Fraunhofer

IZI

FRAUNHOFER INSTITUTE FOR CELL THERAPY AND IMMUNOLOGY IZI

ANNUAL REPORT 2019

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HIGHLIGHTS AND EVENTS 2019

THE FRAUNHOFER IN PUBLIC

Events form a key part of the institute's communication strategy. Fraunhofer IZI once again organized and supported various scientific events and opened its doors to the general public in 2019.

NEW YEAR'S RECEPTION 2019

On January 24, 2019, Fraunhofer IZI came together with the Fraunhofer Center for International Management and Knowledge Economy IMW and biosaxony e. V. to host the New Year's reception. Around 200 guests were welcomed by Professor Ulrike Köhl and Professor Thorsten Posselt, Director of Fraunhofer IMW, as well as André Hofmann, CEO of biosaxony e. V. Guest speaker Professor Herfried Münkler, political scientist at Humboldt-Universität zu Berlin, held a talk on "Europe's new geopolitical challenges". The talk was a parting gift for Fraunhofer IZI founder Professor Frank Emmrich, who stepped back from the institute's management at the end of 2017 and is an avid reader of Münkler's work.

1 *New Year's Reception 2019.*

2 *Boys'Day 2019 at Fraunhofer IZI.*

POSITIVE EVALUATION OF THE ROSTOCK DEPARTMENT

The Extracorporeal Immunomodulation project group was set up as an off-site department belonging to Fraunhofer IZI in Rostock in March 2011. Since then, the group has focused on the development of new diagnosis and treatment methods in the field of extracorporeal organ replacement systems. An external expert committee positively assessed the off-site department in February 2019 and recommended its permanent integration in the organization. Besides scientific quality and profitability, key criteria of the evaluation included the way in which the group complements other research topics at Fraunhofer IZI, its unique features and how it fits within the Fraunhofer-Gesellschaft. The Fraunhofer-Gesellschaft's Executive Board and the Bund-Länder Commission (BLK) have followed the recommendation. Since January 1, 2020, the off-site department has been included in the Fraunhofer-Gesellschaft's regular 90:10 funding, thus safeguarding its future.

GIRLS' DAY AND BOYS' DAY 2019 AT FRAUNHOFER IZI IN LEIPZIG AND ROSTOCK

In 2019, Leipzig's Fraunhofer IZI once again took part in Girls' Day and even put together a program for Boys' Day for the very first time. On March 28, 2019, eleven schoolgirls visited the Immune Tolerance Unit and ten schoolboys spent the day at the MicroDiagnostics Unit, where colleagues gave the groups an insight into the workings of a biomedical research institute. The teenagers spent time in the laboratory, where

they isolated plasmid from Escherichia coli and experimented with gel electrophoresis. The Department of Extracorporeal Immunomodulation also participated in Boys' Day, where six pupils attended the "Washday in the lab" event at the Rostock off-site department. Among other things, they took a closer look at the composition of blood and discovered how it can be tested and analyzed.

SCIENCE CINEMA "CLUB DER ROTEN BÄNDER – WIE ALLES BEGANN"

As part of the Science Cinema series – an events program organized by Leipzig's research institutions – Fraunhofer IZI and Leipzig University welcomed attendees to the Forum of Contemporary History Leipzig. The German film "Club der roten Bänder – Wie alles begann" (2019) was played to a full house. The touching film follows six average teenagers whose lives are thrown into disarray from one day to the next. Their daily routines are suddenly shaped by examinations, diagnoses and hospital visits, which is what ultimately brings them together in the "Club of red bracelets". The podium discussion held after the showing was centered around questions on the current state of cancer research and cancer medicine. Professor Florian Lordick, Director of the University Cancer Center Leipzig, and Fraunhofer IZI Director Professor Ulrike Köhl took part in the podium discussion alongside the film's director Felix Binder and Tom Hoffmann, who was diagnosed with cancer as a teenager.

SAXONY'S MINISTER PRESIDENT MICHAEL KRETSCHMER VISITS FRAUNHOFER IZI

Fraunhofer IZI welcomed Saxony's Minister President Michael Kretschmer and Novartis Oncology Germany to the institute on June 11, 2019, where Director of Fraunhofer IZI Professor Ulrike Köhl and Managing Director of Novartis Oncology in Germany Heinrich Moisa gave an update on the latest developments regarding new cancer therapies. A joint discussion was then held on the challenges and opportunities facing the region of Saxony when it comes to developing these types of innovative immunotherapies. Novartis and Fraunhofer IZI have been working together in the field of CAR-T cell therapies since 2015. The Leipzig-based Fraunhofer institute is one of the central manufacturing and development sites for the cell therapy Kymriah®. Minister President Kretschmer acknowledged just how important the successful cooperation with the Swiss biotechnology and pharmaceutical company is for Saxony as a business location and encouraged "the start of a strategic dialog between universities, non-university facilities, Fraunhofer and Novartis with a focus on Saxony."

DG-GT THEME DAY "CAR-T CELLS AND BEYOND"

On September 16 and 17, 2019, 200 distinguished international experts and junior researchers from the field of cell and gene therapy came together at Fraunhofer IZI in Leipzig to talk about the latest developments in immuno-oncology as part of the DG-GT theme day "CAR-T cells and beyond". As well as discussing current preclinical developments, attendees from the fields of science, medicine and business looked at the latest findings and trends in the manufacture of gene transfer vectors and debated the

1 *Saxony´s minister president Michael Kretschmer (2nd from left) visits Fraunhofer IZI.*

2 *DG-GT Theme Day "CAR-T cells and beyond"*

progress and outcomes of clinical trials. The spotlight was placed on ethical and regulatory aspects linked to the novel immunotherapies.

EXPERT ROUND TABLE: "ONE YEAR OF CAR-T CELL THERAPY IN GERMANY"

One year of hands-on experience with the innovative CAR-T cell therapy in Germany – Novartis and Fraunhofer IZI marked this milestone by inviting journalists and media representatives to an expert roundtable. Since August 27, 2018, patients with certain types of life-threatening blood cancer and extremely limited survival prospects have had the opportunity, for the very first time, to prolong their lives thanks to the CAR-T cell therapy developed by Novartis. In Germany, more than 15 hospitals (effective September 2019) are now certified to carry out this treatment. Novartis has worked closely together with Fraunhofer IZI to establish a complex manufacturing process for CAR-T cells.

FRAUNHOFER MEOS SHOWCASES ITS WORK AT THE LONG NIGHT OF THE SCIENCES IN ERFURT

Erfurt opened its doors for the "Long Night of the Sciences" on November 8, 2019. The Fraunhofer project center Microelectronic and Optical Systems for Biomedicine MEOS took part in the program for the first time. The project center brings together Fraunhofer IZI with the Fraunhofer Institutes for Photonic Microsystems IPMS and for Applied Optics and Precision Engineering IOF. Besides listening to talks on the use and continued development of key technologies such as biosciences, microelectronics, optics and photonics for biomedical applications, interested guests were also able to look around various research stations, where they could have a go at microscoping, try their luck at a Petri dish quiz and make their own non-Newtonian fluid.

IMSAVAR KICK-OFF MEETING

On December 2, 2019, the interdisciplinary consortium imSAVAR came together to hold its kick-off meeting at Fraunhofer IZI. The consortium boasts 28 international partners from eleven nations under the scientific coordination of Fraunhofer IZI, with Novartis representing the industry partners. As part of imSAVAR (Immune Safety Avatar: nonclinical mimicking of the immune system effects of immunomodulatory therapies), innovative model systems are to be developed for the evaluation of immunomodulatory therapeutic agents. The project will receive a total of 11 million euros in funding from the European Union (GA no. 853988) and will run for a period of six years. The industry partners are matching the funding amount for the project.

1 *Kick-off meeting for EU project imSAVAR.*

LOOKING TO 2020

November 10–11, 2020 | Leipzig, Germany
Leipzig Immune ONcology (LION) Conference
www.lion-conference.com

STRUCTURES AND FIGURES 2019

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.

The Fraunhofer Institute for Cell Therapy and Immunology IZI investigates and develops solutions to specific problems at the interfaces of medicine, life sciences and engineering. One of the institute's main tasks is to conduct contract research for companies, hospitals, diagnostic laboratories and research institutes operating in the field of biotechnology, pharmaceuticals and medical engineering.

The Fraunhofer IZI develops, optimizes and validates methods, materials and products for the business units Cell and Gene Therapy, Drugs and Diagnostics. Its areas of competence lie in cell biology, immunology, drug biochemistry, bioanalytics and bioproduction as well as process development and automation. The research focus is on developments in the field of immunoncology and infection research.

The institute works in close cooperation with hospital institutions and performs quality tests besides carrying out the GMP-compliant manufacture of investigational medicinal products. Furthermore, it helps partners obtain manufacturing licenses and permits.

BUSINESS UNITS

- Diagnostics
- Drugs & biologicals
- Cell and gene therapy

COMPETENCIES

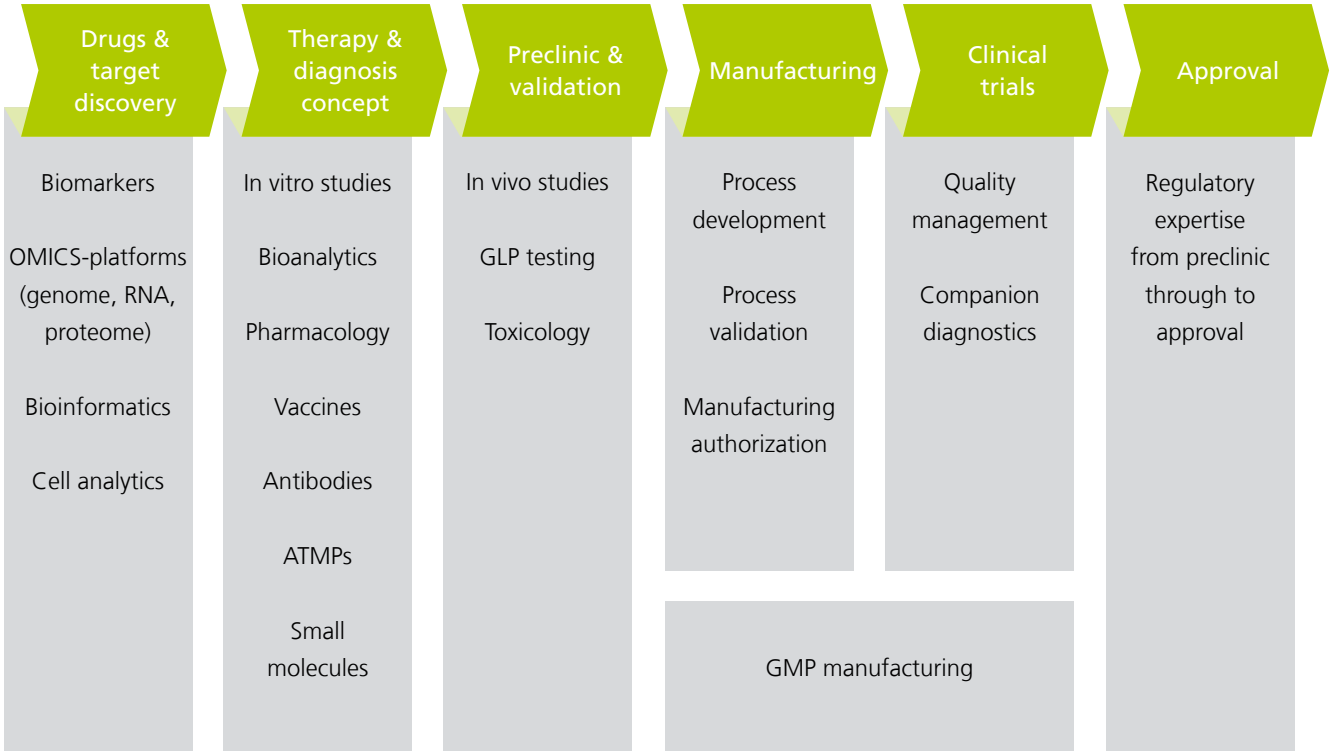
- Bioanalytics
- Biomarkers
- Therapeutic molecules
- Cell techniques

BUSINESS UNITS

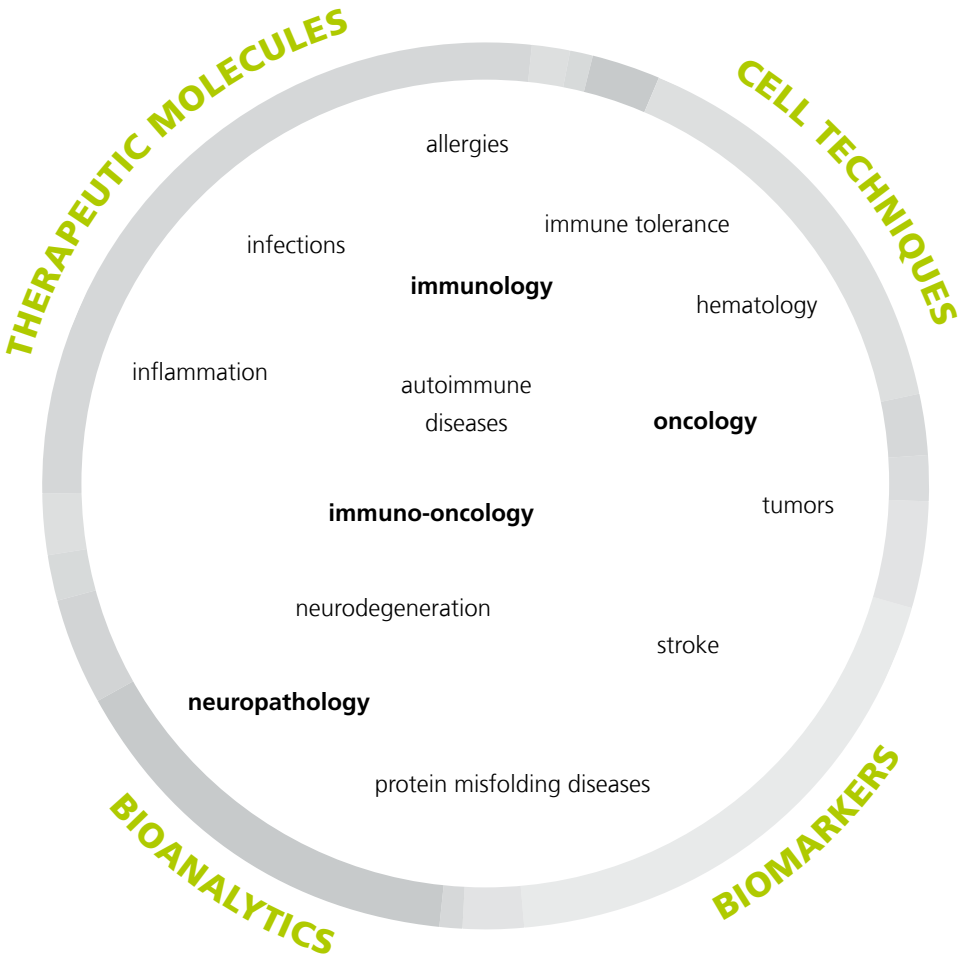
CELL AND GENE THERAPY

DRUGS & BIOLOGICALS

DIAGNOSTICS



COMPETENCIES AND INDICATIONS



ORGANIZATION LEIPZIG HEADQUARTERS

MAY 1, 2020

DIRECTOR

Prof. Dr. Dr. Ulrike Köhl

ADMINISTRATION

Anja Bochmann-Seidel | Annette Schäfer (deputy)

EXECUTIVE DEPARTMENTS

- Business Development and Patent Management
  Dr. Thomas Tradler
- Press and Public Affairs
  Jens Augustin
- Occupational Safety
  Dr. Peter Ruschpler
- IT Management
  Alexander Dossin

CENTRAL FACILITIES

- Center for Experimental Medicine
  Dr. Thomas Grunwald
- Imaging
  Prof. Dr. Ulf-Dietrich Braumann
- GLP Test Facility
  Dr. Jörg Lehmann

OFFICERS

MAIN DEPARTMENT OF GMP CELL AND GENE THERAPY

Dr. Gerno Schmiedeknecht | Kati Kebbel

DEPARTMENT OF GMP PROCESS DEVELOPMENT

PD Dr. Stephan Fricke

DEPARTMENT OF THERAPY VALIDATION

Dr. Jörg Lehmann

- Preclinical Models,
  Sina Riemschneider
- Protein Biomarker,
  Prof. Dr. Stefan Kalkhof
- Cell Line Development,
  Dr. Elke Ueberham
- Manufacturing Biopharmaceuticals,
  Dr. Lukasz Hudak
- Quality Control Biopharmaceuticals,
  Dr. Jens Knauer
- Veterinary Pathology,
  Dr. Anke Hoffmann

DEPARTMENT OF IMMUNOLOGY

PD Dr. Sebastian Ulbert

- Vaccine Technologies,
  PD Dr. Sebastian Ulbert
- Immune Tolerance,
  PD Dr. Stephan Fricke
- Image Analysis of Cell Function, Prof. Dr.
  Ulf-Dietrich Braumann
- Preclinical Validation,
  Dr. Thomas Grunwald
- Ligand Development,
  Dr. Michael Szardenings
- Antimicrobial Agents,
  Dr. Andreas Schubert
- Biological Material Analytics (Fraunhofer IKTS ATTRACT-Group),
  Dr. Juliane Spohn

DEPARTMENT OF CELL THERAPY

Dr. Thomas Grunwald | Dr. Stephan Klöß

- Experimental Imaging,
  Dr. Sebastian Greiser
- Clinic-oriented Therapy Assessment,
  Dr. Antje Dreyer

- Branch Lab Translational Cell Therapy (Hannover),
  Dr. Stephan Klöß

DEPARTMENT OF DIAGNOSTICS

Prof. Dr. Friedemann Horn

- Inflammation Models and Immuno-diagnostics,
  Dr. Franziska Lange
- MicroDiagnostics,
  Dr. Dirk Kuhlmeier
- DNA Nanodevices,
  Dr. David M. Smith
- CardiOmics,
  Prof. Dr. Dr. Dr. Andreas Oberbach
- Next-Generation Diagnostics,
  Dr. Conny Blumert
- Bioinformatics,
  Dr. Kristin Reiche

HEADQUARTER LEIPZIG

ORGANIZATION BRANCHES

MAY 1, 2020

BRANCH BIOANALYTICS AND BIOPROCESSES

Dr. Eva Ehrentreich-Förster (temp.)

MARKETING & COMMUNICATION

Dr. Katharina Kasack

ADMINISTRATION

Katja Okulla

DEPARTMENT OF EXTRACORPOREAL IMMUNO-MODULATION

Prof. Dr. Steffen Mitzner

DEPARTMENT OF DRUG DESIGN AND TARGET VALIDATION

- Molecular Biotechnology, Dr. Holger Cynis
- Protein and Drug Biochemistry, PD Dr. Stephan Schilling
- Drug Design and Analytical Chemistry, Dr. Mirko Buchholz
- Protein Misfolding Diseases, Dr. Anja Schulze

DEPARTMENT OF BIOSYSTEMS INTEGRATION AND PROCESS AUTOMATION

PD Dr. Ralph Hölzel (temp.)

- ivD Platform / PoC Technologies, Dr. Harald Peter
- Biomolecular Nanostructures and Measurement, PD Dr. Ralph Hölzel
- Biomimetic Functional Materials, Dr. Nenad Gajovic-Eichelmann
- Laboratory and Process Automation, Jörg Henkel

DEPARTMENT OF MOLECULAR AND CELLULAR BIOANALYTICS

Dr. Eva Ehrentreich-Förster

- Microarray and Sensor Technology, Dr. Eva Ehrentreich-Förster
- Biomarker Validation and Assay Development, PD Dr. Harald Seitz
- Molecular Bio Engineering, Dr. Markus von Nickisch-Rosenegk
- Microsystems for In Vitro Cell Models, Dr. Katja Uhlig
- Microfluidic Cell Processing and Cell Analytics, Dr. Michael Kirschbaum

DEPARTMENT OF CELL-FREE AND CELL-BASED BIOPRODUCTION

Dr. Stefan Kubick

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

ROSTOCK | HALLE (SAALE) | POTSDAM-GOLM

KEY INSTITUTE FIGURES 2019

AS AT DECEMBER 31, 2019

PROJECT REVENUE

by funding agency

50,6 %
Industry
(TEUR 17 412)

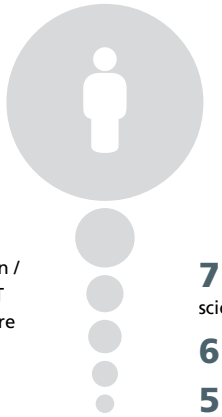
26,6 %
German national and regional government
(TEUR 9 166)

21,9 %
Other (TEUR 7 520)

0,9 %
EU (TEUR 304)

EMPLOYEES

Workforce composition



57 % Scientists incl. visiting scientists

15 % Technical assistants and laboratory technicians

10 % Administration / executive departments / IT and technical infrastructure

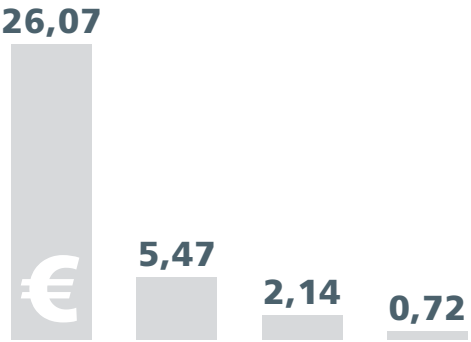
7 % Student / scientific assistants

6 % PhD students

5 % Interns / degree candidates / Bachelor students / Master students / trainees

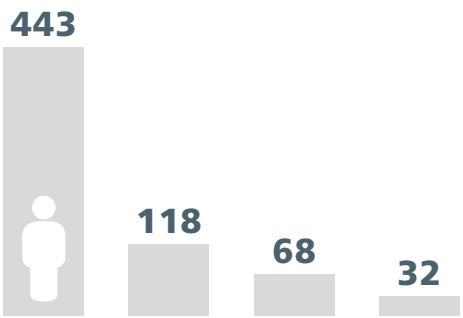
€ 34,4 MIO PROJECT REVENUE

by location in € mio

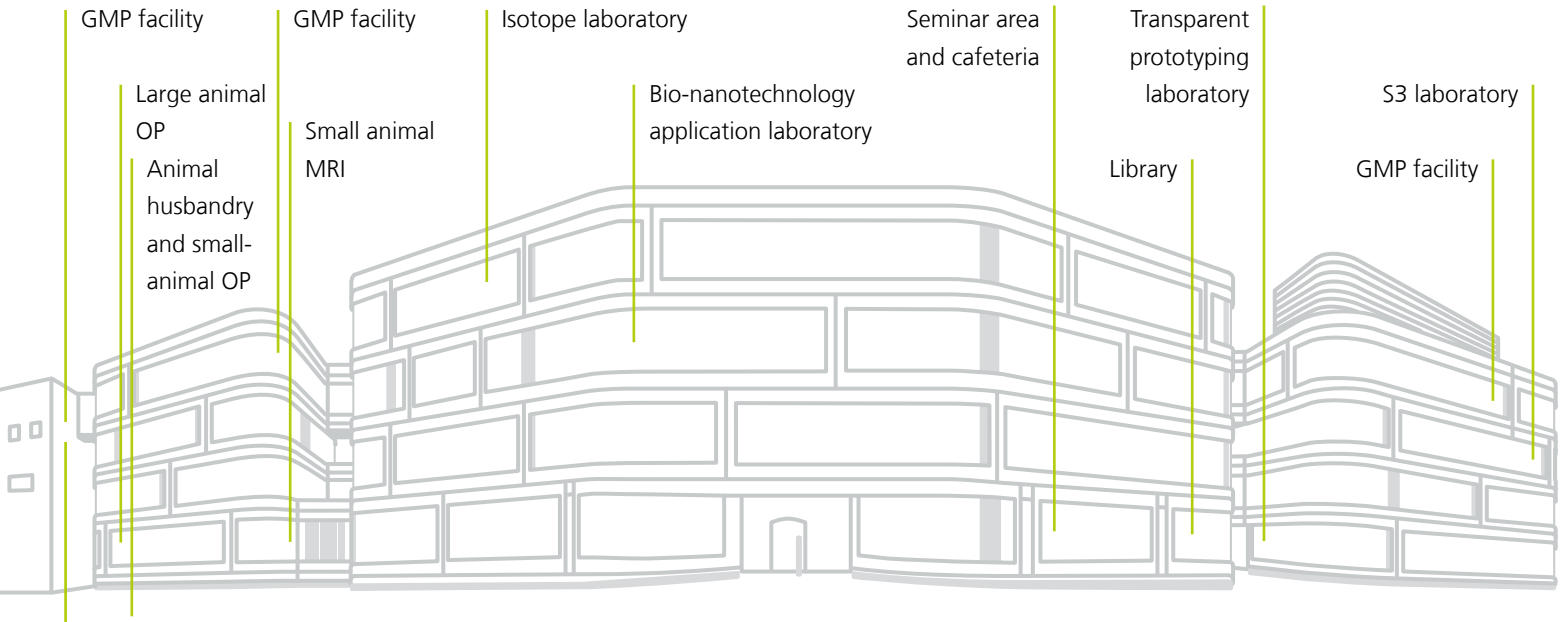


661 EMPLOYEES

by location



RESEARCH INFRASTRUCTURE AT THE LEIPZIG SITE



FIRST EXTENSION BUILDING

Start-up operations: 2012
Usable area: 1 568 m²
Lab space: 470 m²
Offices: 142 m²
Clean rooms: 410 m²

MAIN BUILDING

Start-up operations: 2008
Usable area: 4 131 m²
Lab space: 1 867 m²
Offices: 1 615 m²
Seminar area: 276 m²

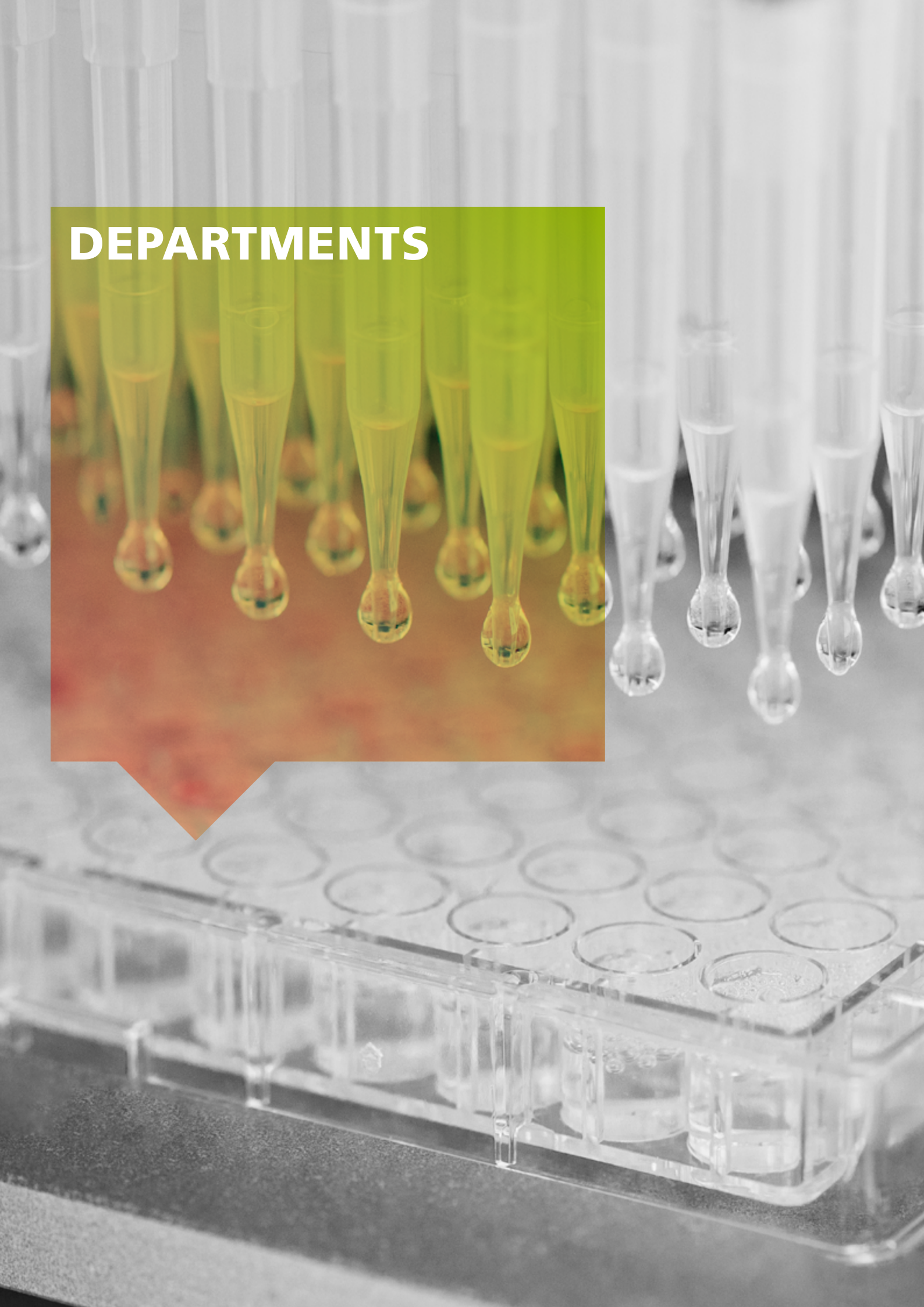
SECOND EXTENSION BUILDING

Start-up operations: 2015
Usable area: 3 050 m²
Lab space: 1 171 m²
Offices: 881 m²
Clean rooms: 402 m²

RENTAL AREA AT BIO CITY LEIPZIG

Start-up operations: 2006
Clean rooms: 334 m²

DEPARTMENTS



LOCATION LEIPZIG, GERMANY

MAIN DEPARTMENT OF GMP CELL AND GENE THERAPY

THE MAIN DEPARTMENT AT A GLANCE

The Main 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 130 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 and gene therapy area.

CORE COMPETENCIES

- Quality assurance
- 1 000 m² clean rooms
- ATMPs
- Process transfer and development
- Manufacturing authorization according to §13 AMG
- Investigational Medicinal Drug Dossiers (IMPD)
- Good Manufacturing Practice (GMP)

CONTACT

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PROJECT EXAMPLES

MANUFACTURE OF KYMRIAH®

The CAR-T cell therapy is a new type of cancer immunotherapy that uses the patient's own T cells to fight certain types of cancer. In order to do this, the cells are collected in the clinic by leukapheresis and then genetically reprogrammed in vitro in such a way that they can use a chimeric antigen receptor (CAR) to recognize cancer cells and other cells that have a special antigen on their surface. Following lymphodepleting chemotherapy, the reprogrammed cells are administered to the patient though an infusion. They then proliferate and can trigger the immune response.

In August 2017, the first CAR-T cell therapy became available in the USA in the form of Kymriah® (CTL019 / tisagenlecleucel). Kymriah® was granted FDA approval for children and young adults aged up to 25 years old diagnosed with acute lymphocytic B-cell leukemia (ALL) who are not responding to the usual therapies or have already suffered relapses. In May 2018, approval was also granted for adult patients with diffuse large B-cell lymphoma (DLBCL) who had suffered relapses after two or more lines of systemic therapy or who have not responded to therapy at all. On August 27, 2018, Novartis announced that it had received approval from the European Commission for both of these indications based on the recommendation given by the European Medicines Agency (EMA).

Fraunhofer IZI has long been an important manufacturing and development site for this innovative CAR-T cell therapy for clinical trials throughout Europe. Currently, prescription-only, approved T-cell therapies will also be manufactured on an interim basis in the Main Department of GMP Cell and Gene Therapy at Fraunhofer IZI, alongside investigational medicinal products. Following a one-year technology transfer period from Novartis' Morris Plains site in New Jersey, USA, and after obtaining manufacturing authorization in accordance with Section 13 of the German Drug Act (AMG), the first clinical batch was manufactured at Fraunhofer IZI in Leipzig in August 2016. Since then, the Main Department of GMP Cell and Gene Therapy has continuously produced CAR-T cell therapies for Novartis.

Until the end of 2019, several 100 batches were delivered to patients, including many children, all across Europe. The extremely complex process involved in manufacturing a Kymriah®-Batch takes several days and involves not only state-of-the-art instrument engineering, but also manual tasks. Before being released for human use, extensive analytical release tests are first conducted on the finished product (e.g. concerning identity, purity, in vitro potency, microbiological safety) and the batch documentation is reviewed in detail.

1 *Manufacture of Kymriah® in the clean room.*

2 *Quality of Kymriah® is examined in the quality control laboratory.*

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ROR1 CAR-T POC INITIATIVE: CAR-T CELLS FOR THE TREATMENT OF BREAST AND LUNG CANCER

With the so-called CAR-T cell therapy, the US Food and Drug Administration (FDA) approved a gene therapy for the first time in 2017 which has already resulted in impressive treatment outcomes in clinical trials involving cancer patients. This revolutionary form of therapy is also the basis of the ROR1 CAR-T research project.

The chimeric antigen receptor (CAR) developed at the University Hospital of Würzburg recognizes the ROR1 molecule, which is expressed in cancer cells in leukemia, for example, as well as in breast and lung cancer. In order to manufacture the cell product, immune cells are first taken from the patient's body by leukapheresis. T helper cells and cytotoxic T cells are then selected by magnetic cell separation. The genetic material for the CAR is introduced into the genome of the T cells via a non-viral gene transfer using the so-called "Sleeping Beauty" transposon system (jumping gene). This reprograms the T cells in such a way that they recognize ROR1-positive cancer cells as "foreign" and eliminate them by releasing cytotoxic messengers. The reprogrammed cells are expanded and administered to the patients intravenously.

The project is being funded as a pilot project under the proof-of-concept initiative launched by the Fraunhofer-Gesellschaft, the Helmholtz Association and Deutsche Hochschulmedizin in order to promote the translation of innovative research projects. The funding will support the conduct of preclinical trials into the safety and efficacy of the ROR1 CAR-T cells and drive clinical translation into a phase I / II study (first in human).

Based on the successful process development on a small scale, an initial test batch adjusted to reflect the actual production scale was manufactured as part of the project, which will be used to further optimize the process with an eye to the stringent production requirements under GMP conditions. At the same time, the required equipment was qualified, the suitability of newly introduced GMP-compliant materials checked and the respective specifications compiled in order to guarantee the consistent quality of these materials. After additional test batches have been completed, the manufacturing process is expected to be validated in the third quarter of 2020. The analytical methods that form part of the so-called safety parameters (mycoplasma, sterility, bacterial endotoxins, vector copy number) are planned to be validated at the same time. An application will be sent to the responsible authority, i.e. Landesdirektion Sachsen (Saxony Land authorities), simultaneously for the manufacturing permit pursuant to Section 13 of the German Drug Act.

1 *Loading the tubing set for selection onto the CliniMACS Plus.*
2 *Preparing for transfection with the MaxCyte GTx.*
3 *Removing the cassette following completion of transfection.*

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LOCATION LEIPZIG, GERMANY

DEPARTMENT OF GMP PROCESS DEVELOPMENT

THE DEPARTMENT AT A GLANCE

The GMP Process Development Unit is responsible for transferring manufacturing processes from the lab into a clinical setting. In order to obtain official manufacturing licenses for the production of clinical test samples, either GMP-compliant processes are developed from scratch or existing processes adapted and optimized.

The department focuses primarily on cell- and gene-based drugs, known as Advanced Therapy Medicinal Products (ATMPs). These include antigen-specific T cells, CAR-T cells, CAR-NK cells, dendritic cells, mesenchymal stem cells (MSC), induced pluripotent stem cells (iPS) and tissue engineering products.

The development of GMP-compliant manufacturing protocols is closely associated here with the definition of respective quality controls.

In the development unit, process adjustments can be tested and optimized flexibly and cost-efficiently. The impact of new devices, media, seed densities and freezing protocols on the GMP process is also investigated here.

This then enables new processes to be implemented and validated in the institute's GMP clean rooms.

CONTACT

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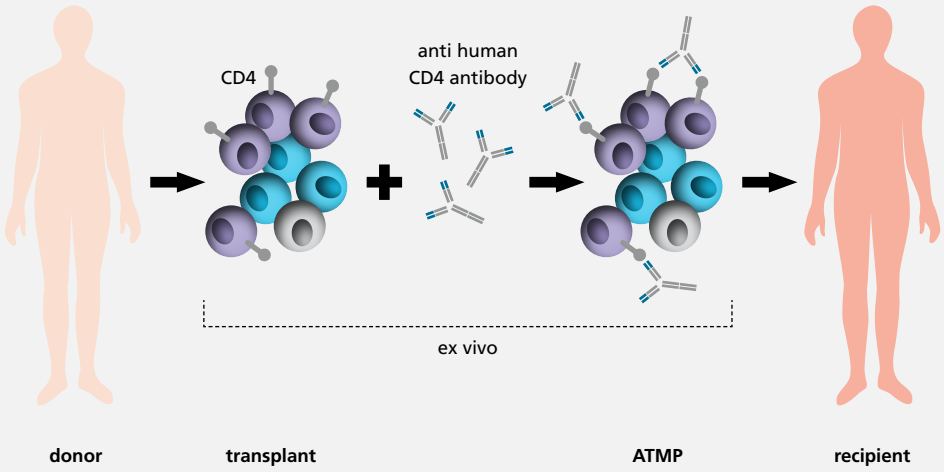

PROJECT EXAMPLE

PRECLINICAL DEVELOPMENT OF AN ADVANCED THERAPY MEDICINAL PRODUCT (ATMP, PALINTRA®) FOR THE PREVENTION OF GRAFT VERSUS HOST DISEASE (GVHD)

The main complication that occurs following hematopoietic stem cell transplantation is graft-versus-host disease (GvHD). The immune response demonstrated by the transplant to the host can prove fatal or result in serious long-term damage and a lifelong need for treatment. Clinical symptoms include inflammation that usually affects the skin, intestine and liver. There is an over 30 percent chance that acute GvHD (grades II to IV) will emerge following stem cell transplantation; this figure rises to 40 percent for chronic GvHD. In terms of pathophysiology, GvHD is triggered by the donor's immunocompetent T cells. These cells recognize antigens from the recipient, which leads to the activation, expansion and release of pro-inflammatory factors besides the activation of additional inflammatory cascades, causing tissue damage in the affected areas.

Current immunosuppression strategies for treating and / or preventing GvHD often prove inadequate, making it all the more necessary for new treatment options for GvHD to be developed as soon as possible.

The GMP Process Development Unit is working on protocols and procedures in preparation for manufacturing an ATMP (advanced therapy medicinal product) to help prevent GvHD under GMP conditions.

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LOCATION LEIPZIG, GERMANY

DEPARTMENT OF THERAPY VALIDATION

THE DEPARTMENT AT A GLANCE

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, lateral flow assays, 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) GMP-compliant production of clinical test samples, e.g. recombinant proteins (manufacturing authorization pursuant to Section 13 of the AMG obtained on July 12, 2018), in a separate clean room facility.

