016)

Anders, Annika. **Identifizierung von allergenen Epitopen des β-Conglycinins der Sojabohne mittels Peptid Phage Display auf Patientenseren.** Technische Hochschule Mittelhessen, Bachelor

Bickel, David. **Strukturbasiertes Design von neuartigen Metallbindegruppen unter Verwendung semi-empirischer und quantenmechanischer Verfahren.** Universität Leipzig, Diplom

Bottke, Alex. **Zellfreie Synthese funktioneller humaner Serotonin- und Dopamintransporter im vesikelbasierten eukaryotischen Lysat.** Universität Potsdam, Master

Brandewiede, Andre Marcel. **Entwicklung einer Fertigungsmethode für Mikrokanäle aus technischen Kunststoffen mit Hilfe einer industriellen Laserschneidanlage.** TU Berlin, Master

Brandl, Madeleine. **Etablierung und Anwendung immunhistochemischer Nachweisverfahren für Tight junction-Proteine in chronischen Kolitismodellen der Maus.** Universität Leipzig, Diplom

Buschmann, Tilo. **The systematic design and application of robust DANN barcodes.** Universität Leipzig, Promotion

Diehl, Rita. **Verträglichkeit und Effektivität Cyclosporin A-vermittelter Immunsuprression beim Schaf für die xenogene, intrazerebrale Transplantation.** Universität Leipzig, Promotion

Doß, Sandra. **Zellbasierte Testung von Hepatotoxizität mit der permanenten Zelllinie HepG2/C3A: Standardisierung, Validierung, Parametererweiterung und Testung von intensivmedizinisch relevanten Medikamenten am Beispiel der Antimykotika und Paracetamol.** Universität Rostock, Promotion

Eschenburg, Christian. **Wasserstoffbasierte Dialyse durch Elektrolyse.** Universität Rostock, Diplom

Finze, Tobias. **Adaption des Cascade-Classifiers Algorithmus zur effizienten Lokalisierung von neuronalen Zellen 3D Konfokal Mikroskopie-Bildern.** HTWK Leipzig, Master

Gerike, Susanna. **Optimierung und Evaluierung von Beschichtungsprotokollen für dynamisch schaltbare Zellkultursubstrate zur Kontrolle des Auswachsens von Fibroblasten und neuronalen SH-SY5Y Zellen.** Freie Universtität, Berin, Bachelor

Graczyk, Jadwiga. **New ways to identify tumor binders from peptide phage display with in silico methods.** TU Berlin, Master

Guthardt, Max. **Heterologous expression and purification of human alpha-synuclein and Adan.** Westfälische Wilhelms-Universität Münster, Master

Haas, Sandra. **Epitopmapping mit Peptid Phage Display und in silico Auswertung.** Hochschule Pforzheim, Bachelor

Hantov, Dimitar. **Modellierung und Optimierung einers auf planaren HF-Resonatoren basierenden Biosensors.** HTWK Leipzig, Master

Heitor Lopes, Ana Leonor. **Characterization and specific isolation strategies of prostate cancer exosomes - Preliminary work for the establishment of an integrated microfluidic platform for exosome isolation and analysis.** Instituto Superior Técnico, Lissabon, Portugal, Master

Hoffmann, Anja. **Establishment of the purification of a murine parvovirus and comparison of the antigenic structure after treatment with low-energy electron irradiation (LEEI) or chemicals.** TU Dresden, Master

Hübner, Andreas. **Phänomenologische Untersuchung des Zusetzens von Hämofiltern und Bestimmung der Lebensdauer, Modellierung und Simulation.** Universität Leipzig, Master

Jager, Anna. **Analyse der antiviralen Eigenschaften und Wirkungsweisen von pflanzlichen Naturstoffen gegen das Respiratorische Syncytialvirus.** Ruhr-Universität Bochum, Promotion

Jahnke, Laura. **Untersuchung verschiedener Abeta-Antikörper hinsichtlich der Mikroglia-vermittelten Phagozytose.** Hochschule Zittau / Görlitz, Bachelor

Jain, Aastha. **Comparison of different selection procedures for the identification of soybean epitope with M13 phage display.** Hochschule Furtwangen, Master

