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Argonne-driven technology is part of a broad initiative to answer fundamental questions about the birth of matter in the universe and the building blocks that hold it all together. Imagine the first ...

Quest to Reveal Fundamental Secrets of the Universe Driven by Curiosity and Technology

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A measurement of a fundamental principle ... is formulated in the standard model of particle physics. In the theory, electrons, muons and ? leptons represent three varieties (or flavours) of ...

Scientists discover support for disputed universal truth of particle physics

Now, measurements of a rare particle-physics decay at the Large Hadron Collider ... doubt that the standard model can be the true theory of everything“. For some time now, physicists have ...

Particle Physics Discovery Raises Hope For A Theory Of Everything

A measurement of a fundamental principle of the standard model of particle physics — lepton flavour universality — captured by the ATLAS detector at the Large Hadron Collider is reported in a paper ...

Physics: ATLAS experiment measurements support universal truth of particle physics

The Standard Model of Particle Physics is scientists' current best theory to describe the most basic building ... have contributed to Nobel Prize-winning discoveries and measurements that refined the ...

DOE Explains...the Standard Model of Particle Physics

Although errors in data or theory may have caused ... can do is seek “as many anomalous measurements as possible, whether at colliders, smaller particle physics experiments, dark matter searches ...

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Measurements From CERN Suggest the Possibility of a New Physics

Division of Physics: Investigator-Initiated Research Projects. The Elementary Particle Theory program encompasses different theoretical tools for understanding the interaction of elementary particles ...

Elementary Particle Physics - Theory

This book is written for students and scientists wanting to learn about the Standard Model of particle physics. Only an introductory course knowledge about quantum theory is needed. The text provides ...

Modern Elementary Particle Physics

“Particle Fever: Particles of the Standard Model of Physics ... certain aspects and measurements of the universe imaginary themselves. That’s where superstring theory comes in.

The Physics of Everything: Understanding Superstring Theory

Uniting the usually distinct areas of particle physics and quantum field theory, gravity and general relativity, this expansive and comprehensive textbook of fundamental and theoretical physics ...

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Advanced Concepts in Particle and Field Theory

The Standard Model of particle physics ... the door to an era of precision measurements that have the potential to uncover yet unknown phenomena—and perhaps physics beyond the Standard Model.

CERN: How we're probing the universe's origins using record precision measurements

In a few years, a new generation of quantum simulators could provide insights that would not be possible using simulations on conventional supercomputers. Quantum simulators are capable of processing ...

Quantum Simulation: Measurement of Entanglement Made Much Easier

If the known virtual particles can't sufficiently explain that gap — assuming the measurements are accurate — researchers deduce that some other, unidentified particle ... hints of new physics,” Fodor ...

Could Misbehaving Muons Upend the Known Laws of Physics?

This article is the first part of a series about quantum field theory published by Quanta ... itself—abstracting them from the world of particle physics and turning them into mathematical ...

The Mystery at the Heart of Physics—That Only Math Can Solve

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This measurement differed just slightly ... continue to poke holes in particle physics' most important theory. But she and other early career scientists have already left an impact for the ...

Young Physicists Are Shaping the Next Generation of Discoveries

The Standard Model of particle ... of these measurements further. Meanwhile, theoretical physicists are working on new calculations to interpret this result. The LHCb physics program will also ...

CERN's LHCb breakthrough will reveal a lot about the universe's origins

A measurement of a fundamental principle of the standard model of particle physics - lepton flavour universality - captured by the ATLAS detector at ...

Scientists part of team to discover support for disputed universal truth of particle physics

The Standard Model of particle ... know from theory that these oscillations follow the path of a familiar type of wave (sinusoidal). Measuring the start of the wave very precisely, we can infer its ...

CERN: How We're Probing the Universe's Origins Using Record Precision Measurements

The results, published in April by the Muon $g-2$ collaboration (pronounced "g minus two"), run counter to the predictions of the top available particle physics theory. That leaves three ...

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Could misbehaving muons upend the known laws of physics?

The Standard Model of particle ... of these measurements further. Meanwhile, theoretical physicists are working on new calculations to interpret this result. The LHCb physics programme will ...

'The editors make a good point in claiming the time has come to upgrade the Standard Model into the 'Standard Theory' of particle physics, and I think this book deserves a place in the bookshelves of a broad community, from the scientists and engineers who contributed to the progress of high-energy physics to younger physicists, eager to learn and enjoy the corresponding inside stories.' Carlos Lourenço CERN Courier

The book gives a quite complete and up-to-date picture of the Standard Theory with an historical perspective, with a collection of articles written by some of the protagonists of present particle physics. The theoretical developments are described together with the most up-to-date experimental tests, including the discovery of the Higgs Boson and the measurement of its mass as well as the most precise measurements of the top mass, giving the reader a complete description of our present understanding of particle physics.

Particle physics is a science about the symmetries of our world. The Standard Model is the fundamental theory of microworld. Particle dynamics in the Standard Model obeys strict symmetry laws with explicit experimental consequences. Priority problems of particle physics based on the Standard Model are more

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accurate theoretical predictions, experimental measurements and data analysis, proof of existence or non-existence of supersymmetry, top quark properties, Higgs boson, exotic quark states, and physics of neutrinos. In this collection of articles, many of these problems are discussed. We recommend this book for students, graduate students, and scientists working in the field of high energy physics.

