ACP/ASP Guest Professor
Prof. Theo LASSER (École Polytechnique Fédérale de Lausanne, EPFL)

Prof. Theo Lasser is a full professor at the École Polytechnique Fédérale de Lausanne (EPFL) and heading the Laboratoire d’Optique Biomédicale (LOB). He is visiting ACP and ASP as a guest professor in May and June 2018, and he will give a series of lectures, open to the interested public.

Theo Lasser's research focuses on functional imaging, the development of coherent imaging methods and its application in medicine and life sciences. Low coherence microscopy (OCM) with applications in diabetes, neuroscience and infectious diseases represent current research interests. Fluorescence microscopy and spectroscopy and in particular superresolution imaging (SOFI) applied to cell imaging complement these research efforts. Besides his publications and patents, he cofounded several companies, which are providing innovative optical instrumentation and services. Before joining EPFL in 1998, he pursued an industry career at Carl Zeiss starting in the central research division, heading the R&D in ophthalmology and in his last assignment as director of Carl Zeiss Research Center, Jena where he initiated various research projects in optics.

Lecture 1: SOFI – a novel road for superresolved microscopy
Tuesday, May 8, 2018. 2:30 pm
Zeiss room at the Fraunhofer IOF, Albert-Einstein-Str. 7, 07745 Jena

Super-resolution optical fluctuation imaging (SOFI) provides an elegant concept for 3D super-resolution imaging. We intend to expand the scope of this imaging technique based on new applications in life sciences and medicine. As a first example, we exploit the higher order cumulant statistics of SOFI, which allows to assess quantitatively the receptor distribution and clustering on T-cells. In a further extension we combine SOFI with a novel label-free white light quantitative phase tomography to provide high-speed 3D imaging (>100 Hz) and spatial super-resolution. Finally we would like to report on our recent progress concerning the gut-Alzheimer Disease link. This project demands a realm of optical techniques ranging from functional brain imaging to a novel way for a fast read-out of the microbiome. These selected examples based on new optical concepts demonstrate the growing potential of optical imaging for medicine and lifesciences.
Lecture 2: Colloquium of the Faculty of Physics and Astronomy:
Imaging across scales – from tissue to DNA

Monday, May 28, 2018. 4:15 pm
Abbeanum, lecture hall 1, Fröbelstieg 1, 07743 Jena
Tissue, cell and subcellular structures can all be visualized based on coherent imaging and provide a variety of information with high spatial and temporal resolution. Structural imaging complemented by functional information can be assessed by coherent imaging based on optical techniques like extended-focus Optical Coherence Microscopy (xf-OCM), Doppler Imaging and photothermal optical lock-in Coherence Tomography (poli OCM), which allows extending these coherent imaging techniques from tissue structure into cellular dimensions. A final outlook into superresolution (SOFI) combined with phase imaging (PRISM) will be demonstrated by fast 3D cell imaging and DNA-mapping used to decipher the DNA information content at high read-out speed.

Lecture 3: Coherent Imaging I

Tuesday, May 29, 2018. 10:00 am
ACP auditorium, Albert-Einstein-Str. 6, 07745 Jena
Statistical optics provides a general framework for the understanding of coherent imaging. Based on the Wiener-Khinchin theorem we will derive a simple but general model exploiting the temporal coherence properties for interferometric imaging. This theoretical framework will be complemented by numerous experimental realizations and results to learn the broad potential of coherent imaging. Learning outcomes:

- Temporal coherence – Wiener-Khinchin theorem
- Coherent imaging – time domain – Fourier domain
- Experimental design – interferometric imaging

Lecture 4: Coherent Imaging II

Tuesday, June 5, 2018. 10:00 am
ACP auditorium, Albert-Einstein-Str. 6, 07745 Jena
Dynamic contrast allowed to see in-vivo the vascularization and the full vessel system down to a depth of 1 mm. This contrast mechanism will be discussed in detail and demonstrated with various examples. This is also the starting point for more advanced concepts like photothermal lock-in techniques allowing to probe cellular mechanisms and processes with high specificity.

The Bessel-beam illumination will be introduced and discussed in detail with its important consequences for high axial and lateral resolution followed by experimental results. Learning outcomes:

- Coherent imaging – contrast mechanisms
- Axicon and Bessel-beam – lateral and axial resolution
- Advanced experimental design – interferometric imaging

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Lecture 5: Coherent Imaging III
Tuesday, June 12, 2018. 10:00 am
ACP auditorium, Albert-Einstein-Str. 6, 07745 Jena
Abstract tba soon