

6/6/22

UNIT: 4 QUANTUM MECHANICS

Page No.	
Date	

Quantum: position, velocity not fixed.
 small particle $v \approx c$ NLM not applicable.
 (microscopic)
 Both particle & wave nature

Nature loses symmetry

* De-Broglie's hypothesis:

A/c to De-Broglie's hypothesis every moving particle is associated with wave called matter wave or De Broglie wave whose wavelength is given by

$$\lambda = \frac{h}{p} = \frac{h}{mv}$$

λ - wavelength
 $h = 6.63 \times 10^{-34} \text{ J}\cdot\text{s}$
 m - mass of particle
 v - velocity of particle

$$m = \frac{m_0}{\sqrt{1 - \frac{v^2}{c^2}}}$$

m_0 - rest mass
 m - Relativistic mass

* * DeBroglie wavelength by Analogy with Radiation:

From the theory of relativity the momentum of massless particle like photon is related to its energy 'E'

$$E = mc \cdot c$$

$$\boxed{E = p \cdot c} \quad \text{--- (i)}$$

From Planck's quantum theory energy E

$$E = h\nu$$

$$\boxed{E = \frac{hc}{\lambda}} \quad \text{--- (ii)}$$

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G.E. Uhlenbeck, G.W. Ford



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Quantum Mechanics Thomas Banks, 2018-12-07 This authoritative advanced introduction provides a complete modern perspective on quantum mechanics It clarifies many common misconceptions regarding wave particle duality and the correct interpretation of measurements The author develops the text from the ground up starting from the fundamentals and presenting information at an elementary level avoiding unnecessarily detailed and complex derivations in favor of simple clear explanations He begins in the simplest context of a two state system and shows why quantum mechanics is inevitable and what its relationship is to classical mechanics He also outlines the decoherence approach to interpreting quantum mechanics Distinguishing features Provides a thorough grounding in the principles and practice of quantum mechanics including a core understanding of the behavior of atoms molecules solids and light Utilizes easy to follow examples and analogies to illustrate important concepts Helps develop an intuitive sense for the field by guiding the reader to understand how the correct formulas reduce to the non relativistic ones Includes numerous worked examples and problems for each chapter

Quantum Statistical Physics (lecture Notes). W. E. Frahn, 1971

Transport Phenomena in Micro- and Nanoscale Functional Materials and Devices Joao B. Sousa, Joao O. Ventura, Andre Pereira, 2021-03-26 Transport Phenomena in Micro and Nanoscale Functional Materials and Devices offers a pragmatic view on transport phenomena for micro and nanoscale materials and devices both as a research tool and as a means to implant new functions in materials Chapters emphasize transport properties TP as a research tool at the micro nano level and give an experimental view on underlying techniques The relevance of TP is highlighted through the interplay between a micro nanocarrier s characteristics and media characteristics long short range order and disorder excitations couplings and in energy conversions Later sections contain case studies on the role of transport properties in functional nanomaterials This includes transport in thin films and nanostructures from nanogranular films to graphene and 2D semiconductors and spintronics and from read heads MRAMs and sensors to nano oscillators and energy conversion from figures of merit micro coolers and micro heaters to spin caloritronics Presents a pragmatic description of electrical transport phenomena in micro and nanoscale materials and devices from an experimental viewpoint Provides an in depth overview of the experimental techniques available to measure transport phenomena in micro and nanoscale materials Features case studies to illustrate how each technique works Highlights emerging areas of interest in micro and nanomaterial transport phenomena including spintronics

Lectures in Statistical Mechanics George Eugène Uhlenbeck, G. W. Ford, E. W. Montroll, 1963

Introduction To Quantum Statistical Mechanics (2nd Edition) N N Bogolubov, Nickolai N Bogolubov Jr, 2009-12-11 Introduction to Quantum Statistical Mechanics Second Edition may be used as an advanced textbook by graduate students even ambitious undergraduates in physics It is also suitable for non experts in physics who wish to have an overview of some of the classic and fundamental quantum models in the subject The explanation in the book is detailed enough to capture the interest of the reader and complete

enough to provide the necessary background material needed to dwell further into the subject and explore the research literature

Lectures on Quantum Statistics Werner Ebeling, Thorsten Pöschel, 2019-05-11 Most of the matter in our universe is in a gaseous or plasma state Yet most textbooks on quantum statistics focus on examples from and applications in condensed matter systems due to the prevalence of solids and liquids in our day to day lives In an attempt to remedy that oversight this book consciously focuses on teaching the subject matter in the context of dilute gases and plasmas while aiming primarily at graduate students and young researchers in the field of quantum gases and plasmas for some of the more advanced topics The majority of the material is based on a two semester course held jointly by the authors over many years and has benefited from extensive feedback provided by countless students and co workers The book also includes many historical remarks on the roots of quantum statistics firstly because students appreciate and are strongly motivated by looking back at the history of a given field of research and secondly because the spirit permeating this book has been deeply influenced by meetings and discussions with several pioneers of quantum statistics over the past few decades

Statistical Physics of Non Equilibrium Quantum Phenomena Yves Pomeau, Minh-Binh Tran, 2019-11-29 This book provides an introduction to topics in non equilibrium quantum statistical physics for both mathematicians and theoretical physicists The first part introduces a kinetic equation of Kolmogorov type which is needed to describe an isolated atom actually in experiments an ion under the effect of a classical pumping electromagnetic field which keeps the atom in its excited state together with the random emission of fluorescence photons which put it back into its ground state The quantum kinetic theory developed in the second part is an extension of Boltzmann's classical non quantum kinetic theory of a dilute gas of quantum bosons This is the source of many interesting fundamental questions particularly because if the temperature is low enough such a gas is known to have at equilibrium a transition the Bose Einstein transition where a finite portion of the particles stay in the quantum ground state An important question considered is how a Bose gas condensate develops in time if its energy is initially low enough

