2 Physics Chapterwise Notes

A timely presentation of new results, challenges, and opportunities in the quickly developing field of nuclear cluster physics, presented by an international group of eminent theoretical and experimental scientists active in the field. Their work reveals how correlations of nucleons can appear spontaneously, propagate, and survive in nuclear matter at both low and high densities. Characteristic nuclear substructures, beyond those predicted by mean-field or collective scenarios, appear on microscopic and cosmic length scales. They can influence the dynamics of fusion of light nuclei and the decay of heavy, fissioning nuclei or of systems produced transiently in heavy-ion reactions. A must-read for young scientists entering the field and a valuable resource for more seasoned nuclear researchers!

Density functional theory (DFT) is by now a well-established method for tackling the quantum mechanics of many-body systems. Originally applied to compute properties of atoms and simple molecules, DFT has quickly become a work horse for more complex applications in the chemical and materials sciences. The present set of lectures, spanning the whole range from basic principles to relativistic and time-dependent extensions of the theory, is the ideal introduction for graduate students or nonspecialist researchers wishing to familiarize themselves with both the basic and most advanced techniques in this field.

In this book, the author leads the reader, step by step and without any advanced mathematics, to a clear understanding of the foundations of modern elementary particle physics and cosmology. He also addresses current and controversial questions on topics such as string theory. The book contains gentle introductions to the theories of special and general relativity, and also classical and quantum field theory. The essential aspects of these concepts are understood with the help of simple calculations; for example, the force of gravity as a consequence of the curvature of the space-time. Also treated are the Big Bang, dark matter and dark energy, as well as the presently known interactions of elementary particles: electrodynamics, the strong and the weak interactions including the Higgs boson. Finally, the book sketches as yet speculative theories: Grand Unification theories, supersymmetry, string theory and the idea of additional dimensions of space-time. Since no higher mathematical or physics expertise is required, the book is also suitable for college and university students at the beginning of their studies. Hobby astronomers and other science enthusiasts seeking a deeper insight than can be found in popular treatments will also appreciate this unique book.

The book presents pedagogical reviews of important topics on high energy physics to the students and researchers in particle physics. The book also discusses topics on the Quark–Gluon plasma, thermal field theory, perturbative quantum chromodynamics, anomalies and cosmology. Students of particle physics need to be well-equipped with basic understanding of many concepts underlying the standard models of particle physics and cosmology. This is particularly true today when experimental results from colliders, such as large hadron collider (LHC) and relativistic heavy ion collider (RHIC), as well as inferences from cosmological observations, are expected to further expand our understanding of particle physics at high energies. This volume is the second in the Surveys in Theoretical High Energy Physics Series (SThEP). Topics covered in this book are based on lectures delivered at the SERC Schools in Theoretical High Energy Physics at the Physical Research Laboratory, Ahmedabad, and the University of Hyderabad.

Readership: Graduate students and researchers in condensed matter physics.

This book describes the basic concepts of various physical phenomena in semiconductors and their modulated structures under high magnetic fields. The topics cover magneto-transport phenomena, cyclotron resonance, far-infrared spectroscopy, magneto-optical spectroscopy, diluted magnetic semiconductors in high magnetic fields, as well as the recent advances in the experimental techniques needed for high field experiments. Starting from the introductory part describing the basic theoretical background, each chapter introduces typical experimental data which were actually obtained in very high magnetic fields mostly in the pulsed field range up to several megagauss (20-100T). The book has both the character of a textbook and a monograph. For researchers and students with an interest in semiconductor physics or in high magnetic fields, it will serve as a useful guide.

This book introduces physics students to concepts and methods of finance. Despite being perceived as quite distant from physics, finance shares a number of common methods and ideas, usually related to noise and uncertainties. Juxtaposing the key methods to applications in both physics and finance articulates both differences and common features, this gives students a deeper understanding of the underlying ideas. Moreover, they acquire a number of useful mathematical and computational tools, such as stochastic differential equations, path integrals, Monte-Carlo methods, and basic cryptology. Each chapter ends with a set of carefully designed exercises enabling readers to test their comprehension.

