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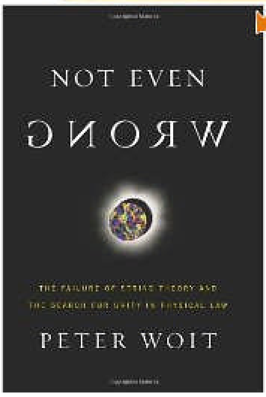

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Not Even Wrong: The Failure of String Theory and the Search for Unity in Physical Law [Hardcover]

Peter Woit (Author)

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Publication Date: **September 4, 2006** | ISBN-10: **0465092756** | ISBN-13: **978-0465092758** | Edition: **1ST**

At what point does theory depart the realm of testable hypothesis and come to resemble something like aesthetic speculation, or even theology? The legendary physicist Wolfgang Pauli had a phrase for such ideas: He would describe them as "not even wrong," meaning that they were so incomplete that they could not even be used to make predictions to compare with observations to see whether they were wrong or not. In Peter Woit's view, superstring theory is just such an idea. In *Not Even Wrong*, he shows that what many physicists call superstring "theory" is not a theory at all. It makes no predictions, even wrong ones, and this very lack of falsifiability is what has allowed the subject to survive and flourish. *Not Even Wrong* explains why the mathematical conditions for progress in physics are entirely absent from superstring theory today and shows that judgments about scientific statements, which should be based on the logical consistency of argument and experimental evidence, are instead based on the eminence of those claiming to know the truth. In the face of many books from enthusiasts for string theory, this book presents the other side of the story.

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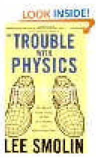

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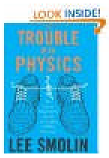

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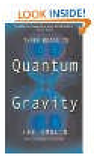

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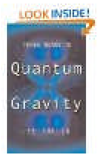

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Editorial Reviews

From Publishers Weekly

String theory is the only game in town in physics departments these days. But echoing Lee Smolin's forthcoming *The Trouble with Physics* (Reviews, July 24), Woit, a Ph.D. in theoretical physics and a lecturer in mathematics at Columbia, points out—again and again—that string theory, despite its two decades of dominance, is just a hunch aspiring to be a theory. It hasn't predicted anything, as theories are required to do, and its practitioners have become so desperate, says Woit, that they're willing to redefine what doing science means in order to justify their labors. The first half of Woit's book is a tightly argued, beautifully written account of the development of the standard model and includes a history of particle accelerators that will interest science buffs. When he gets into the history of string theory, however, his pace accelerates alarmingly, with highly sketchy chapters. Reading this in conjunction with Smolin's more comprehensive critique of string theory, readers will be able to make up their own minds about whether string theory lives up to the hype. *(Sept.)*

Review

"Woit offers some intriguing ruminations on the relationship between physics and mathematics..." -- *New York Times Book Review, 9/17/06*

"[A]n intriguing view of a significant scientific controversy..." -- *Library Journal, 8/15/06*

"[L]ively and entertaining" -- *Discover Magazine, September 2006*

See all Editorial Reviews

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“*Before they read the book, I had some (perhaps not very much) worries that they may be turned off from science (at least from physics.)*”
physics lover | 7 reviewers made a similar statement

“*"The Trouble with Physics" was an easier read, and so if you are a layman with a basic knowledge of physics, this book would be for you.*”
Dusty Matter | 4 reviewers made a similar statement

“*His arguments are very persuasive, and his writing clear and to the point.*”
Dr. Bojan Tunguz | 5 reviewers made a similar statement

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A high-strung but interesting and helpful polemic on string theory
September 4, 2006

By Dr. Lee D. Carlson HALL OF FAME VINE VOICE
Format: Hardcover | Amazon Verified Purchase

String theory is a formidable subject to learn, both from a physical and mathematical standpoint. But it is even a harder subject to teach to an audience of non-experts, not because its ideas are hard to express verbally in front of this audience, but because its practitioners sometimes feel it is beneath them to do so. Those who are not familiar with string theory but are curious as to its conceptual foundations might therefore be left to themselves to pursue an understanding of these foundations. However such an understanding can be obtained, for there are of late a few books that have been written by experts in string theory that are targeted to a readership that have a strong desire to learn the subject.

