Scattering Amplitudes And The Feynman Rules

In a detailed reconstruction of the genesis of Feynman diagrams the author reveals that their development was constantly driven by the attempt to resolve fundamental problems concerning the uninterpretable infinities that arose in quantum as well as classical theories of electrodynamic phenomena. Accordingly, as a comparison with the graphical representations that were in use before Feynman diagrams shows, the resulting theory of quantum electrodynamics, featuring Feynman diagrams, differed significantly from earlier versions of the theory in the way in which the relevant phenomena were conceptualized and modelled. The author traces the development of Feynman diagrams from Feynman's "struggle with the Dirac equation" in unpublished manuscripts to the two of Freeman Dyson's publications which put Feynman diagrams into a field theoretic context. The author brings to the fore that Feynman and Dyson not only created a powerful computational device but, above all, a new conceptual framework in which the uninterpretable infinities that had arisen in the old form of the theory could be precisely identified and subsequently removed in a justifiable manner.
Coherent approach leading to a more comprehensive understanding of quantum field theory and cosmology. Includes discussion of a variety of applications, has numerous worked examples and problems, and is self-contained and suitable for self study.--
Scattering amplitudes are fundamental and rich observables in quantum field theory. Based on the observation that, for massless particles of spin-one or more, scattering amplitudes are much simpler than expected from traditional Feynman diagram techniques, the broad aim of this work is to understand and exploit this hidden structure. It uses methods from twistor theory to provide new insights into the correspondence between scattering amplitudes in supersymmetric Yang-Mills theory and null polygonal Wilson loops. By additionally exploiting the symmetries of the problem, the author succeeds in developing new ways of computing scattering amplitudes.
This engaging introduction to the latest theoretical advances and experimental discoveries in elementary particle physics, culminating in the development of the 'Standard Model', makes this fascinating subject accessible to undergraduate students and aims at motivating them to study it further.
Elementary Particle Physics
A Modern Introduction
Feynman Integrals
Path Integrals From Pev To Tev: 50 Years After Feynman's Paper - Proceedings Of The Sixth International Conference
From Feynman Diagrams to Unitarity Cuts
The Standard Theory
This textbook provides an introduction to string field theory (SFT). String theory is usually formulated in the worldsheet formalism, which describes a single string (first-quantization). While this approach is intuitive and could be pushed far due to the exceptional properties of two-dimensional theories, it becomes cumbersome for some questions or even fails at a more fundamental level. These motivations have led to the development of SFT, a description of string theory using the field theory formalism (second-quantization). As a field theory, SFT provides a rigorous and constructive formulation of string theory. The main focus of the book is the construction of the closed bosonic SFT. The accent is put on providing the reader with the foundations, conceptual understanding and intuition of what SFT is. After reading this book, the reader is able to study the applications from the literature. The book is organized in two parts. The first part reviews the notions of the worldsheet theory that are necessary to build SFT (worldsheet path integral, CFT and BRST quantization). The second part starts by introducing general concepts of SFT from the BRST quantization. Then, it introduces off-shell string amplitudes before providing a Feynman diagrams interpretation from which the building blocks of SFT are extracted. After constructing the closed SFT, the author outlines the proofs of several important properties such as background independence, unitarity and crossing symmetry. Finally, the generalization to the superstring is also discussed.
Please note that the content of this book primarily consists of articles available from Wikipedia or other free sources online. Pages: 33. Chapters: Born approximation, Carrier scattering, Convolution for optical broad-beam responses in scattering media, Diffraction tomography, Dyson series, Feshbach-Fano partitioning, Feynman diagram, Inverse scattering problem, Inverse scattering transform, Luminosity, Marchenko equation, MHV Amplitudes, Momentum-transfer cross section, Optical theorem, Riemann-Hilbert problem, S-matrix, Scattering length, Soft photons, Total active reflection coefficient, Transfer-matrix method (optics), Wick's theorem. Excerpt: In theoretical physics, Feynman diagrams are pictorial representations of the mathematical expressions governing the behavior of subatomic particles. The scheme is named for its inventor, Nobel Prize-winning American physicist Richard Feynman, and was first introduced in 1948. The interaction of sub-atomic particles can be complex and difficult to understand intuitively, and the Feynman diagrams allow for a simple visualization of what would otherwise be a rather arcane and abstract formula. As David Kaiser writes, "since the middle of the 20th century, theoretical physicists have increasingly turned to this tool to help them undertake critical calculations," and as such "Feynman diagrams have revolutionized nearly every aspect of theoretical physics." While the diagrams are applied primarily to quantum field theory, they can also be used in other fields, such as solid-state theory. Feynman proposed an interpretation of the positron as if it were an electron moving backward in time. Thus Feynman diagrams contain both a space axis and a time axis, and antiparticles are interpreted as moving forward in space but backward in time. The calculation of probability amplitudes in theoretical particle physics requires the use of rather large and complicated integrals over a large number of variables. These integrals do, ...
New edition features improved typography, figures and tables, expanded indexes, and 885 new corrections.
This volume contains the proceedings of the International Research Workshop on Periods and Motives--A Modern Perspective on Renormalization, held from July 2-6, 2012, at the Instituto de Ciencias Matemáticas, Madrid, Spain. Feynman amplitudes are integrals attached to Feynman diagrams by means of Feynman rules. They form a central part of perturbative quantum field theory, where they appear as coefficients of power series expansions of probability amplitudes for physical processes. The efficient computation of Feynman amplitudes is pivotal for theoretical predictions in particle physics. Periods are numbers computed as integrals of algebraic differential forms over topological cycles on algebraic varieties. The term originated from the period of a periodic elliptic function, which can be computed as an elliptic integral. Motives emerged from Grothendieck's "universal cohomology theory", where they describe an intermediate step between algebraic varieties and their linear invariants (cohomology). The theory of motives provides a conceptual framework for the study of periods. In recent work, a beautiful relation between Feynman amplitudes, motives and periods has emerged. The articles provide an exciting panoramic view on recent developments in this fascinating and fruitful interaction between pure mathematics and modern theoretical physics.
From Classical to Quantum Fields
Relativistic Quantum Mechanics

