

Spin Physics*. Haiyan Gao and Bo-Qiang Ma (eds). World Scientific Co. Pte. Ltd, Toh Tuck Link, Singapore 596224. 2016. 200 pages. Price: US\$ 78.

The present collection consists of contributions from the plenary sessions (11), including the symposium summary, as well as four articles in the ‘Memorial session’ of the 21st International Symposium on Spin Physics. In addition, there is a short foreword by the editors, who are well-known experts in the field. A long section at the end provides details about the full programme of the symposium, which is one among the series of bi-annual symposia that travel around the world. The present one took place in China and the book cover depicts a picture of the Great Wall. It is a well-edited collection and pleasing to the eye, and a valuable addition to any library.

Spin is a fundamental property of elementary particles and was discovered in the early years of quantum theory and comes in half-integral multiples of Planck’s fundamental constant divided by 2π . It is well-understood for elementary particles such as electrons and its heavier counterparts, and also for force carriers such as the photon, the W and Z bosons of the electro-weak sector as well as gluons, the force carriers of the strong interactions. On the other hand, it poses a challenge for composite particles such as protons and neutrons, which are made up of elementary constituents known as u and d (valence) quarks, and which also contain the so-called ‘sea’ quarks that are pairs of u and anti-u, d and anti-d as well as strange and anti-strange quarks. When

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nucleons group themselves into nuclei, they lead to spin for nuclei as well. Carrying out controlled experiments on projectiles with well-defined spins allows scientists to probe strongly interacting matter using novel methods and allows one to understand the strong interaction dynamics within nucleons and nuclei. This is true in lower energy regimes where many facilities in the world carry out experiments. Note that the strong interactions trap quarks and gluons inside so-called hadronic matter, which comes in two types – mesons (e.g. pions and kaons) and baryons (e.g. protons and nucleons). Although the microscopic theory, which is called quantum chromodynamics, is known, its availability does not suffice to make predictions, due to the strong nature of the force. Instead one resorts to studying the properties on the computer, solving the equations of the microscopic theory numerically requiring vast resources of clockspeed and memory.

Against the above backdrop the reader encounters the first scientific article in this collection entitled ‘The spin structure of the nucleon’ by Ji and Zhao, where the authors go to the infinite momentum frame and study the relationship between two well-known devices known as sum-rules, the first known as the Jaffe–Manohar sum rule, and the second known as the Ji sum rule. The main issue is to separate out the orbital part from the helicity intrinsic to the constituents, and the authors offer some ingredients to carry out this separation.

The weak interactions which are transmitted by the W and Z bosons, leading to radioactive decay, are known to be parity violating, in that they do not respect mirror reflection symmetry. Probing this in purely hadronic reaction is an enormous theoretical as well as experimental challenge. Snow *et al.* in the article entitled ‘Status of theory and experiment in hadronic parity violation’ review present plans and future prospects of this important field. Many experiments in the last five decades have taken place by colliding particles in ‘storage rings’. In ‘Physics with polarized targets in storage ring’, Dmitriy reviews the experiments in nuclear physics as well as in electron/positron and proton/deuteron beams, and discusses the use of polarized gas targets for polarimetry.

The issue of proton spin is something that never goes away. It remains a sensi-

tive probe of how one reaches hadronic matter starting with quarks and gluons. Solving the issue on the computer is reviewed in the article ‘Quark and glue components of the proton spin from lattice calculation’ by Liu for the chi-QCD collaboration.

A fixed target experiment at the world-famous laboratory CERN, known as Common Muon and Proton Apparatus for Structure and Spectroscopy (COMPASS), collides muon and hadron beams of both charges on nuclear targets. At the time the article ‘Latest results from the COMPASS Experiment’ by Stolarski was submitted, phase-II where a measurement of transverse momentum-dependent parton distribution functions as well as its generalized parton distribution functions was taking place. In phase-I longitudinal and transverse spin asymmetries were measured and they are presented in this contribution. A single-page notification of the ‘Summary, report for PSTP2013’ of the polarized source targets and polarimeters held in 2013 giving the URL for conference contributions is also included.

An interesting paper on ‘Three dimensional imaging of the nucleon – TMD (theory and phenomenology)’ by Liang, giving the so-called transverse momentum distribution compares a theoretical framework for so-called inclusive deep inelastic scattering and one-dimensional imaging. A semi-inclusive framework would allow one to go beyond and the author reviews the status of the field in this contribution.

Japan continues to be a power-house for physics research. An ambitious project is the construction of the Japan Proton Accelerator Research Complex (J-PARC) at Tokai. In ‘Spin Physics at J-PARC’, Kumano discusses the physics prospects at this upcoming facility and lists their future improvements of key strong interaction dynamics observables, including the anomalous magnetic moment of the muons, generalized parton distributions, and prospects for resolving nucleon spin.

More speculative but definitely interesting issues have been discussed by Ni in ‘Searches for the role of spin and polarization in gravity: a five-year update’, the background to which dates as far back as 1925, the year of the discovery of electron spin, and whether spin plays any role at all in the general theory of relativity. Interesting constraints are listed.

