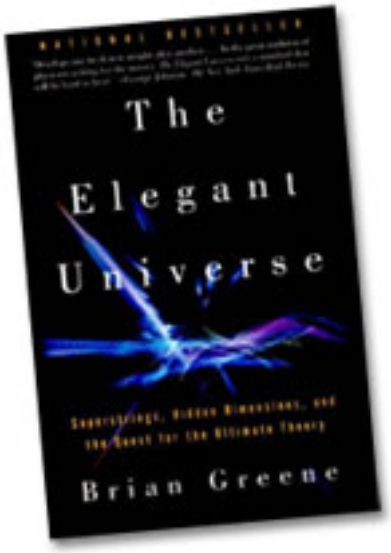
# Brian Green: Book Reviews

## Science as Metaphor

# Where does Brian Greene stand in the pantheon of physicists?

By Amanda Schaffer| Posted Tuesday, July 6, 2004, at 9:16 AM ET




With his 1999 best seller *The Elegant Universe*, a *NOVA* special, and the recent release of a second book, *The Fabric of the Cosmos*, Columbia professor Brian Greene has become the closest thing that physics has to a pop star. A Harvard grad and former Rhodes scholar, lured in 1996 from a professorship at Cornell to a tenured position at Columbia, he has emerged as the chief ambassador of string theory, bringing cutting-edge work to the public in a series of TV appearances and lectures around the globe. His celebrity can be attributed to a widespread popular appetite for avant-garde science dressed in neat metaphorical packages: The universe is elegant; the cosmos is like a string symphony. Yet there is plenty to be suspicious of in Greene's unself-conscious romanticism—his un-nuanced use of terms like elegance and beauty—and his teleological approach to the history of physics. Where, exactly, does he stand in the pantheon of physicists?

Greene may be treated as a kind of New Age, scientific guru by the public, but scientists disagree about the significance of his scholarly work. Each time Greene is featured or reviewed on television or in a magazine, one of string theory's aged, cranky critics is trotted out to offer harsh assessments. (These seem to have had no impact on the public's fascination.) In the *NOVA* special, Nobel laureate Sheldon Glashow drove home the obvious but downplayed fact that string theory has not been—and may never be—experimentally verified, and that it may be more philosophy than physics. More recently, in the *New York*

*Review of Books*, Freeman Dyson, an octogenarian and self-proclaimed "old conservative, out of touch with the new ideas," suggested that string theory may simply be one of history's "fashionable" ideas, the kind that flourish briefly, then forever fade away. Glashow and Dyson raise important points. But in the eyes of a captivated public, such reservations appear to be little more than theoretical technicalities.



First, a quick bit of background: String theory—and superstring/M theory, a variant—both propose a scheme that encompasses two major and previously incompatible scientific frameworks, general relativity and quantum mechanics. General relativity describes gravity in terms of the curvature of space-time by matter/energy and successfully quantifies the very large. Quantum mechanics, on the other hand, explains the behavior of atoms and subatomic particles, characterizing the very small. String theory seeks to unify the mathematics of these colliding theories by positing that all matter and all fundamental forces can be described in terms of the vibrations of tiny, one-dimensional strings. (Mathematically, the theory also requires the existence of multiple, extra dimensions, said to be "curled-up" and as such beyond the realm of our sensory experience.) Greene likens the wiggling strands of string theory to the strings of musical instruments. In his telling, not only do different patterns of vibration produce different particles, but the whole universe is "akin to a string symphony vibrating matter into existence."

Greene will go to nearly any metaphorical lengths to elucidate complex physics. To guide his readers through key concepts, he concocts elaborate scenarios often characterized by cute and slightly corny imagery. (Indeed, his writing is characterized by the rhetoric of self-help literature.) At one point, for instance, he asks us to imagine we've had a bad day—our favorite team lost, our birthday was forgotten, the "last chunk of Velveeta" was eaten by someone else—and tells us to imagine that we then take a boat out on a lake, where "beautiful moonlight reflections dance" on the water's surface. In his eagerness to prod our imaginations—and to make the science non-threatening—Greene indulges in a pandering sort of lyricism. Compared even to other pop-star scientists eager to draw a broad audience, like Stephen Jay Gould and Richard Feynman before him, he seems to work unusually hard to keep the general reader reading.

True, Greene's technical explanations are often effective. Yet the strain of romanticism that emerges—and ultimately becomes inextricable from the discussion of string theory—necessarily raises questions. Greene plays fast and loose with terms like beauty and elegance, using them in a semi-classical, semi-romantic sense, with little distinction between equations and the "reality" they may represent.

