

BOOKSHELF

Warped Passages: Unravelling the Universe's Hidden Dimensions

by Lisa Randall, Allen Lane, Penguin Books. Hardback ISBN 0713996994, £25. (In the US, HarperCollins, ISBN 0060531088, \$27.95.)

They say you should never judge a book by its cover, which is advice worth considering if you're thinking of buying Lisa Randall's *Warped Passages*. The violent pink with the title scrawled graffiti-like across it (in the Penguin edition) makes the book jump off the shelf, screaming "I'm no ordinary popular-science book." Don't be put off. Randall does break the mould, but not by filling the book with graffiti. She delivers a bold journey from the origins of 20th-century science to the frontiers of today's theoretical physics. It's bold because, despite her protestations that the book is about physics and not personalities, it turns out to be a very personal journey in the company of one of the field's most cited practitioners.

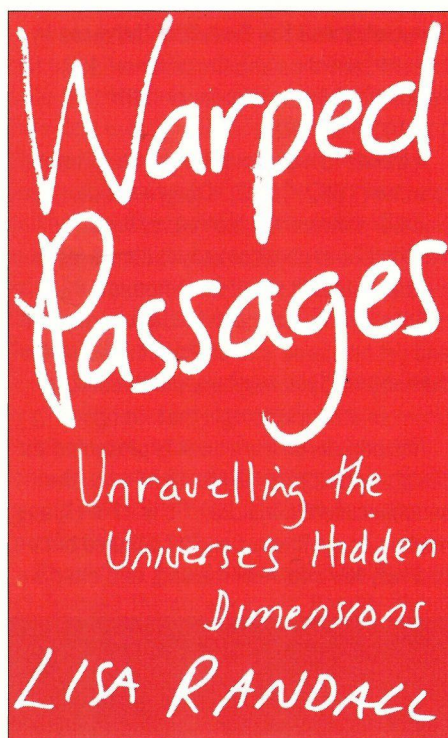
This is most true at the beginning, where Randall tells us a little about who she is and why she has devoted her life's work to the science of extra dimensions. She begins with the words: "When I was a young girl, I loved the play and intellectual games in math problems or in books like *Alice in Wonderland*." Thereafter, she affords us a glimpse of who she is through her choice of musical snippets at the beginning of each chapter, and the Alice-inspired story of Ike, Athena and Dieter, which unfolds throughout the book, one episode per chapter. The result is that the reader gets not only a competent review of a difficult subject, but also a feeling for what drives someone at the cutting edge of science.

I have to confess that I read the story of Ike, Athena and Dieter from cover to cover before embarking on the book proper, and having done so would recommend that course of action. Should physics cease to be a fruitful career, Randall could perhaps turn her hand to fiction. Coupled with the What to Remember and What's New sections at the end of each chapter, the story gives a pretty good overview of what the book is about.

The personality that emerges as the book progresses is not the kind of physicist who would be lost for words at a party if asked what she does. As well as being, according to her publisher, the world's most influential physicist thanks to the citations-index-

Christmas Bookshelf

The World Year of Physics has seen many events take place around the globe, in particular honouring Albert Einstein and his *annus mirabilis* of 1905. This issue, *Bookshelf* looks to Einstein's legacy and to modern ideas about the physics of our universe – and others. Here, physicists who communicate to the wider public give their opinions about books aimed at non-specialist readers, which in this festive season might make suitable presents for family or friends.



topping paper she published with Raman Sundrum in 1999, Randall is also a woman with a life. She has broad interests, she is cultured and she climbs mountains in her spare time. In short, she's the sort of role model science needs.

Clearly conscious of the "no equations" school of science communication, she tries early on to put the reader at ease by promising that the descriptions will never be too complicated. Inevitably she cannot hold this promise throughout, and there are places where even the most dedicated amateur scientists will be baffled, but that is more the nature of the subject than the author. If Niels Bohr thought that quantum mechanics was

profoundly shocking, what would he have made of hidden dimensions? In places, Randall goes so far to try to make things easy that the tone verges on the patronizing, and in others, she hides difficult stuff in a "math notes" section at the end of the book. On balance, however, she has done a good job of making a difficult subject accessible.

