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 2026/2027

AC2 - Ultrafast Nonlinear Electrical Driving of Quantum Materials

Title of PhD Project	**Ultrafast Nonlinear Electrical Driving of Quantum Materials**
Type	Experimental
Supervisor(s)	Prof. Andrea Cavalleri
Affiliation(s):	Max Planck Institute for the Structure and Dynamics of Matter
Number of positions:	1
Abstract:	Optical nonlinear driving of quantum materials has proven to be a powerful approach for manipulating phases of matter and uncovering the underlying coupling between different orders. However, such optical methods typically require intense laser pulses from large-scale amplifiers, making them challenging to integrate into on-chip electronics. This project proposes an alternative route: using strong picosecond current pulses to drive quantum materials into the nonlinear regime, enabling the study of the underlying coupling between different degrees of freedom. The nonlinear and coherent interaction between current pulses and quantum materials offers a pathway to ultrafast, on-chip electrical control of matter phases. The goal of this PhD project is to develop a complete on-chip platform for electrical pump–electrical probe experiments on quantum materials. Candidate materials will be integrated into devices incorporating striplines and photoconductive switches, allowing electrical excitation and detection on picosecond timescales. This PhD position offers the opportunity to combine advanced device fabrication in a cleanroom with a cutting-edge electro-optical platform, exploring nonlinear transport phenomena in quantum materials at ultrafast timescales.
Contact person for scientific questions about the project:	Prof. Andrea Cavalleri: andrea.cavalleri@mpsd.mpg.de Dr. Eryin Wang: eryin.wang@mpsd.mpg.de
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