Generalized Feynman Amplitudes
Second Edition
With Problems and Solutions
Scattering Amplitudes and Wilson Loops in Twistor Space

This book contains a valuable discussion of renormalization through the addition of counterterms to the Lagrangian, giving the first complete proof of the cancellation of all divergences in an arbitrary interaction. The author also introduces a new method of renormalizing an arbitrary Feynman amplitude, a method that is simpler than previous approaches and can be used to study the renormalized perturbation series in quantum field theory.

This invaluable book provides a quick introduction to the rudiments of perturbative string theory and a detailed introduction to the more current topic of D-brane dynamics. The presentation is very pedagogical, with much of the technical detail streamlined. The rapid but highly coherent introduction to the subject is perhaps what distinguishes this book from other string theory or D-brane books. This second edition includes an additional appendix with solutions to the exercises, thus expanding on some of the technical material and making the book more appealing for use in lecture courses. The material is based on mini-courses in theoretical high energy physics delivered by the author at various summer schools, so its actual level has been appropriately tested.

Analytic Properties of Feynman Diagrams in Quantum Field Theory deals with quantum field theory, particularly in the study of the analytic properties of Feynman graphs. This book is an elementary presentation of a self-contained exposition of the majorization method used in the study of these graphs. The author has taken the intermediate position between Eden et al. who assumes the physics of the analytic properties of the S-matrix, containing physical ideas and test results without using the proper mathematical methods, and Hwa and Teplitz, whose works are more mathematically inclined with applications of algebraic topology and homology theory. The book starts with the definition of the quadratic form of a Feynman diagram, and then explains the majorization of Feynman diagrams. The book describes the derivation of spectral representations, the dispersion relations for the nucleon-nucleon scattering amplitude, and for the corresponding partial wave amplitude. The text then analyzes the surface of singularities of a Feynman diagram with notes explaining the Cutkosky rules of the Mandelstam representation for the box diagram. This text is ideal for mathematicians, physicists dealing with quantum theory and mechanics, students, and professors in advanced mathematics.

This textbook on Feynman integrals starts from the basics, requiring only knowledge of special relativity and undergraduate mathematics. Feynman integrals are indispensable for precision calculations in quantum field theory. At the same time, they are also fascinating from a mathematical point of view. Topics from quantum field theory and advanced mathematics are introduced as needed. The book covers modern developments in the field of Feynman integrals. Topics included are: representations of Feynman integrals, integration-by-parts, differential equations, intersection theory, multiple polylogarithms, Gelfand-Kapranov-Zelevinsky systems, coactions and symbols, cluster algebras, elliptic Feynman integrals, and motives associated with Feynman integrals. This volume is aimed at a) students at the master's level in physics or mathematics, b) physicists who want to learn how to calculate Feynman integrals (for whom state-of-the-art techniques and computations are provided), and c) mathematicians who are interested in the mathematical aspects underlying Feynman integrals. It is, indeed, the interwoven nature of their physical and mathematical aspects that make Feynman integrals so enthralling.

