The Universe Within: From Quantum to Cosmos

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A visionary look at the way the human mind can shape the future by world-renowned physicist Neil Turok. Every technology we rely on today was created by the human mind, seeking to understand the universe around us. Scientific knowledge is our most precious possession, and our future will be shaped by the breakthroughs to come. In this personal and fascinating work, Neil Turok, Director of the Perimeter Institute for Theoretical Physics, explores the transformative scientific discoveries of the past three centuries -- from classical mechanics, to the nature of light, to the bizarre world of the quantum, and the evolution of the cosmos. Each new discovery has, over time, yielded new technologies causing paradigm shifts in the organization of society. Now, he argues, we are on the cusp of another major transformation: the coming quantum revolution that will supplant our current, dissatisfying digital age. Facing this brave new world, Turok calls for creatively re-inventing the way advanced knowledge is developed and shared, and opening access to the vast, untapped pools of intellectual talent in the developing world. Scientific research, training, and outreach are vital to our future economy, as well as powerful forces for peaceful global progress.

The Universe Within: From Quantum to Cosmos Details

Date	:	Published October 2nd 2012 by House of Anansi Press (first published September 5th 2012)
ISBN	:	9781770890176
Author	:	Neil Turok
Format	:	Paperback 256 pages
Genre	:	Science, Nonfiction, Physics, Philosophy, Audiobook

From Reader Review The Universe Within: From Quantum to Cosmos for online ebook

Al says

This is the book that got me hooked onto the Massey lectures, which will present me with many joyful insights in the future. In case the name is not familiar at once, as was the case with me, just remember the name of the Hawking-Turok theorem, which he already has under his portfolio. And Neil Turok's in his 40s!

The storytelling is totally immersive, and yes I completely understand that a lot of it is due to the format in which the book is intended to follow, namely a series of public lectures. But a lot of it is also due to Neil Turok's intelligent breakdown of (almost) everything we have learned about science since the time of the Greek philosophers. (he doesn't touch much on biology, for obvious reasons, he's a cosmologist after all) His ability to present complex and sometimes tedious scientific facts and discoveries as a delicious lunch to be eaten and learned, is amazing! I can only envy the students who enroll in his "academy" in Africa, and are lucky enough to be able to feel this teaching.

The book is important due to the very balanced ideology that is brought forward by Turok on the connection between science and society. He affirms that the most important thing is to educate as many people as possible in the greater scientific discoveries that make possible every technology today. He also stands firm on the importance to always have inquisitive mind, or as he puts it "to doubt constantly and to live with uncertainty" which could be easily seen if one is to delve upon the depths of quantum physics theory and its uncertainty about all physical. And finally, he makes the case for a more humane science, where the ideas brought forwards by the leading minds of the day in science would be connected to our humanity, such as our deep connection with nature. Just beautifully said, and what a down-to-Earth thinker!

While I only summarized his ideas presented in the final part of the book, all of his other interpretations of the important discoveries in the past millennium are extremely insightful about science and human nature. He is someone who is not afraid to dismiss in a flash the often dogmatic obsession of Richard Dawkins with religion. At one point, he quotes a review of Dawkins of a book that (erroneously) states that the Universe was created for nothing, with Dawkins boosting of how this disproves religion on cosmological scale. (after evolution) Of course the proof in the book draws the wrong conclusions, but maybe Dawkins is given an example of scientists using un-inquisitive methods to be too sure of their own conclusions, when if we look at the big picture the question of what came before the Big Bang is not going to be proven that easily. Hopefully this book and people like Neil Turok will be able to raise the level of scientific discourse, and bring in a new Golden Age of science.

Patrick Andersen says

Some background: I attended the Calgary Massey lecture (chapter 4 of the book)and have a degree in Chemistry and I consider myself reasonably comfortable with quantum mechanical theory.

The good: I really, really enjoyed his potted history of physics. He does a good job of explaining complex ideas in accessible terms. His overall style works.