CORE COMPETENCIES

- Preclinical studies
- Good laboratory practice
- Immunotoxicology (study design and implementation)
- Protein biomarker (identification and validation)
- Antibody and immunoassay development (diagnostics)

CONTACT

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UNITS

PRECLINICAL MODELS UNIT

The Preclinical Model 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.

CONTACT

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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 particularly in the context of developing and testing novel implants as well as for the medical indications triple-negative breast cancer and chronic inflammatory bowel disease. Multi-omics strategies (especially LC-MS based proteomics) are applied for biomarker detection as well as for the study of disease- or agent-induced effects.

Prof. Dr. Stefan Kalkhof also holds a research professorship position for instrumental bioanalytics at the Coburg University for Applied Science. This synergy enables the application of additional spectroscopic and mass spectrometric approaches e.g. for the direct chemical analysis of implants.

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ANTIBODY PRODUCTION UNIT

The Antibody Production Unit operates a state-of-the-art clean room facility for the GMP-compliant manufacturing of recombinant proteins based on, for example, CHO cell lines. The modular production facility covers clean room categories D to A and stands out due to its high level of flexibility achieved, amongst others, by using single-use disposables. The range of services includes the planning, development and implementation of manufacturing processes and quality control for preclinical and clinical test samples (up to phase II). Test samples can be produced either in bulk or in individual doses.

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CELL LINE DEVELOPMENT UNIT

The Cell Line Development Unit is focused on the detection strategies of biomarkers and molecules based on monoclonal antibodies produced in house. Building on our experience in the field of human and veterinary diagnostics as well as in the area of food allergy analytics, we are working with the user to develop immunology singleplex and multiplex assays. Extraction for the purpose of restoring epitope accessibility in complex, denatured matrices represents a key topic and is especially relevant for the equivalent recovery of analytes in multiplex bead assays. With regard to cell line development for biopharmaceuticals, we draw not only on automated cloning and selection, but also on the label-free detection of biomolecules in real time by means of surface plasmon resonance spectroscopy (SPR). This enables the product to be quantified and characterized at early stages within cell line development, allowing the course for optimization planning to be set in good time.

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VETERINARY PATHOLOGY UNIT

The Veterinary Pathology Unit carries out histopathological and toxicopathological examinations as part of GLP studies investigating the safety and efficacy of drug candidates. In accordance with the regulatory requirements concerning test candidates for new drugs or medical devices, tests for local effects after application and / or toxicity testing, for instance, are carried out in order to ensure that the test candidates are not expected to pose any health risks.

The unit's portfolio covers the planning, drafting, validation, implementation and evaluation of histological test procedures. All work processes, from sampling to processing through to the appropriate histochemical and IHC staining of tissue sections, are carried out in line with relevant SOPs. Various sample systems generated by the group such as paraffin-embedded and cryo-preserved tissue samples, stained tissue sections and also remaining samples are collected in a biobank and archived in compliance with GLP following study completion. The digitalization of tissue sections completes the GLP trial portfolio.

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PROJECT EXAMPLES

CONDUCT OF GLP TOXICITY STUDIES TO APPLY FOR TEST CATEGORY 2

In 2009, the Department of Therapy Validation was recognized by the Saxon State Ministry of the Environment and Agriculture in Dresden as a test facility for conducting non-clinical drug trials under the quality assurance system of good laboratory practice (GLP) in test category 9. The test facility is therefore permitted to conduct non-clinical efficacy and safety studies involving various drug candidates such as advanced therapy medicinal products (ATMPs) and medical devices. The first GLP study to evaluate the migratory and tumorigenic behavior of a now commercially available autologous cell therapy for the treatment of articular cartilage defects was concluded in 2014. The safety and risk profile for the therapy's potential use in humans was able to be assessed based on the results of this study, following the application of the cell therapy in the mouse model. This was then used to help justify a clinical trial involving human subjects. In 2020, the GLP test facility will be working on an application for test category 2, which would enable it to expand its safety testing portfolio. In test category 2, toxicological properties are recorded based on defined research parameters following the application of new drug candidates in a suitable animal model in order to assess possible toxic effects on humans. The study forming the basis of the application will evaluate the systemic toxicity of a therapeutic hepatitis B vaccine following repeated intramuscular application in the mouse model in accordance with the regulatory guidelines of the EMA (CPMP/SWP/465/95) and the WHO (WHO Technical Report Series, No. 927, 2005 Annex 1). The study is being funded under the proof-of-concept initiative together with Helmholtz Zentrum München (German Research Center for Environmental Health) and the Technical University of Munich (Rechts der Isar Hospital) as well as University Medical Center Hamburg-Eppendorf. The Veterinary Pathology working group will carry out the histopathological appraisal of the organs and tissues besides recording and evaluating the test results. The expansion into test category 2 will mark another significant strategic milestone for Fraunhofer IZI's GLP test facility in terms of broadening its expertise and complementing existing safety testing for new drug candidates and medical devices.

1 *Following their removal, organs and tissue taken from the mouse are processed before being examined and analyzed on microscope slides. Various tissue cassettes and a paraffin block can be seen next to the stained tissue sections.*

2 *Tissue sections 3–5 µm in thickness are prepared using the rotary microtome before being placed on microscope slides and stained.*

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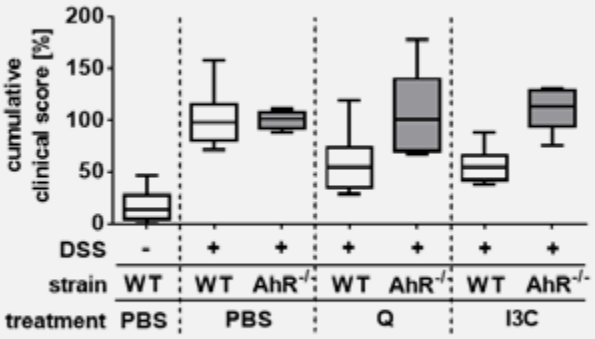

1

DEVELOPMENT OF A NOVEL THERAPEUTIC CONCEPT FOR CHRONIC INFLAMMATORY BOWEL DISEASES (IBD) VIA NON-TOXIC LIGANDS OF THE ARYL HYDROCARBON RECEPTOR

The umbrella term chronic inflammatory bowel disease (IBD) covers disease patterns that are characterized by recurring or continuously emerging inflammatory changes to the bowels. The two main types of IBD are Crohn's disease and ulcerative colitis. In Germany, around 300,000 people currently suffer from these two disorders, which are associated with long-term abdominal pain and diarrhea as well as high levels of fatigue.

Conventional IBD therapies focus on repressing the inflammation using anti-inflammatory drugs. A cure is yet to be found for these diseases, which means any drug therapy generally has to be administered for a person's entire lifetime. This is first and foremost due to the fact that these therapies are systemic treatments. A therapeutic approach is yet to be found which has a causal and sustainable impact on the dysregulation of the intestinal immune system associated with IBD. Surgical measures often give rise to complications and impact on quality of life. The gut microbiome, which is significantly influenced not only by nutrition but also by the use of antibiotics, plays an important role in the emergence of IBD. This is why nutrition and alternatives to antibiotics are playing an increasing role in the development of new approaches to treating these diseases. More recent studies attest to the fact that the aryl hydrocarbon receptor (AhR) presents a highly promising, novel therapeutic target in the case of IBD.

Furthermore, numerous research papers have shown that the AhR plays a significant role in both the innate and the adaptive immune system in terms of maintaining immune homeostasis and controlling inflammatory responses in the intestines. The AhR is central to the communication between immune cells and enterocytes. AhR ligands found in food or the microbiota activate the AhR, promoting the survival and proliferation of immune cells and making a substantial contribution to immune homeostasis. Based on the recently published AhR structure, a highly diagnostic pharmacophore model is to be developed which will be used to select new, previously unknown AhR ligands as candidates for future therapeutic application in IBD cases using structure- and ligand-based methods. Moreover, a drug repositioning approach is to be taken, i.e. drugs which have already been approved or drug candidates currently undergoing clinical testing are to be identified as potential AhR ligands for other indications.

This work was supported by the Fraunhofer Cluster of Excellence Immune-Mediated Diseases CIMD.

1 *Therapeutic effect of plant AhR ligands indole-3-carbinol (I3C) and quercetin (Q) in a mouse model of chronic dextran sulphate induced colitis, shown as an improvement of the cumulative clinical score.*

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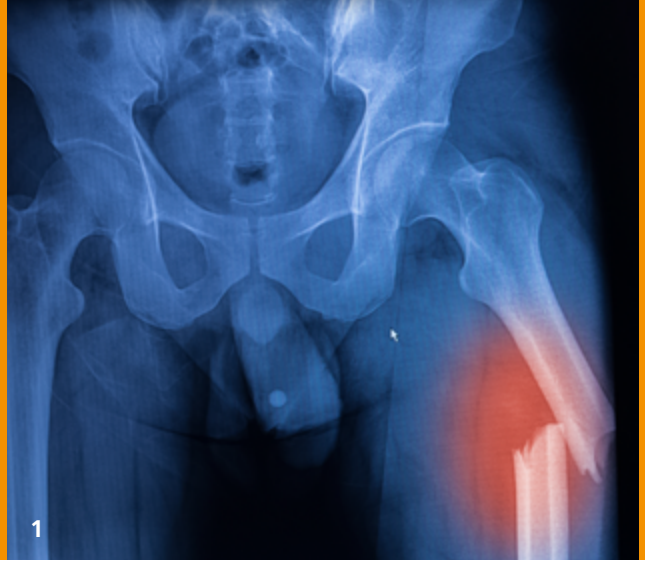

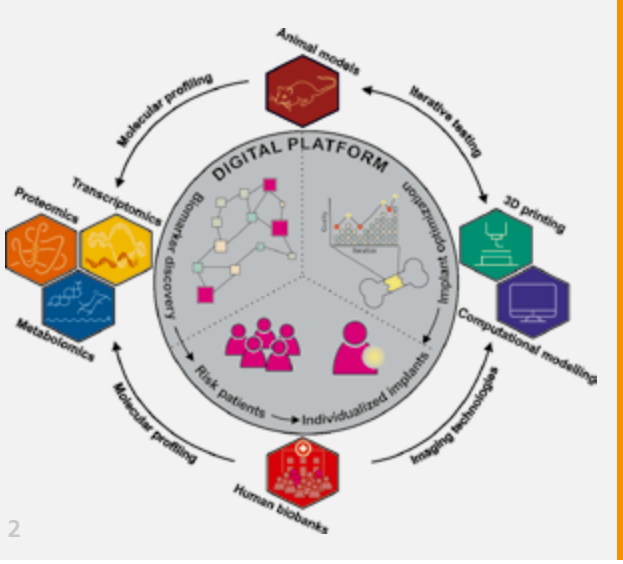

SYSTEMS MEDICINE APPROACH FOR PERSONALIZED BONE DEFECT TREATMENT IN PATIENTS COMORBID WITH TYPE-2 DIABETES (SYMBOD)

Bone possesses the remarkable feature of healing without forming a fibrous scar tissue. However, fracture healing may be compromised under certain disease conditions. Type-2 diabetes mellitus is a metabolic disease known to reduce the vascularization and innervations of regenerated tissue and thus may impair the healing capacities of bones. The central hypothesis of the SyMBoD projects is that the application of individualized and resorbable scaffold materials will guide bone tissue in regeneration and thus improve the fracture healing process. However, if and to which extent such a healing support is necessary depends on the patient's individual traits and further comorbidities.

Yet, there is no diagnostic method to identify patients prone to compromised bone healing at beginning of the therapy. To this end, the SyMBoD projects aims to develop a digital platform for decision-making on individualized therapy plans for patients diagnosed with T2DM. This includes (i) the identification of theranostic biomarkers for early outcome prediction and therapy decision and (ii) the modeling of individualized, patient- and fracture-specific scaffolds for fracture bridging.

As one column of the platform comprehensive and time-resolved molecular patterns of animal studies and human biobank specimen will be collected using transcriptomics, proteomics and metabolomics. By applying bioinformatic approaches data can be correlated to observe healing processes leading to molecular models and theranostic biomarkers. This will guide the patient stratification and identification of risk groups.

As the second column of the platform scaffold materials for bone applications will be optimized by iterative testing in animals. Multi-scaling modeling will be applied for (i) optimizing biomechanical properties of scaffolds of different sizes and (ii) developing computer models to predict optimized individualized patient- and fracture-specific scaffolds.

Both, molecular and biomechanical models will be integrated into a systems medicine digital platform that will support clinicians with identifying patients prone to compromised bone healing and allow the seamless modelling of an optimized and individualized scaffold. Finally, real bone implants can be manufactured from these models in a GMP-compliant manner by applying CAD-CAM 3-D printing techniques with biocompatible and resorpable materials thereby breaking ground for the first individualized therapy in bone reconstruction.

1 *Critical size bone fractures are in the focus in the SyMBoD project. Photo © praisaeng - stock.adobe.com*

2 *Digital platform for individual fracture treatment in T2DM patients.*

PROJECT FUNDING

SPONSORED BY THE

Federal Ministry of Education and Research

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LOCATION LEIPZIG, GERMANY

DEPARTMENT OF IMMUNOLOGY

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. Novel imaging procedures help analyze immunological and cell biological processes.

CORE COMPETENCIES

- Antimicrobial peptides
- Immunome mapping
- Vaccine development
- Immunological models
- Tolerance induction
- Inactivation of pathogens / antibody development

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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 and bacterial 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, dengue, Zika viruses or influenza. 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 Leipzig University.

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LIGAND DEVELOPMENT UNIT

This group applies statistical peptide phage display for the epitope mapping of antibodies (from sera, e.g. allergy and infectious disease diagnostics) as well as for the discovery of novel therapeutic or cell specific ligands. Another topic is in vitro tissue and organoid models for which cutting-edge equipment (FACS, imaging) as well as patented methods to generate iPS cells or surface modifications for cell cultivation are available. One successful spin-off and one more in preparation are testament to the rapid translation of applied research into commercial usage.

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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. The structure of the GMP Process Development Unit guarantees a direct translation of novel therapeutic approaches for ATMPs.

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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, Faculty of Egnineering at Leipzig University of Applied Sciences (HTWK Leipzig).

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BIOLOGICAL MATERIAL ANALYTICS UNIT

The Fraunhofer IKTS working group is based at Fraunhofer IZI and primarily focuses on developing standardized biocompatibility and immunocompatibility tests for assessing implant materials. This includes developing models based on immune cells and devising ways of standardizing the applied tests. Differentiation processes are combined with immunological tests here. This preclinical in vitro data enables conclusions to be drawn on the functionality of new materials depending on the patient's immune system.

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PROJECT EXAMPLES

INACTIVATION OF VIRUSES AND BACTERIA BY MEANS OF LOW-ENERGY ELECTRON IRRADIATION

The inactivation of pathogens using low-energy electron irradiation (LEEI) has long since been a key research area at Fraunhofer IZI. The ionizing radiation destroys the germs' nucleic acids while leaving structural components such as proteins largely intact. This presents a significant advantage over chemical or other physical inactivation methods such as incubation with formaldehyde or heat treatment. Ionizing radiation techniques currently used for sterilization purposes (gamma or roentgen radiation) may only be utilized in specifically shielded buildings so as to avoid any danger being posed to people or the environment. This has prevented their use not only in normal biological and medical laboratories but also in biopharmaceutical manufacturing.

In close cooperation with the Fraunhofer Institutes IPA and FEP, an LEEI pilot facility has been developed that dispenses with major shielding structures. In the reporting year, various automated processes were established using the pilot facility which are able to fully inactivate pathogen suspensions on a multi-liter scale. This facilitates the use of the LEEI procedure in the production of pharmaceuticals. Several bacteria and viruses have been inactivated with the automated LEEI processes and investigations have been conducted into the preservation of the protein antigens following irradiation. The material was subsequently used in several vaccine studies. Taking respiratory syncytial virus (RSV) as an example, it could be shown that proteins, which play a decisive role in inducing a protective immune response, are hardly damaged as a result of irradiation. A complete protective effect could therefore be offered by the vaccine based on the material. These experiments form the basis of the further development of LEEI-based pharmaceutical drugs. In collaboration with a leading company from the field of laboratory automation, devices are now being developed that facilitate the integration of LEEI in industrial manufacturing processes.

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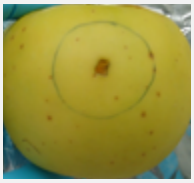
H_20 + Tween

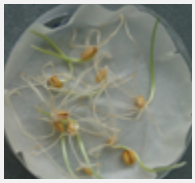
Botrytis cinerea
10^6 conidia/ml



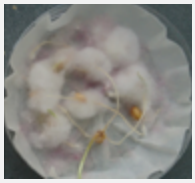
XBD4.DCM
50 µg/ml + B.c.

XBD4.EtOH
50 µg/ml + B.c.

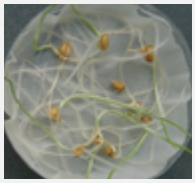
1



PDB Control



PH-1



XBD4.DCM
10 µg/ml + PH-1

XBD4.EtOH
20 µg/ml + PH-1

2

DEVELOPMENT OF BIODEGRADABLE PESTICIDES BASED ON PLANT EXTRACTS WITH AN ANTIMICROBIAL EFFECT

Plant-damaging fungi are increasingly becoming a problem for the global food supply both in western industrialized nations and in developing countries. At the same time, it has become clear in recent years that the antifungal treatment strategies currently in place for plants and fruit are often inadequate as harmful fungi are increasingly developing resistances. This happens in particular when fungicides are unable to be used in a sufficient dose so as to comply with set limit values in crops. The demand for ecologically compatible fungicides with low off-target toxicity is therefore of huge interest.

The need for innovative, plant-based alternatives to fungicides (referred to as botanicals) is also clear from the fact that many current fungicides have to be withdrawn from the market after just a few years due to their side effects. Besides this, EU Directive 1107/2009 states that botanical and extract-based plant protection products are to be approved ahead of synthetically manufactured products based on single substances. Botanicals-based fungicides offer a number of advantages, e.g. they are biodegradable, can be used in organic farming and they do not accumulate in food / along the food chain. Furthermore, plant extracts usually comprise several constituents acting independently of each other. This makes it more difficult for phytopathogenic fungi to develop resistances to the fungicidal constituents of these plant extracts.

The harmful fungi in question, for which a control strategy is to be developed based on plant extracts, generally belong to the aspergillus, fusarium, botrytis, alternaria and penicillium species. Due to their high phytopathological potential and extremely harmful toxins, these fungi present not only an enormous risk to food production around the globe, their mycotoxins can also cause serious illnesses (e.g. tumor diseases, allergies).

In 2019, the Antimicrobial Agents Unit tested more than 30 plant extracts on relevant fungal species such as Fusarium graminearum, Botrytis cinerea and Penicillium expansum. As a result of this testing, four extracts were found to fully inhibit fungal growth both in vitro and in planta on corn and apples, at very low effective concentrations. These plant extracts could therefore provide an alternative to the antifungal plant protection products used to date. The four extracts will now undergo further analyses to investigate parameters relevant to approval such as their UV stability and rainfastness.

1 *Testing the effectiveness of the plant extracts against the harmful fungus Botrytis cinerea on apples.*

2 *Testing the effectiveness of the plant extracts against the harmful fungus Fusarium graminearum on wheat seeds.*

PROJECT FUNDING

Federal Ministry of Food and Agriculture

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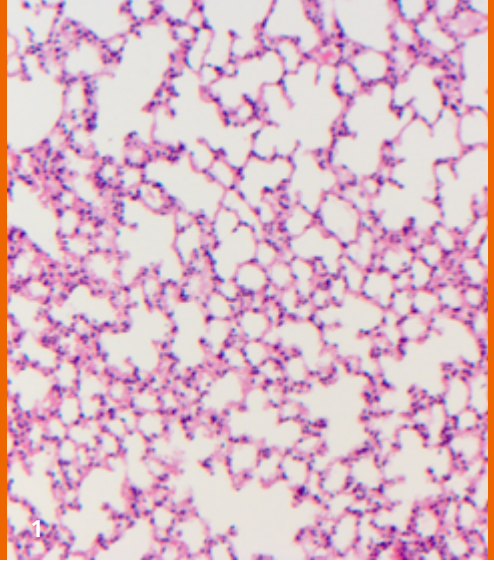

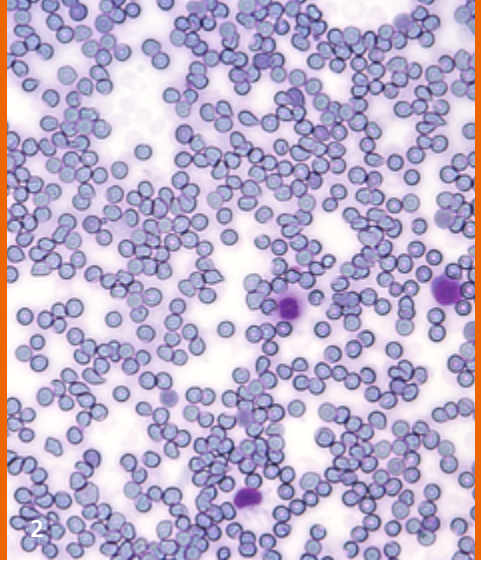

PREVENTION OF ADVERSE IMMUNOLOGICAL COMPLICATIONS WHILE RETAINING THE ANTI-TUMOR EFFECT FOLLOWING STEM CELL TRANSPLANTATION USING ANTI-HUMAN CD4 ANTIBODIES

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

A new approach involves the use of a specific anti-human CD4 antibody. The antibody specifically reduces adverse immune reactions, thus minimizing the chances of aGvHD emerging following stem cell transplantation. The influence of this anti-human CD4 antibody with regard to the prevention of GvHD and under consideration of the graft-versus-leukemia (GvL) effect in a clinically relevant, humanized leukemia model is currently being investigated.

For this purpose models are being used which are particularly well suited for 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.

By 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).

1 *Lung tissue, magnification x10 (HE).*

2 *Blood smear, magnification x100 (Pappenheim).*

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IMMUNOME MAPPING FOR PEPTIDE-IMMUNODIAGNOSTICS

Immunodiagnostics for diseases are usually based on proteins or extracts directly obtained from the pathogenic organism or produced with biotechnological methods. The disadvantage of this approach is that variants are difficult to distinguish, as commonly observed for influenza viruses. Protocols have been established to exactly identify the antibody binding sites (epitopes) of patient antibodies, which are also applicable directly to sera. This allows reliable identification of the pathogen, the causative antigen of allergies, or other indications like (auto)immune or infectious diseases as well as novel approaches for therapy and research.

A steadily growing number of allergy patients could be observed in recent years. Cross reactivities between food allergens reduce the significance of common allergy tests. Epitope-based diagnostics are probably the only alternative to clinical investigations, which require collection of venous blood. Only the provocation with the food is regarded as proof of an allergy, which has to be carried out under medical supervision in a clinic. An efficient diagnosis, appropriate treatment and dietary adjustments are therefore not available for many patients.

The Ligand Development Unit has been conducting research into the epitopes of allergenic soy proteins since 2013, covering an entire spectrum of validated peptide epitopes from allergenic food.

A particularly large project was funded by the Fraunhofer Zukunftsstiftung, which was followed nationally and internationally by allergologists with great interest. In cooperation with several other Fraunhofer institutes and hospitals, the FoodAllergen project aimed at dealing with food allergies using a holistic approach. This also includes the identification of allergens in foods and new processes of producing food ingredients with reduced allergenic potential. By the end of 2019, the epitopes for 14 plant allergens have been identified and many of them have already been tested / validated with more than 200 sera of the Fraunhofer IZI Allergy Biobank. Preparations for a spin-off of the project are already at an advanced stage.

Meanwhile, a new ERAnet project (POC4Allergy) started to develop alternative Point of Care (POC) test systems. The detection technologies are contributed by partners in France and Romania, the Charité in Berlin is once more the clinical partner.

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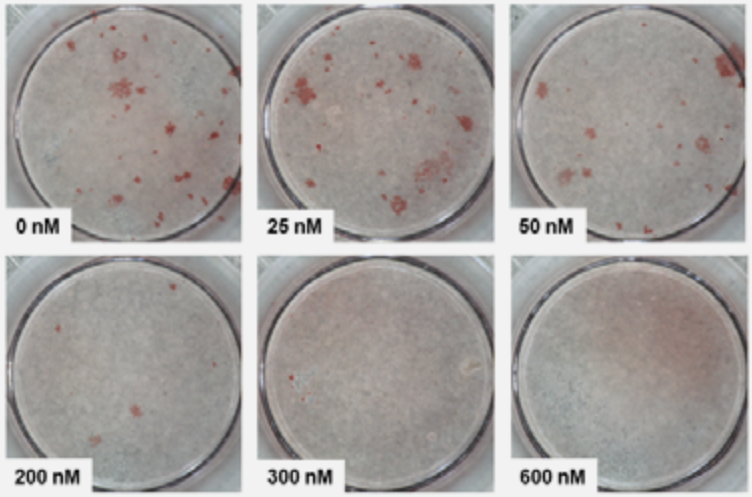
1 *Soybeans. Photo © S.Piyaset – Fotolia.*



1

EFFICACY OF NOVEL HELICASE-PRIMASE-BASED THERAPY FOR HUMAN HERPES SIMPLEX VIRUS (HSV)

Currently, human Herpes Simplex Virus (HSV) infection affects about 82 percent of Germany's population. The pathogen is categorized into two types, which differ in their predilection for the site of infection. HSV type 1 (HSV-1) is associated with a wide range of clinical manifestations including cold sores. In contrast, HSV type 2 (HSV-2) is linked to genital herpes. Both types are able to develop severe disease progression leading to fatal Herpes Simplex Encephalitis (inflammation of the brain).

Until now nucleoside analogues, such as Acyclovir and Valacyclovir, are still the treatment of choice for HSV infections. However, due to the existence of nucleoside-resistant viral strains alternative therapies are needed. Recently, this alternative has been represented by helicaseprimase inhibitors (HPIs), which use a novel mechanism of action to inhibit viral replication. The antiviral efficacy of new drug candidates for the treatment of HSV infections was analyzed in a drug development trial in a mouse model.

Despite the lower dose, we observed a better outcome in clinical parameters using HPI therapy in comparison to Valacyclovir control. No toxic side effects could be observed during the monitoring period of three weeks post infection. The subsequent analysis showed that treated animals harbor a significantly lower viral load compared with placebo animals.

In this project we showed that treatment with the new HPI candidates can significantly reduce or prevent clinical symptoms. HPIs are at least one order of magnitude more potent and efficacious compared to Valacyclovir. Thus, candidates of the new drug class are promising inhibitors of HSV infections in vivo and should be translated into clinical trials.

1 *Dose-dependent reduction of the amount of HSV-infected Vero cells (stained in red) treated with HPI.*

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VACCINATION AGAINST ASTHMA – MUCORSV

Approximately 235 million people worldwide suffer from asthma. Among children, asthma is the most widespread chronic disease, resulting in a severe impact on their quality of life. It has been shown that children who were infected with respiratory syncytial virus (RSV) in infancy or early childhood are more likely to develop asthma later. Glucocorticoids and beta-2 sympathomimetics are used as the standard therapy for asthma, but this treatment is often not sufficient in severe cases and can lead to significant side effects when used for long periods of time. An alternative treatment is therefore urgently required.

Due to the correlation between repeated RSV infections in early childhood and the development of asthma, preventive measures present the most effective mode of action. The MucoRSV project investigates whether a vaccination against RSV can protect from repeated infections and thus prevent asthma.

Currently there are no approved vaccines against RSV. Within the scope of this project, different vaccines will be tested and administered mucosally, i.e. via nasal spray or inhalation. One candidate is a killed vaccine containing virus particles which were inactivated by low-energy electron irradiation. The virus will be packaged in nanoparticles in order to enable an increased uptake via the mucosal membranes. Another vaccine consists of DNA coding for RSV-F, the most important RSV antigen. This DNA is packaged in non-human papilloma-virus capsids and applied using these viral vectors.

A vaccine against RSV could thus not only prevent the viral disease itself, but also reduce serious chronic consequences such as asthma.

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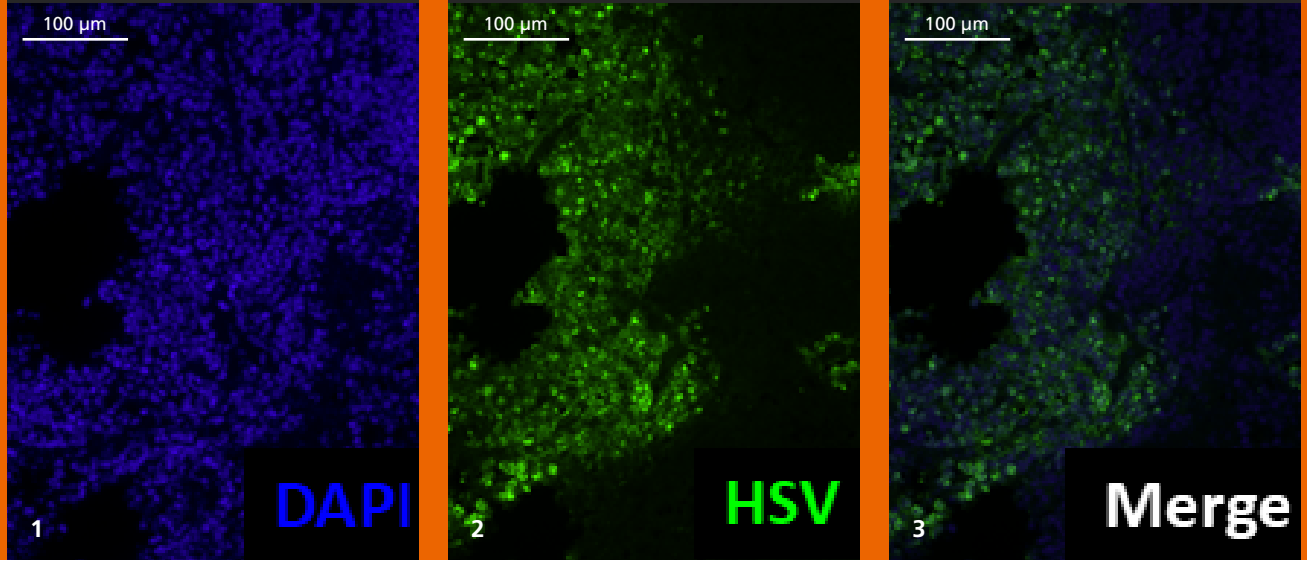

THERAVISION – PLATFORM TECHNOLOGY FOR THE DEVELOPMENT, PRODUCTION AND TESTING OF ONCOLYTIC HERPES SIMPLEX VIRUSES FOR TUMOR THERAPY OF LUNG CANCER

Viruses are able to penetrate cells and produce both foreign and viral proteins. Afterwards they multiply in order to kill the infected cells. Due to the fact that oncolytic (cancer-destroying) viruses selectively kill tumor cells, they have become an emerging hope in cancer therapy. The Herpes Simplex Virus (HSV) is one of those viruses.

We aimed to increase the efficacy of the oncolytic activity of an HSV-1 based vector by genetically introducing different genes for immune modulation and for targeting the optimization of tumor therapy. Thus, the virus-mediated oncolysis is combined with immunotherapy in one virus vector and an effective destruction of tumors as well as metastases is possible. The objective of the project "TheraVision" is to establish a broadly applicable platform technology based on HSV for combinatorial oncolytic virus immunotherapy.

As a proof of concept, an oncolytic virus was developed for the therapy of non-small cell lung cancer (NSCLC), whereby the Fraunhofer IZI established the appropriate mouse model.

The cells of the lung cancer tumors express the reporter Firefly-Luciferase in order to be detected by a highly sensitive light camera in vivo. The tumors showed a significant increase in bioluminescence intensity, which directly corresponds with an increase in size. The treatment of these tumors with an attenuated and neurotoxicity-deleted HSV vector led to a significant reduction in tumor growth and bioluminescence intensity compared to an untreated control group. Furthermore, the attenuated vector with deleted neurotoxicity genes caused a significant reduction of the viral load in the brain in comparison to an unmodified HSV vector.

To analyze the immunotherapeutic activity of novel functionalized oncolytic viruses, this tumor model must still be transferred into humanized mice with the appropriate human tumor in an allogenic immune environment that mimics more the natural situation. Finally, a broadly applicable platform technology to test the efficacy of virus vector and immune therapies or combinations will be available for future endeavors.

1|2|3 *HSV-induced plaque formation in tumor tissue sections of mice after intratumoral virus therapy. DAPI (blue) depicts the cell nucleus and HSV (green) the viral proteins in infected lung cancer cells.*

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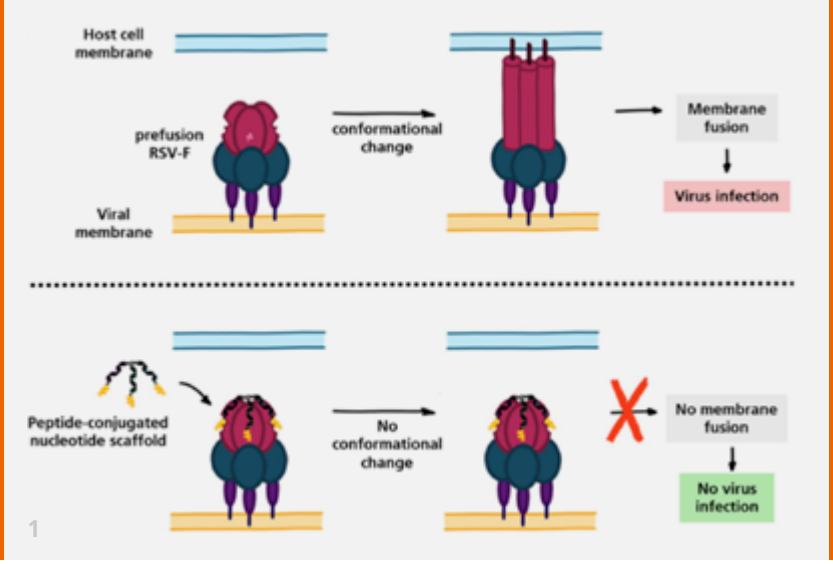

RSV PROTECT

While mostly harmless in healthy adults, Respiratory Syncytial Virus (RSV) is a severe risk to the lives of infants, the elderly, or patients with weakened immune systems. Additionally, RSV disproportionately impacts heavily populated, developing countries such as India or China, and is an increasing risk globally, causing an estimated number of more than 200,000 infant deaths yearly. While risk factors such as pollution or immune deficiency are known, true therapeutic and preventative measures are nearly non-existent. No RSV vaccine has cleared clinical trials despite 5 decades of failed efforts, and the only prophylactic on the market – Palivizumab (Synagis®) – is an expensive monoclonal antibody that is only used in the most high-risk patients in wealthy countries.

The RSV Protect team (Dr. Thomas Grunwald, Dr. Mirko Buchholz, Dr. David M Smith) has been working since 2016 to develop small molecules and synthetic biologics as effective, inexpensive lead compounds to inhibit the virus's ability to enter and infect host cells. By creating compounds that bind to the receptors on the surface of the virus that are responsible for adhering to and fusing with host cells in lungs, the overall infectivity of the virus can be eliminated.

Using this strategy, several small peptides shorter than 15 amino acids were produced, which were targeted to "lock" the main fusion protein of the virus, RSV-F, in a configuration that leaves it unable to inject its genetic material into the host cells. These peptides, which are more than 100 times smaller than a typical antibody, were effective in micromolar concentrations at preventing RSV infections in both cellular model systems and living animals. Replacing essential amino acids in the sequence with non-natural, synthetic derivatives ensures their usability, increases their efficacy, and reduces the risk of unwanted side-effects.

Similar to most viruses, the numerous surface receptors on RSV work together as a deadly team, where 3 identical protein units are geometrically arranged in trimeric form to cooperatively enhance fusion with host cells. Therefore, the principle of multivalence was utilized to arrange 3 of the RSV-blocking peptides on a small structural scaffold made from DNA strands, geometrically complementary to the virus proteins. Presentation on this trivalent, DNA-peptide conjugate was successful in enhancing the protective ability of the peptides 500-fold in cell models, equivalent to levels seen for the only commercially available prophylactic, Palivizumab. This work has paved the way for a patent application and a broader, currently ongoing pre-clinical study.

1 *RSV-F protein enables the binding of the virus to the host cell and fusion with its plasma membrane, therefore infecting the cell. Molecular inhibitors developed in the RSV-Protect project lock RSV-F in its inactive configuration, preventing the virus infection of host cells.*

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LOCATIONS LEIPZIG AND HANNOVER, GERMANY

DEPARTMENT OF CELL THERAPY

THE DEPARTMENT AT A GLANCE

The Department of Cell Therapy prepares new gene and cell therapy procedures for clinical application. This involves the validation of experimental approaches with an eye to safety, feasibility and efficiency. Numerous model systems that facilitate the preclinical testing of novel concepts under the strictest quality criteria have been and continue to be established by the department. These systems lend the obtained results a high level of predictive power with regard to their future clinical application. Cell therapeutic methods are used, for instance, in the case of ischemic diseases such as stroke and myocardial infarction while attention is also given to processes that could prevent cell degeneration and aging. The "sleeping" potential of stem cells is also investigated. Last but not least, the department focuses on cell therapy methods in the field of immuno-oncology, where genetically modified immune cells (cytotoxic T-cells) or natural killer cells (NK cells) are developed to treat tumors.

CORE COMPETENCIES

- Experimental imaging
- Stroke models
- Cell therapeutics
- Preclinical study design
- Experimental neurosurgery
- Histology
- Gene modification of effector cells

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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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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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BRANCH LAB TRANSLATIONAL CELL THERAPY (HANNOVER)

The Branch Lab Translational Cell Therapy develops and validates cell-based advanced therapy medicinal products (ATMPs). To do this, it conducts translational research and develops GMP-compliant manufacturing protocols for cell therapeutics at the interface to preclinical development right through to their transfer into clinical trials. Cell and genetic engineering methods and strategies are implemented and optimized here to specifically manufacture killer lymphocytes and their subpopulations. The ability to overcome so-called tumor immune escape mechanisms in cancer cells is key here. This is achieved by using activated and genetically modified effector cells together with checkpoint inhibitors and stimulating immune cells. These cell therapies boost immune surveillance and strengthen the elimination of resistant cancer cells as well as their malignant precursor cells (so-called tumor stem cells). Another focus of development lies in optimizing the transduction capacity of effector cells using chimeric antigen receptors (CARs) in order to increase cytotoxicity to malignant cells. To do this, human effector cells are separated following lymphapheresis by means of GMP-suitable, fully automated, closed-system production, genetically modified as necessary and expanded as part of clinical upscaling. Moreover, the group is developing GMP-compliant manufacturing and expansion protocols in order to proliferate a sufficient number of activated effector cells.

