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Manipulation and Study of Antiferromagnetic Order Enabled by Focused Ion Beam Fabrication

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In ferromagnetic solids, electron spins prefer to align with each other, with macroscopically observable results and straightforward applications: souvenirs can stick to refrigerators, stable magnetic fields can translate electric currents into sound, and information can be stored in the direction of the collective magnetic moment of a material. In antiferromagnets, on the other hand, spins prefer to be anti-aligned with their neighbors. In practice, this yields much more complicated and varied patterns on a microscopic level, which are more challenging to study directly because they do not generate a net external magnetic field and are difficult to manipulate with one. We are nonetheless interested in these systems, however, both for their exotic phase diagrams and low-energy excitations, and for their use in technological applications made possible by their complex magnetic properties.

By fabricating specialized transport devices using the FIB, we have explored and tested a first-generation prototype for low-power computing components based on antiferromagnets. These devices have also found value as a novel tool for identifying unusual magnetic dynamics and textures that are challenging to study by other means.