

Leibniz ScienceCampus InfectoOptics

Combating infectious diseases with advanced optical methods



Speaker: Marc Thilo Figge

Background

The Leibniz ScienceCampus InfectoOptics in Jena is a collaborative research project of the Leibniz Institutes HKI and IPHT with the Friedrich Schiller University Jena and other extra university research institutions.

Researchers from the life sciences and optics/photonics closely work together with the aim of investigating and combating infectious diseases by means of novel optical technologies.

Natural product researchers and infection biologists are elucidating the molecular mechanisms of infections and are working on the development of novel active compounds against infections.

InfectoOptics fulfils a bridging function between pure basic research and applied research and has contributed to the Jena excellence strategy.





BALANCE THE MICROVERSE







Consolidation Phase



- Building on achievements from the identification phase (2015-2019) by supporting ongoing and new ambitious or high-risk projects that **explore biomedical questions** with advanced optical technologies to combat infectious diseases
- Addressing the high societal need for basic research to quickly, reliably and accurately diagnose and treat infectious diseases through the development of new optical/photonic technologies
- Promising high-risk projects including new aspects will be continued from the identification phase and entirly new concepts will be started

HoT-Aim 2.0 (IPHT, HKI, FSU)

- Understanding fungal infection processes
- Combining biomolecular methods with high spatial resolution microscopy
- Targeting molecular and structural changes down to single molecule level



PNEUTHERA (HKI, IPHT, JUH)

- High-resolution imaging and analysis of alveolus-on-chip model
- Bacterial super-infection in viral pneumonia
- Quantitative monitoring of tailored therapy



IntraPerSpective (JUH, IPHT, FLI)

- Development of label-free, non-invasive destruction-free Raman-based method
- Characterization of intracellular infections within the host
- Application to *Chlamydia abortus* and *Coxiella burnetii* in cell culture



2022

2023



Alveolus-on-chip model



Automated cell segmentation











2021

2020-2021: **Publications: 43 Open Access: 20** Cum-IF: 297

2020

VersaDrop (HKI, IPHT, IOF, FSU)

- Analysis of microorganisms in microfluidic-based droplet cultivation
- Fast, sensitive and label-free spectroscopic methods

Digital board prototype

· Investigation of spatial distribution and dynamics of microorganisms in pl-droplet volumes in real time



iTag (IPHT, HKI)

- Detection of small signaling molecules based on characteristic molecular vibrations
- Combining new imaging methods of stimulated Raman scattering and Raman-excited fluorescence
- New insights about spatial distribution and dynamics of low molecular weight biomarkers



CARS images of caryoynencin in infected champignon



Cell image recorded during CARS



2019

2015-2019: **Publications: 46 Open Access: 18** Cum-IF: 315

Identification Phase

- Establishing the Leibniz ScienceCampus InfectoOptics as a collaborative research center for various scientific disciplines
- Central goal: create mutual understanding by learning each other's scientific "language"
- Combining different model systems and technological approaches

Color-encoding of droplets

Fluorescence scan



	ojects	FastDropFast fiber-based droplet analysis of microorganismNon-invasiv polymit		Intrainf e photonic deciphering of complex crobial infections in real-time		Nanosc stru	NISUS ale imaging of subcellular actures with XUV light		B-TWELVE Microverse remastered B12 vitamers in action		DarkMicro Exploring microbial dark matter with picoliter droplets	
2015	Core pr	HoT-Aim High-end optical technologies for t intracellular, membrane affecting infe	the analysis of ectious processes	BLOODi Whole Blood Imaging	Di Imaging		Lipstaph Role of lipid transfer from host cells chronic infection and consequences response		to <i>S. aureus</i> during for host immune Response of t		Light into Darkness the plankton microbiome to targeted unnatural illumination	
		thilo.figge@leibniz-hki.de									www	.leibniz-hki.de
		Selected publications Kulesa <i>et al.</i> 2018. <i>PNAS</i> . 115(26) Diederich <i>et al.</i> 2019. <i>Nat Commun</i> . 11: 5979 Svensson <i>et al.</i> 2019. <i>Small.</i> 15(4): 1-14 Arend <i>et al.</i> 2020. <i>Anal Chem</i> . 92: 10560-10568			Part	ners:	Leib für A Fritz	oniz-Institut Alternsforschung – z-Lipmann-Institut e.	.V.	Fraunhofer	FRIED UN JEN	RICH-SCHILLER- VERSITÄT A
		Deinhardt-Emmer <i>et al.</i> 2020. Anal Chem Deinhardt-Emmer <i>et al.</i> 2020 Houhou <i>et al.</i> 2020. <i>Opt Expl</i> d'Enfert <i>et al.</i> 2021. <i>FEMS Mi</i>	Deinhardt-Emmer <i>et al.</i> 2020. <i>Biofabrication</i> . 12(2): 025012 Houhou <i>et al.</i> 2020. <i>Opt Express</i> . 28: 21002-21024 d'Enfert <i>et al.</i> 2021. <i>FEMS Microbiol Rev</i> . 45(3): fuaa060			LEIBN Z:HKI	Leibniz Institute for Natural Product Research and Infection Biology Hans Knöll Institute	Ibniz Iph		Ernst-Abbe University of Applied S	e-Hochschule Jena Sciences	UNIVERSITÄTS KLINIKUM Jena