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Signatures of A, B, and C excitons in the optical properties of monolayer transition-metal dichalcogenides

We present a unified description of the excitonic properties of monolayer transition-metal dichalcogenides. We show that the optical properties have a strong dependence on external parameters, namely, the temperature and the dielectric function of the environment. This opens the possibility of engineering at will nano-materials showing strong optical response in the spectral range from the IR to the visible. In addition, we show that the absorbance spectrum is composed of two prominent peaks, below the non-interacting gap. This is due to the presence of Coulomb interactions, in the particle-hole channel, which lead to the A and B excitons. In addition, the optical spectrum at low temperatures shows a signature of a modified Rydberg series. Moreover, above the non-interacting gap there is a large absorption band due to the presence of C-exciton resonances. Using a semi-analytical approach, we develop a generalised Elliot formula, which provides significant insight into the physics of the optical properties of monolayer transition-metal dichalcogenides