

Theory of Superconductivity, Frühjahrsemester 2026

Points that you will (hopefully) understand by the end of the course

- (1) Ideal diamagnetism and zero resistance – equivalent?
- (2) “zero resistance” – really zero or just very small?
- (3) Is superconductivity related to Bose-Einstein condensation?
- (4) Are Cooper pairs bosons?
- (5) Is an energy gap necessary or sufficient for superconductivity?
- (6) The BCS wave function does not conserve particle number – is this a problem? Doesn't one use the same trick in the grand-canonical approach?
- (7) What is the “coherence length”: size of a Cooper pair? typical length scale on which the order parameter varies? Something else?
- (8) Meaning of “coherence factors”.
- (9) How do nonmagnetic / magnetic impurities influence the transition temperature T_C ?
- (10) How do nonmagnetic / magnetic impurities influence the penetration depth λ_L of a magnetic field ?
- (11) Meissner screening currents and persistent currents in a ring – equivalent?
- (12) Difference between type I / type II superconductors
- (13) Difference between the critical fields H_C , H_{C1} , H_{C2} , H_{C3}
- (14) Equations like $\mathbf{j}_s = -\frac{1}{\mu_0 \lambda_L^2} \mathbf{A}$ between the supercurrent density \mathbf{j}_s and the vector potential \mathbf{A} – do they contradict gauge invariance?