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PROJECT EXAMPLES

COMBINATION OF DIRECTED, DUAL-SPECIFIC NK CELLS AND CHECKPOINT INHIBITORS FOR A HEIGHTENED EFFECT AGAINST RESISTANT HEAD AND NECK TUMORS AND TUMOR STEM CELLS

In this project, donor NK cells combined with specific receptors expressed on the cell surface referred to as chimeric antigen receptors (CARs) are manufactured with defined recognition molecules (CD133, CD44v6, HER1, HER2) to specifically target various surface structures / molecules on solid tumors, i.e. squamous cell carcinoma. As part of subsequent (in vitro) efficacy studies, specific recognition and elimination reactions of the activated CAR-NK cells are to be demonstrated against resistant CD133, CD44v6, HER1 or HER2-positive, malignant squamous cell carcinoma cells (cell lines and patient tumor cells). Further efficacy studies are then planned in humanized mouse tumor models (in vivo) using these genetically modified effector lymphocytes to demonstrate proof-of-principle and / or proof-of-concept for the cancer studies. Using this data, a directed, cell-based anti-cancer therapy is to be developed under GMP (good manufacturing practice) conditions, which will facilitate the successful, clinical treatment of patients in the future.

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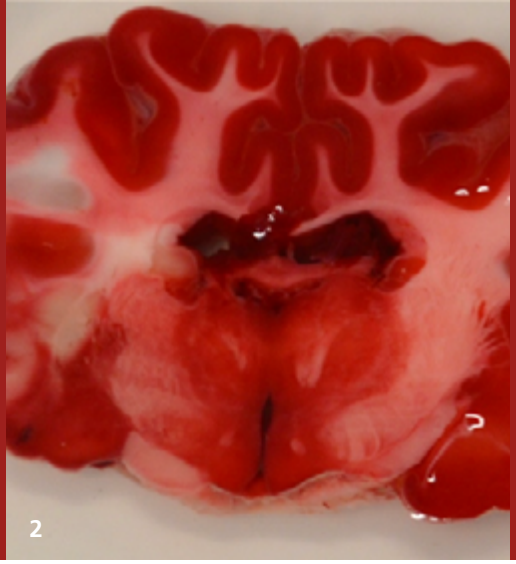

PROOF OF PRINCIPLE FOR A FIRST IN CLASS NEUROPROTECTIVE THERAPY IN STROKE (SAVEBRAIN)

Stroke is the third leading cause of death beside cardio-vascular and tumor disease and the main cause for disability in elderly people. Ischemic stroke is characterized by a cerebral hypoperfusion. This leads to a very low level of oxygen and nutrients of the neuronal tissue and therefore to neuronal damage and early loss of brain areas (primary damage). Due to the cell loss inflammation and apoptosis are initiated leading to secondary damage and a significant higher tissue loss even days after the ischemic event. As a consequence neurotoxic conditions are dominant in the brain. Therapeutic options are limited to recanalisation with recombinant plasminogen activator (rt-PA) having a very close therapeutic time window.

In this project a new therapeutic treatment is being evaluated targeting the inhibition of two neurotoxic mechanisms in comparison with activating a neuroprotecting pathway by combining three different substances. These agents affect the same cellular pathway. Their combination should enhance the clinical outcome through complete restoration of physiological conditions in the brain including the minimization of blood brain barrier breakdown as well as a decrease of tissue loss. One substance alone cannot achieve this and had to highly dosed probably occuring side effects. The three mechanisms of actions have already been validated in rodent studies. STAIR recommends testing in two different animal models with one model being gyrencephalic. This project used a stroke model in sheep. One hour after recanalisation of the middle cerebral artery animals received the three substances followed by imaging and behavioral testing over 28 days. A macrosopic and histological analysis of the brain tissue is performed at the end and compared to a control group.

1 *MR imaging (DWI) of an acute stroke with the occlusion of the middle cerebral artery.*

2 *Illustration of a brain slice stained with TTV, red staining vital tissue, white areas necrotic brain regions (treatment group).*

PROJECT FUNDING

European Research Council
Established by the European Commission

This project has received funding from the European Research Council (ERC) under the European Union's Horizon 2020 research and innovation programme (grant agreement No 737586).

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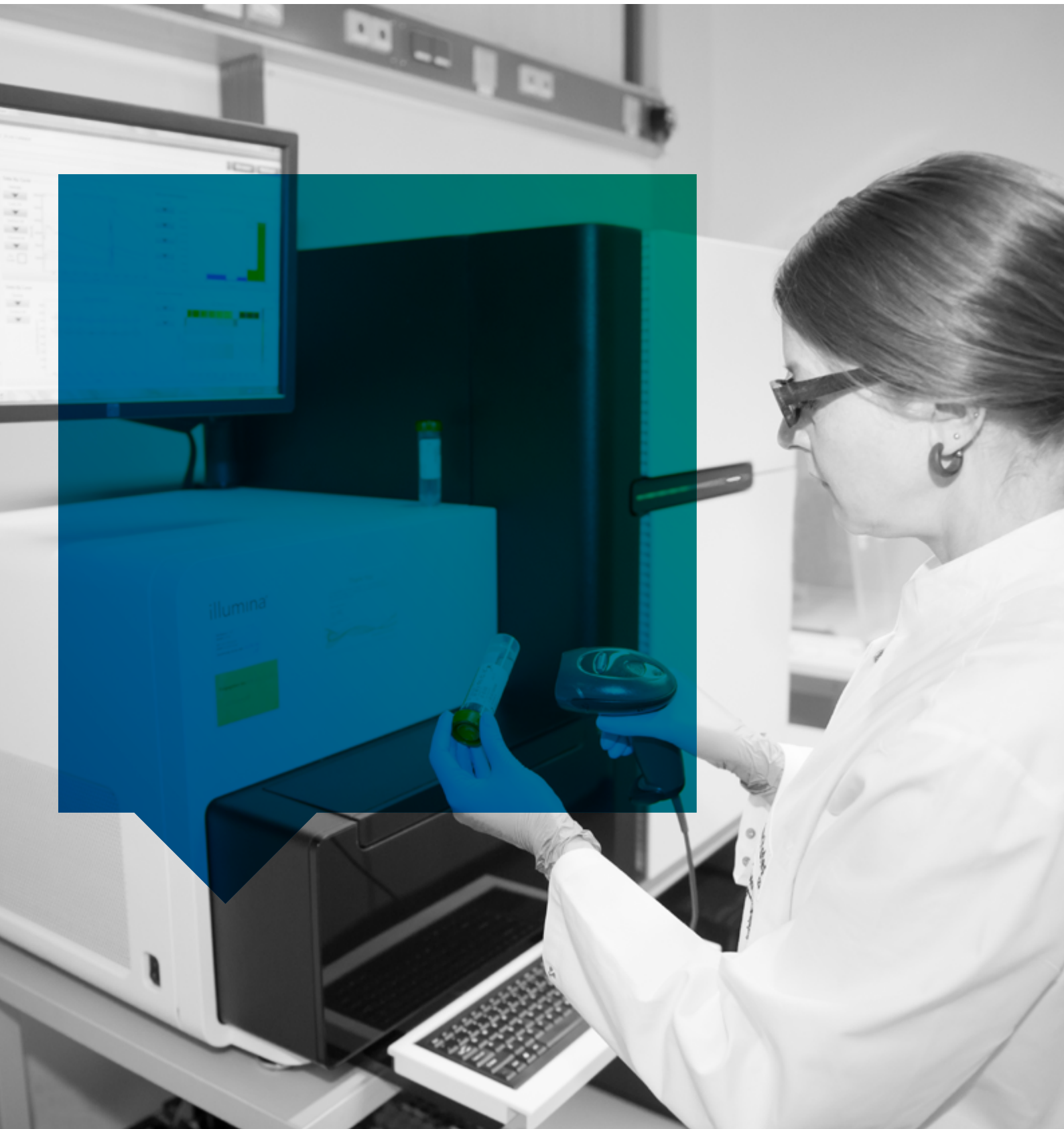
LOCATION LEIPZIG, GERMANY

DEPARTMENT OF DIAGNOSTICS



THE DEPARTMENT AT A GLANCE

The Department of Diagnostics offers a value chain that covers the identification and testing of new biomarkers, the bioinformatic analysis of complex transcriptomic and genomic data ("Big Data") as well as the development of prototypes for in vitro diagnostics and point-of-care platforms. Furthermore, it offers a broad range of analytical methods.

In the department's RIBOLUTION Biomarker Center new biomarkers are being systematically identified and validated using state-of-the-art techniques such as next-generation sequencing (NGS) and microarray analysis. A particular focus is on non-coding RNAs, which show high, so far mostly underestimated, biomarker potential. An experienced bioinformatics group provides efficient processing and (statistical) analysis of molecular biological data, particularly of NGS data obtained from large clinical cohorts. Competencies in study and data management enable our scientists to plan and conduct such cohorts. A quality management system was implemented for these processes and certification according to the ISO 9001 standard is planned for 2020.

A main focus of the department is the development of molecular diagnostic tests in the medical and food sector. This includes PCR and NGS analyses as well as lab-on-a-chip systems. Diagnostic needs are addressed for e.g. cancer, neurogenerative and inflammatory diseases as well as pathogen tests for infectious diseases. Currently, particular focus is being placed on diagnostic and prognostic tests for prostate carcinoma and the detection of pathogens in the field of cardiosurgery and sexually transmitted infections.

Beyond the molecular diagnostic field, the department has a wide range of additional analytical methods at its disposal and develops novel biointeractive molecules on structural DNA-based scaffolds. Furthermore, a large number of cell and animal experimental models are available. Xenogenic transplantation models are also used to bridge the gap between in vivo model and patient.

CORE COMPETENCIES

- Transcriptome analyses
- Next-generation-diagnostics
- Bioinformatics
- Nanotechnology
- Lab-on-chip
- Biomarker identification
- Tumor models
- Quality assurance according to DIN EN ISO9001

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UNITS

INFLAMMATION MODELS AND IMMUNODIAGNOSTICS UNIT

This unit holds a broad spectrum of in vivo models for preclinical proof-of-concept studies. We focus on autoimmune induced joint diseases (e.g. Rheumatoid Arthritis), airway diseases (e.g. bronchial asthma, allergic rhinitis) and chronic kidney diseases. Other main topics are tumor models and humanized in vivo models. In addition, the group specializes in routinely developing new research models as well as in diverse methods of analysis to investigate the in vivo models.

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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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MICRODIAGNOSTICS UNIT

The unit develops molecular diagnostic test systems for the food and medical-clinical area. A major focus is on the use of extracellular vesicles for the early diagnosis of Alzheimer's or cancer, the development of rapid tests for infectious agents and bioanalytical sample preparation. Novel lab-on-a-chip diagnostic platforms, e.g. for the detection of sexually transmitted pathogens in home test format, are being developed with customers. Another focus is on airway analysis using ion mobility spectrometry. Hot embossing technology is available in-house for microfluidics development.

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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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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 fine regulatory 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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CARDIOMICS UNIT

The group uses state-of-the-art OMICS technology platforms to research cardio-surgical locally and systemically relevant infectious diseases. The focus of scientific interest is in particular the crystallization of pathogen-specific virulence factors and their influence on the clinical outcome after implantation of a medically necessary device or implantation of biological or mechanical heart valves as well as their translation into clinical routine. Based on improved diagnostics, alternative treatment methods are evaluated and new interventional procedures taken to clinical maturity. In particular, the working group examines the relationship between infectious diseases and molecular regulatory mechanisms. 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 research group primarily develops diagnostic procedures for determining the effect of factor X inhibitors or coagulation diagnostics in the final section of the plasmatic and thrombocytic coagulation cascade.

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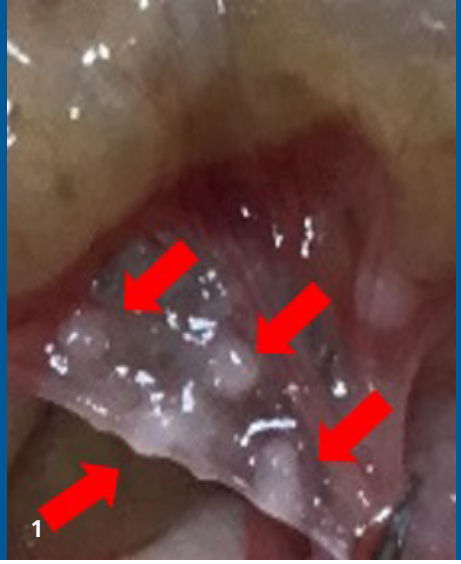

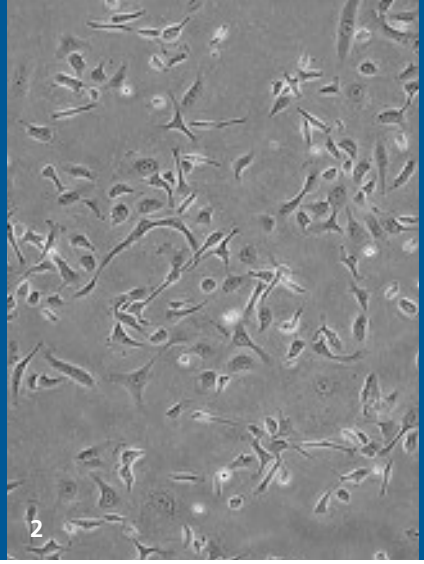

PROJECT EXAMPLES

CAR-NK-CELL THERAPY FOR THE TREATMENT OF PERITONEAL METASTASES

Ovarian cancer is a highly aggressive cancer with a mortality rate of 70 percent. Due to the unspecific and late occurring symptoms, an early detection is often difficult. At this time point, the disease has often already affected the whole peritoneum with multiple metastases on many organs. The currently existing therapy is based on a radical surgical removal of the tumors as far as it is possible followed by a combined chemotherapy using paclitaxel and carboplatin. However, 20 percent of the cases have a primary platin resistance, so that a recurrence of the disease can be observed after 16–22 months. By the event of disease relapse, an immediate change of the therapy as well as alternative treatment strategies are decisive for the survival of the patients. Due to the fact that (i) surgical removal is more than difficult, (ii) radiation therapy is nearly impossible and (iii) chemotherapy is often ineffective, there is an urgent need for new therapeutic strategies treating this type of cancer. NK-cell therapeutics carrying CARs (chimeric antigen receptors) are upcoming therapeutic approaches in the treatment of cancer because of their high efficacy and specificity and minor side effects compared to CAR T-cell therapies.

In this project, innovative NK-cell therapeutics with different CARs will be tested in a previously established orthotopic mouse model for peritoneal metastases. The metastases are induced by intraperitoneal injection of a luciferase labelled ovarian cancer cell line in highly immunodeficient NSG mice. After tumor cell transplantation, the mice are analyzed by different non-invasive imaging techniques particularly by Bioluminescence Imaging (BLI) to monitor tumor growth. Other imaging techniques such as CT or MRI are also possible, all devices are available at the Fraunhofer IZI animal facility. When the tumor load reaches a critical size, the treatment with CAR-NK cells begins. The therapeutic cells are also injected intraperitoneally. During the treatment period and in addition mice are monitored continuously by BLI to analyze the treatment effect. Finally, a model for ovarian cancer peritoneal metastases will be available which will allow testing cell therapeutics on a routine basis to develop innovative therapeutic strategies for the treatment of ovarian cancer.

Prospective projects could include a human immune system in the tumor mouse model for testing e.g. immune checkpoint inhibitors which need the interaction of immune cells for their mechanism of action.

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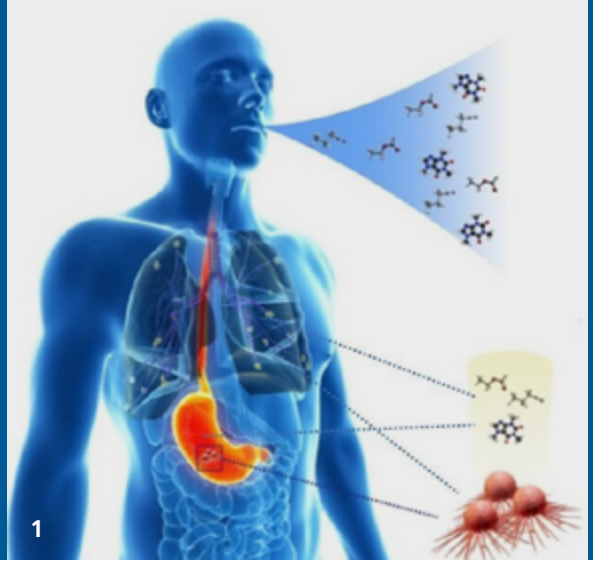
1 *Peritoneal metastases (red arrows) in an NSG mouse 80 days after transplantation.*

2 *SK-OV-3 cells used for this model.*



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DIAGNOSTICS OF VARIOUS DISEASES IN EXHALED AIR USING ION MOBILITY SPECTROMETRY

The diagnosis of diseases should be as quick, easy and inexpensive as possible, directly at the point of care without highly qualified laboratory personnel and also without additional stress for the patient. To meet the existing requirements, research is being carried out at the Fraunhofer IZI and the Fraunhofer Project Center MEOS on a diagnostic method using exhaled air.

Breathing gas analysis has been used clinically for years as part of lung function tests or the urea breath test to detect Helicobacter pylori infections. However, there is a much greater potential in breathing gas diagnostics. There are thousands of so-called volatile organic compounds (VOCs) whose composition in the air we breathe changes with certain diseases and infections. For example, the diabetic patients' smell of overripe fruit is known, caused by a greatly increased concentration of acetone, a VOC.

Most VOCs occur in extremely low concentrations (ppmV to pptV - one particle per million or trillion particles). This places extreme demands on the measurement technology. Conventionally, mass spectroscopic methods are mostly used, which, however, mean an enormously high expenditure on equipment. We therefore focus on ion mobility spectrometry (IMS), which is coupled with gas chromatographic (GC) pre-separation. This technology is much cheaper, more portable (shoebox size) and is already being used for drug and explosives controls.

In Leipzig, GC-IMS was able to differentiate between different bacteria based on their VOC profile after only 90 minutes of cultivation in the laboratory in 2019. In the course of the project, these experiences will now be used to directly examine real breath samples in the clinic. The aim is to diagnose various bacterial and viral infectious diseases, including any existing drug resistance, in patients' breath.

In the MEOS project center in Erfurt, colleagues from Fraunhofer IZI and Fraunhofer IPMS are working on a new IMS system. The centerpiece is a small IMS silicon chip, which is being further developed at Fraunhofer IPMS in Dresden. Potentially miniaturized IMS chips can be inexpensively manufactured in large quantities using the microelectronic manufacturing processes. The new system is to be tested in the diagnosis of neurological diseases and cancer. In addition to the exhaled air, other non-invasive samples such as sweat and urine are also in focus.

1 *VOCs in human breath. © Fig 2 from article: A. Dan Wilson. Finding aroma clues in the human breath to diagnose diseases. Atlas of Science. 2016 Feb 29.*

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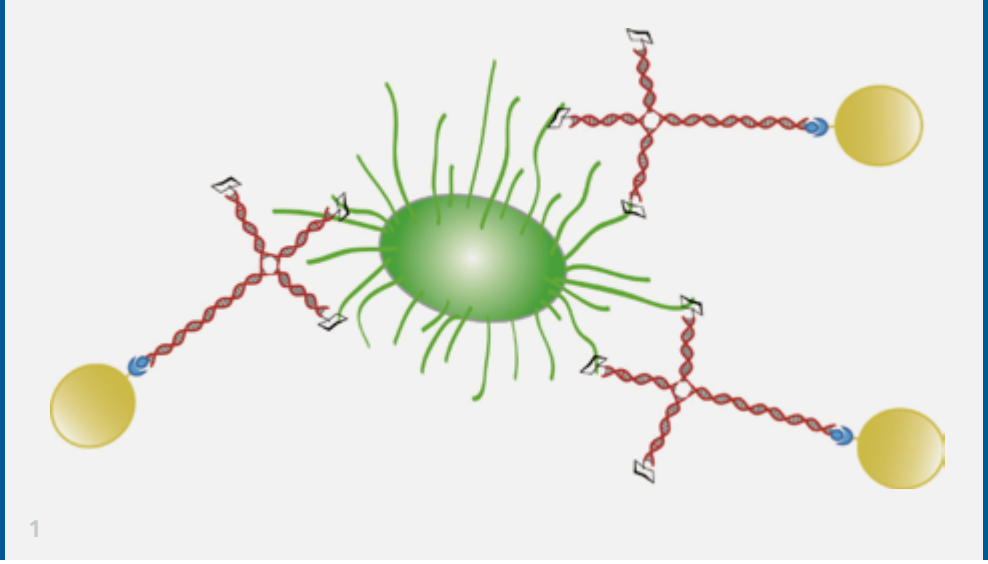

1

GLYCO3DISPLAY – DNA-DIRECTED ASSEMBLY OF GLYCANS FOR ANTI-PATHOGEN SCREENING

Polysaccharides, also known as glycans, are long and complex sugar molecules made up of a chain of monosaccharides such as mannose, glucose or fructose. Numerous glycans are found on the surface of human cells, and are used by disease-causing bacteria or viruses as molecules for recognizing, binding, and eventually infecting the host cells. Therefore, sugar molecules such as mannose, heparin or sialic acid, which are found on the membrane of human cells, are particularly interesting from a medical research perspective. Nanometer-scale geometry also plays an important role here; viruses and bacteria exploit the principles of multivalence, where two or three sugar-binding receptors act cooperatively to more efficiently bind to and infect their targets.

In Glyco3Display, novel carbohydrate-based compounds are created by integrating different glycan molecules with DNA-based structural scaffolds. This approach leads to precise arrangements of defined glycan chains being created with single-nanometer spatial resolution. This brings together two key technologies from partners Fraunhofer IZI and the Max Planck Institute for Colloids and Interfaces: DNA Nanotechnology and Automated Glycan Synthesis.

In the early phases of the project, work focused on creating a high-throughput assay for investigating the binding of specific glycan formulations and arrangements to target pathogens like E. coli bacteria. By integrating the DNA-glycan compounds onto microbeads, any standard automated flow cytometry system can be used to quantify the impact that the exact glycan composition and how they are geometrically arranged on DNA scaffolds has on their ability to bind the surface of the pathogen.

Using the information gained from this assay system, new DNA-glycan compounds can be designed for both diagnostic and therapeutic purposes. By covering the surface of viruses or bacteria with these compounds, their ability to infect host cells can be significantly hindered. These types of "anti-adhesive" or "fusion inhibition" compounds are increasingly being developed for medical markets. Similarly, the specific binding of these DNA-glycan compounds to the surface of pathogens can be utilized instead of traditional capture antibodies in advanced disease diagnostics.

1 *Sugar molecules are conjugated to small, branched DNA structures formed from 4 individual DNA strands. When bound to magnetic beads, these can be used for the high-throughput screening of how compounds bind to bacteria like E. coli.*

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LOCATION ROSTOCK, GERMANY

DEPARTMENT OF EXTRACORPOREAL IMMUNOMODULATION

THE DEPARTMENT AT A GLANCE

The department 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.

CORE COMPETENCIES

- Cellular biosensors
- Medical devices for blood purification
- Dialysis procedure
- Organ-supporting technologies

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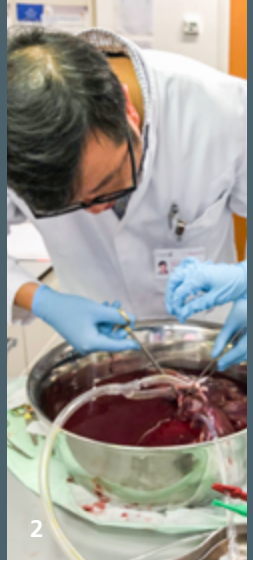

PROJECT EXAMPLES

EX SITU ORGAN PERFUSION

The availability of suitable donor organs for patients with organ failure has been a major problem for many years. On the one hand, the number of donations itself is too low – it is estimated that only about ten percent of the actual demand can be met with transplanted organs. On the other hand, the functionality of donated organs or the health status of potential donors often does not meet medical requirements. Pre-existing diseases of the donor, the presence of risk parameters, especially in the case of livers, e.g. a high degree of adiposity, but also the duration of the ischemic period (lack of blood and oxygen supply to the organ during transport) after organ removal can lead to considerable organ functional losses. Such "marginal" organs usually mean a lower probability of survival for the transplanted patient, or are not even considered as donor organs. However, due to the high demand for donated organs, there is a growing desire to also consider marginal organs for transplantation.

This is where the "OrganFit" project comes in. It is already known from published work that organs can be kept functional for a certain period of time by means of machine perfusion. If the perfusion is then carried out at physiological temperatures ("normothermic"), the preservation of function is improved compared to hypothermic conditions, as the cold ischemia time is reduced.

The organ perfusion platform established in the EXIM department in Rostock will now be used to investigate further approaches that will support the use of marginal livers. For this purpose, both technical and biological approaches are planned to support or even strengthen the natural regeneration potential of livers. Livers from pigs will initially be used to establish and test these approaches. The project is carried out in close cooperation with the Clinic for Transplantation Surgery and the Clinic for Anaesthesia and Intensive Care Medicine of the University Medicine Rostock.

Looking beyond the current project, the technical platform should also enable new cooperations and further research projects and thus make the most diverse use of the opportunities offered by ex situ organ perfusion.

1 *Technical set-up of the perfusion platform.*

2 *Preparation of a pig liver for perfusion.*

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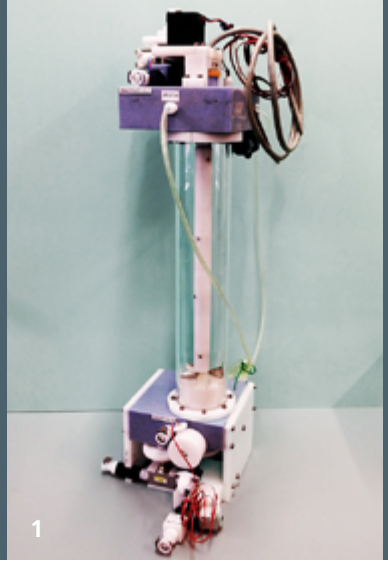

CRYOREGENERATION OF DIALYSATE

Patients whose bodies have a weakened detoxification function due to a late-stage chronic kidney disease regularly need to have dialysis. The principle behind this procedure has been established for decades and is based on extracting water-soluble toxins (uremia toxins) in an extracorporeal filter, i.e. the dialyzer. The toxins pass from the blood into the purifying dialysis water (dialysate) via a membrane in the dialyzer. Around 120 liters of dialysate are required for every dialysis treatment, which usually takes four hours and is repeated three times a week. This water is taken from reverse osmosis (RO) plants in hospitals and specialized dialysis practices. Not only do these plants take up a lot of space and energy, but the water can only be used once as it disappears as waste water following dialysis. Based on a one-year time frame and 90 000 patients in Germany, over 1.7 million cubic meters of highly purified water are needed, without even taking the lost RO water into account.

Based on an approach which has never been applied to dialysis in the past, a procedure is being developed in the Department of Extracorporeal Immunomodulation that facilitates the regeneration of used dialysis water and could therefore completely change the huge problem of water dependability affecting the use of dialysis today. This procedure draws on the concept of freeze concentration used in the beverage industry and is based on the principle that the crystal lattice structure of frozen water excludes any previously dissolved foreign substances. As part of an automatable cycle, the procedure enables contaminated dialysate to be separated into pure water and a small residual volume containing impurities. This residual volume may arise from the patient's regular liquid intake, removing the dialysis' dependency on a pure water supply and making entirely mobile solutions conceivable. The fact that this separation occurs regardless of substance properties such as solubility, polarity, size, density, etc. is hugely beneficial compared with all conventional filter-based procedures, which do not demonstrate a sufficient filter capacity, especially for urea.

The procedure is currently being patented and an automated solution is undergoing development. This technical solution will then be used to carry out extensive investigations to specify process parameters that can later be used when working towards the initial clinical application. Notable industrial companies have already shown an interest in the procedure despite it's early stage of development.

1 *The wash column is central to automating the cryoprocedure.*

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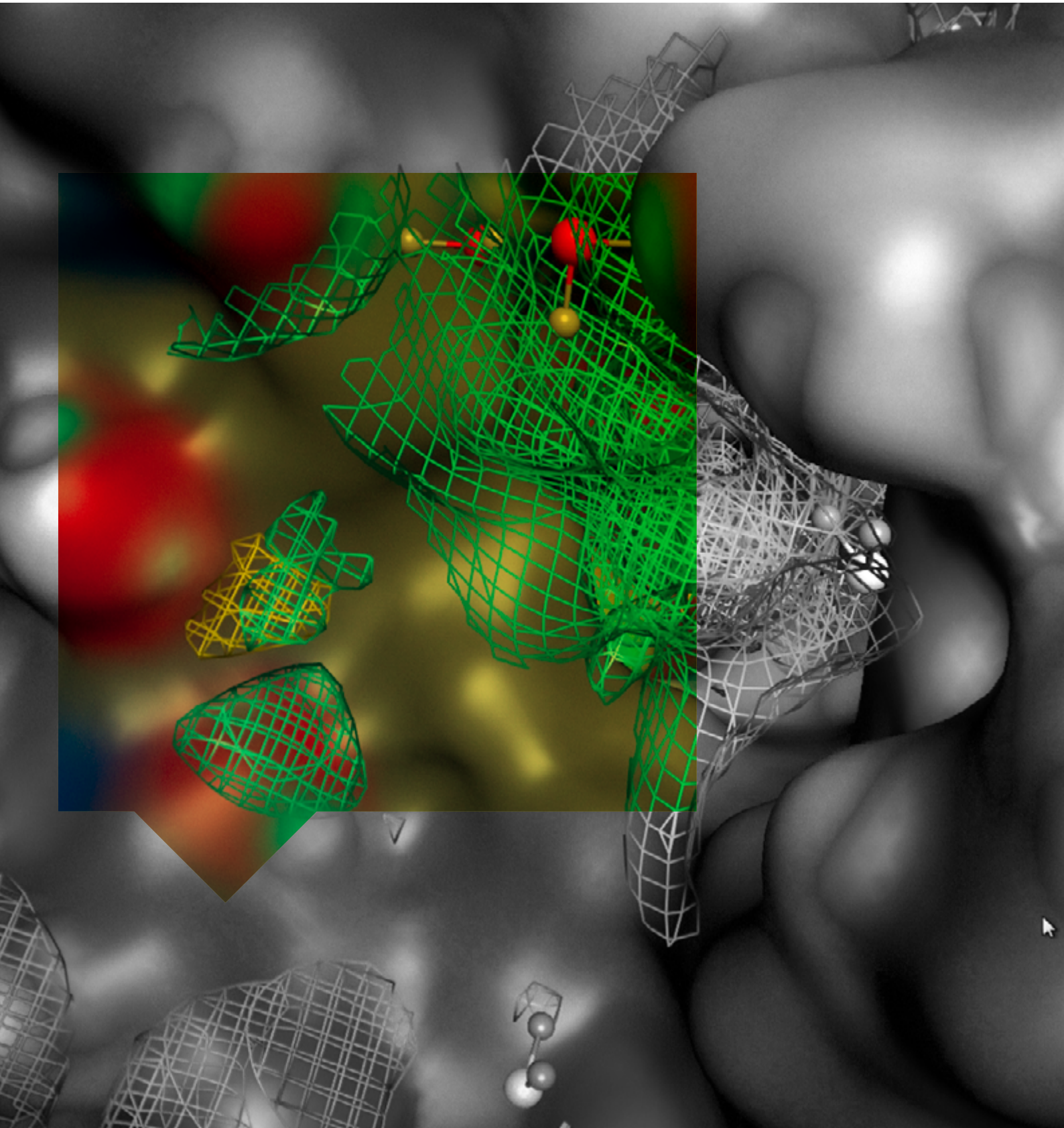
LOCATION HALLE (SAALE), GERMANY

DEPARTMENT OF DRUG DESIGN AND TARGET VALIDATION



THE DEPARTMENT AT A GLANCE

The Department of Drug Design and Target Validation in Halle (Saale) boasts considerable expertise in various areas of preclinical drug development, placing a special focus on neurodegenerative and inflammatory diseases. The department's work covers almost the entire range of activities associated with the early stages of drug development, from identifying and characterizing target proteins to identifying initial drug candidates right over to testing substances in the animal model. Members of staff at the Halle (Saale) branch are characterized by their extensive experience in industrial and pharma-relevant research. This allows scientific issues to be tackled on behalf of industry partners on the one hand, and new drugs and target proteins from the institute's own preliminary research to be identified, patented and subsequently form the basis of industry cooperations on the other.

Small molecules and biologicals will be developed and tested on the back of the department's new treatment concepts. Alongside this, testing procedures will be developed for the identification and diagnostic application of biomarkers, which allow the course of both the disease and therapy to be monitored. Furthermore, the department also houses the expertise required to create pharmacologically relevant in vitro and in vivo models.

Besides modern peptide synthesis and protein analytics methods (MALDI-TOF and LC-MS), the department has also developed a broad spectrum of biophysical methods for characterizing therapeutically relevant metabolic pathways, whose key proteins as well as cell-based and pharmacological models are used to characterize innovative chemical and biological agents.

CORE COMPETENCIES

- Medicinal chemistry
- Assay and model development
- Neurodegenerative diseases
- Pharmacology
- Drug development
- Drug design (in silico)
- Drug testing (preclinical)
- Synthesis

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UNITS

MOLECULAR BIOTECHNOLOGY UNIT

The Molecular Biotechnology Unit develops and establishes analysis and model systems for use in cellular and molecular biology. This involves cell-based assays, gene expression analyses, immunological and protein-chemistry methods, sophisticated cell culture models and animal experiment approaches. In the area of preclinical development, the unit is able to conduct a series of cell-based tests to characterize substances with regard to efficacy, toxicology and transport. Furthermore, in collaboration with the department's analytical laboratory, pharmacokinetic parameters are determined in vivo and the effectiveness of small molecules and protein drugs are investigated in respective disease models. The unit is also able to establish new animal models to investigate enzyme functions in the organism. Beyond this, it assists with drug development in terms of regulatory preclinical practice.

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PROTEIN AND DRUG BIOCHEMISTRY UNIT

The Protein and Drug Biochemistry Unit has extensive experience in the purification of target proteins and their enzymatic characterization. Besides traditional protein chromatography procedures, protein chemical methods are also used, e.g. spectroscopic and crystallographic methods for analyzing structure and enzyme-kinetic effect. The unit specializes in the humanization of antibodies to manufacture protein drugs right up to their semi-preparative extraction. The subsequent structure-activity analysis and 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 Drug Design and Analytical Chemistry Unit covers the entire spectrum of medicinal chemistry and analytics required to identify potential new drug candidates from the field of "small molecules" and develop them into clinical candidates.

By using computational procedures, potential new target molecules are first designed in silico and evaluated as to their efficacy on the target protein. Once this stage is complete, synthesis and real testing on the isolated target protein can then be carried out. The unit is also able to provide analytical assistance to drug development in preclinical and clinical trials. Respective parameters can be pursued using HPLCcoupled mass-spectrometry methods. These investigations can also be conducted in line with regulatory requirements (GLP). Moreover, biophysical methods such as isothermal titration calorimetry and surface plasmon resonance spectroscopy are drawn upon to characterize binding behavior. Biological assays are developed and validated together with the other units, allowing the success of new types of treatment to be monitored using biomarkers.

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PROTEIN MISFOLDING DISEASES UNIT

More than 300 000 new cases of amyloidoses are recorded in Germany every year. The diseases are caused by abnormally modified proteins being deposited in the body, usually in intercellular spaces. These insoluble protein fibrils, referred to as amyloids, damage not only the nervous system but also internal organs such as the heart, liver, kidneys, spleen or gastrointestinal tract and, in severe cases, also lead to their loss of function.

The Protein Misfolding Diseases unit carries out research into the impact of protein post-translational modifications and their influence on the emergence and prevention of amyloid diseases. To be able to detect pathogenic modifications using immunological assays, amyloid proteins are first expressed, purified and made to aggregate in vitro. Monoclonal antibodies are then produced and tested as therapeutic agents. The aim here is to develop personalized treatments in the form of antibodies.

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SACHSEN-ANHALT

EUROPÄISCHE UNION
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Europäischer Fonds für regionale Entwicklung

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PROJECT EXAMPLES

ANTIBODIES FOR THE TREATMENT OF NEURODEGENERATIVE DISEASES

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

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

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

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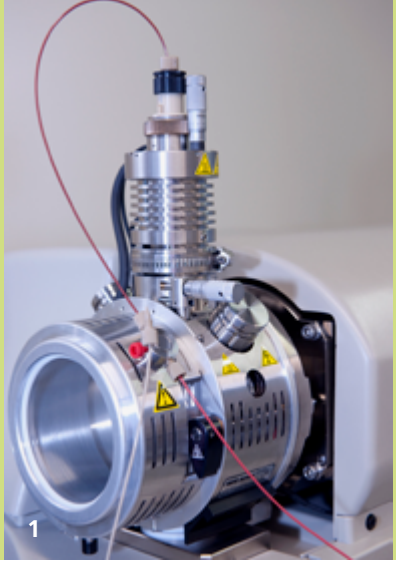
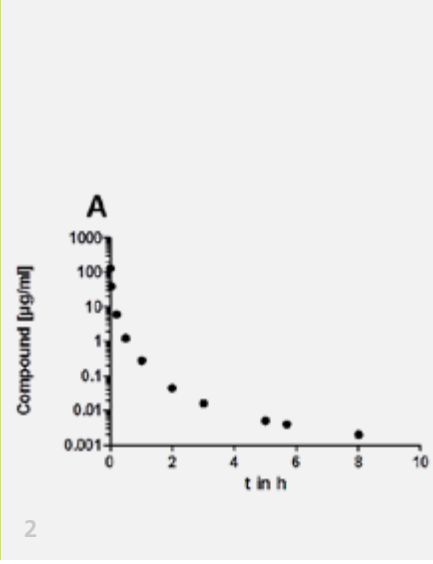
1 *Photo © GordonGrand – Fotolia.com.*





DETERMINATION OF PHARMACOKINETIC PARAMETERS OF SMALL MOLECULES

A comprehensive characterization of physico-chemical, cell-biological and pharmacokinetic properties of small molecules are prerequisite for their preclinical development. This process is required for the application of efficacious, safe and well-tolerated molecules in human subjects later during clinical development. Important steps during preclinics are investigations on liberation, absorption, distribution, metabolism and excretion (L-ADME parameters) in animal models. Here, information on exposure, bioavailability and terminal half-life will be collected. These data serve as decision points for selecting preclinical candidates or are used for optimization, e.g. bioavailability of an already selected candidate, by formulation development.

