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SPECIAL SEMINAR

סמינר מיוחד

## High Coherence Electron Pulses for Ultrafast Transmission Electron Microscopy

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### Abstract

Ultrafast transmission electron microscopy (UTEM) combines the versatile nanoscale imaging, diffraction and spectroscopy available in electron microscopes with femtosecond temporal resolution achieved by a laser-pump/electron-probe scheme [1]. However, to make full use of the capabilities of state-of-the-art TEM, highly coherent electron pulses are required, demanding for novel photocathode concepts.

Here, I will describe the implementation of an advanced UTEM instrument utilizing laser-triggered field emitters and present first applications harnessing its superior electron beam coherence.

Specifically, the Göttingen UTEM employs electron pulses of excellent spatio-temporal properties (down to 0.8-nm focal spot size, 200-fs pulse duration and 0.6-eV spectral bandwidth), generated by localized linear photoemission from a Schottky-type field emitter tip [2].

I will give a brief overview of current experiments in ultrafast imaging and local diffractive probing of condensed matter systems. These include the local diffractive probing of strain dynamics in a single crystalline graphite membrane [3], the laser-induced dynamics of nanopatterned magnetic permalloy thin films [4], and the time-resolved mapping of the charge-density wave phase transition in the correlated material 1T-TaS<sub>2</sub>.

In a further line of applications, we utilize the interaction of fast electrons with intense optical near-fields to establish quantum coherent control of free electron pulses by light [5]. As a particular example, I will describe the three-dimensional optical phase-shaping of electron beams, with applications for generating atto second electron pulse trains [6] and coherent electron beam splitters.

### **Reference:**

- [1] A.H. Zewail, *Science* **328**, 187 (2010).
- [2] A. Feist *et al.*, *Ultramicroscopy* **176**, 63 (2017).
- [3] A. Feist *et al.*, *Struct. Dyn.* **5**, 14302 (2018).
- [4] N. Rubiano da Silva *et al.*, *Phys. Rev. X* **8**, 031052 (2018).
- [5] A. Feist *et al.*, *Nature* **521**, 200–203 (2015).
- [6] K.E. Priebe *et al.*, *Nat. Photonics* **11**, 793–797 (2017).

ההרצאה תתקיים ביום המישי, ה-12.12.19 בשעה 10:00

באודיטוריום המכון למצב מוצק, קומת כניסה

The lecture will take place on Thursday, 12.12.19 at 10:00  
at the Solid State Institute auditorium, entrance floor

**Host: Dr. Ido Kaminer**