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Doping dependence of an exciton-driven CDW phase in 1T-TiSe2

Abstract:
The origin of the robust charge density wave (CDW) phase in this system has been a perennial source of new ideas, concepts, and controversy. A foremost and recurring question has been whether the CDW instability is primarily driven by electron-electron or electron-phonon interactions. Whereas it is clear that both ultimately play an important role in its overall electronic, lattice, and transport properties, the very low carrier density and particular CDW wavevector of this system has led to the suggestion that electron-electron interactions can be the dominant factor driving the CDW instability through a transition to an excitonic insulator state. By gathering the latest quantitative information about the band structure parameters from ARPES and performing a self-consistent Hartree-Fock calculation as a function of doping and temperature, we demonstrate that electron-electron interactions alone can explain very well the variation of Tc with electron doping seen in recent experiments up to densities where the superconducting dome emerges. In addition, the renormalized band structure predicted by our model provides a consistent interpretation for the development of partial gaps and the changes in the nature of charge carriers that are known, experimentally, to take place near Tc.

References

[1] L. Li et al, Nature, 2015 [185-189]
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[3] J. Van Wezel et al, Phys. Rev. B, 2010 [81, 16]
[4] H. Cercellier, Phys. Rev. Lett, 2007 [99, 14]

Figures

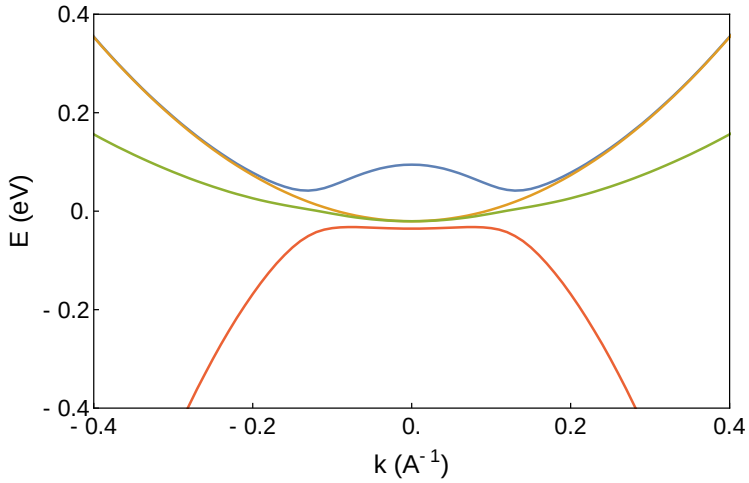

Figure 1: “Renormalized” band structure along the direction at T = 0K with a self-consistent solution of order parameter .

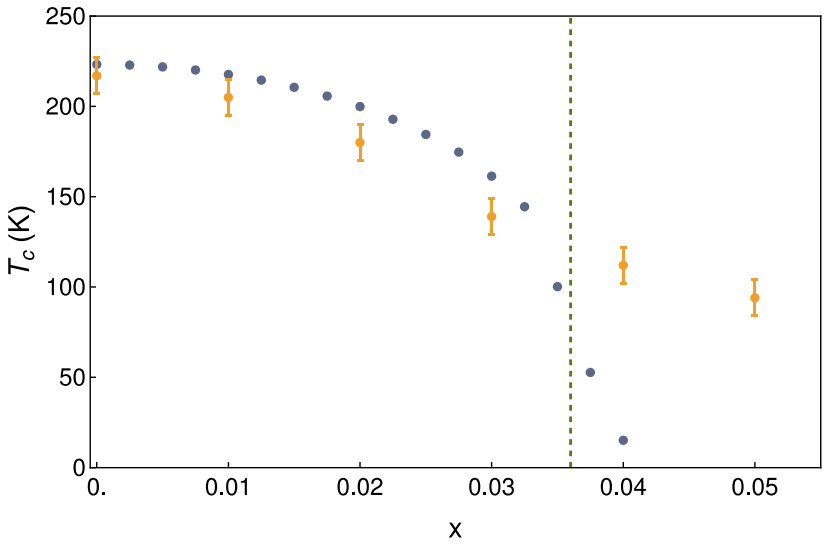

Figure 2: Transition temperature (Tc) versus doping (x) phase diagram.