

## Vortex Jets Spotted in Superconductors

Researchers have identified and studied vortex jets—streams of swirling electrons—that can form at edge defects in current-carrying superconductors.

## By Ryan Wilkinson

material defect at the edge of a superconductor can act as a gate for the entry of vortices—small loops of electric current. But what trajectories do these vortices take when inside the superconductor? And how do these paths change if the current in the material is increased or if an external magnetic field is added? Oleksandr Dobrovolskiy, at the University of Vienna, and his colleagues have now answered these questions [1]. The findings could lead to the observation of new effects in superconductors, such as the generation of sound and spin waves.

In theoretical work, the researchers found that vortices created at an edge defect on a superconducting strip form a jet that crosses the strip owing to the Lorentz force. This jet is narrow near the defect, but mutual repulsion between the vortices causes it to widen as it moves toward the opposite edge of the strip. Such widening produces a local voltage perpendicular to the current in the material, and this voltage first increases and



Credit: A. I. Bezuglyj et al. [1]

then decreases as the current is raised. The team derived expressions for the jet shape in narrow and wide strips and—for the latter—determined how this shape is affected by an external magnetic field.

In experiments, Dobrovolskiy and colleagues confirmed their predicted voltage-current relationship for narrow strips. For wide strips, they showed that the derived magnetic-field dependence of the jet shape agrees with previous observations. Finally, the researchers corroborated their results using simulations, which illustrated that the jet narrows and then forms a "river" as the current is increased. By adding to researchers' understanding of vortex dynamics in superconductors, the findings might improve the performance of superconductor-based single-photon detectors.

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## REFERENCES

 A. I. Bezuglyj *et al.*, "Vortex jets generated by edge defects in current-carrying superconductor thin strips," Phys. Rev. B 105, 214507 (2022).