

INVITATION

to a TALK by

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Femtosecond and attosecond electron microscopy: Seeing atoms and electrons in space and time

The fundamental reason behind almost any light-matter interaction are atomic and electronic motion in space and time. In order to provide a movie-like access to such dynamics, we unify electron microscopy with attosecond and femtosecond laser technology. In this way, we combine the awesome spatial resolution of modern electron beams with the spectacular time resolution that is offered by the cycle period of light [1-2].

Selected results will be reported on the electric fields within metamaterials [2-3], the Einstein-de-Haas effect on atomic dimensions [4], the reaction path of phase transitions [5] and the formation of free-electron qubit states [6]. Many breakthroughs in science and technology have been achieved by novel imaging techniques, and we will discuss how our ultrafast electron microscopy may contribute.

- [1] D. Nabben, J. Kuttruff, L. Stolz, A. Ryabov, P. Baum, "Attosecond electron microscopy of sub-cycle optical dynamics", *Nature*, accepted (2023).
- [2] C. Kealhofer, W. Schneider, D. Ehberger, A. Ryabov, F. Krausz, P. Baum, "All-optical control and metrology of electron pulses", *Science* 352, 429 (2016).
- [3] A. Ryabov and P. Baum, "Electron microscopy of electromagnetic waveforms", *Science* 353, 374 (2016).
- [4] S. R. Tauchert, M. Volkov, D. Ehberger, D. Kazenwadel, M. Evers, H. Lange, A. Donges, A. Book, W. Kreuzpaintner, U. Nowak, P. Baum, "Polarized phonons carry angular momentum in femtosecond demagnetization", *Nature* 602, 73 (2022).
- [5] P. Baum, Ding-Shyue Yang, A. H. Zewail, "4D Visualization of Transitional Structures in Phase Transformations by Electron Diffraction", *Science* 318, 788 (2007).
- [6] M. Tsarev, A. Ryabov, P. Baum, "Free-Electron Qubits and Maximum-Contrast Attosecond Pulses via Temporal Talbot Revivals", *Phys. Rev. Res.* 3, 043033 (2021).

Wednesday, May 3rd, 2023 16:30

Lise Meitner lecture hall, 1st floor
Boltzmannngasse 5, 1090 Vienna

Hosted by: Thomas Juffmann