Abstract booklet

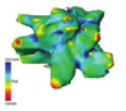
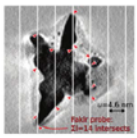
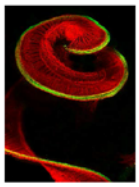
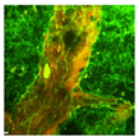
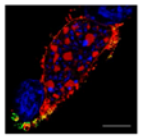
MIC Research Day

UNIVERSITÄT BERN

Date **Wednesday June 28, 2017, 1.00 – 5.30 pm**

Location Department of Infectious Diseases and Pathobiology (DIP), Lecture hall 303, 3rd floor, Länggassstrasse 122, 3012 Bern

Registration www.mic.unibe.ch/Researchday.php
until June 15, 2017
Approved for 0.5 day credit for continued education in animal experimentation in the Kanton of Bern

13:00	Welcome	MIC Board	
13:15	Nadia Mercader	Cutting Edge Microscopy, the new PhD specialization	
13:20	Martin Schwarz *Omicron-Laserage Laserprodukte GmbH, Germany*	Light for Microscopy – Laser, LED and conventional light sources	
13:40	Dimitri Vanhecke *Adolphe Merkle Institute, University of Fribourg*	Assumption-free morphological quantification of single anisotropic nanoparticles and aggregates	
14:05	Marta Roccio *Departement Clinical Research, University of Bern*	Damage and regeneration in the cochlear sensory epithelium	
14:30	Coffee Break		
15:00	Mykhailo Vladymyrov *Laboratory for High Energy Physics, University of Bern*	Real-time data processing for advanced microscopy	
15:25	Neda Haghayegh Jahromi *Theodor Kocher Institute, University of Bern*	Two-photon imaging of T-cell interactions with the inflamed cervical spinal cord microvasculature	
15:50	Livia Niklaus *Institute of Cell Biology, University of Bern*	Liver stage malaria parasites escape host cell autophagy	
16:15	Alexander Ernst *Institute of Anatomy, University of Bern*	Imaging epicardium formation in the zebrafish	
16:40	Conclusions & END	Followed by an **Apéro**	

Organized by
Microscopy Imaging Center (MIC), University of Bern, a collaborative initiative of the Faculty of Medicine, the Faculty of Science and the Vetsuisse Faculty.

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Light for Microscopy – Laser, LED and Conventional Lightsources

M.Schwarz [(1)], R. Dietzel [(1)]

[(1)] *Omicron-Laserage Laserprodukte GmbH, Raiffeisenstraße 5e, 63110 Rodgau*

Different light microscopy approaches in life sciences demand specific requirements of the microscopy light sources. New developments in these microscopy techniques push the limits of the existing excitation equipment or create new requirements for the illumination of the specimen. Especially in imaging facilities with a lot of different experiments running on the same microscope, the flexibility, modularity and possibility for customization of the microscope light sources can be a big advantage.

The talk ‘Light for Microscopy’ will give an overview about conventional, LED-based and laser-based light sources and their specific features and applications in microscopy as well as the customer inspired modular approach of light sources from ‘Omicron-Laserage Laserprodukte GmbH’.

Assumption-free morphological quantification of single anisotropic nanoparticles and aggregates

Dimitri Vanhecke, Laura Rodríguez-Lorenzo, Calum Kinnear, Estelle Durantie, Barbara Rothen-Rutishauser and Alke Petri-Fink

Adolphe Merkle Institute, Université de Fribourg, 1700 Fribourg, Switzerland

Accurate characterization of nanomaterials is in high demand as it holds the key to understanding the structure–function relationship of these promising materials: Au nanostars are currently considered as some of the most efficient photonic nanoparticles (NPs). Whereas nanoparticles with simple geometries, such as spheres, can be approximated by mathematical models, complex anisotropic nano-objects cannot. Indeed, the nanostars' optical, and indeed physicochemical, properties are strongly dependent on local geometric factors with the areas of high surface curvature, i.e. the tips, typically dominating. Precise control and tuning of these geometric factors is particularly interesting for surface-enhanced spectroscopic, catalytic and sensing applications as well as therapeutic approaches.

We present an approach to determine the volume, surface area, and curvature of non-symmetric anisotropic nanoparticles using bright-field electron tomography combined with design-based stereology without the use of segmentation tools or modeling of the particles. The results are validated by thermal reshaping and compared other techiques. Finally, we apply these tools to aggregates to estimate the fractal dimension of aggregated nanoparticles.

Damage and regeneration in the cochlear sensory epithelium

Roccio Marta PhD

Inner Ear Research lab, Department of Clinical Research, University of Bern

Sound perception in mammals relies on the function of highly specialized mechano-sensitive hair cells located in the organ of Corti, within the inner ear. Hair cells convert mechanical signals exerted by the sound pressure waves into electrochemical signals, transferred by the auditory nerve to the cortex, where they are interpreted. Due to the lack of proliferative and regenerative capacity of the sensory epithelium and of the auditory neurons, loss or damage of these cells results in permanent hearing deficit. Disabling hearing loss affects 360M people worldwide with negative impact on the quality of life of those affected and high socio-economic burden.

We are studying possible new therapeutic options to counteract hearing loss based on regenerative medicine principles. On the one hand, we try to trigger (chemically or genetically) the activity of tissue resident somatic progenitors in vivo to induce regeneration of the damaged organ. On the other hand, we are assessing the possibility to transplant progenitor cells for tissue repair. In addition, we study the process of sensory organ regeneration in vitro by making use of methodologies to differentiate pluripotent stem cell into hair cells and auditory neurons. These cell types further allow for in vitro screening of toxic or regenerative compounds.

