Abstract Submitted
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Towards Atomic-Scale Data Storage in Topologically Protected Spin Structures RALPH SKOMSKI, BALA BALAMURUGAN, PRIYANKA MANCHANDA, University of Nebraska, GEORGE C HADJIPANAYIS, University of Delaware, D J SELLMYER, University of Nebraska — Model calculations are used to investigate prospects for atomic-scale data storage in topologically protected spin structures. The approach relies exclusively on exchange interactions, as contrasted to storage based on spin-orbit coupling. The latter category includes magnetocrystalline anisotropy, as in present-day ultrahigh-density recording media, and skyrmions involving Dzyaloshinski-Moriya (DM) interactions. Since spin-orbit coupling is a higher-order relativistic correction to the leading electrostatic terms, including exchange, the corresponding bit sizes are limited to about 5 nm at room temperature. Smaller bit sizes are possible at low temperatures, but cooling is not a practicable solution for most data-storage applications. Our mechanism relies on competing but not necessarily frustrated exchange interactions that realize topological protection through spin angles. The approach can also be considered a magnetic analog to cis-trans isomerism in chemistry and polymer science. The corresponding length scale is of the order of 1 nm, corresponding to an areal-density increase by a factor of order 25 compared to date storage based on spin-orbit coupling. Experimental realizations may involve elements in the middle of the iron transition-metal series, such as Cr, Mn, and Fe. - This research is supported by DOE (DE-FG02-04ER46152), ARO (W911NF-10-2-0099), and NCMN.

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