THE UNIVERSITY OF IOWA

OSTC optical science + technology center

OSTC MATERIALS SEMINAR

Tuesday, January 21, 2014
1:30 p.m.
Conference Room, 104 IATL

Nanomagnets

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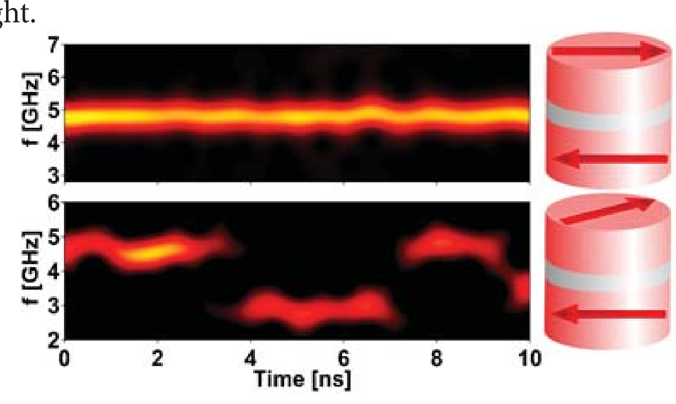
Nanoscale magnetic systems have been the subject of intense research over the past decade. This has partly been driven by developments in magnetic hard disc drives, where the readback sensor is now smaller than 50 nm x 50 nm(!), but partly also driven by new emergent physics in nanoscale magnetic systems. One such example is the spin transfer torque effect, by which a direct current can induce the magnetization to move or oscillate with very high frequencies in nanoscale magnetic systems. Magnetic systems interact through the long-range magnetostatic fields that they generate, just like macroscopic bar magnets. But in nanoscale magnetic systems, other effects that arise from edges and interfaces become important and can compete with the interactions through the magnetostatic fields. These competitions can be designed to give rise to complex and interesting effects.

In this presentation, I will give some background on magnetic materials and interactions, and an overview of the spin transfer torque effect. I will then give some examples of specific systems and the complex and interesting behavior they exhibit. One example is the spin torque oscillator, in which the spin torque effect is used to generate oscillations in the GHz range. Spin torque oscillators can be integrated with conventional electronics, which makes them very attractive for a variety of applications in information processing and communications.

Frequency versus time of a spin torque oscillator: The top figure shows that frequency is stable over a long time. The bottom figure shows that the frequency is hopping with time (mode hopping). This phenomenon depends on the orientation of the magnetization in the spin torque oscillator, indicated by the arrows in the cartoons on the right.



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