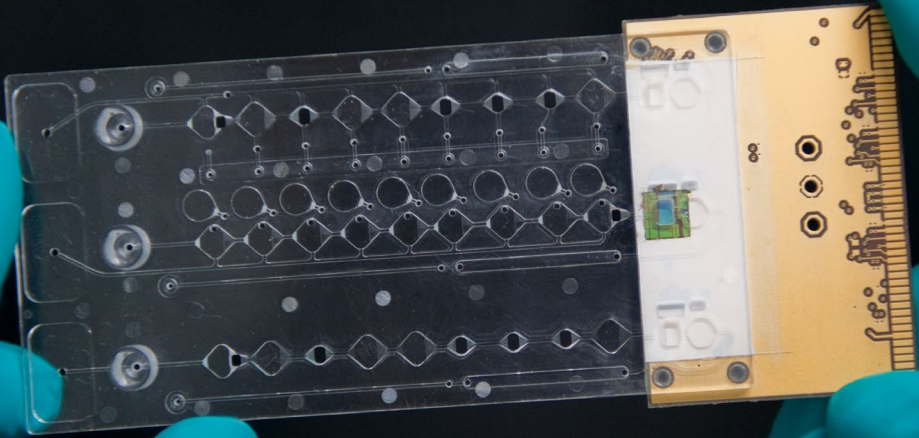




Fraunhofer
IZI

Fraunhofer Institute for Cell Therapy
and Immunology IZI



Competence atlas



Diagnostics

Interdisciplinary competences and partnership for future projects

Medical therapy is difficult to imagine without excellent diagnostics. The SARS-CoV-2 pandemic alone has shown us how diagnostic tests can save lives and make it easier for society to return to normality. But also in the case of oncological, cardio-metabolic, rare or neurological diseases, treating physicians need a well-founded diagnosis.

The Fraunhofer Institute for Cell Therapy and Immunology offers these diagnostic solutions that go far beyond a traditional assay development. With this brochure, we want to show you innovative technologies and diagnostic procedures that address future trends in this important area of research and development.

We would like to offer you our interdisciplinary competences and partnership for future projects – from biomarker research to complete diagnostic devices. Our team is passionate about science and diagnostics, so please feel invited to get in touch with the experts at the institute and to discuss new projects. We look forward to you and your challenges, because we are convinced that solutions like application-oriented, innovative and sophisticated diagnostics have a major benefit on human health. After all, it is through diagnostics that therapy becomes effective and life-saving.



Cell and gene therapy development

Analytics and quality controls

Research topics

- Generation and functionality testing of cell and gene therapeutics (in vitro & in vivo models)
- GMP process & quality control development for cell and gene therapeutics, proteins and viral vector production

Competences

- Molecular phenotyping (e.g. qPCR, ddPCR, Western blot)
- Cellular phenotyping (fluorescence microscopy, flow cytometry, histology)
- Development of cytotoxicity and potency assays
- Automated analytics and quality controls
- Under GMP compliance



Contact

PD Dr. Stephan Fricke
Department of Cell and Gene Therapy
Development
Tel. +49 341 35536-2205
stephan.fricke@izi.fraunhofer.de



Bioassays und lyophilization

Tools for diagnostics and therapy

Research topics

- Lyophilization
- Bioluminescence / luminescent bioassays
- Sample preparation
- Sustainability of POCT

