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Intrinsic spin-orbit contribution to precessional damping in transition metals[1]

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Landau-Lifshitz or equivalently Gilbert damping describe the decay of an precessing magnetization towards equilibrium. Both of these forms describe this decay accurately; that is, very few if any experiments have been analyzed to show that these forms are inadequate. These forms of damping can be derived theoretically from a variety of approaches and for a variety of mechanisms. In many of these mechanisms, spin-orbit coupling plays a crucial role. The spin-orbit coupling can be associated with defects or can be an intrinsic part of the electronic structure of the pure material. In this talk, I describe calculations of the Gilbert damping for the transition metals, Fe, Co, and Ni. These calculations show that damping due to the intrinsic spin-orbit coupling agrees with the measured temperature dependence of the damping. In the presence of a current in the ferromagnet, the damping is modified. I discuss how this modification gives rise to a contribution to the so-called non-adiabatic spin transfer torque and show calculations of this contribution for Fe and Ni.

[1]Work done in collaboration with Keith Gilmore, Ion Garate, Allan MacDonald, Daniel Steiauf, Jonas Seib, and Manfred Fähnle.