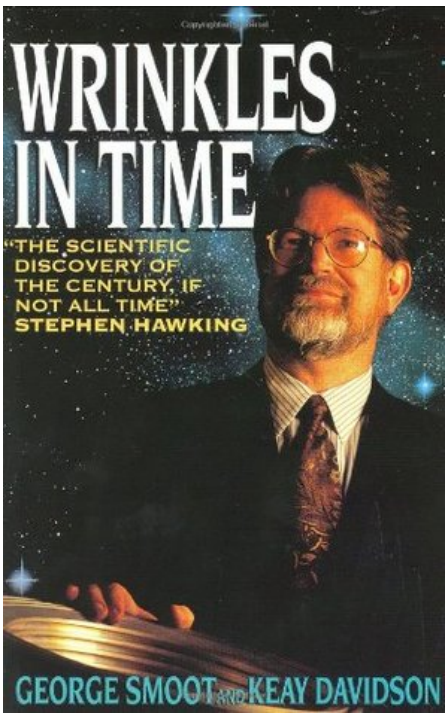

Wrinkles in Time

George Smoot , Keay Davidson

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In April 1992, a discovery was made that changed the way we view the world. Dr. George Smoot, distinguished cosmologist and adventurer, whose quest for cosmic knowledge had taken him from the Brazilian rain forest to the South Pole unveiled his momentous discovery, bringing to light the very nature of the universe. For anyone who has ever looked up at the night sky and wondered, for anyone who has ever longed to pull aside the fabric of the universe for a glimpse of what lies behind it. *Wrinkles in Time* is the story of Smoot's search to uncover the cosmic seeds of the universe. *Wrinkles in Time* is the Double Helix of cosmology, an intimate look at the inner world of men and women who ask. "Why are we here?" It tells the story of George Smoot's dogged pursuit of the cosmic wrinkles in the frozen wastes of Antarctica, on mountaintops, in experiments borne aloft aboard high-altitude balloons, U-2 spy planes, and finally a space satellite. *Wrinkles in Time* presents the hard science behind the structured violence of the big bang theory through breathtakingly clear, lucid images and meaningful comparisons. Scientists and nonscientists alike can follow with rapt attention the story of how, in a fiery creation, wrinkles formed in space ultimately to become stars, galaxies, and even greater delicate structures. Anyone can appreciate the implications of a universe whose end is written in its beginnings - whose course developed according to a kind of cosmic DNA, which guided the universe from simplicity and symmetry to ever-greater complexity and structure. As controversial as it may seem today, *Wrinkles in Time* reveals truths that, in an earlier century, would have doomed its proclaimers to the fiery stake. For four thousand years some people have accepted the Genesis account of cosmic origin; for most of this century, scientists debated two rival scientific explanations known as the steady state and big bang theories. And now, *Wrinkles in Time* tells what really happened.

The personal story behind astrophysicist George Smoot's incredible discovery of the origin of the cosmos, hailed by Stephen Hawking as "The scientific discovery of the century, if not of all time."

Wrinkles in Time Details

Date	:	Published October 1st 1994 by Harper Perennial (first published 1994)
ISBN	:	9780380720446
Author	:	George Smoot , Keay Davidson
Format	:	Paperback 360 pages
Genre	:	Science, Physics, Nonfiction, Astronomy

From Reader Review Wrinkles in Time for online ebook

Kathleen says

Spoiler Alert: COBE totally gives viable evidence of inflationary theory!

This book is an accounting of science as it ought to be done. George Smoot was the project head of the Cosmic Background Explorer satellite that in the early nineties mapped the radiation discovered by Penzias and Wilson in 1964. COBE's discovery of "Wrinkles" in this radiation gives a beautiful picture of what the universe must have looked like only 300,000 years after the Big Bang.

So yes, dramatic evidence of a cosmological theory is always interesting, you say, but you've read *A Brief History of Time*, and you don't really need to know anything more about inflationary theory.

This book is not about inflationary theory.

This book is about doing research. It is about designing a satellite to be launched by the space shuttle only to have the Challenger explode and shuttles put on indefinite hold. It is about working obsessively to make every carefully designed instrument half of its original size in order to fit it on a Delta rocket. This book is about traveling to *Antarctica* for a month in order to rule out every other possibility **before** publishing your extremely promising data. Therefore, I would argue that this book isn't just about finding extremely compelling scientific information; this book is about conducting reasonable, responsible, resplendent science.

I highly recommend it.