Suitable as a textbook for a graduate seminar in mathematical modelling, and as a resource for scientists in a wide range of disciplines. Presents 22 lectures from an international conference in Leibnitz, Austria (no date mentioned), explaining recent developments and results in differential equatio

This volume presents the state-of-the-art in selected topics across modern nuclear physics, covering fields of central importance to research and illustrating their connection to many different areas of physics. It describes recent progress in the study of superheavy and exotic nuclei, which is pushing our knowledge to ever heavier elements and neutron-richer isotopes. Extending nuclear physics to systems that are many times denser than even the core of an atomic nucleus, one enters the realm of the physics of neutron stars and possibly quark stars, a topic that is intensively investigated with many ground-based and outer-space research missions as well as numerous theoretical works. By colliding two nuclei at very high ultra-relativistic energies one can create a fireball of extremely hot matter, reminiscent of the universe very shortly after the big bang, leading to a phase of melted hadrons and free quarks and gluons, the so-called quark-gluon plasma. These studies tie up with effects of crucial importance in other fields. During the collision of heavy ions, electric fields of extreme strength are produced, potentially destabilizing the vacuum of the atomic physics system, subsequently leading to the decay of the vacuum state and the emission of positrons. In neutron stars the ultra-dense matter might support extremely high magnetic fields, far beyond anything that can be produced in the laboratory, significantly affecting the stellar properties. At very high densities general relativity predicts the stellar collapse to a black hole. However, a number of current theoretical activities, modifying Einstein’s theory, point to possible alternative scenarios, where this collapse might be avoided. These and related topics are addressed in this book in a series of highly readable chapters. In addition, the book includes fundamental analyses of the practicalities involved in transiting to an electricity supply mainly based on renewable energies, investigating this scenario less from an engineering and more from a physics point of view. While the topics comprise a large scope of activities, the contributions also show an extensive overlap in the methodology and in the analytical and numerical tools involved in tackling these diverse research fields that are the forefront of modern science.

There are many approaches to noncommutative geometry and its use in physics, the ? operator algebra and C -algebra one, the deformation quantization one, the qu- tum group one, and the matrix algebra/fuzzy geometry one. This volume introduces and develops the subject by presenting in particular the ideas and methods recently pursued by Julius Wess and his group. These methods combine the deformation quantization approach based on the - tion of star product and the deformed (quantum) symmetries methods based on the theory of quantum groups. The merging of these two techniques has proven very fruitful in order to formulate ?eld theories on noncommutative spaces. The aim of the book is to give an introduction to these topics and to prepare the reader to enter the research ?eld himself/herself. This has developed from the constant interest of Prof. W. Beiglboeck, editor of LNP, in this project, and from the authors experience in conferences and schools on the subject, especially from their interaction with students and young researchers. In fact quite a few chapters in the book were written with a double purpose, on the one hand as contributions for school or conference proceedings and on the other handaschaptersforthepresentbook.Thesearenowharmonizedandcomplemented by a couple of contributions that have been written to provide a wider background, to widen the scope, and to underline the power of our methods.

One could make the claim that all branches of physics are basically generalizations of classical mechanics. It is also often the first course which is taught to physics students. The approach of this book is to construct an intermediate discipline between general courses of physics and analytical mechanics, using more sophisticated mathematical tools. The aim of this book is to prepare a self-consistent and compact text that is very useful for teachers as well as for independent study.

This is the proceedings of the Ninth International Symposium on Exotic Nuclei EXON-2018, 10-15 September, Petrozavodsk, Russia. The first symposium took place 27 years ago in 1991 in Foros (Crimea), the later symposiums were held on Baikal Lake, in Peterhof, Khanty-Mansiysk, Sochi, Vladivostok, Kaliningrad and Kazan. The organizers of the Symposium were the five largest scientific centers of heavy-ion physics — JINR (Dubna), the RIKEN Research Center (Japan), the GANIL National Center (France), the GSI Helmholtz Centre for Heavy Ion Research (Germany), the National Superconducting Cyclotron Laboratory (Michigan, USA). The main topics are: properties of light exotic nuclei, synthesis and properties of superheavy elements, rare processes and decays, experimental facilities and future projects.

