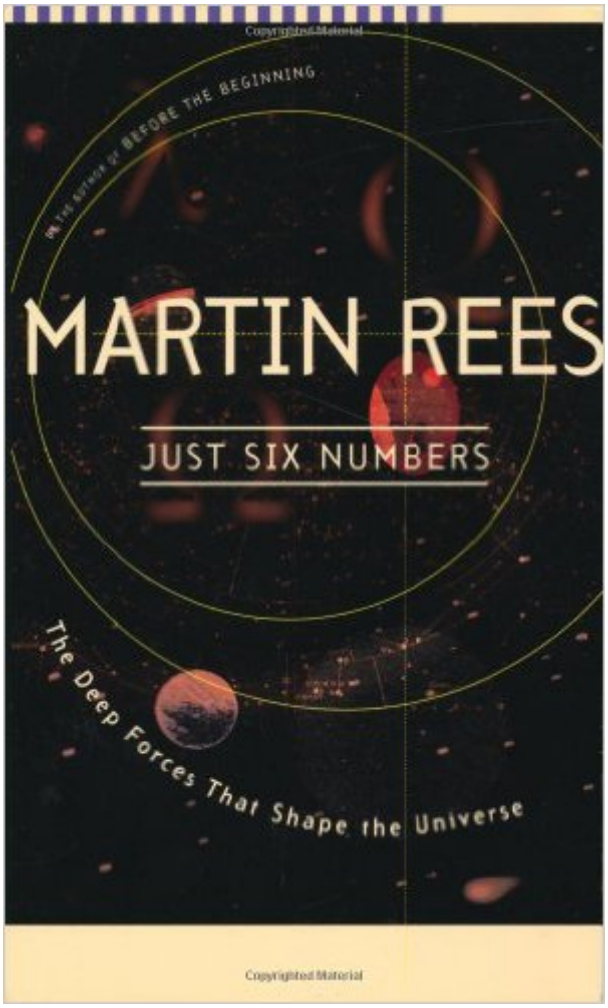
Just Six Numbers: The Deep Forces That Shape The Universe



Synopsis

The genesis of the universe elegantly explained in a simple theory based on just six numbers by one of the world’s most renowned astrophysicists

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Customer Reviews

The author of this book, Sir Martin Rees, is the Royal Society Research Professor at Cambridge University and holds the title of Astronomer Royal. One must assume, then, that the arguments that he puts forward in this book represent the very best thinking of what is to me a very esoteric science. He apologies for the slow gestation of this book, written especially for the Science Masters series. But in my mind he need not apologise as has completed a formidable assignment - that of explaining in everyday terms some of the leading-edge theories in the realm of cosmology. In this book Sir Martin shows how just six numbers, imprinted in the ’big bang’, determine the essential features of the physical cosmos. He also shows that cosmic evolution is highly sensitive to the values of these numbers and that if any one of them were ’untuned’ there could be no stars and no life. Or at least not in the way that we know them today. So what are these six fundamental numbers? The first is a ratio of the strength of the electrical forces that hold atoms together divided by the force of gravity between them. It is very large, about 1036, and were it a few zeros shorter, only a short-lived miniature universe could exist and there would be no time for biological evolution. The second number is also a ratio and is the proportion of energy that is released when hydrogen fuses into helium. This number is 0.007, and if it were 0.006 or 0.008 we could not exist. The third

number, also a ratio, relates the actual density of matter in the universe to a ’critical’ density. At first sight this number appears to be about 0.4. If this ratio were too high the universe would have collapsed long ago: if too low, galaxies or stars would not have formed. The fourth number, only recently discovered, is a cosmic ’antigravity’ and appears to control the expansion of the universe even though it has no discernible effect on scales less than a billion light years. The fifth number is the ratio of the energy required to break apart a galaxy compared to its ’rest mass energy’ and is about 10-5. If this ratio were smaller the universe would be inert and structureless: if much larger the universe would be so violent that no stars or sun systems could survive. The sixth number, surprisingly, is the number of spatial dimensions in our world (3). Life could not exist if this was 2 or 4. In this book Sir Martin discusses each of the above and develops reasons for the limits that he gives. He postulates that perhaps there are some connections between these numbers but states that at the moment we cannot predict any one of them from the values of the others. Perhaps a ’theory of everything’ will eventually yield a formula that interrelates them. More thought provoking is Sir Martin’s discussion of what or who ’tuned’ these numbers. He identifies three scenarios. One is the hard-headed approach of ’we could not exist if these numbers weren’t adjusted in this special way: we manifestly are here, so there’s nothing to be surprised about’. Another is that the ’tuning’ of these numbers is evidence of a beneficent Creator, who formed the universe with the specific intention of producing us. For those who do not accept the ’providence’ or Creator arguments, and Sir Martin places himself in this category, there is another argument, though still conjectural. This is that the ’big bang’ may not have been the only one. Separate universes may have cooled down differently, ending up governed by different laws and defined by different numbers. Certainly, reading this book (and its no light task in coming to grips with the scale or immensity of the numbers) has been rewarding for me and has awakened in me an interest in looking further into other discussions regarding the ’big bang’, time and parallel universes.David Skea, Reviewer

