

Topics in Quantum Many Body Theory

Questions for the oral exam:

- 1) Feynman path integral.
- 2) Coherent state functional integral.
- 3) Wick theorem.
- 4) Perturbation theory for the partition function, linked cluster theorem.
- 5) Perturbation theory for the imaginary time Green's function.
- 6) Techniques for Matsubara summations.
- 7) The meaning of the phenomenological Landau functional, the Fermi liquid theory and its justification. What is a one-to-one correspondence?
- 8) Thermodynamics properties of the Fermi liquid. Derivation of specific heat, compressibility and susceptibility. How is the effective mass related to the bare mass?
- 9) Collective excitations of the Fermi liquid. Kinetic equation and its solutions for zero and first sounds.
- 10) Microscopic derivation of Fermi liquid and Luttinger theorem using many-body Green functions. Ward identities for interacting fermions in the presence of the Fermi surface.
- 11) Ground state energy of the electron gas. Random phase approximation.
- 12) From microscopic Hamiltonian to Landau free energy: case of magnetic transitions for interacting fermions on a lattice.