# String Theory Methods For Condensed Matter Physics

Differential geometry and topology have become essential tools for many theoretical physicists. In particular, they are indispensable in theoretical studies of condensed matter physics, gravity, and particle physics. Geometry, Topology and Physics, Second Edition introduces the ideas and techniques of differential geometry and topology at a level suitable for postgraduate students and researchers in these fields. The second edition of this popular and established text incorporates a number of changes designed to meet the needs of the reader and reflect the development of the subject. The book features a considerably expanded first chapter, reviewing aspects of path integral quantization and gauge theories. Chapter 2 introduces the mathematical concepts of maps, vector spaces, and topology. The following chapters focus on more elaborate concepts in geometry and topology and discuss the application of these concepts to liquid crystals, superfluid helium, general relativity, and bosonic string theory. Later chapters unify geometry and topology, exploring fiber bundles, characteristic classes, and index theorems. New to this second edition is the proof of the index theorem in terms of supersymmetric quantum mechanics. The final two chapters are devoted to the most fascinating applications of geometry and topology in contemporary physics, namely the study of anomalies in gauge field theories and the analysis of

Polakov's bosonic string theory from the geometrical point of view. Geometry, Topology and Physics, Second Edition is an ideal introduction to differential geometry and topology for postgraduate students and researchers in theoretical and mathematical physics.

A comprehensive, graduate-level textbook introducing quantum field theory, giving equal emphasis to operator and path integral formalisms.

Quantum phase transitions (QPTs) offer wonderful examples of the radical macroscopic effects inherent in quantum physics: phase changes between different forms of matter driven by quantum rather than thermal fluctuations, typically at very low temperatures. QPTs provide new insight into outstanding problems such as high-temperature superconductivity and display fundamental aspects of quantum theory, such as strong correlations and entanglement. Over the last two decades, our understanding of QPTs has increased tremendously due to a plethora of experimental examples, powerful new numerical methods, and novel theoretical understanding of previously intractable quantum many-body problems. Understanding Quantum Phase Transitions organizes our current understanding of QPTs with an emphasis on examples from condensed matter physics. Bringing together 48 well known physicists involved with the theory and observation of QPTs, this unique work provides a thorough yet concise examination of the field. Each chapter takes readers through past discoveries right up through the latest research results, and then ends with open questions and unsolved problems. Part I treats new concepts and

directions in QPTs, from dynamics through dissipation and entanglement, and includes introductory material suitable for scientists new to the field. Part II explores specific models, systems, and aspects of QPTs, including topological order, the Kondo lattice, the Jaynes-Cummings lattice, reduced dimensionality, finite-size effects and metastability, and QPTs in Bose-Einstein condensates. Part III covers experiments motivated by a deeper understanding of QPTs, including quantum dots, 2D electron systems, frustrated lattices in molecular antiferromagnets, heavy fermions, and ultracold atoms in optical lattices. Part IV presents advances in numerical methods used to study QPTs, including cluster Monte Carlo and the worm algorithm, matrix-product-state methods, and dynamical mean-field theory. Part V looks at the relevance of QPTs beyond condensed-matter physics, including their occurrence in neutron stars, the quark-gluon plasma, cavity QED systems, and string theory. Graduate students, post-doctoral researchers, and professional scientists who seek a deep knowledge of QPTs will all find this book very useful. Researchers in the field will enhance their appreciation of the incredible breadth of the subject in chapters covering material outside their specialties.

String Theory Methods for Condensed Matter PhysicsCambridge University Press

The application of field theoretic techniques to problems in condensed matter physics has generated an array of concepts and mathematical techniques to attack a range of problems such as the theory of quantum phase transitions, the quantum Hall effect, and quantum wires.

While concepts such as the renormalization group, topology, and bosonization have become necessary tools for the condensed matter physicist, enough open problems and interesting applications remain to drive much activity in this area in the coming years. Field Theories in Condensed Matter Physics presents a comprehensive survey of the concepts, techniques, and applications of the field. Written by experts and carefully edited, the book provides the necessary background for graduate students entering the area of modern condensed matter physics. It also supplies field theorists with a valuable introduction to the areas in condensed matter physics where field theoretic concepts can be fruitfully applied.

