Annual Review of Nuclear and Particle Science. Boris Kayser, Barry R. Holstein and Abolhassan Jawahery (eds). Annual Reviews, 4139, El Camino Way, P.O. Box 10139, Palo Alto, California, USA. 2007. vol. 57. 503 pp. Price not mentioned.

The *Annual Review of Nuclear and Particle Science* is brought out every year and provides a compendium of review articles in the field. The volume being reviewed contains 15 articles among which 13 fall into the category described above, while two are of general interest.

It is now known that nuclei of all stable matter are made up of nucleons, namely protons and neutrons. Nucleons are composite and are made up of elementary particles known as quarks, which interact strongly through the exchange of gluons. This is the theory of 'colour' forces, where the quarks and gluons are said to carry colour charges. The strong interactions are such that the quarks and gluons are doomed to be confined inside so-called hadronic matter. These quark and gluon degrees of freedom play a dynamic role only under extreme laboratory conditions, when they are struck with very large momentum transfers by probes such as virtual photons, for instance. At conventional energies, these degrees of freedom freeze out, and the 'spectrum' of the strong interactions is populated by more familiar particles, the hadrons. The hadrons come in two varieties. The first are known as baryons, of which nucleons are examples and are made up of three constituent quarks, which themselves come in six 'flavours', namely up, down, strange, charm, bottom and top flavours, given here in the order of increasing masses. The second are known as mesons and are made up of quark and anti-quark pairs. All heavy quarks are unstable and decay into their lighter counterparts. It is as a result of this that a free neutron is unstable and decays in about 10 min into a proton, an electron and an anti-neutrino. The force responsible for this decay is the weak interaction. We note here that at low energies it is only the weak interaction that can change particle type of all conventional matter. Note also that in the reaction mentioned earlier, there is a change in the electric charge of the hadronic daughter. Electrically charged particles, on the other hand, interact amongst themselves through the electromagnetic interaction without changing particle type at low energies.

There is now a modern theory of weak and electromagnetic interactions known as the electroweak theory. This theory supplements the familiar weak and electromagnetic interactions, associated with which are force carriers known as the $W^{\pm}$ and the photon respectively, with another interaction known as the neutral current interaction due to a force carrier known as the Z^0. The $W^{\pm}$ and Z^0 are massive particles, almost a hundred times as heavy as a proton, and are unstable, but make their presence felt through quantum-mechanical effects at low energies. The neutral current interaction can change particle type only at higher orders in the coupling of this particle with matter. Thus the change in particle type in such interactions also could provide a sensitive laboratory for probing interactions beyond what has come to be known as the standard model, viz. the theory of strong and electroweak interactions.

While the electroweak interactions can be worked out as the theory has coupling constants which are numerically small, the same cannot be done with the strong interactions at low energies. Other techniques have to be therefore invented to study the low-energy spectrum, taking its existence for granted, while remaining faithful to the constraints from the underlying theory. Consider collisions of nuclei, a complex collection of individual nucleons, resulting in a bubbling miasma of quarks and gluons when subject to extreme conditions, leading to such exotic states of matter known as the quark–gluon plasm. Exciting developments have occurred in other ambitious fields, with surprising connections to such phenomena: string theory has come up with such surprising connections, which are also reviewed in the present collection.

While cosmology today has turned into a precision science with probes that have been sent up into the sky on satellites and balloons, with more experiments and observations on the drawing board and in various stages of preparation, the results from their provide valuable constraints on microscopic laws. This remarkable cosmic dance between the microscopic and macroscopic is reviewed here in a collection of articles. Finally, there are a couple of articles on venerable experiments and experimental techniques, a useful general article on error analysis and another on the art of communication. We now proceed to discuss the articles in some detail.

The subject of effective field theories is reviewed in two independent articles. C. P. Burgess has authored 'An introduction to effective field theory', which is a pedagogical article. A variety of phenomena are considered and the basis for modern effective field theory and the technicalities is presented in a user-friendly manner. It must, however, be borne in mind that the subjects dealt with here are complex and require a reasonable knowledge of field theory. The article entitled 'Chiral perturbation theory' by Véronique Bernard and Ulf-G. Meißner is a concrete effective field theory for the low energy degrees of freedom of the strong interaction, namely the pions and kaons. In this review nucleons are not included. The connection of these to the lattice is also reviewed, which makes the article particularly useful. Indeed, as mentioned in the introduction, the issue of changing of particle type where there is no change in the electric charge is a significant subject. Luca Silvestrini in the article entitled 'Searching for new physics in $b \to s$ hadronic Penguin decay' provides a review on precisely such a process. The term 'Penguin decay' refers to the contributions to such exotic decays in which a constituent b quark in a meson decays through a complicated Feynman diagram into an s quark. Such diagrams are present in the Standard Model, and there may be diagrams induced by concepts beyond the Standard Model physics, which also contribute to the decay. The presence of strong interactions which bind both the mother b as well as the daughter s quarks leads to complications as regards the precise estimates for such a transition. The subject gains importance in the light of recent experimental information coming from the so-called B-factories (experiments producing a large number of mesons with b quarks in them), where the experimental collaborations known as BELLE and BABAR have been gathering data.

