

Abstract Submitted
for the MAR11 Meeting of
The American Physical Society

Current-Induced Torques in the Presence of Spin-Orbit Coupling

M.D. STILES, PAUL M. HANEY, Center for Nanoscale Science and Technology, National Institute of Standards and Technology — In systems without spin-orbit coupling, the simple connection between spin transfer torque and the divergence of the spin current has provided a simple description of current induced torques. Here, we generalize this relationship for systems with strong spin-orbit coupling to a relationship between spin transfer torques, total angular momentum current, and mechanical torques. In such systems, the spin-orbit coupling modifies the behavior of the spin transfer torques. For example, the it can give rise to a persistent spin transfer torque in a spin valve: the spin transfer torque density approaches a constant value rather than decaying away from the interface. This approach also provides a formal expression for the mechanical torque at a single ferromagnetic-nonmagnetic interface.

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Date submitted: 28 Dec 2010

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