Recent developments in theoretical physics include new instances of the unification of quite different phenomena. The theoretical community is challenged by the growing interactions between high-energy physics, statistical physics, and condensed matter physics. The common language, though, is exact solutions of two-dimensional and conformable field theories. This volume is a faithful representation of this interdisciplinary domain. Conformable and integrable field theories have been active research topics for several decades. The main recent developments concern the boundary effects and applications to disordered systems. The number of applications of the exact methods to condensed-matter problems has been growing over the years. Nowadays it is widely recognized that strongly interacting systems in low dimensions can be successfully described by integrable and conformable theories. This volume is an

indispensable aid to those seeking to find their way in this domain.

Theoretical physics is a vast set of subjects, ideas and methods, with wide and unexpected applications to many interdisciplinary problems. But no general international conference had tried to review in depth this huge and burgeoning field since the Trieste conference in 1968. The International Conference on Theoretical Physics, TH-2002, which took place at the Unesco building, Paris, from July 22 to 27, 2002, addressed this challenge.The reader will find in this book all invited and received contributions to the conference. After the general lectures of Nobel prize winners Anderson and Yang, the contributions by experts cover all aspects of modern theoretical physics ranging from particle physics, string theory, cosmology, statistical and condensed matter physics to dynamical systems and quantum chaos, the physics/biology interface, information theory and quantum computing.

Boundary conformal field theory is concerned with a class of two-dimensional quantum field theories which display a rich mathematical structure and have many applications ranging from string theory to condensed matter physics. In particular, the framework allows discussion of strings and branes directly at the quantum level. Written by internationally renowned experts, this comprehensive introduction to boundary conformal field theory reaches from theoretical foundations to recent developments, with an emphasis on the algebraic treatment of string backgrounds. Topics covered include basic concepts in conformal field theory with and without boundaries, the mathematical description of strings and D-branes, and the geometry of strongly curved spacetime. The

book offers insights into string geometry that go beyond classical notions. Describing the theory from basic concepts, and providing numerous worked examples from conformal field theory and string theory, this reference is of interest to graduate students and researchers in physics and mathematics.

An introduction to classical field theory focusing on methods and solutions, providing a foundation for the study of quantum field theory.

Providing a new perspective on quantum field theory, this book gives a pedagogical and up-to-date exposition of non-perturbative methods in relativistic quantum field theory and introduces the reader to modern research work in theoretical physics. It describes in detail non-perturbative methods in quantum field theory, and explores two- dimensional and four-dimensional gauge dynamics using those methods. The book concludes with a summary emphasizing the interplay between two- and four- dimensional gauge theories. Aimed at graduate students and researchers, this book covers topics from two-dimensional conformal symmetry, affine Lie algebras, solitons, integrable models, bosonization, and 't Hooft model, to four-dimensional conformal invariance, integrability, large N expansion, Skyrme model, monopoles and instantons. Applications, first to simple field theories and gauge dynamics in two dimensions, and then to gauge theories in four dimensions and quantum chromodynamics (QCD) in particular, are thoroughly described.

"Mathematical physics refers to development of mathematical methods for application to problems in physics. Physics, as in the language of a physicist, is the study of matter and energy and to a layman it is simply the study of Nature. Physics deals into the deeper insights and truths about the universe. As it is known globally, Mathematics is the language for physicists, and without proper mathematical knowledge it is nearly

impossible to learn or understand higher physics. Mathematics is required not to understand the physical phenomenon but to convey and exchange the knowledge and information about it among the scientific community and the common masses in a proper structure. The effort to put physical theories on a mathematically rigorous footing has inspired many mathematical developments, such as, the development of quantum mechanics and some aspects of functional analysis parallel each other in many ways. The mathematical study of quantum mechanics, quantum field theory and quantum statistical mechanics has motivated results in operator algebras. The attempt to construct a rigorous quantum field theory has also brought about progress in fields such as representation theory. Use of geometry and topology plays an important role in string theory. Mathematical Physics provides a broad coverage of the field of mathematical physics, from dominantly mathematical subjects to particle physics, condensed matter, and application of mathematical physics methods in various areas such as astrophysics, together with functional analysis, linear and partial differential equations, algebras, modern differential and algebraic geometry and topology, representations of Lie groups, calculus of variations, asymptotic methods, random process theory, dynamical systems, and control theory. This book aims to expose the reader to the indispensable role that mathematics plays in modern physics. "