The author of this book recognizes the paucity of expository material on string theory, particularly that dealing with the mathematical formalism, and although this book is a polemic against string theory and its status as a physical and scientific theory, the author introduces (perhaps on purpose) the reader to the theory in a way that is understandable without sacrificing scientific accuracy. But the book could also be of interest to more advanced readers, i.e. those (such as this reviewer) who have a thorough understanding of the physics and mathematics behind string theory but who are not conducting research in it. The author demands rightfully that scientific theory must be testable or at least must have some amount of empirical predictions. He pulls no punches in his critique of string theory, and is very open about what he thinks are the motivations behind those who are actively involved in it. Read more ›

16 Comments | **Was this review helpful to you?** Yes No

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A timely and honest critique September 12, 2006

By Dr. Bojan Tunguz HALL OF FAME TOP 50 REVIEWER VINE VOICE

Format: Hardcover

I've been following the arguments made by Peter Woit against String Theory for quite some time, and it's a pleasure to be able to have them all in a single volume. His arguments are very persuasive, and his writing clear and to the point. This, however, is not a book that the general audience will find easy to follow. The earlier chapters recount the canonical story of the success of the particle physics in the 20th century, and if you are familiar with that story you can safely skip these chapters. The later chapters are the really interesting ones, but unless you have at least some familiarity with theoretical particle physics and the modern mathematics, you might find yourself lost. Even with that caveat it is still possible to appreciate the central theme of this book: theoretical particle physics took a wrong turn somewhere in the late 70s and the early 80s, and has never been able to recover from this. Woit is appealing in this book to the practitioners in the field to be more honest with their assessments of the direction in which the theoretical particle physics is headed, and the lack of any meaningful progress.

Unfortunately, I am very sceptical of the potential impact of this book on the field of particle physics. The Emperor is naked, but he is perceived as irrelevant as well.

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104 of 114 people found the following review helpful

Open mind September 4, 2006

By Couder

Format: Hardcover

The first part - essentially an account of the development of the standard model - really isn't aimed at the layperson at all - the total lack of equations notwithstanding. I much prefer F. Close's "The Cosmic Onion" (released in 1983 but a new edition called "The New Cosmic Onion" is now available), Veltman's "Facts and Mysteries in Elementary Particle Physics" or even Lisa Randall's account in her very popular "Warped passages". However, Peter Woit does show some originality in approaching the matter from a mathematician's point of view, and in elucidating the important role of Hermann Weyl in the development of quantum mechanics, something you certainly won't find in other popular books on theoretical physics.

The second part sets out to prove that String Theory (ST), the acclaimed (or proclaimed?) successor of the standard model - is "not even wrong", meaning that this theory can't even be falsified. A very ungrateful task, given a) the attractiveness String Theory noticeably exerts on both professional theoretical physicists and laypersons alike (as evidenced by the huge popularity of Brian Greene's and Michio Kaku's books, amongst others); and b) the fact that alternative (and far less celebrated) approaches seem to be - from a layman's perspective at least - as tentative as ST.
I cannot say his strategy appears to be very coherent - we rather get a succession of pinprick attacks. Each of those in itself would probably not have convinced me there was something wrong with ST, but taken together, they succeed in making ST far less incontestable than some popular science writers would have us believe.
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Good book. Elucidating subjects like this is not easy. Most readers will be well educated and the interested ones will welcome a deeper explanation than was provided. Read more
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A bit difficult for the casual reader
I bought this book as I have a passing interest in String Theory as a physics graduate from U.C. Berkeley almost 30 years ago. Read more
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Huh? August 28, 2006

By Free Thinker

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It is said that over the entrance to Plato's Academy hung a sign that read "let no one ignorant of geometry enter these walls." A similar sign should be posted on the cover of this book, also mentioning a knowledge of calculus, algebra, and number theory. Nonetheless it is a very good book which illustrates how fads and peer pressure can effect even the most dispassionate among us.