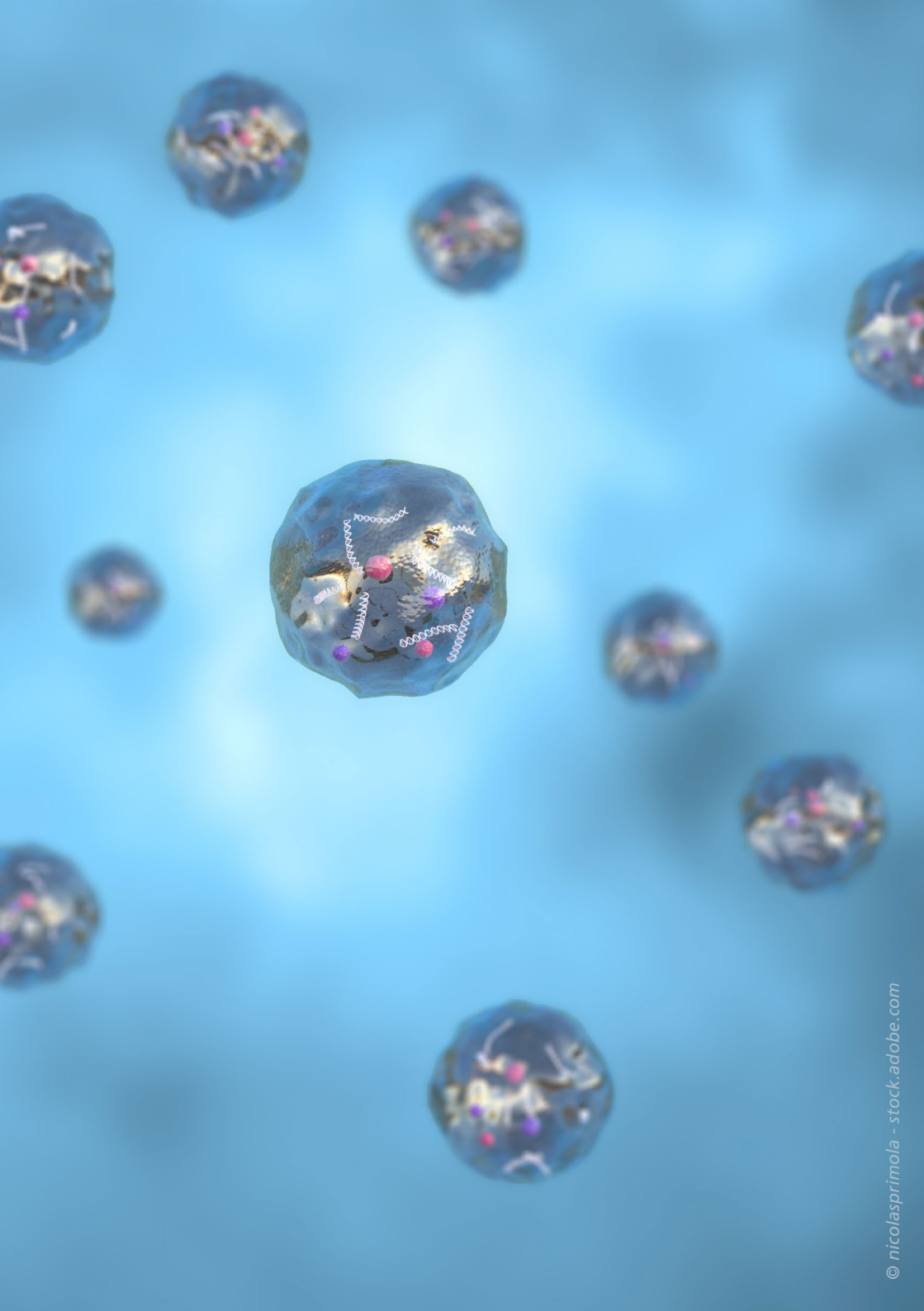
Competences

- Developing adapted lyophilization processes and verify lyophilized product regarding certain parameters
- Validating and experimenting with assays based on bioluminescence
- Developing sample preparation technologies and handling e.g. whole blood filtration via membranes
- Finding more sustainable materials for POCT and verifying them with practical assays



Contact

Alina Menge
MicroDiagnostics Unit
Department of Diagnostics
Tel. +49 341 35536-9325
alina.menge@izi.fraunhofer.de



Liquid biopsy

Tools for diagnostics and therapy

Research topics

- Extracellular vesicles and their use in diagnostics and therapy
- Detection of cytokine release syndrome

Competences

- Total and specific isolation of extracellular vesicles from cell culture supernatant, blood plasma and urine
- Characterization of extracellular vesicles
- Antibody-microarray
- Homogeneous immunoassays
- Assay integration in microfluidic devices



Contact

Dr. Susann Allelein
MicroDiagnostics Unit
Department of Diagnostics
Tel. +49 341 35536-9329
susann.allelein@izi.fraunhofer.de



Sample preparation

Solutions for preanalytical phase in diagnostics

Research topics

- Integrated diagnostics & Point-of-care tests
- Medical diagnostics
- Environmental, food & beverage analytics

Competences

- Target isolation & enrichment
- Lysis techniques for cells and viruses
- Inactivation of inhibitors
- Strategies for rare targets
- Technical integration of sample preparation into test systems



Contact

Dr. Natalia Sandetskaya
MicroDiagnostics Unit
Department of Diagnostics
Tel. +49 341 35536-9310
natalia.sandetskaya@izi.fraunhofer.de



Microfluidics

Tools for diagnostics and research

Research topics

- Integrated diagnostics & Point-of-care devices
- Organs-on-chip
- Microfluidic design

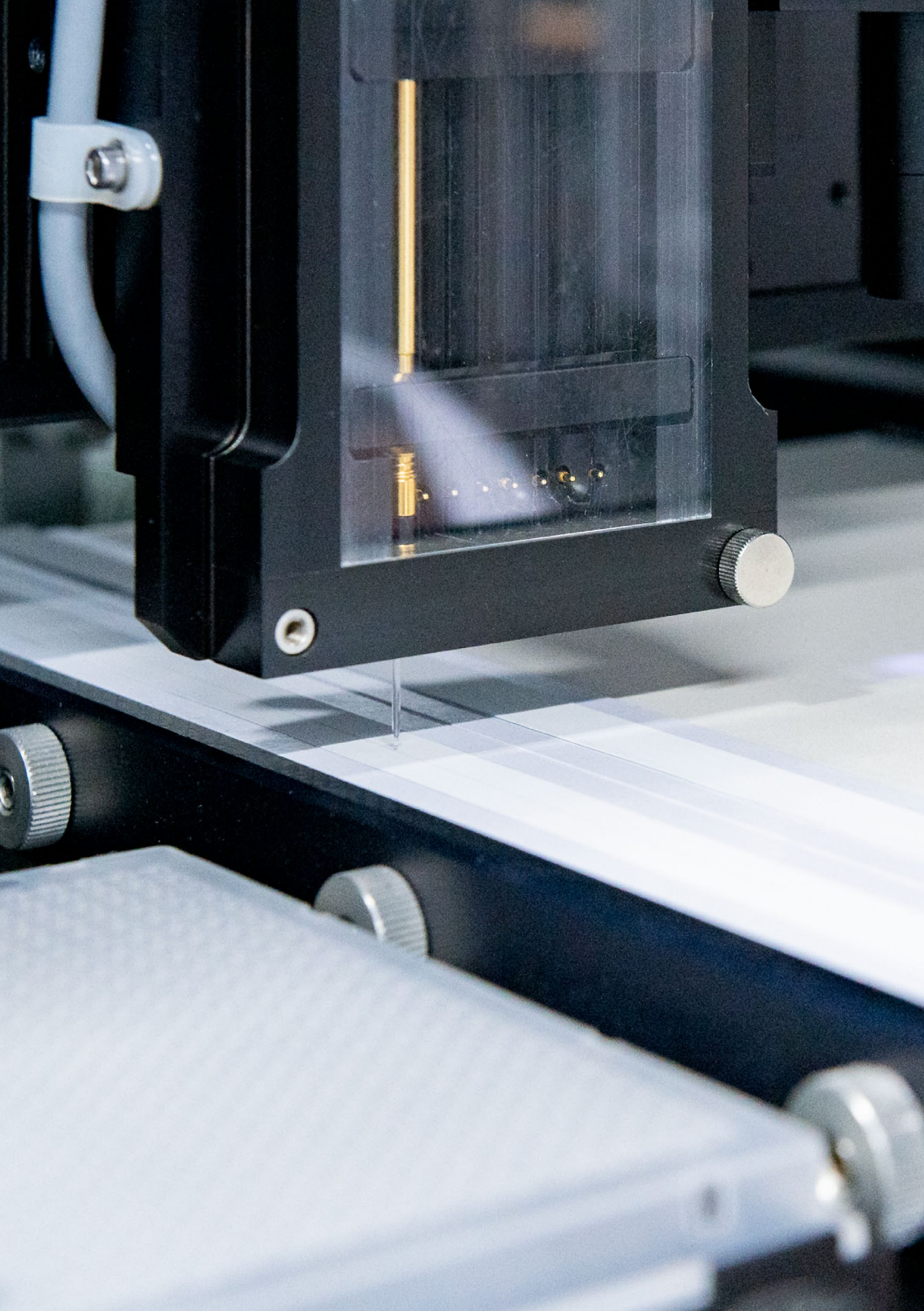
Competences

- Design, development and testing of microfluidic structures
- Hot-embossing for rapid prototyping of microfluidics and optical structures
- Process development and optimization in manufacturing technology