In Greene's view, an equation that funnels vast complexity into a simple, logical formulation is elegant; a universe that conforms to such an equation is elegant and therefore beautiful as well. In essence, he follows in the tradition of Einstein, who famously said, "Make everything as simple as possible, but no simpler." Greene himself is even more explicit: "The tantalizing discomfort of perplexity is what inspires otherwise ordinary men and women to extraordinary feats of ingenuity and creativity; nothing quite focuses the mind like dissonant details awaiting harmonious resolution." Greene treats scientific work as a kind of poetic quest, and beauty as crucial evidence of truth. As he makes the case for string

theory, we can almost hear Keats in the background whispering "beauty is truth, truth beauty."

This approach is not risk-free. Although many features of the physical world do conform to simple equations, there is no guarantee that the unknown will be "elegant" as well. That is to say, research may be prejudiced by aesthetic considerations, and as a result, we may miss out on truths that turn out to be messy and inelegant. Some, including Glashow, worry that many talented young physicists are drawn to the hip realm of string theory and pay virtually no attention to experimental work: "What we do is not of any direct interest to them," Glashow told *NOVA*. (Dyson goes so far as to say that quantum mechanics and relativity need not be reconciled at all, though he is clearly in the minority here; most physicists would agree that some theory capable of bridging general relativity and quantum mechanics would eventually be needed for a full understanding of black holes, for instance, or of the Big Bang.)

Greene's unifying impulse also informs his reading of history in ways that would not please a historian of science. His tale is an end-oriented one, a story of increasing progress, synthesis, and unity: "The explanatory arrow seems to be converging on a powerful, yet-to-be discovered framework that would unify all of nature's forces and all of matter within a single theory capable of describing all physical phenomena." Is this where physics has been headed all along? Or are string theorists indulging in a bit of "hubris," as Glashow and other critics contend? Greene's work is seductive in part because it puts forth the notion that we occupy a special place in the history of ideas; we are on the verge of an ultimate discovery, an idea to end all ideas. This is a dazzling vision—but it is also, statistically speaking, unlikely.

One alternative, usefully laid out by Dyson in the *NYRB*, is that the history of contemporary physics is propelled by cycles of revolutionary and conservative thinkers—"those who build grand castles in the air and those who prefer to lay one brick at a time on solid ground." In Dyson's schema, revolutionaries like Werner Heisenberg, Erwin Schrodinger, and Einstein were succeeded by conservatives like Richard Feynman and Dyson himself, who work out crucial details without overturning frameworks wholesale. Nicely implicit in Dyson's formulation is the idea that there is no end to science; there are moments of revolutionary change, but the process side steps, back steps, and repeats—and will continue to do so.

So what does it say about the cross-talk between science and popular culture that Brian Greene is a celebrity and Freeman Dyson is not? First, the particular state of physics today allows for the expansiveness and wonder championed by Greene: String theory has not been proved right, but it hasn't been proved wrong, either. In fact, given its un-provability, it might be "permanently safe" (Glashow again) from meaningful refutation. Thus it serves as a perfect canvas on which idealism, optimism, and romanticism can be easily projected. Greene himself confides that scientific research has made him "feel a closer connection to the cosmos; I've found that you can come to know the universe not only by resolving its mysteries, but also by immersing yourself within them." It's easy to see, then, why those inclined toward New Age thinking, or who search for spiritual significance in the material world, would find Greene highly attractive; Deepak Chopra would love Brian Greene (though the reverse is probably not true). The very qualities that make fellow scientists

skeptical—the obsession with elegance, the quasi-spiritual shtick—are precisely what dazzle a public hungry for meaning.

# Multiple-Universe Theory Made, Well, Easier

**By JANET MASLIN**

**Published: January 26, 2011**

It would not be fair to describe the experience of reading the renowned physicist Brian Greene as a battle of wits. It's no battle. Most of the wits are on one side, no matter how nicely Mr. Greene tries to soft-pedal his brilliance. After all, he is the scientist who has written so enticingly about superstring theory, Calabi-Yau manifolds and the goings-on at the Large Hadron Collider. You are the one who gets agitated when Mr. Greene makes reference to "conformally invariant supersymmetric quantum gauge field theory" and such.