We are assessing different imaging modalities to study these processes. We have optimized clearing methods and 3D imaging of whole cochleas as a possible new way to assess damage and repair of the inner ear. Furthermore, we make use of organoid culture methods to derive sensory cells from pluripotent cells. Confocal and lightsheet microscopy approaches are being evaluated as methods to quantify hair cell numbers in vitro in these 3D culture models. I will present some of our ongoing work covering these approaches and imaging techniques.

Real-time data processing for advanced microscopy

Mykhailo Vladymyrov

Laboratory for High Energy Physics, University of Bern

Real-time data processing is vital for advance of intravital study .Fast data processing with the use of Graphical Processors, allows building real-time control systems including but not limited to correcting for tissue drift or following a selected cell over its lifetime. We apply our experience in particle physics detector data acquisition and analysis using high performance real-time data processing to allow long term acquisitions and real-time cell tracking to follow single cells. This can broaden possibilities of intravital microscope imaging.

Two-photon imaging of T-cell interactions with the inflamed cervical spinal cord microvasculature

Neda Haghayegh Jahromi[1]; Heidi Tardent[1]; Gaby Enzmann[1]; Urban Deutsch[1]; Naoto Kawakami[2,3]; Stefan Bittner[4]; Dietmar Vestweber[5]; Frauke Zipp[4]; Jens V. Stein[1]; Britta Engelhardt[1]

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T-cell migration across the blood-brain barrier (BBB) is a crucial step in the pathogenesis of experimental autoimmune encephalomyelitis (EAE), an animal model of multiple sclerosis (MS). Two-photon intravital microscopy (2P-IVM) has been established as a powerful tool to study cell-cell interactions in inflammatory EAE lesions in living animals. In EAE, central nervous system (CNS) inflammation is strongly pronounced in the spinal cord, an organ in which 2P-IVM imaging is technically very challenging and has been limited to the lumbar spinal cord. In addition cervical spinal cord lesions are seen in MS. We have therefore established a novel spinal cord window preparation allowing to use 2P-IVM to image immune cell interactions with the cervical spinal cord microvascular endothelium during EAE over extended time. We observed differences in the angioarchitecture of the cervical spinal cord versus the lumbar spinal cord, which will entail different hemodynamic parameters in these different vascular beds and thus may influence T-cell trafficking to different parts of the spinal cord. We presently employ this novel window preparation to directly compare the multi-step extravasation of encephalitogenic Th1 versus Th17 across cervical spinal cord microvessels *in vivo*. This analysis includes investigation of the cellular pathway of T-cell diapedesis across the BBB by visualization of endothelial junctions in this vascular bed.

Liver stage malaria parasites escape host cell autophagy

Livia Niklaus

Institute of Cell Biology, University of Bern

Plasmodium parasites are the causative agent of malaria and are transmitted by *Anopheles* mosquitoes. Before the clinically relevant blood stage, the parasites infect hepatocytes where they reside in a special compartment called parasitophorous vacuole (PV). A host cell autophagy-related process plays an important role in the control of liver stage *Plasmodium* parasites. Previously, we have shown that autophagy markers, like LC3, localise to the PV membrane (PVM) in early liver stages. It has been found that viable parasites can exclude LC3 from the PVM at later liver stages and preliminary experiments suggest membrane shedding as a possible mechanism. To prove membrane shedding by biophysical means, we expressed parasite and host cell PVM proteins tagged with photo-convertible fluorescent proteins and analysed their localization before and after photo-conversion.

Membrane shedding depends on a constant supply of phospholipids. We are currently investigating whether the host cell ER or even the parasite ER contributes to this supply. Putative contact site proteins that could be involved in PVM and ER phospholipid exchange have been identified and now we investigate their localisation and their function in *P. berghei*-infected host cells. Different microscopy techniques like long-term video imaging and confocal microscopy but also super resolution (STED) microscopy as well as electron microscopy (serial block phase microscopy) have been employed to characterise parasite localisation and parasite-host cell interaction in greater detail. These techniques confirmed that parasite and host cell ER are closely associated with the parasite. Now we will try to manipulate this connection to investigate whether this has an effect on parasite development.

Imaging epicardium formation in the zebrafish

Alexander Ernst

Institute of Anatomy, University of Bern

The zebrafish is an established model organism for developmental studies. Cardiovascular diseases are a major burden to human health. The heart tissue is mainly structured in three layers namely endocardium, myocardium and epicardium. The epicardium plays an important role in nourishing and protecting the myocardium. Nevertheless, our knowledge on the outermost layer of the heart is still quite scarce.

How is the epicardium being formed? A transient structure, the pro-epicardium (PE), can be found in the dorsal pericardial wall. These pro-epicardial cells will start to populate the surface of the heart.

Our aim is to characterize the mechanisms of pro-epicardium formation and layer creation on the myocardial surface, using confocal laser scanning microscopy *in situ* and *in vivo*.

For imaging of zebrafish embryos the Zeiss LSM880 offers great hardware, as the 40x water immersion objective lens (NA 1.2) gives a good resolution and a long working distance at the same time. In addition, the new *Airyscan Fastmode* allows to image dynamic structures in high resolution. Newly developed processing methods even allow proper visualization of the beating embryonic heart.