Contact

Dr. Kai Mattern
MicroDiagnostics Unit
Department of Diagnostics
T. +49 341 35536-5221
kai.mattern@izi.fraunhofer.de



MicroArray and lateral flow test

Tools for diagnostics and therapy

Research topics

- MicroArrays and lateral flow tests are multi-purpose tools in diagnostics
- Antibody-, peptide-, oligonucleotide- or artificial molecule-based assays for the detection of pathogens and biomarkers
- Visible- or fluorescence-based read-out

Competences

- Design, development and testing of MicroArrays and innovative lateral flow assays
- Interdisciplinary exchange for assay development
- Integration into microfluidic structures



Contact

Andreas Kölsch
MicroDiagnostics Unit
Department of Diagnostics
Tel. +49 341 35536-9331
andreas.koelsch@izi.fraunhofer.de



Next-generation diagnostics

Genomics & transcriptomics for diagnostics and research

Research topics

- Genomics & Transcriptomics for clinical and non-clinical research e.g. in oncology and immuno-oncology
- Biomarker discovery and validation using next-generation sequencing and PCR-based methods
- Pathogen testing (e.g. SARS-CoV2 detection)

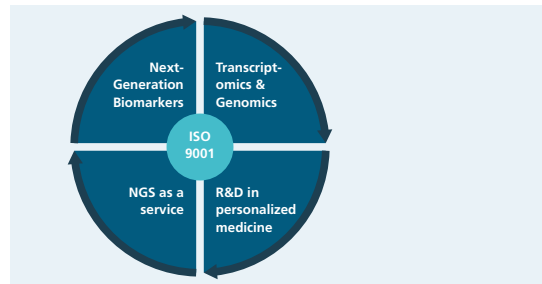
Competences

Classical NGS methods

- Whole transcriptome sequencing (mRNA and total RNA)
- Whole genome and exome sequencing
- Small genome and 16S sequencing

Advanced NGS methods

- Single-cell multi-omics
- Spatial transcriptomics



Contact

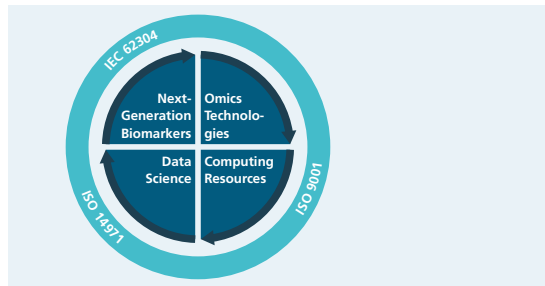
Dr. Conny Blumert
 Next-Generation Diagnostics Unit
 Department of Diagnostics
 Tel. +49 341 35536-3301
conny.blumert@izi.fraunhofer.de



Medical bioinformatics for precision medicine

Research topics

- Medical bioinformatics in oncology and immuno-oncology
- Software development for precision medicine
- Biomarker discovery and validation
- Computational RNA biology & functional genomics



Competences

- Machine learning & multi-omics: Machine learning & AI for deep molecular data; multi-modal data science; statistical learning; integrative bioinformatics; pipeline development
- Software components for IVDs: Development of algorithms and software components for medical devices in particular in-vitro diagnostic devices (IVDs) and lab developed tests



Contact

Dr. Kristin Reiche
Bioinformatics Unit
Department of Diagnostics
Tel. +49 341 35536-5221
kristin.reiche@izi.fraunhofer.de



