

Superconductivity: from conventional to exotic

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Abstract. Superconductivity is not a recent phenomenon: It was first observed in 1911. And its first microscopic explanation was formulated by Bardeen, Cooper, and Schrieffer (BCS) in 1957. Nevertheless, it remains a fascinating phenomenon that provides evidence for quantum coherence on a macroscopic scale. And it is also an active field of research with many new emerging concepts. The aim of the lecture will be to give an general introduction to superconductivity, as well as present some of the ideas of ongoing research in this field.

I will start by introducing the phenomenology of superconductivity. I will then present the conventional BCS theory, and show that it allows explaining basic properties of superconducting materials. The BCS theory will be further extended to various kinds of anisotropic pairings. This will allow discussing the basic properties of unconventional, ferromagnetic, non-centrosymmetric, and topological superconductors. A last part of the lecture will address more exotic topics, such as the strong-coupling theory of superconductivity, the crossover to the Bose-Einstein condensation, and the superconductivity of strongly disordered electronic systems.

Many excellent textbooks on superconductivity exist, see for instance Refs. [1–3]. Monographs on unconventional [4], disordered [5], non-centrosymmetric [6], and topological [7] superconductors can also be found.

References

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