Spin current propagation through antiferromagnetic thin film metamaterials

Antiferromagnetic materials have generated great excitement due to their ability to conduct pure spin currents over micron scale distances. In materials such as NiO, that have biaxial magnetic anisotropy, it has been proposed that spin amplification may also be possible, paving the way to more energy efficient operation of magnetic random access memory (MRAM) devices. In this project, the relationship between the propagation of spin current and the underlying antiferromagnetic spin wave excitations will be explored so that the optimum conditions for spin amplification can be determined and realised. Ultimately, it may be possible to realise multi-stage spin amplification through the creation of multi-layered antiferromagnetic metamaterials. Antiferromagnetic spin waves will be detected by means of ultrafast magneto-optical measurements, while spin current propagation will be detected by x-ray detected ferromagnetic resonance measurements at a synchrotron source as shown schematically within the figure.

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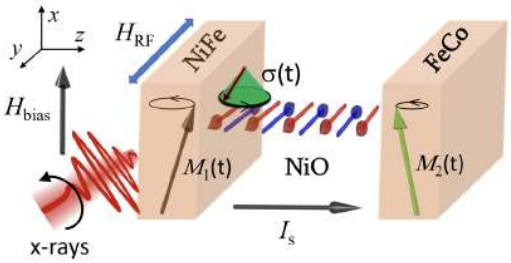

Schematic representation of x-ray detected Ferromagnetic Resonance measurements of spin propagation through NiO. Precessional spin pumping from the NiFe layer leads to spin current being driven through the NiO and detected via the induced precession of the FeCo layer (from Dabrowski et al. Phys. Rev. Lett. ***124****, 217201 (2020)).*