Statistical consulting

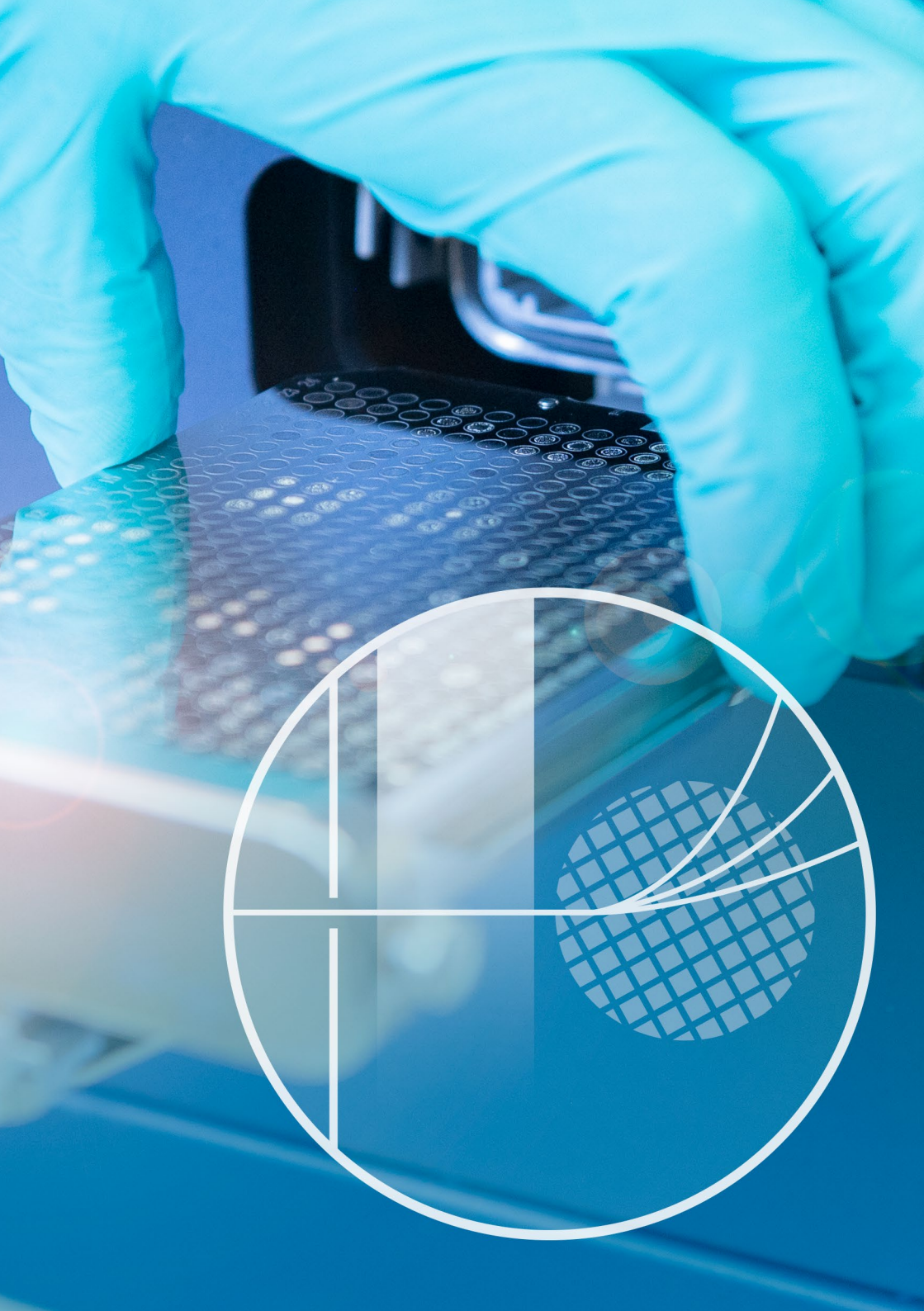
Competences

- Support of applications for animal experiments (TVV/TVA) including case number planning and joint preparation of the biometrics section for the application text, advice in experimental design for the trial, determination of strategy and appropriate statistical methods for the subsequent evaluation
- Support for the biometric planning of other experiments, e.g. case number planning in the context of third-party funding applications
- Support in statistical planning for students and PhD students



Contact

Dr. Markus Kreuz
Bioinformatics Unit
Diagnostics Department
Tel. +49 341 35536 5211
markus.kreuz@izi.fraunhofer.de



Chromatography & mass spectrometry

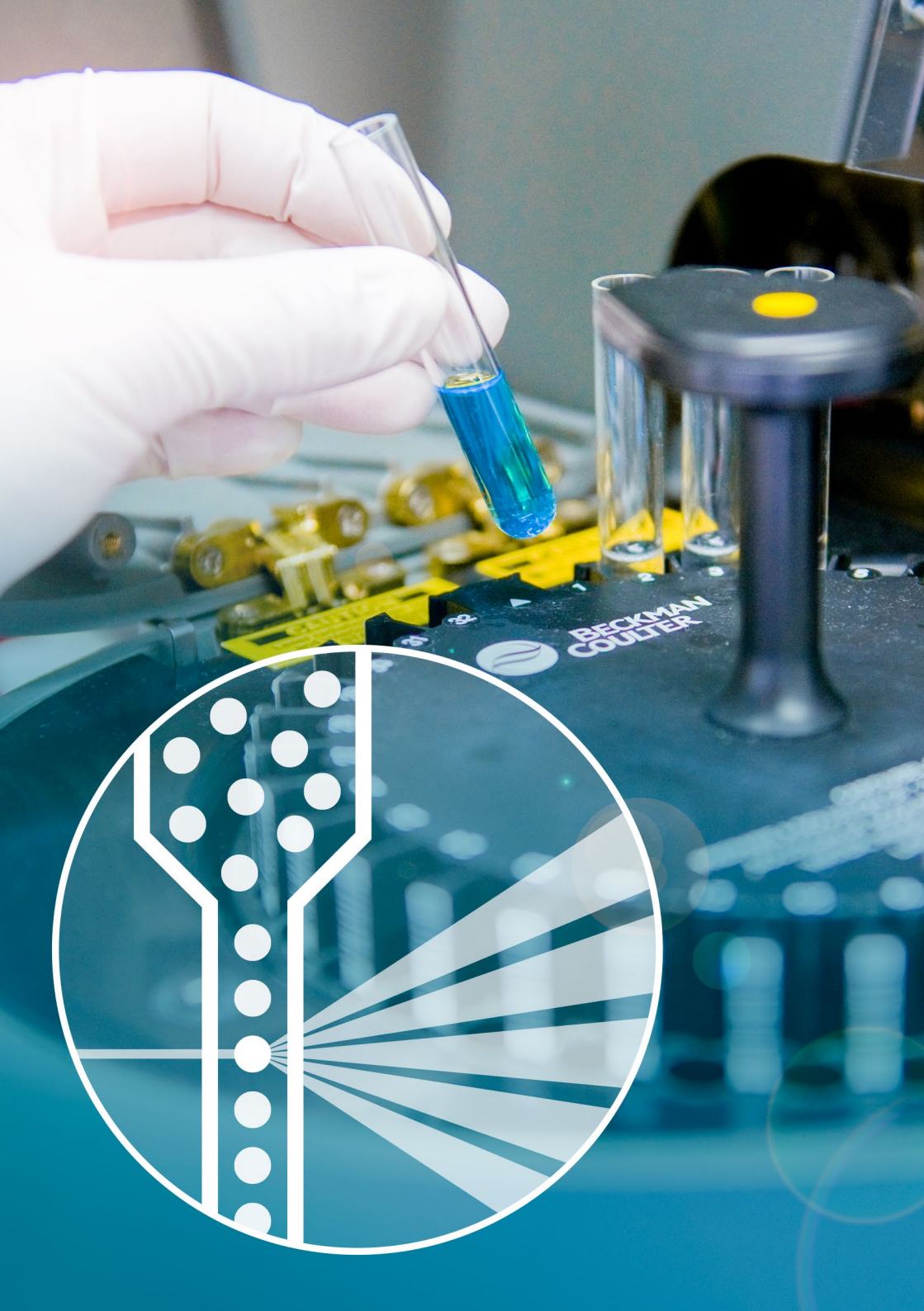
Competences

- Preparative chromatographic separations (RP, SEC, IC)
- Identity determination of isolated proteins by peptide mass fingerprinting (PMF) and MS/MS analyses
- MS-based elucidation and detection of protein modifications and protein interactions
- Consulting, sample preparation, performance and evaluation of proteomics studies
- Determination of toxins and metabolites in biofluids by Multiple Reaction Monitoring (MRM)
- Analysis of active substances and their degradation products by MRM
- Characterization of ssDNA and ssDNA conjugates



