MAR17-2016-001080

Abstract for an Invited Paper
for the MAR17 Meeting of
the American Physical Society

Ultra-low magnetic damping in metallic and half-metallic systems.

JUSTIN SHAW, NIST

The phenomenology of magnetic damping is of critical importance to devices which seek to exploit the electronic spin degree of freedom since damping strongly affects the energy required and speed at which a device can operate. However, theory has struggled to quantitatively predict the damping, even in common ferromagnetic materials. This presents a challenge for a broad range of applications in magnonics, spintronics and spin-orbitronics that depend on the ability to precisely control the damping of a material. I will discuss our recent work to precisely measure the intrinsic damping in several metallic and half-metallic material systems and compare experiment with several theoretical models.[1-7] This investigation uncovered a metallic material composed of Co and Fe that exhibit ultra-low values of damping that approach values found in thin film YIG.[8] Such ultra-low damping is unexpected in a metal since magnon-electron scattering dominates the damping in conductors. However, this system possesses a distinctive feature in the bandstructure that minimizes the density of states at the Fermi energy n(EF). These findings provide the theoretical framework by which such ultra-low damping can be achieved in metallic ferromagnets and may enable a new class of experiments where ultra-low damping can be combined with a charge current. Half-metallic Heusler compounds by definition have a bandgap in one of the spin channels at the Fermi energy. This feature can also lead to exceptionally low values of the damping parameter. Our results show a strong correlation of the damping with the order parameter in Co2MnGe. Finally, I will provide an overview of the recent advances in achieving low damping in thin film Heusler compounds. [1] Mankovsky et al., Phys. Rev. B 87, 014430 (2013) [2] Turek et al., Phys. Rev. B 92, 214407 (2015). [3] Gilmore et al., Phys. Rev. Lett. 99, 027204 (2007) [4] Thonig et al., New J. Phys. 16, 013032 (2014) [5] Brataas et al., Phys. Rev. Lett. 101, 037207 (2008) [6] Starikov et al., Phys. Rev. Lett. 105, 236601 (2010) [7] Liu et al., Phys. Rev. B 84, 014412 (2011) [8] Schoen et al., Nature Physics 12, 839 (2016)