Abstract Submitted
for the MAR11 Meeting of
The American Physical Society

Oscillatory spin polarization and magneto-optical Kerr effect in Fe_3O_4 thin films on GaAs(001) YAN LI[1], WEI HAN, A.G. SWARTZ, K. PI, J.J.I. WONG, Dept. of Physics and Astronomy, UC Riverside, S. MACK, D.D. AWSCHALOM, Center for Spintronics and Quantum Computation, University of California, Santa Barbara, CA 93106, R.K. KAWAKAMI, Department of Physics and Astronomy, University of California, Riverside, CA 92521 — Magnetite is an attractive material for spin injection and detection, because the theory predicts completely negative spin polarization at the Fermi level at room temperature. We fabricated high quality Fe_3O_4 films on GaAs (001) by molecular beam epitaxy. The Fermi level spin polarization of the Fe_3O_4 film was probed using the ultrafast optical measurement of ferromagnetic proximity polarization (FPP). The systematic thickness dependence of FPP and MOKE were measured on wedged Fe_3O_4 films on GaAs(001), and similar oscillatory and sign reversing behaviors were observed even though the two measurements rely on different mechanisms (spin dependent electron reflection for FPP, and optical transitions for MOKE). Quantum confinement of the t_{2g} states near the Fermi level provides an explanation for the similar thickness dependences of the FPP and MOKE oscillations.

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Date submitted: 26 Nov 2010 Electronic form version 1.4