Current-driven coupled nuclear- and electron-spin dynamics

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Nuclear spins, with their long coherence times, are fundamental to nuclear magnetic resonance (NMR) and magnetic resonance imaging (MRI), serving as powerful tools for probing microscopic properties of matter. In addition to having a spin angular-momentum comparable to that of electrons, nuclear spins have unique advantages. For instance, they can maintain high entropy even at extremely low temperatures and strong magnetic fields, where electron spin dynamics are inevitably frozen out. Despite these fascinating properties, the application of nuclear spins in spintronics has been limited. Recently, however, spin-current generation from nuclear spins have been reported [1,2]. These studies utilize an antiferromagnetic insulator $MnCO_3$, in which nuclear and electron spins are coupled by strong hyperfine interaction between them, showing the potential to harness hyperfine coupling for exploring nuclear spintronic phenomena. In this presentation, I will discuss our recent results on current-induced nuclear and electron spin dynamics in a metallic ferromagnet and their electrical detection through hyperfine interactions.

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