Electron-hole fluctuations driving the charge density wave phase transition in $TiSe_2$

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Abstract:

There is a longstanding open question about the existence of a condensate of electron-hole pairs (excitons) in a way as it is well known for pairs of electrons, Cooper-pairs, in superconductivity. $TiSe_2$ exhibits an unusual temperature-dependence of transport experiments and a specific band configuration that has been related to the possible formation of excitons. Indeed, at the temperature of 200K, the layered, quasi-two-dimensional $TiSe_2$ undergoes a phase transition towards a charge density wave (CDW) phase, which is accompanied by a periodic lattice distortion (PLD) [1].

I propose the exciton condensate phase model [2] as the electronic origin of the CDW phase of $TiSe_2$. This scenario is supported by the good agreement between measured angle-resolved photoemission spectroscopy data and photoemission intensity maps calculated by the spectral function within this model [3]. With the help of perturbation theory calculations, I will motivate that above 200K, strong electron-hole fluctuations are provoking an electronic instability towards the CDW phase [4]. Eventually, this instability drives the PLD via the electron-phonon coupling [5].

References:

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