Popular science books are often so simplified that little is gained by reading them. Add equations, and some people will ignore the book. Become detailed in mathematics, and more people will be lost. Professor Rees has done a remarkable service in this outstanding book by taking mathematical ratios and exploring their implications in nonmathematical ways. The result builds a totally new metaphor for considering the structure of the universe . . . that of a stable system.He then takes that metaphor and uses it to build an understanding of the important unanswered questions about cosmology and how answers may be derived through a combination of experimenation, observation, and systems analysis. As a result, the nonscientist is brought into the "thinking" part of

these scientific areas without needing to have much scientific background.I was attracted to the book by the concept of how six numbers could explain a great deal about the universe. The development of that theme turned out to be a pleasant surprise.The six numbers are:nu (a ratio of the strength of electrical forces that hold atoms together compared to the force of gravity which is 10 to the 37th power)epsilon (how firmly the atomic nuclei bind together which is 0.004)omega (amount of material in the universe)lambda (force of cosmic "antigravity" discovered in 1998, which is a very small number)Q (ratio of two fundamental energies, which is 1/100,000)delta (number of spatial dimensions in our universe)Doesn't look overwhelming, does it? Well, that highlights the book's strength, which is to explain the importance of these numbers. Basically, Professor Rees describes the background behind how the numbers were developed, then explores the implications of the number (especially by looking at what happens if the number was much larger or smaller), and then ties the number to implications for other cosmological questions and puzzles. Building from one to the next, he describes the current state of cosmological thinking through an architecture of these six numbers. To this summary of the known science, he adds his own conjectures by way of potential hypotheses for future testing.We are at an interesting time for cosmological study. Because our ability to peer into space is improving rapidly due to advances in space and earth telescopes, more kinds of observations can be conducted to test basic theories about the nature of the forces in the universe. We should expect rapid progress in knowledge, as a result. Stephen Hawking has placed a twenty dollar bet that the elusive "unified field theory" that frustrated Einstein will appear within twenty years (but you should also know that he just paid off a loss on the same bet). A pathway that follows along understanding superstrings of 10 dimensional matter seems promising in this regard for now.I found the writing to be very appealing in this book. Professor Rees is gifted in using examples to make the incomprehensible more meaningful. He is also ruthless in excising any detail that you do not need to know to comprehend the points he is developing. So you get a lean, compact argument. He writes clearly, which simplifies the reader's task while increasing the reader's pleasure. The text is benefited by several interesting illustrations, as well.After you have finished reading this informative and stimulating book, ask yourself what the implications of a stable system are. Does it mean that some greater hand has been involved? Does it have no further implications, whatsoever? Does it mean that even greater systems should be assumed? How does it square with the notion of entropy (order becoming disordered)? If you are like me, new questions and perspectives will occur to you after reading this book that will greatly increase your interest in and appreciation of cosmology and physics.Look backward and outward to see the future more clearly, and then ask, "What is the essence?"

Interesting book on Cosmology. It describes the current situation well: the values of many of the basic physical constants in our Universe are critical to the existence of life and ourselves (the Anthropic Principle). Rees chooses six of these constants (he could have taken more) and explains in detail why they are critical. Five are interesting and up to date. The sixth (3 dimensions) is a little disappointing, and has been discussed in length, in the same context, for more than a century. The arguments given in the book could also be taken as clues for the existence of God, but the author prefers the hypothesis of infinite universes. It's interesting to see that Occam's razor, which was used once against God's existence, is now against the multiverse theory, which multiplies entities to infinity. Rees simply answers that Occam's razor may not be applicable at this level! In any case, God's existence and the multiverse hypothesis are both outside science, for they cannot be falsified. This means that the book, although purporting to be science, ends in a metaphysical conclusion. Good reading, anyway, though one may not agree with the conclusion.

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