

## BOOK REVIEWS

sequences of the genome, the phenotypes associated with them and their possible role in disease causation.

The recent developments in understanding the genetic basis of human genetic diseases have resulted in medical genetics moving from bench to bedside. Four chapters in the book deal with the practical implications of the new knowledge being generated regarding the genetics of atrial fibrillation, Parkinsonism, speech and language disorders and schizophrenia. Xiao *et al.* discuss the genetic mechanisms underlying atrial fibrillation and how the integration of this genetic information into clinical practice may aid in the early identification of at-risk patients. Further, the knowledge of the molecular pathways involved may help in identifying potential therapeutic targets. Gejman *et al.* present a detailed description of the molecular genetics of schizophrenia, the role of genotyping arrays and next-generation sequencing in the elucidation of the genetic basis of the condition, the genetic variations associated with it, and its genetic overlap with other psychiatric disorders. The chapter by Kang *et al.* throws new light on the genetic basis of speech and language disorders such as aphasia, stuttering, articulation disorders, verbal dyspraxia and dyslexia, and the utility of linkage studies and the candidate gene approach in exploring the genetic mechanisms underlying such

conditions. The chapter on genetics of Parkinson disease by Martin *et al.* reviews the recent research data obtained from mouse models with mutations in genes known to be associated with Parkinson's disease, including  $\alpha$ -synuclein, LRRK2, PINK1, parkin, and DJ-1 and attempts to elucidate the molecular pathogenesis of this condition.

The most famous application of knowledge regarding genetic variation in humans has been in the field of DNA fingerprinting. The use of different markers of variation has helped in the identification of victims in mass disasters as well as aided the law enforcement agencies in the prosecution of culprits and exoneration of innocent persons. 'Genetics of innocence' has been vividly discussed in an aptly titled chapter by Hampikian *et al.* The authors provide an interesting account of the various developments in this field over the last 25 years followed by interesting case studies wherein DNA fingerprinting has helped in proving the innocence of wrongly convicted people.

Availability of the complete human genome sequence has shifted the focus of research towards understanding the regulation of expression of genes. The regulatory variation within and among different species has been discussed in four different chapters, giving a flavour of recent trends in this field. In addition, the biology of stem cells and their pluripotency also has been dealt with by Loh *et al.* in a simple yet informative style.

Cancer has been termed the 'emperor of all maladies' and the treatment avenues have been limited in spite of various advances in this field. The availability of next-generation sequencing strategies with the ability to sequence the whole genome in a few days has renewed interest in this field. Wong *et al.* provide a detailed account of various innovations in sequencing technologies, and their application in detection of germ line and somatic mutations in cancer. The ultimate aim of all genetic studies is to improve our understanding of genetic variation in humans and its relation to human diseases. Medicine is slowly moving from the 'one size fits all' concept of treatment towards 'personalized medicine', wherein the patient is treated individually based on his/her susceptibility to diseases and expected response to a particular treatment. This emerging

concept has been lucidly dealt with by Isaac *et al.* in the chapter on personalized medicine.

Overall the book is an interesting compilation of articles on human genetics and genomics. It will prove to be a useful reference for investigators and researchers in the respective fields.

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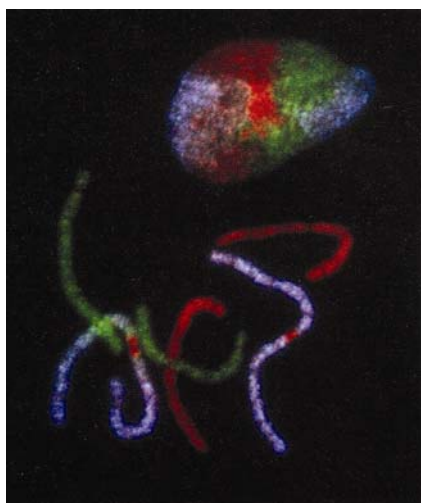
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**Annual Review of Nuclear and Particle Science, 2011.** Barry R. Holstein, Wick C. Haxton and Abolhassan Jawahery (eds), Annual Reviews, 4139, El Camino Way, P.O. Box 10139, Palo Alto, CA 94303-0139, USA. Vol. 61, vii + 532 pp. Price: US\$ 86.

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This volume is a collection of twenty useful articles at the forefront of research in particle physics and nuclear physics and cosmology, and the interactions between these fields. Interestingly, the present volume has no preface or introduction and leaves the task of capturing the essence of the collection to the reader, or indeed to the reviewer of the book.

