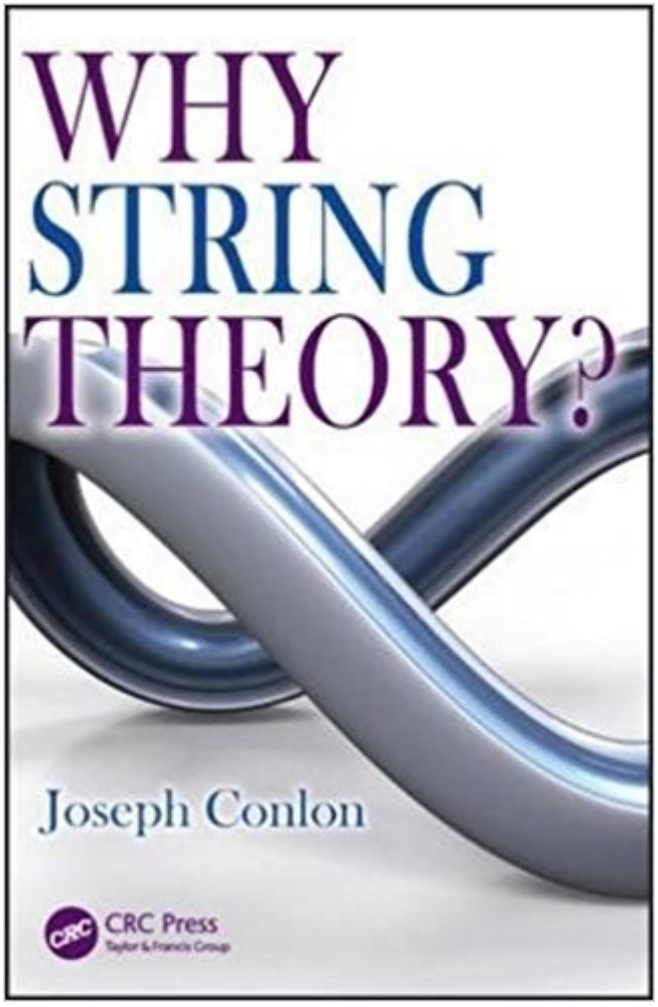
Why String Theory?



Synopsis

Physics World’s ’Book of the Year’ for 2016 An Entertaining and Enlightening Guide to the Who, What, and Why of String Theory, now also available in an updated reflowable electronic format compatible with mobile devices and e-readers. During the last 50 years, numerous physicists have tried to unravel the secrets of string theory. Yet why do these scientists work on a theory lacking experimental confirmation? Why String Theory? provides the answer, offering a highly readable and accessible panorama of the who, what, and why of this large aspect of modern theoretical physics. The author, a theoretical physics professor at the University of Oxford and a leading string theorist, explains what string theory is and where it originated. He describes how string theory fits into physics and why so many physicists and mathematicians find it appealing when working on topics from M-theory to monsters and from cosmology to superconductors.

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Customer Reviews

"There is no direct experimental evidence for string theory. And yet it is one of the biggest games in town. So why do physicists study it and what is it? To answer these questions you need an insider like Conlon, the perfect guide to lead you into the mysterious world of vibrating strings and multidimensional space. Why String Theory? wonderfully unwraps the science, history and philosophy behind one of the most challenging theories of the twenty-first century." Ã¢â ¬â ¢Marcus du Sautoy, Simonyi Professor for the Public Understanding of Science, University of Oxford, UK, and Author of The Music of the Primes "Joe Conlon has taken on the formidable task of explaining