The bad: Nearly half of the Calgary lecture (this book is essentially the transcript, so half of chapter 4 and good portions of other chapters) are autobiographical and discussions of the state of science learning in Africa. He advocates hard for the idea that the next Einstein could be anywhere, so developed nations should

be doing something to encourage high science in developing countries. Don't get me wrong, people everywhere in the world are smart, clever, insightful, driven, etc. But there are more pressing needs (economic and political stability, clean water, universal *basic* education, immunizations, food security to name a few) that need to be addressed before the population of any nation can even start grooming and supporting ultra-specialists like scientists.

The other bad: not so much bad as an unfortunate consequence of the subject material is that sooner or later the ideas become incomprehensible. I imagine a lay reader finds very nearly everything about quantum mechanics bizarre and completely incompatible with their understanding of the world. I made it most of the way through before I couldn't internalize the concepts in a way that made any sense to me at all.

The ugly: I cringe when anybody stands up and says "X will CHANGE THE WORLD!!" The vast majority of the time it doesn't (especially when it's vaporware; nuclear fusion was supposed to change the world 30 years ago and is nowhere closer to being even vaguely useful than it was 50 years ago) and it's the things we didn't see coming that change everything (computers/internet cum smartphones, for example). Quantum computing is his amazing technology that isn't quite here yet but will, nonetheless, change everything and provide a path to fix all kinds of problems though it's not entirely clear how. It's all a bit starry-eyed for something that is mostly theory at the moment. The proof is in the pudding, and so far all we have is a few pudding recipes and some proto-pudding.

Stephane says

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Neil Turok.

I readily confess that I am not necessarily an optimist. When presented with a positive outcome in any given situation, I try to find ways it can go bad. Likewise, when someone paints a bleak picture of something, I try to find some good. I don’t know what that makes me, probably annoying, but I generally think that the best and the worst outcomes of any complex situation are equally possible.

Neil Turok, however, is clearly an optimist. He also really likes science and believes in it, as a force to shape society for the best. His enthusiasm is well taken, but it also causes him to be a little scattered. Fostering access to science, cosmology, history of science and quantum computing are all broach upon in his book, and that is amongst other topics. It is a lot, perhaps too much.

And we come to a passage like this one:

One proposal now being considered is to install highly sensitive biochemical quantum detector is every home. In this way, the detailed medical condition of everyone of us could be continuously monitored. The data would be transmitted to banks of computers which would process and screen it for any signs of risk. The results of any medical treatment and dietary change or any other intervention could be constantly gathered.

Turok think this is awesome, that it will allow us to live longer, healthier lives and get better medical care. Perhaps he is right. But me, on the other hand, I see myself bitterly holding a chocolate bar and not being willing to eat it, for fear of my insurance premium going up; or I imagine a world where ads for salty snacks start to pop up on my feed at the very instant I crack a beer open... where my boss knows how many beers I had last night. Now nobody needs that! Nobody needs either an increase of the blurring of needs vs. desires that targeted marketing instill.

Yet, Turok might still be right, he sees such data as being used for the common good; and I see it as being

used for profit and turned into a hacker's playground. In truth, it might probably be both. But we need people like Turok to chart the path, to structure and articulate a vision of science can and will improve everyone's life.

This is obviously an inconsequential passage in the book, but it might provide an idea of the perspective under which it is generally written. To be fair, I am certainly hopeful Turok's vision comes to life. I appreciate and agree with him that science is a powerful force generally for the good, but also that science in itself is not quite enough for us to apprehend and understand the world we live in. I think Turok would agree with me on that. There is modesty in his optimism that I found most welcomed.