Contact

Prof. Dr. Stefan Kalkhof
Proteomics Unit
Department of Preclinical Development
and Validation
Tel. +49 160 5916475
stefan.kalkhof@izi.fraunhofer.de



Flow cytometry and FACS

Competences

- Cell-based assays (immunophenotyping, apoptosis, internalization, proliferation / cell cycle, migration, degranulation)
- Cell sorting
- Advice on set-up of experiments, evaluation and other flow cytometry-related topics

Equipment

- Beckman Coulter: Navios Ex TM 10/3, CytoFlex
- Merck/Luminex: ImageStream-X MarkII, FLEXMAP 3D
- BD: Influx Cell Sorter
- Sartorius: IntelliCyt ique Gen 2
- Miltenyi: MACSQuant X



Contact

Dr. Christin Möser
DNA Nanodevices Unit
Department of Diagnostics
Tel. +49 341 355369314
christin.mooser@izi.fraunhofer.de



Microscopy and image analysis

Core Unit Imaging

Competences

- Acquisition and evaluation of various (also correlative) image data
- Brightfield, live cell, fluorescence and confocal laser scanning microscopy
- Slide scanning services
- In vivo imaging via magnetic resonance imaging (MRI), computed tomography (CT) and optical imaging (BLI/FLI) for small animals
- Microscopy training of users and technical support



Contact

Dr. Sebastian Greiser
Experimental Imaging Unit
Department of Diagnostics
Tel. +49 341 35536-5404
sebastian.greiser@izi.fraunhofer.de

OPEN

ORIGINAL ARTICLE

Specific detection of dengue and Zika virus antibodies using envelope proteins with mutations in the conserved fusion loop

Alexandra Rockstroh¹, Beyene Moges¹, Luisa Barzon², Alessandro Sinigaglia², Giorgio Palu²,
Widuranga Kumbukgolla³, Jonas Schmidt-Chanasit^{4,5}, Manoel Sarno^{6,7}, Carlos Brites⁶, Andres Moreira-Soto^{8,9},
Jan Felix Drexler^{5,9}, Orlando C Ferreira¹⁰ and Sebastian Ulbert¹



EMi



Taylor & Francis
Taylor & Francis Group

Emerging Microbes & Infections
2021, VOL. 10
<https://doi.org/10.1080/22221751.2021.1913973>

OPEN ACCESS

Check for updates

Correlation of humoral immune responses to different SARS-CoV-2 antigens with virus neutralizing antibodies and symptomatic severity in a German COVID-19 cohort

Alexandra Rockstroh^a, Johannes Wolf^{b,c}, Jasmin Fertey^a, Sven Kalbitz^d, Stefanie Schroth^d,
Christoph Lübbert^{d,e,f}, Sebastian Ulbert^{a,x} and Stephan Borte^{b,c,x}



viruses

Article

Pathogens Inactivated by Low-Energy-Electron Irradiation Maintain Antigenic Properties and Induce Protective Immune Responses

Jasmin Fertey¹, Lea Bayer¹, Thomas Grunwald¹, Alexandra Pohl², Jana Beckmann²,
Gaby Goltzmann², Javier Portillo Casado², Jessy Schönfelder², Frank-Holm Rögner²,
Christiane Wetzel², Martin Thoma³, Susanne M. Bailer^{4,5}, Ekkehard Hiller⁴, Steffen Rupp⁴
and Sebastian Ulbert^{1,*}



Native and recombinant antigens

Tools for serological diagnosis of infections

Research topics

- Antibody detection with high specificity and sensitivity
- Viral and bacterial pathogens
- Zoonoses and (re-)emerging infections

Competences

- Inactivation of pathogens by low-energy irradiation to yield intact native antigens (patent)
- Mutant recombinant proteins to increase specificity by reduction of cross-reactive antibody binding (patent)
- Serum neutralisation assays up to BSL-3 to test for protective antibodies



Contact

Dr. Jasmin Fertey
Vaccine Technologies Unit
Department of Vaccines and Infection
Models
Tel. +49 341 35536-2160
jasmin.fertey@izi.fraunhofer.de



Expression
Diagnostics Protein Sequence

Regulation Surface Posttranslational Modification

ModeOfAction Structure

Proteomics

Signalling Quantification

Phosphorylation Surface Proteome

Drug Targets Interactome

Protein Protein Interaction

Proteomics

Biomarkers and understanding disease

Research topics

- Identification and validation of proteins to be used as diagnostic biomarkers or representing therapeutic targets
- Mode of Action of drugs and biomaterials
- Role of exosomes in diseases

