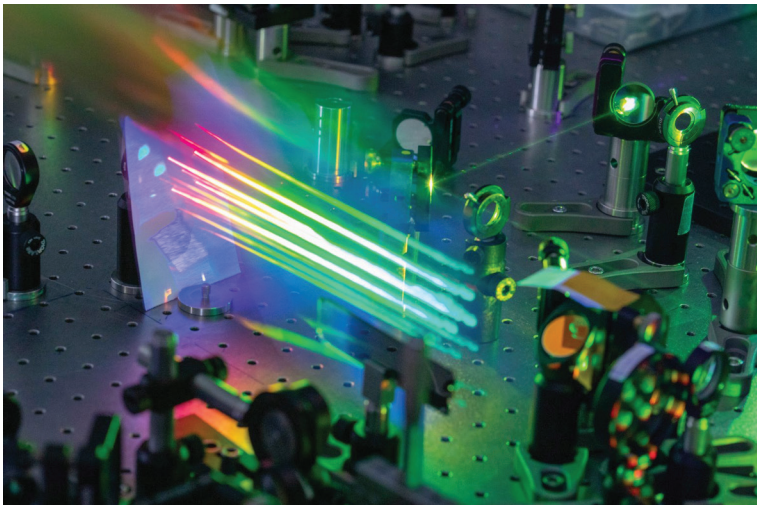


<https://uni-due.zoom-x.de/j/64228670246?pwd=RjVQeFNIUkRKrkpiNVpKYXhJaFNLdz09> (gilt für alle Vorträge)

Femtosecond holographic microscopy: from single nano-objects to chiroptical imaging

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Far-field ultrafast microscopy techniques are valuable in revealing spatio-temporal dynamics in matter, with applications ranging from measuring ultrafast carrier diffusion in the solid state to performing spectroscopy of single nano-objects. However, typically fields of view of only a few microns are used, severely hampering applications that lack a very small and findable region of interest. In this talk, I will present recent results from our group combining off-axis holography with femtosecond pulses to perform ultrafast microscopy over $100 \times 100 \mu\text{m}^2$ areas. I will show how the extended field of view can be exploited to simultaneously perform ultrafast spectroscopy of dozens of single nanoparticles [1], or to measure ultrafast diffusion of hot carriers in semiconductors around 100 nm near diffraction limited excitation spots [2]. Moreover, holography recovers the complex-valued electric field, and access to the typically unavailable phase information can be valuable, which I will demonstrate with two applications. The first is to perform ultrafast spectroscopy on dozens of individual nanoparticles diffusing in solution whilst tracking their positions in 3D over a

volume of $100 \times 100 \times 100 \mu\text{m}^3$ [3]. The second is to perform ultrafast chiroptical widefield microscopy, where the full polarization information is recorded for each pixel, in such a way that each hologram simultaneously records the transient absorption transient phase, transient circular dichroism and transient Faraday rotation [4]. As an example, I will show data on the spatio-temporal dynamics of light-induced demagnetization in a ferromagnet.

[1] M. Liebel, F. V. A. Camargo, G. Cerullo, and N. F. van Hulst, „Ultrafast Transient Holographic Microscopy,“ *Nano Lett.* 21, 1666-1671 (2021)

[2] M. Hörmann, F. Visentin et al., „High-sensitivity visualization of ultrafast carrier diffusion by widefield holographic microscopy,“ *Ultrafast Sci.* 3, 0032 (2023)

[3] M. Liebel, F. V. A. Camargo, G. Cerullo, and N. F. van Hulst, „Widefield phototransient imaging for visualizing 3D motion of resonant particles in scattering environments,“ *Nanoscale*, 14, 3062-3068 (2022)

[4] M. Hörmann, F. Visentin, J. A. Gessner et al. „Ultrafast holographic chiroptical microscopy,“ *Nat. Photon.* 20, 592–599 (2026)