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Statistical Mechanics

Lecture 5 Quantum

Statistical Mechanics

Lecture Notes

Quantum statistics

dictates two options,

either $n_k = 0, 1$, for a

gas of fermions or $n_k =$

$0, 1, \dots, \infty$ for bosons. QF

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$$k = \sum_{k=0}^{\infty} n_k = 0. = 1$$

+ $e^{-(\mu - \epsilon_k)}$ while for bosons the right hand side is an infinite

geometric series

$$k = \sum_{k=0}^{\infty} e^{-(\mu - \epsilon_k)} = \frac{1}{1 - e^{-(\mu - \epsilon_k)}}.$$

Statistical Mechanics

Lecture Notes 3 -

Quantum statistics ...

Quantum Statistical

Mechanics. p p X. VI.

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Mechanics. There are limitations to the applicability of classical statistical mechanics. The need to include quantum mechanical effects becomes specially apparent at low temperatures. In this section we shall first demonstrate the failure of the classical results in the contexts

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of heat capacities of molecular gases and solids, and the ultra-violet catastrophe in black body radiation.

VI. Quantum
Statistical Mechanics
- MIT

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1.1 Probability

Amplitudes. A key aspect of QM is that probability enters in

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an unusual way. To stress this point let's recall that "classical" probabilities follow rules like: If A, B are independent events with probabilities $P(A)$ and $P(B)$, then the probability for A and B is $P(A \text{ and } B) = P(A)P(B)$.

Lecture Notes for
Quantum Mechanics

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This set of supplementary lecture notes is the outgrowth of a course I taught,

ECE 487, Quantum Electronics, at ECE Department,

University of Illinois at Urbana-Champaign. It was intended to teach quantum mechanics to undergraduate students as well as graduate students.

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The primary text book
for this course is
Quantum Mechanics
for Scientists and

Quantum Mechanics
Made Simple: Lecture
Notes

Lecture Note 18
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L19: Mean field theory
of condensation,
Corresponding states,

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Critical point behavior

(from L17 & L18)

Lecture Note 19

(PDF) L20: Dilute

Polyatomic Gases,

Vibrations of a Solid,

Black-body Radiation:

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Microstates, Quantum

Macrostates: Lecture

Note 21 (PDF) VII.

Lecture Notes |

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Statistical Mechanics

I: Statistical ...

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The third law of thermodynamics. Quantum micro and macro states. The density matrix and its properties.

Physics 611.
Statistical Mechanics
David Tong: Lectures on Statistical Physics.
This is an introductory course on Statistical Mechanics and

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Thermodynamics

given to final year undergraduates. They were last updated in

May 2012. Full lecture notes come in around 190 pages. Individual chapters and problem sets can also be found below.

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David Tong --

Lectures on Statistical

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Physics

The energy eigenstates of one particle are $\psi_{n_x, n_y, n_z}(\vec{x}) = \sin(k_x x) \sin(k_y y) \sin(k_z z)$ with $k_x = \frac{n_x \pi}{L}$, $k_y = \frac{n_y \pi}{L}$, $k_z = \frac{n_z \pi}{L}$; and $n_x, n_y, n_z = 1, 2, 3, \dots$ with energy eigenvalues $E_{n_x, n_y, n_z} = \frac{\hbar^2}{2m} (k_x^2 + k_y^2 + k_z^2)$.

8.044 Lecture Notes
Chapter 9: Quantum
Ideal Gases

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particle creation

operators with

quantum number l

$c_{j n_1 n_2 \dots i} = 0$ if $n_l = 1$

for fermions $p_{j n_1 n_2 \dots i} = 1$

$(-1)^{P_l} \prod_{j=1}^{n_l} p_{j n_1 n_2 \dots i}$

else: (17)

Here the $+ (-)$ sign

applies to bosons

(fermions). particle

annihilation operators

with quantum number

l $c_{j n_1 n_2 \dots i} = p_{j n_1 n_2 \dots i}$

$(-1)^{P_l} \prod_{j=1}^{n_l} p_{j n_1 n_2 \dots i}$

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(18) We note that (18) follows from (17) by $\int_{\mathcal{M}} \psi^* \mathcal{L} \psi = \int_{\mathcal{M}} \psi^* \mathcal{L} \psi$

Advanced Quantum Theory - University of Oxford

The topics covered in this course sequence will include classical mechanics, quantum mechanics, the general and special

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theories of relativity,
electromagnetism,
cosmology, and black
holes. ... Statistical
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a lot of searches for
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The Complete
Leonard Suskind
Lectures | Ted Young

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Statistical Physics. An introduction to statistical mechanics and thermodynamics, aimed at final year undergraduates. After developing the fundamentals of the subject, the course covers classical gases, quantum gases and phase transitions.

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David Tong:

Cambridge Lecture
Notes on Theoretical
Physics

Statistical mechanics

This is an advanced undergraduate level course on statistical mechanics. An interesting peculiarity of the course is that it contains an introduction to two of the most beautiful

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models in non-equilibrium statistical physics: the Kac ring model, and the

Ehrenfest urn model.

You can download the lecture notes (in French) here.

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Vibrations of Solid

(Low Temperature)

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Mechanics

This volume,

Statistical Mechanics:

Lecture notes, is

intended to be the

basis for a one-

semester graduate-

level course on

thermodynamics and

statistical mechanics.

