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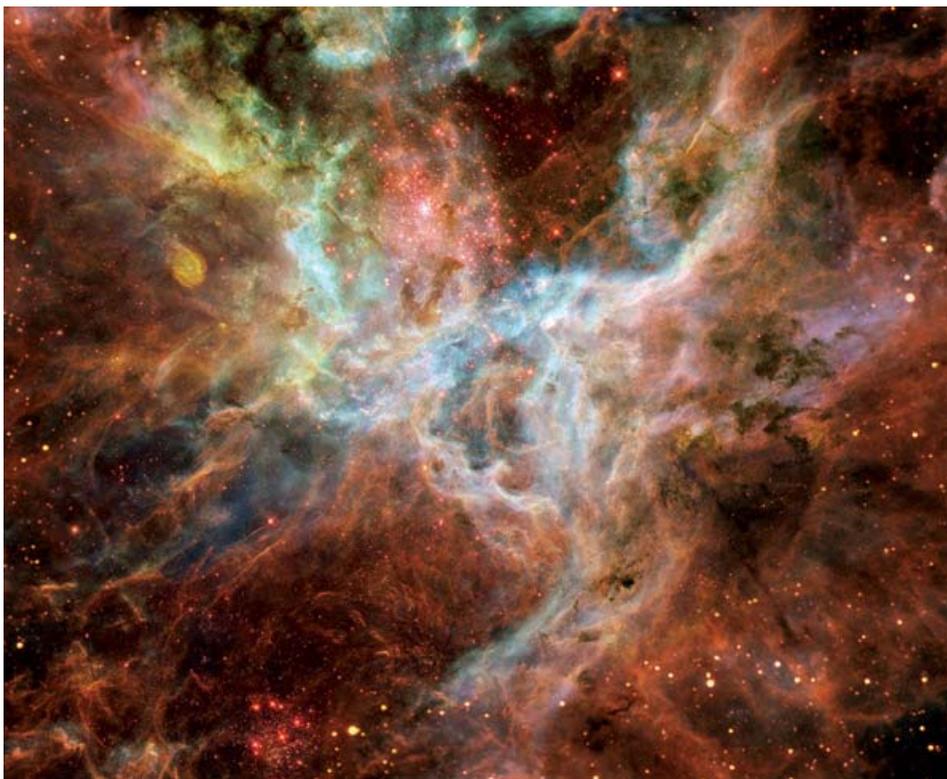
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## An insider's guide to modern particle physics

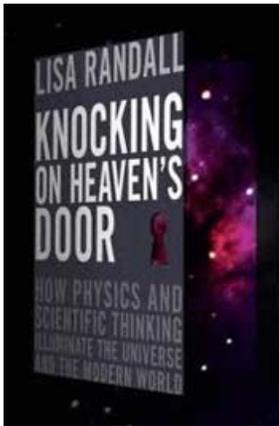
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**Books***Michael Brooks, consultant**(Image: ESA/NASA/Danny Lacrue)*

*In Knocking on Heaven's Door, Harvard physicist Lisa Randall gives a candid account of cutting-edge efforts to understand the universe*

LISA RANDALL first encountered the phrase "knocking on heaven's door" in 1987, at a concert featuring Bob Dylan and the Grateful Dead. She chose it as the title for this book because particle physicists are still knocking, she says.

There is no guarantee that they will ever get a satisfactory answer, though. "A great deal remains beyond the reach of current experiments - or even any experiment we can dream of," Randall says in this lucid, warts-and-all guidebook to the most esoteric frontier in modern science.



An alternative title might have been "Somewhere over the rainbow". A lot has been said and written about the lack of experimental support for the constructions of 21st century physics. String theory remains entirely untestable. The Higgs boson is proving elusive and physicists now concede that it may not exist - potentially plunging the standard model of particle physics into crisis. The only alternative, known as supersymmetry, is failing its initial experimental tests, though there is room for it to come good yet.

Armchair physicists wring their hands at the wriggling and weaselling that results from all of this: in the absence of experimental support (and sometimes in the presence of experimental falsification), theorists tweak and supplement their theories, finding reasons why their original predictions might have been wrong, and nudging their calculations towards the

niches that remain experimentally unexplored.

On the face of it, it does make physics look disconnected from reality. But it becomes clear from Randall's startlingly honest book that this is the realpolitik of investigating the universe in the 21st century. Clearly, we're not in Kansas any more: the low-hanging fruit has gone, and physicists are led by the intricacies of our mathematics, our intuition and our data into areas where perhaps no one wants to go - and experiments struggle to follow.

Yet go we must. That is what humans do. This is an expert guidebook for the journey, and it is beautifully written in easy, flowing prose. Following Randall through this landscape, it is easy to forget that she is one of the world's most eminent theorists, a Harvard University professor whose papers receive stratospheric numbers of citations. Her touch is light and deft; these are not topics that come easily to life, and they are unavoidably complex at times, but Randall's calm authority and clarity of explanation are exemplary.

*Knocking on Heaven's Door* is not one of those neat and tidy patrician books that tells you how the clever physicists have worked everything out. It is more like being taken behind the curtain in Oz and given a full tour by the wizard. By the end, Randall has explained just what it is that physicists at the Large Hadron Collider at CERN near Geneva, Switzerland, will spend the next few years trying to understand - and why they might fail.

Cynics could (and will) say that everything this book describes might turn out to be wrong. Randall would probably concur. "Twenty years from now, people might smile at our ignorance," she says of our struggle to understand the universe. "We can't be as smug about our understanding of the evolution of the universe as the incredible agreement of cosmological theory with cosmological data might suggest."

There is no mysterious conjuring going on in the palace of theoretical physics; just a lot of hard and very complicated work, and plenty of awareness of the limitations of science. Randall dissects what it means to make a measurement, to be scientifically "certain" of a result. She discusses how theorists construct unavoidably flawed models for experimentalists to work from. She is a champion of science, but an informed, thoughtful, appropriately sceptical one.

Whether heaven answers or not, she says, scientists can't help but keep knocking.

#### Book information:

***Knocking on Heaven's Door* by Lisa Randall**

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