

BOOKSHELF

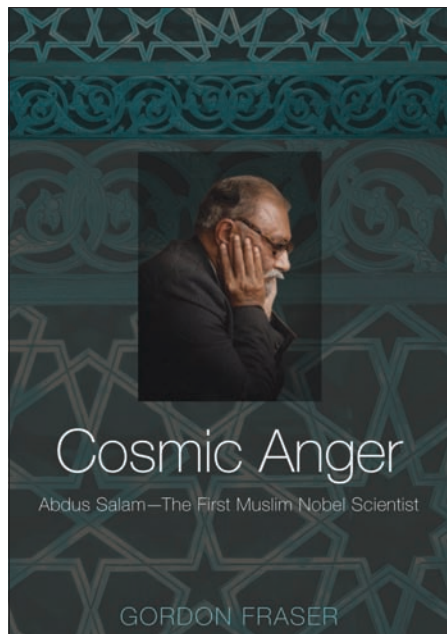
Cosmic Anger: Abdus Salam – The First Muslim Nobel Scientist by Gordon Fraser. Oxford University Press. Hardback ISBN 9780199208463 £25 (\$49.95).

The late Abdus Salam – the only Nobel scientist from Pakistan – came from a small place in the Punjab called Jhang. The town is also famous for “Heer-Ranjha”, a legendary love story of the Romeo-and-Juliet style that has a special romantic appeal in the countryside around the town. Salam turned out to be another “Ranjha” from Jhang, whose first love happened to be theoretical physics. *Cosmic Anger*, Salam’s biography by Gordon Fraser, is a new, refreshing look at the life of this scientific genius from Pakistan.

I have read several articles and books about Salam and also met him several times, but I still found Fraser’s account instructive. What I find intriguing and interesting about *Cosmic Anger* is first the title, and second that each chapter of the book gives sufficient background and historical settings of the events that took place in the life of Salam. In this regard the first three chapters are especially interesting, in particular the third, where the author talks about Messiahs, Mahdis and Ahmadis. This shows in a definitive way the in-depth knowledge that Fraser has about Islam and the region where Salam was born.

In chapter 10, Fraser discusses the special relationship between Salam and the former President of Pakistan, Ayub Khan. I feel that more emphasis was required about the fact that for 16 years, from 1958 to 1974, Salam had the greatest influence on the scientific policies of Pakistan. On 4 August 1959, while inaugurating the Atomic Energy Commission, President Ayub said: “In the end, I must say how happy I am to see Prof. Abdus Salam in our midst. His attainments in the field of science at such a young age are a source of pride and inspiration for us and I am sure that his association with the commission will help to impart weight and prestige to the recommendations.” Salam was involved in setting up the Atomic Energy Commission and other institutes such as the Pakistan Institute of Nuclear Science and Technology and the Space and Upper Atmosphere Research Commission in Pakistan.

Finally, I find the book to be a well written account of the achievements of a genius who was a citizen of the world, destined to play a memorable role in the global development of



science and technology. At the same time, in many ways Salam was very much a Pakistani. In the face of numerous provocations and frustrations, he insisted on keeping his nationality. He loved the Pakistani culture, its language, its customs, its cuisine and its soil where he was born and is buried. *Hafeez Hoorani, National Centre for Physics, Quaid-E-Azam University.*

Gravitational Waves Vol 1: Theory and Experiments by Michele Maggiore, Oxford University Press. Hardback ISBN 9780198570745 £45 (\$90).

This is a complete book for a field of physics that has just reached maturity. Gravitational wave (GW) physics recently arrived at a special stage of development. On the theory side, most of the generation mechanisms have been understood and some technical controversies have been settled. On the experimental side, several large interferometers are now operating around the world, with sensitivities that could allow the first detection of GWs, even if with a relatively low probability. The GW community is also starting vigorous upgrade programmes to bring the detection probability to certitude in less than a decade from now.