Tom says

It appears that those seeking answers to the big questions around ontology and epistemology are more likely to be found in physics than philosophy. Neil Turok is the Director of the Perimeter Institute in Waterloo, Ontario and a protégé of Stephen Hawking (who is also on faculty at the Perimeter Institute). This book represents the Massey Lectures for 2012.
I began with great hopes that I would emerge with a better understanding of modern physics, but found the first half of the book almost impenetrable. Mind you he avoided any mathematics (ok there is one equation), but I think sometimes those who live in the world of advanced mathematics, and who try to explain it to the rest of us, are like the Korean/Chinese/Japanese workers who wrote the assembly instructions and directions for our appliances...sometimes baffling…sometimes infuriating.
With persistence it is possible to glean quite a lot from the book however. I particularly appreciated the historical review of physics in the 20th century. Planck-Maxwell-Bohr-Einstein et al were names learned in high school physics, but I did not appreciate how it all fits together until now. Just as Maxwell unified electricity, magnetism and light, Einstein unified space, time, energy, and gravity. To quote Einstein: "Before Maxwell, physical reality was thought of as consisting of material particles…Since Maxwell's time, physical reality has been thought of as represented by continuous fields." Einstein equated mass and energy.
The current debates about the models of the universe and its origins was helpful to read. In considering ontological questions like this, what distinguishes physics from philosophy is that the physicists seek experimental proof of their models.
Nevertheless, I find it very difficult to understand concepts such as space-time, or that gravity is the bending of space time, by matter. Unless, one is steeped in the mathematics behind these concepts, they seem quite distant from our day to day reality. This reminded me of Neil Stephenson's futuristic novel, Anathem, which portrays a time when those with advanced mathematical understanding are housed separately from the remainder of society.
Having read this, I am also reminded, of Northrop Frye's point that God is not a noun, but a verb

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Stefany GG says

Un repaso de la física moderna, con un lenguaje sencillo y esperanzador, como una llamada de atención para dejar de ser testigos desinformados y dar ese paso a tomar acciones e involucrarte en la ciencia. Plantea la necesidad de mantener una mente inquisitiva, ahondar en las profundidades de todo aquello que damos por sentado y ser partícipes de lo que está por venir. El autor, además, nos llama a abogar por una ciencia más humana donde las ideas sean llevadas a cabo por mentes brillantes conectadas a nuestra humanidad y la

naturaleza. Se necesitan urgentemente agentes de cambio, pero sobre todo agentes informados.

Brooke Graham says

I cried twice in the first chapter.

Beth says

Really 4 1/2 stars, because the author is repetitious in some parts.

Loved this book. Although it was right at the edge of my ability to understand parts of it, it was fascinating. Every 10 years or so, I like to catch up with the latest developments in the quantum world. This book is based on this year's Massey Lectures, a Canadian institution that always delivers an in-depth, thoughtful look at an interesting topic by a speaker who is knowledgeable and good at communicating.

This latest look at quantum physics caught me up on what has been discovered and is on the horizon, but better yet, put it in the context of what that means in my real life, now and in the future. In addition, Turok looks at the relationship between science and human striving, the relationship between scientists and the general population, and his take on the next steps in human evolution. He is a top-level scientist who is also a deep thinker and compelling communicator regarding our common human life. What a refreshing combination! Who would think that reading a book on quantum physics would give one inspiration and hope about our future!

Anna says

In spirit of #NonFictionNovember2016.
Listened to the final brilliant lecture today. Loved it!
I've never been good at physics, unfortunately, but this book gives me hope. Wish I've been taught by Neil Turok... He rocks!

Louis says

On a bit of a space and science kick recently and this the best out of what was on the shelf at the library fun. COuld be a bit preachy at times but it does line up with his message of needing all minds to look at bigger problems. wasn't really trying to guess at how quantum computers will be used but was more abstract about it. sounds both fascinating and terrifying. if you can prove that 2 things are linked no matter how far apart then prove that one is doing the opposite of the first when does the minority report come out? like the short introduction series, I'll probably check out more of these massy lectures (plus; its Canadian).

