

科目番号 03-501203 科目名 固体物理第三
Course Number Title

教員名 求 幸年
Instructor

1.5 単位
1.5 credit

標準カリキュラム 理工工学科
Department

時期 3/4/5/6年 夏学期 火曜日 13:00-14:30 本郷
Schedule

工61号講義室

講義の目的(Purpose): The purpose of this course is to introduce quantum many-body physics, connect this to what you already know from Solid State Physics 1&2, and extend this a bit further. This should provide a general conceptual framework for future specialized or advanced topics.

講義項目(Outline)

理解すべき事項(Objectives)

1. Introduction
 - 1.1 Where are we going?
 - 1.2 General set up of the problem
 - 1.3 Plan of this lecture
2. Second quantization
 - 2.1 Harmonic oscillator
 - 2.2 Second quantization of many boson systems
 - 2.3 Second quantization of many fermion systems
 - 2.4 Second quantized form of the operators
 - 2.5 Field operators
3. Many electron systems
 - 3.1 Homogeneous electron gas
 - 3.2 General form in the Bloch representation
 - 3.3 Hubbard model
 - 3.4 Hartree approximation
 - 3.5 Hartree-Fock approximation
 - 3.6 Dielectric response
4. Many boson systems
 - 4.1 Phonons
 - 4.2 Bose-Einstein condensation in noninteracting Bose gas
 - 4.3 Interacting many boson system
5. Electron-phonon interaction
 - 5.1 General formulation
 - 5.2 Second-order perturbation in electron-phonon interaction
6. Superconductivity
 - 6.1 Phenomena
 - 6.2 Cooper pair instability
 - 6.3 Bardeen-Cooper-Schrieffer (BCS) theory
7. Magnetism
 - 7.1 Magnetic moments
 - 7.2 Paramagnetism of noninteracting magnetic moments
 - 7.3. Exchange interactions
 - 7.4. Models for localized spin systems
 - 7.5. Mean-field approximation

- basics of quantum many-body physics
- second quantization
- elementary approximations for electron-electron correlations
- fundamental theory for superfluidity in many boson systems
- some consequences of electron-phonon coupling
- fundamental theory for superconductivity
- fundamental theory for magnetism

関連する講義(Related Courses)

事前履修(Prerequisites): 固体物理, 第一, 第二, 量子力学, 第一

並行履修(Parallel):

事後履修(After Completion): 固体物理, 第四

参考書(テキスト) / Reference (Textbook):

参考書(演習書) / Reference (Exercise Book):

講義ノートのリンク先 / Reference (Link to lecture notes):

成績評価(Grade Evaluation): 期末試験

科目の性格(Description):

備考(Notes):

授業使用外国語(Language used in class):