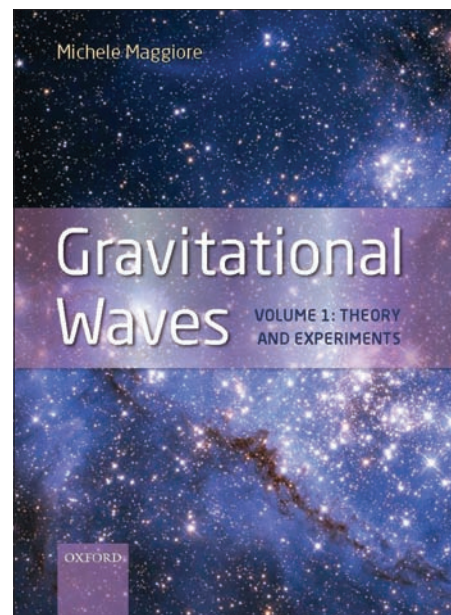
The need for a textbook that treats the production and detection of GWs systematically is clear. Michele Maggiore has succeeded in doing this in a way that is fruitful not only for the young physicist starting to

work in the field, but also for the experienced scientist needing a reference book for everyday work.

In the first part, on theory, he uses two complementary approaches: geometrical and field-theoretical. The text fully develops and compares both, which is of great help for a deep understanding of the nature of GWs. The author also derives all equations completely, leaving just the really straightforward algebra for the reader. A basic knowledge of general relativity and field theory is the only prerequisite.

Maggiore explains thoroughly the generation of gravitational radiation by the most important astrophysical sources, including the emitted power and its frequency distribution. One full chapter is dedicated to the Hulse-Taylor binary pulsar, which constituted the first evidence for GW emission. The “tricky” subject of post-Newtonian sources is also clearly introduced and developed. Exercises that are completely worked out conclude most of these theory chapters, enhancing the pedagogical character of the book.

The second part is dedicated to experiments and starts by setting up a background of data-analysis techniques, including noise spectral density, matched filtering, probability and statistics, all of which are applied to pulse and periodic sources and to stochastic backgrounds. Maggiore treats resonant mass detectors first, because they were the first detectors chronologically



to have the capability of detecting signals, even if only strong ones originating in the neighbourhood of our galaxy. The study of resonant bar detectors is instructive and deals with issues that are also very relevant to understanding interferometers. The text clearly explains fundamental physics issues, such as approaching the quantum limits and quantum non-demolition measurements.

The last chapter is devoted to a complete and detailed study of the large interferometers – the detectors of the current generation – which should soon make the first detection of GWs. It discusses many details of these complex devices, including their coupling to gravitational waves, and it makes a careful analysis of all of the noise sources.

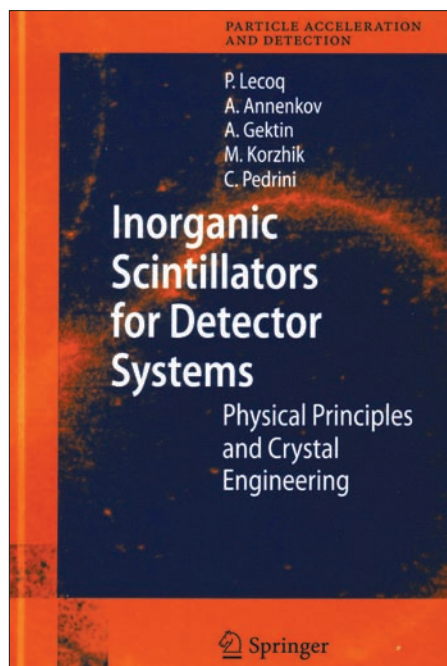
Lastly, it is important to remark on a little word that appears on the cover: “Volume 1”. As the author explains in the preface, he is already working on the second volume. This will appear in a few years and will be dedicated to astrophysical and cosmological sources of GWs. The level of this first book allows us to expect an interesting description of all “we can learn about nature in astrophysics and cosmology, using these tools”.
Carlo Bradaschia, INFN/Pisa.

Inorganic Scintillators for Detector Systems by P Lecoq *et al.*, Springer.

Hardcover ISBN 9783540277668, £79 (€105.45).

This book covers a highly topical area of modern detector physics – scintillators. Initially developed as a tool for scientific exploration, scintillation detectors rapidly migrated into applications in our day-to-day lives, such as in energy production, security applications and the medical sector. The development of high-quality scintillators is an example of how demanding technological requirements in high-energy physics drive development and optimization processes that eventually benefit the general public. In this book the authors tell the story of two decades of major progress, largely motivated by building the largest electromagnetic calorimeter in high-energy physics with lead tungstate (PbWO_4), and by the development of a scintillator, lutetium aluminium perovskite (LuAP), for medical applications.

