Chez Pierre

Presents ...

Monday, October 27, 2014
12:00pm
MIT Room 4-331

Chez Pierre Seminar

Sander Otte

Delft University of Technology, The Netherlands

"Spin wave imaging in atomically designed nanomagnets"

The macroscopic dynamics of all magnetic materials are governed by collective excitations such as spin waves and domain walls. Whereas conventional spectroscopy techniques provide excellent information about these modes in reciprocal space, direct atomic scale imaging of magnetic dynamics in real space is quite challenging to achieve. I will start this talk by giving an overview of experiments performed over the last 10 years, aimed to reach this goal by assembling magnetic atoms one-by-one on a surface in a low temperature STM[1–6].

Next, I will present two complementary ways to image spin waves in atomically designed nanomagnets[7]: chains of spin S = 2 Fe atoms on a Cu_2N surface, constructed in such a way that the exchange coupling between the atoms is ferromagnetic. First, inelastic electron tunneling spectroscopy (IETS) reveals wavelike variations of the spin excitation intensity along the chain, providing a direct mapping of the spin wave dispersion. Second, current driven switching of the entire chain between its two magnetic ground states is found to depend strongly on the position of the STM tip over the chain, in a manner that correlates with the observed spin waves. Our observations, combined with model calculations based on master equations, reveal the complete reversal path: starting with a spin wave excitation localized near the edges of the chain followed by a domain wall shifting through the chain from one end to the other. Our findings open the way towards imaging of more complex collective spin behavior in engineered spin lattices.

1. Hirjibehedin et al., Science 317, 1199 (2007)
2. Otte et al., Nature Phys. 4, 847 (2008)
3. Loth et al., Nature Phys. 6, 340 (2010)
4. Loth et al., Science 335, 196 (2012)
5. Khajetoorians et al., Science 339, 55 (2013)
6. Bryant et al., PRL 111, 127203 (2013)
7. Spinelli et al., Nature Mat. 13, 782 (2014)
http://ottelab.