Ben Babcock says

Certain things just make Canadian public broadcasting awesome, and the Massey Lectures are one shining example. For one week, since 1961, with a few exceptions, CBC radio has broadcast annual lectures on a topic from philosophy or culture by notable figures. These lectures now get published in book format. Douglas Coupland's most recent novel, *Player One* , is an adaptation of the lectures he gave in 2010. Now Neil Turok, a noted physicist and current director of the Perimeter Institute, has had a go. With *The Universe Within*, Turok brings the very big and the very small to the forefront of public consciousness as he looks at cosmology and quantum physics and where science and society are going from here.

Just as the Massey Lectures themselves excite me, so too do books on science. There's just something so *decadent* about sinking into a good book explaining how the world works, and how we know this how the world works, and of course, all the affairs and scandals the people who learned how the world works had while learning it! Science and the history of science are intensely fascinating concepts. Turok has done his best to recap the better part of twentieth-century physics, with brief trips further into the past to bring us the origins of scientific thought in Anaximander and Pythagoras' Greece.

Turok begins with a passionate encomium of the power of science and mathematics to explain our world. Calling it "magic that works", he explains the origins of quantum mechanics, the most recent (and probably biggest) revolution in physics. From Max Planck to Einstein to Hawking and himself, Turok points out how quantum mechanics—which is normally only good on the small scale—could help us answer one of the biggest questions of all: how did the universe begin? He intersperses this tale with more personal stories of growing up in South Africa, Tanzania, and England, and of his own efforts to help raise the profile of science in Africa. (Indeed, Turok's perspective as a native of South Africa allows him to speak about the challenges facing African nations with an authority few renowned scientists possess. Let's hope that changes as Africa produces more renowned scientists!)

The links that Turok draws between quantum mechanics and cosmogony are interesting. The classical big bang theory and its inflationary addendum are the most well-known origin theories, but they have their drawbacks. Most notoriously, the big bang theory inevitably results in a singularity at time zero—a point where our mathematics are unable to make sense of the initial conditions of the universe. We can explain what happened 10^(-43) seconds after the beginning of the universe, but not what happened *at* the beginning. That's why some physicists, Turok included, are championing a **cyclical theory of big bangs** —and they are hoping quantum mechanics will help them prove it. Cyclical big bang theory side-steps the singularity problem through clever theorizing and equally clever math. It also offers an answer to another nagging physics problem: fine-tuning.

Physicists have, since the middle of the twentieth century, been able to summarize all of physics quite concisely. In fact, they can do it with a single, beautiful equation. It involves quite a few constants whose values have been measured or calculated to great precision—but we don't know *why* the constants have those values, other than that if they didn't, we wouldn't be here. Hence the **anthropic principle** : the universe is the way it is because if it weren't, we wouldn't be around to see it. The cyclical big bang theory negates the need for the anthropic principle, because it sees the birth and destruction of infinitely many universes.

Of course, having a theory and sensible is one thing. Having evidence is quite another, and that's what Turok needs next. I knew that gravitational waves are a predicted but not yet observed phenomenon of general relativity. I didn't know that detecting long wavelength gravitational waves in the cosmic background radiation would lend strength to inflationary theory! It's cool to find out how some of the experiments currently being conducted could affect contemporary competing theories. On a related note, this might be one of first books to note the discovery of the Higgs boson by the Large Hadron Collider. Turok doesn't mention that the Higgs' existence hasn't been officially acknowledged; we've detected *a* particle that is almost certainly what we'd call the Higgs boson, though we still need a little more data to call it a day. But I

forgive him because he’s probably very excited. So am I!

In the last part of the book, Turok shifts focus from cosmology to computer science. He explains the role of physics in developing computing and pays particular attention to the possibilities that might open up if we get **quantum computing** working. With a brief detour into Teilhard’s Omega Point and some name-checking of Marshall McLuhan, Turok settles down to discuss some of the difficulties facing us in pushing science to that next level. I sense that this is supposed to be the most important and profound part of the book, but it comes off as the weakest and least substantive. After an interesting hundred pages on the history of physics and the origin of the universe, the last chapter is a mixture of blue-sky enthusing for the future and realistic evaluations of our current challenges. In the end, it didn’t really leave me excited or inspired, though I certainly found the book informative and sometimes entertaining.