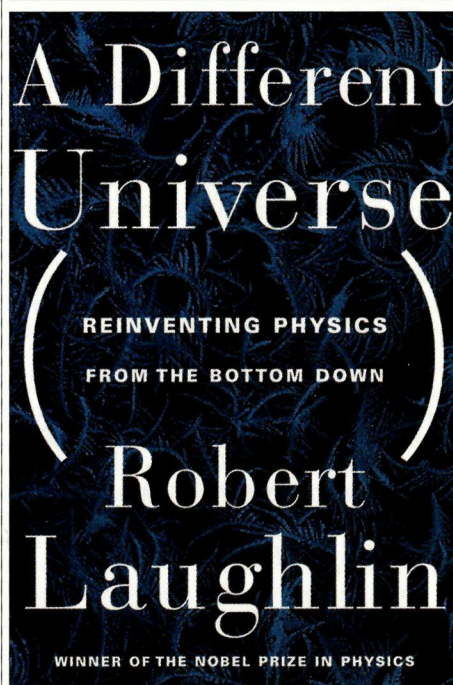
Bohr is on record as saying to a young physicist, "We are all agreed that your theory is crazy. The question which divides us is whether it is crazy enough to have a chance of being correct." Could the same be true of extra dimensions? If you do not already have an opinion, this book will certainly help you to make up your mind. Don't let the cover, or the publisher's hype, put you off.

James Gillies, CERN.

A Different Universe: Reinventing Physics from the Bottom Down by Robert Laughlin, Basic Books. Hardback ISBN 046503828X, \$26 (£15.50).

Despite the fact that the author has a Nobel Prize in Physics, this is rather an easy book to read. While not as funny as Richard Feynman's jokes, and fortunately not as exquisitely informal (this is an understatement) as João Magueijo's *Faster than the Speed of Light*, it is quite nicely written, good humoured and even sprinkled with poetic eloquence. I actually enjoyed reading the innumerable biographical anecdotes (at least the first 50 or so), even though most seemed rather irrelevant for the purpose of the book, which could easily be half as thick without any loss in real content.

Let me do justice to the book by wandering myself. We often hear at CERN that particle physics deals with the most fundamental level, the "ultimate theory", from which everything else should, in principle even if not in practice, be derivable. But systems above certain levels of complexity exhibit "emergent" laws that cannot be derived through such a "bottom-up" approach. It is particularly interesting to note that superconductivity cannot be derived from fundamental principles, especially when we see how crucially dependent we are on superconductivity to perform our "fundamental" studies at CERN. A little modesty would not harm some particle physicists. We can't always learn how a toy works by breaking it to pieces; sometimes all we learn is that the broken



toy doesn't work any longer.

This is the central point of Laughlin's thought-provoking book: there's a different universe out there, which we can easily see if we care to look, and where certain things are more than the sum of their parts.

This is surely not a new idea. "More is different" claimed Philip Anderson 33 years ago, at a time when Jacques Monod argued that the higher levels of reality are not necessarily determined by the lower levels.

What I enjoyed most in Laughlin's "different" book were the descriptions of several eye-opening experimental observations – such as the von Klitzing and Josephson effects – which intrinsically depend on collective behaviour (the effects disappear in very small samples) but provide today's most accurate measurements of the fundamental constants e and h .

Unfortunately these fascinating issues are not really described in much detail, while too many pages, especially at the end of the book, are devoted to less relevant topics, seemingly motivated by polemic fights with "hard-boiled reductionists" who are accused of believing that nothing fundamental is left undiscovered. However, don't miss chapter 15, which is about a "cast of characters" trying to define what "emergence" means; this is particularly hilarious if you have read Arthur Koestler's *The Call-Girls* (1972).

Laughlin's book is definitely worth reading,

although I was disappointed; there is a lot of talking but in the end not much physics really gets reinvented. It is a pity that Laughlin spends much of his energy fighting reductionism rather than detailing his own new ideas. And a little modesty would also not harm his arguments. Emergence and reductionism are equally important in our quest for understanding the (single) universe around us – as Freud said, on psychology and biology, "Some day the two will meet." If you are interested in these topics, read Koestler's *The Ghost in the Machine* (1967) and Stuart Kauffman's *At Home in the Universe* (1995). Carlos Lourenço, CERN.