Kim says

As someone who is interested in cosmology and astronomy, I found this book to be very interesting. Smoot does a very good job of explaining the history of cosmology and the background to COBE, his satellite to study the cosmic microwave background radiation. He also adds a little bit of personal experiences to lighten the tone - so it's not ALL science-speak. And then he rounds it off by talking about the experiment and its findings. The book is not very difficult to read, like some science books can be.

I noticed that another reviewer made the comment that Smoot is very self-congratulatory. I would have to agree that, by his writing, he thinks very highly of himself and his accomplishment. But I did not find this to be distracting. He was proud of what he had done and rightly so; this tone did not detract from the book for me.

Kadri says

It was a lot more interesting than I thought it would be. Basically you get the story of how an important discovery was made - what the scientists had to do to get answers to the problems they were trying to solve and how they had a lot of interesting adventures in the mean time from Brazilian jungles to the South Pole.

A certain thing to take away from reading this book - doing scientific experiments on high altitude balloons is a nerve-wrecking business.

Keith says

I finally got around to reading this because it was referenced in *About Time* . This was not nearly so well written, but it was an interesting companion read nonetheless.

Both book cover some of the same background, bringing the reader up to speed on certain necessary concepts and the history of astronomy and cosmology. The focus here is a bit more narrow, however, as well it should be since the author is dealing with the story of his own contributions to the science, rather than providing an overview. Still, it felt a bit more disjointed, jumping through history seemingly at random to set up elements of what amounts to Smoot's professional biography as much as, if not more than, the story of the COBE project and its sister-studies.

Nevertheless, that personal touch made it a more... well, personal story, which assuredly is less dry than the usual science book. Astronomy can seem like a very straightforward study, and not particularly exciting in any way other than the wonder of the stars, but the stories of Smoot's failures as well as successes, and the obstacles—financial, administrative, and competitive—he and his fellows faced lend an air of urgency that scientific discovery tales often lack.

Not to mention that I now have a much better understanding of the then-current evidence for and against the standard "big bang theory" of the origin of the cosmos. The two books together served well to stitch the fabric of space-time together in my mind in a way my academic studies never did.

Manny says

I am warned that I should take this book with a pinch of salt, since Smoot may not be telling us the whole truth and nothing but the truth. But dammit, I want to believe him. This is what science should be like: go out and look for the data, no matter what it costs you. At several points, you just can't help comparing him with Indiana Jones.

Smoot started off in the early 70s as a particle physicist, where the norm was already for people to work together in big teams. But he was ambitious, and thought he'd never get anywhere as an anonymous member of a giant collaboration. He looked around and got interested in observational cosmology, which was finally starting to take off. In particular, he was greatly influenced by Peebles's book on the subject. People had just found the Cosmic Microwave Background Radiation - the faint radiation coming from all over the sky that was generally assumed to come from the Big Bang - but no one knew much about it. Peebles urged researchers to find out more.

Smoot started doing cosmology, though he didn't immediately get involved with the CMBR. His first project was an attempt to detect antimatter atoms in cosmic rays, which at the time was another hot topic: some people thought there was a lot of antimatter out there just waiting to be discovered. Maybe there were antimatter suns with antimatter planets orbiting them. (This is for example the premise of Jack Williamson's SF novel *Seetee Ship*). Now, it's hard to remember that it was ever more than science-fiction, but then it was

taken seriously.

Smoot set out to look for antimatter in cosmic rays, flying experiments in balloons to get them high enough to have a chance of catching something. There were all sorts of exotic accidents. One balloon crashes on a farm in the Badlands, and they have to retrieve the tapes from the wreckage. At the end, they have tens of thousands of events recorded, and they analyze them all to try and figure out if they've found any antimatter. They can explain every event as normal, with one single exception; as far as they can see, it's possible that it's antimatter. But the odds are only three to one in their favor, so they decide to run a bunch more balloon experiments. They never find another possible antimatter event - so it's a negative result, but an interesting one which more or less refutes the idea that there are antimatter stars.

As you can see, Smoot is a careful guy who knows how to get things done. He then starts a new project which finally does get to looking at the CMBR; he wants to use it to establish a universal frame of reference, so that he can measure the absolute velocity of the Earth. Everyone tells him this can't be done, since it means measuring temperature differences in the CMBR of around a thousandth of a degree, and there is no way to fly the experiment. But Smoot has heard that old U-2 spy planes are possibly being made available for scientific research purposes, he works his connections, he persuades people to do the incredibly tricky engineering, and he gets data which indicates that the Earth's velocity (indeed, our galaxy's velocity) is far greater than it should be, which has many interesting consequences for cosmology. Unfortunately, skeptics argue that it could be a false signal, and the only way to find out is to redo the experiment in the Southern Hemisphere. He somehow ships everything down to Peru, bribes and wheedles his way into getting approval, and collects his data. It turns out that the signal is genuine.

