

Stabilizing Magnetic Defects

Researchers have shown that defects in lattices of magnetic quasiparticles called skyrmions can be created, stabilized, and manipulated.

By **Marric Stephens**

A hexagonal lattice is the most space-efficient way to pack circular disks on a flat surface. The same rule applies to 2D lattices of magnetic skyrmions, which are whirlpool-like twists in a material's magnetic texture. Like other lattices, skyrmion lattices can exhibit defects where one skyrmion has a surfeit or a deficit of neighbors. Now Thibaud Denneulin at Jülich Research Centre in Germany and colleagues have created and stabilized such defects, whose elusiveness has, until now, made them hard to study [1].

If a defect is introduced into a hexagonal lattice so that a given node has only five neighbors, the discrepancy is usually balanced by the creation of a seven-neighbor defect nearby. Isolating just one of these defects in a skyrmion lattice is difficult because elastic stresses cause it to reconfigure, expelling the defect to the boundary.

Denneulin and colleagues stabilized a five-neighbor defect by strictly controlling the skyrmion population and the potential-energy landscape. They etched a submicrometer, pentagonal corral in a film of iron germanide. This material usually has a striped magnetic texture, but by strengthening

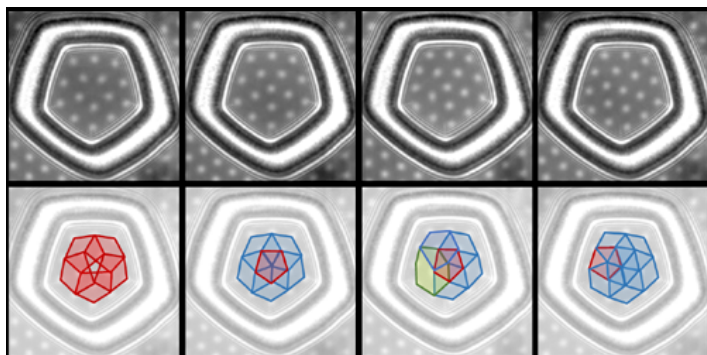
and weakening a magnetic field over several cycles, they caused the magnetic stripes to pinch off into skyrmions. Populating the pentagon with precisely 16 skyrmions yielded a central skyrmion with five neighbors, surrounded by two rings of hexagonally arranged skyrmions. The adjacent hexagonal lattice and the pentagonal boundary made the movement of the single defect energetically unfavorable.

The researchers then increased the skyrmion population to 17, allowing for the creation of an additional seven-neighbor defect alongside the central five-neighbor defect. The location of this additional defect dithered among the pentagon's corners. By tilting the material relative to the magnetic field, Denneulin and colleagues could make the defect settle on a single corner. They say that this control could make such pentagonal skyrmion systems useful as base-five information-processing elements.

Marric Stephens is a Corresponding Editor for *Physics Magazine* based in Bristol, UK.

REFERENCES

1. T. Denneulin *et al.*, "Magnetic skyrmion lattice disclinations in pentagon- and heptagon-shaped FeGe nanostructures," *Phys. Rev. B* **114**, 024411 (2026).



Credit: T. Denneulin *et al.* [1]