The Department of Drug Design and Target Validation at Fraunhofer IZI develops new molecular therapies for neurodegenerative and inflammatory disorders. The department's strategy includes identifying novel drug target and testing novel therapies. For characterizing new small molecule classes, a catheter-based rat model for analyzing pharmacokinetics of such compounds has been established by the Molecular Biotechnology unit. The model is comprised of surgical application of a catheter in the jugular vein *(V. jugularis)* and in the carotid artery *(A. carotis communis),* respectively. Using this method, it is possible to obtain complete compound profiles from a single animal, which avoids inter-individual variations, e.g. when using mice. In addition, a close collaboration with the Drug Design and Analytical Chemistry unit enables rapid determination of compounds concentrations in blood samples by LC-MS.

The applied method is being used successfully within the Department of Drug Design and Target Validation, e.g. for own projects, such as the development of novel inhibitors for alternative beta-secretases or the development of novel inhibitors for the treatment of periodontitis. It is also requested and used by partners from industry and academia.

1|2 *Mass spectrometry analysis to determine the concentration of the active ingredient in the organism (A).*

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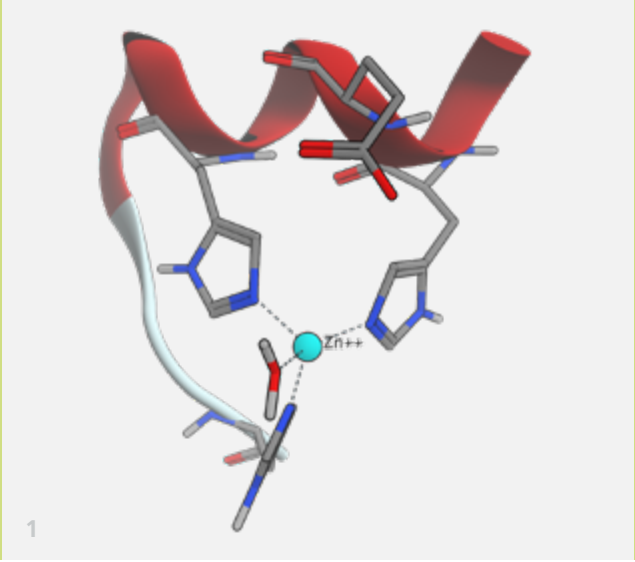

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BROADENING THE CHEMICAL SPACE OF METAL BINDING GROUPS

A whole spectrum of target enzymes seen to be of medical interest contain a metal ion in their active site that is involved in the catalysis of the corresponding reaction. These metal ions usually present a starting point for the development of new drugs as the principal affinity of the respective inhibitor often emerges as the result of the medicinal substance binding to these metals. As however, until now, only very few active metal binding groups have been described in the literature, which then often do not block the actual target enzyme selectively but also other metal-dependent enzymes, the development of highly promising approaches often failed. Due to cross-reactivities within the enzyme class, matrix-metallo-protease inhibitors, for instance, were not pursued further despite years of intensive research.

A new computational chemistry approach has been developed in the Drug Design and Analytical Chemistry Unit that represents a combination of semi-empirical and quantum chemical methods alongside ligand- and structure-based approaches. Based on these complex calculations, it is now possible to significantly expand the chemical space of metal binding groups. Fragments discovered here are adapted for the respective application and constitute completely new chemical classes of molecules for future medicinal-chemical development. In the case of one particular metal-dependent acyltransferase, for example, alongside the four metal binders already known, another six new and just as active compound classes were able to be identified and pursued further.

As they had never been described in the past, they have now expanded the patent portfolio of the Department of Drug Design and Target Validation. The approach depicted here is currently being modified and adapted to the molecular properties of another target protein from the Astazine family. The aim is to avoid the possible adverse effects of potential new drugs described in the literature for the metal binding groups utilized so far.

1 *View of the active site of Meprin β, a possible target enzyme involved in various fibrotic diseases. The graphic shows catalytically active zinc with the coordinating amino acids and a water molecule as the 4th ligand.*

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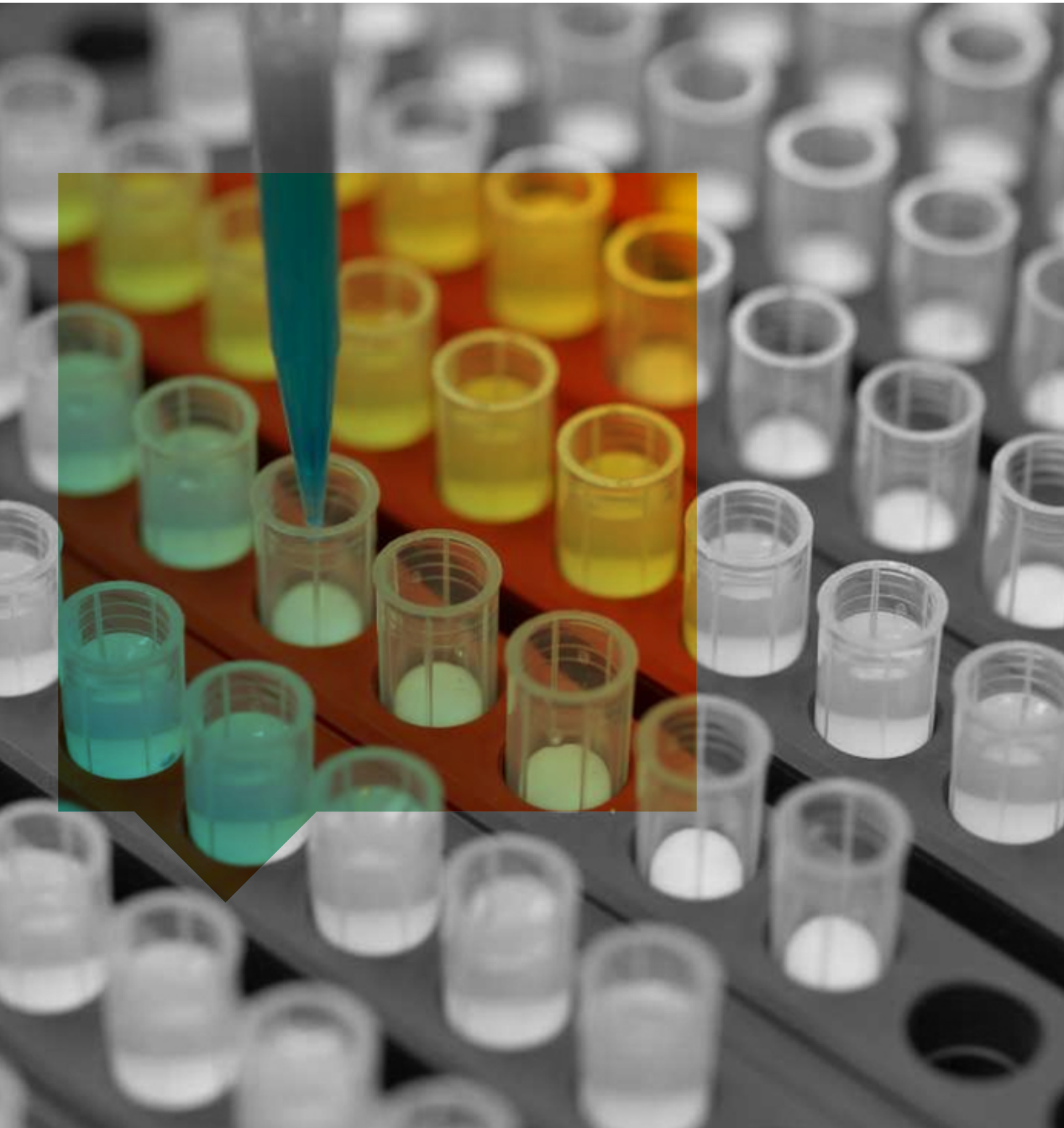
LOCATION POTSDAM-GOLM, GERMANY

DEPARTMENT OF BIOSYSTEMS INTEGRATION AND PROCESS AUTOMATION



THE DEPARTMENT AT A GLANCE

The department delivers solutions for complex laboratory automation tasks in biotechnology.

The department focuses on processes related to bioanalysis, diagnostics and cell culture, expansion, preparation and monitoring and aims at increasing the efficiency, quantity and quality of laboratory processes including 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 variants in diagnostics and analytics.

CORE COMPETENCIES

- Point-of-care
- In vitro diagnostics
- Automation
- Assay development
- Device development
- Process automation

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UNITS

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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BIOMOLECULAR NANOSTRUCTURES AND MEASUREMENT TECHNOLOGY UNIT

The unit carries out research and development for the analysis of biomolecular interfaces and higher-order electronic effects. We focus on applications for point-of-care testing, however applications in a laboratory environment are also included. The unit covers a broad range of microscopy techniques 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 immunoassays. Homogeneous assays with an affordable electrochemical readout system are one focus, but also innovations of mature technologies: The hydrophilic surface coating for plastic disposables TruContact® minimizes antibody and sample consumption as well as unspecific protein binding in ELISA. "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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IVD PLATFORM / POC TECHNOLOGIES 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.

Current activities are focused around processing and detecting microbial samples (infection diagnostics, hygiene) and characterizing antibiotic resistances besides detecting specific nucleic acids in blood and other body fluids.

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PROJECT EXAMPLE

NEW RAPID ANTIBIOTICS TEST: BETTER TREATMENT FOR DIABETIC FOOT ULCERS

People with type 2 diabetes often suffer from poorly-healing infected wounds on their feet. Using existing methods, however, it takes two days to grow a bacterial culture used to identify the pathogens infecting the wound and their antibiotic resistance – and thus to find an effective antibiotic. With the help of a new rapid test developed by Fraunhofer researchers, it will take just one hour to obtain this information in future.

Almost a thousand people are diagnosed with diabetes every day in Germany – more than 90 percent of them have type 2 diabetes. And the number of people developing the condition is rising both in Europe and worldwide. Type 2 diabetes can lead to numerous comorbidities, including hyperglycemia-induced damage to nerve cells. Affected patients lose feeling in their extremities and often develop skin ulcers that take a long time to heal, if at all. These wounds frequently become infected with various pathogens. Accordingly, doctors usually treat them with antibiotics. The problem is that not every antibiotic works against every pathogen, and antibiotic resistance is becoming more common.

A new type of rapid test enables doctors to use the right antibiotic from the beginning. It was developed in the MIDARDI project by researchers from the Fraunhofer Institutes for Cell Therapy and Immunology, Department of Bioanalytics and Bioprocesses IZI-BB (Potsdam), and for Electronic Nano Systems ENAS (Chemnitz) together with the company BiFlow Systems GmbH and partners in India. "With our rapid test, it's possible to determine within one hour which bacteria have infected the wound and what antibiotic resistance they have – allowing doctors to choose suitable antibiotics right from the start of the treatment," (Dr. Harald Peter, Group Leader at Fraunhofer IZI-BB).

Instead of culturing bacteria in the lab and observing how they react to various antibiotics, the rapid test analyzes the DNA of the bacteria. The doctor takes a swab of the wound and puts the wound fluid on the input area of the roughly smartphone-sized cartridge. On the inside, the bacteria are extracted, and their DNA is exposed and dissected. A biosensor built into the cartridge contains special capture molecules, which form the matching counterparts to the DNA strands of the bacteria and the mutated DNA that causes defined resistance. If a strand of DNA matches a certain capture molecule, it binds to it, while the DNA strands on all other capture molecules are removed in a rinsing cycle. The illumination of the fluorescence-labeled bacterial DNA reveals what capture molecules the pathogen DNA has bonded to – allowing a rapid species and antibiotic resistance identification.

1 *Microfluidic cartridge for on-site analysis.*
Photo © BiFlow Systems GmbH.

PROJECT FUNDING

SPONSORED BY THE

Federal Ministry of Education and Research

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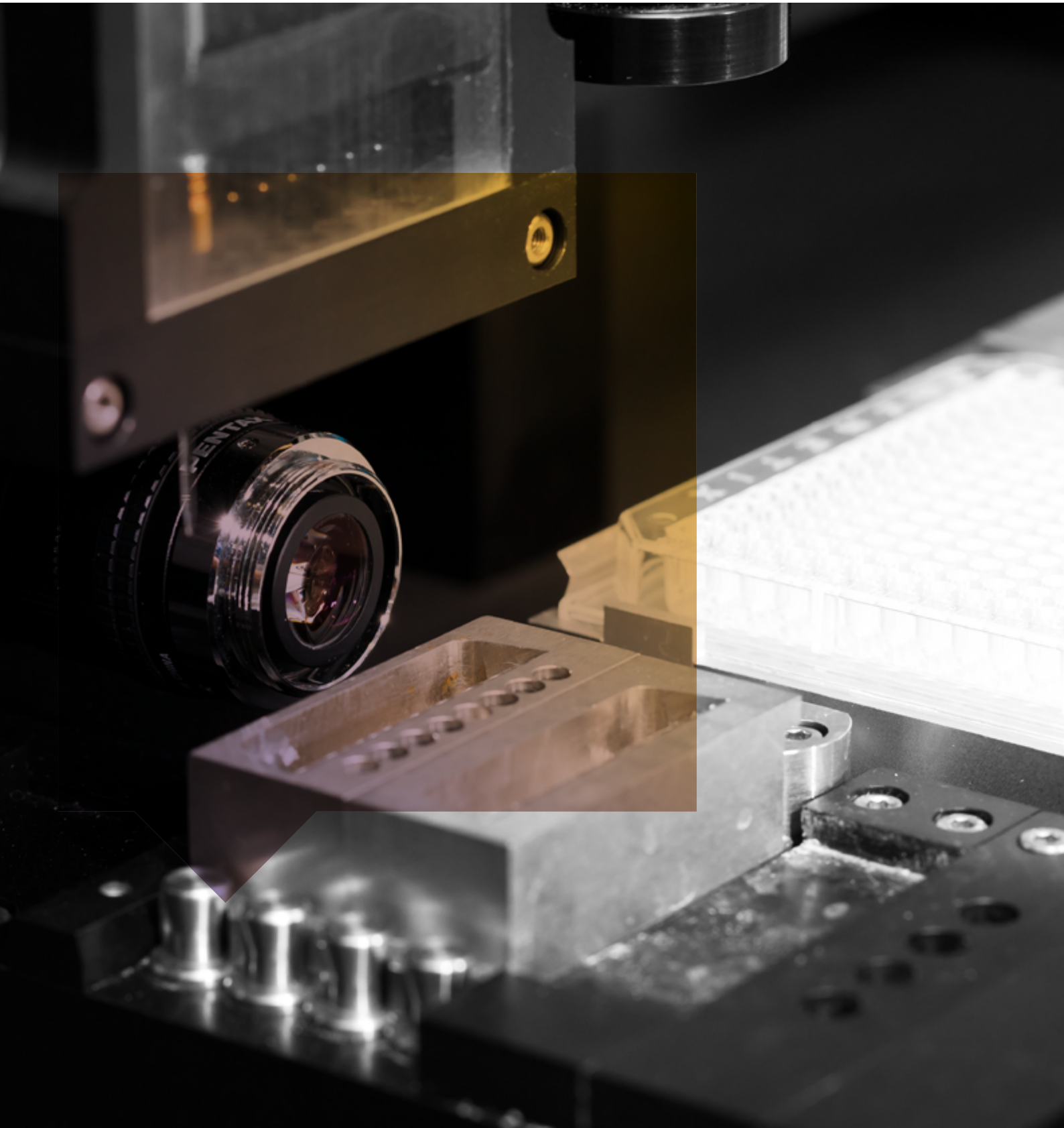
LOCATION POTSDAM-GOLM, GERMANY

DEPARTMENT OF MOLECULAR AND CELLULAR BIOANALYTICS



THE DEPARTMENT AT A GLANCE

The department deals to develop systems to detect, analyze and process challenging biological samples. These systems address demands 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 department develops point-of-care tests, e.g. for drug and serum screening, and likewise assays for the validation of biomarkers. Lab-on-a-chip systems for cultivating, processing and analyzing cell samples present a further focus. These chips allow long-term cultivation and toxicity tests on suitable cell clusters and micro-precise positioning of single cells or sorting heterogeneous cell populations. All of the department's activities 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. Its competence in molecular and cell biology allows the department to use its technological abilities in the most purposeful manner. 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 provides solutions that facilitate and support the web-based case-by-case and sample-by-sample search for human biospecimens and associated data across institutional and national borders.

CORE COMPETENCIES

- Lab-on-chip
- Microfl uidics and systems
- Biobanks
- Rapid prototyping
- Biosensor technology
- Assay development
- Functionalized surfaces

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UNITS

MICROFLUIDIC CELL PROCESSING AND CELL ANALYTICS UNIT

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 highly precise handling and sorting of single cells and particularly small cell samples in microfluidic chips. 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. In this area, the unit is developing powerful test systems for the assessment of blood compatibility of cardiovascular medical devices under highly controlled flow conditions.

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BIOMARKER VALIDATION AND ASSAY DEVELOPMENT UNIT

The group's activities include the development of specific assays for detecting and quantifying analytes in different matrices. The platforms used include microarrays, ELISA, lateral flow systems and bead-based assays for life science, environmental and food analysis. In addition, physico-chemical parameters such as kinetic constants (KD) can be determined and the composition or modification of surfaces can be characterized. All techniques are continuously being further developed for customer-specific applications. These applications include systems biology projects, the kinetic analysis of antibodies and the quantification of specific markers in serum samples.

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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 UNIT

The Microsystems for In Vitro Cell Models Unit develops customer-specific, efficient methods and prototypes for the cultivation, characterization and processing of demanding cell samples. The design and implementation of innovative concepts are based on the group's comprehensive expertise in microreactors, microfluidics, sensor technology and functional polymer coatings, and on its know-how in cell biology, toxicology and bioanalytics. The interdisciplinary orientation of the research unit enables a well-founded and targeted advice as well as an efficient execution of the customer's specific needs. Activities focus on (i) developing in vitro test methods for assessing the toxicity of drugs and chemicals based on organ-on-chip systems and relevant cell models, as well as (ii) establishing intelligent polymer coatings which allow the behavior of adherent cells on technical surfaces to be controlled.

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MICROARRAY AND BIOSENSOR TECHNOLOGY UNIT

Currently, the request for fast information generation is rapidly increasing, and this also applies to analytical questions about "WHAT" or "HOW MUCH" to draw conclusions about one's own behavior.

The "interface problem" is a major obstacle wherever natural structures meet technical systems.

Another is the challenge to draw as much analytical information as possible from as little and as native material as possible.

The solution lies in the modification of the respective surfaces. Through defined (bio)chemical functionalization, e.g. by branched linkers or the application of thin films using biopolymer-based membranes or switchable hydrogel layers, surfaces with new properties or so-called intelligent surfaces are created. The technological implementation takes place both on geometric materials such as fibers and on planar carriers such as plates or chips. The treatable surfaces themselves vary from glasses and wafer materials to natural fibers and plastics.

The result is independent sensor elements (e.g. test strip-based PoNd) or biosensor-based analytic tools (e.g. cell and peptide chips), for which various questions from the fields of environmental analysis, food monitoring, herd management, process control or diagnostics can be used on site and enable immediate data evaluation and transmission.

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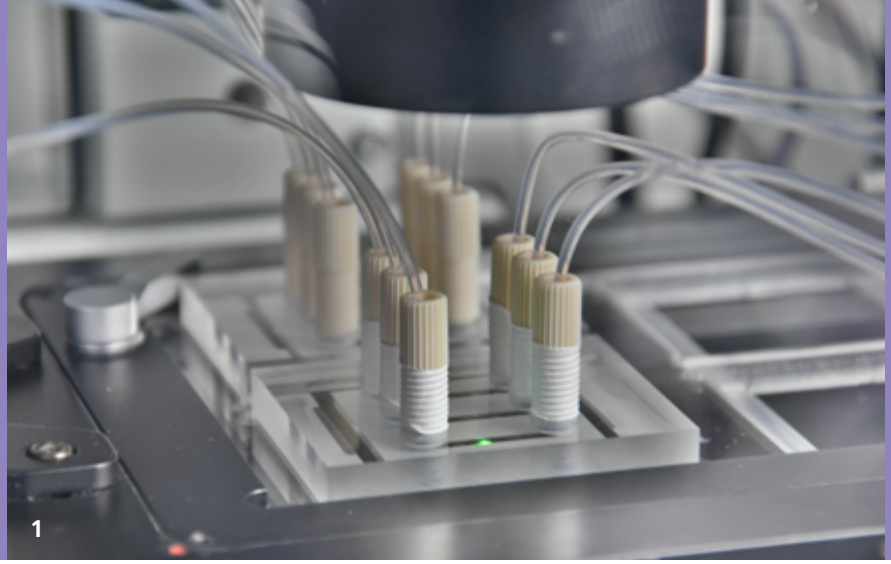

PROJECT EXAMPLES

DEVELOPMENT OF A PHYSIOLOGICALLY RELEVANT TEST SYSTEM FOR THE IN VITRO DETECTION OF HEPATOTOXICITY IN HIGH THROUGHPUT (HEPATOTOX)

For evaluating the toxicity and biocompatibility of pharmaceuticals, chemicals and cosmetics, alternative methods to animal testing, i.e. in vitro test systems, will be the standard in the near future. Besides the ethical motivation, the time and cost required for animal models is pushing the development and establishment of such cell tests forward.

One difficulty in the evaluation of in vitro toxicity measurements of new substances is the measurement of meaningful parameters that actually provide information on the condition of the cells or tissue. As yet, endpoint analyses (cell staining, gene and protein expression) prevail, but adapting them individually to the questions at hand takes considerable effort.

In the "HepatoTox" project, an organ-on-chip system is being developed with regard to higher throughput and the use of relevant cell models. The microfluidic bioreactor ensures 1. physiological conditions for the long-term culture of primary-like liver cells in a 3D matrix, 2. the measurement of cell vitality in real-time by integrating optical oxygen sensor particles and 3. the parallel analysis of up to twelve independent conditions by upscaling the fluidic elements and automating the system. In combination with the use of physiologically relevant cell models (Prof. Küpper, B-TU), the organ-on-chip system will be validated with reference substances to evaluate the significance and performance of the measurement system.

In addition to the commercialization of the organ-on-chip system, the project aims at providing a service to chemical and pharmaceutical companies in accelerating the registration procedures of newly developed substances.

1 *Organ-on-chip system for long-term cultivation of hepatocytes with integrated optical sensors for real-time measurement of cell vitality.*

PROJECT FUNDING

EUROPEAN UNION
European Regional
Development Fund

This project is funded by the European Regional Development Fund and the Land of Brandenburg.

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BIODETECTOR - INTEGRATED DETECTION SYSTEM FOR BIOLOGICAL CONTAMINATION IN FUELS

The aim of the project was to develop an integrated system for DNA-based detection of biological contamination in fuels with minimal user effort. The biological contamination of fuel is an important issue in all areas where large amounts of fuel are needed or where fuel is stored over a long period of time, e.g. in transportation (freight and passenger transport, aviation) but also in the leisure sector e.g. boat engines and in agriculture (tractors and diesel tanks). The danger of clogged pipes by bacteria or fungi is very high. More than 100 different bacteria, yeasts and fungi are known to cause contamination and form bio-sludge in fuels. *Hormoconis resinae,* the so-called "diesel bug" or "kerosene fungus", is a so-called lead organism. It represents with 70-90% the most frequently occurring organism in contaminated fuels. Microorganisms are not only dangerous because they clog pipes and filters, but are also the cause of corrosion in fuel tanks.

Together with the expertise of the project partners M2-Automation and the Federal Institute for Materials Research and Testing (Department of Biological Materials Damage and Reference Organisms), researchers at Fraunhofer IZI-BB have developed a system that is capable of meeting the necessary requirements from sampling to sample preparation and detection.

The new method is characterized by:

- an integrated system solution
- acquisition with minimal sample preparation
- a timely detection at the place of sampling e.g. at the airport with presentation of the results and resulting recommendations for action
- the simultaneous detection of several relevant organisms (multiplexing)
- minimal user effort

Compared to the immunological methods already on the market, the new technology is more specific, faster and more sensitive. At the same time, the method enables the detection of a broad spectrum of microorganisms that are important for the contamination and degradation of fuel. The method can be transferred to other (viscous) liquids such as lubricating oils and paints.

1 *Contaminated fuel. Photo © BAM.*

2 *Added fuel filter. Photo © BAM.*

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LOCATION POTSDAM-GOLM, GERMANY

DEPARTMENT OF CELL-FREE AND CELL-BASED BIOPRODUCTION

THE DEPARTMENT AT A GLANCE

Conserving resources and creating efficient material cycles are two challenges currently facing the economy and technology. The sufficient and affordable availability of high-quality synthetic products is an important basis for making progress in the health care sector. Active agents and analytes, biomolecules such as enzymes, antibodies and aptamers often are key molecules of drug development in terms of diagnostics and therapy. But also in food and environmental technology, in the agricultural, cosmetics and detergent industries, the need for synthetic biomolecules is constantly on the rise. At present, many of these substances are manufactured using living cells and organisms. However, this is subject to considerable limitations. A sizable material and energy input has to be made to preserve cell metabolism itself. Beyond this, many metabolites, by-products and proteins, also in higher concentrations, are toxic to cells or organisms and can impede or even prevent these substances from being manufactured cost-effectively.

The cell-free bioproduction of high-quality proteinogenic biomolecules opens up completely new possibilities. By using the subcellular components of the organisms required for synthesis in suitable reaction environments it is possible to efficiently manufacture biomolecules with complex and also completely new properties. The technologies established at the Potsdam-Golm site allow these procedures to be used in an economically efficient way, thus creating a new basis for the economic production of active proteins.

The development, synthesis and also transfer of functional nucleic acids such as aptamers into market-relevant applications are just as much a focus as the analysis of cold-adapted snow algae in extremophile research. The latter of these are being used to extract high-quality substances such as antioxidants or fatty acids and are being manufactured in photobioreactors. The CCCryo culture collection as a unique bioresource can be used by academic and private sector interested parties.

CORE COMPETENCIES

- Cell-free protein synthesis
- Interaction assays
- Protein characterization
- "On-chip" synthesis
- Antibodies and membrane proteins
- Massproduction of algae
- Biosynthesis of toxic proteins
- Photo bioreactors
- Cryophilic algae collection
- Functional nucleic acids

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UNITS

CELL-FREE PROTEIN SYNTHESIS UNIT

The unit researches and develops systems for the cell-free synthesis of recombinant proteins. A special focus lies on characterizing, modifying and examining the functions of cell-free manufactured 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 post-translationally 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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EUKARYOTIC LYSATES UNIT

The unit develops cultivation systems of eukaryotic cell lines for the production of translational lysates for protein synthesis. In this respect, the testing of cell lines for their in vitro expression capabilities is of the highest interest. Furthermore, the unit continues to develop and optimize cell-free eukaryotic translation systems and investigates the influence of fermentation, cell disruption, and transcriptional and translational components on the productivity of the lysates. Based on this, the synthesis of proteins can be carried out in cell-free systems under the optimal conditions for the respective protein. The optimal synthesis conditions are protein-specific and are determined in evaluation studies. On request, protein syntheses can also be carried out under GLP conditions.

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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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FUNCTIONAL NUCLEIC ACIDS – APTAMERS UNIT

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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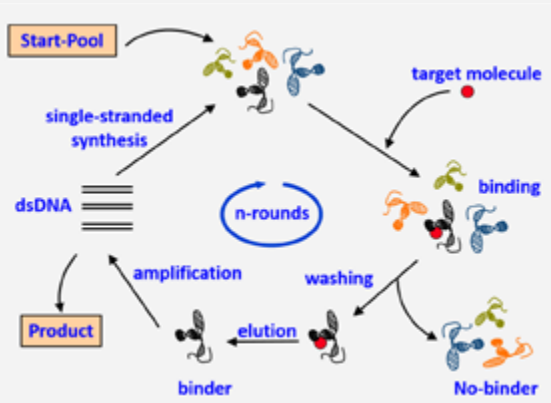

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PROJECT EXAMPLE

APTAMER-BASED LATERAL FLOW RAPID TEST FOR DIAGNOSING ANTIBIOTIC RESISTANCES (ALF TEST)

The number of diseases caused by antibiotic-resistant bacteria is increasing around the globe: In 2005 in the European Union alone, around 50,000 people died from infections with resistant bacteria, while around 3 million people became infected. By 2050, the mortality rate is expected to be ten times this figure. Particularly multidrug-resistant Gram-negative bacteria (MDRGN) are becoming worryingly dangerous. It is vital that patients are diagnosed quickly and reliably in order to treat and isolate them effectively.

In Germany, around 20 million patients are treated in hospital every year. Due to the sharp increase of MDRGN infections, the Deutsche Stiftung Patientenschutz, an organization which represents the interests of the seriously ill, care recipients and end-of-life patients in Germany, is calling for all hospital patients to be screened upon being admitted to hospital. In addition to this, infected patients in particular are to be screened at least weekly.

The aim of this collaboration project is to conduct research into a new kind of lateral flow rapid test for detecting antibiotic-resistant bacteria. The rapid test is based on aptamers, i.e. short, single-stranded DNA or RNA nucleic acids, and is designed to detect bacteria within an hour without the need for further devices or specialist expertise. Patients are tested for the carbapenemases (bacterial enzymes) of the most common hospital infections. The rapid test will help prevent the spread of MDRGN bacteria, improve treatment and reduce the use of antibiotics. Once the project has ended, the initial aim will be to market the rapid test for high-risk patients.

PROJECT FUNDING

SPONSORED BY THE

Federal Ministry of Education and Research

VDI Technologiezentrum

1 *Strip test example.*

2 *SELEX process for generating aptamers.*

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CENTRAL FACILITIES AND SERVICES

GLP TEST FACILITY

Good Laboratory Practice (GLP) describes a quality assurance system for conducting safety tests on chemicals, drugs, pesticides and food additives. It regulates the implementation, documentation, archiving and reporting of respective tests.

Fraunhofer IZI has been certified as a GLP test facility since 2009. The facility plans and conducts preclinical efficacy and safety studies for new drug candidates (especially ATMPs) and medical devices (ISO 10993) under GLP and GLP-analogous conditions. This involves developing and validating suitable in vitro and in vivo models. The test facility boasts a state-of-the-art setup for keeping small animals as well as small and large animal operating rooms. Furthermore, a broad spectrum of validated SOPs are implemented here for equipment and methods.

The test facility is currently certified for testing category 9. This includes, among other things, safety testing for ATMP immunotoxicity / immunogenicity, biodistribution and tumorigenicity in vitro and in vivo.

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GMP MANUFACTURING

GMP (Good Manufacturing Practice) describes a set of quality assurance guidelines for production and quality control processes and spaces with regard to drug manufacturing. It regulates, among other things, the requirements concerning hygiene, human resources, facilities, equipment, documentation and controls.

Fraunhofer IZI assumes the manufacture of investigational medicinal products for clinical trials. Manufacturing capacities here range from recombinant proteins over to so-called advanced therapy medicinal products (ATMPs). These include cell-based drugs such as gene therapeutics, somatic cell therapy medicinal products as well as tissue engineering products.

BIOPHARMACEUTICALS

In recent years, the increasing number of therapeutic monoclonal antibody (mAb) candidates under preclinical and clinical development have required new flexible, efficient, and economic opportunities for GMP production of therapeutic antibody candidates. Small-scale batch production of test samples for late preclinical GLP animal studies or for phase-1 and phase-2 clinical studies is often not appropriate for large-scale manufacturing facilities in the industry.

The clean rooms used for production of biopharmaceuticals cover a total area of 180 m² and comprise all clean room categories from D to A. 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 1 / 2) test samples as well as for process or instrument validation projects under consideration of special customer requests. The standard equipment can be easily adapted for new products.

The manufacturing team's portfolio includes transferring biopharmaceutical candidates from preclinical research into clinical development, drafting user-specific processes and manufacturing.

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 by integrated sample filling

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WHY ARE GLP AND GMP 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 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 committee 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.

ADVANCED THERAPY MEDICINAL PRODUCTS (ATMPS)

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 transfer) 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 and gene therapeutic products (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 pursuant to section 13 of the German Drug Act (AMG).

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IMAGING

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)

- 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)

- Depiction of dense (bone, cartilage) and contrast-enhanced (soft tissue) structures
- 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 by means of fluorescent imaging tomography (FLIT) or, in the case of bioluminescent sources, by means of diffuse light imaging tomography (DLIT) and spectral unmixing

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

Clearing tissue samples

- Preparing samples for imaging (especially 3D fluorescence microscopy)
- Enabling detailed images of deeper layers of the sample that are usually only visible through histological sections

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

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

Atomic force microscopy

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

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

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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 officers 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.

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: Ultra-high-throughput sequencing platforms
- Hamilton Microlab STARlet / STARplus: Fully automated preparation of samples for sequencing and fully automated extraction and purification of nucleic acids
- Agilent microarray scanner
- EMD: Quality and quantity analyses of minimal amounts of nucleic acids with high sensitivity; developed by Fraunhofer FIT
- QIAcube: Semi-automated extraction and purification of nucleic acids
- RiBOT: 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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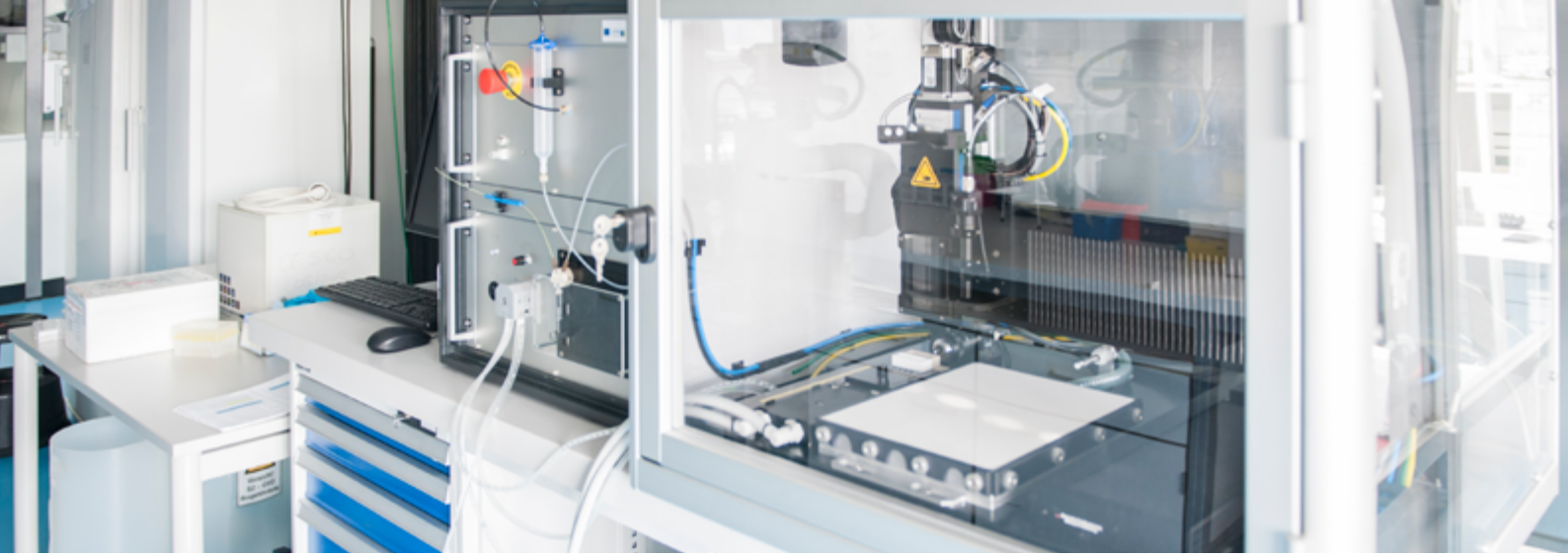

BIO-NANOTECHNOLOGY APPLICATION LABORATORY (BNAL)

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: 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.
- 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: Rapid, multiplex, high-throughput screening of cells and beads in suspension.
- Fluorescence relaxation for characterizing cells in flow cytometry as a new, label-free procedure that will also be used to characterize cell therapeutic agents and which will be tested on a BD Influx high-throughput cell sorter.

SURFACE STERILIZATION AND MODIFICATION

- Electron beam dosimeter: 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: Sterilization of package / surfaces, inactivation of microorganisms for vaccine production or targeted adjustment of material properties by means of electron irradiation.

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: 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: Production-relevant manufacturing of nanostructured surfaces on glass and polymer surfaces.

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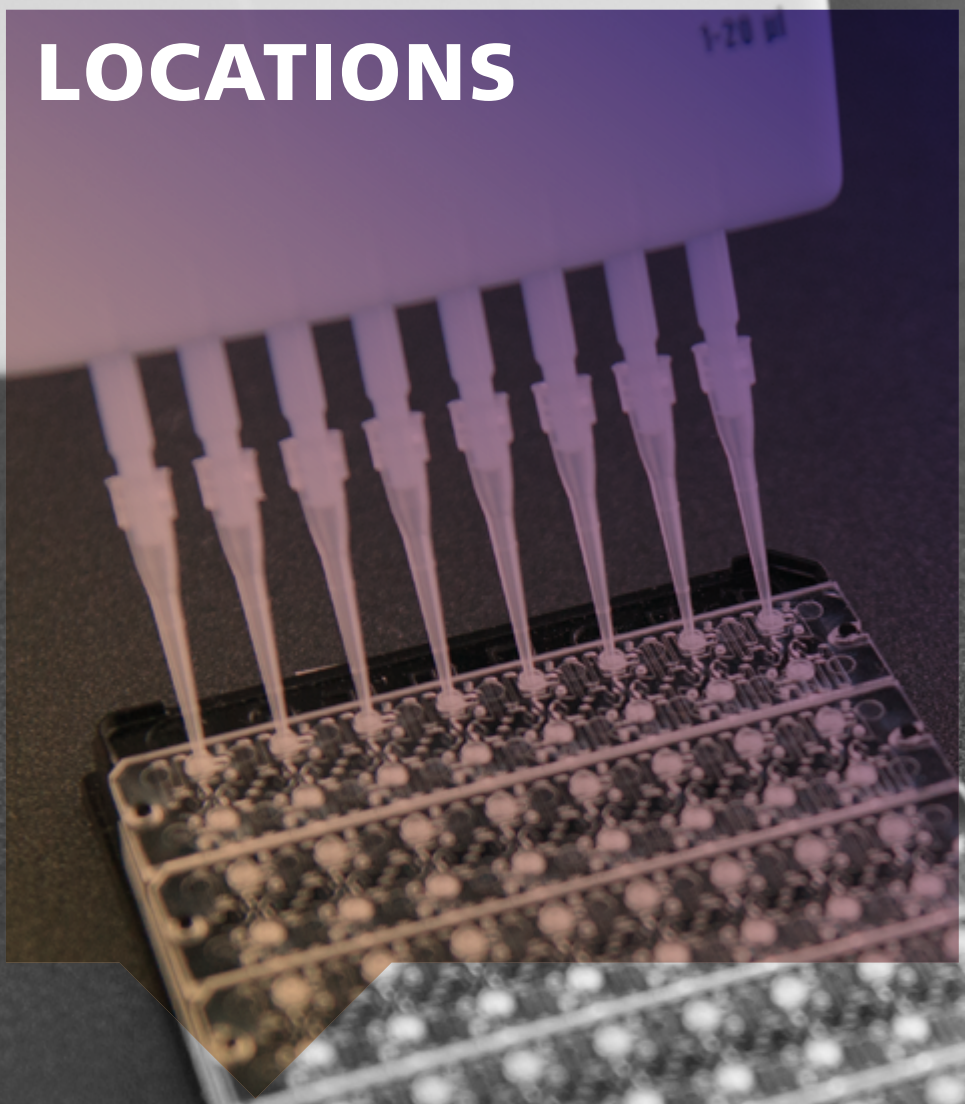
LOCATIONS



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Branch Lab Translational Cell Therapy
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Project Center Microelectronic and
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Erfurt, Thuringia

SOUTH KOREA

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

HEADQUARTER

LEIPZIG, SAXONY, GERMANY

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

The research infrastructure at the headquarters is complemented by various special facilities found in the extension 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 1 000 m².

