"Fourier Domain Mode Locking (FDML): A new laser for Megahertz optical coherence tomography (OCT) and molecular stimulated Raman imaging"

Lecturer:

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University:

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Area:

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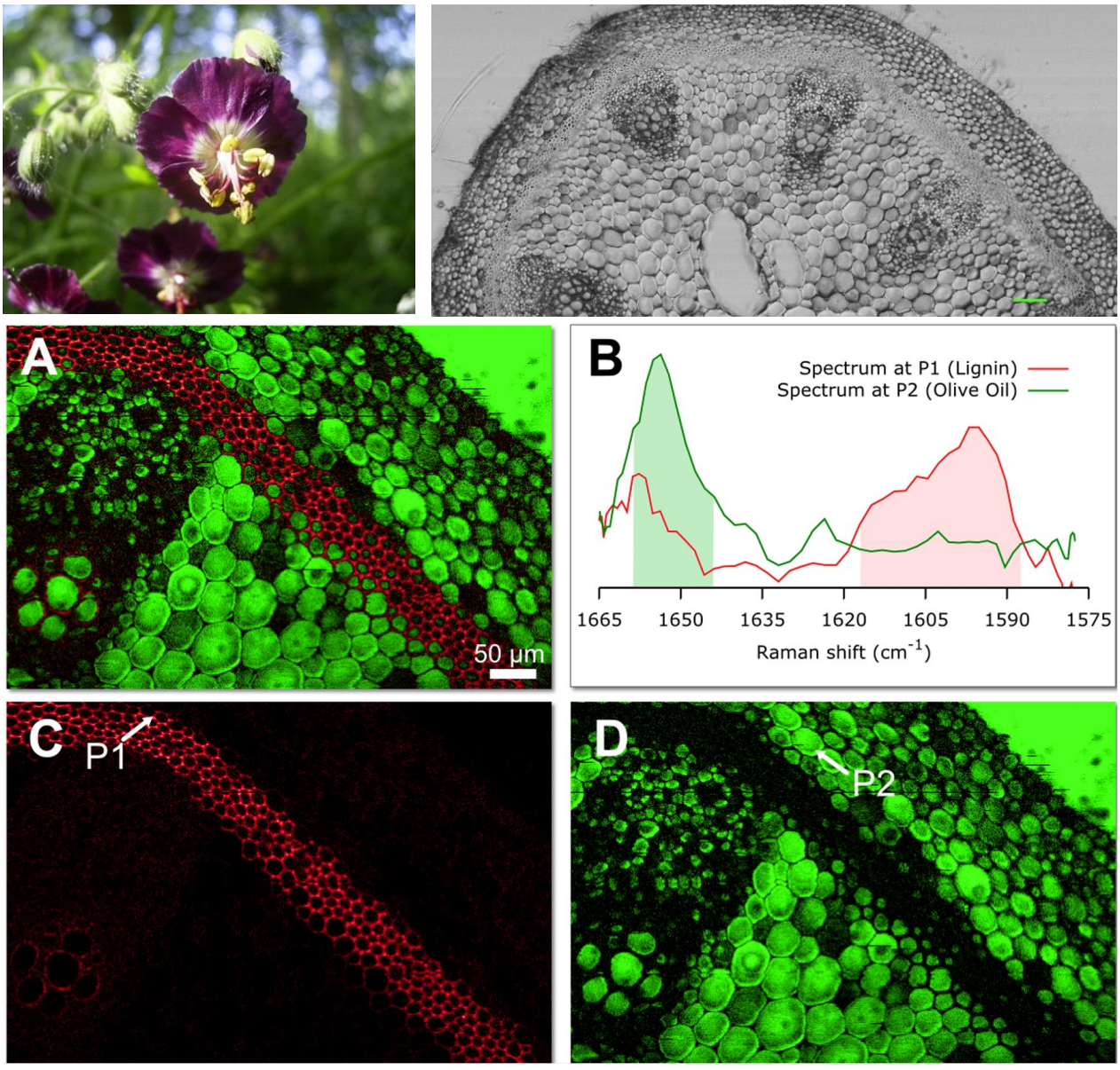
Abstract:

Optical coherence tomography (OCT) is one of the biggest and fastest growing fields in optics. This new optical imaging modality is mainly used in biomedical applications, where it can provide depth resolved three-dimensional tissue contrast with micron scale resolution. One implementation of OCT requires rapidly wavelength swept, narrowband cw-laser light sources. Since the performance requirements of such OCT lasers substantially differ from classical tunable lasers, over the last ten years many groups have spent great effort on developing appropriate laser sources. Some of the best performing OCT light sources are the recently invented Fourier Domain mode locked (FDML) lasers, which enabled OCT depth scan rates well into the Multi-Megahertz range (MHz-OCT) for the first time. The talk will discuss the FDML mechanism, the related physics behind it, the involved laser technology, and various OCT imaging examples from ophthalmology, cardiology, developmental biology and genetics.

Besides OCT, which is the main FDML application, these new light sources appear promising for the generation of short laser pulses, general fiber sensing applications, ultra-rapid real time spectroscopy and hyper-spectral stimulated Raman microscopy with molecular contrast. The application of FDML lasers for Raman sensing appears exceptionally attractive, since a future combined OCT and Raman imaging system will enable a fast, depth resolved molecular imaging engine, fully compatible to fiber endoscopic beam delivery for in vivo imaging in patients. The advantages of stimulated Raman sensing compared to current state of the art technology will be discussed, together with the remaining challenges faced by today's FDML-Raman prototypes.



TiCo-Raman using FDML: „Geranium phaeum"

Biography:

Prof. Dr. Robert Huber is the head of a research group at Universität zu Lübeck focusing on novel laser light sources and biomedical in vivo imaging. He studied general physics at the LMU Munich with major astronomy and nuclear physics. He received his Diplom (~Master) in 1998 and his Dr. rer. nat. (~PhD) in 2002. During his PhD his research focused on femtosecond laser technology and spectroscopy and he studied fastest electron transfer processes in novel solar cells. From 2002-2003 Robert Huber worked at the University of Frankfurt in the Department of Physical Chemistry as postdoc on conformational dynamics of biomolecules. From 2003 to 2007 he worked in the group of Prof. James Fujimoto, who is credited with the invention of optical coherence tomography, at the Massachusetts Institute of Technology (MIT) as postdoctoral associate. Robert Huber developed wavelengths swept lasers for optical coherence tomography and invented the Fourier Domain Mode Locked (FDML) laser. From 2007 -2012 Robert Huber lead an independent research group in the Emmy Noether program of the German research foundation (DFG). Since 2010 he leads an ERC Starting grant group. Since Sept. 2013 he is Professor of Optical in vivo Imaging at the University of Luebeck. Robert Huber co-authored 105 peer reviewed publications including 62 international journal articles. His publications attracted 3305 citations and he has an h-index of 28. He holds 11 patents. He received the Albert Weller Preis 2003, the Rudolf Kaiser Preis 2008 and the Klung Wilhelmy Weberbank Preis 2013. In the years 2011 and 2012 Robert Huber was elected as one of Germany's 40 top talents under the age of 40 in the field of science by the business magazine CAPITAL. He was awarded an ERC Starting Grant 2010 ("FDML:Raman", 01.01.2010 -) and an ERC Consolidator Grant 2014 ("ENCOMOLE-2i", 01.01.2016 -). He is cofounder of the Optores GmbH, commercializing FDML lasers.