Annotations to Quantum Statistical Mechanics In-Gee Kim, 2018-03-14 This book is a rewritten and annotated version of Leo P Kadanoff and Gordon Baym's lectures that were presented in the book Quantum Statistical Mechanics Green's Function Methods in Equilibrium and Nonequilibrium Problems The lectures were devoted to a discussion on the use of thermodynamic Green's functions in describing the properties of many particle systems The functions provided a method for discussing finite temperature problems with no more conceptual difficulty than ground state problems and the method was equally applicable to boson and fermion systems and equilibrium and nonequilibrium problems The lectures also explained nonequilibrium statistical physics in a systematic way and contained essential concepts on statistical physics in terms of Green's functions with sufficient and rigorous details In Gee Kim thoroughly studied the lectures during one of his research projects but found that the unspecialized method used to present them in the form of a book reduced their readability He started the tedious work of rewriting and annotating them to fully understand the

formalism of nonequilibrium quantum statistical mechanics While doing so he realized they can be a useful resource for students of modern physics but will have to be upgraded to match pace with the evolved curricula Being aware that besides completing the course work and passing the relevant examinations it is necessary for graduate students of modern physics to make the knowledge of a topic concrete in their minds This book is a systematically prepared summary of those lectures and will be extremely useful for graduate students as well as senior researchers to settle down the key knowledge of the subject

Methods in Statistical Mechanics Osvaldo Civitarese, Manuel Gadella, 2020-09-08 This book presents a variety of techniques for tackling phenomena that are not amenable to the conventional approach based on the concept of probabilities The methods described rely on the use of path integration thermal Green functions time temperature propagators Liouville operators second quantization and field correlators at finite density and temperature Also exploring the statistical mechanics of unstable quantum systems the book is intended as a supplementary or reference text for use in one semester graduate courses on Quantum Mechanics Thermodynamics Electromagnetism and Mathematical Methods in Physics

Statistical Structure of Quantum Theory Alexander S. Holevo, 2003-07-01 New ideas on the mathematical foundations of quantum mechanics related to the theory of quantum measurement as well as the emergence of quantum optics quantum electronics and optical communications have shown that the statistical structure of quantum mechanics deserves special investigation In the meantime it has become a mature subject In this book the author himself a leading researcher in this field surveys the basic principles and results of the theory concentrating on mathematically precise formulations Special attention is given to the measurement dynamics The presentation is pragmatic concentrating on the ideas and their motivation For detailed proofs the readers researchers and graduate students are referred to the extensively documented literature

Introduction To Quantum Statistical Mechanics Nikolai N Bogolubov Jr, N N Bogolubov, 1982-01-01 This text represents the first translated edition of a special series of lectures delivered at the Physics Department of the Moscow State University It can serve as an introduction to a large group ranging from final year undergraduates to researchers and others requiring and understanding of Quantum Statistics and Second Quantization methods

Mathematical Foundations of Quantum Statistical Mechanics D.Y. Petrina, 2012-12-06 This monograph is devoted to quantum statistical mechanics It can be regarded as a continuation of the book *Mathematical Foundations of Classical Statistical Mechanics Continuous Systems* Gordon Breach SP 1989 written together with my colleagues V I Gerasimenko and P V Malyshev Taken together these books give a complete presentation of the statistical mechanics of continuous systems both quantum and classical from the common point of view Both books have similar contents They deal with the investigation of states of finite systems which are described by infinite sequences of statistical operators reduced density matrices or Green's functions in the quantum case and by infinite sequences of distribution functions in the classical case The equations of state and their solutions are the main object of investigation in these books For infinite systems the solutions of the equations of state are constructed by

using the thermodynamic limit procedure according to which we first find a solution for a system of finitely many particles and then let the number of particles and the volume of a region tend to infinity keeping the density of particles constant. However, the style of presentation in these books is quite different.

Lectures on Quantum Statistics Nikolaj N. Bogoljubov, 1970

[Lectures in Statistical Mechanics](#) G.E. Uhlenbeck, G.W. Ford, 1963-01-01

Quantum Statistical Mechanics: Selected Works Of N N Bogolubov Nickolai N Bogolubov Jr, 2014-08-14. In this book we have solved the complicated problem of constructing upper bounds for many time averages for the case of a fairly broad class of model systems with four fermion interaction. The methods proposed in this book for solving this problem will undoubtedly find application not only for the model systems associated with the theory of superconductivity considered here. The theoretical methods developed in Chapters 1 and 2 are already applicable to a much broader class of model systems from statistical physics and the theory of elementary particles.

Statistical Mechanics Richard P. Feynman, 1998-03-26. Physics rather than mathematics is the focus in this classic graduate lecture note volume on statistical mechanics and the physics of condensed matter. This book provides a concise introduction to basic concepts and a clear presentation of difficult topics while challenging the student to reflect upon as yet unanswered questions.

Quantum Statistical Mechanics Paul Herman Ernst Meijer, 1966

Quantum Statistical Mechanics William C. Schieve, Lawrence P. Horwitz, 2009-04-16. Introduces many body theory of modern quantum statistical mechanics to graduate students in physics, chemistry, engineering, and biology.

Introduction to Non-equilibrium Quantum Statistical Mechanics Shigeji Fujita, 1966

Statistical Mechanics Richard Phillips Feynman, 1972

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