


Walter Greiner  
Berndt Müller

# Gauge Theory of Weak Interactions

*Fourth Edition*

 Springer

# Gauge Theory Of Weak Interactions

**Walter Greiner, Berndt Müller**



## **Gauge Theory Of Weak Interactions:**

Theoretical Physics Text and Exercise Books Walter Greiner, Berndt Müller, 2012-12-06 More than a generation of German speaking students around the world have worked their way to an understanding and appreciation of the power and beauty of modern theoretical physics with mathematics the most fundamental of sciences using Walter Greiner's textbooks as their guide The idea of developing a coherent complete presentation of an entire field of science in a series of closely related textbooks is not a new one Many older physicists remember with real pleasure their sense of adventure and discovery as they worked their ways through the classic series by Sommerfeld by Planck and by Landau and Lifshitz From the students viewpoint there are a great many obvious advantages to be gained through use of consistent notation logical ordering of topics and coherence of presentation beyond this the complete coverage of the science provides a unique opportunity for the author to convey his personal enthusiasm and love for his subject The present five volume set Theoretical Physics is in fact only that part of the complete set of textbooks developed by Greiner and his students that presents the quantum theory I have long urged him to make the remaining volumes on classical mechanics and dynamics on electromagnetism on nuclear and particle physics and on special topics available to an English speaking audience as well and we can hope for these companion volumes covering all of theoretical physics some time in the future

### **Gauge Theory of Weak Interactions**

Professor at the Institute of Theoretical Physics Walter Greiner, Walter Greiner, Berndt Müller, 2000 Gauge Theory of Weak Interactions treats the unification of electromagnetic and weak interactions and considers related phenomena First the Fermi theory of beta decay is presented followed by a discussion of parity violation clarifying the importance of symmetries Then the concept of a spontaneously broken gauge theory is introduced and all necessary mathematical tools are carefully developed The standard model of unified electroweak interactions is thoroughly discussed including current developments The final chapter contains an introduction to unified theories of strong and electroweak interactions Numerous solved examples and problems make this volume uniquely suited as a text for an advanced course This third edition has been carefully revised

**Gauge Theory of Weak Interactions** Walter Greiner, Berndt Müller, 1996 Gauge Theory of Weak Interactions treats the unification of electromagnetic and weak interactions and considers related phenomena First the Fermi theory of beta decay is presented followed by a discussion of parity violation clarifying the importance of symmetries Then the concept of a spontaneously broken gauge theory is introduced and all necessary mathematical tools are carefully developed The standard model of unified electroweak interactions is thoroughly discussed including current developments The final chapter contains an introduction to unified theories of strong and electroweak interactions Numerous solved examples and problems make this volume uniquely suited as a text for an advanced course This third edition has been carefully revised

*Gauge Theory of Weak Interactions* Berndt Müller, 2000-01-01      *Selected Papers on Gauge Theory of Weak and Electromagnetic Interactions* C. H. Lai, 1981 A volume of selected original papers on the synthesis of the two