Symmetry and the Beautiful Universe by Leon M Lederman and Christopher T Hill, Prometheus Books. Hardback ISBN 1591022428, \$29.

A tribute to mathematical genius Emmy Noether (1882–1935) is long overdue. Noether's theorem, which neatly linked symmetries in physical laws to constants of nature, heralded the most important conceptual breakthrough of modern physics and yet her name is rarely found in books on the subject. *Symmetry and the Beautiful Universe* attempts to right that wrong.

This popular-science book is presented as being accessible to "lay readers" and "the serious student of nature". So is it? Well, any treatise on symmetry begs for pictures but we find very few until near the end, and often we

get the proverbial thousand words instead. Also there are more mathematical equations than appear at first sight, as some are embedded in the text. So, I suspect that the going would be easier for the serious student than for lay readers.

The range of topics and styles is humongous, from cartoon character Professor Peabody with angular momentum worthy of a dervish (smoking a pipe), to Feynman diagrams for first-order quantum corrections in electron–electron scattering. The short biography of Noether is good and her theorem is well praised, although the chapter devoted to explaining it is rather long-winded.

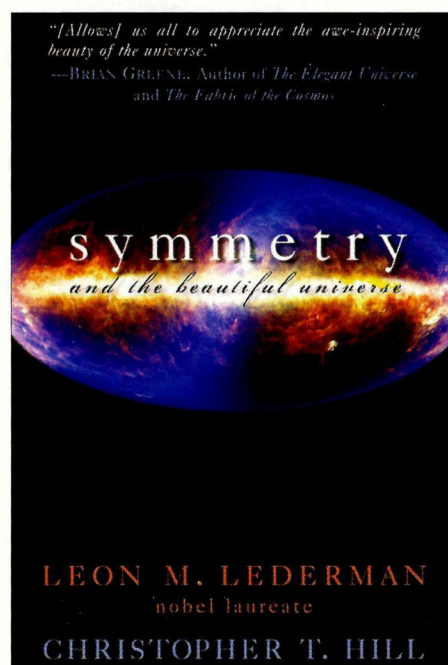
More than once the reader is first given an esoteric example of some process or other and only later a more familiar example; momentum conservation starts with radioactive neutron decay and goes on to colliding billiard balls. Then there are "gedanken" experiments. These are familiar devices to scientists but will a lay reader believe that space is isotropic because a hypothetical experiment is said to show that it is? And sometimes the book is mystifyingly US-centric. What are EPA rules? And why is Kansas special?

However, the undeniable enthusiasm of the authors for their subject, indeed for almost any subject, shines brightly throughout. Even leaving aside the 60 or so pages of notes and appendix, the book brims over with facts, figures and fun fictions, often straying far from the subject of symmetry. I estimate that a smart cut-and-paste editor could produce three good books out of the material on offer, each at a quite different level. Find your own.

Reviewing a book that has one Nobel laureate as an author and two among the constellation of stars glowingly quoted on the dust jacket is a daunting task. I was once told that "astounding" conveys an acceptable amalgam of the polite and the honest when one is overwhelmed. This book is astounding. Peggie Rimmer, CERN.

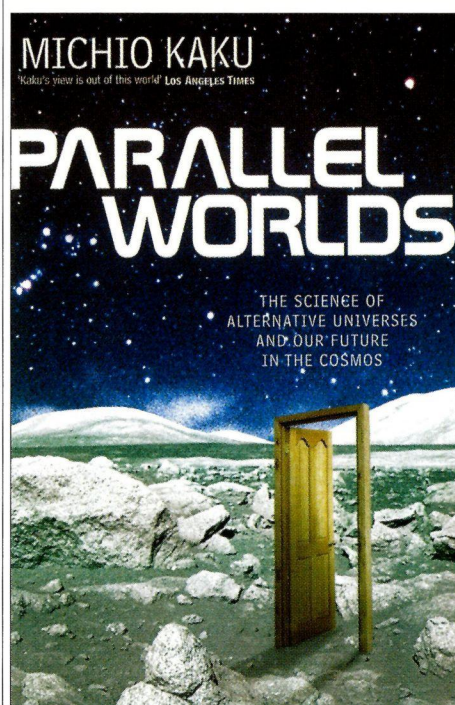
Parallel Worlds: The Science of Alternative Universes and our Future in the Cosmos by Michio Kaku, Allen Lane, Penguin Books. Hardback ISBN 0713997281, £20.00. (In the US, Doubleday. Hardback ISBN 0385509863, \$27.95.)

