Ultrafast collapse of periodic long-range order tracked by time-resolved XUV-ARPES

T. Rohwer[1], S. Hellmann[1], M. Wiesenmayer[1], C. Sohrt[1], A. Stange[1], M. Kalläne[1], S. Mathias[2,3], L. Kipp [1], K. Rossnagel[1], M. Bauer [1]

[1] *IEAP, Universität Kiel, 24118 Kiel, Germany*
[2] *Department of Physics and Research Center OPTIMAS, University of Kaiserslautern, 67663 Kaiserslautern, Germany*
[3] *JILA, University of Colorado and NIST, Boulder, Co 80309-0440, USA*

The combination of ultrafast light sources in the UV spectral regime and the technique of photoelectron spectroscopy provides a unique tool for a most direct access to ultrafast processes in condensed matter systems that couple to electronic degrees of freedom. Angular resolution enables one in this context to monitor the temporal evolution of the valence electronic band structure of a solid at selected - and possibly critical - points in momentum space [1]. In this contribution we will present time- and angle-resolved photoemission spectroscopy (trARPES) experiments using femtosecond XUV pulses generated in a high harmonic light source, to study the ultrafast dynamics of a laser-induced phase transition in 1T-TiSe2. In response to a photoexcitation with an intense IR-pulse, we monitor the transient suppression of a phase characteristic band backfolding, indicative for a loss of long-range order in the CDW state (see Fig. 1). The characteristic response time of this process critically dependens on the IR pump fluence and we observe response times as short as 20 fs. We show that dynamical screening because of the transient generation of free carriers accounts for the observed timescales, the amplitudes of suppression, and the fluence dependence.

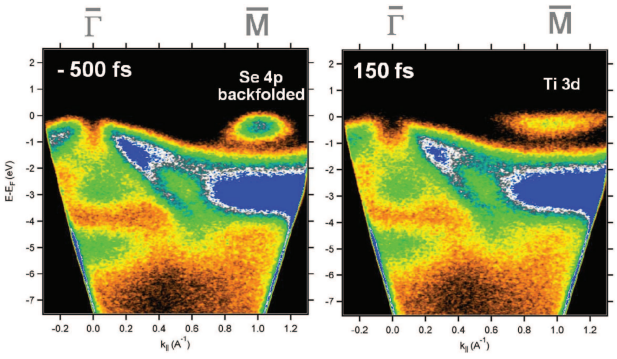

Figure 1: Time-resolved ARPES snapshots of 1T-TiSe2 prior (left) and after (right) excitation with a 30 fs IR laser pulse; the changes at the M point arise from the transient population of the Ti 3d band and the suppression of Se 4p band backfolding due to the (2x2x2) CDW reconstruction.

[1] F. Schmitt, et al., Science **321**, 1649 (2008).