This course-based monograph introduces the reader to the theory of continuous measurements in quantum mechanics and provides some benchmark applications. The approach chosen, quantum trajectory theory, is based on the stochastic Schrödinger and master equations, which determine the evolution of the a-posteriori state of a continuously observed quantum system and give the distribution of the measurement output. The present introduction is restricted to finite-dimensional quantum systems and diffusive outputs. Two appendices introduce the tools of probability theory and quantum measurement theory which are needed for the theoretical developments in the first part of the book. First, the basic equations of quantum trajectory theory are introduced, with all their mathematical properties, starting from the existence and uniqueness of their solutions. This makes the text also suitable for other applications of the same stochastic differential equations in different fields such as simulations of master equations or dynamical reduction theories. In the next step the equivalence between the stochastic approach and the theory of continuous measurements is demonstrated. To conclude the theoretical exposition, the properties of the output of the continuous measurement are analyzed in detail. This is a stochastic process with its own distribution, and the reader will learn how to compute physical quantities such as its moments and its spectrum. In particular this last concept is introduced with clear and explicit reference to the measurement process. The two-level atom is used as the basic prototype to illustrate the theory in a concrete application. Quantum phenomena appearing in the spectrum of the fluorescence light, such as Mollow’s triplet structure, squeezing of the fluorescence light, and the linewidth narrowing, are presented. Last but not least, the theory of quantum continuous measurements is the natural starting point to develop a feedback control theory in continuous time for quantum systems. The two-level atom is again used to introduce and study an example of feedback based on the observed output.

This book pays tribute to 25 Singaporean South Asians who pioneered and excelled in their respective fields from 1950 to 2015. It is meant to be a 'quick take' on 25 Singaporean South Asian personalities, across a broad spectrum of professions and activities, who believed in the value and virtue of service to the community and gave the best of themselves.They had a sense of mission in their professions, dedicated to what they were doing and fostered a sense of community and nation. Many of them laid foundations that triggered the transformation of the island, including sportspeople whose records have stood the test of time. They were a people of their time whose work many may not know but which we hope will inspire others. This book is timely, for those who want to get a snapshot appreciation of the contributions of Singaporean South Asians.

- Up-to-date account of the principles and practice of inelastic and spectroscopic methods available at neutron and synchrotron sources - Multi-technique approach set around a central theme, rather than a monograph on one technique - Emphasis on the complementarity of neutron spectroscopy and X-ray spectroscopy which are usually treated in separate books

This book presents some of the latest achievements in nanotechnology and nanomaterials from leading researchers in Ukraine, Europe, and beyond. It features contributions from participants in the 3rd International Science and Practice Conference Nanotechnology and Nanomaterials (NANO2015) held in Lviv, Ukraine on August 26-30, 2015. The International Conference was organized jointly by the Institute of Physics of the National Academy of Sciences of Ukraine, University of Tartu (Estonia), Ivan Franko National University of Lviv (Ukraine), University of Turin (Italy), Pierre and Marie Curie University (France), and European Profiles A.E. (Greece). Internationally recognized experts from a wide range of universities and research institutions share their knowledge and key results on topics ranging from nanooptics, nanoplasmonics, and interface studies to energy storage and biomedical applications.

The 3rd edition is thoroughly revised, applications are substantially enriched, it includes a new account of the early history of the subject (from 1800 to 1957) and a new chapter recounting the recent solution of open problems of long standing in classical aerodynamics. The bibliography comprises now over fifteen hundred titles. From the reviews: "The author is known as one of the leading experts in the field. His masterly written book is, surely, the most complete exposition in the subject of conservations laws." --Zentralblatt