The introductory chapter deals with the terminology, key aspects and basics of the scintillation process, and it finishes by giving a table based on a combined



classification of scintillators. This is most informative for the end-users of scintillators, but caution must be exercised as some of the information is out of date. For example, a rather optimistic light yield for zinc tungstate (ZnWO_4) of 21 500 photons/MeV is given (taken from a reference from 1962), whereas around 9300 photons/MeV would be more appropriate. There are also some typos. For example, the scintillation time-constant of calcium tungstate (CaWO_4) is given as “600 ns”, whereas it should read 6000 ns.

The next chapter discusses how scintillator development is influenced and guided by user requirements. The authors review five main areas of scintillator applications and set the scene for dealing with the often conflicting demands on scintillator characteristics. Then follows a substantial chapter that discusses the scintillation mechanisms of inorganic scintillators in great detail. The text is well written so that newcomers to the field and experts alike will enjoy it.

Producers of scintillating crystals are the main target audience for the next two chapters, which deal with the influence of crystal structure defects on the scintillation process and on crystal engineering. They give valuable information about crystal production, for PbWO_4 in particular, as well as useful recipes and ideas for solutions to various issues. Such information is often absent, or at best summarized, in short

publications. A description of strategies that are common to developing scintillators for high-energy physics and for medical applications forms the final chapter.

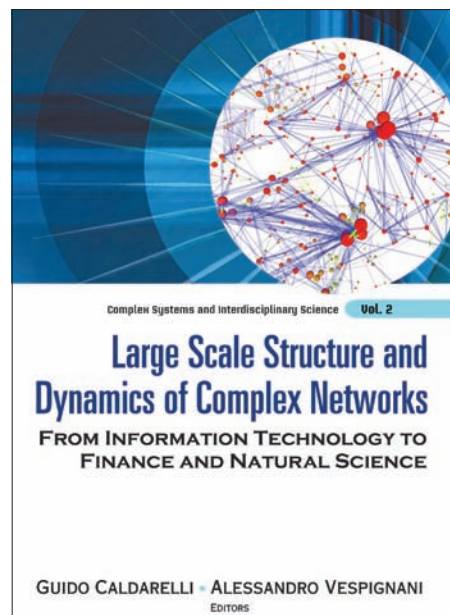
Overall, the book is interesting and informative for the user – novice and expert – with sections at the right level for each.
Hans Kraus, Oxford University.

Large Scale Structure and Dynamics of Complex Networks: from Information Technology to Finance and Natural Science

edited by Guido Caldarelli and Alessandro Vespignani, World Scientific. Hardback ISBN 9789812706645 £49 (\$98).

Networks are everywhere, in social institutions as well as in economic, biological and technological systems. They are not a new phenomenon, but our understanding has not kept up with their influence and our increasing dependence on them. The complexity of networks has now become a central issue in characterizing, modelling and understanding them in many different disciplines, from physics, biology and mathematics to engineering and computer science. It is therefore important to seek the development of a methodological and theoretical framework, in order to define the general principles underlying the dynamics and structures of complex networks.

Researchers are now discovering the general concepts and properties of highly diversified networks, from living cells to electric power grids, and, thanks to progress



in information technologies, it is possible to analyse the large-scale statistical properties of networks. It is also evident that many complex evolving networks share a sophisticated topology. Intrinsic properties of complex systems, such as robustness to disturbances or information transmission time, are a direct consequence of this underlying network topology, which, in some cases, could be explicitly engineered.

The authors of this volume intend to show both a snapshot of forefront research activities in the field of complex systems and the achievements of the European project on Coevolution and self-organization in dynamical networks (COSIN; see www.cosinproject.org). The wide interdisciplinary approach is emphasized by the various chapters, which start with an introduction to the basic notation and definitions, based on graph theory, followed by an overview of the main classes of models: static random networks and evolving random networks.

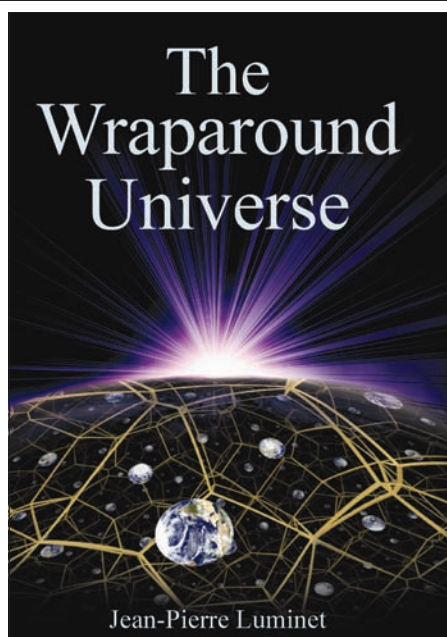
Chapters three to six deal mainly with various aspects of complex networks, from the topological properties that may impact a variety of related topics, to the state of the art in network visualization – a challenging issue. The remaining four chapters focus on more specific fields. “Modeling the webgraph: how far we are” considers the graph induced by the hyperlink structure of the web, the nodes of which are the HTML pages with the edges being the links among them. “The large scale structure of the Internet” reviews the results obtained in the characterization of this large-scale complex network. Chapter nine looks at two of the most commonly used characterizations of a community of biological species: the food web and the taxonomic tree. The final chapter reviews some of the main general findings about social networks and then focuses on a specific case of an economical network: the boards of directors of large corporations.

