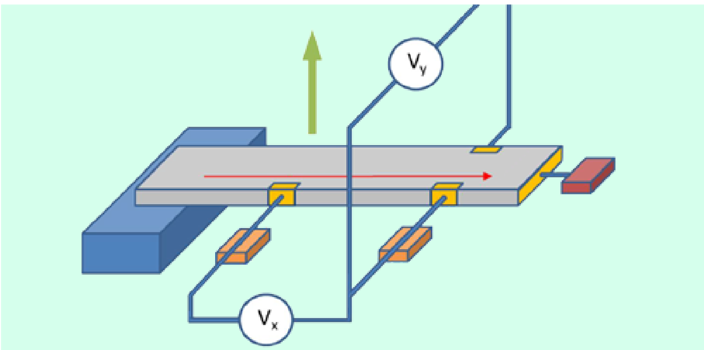
Unexpected Universality in Superconductor Behavior

In contrast with predictions, researchers find no variation in a thermoelectric signal (known as the Nernst signal) for different types of superconductor.

By Katherine Wright

Kamran Behnia has a passion for Nernst signals and has spent the last two decades exploring their manifestation in different solids. These voltage signals arise when a material is subjected to a thermal gradient and a magnetic field. He and others have found that the magnitude of the signal varies wildly in different metals, and the same was predicted to be true for superconductors. However, new experiments by Behnia, who works at ESPCI Paris, and his colleagues now negate that expectation [**1**].

The team studied the Nernst signal produced by two superconductors: crystalline strontium titanate and an amorphous mixture of molybdenum and germanium. They cooled the materials to below the superconducting temperatures and then subjected them to the needed temperature gradient and magnetic field. They found that the measured signals matched those obtained for three previously studied superconductors: a high-temperature cuprate, an iron-based material, and an organic material.



Credit: C. W. Rischau *et al.* [**1**]

Behnia said the finding was unexpected because of the predicted source of the Nernst signal in these materials. The signal is thought to come from the temperature-driven movement of superconducting vortices. The size and entropy of a given superconductor's vortices depend on its superconducting temperature and other material-specific parameters. And these differences should—according to theories—lead to variations in the Nernst signals produced by different superconductors. But that is not what the experiments show.

Behnia expects his team's findings will send theorists back to their desks to find the missing puzzle piece that explains the data-prediction mismatch. He also hopes that experimentalists will head to the lab to check how the Nernst signal produced by their favorite superconductor compares with those the team studied.

Katherine Wright is a Senior Editor for *Physics*.

REFERENCES

1. C. W. Rischau *et al.*, "Universal bound to the amplitude of the vortex Nernst signal in superconductors," **Phys. Rev. Lett. 126, 077001 (2021).**