The Universe Within is part cosmology, part history, part philosophy. The first two are excellent in every respect. The last part has its moments but doesn’t quite integrate with the rest of the book. Perhaps this is a result of its adaptation from lectures, for the entire book has moments where it seems to lack focus or direction. Turok is at his best when he is explaining the link between history and physics—the how we know what we know part—and for that alone, this is a good book to read.

Chrissy says

This was a fairly quick read, enjoyable as a refresher on modern physics and inspiring as a call to arms for more-- better!-- scientific discovery. I do feel as though the tone failed at times to toe the line between being layman-accessible and being fully explanatory. I was occasionally bored by what seemed to me to be over-explanations of simple classical physics, but otherwise occasionally overwhelmed by the complexity of string theory; being a scientist myself, I have a hard time watching details get glossed over. That said, it's hard to know the extent to which this issue was a result of some flaw in Turok's writing or editing, rather than simply the seriously challenging nature of the material. Simplification of string theory or M theory, for example, is no small feat. Moreover, I may not be the target audience for a book like this... I'm no physicist, but I know a little about a lot of scientific fields. I almost feel I should be reading less and less accessible books on these topics to satisfy my curiosity.

One further caveat on my enjoyment of this book: despite the title and the image of a human brain on the cover, there is nothing in here relating to neuroscience at all. That will teach me to judge a book by its cover...

Daniel Kukwa says

An expansive look at what physics reveals to humanity, that manages to present a beautiful overview without completely shredding my brain. That said, it gets a point off for an odd and out-of-tune swipe at the Dawkins' brigade in the conclusion...as it chiding them for their bold temerity.

Ann says

This is a nice trippy book that swoops from formation of stars to the carbon and molybdenum in our bodies. There are many fascinating ideas and conjunctions, and it's fun to read. HOWEVER, right in the middle the author states, "Bodies are pulled to earth to a degree that is proportional to their mass.... Lighter animals accelerate less during a fall than do big ones for these same reasons."
Wait a minute, this was shortly after a discussion of Galileo. Didn't he disprove this theory from the Tower of Pisa?
After this, I have trouble believing what I'm reading. Too bad.

Kaitlyn says

Turok explains concepts clearly and conversationally. His approach is that science should be accessible to all and scientists should engage with those in the fields of history, art, literature, and music—we all share the same goal, to explore and appreciate the universe and cooperation is the way of the future. An incredibly inspiring book.

Jason Williams says

The Universe Within: From Quantum to Cosmos by Neil Turok

I had not heard of Neil Turok before, but as a book from the Massey Lectures it was sure to be thought provoking.

While not as in-depth as some of the more popular recent physics books, it does illuminate the names of some researchers and scientists that I had not encountered before.

Turok is enthused about the potential of recent finds in the field, and the book is incredibly up-to-date with summations of the recent CERN discoveries about the Higgs Bosun particle.

There is s great deal of speculation that the information age will enable brilliant minds in third world countries to make their own contributions to the field of physics. Turok is involved in a school system in Africa to seek out the best minds and provide them with a space to learn and explore their own ideas.

Towards the end of the book his enthusiasm turns to a bit of speculation with paragraphs like this:

"With their vast information processing capacities, quantum computers may be able to monitor, repair or even renew our bodies. They will allow us to run smart systems to ensure that energy and natural resources are utilized with optimal efficiency. They will help us to design and oversee the production of new materials, like carbon fibres for space elevators and antimatter technologies for space propulsion."

The book is an interesting read, although the first section covers much of the same ground, in an introductory manner, as other books in this genre.
