Abstract Submitted
for the MAR08 Meeting of
The American Physical Society

Spin Pumping of Current in Non-Uniform Conducting Magnets[1]

WAYNE SASLOW, Texas A&M University — Using irreversible thermodynamics we show that current-induced spin transfer torque within a magnetic domain implies spin pumping of current within that domain. This has experimental implications for samples both with conducting leads and that are electrically isolated. These results are obtained by deriving the dynamical equations for two models of non-uniform conducting magnets: (1) a generic conducting magnet, with net conduction electron density n and net magnetization $\vec{M}$; and (2) a two-band magnet, with up and down spins each providing conduction and magnetism. For both models, in regions where the equilibrium magnetization is non-uniform, voltage gradients can drive adiabatic and non-adiabatic bulk spin torques. Onsager relations then ensure that magnetic torques likewise drive adiabatic and non-adiabatic currents – what we call bulk spin pumping. For a given amount of adiabatic and non-adiabatic spin torque, the two models yield similar but distinct results for the bulk spin pumping, thus distinguishing the two models. As for recent spin-Berry phase work, we find that within a domain wall the ratio of the effective emf to the magnetic field is approximately given by $P(2\mu_B/e)$, where P is the spin polarization. The adiabatic spin torque and spin pumping terms are shown to be dissipative.

[1]Supported by Department of Energy grant DE-FG02-06ER46278.

Wayne Saslow
Texas A&M University

Date submitted: 04 Dec 2007 Electronic form version 1.4