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Abstract

Quantised magnetic flux lines in superconductors, and their phase transitions studied with neutrons

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The coherent nature of the superconducting state causes magnetic fields passing through superconductors to form lines - each containing one quantum of magnetic flux. In the ideal situation, these magnetic flux lines form a mesoscopic two-dimensional crystal, which is tuneable by varying the value and direction of the magnetic field and the temperature. Just like three-dimensional crystals, these flux lines can form different structures, which give us information about the underlying superconducting state. Also, like three-dimensional crystals, these flux structures may melt with increasing temperature. The spatial scale of magnetic flux line arrangements often makes them suitable for SANS studies. The “contrast” that causes the diffraction of neutrons is the spatial variation of magnetic field when flux lines are present.
I shall talk about the history of the flux quantum and of the use of neutrons to study flux line structures in conventional and unconventional superconductors, ending with a description of how this subject interfaces with the famous “hairy ball” theorem in topology