Abstract Submitted
for the MAR10 Meeting of
The American Physical Society

Disorder-induced linear magnetoresistance in composite films of self-assembled MnAs nanoparticles in GaAs DON HEIMAN, HANNAH JOHNSON, STEVE BENNETT, RADHIKA BARUA, LAURA LEWIS, Northeastern University — The discovery of novel effects arising from the interplay of charge carriers with structural disorder is expected to contribute to future device applications. Strong electrical disorder in semiconductors provided by compositional inhomogenities has led to anomalously large magnetoresistance (MR) which increases linearly with increasing magnetic field and does not appear to saturate even at high fields.[1] In our study, we find that composite films containing self-assembled MnAs nanoparticles embedded in GaAs exhibit nonsaturating positive MR which is linear in magnetic fields up to H=14 T. A MR of 900% is observed at 25 K. The magnitude of the linear MR is found to be proportional to the carrier mobility over the measured temperature range, T=25 to 300 K. Furthermore, the crossover field, where the MR dependence on field crosses over from quadratic to linear behavior is found to be inversely proportional to carrier mobility. These proportionalities are obeyed over 4 orders of magnitude of carrier concentration. This remarkable relationship linking the MR to the average macroscopic carrier mobility is explained by a model of random disorder in the nanoscale mobility. Work supported by NSF grant DMR-097007.

[1] R. Xu, et al., Nature 390, 57 (1997).

Don Heiman
Northeastern University

Date submitted: 09 Dec 2009 Electronic form version 1.4