In this thesis we discuss spontaneous symmetry breaking in the context of the Anti-de Sitter/Conformal field theory (AdS/CFT) correspondence and interpret it as as a model of superconductivity or superfluidity in strongly coupled systems. After reviewing relevant aspects of the AdS/CFT correspondence and the standard Bardeen-Cooper-Schrieffer (BCS) theory of superconductivity, we investigate how

spontaneous breaking of an abelian symmetry can occur in the context of AdS/CFT, a construction which is often called a "holographic superconductor, " as in the spontaneously broken phase there is infinite DC electrical conductivity and a pronounced gap in the AC conductivity. We begin by working in the probe limit, where much of the analysis is simplified but we are unable to study the system at low temperatures. In this limit we study holographic s-wave superconductors and find remarkably general behavior for a wide class of theories. We next study p-wave holographic superconductors in the probe limit and find spontaneous time-reversal symmetry breaking and other interesting features. We then study the s-wave system away from the probe limit, analyze the zero temperature limit of these holographic superconductors, and find that despite having to rely on numerical methods for much of our work, we are able to deduce strong analytic results about the apparent gap in AC conductivity at zero temperature. We then study fermionic transport of the s-wave superconductors, in analogy to photoemission experiments on laboratory superconductors. We also discuss new developments which should allow us to further probe the exciting new developments connecting condensed matter physics and string theory.

This book presents a selection of advanced lectures from leading researchers, providing recent theoretical results on strongly coupled quantum field theories. It also analyzes their use for describing new quantum states, which are physically realizable in condensed matter, cold-atomic systems, as well as artificial materials. It particularly focuses on the engineering of these states in quantum devices and novel materials useful for quantum information processing. The book offers graduate students and young researchers in the field of modern condensed matter theory an updated review of the most relevant theoretical methods used in strongly

coupled field theory and string theory. It also provides the tools for understanding their relevance in describing the emergence of new quantum states in a variety of physical settings. Specifically, this proceedings book summarizes new and previously unrelated developments in modern condensed matter physics, in particular: the interface of condensed matter theory and quantum information theory; the interface of condensed matter physics and the mathematics emerging from the classification of the topological phases of matter, such as topological insulators and topological superconductors; and the simulation of condensed matter systems with cold atoms in optical lattices.

In recent years topology has firmly established itself as an important part of the physicist's mathematical arsenal. Topology has profound relevance to quantum field theory-for example, topological nontrivial solutions of the classical equa tions of motion (solitons and instantons) allow the physicist to leave the frame work of perturbation theory. The significance of topology has increased even further with the development of string theory, which uses very sharp topologi cal methods-both in the study of strings, and in the pursuit of the transition to four-dimensional field theories by means of spontaneous compactification. Im portant applications of topology also occur in other areas of physics: the study of defects in condensed media, of singularities in the excitation spectrum of crystals, of the quantum Hall effect, and so on. Nowadays, a working knowledge of the basic concepts of topology is essential to quantum field theorists; there is no doubt that tomorrow this will also be true for specialists in many other areas of theoretical physics. The amount of topological information used in the physics literature is very large. Most common is homotopy theory. But other subjects also play an important role: homology theory, fibration theory (and characteristic classes in particular), and also branches of

mathematics that are not directly a part of topology, but which use topological methods in an essential way: for example, the theory of indices of elliptic operators and the theory of complex manifolds.

Presenting a variety of topics that are only briefly touched on in other texts, this book provides a thorough introduction to the techniques of field theory. Covering Feynman diagrams and path integrals, the author emphasizes the path integral approach, the Wilsonian approach to renormalization, and the physics of non-abelian gauge theory. It provides a thorough treatment of quark confinement and chiral symmetry breaking, topics not usually covered in other texts at this level. The Standard Model of particle physics is discussed in detail. Connections with condensed matter physics are explored, and there is a brief, but detailed, treatment of non-perturbative semi-classical methods. Ideal for graduate students in high energy physics and condensed matter physics, the book contains many problems,which help students practise the key techniques of quantum field theory.

