New approaches for Néel vector detection in antiferromagnetic spintronics

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Antiferromagnetic (AFM) spintronics is an emerging field of research, which exploits the Néel vector to control spin- and orbital-dependent transport properties. This talk will address three novel approaches to detect the Néel vector in collinear compensated AFM metals via their transverse and longitudinal conductivity. The first approach utilizes room-temperature AFM metal $MnPd_2$ that allows the electrical control of the Dirac nodal line by the Néel spin-orbit torque [1]. The reorientation of the Néel vector leads to switching between the symmetry-protected degenerate state and the gapped state which modulates the spin Hall conductivity. The second approach involves the nonlinear anomalous Hall effect that can be used to detect the Néel vector in most compensated antiferromagnets supporting the antidamping spin-orbit torque [2]. The magnetic crystal group symmetry of these antiferromagnets, such as CuMnSb, combined with spin-orbit coupling produce a sizable Berry curvature dipole and hence the nonlinear anomalous Hall effect. The third approach highlights antiferromagnets exhibiting a non-spin-degenerate Fermi surface and thus momentum-dependent spin polarization which can be functionalized in AFM tunnel junctions [3]. Using RuO_2 as a representative example of such antiferromagnets, a giant tunneling magnetoresistance effect is predicted for RuO_2-based AFM tunnel junctions. These results broaden the scope of materials and approaches, which can be exploited in AFM spintronics.

References:

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