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EINLADUNG zum IFP-SEMINAR

Production and Application of Electron Vortex Beams

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Wiedner Hauptstraße 8-10, 1040 Wien
Seminarraum DC rot 07 (roter Bereich, 7. OG)

Abstract:

By placing a holographic vortex mask (HVM) in the condenser system of a transmission electron microscope (TEM), electron vortex beams (EVBs) can be produced [1]. They carry quantized orbital angular momentum (OAM) as well as a quantized magnetic moment.
Using binary holographic vortex masks (HVMs) represents a powerful and straight forward method to produce EVBs [1]. For the applications presented here, i. a. large scale high, high efficiency HVMs with low grating periodicities are needed. Thus, measures to improve the production process of HVMs with the aim to enhance their fidelity and diffraction efficiency will be presented.

Due to the intrinsic chirality of EVBs, they have become a promising candidate for energy-loss magnetic chiral dichroism (EMCD) measurements. In magnetic materials, atom-sized EVBs are naturally produced in inelastic scattering events. By employing HVMs as OAM filtering elements in a post-specimen geometry [2], it was possible to discern small asymmetries in the OAM content of the outgoing wave field, indicative of a faint EMCD signal, with sub-nanometre resolution.

EVBs can also be used to study the interactions of the electron OAM with the magnetic lens field of a TEM. It could be found that their rotational behaviour reveals peculiar rotational dynamics, departing from what standard electron imaging theory would predict [3], including free-electron Landau states [4].

[1] J. Verbeeck et al., Nature 467 (2010), 09366; K.Y. Bliokh et al., Physics Reports 690 (2017), 1-70.
[2] T. Schachinger et al., Ultramicroscopy 179 (2017), 15-23.
[3] T. Schachinger et al., Ultramicroscopy 158 (2015), 17–25.
[4] P. Schattschneider, T. Schachinger et al., Nature Commun. 5 (2014), 4586.