It's basic message can be summed up as follows: 20th century physics did a great job of explaining how the world works. By 1975 the fundamentals of underlying reality were pretty well understood, save for a few loose threads. The most troublesome of these was the question of how to explain gravity in a way that harmonized with quantum mechanics.

A group of well-meaning mathematicians and physicists developed an idea called string theory to solve this final problem.From the first it appealed to many as an elegant and beautiful theory, and soon the physics community was singing its praises.

Unfortunately, many decades later, it remains not only unproven but unprovable. No one has yet devised a way to make predictions from it that can be proven true or falsified, ex. the claim that there are dimensions beyond the four we currently experience. Without the ability to empirically examine its claims, it is not science, but rather a form of mathematical philosophy. Given this, it behooves the scientific community to look in other directions for a true unified field theory.

It takes the author 275 pages to say this, and along the way he dumps on heavy doses of higher math terminology which will leave the unitiated with their heads spinning. Being no mathematician, I was sent to the dictionary numerous times seeking meanings for several of the terms he threw out. Read more ›

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string theory is an area of mathematics

That is the author's contention, and it is difficult to disagree with. String theory has created a lot of interesting mathematics, and has shown mathematicians that the physicists'... Read more

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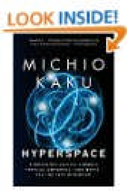

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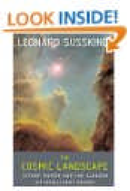

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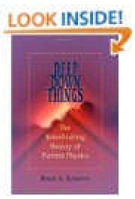

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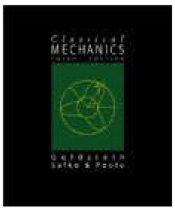

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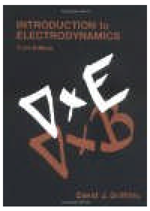

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Is String Theory Even Wrong?

Peter Woit

For nearly 18 years now, most advanced mathematical work in theoretical particle physics has centered on something known as string theory. This theory is built on the idea that elementary particles are not point-like objects but are the vibration modes of one-dimensional "string-like" entities. This formulation hopes to do away with certain lingering problems in fundamental particle physics and to offer the possibility of soon explaining *all* physical phenomena everything from neutrinos to black holes with a single theory. Fifteen years ago Edward Witten of the Institute for Advanced Study made the widely quoted claim that "string theory is a part of 21st-century physics that fell by chance into the 20th century," so perhaps it is now time to begin judging the success or failure of this new way of thinking about particle physics.

The strongest scientific argument in favor of string theory is that it appears to contain a theory of gravity embedded within it and thus may provide a solution to the thorny problem of reconciling Einstein's general relativity with quantum mechanics and the rest of particle physics. There are, however, two fundamental problems, which are hard to get around.

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First, string theory predicts that the world has 10 space-time dimensions, in serious disagreement with all the evidence of one's senses. Matching string theory with reality requires that one postulate six unobserved spatial dimensions of very small size wrapped up in one way or another. All the predictions of the theory depend on how you do this, but there are an infinite number of possible choices, and no one has any idea how to determine which is correct.

The second concern is that even the part of string theory that is understood is internally inconsistent. This aspect of the theory relies on a series expansion, an infinite number of terms that one is supposed to sum together to get a result. Whereas each of the terms in the series is probably finite, their sum is almost certainly infinite. String theorists actually consider this inconsistency to be a virtue, because otherwise they would have an infinite number of consistent theories of gravity on their hands (one for each way of wrapping up six dimensions), with no principle for choosing among them.

The "M" Word

These two problems have been around since the earliest work on string theory along with the hope that they would somehow cancel each other out. Perhaps some larger theory exists to which string theory is just an approximate solution obtained by series expansion, and this larger theory will explain what's going on with the six dimensions we can't see. The latest version of this vision goes under the name of "M-theory," where the "M" is said variously to stand for "Membrane," "Matrix," "Mother," "Meta," "Magic" or "Mystery" although "Mythical" may be more appropriate, given that nearly eight years of work on this idea have yet to lead to even a good conjecture about what M-theory might be.

