Abstract Submitted
for the MAR14 Meeting of
The American Physical Society

The effect of spin transport on lifetime in nanoscale systems JEREMY CARDELLINO, NICOLAS SCOZZARO, MICHAEL HEMAN, ANDREW BERGER, CHI ZHANG, KIN CHUNG FONG, CIRIYAM JAYAPRAKASH, DENIS PELEKHOV, CHRIS HAMMEL, The Ohio State University, DEPARTMENT OF PHYSICS, PROF. P. CHRIS HAMMEL RESEARCH TEAM — Spin transport electronics utilizes electron spin as a state variable for information processing and storage. This requires manipulation of spin ensembles for data encoding, and spin transport for information transfer. Here we report spatially resolved magnetic resonance studies of electron spin ensembles confined to a quasi 1D 'spin nanowire' formed by nitrogen ion implantation in diamond. We obtain the ensemble spin lifetime, that is, spin autocorrelation time, by measuring statistical fluctuations of the net moment ($\sqrt{N}$ <100 net spins), which is in thermal equilibrium and has no imposed polarization gradient. We find the lifetime of the ensemble is dominated by spin transport from the ensemble into an adjacent reservoir, which is in striking contrast to conventional spin-lattice relaxation measurements of isolated spin ensembles. In addition, using a novel spin manipulation protocol, we demonstrate spectroscopic measurements on nanoscale spin ensembles that corroborate spin transport in strong field gradients. Our experiments, supported by microscopic Monte Carlo modelling, provide a unique insight into the intrinsic dynamics of charge-motion-free spin currents needed for nanoscale devices which seek to control spins.

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Date submitted: 12 Nov 2013 Electronic form version 1.4