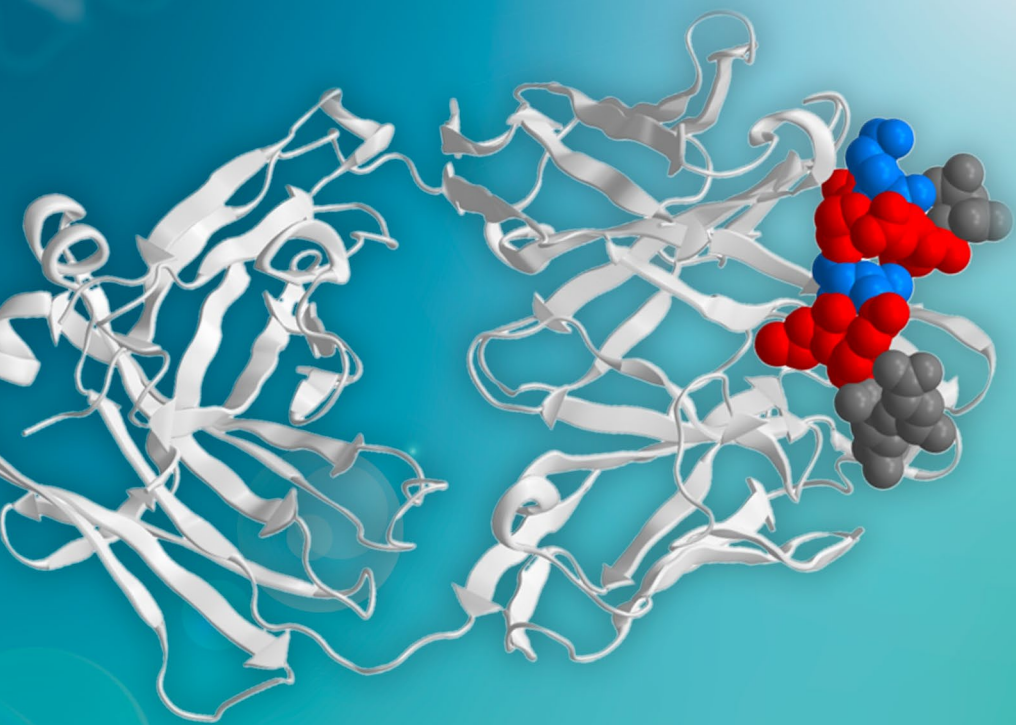
Competences

- Quantitative Proteomics
- Protein/Protein/Ligand-Interaction
- Signaling analysis



Contact

Prof. Dr. Stefan Kalkhof
Proteomics Unit
Department of Preclinical Development
and Validation
Tel. +49 160 5916475
stefan.kalkhof@izi.fraunhofer.de



Antibody epitopes

Understanding antibody characteristics

Research topics

- Antibody epitope mapping
- Specificity of polyclonal sera
- Validation for diagnostic and therapeutic applications

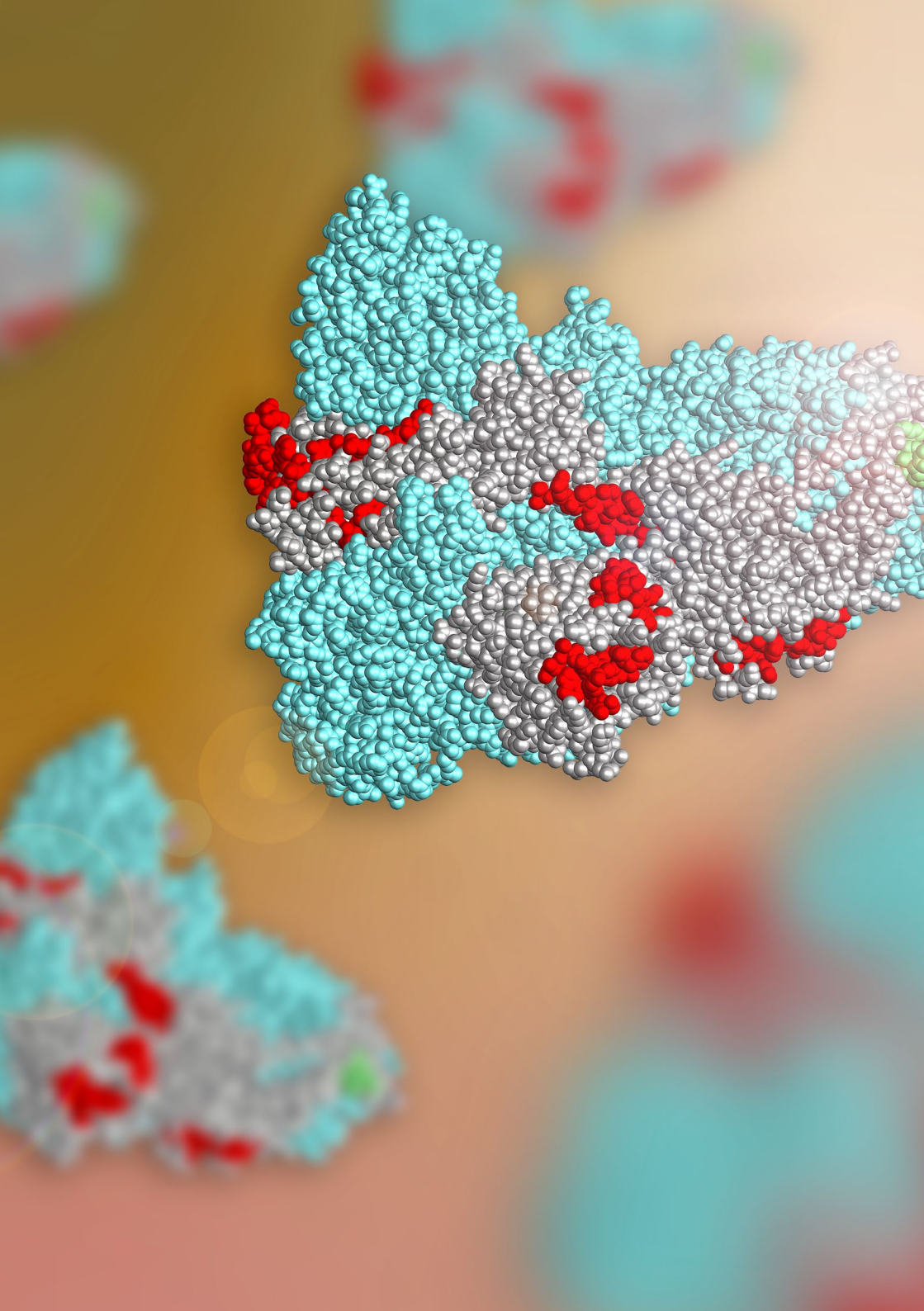
Competences

- Antibody epitope fingerprinting from μg amounts of antibody
- Epitopes at amino acid resolution
- Mapping multiple antibodies in parallel