Jedraszczak, Nicole. **Entwicklung eines Multiplex Bead Assays zur Detektion der Substratspezifität der Glycogen-Synthase-Kinase 3 (GSK3).** Beuth Hochschule für Technik, Master

Jumel, Tobias. **Identification of allergy-relevant Epitopes of the Soy Protein Beta-Conglycinin using Peptide Phage Display.** Brandenburgische TU Cottbus-Senftenberg, Bachelor

Kipping, Lydia. **Einfluss der Aktivierung des Arylhydrocarbon Rezeptors auf die Myelopoesis.** Martin-Luther-Universität Halle-Wittenberg, Master

Koch, Stephanie. **Verbesserung der Reinheit und der Lagerung phagozytierender Zellen aus Blutspenden zur Anwendung in der Humanmedizin.** Universität Rostock, Promotion

Krebber, Katharina. **Biochemische Charakterisierung der C176A-Variante der Glutaminylzyklase aus Porphyromonas gingivalis.** Martin-Luther-Universität Halle-Wittenberg, Master

Laux, Eva-Maria. **Electric field-assisted immobilization and alignment of biomolecules.** Universität Potsdam, Promotion

Lawrenz, Mandy. **Vergleichende Microarrayanalysen zur Qualität von unterschiedlichen Oberflächen.** Universität Potsdam, Bachelor

Meinecke, Ann-Christin. **Expression und subzelluläre Lokalisation von Hüllproteinen humaner endogener Retroviren.** Martin-Luther-Universität Halle-Wittenberg, Master

Michael, Hendrik. **Quantification of a human sepsis biomarker.** Martin-Luther-Universität Halle-Wittenberg, Master

Nitzer, Tatjana. **Synthese, funktionelle Charakterisierung und ortsgerichtete Fluoreszenzmarkierung von Antikörperfragmenten in eukaryotischen zellfreien Systemen.** TU Berlin, Diplom

Nitzsche, Franziska. **Genetic engineering of mesenchymal stem cells for improved homing.** Universität Lübeck, Promotion

Oelkrug, Christopher. **Migration of antigen specific T cells into tumours: MHC antigen recognition and peptide gap-junctional communication via Connexin 43.** University of Nottingham, Promotion

Petruschke, Hannes. **Die Rolle von Interleukin-22 in einem durch Salmonella enterica induzierten Maus-Kolitismodell.** Martin-Luther-Universität Halle-Wittenberg, Master

Pham, Thanh-Hoai. **Expression und Reinigung des Hüllproteins des humanen endogenen Retrovirus' HERV-K18.** Martin-Luther-Universität Halle-Wittenberg, Bachelor

Prokopovic, Vladimir. **Light-triggered release of bioactive compounds from HA/PLL multilayer films for stimulation of cells.** Universität Potsdam, Promotion

Puder, Marcus. **Überprüfung und Etablierung von Algorithmen zur Identifizierung von Peptidmotiven in NGS-Datensätzen aus Phage-Display-Experimenten.** Hochschule Mittweida, Master

Quast, Robert. **Synthesis and site-directed modification of membrane proteins using non-canonical amino acids in a cell-free system derived from cultured Spodoptera frugiperda cells.** Universität Potsdam, Promotion

Rüppel, Nadine. **Enrichment of Staphylococcus aureus via specific aptamers and detection by magnetic particle enhanced surface plasmon resonance spectroscopy.** Universität Bayreuth, Master

Schenk, Mathias. **Expression, Reinigung und Charakterisierung verschiedener monoklonaler Antikörper gegen Isoaspartat-modifizierte Varianten des Aβ-Peptides.** Martin-Luther-Universität Halle-Wittenberg, Master

Schmidt, Alina. **Entwicklung Peptid-basierter antimikrobieller Oberflächen auf Silikon-Hydrogel-Polymeren.** Universität Potsdam, Bachelor

Schulze, Axel. **Untersuchung des Einflusses der Phosohorylierung von Initiationsfaktor eIF2alpha auf die zellfreie Proteinsynthese in Cap-abhängigen und Cap-unabhängigen Systemen.** Universität Potsdam, Master