Unitarity and Analyticity in Complex Energy Plane of General Scattering Amplitudes
Analytic Properties of Feynman Diagrams in Quantum Field Theory
The New Millennium Edition: Quantum Mechanics
Scattering Theory
Feynman Amplitudes, Periods and Motives
Scattering Amplitudes in Gauge Theories

Quantum Field Theory has become the universal language of most modern theoretical physics. This introductory textbook shows how this beautiful the offers the correct mathematical framework to describe and understand the fundamental interactions of elementary particles. The book begins with a bri reminder of basic classical field theories, electrodynamics and general relativity, as well as their symmetry properties, and proceeds with the principles quantisation following Feynman's path integral approach. Special care is used at every step to illustrate the correct mathematical formulation of the underlying assumptions. Gauge theories and the problems encountered in their quantisation are discussed in detail. The last chapters contain a full description of the Standard Model of particle physics and the attempts to go beyond it, such as grand unified theories and supersymmetry. Written for advanced undergraduate and beginning graduate students in physics and mathematics, the book could also serve as a reference for active researcher the field.

This book is the first to cover marketing management issues in geographically remote industrial clusters (GRICs). The phenomena of GRICs have increased in importance, especially in the Nordic countries, due to changes in industry structures as well as political ambitions. The practice of marketi and marketing management is not singular to industry clusters in Nordic countries. Remote areas in parts of the United States, South and Central Ame and South East Asia exhibit similar tendencies.The problems faced by many entrepreneurial managers managing start-up or even existing enterprises complex and require an in-depth understanding not only of the problems themselves, but also of the contextual framework in which these problems ne be solved. This book contains original cases that cover issues like cluster formation, information gathering, marketing strategies and operations, and information-technology. Examples come from industries like textile & furniture, automobile, agro-machinery, food, wine, software, and management consulting.

Quantum field theory is the basic mathematical framework that is used to describe elementary particles. This textbook provides a complete and essent introduction to the subject. Assuming only an undergraduate knowledge of quantum mechanics and special relativity, this book is ideal for graduate students beginning the study of elementary particles. The step-by-step presentation begins with basic concepts illustrated by simple examples, and pro through historically important results to thorough treatments of modern topics such as the renormalization group, spinor-helicity methods for quark and

gluon scattering, magnetic monopoles, instantons, supersymmetry, and the unification of forces. The book is written in a modular format, with each cha as self-contained as possible, and with the necessary prerequisite material clearly identified. It is based on a year-long course given by the author and contains extensive problems, with password protected solutions available to lecturers at www.cambridge.org/9780521864497.
A fully updated edition of the classic text by acclaimed physicist A. Zee Since it was first published, Quantum Field Theory in a Nutshell has quickly established itself as the most accessible and comprehensive introduction to this profound and deeply fascinating area of theoretical physics. Now in thi fully revised and expanded edition, A. Zee covers the latest advances while providing a solid conceptual foundation for students to build on, making thi most up-to-date and modern textbook on quantum field theory available. This expanded edition features several additional chapters, as well as an enti new section describing recent developments in quantum field theory such as gravitational waves, the helicity spinor formalism, on-shell gluon scatterin recursion relations for amplitudes with complex momenta, and the hidden connection between Yang-Mills theory and Einstein gravity. Zee also provide added exercises, explanations, and examples, as well as detailed appendices, solutions to selected exercises, and suggestions for further reading. The accessible and comprehensive introductory textbook available Features a fully revised, updated, and expanded text Covers the latest exciting advance the field Includes new exercises Offers a one-of-a-kind resource for students and researchers Leading universities that have adopted this book include Arizona State University Boston University Brandeis University Brown University California Institute of Technology Carnegie Mellon College of William & Mary Cornell Harvard University Massachusetts Institute of Technology Northwestern University Ohio State University Princeton University Purdue University - Main Campus Rensselaer Polytechnic Institute Rutgers University - New Brunswick Stanford University University of California - Berkeley University of Central Florida University of Chicago University of Michigan University of Montreal University of Notre Dame Vanderbilt University Virginia Tech University