MATH
The aim of this book is to introduce a graduate student to selected concepts in condensed matter physics for which the language of field theory is ideally suited. The examples considered in this book are those of superfluidity for weakly interacting bosons, collinear magnetism, and superconductivity. Quantum phase transitions are also treated in the context of quantum dissipative junctions and interacting fermions constrained to one-dimensional position space. The style of presentation is sufficiently detailed and comprehensive that it only presumes familiarity with undergraduate physics.
The lecture notes presented here in facsimile were prepared by Enrico Fermi for students taking his course at the University of Chicago in 1954. They are vivid examples of his unique ability to lecture simply and clearly on the most essential aspects of quantum mechanics. At the close of each lecture, Fermi created a single problem for his students. These challenging exercises were not included in Fermi's notes but were preserved in the notes of his students. This second edition includes a set of these assigned problems as compiled by one of his former students, Robert A. Schluter. Enrico Fermi was awarded the Nobel Prize for Physics in 1938.
Magnetic control of the properties and the flow of liquids is a challenging field for basic research and for applications. This book is meant to be both an introduction to, and a state-of-the-art review of, this topic. Written in the form of a set of lectures and tutorial reviews, the book addresses the synthesis and characterization of magnetic fluids, their hydrodynamical description and their rheological properties. The book closes with an account of magnetic drug targeting.
Covering the theory of computation, information and communications, the physical aspects of computation, and the physical limits of computers, this text is based on the notes taken by one of its editors, Tony Hey, on a lecture course on computation given b
This book is based on the lecture notes of a one-semester course on black hole astrophysics given by the author and is aimed at advanced undergraduate and graduate students with an interest in astrophysics. The material included goes beyond that found in classic textbooks and presents details on astrophysical manifestations of black holes. In particular, jet physics and detailed accounts of objects like microquasars, active galactic nuclei, gamma-ray bursts, and ultra-luminous X-ray sources are covered, as well as advanced topics like black holes in alternative theories of gravity. The author avoids unnecessary technicalities and to some degree the book is self-contained. The reader will find some basic general relativity tools in Chapter 1. The appendices provide some additional mathematical details that will be useful for further study, and a guide to the bibliography on the subject.
Pulsars, generally accepted to be rotating neutron stars, are dense, neutron-packed remnants of massive stars that blew apart in supernova explosions. They are typically about 10 kilometers across and spin rapidly, often making several hundred rotations per second. Depending on star mass, gravity compresses the matter in the cores of pulsars up to more than ten times the density of ordinary atomic nuclei, thus providing a high-pressure environment in which numerous particle processes, from hyperon population to quark deconfinement to the formation of Boson condensates, may compete with each other. There are theoretical suggestions of even more ""exotic"" processes inside pulsars, such as the formation of absolutely stable strange quark matter, a configuration of matter even more stable than the most stable atomic nucleus, ^T56Fe. In the latter event, pulsars would be largely composed of pure quark matter, eventually enveloped in nuclear crust matter. These features combined with the tremendous recent progress in observational radio and x-ray astronomy make pulsars nearly ideal probes for a wide range of physical studies, complementing the quest of the behavior of superdense matter in terrestrial collider experiments. Written by an eminent author, Pulsars as Astrophysical Laboratories for Nuclear and Particle Physics gives a reliable account of the present status of such research, which naturally is to be performed at the interface between nuclear physics, particle physics, and Einstein's theory of relativity.
Understanding the dynamics of gauge theories is crucial, given the fact that all known interactions are based on the principle of local gauge symmetry. Beyond the perturbative regime, however, this is a notoriously difficult problem. Requiring invariance under supersymmetry turns out to be a suitable tool for analyzing supersymmetric gauge theories over a larger region of the space of parameters. Supersymmetric quantum field theories in four dimensions with extended N=2 supersymmetry are further constrained and have therefore been a fertile field of research in theoretical physics for quite some time. Moreover, there are far-reaching mathematical ramifications that have led to a successful dialogue with differential and algebraic geometry. These lecture notes aim to introduce students of modern theoretical physics to the fascinating developments in the understanding of N=2 supersymmetric gauge theories in a coherent fashion. Starting with a gentle introduction to electric-magnetic duality, the author guides readers through the key milestones in the field, which include the work of Seiberg and Witten, Nekrasov, Gaiotto and many others. As an advanced graduate level text, it assumes that readers have a working knowledge of supersymmetry including the formalism of superfields, as well as of quantum field theory techniques such as regularization, renormalization and anomalies. After his graduation from the University of Tokyo, Yuji Tachikawa worked at the Institute for Advanced Study, Princeton and the Kavli Institute for Physics and Mathematics of the Universe. Presently at the Department of Physics, University of Tokyo, Tachikawa is the author of several important papers in supersymmetric quantum field theories and string theory.
Functional analysis is a well-established powerful method in mathematical physics, especially those mathematical methods used in modern non-perturbative quantum field theory and statistical turbulence. This book presents a unique, modern treatment of solutions to fractional random differential equations in mathematical physics. It follows an analytic approach in applied functional analysis for functional integration in quantum physics and stochastic Langevin?turbulent partial differential equations.

