Contribution ID: **72** Type: **Invited Talk**

Evidence for a common origin of spin-orbit torque and the Dzyaloshinskii-Moriya interaction at a Py/Pt interface

Wednesday, 22 February 2017 11:24 (36 minutes)

Harnessing spin-charge conversion through current-driven spin torques and spin precession-driven charge currents is widely regarded as a key for the development of scalable and efficient spintronic devices. These conversion processes occur across ferromagnet/normal metal (FM/NM) interfaces where there is strong spin-orbit coupling (SOC) but where details of the underlying physics are still much debated. SOC also underlies the interfacial Dzyaloshinskii-Moriya interaction (DMI). While efficient spin-charge conversion and large DMI often coincide, a causal connection between these two phenomena has not yet been experimentally established. It was recently proposed that a Rashba Hamiltonian operative at a FM/NM interface gives rise to both spin-orbit torques (SOT) and DMI, such that the presence one effect implies the other [1]. Despite the complexity of interfacial spin interactions, this theory provides a simple, testable quantitative relation between the DMI and SOT. Here, we use a powerful new microwave spectroscopy method to detect inverse spin-charge conversion processes in FM/NM bilayers [2] and demonstrate that the magnitude of the SOT is in good agreement with the theoretically-predicted value based on the previously measured value of DMI in identical bilayers [3].

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[2] A. J. Berger, E. R. J. Edwards, H. T. Nembach, J. M. Shaw, A. D. Karenowska, M. Weiler, T. J. Silva, arXiv:1611.05798 (2016).
[3] H. T. Nembach, J. M. Shaw, M. Weiler, E. Jue, and T. J. Silva, Nature Physics 11, 825 (2015).

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