Contact

Dr. Nicolas Delaroque
Ligand Development Unit
Department of Diagnostics
Tel. +49 341 35536-2162
nicolas.delaroque@izi.fraunhofer.de



Epitope mapping of the immunome

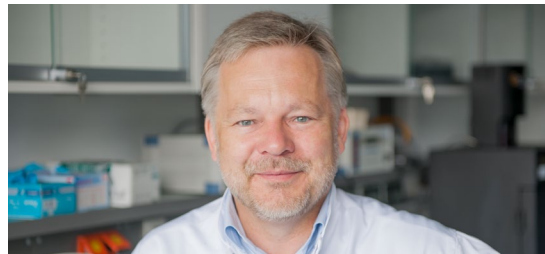
Immune reactions to disease and vaccination

Research topics

- Mapping the individual immune response
- Identifying and comparing epitopes on (auto-)antigens
- Applications: Allergies, auto-immune disease, vaccines, etc.

Competences

- Immune disease related peptide epitopes for diagnostics
- Comparing immunomes from a larger number of patients
- Anti-drug antibodies
- Ressource saving: 100 µl serum are sufficient
- In silico analyses of data allows for follow-up studies



Contact

Dr. Michael Szardenings
Ligand Development Unit
Department of Diagnostics
Tel. +49 341 35536-2805
michael.szardenings@izi.fraunhofer.de

Clinical relevance of peptides recognition at EoT

GL15 (epitope) TELEDGETKF

IgE: Decrease of LOEL_{obj} at EoT
 IgG: Increase of LOEL_{subj} at EoT

GL14 (mimotope) KVELEDGEYVH

IgG: Decrease Cor a 1-spec. IgE conc. at EoT
 IgG: Increase intensity lip swelling at EoT

Bet v 1	I	S	F	P	E	G	F	P	F	K	Y	V
Gly m 4	I	T	F	L	E	D	G	E	T	K	F	V
Cor a 1.01	I	T	F	G	E	G	R	Y	K	Y	V	
Cor a 1.04	I	T	F	A	E	G	E	R	F	K	Y	M
Api g 1	I	T	L	D	G	G	R	I	T	T	M	
	57										67	

GL12 (mimotope) CNGLGHYGDAEPC

IgE: Increase of Bet v 1-, Gly m 4-spec. IgE at EoT
 IgE: Decrease of LOEL_{obj} at EoT
 IgG: Increase of LOEL_{subj} at EoT

Bet v 1	K	Y	H	T	K	G	D	H	E	V	K	A	E
Gly m 4	K	Y	E	T	K	G	D	A	E	P	N	Q	D
Cor a 1.01	K	F	H	A	K	G	D	H	E	I	N	A	E
Cor a 1.04	K	Y	H	T	K	G	A	S	I	N	E	E	
Api g 1	I	F	H	T	K	G	D	A	V	M	P	E	E
	127										139		

HU4 (mimotope) SSKSVVEVPEDY

IgG: Decrease of number of subj. symp. at EoT
 IgG: Decrease of LOEL_{subj} at EoT

Bet v 1	F	P	K	V	A	P	Q	A	I	S	S	V	E	N	I	E	G	N
Gly m 4	I	P	K	A	L	-	D	S	F	K	S	V	E	N	V	E	G	N
Cor a 1.01	I	P	K	V	A	P	Q	A	I	S	V	E	N	V	E	G	N	
Cor a 1.04	I	P	K	V	A	P	Q	H	F	T	S	A	E	N	L	E	G	N
Api g 1	L	P	K	A	A	P	G	A	Y	K	S	V	E	-	I	K	G	D
	30																46	

GL2 (epitope) LGFTESITENH

IgG: Decrease Cor a 1-spec. IgE conc. at EoT
 IgG: Decrease intensity oral itching/tingling

Bet v 1	I	G	D	T	L	E	K	I	S	N	E	N	K	V	L	
Gly m 4	L	P	D	A	E	N	I	D	S	A	C	M				
Cor a 1.01	L	G	D	K	E	R	V	C	H	E	L	V	M			
Cor a 1.04	L	G	H	T	L	E	N	I	S	V	E	L	K	M	A	
Api g 1	L	L	G	F	T	E	S	I	T	E	N	H	V	L	V	
	96													110		



Food allergy diagnostics

Cross reactivity and relevance of food allergens

Research topics

- Improving diagnosis of food allergies
- Cross reactivity between food allergens
- Identification of allergy related peptide epitopes
- Immune response to allergy treatments