While reading Michio Kaku's latest book, *Parallel Worlds*, I left it for a few days on the coffee table at home. At this time we had a



visitor who, although interested in science in general, is not a physicist. After browsing through the book, he started reading it and was disappointed to see it disappear one day when I went away on a trip. He has been inquiring about getting the book back ever since. Although based on limited statistics, this is an excellent recommendation for *Parallel Worlds* – you do not need to be a physicist to find the book fascinating.

But what does a (non-theoretical) particle physicist think about the book? Well, I really



enjoyed it. It is a rather complete book on cosmology for the layman, taking us from Einstein to M-theory in a language that manages to be understandable without being trivial. If you, like me, would like to know the difference between 10- and 11-dimension string theory or find it difficult to explain to your fascinated friends (or to yourself) the concept of the holographic universe, this book will give you plenty of ammunition.

Kaku discusses all of the important theories, observations and experimental results that have shaped our understanding of the universe over the past century, and mainly the past 30 years. A big portion of the book discusses string theory, which is close to Kaku's heart, in an informative and understandable way. The book is also full of Kaku's accounts of his favourite science-fiction stories (when he wants to demonstrate

a point that happens to have excited the imagination of science-fiction writers) as well as excerpts from the works of poets, other writers and Nobel laureates.

A large portion of the book, as its name suggests, revolves around the many different sorts of parallel universes that might exist and their relation (and possible interaction) with ours. The discussion eventually leads to ideas about how our distant descendants might try to escape a dying or inhospitable universe. Ironically, this was for me the least interesting part of the book, however it does devote a few pages to fascinating subjects such as the question of consciousness, the anthropic principle and religion.

Minor gripes include Kaku's insistence on not using scientific notation: a trillion electronvolts means to me much less than 1 TeV, and how long exactly is 30 billionths of an inch? Surely Kaku's intended audience would be less perplexed by 10^{18} than by "a million trillion". Another point is his assertion that particle physicists have introduced "hundreds of point-like particles" to the theory. Three families of four fermions each do not make hundreds of particles.

The book also includes a useful index and a glossary, and has notes with further explanations, which unfortunately I found only after I had finished reading the book. It would have been helpful to include note numbers in the text.

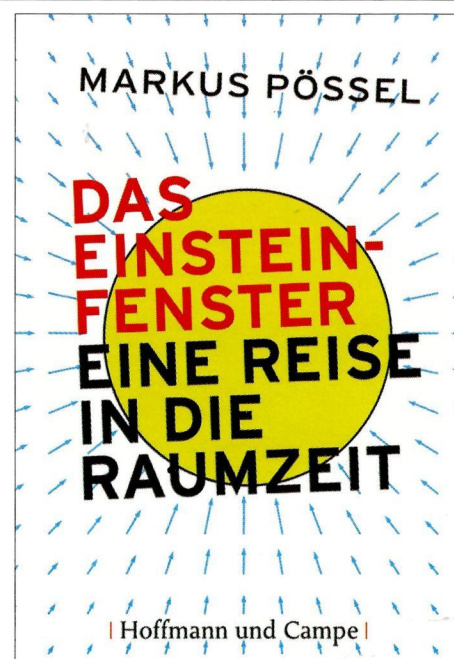
Should you go out and buy this book for Christmas? The answer is yes. *Parallel Worlds* is an excellent read. Just do not leave it on the coffee table.

Mike Koratzinos, CERN.