I haven't even got to the COBE satellite mission, the high point of the book, but you get the picture. In a way, I don't care if Smoot is stretching the truth or exaggerating his role. I think people like him are essential when you have a new field that's just opening up; another example that springs to mind is Galileo, clearly one of his heroes. Smoot advanced the state of our understanding of the universe a great deal by being willing to do whatever it took to find answers to questions that many people thought were too difficult to investigate. He learned tricky theoretical ideas and turned them into concrete experiments, he put together crack teams of engineers and forced them to build devices with ridiculous levels of robustness and accuracy, he sat in budget meetings and persuaded people who didn't like him to give him money, and when necessary he went in person to the Amazon jungle or the South Pole to get the observations he needed.

And all the time, he was careful never to believe he'd found something when it was possible that all he had was wishful thinking. He tried his damnedest to eliminate uncertainties, and at one point towards the end of the COBE project he offered a substantial reward to any member of the team who could show why the current results were not correct. Maybe he wasn't 100% honest, but neither was Galileo. For my money, Smoot will go down in history as another truly first-rate experimental scientist.

Andrew Rothschild says

Loved the book. Clearly the title plays on Hawkings A Brief History but the subject matter is very different, dealing with the origins of space and time and the adventure that the author and his team embarked upon attempting to discover why the universe is not just comprised of dust. For the curious mind with a bent for science, a must read.

Connie says

When I was younger and was interested in this topic (and more up on my chemistry and physics) I would have enjoyed this book more. Dr. Smoot mentioned that he had to pared down the manuscript from 600 pages and lost a lot of personal dynamics...I may have been more interested in that manuscript.

If you are physics, cosmology, or astrology enthusiast...you will find this book very rewarding!

Peter Timson says

I have a Little, Brown & Co edition from 1993 in hardback. Very interesting but heavy going. Not one to give up, it took me ages to complete.

Nick Black says

This was a good introduction to the pop aspects of quantum fluctuation, COBE's confirmation of quadrapolar background radiation following Penzias-and-Wilson's discovery of the isotropic 2.725K CMBR (as immortalized on the back of an XKCD shirt I bought the day of release -- the front reads: "SCIENCE: IT WORKS, BITCHES". Huzzah! Popular garb down at the Institute of Technology), and the exciting cosmological research of the late twentieth century. On the con side: Smoot is a ruthless self-propagandist with an ego the size of the observable universe (necessary, it seems, to work at LBNL); his constant self-congratulation was already nauseating to read at 16 (although not so bad as Michio Kaku). When I went back and reread this a few years ago, knowing much more about the drama and intrigues behind COBE (especially as exposed around the 2006 awarding of Smoot's (deserved) Nobel prize), it made me physically ill.

This book is worth reading, and George Smoot's one hell of a scientist, but this could all have been done a lot better. Check out John Mather's book The Very First Light for the rest of the story.

Erik Graff says

This is a book on physical cosmology intended for the general public. After the briefest of introductions to the field the issue at hand resolves to defending the big bang theory by accounting for the formation of structured matter (galaxies, nebulae and the like) in the cosmos. The portion of this work done by Smoot and colleagues is detailed.

In fact, much of this book would not be readily accessible to the general public. Personally, I found much of it dull and obscure, though I did appreciate his treatment of 'dark matter.'

Rian Nejar says

A descriptive, well-written book about the history of advancement of our understanding of cosmic phenomena. Nevertheless, the mix of travel, ballooning, and budget adventures with historical and contemporary scientific advancements bewilders the serious and the lay reader alike.

Did the author really need his formally attired persona on the front cover?

Ishmael Seaward says

Loved it, but then I'm a nerdy geek, or maybe a geeky nerd. I thought it was a good, straight-forward read on what was known when, and then what was done to add to the knowledge base. The end result is that the cosmic background radiation, once thought to be uniform, is not really uniform, but patchy. And the patches are where the galaxies were formed, which leads to the present day non-uniformity of the distribution of galaxies.

Jan Graf von der Pahlen says

An incredible read: Talking about the discovery and investigation of the cosmic microwave background and the resulting consequences to the physics community would have been fascinating enough. Yet the author actually gives a concise and understandable introduction to cosmology and astronomy with many useful illustrations, making this a truly enjoyable read for a student of physics.

