Raman Spectroscopy of Quasi-two-dimensional materials

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Quasi-two-dimensional materials, known for their easy exfoliation to a monolayer and unique optical and transport properties are promising candidates for nanospinctronics and nanoelectronics. Experimental confirmation of magnetic ordering in these complex systems, which persists down to a monolayer, did not only widen up the area of their potential application, but also opened up a completely new experimental field in condensed matter physics – low dimensional magnetism. As previously proposed theories forbid magnetic ordering in 2D systems, it is no surprise that magnetic quasi-2D materials have only recently become an area of extensive study. Additionally, studies done on the transition metal dichalcogenides show that these materials host a very intriguing quantum phenomenon - charge density waves (CDW), which unexpectedly co-exist with superconductivity (SC). The mechanism behind the formation of CDW and its coexistance with SC still remain unexplained and are widely studied. In this talk I will present results of Raman Spectroscopy studies of the three magnetic Quasi-2D materials – ferromagnetic CrI_3 and VI_3, ferrimagnetic $Mn_3Si_2Te_6$. The main focus will be put on the lattice properties and various phase transitions in these compounds. I will also present study of charge density wave formation in 1T-TaS2, demonstrating that the Raman Spectroscopy can be used as a poweful tool in distinguishing the CDW and Mott gap, and for the determination of the size of the Mott gap.

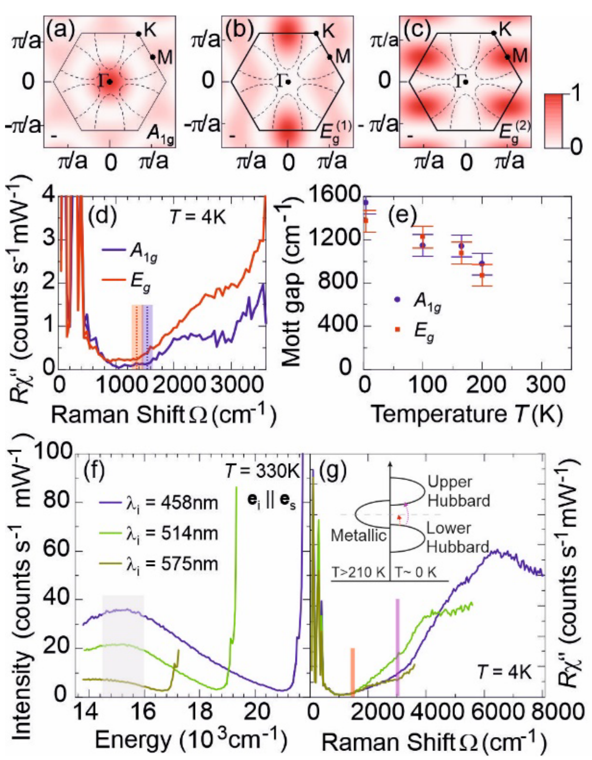

Figure. Evolution of CDW and Mott gaps in 1T-TaS_2. (a-c) Squared Raman vertices and Fermi surface for the indicated symmetries in the normal phase above T_{IC}. (d-g) Low energy Raman spectra for A_{1g} symmetry (blue) and E_g symmetries (red) at temperatures as indicated. (h) High energy spectra at 4 K. Vertical dashed lines and colored bars indicate the approximate size and error bar of the Mott gap for the correspondingly colored spectrum. (i) Temperature dependence of the Mott gap Δ_μ(μ = A_{1g};E_g)