Spin dynamics in quasi-2D van der Waals antiferromagnets

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Layered van der Waals (vdW) magnetic compounds attract currently large attention as they may display an intrinsically low-dimensional magnetic behavior and as such offer an extensive materials base for exploring fundamental magnetic properties of strongly correlated two-dimensional (2D) electron systems [1-4]. Moreover, the structural and compositional variety of these class of materials offers a possibility to realize magnetic ground states with desired types of order and intrinsic anisotropy essential for their application in next-generation spintronic devices [4]. In particular, many of vdW compounds are low-damping antiferromagnetic (AFM) dielectrics, and as such they become promising materials in the new rapidly developing field of AFM spintronics that leverages AFM magnons for transmitting of spin currents instead of electric current to transport and process information [5-7].

Electron Spin Resonance (ESR) spectroscopy and related ferromagnetic (FM) and AFM resonance techniques, FMR and AFMR, play an important role in obtaining valuable insights into the static and dynamic magnetic properties of vdW compounds [8]. In this talk, we will discuss the spin dynamics in the paramagnetic state and the AFM magnon excitations in the magnetically ordered state of two representative vdW antiferromagnets $Mn_2P_2S_6$ and $CuCrP_2S_6$, as revealed by ESR and AFMR spectroscopies [9-11]. It will be shown that in the paramagnetic state both compounds demonstrate an inherent 2D correlated spin dynamics characterized by the diffusive long-time decay of the in-plane spin correlation function evidencing the weakness of the interlayer magnetic coupling in bulk singe crystals. In the AFM ordered state the low-energy magnon excitations probed by AFMR show strikingly different behavior in these compounds due to their distinct magnetic anisotropies. Remarkably, it was found that the properties of these magnon modes can be controlled and selectively tuned by application of an external magnetic field. Based on these interesting findings we discuss the perspectives for the use of $Mn_2P_2S_6$ and $CuCrP_2S_6$ as transmitting medium for spin currents in prototype magnonic devices.

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