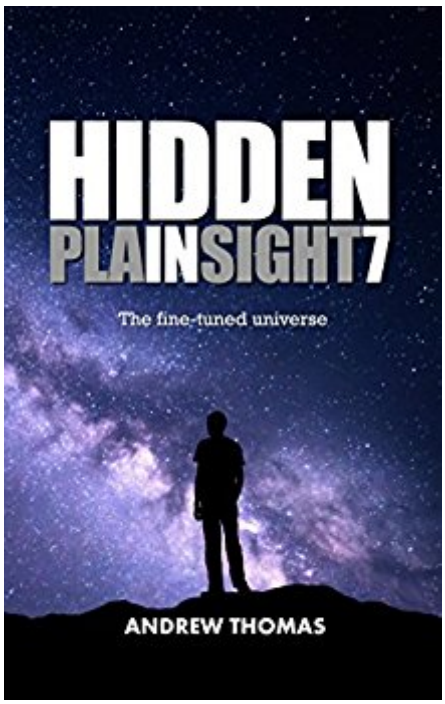
Hidden In Plain Sight 7: The Fine-Tuned Universe



Synopsis

The answers to the big questions: Are the laws of physics fine-tuned for life? Are we alone in the universe? Why is gravity so weak? How can I predict the winner of every horse race?

Book Information

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Customer Reviews

Dr. Thomas is building up a delightful corpus of books on various problems in physics and cosmology all centered around the theme of finding solutions based on new ways of looking at what we already know. In this book, the focus is the fine tuning of the cosmological settings, the various dimensionless numbers that represent ratios between forces and weights that underlie the specific nature and physical stability of the cosmos. The particular settings we find in our universe produce conditions that make it possible for life (and consciousness) to emerge in pockets where local conditions happen to be particularly favorable. Not every star has planets capable of supporting life, but however few or many of these stars there are, if the various forces and constants of universe (gravity, electromagnetism, the strong and weak nuclear forces, and the cosmological constant in particular) had come out differently there wouldn’t be any life sustaining conditions anywhere.He begins with a look at the numbers at issue, and then moves on to various sorts of explanations and

pseudo-explanations like "the anthropic principle" and the multiverse. Moving from the cosmological to the more local, the appearance of life on planets, he covers a methodology, Bayesian inference in probability theory that he suggests will help us decide if there was fine tuning (or at least the appearance of fine tuning) or if life is so common that a variety of force settings and local conditions might accommodate it. He concludes here that the "life sustaining" conditions we know locally (Earth being in the sun's "Goldilocks zone", the sun being in the galaxy's best zone for stable long lived stars) at the local level do seem rather lucky.Returning to the larger theme of the cosmological constants Dr. Thomas tells us that the right way to look at the underlying physics of the universe is Quantum Field Theory (QFT) and in particular the "field view" (credit Paul Dirac) of QFT. The "field view" allows us to describe quantum behavior that appears mysterious in traditional QM. The first QFT chapter discuss the difference between the four most fundamental forces viewed as fields pervading the entire universe. In the second QFT chapter he turns to the particle view of QFT (credit Richard Feynman) because, Thomas explains, it is easier to describe. He gives a good explanation of Feynman diagrams including how they are used to calculate quantum probabilities incorporating all the behaviors accommodated by the field view. This is the nicest explanation of this process I've seen in a lay book. Thomas then examines the idea of "naturalness" and what physics would be like if all the forces had the same values. The universe would fall out of the laws alone there being no "special numbers" to plug into the equations. This is a key idea for him because it turns out there was a time when this was the case, the "Planck Era" literally the first Planck time following the big bang.In his last chapter, Thomas shifts to explaining just one of the present "great mysteries" of physics, why gravity is so weak compared to the other 3 forces. He reviews alternative explanations (string theory, super-symmetry, and the role of inflation) and then proposes one of his own that is simpler and avoids problems with the alternatives; a solution "in plain sight". He begins by assuming that the forces, once set, have not changed. In his view, in the first Planck-time the four forces were perfectly unified but gravity separated from the other three at a higher temperature 10^19 deg. K while the others broke apart a few planck-times later at roughly 10^17 deg. K (strong nuclear force) and 10^16 deg. K (electromagnetism and weak nuclear force). This has consequences due to the kinetic energy difference of the entire mass-energy constituents of the universe between those temperatures. In effect, as the universe cooled, it became lighter. It retained all the "rest mass" it had in the "Planck Era" (that first Planck-time), but the kinetic energy of that mass keeps falling as the universe expands and cools making the universe as a whole progressively lighter (thanks to E=mc^2 because m=E/c^2 so as kinetic energy drops, m gets smaller).Although a great solution to the question of the strength of gravity compared to the other forces, it still doesn't answer the