fundamental forces of nature It is intended to provide graduate students and physicists in the field with an easy access to the original literature *Gauge Theory of Weak Interactions* Walter Greiner, Berndt Müller, 1996 **Gauge Theory Of Weak And Electromagnetic Interactions** Choy Heng Lai, 1981-01-31 A volume of selected original papers on the synthesis of the two fundamental forces of nature It is intended to provide graduate students and physicists in the field with an easy access to the original literature *Gauge Theory Of Weak Interactions, 3E* Greiner, 2008-09-01 **Gauge Theories of Weak Interactions** J. C. Taylor, 1979-02-22 The interaction between neutrinos and matter is an example of the type classified as weak and such interactions also allow many elementary particle decays and the beta decay of the nuclei The development of gauge theories has provided the basis for a complete and consistent account of weak interactions at the same time displaying their unity with electromagnetism Gauge theories in this context were first proposed in 1967 Rapid mathematical development took place from 1971 and on this book's publication in 1979 a moderate amount of empirical verification had been achieved **Gauge Theories Of Strong, Weak, And Electromagnetic Interactions** Chris Quigg, 2021-12-13 This monograph presents a coherent and elementary introduction to Gauge theories of the fundamental interactions and their applications to high energy physics It deals with the logic and structure of local Gauge symmetries and Gauge theories from quantum electrodynamics through unified theories of the interactions among leptons and quarks Many explicit calculations provide the reader with practice in computing the consequences of these theories and offer a perspective on key experimental investigations First published in 1983 this text is ideal for a one semester course on Gauge theories and particle physics Specialists in particle physics and others who wish to understand the basic ideas of Gauge theories will find it useful as a reference and for self study **Gauge Theories of the Strong, Weak, and Electromagnetic Interactions** Chris Quigg, 2013-09-23 A thoroughly revised edition of a landmark textbook on gauge theories and their applications to particle physics This completely revised and updated graduate level textbook is an ideal introduction to gauge theories and their applications to high energy particle physics and takes an in depth look at two new laws of nature quantum chromodynamics and the electroweak theory From quantum electrodynamics through unified theories of the interactions among leptons and quarks Chris Quigg examines the logic and structure behind gauge theories and the experimental underpinnings of today's theories Quigg emphasizes how we know what we know and in the era of the Large Hadron Collider his insightful survey of the standard model and the next great questions for particle physics makes for compelling reading The brand new edition shows how the electroweak theory developed in conversation with experiment Featuring a wide ranging treatment of electroweak symmetry breaking the physics of the Higgs boson and the importance of the 1 TeV scale the book moves beyond established knowledge and investigates the path toward unified theories of strong weak and electromagnetic interactions Explicit calculations and diverse exercises allow readers to derive the consequences of these theories Extensive annotated bibliographies accompany each chapter amplify points of conceptual or technical interest introduce further

applications and lead readers to the research literature Students and seasoned practitioners will profit from the text s current insights and specialists wishing to understand gauge theories will find the book an ideal reference for self study Brand new edition of a landmark text introducing gauge theories Consistent attention to how we know what we know Explicit calculations develop concepts and engage with experiment Interesting and diverse problems sharpen skills and ideas Extensive annotated bibliographies *Gauge Theories in Particle Physics, Volume II* I.J.R. Aitchison,A.J.G. Hey,2003-12-01 This is the second volume of the third edition of a successful text now substantially enlarged and updated to reflect developments over the last decade in the curricula of university courses and in particle physics research Volume I covered relativistic quantum mechanics electromagnetism as a gauge theory and introductory quantum field theory and ended with the formulation and application of quantum electrodynamics QED including renormalization Building on these foundations this second volume provides a complete accessible and self contained introduction to the remaining two gauge theories of the standard model of particle physics quantum chromodynamics QCD and the electroweak theory The treatment significantly extends that of the second edition in several important respects Simple ideas of group theory are now incorporated into the discussion of non Abelian symmetries Two new chapters have been added on QCD one devoted to the renormalization group and scaling violations in deep inelastic scattering and the other to non perturbative aspects of QCD using the lattice path integral formulation of quantum field theory the latter is also used to illuminate various aspects of renormalization theory via analogies with condensed matter systems Three chapters treat the fundamental topic of spontaneous symmetry breaking the Bogoliubov superfluid and the BCS superconductor are studied in some detail one chapter is devoted to the implications of global chiral symmetry breaking in QCD and one to the breaking of local  $SU(2) \times U(1)$  symmetry in the electroweak theory Weak interaction phenomenology is extended to include discussion of discrete symmetries and of the possibility that neutrinos are Majorana rather than Dirac particles Most of these topics are normally found only in more advanced texts and this is the first book to treat them in a manner accessible to the wide readership that the previous editions have attracted

