<<超对称和弦论>>

图书基本信息

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前言

As this is being written, particle physics stands on the threshold of a new era, withthe commissioning of the Large Hadron Collider （LHC） not even two years away.In writing this book, I hope to help prepare graduate students and postdoctoralresearchers for what will hopefully be a period rich in new data and surprisingphenomena.The Standard Model has reigned triumphant for three decades. For just as long,theorists and experimentalists have speculated about what might lie beyond. Manyof these speculations point to a particular energy scale, the teraelectronvolt （TeV）scale which will be probed for the first time at the LHC. The stimulus for thesestudies arises from the most mysterious - and still missing - piece of the StandardModel: the Higgs boson. Precision electroweak measurements strongly suggest thatthis particle is elementary （in that any structure is likely far smaller than its Comptonwavelength）, and that it should be in a mass range where it will be discovered at theLHC. But the existence of fundamental scalars is puzzling in quantum field theory,and strongly suggests new physics at the TeV scale. Among the most prominentproposals for this physics is a hypothetical new symmetry of nature, supersymmetry,which is the focus of much of this text. Others, such as technicolor, and large orwarped extra dimensions, are also treated here.　 Even as they await evidence for such new phenomena, physicists have becomemore ambitious, attacking fundamental problems of quantum gravity, and specu-lating on possible final formulations of the laws of nature. This ambition has beenfueled by string theol., which seems to provide a complete framework for thequantum mechanics of gauge theory and gravity. Such a structure is necessary togive a framework to many speculations about beyond the Standard Model physics.Most models of supersymmetry breaking, theories of large extra dimensions, andwarped spaces cannot be discussed in a consistent way otherwise.

内容概要

The Standard Model has reigned triumphant for three decades. For just as long， theorists and experimentalists have speculated about what might lie beyond. Manyof these speculations point to a particular energy scale， the teraelectronvolt （TeV） scale which will be probed for the first time at the LHC. The stimulus for thesestudies arises from the most mysterious - and still missing - piece of the StandardModel： the Higgs boson. Precision electroweak measurements strongly suggest thatthis particle is elementary （in that any structure is likely far smaller than its Comptonwavelength）， and that it should be in a mass range where it will be discovered at theLHC. But the existence of fundamental scalars is puzzling in quantum field theory， and strongly suggests new physics at the TeV scale. Among the most prominentproposals for this physics is a hypothetical new symmetry of nature， supersymmetry， which is the focus of much of this text. Others， such as technicolor， and large orwarped extra dimensions， are also treated here.

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章节摘录

插图：The strong interactions, as their name implies, are characterized by strong cou-pling. As a result, perturbative methods are not suitable for most questions. Incomparing theory and experiment, it is necessary to focus on a few phenomenawhich are accessible to theoretical analysis. By itself, this is not particularly dis-turbing. A parallel with the quantum mechanics of electrons interacting with nucleiis perhaps helpful. We can understand simple atoms in detail; atoms with verylarge Z can be treated by Hartree-Fock or other methods. But atoms with inter-mediate Z can be dealt with, at best, by detailed numerical analysis accompaniedby educated guesswork. Molecules are even more problematic, not to mentionsolids. But we are able to make detailed tests of the theory （and its extensionin quantum electrodynamics） from the simpler systems, and develop qualitativeunderstanding of the more complicated systems. In many cases, we can do quanti-tative analysis of the small fluctuations about the ground states of the complicatedsystem.In the theory of strong interactions, as we will see, many problems are hopelesslycomplicated. Low-lying spectra are hard; detailed exclusive cross sections in high-energy scattering essentially impossible. But there are many que~stions we cananswer. Rates for many inclusive questions at very high energy and momentumtransfer can be calculated with high precision. Qualitative features of the low lyingspectrum of hadrons and their interactions at low energies can be understood in aqualitative （and sometimes quantitative） fashion by symmetry arguments. Recently,progress in lattice gauge theory has made it possible to perform calculations whichpreviously seemed impossible, for features of spectra and even for interaction ratesimportant for understanding the weak interactions.

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