Abstract Submitted
for the MAR12 Meeting of
The American Physical Society

Direct Imaging of Non-Adiabatic Spin Torque Effects on Vortex Core Orbits SHAWN POLLARD, LEI HUANG, Department of Condensed Matter Physics, Brookhaven National Laboratory, NY 11973, KRISTEN BUCHANAN, Department of Physics, Colorado State University, Fort Collins, CO 80523, DARIO ARENA, National Synchrotron Source, Brookhaven National Laboratory, NY 11973, YIMEI ZHU, Department of Condensed Matter Physics, Brookhaven National Laboratory, NY 11973 — Recently high frequency, current induced vortex motion has received a great deal of interest from a spintronic perspective, as it suggests a possible low power, high speed writing process. However, understanding the processes that govern this motion, specifically the relative contributions of adiabatic and non-adiabatic spin torque effects, has been difficult due to experimental constraints. We developed a novel TEM sample stage in which we apply high frequency currents in-situ to excite resonant motion in Permalloy disc structures (2000x2000x50nm) with high spatial resolution (<5nm for dynamic measurements). We have imaged the time-averaged vortex trajectory through resonance. We find that the orbital amplitudes are drastically different for clockwise and counterclockwise chiralities, indicating the presence of both Oersted fields and non-adiabatic spin torque effects, and that the orbital size scales linearly with current density varied between (7.1-10.0)x10^{10} A/m^2. These results allow us to extract a value for the non-adiabatic spin torque with unprecedented precision. Additionally, we report on off-resonance effects, such as tilting and variations in the ellipticity of the orbit as it is swept through resonance, with first of their kind experimental observations.

Shawn Pollard
Department of Condensed Matter Physics,
Brookhaven National Laboratory, NY 11973

Date submitted: 29 Nov 2011 Electronic form version 1.4