The field of elementary particle physics is now in the era of the Large Hadron Collider (LHC), which is putting forth data collected at a 'centre of mass' energy of 7 Tevaelectronvolts (one half of its peak design energy) in the collisions of protons on protons in a 26.7 km, two-ring tunnel that runs below the Franco-Swiss border outside Geneva. The results from the experiment regale the minds and the imagination of all those who follow the trajectory of this most fascinating of fields. Lyndon Evans authors an article entitled 'The Large Hadron Collider', which is described in the abstract as '... the most complex instrument ever built for particle physics research'. In the article an introduction is provided on the fantastic challenges that have been faced in the construction of this gargantuan machine, a great triumph of modern technology science. Furthermore, a great

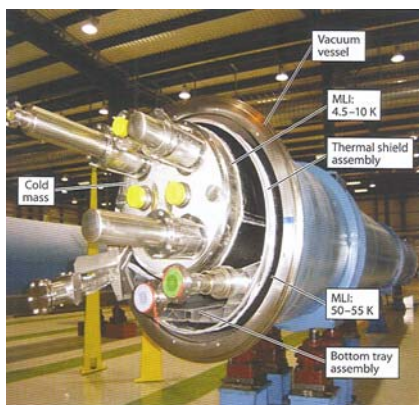


The three pairs of chromosomes of the female Indian muntjac in metaphase and interphase nuclei show the arrangement of chromosomal territories at interphase. Chromosomes 1, 2 and X+3 are shown in light blue, green and red respectively.

challenge that scientists face is that of handling the vast amounts of data that are generated by the experiment. The article ‘Computing for the Large Hadron Collider’ by Ian Bird describes in detail the Worldwide LHC Computing Grid (WLCG), and the design of the distribution system. A brief description of the outlook is also presented, especially in light of the first year of data-taking at the LHC, which the author believes has validated the model. A timely article entitled ‘Advances in tracking detectors’ by Frank Hartmann and Jochen Kaminski also appears in the volume.

The year 2011 saw the Nobel Prize for physics awarded to the discovery of dark energy and acceleration of the universe. The field itself brings together elementary particle physics and cosmology in an unprecedented manner, made possible in the ‘era of precision cosmology’ as termed in the article ‘Supernova cosmology: legacy and future’ by Ariel Goobar and Bruno Leibundgut.

In the vein that combines the micro with the macro we find two more articles in the collection, namely ‘The primordial lithium problem’ by Brian D. Fields and ‘Neutrino mass in cosmology: status and prospects’ by Yvonne Y. Y. Wong. In the former we find an illuminating review on the problem of primordial lithium abundance, left behind from the big bang (recall that nucleosynthesis and the computed rates when compared to the measured ones provide some of the most compelling pieces of evidence for the veracity of the standard big bang cosmology) lies below the computed one from big bang nucleosynthesis combined with the Wilkinson microwave anisotropy probe constraints by a factor of three to four.



LHC dipole cryomagnet assembly.

The author describes in great detail the problem and plausible solutions from astrophysics, nuclear physics or indeed physics beyond the ‘standard model’ (BSM) of elementary particle physics. A brief digression before we describe the latter contribution is in order: Recall here that the standard model (SM) is the framework within which we today understand the electromagnetic, weak and strong interactions, where the microscopic degrees of freedom are the quarks (which come in ‘flavours’ named up, down, strange, charm, b(ottom) and top) and leptons (electron and its neutrino, muon and its neutrino, the  $\tau$ -lepton and its neutrino), with forces transmitted by the (massless) photon (electromagnetic, infinite-ranged), (massive)  $W$  and  $Z$  bosons (weak, sub-nuclear ranged) and (massless) gluon (strong, confined and hence short-ranged). Indeed the  $W$  and  $Z$  bosons are assumed to have become massive due to ‘spontaneous symmetry breaking’, which would have left behind at least one Higgs boson. The laws that govern the transitions among these quarks and their admixtures described by the so-called Cabibbo–Kobayashi–Maskawa (CKM) matrix fall into the purview of SM. The picture has become richer in the first decade of this century when definitive evidence was found for masses of the neutrinos, which would then bring in such admixtures among neutrinos to name one possible consequence. Returning now to the contribution of Wong, an overview is provided of the role of neutrino masses in cosmology with emphasis on their impact on the evolution of cosmological perturbations. It is pointed out that astonishingly large-scale matter distributions provide a more sensitive probe of neutrino masses than laboratory experiments.

