Order parameter dynamics in Density Waves probed by femtosecond electron diffraction

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Reduced dimensionality seems to be an intrinsic property governing phenomena like high temperature superconductivity and charge density wave (CDW) formation. The latter are typical for quasi one- or two-dimensional metals at reduced temperatures. According to the standard Peierls Fermi surface nesting scenario the appearance of CDW phase at low temperatures is driven by the divergent static electronic susceptibility at a wave vector $q=2k_F$. Recently, this classical picture has been challenged [1], arguing that the appearance of CDWs, in particular in the transition-metal dichalcogenides, is due to strong (q-dependent) electron-phonon coupling [1].

I will review recent studies of transition-metal dichalcogenides, where the evolution of the order parameter (atomic displacement) following excitation with a femtosecond optical pulse has been directly recorded using femtosecond electron diffraction (FED) [2-4]. With FED we were able to directly follow the photo-triggered dynamics of periodic lattice distortion (order parameter) in dichalcogenides [2-4], point out the importance of three-dimensionality for the existence of CDWs in these quasi-2D systems [3], and to track the different stages of the photo-induced phase transition between different CDW phases [4].

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