Abstract Submitted
for the MAR11 Meeting of
The American Physical Society

Ultrafast Measurement of Critical Slowing Down of Hole-Spin Relaxation in Ferromagnetic GaMnAs AARON PATZ, TIANQI LI, Ames Laboratory and Department of Physics and Astronomy, Iowa State University, ILIAS PERAKIS, Department of Physics, University of Crete, Greece, XINYU LIU, JACEK FURDYNA, Department of Physics, University of Norte Dame, JI-GANG WANG, Ames Laboratory and Department of Physics and Astronomy, Iowa State University — We have studied ultrafast photoinduced hole spin relaxation in GaMnAs via degenerate ultrafast magneto-optical Kerr spectroscopy. Near-infrared pump pulses strongly excite the sample, and probe pulses at the same photon energy reveal subpicosecond demagnetization accompanied by energy and spin relaxation of holes manifesting themselves as a fast (∼200fs) and a slow (ps) recovery of transient MOKE signals. By carefully analyzing the temporal profiles at different temperatures, we are able to isolate femtosecond hole spin relaxation processes, which are subject to a critical slowing down near the critical temperature of 77K. These results demonstrate a new spectroscopy tool to study the highly elusive hole spin relaxation processes in heavily-doped, correlated spin systems, and have important implications for future applications of these materials in spintronics and magnetic-photonic-electronic multifunctional devices.

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Date submitted: 27 Nov 2010 Electronic form version 1.4