The reigning Standard Model of particle physics, which string theory attempts to encompass, involves at its core certain geometrical concepts, namely the Dirac operator and gauge fields, which are among the deepest and most powerful ideas in modern mathematics. In string theory, the Dirac operator and gauge fields are not fundamental: They are artifacts of taking a low-energy limit. String theorists ask mathematicians to believe in the existence of some wonderful new sort of geometry that will eventually provide an explanation for M-theory. But without a serious proposal for the underlying new geometry, this argument is unconvincing.

The experimental situation is similarly bleak. It is best described by Wolfgang Pauli's famous phrase, "It's not even wrong." String theory not only makes no predictions about physical phenomena at experimentally accessible energies, it makes no precise predictions whatsoever. Even if someone were to figure out tomorrow how to build an accelerator capable of reaching the astronomically high energies at which particles are no longer supposed to appear as points, string theorists would be able to do no better than give qualitative guesses about what such a machine might show. At the moment string theory cannot be falsified by any conceivable experimental result.

There is, however, one physical prediction that string theory does make: the value of a quantity called the cosmological constant (a measure of the energy of the vacuum). Recent observations of distant supernovae indicate that this quantity is very small but not zero. A simple argument in string theory indicates that the cosmological constant should be at least around 55 orders of magnitude larger than the observed value. This is perhaps the most incorrect experimental prediction ever made by any physical theory that anyone has taken seriously.

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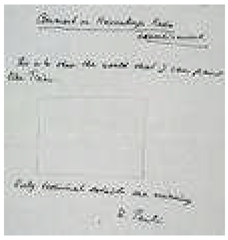

With such a dramatic lack of experimental support, string theorists often attempt to make an aesthetic argument, professing that the theory is strikingly "elegant" or "beautiful." Because there is no well-defined theory to judge, it's hard to know what to make of these assertions, and one is reminded of another quotation from Pauli. Annoyed by Werner Heisenberg's claims that, though lacking in some specifics, he had a wonderful unified theory (he didn't), Pauli sent letters to some of his physicist friends each containing a blank rectangle and the text, "This is to show the world that I can paint like Titian. Only technical details are missing." Because no one knows what "M-theory" is, its beauty is that of Pauli's painting. Even if a consistent M-theory can be found, it may very well turn out to be something of great complexity and ugliness.

What exactly *can* be said for string theory? In recent years, something called the Maldacena conjecture has led to some success in using string theory as a tool in understanding certain quantum field theories that don't include gravity. Mathematically, string theory has covered a lot of ground over the past 18 years and has led to many impressive new results. The concept of "mirror symmetry" has been very fruitful in algebraic geometry, and conformal field theory has opened up a new, fascinating and very deep area of mathematics. Unfortunately for physics, these mathematically interesting parts of string theory do little to connect it with the real world.

String theory has, however, been spectacularly successful on one front public relations. For example, it's been the subject of the best-selling popular science book of the past couple years: *The Elegant Universe* by Brian Greene, one of my colleagues at Columbia. The National Science Foundation is funding a series of *NOVA* programs based on his accessible and inspiring book. What is more, the Institute for Theoretical Physics at the University of California, Santa Barbara, organized last spring a conference to train high school teachers in string theory so that they can teach it to their students. And *The New York Times* and other popular publications regularly run articles on the latest developments in string theory.

It's easy enough to see why the general public is taken with string theory, but one wonders why so many particle theorists are committed to working on it. Sheldon Glashow, a string-theory skeptic and Nobel-laureate physicist at Harvard, describes string theory as "the only game in town." Why this is so perhaps has something to do with the sociology of physics.

During much of the 20th century there were times when theoretical particle physics was conducted quite successfully in a somewhat faddish manner. That is, there was often only one game in town. Experimentalists regularly discovered new and unexpected phenomena, each time leading to a flurry of theoretical activity (and sometimes to Nobel prizes). This pattern ended in the mid-'70s with the overwhelming experimental confirmation and widespread acceptance of the Standard Model of particle physics. Since then, particle physics has been a victim of its own success, with theoreticians looking for the next fad to pursue and finding it in string theory.