Das Einstein-Fenster – Eine Reise in die Raumzeit by Markus Pössel, Hoffmann und Campe Verlag. Hardback ISBN 3455094945, €30.

"Can only a genius understand Einstein? No..." claims author Markus Pössel on the back cover of his new book, which is aimed at the reader who is interested in modern science. Among the many books to mark the 100th anniversary of Einstein's *annus mirabilis*, this one appeals immediately because of its high-quality design and the many colourful photos and illustrations. But can it deliver on its promise?

In the first part we are led to the basic concepts of special and general relativity, following a more phenomenological approach.



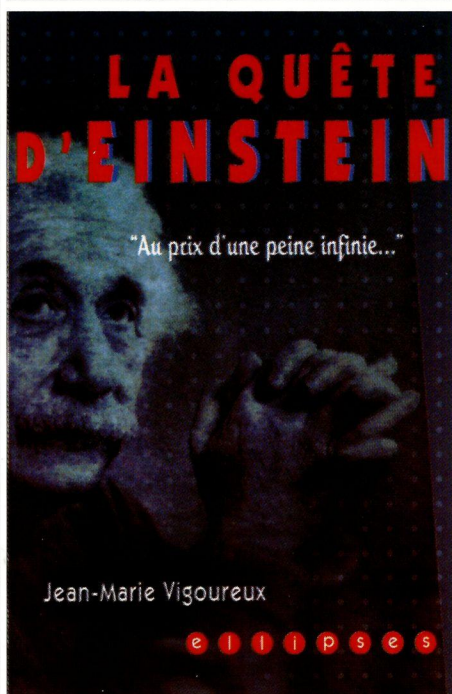
With the help of facts, many pictures and stories relating to everyday life, Pössel manages to give us a flavour of this new world of extremes. Numerical examples substitute for mathematical equations and give a notion of reality. Minkowski diagrams are introduced and used wherever possible. In the context of general relativity, emphasis is put on the correct development of the geometrical principles, which is done with great care.

The second part covers the applications of relativity: our solar system, gravitational waves, stars, black holes and cosmology. The comparatively short third part is a surprisingly detailed discussion of gravitational-wave detection, which puts the reader at the forefront of this exciting field of research.

The chosen approach to relativity is similar to that of university textbooks, where all mathematical equations are substituted by pictures and numerical examples. This disguises the essential principles and occasionally makes it a cumbersome read. It is also questionable whether the sometimes awkward embellishments to the explanations serve the purpose of clarity. Nevertheless, Pössel takes the reader on an exciting journey through space-time.

"Can only a genius understand Einstein?" With this book in hand, average readers can understand him too, provided their curiosity is strong enough to help them find the necessary patience and stamina.

Thilo Pauly, CERN.



La quête d'Einstein: "Au prix d'une peine infinie..." par Jean-Marie Vigoureux, Editions Ellipses. Broché ISBN 2729823557, €19.50.

Un de plus! Cette année 2005 aura vu la multiplication d'ouvrages dédiés à Albert Einstein. Certains développent prioritairement l'histoire de l'homme et de sa vie, d'autres s'intéressent à sa théorie de la relativité.

Le présent livre commence par clarifier la question de la gravitation à l'aube du 20^e siècle, avec ses grands succès (pendule de Foucault, découverte de la planète de Le Verrier) et ses échecs (problème à trois corps, périhélie de Mars), ces derniers semblant indiquer le besoin d'une "nouvelle physique".

La partie de l'ouvrage la plus intéressante est l'introduction qui traite des débats philosophiques sur la notion de force agissant à distance à travers le vide, et sur les concepts d'espace et de temps avec les critiques de Ernst Mach pour qui l'espace est impensable sans la matière nécessaire pour le définir. Alors, Einstein arrive.

Le livre est très documenté, il comprend deux pages entières de bibliographie. Il ne comporte pratiquement aucune équation, même pas les transformations de Lorentz, ce qui est un bon point pour certains lecteurs. Cela limite cependant la compréhension globale, et les propriétés induites par la théorie (dilatation des temps, contraction des longueurs) sont données sans explication claire.