The essential introduction to modern string theory—now fully expanded and revised String Theory in a Nutshell is the definitive introduction to modern string theory. Written by one of the world's leading authorities on the subject, this concise and accessible book starts with basic definitions and guides readers from classic topics to the most

exciting frontiers of research today. It covers perturbative string theory, the unity of string interactions, black holes and their microscopic entropy, the AdS/CFT correspondence and its applications, matrix model tools for string theory, and more. It also includes 600 exercises and serves as a self-contained guide to the literature. This fully updated edition features an entirely new chapter on flux compactifications in string theory, and the chapter on AdS/CFT has been substantially expanded by adding many applications to diverse topics. In addition, the discussion of conformal field theory has been extensively revised to make it more student-friendly. The essential one-volume reference for students and researchers in theoretical high-energy physics Now fully expanded and revised Provides expanded coverage of AdS/CFT and its applications, namely the holographic renormalization group, holographic theories for Yang-Mills and QCD, nonequilibrium thermal physics, finite density physics, and entanglement entropy Ideal for mathematicians and physicists specializing in theoretical cosmology, QCD, and novel approaches to condensed matter systems An online illustration package is available to professors

Covering the Cosmos from before the Big Bang through to the creation of our universe and up to but not including our arrival on stage; our will is not yet imposed, we had no hand, act nor part in its

provisions, beyond investigating to understand what has been delivered us. The many aspects of the Cosmos are melded, in a headline driven style, to paint a cohesive picture as well as allowing the reader choose to delve further where they may choose to paint their personal picture. Cosmos – includes; • The creation mechanism for our Universe and why there exists a possible Multiverse. • The creation mechanisms of the galaxies with their diversity of Star types. • The space exploration of our Solar System. • The Earth and Moon from their birth to their life driving engines for our planet. • The evolutionary processes that led to our arrival on the planet. • Our natural world with its great events. • Documentary video links on all topics of the book are included. The story is factual in manner, in the proper tradition of reporting, no personal opinions are expressed. The life stories of the standout personalities, in text and video, without whom what is now known, could not have been unraveled, in the case of Cosmos, they are; • Galileo Galilei • Isaac Newton • Albert Einstein • Charles Darwin This is a Video Book, vBook, beyond its text there are 150+ video titles, 100+ viewing hours, downloaded and stored locally on your computer, to be able to watch anytime, offline, without the need for local internet connection. Google ‘Cosmos’ and you get about 27,800,000 search results, so over these last several years I’ve searched out the best documentary

videos with their hyperlinks included here, blending their content to report cohesively, supplementing, where appropriate, from Wikipedia and also include those hyperlinks for readers wanting to delve further. The 'List of Contents' runs to 6 levels to provide a form of map to the reader as the reporting sequence is not a mere chronology of Cosmic events, it delves, as necessary into the stories as to how the events became understood to us. There is a 7th level, hyperlinked, at its base, which brings further background content, from Wikipedia, to those who choose to read further into any of the topics. The 'Index' allows navigation for the reader who has specific interests to investigate through the fabric of the report. The 'Text' is structured to 4 levels beginning with the primary, headline driven, main body content followed by relevant Wikipedia extracts, indented in purple, for those choosing to read further into a particular topic through to hyperlinked Wikipedia - Full Article text within the book and in turn out to the website itself. For the reader that wants to stay with the big picture, main body content, there is a "Skip" link to take you past each of the extracts, on to the next headline title and main body content. There are 150+ video content links delivering 100+ hours of viewing time, of the best documentary film available online. The main sequence structure is; • Cosmology – Universe & Multiverse • Geology – Earth & Moon • Biology –

Life – Plant & Animal • Ecology – Evolution & Environment – Plant, Animal & Human Special Edition There is also a Special Edition of this book available for US$49.95 which streams all video content from a secure Cloud Drive; therefore, video content cannot be removed by third party video platform providers such as YouTube, DailyMotion, Vimeo….. This Standard Edition streams from these. The Cloud Drive Server also allows you conveniently download to your local drive, as much video content as you choose, to watch, offline, at a time that best suits you. To view or purchase, paste the books ASIN: B00LEWY5WW into the Kindle Store search box. If you've any queries, feel welcome to contact bangtoeternityandbetwixt@gmail.com

