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Electronic Interactions in Two-Dimensional Materials

Since the isolation of monolayer graphene, the library of two dimensional (2d) materials has been continuously growing. Together with recent developments in on-demand stacking of these atomically thin crystals, a whole new class of hybrid materials is coming into reach, which holds promises from the realization of exotic electronic quantum phases at elevated temperatures to novel optoelectronic applications. Interactions between electrons are central to all these kinds of promises. In my talk, I will discuss why Coulomb interactions in 2d materials are very different from their 3d counterparts, how they influence material properties and how interactions can be manipulated in 2d materials. As example systems I will consider graphene as well as doped and optically excited MoS_2. In these systems interactions renormalize electronic quasiparticles through pronounced band gaps shifts, lead to the emergence of many-particle modes such as excitons with unusually high binding energies and can finally drive the electron system towards different kinds of instabilities including superconductivity and charge density wave states.