

MAR11-2010-005060

Abstract for an Invited Paper  
for the MAR11 Meeting of  
the American Physical Society

### **Quantum information in silicon: Initialization, manipulation, storage and readout<sup>1</sup>**

GAVIN W. MORLEY, London Centre for Nanotechnology and Department of Physics and Astronomy, University College London, UK

Spin qubits in silicon are exciting because of their long coherence times [1] and the electrical readout of the state of one electron spin [2]. In a single experiment we demonstrate initialization [3], manipulation, storage and electrical readout of quantum information with a small ensemble of phosphorus electronic and nuclear spins in silicon [4]. Our electrical readout does not destroy the electron spin coherence which is limited instead by naturally-occurring <sup>29</sup>Si nuclear spins. These experiments require a pulsed electron spin resonance spectrometer operating at high magnetic fields [5]. Silicon quantum computers would benefit from having a second dopant species which can be addressed selectively [6-8], and we find that bismuth atoms are well suited for this role [9]. They offer long spin coherence times [9,10] as well as new opportunities [11] when compared with phosphorus.

[1] A M Tyryshkin & S A Lyon, Phosphorus electron spin coherence time can be over 10 s, Private communication (2010)

[2] A Morello *et al*, Nature **467**, 687 (2010)

[3] D R McCamey, J van Tol, G W Morley & C Boehme, Phys Rev Lett **102**, 027601 (2009)

[4] G W Morley *et al*, Phys Rev Lett **101**, 07602 (2008)

[5] G W Morley, L-C Brunel & J van Tol, Rev Sci Instrum **79**, 064703 (2008)

[6] A M Stoneham, A H Harker & G W Morley, J Phys Condens Matter **21**, 364222 (2009)

[7] A M Stoneham, A J Fisher & P T Greenland, J Phys Condens Matter **15**, L447 (2003)

[8] P T Greenland *et al*, Nature **465**, 1057 (2010)

[9] G W Morley *et al*, Nature Mater **9**, 725 (2010)

[10] R E George *et al*, Phys Rev Lett **105**, 067601 (2010)

[11] M H Mohammady, G W Morley & T S Monteiro, Phys Rev Lett **105**, 067602 (2010)

<sup>1</sup>Work supported by the Royal Commission for the Exhibition of 1851, EPSRC, NSF and the State of Florida.