The structure of the

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course is mostly traditional, besides that due to the current interest in nanoscale systems and ultrasensitive physical measurements, large attention is given to classical and quantum fluctuations of various physical variables.

Statistical Mechanics:
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Assuming all configurations of a quantum system with a given total energy are equally likely, you can find the statistical properties of quantum mechanical s...

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The lectures were meant to complement

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this subject with background material on the equilibrium statistical mechanics of quantum spin chains from a vertex model perspective.

The author was asked to provide a minimal introduction to quantum spin systems including notions like the reduced density

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Statistical mechanics
matrix and correlation
functions of local
observables.

Lecture Notes

Statistical mechanics
of integrable quantum
spin ... - SciPost

(April 1, 2013)

Leonard Susskind
introduces statistical
mechanics as one of
the most universal
disciplines in modern
physics. He begins

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Statistical physics has its origins in attempts to describe the thermal properties of matter in terms of its constituent particles, and has played a fundamental role in the development of

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Statistical mechanics.

Based on lectures taught by Professor Kardar at MIT, this textbook introduces the central concepts and tools of statistical physics. It contains a chapter on probability and related issues such as the central limit theorem and information theory, and covers interacting

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particles, with an extensive description of the van der Waals equation and its derivation by mean field approximation. It also contains an integrated set of problems, with solutions to selected problems at the end of the book and a complete set of solutions is available

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to lecturers on a
password protected
website at www.cambridge.org/9780521873420. A companion
volume, Statistical
Physics of Fields,
discusses non-mean
field aspects of
scaling and critical
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the perspective of
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This book provides a rapid overview of the basic methods and

concepts in

mechanics for

beginning Ph.D.

students and

advanced

undergraduates in

applied mathematics

or related fields. It is

based on a graduate

course given in

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2006-07 at the

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Mathematical

Sciences. Among

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introduces Newton's

law, action principles,

Hamilton-Jacobi

theory, geometric

wave theory,

analytical and

numerical statistical

mechanics, discrete

and continuous

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Statistical mechanics,
and quantum path-
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focus is on

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theory, which appears
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principle of classical mechanics, and in the geometric theory of dispersive wavetrains.

The material is developed in a sequence of simple examples and the book can be used in a one-semester class on classical, statistical, and quantum mechanics. Some familiarity with

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differential equations

is required but

otherwise the book is

self-contained. In

particular, no previous

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is assumed. Titles in

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Modern introduction to quantum field theory for graduates, providing intuitive, physical explanations supported by real-world applications and homework problems.

This book is a collection of lecture notes from the Symposium on Quantum Computing,

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Thermodynamics, and
Statistical Physics,
held at Kinki
University in March

2012. Quantum
information theory has
a deep connection
with statistical physics
and thermodynamics.

This volume
introduces some of
the topics on interface
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included in the lecture notes include quantum annealing method, nonequilibrium thermodynamics and spin glass theory, among others. These subjects were presented with much emphasis put in its relevance in quantum information theory. These lecture notes

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are prepared in a self-contained manner so that a reader with modest background may understand the subjects.

Statistical Mechanics:
Lecture notes forms
the basis for a one-

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Semester course on thermodynamics and statistical mechanics with large attention given to fluctuations of various physical variables. To help develop the students toolkit, a brief introduction to physics kinetics is also included.

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"This book excels by its variety of modern examples in solid state physics, magnetism, elementary particle physics [...] I can recommend it strongly as a valuable source, especially to those who are teaching basic statistical physics at our universities."

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These lecture notes cover Statistical Mechanics at the level of advanced undergraduates or postgraduates. After a review of thermodynamics, statistical ensembles are introduced, then applied to ideal gases, including

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degenerate gases of bosons and fermions, followed by a treatment of systems with interaction, of real gases, and of stochastic processes. The book offers a comprehensive and detailed, as well as self-contained, account of material that can and has been

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covered in a one-semester course for students with a basic understanding of thermodynamics and a solid background in classical mechanics.

The first volume (General Theory) differs from most textbooks as it emphasizes the mathematical

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Structure and

mathematical rigor, while being adapted to the teaching the first semester of an advanced course in Quantum Mechanics (the content of the book are the lectures of courses actually delivered.). It differs also from the very few texts in Quantum Mechanics that give

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emphasis to the mathematical aspects because this book, being written as Lecture Notes, has the structure of lectures delivered in a course, namely introduction of the problem, outline of the relevant points, mathematical tools needed, theorems, proofs. This makes

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this book particularly useful for self-study and for instructors in the preparation of a second course in Quantum Mechanics (after a first basic course). With some minor additions it can be used also as a basis of a first course in Quantum Mechanics for students in

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mathematics

curricula. The second part (Selected Topics)

are lecture notes of a

more advanced

course aimed at

giving the basic

notions necessary to

do research in several

areas of mathematical

physics connected

with quantum

mechanics, from solid

state to singular

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interactions, many body theory, semi-classical analysis, quantum statistical mechanics. The structure of this book is suitable for a second-semester course, in which the lectures are meant to provide, in addition to theorems and proofs, an overview of a more specific subject and

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hints to the direction of research. In this respect and for the width of subjects this second volume differs from other monographs on Quantum Mechanics. The second volume can be useful for students who want to have a basic preparation for doing research and for

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