

Condensed Matter Theory: Special Topics

Quantum Many-Body Theory – SuSe'22

Topics

- “More is different”: Interaction effects in condensed matter
- Magnetism & superconductivity
- Green functions & diagrammatic many-body perturbation theory
- Path integrals in quantum many-body physics
- Spontaneous symmetry breaking and collective phenomena

Schedule (Preliminary)

Entrée:

- Second quantization
- Interaction effects in solids and electronic correlations: Mott-Hubbard physics, magnetism, superconductivity

Premier plat principal:

- Many-body Green functions: Definition, equations of motion, self-energy and Dyson equation
- Matsubara Green functions & Wick's theorem
- Feynman diagrams: Introduction, linked cluster theorem & block diagrams, examples: Hartree-Fock, GW, DMFT

Cours intermédiaire:

- Superconductivity: BCS and Gorkov theory

Deuxième plat principal:

- Coherent states: Bosons, Fermions, Grassmann numbers
- Coherent state path integrals
- Broken symmetry and collective phenomena

Dessert:

- Dynamical Mean Field Theory and Dual Fermions

Literature

- **Bruus, Flensberg: Many-Body Quantum Theory in Condensed Matter Physics: An Introduction**
- **Altland, Simons: Condensed Matter Field Theory**
- **Doniach, Sondheimer: Green's function for solid state physicists, Imperial College Press**
- **Coleman: Introduction to Many-Body Physics**
- Mahan: Many-Particle Physics
- Fetter, Walecka: Quantum Theory of Many-Particle Systems
- Lifschitz and Pitajewski: Statistical Physics, Part 2. (Vol. 9 of Landau and Lifschitz "Course of Theoretical Physics")
- Abrikosow, Gorkov and I. E. Dzyaloshinski: Methods of Quantum Field Theory in Statistical Physics (Prentice-Hall)
- Negele, Orland: Quantum Many Particle Systems

Exam

- Oral exam (45 mins.). Possible dates: August 3rd and 4th or September 11th and 12th 2022