Over the past decades the current theoretical description, the Standard Model of elementary particle physics, was solidified by many measurements as the basic theory describing fundamental particles and their interactions. It is extremely successful in explaining the high-precision data collected by experiments so far. The Standard Model includes several intrinsic parameters which have to be measured in experiments. Independent analyses of different physical processes can constrain those parameters. By combining those measurements physicists might be sensitive to physics beyond the Standard Model. If they are inconsistent it allows to get a hint on the theory that might supersede the Standard Model. The goal of the analysis presented in this thesis is to measure some of these parameters in the B_{s} meson system. The B_{s} meson, consisting of an anti- b and s quark, is not a pure mass eigenstate, thus allowing a B_{s} meson to oscillate into its antiparticle via weak interacting processes. This is a general feature of any neutral meson. The history of meson mixing measurements is more than 50 years old. It was first observed in the kaon system. The oscillation in the B_{d} system was measured very precisely by the B factories, whereas the oscillation frequency of the B_{s} was measured with more than 5σ significance last year by CDF and first evidence for mixing in the D_0 system was presented only this year.

This first open access volume of the handbook series contains articles on the standard model of particle

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physics, both from the theoretical and experimental perspective. It also covers related topics, such as heavy-ion physics, neutrino physics and searches for new physics beyond the standard model. A joint CERN-Springer initiative, the "Particle Physics Reference Library" provides revised and updated contributions based on previously published material in the well-known Landolt-Boernstein series on particle physics, accelerators and detectors (volumes 21A,B1,B2,C), which took stock of the field approximately one decade ago. Central to this new initiative is publication under full open access.

The Standard Model is the most comprehensive physical theory ever developed. This textbook conveys the basic elements of the Standard Model using elementary concepts, without the theoretical rigor found in most other texts on this subject. It contains examples of basic experiments, allowing readers to see how measurements and theory interplay in the development of physics. The author examines leptons, hadrons and quarks, before presenting the dynamics and the surprising properties of the charges of the different forces. The textbook concludes with a brief discussion on the discoveries of physics beyond the Standard Model, and its connections with cosmology. Quantitative examples are given, and the reader is guided through the necessary calculations. Each chapter ends in the exercises, and solutions to some problems are included in the book. Complete solutions are available to instructors at www.cambridge.org/9781107406094.

Experimental Particle Physics is written for advanced undergraduate or beginning postgraduate students starting data analysis in experimental particle physics at the Large Hadron Collider (LHC) at CERN. Assuming only a basic knowledge of quantum mechanics and special relativity, the text reviews the current state of affairs in particle physics, before comprehensively introducing all the ingredients that go

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into an analysis.

This work develops novel data analysis techniques enabling aspects of the Standard Model of particle physics to be tested with unprecedented precision using data from the DZero experiment at the high energy “Tevatron” proton-antiproton collider at Fermilab, Chicago. Vesterinen's measurements of the transverse momentum of Z bosons using the novel variable q_T have exposed deficiencies in the current state-of-the-art theoretical predictions for vector boson production at hadron colliders. These techniques are now being used in the experiments at CERN's Large Hadron Collider (LHC) and have stimulated considerable interest in the theoretical particle physics community. Furthermore, Vesterinen's measurements of the cross sections for the production of pairs of vector bosons (WZ and ZZ) are to date the most precise ever made.

The book provides theoretical and phenomenological insights on the structure of matter, presenting concepts and features of elementary particle physics and fundamental aspects of nuclear physics. Starting with the basics (nomenclature, classification, acceleration techniques, detection of elementary particles), the properties of fundamental interactions (electromagnetic, weak and strong) are introduced with a mathematical formalism suited to undergraduate students. Some experimental results (the discovery of neutral currents and of the W^\pm and Z^0 bosons; the quark structure observed using deep inelastic scattering experiments) show the necessity of an evolution of the formalism. This motivates a more detailed description of the weak and strong interactions, of the Standard Model of the microcosm with its experimental tests, and of the Higgs mechanism. The open problems in the Standard Model of the microcosm and macrocosm are presented at the end of the book.

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The main pacemakers of scientific research are curiosity, ingenuity, and a pinch of persistence. Equipped with these characteristics a young researcher will be successful in pushing scientific discoveries. And there is still a lot to discover and to understand. In the course of understanding the origin and structure of matter it is now known that all matter is made up of six types of quarks. Each of these carry a different mass. But neither are the particular mass values understood nor is it known why elementary particles carry mass at all. One could perhaps accept some small generic mass value for every quark, but nature has decided differently. Two quarks are extremely light, three more have a somewhat typical mass value, but one quark is extremely massive. It is the top quark, the heaviest quark and even the heaviest elementary particle that we know, carrying a mass as large as the mass of three iron nuclei. Even though there exists no explanation of why different particle types carry certain masses, the internal consistency of the currently best theory—the standard model of particle physics—yields a relation between the masses of the top quark, the so-called W boson, and the yet unobserved Higgs particle. Therefore, when one assumes validity of the model, it is even possible to take precise measurements of the top quark mass to predict the mass of the Higgs (and potentially other yet unobserved) particles.

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