Reggeization of the Fermion-fermion Scattering Amplitude in Non-Abelian Gauge Theories

QED

An Introduction to String Theory and D-brane Dynamics

Modern Analytic Methods for Computing Scattering Amplitudes

A Guide to Feynman Diagrams in the Many-Body Problem

Proceedings Of The 29th International Conference On High Energy Physics: Ichep '98 (In 2 Volumes)

Providing a comprehensive, pedagogical introduction to scattering amplitudes in gauge theory and gravity, this book is ideal for graduate students and researchers. It offers a smooth transition from basic knowledge of quantum field theory to the frontier of modern research. Building on basic quantum field theory, the book starts with an introduction to the spinor helicity formalism in the context of Feynman rules for tree-level amplitudes. The material covered includes on-shell recursion relations, superamplitudes, symmetries of N=4 super Yang–Mills theory, twistors and momentum twistors, Grassmannians, and polytopes. The presentation also covers amplitudes in perturbative supergravity, 3D Chern–Simons matter theories, and color-kinematics duality and its connection to 'gravity=(gauge theory)x(gauge theory)'. Basic knowledge of Feynman rules in scalar field theory and quantum electrodynamics is assumed, but all other tools are introduced as needed. Worked examples demonstrate the techniques discussed, and over 150 exercises help readers absorb and master the material.
This book is a graduate-level self-study guide of bound states in elementary particle physics and consequently in the standard model. The author first recalls the usual quantum electrodynamics (QED) approach to atoms in terms of Feynman diagrams, which assume free states at asymptotic times. Motivated by general principles and data, he then develops a novel method based on a Fock expansion of bound states in temporal gauge. The properties of relativistic bound states are discussed for Dirac states, atoms in motion, QED in D=1+1 dimensions, and hadrons in quantum chromodynamics (including color confinement). This book provides complementary material for quantum field theory courses and is accessible for graduate students and more senior researchers.
These proceedings consist of plenary rapporteur talks covering topics of major interest to the high energy physics community and parallel sessions papers which describe recent research results and future plans.

Scattering Amplitudes in Gauge TheoriesSpringer

Crossing the Boundaries

One-loop Calculations in Quantum Field Theory

Journey to the Bound States

The Strange Theory of Light and Matter

Quantum Fields

Aspects of Scattering Amplitudes and Moduli Space Localization

This volume comprises review papers presented at the Conference on Antidifferentiation and the Calculation of Feynman Amplitudes, held in Zeuthen, Germany, in October 2020, and a few additional invited reviews. The book aims at comprehensive surveys and new innovative results of the analytic integration methods of Feynman integrals in quantum field theory. These methods are closely related to the field of special functions and their function spaces, the theory of differential equations and summation theory. Almost all of these algorithms have a strong basis in computer algebra. The solution of the corresponding problems are connected to the analytic management of large data in the range of Giga- to Terabytes. The methods are widely applicable to quite a series of other branches of mathematics and theoretical physics.
"This book grew out of a need to have a set of easily accessible notes that introduced the basic techniques used in modern research on scattering amplitudes. In addition to the key tools, such a review should collect some of the small results and intuitions the authors had acquired from their work in the eld and which had not reviously been exposed in the literature. As the authors quickly realized, such an introduction would bring the reader only part of the way towards some of the most exciting topics in the eld, so they decided to add a little extra" material. While doing so and this took quite a while the authors remained in full and complete denial about writing a book. It was only at the end of process that they faced their worst fears: the review was becoming a book. You now hold the result in your hands. Because the authors were not writing a book, they actually thoroughly enjoyed the work. Their hope is that

