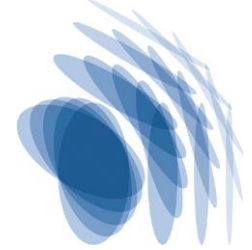


Max-Planck-Institut für Struktur und Dynamik der Materie

Max Planck Institute for the Structure and Dynamics of Matter



IMPRS UFAST Call for PhD applications 2025/2026



TH1 – Sensing of relativistic electrons with chip-integrated photonics

Title of PhD Project	Sensing of relativistic electrons with chip-integrated photonics
Type	Experimental
Supervisor(s)	Tobias Herr
Affiliation(s):	UHH / DESY
Number of positions:	1
Abstract:	<p>Nonlinear optical effects can be harnessed to manipulate light with light. In chip-integrated nonlinear photonic waveguides, this coupling can be drastically enhanced. This thesis will explore and develop a novel chip-integrated photonic sensor for relativistic electrons in free-electron lasers (FELs). Specifically, we aim to detect the interaction between the electrons' electric field and the electric field of an ultrashort laser pulse, providing precise timing and spatial information on the relativistic electrons—a critical prerequisite for, e.g., time-resolved, atomic-resolution imaging of biomolecules. The chip-integrated photonic platform is expected to boost current sensitivity by orders of magnitude and may also be used to study fast, non-repetitive phenomena in chemistry and biology.</p> <p>The thesis will leverage experimental, numerical, and analytical techniques at the forefront of integrated photonics, ultrafast lasers, and nonlinear optics. It will include the design of advanced chip-integrated laser systems as well as experiments in our state-of-the-art laboratory. The work combines exploration of unknown physics with the development of immediately relevant and impactful optical technologies. We regularly present our results at international conferences and collaborate closely with leading research groups across scientific disciplines.</p> <p>Ludwig et al., Nature Comm. 15, 1, 7614 (2024), DOI: 10.1038/s41467-024-51560-x. Ulanov et al., Nature Photon. 18, 294-298 (2024), DOI: 10.1038/s41566-023-01367-x. Steffen et al., Rev. of Sci. Instr., 91, 045123 (2020), DOI: 10.1063/1.5142833.</p>
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