Abstract Submitted
for the MAR13 Meeting of
The American Physical Society

Dynamic nuclear polarization of single nitrogen isoelectronic centers in GaAs GABRIEL ETHIER-MAJCHER, PHILIPPE ST-JEAN, SEBASTIEN FRANCOEUR, Ecole Polytechnique de Montreal — Due to their very long coherence time, nuclear spins of atomic systems represent good candidates for spin-based qubits in semiconductors. In this work, the dynamic nuclear polarization of isoelectronic centers formed from two nitrogen impurities in GaAs is investigated as a function of the external magnetic field and the polarization ellipticity of the exciting light. The nuclear spins of a single center are probed by the Overhauser shift of the neutral exciton and negatively charged exciton bound states. A nuclear magnetic field of 25 mT is measured at low external magnetic field and it decreases with this external field, indicating an efficiency loss in the exciton-nucleus spin-flip process. A peculiar Overhauser shift, scaling as the square of the ellipticity, is found for the exciton. A strong hysteretic behavior is also observed for both the neutral and charged excitons. These effects are believed to originate from the complex dynamic of the hyperfine interaction between the different excitonic spin states and nuclei. Our results show that dynamic nuclear polarization, much studied in quantum dots, is scalable to a single atomic-sized system. These results represent a first step towards the optical control of single nuclear spins in semiconductors.

Gabriel Ethier-Majcher
Ecole Polytechnique de Montreal

Date submitted: 09 Nov 2012 Electronic form version 1.4