FACTS

- Address: Perlickstraße 1, 04103 Leipzig, Germany
- Usable area: 8 749 m²
- Employees: 443
- Focal areas: Cell engineering, cell therapy, drugs, diagnostics, immunology

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BRANCH BIOANALYTICS AND BIOPROCESSES

POTSDAM-GOLM, BRANDENBURG, GERMANY

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

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

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

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

FACTS

- Address: Am Mühlenberg 13, 14476 Potsdam-Golm, Germany
- Usable area: 4 096 m²
- Employees: 118
- Focal areas: Biotechnology, bioproduction, bioanalytics, automation

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DEPARTMENT OF DRUG DESIGN AND TARGET VALIDATION

HALLE (SAALE), SAXONY-ANHALT, GERMANY

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

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

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

FACTS

- Address: Weinbergweg 22, 06120 Halle (Saale), Germany
- Usable area: 1 300 m²
- Employees: 68
- Focal areas: Biochemistry, pharmacology, drug development, analytics

MANAGEMENT

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DEPARTMENT OF EXTRACORPOREAL IMMUNOMODULATION

ROSTOCK, MECKLENBURG-WESTERN POMERANIA, GERMANY

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

The department 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.

FACTS

- Address: Schillingallee 68, 18057 Rostock, Germany
- Usable area: 700 m²
- Employees: 32
- Focal areas: Organ-supporting technologies, clinical trials

MANAGEMENT

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BRANCH LAB TRANSLATIONAL CELL THERAPY

HANNOVER, LOWER SAXONY, GERMANY

The Branch Lab Translational Cell Therapy develops and validates cell-based advanced therapy medicinal products (ATMPs). To do this, it conducts translational research and develops GMP-compliant manufacturing protocols for cell therapeutics at the interface to preclinical development right through to their transfer into clinical trials. Cell and genetic engineering methods and strategies are implemented and optimized here to specifically manufacture killer lymphocytes and their subpopulations. The ability to overcome so-called tumor immune escape mechanisms in cancer cells is key here. This is achieved by using activated and genetically modified effector cells together with checkpoint inhibitors and stimulating immune cells. These cell therapies boost immune surveillance and strengthen the elimination of resistant cancer cells as well as their malignant precursor cells (so-called tumor stem cells).

Another focus of development lies in optimizing the transduction capacity of effector cells using chimeric antigen receptors (CARs) in order to increase cytotoxicity to malignant cells. To do this, human effector cells are separated following lymphapheresis by means of GMP-suitable, fully automated, closed-system production, genetically modified as necessary and expanded as part of clinical upscaling.

Moreover, the group is developing GMP-compliant manufacturing and expansion protocols in order to proliferate a sufficient number of activated effector cells.

FACTS

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MANAGEMENT

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PROJECT CENTER MICROELECTRONIC AND OPTICAL SYSTEMS FOR BIOMEDICINE

ERFURT, THURINGIA, GERMANY

The Microelectronic and Optical Systems for Biomedicine project center in Erfurt brings together the core competencies of three Fraunhofer institutes to span the disciplines of biosciences, microelectronics, microsystems technology, optics and photonics. This combined expertise will be used to develop application-ready systems in the areas of medical engineering, analytics, diagnostics, biotechnology, biophotonics, pharma, health care, ageing and food economics which will then be transferred into industry. Fields of application here include improved medical imaging and visualization as well as technologies for biomarker analysis.

INVOLVED FRAUNHOFER INSTITUTES

- Fraunhofer Institute for Applied Optics and Precision Engineering IOF (www.iof.fraunhofer.de/en)
- Fraunhofer Institute for Photonic Microsystems IPMS (www.ipms.fraunhofer.de/en)
- Fraunhofer Institute for Cell Therapy and Immunology IZI (www.izi.fraunhofer.de/en)

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JLCI – JOINT LABORATORY OF CHONNAM NATIONAL UNIVERSITY HOSPITAL HWASUN IN COLLABORATION WITH FRAUNHOFER IZI

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. A vibrant biotech and medtech industry has established itself in the local area. 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 was financed until 2017 by the Korean Ministry of Education, Science and Technology in Gwangju, Jeollanam-do, South Korea, as part of an initiative to strengthen international cooperation. Since 2018, additional funds have been authorized by the provincial government of Jeollanam do and the district of Hwasun gun in order to facilitate stronger connections within the industry and with other research institutes in Korea and Germany through professional business development.

Various projects have been conducted to date at the JLCI, e.g. in the field of senescence and cancer research, also as part of funding measures associated with the Federal Ministry of Economics and Technology's Central Innovation Program for SMEs. Several Fraunhofer IZI delegations have already taken part in conferences and research stays in Korea and a number of Korean colleagues have also worked at Fraunhofer IZI. The joint research work is documented in many joint publications. German-Korean symposia have so far taken place on an annually rotating basis.

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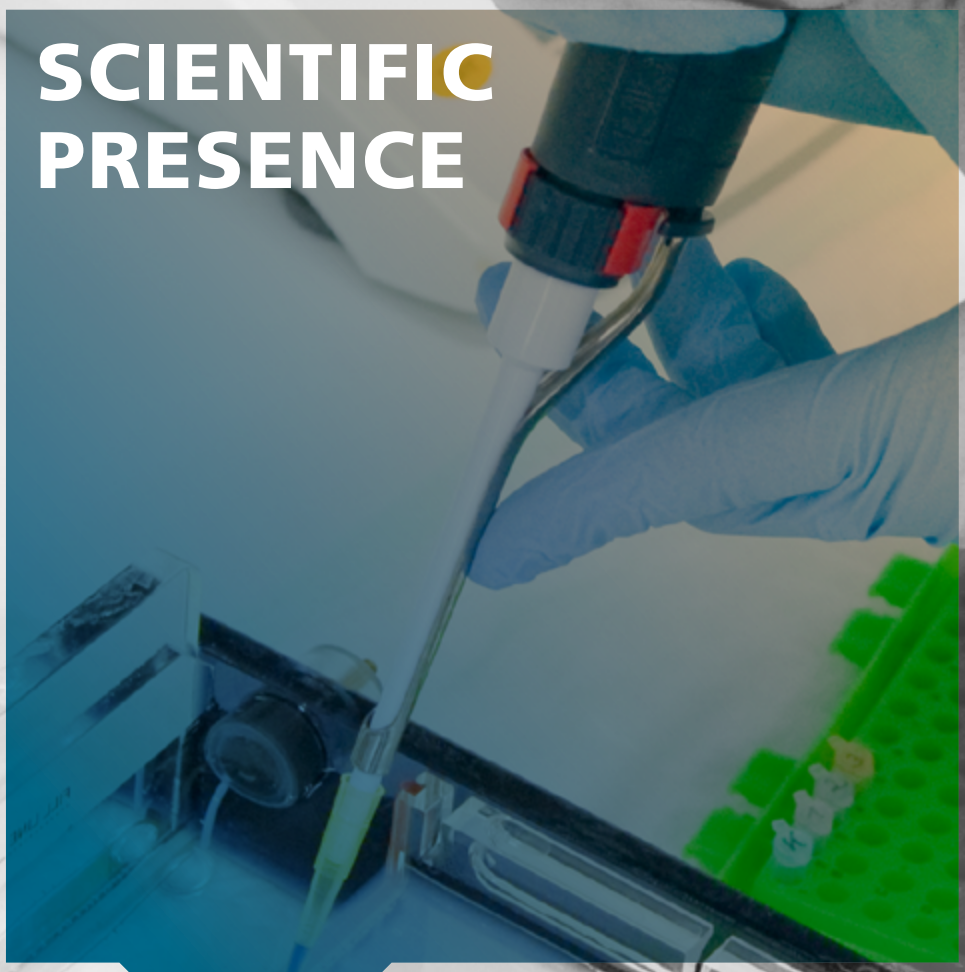
SCIENTIFIC PRESENCE



CONVENTIONS AND CONFERENCES

1. Brandenburger Versorgungsforschungskongress, Neuruppin, Germany, September 13, 2019

13th Vaccine Congress, Bangkok, Thailand, September 15–18, 2019

15th German Conference on Cheminformatics, Mainz, Germany, November 3–5, 2019

15th Leipzig Research Festival for Life Sciences, Leipzig, Germany, January 18, 2019

18th Congress of the Japanese Society for Regenerative Medicine, Kobe, Japan, March 21–23, 2019

19. Jahrestagung der Arbeitsgemeinschaft Akkreditierter Laboratorien, Berlin, Germany, September 13–14, 2019

1st Bonn Nanobody Symposium, Bonn, Germany, September 5–6, 2019

20th International Symposium on Albumin Dialysis, Rostock, Germany, September 6–8, 2019

23. Phytopharmaka Symposium 2019, Mannheim, Germany, October 9–10, 2019

24th Annual Meeting of the RNA Society, Krakow, Poland, June 11–16, 2019

29th Annual Meeting of the DGfZ »Visions in Cytometry«, Berlin, Germany, September 25–27, 2019

29th Annual Meeting of the Society for Virology, Düsseldorf, Germany, March 20–23, 2019

29th European Congress of Clinical Microbiology & Infectious Diseases, Amsterdam, The Netherlands, April 13–16, 2019

2nd Autumn Meeting German Society for Extracellular Vesicles, Freising, Germany, November 28–29, 2019

2nd European Biosensor Symposium EBS2019, Florence, Italy, February 18–21, 2019

3rd KDDF Global C&D Tech Fair, Seoul, South Korea, February 20, 2019

33rd EFFoST International Conference, Rotterdam, The Netherlands, November 12–14, 2019

4. Forum Veterinärdiagnostik, Berlin, Germany, May 9, 2019

4. Münchner Point-of-Care Testing Symposium, Munich, Germany, March 11–13, 2019

4th International Symposium on Immunotherapy, London, Great Britain, May 24–25, 2019

5. Forum Veterinärdiagnostik, Berlin, Germany, September 24, 2019

5. International Symposium of the SFB 765 »Multivalency in Chemistry and Biology«, Berlin, Germany, September 30 – October 2, 2019

5. NutriAct-Jahrestagung, Potsdam, Germany, November 8, 2019

6. Update: Prädiktive molekularpathologische Diagnostik, Frankfurt am Main, Germany, October 11, 2019

7th European Congress of Virology (ECV) 2019, Rotterdam, The Netherlands, April 28 – May 1, 2019

9. Herbsttreffen der AG Molekularpathologie der Deutschen Gesellschaft für Pathologie e.V., Wiesloch, Germany, November 14–15, 2019

9th Alpbach Workshop on Affinity Proteomics, Alpbach, Austria, March 11–13, 2019

9th International Symposium on Recent Advances in Food Analysis, Prague, Czech Republic, November 5–8, 2019

Abschlussveranstaltung der Förderlinie »ProProfessur« des Landes Hessen, Gießen, Germany, November 21, 2019

AlpenFlow 2019. Österreichische Gesellschaft für Zytometrie, Bad Ischl, Austria, December 5–7, 2019

Analysieren, Kultivieren, Desinfizieren – Ein Anwenderblick auf neue Polymere und Oberflächen in der Biotechnologie, Potsdam, Germany, September 11, 2019

BfR-Symposium »Zoonosen und Lebensmittelsicherheit«, Berlin, Germany, November 4–5, 2019

Bio Internatonal Convention 2019, Philadelphia, USA, June 3–6, 2019

BioBilanz 2019, Berlin, Germany, January 24, 2019

BIOCHIP Berlin International Forum on BioChips and BioChip Solutions, Berlin, Germany, May 7–8, 2019

BIO-Europe®, Hamburg, Germany, November 11–13, 2019

BioJapan 2019, Yokohama, Japan, October 9–11, 2019

Biologische Transformation mit Schwerpunkt Bio-ökonomie, Berlin, Germany, September 26, 2019

Bionnale 2019, Berlin, Germany, May 7, 2019

BioProcess International European Summit 2019, Vienna, Austria, April 2–5, 2019

Biotech Showcase 2019, San Francisco, USA, January 7–10, 2019

Boehringer Ingelheim – Networking Reception, Berlin, Germany, September 30, 2019

Breath Summit 2019, Leicestershire, Great Britain, September 8–11, 2019

Cell & Gene Meeting on the Mediterranean, Barcelona, Spain, March 23–24, 2019

Cluster Pitches – Klinik trifft Diagnostik, Hennigsdorf, Germany, October 24, 2019

Clusterkonferenz Gesundheitswirtschaft Berlin-Brandenburg 2019, Potsdam, Germany, November 7, 2019

COMPAMED 2019, Düsseldorf, Germany, November 18–21, 2019

CYTO 2019 – 34th Congress of the International Society for Advancement of Cytometry, Vancouver, Canada, June 22–26, 2019

Day of Intravital Microscopy, Marburg, Germany, November 25–26, 2019

Denkfabrik CDU – Fachforum 4 »Unser Europa für eine verlässliche Gesundheits- & Pflegeversorgung in Sachsen«, Dresden, Germany, May 17, 2019

deRSE19 – Konferenz für ForschungssoftwareentwicklerInnen in Deutschland, Potsdam, Germany, June 4–6, 2019

DG-GT Theme Day »CAR-T cells and beyond«, Leipzig, Germany, September 16–17, 2019

DNA Mitteldeutschland, Leipzig, Germany, November 29, 2019

DNA Mitteldeutschland, Jena, Germany, May 23, 2019

EFRE.BB 21|27, Potsdam, Germany, October 1, 2019

EIT Health Matchmaking, Berlin, Germany, February 6–7, 2019

Fraunhofer-Symposium »Netzwert«, Munich, Germany, February 26–27, 2019

GE Healthcare Life Sciences Cell Therapy Insight, Leipzig, Germany, November 13, 2019

German Society for Extracellular Vesicles Annual Meeting, Frankfurt am Main, Germany, March 7–8, 2019

Global Expert Mission: UK-Germany Antimicrobial Resistance (AMR), Potsdam, Germany, May 20–24, 2019

GlycoBioTec 2019, Berlin, Germany, January 28–30, 2019

HEC 22 – 22nd Heart of Europe Bio-Crystallography Meeting 2019, Obergurgl, Austria, September 12–14, 2019

in-cosmetics Global 2019, Paris, France, April 2–4, 2019

Innovationstag Mittelstand des BMWi 2019, Berlin, Germany, May 9, 2019

ISEV Annual Meeting, Kyoto, Japan, April 24–28, 2019

Jahrestagung der Deutschen, Österreichischen und Schweizerischen Gesellschaften für Hämatologie und Medizinische Onkologie, Berlin, Germany, October 11–14, 2019

Junior Scientist Symposium FLI 2019, Jena, Germany, September 25–27, 2019

Kick-off Meeting RESTORE, Berlin, Germany, May 6, 2019

KI-Hub Sachsen »Wir bringen KI in die Anwendung«, Chemnitz, Germany, October 29, 2019

LABVOLUTION, Hannover, Germany, May 21–23, 2019

Lebensmittelsicherheit in Deutschland – was bleibt? Wie Lebensmittelverarbeitung die Inhaltsstoffe verändert, Potsdam-Rehbrücke, Germany, June 4, 2019

Life Science Forum Sachsen 2019 und Gesundheitsforum Healthy Saxony »Innovationen für die onkologische Versorgung«, Chemnitz, Germany, October 9, 2019

LSFM2019: The Light Sheet Microscopy Conference, Frankfurt am Main, Germany, December 4–6, 2019

MEDICA 2019, Düsseldorf, Germany, November 18–21, 2019

MMC 2019 – Microscience Microscopy Congress, Manchester, Great Britain, July 1–4, 2019

Networking-Event »Women in Oncology«, Berlin, Germany, November 27, 2019

New and Emerging Technologies 2019 »Biotech meets Medicine«, Potsdam-Golm, Germany, September 18–20, 2019

Phacilitate Cell and Gene Therapy World, Miami, USA, January 22–24, 2019

Potsdamer GründerTag 2019, Potsdam, Germany, June 13, 2019

RegMed-Forum 2019: Zell- und Gentherapien – ein Dialog zwischen Patienten, Ärzten und Wissenschaftlern, Berlin, Germany, October 22, 2019

Sondersitzung GESUNDHEIT: Antibiotikaresistenz, Berlin, Germany, October 17, 2019

Tag der Bioökonomie, Berlin, Germany, September 26, 2019

Tag der Immunforschung, Frankfurt am Main, Germany, June 19, 2019

»The product is the process – is it?« Quality aspects in the production of ATMP, Potsdam, Germany, November 12, 2019

Update Hämatologie / Onkologie, Hamburg, Germany, August 16–17, 2019

VIP+ Innovationstagung, Berlin, Germany, March 26, 2019

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Asociación de la Industria Navarra, Cordovilla, Spain

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

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

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Fraunhofer Institute for Applied Optics and Precision Engineering IOF, Jena, Germany

Fraunhofer Institute for Applied Polymer Research IAP, Potsdam, Germany

Fraunhofer Institute for Biomedical Engineering IBMT, St. Ingbert, Germany

Fraunhofer Institute for Ceramic Technologies and Systems IKTS, Dresden, Germany

Fraunhofer Institute for Chemical Technology ICT, Pfinztal, Germany

Fraunhofer Institute for Electronic Nano Systems ENAS, Chemnitz, Germany

Fraunhofer Institute for Interfacial Engineering and Biotechnology IGB, Stuttgart, Germany

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Fraunhofer Institute for Photonic Microsystems IPMS, Dresden, Germany

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University of Bern, Bern, Switzerland

University of Bonn, Bonn, Germany

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Afex GmbH, Mildenau, Germany

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Airbus AG, Hamburg, Germany

AJ Innuscreen GmbH, Berlin, Germany

AJ Roboscreen GmbH, Leipzig, Germany

AKT Angewandte Kommunikationstechnik GmbH, Beucha, Germany

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aokin AG, Berlin, Germany

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ASA Spezialenzyme GmbH, Wolfenbüttel, Germany

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Bayer Vital GmbH, Leverkusen, Germany

Becit GmbH, Bitterfeld-Wolfen, Germany

Beiersdorf AG, Hamburg, Germany

BELANO medical AG, Hennigsdorf, Germany

BellaSeno GmbH, Leipzig, Germany

Berthold Technologies GmbH & Co. KG, Bad Wildbad, Germany

Biametrics GmbH, Tübingen, Germany

BianoGMP GmbH, Gera, Germany

Bianoscience GmbH, Gera, Germany

BiFlow Systems GmbH, Chemnitz, Germany

Bill and Melinda Gates Foundation, Seattle, USA

BioArtProducts GmbH, Rostock, Germany

Bioavid Diagnostics GmbH & Co. KG, Wendelsheim, Germany

BioComo Incorporation, Komono, Japan

BioCopy GmbH, Freiburg im Breisgau, Germany

BIOCYC Gesellschaft für Biotechnologie und Recyclingverfahren mbH & Co. Entwicklungs KG, Potsdam, Germany

BioEcho Life Sciences GmbH, Dormagen, Germany

BioGenes GmbH, Berlin, Germany

BIOSYNTAN GmbH, Berlin, Germany

BioTeZ Berlin Buch GmbH, Berlin, Germany

BM Bioscience Technology GmbH, Laage, Germany

Boehringer Ingelheim Animal Health, Hannover, Germany

Boehringer Ingelheim Veterinary Research Center GmbH & Co. KG, Hannover, Germany

Brandenburg Antiinfektiva GmbH, Borstel, Germany

CANDOR Bioscience GmbH, Wangen, Germany

Cellavent GmbH, Düsseldorf, Germany

Chiracon GmbH, Luckenwalde, Germany

Clearum GmbH, Rostock, Germany

C-Lecta GmbH, Leipzig, Germany

CO.DON AG, Teltow, Germany

Cogen Therapeutics, Cambridge, USA

Colibri Photonics GmbH, Potsdam, Germany

CONGEN Biotechnologie GmbH, Berlin, Germany

CureVac AG, Tübingen, Germany

CytoSorbents Europe GmbH, Berlin, Germany

Daiichi Sankyo Co. Ltd., Tokyo, Japan

diamond inventics GmbH, Berlin, Germany

DMCE GmbH & Co KG, Linz, Austria

DOKAtec GmbH, Sömmerda, Germany

DST Diagnostische Systeme & Technologien GmbH, Schwerin, Germany

DYN Labs Ltd., Caesarea, Israel

Dynamic Biosensors GmbH, Martinsried, Germany

Epimune GmbH, Berlin, Germany

epiontis GmbH, Berlin, Germany

Epitopic GmbH, Leipzig, Germany

ERBER AG, Getzersdorf, Austria

ERT-OPTIK Dr. Thiel GmbH, Ludwigshafen, Germany

Evonik Creavis GmbH, Marl, Germany

Experimental Pharmacology & Oncology Berlin-Buch GmbH, Berlin, Germany

FIM Biotech GmbH, Berlin, Germany

FjordAlg AS, Svelgen, Norway

Fresenius Kabi Deutschland GmbH, Bad Homburg, Germany

fzmb GmbH, Bad Langensalza, Germany

GA Generic Assays GmbH, Blankenfelde-Mahlow, Germany

Geräte- und Vorrichtungsbau Spitzner OHG, Leipzig, Germany

GeSiM Gesellschaft fuer Silizium-Mikrosysteme mbH, Großerkmannsdorf, Germany

GLYCON Biochemicals GmbH, Luckenwalde, Germany

Glycotope GmbH, Berlin, Germany

GNA Biosolutions GmbH, Martinsried, Germany

GVG Diagnostics GmbH, Leipzig, Germany

IBA GmbH, Göttingen, Germany

Ichor Medical Systems Inc., San Diego, USA

Icon Genetics GmbH, Halle (Saale), Germany

Idifarma Desarrollo Farmacéutico S.L., Navarra, Spain

Idris Oncology, Leiden, The Netherlands

IDT Biologika GmbH, Dessau-Roßlau, Germany

IgNova GmbH, Oberursel, Germany

Immunic AG, Martinsried, Germany

Immunolab GmbH, Kassel, Germany

in.vent DIAGNOSTICA GMBH, Hennigsdorf, Germany

Innovative Molecules GmbH, Bad-Salzuflen, Germany

inotec Forschungs- und Entwicklungsgesellschaft mbH, Leipzig, Germany

Institut für Produktqualität GmbH, Berlin, Germany

InstrAction GmbH, Mannheim, Germany

INVICOL GmbH, Berlin, Germany

IONERA Technologies GmbH, Freiburg, Germany

Iovance Biotherapeutics Inc, San Carlos, USA

Ipratech SA, Mons, Belgium

Iris Biotech GmbH, Marktredwitz, Germany

JenaBios GmbH, Jena, Germany

Kapelan Bio-Imaging GmbH, Leipzig, Germany

Kephera Diagnostics LLC, Framingham, USA

KET Kunststoff- und Elasttechnik GmbH, Radeberg, Germany

Labor LS SE & Co. KG, Bad Bocklet-Großenbrach, Germany

Life Science Inkubator GmbH, Bonn, Germany

Lipocalyx GmbH, Halle (Saale), Germany

Lipotype GmbH, Dresden, Germany

LOHMANN TIERZUCHT GmbH, Cuxhaven, Germany

LSA GmbH Leischnig Schaltschrankbau Automatisierungstechnik, Wolkenstein, Germany

Lufthansa Technik AG, Hamburg, Germany

LXP Group GmbH, Teltow, Germany

M2-Automation GmbH, Berlin, Germany

Magna Diagnostics GmbH, Leipzig, Germany

medac Gesellschaft für klinische Spezialpräparate mbH, Wedel, Germany

Medichema GmbH, Chemnitz, Germany

MEDIPAN GmbH, Dahlewitz, Germany

Mibelle Biochemistry – Mibelle AG, Buchs, Schwitzerland

MicroDiscovery GmbH, Berlin, Germany

microfluidic ChipShop GmbH, Jena, Germany

Micro-Hybrid Electronic GmbH, Hermsdorf, Germany

MicroMatrices Associates Ltd, Dundee, Great Britain

MIKROGEN GmbH, Neuried, Germany

Moderna, Inc., Cambridge, USA

Molzym GmbH & Co. KG, Bremen, Germany

Nanion Technologies GmbH, Munich, Germany

nal von minden GmbH, Regensburg, Germany

Navigo Proteins GmbH, Halle (Saale), Germany

NEUWAY Pharma GmbH, Bonn, Germany

new/era/mabs, Potsdam, Germany

Nipro Europe NV, Brussels, Belgium

Nomad Bioscience GmbH, Halle (Saale), Germany

Novartis Pharma AG, Basel, Schwitzerland / Morris Plains, USA

Novartis Pharma GmbH, Nürnberg, Germany

NovaTec Immundiagnostica GmbH, Dietzenbach, Germany

NTG Neue Technologien GmbH & Co. KG, Gelnhausen, Germany

Omniox Inc., San Carlos, USA

opTricon – Entwicklungs-gesellschaft für Optische Technologien mbH, Berlin, Germany

Plexense Inc., Gyeonggi-do, South Korea

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

PolyAn GmbH, Berlin, Germany

PolyQuant GmbH, Bad Abbach, Germany

Praxis Pharmaceutical, Miñano, Spain

Precision NanoSystems Inc., Vancouver, Canada

preclinics GmbH, Potsdam, Germany

Primacyt GmbH, Schwerin, Germany

Primedica GmbH, Dortmund, Germany

Pronaia Vermögens-beteiligung GmbH, Wiesbaden, Germany

quartett Immunodiagnostika, Biotechnologie + Kosmetik Vertriebs GmbH, Berlin, Germany

RIPAC-LABOR GmbH, Potsdam, Germany

Roche Glycart AG, Schlieren, Schwitzerland

SanWa Biotech, Hong Kong, China

Sartorius Stedim Biotech GmbH, Göttingen, Germany

SB Science Management UG, Berlin, Germany

SCHMUHL Faserverbund-technik GmbH & Co. KG, Remptendorf, Germany

Scienion AG, Berlin, Germany

scienova GmbH, Jena, Germany

Sciomics GmbH, Neckargemünd, Germany

SELEKTIS GmbH, Berlin, Germany

SelfDiagnostics Deutschland GmbH, Leipzig, Germany

Seramun Diagnostica GmbH, Heidesee, Germany

Serumwerk Bernburg AG, Bernburg, Germany

SerYmun Yeast GmbH, Halle (Saale), Germany

SFC Co. Ltd., Yongin-si, South Korea

Siemens AG, Munich / Erlangen, Germany

Sixfold Bioscience Inc., London, Great Britain

SKW Stickstoffwerke Piesteritz GmbH, Lutherstadt Wittenberg, Germany

Sonovum GmbH, Leipzig, Germany

Surflay Nanotec GmbH, Berlin, Germany

Syngenta UK Limited, Jeallott`s Hill, Great Britain

TBioMed, Heinrichsberg, Germany

Tcell Tolerance GmbH, Leipzig, Germany

Trifolio-M GmbH, Lahnau, Germany

TWINCORE – Zentrum für Experimentelle und Klinische Infektionsforschung GmbH, Hannover, Germany

Vaccinex Inc., Rochester, USA

Villeroy & Boch AG, Mettlach, Germany

Vita 34 AG, Geschäftsbereich BioPlanta, Leipzig, Germany

Vita34 AG, Leipzig, Germany

Vivoryon Therapeutics AG, Halle (Saale), Germany

We love apps, Erfurt, Germany

WISAG AG, Frankfurt am Main, Germany

Wrig Nanosystems GmbH, Leipzig, Germany

YUMAB GmbH, Braunschweig, Germany

Zellmechanik Dresden GmbH, Dresden, Germany

TEACHING ACTIVITIES

Beuth University of Applied Sciences Berlin

Selected aspects of biotechnology: Cell free protein synthesis (lecture), Dr. Stefan Kubick

Training in protein biochemistry (training), PD Dr. Harald Seitz

Freie Universität Berlin

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

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

Optical microscopy of the submicroscopic (course), PD Dr. Ralph Hölzel, Eva-Maria Laux

Hospital Chemnitz

Advanced training for assistant doctors (seminar), PD Dr. Stephan Fricke

Leipzig University

Acute and chronic infection of the cardiovascular system (lecture), Prof. Dr. Dr. Dr. Andreas Oberbach

Bed Site teaching (seminar), P rof. Dr. Dr. Dr. Andreas Oberbach

Cardiosurgical emergencies (lecture), Prof. Dr. Dr. Dr. Andreas Oberbach

Drug analysis – Drug monitoring I (seminar), Dr. Mirko Buchholz

Drug analysis – Drug monitoring II (seminar), Dr. Mirko Buchholz

Experimental physics and its mathematical methods EP3 – optics and thermodynamics (lecture), Dr. Jörg Schnauß

Immunological internship, 6th semester human medicine (training), Dr. Dennis Löffler, Dr. Conny Blumert

International guidelines for drugs, EMA and FDA; strategies and methods for testing for immunotoxic effects of chemicals and drugs (lecture), Dr. Jörg Lehmann

Lab training molecular medicine / virology (training), PD Dr. Sebastian Ulbert, Dr. Jasmin Fertey

Molecular aspects of food allergy (lecture), Dr. Elke Ueberham

Molecular medicine / virology (lecture), PD Dr. Sebastian Ulbert

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

Morphology and function of immunological cells and organs / basic functions of the immune system (lecture), Dr. Jörg Lehmann

Organic chemistry (training), Dr. Daniel Ramsbeck

Pharmaceutical biology / immunology (lecture), Dr. Jörg Lehmann

Preclinical in vitro and in vivo models for the detection and evaluation of immunotoxic effects of drugs (lecture), Sina Riemschneider

QSB4 autoimmunity and pathogenic immune reactions (course), Dr. Peter Ruschpler

QSB4 infectiology / immunology (lecture), Prof. Dr. Dr. Ulrike Köhl

Soft matter physics and biological physics (lecture / seminar), Dr. Jörg Schnauß, Dr. David M. Smith

Statistical learning (lecture), Dr. Kristin Reiche, Dr. David Petroff, Dr. Andreas Kühnapfel, Prof. Martin Bogdan

Surgical exercise (seminar), Prof. Dr. Dr. Dr. Andreas Oberbach

Therapy of heart failure (lecture), Prof. Dr. Dr. Dr. Andreas Oberbach

Transplantation and implantation of artificial heart (lecture), Prof. Dr. Dr. Dr. Andreas Oberbach

Vector-borne virus infection (lecture), PD Dr. Sebastian Ulbert

Virology (training), Dr. Lea Bayer, Dr. Thomas Grunwald

Leipzig University Medicine

POL-1 course (course), Dr. Yarúa Jaimes

Training immunology (training), Dr. Yarúa Jaimes, Kerstin Wenk

Leipzig University of Applied Sciences (HTWK Leipzig)

Biomedical imaging (lecture), Prof. Dr. Ulf-Dietrich Braumann

Bioreactors (lecture), Prof. Dr. Ulf-Dietrich Braumann

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

Imaging (lecture), Prof. Dr. Ulf-Dietrich Braumann

Microscopic imaging (lecture), Prof. Dr. Ulf-Dietrich Braumann, Dr. Sebastian Greiser

Microscopic image processing (lecture), Prof. Dr. Ulf-Dietrich Braumann

Production of recombinant proteins in a bioreactor using monoclonal antibodies as an example – Critical process parameters and control – GMP production (lecture), Dr. Maximilian Hoffmann

Stem cell biology (within bioreactors) (lecture), Dr. Claire Fabian

Martin Luther University Halle-Wittenberg

Animal Experimental Replacement Methods – Organ on a Chip (within the framework of the Colloquium on Animal Experimentation) (lecture), Dr. Claire Fabian

Applied cheminformatics for bioinformaticians (seminar), Dr. Mirko Buchholz, Christian Jäger

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

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

Non-curricular teaching (module supervision in the master program biochemistry / molecular biology for physicians) (training / seminar), Dr. Holger Cynis

Technical University of Berlin

Cell-free synthesis of membrane proteins (training), Dr. Stefan Kubick

Membrane proteins: Classification, structure and function (lecture), Dr. Stefan Kubick

University of Applied Sciences Zittau / Görlitz

GMP – Basic training (lecture), Dr. Maximilian Hoffmann

Production of recombinant proteins in a bioreactor using monoclonal antibodies as an example – Critical process parameters and control – GMP production (lecture), Dr. Maximilian Hoffmann

University of Potsdam

Applied limnology: Snow algae as an interesting bioresource for basic research and industrial bioproduction of algal metabolites (lecture), Dr. Thomas Leya

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

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

Immunobiological methods (seminar), PD Dr. Harald Seitz

EVALUATOR ACTIVITIES

ACS Applied Materials & Interfaces, Dr. Claus Duschl

Advances in Dairy Research, Dr. Jörg Lehmann

Alexander von Humboldt Foundation, Prof. Dr. Dr. Ulrike Köhl

Alzheimer's Association, Dr. Holger Cynis

American Association for Cancer Research, Prof. Dr. Dr. Ulrike Köhl

Analytical Chemistry, Dr. Eva Ehrentreich-Förster

Arctic, Antarctic, and Alpine Research, Dr. Thomas Leya

Austrian Research Promotion Agency (FFG), Franziska Lange

AWIPEV Arctic Research Base, Dr. Thomas Leya

BMC Bioinformatics, Michael Rade

BMC Veterinary Research, Dr. Elke Ueberham

Clinical Science, Dr. Holger Cynis

Cytometry Part A, Prof. Dr. Attila Tárnok

Deutsche Forschungsgemeinschaft (DFG, German Research Foundation), Dr. Eva Ehrentreich-Förster, Prof. Dr. Dr. Ulrike Köhl

Deutsche Krebshilfe, Prof. Dr. Dr. Ulrike Köhl

Emerging Micobes and Infections, PD Dr. Sebastian Ulbert

Engineering in Life Sciences, Dr. Stefan Kubick

European Society for Blood and Marrow Transplantation (EBMT), Prof. Dr. Dr. Ulrike Köhl

Faculty 1000, Dr. Jörg Lehmann

Frontiers in Aging Neuroscience, Dr. Holger Cynis

Future Virology, PD Dr. Sebastian Ulbert

German Center for Infection Research, PD Dr. Sebastian Ulbert

High-Tech Gründerfonds Bonn über das Steinbeis Transferzentrum, Dr. Mirko Buchholz

Jose Carreras Stiftung, Prof. Dr. Dr. Ulrike Köhl

Journal Blood Reviews, Prof. Dr. Dr. Ulrike Köhl

Journal Frontiers in Immunology, Prof. Dr. Dr. Ulrike Köhl

Journal Human Gene Therapy, Prof. Dr. Dr. Ulrike Köhl

Journal of Alzheimer's Disease, PD Dr. Stephan Schilling

Journal of Clinical Microbiology, PD Dr. Sebastian Ulbert

Journal of Molecular Therapy, Prof. Dr. Dr. Ulrike Köhl

Journal of Proteomics, Prof. Dr. Stefan Kalkhof

Material Science and Engineering: C, Dr. Claus Duschl

Metabolic Brain Disease, PD Dr. Stephan Schilling

Molecular Biology Reports, Dr. Holger Cynis

Parasites & Vectors, PD Dr. Sebastian Ulbert

PLoS One, Dr. Thomas Grunwald, Dr. Jörg Lehmann, Prof. Dr. Dr. Dr. Andreas Oberbach

Scientific Reports, Prof. Dr. Stefan Kalkhof

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

The Journal of Thoracic and Cardiovascular Surgery, Prof. Dr. Dr. Dr. Andreas Oberbach

Vaccine, Dr. Thomas Grunwald

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

Veterinary Immunology and Immunopathology, Dr. Jörg Lehmann

Viral Immunology, PD Dr. Sebastian Ulbert

ASSOCIATION MEMBERSHIPS

Alliance for Regenerative Medicine, Dr. Thomas Tradler MBA

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, PD Dr. Stephan Schilling

American Chemical Society (ACS), Christian Jäger, Dr. Mirko Buchholz, Dr. Daniel Ramsbeck

American Society for Mass Spectrometry, Prof. Dr. Stefan Kalkhof

biosaxony e.V., Dr. Thomas Tradler MBA

bbb – Biotechnologieverbund Berlin-Brandenburg e.V., Dr. Thomas Tradler MBA

btS – Biotechnologische Studenteninitiative e.V., Carolin Meier

Dachverband der Technologen/-innen und Analytiker/-innen in der Medizin Deutschland e.V., Ulrike Ehlert

DECHEMA Gesellschaft für Chemische Technik und Biotechnologie e.V. (Society for Chemical Engineering and Biotechnology), Dr. Mirko Buchholz, Dr. Stefan Kubick

Deutsch-Kanadische Gesellschaft (DKG), Dr. Thomas Tradler MBA

Deutsche Arbeitsgemeinschaft für Knochenmark und Blutstammzelltransplantation e.V., Prof. Dr. Dr. Ulrike Köhl

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

Deutsche Gesellschaft für Gentherapie e.V., Prof. Dr. Dr. Ulrike Köhl

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

Deutsche Gesellschaft für Hämatologie und Medizinische Onkologie e.V., Prof. Dr. Dr. Ulrike Köhl

Deutsche Gesellschaft für Medizinische Physik e.V., Prof. Dr. Ulf-Dietrich Braumann

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

Deutsche Gesellschaft für Pathologie e.V., Dr. Kristin Reiche

Deutsche Gesellschaft für Proteomforschung e.V., Dr. Stefan Kubick

Deutsche Gesellschaft für Regenerative Medizin e.V., PD Dr. Stephan Fricke

Deutsche Gesellschaft für Thorax-, Herz- und Gefäßchirurgie e.V. (DGTHG), Prof. Dr. Dr. Dr. Andreas Oberbach

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

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

DFG Cluster of Excellence »Rebirth – Regenerative Medicine«, Prof. Dr. Dr. Ulrike Köhl

DGBMT German Society for Biomedical Engineering, Dr. Cornelia Hettrich

DiagnostikNet-BB e. V. Netzwerk Diagnostik Berlin-Brandenburg, Dr. Marcus Menger

DIN-Normenausschuss Grundlagen des Umweltschutzes (NAGUS), Dr. Thomas Leya

European Academy of Allergy and Clinical Immunology (EAACI), Lisbeth Ramirez Caballero

European QP Association, Dr. Maximilian Hoffmann

European Society for Blood and Marrow Transplantation (EBMT), Prof. Dr. Dr. Ulrike Köhl

