Fakultät für Naturwissenschaften, Fachbereich Physik

Announcement

Condensed Matter Theory A: Quantum Mechanics on Macroscopic Scales

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Description

The lecture explores theoretical and experimental developments in solid state physics over the past twenty years that describe and access quantum mechanical properties on growing length scales and with growing complexity.

Low-temperature properties of condensed matter systems are governed by quantum mechanics. Many-body effects are crucial and may lead to completely new phenomena, determined by the dynamics of new collective degrees of freedom. In superconducting devices, the quantum dynamics of these collective variables can be observed, manipulated and exploited for applications, e.g., for quantum-information technologies. In this course, we will study the physics underlying such devices and introduce tools for their analysis and description.

- Introduction
- Macroscopic quantum oscillator
- Nonlinear oscillator: Josephson junction
- From artificial atoms to circuit-QED
- Basics of open quantum systems: master equation
- Single charge transfer
- From circuit-QED to Josephson photonics

Recommended prerequisites

Quantum Mechanics, Solid State Physics, Thermodynamics/Statistics

Literature

- Michel Devoret, Quantum fluctuations in electrical circuits, Les Houches Lectures, with Uri Vool, arXiv:1610.03438
- Tero T. Heikkilä,The Physics of Nanoelectronics: Transport and Fluctuation Phenomena at Low Temperatures
- P. Breuer and F. Petruccione, The Theory of Open Quantum Systems, Oxford University Press

Details

Lecture (3 h/week), exercise (2 h/week)
6 ECTS credits

Lecturer

PD Dr. Björn Kubala, DLR Institute QT