Turning now to the study of strongly interacting matter at extreme conditions, we consider the article entitled 'Glauber modeling in high-energy nuclear collisions' by Miller *et al.* The subject is named after Roy Glauber, Nobel Laureate in Physics in the year 2006, who had proposed a theory for scattering of composite systems, which has been developed and adapted for studying processes

at the Relativistic Heavy Ion Collider, where ultrarelativistic collisions take place of ions with enormously high multiplicities. Carl E. Carlson and Marc Vanderhaegen author the review entitled 'Two-photon physics in hadronic processes', where such exchange contributions to elastic electron scattering are reviewed. Such contributions are of importance to the resolution of experimental discrepancies arising from the extraction of nucleon form factors between polarized and unpolarized electron beam scattering experiments. Stanislaw Mrówczyński and Markus H. Thoma author an interesting article entitled 'What do electromagnetic plasmas tell us about the quark–gluon plasma?' Although the underlying forces of electromagnetic and strong interactions are qualitatively and quantitatively different, the authors here point out that there are some properties of the latter which can be studied by analogy with the former, keeping in mind that the former have been well studied.

As mentioned in the introductory part of this article, the microscopic and the macroscopic each affects the latter. The laws of one determine the gross properties of the other; the observation of effects on the latter provides constraints on the former. Appearing in this broad category is the article entitled 'The cosmic microwave background for pedestrians: A review for particle and nuclear physicists' by Smatleben *et al.* Today is an age of precision measurements of the properties of the cosmic microwave background radiation, with its anisotropies mapped out in great detail. Another effect is the polarization of this background which fingerprints the anisotropy. Future experiments are likely to study this in great detail. Strong *et al.* present a review entitled 'Cosmic-ray propagation and interactions in the Galaxy', surveying the theory as well as experimental tests for the propagation of highly energetic cosmic rays in the Galaxy. Cosmic-ray physics which is the progenitor of modern-day experimental elementary particle physics, continues to present puzzles and is a subject that engages the attention of several experiments worldwide. Gary Steigman, one of the pioneers of the big bang nucleosynthesis calculations, authors the review entitled 'Primordial nucleosynthesis in the precision cosmology era', wherein he demonstrates the state-of-the-art of the subject and also reviews the manner in which the internal consistency of the computations is able to constrain beyond the Standard Model physics.

Among the astonishing findings in theoretical physics in the recent past, there are tools provided by string theory, the esoteric candidate for the theory of everything, including unification of gravitation with the Standard Model, for the study of the quark–gluon plasma. Dam T. Son and Andrei O. Starinets in their review entitled 'Viscosity, black holes, and quantum field theory' provide a rapid summary of these astonishing trends. In particular, it is shown that the application of the Anti-de Sitter/Conformal Field Theory correspondence to finite-temperature field theory and the resulting hydrodynamic behaviour of field theory leads to a bound on the ratio of the shear viscosity to the specific entropy. In the review entitled 'Physics of string flux compactifications' by Denef *et al.*, the state of this subject is presented. Flux compactification arises in a specific string theory known as Type IIB string theory, which has the promise of addressing several outstanding problems both in cosmology and in particle physics. Although string theory is yet to provide realistic candidates for particle physics, it remains one of the most active fields of research in theoretical physics.

In the past, the *Annual Reviews* would often carry the reminiscences of a life spent in science. In the present volume, this has been replaced by the life story of the Indiana Cooler, which spent a lifetime exploring the properties of electron cooling. A detailed description of the achievements of this venerable facility is presented. Kai Vetter has authored the review 'Recent developments in the fabrication and operation of germanium detectors'. Germanium detectors are crucial for detection of photons over several orders of magnitudes and find applications in particle and nuclear physics experiments.

Joel Heinrich and Louis Lyons have authored 'Systematic errors', which is a general article on the subject, and is accessible to any scientist. It is a valuable article in the collection.

Finally we turn to the article by Judy Jackson and Neil Calder entitled 'Quantum communication', which is not on the popular subjects such as teleportation and information of the scientific kind, but on the art of communication to a general and interested public, on what is happening in the extreme quantum world of elementary particle physics. The magazine *Symmetry* from Fermilab and SLAC in USA, is a example of such fine journalism which is discussed in detail in this article, in addition to the dynamics associated with the production of several popular accounts of particle physics.

In summary, I have reviewed a collection of fifteen articles in the present volume which captures the most central developments in the fields of nuclear and particle physics in recent times, and is a valuable addition to every library.

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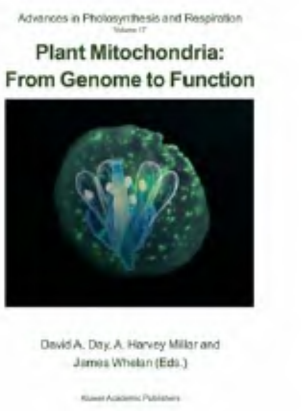

Plant Mitochondria: From Genome to Function. Advances in Photosynthesis and Respiration Series. David A. Day, Harvey Millar and James Whelan (eds). (Series Editor, Govindjee). Springer, 2005. vol. 17. 2005. 325 pp. Price: US$ 269.

Advances in Photosynthesis and Respiration is a book series that has covered, in great depth and breadth, various research topics related to photosynthesis and respiration. Its founding editor is Govindjee, University of Illinois at Urbana, Illinois; its first volume was published in 1994, and its 27th volume in 2007. Book reviews on almost all the volumes have appeared in *Current Science*, with a few