Selke, Philipp. **Etablierung immunhistochemischer Mehrfachfärbungen von Immunzellen und Zytokinen in Kolonquerschnitten muriner Kolitismodelle.** Universität Rostock, Bachelor

Stahl, Lilly. **Gene expression changes in human T cells subsequent to anti-CD4 incubation.** Eberhard-Karls-Universität Tübingen, Diplom

Tittel, Franziska. **Entwicklung eines Programmes mit Matlab zur semiautomatisierten Bearbeitung von Bilddateien aus der Magnetresonanztomographie.** Hochschule Köthen, Bachelor

Wienke, Julia. **Identifikation und Unterscheidung von klinisch relevanten Staphylokokken mit Multiplex-PCR und DNA-Mikroarray.** Universität Potsdam, Master

Zoldan, Katharina. **Auswahl und Validierung immunologischer Indikatoren für entzündliche Erkrankungen bei Hochleistungsmilchkühen.** Universität Leipzig, Promotion

PRIZES

Fraunhofer IZI publication prize awarded to Alexandra Rockstroh from the Vaccine Technologies unit for the topic "Recombinant Envelope–Proteins with Mutations in the Conserved Fusion Loop Allow Specific Serological Diagnosis of Dengue–Infections "

Fraunhofer IZI Science Day poster prizes awarded to Victoria Gröger from the Molecular Biotechnology unit on the topic "Expression and characterization of envelope proteins from human endogenous retroviruses", to Vera Nykiel from the Molecular Biotechnology unit on the topic "Effect of Inhibition of Glutaminyl Cyclases on instent restenosis in an atherosclerotic rabbit model " and to Linda Liebe from the Drug Design and Analytical Chemistry unit on the topic "Inhibitor Development for a new Therapeutic Approach in the Treatment of Periodontitis"

EU Marie Skłodowska-Curie fellowship / Horizon2020 awarded to Dr Jana Burkhardt from the OpTcell unit for the BITCAT project

Dr. Ralph Hölzel from the Biomolecular Nanostructures & Measurement Technology unit appointed **Member of the Scientific Board of IET Nanobiotechnology.**

PATENTS

The patent portfolio of the Fraunhofer IZI currently holds 42 patent families which are available for use in cooperation projects as well as for direct commercialization and licensing.

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Fraunhofer IZI holds patent families 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
- Cell-free protein synthesis procedure
- 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
- Procedure for manufacturing a leukocyte preparation
- Development of antimicrobial peptides
- Diagnosis of chronic obstructive pulmonary disease

FURTHERANCE

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. The plot of land is provided by the City of Leipzig in hereditary leasehold and free of charge. Furthermore, Fraunhofer IZI would like to thank the Leipzig Foundation for Innovation and Technology Transfer for its support during the institute's construction phase from 2005 to 2010.

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. Henrich Guntermann (Chair) (President Europe & Immunology Group Nuvo Research Inc.)
- Uwe Albrecht (Mayor and Councillor for Economics and Labour, City of Leipzig)
- MR'in Dr. Annerose Beck Saxon State Ministry of Science and the Arts (SMWK), Head of National-Regional Research Centers Administration)
- Bettina Berendsen (Sartorius Stedim Systems GmbH, Vice President Bioprocess Sales Europe)
- Klaus Berka (Analytik Jena AG, Chairman)
- Prof. Dr. Walter Brehm (Veterinary Medicine Faculty, Leipzig University, Dean)
- Prof. Dr. Jörg Gabert (Genolytic GmbH)
- Prof. Dr. Andreas H. Guse (University Hospital Hamburg-Eppendorf, Vice-Dean for Teaching)
- Prof. Dr. Hans-Martin Jäck (University Hospital Erlangen, Head of the Molecular Immunology Department, President of the German Society for Immunology)
- Prof. Dr. Markus Löffler (Leipzig University, Head of the Institute for Medical Informatics, Statistics and Epidemiology)
- Dr. Uwe Marx (TU Berlin / TissUse GmbH)
- Dr. Kai Pinkernell (Medigene AG)
- Prof. Dr. Andreas Pinkwart (HHL Leipzig Graduate School of Management, Dean)
- Dr. Mark Wolters (Bayer Pharma AG)

FRAUNHOFER-GESELLSCHAFT

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 69 institutes and research units. The majority of the nearly 24,500 staff are qualified scientists and engineers, who work with an annual research budget of more than 2.1 billion euros. Of this sum, more than 1.9 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 Länder 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.