The book also includes a detailed list of references, spanning a wide spectrum of disciplines, which underline the importance of the interdisciplinary approach in this field.

Gian Piero Siroli, University of Bologna and CERN.

The Wraparound Universe by Jean-Pierre Luminet, A K Peters. Hardback ISBN 9781568813097 \$39.

The first thing that impressed me about



this book by Jean-Pierre Luminet is the way that the text is organized. Although the author seems to suggest that the reader uses the references as a way to jump between different chapters – rather like hyperlinks on the web – what I really appreciated is that the book has 45 short chapters, each just a few pages long. This allows the reader to taste and digest it bit by bit, following their own rhythm.

Luminet has done his best to explain everything in a simple but never simplistic way, so it may take different people a different amount of time, and this structure makes it easier to adapt to each reader's needs. This could be one of the reasons why the book has had two editions in the original French as well as this English translation, and will probably be translated into other languages.

If you know a little of modern cosmology, you will read this book avidly from the first page to the last. I should admit that I felt ignorant at the beginning because I had never realized the importance of topology when discussing cosmic evolution (the fact that apparently I was not alone is not a good excuse). Consequently I'm grateful to Luminet for having made the role of topology in modern cosmology clear.

For example, I learned that the finite or infinite character of space depends both on its curvature and on its topology, though the latter is often neglected, even in refereed papers published by important journals. In addition, I realized that Einstein's

equations do not set constraints *a priori* on the universe's topology. Rather, they can be solved for different boundary conditions, which include the specification of the three-dimensional space topology.

Space may have positive, null or negative curvature – a property of the “metric” that encodes the machinery to measure distances. We say that the geometry is spherical, Euclidean or hyperbolic in these three cases. The metric is the subject of Einstein's equations, which express it as a function of the total energy content of the universe through the energy-momentum tensor and the cosmological constant. On the other hand, the equations do not constrain the topology of the universe at all.

The simplest topology is “simply connected” (i.e. we can shrink all closed loops down to points without “exiting” from the space), and this is often implicitly assumed in books and articles about cosmology. However, “multiply connected” topologies are also possible (with any curvature), and if their “volume” is smaller than the visible universe, they may leave distinct signatures on the cosmic microwave background radiation, which could be experimentally detectable.

In general, a multiply connected universe would produce several images of each galaxy, and different topologies would produce different patterns, although searching for them is not an easy task. Luminet shows that the most recent data about the cosmic background radiation from the Wilkinson Microwave Anisotropy Probe are fitted better by “well-proportioned spaces”, among which the best seems to be the “spherical dodecahedral Poincaré space”, the volume of which is a 120th of the hypersphere (i.e. the simply connected topology) with the same curvature. This conclusion has been criticized by many researchers, but cannot be falsified with the present data. However, the Planck satellite should be able to provide measurements precise enough to discard this possibility if wrong and, possibly, identify the topology of our universe.

Luminet also considers the sociology of science. Comments about the impact of different ideas or even about the same ideas in different historical and geographical conditions are scattered throughout, but especially occur at the end. In conclusion, the book is well within the reach of the general public but still offers valuable insights to more

expert people. It raises a number of questions and tries to provide a few answers in one of the most fascinating subjects of modern research.

Diego Casadei, New York University and CERN.

The Formation of the Solar System:

Theories Old and New by Michael Woolfson, Imperial College Press. Hardback ISBN 9781860948244, £49 (\$95).

Starting from ancient times, this book looks at various ideas about the solar system, and details how theories about planet formation evolved over time. The author spells out the constraints that each theory had to fit (and which observations were less crucial), along with the problems and benefits of each model. With observations continually improving, some theories were discarded, others were refined and revisited decades or centuries later, and new ones also emerged. The past 100 to 200 years especially have seen much more detailed observations and new insights into what bodies are to be found in our solar system and the different features that they exhibit.

