Abstract Submitted
for the MAR17 Meeting of
The American Physical Society

Spin Pumping Oscillator Coupled Logic for Phase-Based Boolean Computing SHALOO RAKHEJA, New York University — In this work, we demonstrate the dynamics of a spin pumping oscillator coupled (SPOC) device in which the magnetization dynamics are driven by spin pumping current generated from a ferromagnet precessing at rf frequencies. In this work, we specifically use the transverse oscillating ac component of the spin pumping current to encode information for implementing phase-based Boolean logic. The advantage of phase-based SPOC device is that switching between logic values does not, in principle, involve energy expenditure. The latency of the SPOC device is primarily limited by the setup time of oscillations in the ferromagnet, which is lower than that required for full magnetization reversal. As such, the SPOC device offers advantages in terms of energy dissipation and latency when compared against other nanoscale devices for beyond-CMOS computing. The major highlights of this work include evaluation of the performance metrics – energy, delay, and power – of the SPOC device using physics-based models of spin oscillators and spin pumping. We also identify a set of material and geometrical parameters of the SPOC device to achieve correct logic functionality, while also minimizing the overall energy per bit and power dissipation.

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Date submitted: 11 Nov 2016 Electronic form version 1.4