you will enjoy it too and that you will nd it useful"--

*** Which problems do arise within relativistic enhancements of the Schrödinger theory, especially if one adheres to the usual one-particle interpretation? * To what extent can these problems be overcome? * What is the physical necessity of quantum field theories? In many textbooks, only insufficient answers to these fundamental questions are provided by treating the relativistic quantum mechanical one-particle concept very superficially and instead introducing field quantization as soon as possible. By contrast, this book emphasizes particularly this point of view (relativistic quantum mechanics in the ''narrow sense''): it extensively discusses the relativistic one-particle view and reveals its problems and limitations, therefore illustrating the necessity of quantized fields in a physically comprehensible way. The first two chapters contain a detailed presentation and comparison of the Klein-Gordon and Dirac theory, always with a view to the non-relativistic theory. In the third chapter, we consider relativistic scattering processes and develop the Feynman rules from propagator techniques. This is where the indispensability of quantum field theory reasoning becomes apparent and basic quantum field theory concepts are introduced. This textbook addresses undergraduate and graduate Physics students who are interested in a clearly arranged and structured presentation of relativistic quantum mechanics in the "narrow sense" and its connection to quantum field theories. Each section contains a short summary and exercises with solutions. A mathematical appendix rounds out this excellent textbook on relativistic quantum mechanics.**

Outlining a revolutionary reformulation of the foundations of perturbative quantum field theory, this book is a self-contained and authoritative analysis of the application of this new formulation to the case of planar, maximally supersymmetric Yang–Mills theory. The book begins by deriving connections between scattering amplitudes and Grassmannian geometry from first principles before introducing novel physical and mathematical ideas in a systematic manner accessible to both physicists and mathematicians. The principle players in this process are on-shell functions which are closely related to certain sub-strata of Grassmannian manifolds called positroids - in terms of which the classification of on-shell functions and their relations becomes combinatorially manifest. This is an essential introduction to the geometry and combinatorics of the positroid stratification of the Grassmannian and an ideal text for advanced students and researchers working in the areas of field theory, high energy physics, and the broader fields of mathematical physics.

Scattering Amplitudes in Gauge Theory and Gravity

Analytic Properties of Feynman Integrals for Scattering Amplitudes

A Modern Primer

The Feynman Lectures on Physics, Vol. III

International Series of Monographs in Natural Philosophy

Field Theory

This work presents some essential techniques that constitute the modern strategy for computing scattering amplitudes. It begins with an introductory chapter to fill the gap between a standard QFT course and the latest developments in the field. The author then tackles the main bottleneck: the computation of the loop Feynman integrals. The most efficient technique for their computation is the method of the differential equations. This is discussed in detail, with a particular focus on the mathematical aspects involved in the derivation of the differential equations and their solution. Ample space is devoted to the special functions arising from the differential equations, to their analytic properties, and to the mathematical techniques which allow us to handle them systematically. The thesis also addresses the application of these techniques to a cutting-edge problem of importance for the physics programme of the Large Hadron Collider: five-particle amplitudes at two-loop order. It presents the first analytic results for complete two-loop five-particle amplitudes, in supersymmetric theories and QCD. The techniques discussed here open the door to precision phenomenology for processes of phenomenological interest, such as three-photon, three-jet, and di-photon + jet production.

Introduction to Gauge Field Theory provides comprehensive coverage of modern relativistic quantum field theory, emphasizing the details of actual calculations rather than the phenomenology of the applications. Forming a foundation in the subject, the book assumes knowledge of relativistic quantum mechanics, but not of quantum field theory. The book is ideal for graduate students, advanced undergraduates, and researchers in the field of particle physics.

Analytic properties of general scattering ampli tudes are considered under the assumption of analyticity in channel energy plane and using unitarity, similar behaviour is done for Feynman amplitudes. (Author).

Superb introduction for nonspecialists covers Feynman diagrams, quasi particles, Fermi systems at finite temperature, superconductivity, vacuum amplitude, Dyson's equation, ladder approximation, and more. "A great delight." — Physics Today. 1974 edition.

Quantum Field Theory in a Nutshell

Born Approximation, Carrier Scattering, Convolution for Optical Broad-Beam Responses in Scattering Media, Diffraction Tomography, D

A Comprehensive Treatment for Students and Researchers

Grassmannian Geometry of Scattering Amplitudes

With Application to Two-loop Five-particle Processes

String Field Theory

An Introduction to Quantum Field Theory is a textbook intended for the graduate physics course covering relativistic quantum mechanics, quantum electrodynamics, and Feynman diagrams. The authors make these subjects accessible through carefully worked examples illustrating the technical aspects of the subject, and intuitive explanations of what is going on behind the mathematics. After presenting the basics of quantum electrodynamics, the authors discuss the theory of renormalization and its relation to statistical mechanics, and introduce the renormalization group. This discussion sets the stage for a discussion of the physical principles that underlie the fundamental interactions of elementary particle physics and their description by gauge field theories.