**Andrew Cross**

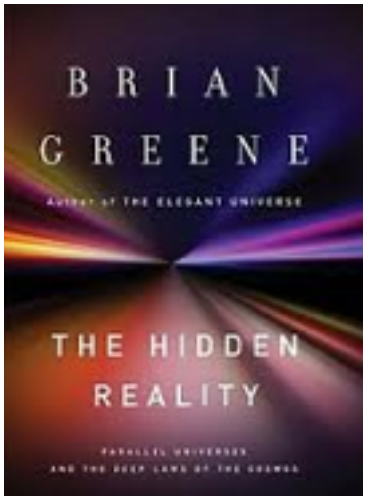
Brian Greene

**THE HIDDEN REALITY (2011)**

**Parallel Universes and the Deep Laws of the Cosmos**

By Brian Greene

Illustrated. 370 pages. Alfred A. Knopf. $29.95.



**Related**

Excerpt: 'The Hidden Reality' (randomhouse.com)

- **Sunday Book Review: 'The Hidden Reality' by Brian Greene (February 6, 2011)**

But there is very good reason to go mano a mano with Mr. Greene when he delivers a new book. He has already written "The Elegant Universe" and "The Fabric of the Cosmos," two heady but surprisingly accessible explanations of thrillingly arcane research. Reading them is far more edifying than baffling, even if they have patches of authorial quicksand here and there. Over all, Mr. Greene has a gift for elucidating big ideas and knowing that a bombardment of too many small ones might make the armchair physicist implode.

"The art of theoretical physics lies in simplifying the horrendously complex so as to preserve essential physical features while making the theoretical analysis tractable," he writes encouragingly in his latest mind-bender, "The Hidden Reality." To put that in even more user-friendly fashion, Mr. Greene values "the art of knowing what to ignore."

He says this at the very the start of the new book. And it is a necessary reassurance, especially when Mr. Greene offers a preliminary idea of what subjects he will be taking on. This book explores the idea of parallel universes, the array of different forms they might take, the wigginess of their implications ("this would blow Newton's mind"), the wild extremes that can be extrapolated from such conjectures and the challenge of backing up theory with scientific proof. Yet his book's first page promises that it will take "no expertise in physics or mathematics on the part of the reader" to keep up.

He lays more groundwork for the readability of "The Hidden Reality" when he puts certain groundbreaking, now basic ideas in their proper perspective. In 1919, when astronomical observations validated Einstein's 1915 predictions about planetary motion, The New York Times ran an article with the headline "Lights All Askew in the Heavens, Men of Science More or Less Agog." Now, Mr. Greene points out, nobody's agog — and you're apt to be walking around with a hand-held device that has a GPS, the accuracy of which can be traced to Einstein. Perhaps future generations will similarly take in stride the thought of parallel universes — and not just the kinds that are a mainstay of comic books and science fiction.

"The Hidden Reality" starts small (sort of) by raising the question of whether space is infinite or finite. Then it segues to the cosmological principle ("the assumed homogeneity of the cosmos") and that principle's implications for how a multiverse (a plural for "universe") might be configured. A little further on in this same early chapter, Mr. Greene, who relies on earthly reference points like "South Park" and "The Honeymooners" to simplify difficult concepts, imagines a woman who has many shoes. Calling her Imelda, he uses her wardrobe permutations to make a more abstract point: "an infinite number of appearances with a finite number of outfits ensures infinite repetition."

This chapter is called "Endless Doppelgängers." It builds upon the idea that infinite variations of ourselves, our lives and our solar system are within the theorist's realm of possibility. Got that? Mr. Greene then moves to "Eternity and Infinity," and soon he is

introducing both inflationary cosmology, which is one thing, and the inflation (sic) field, which is quite another, in a book that desperately needs a glossary. (It doesn't have one. And its illustrations aren't as helpful as they might be.)

Then he sets forth colossal numbers that are "so extreme that they defy analogy." But he offers an analogy anyway, and it's the kind that make his book so startling: "They imply that a region of space the size of a pea would be stretched larger than the observable universe in a time interval so short that the blink of an eye would overestimate it by a factor larger than a million billion billion billion."

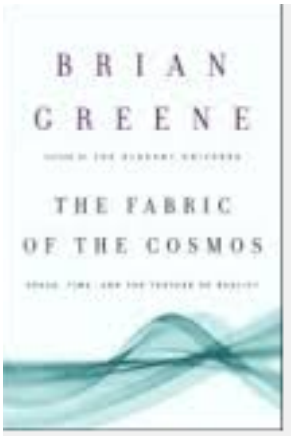
By now, the 11-dimension string theory models of his earlier books (to which Mr. Greene helpfully steers the reader for background material) are looking downright commonsensical. "The Hidden Reality" moves on to increasingly speculative and exotic discussions of a bubble multiverse ("Think of the universe as a gigantic block of Swiss cheese. ...") a holographic one, a brane-world scenario (courtesy of string theory), computer-driven simulations, questions of how probability relates to infinity, and the Many Worlds view of quantum mechanics. "A frequent criticism of the Many Worlds approach is that it's just too baroque to be true," Mr. Greene writes. Readers aren't apt to disagree.

