Abstract Submitted
for the MAR15 Meeting of
The American Physical Society

Three dimensional magnetic abacus memory SHILEI ZHANG, University of Oxford , JINGYAN ZHANG, University of Science and Technology Beijing, ALEXANDER BAKER, University of Oxford, SHOUGUO WANG, Chinese Academy of Science, GUANGHUA YU, University of Science and Technology Beijing, THORSTEN HESJEDAL, University of Oxford — Stacking nonvolatile memory cells into a three-dimensional matrix represents a powerful solution for the future of magnetic memory [1,2]. However, it is technologically challenging to access the individual data in the storage medium if large numbers of bits are stacked on top of each other. Here we introduce a new type of multilevel, nonvolatile magnetic memory concept, the magnetic abacus [3]. Instead of storing information in individual magnetic layers, thereby having to read out each magnetic layer separately, the magnetic abacus adopts a new encoding scheme which envisages a classical abacus with the beads operated by electron spins. It is inspired by the idea of second quantization, dealing with the memory state of the entire stack simultaneously. Direct read operations are implemented by measuring the artificially engineered 'quantized' Hall voltage [4], representing a count of the spin-up and spin-down layers in the stack. This concept of 'second quantization of memory' realizes the 3D memory architecture with superior reading and operation efficiency, thus is a promising approach for future nonvolatile magnetic random access memory. [1] Parkin, S. S. P. et al. Science 320, 190 (2008). [2] Lavrijsen, R. et al. Nature 493, 647 (2013). [3] Zhang, S. L. et al. Sci. Rep. 4, 6109 (2014). [4] Zhang, S. L. et al. Sci. Rep. 3, 2087 (2013).

Shilei Zhang
University of Oxford

Date submitted: 13 Nov 2014 Electronic form version 1.4