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Annual Review of Nuclear and Particle Science presents every year a collection of articles which aim to capture important trends in nuclear and particle physics as well as neighbouring fields such as cosmology.

The present era is one in which there are said to be two Standard Models, one of elementary particle physics and field theory and one of cosmology. They have been developed over the last 60 years and give today a fair description of the smallest and largest structures of the universe. As described in this book, they allow us to make precise predictions. An equally extraordinary development on the experimental side has made possible meaningful tests at very high precision. This book is witness to this astonishing progress. It tells us how far we have come in our understanding of nature, about recent progress, and what issues remain open to approach a unified 'One standard model of fundamental physics' even further.

The standard model of particle physics, which links the electromagnetic and weak interactions and combines them with the strong interactions (often referred to as QCD), is a quantum gauge field theory bases on the symmetry group $U(1) \times SU(2) \times SU(3)$. In gauge theories, forces are mediated by spin-1 particles. Of these, the photon and the gluons responsible for the electromagnetic and strong interactions respectively, are massless, while those associated with the weak interactions, the W and Z bosons, have a mass of a little more than 80 and 90 GeV/c^2. This puzzling situation was to be explained by the Higgs mechanism, which implied the existence of a new particle. It was a great success when this particle, called the Higgs boson, was found at the LHC at CERN, with a mass of 125 GeV/c^2.

Furthermore, all the elementary particles that make up all matter interacting through these forces have been found. These are the six leptons, the electron and its neutrino, the muon and its neutrino and the tau lepton and its neutrino, and the six quarks, the u and d quarks, the s and c quarks, and finally, the b and t quarks. The lightest of these are stable and make up ordinary matter, while the muon, the tau and the four quarks s, c, b, t decay rapidly. Using increasingly sophisticated methods of working with gauge field theories, calculations of observables and their experimental measurements agree to very high precision. Work, both in theory and experiment, is in progress to go even further, and aims at either improving the agreement between theory and experiment or finding slight disagreements that would point to new physics beyond the Standard Model, which is the goal of research in particle physics.

Nevertheless, there remain unexplained facts. Within the Standard Model, the mass of the neutrinos, measured to be non-zero, cannot be accounted for. And results from cosmology, thought to be explained by concepts of particle physics, such as the absence of large amounts of antimatter and the presence of dark matter and dark energy, are not accounted for by the standard model of particle physics. Furthermore, there are some minor discrepancies (anomalies) between theory and experiment. Most have not survived the test of time, but with ever-rising precision such anomalies may come back.

The Standard Model of Cosmology gives us a picture of the universe; the main mathematical tool is Einstein's General Theory of Relativity. It is generally agreed that the universe is essentially isotropic, homogeneous and expanding. The momentous discovery of the microwave background in 1965 (curiously not far away from the papers of P. Higgs in 1964 and of S. Weinberg and A. Salam, who established the standard model of particle physics in 1967) confirmed the big bang and, thereby also the connection to particle physics (in the early stages). Since then, many discoveries have led to the standard 'ΛCDM model of cosmology, consisting of 5% ordinary matter, 27% dark matter and 68% dark energy. Furthermore, with the discovery of gravitational waves, the general theory of relativity was even more firmly established. But as mentioned above, so far, there is no particle physics explanation for these.

The present collection of articles is indeed largely situated in the thick of these subjects. The articles summarize recent developments in theory and experiment and the challenges ahead in confirming, validating and pushing the frontiers of the subjects. Some articles have a wider perspective on the subjects, while others are narrower in their treatment or give a momentous view.

Michael S. Turner, in the article entitled 'The road to precision cosmology' offers the opening salvo of this collection. In a clear, insightful, and yet very personal way, he leads us through the evolution of cosmology towards a precision science, starting from the early beginnings a century ago, the emergence of the hot big bang universe to the present. Besides theoretical considerations, the enormous progress in experimental work is described. At the same time, this article is a wonderful reminder of how far we have come but is also an exciting motivation to go further.

Since the objects in the sky do not only emit visible light, laboratories underground can gather additional and focused information, as much unwanted background is shielded. The article 'Exploring stars in underground laboratories: Challenges and solutions', by Marialuisa Aliotta *et al.* gives a status update on the LUNA underground facility, its accomplishments and an outlook on future plans at underground laboratories.

The recent, often spectacular advances in quantum systems may be used to design better detectors. In 'Novel quantum sensors for light dark matter and neutrino detection', Sunil R. Golwala and Enectali Figueroa-Feliciano describe how such detectors, with their improved energy sensitivity, could improve measurements of neutrino properties in future.

Short-lived radionuclides were present in the early stages of the solar system. In 'Short-lived nuclides in the early solar system: Abundances, origins and applications', Andrew M. Davis tells us how their abundance influences the history of the formation of the solar system.

Neutrinos are ubiquitous in the Universe since they are produced in stellar reactions and provide much information in astrophysics and cosmology. In their contribution, 'High-energy extragalactic neutrino astrophysics', Naoko Kurahashi *et al.* cover the status of our knowledge of neutrinos and their increasing use in understanding extragalactic objects.

So far, the observed Higgs particle is compatible with the Standard Model of Particle Physics. However, in several physics' scenarios beyond the Standard Model, designed to address some of the less understood features of the Standard Model, there are new light particles. In 'Exotic Higgs Decays', Maria Cepeda *et al.* tell us how decays of the Higgs particle into such particles could open windows to new scenarios.