The author looks in particular at the solar nebula theory, which has been developed extensively during the past decades and now offers mechanisms for many aspects of planet formation. However there are still theoretical difficulties and some new observations that

do not fit with this model. The author has therefore developed a different model, the capture theory, which he first proposed in 1962 and has since developed. Although this model describes the detailed structure of the solar system and its formation, the author does not claim to have found the final answer, only a plausible one.

The book is written for a lay audience: the author avoids formulas – only in the second half are there a few – and uses simple illustrations and two-dimensional models to explain the concepts that he is describing. He also tries to connect to the reader's everyday experience. For example, he realises that zodiacal light cannot usually be seen in cities because of light pollution, and that the term “isotopes” usually appears in articles about nuclear reactors rather than astronomy. I also very much appreciated that he tried to put a face to the different theories by having many portraits of astronomers.

All in all, the book gives a good overview for both specialist and non-specialist readers. The non-specialists will need to invest some effort towards the end, where the author describes the current dominating theories in detail; and for those who want to go deeper into the field there are extensive references for each chapter.

Hannelore Hämmerle, MPG Munich.

Books received

The Light Fantastic: A Modern Introduction

to Classical and Quantum Optics by Ian R Kenyon, Oxford University Press. Hardback ISBN 9780198566458 £59.95 (\$120). Paperback ISBN 9780198566465, £29.95 (\$60).

This book presents a thorough and self-contained introduction to modern optics, covering in full the three components of ray optics, wave optics and quantum optics. Digital cameras, LCD screens, aircraft laser gyroscopes and the optical-fibre-based Internet illustrate the penetration of optics into 21st-century life. These and many more modern applications are presented from first principles. The self-contained material allows the reader to select specific themes, which are grouped in the following way: paraxial ray optics with matrix methods and aberrations; interference, coherence and interferometers; diffraction, spectrometers and Gaussian beams; fourier optics, holography and information processing; Maxwell's theory;

scattering, absorption and dispersion in bulk materials; and interface behaviour, etc.

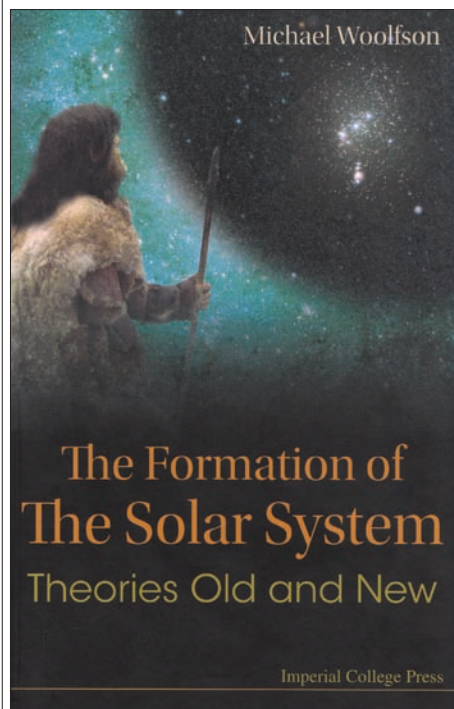
Simple Models of Magnetism by Ralph Skomski, Oxford University Press. Hardback ISBN 9780198570752, £39.95 (\$80).

For hundreds of years, models of magnetism have been pivotal in the understanding and advancement of science and technology, from the interpretation of the Earth as a magnetic dipole to quantum mechanics, statistical physics and modern nanotechnology. This book is the first to envision the field of magnetism in its entirety. It complements a rich literature on specific models of magnetism and provides an introduction to simple models, including some simple limits of complicated models. Written in an easily accessible style, with a limited amount of mathematics, it covers a range of quantum-mechanical, finite-temperature, micromagnetic and dynamical models and deals not only with basic magnetic quantities but also with modern areas, such as nanomagnetism and spintronics, and with “exotic” themes, as exemplified by the polymer analogy of magnetic phase transitions.

Introduction to Quantum Effects in Gravity

by Viatcheslav Mukhanov and Sergei Winitzki, Cambridge University Press. Hardback ISBN 9780521868341 £45 (\$85).