One reason that only one new theory has blossomed is that graduate students, post-docs and untenured junior faculty interested in speculative areas of mathematical physics beyond the Standard Model are under tremendous pressures. For them, the idea of starting to work on an untested new idea that may very well fail looks a lot like a quick route to professional suicide. So some people who do not believe in string theory work on it anyway. They may be intimidated by the fact that certain leading string theorists are undeniably geniuses. Another motivation is the natural desire to maintain a job, get grants, go to conferences and generally have an intellectual community in which to participate. Hence, few stray very far from the main line of inquiry.

Affirmative Actions

What can be done to inject more diversity of thought into this great quest of theoretical physics? Even granting that string theory is an idea that deserves to be developed, how can people be encouraged to come up with promising alternatives? I would argue that a good first step would be for string theorists to acknowledge publicly the problems and cease their tireless efforts to sell this questionable theory to secondary school teachers, science reporters and program officers.

The development of competing approaches will require senior string theorists to consider working on less popular ideas and begin encouraging their graduate students and post-docs to do the same. Instead of trying to hire people working on the latest string-theory fad, theory groups and funding agencies could try to identify young mathematical physicists who are exploring completely different avenues. (Pushing 45, I no longer qualify.) Finding ways to support such people over the long term would give them a much-needed chance to make progress.

Although I am skeptical of science writer John Horgan's pessimistic notion that physics is reaching an end, the past 15 years of research in particle theory make depressingly clear one form such an end could take: a perpetual, well-promoted but never-successful investigation of a theory that has no connection with the physical world. If only physicists have the will to abandon a failed project and start looking for some new ideas, this sad fate can be avoided.

Comment on Peter Woit's blog („Not Even Wrong") on „Multiverse Mania"

(http://www.math.columbia.edu/~woit/wordpress/?p=4447&cpage=1#comment-104367)

February 22, 2012 at 11:03 am

Peter, I share your reservations regarding the many-worlds-hype (as far as it is a hype), but you have to differentiate:

Max Tegmark's level 1 appears trivial to me, since any possible state must exist within any given approximation at a sufficient distance in a presumed infinite universe. However, proposed numbers for distances are usually quite unrealistic if they are based on mere chance fluctuations (such as "Boltzmann brains") and do not consider an evolutionary universe of given age. (I have never seen realistic estimates for the rate of evolution of specific life forms per volume, for example, but I don't actually care for such trivial doppelgangers at huge distances.)

If you give up homogeneity (as you do in inhomogeneous inflationary models, usually presented at his level 2), you may speculate about all kinds of "landscapes" and ages, including bubble universes and all that, but any estimates must depend on your specific speculation – so here is the true hype.

The original many worlds concept (Everett) is given by his level 3. They do not exist somewhere in space and time, but somewhere else in what we classically call configuration space.[*] In contrast to all other levels, these many worlds are NOT science fiction, since they are solely based on the empirically well founded Schrödinger equation. (I would instead regard collapse theories or hidden variables, when used to avoid Everett's conclusion, as science fiction.) Unfortunately, David Deutsch introduced considerable confusion, when he turned Everett's proposal into science fiction by considering time travel between different "worlds" (in conflict with Schrödinger and decoherence, for example), or when he regarded quantum computers as calculating in parallel worlds. This parallelism would be no more than the superposition principle. If quasi-classical "worlds" are defined to split according to

[*] Note added: Every Everett „world" will in general represent a whole multiverse in the sense of level 1 and 2 – possibly including its own spacetime, even though measurement-type processes would affect the local density matrices only in their causal future.

decoherence, quantum computers have to remain in one and the same world in order to be able to produce results that may be used in our world.

Tegmark's level 4, finally, seems to be based on a confusion between the concepts of physical existence (to be based on observations and experience) and mathematical existence (which means no more than consistency of an otherwise arbitrary definition – usually within a given axiomatic system). This level does not seem to be relevant for physics at all (except that inconsistent formal concepts cannot be consistently used in physics either).