Gauge theories of weak interactions John C. Taylor,1978 Gauge Theories in Particle Physics, 40th Anniversary Edition: A Practical Introduction, Volume 2 Ian J R Aitchison,Anthony J.G. Hey,2024-06-19 The fifth edition of this well established highly regarded two volume set continues to provide a fundamental introduction to advanced particle physics while incorporating substantial new experimental results especially in the areas of Higgs and top sector physics as well as CP violation and neutrino oscillations It offers an accessible and practical introduction to the three gauge theories comprising the Standard Model of particle physics quantum electrodynamics QED quantum chromodynamics QCD and the Glashow Salam Weinberg GSW electroweak theory Volume 2 of this updated edition covers the two non Abelian gauge theories of QCD and the GSW theory A distinctive feature is the extended treatment of two crucial theoretical tools spontaneous symmetry breaking and the renormalization group The underlying physics of these is elucidated by parallel discussions of

examples from condensed matter systems superfluidity and superconductivity and critical phenomena This new edition includes updates to jet algorithms lattice field theory CP violation and the CKM matrix and neutrino physics New to the fifth edition Tests of the Standard Model in the Higgs and top quark sectors The naturalness problem and responses to it going beyond the Standard Model The Standard Model as an effective field theory Each volume should serve as a valuable handbook for students and researchers in advanced particle physics looking for an accessible introduction to the Standard Model of particle physics

Ian J R Aitchison is Emeritus Professor of Physics at the University of Oxford He has previously held research positions at Brookhaven National Laboratory Saclay and the University of Cambridge He was a visiting professor at the University of Rochester and the University of Washington and a scientific associate at CERN and SLAC Dr Aitchison has published over 90 scientific papers mainly on hadronic physics and quantum field theory He is the author of two books and joint editor of further two Anthony J G Hey is now Honorary Senior Data Scientist at the UK's National Laboratory at Harwell He began his career with a doctorate in particle physics from the University of Oxford After a career in particle physics that included a professorship at the University of Southampton and research positions at Caltech MIT and CERN he moved to Computer Science and founded a parallel computing research group The group were one of the pioneers of distributed memory message passing computers and helped establish the MPI message passing standard After leaving Southampton in 2001 he was director of the UK's eScience initiative before becoming a Vice President in Microsoft Research He returned to the UK in 2015 as Chief Data Scientist at the UK's Rutherford Appleton Laboratory He then founded a new Scientific Machine Learning group to apply AI technologies to the Big Scientific Data generated by the Diamond Synchrotron the ISIS neutron source and the Central Laser Facility that are located on the Harwell campus He is the author of over 100 scientific papers on physics and computing and editor of The Feynman Lectures on Computation

Gauge Theories in Particle Physics, Third Edition - 2 volume set Ian J.R. Aitchison, I.J.R. Aitchison, A.J.G. Hey, Anthony J.G. Hey, 2004-01-01 This two volume set provides an accessible practical and comprehensive introduction to the three gauge theories of the standard model of particle physics quantum electrodynamics QED quantum chromodynamics QCD and the electroweak theory For each of them the authors provide a thorough discussion of the main conceptual points a detailed exposition of many practical calculations of physical quantities and a comparison of these quantitative predictions with experimental results For this third edition much has been rewritten to reflect developments over the last decade both in the curricula of university courses and in particle physics research On the one hand substantial new material has been introduced that is intended for use in undergraduate physics courses New introductory chapters provide a precise historical account of the properties of quarks and leptons and a qualitative overview of the quantum field description of their interactions at a level appropriate to third year courses The chapter on relativistic quantum mechanics has been enlarged and is supplemented by additional sections on scattering theory and Green functions in a form appropriate to fourth year courses On the other hand since precision

experiments now test the theories beyond lowest order in perturbation theory an understanding of the data requires a more sophisticated knowledge of quantum field theory including ideas of renormalization The treatment of quantum field theory has therefore been considerably extended to provide a uniquely accessible and self contained introduction to quantum field dynamics as described by Feynman graphs The level is suitable for advanced fourth year undergraduates and first year graduates These developments are all contained in the first volume which ends with a discussion of higher order corrections in QED The second volume is devoted to the non Abelian gauge theories of QCD and the electroweak theory As in the first two editions emphasis is placed throughout on developing realistic calculations from a secure physical and conceptual basis

