

1 Introduction to many-body systems and mean field theories

1.1 Revision of many-body physics

Lecture
1–19.10.2022

In undergraduate quantum mechanics, two kinds of problems are always addressed (here for the special case of electrons in an electro magnetic field):

One-body problem:

Two-body problem:

Many-body problem:

1.2 Quantum-mechanical and statistical description of non-interacting many-body systems

Lecture
2–20.10.2022

1.2.1 Quantum Mechanics

We construct an N -particle Hilbert space as the tensor product of N single-particle Hilbert spaces:

$$\mathcal{H}_N = \mathcal{H}_1^{(1)} \otimes \dots \otimes \mathcal{H}_1^{(N)} \quad (1.1)$$

A Hamiltonian in a Hilbert space like that consists of a sum of single-particle Hamiltonians:

$$H_N = H^{(1)} + \dots + H^{(N)} \quad (1.2)$$

where each