PW's answer:

Thanks for the clear outline of the various "multiverses", which seems quite sensible to me.

One of the more annoying aspects of multiverse mania is the tendency to throw some very different things all together. In particular, there's

1. The "multiple worlds" of decohered quantum phenomena, which are an interesting and very real topic we know a lot about theoretically and experimentally.

2. The cosmological "multiverse" of causally separated parts of what used to be called the universe. These may exist, but require a serious theory, since we have no direct experimental evidence. These are the ones that get exploited by string theorists, giving them whatever properties (different values for anything string theory should be able to explain but can't) they find convenient.

3. Different laws of physics. Once we understand what the fundamental consistent mathematical structure is behind the laws of physics, we may very well find out that it contains pieces disconnected from ours (with different values of some constant, different numbers of dimensions, different gauge groups, etc.). Then if one wants to think of these pieces as "existing", I suppose one can. But we're a long way away from this…

The Inelegant Universe

Two new books argue that it is time for string theory to give way

by George Johnson

The Trouble with Physics: The Rise of String Theory, the Fall of a Science, and What Comes Next
by Lee Smolin
Houghton Mifflin, 2006

Not Even Wrong: The Failure of String Theory and the Search for Unity in Physical Law
by Peter Woit
Basic Books, 2006

When you click the link for the Postmodernism Generator (**www.elsewhere.org/pomo**), a software robot working behind the scenes instantly throws together a lit-crit parody with a title like this: "Realities of Absurdity: The dialectic paradigm of context in the works of Fellini." And a text that runs along these lines: "In a sense, the main theme of the works of Fellini is the futility, and hence the stasis, of precapitalist sexuality. An abundance of deconceptualisms concerning a self-falsifying reality may be revealed."

Reload the page and you get "The Dialectic of Sexual Identity: Objectivism and Baudrillardist hyperreality" and then "The Meaninglessness of Expression: Capitalist feminism in the works of Pynchon."

With a tweak to the algorithms and a different database, the website could probably be made to spit out what appear to be abstracts about superstring theory: "Frobenius transformation, mirror map, and instanton numbers" or "Fractional two-branes, toric orbifolds, and the quantum McKay correspondence."

Those are actually titles of papers recently posted to the **arXiv.org** repository of preprints in theoretical physics. And they may well be of scientific worth if -- that is -- superstring theory really is a science. Two new books suggest otherwise: that the frenzy of research into strings and branes and curled-up dimensions is a case of surface without depth, a solipsistic shuffling of symbols as relevant to understanding the Universe as randomly generated dadaist prose.

In this grim assessment, string theory -- an attempt to weave together General Relativity and Quantum Mechanics -- is not just untested but untestable, incapable of ever making predictions that can be experimentally checked. With no means to verify its truth, superstring theory -- in the words of Burton Richter, director emeritus of the Stanford Linear Accelerator Center -- may turn out to be "a kind of metaphysical wonderland." Yet it is being pursued as vigorously as ever, its critics complain, treated as the only game in town.

"String theory now has such a dominant position in the academy that it is practically career suicide for young theoretical physicists not to join the field," writes Lee Smolin, a physicist at the Perimeter Institute for Theoretical Physics, in The Trouble with Physics: The Rise of String Theory, the Fall of a Science, and What Comes Next. "Some young string theorists have told me that they feel constrained to work on string theory -- whether-or-not they believe in it -- because it is perceived as the ticket to a professorship at a university."

The counterargument, of course, is that string theory is dominant because the majority of theorists sense that it is the most promising approach -- that the vision of oscillating strings singing the cosmic harmonies is so beautiful that it has to be true. But even that virtue is being called into question. "Once one starts learning the details of 10-dimensional superstring theory, anomaly cancellation, Calabi-Yau spaces, etc., one realizes that a vibrating string and its musical notes have only a poetic relationship to the real thing at issue," writes Peter Woit, a lecturer in mathematics at Columbia University, in Not Even Wrong: The Failure of String Theory and the Search for Unity in Physical Law. The contortions required to hide away the seemingly nonexistent extra dimensions have resulted in structures Woit finds "exceedingly complex" and "exceedingly ugly."

