Spin-orbit twisted spin waves in quasi-two-dimensional electron gases

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Interest in spin waves has risen in recent years in the context of spintronics, since spin waves could offer a low-dissipation alternative to traditional methods for transporting and treating information. However, such a vision creates the need for controlling their propagation by electrical, magnetic and optical means - a challenge that remains still largely unmet. This talk reports conclusive evidence that the group velocity of spin waves can be controlled both in *amplitude* and *orientation* by varying the strength of the spin-orbit coupling [1-3]. We present a theoretical and numerical study of spin-wave dispersions in a spin-polarized electron gas in a dilute magnetic semiconductor heterostructure, using time-dependent density-functional response theory [4]. The system under study is an n-doped CdMnTe quantum well with an in-plane magnetic field. Rashba and Dresselhaus spin-orbit coupling induces a wavevector-dependent spin splitting in the conduction bands. The spin waves hence travel through a spin-orbit twisted medium. Our results are confirmed by experiment, which demonstrates the exciting possibility of controlling the direction and velocity of spin waves by optical or electrical gating. This paves the way for novel applications in spin-wave based transistors, spin-wave routing devices or for the realization of lenses for spin waves.

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