Presents recent advances of perturbative relativistic field theory in a pedagogical and straightforward way. For graduate students who intend to specialize in high-energy physics.

This thesis proposes a new perspective on scattering amplitudes in quantum field theories. Their standard formulation in terms of sums over Feynman diagrams is replaced by a computation of geometric invariants, called intersection numbers, on moduli spaces of Riemann surfaces. It therefore gives a physical interpretation of intersection numbers, which have been extensively studied in the mathematics literature in the context of generalized hypergeometric functions. This book explores physical consequences of this formulation, such as recursion relations, connections to geometry and string theory, as well as a phenomenon called moduli space localization. After reviewing necessary mathematical background, including topology of moduli spaces of Riemann spheres with punctures and its fundamental group, the definition and properties of intersection numbers are presented. A comprehensive list of applications and relations to other objects is given, including those to scattering amplitudes in open- and closed-string theories. The highlights of the thesis are the results regarding localization properties of intersection numbers in two opposite limits: in the low- and the high-energy expansion. In order to facilitate efficient computations of intersection numbers the author introduces recursion relations that exploit fibration properties of the moduli space. These are formulated in terms of so-called braid matrices that encode the information of how points braid around each other on the corresponding Riemann surface. Numerous application of this approach are presented for computation of scattering amplitudes in various gauge and gravity theories. This book comes with an extensive appendix that gives a pedagogical introduction to the topic of homologies with coefficients in a local system.

At the fundamental level, the interactions of elementary particles are described by quantum gauge field theory. The quantitative implications of these interactions are captured by scattering amplitudes, traditionally computed using Feynman diagrams. In the past decade tremendous progress has been made in our understanding of and computational abilities with regard to scattering amplitudes in gauge theories, going beyond the traditional textbook approach. These advances build upon on-shell methods that focus on the analytic structure of the amplitudes, as well as on their recently discovered hidden symmetries. In fact, when expressed in suitable variables the amplitudes are much simpler than anticipated and hidden patterns emerge. These modern methods are of increasing importance in phenomenological applications arising from the need for high-precision predictions for the experiments carried out at the Large Hadron Collider, as well as in foundational mathematical physics studies on the S-matrix in quantum field theory. Bridging the gap between introductory courses on quantum field theory and state-of-the-art research, these concise yet self-contained and course-tested lecture notes are well-suited for a one-semester graduate level course or as a self-study guide for anyone interested in fundamental aspects of quantum field theory and its applications. The numerous exercises and solutions included will help readers to embrace and apply the material present ed in the main text.

Introduction to Gauge Field Theory Revised Edition

The Genesis of Feynman Diagrams

Anti-Differentiation and the Calculation of Feynman Amplitudes

An Introduction To Quantum Field Theory

The Relationship of Feynman Parametrization to the Double Spectral Representation of Scattering Amplitudes for Higher Spin Particles

Celebrated for his brilliantly quirky insights into the physical world, Nobel laureate Richard Feynman also possessed an extraordinary talent for explaining difficult concepts to the general public. Here Feynman provides a classic and definitive introduction to QED (namely, quantum electrodynamics), that part of quantum field theory describing the interactions of light with charged particles. Using everyday language, spatial concepts, visualizations, and his renowned "Feynman diagrams" instead of advanced mathematics, Feynman clearly and humorously communicates both the substance and spirit of QED to the layperson. A. Zee's introduction places Feynman's book and his seminal contribution to QED in historical context and further highlights Feynman's uniquely appealing and illuminating style.

The success of the experimental program at the Tevatron re-inforced the idea that precision physics at hadron colliders is desirable and, indeed, possible. The Tevatron data strongly suggests that one-loop computations in QCD describe hard scattering well. Extrapolating this observation to the LHC, we conclude that knowledge of many short-distance processes at next-to-leading order may be required to describe the physics of hard scattering. While the field of one-loop computations is quite mature, parton multiplicities in hard LHC events are so high that traditional computational techniques become inefficient. Recently new approaches based on unitarity have been developed for calculating one-loop scattering amplitudes in quantum field theory. These methods are especially suitable for the description of multi-particle processes in QCD and are amenable to numerical implementations. We present a systematic pedagogical description of both conceptual and technical aspects of the new methods.

Nuclear Science Abstracts

From the Hubble to the Planck Scale

Quantum Field Theory