

**Examination Topics**  
**on Advanced Quantum Mechanics Course**  
**(For PhD Students)**

*Spring 2016/17*

1. Basic concept of spontaneous symmetry breaking
2. The Lieb-Mattis model
3. Quantizing lattice vibrations: Phonons in crystals
4. Quantum melting
5. Electron-phonon coupling: The Holstein and Peierls models
6. The small polaron problem
7. The Hartree-Fock approximation for fermions
8. Mean-field magnetic order vs the exact ground state: A two-site problem
9. Superconductivity in the strong coupling limit I: Effective Hamiltonian for low-energy excitations
10. Magnetic field in Hubbard-like models: The Peierls construction
11. Superconductivity in the strong coupling limit II: Spontaneous symmetry breaking and the Meissner-Ochsenfeld effect

(-) Adam Rycerz