There are many interesting articles in the traditional ambit of the collection, viz. that of particle physics and nuclear physics, and at their interface. The properties of nucleons, sub-nuclear particles and methods of discovering them at ever-increasing precision are some of the areas that are covered in the volume. For instance, the lifetime of the neutral pion, one of the particles that produces the inter-nucleon force, is a sensitive probe of the structure of strong interactions and proceeds through a profound and subtle effect known as the ‘anomaly’. In the real world where quarks are very light, but not absolutely massless, their effects

play a role in the lifetime. The methods of measurement and present-day experiments, including those based on the well-known Primakoff effect, are described in the article ‘Neutral pion decay’ by R. Miskimen. The article on ‘Symmetry tests in nuclear beta decay’ by Nathal Severijns and Oscar Naviliat-Cuncic describes how nuclear beta decay provides a sensitive laboratory for the measurement of the unitarity constraints on the CKM matrix, and how exotic couplings reveal themselves in such experiments, and on possible violations of discrete symmetries such as parity and time reversal. In the article entitled ‘Neutrino–nucleus interactions’ by Gallagher *et al.*, the authors describe how the presence of neutrino masses that lead to their flavour oscillations has led to a new generation of neutrino experiments. Determination of the structure of protons, neutrons and the deuteron continues to capture the imagination of experimentalists, which is described in the article ‘Spin-dependent electron scattering from polarized protons and deuterons with the BLAST experiment at MIT-Bates’ by Hassell *et al.*

In the realm of low-energy elementary particle physics, where the high intensity frontier meets the rigorous demands of SM, we find two articles of interest. The first is that on ‘Rare kaon and pion decays: incisive probes for new physics beyond the standard model’ by Bryman *et al.* The current status and prospects of the field are reviewed and a specific rare decay of a kaon into a pion and a neutrino pair occupies pride of place in this study, along with tests of electron and muon universality with precision kaon and pion decays. ‘Semileptonic B meson decays’ by Vera G. Lüth describes how the decays of the B mesons into a lepton pair offer a sensitive probe of the structure of the CKM matrix, thereby providing a test of SM. In ‘Physics opportunities at the next generation of flavour physics experiments’, Marco Ciuchini and Achille Stocchi ask what would be the most important quantities to measure in the future so as to find the structure of BSM physics.

At higher energies, the elementary particle zoo opens up to the production of a large number of top quarks,  $W$  and  $Z$  bosons. Recall that before the advent of LHC, the high-energy frontier was dominated by the discoveries at the Tevatron machine at Fermilab, Illinois,

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USA. Matthew Herndon provides a useful review in 'Higgs boson searches at the Tevatron', Ann Heinson and Thomas R. Junk review the CDF and D0 experiments at Tevatron, 'Observation of single top quark production' (it may be recalled that typically top and anti-top quark pairs are produced in great abundance, while single top quarks are a very rare event). In these articles a useful discussion is provided on the prospects of such searches and measurements at LHC. Mark S. Neubauer in 'Diboson production at colliders', reviews the production of pairs of  $W$  and  $Z$  bosons at the Tevatron and at LHC. Through this process, physicists hope to uncover the mysteries of the phenomenon of symmetry breaking, and to study possible deviations from SM. John Campbell and Michelangelo Mangano review 'Associated production of  $W/Z$  gauge bosons and jets in

hadronic collisions' at the Tevatron and LHC colliders, and compare available data with theoretical predictions.

What if nature itself provided us with high-energy accelerators? Indeed, the cosmos itself behaves as one, constantly bombarding the earth's atmosphere with highly energetic particles. In 'Extensive air showers and hadronic interactions at high energy', Engel *et al.* describe the subject and comment on the interaction of air showers and particle accelerator measurements.

Where would scientists be if there was no one to tell them how to analyse their data? Pushpalatha C. Bhat in an article entitled 'Multivariate analysis methods in particle physics', arms the reader with the requisite tools to do so. What of the future? How does one get the young to join the enlightened on this voyage of discovery? In 'Particle physics outreach

to secondary education', Bardeen *et al.* describe among others the efforts of Fermilab through its QuarkNet programme

In summary, the articles by the finest and most active researchers provide a valuable source of reference and could also double up as an introduction. A rare treat indeed and a must for every library.

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