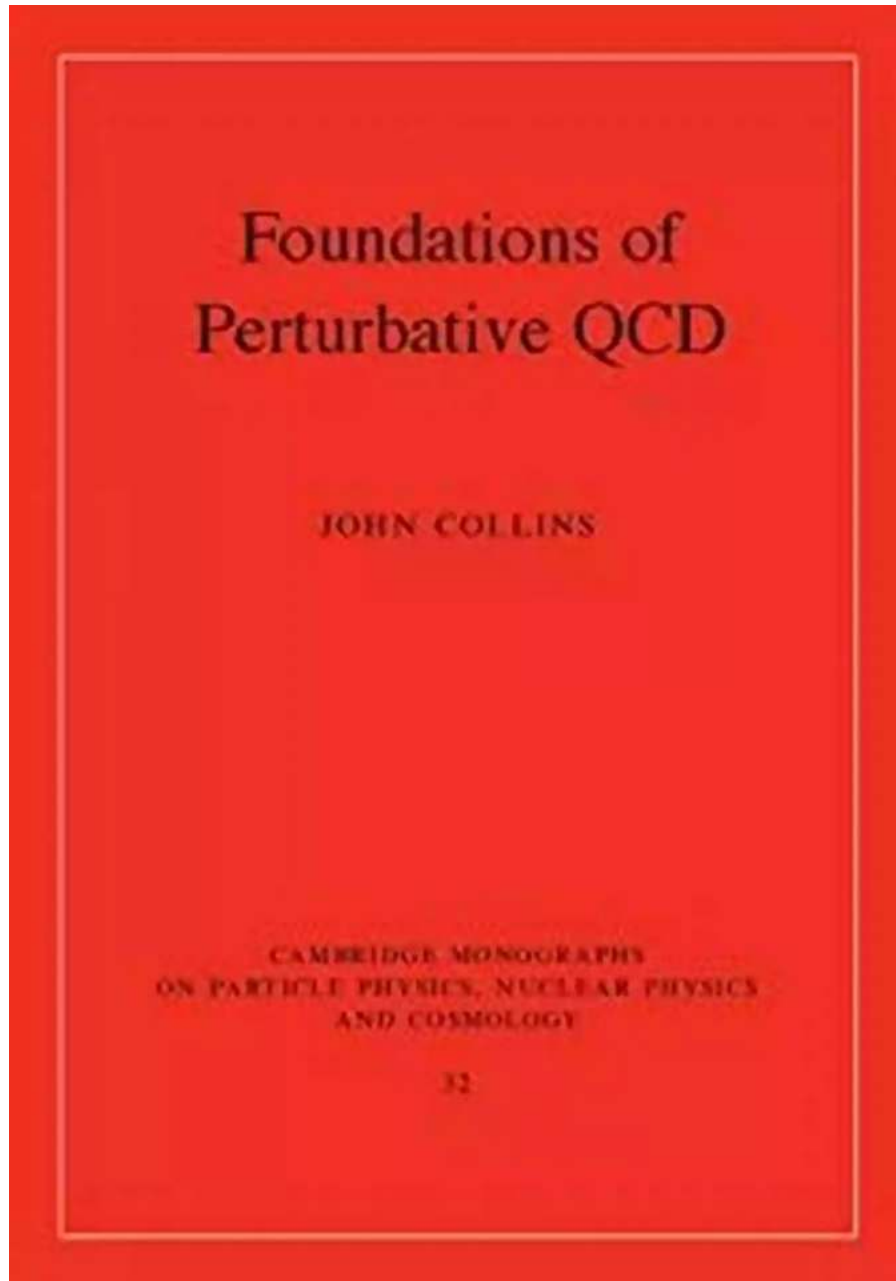


Unveiling the Mysteries: Foundations of Perturbative QCD

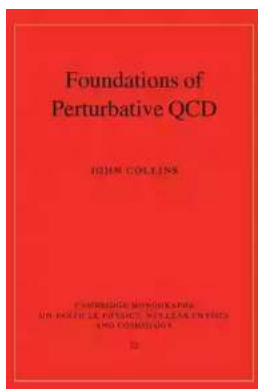


The realm of particle physics is a captivating field that delves into the fundamental building blocks of the universe. Among the various theories that attempt to explain the behavior of these particles, one of the most influential and extensively studied is Perturbative Quantum Chromodynamics (pQCD).

Developed over decades of scientific research, this framework has revolutionized our understanding of the strong nuclear force and the interactions between quarks and gluons.

What is Perturbative QCD?