The discovery of a duality between Anti-de Sitter spaces (AdS) and Conformal Field Theories (CFT) has led to major advances in our understanding of quantum field theory and quantum gravity. String theory methods and AdS/CFT correspondence maps provide new ways to think about difficult condensed matter problems. String theory methods based on the AdS/CFT correspondence allow us to transform problems so they have weak interactions and can be solved more easily. They can also help map problems to different descriptions, for instance mapping the description of a fluid using the Navier-Stokes equations to the description of an event horizon of a black hole using Einstein's equations.

This textbook covers the applications of string theory methods and the mathematics of AdS/CFT to areas of condensed matter physics. Bridging the gap between string theory and condensed matter, this is a valuable textbook for students and researchers in both fields.

This volume, 106 of the Les Houches Summer School series, brings together applications of integrability to supersymmetric gauge and string theory. The book focuses on the application of integrability and problems in quantum field theory. Particular emphasis is given to the exact solution of planar N=4 super-Yang-Mills theory and its relation with string theory on the one hand, and the exact determination of the low-energy physics of N=2 super-Yang-Mills theories on the other; links with other domains are also explored. The purpose of the Les Houches Summer School was to bring together young researchers and specialists from statistical physics, condensed matter physics, gauge and string theory, and mathematics, to stimulate discussion across these different research areas.

This primer is a comprehensive collection of analytical and numerical techniques that can be used to extract the non-perturbative physics of quantum field theories. The intriguing connection between Euclidean Quantum Field Theories (QFTs) and statistical mechanics can be used to apply Markov Chain Monte Carlo (MCMC) methods to

investigate strongly coupled QFTs. The overwhelming amount of reliable results coming from the field of lattice quantum chromodynamics stands out as an excellent example of MCMC methods in QFTs in action. MCMC methods have revealed the non-perturbative phase structures, symmetry breaking, and bound states of particles in QFTs. The applications also resulted in new outcomes due to cross-fertilization with research areas such as AdS/CFT correspondence in string theory and condensed matter physics. The book is aimed at advanced undergraduate students and graduate students in physics and applied mathematics, and researchers in MCMC simulations and QFTs. At the end of this book the reader will be able to apply the techniques learned to produce more independent and novel research in the field.

Theoretical physics is a vast set of subjects, ideas and methods, with wide and unexpected applications to many interdisciplinary problems. But no general international conference had tried to review in depth this huge and burgeoning field since the Trieste conference in 1968. The International Conference on Theoretical Physics, TH-2002, which took place at the Unesco building, Paris, from July 22 to 27, 2002, addressed this challenge. The reader will find in this book all invited and received contributions to the conference. After the general lectures of Nobel prize winners Anderson and Yang, the contributions by

experts cover all aspects of modern theoretical physics ranging from particle physics, string theory, cosmology, statistical and condensed matter physics to dynamical systems and quantum chaos, the physics/biology interface, information theory and quantum computing.

This volume is a collection of dedicated reviews covering all aspects of theoretical high energy physics and some aspects of solid state physics. Some of the papers are broad reviews of topics that span the entire field while others are surveys of authors' personal achievements. This is the most comprehensive review collection reflecting state of the art at the end of 2004. An important and unique aspect is a special effort the authors have invested in making the presentation pedagogical.

This book is a collection of lectures given in July 2007 at the Les Houches Summer School on "String Theory and the Real World: From particle physics to astrophysics." Provides a pedagogical introduction to topics in String Theory, and Cosmology Addresses each topic from the basis to the most recent developments Covers the lectures by internationally-renowned and leading experts

