TT 86: Low-Dimensional Systems: Charge Order

Time: Friday 11:15–12:00 Location: HSZ 103

TT 86.1 Fri 11:15 HSZ 103

Origin of the negative plasmon dispersion in $NbSe_2$ and related systems. — •Eric Müller, Martin Knupfer, and Bernd Büchner — IFW-Dresden, P.O.Box 270116, DE-01171 Dresden, Germany

The charge carrier plasmon excitations of $2H$-$NbSe_2$ and related single crystalline systems have been investigated using electron energy-loss spectroscopy. These systems consist of hexagonal layers with weak interlayer van-der- Waals bonding.

We compare two possible routes to explain the observed unusual negativ plasmon dispersion; charge density wave plasmon interaction and band structure effects. Motivated by the orbital character of the plasmon dispersion in alkali metal doped transition metal dichalcogenides, we demonstrate that the separation of the plasmon from the screening contributions of single particle excitations by a Kramers-Kronig analysis reveals a positive (unscreened) plasmon dispersion.

TT 86.2 Fri 11:30 HSZ 103

Electronic self-organization in layered transition metal dichalcogenides — •Tobias Ritschel[1], Jan Trinckauf[2], Martin von Zimmermann[3], Klaus Koepernik[2], Peter Abbamonte[5], Young Joe[5], Helmuth Berger[4], Bernd Büchner[1,2], and Jochen Geck[1] — [1]TU Dresden — [2]IFW, Dresden — [3]DESY Hamburg — [4]Ecole polytechnique Federale de Lausanne — [5]University of Illinois

We combined density functional theory (DFT) with angle-resolved photoemission spectroscopy (ARPES) and x-ray diffraction to discover that the electronic order in the prototypical charge density wave system 1T-TaS_2 involves complex orbital textures. Most importantly, the low energy electronic band structure parallel to the layers depends crucially on the stacking of these orbital textures in the perpendicular direction, which challenges the classical view of these materials as being quasi 2D-systems. Recently, we refined our DFT models to implement an approximation of the partially disordered character, which is found experimentally for the orbital texture stacking in the so-called Mott-phase of 1T-TaS_2. The excellent agreement of these simulations with ARPES data indicates that the previous paradigm of a Mott-gap in this system needs to be reconsidered. Instead, we find firm evidence that the corresponding gap is predominantly caused by hybridization between the orbital textures in adjacent TaS_2-layers. We will discuss these results with respect to recent experiments which reported marked changes of macroscopic properties in exfoliated transition metal dichalcogenides as a function of thickness. Understanding such effects is increasingly important with respect to future applications.

TT 86.3 Fri 11:45 HSZ 103

Pressure dependent x-ray diffraction study of the electronic order in $IrTe_2$ — •Maximilian Kusch[1,2], Tobias Ritschel[2], Jan Trinckauf[1], Gaston Garbarino[3], Sang-Wook Cheong[4], and Jochen Geck[2] — [1]Institute for Solid State and Materials Research, Helmholtzstrasse 20, 01069 Dresden, Germany — [2]Institut für Strukturphysik, Technische Universität Dresden D-01062 Dresden, Germany — [3]European Synchrotron Radiation Facility, B.P.220, 38043 Grenoble, France — [4]Department of Physics and Astronomy Rutgers, The State University of New Jersey 136 Frelinghuysen Road Piscataway, NJ 08854-8019 USA

The proximity of spatial electronic order and superconductivity in the transition metal dichalcogenides (TMDs) currently attracts a lot of interest. At ambient pressure, also pristine IrTe2 exhibits electronic order below $T_s \approx 250$ K and becomes superconducting upon doping with Pd and Pt, although it remains unclear whether this transition is similar to other TMDs. In addition, contrary to other TMDs, measurements of the electrical resistivity indicate a stabilization of the electronic order accompanied by a suppression of the superconducting phase. In order to clarify the underlying physics we performed pressure dependent single crystal XRD measurements up to 42 GPa on $IrTe_2$ and its Pd (4%) and Pt (7%) doped variants. Our data reveal two transitions in $IrTe_2$ upon increasing pressure, where the first one is identified by surprisingly strong superlattice reflections, whereas the second one is better described by a transformation into a completely new crystal structure with a large unit cell.