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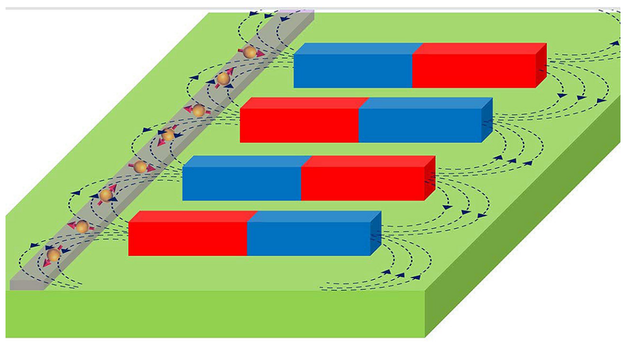
Array of alternating nanomagnets with high contrast coercivity creates 1D, rotating nanoscale magnetic field.



Simple-to-program nanoscale magnetic fields have applications in nanoscale magnetic resonance imaging, nanoparticle manipulation and the engineering of Majorana fermions—particles with potential in quantum computing. Hosting Majorana fermions in a material requires a nanoscale magnetic field to be in one dimension (1D) and spatially rotating. Sapkota et al. demonstrated a new method for creating this sort of magnetic field.

The authors deposited an array of alternating samarium cobalt and cobalt nanomagnets on a silicon substrate. $SmCo_5$ and Co differ greatly in coercivity, which is a magnetic material's resistance to changes in magnetization. This high coercivity contrast allowed the authors to program the nanomagnets using an external magnetic field. First, the authors applied a magnetic field higher than both coercivity values. They then reversed the magnetic field, which flipped the polarization of nanomagnets with smaller coercivity. The result was an array of nanomagnets with alternating polarization, creating a 1D, rotating magnetic field.

Author Tzu-Ming Lu said leveraging high coercivity contrast to program nanomagnets can be easily extended to more complicated magnetic field patterns and arrays with more than two magnetic materials.

Previously, researchers have used semiconductor nanowires with strong spin-orbit coupling to host Majorana fermions. However, if a 1D, rotating nanoscale magnetic field is coupled to a silicon-based system, the silicon system's band structure mimics a strongly spin-orbit-coupled nanowire system. This suggests that silicon, a well-known and readily available material, is a potential platform to study Majorana fermions. Lu said it's easier to imagine scaling up a silicon-based topological quantum computing system than nanowire-based systems.

Next, Sapkota et al. want to individually program the polarization of nanomagnets using electric signals instead of an external magnetic field, further simplifying programming.

Source: "Creation of nanoscale magnetic fields using nano-magnet arrays," by K. R. Sapkota, S. Eley, E. Bussman, C. T. Harris, L. N. Maurer, and T. M. Lu, *AIP Advances* (2019). The article can be accessed at https://doi.org/10.1063/1.5098768.