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

Freundeskreis Tiermedizin der Veterinärmedizinischen Fakultät Leipzig e.V., Dr. Anke Hoffmann, Dr. Jörg Lehmann,

German Lymphoma Alliance e.V., PD Dr. Stephan Fricke, Dr. Markus Kreuz,

German Physical Society, Dr. Claus Duschl, Martin Glaser, Tina Händler, PD Dr. Ralph Hölzel, Dr. Jörg Schnaus

German Qualified Person Association (GQPA),
Martin Dähne,
Ulrike Jehmlich,
Kati Kebbel,
Dr. Jörg Lehmann,
Dr. Gerno Schmiedeknecht

German Society for Extracellular Vesicles GSEV,
Dr. Dirk Kuhlmeier

German Society for Immunology (DGfI), Dr. Lea Bayer,
PD Dr. Stephan Fricke,
Dr. Andreas Grahnert,
Max Guthardt,
Prof. Dr. Dr. Ulrike Köhl,
Janine Kohlschmidt,
Dr. Franziska Lange,
Dr. Jörg Lehmann,
Dr. Gustavo Makert dos Santos,
Sina Riemschneider

German Society for Mass Spectrometry DGMS,
Prof. Dr. Stefan Kalkhof

German Society for Plant Sciences, Dr. Thomas Leya

German Zoological Society,
Dr. Gustavo Makert dos Santos

Gesellschaft Deutscher Chemiker (GDCh),
Dr. Mirko Buchholz,
Dr. Eva Ehrentreich-Förster,
Dr. Marcus Menger,
Dr. Daniel Ramsbeck,
Dr. Michael Szardenings

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

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

Glyconet Berlin Brandenburg (glyconetBB e.V.), Dr. Stefan Kubick

Hilfe für Krebskranke Kinder Frankfurt e.V., Prof. Dr. Dr. Ulrike Köhl

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

Integriertes Forschungs- und Behandlungszentrum für Transplantation (IFB-Tx),
Prof. Dr. Dr. Ulrike Köhl

International Society for Cell & Gene Therapy (ISCT),
Prof. Dr. Dr. Ulrike Köhl

International Society for Extracellular Vesicles,
Dr. Yarua Jaimes,
Dr. Dirk Kuhlmeier,
Ana Lopes,
Paula Medina-Pérez,
Sabrina Rau

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

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

International Society on Aptamers (INSOAP),
Dr. Marcus Menger

International Union for the Study of Social Insects (IUSSI),
Dr. Gustavo Makert dos Santos

KGF Knochenmarktransplantation / Gentherapie Frankfurt am Main, Prof. Dr. Dr. Ulrike Köhl

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

Neurowissenschaftliche gesellschaft e. V. (NWg),
Dr. Anna Leichsenring

Pädiatriatische Arbeitsgemeinschaft für Knochenmark- und Blutstammzelltransplantation (PÄD-AG-KBT), Prof. Dr. Dr. Ulrike Köhl

SFB738 »Konventionelle und innovative Transplantate«,
Prof. Dr. Dr. Ulrike Köhl

Society for Biochemistry and Molecular Biology (Gesellschaft für Biochemie und Molekularbiologie, GBM),
Dr. Holger Cynis,
Prof. Dr. Friedemann Horn,
Dr. Stefan Kubick,
Dr. Marcus Menger,
Dr. Markus von Nickisch-Rosenegk,
Dr. Kristin Reiche,
PD Dr. Stephan Schilling,
Lilly Stahl,
Dr. Michael Szardenings

Society for Neuroscience (SfN), Dr. Holger Cynis,
PD Dr. Stephan Schilling

Society for Paediatric Oncology and Haematology (GPOH), Prof. Dr. Dr. Ulrike Köhl

Society for Virology (Gesellschaft für Virologie; GfV),
Dr. Jasmin Fertey,
Dr. Thomas Grunwald,
PD Dr. Sebastian Ulbert

The Network for Pharma Solutions – NetPhaSol,
Dr. Marcus Menger

The RNA Society,
Dr. Sandy Tretbar

Tierärztliche Vereinigung für Tierschutz e.V.,
Dr. Vera Rieckmann

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

PUBLICATIONS

Adamatzky A, Huber F, Schnauß J. **Computing on actin bundles network.** Scientific Reports 9 (2019), 1, 15887, 10 pages. doi: 10.1038/s41598-019-51354-y

Adamatzky A, Schnauß J, Huber F. **Actin droplet machine.** Royal Society Open Science 6 (2019), 12, 191135, 16 pages. doi: 10.1098/rsos.191135

Aleksandrova K, Leise J, Priesner C, Melk A, Kubaink F, Abken H, Hombach A, Aktas M, Essl M, Bürger I, Kaiser A, Rauser G, Jurk M, Goudeva L, Glienke W, Arseniev L, Esser R, Köhl U. **Functionality and cell senescence of CD4/CD8-selected CD20 CAR T cells manufactured using the automated CliniMACS Prodigy® platform.** Transfusion medicine and hemotherapy 45 (2019), 1, pages 47-54. doi: 10.1159/000495772

Al-Essa MK, Melzer S, Tárnok A. **Two-color analysis of leukocytes labeled by modified RBCs and their fragments.** Cytometry Part A 95 (2019), 3, pages 339-346, doi: 10.1002/cyto.a.23682

Anywar G, Kakudidi E, Byamukama R, Mukonzo J, Schubert A, Oryem-Origa H. **Indigenous traditional knowledge of medicinal plants used by herbalists in treating opportunistic infections among people living with HIV/AIDS in Uganda.** Journal of Ethnopharmacology 246 (2020), article 112205 13 pages, doi: 10.1016/j.jep.2019.112205

Aswal S, Kumar A, Semwal RB, Chauhan A, Kumar A, Lehmann J, Semwal DK. **Drimia indica: a plant used in traditional medicine and its potential for clinical uses.** Medicina 55 (2019), 6, 16 pages, doi: 10.3390/medicina55060255

Ayobahan SU, Eilebrecht E, Kotthoff M, Baumann L, Eilebrecht S, Teigeler M, Hollert H, Kalkhof S, Schäfers C. **A combined FSTRA-shotgun proteomics approach to identify molecular changes in zebrafish upon chemical exposure.** Scientific reports 9 (2019), 6599, 12 pages. doi: 10.1038/s41598-019-43089-7

Ayobahan SU, Eilebrecht S, Baumann L, Teigeler M, Hollert H, Kalkhof S, Eilebrecht E, Schäfers C. **Detection of biomarkers to differentiate endocrine disruption from hepatotoxicity in zebrafish (Danio rerio) using proteomics.** Chemosphere 240 (2020), 124970, 12 pages. doi: 10.1016/j.chemosphere.2019.124970

Barth M, Gröger V, Cynis H, Staege MS. **Identification of human endogenous retrovirus transcripts in Hodgkin Lymphoma cells.** Molecular biology reports 46 (2019)2, pages 1885-1893, doi: 10.1007/s11033-019-04640-x

Behm LVJ, Gerike S, Grauel MK, Uhlig K, Pfisterer F, Baumann W, Bier FF, Duschl C, Kirschbaum M. **Micropatterned thermoresponsive cell culture substrates for dynamically controlling neurite outgrowth and neuronal connectivity in vitro.** ACS Applied Bio Mater 7 (2019), 2, 2853-2861. doi: 10.1021/acsabm.9b00246

Belkum A, Bachmann TT, Lüdke G et al. **Developmental roadmap for antimicrobial susceptibility testing systems.** Nature Reviews Microbiology 17 (2019), S. 51-62. doi: 10.1038/s41579-018-0098-9

Bender P, Egger A, Westermann M, Taudte N, Sculean A, Potempa J, Möller B, Buchholz M, Eick S. **Expression of human and Porphyromonas gingivalis glutaminyl cyclases in periodontitis and rheumatoid arthritis – a pilot study.** Archives of oral biology 97 (2019), January, pages 223-230, doi: 10.1016/j.archoralbio.2018.10.022

Bengtsson E, Tárnok A. **Special section on image cytometry.** Cytometry Part A 95 (2019), 4, pages 363-365, doi: 10.1002/cyto.a.23762

Binner C, Wagner J, Schmalz G, Eisner M, Rast J, Kottmann T, Haak R, Oberbach A, Borger MA, Garbade J, Ziebolz D. **Insufficient oral behaviour and the high need for periodontal treatment in patients with heart insufficiency and after heart transplantation: a need for special care programs?** Journal of Clinical Medicine 8 (2019), 10, Articel 1668, 10 pages. doi: 10.3390/jcm8101668

Bitar M, Boldt A, Freitag MT, Gruhn B, Köhl U, Sack U. **Evaluating STAT5 phosphorylation as a mean to assess T cell proliferation.** Frontiers in immunology 10 (2019), article 722, 11 pages. doi: 10.3389/fimmu.2019.00722

Blaess M, Deigner HP. **Derailed ceramide metabolism in atopic dermatitis (AD): a causal starting point for a personalized (basic) therapy.** International journal of molecular sciences 20 (2019), 16, 15 pages, doi: 10.3390/ijms20163967

Bocker HT, Heinrich T, Liebmann L, Hennings JC, Seemann E, Gerth M, Jakovčevski I, Preobraschenski J, Kessels MM, Westermann M, Isbrandt D, Jahn R, Qualmann B, Hübner CA. **The Na+/H+ exchanger Nhe1 modulates network excitability via GABA release.** Cerebral cortex 13 (2019), 29, pages 4263-4276, doi: 10.1093/cercor/bhy308

Bozza FA, Moreira-Soto A, Rockstroh A, Fischer C, Nascimento AD, Calheiros AS, Drosten C, Bozza PT, Souza TML, Ulbert S, Drexler JF. **Differential shedding and antibody kinetics of Zika and Chikungunya Viruses, Brazil.** Emerging Infectious Diseases 25(2019), 2, pages 311-315. doi: 10.3201/eid2502.180166

Bremm M, Pfeffermann LM, Cappel C, Katzki V1, Erben S, Betz S, Quaiser A, Merker M, Bonig H, Schmidt M, Klingebiel T, Bader P, Huenecke S, Rettinger E. **Improving clinical manufacturing of IL-15 activated cytokine-induced killer (CIK) cells.** Frontiers in immunology 10 (2019), Artikel 1218, 12 pages. doi: 10.3389/fimmu.2019.01218

Bursch F, Rath KJ, Sarikidi A, Böselt S, Kefalakes E, Osmanovic A, Thau-Habermann N, Klöß S, Köhl U, Petri S. **Analysis of the therapeutic potential of different administration routes and frequencies of human mesenchymal stromal cells in the SOD1G93A mouse model of amyotrophic lateral sclerosis.** J Tissue Eng Regen Med. 2019 Apr;13(4):649-663. doi: 10.1002/term.2846. Epub 2019 Mar 20.

Comoli P, Chabannon C, Koehl U, Lanza F, Urbano-Ispizua A, Hudecek M, Ruggeri A, Secondino S, Bonini C, Pedrazzoli P. **Development of adaptive immune effector therapies in solid tumors.** Ann Oncol. 2019 Nov 1;30(11):1740-1750. doi: 10.1093/annonc/mdz285

Cossarizza A, Chang HD, Radbruch A, Acs A, Adam D, Adam-Klages S, Agace WW, Aghaeepour N, Akdis M, Allez M, Almeida LN, Alvisi G, Anderson G, Andrä I, Annunziato F, Anselmo A, Bacher P, Baldari CT, Bari S, Barnaba V, Barros-Martins J, Battistini L, Bauer W, Baumgart S, Baumgarth N, Baumjohann D, Baying B, Bebawy M, Becher B, Beisker W, Benes V, Beyaert R, Blanco A, Boardman DA, Bogdan C, Borger JG, Borsellino G, Boulais PE, Bradford JA, Brenner D, Brinkman RR, Brooks AES, Busch DH, Büscher M, Bushnell TP, Calzetti F, Cameron G, Cammarata I, Cao X, Cardell SL, Casola S, Cassatella MA, Cavani A, Celada A, Chatenoud L, Chattopadhyay PK, Chow S, Christakou E, Čičin-Šain L, Clerici M, Colombo FS, Cook L, Cooke A, Cooper AM, Corbett AJ, Cosma A, Cosmi L, Coulie PG, Cumano A, Cvetkovic L, Dang VD, Dang-Heine C, Davey MS, Davies D, De Biasi S, Del Zotto G, Dela Cruz GV, Delacher M, Della Bella S, Dellabona P, Deniz G, Dessing M, Di Santo JP, Diefenbach A, Dieli F, Dolf A, Dörner T, Dress RJ, Dudziak D, Dustin M, Dutertre CA, Ebner F, Eckle SBG, Edinger M, Eede P, Ehrhardt GRA, Eich M, Engel P, Engelhardt B, Erdei A, Esser C, Everts B, Evrard M, Falk CS, Fehniger TA, Felipo-Benavent M, Ferry H, Feuerer M, Filby A, Filkor K, Fillatreau S, Follo M, Förster I, Foster J, Foulds GA, Frehse B, Frenette PS, Frischbutter S, Fritzsche W, Galbraith DW, Gangaev A, Garbi N, Gaudilliere B, Gazzinelli RT, Geginat J, Gerner W, Gherardin NA, Ghoreschi K, Gibellini L, Ginhoux F, Goda K, Godfrey DI, Goettlinger C, González-Navajas JM, Goodyear CS, Gori A, Grogan JL, Grummitt D, Grützkau A, Haftmann C, Hahn J, Hammad H, Hämmerling G, Hansmann L, Hansson G, Harpur CM, Hartmann S, Hauser A, Hauser AE, Haviland DL, Hedley D, Hernández DC, Herrera G, Herrmann M, Hess C, Höfer T, Hoffmann P, Hogquist K, Holland T, Höllt T, Holmdahl R, Hombrink P, Houston JP, Hoyer BF, Huang B, Huang FP, Huber JE, Huehn J, Hundemer M, Hunter CA, Hwang WYK, Iannone A, Ingelfinger F, Ivison SM, Jäck HM, Jani PK, Jávega B, Jonjic S, Kaiser T, Kalina T, Kamradt T, Kaufmann SHE, Keller B, Ketelaars SLC, Khalilnezhad A, Khan S, Kisielow J, Klenerman P, Knopf J, Koay HF, Kobow K, Kolls JK, Kong WT, Kopf M, Korn T, Kriegsmann K, Kristyanto H, Kroneis T, Krueger A, Kühne J, Kukat C, Kunkel D, Kunze-Schumacher H, Kurosaki T, Kurts C, Kvistborg P, Kwok I, Landry J, Lantz O, Lanuti P, LaRosa F, Lehuen A, LeibundGut-Landmann S, Leipold MD, Leung LYT, Levings MK, Lino AC, Liotta F, Litwin V, Liu Y, Ljunggren HG, Lohoff M, Lombardi G, Lopez L, López-Botet M, Lovett-Racke AE,

Lubberts E, Luche H, Ludewig B, Lugli E, Lunemann S, Maecker HT, Maggi L, Maguire O, Mair F, Mair KH, Mantovani A, Manz RA, Marshall AJ, Martínez-Romero A, Martrus G, Marventano I, Maslinski W, Matarese G, Mattioli AV, Maueröder C, Mazzoni A, McCluskey J, McGrath M, McGuire HM, McInnes IB, Mei HE, Melchers F, Melzer S, Mielenz D, Miller SD, Mills KHG, Minderman H, Mjösberg J, Moore J, Moran B, Moretta L, Mosmann TR, Müller S, Multhoff G, Muñoz LE, Münz C, Nakayama T, Nasi M, Neumann K, Ng LG, Niedobitek A, Nourshargh S, Núñez G, O'Connor JE, Ochel A, Oja A, Ordonez D, Orfao A, Orlowski-Oliver E, Ouyang W, Oxenius A, Palankar R, Panse I, Pattanapanyasat K, Paulsen M, Pavlinic D, Penter L, Peterson P, Peth C, Petriz J, Piancone F, Pickl WF, Piconese S, Pinti M, Pockley AG, Podolska MJ, Poon Z, Pracht K, Prinz I, Pucillo CEM, Quataert SA, Quatrini L, Quinn KM, Radbruch H, Radstake TRDJ, Rahmig S, Rahn HP, Rajwa B, Ravichandran G, Raz Y, Rebhahn JA, Recktenwald D, Reimer D, Reis E Sousa C, Remmerswaal EBM, Richter L, Rico LG, Riddell A, Rieger AM, Robinson JP, Romagnani C, Rubartelli A, Ruland J, Saalmüller A, Saeys Y, Saito T, Sakaguchi S, Sala-de-Oyanguren F, Samstag Y, Sanderson S, Sandrock I, Santoni A, Sanz RB, Saresella M, Sautes-Fridman C, Sawitzki B, Schadt L, Scheffold A, Scherer HU, Schiemann M, Schildberg FA, Schimisky E, Schlitzer A, Schlosser J, Schmid S, Schmitt S, Schober K, Schraivogel D, Schuh W, Schüler T, Schulte R, Schulz AR, Schulz SR, Scottá C, Scott-Algara D, Sester DP, Shankey TV, Silva-Santos B, Simon AK, Sitnik KM, Sozzani S, Speiser DE, Spidlen J, Stahlberg A, Stall AM, Stanley N, Stark R, Stehle C, Steinmetz T, Stockinger H, Takahama Y, Takeda K, Tan L, Tárnok A, Tiegs G, Toldi G, Tornack J, Traggiai E, Trebak M, Tree TIM, Trotter J, Trowsdale J, Tsoumakidou M, Ulrich H, Urbanczyk S, van de Veen W, van den Broek M, van der Pol E, Van Gassen S, Van Isterdael G, van Lier RAW, Veldhoen M, Vento-Asturias S, Vieira P, Voehringer D, Volk HD, von Borstel A, von Volkmann K, Waisman A, Walker RV, Wallace PK, Wang SA, Wang XM, Ward MD, Ward-Hartstonge KA, Warnatz K, Warnes G, Warth S, Waskow C, Watson JV, Watzl C, Wegener L, Weisenburger T, Wiedemann A, Wienands J, Wilharm A, Wilkinson RJ, Willimsky G, Wing JB, Winkelmann R, Winkler TH, Wirz OF, Wong A, Wurst P, Yang JHM, Yang J, Yazdanbakhsh M, Yu L, Yue A, Zhang H, Zhao Y, Ziegler SM, Zielinski C, Zimmermann J, Zychlinsky A. **Guidelines for the use of flow cytometry and cell sorting in immunological studies (second edition).** European Journal of Immunology 49 (2019), 10, pages 1457-1973. doi: 10.1002/eji.201970107

Costa-Marques L, Katrin K, Pardon M, Leovsky C, Swarbrick S, Fabian C, Stolzing A. **Transplantation of bone marrow derived macrophages reduces markers of neuropathology in an APP/PS1 mouse model.** Translational Neurodegeneration 8 (2019), 33, 11 pages. doi: 10.1186/s40035-019-0173-9

Czechowska K, Lannigan J, Wang L, Arcidiacono J, Ashhurst TM, Barnard RM, Bauer S, Bispo C, Bonilla DL, Brinkman RR, Cabanski M, Chang HD, Chakrabarti L, Chojnowski G, Cotleur B, Degheidy H, Dela Cruz GV, Eck S, Elliott J, Errington R, Filby A, Gagnon D, Gardner R, Green C, Gregory M, Groves CJ, Hall C, Hammes F, Hedrick M, Hoffman R, Icha J, Ivaska J, Jenner DC, Jones D, Kerckhof FM, Kukat C, Lanham D, Leavesley S, Lee M, Lin-Gibson S, Litwin V, Liu Y, Molloy J, Moore JS, Müller S, Nedbal J, Niesner R, Nitta N, Ohlsson-Wilhelm B, Paul NE, Perfetto S, Portat Z, Props R, Radtke S, Rayanki R, Rieger A, Rogers S, Rubbens P, Salomon R, Schiemann M, Sharpe J, Sonder SU, Stewart JJ, Sun Y, Ulrich H, Van Isterdael G, Vitaliti A, van Vreden C, Weber M, Zimmermann J, Vacca G, Wallace P, Tárnok A. **Cyt-Geist: current and future challenges in Cytometry: reports of the CYTO 2018 conference workshops.** Cytometry Part A 95 (2019), 6, pages 598-644, doi: 10.1002/cyto.a.23777

de Vera J-P, Alawi M, Backhaus T, Baqué M, Billi D, Böttger U, Berger T, Cockell C, Demets R, Noetzel R d l T, Edwards H, Elsaesser A, Fagliarone C, Fiedler A, Foing B, Foucher F, Fritz J, Hanke F, Herzog T, Horneck G, Hübers H-W, Huwe B, Joshi J, Kozyrovska N, Kruchten M, Lasch P, Lee N, Leya T, Lorek A, Moritz S, Möller R, Olsson-Francis K, Onofri S, Ott S, Pacelli C, Podolich O, Martínez-Frías J, Rabbow E, Reitz G, Rettberg P, Reva O, Rothschild L, Sancho L G, Schulze-Makuch D, Selbmann L, Serrano P, Szewzyk U, Verseux C, Wagner D, Westall F, Wolter D, Zucconi L. **Limits of life and the habitability of Mars: The ESA space experiment BIOMEX on the ISS.** Astrobiology 19 (2019), 2, pages 145-157. doi: 10.1089/ast.2018.1897

Dluczek S, Tretbar US, Fricke S, Koehl U. **CAR-T-Zellen: Update 2019.** Transfusionsmedizin 9 (2019), 3, pages 187-200, doi: 10.1055/a-0833-2631

Dondapati SK, Lübberding H, Zemella A, Thoring L, Wüstenhagen DA, Kubick S. **Functional reconstitution of membrane proteins derived from Eukaryotic Cell-Free Systems.** Frontiers in Pharmacology (2019), 9 pages. doi: 10.3389/fphar

Dondapati SK, Pietruschka G, Thoring L, Wüstenhagen DA, Kubick S. **Cell-free synthesis of human toll-like receptor 9 (TLR9): Optimization of synthesis conditions and functional analysis.** PLoS One 14 (2019), 4, e0215897, 16 pages. doi: 10.1371/journal.pone.0215897

Fayad L, Oberbach A, Schweitzer M, Askin F, Voltaggio L, Larman T, Enderle M, Hahn H, Khashab MA, Kalloo AN, Kumbhari V. **Gastric mucosal devitalization (GMD): translation to a novel endoscopic metabolic therapy.** Endoscopy International Open (2019), 07, 6 pages. doi: 10.1055/a-0957-3067

Fayad L, Schweitzer M, Raad M, Simsek C, Oleas R, Dunlap MK, Shah T, Doshi J, El Asmar M, Oberbach A, Singh VK, Steele K, Magnussen T, Kalloo AN, Khashab MA, Kumbhari V. **A real-world, insurance-based algorithm using the two-fold running suture technique for transoral outlet reduction for weight regain and dumping syndrome after Roux-En-Y gastric bypass.** Obesity Surgery 29 (2019), pages 2225-2232. doi: 10.1007/s11695-019-03828-1

Fayad L, Simsek C, Oleas R, Ichkhanian Y, Fayad GE, Ngamreungphong S, Schweitzer M, Oberbach A, Kalloo AN, Khashab MA, Kumbhari V. **Safety and efficacy of endoscopically secured fully covered self-expandable metallic stents (FCSEMS) for post-bariatric complex Stenosis.** Obesity Surgery 29 (2019), pages 3484-3492. doi: 10.1007/s11695-019-04021-0

Frimmel S, Hinz M, Schipper J, Bogdanow S, Mitzner S, Koball S. **Cytokine adsorption is a promising tool in the therapy of hemophagocytic lymphohistiocytosis.** International Journal of Artificial Organs 42 (2019), 11, pages 658-664. doi: 10.1177/0391398819857444

Gialluisi A, Andlauer TFM, Mirza-Schreiber N, Moll K, Becker J, Hoffmann P, Ludwig KU, Czamara D, St Pourcain B, Brandler W, Honbolygó F, Tóth D, Csépe V, Huguet G, Morris AP, Hulslander J, Willcutt EG, DeFries JC, Olson RK, Smith SD, Pennington BF, Vaessen A, Maurer U, Lyytinen H, Peyrard-Janvid M, Leppänen PHT, Brandeis D, Bonte M, Stein JF, Talcott JB, Fauchereau F, Wilcke A, Francks C, Bourgeron T, Monaco AP, Ramus F, Landerl K, Kere J, Scerri TS, Paracchini S, Fisher SE, Schumacher J, Nöthen MM, Müller-Myhsok B, Schulte-Körne G. **Genome-wide association scan identifies new variants associated with a cognitive predictor of dyslexia.** Translational psychiatry 9 (2019), 1, article no 77, 15 pages, doi: 10.1038/s41398-019-0402-0

Godino N, Pfisterer F, Gerling T, Guernth-Marschner C, Duschl C, Kirschbaum M. **Combining dielectrophoresis and computer vision for precise and fully automated single-cell handling and analysis.** Lab on a Chip 24 (2019), 19, pages 4016-4020. doi: 10.1039/c9lc00800d

Golde T, Glaser M, Tutmarc C, Elbalasy I, Huster C, Busteros G, Smith DM, Herrmann H, Käs JA, Schnauß J. **The role of stickiness in the rheology of semiflexible polymers.** Soft matter 15 8 (2019), pages 4865-4872, doi: 10.1039/C9SM00433E

Haange SB, Jehmlich N, Hoffmann M, Weber K, Lehmann J, von Bergen M, Slanina U. **Disease development is accompanied by changes in bacterial protein abundance and functions in a refined model of dextran sulfate sodium (DSS)-induced colitis.** Journal of proteome research 18 (2019), 4, pages 1774-1786, doi: 10.1021/acs.jproteome.8b00974

Haehnel S, Reiche K, Loeffler D, Horn A, Blumert C, Puppel SH, Kaiser N, Rapp F, Rade M, Horn F, Meixensberger J, Bechmann I, Gaunitz F, Winter K. **Deep sequencing and automated histochemistry of human tissue slice cultures improve their usability as preclinical model for cancer research.** Sci Rep. 2019 Dec 27;9(1):19961

Hartlage-Rübsamen M, Ratz V, Zeitschel U, Finzel L, Machner L, Köppen J, Schulze A, Demuth HU, von Hörsten S, Höfling C, Rossner S. **Endogenous mouse huntingtin is highly abundant in cranial nerve nuclei, coaggregates to Abeta plaques and is induced in reactive astrocytes in a transgenic mouse model of Alzheimer's disease.** Acta Neuropathologica Communications, (2019) 7:79

Hays JP, Mitsakakis K, Luz S, Van Belkum A, Becker K, Van den Bruel A, Harbarth S, Rex JH, Simonsen GS, Di Gregori V, Lüdke G, Van Staa T, Moran-Gilad J, Bachmann TT, JPIAMR AMR-RDT consortium. **The successful uptake and sustainability of rapid infectious disease and antimicrobial resistance point-of-care testing requires a complex »mix-and-match« implementation package.** European Journal of Clinical Microbiology & Infectious Diseases 38 (2019), pages 1015–1022. doi: 10.1007/s10096-019-03492-4

Hillmann A, Paebst F, Brehm W, Piehler D, Schubert S, Tárnok A, Burk J. **A novel direct co-culture assay analyzed by multicolor flow cytometry reveals context- and cell type-specific immunomodulatory effects of equine mesenchymal stromal cells.** PLoS one 14 (2019), 6, 21 pages, doi: 10.1371/journal.pone.0218949

Huber R, Kirsten H, Näkki A, Pohlers D, Thude H, Eidner T, Heinig M, Brand K, Ahnert P, Kinne RW. **Association of human FOS promoter variants with the occurrence of knee-osteoarthritis in a case control association study.** International journal of molecular sciences 20 (2019), 6, 13 pages, doi: 10.3390/ijms20061382

Kämpf C, Specht M, Scholz A, Puppel SH, Doose G, Reiche K, Schor J, Hackermüller J. **uap: reproducible and robust HTS data analysis.** BMC Bionformatics, 20 (2019), 664, 9 pages. doi: 10.1186/s12859-019-3219-1

Kern K, Havenith H, Delaroque N, Rautenberger P, Lehmann J, Fischer M, Spiegel H, Schillberg S, Ehrentreich-Foerster E, Aurich S, Treudler R, Szardenings M. **The immunome of soy bean allergy: comprehensive identification and characterization of epitopes.** Clinical & experimental allergy 49 (2019), 2, pages 239-251, doi: 10.1111/cea.13285

Kielar C, Xin Y, Xu X, Zhu S, Gorin N, Grundmeier G, Möser C, Smith DM, Keller A. **Effect of staple age on DNA origami nanostructure assembly and stability.** Molecules 24 (2019), 14, 12 pages, doi: 10.3390/molecules24142577

Kloess S, Kretschmer A, Stahl L, Fricke S, Koehl U. **CAR-Expressing Natural Killer Cells for Cancer Retargeting.** Transfus Med Hemother. 2019 Feb;46(1):4-13. doi: 10.1159/000495771

Kloess S, Oberschmidt O, Dahlke J, Vu XK, Neudoerfl C, Kloos A, Gardlowski T, Matthies N, Heuser M, Meyer J, Sauer M, Falk C, Koehl U, Schambach A, Morgan MA. **Preclinical Assessment of Suitable Natural Killer Cell Sources for Chimeric Antigen Receptor Natural Killer-Based »Off-the-Shelf« Acute Myeloid Leukemia Immunotherapies.** Human Gene Therapy 30 (2019), 4, pages 381-401. doi: 10.1089/hum.2018.247

Küster E, Kalkhof S, Aulhorn S, von Bergen M, Gündel U. **Effects of five substances with different modes of action on cathepsin H, C and L activities in zebrafish embryos.** International journal of environmental research and public health 16 (2019), 20, 15 pages, doi: 10.3390/ijerph16203956

Lienau C, Gräwert T, Alves Avelar LA, Illarionov B, Held J, Knaab TC, Lungerich B, van Geelen L, Meier D, Geissler S, Cynis H, Riederer U, Buchholz M, Kalscheuer R, Bacher A, Mordmüller B, Fischer M, Kurz T. **Novel reverse thia-analogs of fosmidomycin: synthesis and antiplasmodial activity.** European journal of medicinal chemistry 181 (2019), Artikel 111555, 12 pages, doi: 10.1016/j.ejmech.2019.07.058

Luehr M, Bauernschmitt N, Peterss S, Li Y, Heyn O, Dashkevich A, Oberbach A, Bagaev E, Pichlmaier MA, Juchem G, Hagl C. **Incidence and surgical outcomes of patients with native and prosthetic aortic valve endocarditis.** Annals of Thoracic Surgery (2019) pre-proof. doi: 10.1016/j.athoracsur.2019.10.029

Mahmoud M, Laufer S, Deigner HP. **Visual aptamer-based capillary assay for ethanolamine using magnetic particles and strand displacement.** Mikrochimica acta 186 (2019), 11, 8 pages, doi: 10.1007/s00604-019-3795-9

Mahmoud M, Laufer S, Deigner HP. **Data for homogeneous thermofluorimetric assays for ethanolamine using aptamers and a PCR instrument.** Data in brief 24 (2019), 103946, 11 pages, doi: 10.1016/j.dib.2019.103946

Mahmoud M, Laufer S, Deigner HP. **An aptamer based thermofluorimetric assay for ethanolamine.** Biochimie 158 (2019), pages 233-237, doi: 10.1016/j.biochi.2019.01.014

Oberbach A, Friedrich M, Lehmann S, Schlichting N, Kullnick Y, Gräber S, Buschmann T, Hagl C, Bagaev E; CardiOmics group; Clinical Microbiology group; Bioinformatics group. **Bacterial infiltration in structural heart valve disease.** The journal of thoracic and cardiovascular surgery (2019), [Epub ahead of print], doi: 10.1016/j.jtcvs.2019.02.019

Oberbach A, Schlichting N, Friedrich M, Lehmann S, Kullnick Y, Pichlmaier M, Hagl C, Bagaev E; CardiOmics group; Clinical Microbiology group; Clinical; Management group. **Quantification of Multiple Bacteria in Calcified Structural Valvular Heart Disease.** Semin Thorac Cardiovasc Surg. 2019 Oct 9. pii: S1043-0679(19)30319-3. doi: 10.1053/j.semtcvs.2019.10.003

Oberbach A, Schlichting N, Kullnick Y, Heinrich M, Lehmann S, Retschlag U, Friedrich M, Fayad L, Dietrich A, Khashab MA, Kalloo AN, Kumbhari V. **Gastric mucosal devitalization improves blood pressure, renin and cardiovascular lipid deposition in a rat model of obesity.** Endoscopy International Open 07 (2019), 11 pages. doi: 10.1055/a-0990-9683

Oberschmidt O, Morgan M, Huppert V, Kessler J, Gardlowski T, Matthies N, Aleksandrova K, Arseniev L, Schambach A, Koehl U, Kloess S. **Development of Automated Separation, Expansion, and Quality Control Protocols for Clinical-Scale Manufacturing of Primary Human NK Cells and Alpharetroviral Chimeric Antigen Receptor Engineering.** Hum Gene Ther Methods. 2019 Jun;30(3):102-120. doi:10.1089/hgtb.2019.039. Epub 2019 May 16

Procházková L, Leya T, Křížková H, Nedbalová L. **Sanguina nivaloides and Sanguina aurantia gen. et spp. nov. (Chlorophyta): the taxonomy, phylogeny, biogeography and ecology of two newly recognised algae causing red and orange snow.** FEMS Microbiol. Ecol. 95(6), (2019), fiz064

Rauwald HW, Liebold T, Grötzinger K, Lehmann J, Kuchta K. **Labdanum and Labdanes of Cistus creticus and C. ladanifer: anti-Borrelia activity and its phytochemical profiling.** Phytomedicine 60 (2019), article 152977, doi: 10.1016/j.phymed.2019.152977

Rockstroh A, Moges B, Berneck BS, Sattler T, Revilla-Fernández S, Schmoll F, Pacenti M, Sinigaglia A, Barzon L, Schmidt-Chanasit J, Nowotny N, Ulbert S. **Specific detection and differentiation of tick-borne encephalitis and West Nile virus induced IgG antibodies in humans and horses.** Transboundary and emerging diseases 66 (2019), 4, 8 pages, doi: 10.1111/tbed.13205

Ruppert C, Phogat N, Laufer S, Kohl M, Deigner HP. **A smartphone readout system for gold nanoparticle-based lateral flow assays: application to monitoring of digoxigenin.** Mikrochimica acta 186 (2019), 2, 9 pages, doi: 10.1007/s00604-018-3195-6

Sandetskaya N, Isserstedt-John N, Koelsch A, Schattschneider S, Kuhlmeier D. **An integrated homogeneous SPARCL™ immunoassay for rapid biomarker detection on a chip.** Analytical methods 11 (2019), 19, pages 2542-2550, doi: 10.1039/c9ay00198k

Sass S, Stöcklein WFM, Klevesath A, Hurpin J, Menger M, Hille C. **Binding affinity data of DNA aptamers for therapeutic anthracyclines from microscale thermophoresis and surface plasmon resonance spectroscopy.** Analyst. 144 (2019), 20, S. 6064-6073

Schüttler A, Altenburger R, Ammar M, Bader-Blukott M, Jakobs G, Knapp J, Krüger J, Reiche K, Wu GM, Busch W. **Map and model-moving from observation to prediction in toxicogenomics.** GigaScience 8 (2019), 6, 22 pages, doi: 10.1093/gigascience/giz057

Simsek C, Ichkhanian Y, Fayad L, Steele KE, Schweitzer MA, Lamond K, Vosoughi K, Doshi J, Shah T, Oberbach A, Al-Sabban A, Gandsas A, Kalloo AN, Khashab MA, Kumbhari V. **Secured lumen-apposing fully covered metallic stents for Stenoses in post-bariatric surgery patients.** Obesity Surgery 29 (2019), pages 2695-2699. doi: 10.1007/s11695-019-03906-4

Sinet-Mathiot V, Smith GM, Romandini M, Wilcke A, Peresani M, Hublin JJ, Welker F. **Combining ZooMS and zooarchaeology to study Late Pleistocene hominin behaviour at Fumane (Italy).** Scientific reports 9 (2019), 1, article 12350, 13 pages, doi: 10.1038/s41598-019-48706-z

Stahl L, Duenkel A, Hilger N, Tretbar US, Fricke S. **The epitope-specific anti-human CD4 antibody MAX.16H5 and its role in immune tolerance.** Frontiers in immunology 10 (2019), article 1035, 12 pages, doi: 10.3389/fimmu.2019.01035

Szendy M, Kalkhof S, Bittrich S, Kaiser F, Leberecht C, Labudde D, Noll M. **Structural change in GadD2 of Listeria monocytogenes field isolates supports nisin resistance.** International journal of food microbiology 305 (2019), article 108240, doi: 10.1016/j.ijfoodmicro.2019.108240

Thabet A, Schmäschke R, Fertey J, Bangoura B, Schönfelder J, Lendner M, Ulbert S, Daugschies A. **Eimeria tenella oocysts attenuated by low energy electron irradiation (LEEI) induce protection against challenge infection in chickens.** Veterinary parasitology 266 (2019), pages 18-26, doi: 10.1016/j.vetpar.2019.01.001

Ueberham E, Spiegel H, Havenith H, Rautenberger P, Lidzba N, Schillberg S, Lehmann J. **Simplified tracking of a soy allergen in processed food using a monoclonal antibody-based sandwich ELISA targeting the soybean 2S albumin gly m 8.** Journal of agricultural and food chemistry 67 (2019), 31, pages 8660-8667, doi: 10.1021/acs.jafc.9b02717

Ulbert S. **West Nile virus vaccines – current situation and future directions.** Human vaccines & immunotherapeutics 15 (2019), 10, pages 2337-2342, doi: 10.1080/21645515.2019.1621149

Valainis D, Dondl P, Foehr P, Burgkart R, Kalkhof S, Duda GN, van Griensven M, Poh PSP. **Integrated additive design and manufacturing approach for the bioengineering of bone scaffolds for favorable mechanical and biological properties.** Biomedical Materials 14 (2019), 6, Articel 065002, 14 pages. doi: 10.1088/1748-605X/ab38c6

Wagner M, Hänsel R, Reinke S, Richter J, Altenbuchinger M, Braumann UD, Spang R, Löffler M, Klapper W. **Automated macrophage counting in DLBCL tissue samples.** Biological procedures online 21 (2019), article 13, 18 pages, doi: 10.1186/s12575-019-0098-9

Walcher L, Müller C, Hilger N, Kretschmer A, Stahl L, Wigge S, Rengelshausen J, Müller AM, Fricke S. **Effect of combined sublethal X-ray irradiation ancyclosporine a treatment in NOD scid gamma (NSG) mice.** Experimental animals 68 (2019), 1, pages 1-11, doi: 10.1538/expanim.18-0056