As mentioned above, (small) discrepancies exist between experiment and theory. Over the last years, vexing discrepancies in the decay from the b quark persisted and have led to much theoretical work. This is the topic of 'B flavor anomalies: 2021 theoretical status report' by David London and Joaquim Matias. Since that article was written, many of these anomalies have disappeared due to large new data by the LHCb experiment in CERN. While the practical significance of the article is therefore diminished for the moment, it addresses in many ways the problems that fall into the ambit of 'flavour physics' where the Standard Model of particle physics does not offer sufficient insight.

A closely related topic is that of the article 'Electroweak penguin decays of b-flavoured hadrons' by Ulrike Egede *et al.* In the Standard Model, and because of the suppressed decay rate of the b-quark, the so-called penguin decays, which occur only at the one-loop level, are well observable. They provide a lot of information on the flavour-related structure of the underlying models – they are the drosophila of flavour physics. This article gives an extensive and useful overview of these decays.

An important and testable feature of the Standard Model is the occurrence of repeated 'generations' of particles with the same properties except for their masses. This issue is addressed in 'Testing lepton flavour universality with pion, kaon, tau and beta decays' by Douglas Bryman *et al.* The authors provide an exhaustive overview of the experimental situations and the implications for future theories.

While the long-standing belief that neutrinos are massless has been shattered, the exact masses are still not unknown. In 'Probing the neutrino-mass scale with the KATRIN experiment', Alexey Lokhov *et al.* describe the recent results and future plans of the KATRIN experiment, the world's leading direct (electron)-neutrino mass measurement. While the present sensitivity stands at 0.8 eV, the goal is to reach 0.2 eV in the near future. Furthermore, they discuss the search for light sterile neutrinos.

Among the models beyond the Standard Model, some with enhanced couplings to the heave particles of the Standard Model, like the Z, W, t, H, because of some unknown strong dynamics. In his contribution 'Searches for heavy resonances with substructure', Petar Maksimovic describes the observable effects of such scenarios and their signatures, distinct from the Standard Model.

Successful analysis at LHC requires difficult heavy-duty theoretical computations at the forefront of particle physics. Thomas Gehrmann and Bogdan Malaescu describe the state of the art in 'Precision QCD physics at the LHC'. QCD, or Quantum Chromodynamics, is the microscopic theory of strong interactions. The calculations in QCD have been constantly improved over the last decade; they are at the edge of the techniques of quantum field theory and use the most advanced concepts of information technology. The achievements described in this article are of the highest quality and a solid foundation for future work.

The difficulties of mastering the non-perturbative aspects of QCD have led to a numerical treatment based on discretizing space and time. In 'Status of lattice QCD determination of nucleon form factors', Aaron S. Meyer *et al.* review the status of this difficult field, which merges deep issues in field theory and numerical Work. As can be seen, the properties of some of the most ubiquitous particles in the Universe, namely the proton and neutron, continue to be of interest to theoreticians as well as to experimentalists.

Apart from the issues concerning the two Standard Models, there remain unresolved puzzles at the subatomic level, some of which may also have repercussions at the more fundamental level. One area of interest is muonic atoms. Since the muon is much closer to the nucleus, one can probe light nuclei with high precision. Aldo Antognini *et al.* show in 'The proton structure in and out of muonic hydrogen' how to allow for precision measurements of fundamental constants, tests of QCD-bound states and even for searches of new physics.

The neutron has had its own riddles; for instance, its lifetime remained unknown for many years. But it also allows for tests of fundamental physics, such as CP-violation. Recent technological developments have allowed us to produce large samples of them, making precision measurement possible. The progress and outlook are described in the article 'Fundamental neutron physics at spallation sources' by Nadia Fomin *et al.*

Knowledge of the detailed nuclear structure in unusual conditions is important for understanding astrophysical objects like neutron stars and low-to-medium energy scattering, including neutrino oscillation effects in matter. John Arrington *et al.* review recent progress in the article 'Progress in understanding short-range structure in nuclei'. The emergence of laboratory astrophysics and its implications is a fascinating new development.

Somewhat outside the focus is the contribution 'Something can come of nothing: Surface approaches to quantum fluctuations and Casimir force' by Giuseppe Bimonte *et al.*. Since the pioneering calculation by Casimir in 1948, who showed that vacuum fluctuation indeed gives rise to a measurable force, there are many extensions, including the work on material, surface or temperature dependence, with possible application in nanotechnology. This article reviews these developments and points to open the problems in this domain.

In this lengthy review of the *Annual Review of Nuclear and Particle Science*, we have attempted to relate to the prospective readers the essence of this collection of articles and their setting in the fields of elementary particle physics, nuclear physics and cosmology. We believe that these articles provide valuable overviews for young researchers, motivate them to explore the fields in greater detail, and provide them and experienced researchers with an extensive bibliography. This volume is a useful addition to every reference library in the world with a readership in the field covered, and we encourage libraries to procure copies.

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Annual Review of Medicine, 2022. Mary E. Klotman, Michael S. Parmacek and Howard A. Rockman (eds). Annual Reviews, 1875 S. Grant Street, Suite 700, San Mateo, California 94402, USA. Vol. 73. x + 602 pages. Price: US$ 118.00. ISBN 978-0-8243-0573-4.

Yet another edition of *Annual Review of Medicine* is here. Given that all of 2020 and 2021 seemed to revolve around only one thing – COVID-19 – it comes as no surprise that COVID-19 dominates even in this volume. Whereas the 2020 edition that I had reviewed (*Curr. Sci.*, 2022, **123**(11), 1394–1395) had 392 pages, this one has as many as 602 pages. Of these, 166 pages are devoted to articles related to COVID-19/SARS-CoV-2 and include the topics of