New Structures for PhysicsSpringer

This volume provides a series of tutorials on mathematical structures which recently have gained prominence in physics, ranging from quantum foundations, via quantum information, to quantum gravity. These include the theory of monoidal categories and corresponding graphical calculi, Girard’s linear logic, Scott domains, lambda calculus and corresponding logics for typing, topos theory, and more general process structures. Most of these structures are very prominent in computer science; the chapters here are tailored towards an audience of physicists.

Distributions and Their Applications in Physics is the introduction of the Theory of Distributions and their applications in physics. The book contains a discussion of those topics under the Theory of Distributions that are already considered classic, which include local distributions; distributions with compact support; tempered distributions; the distribution theory in relativistic physics; and many others. The book also covers the Normed and Countably-normed Spaces; Test Function Spaces; Distribution Spaces; and the properties and operations involved in distributions. The text is recommended for physicists that wish to be acquainted with distributions and their relevance and applications as part of mathematical and theoretical physics, and for mathematicians who wish to be acquainted with the application of distributions theory for physics.

But all the clocks in the city Began to whirr and chime: ’O let not Time deceive you, You cannot conquer Time. W. H. Auden It is hard to think of a subject as rich, complex, and important as time. From the practical point of view it governs and organizes our lives (most of us are after all attached to a wrist watch) or it helps us to wonderfully ?nd our way in unknown territory with the global positioning system (GPS). More generally it constitutes the heartbeat of modern technology. Time is the most precisely measured quantity, so the second de?nes the meter or the volt and yet, nobody knows for sure what it is, puzzling philosophers, artists, priests, and scientists for centuries as one of the enduring enigmas of all cultures. Indeed time is full of contrasts: taken for granted in daily life, it requires sophisticated experimental and theoretical treatments to be accurately “produced. ” We are trapped in its web, and it actually kills us all, but it also constitutes the stuff we need to progress and realize our objectives. There is nothing more boring and monotonous than the tick-tock of a clock, but how many fascinating challenges have physicists met to realize that monotony: Quite a number of Nobel Prize winners have been directly motivated by them or have contributed 1 signi?cantly to time measurement.

The present treatise is concerned with the quantum mechanical theory of measurement. Since the development of quantum theory in the 1920s the measuring process has been considered a very important problem. A large number of articles have accordingly been devoted to this subject. In this way the quantum mechanical measurement problem has been a source of inspiration for physical, mathematical and philo sophical investigations into the foundations of quantum theory, which has had an impact on a great variety of research fields, ranging from the physics of macroscopic systems to probability theory and algebra. Moreover, while many steps forward have been made and much insight has been gained on the road towards a solution of the measurement problem, left open nonetheless are important questions, which have in duced several interesting developments. Hence even today it cannot be said that the measurement process has lost its topicality and excite ment. Moreover, research in this field has made contact with current advances in high technology, which provide new possibilities for per forming former Gedanken experiments. For these reasons we felt that the time had come to develop a systematic exposition of the quantum theory of measurement which might serve as a basis and reference for future research into the foundations of quantum mechanics. But there are other sources of motivation which led us to make this effort. First of all, in spite of the many contributions to measurement theory there is still no generally accepted approach.

After some decades of work a satisfactory theory of quantum gravity is still not available; moreover, there are indications that the original field theoretical approach may be better suited than originally expected. There, to first approximation, one is left with the problem of quantum field theory on Lorentzian manifolds. Surprisingly, this seemingly modest approach leads to far reaching conceptual and mathematical problems and to spectacular predictions, the most famous one being the Hawking radiation of black holes. Ingredients of this approach are the formulation of quantum physics in terms of C*-algebras, the geometry of Lorentzian manifolds, in particular their causal structure, and linear hyperbolic differential equations where the well-posedness of the Cauchy problem plays a distinguished role, as well as more recently the insights from suitable concepts such as microlocal analysis. This primer is an outgrowth of a compact course given by the editors and contributing authors to an audience of advanced graduate students and young researchers in the field, and assumes working knowledge of differential geometry and functional analysis on the part of the reader.

This volume reviews the current understanding of the Fermi-Pasta-Ulam (FPU) Problem without trying to force coherence on differing perspectives on the same problem by various groups or approaches. The contributions lead the interested but inexperienced reader through gradual understanding, starting from general analysis and proceeding towards more specialized topics. The volume also includes a reprint of the original Fermi-Pasta-Ulam paper.