Universität Münster

Aktuelle Fragen der Nanophysik

Montag, 01.07.2024 um 15:15 Uhr
R87, Wilhelm-Klemm-Str. 10

Magnetoelectric effects and non-reciprocal transport in superconducting systems

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Non-reciprocal transport effects have been proposed and observed in various structures, driven by the search for a superconducting diode, i.e., a superconducting device with a critical current dependent on the direction of the applied current. Beyond promising applications in superconducting electronics, the physics underlying non-reciprocal effects is notably intricate, particularly in systems where superconductivity coexists with spin-dependent fields, giving rise to emergent states.

In this presentation, I will discuss the superconducting diode effect and its connections with other, hitherto unconnected phenomena such as the spin-galvanic effect, anomalous supercurrents, the superconducting helical phase, and magnetoelectric effects induced by isotropic spin-orbit coupling. I will also briefly explain a novel way to derive an effective field theory for a unified description of transport in normal and superconducting metals in the presence of generic spin-orbit coupling based only on fundamental symmetry constraints. Finally, I will discuss recent experiments in the light of our theory.