TECHNISCHE UNIVERSITÄT DRESDEN

School of Science Faculty of Physics

PHYSICS COLLOQUIUM

Speaker: **Dr. Michael Rüsing**
Institute of Applied Physics,
TU Dresden, Germany

Topic: **Towards Quantitative nonlinear microscopy at the nanoscale**
Introduction for habilitation

Time and place: Tuesday, April 11, 2023, **2:50 pm** – hybrid event
The colloquium will be held in REC/C213.
Online participation possible:
Zoom-Meeting: Meeting-ID: 631 3817 8900 / passcode: PK-SoSe23
https://tu-dresden.zoom.us/j/63138178900?pwd=RVVZM3N4azdmNmVJQ2RWUTZ0TkhXdz09

Host: Prof. Lukas Eng

Abstract: Nonlinear optical (NLO) microscopy is widely employed for spatial analysis in material science. A key feature of NLO processes is that they do not rely on probing energy transitions, but rather just depend on the local symmetry and crystallographic structure. This makes NLO methods very attractive, as they do not require any special sample preparation and can provide intricate insight into many properties.
The signal generation in NLO microscopy largely depends on the phase matching between the interacting beams, which itself depends on material properties, such as the dispersion of the refractive indices, or the focusing of the light. As NLO are very sensitive to small changes, small variations in focusing, thickness, refractive index or wavelength can result in huge signal changes limiting the capability for quantitative analysis, if not accurately accounted for.
In this work, I will show how all these effects can be dealt with theoretically by developing numerical, as well as semi-analytical models allowing to describe experiments with high accuracy. To demonstrate and test the capabilities of the modeling approaches, experiments are performed on ferroelectric domain structures in lithium niobate. Here, for example, in periodically poled thin films, the experiments show that quantitative analysis allows to extract information way below the diffraction limit due to the coherent nature of a NLO process. The joint experimental and theoretical approach represent a powerful tool for the interpretation and analysis of NLO experiments guiding the way to new techniques, such as Coherent Anti-Stokes Raman (CARS) spectroscopy.

Bio: Dr. Michael Rüsing received his PhD in 2018 from the University of Paderborn on spectroscopy in ferroelectric materials. From 2018-2019 he was a postdoctoral researcher at the University of California, San Diego, where he worked on integrated, nonlinear photonics in silicon. Since 2019, he leads a research team at the IAP under the supervision of Prof. Eng on ferroelectric materials.