This is the first introductory textbook on quantum field theory in gravitational backgrounds intended for undergraduate and newly graduated students in the fields of theoretical astrophysics, cosmology, particle physics and string theory. It covers the basic (but essential) material of the quantization of fields in an expanding universe and quantum fluctuations in inflationary space-time. It also contains a detailed explanation of the Casimir, Unruh and Hawking effects, and introduces the method of effective action used for calculating the back-reaction of quantum systems on a classical external gravitational field. The broad scope of the material covered will provide the reader with a thorough perspective on the subject, every major result being derived from first principles and thoroughly explained. The book is self-contained, assuming only a basic knowledge of general relativity, and it provides exercises with detailed solutions throughout.



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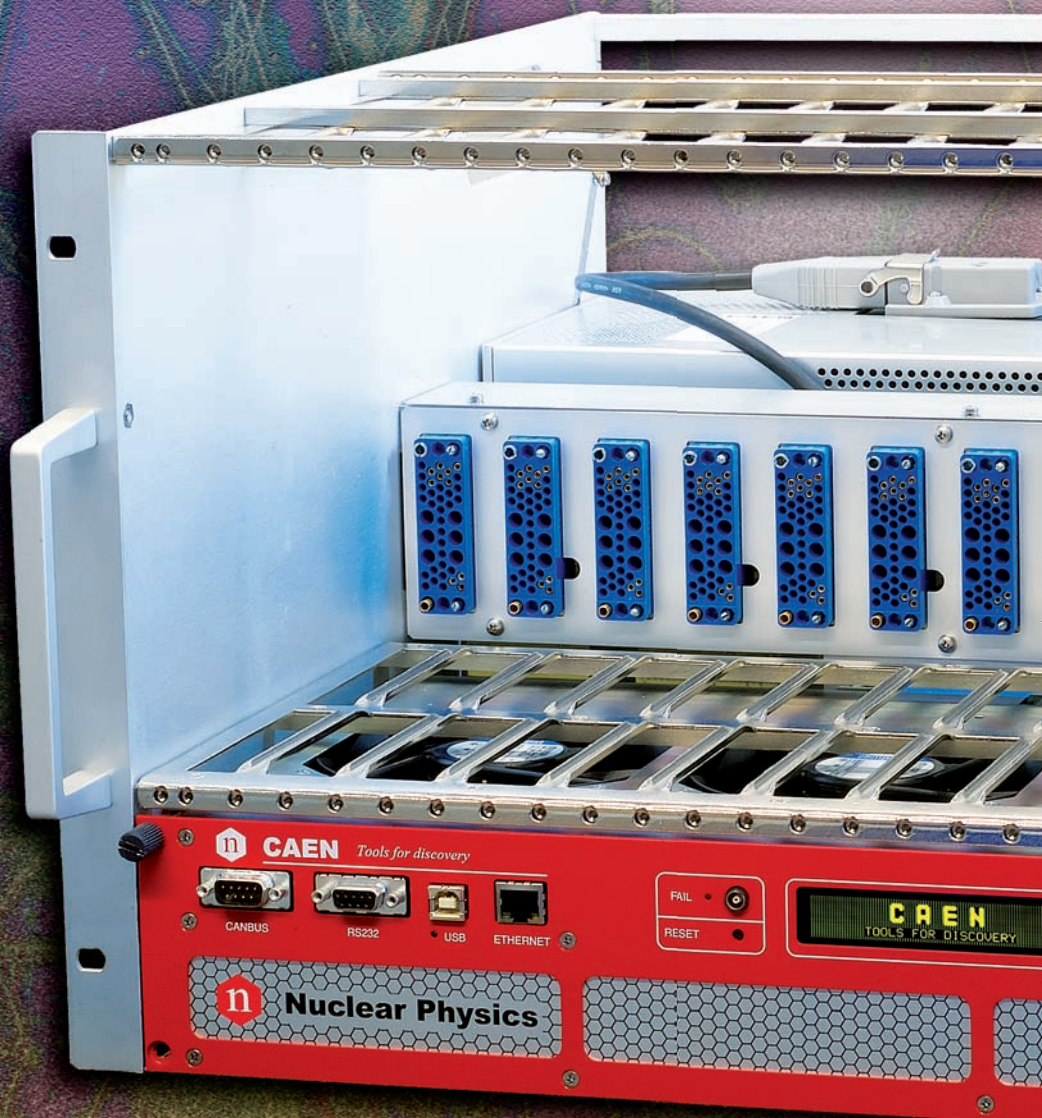
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