Quantum Theory of Many-Body Systems

PHT.527UF compulsory in the **Module** „Quantum Many-Body Physics“

Former „Green's functions in Many-Particle Physics“

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Introductory lecture Mo. March 4.th 2024 at 16:00 (see TUG online)

schedule can be changed upon request by the participants

The starting point to treat many-particle systems, such as in condensed matter, is the Schrodinger equation. In principle, we know how to solve it, for example numerically. In practice, this is a formidable, essentially impossible task due to the huge number of degrees of freedom.

Fortunately, approaches based on Feynman diagrams allow for a perturbative treatment of this problem which also provide an intuitive understanding of processes which are going on. Green's functions describe the propagation of particles in the background of other ones. The first effect of the interaction is the occurrence of the so-called self-energy which describes modification of the mass and lifetime of a particle due to the interaction with other ones.This course deals with the formalism and the mathematical framework of Green's functions. The ultimate goal is to predict the properties of many-body systems, as well as their response to external perturbation produced, for example, by experimental measurements.

The course consists of a highly interactive class whereby the presentation is alternated by exercises and tasks carried out by the participants in order to achieve an optimal comprehension of the subject.

- Correlation functions and linear response
- Definition of Green's functions (GF) for fermions and bosons
- Temperature, retarded and time-ordered GF. Spectral representation
- Perturbation theory and Feynman diagrams
- Self-energy. Approximation methods
- Electron gas