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Theory of Superconductivity, Frühjahrsemester 2026

Preliminary outline

I. Introduction and phenomenology
I.1 Infinite conductivity and ideal diamagnetism

II. The Bardeen-Cooper-Schrieffer (BCS) theory
II.1 Cooper instability
II.2 Attractive interaction
II.3 The BCS ground state
II.4 Alternative approach: Bogoliubov transformation
II.5 Thermodynamic quantities
II.6 Tunneling phenomena
II.7 Electrodynamics of superconductors

III. Ginzburg-Landau (GL) theory
III.1 GL free energy
III.2 The GL equation
III.3 The linearized GL equation; type I and type II superconductors

IV. The Josephson effects
IV.1 The Josephson equations
IV.2 The RCSJ model
IV.3 Josephson junctions and magnetic fields; the DC SQUID
IV.4 The Cooper pair box
IV.5 Superconducting quantum bits

V. Inhomogenous superconductors
V.1 The Bogoliubov - de Gennes equations
V.2 Andreev scattering

VI. Fluctuation effects
VI.1 Resistance of a thin superconducting wire