Effect of magnon-magnon interaction on the ferromagnetism in hexagonal manganese pnictide monolayers

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The low dimensional magnetism has a key role in developing the novel nano-scale spintronics devices and understanding quantum magnetism. According to the Mermin–Wagner–Hohenberg theorem, the long-range magnetic order is thermally unstable for the 1D and 2D isotropic spins at a finite temperature [1]. However, recent successful synthesis of two-dimensional magnets has shown that magnetic anisotropy can repress the thermal fluctuations and stabilize log-range magnetic order at finite temperature [2]. Accordingly, 2D magnetization opens up many novel, vast and interesting questions and challenges that are not clear until now. The physics of high temperature is affected by magnon-magnon interaction and the presence of this interaction plays an essential role when studying excited states at finite temperatures close to phase transitions. In our study, the second-order of Holstein-Primakoff transformations are used to describe interacting magnons in hexagonal MnX (X = N, P, As, Sb) monolayers with an out-of-plane or in-plane easy axis. We map the DFT results into an effective anisotropic Heisenberg Hamiltonian. Our studies indicate that the magnon-magnon interaction slightly softens the magnetic excitation energy and significantly reduces the magnon energy gap which is crucial for finite temperature long-range magnetic order in 2D [3].

References:

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