string theory, one of the great theoretical developments of the late 20th century. Building on the successes of fundamental particle physics and general relativity, string theory attempts to dig deeper into reality and to come up with a more consistent and mathematically powerful approach to how the universe works. With remarkable clarity and clear prose, Conlon assembles the edifice of string theory in a way that makes it clear why it is such an important intellectual endeavour. He offers a balanced account of its successes and failures and presents a robust response to the critics of string theory. This is a timely, intelligent, and exciting book that describes the joy and pain of working at the frontiers of theoretical physics."Ã¢â ¬â ¢Pedro Ferreira, Author of The Perfect Theory, and Professor of Astrophysics, University of Oxford, UK "A very engaging and up-to-date discussion of string theory that describes its main goals and achievements. It includes the history of how it was developed, with its interesting twists and turns. The surprising connections with other areas of physics and mathematics are clearly explained. Highly recommended for a lay reader with an interest in fundamental physics."Ã¢â ¬â ¢Juan Maldacena, Institute for Advanced Study, Princeton, New Jersey, USA "This is arguably the most compelling set of arguments to explain why string theory has been so attractive to several generations of theoretical physicists in the past three decades despite the lack of experimental evidence. It is written not only with the passion of a practitioner and the broad knowledge and fresh mind of an accomplished young Oxford professor but also with an effort to be understood by enthusiasts of popular science, either young students with an interest in science, researchers in other fields, or the general public. The author introduces subjects with original, witty, and often funny arguments, without offending the intelligence of the reader. Besides being an excellent introduction to string theory, the book is also a unified presentation of the latest developments and open questions in fundamental physics, covering the importance of the basic building blocks of nature, including the recent Higgs discovery, to the latest developments in astrophysics, early universe cosmology, and black hole physics, as well as apparently unrelated subjects such as material science and superconductivity. It also addresses the standard criticisms of string theory and provides honest and thoughtful answers while recognising the weak points and open challenges. In addition, it emphasises the fact that string theory is not only a theory of gravity at the microscopic level but the most ambitious theory ever devised that encompasses all particles and interactions in a consistent manner and deserves to be explored by the most inquisitive and curious minds."Ã¢â ¬â ¢Fernando Quevedo, Director ICTP, Trieste, Italy, and Professor of Theoretical Physics, University of Cambridge, UK "In this book, Professor Conlon has providedÃ¢â ¬â ¢as he promises in his prefaceÃ¢â ¬â ¢an astonishingly clear tour of modern physics. It is hard to think of a better, clearer, or wittier review, and one that will be particularly useful

to science undergraduates curious as to where their field is heading. School students who have done some reading around the subject (e.g., who have read books by Brian Greene) might also find this work of great value. ItÃ¢â ¬â„¢s highly recommended."Ã¢â ¬â ¢Nigel Seel on his blog Wading Through Treacle, January 2016 "Conlon is a lively, entertaining writer Ã¢â ¬Â¦ [he] does a great job of explaining the point of view of typical physicists now working on string theory. He also very ably explains the Ã¢â ¬Ëœsociology Ã¢â ¬â„¢ of the field, the different kinds of people who work in this area and their varying sorts of goals and motivations. Ã¢â ¬Â¦ I recommend [the book] highly to anyone who cares about these issues."Ã¢â ¬â ¢Peter Woit on his blog Not Even Wrong, December 2015

Joseph Conlon is a professor of theoretical physics at the University of Oxford and a fellow and tutor in physics at New College. He has been a recipient of the student-nominated Outstanding Tutor award across physical and life sciences for his undergraduate teaching. He is a world-leading researcher on string theory and the author of over 50 scientific papers. He has also given over 100 seminar and conference talks worldwide. His research mainly focuses on phenomenological applications of string theory to particle physics and cosmology. Visit WhyStringTheory.com for more details about his work.

Most books on string theory concentrate on the desire for a single, unifying Theory of Everything (ToE) and give the impression that string theorists are all of a single mind in this regard. This book is different. It does not pit string theory against quantum theory, and it delves into the multitude of reasons why physicists with different interests concern themselves with string theory. The short answer is that string theory solves a plethora of problems in various fields of interest.You will also enjoy what Americans would call the playful word choices of our friends across the pond. The author teaches at Oxford and has the typical English propensity for using one $10 word where several $1 words would be more economical. This is not a criticism, since anyone who reads this book will have long ago succumbed to the joy of learning. Most Americans will have need to look up words like ÃƒÂ¢Ã â ¬Ã Å“peregrinationÃƒÂ¢Ã â ¬Ã Â• and ÃƒÂ¢Ã â ¬Ã Å“myrmecologyÃƒÂ¢Ã â ¬Ã Â• on their smart phone, but will enjoy adding such words to their personal lexicon.The author also has a playful way of dealing with the subject matter. One example should suffice. When talking about the Big Bang, Conlon says, ÃƒÂ¢Ã â ¬Ã Å“What did happen earlier than one second [after the Big Bang]? We do not know. In this epoch, all is speculation. There is good speculation and bad speculation. ÃƒÂ¢Ã â ¬Ã Â¦ Much has been said