Le choix des conséquences abordées de

la relativité est un peu arbitraire. L'auteur ne débat pas de la fameuse équation $E = mc^2$, à peine citée, mais 10 pages sont consacrées aux tentatives infructueuses de Joseph Weber pour mettre en évidence les ondes gravitationnelles. Les acquis récents de la cosmologie (fond cosmologique, énergie noire) ne sont pas présentés, et aucune perspective n'est indiquée. La dernière partie relate la vie à Princeton d'un anticonformiste solitaire, bercant le rêve d'une théorie du tout.

Il existe sur le marché des biographies d'Einstein plus vivantes et des exposés plus complets de la relativité et de ses conséquences. Cet ouvrage donne l'impression d'un travail un peu impersonnel d'érudit. Ce qui peut gêner est le point de vue souvent hagiographique: on lit le récit de la vertueuse vie de Saint Albert, savant et philosophe en quête d'harmonie, et le sous-titre du livre "au prix d'une peine infinie" va jusqu'à lui conférer les palmes du martyr... ce qui peut paraître très exagéré.

Malgré tout, le livre vaut par de petits exemples bien expliqués qui aident à concrétiser la démarche d'Einstein vers l'élaboration de sa grande théorie de la relativité.

François Vannucci, Université de Paris7 and IN2P3.

The Artful Universe Expanded by John D Barrow, Oxford University Press. Hardback ISBN 019280569X, £20 (\$30).

One contender for the premier division of popular-science writers is cosmologist John Barrow. He now has a long list of impressive titles to his credit, notably *The Anthropic Cosmological Principle* (with Frank Tipler), which introduced a whole new slant on cosmology and has become a classic of modern science, and *The Left Hand of Creation* (with Joseph Silk), which was one of the first popular books on modern cosmology.

Some arrogant physicists condemn any science that is not quantum mechanics or relativity as being lightweight. This pompous attitude antagonizes scientists in other disciplines, and many non-scientists too. Barrow's imaginative literary work helps to demolish such preconceptions, breaking down barriers between specialist subjects and showing how far a mathematical approach can reach.

Barrow says that the popularization of

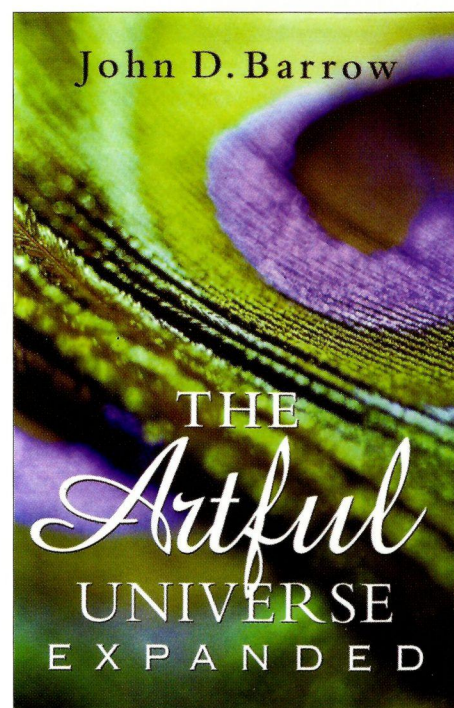
quantum physics and cosmology has been well exploited, and aspiring writers should look elsewhere for subject matter. Heeding this advice, *The Artful Universe Expanded*, an updated and enlarged edition of a book that first appeared in 1995, is a collection of largely self-contained pieces in which scientific arguments illuminate a range of topics that include art, music, evolution and tradition.

