Abstract Submitted
for the MAR14 Meeting of
The American Physical Society

Single-spin quantum coherence beyond 10 seconds in an isotopically engineered silicon nanostructure[1] ANDREA MORELLO, JUHA MUHONEN, JUAN PABLO DEHOLLAIN, ARNE LAUCHT, FAY HUDSON, Univ of New South Wales, KOHEI ITOH, Keio University, DAVID JAMIESON, JEFFREY MCCALLUM, University of Melbourne, ANDREW DZURAK, Univ of New South Wales — The single-shot readout and coherent control of both the electron and the nuclear spin of a single P atom in silicon has been recently demonstrated, using ion-implanted donors in MOS nanostructures. It is known from bulk experiments that P donors in isotopically purified ^{28}Si exhibit record coherences, but it is also suspected that the proximity to a Si/SiO$_2$ interface will deteriorate the coherence time. Here we present the first experiment on single electron and nuclear spin qubits in an isotopically engineered ^{28}Si nanostructure. We measured exceptionally sharp electron spin resonance lines ($<$ 2 kHz wide), and we obtained single-qubit control fidelities in excess of 99%. We performed noise spectroscopy experiments to extract the power spectral density of the decoherence sources acting on the electron and the nucleus. Contrary to widespread belief, our data show that the ultimate limit for single-spin coherence in our nanostructure is not set by charge noise and interface effects, but simply by broadband thermal radiation coupled to the qubit through a high-bandwidth transmission line. Using dynamical decoupling, we measured coherence times up to $T_{2e} = 0.5$ s for the electron, and $T_{2n} = 18$ s for the ^{31}P nucleus.

[1]Funded by the Australian Research Council (CE11E0096) and the U.S. Army Research Office (W911NF-13-1-0024)

Andrea Morello
Univ of New South Wales

Date submitted: 13 Nov 2013 Electronic form version 1.4