Fritz-Haber-Institut der Max-Planck-Gesellschaft

Physikalische Chemie — Direktor: Prof. Dr. Martin Wolf

MAX-PLANCK-GESELLSCHAFT

PC Seminar:

Monday, September 25, 2017, at 11:00 a.m. ;

Christopher Nicholson

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Electronic Structure and Dynamics of Quasi-One Dimensional Materials

Richard-Willstätter -Haus, Faradayweg 10.

Abstract:

Knowledge gained by studying low dimensional materials not only increases our fundamental understanding of matter, but may also be used to develop nanotechnologies addressing some of the great challenges faced by humankind. In particular by restricting electrons to one-dimensional (1D) wires, the enhancement of the Coulomb interaction and the reduction of scattering phase space results in a range of phenomena including metal-to-insulator transitions, charge density waves (CDWs) and possibly the Tomonaga-Luttinger liquid. Here, the focus of is on model quasi-1D materials in which coupling of 1D wires to a higher dimensional environment is present, for example via inter-wire or wire-substrate coupling; features common to real world systems.

Following an introduction to quasi-1D materials, the technique of angle resolved photoemission spectroscopy (ARPES) will be introduced. The power of ARPES to quantify higher dimensional coupling in quasi-1D systems will be briefly illustrated using the bulk 1D compound NbSe3. Extending ARPES to the time-domain by utilizing a novel high-harmonic-generation source allows the photo-induced CDW transition in In/Si(111) atomic wires to be investigated with unprecedented detail. The phase transition is found to evolve on three distinct time scales, including clearly separated metal-to-insulator and structural transitions. An exceptional agreement between experiment and molecular dynamics simulations is found, allowing microscopic insights into the phase transition mechanism. Finally a link is made from the transient electronic structure to the ultrafast formation of bonds in real space. The results presented provide detailed insights into quasi-1D materials.