Abstract Submitted
for the MAR12 Meeting of
The American Physical Society

Newtonian reciprocality between spinmotive forces (SMF) and spin-torque-transfer (STT) STEWART BARNES, Physics Department, University of Miami, Coral Gables, FL — An SMF and the STT effect are reflected in definitions

$$\vec{p} = m\vec{v} + e\vec{A}_s \qquad \text{and} \qquad H = H_0 + e\Phi_s + eA_{0s},$$

valid beyond the adiabatic approximation, where the momentum $m\vec{v}$ is mechanical, while $\vec{p}$ is that conjugate to the position $\vec{r}$, H is the full Hamiltonian while H_0 is that for uniform magnet. Here $(\vec{A}_s, A_{0s})$ is the four vector which reflects the *linear* momentum of the magnetic system. The spin magnetic and electric fields

$$B_i = -\frac{im^2}{\hbar}\epsilon_{ijk}[v_j, v_k] \quad \text{and} \quad E_i = -\frac{im^2}{\hbar}[v_i, v_0]; \quad i = \{x, y, z\}$$

where $i\partial_t = mv_0 + eA_0$, and involve commutators. The Landau-Lfttshitz equations are an *emergent*. They correspond to

$$[S_z, (H_0 + e\Phi_s + eA_{0s})] = 0$$

as required to separate the *slow* magnetic and *fast* electronic degrees of freedom. E.g. $L = (enA\dot{z} - \dot{q})\frac{\hbar}{e}\phi + g\mu_B BnAx - q\mathcal{E}$ is the Lagrangian for simple domain wall connected to a battery emf $\mathcal{E}$. SMF-SST reciprocality reflects Newtonian third law and *not* an Onsager relationship between transport coefficients. Experiment for spin-valves and MTJs will be reviewed.

Stewart Barnes
Physics Department, University of Miami, Coral Gables, FL

Date submitted: 21 Nov 2011 Electronic form version 1.4