Abstract Submitted
for the MAR11 Meeting of
The American Physical Society

Fast transport of superparamagnetic beads by field-driven magnetic domain walls ELIZABETH RAPOPORT, GEOFFREY BEACH, Massachusetts Institute of Technology — The manipulation of superparamagnetic (SPM) beads with magnetic domain walls (DWs) is of interest for biomedical applications [1, 2]. We present data supporting fast, continuous transport of SPM beads by field-driven DWs along straight magnetic nanowires. If the magnetostatic binding force (F_b) between a DW and an SPM bead exceeds the Zeeman force (F_Z) from a driving field, DW velocity is limited by the hydrodynamic drag force on the bead [3], and a wall-bead pair can be propelled at high speeds. We have combined micromagnetic simulations and numerical calculations to determine F_b, covering the parameter space of bead radius, wire width and thickness, and domain wall type. Comparing F_b and F_Z for different applied fields, we find that the field, H_{crit}, at which the Zeeman force separates the wall from the bead, is maximized by the same wire width, independent of bead size. Optimal conditions for continuous bead transport are achieved with 150 nm wide wires, which can transport 500 nm radius beads in driving fields up to 90 Oe, corresponding to transport velocities of up to 8 mm/s. These results suggest that fast, long-distance transport of SPM beads is possible using simple linear magnetic guide-wire structures. [1] M. Donolato, et al., Nanotechnology 20 (2009) [2] G. Vieira et al., Phys. Rev. Lett. 103, 128101 (2009) [3] M.T. Bryan et al., Appl. Phys. Lett. 96,192503 (2010)

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Date submitted: 19 Nov 2010 Electronic form version 1.4