question of why any of the forces have precisely the values they do. Why did gravity separate at 10^19 and not a little higher or lower? Why did the other three forces separate where they did and not a bit higher or lower? Thomas' hypothesis accounts for the ratios between the forces, but not their absolute values. He says as much and notes that it may never be possible to know exactly why the separations occurred exactly where they did. For one reason or another, it seems we do live in a special universe.An easy read, well written, another brick in the edifice Dr. Thomas seems to be weaving through his now 7 "Hidden in Plain Sight" books.

Another fascinating read by Andrew Thomas which should stimulate more thought about the possibility of life outside of our solar system. One reviewer questioned the need for Bayes Theorem. My 2 cents would be that conditional probability is a very important consideration when speculating on the existence of life in other parts of the universe. Given that there is probably a huge number of planets with similar environments to Earth, by considering Bayes Theorem, one would expect life to exist on some of them. This of course assumes that life forms simply by a sequence of unplanned and highly improbable events (no intelligence at work). As long as none of the probabilities are zero, there are enough planets out there that at least one other would eventually experience a necessary sequence. Something about monkeys and type-writers comes to mind.I particularly like his discussion about field theory to possibly explain some of the weird quantum effects, or at least where to look to explain them.Ditto for his last chapter and his speculative explanation for why the hierarchy problem exists. I'm right with him on focusing more on what we can see and test rather than dreaming up exotic forms of reality.

This is an excellent example of popular science writing done right.There are six or more fundamental constants in the universe that must have been almost exactly what they are now or the universe as we know it would not exist, and certainly life would not be present. To me, this suggests Design. Some other theories have been presented and debunked. I laugh at the multiverse hypothesis: an infinitude of universes and one of them happened to turn out right. Thomas has a different explanation, one awaiting further investigation.I'm buying another of his books right away.

Andrew Thomas writes in such a clear and concise way. One or two of the series have lost me in odd places regarding the math but he makes it clear at the start that the mathematics are not a deal breaker in order to enjoy the book.This book (No 7) is fascinating and his explanations and ideas really make sense of what is quite a complicated and emotive subject.

I always look forward to the next edition of the "Hidden in Plain Sight" series and this one was another excellent book. Andrew Thomas informs with great clarity and has a special gift to be able to explain complex subjects in a very comprehensible manner. He touches on several subjects in this book including quantum field theory and why gravity is so weak. These are great books on physics that are very accessible to the general science reader.

All of the "Hidden in Plain Sight" books by Andrew Thomas are good reads, especially for the non-physicist reader. All subjects are well explained without a lot of 'academic filler.' Thomas is easy on the math side too. What I've learned from his books makes reading other authors a bit easier. Can't wait to read his book 8.

I have read all 7 hidden in plain sight books I really like the idea that there is only one universe and that there is nothing outside of it. I have a little trouble with extreme gravity modification also the will never detect the graviton. Still it is very interesting to speculate on new cosmology.

A really good physics for non-math majors book. I like Andrew's very logical approach to problem solving. I also like his refusal to give in to the easy way out of physics problems. He disdains the anthropic principle and the multiverse as useful explanations for unanswered scientific questions. All of "Hidden In Plain Sight" series and fun to read and you don't need to be a math major to understand them.

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