Perturbative QCD, often referred to as pQCD, is a branch of theoretical physics that focuses on simulating and calculating the interactions between quarks and gluons within the context of Quantum Chromodynamics (QCD). QCD is a theory that describes the strong nuclear force, which is responsible for holding atomic nuclei together.



Foundations of Perturbative QCD (Cambridge Monographs on Particle Physics, Nuclear Physics and Cosmology Book 32)

by Todd Lewan(1st Edition, Kindle Edition)

★★★★★ 5 out of 5

Language : English
File size : 17598 KB
Text-to-Speech : Enabled
Screen Reader : Supported
Enhanced typesetting : Enabled
Print length : 640 pages



Unlike other fundamental forces, such as electromagnetism, the strong force becomes stronger at higher energies and shorter distances. This phenomenon, known as "asymptotic freedom," led to the development of pQCD as a calculational tool. By treating interactions between quarks and gluons as a perturbation of the QCD vacuum, pQCD allows physicists to make precise predictions about the behavior of particles at high energies.

The Cambridge Monographs on Particle Physics

Within the vast landscape of scientific literature, the Cambridge Monographs on Particle Physics stand out as esteemed resources for in-depth knowledge and understanding. The monograph series covers a wide range of topics in current particle physics research, offering comprehensive and authoritative accounts of theoretical and experimental aspects.

The monograph "Foundations of Perturbative QCD" is one of the prominent volumes in this series. Authored by a team of distinguished physicists, it presents a rigorous exploration of pQCD from its basic principles to advanced applications. The book combines theoretical framework, insightful calculations, and experimental results, providing readers with a holistic view of this groundbreaking field.

Unraveling the Building Blocks: Principles and Techniques

Foundations of Perturbative QCD begins by introducing the theoretical foundations of pQCD. It outlines the principles of Quantum Field Theory (QFT), explaining how they are applied to QCD. The authors elucidate the mathematical machinery behind pQCD, including Feynman diagrams and renormalization techniques.

With these foundational concepts established, the book progresses into more advanced topics. It explores the intricacies of parton distribution functions, which are vital for understanding the internal structure of hadrons. The authors tie in concepts from high-energy experiments, showcasing the connection between theory and experimental data.

Furthermore, the monograph details the calculations involved in pQCD. It offers step-by-step explanations of perturbative calculations at leading and next-to-

leading orders, providing readers with a comprehensive understanding of the mathematical techniques used in the field.

From Quarks to Phenomenological Applications

Theoretical frameworks are invaluable, but their true value is unleashed when they can make experimentally testable predictions. The final sections of "Foundations of Perturbative QCD" focus on the phenomenological applications of pQCD.

The book explores the use of pQCD in determining parton distribution functions for different hadrons, which serve as input for high-energy experiments. It delves into processes such as deep inelastic scattering and electron-positron annihilation, shedding light on the underlying mechanisms.

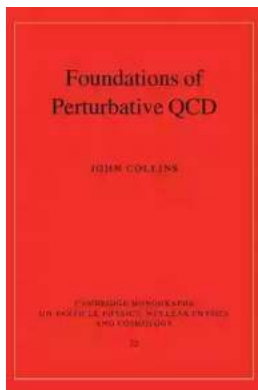
Beyond these fundamental processes, the monograph also discusses the application of pQCD in diverse scenarios, including the production of heavy quarks, jets, and Higgs bosons. The authors provide an insightful overview of these phenomenological studies, revealing the versatility of pQCD as a tool to understand a broad range of particle physics processes.

: A Gateway to the Quantum Universe

The Cambridge Monographs on Particle Physics' "Foundations of Perturbative QCD" offers an illuminating journey through the world of pQCD. It encapsulates the theoretical groundwork, computational techniques, and experimental compatibility of perturbative Quantum Chromodynamics.

This monograph serves as an indispensable reference for researchers, graduate students, and enthusiasts aiming to deepen their knowledge of particle physics. Its meticulous approach and comprehensive coverage ensure that readers gain a

profound understanding of the foundations and applications of pQCD. With its immense contribution to the field, "Foundations of Perturbative QCD" is an essential addition to any scientific library.



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The most non-trivial of the established microscopic theories of physics is QCD: the theory of the strong interaction. A critical link between theory and experiment is provided by the methods of perturbative QCD, notably the well-known factorization theorems. Giving an accurate account of the concepts, theorems and their justification, this book is a systematic treatment of perturbative QCD. As well as giving a mathematical treatment, the book relates the concepts to experimental data, giving strong motivations for the methods. It also examines in detail transverse-momentum-dependent parton densities, an increasingly important subject not normally treated in other books. Ideal for graduate students starting their work in high-energy physics, it will also interest experienced researchers wanting a clear account of the subject.



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