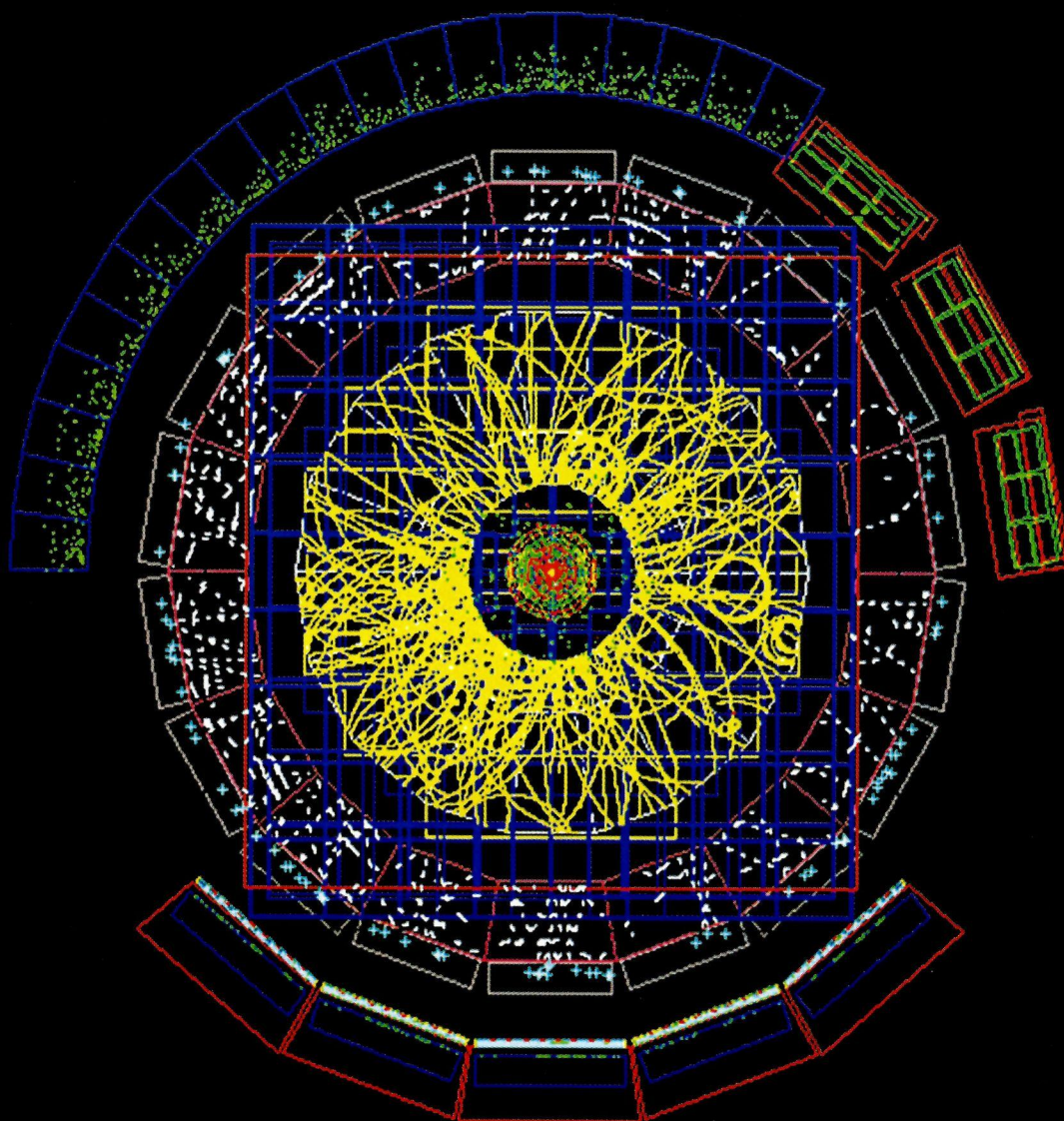
The result is a delightfully diverse package of thought-provoking and entertaining articles. Ploughing through even the best popular science demands a certain effort and motivation, but the compact articles in this book are accessible. It is a book to dip into and meet, for example, "Jack the Dripper" – the fractal-inspired Jackson Pollock.

While Barrow is particularly good at explaining the sizes of things, in a few places there is a sense of *déjà vu*. Barrow's figure 3.2 on the distribution of masses and sizes in the universe is the same as figure 5.1 in his *Between Inner Space and Outer Space*, published in 1999; and the customary illustrations of symmetry by Maurits Escher also appear in the book.

A mine of stimulating material, *The Artful Universe Expanded* anthology is a good choice for travellers or those simply looking for insight, and it is a prolific source of ideas for offbeat talks.