**Gauge Theories in Particle Physics: A Practical Introduction, Volume 2: Non-Abelian Gauge Theories** Ian J R Aitchison,Anthony J.G. Hey,2012-12-17 Volume 2 of this revised and updated edition provides an accessible and practical introduction to the two non Abelian quantum gauge field theories of the Standard Model of particle physics quantum chromodynamics QCD and the Glashow Salam Weinberg GSW electroweak theory This volume covers much of the experimental progress made in the last ten years A new chapter on CP violation and oscillation phenomena describes CP violation in B meson decays as well as the main experiments that have led to our current knowledge of mass squared differences and mixing angles in neutrino physics Exploring a new era in particle physics this edition discusses one of the most recent and exciting breakthroughs the discovery of a boson with properties consistent with those of the Standard Model Higgs boson It also updates many other topics including jet algorithms lattice QCD effective Lagrangians and three generation quark mixing and the CKM matrix New to the Fourth Edition New chapter on CP violation and oscillations in mesonic and neutrino systems New section on three generation quark mixing and the CKM matrix Improved discussion of two jet cross section in electron positron annihilation New section on jet algorithms Recent lattice QCD calculations with dynamical fermions New section on effective Lagrangians for spontaneously broken chiral symmetry including the three flavor extension meson mass relations and chiral perturbation theory Update of asymptotic freedom Discussion of the historic discovery of a Higgs like boson The authors discuss the main conceptual points of the theories detail many practical calculations of physical quantities from first principles and compare these quantitative predictions with experimental results helping readers improve both their calculation skills and physical insight

**Gauge Theory of Weak and Electromagnetic Interactions** C. H. Lai,1981 Gauge Theory and a Model of Weak Interactions Bryan John Laughland,1981 **Gauge**

**Theories in Particle Physics: A Practical Introduction, Fourth Edition - 2 Volume set** Ian J.R. Aitchison,Anthony J.G. Hey,2021-01-14 The fourth edition of this well established highly regarded two volume set continues to provide a fundamental introduction to advanced particle physics while incorporating substantial new experimental results especially in the areas of CP violation and neutrino oscillations It offers an accessible and practical introduction to the three gauge theories included in the Standard Model of particle physics quantum electrodynamics QED quantum chromodynamics QCD

and the Glashow Salam Weinberg GSW electroweak theory In the first volume a new chapter on Lorentz transformations and discrete symmetries presents a simple treatment of Lorentz transformations of Dirac spinors Along with updating experimental results this edition also introduces Majorana fermions at an early stage making the material suitable for a first course in relativistic quantum mechanics Covering much of the experimental progress made in the last ten years the second volume remains focused on the two non Abelian quantum gauge field theories of the Standard Model QCD and the GSW electroweak theory A new chapter on CP violation and oscillation phenomena describes CP violation in B meson decays as well as the main experiments that have led to our current knowledge of mass squared differences and mixing angles for neutrinos Exploring a new era in particle physics this edition discusses the exciting discovery of a boson with properties consistent with those of the Standard Model Higgs boson It also updates many other topics including jet algorithms lattice QCD effective Lagrangians and three generation quark mixing and the CKM matrix This revised and updated edition provides a self contained pedagogical treatment of the subject from relativistic quantum mechanics to the frontiers of the Standard Model For each theory the authors discuss the main conceptual points detail many practical calculations of physical quantities from first principles and compare these quantitative predictions with experimental results helping readers improve both their calculation skills and physical insight

**Gauge Theories in Particle Physics**, Ian Johnston Rhind Aitchison, Anthony J. G. Hey, 1989 Intended as an accessible and practical introduction to gauge theories this volume discusses the main conceptual aspects examines the practical calculations of physical quantities and offers comparisons of these quantitative predictions with experimental results

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