or written about what may have happened before the Big Bang, including anthropic landscapes of different laws of physics and eternally reproducing multiverses of many possible universes. It is not that the ideas are necessarily wrong. It is rather that the extravagance of these conjectures is matched only by the paucity of either rigorous calculation or observational motivation. The danger is that this replaces physicsÃƒÂ¢Ã â ¬Ã â„¢ long-standing chaste marriage of solid theory and careful experiment with a form of scientific soft porn best suited for the pages of glossy magazines.ÃƒÂ¢Ã â ¬Ã Â•As a result, the book is serious but fun to read.I particularly enjoyed the chapter entitled, ÃƒÂ¢Ã â ¬Ã Å“What Was String TheoryÃƒÂ¢Ã â ¬Ã Â•, which is a detailed recounting of string theory history from 1968 to 1996. This is followed by, ÃƒÂ¢Ã â ¬Ã Å“What Is String TheoryÃƒÂ¢Ã â ¬Ã Â•, which brings us up to 2014 and a bit of 2015. All solid stuff peppered with periodic recollections of who was in the White House, a Top 40 song or band, together with notable sporting and other events from each important era in physics that ÃƒÂ¢Ã â ¬Ã â œ once again ÃƒÂ¢Ã â ¬Ã â œ make the book fun to read. Along the way we learn why and how string theory morphed from a ÃƒÂ¢Ã â ¬Ã Å“Theory of EverythingÃƒÂ¢Ã â ¬Ã Â• into a powerful problem-solving tool for other branches of physics and for mathematics as well, while the author quickly recognizes the community of physicists still laboring on an all-encompassing String ToE.Subsequent chapters elaborate on the use of string theory in quantum physics ÃƒÂ¢Ã â ¬Ã â œ particularly in strong coupling situations ÃƒÂ¢Ã â ¬Ã â œ and mathematics, cosmology, particle physics and even quantum gravity. In the latter Chapter, the author notes that we need to be able to observe physics at the Planck length ÃƒÂ¢Ã â ¬Ã â œ either directly or indirectly ÃƒÂ¢Ã â ¬Ã â œ to validate quantum gravity. In other parts of the book, he correctly infers the same for quantum field theory and string theory. But then he goes on to say, ÃƒÂ¢Ã â ¬Ã Å“The absence of direct probes of quantum gravity does not preclude indirect probes, where physics present at the Planck length can bubble up to produce observable effects in doable experiments.ÃƒÂ¢Ã â ¬Ã Â• And the book contains examples of such experiments in more than one Chapter.Chapter 13 ÃƒÂ¢Ã â ¬Ã â œ ÃƒÂ¢Ã â ¬Ã Å“Criticisms of String TheoryÃƒÂ¢Ã â ¬Ã Â• ÃƒÂ¢Ã â ¬Ã â œ is poorly titled. A much more complete title for this Chapter would be ÃƒÂ¢Ã â ¬Ã Å“Refuting String Theory CriticismsÃƒÂ¢Ã â ¬Ã Â•. Much can be learned from this Chapter alone.A book like this ÃƒÂ¢Ã â ¬Ã â œ the quality of which does not come along very often ÃƒÂ¢Ã â ¬Ã â œ allows us to sit back in our easy chairs and ponder where the world of physics has been, how we got here, and where weÃƒÂ¢Ã â ¬Ã â„¢re going. Since the storyteller is accurate and detailed, the story cannot help but spark new thoughts about possible new avenues of investigation. ItÃƒÂ¢Ã â ¬Ã â„¢s that kind of book, with only enough math to

clarify the subject matter, never veering off on a tedious math tangent.I discovered this book by searching for ÃƒÂ¢Ã â ¬Ã Å“String TheoryÃƒÂ¢Ã â ¬Ã Â• in the ÃƒÂ¢Ã â ¬Ã Å“BooksÃƒÂ¢Ã â ¬Ã Â• category at ÃƒÂ¢Ã â ¬Ã â œ just to see if there was something new on the subject ÃƒÂ¢Ã â ¬Ã â œ and I am very glad that I did. This is the best overall grasp IÃƒÂ¢Ã â ¬Ã â„¢ve read.