Wichmann G, Gaede C, Melzer S, Bocsi J, Henger S, Engel C, Wirkner K, Wenning JR, Wald T, Freitag J, Willner M, Kolb M, Wiegand S, Löffler M, Dietz A, Tárnok A. **Discrimination of head and neck squamous cell carcinoma patients and healthy adults by 10-color flow cytometry: development of a score based on leukocyte subsets.** Cancers 11 (2019), 6, article 814, 18 pages, doi: 10.3390/cancers11060814

Wilmschen S, Schneider S, Peters F, Bayer L, Issmail L, Bánki Z, Grunwald T, von Laer D, Kimpel J. **RSV vaccine based on rhabdoviral vector protects after single.** Vaccines 7 (2019), 3, article 59, 17 pages, doi: 10.3390/vaccines7030059

Wittenbrink N, Herrmann S, Blazquez-Navarro A, Bauer Ch, Lindberg E, Reinke P, Sawitzki B, Thomusch O, Hugo Ch, Babel N, Seitz H, Or-Guil M. **A novel approach reveals that HLA class 1 single antigen bead-signatures provide a means of high-accuracy pre-transplant risk assessment of acute cellular rejection.** BMC Immunology 20 (2019), Articel 11, 10 pages. doi: 10.1186/s12865-019-0291-2

Yakoub-Agha I, Chabannon C, Bader P, Basak GW, Bonig H, Ciceri F, Corbacioglu S, Duarte RF, Einsele H, Hudecek M, Kersten MJ, Köhl U, Kuball J, Mielke S, Mohty M, Murray J, Nagler A, Robinson S, Saccardi R, Sanchez-Guijo F, Snowden JA, Srour M, Styczynski J, Urbano-Ispizua A, Hayden PJ, Kröger N. **Management of adults and children undergoing CAR t-cell therapy: best practice recommendations of the European Society for Blood and Marrow Transplantation (EBMT) and the Joint Accreditation Committee of ISCT and EBMT (JACIE).** Haematologica. 2019 Nov 21. pii: haematol.2019.229781. doi: 10.3324/haematol.2019.229781

Yerebakan C, Boltze J, Elmontaser H, Yoruker U, Latus H, Khalil M, Ostermayer S, Steinbrenner B, Apitz C, Schneider M, Suchowski M, Ruetten R, Mueller K, Kerst G, Schranz D, Akintuerk H. **Effects of pulmonary artery banding in doxorubicin-induced left ventricular cardiomyopathy.** The journal of thoracic and cardiovascular surgery 157 (2019), 6, pages 2416-2428, doi: 10.1016/j.jtcvs.2019.01.138

Yu-Taeger L, Stricker-Shaver J, Arnold K, Bambynek-Dziuk P, Novati A, Singer E, Lourhmati A, Fabian C, Magg J, Riess O, Schwab M, Stolzing A, Danielyan L, Nguyen HHP. **Intranasal administration of mesenchymal stem cells ameliorates the abnormal dopamine transmission system and inflammatory reaction in the R6/2 mouse model of huntington disease.** Cells 8 (2019), 6, 22 pages, doi: 10.3390/cells8060595

Zhong Z, Portela Catani JP, Mc Cafferty S, Couck L, Van Den Broeck W, Gorlé N, Vandenbroucke RE, Devriendt B, Ulbert S, Cnops L, Michels J, Ariën KK0, Sanders NN. **Immunogenicity and protection efficacy of a naked self-replicating mRNA-Based Zika Virus vaccine.** Vaccines 7 (2019), 3, Articel 93, 17 pages. doi: 10.3390/vaccines7030096

ABSTRACTS

Allelein S. **Isolation and characterization of prostate-derived extracellular vesicles as liquid biopsy strategy in cancer.** GSEV autumn meeting, November 28–29, 2019, Freising, Germany

Allelein S. **Isolation and characterization of extracellular vesicles.** BBZ-Methodenworkshop, December 5, 2019, Leipzig, Germany

Altattan B. **Synthesis and Characterization of functionalized nanostructures for the inhibition of Respiratory Syncytial Virus (RSV).** DNA Mitteldeutschland meeting, November 29, 2019, Fraunhofer IZI Leipzig, Germany

Arnold K, Fabian C, Danielyan L, Yu-Taeger L, Nguyen H, Stolzing A. **Intranasal Administration of Mesenchymal Stem Cells reduces Neuroinflammation.** 7th Annual GSCN Conference, September 23–25, 2019, Berlin, Germany

Baqué M, Hanke F, Böttger U, Leya T, Möller R, de Vera J-P. **Supporting future »search-for-life« missions: spectroscopy analysis of biosignatures after space and Mars-like environment exposure.** 12th Workshop FT-IR Spectroscopy in Microbiological and Medical Diagnostics, October 10–11, 2019, Berlin, Germany

Bayer L, Gümpel J, Hause G, Müller M, Grunwald T. **Genetic vaccination against RSV using Non-Human Papilloma Viruses.** 13th Vaccine Congress, September 15–18, 2019, Bangkok, Thailand

Blaudszun A-R, Stahl L, Hilger N, Fricke S. **An innovative therapeutic approach to prevent graft-versus-host disease with preserved graft-versus-leukemia effect by ex vivo incubation of hematopoietic stem cell grafts with anti-human CD4 antibodies.** BIOplus 2019, November 12–13, 2019, Seoul, South Korea

Blaudszun A-R, Stahl L, Hilger N, Fricke S. **An innovative therapeutic approach to prevent graft-versus-host disease with preserved graft-versus-leukemia effect by ex vivo incubation of hematopoietic stem cell grafts with anti-human CD4 antibodies.** JLCI Mini Symposium, November 14, 2019, Hwasun, South Korea

Blaudszun A-R, Zönnchen B, Hilger N, Stahl L, Tretbar US, Fricke S. **TDM-GvL: Transfer eines Diagnose- und Monitorsystems für die Erfassung der Graft-versus-Leukemia-(GvL)-Reaktion in die klinische Anwendung.** 2. Workshop zum Schwerpunkt S2 Ganzheitliche Wirkstoffsysteme, December 6, 2019, Leipzig, Germany

Cynis H, Barendrecht S, Geissler S, Demuth HU, Schilling S, Schreurs A, Balschun D. **Characterization of a novel humanized wild-type tau expressing mouse model in high-amyloid background of 5xFAD mice.** Alzheimer's Association International Conference (AAIC) 2019, July 14–18, 2019, Los Angeles, USA

Cynis H. **Viromer-mediated delivery of therapeutic mRNAs in vitro and in vivo.** GlycoNet – Biotech meets Medicine, September 18–20, 2019, Potsdam, Germany

Cynis H. **Charakterisierung von HERV-Hüllproteinen mit dem Ziel der Entwicklung therapeutischer Antikörper für HERV-assoziierte Autoimmun- und Tumorerkrankungen.** Medical Update, November 27, 2019, Halle (Saale), Germany

Cynis H. **Generation and characterization of a human tau knock-in mouse.** The Neuro4D Conference 2019, May 13–14, 2019, Mainz, Germany

Dluczek S, Tretbar US, Nimke C, Fricke S. **Twin-track strategy for the development of CD4-CARs against T cell malignancies.** DG-GT Theme Day »CAR-T cells and beyond«, September 16–17, 2019, Leipzig, Germany

Doß S, Haller K, Potschka H, Hofrichter J, Sauer M. **In vitro hepatotoxicity of drugs using for analgosedation in ICU patients.** Pharm-Tox Summit, February 25–28, 2019, Stuttgart, Germany

Dossin A, Illig T, Müller M, Lehmann J, Lidzba N, Rogell L, Volland S. **Strukturharmonisierung der Biomaterialbanken.** Tag der Immunforschung (Fraunhofer CIMD), June 19, 2019, Frankfurt am Main, Germany

Dreyer A, Jakubke N, Harzendorf I, Unger L, Leupold J, Boltze J. **Stroke model in sheep: behavioral testing and postoperative care.** 14. FELASA-Kongress, June 10–13, 2019, Prague, Czech Republic

Dreymann N, Wünsche J, Klevesath A, Czepluch D, Sabrowski W, Menger M. **Aptamer-based biomarker assay for cancer detection.** Aptamer 2019, April 3–4, 2019, Oxford, Great Britain

Dreymann N, Wünsche J, Klevesath A, Czepluch D, Sabrowski W, Menger M. **Aptamers in diagnostics: assay formats for the early detection of Bladder Cancer.** 2nd new and emerging technolgies – Biotech meets Medicine, September 18–20, 2019, Potsdam, Germany

Dreymann N. **Aptamer-based biomarker assay for cancer detection.** Aptamer 2019, April 3, 2019, Oxford, Great Britain

Ehrentreich-Förster E, Seitz H. **Technologies for the Analysis of human samples – Analytic & Services.** Tag der Immunforschung (Fraunhofer CIMD), June 19, 2019, Frankfurt am Main, Germany

Ehrentreich-Förster E, Seitz H. **(Bio)analytical methods and appliactions in medical context.** Tag der Immunforschung (Fraunhofer CIMD), June 19, 2019, Frankfurt am Main, Germany

Fabian C, Pietsch S, Thome UH, Laube M. **Development of a lung organoid model to study fetal lung maturation.** EMBO | EMBL Symposium: Synthetic Morphogenesis: From Gene Circuits to Tissue Architecture, March 17–20, 2019, Heidelberg, Germany

Fabian C. **Stem cells and 3D cell culture models.** Kompetenzplattform »Neue Therapien«, ImmuMed Cluster Meeting, October 8, 2019, Leipzig, Germany

Fabian C. **Preclinical validation – Fraunhofer IZI.** 66. Focus group meeting alternative animal models of ageing, Leibniz Research Alliance Healthy Ageing, July 19–20, 2019, Berlin, Germany

Fabian C. **Miniaturisierte Organmodule in der Biosystemtechnik.** 2. Workshop zum Schwerpunkt S2 Ganzheitliche Wirkstoffsysteme, December 6, 2019, Leipzig, Germany

Fabian C. **Miniaturisierte Organmodule in der Biosystemtechnik.** Workshop »Ganzheitliche Wirkstoffsysteme« Leistungs- und Transferzentrum Chemie und Biosystemtechnik, May 8, 2019, Leipzig, Germany

Fertey J. **Low energy electron irradiation efficiently inactivates pathogens in liquids and is a promising novel method for the generation of vaccines.** 7th European Congress of Virology, April 28 – May 1, 2019, Rotterdam, The Netherlands

Fricke S. **CAR-T- Zelltherapie: Optionen und Realität.** 3. Erfurter Symposium, Augustiner Kloster Erfurt, Stammzelltransplantation, April 10, 2019, Erfurt

Fricke S. **CAR-T- Zelltherapie: Optionen und Realität.** Laborfortbildung Diagnostik-Labor Chemnitz, May 14, 2019, Chemnitz, Germany

Fricke S. **Hohes Potenzial neuer immunonkologischer Therapien: CAR-T-Zelltherapie.** Hämatologisch-onkologisches Wintersymposium Schloss Ettersburg 2019, January 12, 2019, Ettersburg, Germany

Gerling T, Pfisterer F, Godino N, Gürnth-Marschner C, Duschl C, Kirschbaum M. **Microfluidic system for high precision cell processing at single-cell resolution.** DG-GT Theme Day »CAR-T cells and beyond«, September 16–17, 2019, Leipzig, Germany

Glaser M. **Systematic Altering of Semiflexible DNA-based Polymer Networks via Tunable Cross-linking.** DNA Mitteldeutschland, November 29, 2019, Leipzig, Germany

Graf A, Bauer T, Schönfelder J, Kuhlmeier D, Hild OR. **MEMS based device concept for future IMS instrumentation.** ISIMS conference, July 28 – August 1, 2019, Hannover, Germany

Grasse N. **Stimulation of EphA2 receptors via DNA-templated oligovalence in glioblastoma cells.** DNA Mitteldeutschland, November 29, 2019, Leipzig, Germany

Graunitz J, Kuhn S, Stiehl C, Schneemann M, Morschhauser A, Peter H, Bier FF, Nestler J. **DNA digestion using immobilized DNase Type I in a microfluidic catridge.** MicroTAS 2019, October 27–31, 2019, Basel, Schwitzerland

Händler T, Tutmarc C, Käs J, Smith D, Schnauß J. **Reptation dynamics in semiflexible polymer networks.** Physics of Cancer, September 25–27, 2019, Leipzig, Germany

Hesse C, Beneke V, Blaudszun A-R, Fricke S, Schubert A, De Bruin N, Parnham MJ, Sewald K, Braun A. **Restoring the immune tolerance through antibody-mediated microbiome correction.** Tag der Immunforschung (Fraunhofer CIMD), June 19, 2019, Frankfurt am Main, Germany

Hesse C, Beneke V, Parnham M, Fricke S, Lehmann J, Lochner M, Weigert A, Boldt A, Prasse A, Sewald K, Braun A. **Competence platform Th17-mediated diseases.** Tag der Immunforschung (Fraunhofer CIMD), June 19, 2019, Frankfurt am Main, Germany

Hettrich C, Ehrentreich-Förster E, Hettrich K. **Apparatefreie Atemgasanalyse mit funktionsintegrierten Oberflächen.** Tag der Immunforschung (Fraunhofer CIMD), June 19, 2019, Frankfurt am Main, Germany

Hettrich C, Kersting S, Ehrentreich-Förster E. **Schnelle Vor-Ort-Detektion auf Pathogene und Antibiotikaresistenzen für sichere Lebensmittel.** Lebensmittelsicherheit in Deutschland – was bleibt? Wie Lebensmittelverarbeitung die Inhaltsstoffe verändert. Deutsches Institut für Ernährungsforschung Potsdam-Rehbrücke, June 4, 2019, Potsdam, Germany

Heuer H, Szardenings M. **Die neue Vielfalt der Wirbelstromprüfung: Von der ET-Prüfung an Metallen bis zur Induktiv Elektrischen Impedanzspektroskopie an Nichtleitern.** 4. Stammtisch der biosaxony-Arbeitsgruppe Blut, September 30, 2019, Dresden, Germany

Hoffmann M, Penk J, Starke J, Leibner R, Jehmlich U, Horn K, Lehmann J. **Establishment of a flexible small-scale manufacturing facility for the GMP-production of therapeutic human monoclonal antibodies.** BioProcess International European Summit 2019 (KN365), April 2–4, 2019, Vienna, Austria

Hofrichter J, Redwanz C, Doss S, Mitzner S, Sauer M. **Protein-bound uremic toxins accumulate in the cerebric of rats with chronic renal failure and affect blood brain-barrier integrity in vitro.** Pharm-Tox Summit, February 25–28, 2019, Stuttgart, Germany

Hölzel R, Knigge X, Laux E-M, Noffke M, Stanke S, Bier FF. **Nanoelektroden-Arrays für die Oberflächenfunktionalisierung.** Workshop Analysieren, Kultivieren, Desinfizieren, September 11, 2019, Potsdam, Germany

Hölzel R, Knigge X, Laux E-M, Noffke M, Stanke S, Wenger C, Bier FF. **AC electrokinetic immobilisation of nanoparticles and proteins.** 2. European Biosensor Symposium 2019, February 18–21, 2019, Florence, Italy

Hölzel R, Knigge, X, Laux E-M, Noffke, M, Stanke S, Wenger C, Bier FF. **AC electrokinetic immobilisation of nanoparticles and proteins.** Single Molecule Sensors and Nanosystems, April 3–5, 2019, Munich, Germany

Issmail L, Möser C, Jäger C, Ramsbeck D, Kleinschmidt M, Buchholz M, Smith D, Grunwald T. **Evaluation of novel potent inhibitors of respiratory syncytial virus entry.** 15th Leipzig Research Festival for Life Sciences, January 18, 2019, Leipzig, Germany

Issmail L, Möser C, Jäger C, Ramsbeck D, Kleinschmidt M, Buchholz M, Smith D, Grunwald T. **Evaluation of novel potent inhibitors of respiratory syncytial virus entry.** 29th Annual Meeting of the Society for Virology, March 20–23, 2019, Düsseldorf, Germany

Jaimes Y, Kaniowska D, Wenk K, Lange F, Greiser S, Braumann UD. **Mesenchymal stromal cells derived-extracellular vesicles effect on microglia cells.** International society for extracellular vesicles, April 24–28, 2019, Kyoto, Japan

Jeraldo P, Liu Y, Schulze-Makuch D, de Vera J-P, Cockell C, Leya T, Baqué M, Walther-Antonio M. **Bioinformatics characterization of single-cell isolates from the BIOMEX experiment.** ASM Microbe 2019, June 20–24, 2019, San Francsico, USA

Jeraldo P, Schulze-Makuch D, de Vera J-P, Cockell C, Leya T, Baqué M, Walther-Antonio M. **Single cell whole genome amplification in optofluidic platform and sequencing assessment from the Biology and Mars Experiment (BIOMEX).** Astrobiology Science Conference (AbSciCon) 2019, June 24–28, 2019, Seattle, Washington, USA

Kaniowska D, Wenk K, Lange F, Greiser S, Braumann UD, Jaimes Y. **Extracellular vesicles from adipose-derived stem cells modulate microglia activation.** German stem cell network annual conference, September 23–25, 2019, Max Delbrück Center, Berlin, Germany

Kaniowska D, Wenk K, Lange F, Greiser S, Braumann UD, Jaimes Y. **Mesenchymal stromal cells derived-extracellular vesicles effect on microglia cells.** ISEV 2019 – Annual Meeting of The International Society for Extracellular Vesicles, April 24–28, 2019, Kyoto, Japan

Kern K, Delaroque N, Lidzba N, Lehmann J, Fischer M, Ehrentreich-Förster E, Treudler R, Worm M, Braun A, Szardenings M. **Cross Reactivities in Tree Nut Allergies.** Deutscher Allergiekongress, September 26–28, 2019, Hannover, Germany

Kersting S, Schmidt AEM, Rapsch K, Assmann J, Bethe A, Wieler LH, Fidelak C, Janßen T, Tadros M, Ehrentreich-Förster E, von Nickisch-Rosenegk M. **Use of antimicrobial peptides for the generation of biocidal surfaces in dairy processing.** Lebensmittelsicherheit in Deutschland – was bleibt? Wie Lebensmittelverarbeitung die Inhaltsstoffe verändert. Deutsches Institut für Ernährungsforschung, June 4, 2019, Potsdam-Rehbrücke, Germany

Kersting S. **Schnelle Identifizierung von Pathogenen und Resistenzen.** Lebensmittelsicherheit in Deutschland – was bleibt? Wie Lebensmittelverarbeitung die Inhaltsstoffe verändert. Deutsches Institut für Ernährungsforschung, Jne 4, 2019, Potsdam-Rehbrücke, Germany

Kirschbaum M. **High-precision single-cell processing in microfluidic channels.** Berlin Single-Cell Club, October 7, 2019, Berlin, Germany

Kleymann G, Hamprecht K, Uhlig N, Bravo F, Grunwald T, Bernstein D. **A new class of helicase-primase inhibitors as drug candiates for therapy of herpes simplex disease.** STI & HIV 2019 World Congress, July 14–17, 2019, Vancouver, Canada

Knigge X, Wenger C, Bier FF, Hölzel R. **Dielectrophoretic immobilization of single Biomolecules.** 2. European Biosensor Symposium 2019, February 18–21, 2019, Florence, Italy

Knigge X, Wenger C, Bier FF, Hölzel R. **Immobilization of Single Biomolecules on Nano-Electrode Arrays by Dielectrophoresis.** Single Molecule Sensors and Nanosystems, April 3–5, 2019, Munich, Germany

Knigge X, Wenger W, Bier FF, Hölzel R. **Parallel single molecule immobilization by dielectrophoresis.** 25th International Workshop on Single Molecule Spectroscopy and Super-resolution Microscopy in the Life Sciences, September 3–6, 2019, Berlin, Germany

Köhl U. **CAR expressing effector cells for cancer retargeting: From manual to automated manufacturing.** EBMT-Annual Meeting, March 24–27, 2019, Frankfurt am Main, Germany

Köhl U. **CAR expressing effector cells: From manual to automated manufacturing.** Novartis-CGT-Learning Academy, April 25, 2019, Stein, Schwitzerland

Köhl U. **CAR expressing effector cells: From manual to automated manufacturing.** Novartis-CGT-Learning Academy, December 12, 2019, Stein, Schwitzerland

Köhl U. **CAR expressing NK cells.** 6. Immuno Therapy of Cancer Conference, April 11–13, 2019, Vienna, Austria

Köhl U. **CAR expressing NK cells for cancer retargeting.** NK-2019-Meeting (18. Meeting of the Society of Natural Immunity), September 30 – October 3, 2019, Luxembourg, Luxembourg

Köhl U. **CAR expressing T and NK cells for cancer retargeting: From manual to automated manufacturing.** Gene therapy-Symposium, BMFZ, September 24, 2019, Düsseldorf, Germany

Köhl U. **CAR T-Zelltherapie: Herstellungsverfahren und klinischer Einsatz.** Symposium für Industrielle Zelltechnik: Zelltechnik – Heute, morgen, übermorgen, September 5–6, 2019, Lübeck, Germany

Köhl U. **Ein persönlicher Blick auf die Entwicklung der Zell-und Gentherapie in der Immunonkologie.** FIT-Mentorinnen-Programm, Mentoring Hessen, June 28, 2019, Frankfurt am Main, Germany

Köhl U. **From CAR expressing T cells to CAR NK cells for cancer retargeting.** RCI-International Symposium, July 16–18, 2019, Regensburg, Germany

Köhl U. **From CAR expressing T cells to CAR NK cells for cancer retargeting.** Symposium »Somatisches Genome Editing« der Stiftung WISSEN, February 1, 2019, Cologne, Germany

Köhl U. **From CAR T cells to CAR NK cells for improvement of cancer retargeting.** ATMP-Gentherapie-Tagung der DECHEMA, January 30, 2019, Frankfurt am Main, Germany

Köhl U. **From CAR T cells to CAR NK cells for improvement of cancer retargeting.** ESH International Conference on Immune and Cellular Therapies, September 20–22, 2019, Mandelieu, France

Köhl U. **GMP manufacturing of CAR T cells.** Symposium Translation of CAR-T cell technology into clinical reality, November 25, 2019, Langen, Germany

Köhl U. **Innovation in T cell therapies.** Preceptorship CD19 CAR-T cell treatment for DLBCL patients, November 18–19, 2019, Vienna, Austria

Köhl U. **Innovationen durch Kooperationen.** CDU-Landesgruppe Sachsen / Novartis, May 13, 2019, Berlin, Germany

Köhl U. **Immunologische Grundlagen: Zelluläres Immunsystem und Mechanismen.** Medical Insight Training, MSD, October 29, 2019, Haar, Germany

Köhl U. **Immunonkologie und Gentherapie.** Tagung der CCC-Initiative Mitteldeutschland, October 23, 2019, Jena, Germany

Köhl U. **Manufacturing and application of CAR T-cells to treat cancer: chances and safety matters for patients.** Meeting der europäischen Beratungskommissionen für die Biologische Sicherheit (MEACB), November 6, 2019, Berlin, Germany

Köhl U. **Manufacturing of CAR T cells for clinical trials with a special view on manufacturing challenge.** ESH International Conference on Immune and Cellular Therapies, September 20–22, 2019, Mandelieu, France

Köhl U. **NK CAR-Zellen.** DAG-KBT-Jahrestagung, June 7, 2019, Berlin, Germany

Köhl U. **Possibilities and limitations of cellular therapies in immune oncology.** DGHO-Jahrestagung, October 12–14, 2019, Berlin, Germany

Köhl U. **Presence and future of cellular therapy in hematology.** 10. MDS-Colloquium, November 9, 2019, Leipzig, Germany

Köhl U. **Proof-of-Concept-Plattform – Mit der Sleeping Beauty gegen Krebs.** Fraunhofer-Symposium »Netzwert«, February 26–27, 2019, Munich, Germany

Köhl U. **Überblick über die Entwicklungen, Funktionsweisen und Herstellung im Bereich Zell- und Gentherapien.** Novartis-Tagung, October 8, 2019, Berlin, Germany

Köhl U. **Von CAR T-Zellen zu CAR NK-Zellen in der Krebstherapie.** Jahrestagung Dt. Pharmazeutische Gesellschaft, January 12, 2019, Dresden, Germany

Köhl U. **Von der manuellen zur automatisierten Herstellung von ATMPs.** Fokustag »Automatisierte, qualitätsgesicherte Arzneimittelherstellung«, November 12, 2019, Dresden, Germany

Köhl U. **Zellbasierte Krebstherapien – Wohin geht die Reise?** Tagung der Stiftung für Krebskranke Kinder, November 22, 2019, Frankfurt am Main, Germany

Kohlschmidt J, Kalkhof S, Lehmann J. **Development of a novel therapy concept for chronic inflammatory bowel disease (IBD) via non-toxic ligands of the aryl hydrocarbon receptor.** Tag der Immunforschung (Fraunhofer CIMD), June 19, 2019, Frankfurt am Main, Germany

Köppen J. **Targeting Amyloidosis.** GlycoNet – Biotech meets Medicine, September 18–20, 2019, Potsdam, Germany

Körner S, Makert G, Mertens-Scholz K, Henning K, Pfeffer M, Nijhof A, Ulbert S. **Evaluation of the vector competence of ticks for Coxiella burnetii using an artificial feeding system.** Zoonoses 2019 – International Symposium on Zoonoses Research, October 16–18, 2019, Berlin, Germany

Kossatz-Böhlert U. **Immune Tolerance Unit.** Glycotope GmbH, December 16, 2019

Kossatz-Böhlert U. **CAR T-Zelltherapie – Update 2019.** Weiterbildung für Onkolotsen, Sächsische Krebsgesellschaft, November 8, 2019, Zwickau, Germany

Kreuz M, Otto D, Füssel S, Blumert C, Bertram C, Puppel SH, Löffler D, Buschmann T, Christ S, Friedrich M, Specht M, Toma MI, Fröhner M, Baretton GB, Löffler M, Hackermüller J, Reiche K, Wirth M, Horn F. **Prognostic biomarkers for prostate cancer.** 15th Research Festival for Life Sciences, January 18, 2019, Leipzig, Germany

Kruse M, Stanke S, Warmt C, Müller-Landau H, Hölzel R, Rant U, Bier FF. **Measuring multivalent interaction of Influenza A and peptides using electrinically switchable DNA nanolevers.** 5. International Symposium Multivalency in Chemistry and Biology 2019, September 30 – October 2, 2019, Berlin, Germany

Kruse M, Stanke S, Warmt C, Müller-Landau H, Hölzel R, Rant U, Bier FF. **Measuring multivalent interactions between influenza A and peptides using electronically switchable DNA nanolevers.** 2. European Biosensor Symposium 2019, February 18–21, 2019, Florence, Italy

Kruse M. **Applying SwitchSense technology to virus detection.** User Meeting Dynamic Biosensors, June 2019, Munich, Germany

Kubick S. **Cell-free Synthesis and functional Characterization of Membrane Proteins.** Seminar AG Bader, Max-Delbrück-Centrum (MDC), May 13, 2019, Berlin, Germany

Kubick S. **Das Fraunhofer-Institut für Zelltherapie und Immunologie, Institutsteil Bioanalytik und Bioprozesse – Fraunhofer IZI-BB.** Gesundheitscampus, Medizinische Hochschule Brandenburg (MHB), July 1, 2019, Brandenburg, Germany

Kubick S. **Synthesis of »difficult-to-express proteins« in Cell-free Systems.** Seminarreihe »Advanced Biochemistry«, Freie Universität Berlin, July 5, 2019, Berlin, Germany

Kubick S. **Cell-free and Cell-based Bioproduction.** Department of Biotechnology, University of natural Resources and Life Sciences (BOKU), July 15, 2019, Vienna, Austria

Kubick S. **Cell-free Synthesis and Functional Analysis of Membrane Proteins, Glycoproteins and Cytotoxic Proteins.** Robert Koch-Institut, August 8, 2019, Berlin, Germany

Kubick S. **A Cell-free platform for rapid synthesis, purification and functional analysis of membrane proteins.** Lehrstuhl für Molekulare Biochemie, Universität Leipzig, April 26, 2019 Leipzig, Germany

Kubick S. **New and Emerging Technologies.** Tagung »New and Emerging Technologies 2019«, September 18, 2019, Potsdam-Golm, Germany

Laube M, Pietsch S, Thome UH, Fabian C. **Development of a lung organoid model to study fetal lung maturation.** 45. Jahrestagung der Gesellschaft für Neonatologie und Pädiatrische Intensivmedizin e. V. (GNPI), May 23–25, 2019, Leipzig, Germany

Laube M, Pietsch S, Thome UH, Fabian C. **Development of a Lung Organoid Model to Study Fetal Lung Maturation.** ERS Research Seminar: Early origins of lung disease: an interdisciplinary approach, November 11–12, 2019, Lisbon, Portugal

Lehmann S. **STEN Studie: Gewichtsreduktion durch Sport.** Bariatrietage, November 15, 2019, Leipzig, Germany

Leichsenring A, Greiser S, Grunwald T, Lange F. **Refinement of a model of chronic kidney disease (CKD) in WISTAR rats.** 14th FELASA Congress, June 10–13, 2019, Prague, Czech Republic, Laboratory Animals 53 (2019), 1S, pages. 28-203. doi: 10.1177/0023677219839199

Leya T, Baqué M, Rabbow E, de Vera J-P P. **Cryophilic algae survive in space.** BIOMEX Closing Ceremony Meeting in DLR, March 27–29, 2019, Berlin, Germany

Leya T. **Cryophilic algae and their potential for a biobased economy.** Bionnale 2019, May 7, 2019, Berlin, Germany

Leya T. **Kälteangepasste Schneealgen und ihr Potenzial in einer biobasierten Wirtschaft.** Sciencet2Go, December 16, 2019, Postdam, Germany

Lidzba N, Malessa L, Rautenberger P, Lehmann J, Ueberham E. **All in one sweep – a Legume Allergen Detection Assay (LADA).** RAFA 2019, November 5–8, 2019, Prague, Czech Republic, Book of abstracts, page 231

Lindner N, Bailer S, Bohle K, Dandekar G, Werno C, Lange F, Grunwald T. **Lung tumor model for preclinical testing of HSV-1 based oncolytic viruses in humanized mice.** 7th European Congress of Virology, April 28 – May 1, 2019, Rotterdam, The Netherlands

Lindner N, Krause J, Kleymann G, Grunwald T. **Efficacy of novel helicase-primase based therapy for human Herpes simplex virus (HSV) in an infection mouse model.** 29th Annual Meeting of the Society for Virology, March 20–23, 2019, Düsseldorf, Germany

Liu Y, Jeraldo P, Schulze-Makuch D, de Vera J-P, Cockell C, Leya T, Baqué M, Walther-Antonio M. **Single cell whole genome amplification in optofluidic platform and sequencing assessment from the BIOMEX experiment.** BIOMEX Closing Ceremony Meeting, March 27–29, 2019, Berlin, Germany

Liu Y, Jeraldo P, Schulze-Makuch D, de Vera J-P, Cockell C, Leya T, Baqué M, Walther-Antonio M. **Single cell whole genome amplification in optofluidic platform and sequencing assessment from the Biology and Mars Experiment (BIOMEX).** Astrobiology Science Conference (AbSciCon) 2019, June 24–28, 2019, Seattle, Washington, USA

Makert G, Körner S, Henning K, Mertens-Scholz K, Ulbert S. **Development of an in vitro feeding system for ticks as tool to explore the potential transmission routes of Q fever.** 13th International Symposium on Ticks and Tick-borne Diseases, March 28–30, 2019, Weimar, Germany

Makert G, Ulbert S. **Impfstoffentwicklung gegen die Rote Vogelmilbe (Dermanyssus gallinae).** DLG Geflügeltagung, February 25–26, 2019, Celle, Germany

Makert GR, Körner S, Mertens-Scholz K, Henning K, Nijhof A, Pfeffer M, Ulbert S. **Development of an in vitro feeding tool for examination of possible Q fever transmission routes in ticks.** Tagung der Deutschen Veterinärmedizinischen Gesellschaft (DVG), Fachgruppe Parasitologie und parasitäre Krankheiten, June 17–19, 2019, Leipzig, Germany

Matiebe A, Makert G, Ulbert S. **Development of methods for the in vitro characterization of the NK92 cell line after electron beam-based inactivation.** DG-GT Theme Day »CAR-T cells and beyond«, September 16–17, 2019, Leipzig, Germany

Menger M. **Universal aptamer against superantigens.** Aptamer 2019, April 3, 2019, Oxford, Great Britain

Menger M. **Specific molecular recognition by aptamers.** Seminar, April 16, 2019, Optricon Berlin, Germany

Menger M. **Aptamers as specific recognotion elements.** Innovate UK – Know-ledge Transfer Network, May 20, 2019, Potsdam, Germany

Menger M. **Selection and separation steps in the SELEX workflow.** Aptamer Workshop 2019, Universität Bonn, September 3, 2019, Bonn, Germany

Menger M. **Sequence analysis & Interaction analysis.** Aptamer Workshop 2019, Universität Bonn, September 5, 2019, Bonn, Germany

Menger M. **Mehrfach-Aktivierung von Aptameren auf diversen Oberflächen.** Workshop Oberflächen und Polymere in den Life Sciences, September 11, 2019, Potsdam, Germany

Menger M. **Specific Molecular Recognition by Aptamers.** Seminar INVICOL, October 2, 2019, Berlin, Germany

Menger M. **RNA- und DNA-Aptamere als spezifische Erkennungselemente in der Tiermedizin.** Tierbiochemische Seminar, FU Berlin, November 15, 2019, Berlin, Germany

Menger M. **Aptamere als Wirkstoff oder Carrier.** Workshop Gezielter Wirkstoff-transport, Berlin Partner, December 10, 2019, Berlin, Germany

Mollenkopf P, Lorenz J, Glaser M, Käs JA, Smith D, Schnauß J. **Friction in isotropic polymer networks.** Soft Matter Day, Peter Debye Institute for Soft Matter Physics, July 5, 2019, Leipzig, Germany

Mollenkopf P, Lorenz J, Glaser M, Käs JA, Smith D, Schnauß J. **Friction in isotropic polymer networks.** 10th Physics of cancer symposium, Center for Biotechnology and Biomedicine, August 25–27, 2019, Leipzig, Germany

Möser C. **Imaging of Sugar-functionalized DNA Origami structures using FM/3D-AFM.** 8th Bio-AFM summer school, Nano Life Science Institute, Kanazawa University, August 24, 2019, Kanazawa, Japan

Müller C, Rositzka L, Hanash S, Lehmann J. **In-vitro validation of Glypican-1 as a novel potential target for antibody- or CAR-based therapies of triple-negative breast cancer (TNBC).** Immuno-Oncology Summit, August 4–9, 2019, Boston, USA

Müller C, Rositzka L, Lehmann J. **In-vitro analysis of a novel therapeutic biomarker for an antibody-based therapy against triple-negative breast cancer.** 15th International Symposium »Tumor Immunology meets Oncology XIV«, Martin-Luther-Universität Halle-Wittenberg, April 25–27, 2019, Halle (Saale), Germany

Nestler J, Stiehl C, Graunitz J, Geidel S, Morschhauser A, Otto T, Schneemann M, Jnana A, Murali TS, Satyamoorthy K, Maheswari SU, Ramakrishnan S, Halder P, Dendukuru D, Bier FF, Peter H. **Self-Contained Diagnostic Platform for Pathogen and Antibiotic Resistance Detection for Diabetic Foot Ulcers.** MicroTAS 2019, October 27–31, 2019, Basel, Schwitzerland

Noffke M, Knigge X, Wenger C, Bier FF, Hölzel R. **Production and characterization of enzyme nanoarrays assisted by alternating electric fields.** 2. European Biosensor Symposium 2019, February 18–21, 2019, Florence, Italy

Noffke M, Knigge X, Wenger C, Bier FF, Hölzel R. **Deterministic singling of enzyme molecules on nanoelectrode arrays.** 25th International Workshop on Single Molecule Spectroscopy and Super-resolution Microscopy in the Life Sciences, September 3–6, 2019, Berlin, Germany

Noffke M, Knigge X, Wenger C, Bier FF, Hölzel R. **Production of single enzyme nanoarrays assisted by alternating electric fields.** Single Molecule Sensors and Nanosystems, April 3–5, 2019, Munich, Germany

Obendorf J, Fabian C, Thome UH, Laube M. **Kinase signaling mediates mesenchymal stem cell conditioned medium-induced Na+ channel activity in fetal lung cells.** 45. Jahrestagung der Gesellschaft für Neonatologie und Pädiatrische Intensivmedizin e. V. (GNPI), May 23–25, 2019, Leipzig, Germany

Pfisterer F, Gerling T, Godino N, Guernth-Marschner C, Duschl C, Kirschbaum M. **High-precision single-cell processing in a microfluidic flow-through format.** 1st advanced therapies science meeting, November 25–26, 2019, Berlin, Germany

Rade M, Sewald K, Reiche K. **A time-resolved meta-analysis of consensus gene expression profiles during human naive t-cell activation.** DG-GT Theme Day »CAR-T cells and beyond«, September 16–17, 2019, Leipzig, Germany

Ramirez-Caballero L, Delaroque N, Szardenings M, Kern K, Wehrmann D, Puder M. **Mapping the antibody specificity in birch-related soy allergic patients before and after allergen immuno-therapy.** 18th Immunology Winter School on Basic Immunology Research in Allergy and Clinical Immunology, EAACI, January 23–26, 2019, Chamonix, France

Ramirez-Caballero L, Delaroque N, Szardenings M. **Antibody response after hepatitis B vaccine boost mapped with peptide-phage display.** BIONATURE, International Conference on Bioenvironment, Biodiversity and Renewable Energies, February 22–24, 2019, Ibarra, Ecuador

Rautenberger P, Lehmann J, Ueberham E. **Development of a test system based on monoclonal antibodies for the detection of allergenic lupin proteins in processed food products.** EFFoST 2019, November 12–14, 2019, Rotterdam, The Netherlands

Rautenberger P. **Development of immunoassays for the detection of lupin allergens in food.** Research Festival 2019, January 18, 2019, Leipzig, Germany

Rautenberger P, Lidzba N, Lehmann J, Ueberham E. **Detecting lupin major allergen conglutin β from various lupin species using newly established monoclonal antibodies.** RAFA 2019, November 5–8, 2019, Prague, Czech Republic, Book of abstracts, page 236

Reiche K, Kreuz M, Otto D, Füssel S, Blumert C, Bertram C, Puppel SH, Löffler D, Buschmann T, Christ S, Friedrich M, Specht M, Toma MI, Fröhner M, Baretton GB, Brigant A, Montorsi F, Löffler M, Hackermüller J, Wirth M, Horn F. **Prognostic biomarkers for prostate cancer.** e:Med Summer School: CLONE – Clinical Trials in Oncology in the New Era of Omics, Big Data, and Modeling, June 24–28, 2019, Halle (Saale), Germany

Rockstroh A, Berneck B, Moges B, Drexler F, Barzon L, Schmidt-Chanasit J, Ulbert S. **Specific serology in areas of flavivirus co-circulation.** 7th European Congress of Virology, April 28 – May 1, 2019, Rotterdam, The Netherlands

