

Schedule of Advanced Solid State Physics

- (1) Superconductivity I
 - The BCS-theory (Bardeen, Cooper and Schrieffer)
 - Experimental results in SC
 - Bogoliubov transformation
 - Ginzburg-Landau theory
 - Superconductors of type I and II
- (2) Electron Wave Function in a Magnetic Field
 - Classical Landau states
 - Relativistic Dirac states
- (3) Superconductivity II
 - Vortex lattice
 - Time-dependent Ginzburg-Landau equation
 - Aslamazov-Larkin fluctuations
- (4) Quantum Hall Effect
 - Two-Dim. Electron Gas
 - Edge States
 - Edge currents and forbidden backscattering
- (5) Graphene
 - Lattice structure and reciprocal lattice
 - Band structure calculation
 - Linear dispersion and Dirac points
 - Haldane's Spin Hall effect(4. Carbon Nanotubes
 - Folding condition
 - Band structure, metal or semiconductor
- (6) Hamiltonian in second quantization
- (7) Topological Insulators
 - Spin-orbit interaction, inverted spectrum
 - Effective two-dimensional Dirac Hamiltonian
 - Spin-Momentum locking

Aharonov-Bohm Effect

(8) Berry Phase

Hamiltonian for a closed path in parameter space

Berry phase

Berry connection

Berry curvature

(9) Quantum Interference in Disordered Low-Dim. Conductors

Experimental results

The fan-diagram

Electron-electron interaction

(10) Single Electron Transistor