Why String Theory? is a very interesting book that brings the topic up to date as a nice complement to older overviews such as those of Brian Green and Lee Smolin. It is rated as ÃƒÂ¢Ã â ¬Ã Å“five starsÃƒÂ¢Ã â ¬Ã Â• and is even recommended by Peter Woit (perhaps because it is lacking in commonly found string theory hyperbole). It admits that, ÃƒÂ¢Ã â ¬Ã Å“there is no direct experimental evidence for string theory!ÃƒÂ¢Ã â ¬Ã Â• And, indeed, most string theorists are little concerned with verification by experiment. The subject instead has other redeemable aspects such as wonderfully rich ÃƒÂ¢Ã â ¬Ã Å“physical mathematicsÃƒÂ¢Ã â ¬Ã Â• and a world of insight into physical possibilities as well as food for pure mathematicians. Theoretical work on the AdS/CFT correspondence by Starinets and Son predicted that quark-gluon plasma might be lacking in viscosity (and that turned out to be true). Calabi-Yau spaces became a rich field of study. The book is well written, and the language is rich and colorful: ÃƒÂ¢Ã â ¬Ã Å“in EinsteinÃƒÂ¢Ã â ¬Ã â„¢s theory, geometry is dynamical. If you strike it, it rings.ÃƒÂ¢Ã â ¬Ã Â• One can have the choice of ÃƒÂ¢Ã â ¬Ã Å“an atlas of charts rather than a globe.ÃƒÂ¢Ã â ¬Ã Â• ÃƒÂ¢Ã â ¬Ã Å“M-theory is known from its boundaries. The Picts and Numidians could infer the existence of Rome from their battles with its legions, but could never know that it has seven hills.ÃƒÂ¢Ã â ¬Ã Â• ÃƒÂ¢Ã â ¬Ã Å“Gauge symmetries are to the Standard Model of particle physics what carbon is to organic moleculesÃƒÂ¢Ã â ¬Ã Â|ÃƒÂ¢Ã â ¬Ã Â•I took many notes and learned things such as: there could have been an early cosmological era of ÃƒÂ¢Ã â ¬Ã Å“moduli;ÃƒÂ¢Ã â ¬Ã Â• string theory predicts a new possible ÃƒÂ¢Ã â ¬Ã Å“dark radiationÃƒÂ¢Ã â ¬Ã Â• in the universe; calculations can often avoid singularities and give finite answers; dualities enable some hard problems to become much easier calculations; there is fashion in physics; strings and branes are equally important; tachyons signal an instability (versus being hyper-luminal); and ÃƒÂ¢Ã â ¬Ã Å“axion-like particles arise ubiquitously in string theory.ÃƒÂ¢Ã â ¬Ã Â• I recommend this book; and since it doesnÃƒÂ¢Ã â ¬Ã â„¢t show any math, the kindle version is adequate.

I thought that Prof. Conlon’s book was excellent for providing a perspective on string theory, and why it has retained enduring interest among physicists and mathematicians. He presents a number

of different points of view, mostly helping to show the importance of string theory, and some background on its history and evolution. The theory is not currently experimentally accessible, and its claims, such as the existence of extra dimensions, which are to a certain extent empirically testable, have universally resulted in negative results. Nevertheless, there is a richness about string theory, in that it has led to interesting physical models, to methods in physics which are quite novel, and almost bound to have significance beyond string theory in other areas of physics and science generally, and to some extremely significant results in modern mathematics. As an indicator of this latter point, Prof. Witten, a principal string theorist, won the Fields Medal, which is a very prestigious award in mathematics. In addition, due to its obvious beauty and rich results, it has attracted numerous mainstream physicists who work in quantum field theory. Due to the achievements of its proponents, string theory has retained considerable interest, despite its tenuous connection to experiments. Prior to reading this book, I was aware of a number of aspects of string theory, but I thought that this book is extremely well-written and helps one with the "big picture" for string theory. I recommend this book highly as one that speaks broadly about this field, to all who have an interest in knowing and understanding string theory better, but have little direct knowledge of the field. My personal view is that string theory is one of the most important physical theories of our times, whether or not it describes nature correctly. I recommend this book highly for the outsider to gain a better appreciation.

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