Rosencrantz S, Menger M. **AptaGlyc – Aptamere zur Detektion von Glykosylierungsveränderungen.** Seminar Fraunhofer-Forschungscluster CMID, October 28, 2019, Frankfurt am Main, Germany

Roy U, Fournelle M, Greiser S, van Gorkum R, Speicher D, Grunwald T, Kozerke S, Tretbar St, Landgraf L, Melzer A. **Towards magnetic resonance image-guided focused ultrasound in vivo in 7 Tesla preclinical MRI.** The international Society for Medical Innovation and Technology, October 10–11, 2019, Heilbronn, Germany

Roy U, van Gorkum R, Fournelle M, Greiser S, Speicher D, Grunwald T, Kozerke S, Tretbar St, Landgraf L, Melzer A. **Preclinical MRI-Guided focused ultrasound hyperthermia in 7 t MRI.** Joint meeting of the International Society for Therapeutic Ultrasound (ISTU) and the European Focused Ultrasound Charitable Society (EUFUS), June 13–15, 2019, Barcelona, Spain

Sabrowski W, Klevesath A, Czepluch D, Dreymann N, Menger M. **Generation of DNA aptamers against small molecules using Capture-SELEX.** Aptamer 2019, April 3–4, 2019, Oxford, Great Britain

Sabrowski W, Klevesath A, Czepluch D, Dreymann N, Menger M. **Characterization of enriched DNA pools targeting small molecules.** 2nd new and emerging technologie – Biotech meets Medicine, September 18–20, 2019, Potsdam, Germany

Sabrowski W. **Generation of DNA aptamers against small molecules using Capture-SELEX.** Aptamer 2019, April 3, 2019, Oxford, Great Britain

Safraou Y, Benkmann A, Körtge A. **OrganFit – Extracoporeal transplant organ perfusion.** International Symposium on Albumin Dialysis, September 6–8, 2019, Rostock, Germany

Sass S, Stöcklein WFM, Klevesath A, Hurpin J, Hille C, Menger M. **Two-state binding model of DNA aptamers for therapeutic anthracyclines.** Aptamers in Bordeaux 2019, June 28–29, 2019, Bordeaux, France

Schilling S. **IsoAspartate-Aβ specific antibody attenuates Alzheimer's Disease-like pathology in transgenic mice.** The Neuro4D Conference 2019, May 13–14, 2019, Mainz, Germany

Schimmelpfennig C, Kreuz M, Füssel S, Wirth M, Horn F, Reiche K. **Gene fusions as prognostic markers for prostate cancer.** ISMB, July 21–25, 2019, Basel, Schwitzerland

Schlenzig D. **Structural Analysis of Glycosylated Meprin Endoproteases.** GlycoNet – Biotech meets Medicine, September 18–20, 2019, Potsdam, Germany

Schlichting N. **Sport-Intervention nach Bariatrischer Chirurgie – Effekte auf die Gerinnung.** Bariatrietage, November 15, 2019, Leipzig, Germany

Schlichting N. **Was macht uns am Darmmikrobiom krank? – Eine unendliche Geschichte.** Bariatrietage, November 15, 2019, Leipzig, Germany

Schmidt M, Rohde F, Braumann UD. **Correlia: An ImageJ-based Tool for the Co-registration of Multimodal Correlative Microscopy Data.** MC 2019 – Microscopy Conference 2019, Technische Universität Berlin, September 1–5, 2019, Berlin, Germany

Schnauß J, Golde T, Glaser M, Händler T, Tutmarc C, Elbalasy I, Käs JA, Herrmann H, Smith DM. **Glassy Dynamics in Composite Biopolymer Networks.** APS March Meeting, March 4–8, 2019, Boston, USA

Schnauß J. **Actin – a universal Tool.** Vorlesung Reihe Cell Machines II, November 12, 2019, Dresden, Germany

Schönfelder J, Graf A, Bauer T, Hild OR, Kuhlmeier D. **MEMS based device concept for future IMS instrumentation in breath research.** Breath Summit 2019, September 8–11, 2019, Leicestershire, Great Britain

Schreurs, A, Sabanov V, Barendrecht S, Schilling S, Demuth HU, Cynis H, Balschun D. **Early Hippocampal synaptic Deficits in a Novel Mouse Model with humanized wild-type Tau Expression.** The 14th International Conference on Alzheimer's & Parkinson's Diseases, March 26–31, 2019, Lisbon, Portugal

Seier F. **Binding E. coli to Mannose polymers coupled With DNA nanostructures.** DNA Mitteldeutschland, November 29, 2019, Leipzig, Germany

Smith DM. **Using DNA-based nanotemplating to enhance biological function of peptides.** 14th Annual Peptide Symposium, March 18–21, 2019, Cologne, Germany

Smith DM. **Using nucleotide-based nanotemplating to enhance binding and signaling of bioactive peptides.** UCCL Kooperationstreffen, June 27, 2019, Leipzig, Germany

Smith DM. **Using nucleotide-based nanotemplating to enhance binding and signaling of bioactive peptides.** Institut für Klinische Immunologie, August 21, 2019, Leipzig, Germany

Smith DM. **DNA Nanostructures: Programmable scaffolds for new therapies and diagnostics.** Bio-Plus Korea, November 12–13, 2019, Seoul, South Korea

Smith DM. **DNA Nanostructures: Programmable scaffolds for new therapies and diagnostics.** JLCI Joint Symposium, November 14, 2019, Gwangju, South Korea

Steppert I, Bangen LM, Schönfelder J, Kuhlmeier D. **Development of an IMS-Based method for passenger control at airports: a proof-of-concept study.** Breath Summit 2019, September 8–11, 2019, Leicestershire, Great Britain

Szardenings M, Kern K, Havenith H, Delaroque N, Rautenberger P, Lehmann J, Fischer M, Spiegel H, Schillberg S, Ehrentreich-Foerster E, Aurich S, Treudler R. **The Immunome of Soybean Allergy Comprehensive Identification and Characterization of Epitopes.** PepTalk, January 14–18, 2019, San Diego, USA

Szardenings M, Ramirez-Caballero L, Delaroque N, Fischer M, Puder M, Wehrmann D. **High precision antibody epitopes from peptide phage display without repeated enrichment rounds.** Antibody Engineering & Therapeutics Europe, June 11–13, 2019, Amsterdam, The Netherlands

Szardenings M. **Peptide based diagnostics for infectious disease.** Vortrag, Humboldt Symposium, February 22–24, 2019, Ibarra, Ecuador

Szardenings M. **Mapping epitopes from allergy patient sera.** Freisinger Tage: Pflanzliche Lebensmittelproteine, May 15–16, 2019, Freising, Germany

Szardenings M. **Tomorrow's diagnostics: Epitope resolved immune diagnostics.** BIOPLUS, November 12–13, 2019, Seoul, South Korea

Szardenings M. **Tomorrow's diagnostics: Epitope resolved immune diagnostics.** CNUHH, November 14, 2019, Hawsun, South Korea

Szardenings M. **Immundiagnostik auf Epitopbasis: Beispiel Allergie.** 4. Stammtisch der biosaxony-Arbeitsgruppe Blut, September 30, 2019, Dresden, Germany

Szardenings M. **Peptide based diagnostics for infectious disease.** Öff. Vortrag, Asan Hospital, March 12, 2019, Seoul, South Korea

Szardenings M. **Statistical peptide phage display.** Kompetenzplattform »Neue Therapien«, Fraunhofer CIMD, April 25, 2019, Frankfurt am Main, Germany

Szardenings M. **Stand Miniprojekt PsA_PsO Serenevaluierung.** Kompetenzplattform »Neue Therapien«, ImmuMed Cluster Meeting, October 8, 2019, Leipzig, Germany

Tárnok A, Zeynalova S, Melzer S, Gross M, Löffler M, Buschsch K. **Monocyte subset distribution as risk predictor for coronary heart disease (CHD).** SPIE Photonics West 2019, February 2–7, 2019, San Francisco, USA

Tárnok A. **Publishing in high impact journals: advice and tips from Cytometry A.** Invited Lecture: Advances in High-Content Single Cell Analysis, Sino-US Workshop, July 6–11, 2019, Shanghai, China

Tradler T. **Business Development and BD Contractual Law.** KIC Europe Workshop am Fraunhofer IZI, August 27, 2019, Leipzig, Germany

Tradler T. **Business Development and BD Contractual Law.** Workshop Universität Lublin, June 21, 2019, Lublin, Poland

Tradler T. **Fraunhofer IZI – Regenerative Medicine Strategies & Projects.** JSRM Annual Meeting 2019, March 21, 2019, Kobe, Japan

Tradler T. **Showcase 4: Fraunhofer IZI.** 3rd KDDF Global TechFair, February 20, 2019, Seoul, South Korea

Tretbar US, Zönnchen B, Hilger N, Stahl L, Blaudszun A-R, Fricke S. **TDM-GvL: Transfer eines Diagnose- und Monitorsystems für die Erfassung der Graft-versus-Leukemia-(GvL)-Reaktion in die klinische Anwendung.** 1. Workshop zum Schwerpunkt S2, Ganzheitliche Wirkstoffsysteme, May 10, 2019, Germany

Tretbar US. **Maßgeschneiderte mizellare Nano-Carrier als Transfektionssystem für mRNA zur Adressierung von Immunzellen.** Fraunhofer Cluster of Excellence Immune-Mediated Diseases CIMD, October 28, 2019, Frankfurt am Main, Germany

Uhlig K. **Zellablösung mittels Temperatur für anspruchsvolle Zellkultivierung.** Analysieren, Kultivieren, Desinfizieren – Ein Anwenderblick auf neue Polymere und Oberflächen in der Biotechnologie, September 11, 2019, Potsdam, Germany

Valdez-Ferraz C. **DR5 stimulation with DNA-templated multivalent arrangements of TRAIL-mimicking peptides.** DNA Mitteldeutschland, November 29, 2019, Leipzig, Germany

Valdez-Ferraz C. **DR5 stimulation with DNA-templated multivalent arrangements of TRAIL-mimicking peptides.** Physik der Weichen Materie Gruppenvorstellungsreihe, December 16, 2019, Leipzig, Germany

Volland S, Lidzba N, Rogell L, Lehmann J, Köhm M, Klopp N, Illig T, Hohlfeld J, Müller M. **Structural Harmonization of the Biobanks of Fraunhofer IME-TMP, IZI, ITEM.** Biobanking-Symposium, December 4–5, 2019, Berlin, Germany

Walcher L, Kistenmacher A-K, Klöß S, Ulbert S, Köhl U, Fricke S. **Electron Beam Irradiation-based Inactivation of Chimeric Antigen Receptor (CAR) NK-92 Cells for Therapy of Acute Myeloid Leukemia (AML).** DG-GT Theme Day »CAR-T cells and beyond«, September 16–17, 2019, Leipzig, Germany

Warmt C, Erazo Lugo MK, Ritter J, Hintze L, Kurt B, Fenzel CK, Henkel J, Bier FF. **Novel RT-PCR based assay for the fast detection of circular RNAs (circRNA).** 2nd European Biosensor Symposium 2019, February 18–21, 2019, Florence, Italy

Warmt C. **RT-PCR based assay for the fast detection of circular RNAs.** 2nd European Biosensor Symposium 2019, February 18–21, 2019, Florence, Italy

Wussow S, Jäger C, Naumann M, Buchholz M. **The Trajectophore – A new method for a dynamic Structure-Based Pharmacophore Search.** GCC 2019 – 15th German Conference on Cheminformatics, November 3–5, 2019, Mainz, Germany

Wüstenhagen DA, Dondapati SK, Ramm F, Stech M, Zemella A, Kubick S. **Evaluation of protein synthesis of »difficult-to-express« proteins in cell-free systems.** New & Emerging Technologies, September 18–20, 2019, Potsdam-Golm, Germany

BOOK ARTICLES

Adamatzky A, Tuszynski J, Pieper J, Nicolau DV, Rinaldi R, Sirakoulis G, Erokhin V, Schnauß J, Smith DM. **Towards Cytoskeleton Computers. A proposal.** Adamatzky A (Hrsg.): From parallel to emergent computing. Boca Raton, Florida : CRC Press 2019, pages 575-596. doi: 10.1201/9781315167084

Gallin P, Wolf M, Rudolph M, Braumann UD. **Optische Fahrzeugnummernidentifikation auf Basis einer Mustererkennung – Konzeptentwicklung und rechentechnische Implementierung.** Riedel R, Bullinger-Hoffmann AC: Die hybride Fabrik – menschliche und künstliche Intelligenz im Einklang: VPP2019 – Vernetzt Planen und Produzieren, Tagungsband, Chemnitz, 06. und 07. November 2019. Chemnitz : Technische Universität Chemnitz, 2019, 1 CD-ROM. Wissenschaftliche Schriftenreihe des Instituts für Betriebswissenschaften und Fabriksysteme, Sonderheft 25, pages 187-196

Neumann M, Henkel J, Bier FF, Gajovic-Eichelmann N. **Entwicklung von Cardiac Marker Schnelltests für verschiedene Immunoassay Plattformen.** Fritz M: Digitale und analoge Begleiter für eine alternde Bevölkerung, Wissenschaftliche Beiträge zum digilog-Kongress 2019. Neuruppin : ccc.Centrer for Connected Health Care UG, pages 110-113 (ISBN 978-3-00-062150-5)

Peter H et al. **Lab-on-a-chip device for rapid measurement of Vitamin D levels.** Guest P (eds): Investigations of Early Nutrition Effects on Long-Term Health. New York, NY : Humana Press, 2019, pages: 477-486. Methods in Molecular Biology, 1735. (ISBN 978-1-4939-7613-3). doi: 10.1007/978-1-4939-7614-0_35

Sandetskaya N. **Advances in the detection of pathogen in sepsis diagnostics.** Endotoxin detection and control in pharma, limulus, and mammalian systems (2019), pages 787-806. doi: 10.1007/978-3-030-17148-3_21

Zemella A, Richter T, Thoring L, Kubick S. **A Combined Cell-Free Protein Synthesis and Fluorescence-Based Approach to Investigate GPCR Binding Properties.** Methods Mol Biol. 2019;1947:57-77. doi: 10.1007/978-1-4939-9121-1_4

BOOK

Seitz H, Stahl F, Walter JG. **Catalytically active nucleic acids.** Cham, Springer [2020], VII, 123 pages. ISBN 978-3-030-29646-9. Advances in biochemical engineering, biotechnology 170. doi: 10.1007%2F978-3-030-29646-9

OTHER PUBLICATIONS

Czechowska K, Tárnok A. **New on the block: the workshop reports (Editorial).** Cytometry Part A 95 (2019), 6, pages 595-597, doi: 10.1002/cyto.a.23800

Del Zotto G, Preijers F, Tárnok A. **Phenotype Reports (Editorial).** Cytometry Part A 95 (2019), 6, pages 645-646, doi: 10.1002/cyto.a.23796

Gavasso S, Bringeland GH, Tárnok A. **Receptor occupation in the fjords (Editorial).** Cytometry Part A 95 (2019), 10, pages 1044-1045, doi: 10.1002/cyto.a.23856

Goldau R. **Rückgewinnung von Dialysewasser – Neuer Ansatz.** Der Nierenarzt 6 (2019), pages 24–30.

Humpe A, Koehl U. **Cellular therapeutics – living drugs: a rising star at the horizon of immunotherapy in hematology and oncology (Editorial).** Transfusion medicine and hemotherapy 46 (2019), 1, page 2. doi: 10.1159/000497051

Ibrahim B, Stange J, Dominik A, Sauer M, Doß S, Eggert M. **Albumin promotes proliferation of G1 arrested serum starved hepatocellular carcinoma cells.** PeerJ Preprints, May 13, 2019, doi 10.7287/peerj.preprints.27728v1

Leya T. **Die blutrote Schneealge ist Alge des Jahres 2019.** Radiobeitrag in: RBB Kulturradio am Vormittag. Pirich, C., (ed.). Kulturradio, Rundfunk Berlin Brandenburg, Berlin, Germany

Leya T. **Die Alge des Jahres 2019 und andere kälteliebende Schneealgen und ihr Potential für die Lebensmittelindustrie.** In: RFL – Rundschau für Fleischhygiene und Lebensmittelüberwachung. Vol. 71. Presse Dienstleistungsgesellschaft mbH & Co. KG, Alfeld (Germany)

Lordick F, Platzbecker U, Buech E, Koehl U. **Molekulare und zellbasierte Krebstherapie – quo vadis?** Der Onkologe (2019), Sonderheft, 7 pages. doi: 10.1007/s00761-019-0612-3

Müller M. **Miniaturisierung von diagnostischen Point-of-care-Plattformen.** BIOspektrum (2019) 25: 538

Tárnok A. **SRL communi(ty) cate (Editorial).** Cytometry Part A 95 (2019), 2, pages 141-143, doi: 10.1002/cyto.a.23727

Tárnok A. **Cancer and cytometry (Editorial).** Cytometry Part A 95 (2019), 3, pages 257-258, doi: 10.1002/cyto.a.23740

Tárnok A. **New year note 2019: Welcome to the year fo the pig (Editorial).** Cytometry Part A 95 (2019), 1, page 9, doi: 10.1002/cyto.a.23714

Tárnok A. **Supervised Cytometry (Editorial).** Cytometry Part A 95 (2019), 9, pages 941-942, doi: 10.1002/cyto.a.23894

Tárnok A. **Computational cytometry (Editorial).** Cytometry Part A 95 (2019), 7, pages 706-707, doi: 10.1002/cyto.a.23856

Tárnok A. **End of Year Note 2019 (Editorial).** Cytometry Part A 95 (2019), 12, pages 1221-1222. doi: 10.1002/cyto.a.23950

Tárnok A. **Nobel prize for medicine 2019 and the impact of cytometry (Editorial).** Cytometry Part A 95 (2019), 11, pages 1127-1128. doi: 10.1002/cyto.a.23923

Thoring L, Zemella A, Wüstenhagen D, Kubick S. **Accelerating the production of druggable targets: Eukaryotic Cell-Free Systems come into focus.** Methods Protoc. 2019 Apr 16;2(2). pii: E30. doi: 10.3390/mps2020030.

Vogel M, Tangermann P. **Better treatment for diabetic foot ulcers.** Fraunhofer Research News / October 1, 2019

GRADUATION (CLASS OF 2019)

Adhikari, Goma. **Transfer of complex sample preparation followed by qPCR analysis to a prototype for epigenomic examination of sample material for clinical research.** Beuth University of Applied Sciences Berlin, Bachelor thesis

Arndt, Nina. **Fluoreszenzoptische Charakterisierung einer zwitterionischen Antifouling Beschichtung.** Technische Universität Berlin, Bachelor thesis

Banek, Angela. **Influence of glyphosate and its formulations on intestinal epithelial cell lines and commensal bacteria in vitro.** University of Mannheim, Bachelor thesis

Baumgarte, Simon. **Development of quantitative Detection Strategies for potential Cancer Biomarkers from Extracellular Vesicles using Lateral Flow Assays.** Aalborg University, Master thesis

Behm, Laura. **Thermoresponsive Zellkultursubstrate für zeitlich-räumlich gesteuertes Auswachsen neuronaler Zellen.** University of Potsdam, Doctoral thesis

Boomgarden, Marlene. **Charakterisierung eines Inflammationscocktails in einem in vitro-Modell der Bluthirnschranke – Überprüfung der Wirksamkeit von Blutreinigungsverfahren.** University of Rostock, Master thesis

Bornmüller, Ailyn. **Analyse der Expressionsrate verschiedener ARMS-Konstrukte im Zusammenhang mit TRPV1.** Beuth University of Applied Sciences Berlin, Master thesis

Bräuer, Dennis. **Site-specific incorporation of non-canonical amino acids into cation channels using a tyrosine-based orthogonal tRNA/tRNA-synthetase pair in eukaryotic cell-free systems.** Beuth University of Applied Sciences Berlin, Master thesis

Cavak, Nino Dennis. **Integration of the orthogonal E.coli tRNATyr CUA-tyrosyl-tRNA synthetase and the Methanosarcina mazei tRNAPyl CUA-pyrrolysyl-tRNA synthetase into CHO cells for the generation of cell-free protein labeling systems.** Technische Universität Berlin, Master thesis

Didwischus, Nadine. **Cognitive decline of spontaneously hypertensive mice correlates with hypertensive immunophenotype.** Leipzig University, Doctoral thesis

Ettingshausen, Johanna. **Screening of microalgae and cyanobacteria for UV-absorbing substances.** Technische Universität Berlin, Bachelor thesis

Fadejeva, Jelizaveta. **Evaluation unterschiedlicher PCR-Amplifikatlängen für eine optimierte DNA-Microarray-Hybridisierung.** Beuth University of Applied Sciences Berlin, Bachelor thesis

Feist, Henriette Victoria. **Etablierung der CRISPR/Cas Methode zur Generierung Glypican-1-negativer Zelllinien des dreifach-negativen Mammakarzinoms.** Leipzig University, Diploma thesis

Fischer, Joe. **Tumortherapie mit onkolytischen Viren Nachweis von Tumor- und Herpes viralen Antigenen.** Mittweida University of Applied Sciences, Bachelor thesis

Flechner, Marie. **Optimierung der Zellkulturbedingungen in 3D Kollagenmatrices eines Mikrobioreaktors zur Untersuchung von Paracetamol-induzierter Hepatotoxizität.** Technische Universität Berlin, Master thesis

Gabriel, Franziska. **Reinigung, enzymkinetische Untersuchung und Co-Kristallisation der bakteriellen Urease aus Sporosarcina pasteurii im Komplex mit ausgewählten Inhibitoren.** Martin Luther University Halle-Wittenberg, Master thesis

Gebler, Jan. **Automatisierung und Validierung eines Messsystems zur in-vitro-Erfassung von Hepatotoxizität in Echtzeit.** Hamburg University of Applied Sciences, Master thesis

Gerike, Susanna. **A cultivation protocol for growing P19-derived neurons on micropatterned temperature-responsive surfaces for controlled neuronal network formation.** Freie Universität Berlin, Bachelor thesis

Hillmer, Jasmine. **Validierung eines neuartigen Workflows zur Generierung von Leitstrukturen in der Wirkstoffforschung.** Martin Luther University Halle-Wittenberg, Bachelor thesis

Jansig, Edith. **Untersuchungen zur Eignung von Viromeren als neue Trägermaterialien für die Gentherapie entzündlicher Erkrankungen.** Leipzig University, Doctoral thesis

Kamischke, Julia. **Untersuchungen zur Stabilisierung des in-vivo-Phänotyps von Mikroglia in der Zellkultur.** Martin Luther University Halle-Wittenberg, Master thesis

Kitte, Reni. **Isolation and characterization of antimicrobial phytosubstances from Warburgia ugandensis in vitro.** HTW Berlin – University of Applied Sciences, Master thesis

Krüger, Karolin. **Einfluss von kommensalen Bakterien auf das Wachstum und die Toxinproduktion von Clostridium difficile.** University of Rostock, Master thesis

Kurt, Büsra. **Untersuchungen zur Detektion von zirkulärer RNA mittels onChip-PCR.** Beuth University of Applied Sciences Berlin, Bachelor thesis

Lenschow, Lukas. **Identification of peptide epitopes recognised by sera of patients with fish allergy – Identifizierung von Peptid-Epitopen, die durch Patienten-Seren mit Fischallergie erkannt werden.** Universität zu Lübeck, Master thesis

Lerma Romera, Jorge Alberto. **Optimization and characterization of a human and murine anti-isoaspartate-Aβ-antibody.** Martin Luther University Halle-Wittenberg, Master thesis

Markshausen, Angelina. **Stabilitätsuntersuchungen eines monoklonalen anti-CD4 Antikörpers mittels nanoDSF-Technologie.** Mittweida University of Applied Sciences, Bachelor thesis

Matiebe, Anne. **Etablierung von Methoden für die in-vitro-Charakterisierung der NK-92-Zelllinie nach einer Elektronenstrahl-basierten Inaktivierung.** Anhalt University of Applied Sciences, Master thesis

Nottebrock, Alessia. **Charakterisierung und Etablierung eines Modells der moderaten, chronischen Niereninsuffizienz (Chronic Kidney Disease, CKD) in Wistar-Ratten.** University of Applied Sciences Jena, Master thesis

Oelkers, Betty. **Die Rolle der SUMOylierung bei der ischämischen Stressantwort neuraler Zellen.** Leipzig University, Doctoral thesis

Popp, Georg. **Entwicklung eines effizienten echtzeitfähigen Bildfusions-Algorithmus.** Leipzig University of Applied Sciences (HTWK Leipzig), Master thesis

Raue, Christian. **Neue Ansätze und Weiterentwicklungen für den Nachweis von Phosphorylierungen mit Multiplex Immunoassays auf der Luminex-Plattform.** Beuth University of Applied Sciences Berlin, Master thesis

Reichelt, Hendrik. **Etablierung eines Immunassays für die Quantifizierung von Transcobalamin als Basis für die Entwicklung eines Lateral-Flow-Tests für aktives B12.** Mittweida University of Applied Sciences, Master thesis

Sabrowski, Wiebke. **Generation and characterization of DNA aptamers against small molecules using Capture-SELEX.** Freie Universität Berlin, Master thesis

Safraou, Yasmine. **Development of a normothermic liver perfusion platform: Technical contributions and biological analyses.** University of Tunis, Tunesien, Master thesis

Santa-ardharnpreecha, Suttinee. **Studies on hazelnut epitopes of antibodies in sera from allergy patients and immunized rabbits.** Martin Luther University Halle-Wittenberg, Master thesis

Schaller, Julia. **Charakterisierung des Zellverhaltens auf thermoresponsiven Polymeroberflächen.** Humboldt-Universität zu Berlin, Master thesis

Schilling, Stephan. **Untersuchungen zur Rolle N-terminaler Peptidmodifikationen bei dementiellen Erkrankungen sowie daraus folgende Ansätze zur Unterdrückung pathophysiologischer Prozesse.** Martin Luther University Halle-Wittenberg, Habilitation

Schloßhauer, Jeffrey. **Qualifying a mutually orthogonal pyrrolysyl-tRNA synthetase-tRNA(Pyl) pair for fluorescent labeling of anion channels in eukaryotic cell-free systems.** Freie Universität Berlin, Master thesis

Schmidt, Cassandra. **Entwicklung eines Reversen Genetik Systems, für das Respriatorische Synzytial Virus.** Mittweida University of Applied Sciences, Bachelor thesis

Schöne, Lisa Marie. **Reducing phototoxicity using new live cell imaging devices.** Technische Universität Dresden, Master thesis

Seydel, Aleksandra. **Establishment and characterization of a mouse model of chronic Salmonella enterica infection as a proposed animal model for human inflammatory bowel disease.** Leipzig University, Doctoral thesis

Soyka, Nico. **Biochemische und molekularbiologische Charakterisierung von Mastitis-Erregern aus Milchproben.** University of Potsdam, Bachelor thesis

Teneng, Bertrand Tangu. **Silencing »Alu RNA« as a potential therapy for Age-related Macular Degeneration (AMD).** Martin Luther University Halle-Wittenberg, Master thesis

Vargas Rodriguez, Angela Maria. **Investigation of recombinant protein production in cytoplasm and periplasm u-sing Vibrio natriegens.** Martin Luther University Halle-Wittenberg, Master thesis

Weiß, Vitalis. **Hard- und Softwarerealisierung eines Optical Projection Tomography (OPT)-Systems.** Leipzig University of Applied Sciences (HTWK Leipzig), Master thesis

Zemella, Anne. **Fluoreszenzmarkierung und Modifizierung von komplexen Proteinen in eukaryotischen zellfreien Systemen durch die Etablierung von orthogonalen tRNA/Aminoacyl-tRNA-Synthetase-Paaren.** University of Potsdam, Doctoral thesis

PRIZES

Award from the HTW Berlin – University of Applied Sciences for one of the best degrees in 2019 awarded to Reni Kitte at the end of the master study

Best Poster Award des 2nd European Biosensor Symposium 2019 für Christian Warmt zum Thema "Novel RT-PCR based assay for the fast detection of circular RNAs (circRNA)"

Excellence award 2019 of the Fraunhofer-Gesellschaft awarded to PD Dr. Stephan Fricke on the topic "GvHD prevention"

Flashtalk Award of the Aptamers 2019 – 6th International Symposium of the International Society on Aptamers (INSOAP) awarded to Nico Dreymann on the topic "Aptamer-based Biomarker Assay for Cancer Detection"

Fraunhofer IZI Science Day poster prizes were awarded to Ioana Sonya Ciulean on the topic "Head and neck cancer therapy with CAR-NKs" / to Christin Möser on the topic "Oligovalent enhancement of biomolecules presented on DNA nanostructures" / to Michael Rade on the topic "Gene expression profiling during activation of human naïve T cells"

Fraunhofer IZI Science Day publication prizes were awarded to Dr. Jessica Freitag on the topic "Synthetic transient crosslinks program the mechanics of soft, biopolymer-based materials" / to Dr. Daniel Ramsbeck on the topic "Structure-guided design, synthesis, and characterization of next-generation meprin β inhibitors" / to Nadja Hilger on the topic "Incubation of Immune Cell Grafts With MAX.16H5 IgG1 Anti-Human CD4 Antibody Prolonged Survival After Hematopoietic Stem Cell Transplantation in a Mouse Model for Fms Like Tyrosine Kinase 3 Positive Acute Myeloid Leukemia"

Hugo Geiger Prize (2nd place) awarded by the Bavarian Ministry of Economic Affairs, Regional Development and Energy to Dr. Lea Bayer on the topic of dissertation "Novel approaches to an RSV vaccine: Papillomavirus-based delivery of a genetic vaccine and low-energy electron irradiation for the production of a killed vaccine"

Karl Schügerl Prize 2019 awarded by the Institute of Technical Chemistry of the Leibniz University Hannover to Julia Penk on the topic "Optimization of the upstream process and establishment of the downstream sequence for GMP-compliant biotechnological production of a humanized anti-CD4 IgG4 antibody"

PhD sponsorship of Leipzig University Medicine awarded to Phil Rademacher on the topic "Importance of extracellular vesicles in inflammatory processes"

Poster Award of the Aptamers 2019 – 6th International Symposium of the International Society on Aptamers (INSOAP) awarded to Wiebke Sabrowski on the topic "Generation of DNA aptamers against small molecules using Capture-SELEX"

Poster prize of the 15th Research Festival for Life Sciences of Leipzig University awarded to Dr. Markus Kreuz on the topic "Prognostic biomarkers in prostate carcinoma"

Poster prizes of the 2nd New and Emerging Technologies – Biotech meets Medicine were awarded to Wiebke Sabrowski on the topic "Characterization of enriched DNA pools targeting small molecules" / to Nico Dreymann on the topic "Aptamers in Diagnostics: Assay Formats for the Early Detection of Bladder Cancer"

Poster prize of the 5th International Symposium Multivalency in Chemistry and Biology awarded to Marlen Kruse on the topic "Virus detection through SwitchSense technology"

Poster prize of the International Symposium on Albumin Dialysis awarded to Dr. Andreas Körtge on the topic "Construction of a normo-thermal liver perfusion platform"

Promotion prize of the Faculty of Medicine of Leipzig University awarded to Dr. Alexandra Rockstroh on the topic "Development of methods for the specific, serological diagnosis of dengue and zika virus infections with modified envelope proteins"

PATENTS

The patent portfolio of the Fraunhofer IZI currently holds 50* 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
- Procedure for diagnosing chronic lung diseases
- 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
- Treating neurogenic immunodepression following brain injuries
- Technologies for generating pluripotent stem cells
- Biomarkers and diagnostic systems for application in human or veterinary medicine
- RNA species for therapeutic and / or diagnostic use
- Treatment approaches for cancer
- Procedures and devices for point-of-care diagnostics
- Drugs for the treatment of infectious as well as fibrotic and neurodegenerative diseases
- Procedure for immunomodulation and treatment of immunological diseases
- Surface modification
- Inactivating pathogens as part of vaccine production and novel vaccine candidates
- Methods for transferring nucleic acids into cells
- Epitopes from food relevant to the development of allergies
- Procedure for transplanting microbiomes
- Components of microscopical systems, especially from light sheet microscopy

- Methods for ascertaining liver function and regeneration
- Mineral compounds for the prevention / treatment of kidney and bowel diseases
- Dialysis procedures and novel components of dialysis systems
- Biomarkers and diagnostic procedures for dyslexia based thereon

* without Fraunhofer IZI-BB patents

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.

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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.

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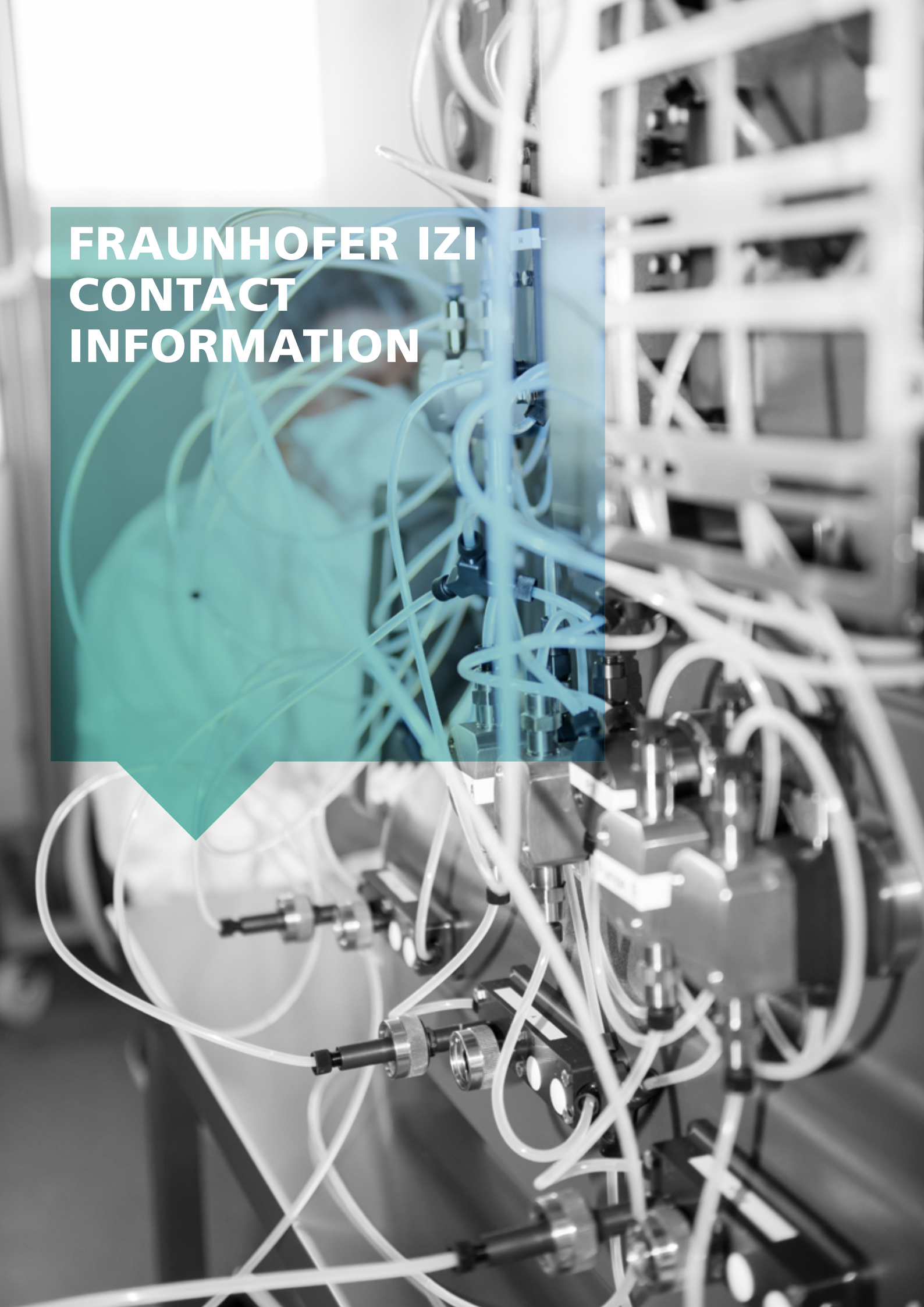

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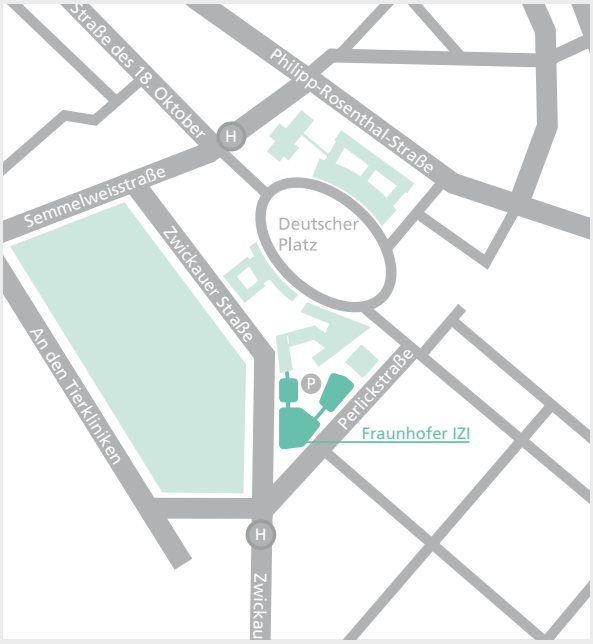

ADDRESS

Fraunhofer Institute for Cell Therapy and Immunology
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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 station, turn right towards Augustusplatz (Leipzig Opera House). At Augustusplatz turn left and keep to the right, then follow Prager Straße. Turn right at Semmelweissstraße, follow the road and then turn left onto Zwickauer Straße. Follow this road until you turn left into Perlickstraße.

A14 – Exit Leipzig-Mitte: Take the B2 (via Maximilianallee) in the direction of the city center ("Zentrum") and follow the B2 (via Gerichtsweg). Turn left onto Prager Straße (B2) in the direction of "Alte Messe", then turn right onto "Alte Messe". Turn right at Semmelweissstraße, follow the road and then turn left onto Zwickauer Straße. Follow this road until you turn left into Perlickstraße.

A38 – Exit Leipzig-Süd: Take the B2 in the direction of the city center ("Zentrum") and turn off at exit "Richard-Lehmann-Straße". Follow Richard-Lehmann-Straße and turn off before the BMW car dealership onto Zwickauer Straße in

the direction of "Alte Messe", then turn right onto Perlickstraße.

The car park is accessible from Perlickstraße. You will find visitors' parking right in front of the façade of the institute.

BY TRAIN AND PUBLIC TRANSPORT

Take the train to Leipzig Hauptbahnhof central station, and then continue with tram line 16 towards Lößnig. Get off at the stop "An den Tierkliniken", directly opposite the institute. The closest overground train ("S-Bahn") station is "Leipzig MDR" and all overground 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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