Abstract Submitted
for the MAR16 Meeting of
The American Physical Society

A simple and effective theory for all-optical helicity-dependent spin switching[1] GUOPING ZHANG, Department of Physics, Indiana State University, Terre Haute, IN 47809, USA, YIHUA BAI, Office of Information Technology, Indiana State University, USA, THOMAS F GEORGE, University of Missouri-St. Louis — All-optical helicity-dependent spin switching (AOS) represents a new frontier in magnetic recording technology, where a single ultrafast laser pulse, without any assistance from an external magnetic field, can permanently switch spin within a few hundred femtoseconds. By contrast, the existing theory does rely on an artificial magnetic field to switch spins. Here we develop a microscopic spin switch theory, free of any artificial field, and demonstrate unambiguously that both circularly and linearly polarized lights can switch spins faithfully. Our theory is based on the Hookean theory, but includes two new elements: spin-orbit coupling and exchange interaction. We predict that left (right) circularly polarized light only flips (flops) spin, a symmetry constraint that strongly favors ferrimagnetic orderings over ferromagnetic ones, with the allowable exchange interaction within 10 meV, consistent with all prior theories. The effect of the laser amplitude is highly nonlinear: If it is too weak, AOS does not occur, but if too strong, the spin cants; a compromise between them produces a narrow spin reversal window as observed experimentally. We envision that our model can be easily extended to describe spin frustrated systems and multiferroics, where the light-spin interaction

[1]Supported by the U.S. Department of Energy under Contract No. DE-FG02-06ER46304 and the National Energy Research Scientific Computing Center

Guoping Zhang
Indiana State University

Date submitted: 08 Oct 2015 Electronic form version 1.4