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A New Dimension To Add To Your Knowledge Of The Universe And Your Littlebits

By Brian Cox

Warped Passages: Unravelling the Universe's Hidden Dimensions
By Lisa Randall
Allen Lane - The Penguin Press
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Warped Passages is an excellent and timely book. A glance at the subtitle, however, may cause you to question whether this is a book of interest to the general reader. Lisa Randall, you see, believes that the universe has extra, hidden dimensions, which we may discover within the next decade. I ask the reader to pause for a second and think about what that means. The room in front of your eyes looks three-dimensional. That is to say, any point in the room requires three numbers (the distance up, down and across from where you are sitting) to locate it. Add another co-ordinate for time and you have the Einsteinian four-dimensional space-time that has underpinned all of 20th-century physics. Randall confidently states that she believes that there is at least one more dimension, possibly infinite in size, at every point in the space in front of your eyes, and that we may be on the verge of proving this to be the case. It sounds like science fiction, as the dust jacket tritely suggest, but Randall knows what she is talking about. She is the most cited particle theorist in the world over the past five years, which gives her the authoritative, confident, often irreverent voice of a real working physicist. This is refreshing in a popular science market dominated by professional science writers, whose experience at the cutting edge is often limited.

Randall gets right to the point in the introduction, asking perhaps the most important question in modern physics: why is gravity so weak? "A tiny magnet can lift a paperclip even though all the mass of the Earth is pulling it in the opposite direction." The physicist's name for this most basic of questions is the hierarchy problem. Put another way, if a physicist were to try to deduce the masses of the elementary particles, knowing only the strength of gravity as we see it on Earth, she would get the answer wrong by a factor of 10 million billion. Randall (and many other particle physicists) believes that this may well point to a fundamental gap in our understanding of the way the universe works.

After an introduction to the concepts of extra dimensions, the book splits into two sections. The first is a review of particle physics as seen at the dawn of the 21st century, from quantum mechanics and relativity to the standard model, the incredibly successful theory developed during the second half of the past century, which accurately describes the interactions of all the known particles and forces in our world (with the important exception of gravity).

This ground has been covered many times in popular science books, but what makes Randall's approach different is that she is not frightened of going straight for the fundamental concepts, even if these are difficult. An example is her description of the Higgs mechanism for generating particle masses. This is motivated by a discussion of the weak nuclear force, unfamiliar to most readers, no doubt, although without it the Sun would not work. I have read no book for the non-professional that motivates the Higgs mechanism by considering the problems caused at high energies by the longitudinal polarisations of the W and Z bosons. I use the scary words in the previous sentence not to baffle, but to make a point. Randall does not shy away from using the correct terminology to describe challenging ideas.

It is difficult stuff, but she makes it as simple as possible without diluting the content, and just having heard of these concepts is important.

Every educated person should have a passing contact with them because they are our best description of the fundamental building blocks of the world, including the little pieces of matter that you are made of.

The book continues with an (at times) irreverent description of string theory, which Randall calls a "top-down" approach to attacking the problems of the standard model and gravity by unifying them into a single theory.

Again, hers is the true voice of a working physicist. A group of string theorists in Florence learning Italian, says Randall, would spend so much time trying to grasp the inner logic of the grammar that they would probably starve to death before they learnt how to ask for dinner. This book is a manifesto, a statement of intent, as much as a science book for the lay reader.

As Randall constantly reminds the reader, speculation about the universe becomes real science when it makes predictions that can be verified experimentally. The reason why her work on extra dimensions falls within this definition of science, and the reason why I describe this book as timely, is the imminent completion of the Large Hadron Collider (LHC) at Cern, the European Organisation for Nuclear Research, in Geneva. At 27km in circumference, and with two giant detectors each of which would struggle to fit inside St Paul's Cathedral, it is by far the largest particle physics experiment ever constructed. The final section of the book describes how, by focusing on extra dimensions as a resolution to the hierarchy problem, a host of new particles are predicted that can and should (if Randall and collaborators are correct) be seen at the LHC. The scientific and cultural ramifications of such a discovery would be immense. We could, by 2010 or earlier, have proof that all human experience has, until this point in history, been confined to a four-dimensional sheet floating in an unimaginably larger, higher-dimensional universe. I think that everyone should be aware that modern science has brought us to a point where these concepts can not only be discussed, but also tested in a laboratory.

When the LHC is turned on, as Randall says, "secrets of the cosmos will begin to unravel". This book is an excellent introduction to the new age of particle physics awaiting us all in a few years' time.

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