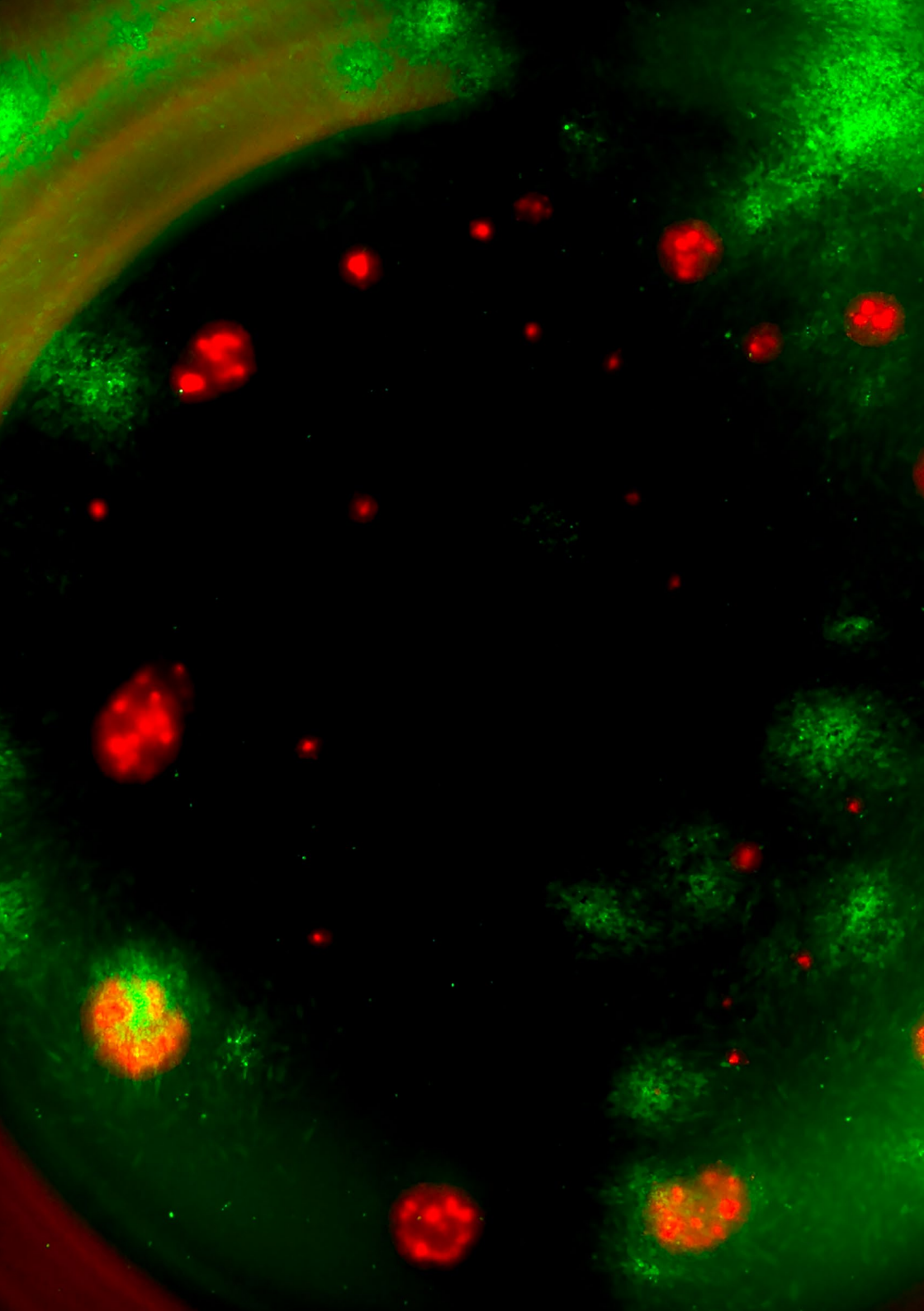
Competences

- Allergy related peptide epitopes for diagnostics
- Large biobank and data sets from hundreds of patients ready to use
- Peptide epitope arrays
- In silico analyses of data allows for follow-up studies



Contact

Dr. Karolin Kern
Ligand Development Unit
Department of Diagnostics
Tel. +49 341 35536-3460
karolin.kern@izi.fraunhofer.de



Tissue and cell targeting peptides

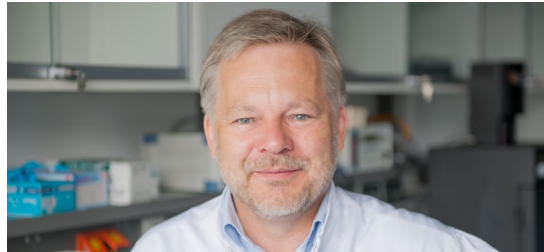
Tools for diagnostics and therapy

Research topics

- Specific binding to (cancer-)tissue or cell types
- Drug delivery
- Imaging
- Diagnostics

Competences

- Successful selection of short peptides binding to cells and/or tumor tissues
- Differential selection methods
- Databases for different tumor tissues



Contact

Dr. Michael Szardenings
Ligand Development Unit
Department of Diagnostics
Tel. +49 341 35536-2805
michael.szardenings@izi.fraunhofer.de



Gaseous analyte detection

Tools for diagnostics and therapy

Research topics

- Analysis of volatile organic compounds (VOCs)
- Detection of infections and other diseases as well as antibiotic resistance
- Breath analysis

Competences

- Ion mobility spectrometry of gaseous samples, headspace above cultures and other samples, exhaled breath
- Method development
- Data analysis of IMS spectra



Contact

Dr. Jessy Schönfelder
MicroDiagnostics Unit
Department of Diagnostics
Tel. +49 361 66338160
jessy.schoenfelder@izi.fraunhofer.de



dynamic
BIOSENSORS

DNA Nanodevices group

Competences

- Synthesis, characterization & application of DNA-based nanostructures for diagnostic approaches
- Functionalization of DNA strands & nanostructures with (bio)molecules such as fluorophores, biotin, peptides, sugars, small molecules, etc.
- Antibody functionalization with fluorophores, small molecules, nucleotides, etc.
- Cell culture assays (e.g. proliferation, apoptosis, migration/invasion) and flow cytometry analyses
- Virus culture assays (e.g. infection inhibition assays, ELISA, dynamic light scattering (DLS) of viruses) and virus production
- Large-scale production of phage-derived scaffold DNA for DNA origami fabrication



Contact

Dr. David M Smith
DNA Nanodevices Unit
Department of Diagnostics
Tel. +49 341 35536-9311
david.smith@izi.fraunhofer.de



Status: Analysis

NH₂

CardiOMICs Unit

Research topics

- Clinical studies on infectious diseases relevant to cardio- and prosthetic-surgery
- Identification of microorganisms and their virulence profiles in clinical samples
- Analysis of digitization in ambulant and clinical healthcare structures based on real patient pathways

Competences

- Processing of clinical and experimental studies
- Molecular and immune biological diagnostics based on proteomics, NGS and targeted PCR
- Histological and ultrastructural analysis of tissue
- Translation of diagnostic procedures into clinical routine



Contact

Prof. Dr. Dr. Dr. Andreas Oberbach
CardiOMICs Unit
Department of Diagnostics
Tel. +49 341 35536-5260
andreas.oberbach@izi.fraunhofer.de

Contact

Dr. Dirk Kuhlmeier
Head of Department of Diagnostics
Tel. +49 341 35536-9312
dirk.kuhlmeier@izi.fraunhofer.de

Fraunhofer Institute for Cell Therapy
and Immunology IZI
Perlickstraße 1
04103 Leipzig
Germany
www.izi.fraunhofer.de