On the other hand, in the future, if a high-energy collider is built, it would collide electrons with positrons, polarizing the beams so that they have preferential spin orientation in the direction of motion leading to longitudinally polarized beams, or in a chosen direction in a plane perpendicular to the direction of motion, leading to transversely polarized beams. The availability of such polarized beams as the proposed International Linear Collider (ILC) would enhance the resolving power of the machine in collisions to departures from the predictions of the so-called Standard Model of electro-weak interactions, and also improve the potential to carry out precision measurements. Vauth and List review the subject and its technical aspects, including creation as well as measurement of polarization in the article entitled 'Beam polarization at the ILC: physics case and realization'. A 'Symposium Summary' by Milner also presents an enriching historical perspective.

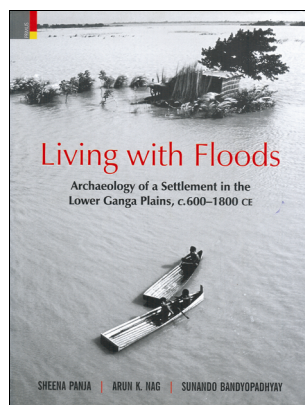
A tribute to a pioneer in the field, Michel Borghini, who passed away unexpectedly in 2012 from the *CERN Courier* is included in the collection. Akira Msaiki in the Memorial Section recalls the early years of spin physics – in memory of Michel Borghini, while Werner Meyer wishes to go forward in 'Today's polarized solid targets in Borghini's footsteps', where he points out the importance of solid diamagnetic materials, while an acolyte Wim de Boer recalls Borghini's contributions in 'Michel Borghini as a mentor and father of the theory of polarization in polarized targets'. He also points out how Borghini's spin temperature theory is now applied in cancer therapy, where polarized protons are able to help detect small tumours.

In conclusion, this collection provides a state-of-the-art companion to those who work in the theory and experimental aspects of spin physics. The editors must be congratulated on their effort and the book would be an excellent addition to any collection in high-energy physics.

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Living with Floods: Archaeology of a Settlement in the Lower Ganga Plains, c. 600–1800 CE. Sheena Panja, Arun K. Nag and Sunando Bandyopadhyay. Primus Books. An Imprint of Ratna Sagar P. Ltd, Virat Bhavan, Mukherjee Nagar, Commercial Complex, Delhi 110 009, 2015. xvi + 292 pages. Price: Rs 1900.

Settlements on river banks are subject to seasonal floods that are recurrent during the peak of monsoon over the Indian subcontinent. Though the intensity of monsoon floods varies from region to region, some areas are prone to intense annual floods. The Ganga–Brahmaputra (G–B) Basin is known for such catastrophic events which are triggered by the monsoon system over the subcontinent, particularly during the southwest monsoon season. Flood science, an interdisciplinary endeavour, helps understand the causes of flood hazards and facilitates disaster management strategies. Major flood studies in India have been carried out on large peninsular rivers, lake deposits and the mighty river systems of northern India, including the Ganga and Brahmaputra. Flood studies in the deltaic region are hardly known to have taken place. History of floods is inseparable from the history of the land in general and the settlement history in particular. It has been observed that floods in the lower reaches of the Ganga and Brahmaputra have not increased over the last few decades¹. Flood studies in a dynamic delta generated by two mighty rivers are of great relevance to us, like the Bengal Fan to earth scientists. In view of the global warming threat, there is increasing concern among Quaternary scientists that the magnitude and frequency of abrupt events, for example, calamitous floods, are likely to increase and the region prone to such calamities is

likely to experience higher intensity of floods and consequent damage to the life of people and their settlements. Adequate disaster management strategies need to be in place.

During the last couple of decades, flood science in India has developed models for interpreting natural indicators of floods. Palaeoflood records have been identified in rivers, lakes and archaeological contexts. In archaeological studies, the latter occupy priority to be able to reconstruct past human response to natural calamities such as floods and the coping strategies in the past. Floods are hazardous to the stability of the settlements, but they are also harbingers of productivity and prosperity provided the inhabitants know how to live with floods. Flood records have been used to interpret the magnitude and scale of the event, the recurrence of tropical storms and intensity of monsoonal precipitation. Palaeoflood studies have generally been focused on slackwater deposits and palaeostage indicators. On the other hand, multidisciplinary studies on river-bank archaeological settlements have revealed records of human response to flood hazards and signatures of palaeofloods. Therefore, flood science needs to organize its programme for maximum societal benefit and society wants a prediction of its future. Flood scientists in India have recognized that Indian flood records provide ample scope for naturalistic/interpretive flood studies².

This prompted me to review *Living with Floods* from the perspective of palaeoflood studies as well as to understand the potential of deltaic archaeological sites to reconstruct human response to floods in the Ganga–Brahmaputra delta, the largest anywhere in the world. Current flood studies have been restricted to the northern sectors of the G–B Basin. Unfortunately, earth scientists have paid little attention to the palaeohydrology of this region. Flood hazards in this region are recurrent and catastrophic affecting the life of its inhabitants; yet the region is most populous. During the Late Holocene, population density had increased steadily, accompanied by higher density of settlements. How these settlers have adapted to the calamity-ridden landscape is of concern to us. Presumably, the book addresses this issue.

This book is authored by three scholars comprising two archaeologists and one