Adam says

This was my first book about cosmology / astrophysics. Smoot (and friends) tell the full story of the COBE experiments and data, and explain the consequences of the data very clearly.

Philip Mills says

I found this book well written and provocative. The author's description of time and its lack of smoothitude (a word I just made up) has occupied my thoughts a great deal since I read the book. It's the sort of book that, and this is the best compliment I can give, made me want to have lunch with the author.

G.R. Reader says

Almost everything in this book is true. My lawyer strongly suggests I should leave it at that.

Ellen says

I really enjoyed this book. First, I have a story of how I found this book-I love these kinds of stories. We love the Big Bang Theory sit com on CBS. We find the writing to exceptional, the characters endearing and the situations hysterical. I also love that they really work hard to make the science authentic by having a scientific consultant. They also have very impressive cameo appearances by well-know members of the scientific community. In one episode, our beloved characters are on a train on the way to a conference in Pasadena. On the train, Leonard is reading a book by George Smoot, the man they are going to the conference to see. The book is Wrinkles in Time. I'm intrigued by the book and the play on the title of the beloved Madeline L`Engle book.
I loved this book! I can't say that I completely understood it but I found it incredibly interesting and written for a layperson to understand. It really makes me want to read and understand more.

Michael Schulz says

Very good science book, not too deep in the science, but he explains the important points very well. Interesting look at the search for "wrinkles" in the cosmic background radiation. Good mix of science and human adventure. I picked this to read after seeing George Smoot on the "Big Bang Theory" TV show. (He'll never be a good actor!)

Last Ranger says

Taming the Cosmic Zoo:

Written primarily for the layman reader, "Wrinkles in Time" nevertheless attracted a lot of attention from the academic world as well. The authors, Nobel Laureate George Smoot and award-winning journalist Keay Davidson, chronicle a paradigm changing discovery in Cosmology; the texture of the early universe. Part personal memoir and part science-history, Smoot shares his thoughts and insights on the efforts to solve the cosmic mystery of the Big Bang and why the Universe is filled with planets, stars and galaxies. While this is not a cosmological text-book it does offer up some complex scientific concepts and gives an in depth journal of how scientists work with, and compete with, one another. Starting out in the heady days before the 20th Century, Smoot sheds light on some early workers in astronomy and their ground breaking discoveries. Anyone who has read Sagan's "Cosmos" or Tyson's "Origins" may find themselves in some familiar territory here but Smoot's covers it in a fresh way so that it doesn't come across as repetitive. How did people arrive at the concepts of an evolving, as opposed to a static, universe? Who were some of these early workers and how did society judge them? The book really takes off when it cover Smoot's efforts prior to his days on the COBE Mission. His work on the "Echo" projects and his flights on the U-2 aircraft were, for him, both fruitful and frustrating. Doing research with High-altitude balloons had him, and his colleagues, on the edge of their seats. His memories of where he was and what he was doing during the Challenger Disaster and other important moments in science add a personal touch to some historic moments. It's not enough just to make scientific discoveries, you must decide when and how to publish your findings. Too soon and you might overlook vital information or miss minor errors, too late and other teams might "scoop you" by

reaching the same conclusions as yours. You and your whole team could end up as "also rans" with nothing to show for all your time and effort but a footnote on someone else's paper. Apparently scientific research is not for the faint of heart. Two years after launching the COBE Satellite Smoot found himself in Antarctica checking on his satellite's telemetry and verifying his theory. He and his team would work together in preparation for going public with his findings to the American Physical Society in 1992. Even with all his work there would still be some controversy about the Big Bang and his evidence for "Wrinkles" in the cosmic background radiation. But that's how science works and Smoot and Davidson cover it all in this wonderful book. If you'r at all interested in Cosmology and what it takes to make a paradigm changing theory then this book may be right up your alley. "Wrinkles in Time" is profusely illustrated with numerous charts, graphs and schematic drawings along with archival and personal photo's, B&W and color too. For me this was a very satisfying read and a close look at some historic moments in science.

Last Ranger

Laura says

The first part of this book was a slog: Smoot made the history of Cosmology as dry and dull as he possibly could. However, once the story switched to his personal search for the structure in the microwave background it picked up. I was an undergraduate when the COBE results came out in 1992 and I remember how excited people were around the JHU Physics & Astronomy Department. I didn't fully appreciate what these observations meant at the time - but it certainly made it feel exciting to be becoming an astronomer. Big Things were being discovered - we knew so much and so little, there was lots to do and I was heading off to do some of it! It was rather fun to read about all the things going on in the background, all the hard work and persistence that lead up to this momentous announcement.