Gordon Fraser, Divonne-les-Bains.





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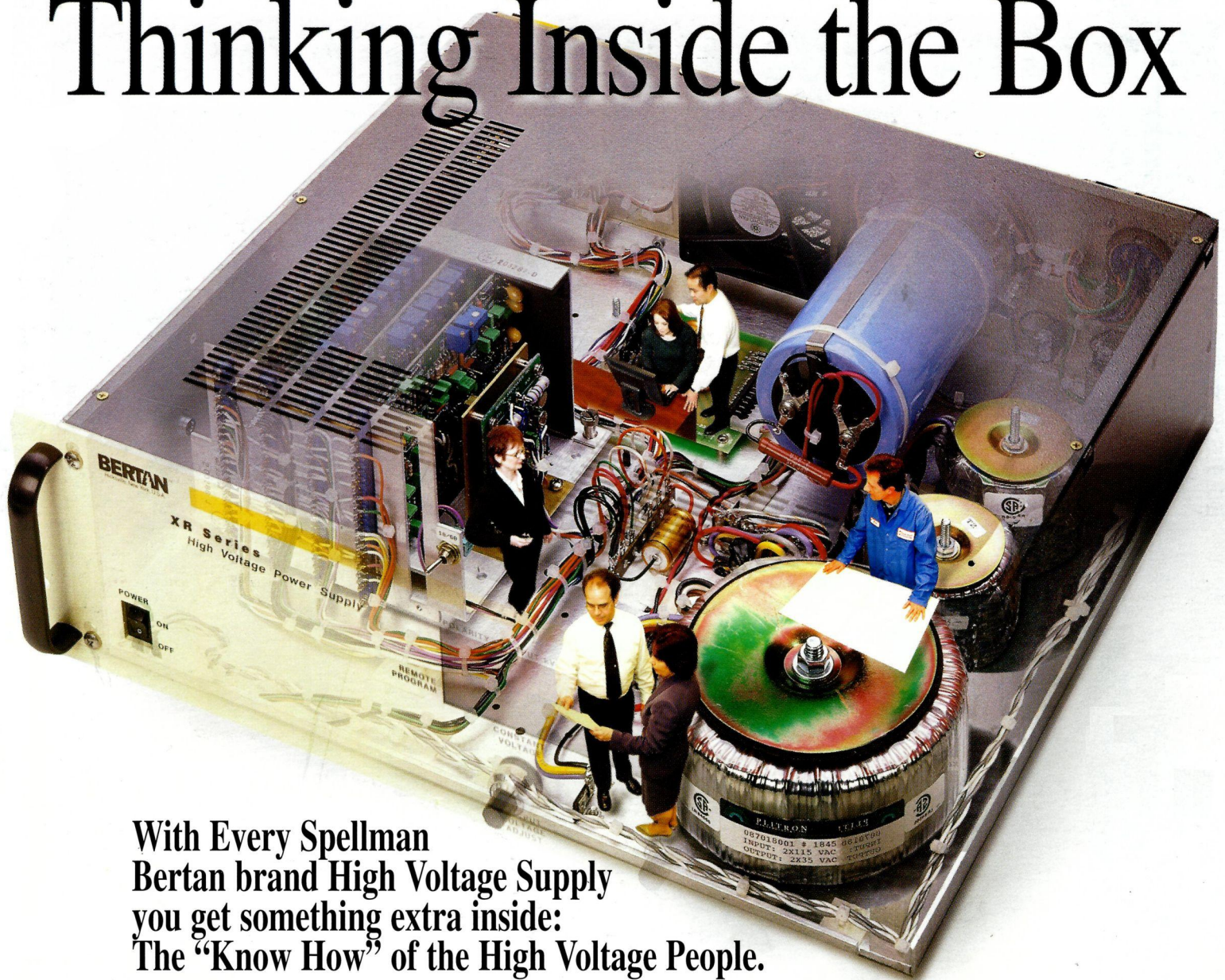
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Image: Prototype display of a simulated event, courtesy of the ALICE collaboration.

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