International collaborations with excellent research partners and innovative companies around the world ensure direct access to regions of the 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.

Executive board

- Prof. Dr.-Ing. Reimund Neugebauer, President, Corporate Policy and Research Management
- Prof. Dr. Georg Rosenfeld, Technology Marketing and Business Models
- Prof. Dr. Alexander Kurz, Human Resources, Legal Affairs and IP Management
- Prof. (Univ. Stellenbosch) Dr. Alfred Gossner, Finance, Controlling (incl. Business Administration, Purchasing and Real Estate) and Information Systems

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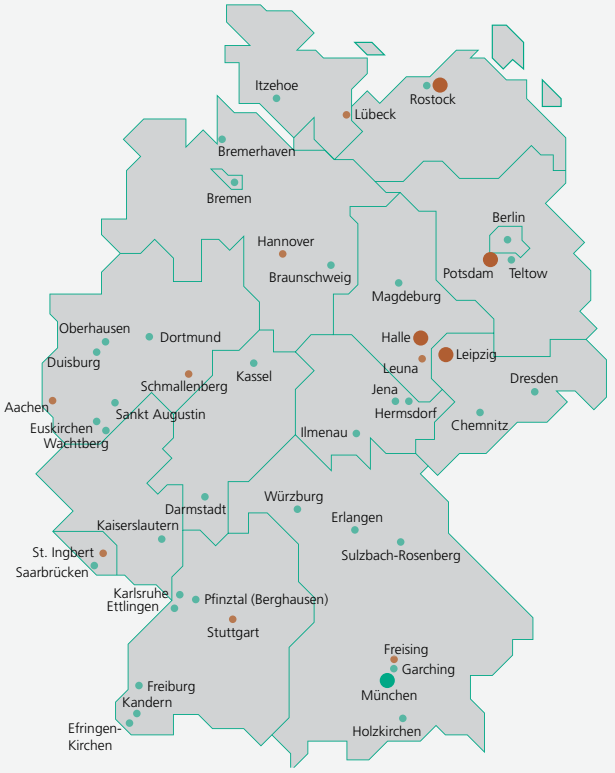
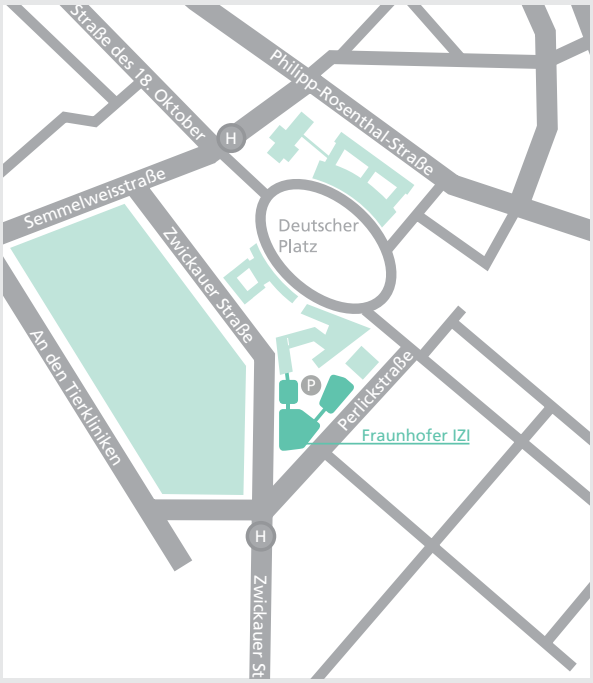


- Fraunhofer Institute
- Head office of the Fraunhofer-Gesellschaft, Munich
- Location of institute of the Fraunhofer Group for Life Sciences
- Fraunhofer IZI
- Institute / independent research
- Other location

FRAUNHOFER IZI
CONTACT INFORMATION

HOW TO REACH US



Address

Fraunhofer Institute for Cell Therapy and Immunology
Perlickstraße 1
04103 Leipzig
Germany

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 sta tion, 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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