This book provides a comprehensive overview of developments in the field of holographic entanglement entropy. Within the context of the AdS/CFT correspondence, it is shown how quantum entanglement is computed by the area of certain extremal surfaces. The general lessons one can learn from this connection are drawn out for quantum field theories, many-body physics, and quantum gravity. An overview of the necessary background material is provided together with a flavor of the exciting open questions that are currently being discussed. The book is divided into four main parts. In the first part, the concept of entanglement, and

methods for computing it, in quantum field theories is reviewed. In the second part, an overview of the AdS/CFT correspondence is given and the holographic entanglement entropy prescription is explained. In the third part, the time-dependence of entanglement entropy in out-of-equilibrium systems, and applications to many body physics are explored using holographic methods. The last part focuses on the connection between entanglement and geometry. Known constraints on the holographic map, as well as, elaboration of entanglement being a fundamental building block of geometry are explained. The book is a useful resource for researchers and graduate students interested in string theory and holography, condensed matter and quantum information, as it tries to connect these different subjects linked by the common theme of quantum entanglement.

The book is based on lectures given at the TASI summer school of 2010. It aims to provide advanced graduate students, postdoctorates and senior researchers with a survey of important topics in particle physics and string theory, with special emphasis on applications of methods from string theory and quantum gravity in condensed matter physics and QCD (especially heavy ion physics).

Lattice 89

A collection of articles discussing integrable systems and algebraic geometry from leading researchers in the field.

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This volume of the CRM Conference Series is based on a carefully refereed selection of contributions presented at the "11th International Symposium on Quantum Theory and Symmetries", held in Montréal, Canada from July 1-5, 2019. The main objective of the meeting was to share and make accessible new research and recent

results in several branches of Theoretical and Mathematical Physics, including Algebraic Methods, Condensed Matter Physics, Cosmology and Gravitation, Integrability, Non-perturbative Quantum Field Theory, Particle Physics, Quantum Computing and Quantum Information Theory, and String/ADS-CFT. There was also a special session in honour of Decio Levi. The volume is divided into sections corresponding to the sessions held during the symposium, allowing the reader to appreciate both the homogeneity and the diversity of mathematical tools that have been applied in these subject areas. Several of the plenary speakers, who are internationally recognized experts in their fields, have contributed reviews of the main topics to complement the original contributions.

This 2002 book introduces the quantum theory of gauge fields. Emphasis is placed on four non-perturbative methods: path integrals, lattice gauge theories, the 1/N expansion, and reduced matrix models, all of which have important contemporary applications. Written as a textbook, it assumes a knowledge of quantum mechanics and elements of perturbation theory, while many relevant concepts are pedagogically introduced at a basic level in the first half of the book. The second half comprehensively covers large-N Yang-Mills theory. The book uses an approach to gauge theories based on path-dependent phase factors known as the Wilson loops, and contains problems with detailed solutions to aid understanding. Suitable for advanced graduate courses in quantum field theory, the book will also be of interest to researchers in high energy theory and condensed

matter physics as a survey of recent developments in gauge theory.

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This relatively new field applies equations from string theory to solve the questions of early cosmology, since the standard picture of our universe emerging from a 'big bang' leaves many fundamental issues unanswered. String theory, on the other hand, postulates that fundamental ingredients of nature are not zero-dimensional point particles but tiny one-dimensional filaments. This theory harmoniously unites quantum mechanics and general relativity -- the previously known laws of the small and the large -- which are otherwise incompatible. The field of string cosmology has matured considerably over the past few years, attracting many new adherents. Due to the multidisciplinary nature of the topic, it is difficult for practitioners to be conversant with all the many different aspects. This book thus fills a huge gap by bringing together all the different strains of research into one single volume. The resulting collection of selected articles presents the latest, ongoing results from renowned experts currently working in the field. From the contents: * Introduction to Cosmology and String Theory * String Inflation: Brane Inflation and Inflation from Moduli * Cosmic Superstrings * The CMB as a Possible Probe of String Theory * String Gas Cosmology * Gauge-gravity Duality and String Cosmology * Heterotic M-theory and C A welcome addition to the literature for graduate students, students in astronomy, astronomers, mathematicians and

theoretical physicists.