"My taste is for the expansive," Mr. Greene writes late in the book. "But I draw the line at ideas that have no possibility of being confronted meaningfully by experiment or observation, not because of human frailty or technological hurdles but because of the proposals' inherent nature." Thus, the ninth and last multiverse under discussion ("the Ultimate Multiverse") is seen as so far beyond the bounds of scientific proof that "The Hidden Reality" has reached its limit. That's where it leaves Mr. Greene. Where will this book leave you?

Bottom line: It's exciting and rewarding to read him even when the process is a struggle. This book is significantly more difficult than his earlier ones, but it still captures and engages the imagination. It can veer from eye-glazing passages to simple, crystal-clear thoughts (bubble universes appear finite from the inside but infinite from the outside; got it!), only to get lost again when stringy geometry and sticky branes enter the fray. It can make you wish Tom Lehrer were setting this stuff to music. And it can make you marvel at the thought of a parallel universe in which you read "The Hidden Reality" and every word makes perfect sense to you. That won't happen in this one

# 'Fabric of the Cosmos' review: time, space and string theory

**Theoretical physicist Brian Greene guides laymen through an understanding of the universe on PBS.**



November 02, 2011| By Robert Lloyd, Los Angeles Times Television CriticScience, which is confusing to many people — some to the point that they regard it as a form of superstition — has always needed its champions, its spokespersons, its interpreters, big brains who also function efficiently as celebrities and have a knack for taking impossible-sounding theories and making them sound, at least for the moment they're speaking, comprehensible.

Here comes Brian Greene, again. (He is TV's favorite theoretical physicist.) Like Carl Sagan and Stephen Hawking before him, Greene — whose "The Fabric of the Cosmos" begins a four-week run Wednesday in the framework of the PBS series "Nova" — is both mediagenic and a working scientist. You feel that he is telling you what he thoroughly knows, not stuff he had to write down to remember.

Based on Greene's 2005 book of the same name, "The Fabric of the Cosmos" is a sequel in content and form to his 2003 Peabody Award-winning series, "The Elegant Universe," also based on a book of the same name. I've seen the first two of its four episodes, dealing with space and time, two things that get more complicated the more you stare at them; the second two will look at quantum mechanics and the multiverse. The series necessarily condenses the book — a book I have partly read and have possibly partly understood — which runs 493 pages, not counting the footnotes. But your head will still be full by the time it gets done with you. Some spillage should be expected; you may need to watch it again.

Sagan, an outward-gazing astronomer whose 1980-81 series "Cosmos" was subtitled "A Personal Journey," personified the scientist as poet: "the cosmos in which we float like a mote of dust in the morning sky" is a typical Saganism. Greene, whose main interest is subatomic string theory and the extra, invisible dimensions that are required to mathematically reconcile the differing physics of big objects and small, is by contrast a bit of a comedian, a puckish guide to places where nothing makes ordinary sense and life among the particles is a nonstop party of creation and annihilation. Even the emptiness that makes up most of the universe — if you sucked out all the space from between the atoms of the Empire State Building, we're told, you'd have something like a grain of rice weighing hundreds of millions of pounds, which seems totally useless as a building or as rice — teems with activity.

Appropriately, the series is a busy, noisy affair, with the host now here, now there, by a river, in Times Square, in a cab, in a pool hall, digitally inserted into a space-time port of the future. (The green-screened skits can slow down Greene some; at times "Fabric" has the feel of "Blue's Clues.") The production makes concrete the metaphors by which the unmathematical must grasp the arcane — a discussion of time's arrow requires an arrow, Isaac Newton's description of space as a stage leads us to a theater. The Higgs Field, which is supposed to give particles their mass, is pictured as a crowd of paparazzi at a film premiere, lending varying weight to the major and minor celebrities whose progress it does or does not impede.

Greene and his guest brainiacs do have a tendency to speak about things like parallel planes, black holes and the end of time as if they were places one could actually hang out, an

impression the accompanying computer animations reinforce. Conversely, most of us do not see ourselves as molecules, atoms or vibrating strings. The old illusions stay fast, the old metaphors still work. But it's good, anyway, to know them for what they are.

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