PHYSICS DEPARTMENT COLLOQUIUM

"Dynamics of Nanomagnets Driven by Spin-Polarized Current"

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Spin-polarized electrons traversing a ferromagnet can transfer spin angular momentum to the local magnetization, thereby inducing magnetization reversal or exciting persistent magnetization dynamics. To understand the mechanism of this recently discovered effect, we make time-resolved measurements of spin-transfer-driven excitations in nanoscale ferromagnetic dots. We find that spin-polarized current generates coherent magnetic excitations with coherence significantly exceeding that of the field-driven modes observed in ferromagnetic resonance experiments. In the switching regime, magnetization reversal induced by spin-polarized current is accomplished via a process of precession, and the switching time is determined by competition between transfer of angular momentum and magnetic energy dissipation. Measurements of magnetic relaxation in the presence of spin-polarized current show that the relaxation is strongly current-dependent. Our observations provide important tests of competing theories of spin transfer and demonstrate feasibility of its technological applications in the areas of high frequency communications and non-volatile electronics.

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