The Conference on Quantum Mechanics, Elementary Particles, Quantum Cosmology and Complexity was held in honour of Professor Murray Gell-Mann's 80th birthday in Singapore on 24–26 February 2010. The conference paid tribute to Professor Gell-Mann's great achievements in the elementary particle physics. This notable birthday volume contains the presentations made at the conference by many eminent scientists, including Nobel laureates C N Yang, G 't Hooft and K Wilson. Other invited speakers include G Zweig, N Samios, M Karliner, G Karl, M Shifman, J Ellis, S Adler and A Zichichi. About Murray Gell-Mann Murray Gell-Mann, born September 15, 1929, won the 1969 Nobel Prize in physics for his work on the theory of elementary particles. His contributions span the entire history of particle physics, from the early days of the particle zoo to the modern day QCD. Along the way, even as he proposed new quantum numbers to bring order into the zoo, he had fun in naming them. And thus was born Strangeness, Flavor, Hadrons, Baryons, Leptons, the Eightfold Way, Color, Quarks, Gluons and, with Harald Fritzsch, the standard field theory of strong interactions, Quantum Chromodynamics (QCD). He also proposed with Richard Feynman the V-A theory of beta decay. Gell-Mann discovered the Current Algebra, proposed (with Levy) the sigma model of pions and the see-saw mechanism for the neutrino masses. Contents:Murray Gell-Mann — A Scientific Biography (H Fritzsch)Memories of Murray and the Quark Model (G Zweig)Some Problems in Cold Atom Research (C N Yang)Murray and the Omega Minus(N P

Samios)From ?- to ?b (M Karliner)Early History of QCD and Quarks (G Karl)Understanding Confinement in QCD: Elements of a Big Picture (M Shifman)QCD — Mass and Gauge in a Field Theory. QCD Glue Mesons (P Minkowski)The QCD Coupling and Parton Distributions at High Precision (J Blümlein)What We Know and Don't Know about the Origin of the Spin of the Proton (A W Thomas et al.)Determination of Light Quark Masses in QCD (C A Dominguez)The Elusive Higgs Boson(s) (J F Gunion)Prospects for New Physics at the LHC (J Ellis)Murray Gell-Mann and the Last Frontier of LHC Physics: The QGCW Project (A Zichichi)Some Lessons from Sixty Years of Theorizing (M Gell-Mann)New Gauge Symmetry in Gravity and the Evanescent Role of Torsion (H Kleinert)Neutrino Masses and Grand Unification of Flavor (R N Mohapatra)LHC and the Seesaw Mechanism (G Senjanovi?)Neutrino Mixing, Leptonic CP Violation, the See-Saw Mechanism and Beyond (S T Petcov)Some Recent Progress in AdS/CFT (J H Schwarz)Aspects of String Phenomenology (I Antoniadis)String Corrections to QCD (D Lüst)Maximal Supersymmetry and Exceptional Groups (L Brink)Gauge/Gravity Duality and Some Applications (S R Wadia)Quantum Mechanics and Field Theory with Momentum Defined on an Anti-de-Sitter Space(M Bander)Gauge Symmetry in Phase Space Consequences for Physics and Space-time (I Bars)Composite Higgs Particle (K Yamawaki)Black Holes and Attractors in Supergravity (A Ceresole & S Ferrara)Gauge Theory of Gravity with de Sitter Symmetry as a Solution to the Cosmological Constant

Problem and the Dark Energy Puzzle (P Chen)Relaxing the Cosmological Constant on Large Distance Scales (A Zee)Inflation: Theory and Observations (V Mukhanov)Holographic Space-Time and Its Phenomenological Implications (T Banks)Modeling the Flyby Anomalies with Dark Matter Scattering (S L Adler)Physics of Micro Black Holes (G Dvali)Possible Solution of Dark Matter, the Solution of Dark Energy and Gell-Mann as Great Theoretician (P H Frampton)Reasoning by Analogy: Attempts to Solve the Cosmological Constant Paradox (R A Porto & A Zee)Manifestations of Space-Time Variation of Coupling Constants and Fundamental Masses (V V Flambaum & J C Berengut)Classical Cellular Automata and Quantum Field Theory (G 't Hooft)Could Testing of the Laws of Physics Ever be Complete? (K G Wilson)and other papers Readership: Researchers and graduate students in high energy physics and theoretical physics.
Keywords:Gell-Mann;History of Quark Model;Eightfold Way;Hadron;Baryon;Meson