3.6 Many-particle theory

For the description of a quantum mechanical system of several particles we need an additional axiom:

5. Quantum mechanical particles are principally indistinguishable.

This axiom is necessary, because for the description of the complete system we normally use a representation in which the state of each electron is determined.

Let n_i be a set of quantum numbers; the complete state is then described by

$$|\psi\rangle = |n_1, n_2, n_3, ...\rangle \tag{3.22}$$

As long as the system is not disturbed, e.g. by measuring single electrons, no single electrons exist. Single electrons which may be detected are generated by the measurement. Before a measurement has been performed no single "particles" exist.

To emphasize this fact, a system of non-interacting electrons in a solid is often called "Jellium". This describes the non-local character of the electrons. Another example is the use of the phrase "Fermi-sea".

This has to be considered when calculating many-particle systems.