Many physicists will take exception to such harsh judgments (3 sympathetic treatments of superstrings were reviewed here in April). But neither of these books can be dismissed as a diatribe. Both Smolin and Woit acknowledge that some important mathematics has come from contemplating superstrings. But with no proper theory in sight, they assert, it is time to move on. "The one thing everyone who cares about fundamental physics seems to agree on is that new ideas are needed," Smolin writes. "We are missing something Big."

The story of how a backwater of theoretical physics became not just the rage but the establishment has all the booms and busts of an Old West mining town. Unable to fit the 4 forces of Nature under the same roof, a few theorists in the 1970s began adding extra rooms -- the 7 dimensions of additional closet space that unification seemed to demand. With some mathematical sleight-of-hand, these unseen dimensions could be curled up ("compactified") and hidden inside the cracks of the theory. But there were an infinite number of ways to do this. One of the arrangements might describe this Universe. But which?

The despair turned to excitement when the possibilities were reduced to five and to exhilaration when in the mid-1990s, the five were funneled into something called "M-theory", which promised to be the one true way. There were even hopes of experimental verification. A piece that I wrote around that time carried this now embarrassing headline: "Physicists Finally Find a Way to Test Superstring Theory."

That was 6 years ago. And to hear Smolin and Woit tell it, the field is back to "square one". Recent research suggests that there are, in fact, some **10,500** perfectly good M-theories -- each describing a different physics. The 'Theory of Everything' -- as Smolin puts it -- has become a theory of anything.

Faced with this free-for-all, some string theorists have concluded that there is no unique theory, that the Universe is not elegant but accidental. If so, trying to explain the value of the cosmological constant would make as much sense as seeking a deep mathematical reason for why stop signs are octagonal or why there are 33 human vertebrae.

Most theorists reject this postmodern fatalism, hoping for the breakthrough that points the way to the mountaintop. Gathering in Beijing this summer for the Strings 2006 conference, they packed the Great Hall of the People to hear Stephen Hawking declare: "We are close to answering an age-old question. Why are we here? Where did we come from?"

George Johnson's books include Fire in the Mind: Science, Faith, and the Search for Order and Strange Beauty: Murray Gell-Mann and the Revolution in 20th Century Physics. He resides on the Web at talaya.net

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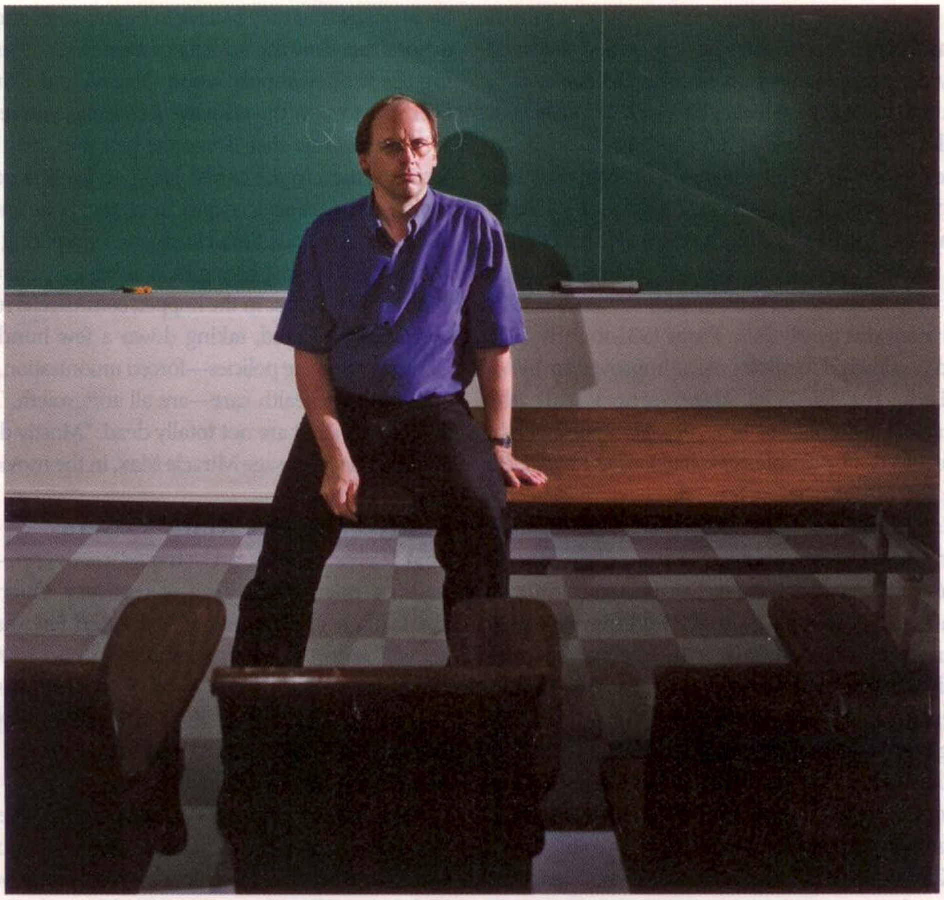
else if accessing these files from the CD in a MS-Word session, simply <CLOSE> this file's window-session; the previous window-session should still remain 'active'

Peter Woit

String Theory Skeptic

How Peter Woit helped change the debate—from outside the brotherhood of physics.

By Lee Gomes



SETH KRUSHNER FOR FORBES

LAY PEOPLE TEND TO REGARD SCIENCE, ESPECIALLY PHYSICS, AS a lofty temple inhabited by serene, Spock-like wise men. Working scientists, though, will tell you it's more like the stock market, full of fads and fashions, booms and busts. Consider the story of the branch of physics known as string theory and what happened to it after it attracted the attention of a mathematician named Peter Woit.

Three years ago Woit, who teaches mathematics at Columbia University, published *Not Even Wrong*. The book combines science and polemics to argue that string theorists were heading down a scientific rat hole, one where fancy math tricks had been mistaken for genuine physics. At the time the conventional wisdom was that string theorists were the best in the business and on the brink of a new revolution on par with Einstein's theory of relativity.

Woit's book got its title from a rebuke once uttered by Austrian physicist Wolfgang Pauli (dismissing a muddled analysis of a physics problem, he said, "It's not right. It's not even wrong."). The timing was good, like a Wall Street analyst calling the top of a market the day before a crash commences. Boom turned into bust; university physics departments, which had been rushing to hire young string theorists, suddenly didn't want to talk to them anymore.

"String theory was a bubble waiting to be pricked," says Woit, 51. "The fundamentals just weren't there anymore."

The reversal of fortune for string theory has happened for reasons that go well beyond the publication of Woit's book. And to be sure, the theory hasn't disappeared, not by a long shot. But Woit's saga is nonetheless a good tale of how science really happens and the way someone from outside a field's inner circle can sometimes force his way into the debate.

What exactly is string theory? We already know about the atom, the smallest unit of any element, which is in turn made up of electrons spinning around a nucleus. Those subatomic particles are usually thought of as little dots. String theorists, though, replace the dots with tiny strings. Those strings, says the theory, are basically all the same but appear to us as different kinds of particles because they are vibrating at different frequencies.

There is no direct evidence that the world really is made of strings; the idea was first proposed simply because it made a certain amount of mathematical sense. The theory became more popular when physicists realized that replacing dots with strings would solve an enormous math problem left over from 20th-century physics: unifying the force of gravity with the forces that explain the interaction of atomic particles. Any theory that managed that job would qualify for the final "theory of everything," explaining all natural phenomena, for which physicists have been searching since the ancient Greeks.

"It's common in physics for people to have incredibly ambitious ideas that don't pan out but lead to rich mathematical ideas that end up being very useful."

String theory took off in the mid-1990s, following some important insights from a physicist, Edward Witten. It quickly became the rage among the world's elite theoretical physicists. The best graduate students devoted their studies to it, and the work was profiled in books and PBS documentaries. Nobel Prizes were assumed to be waiting in the wings.

Physicists come in two varieties: The experimental ones sit at the controls of huge machines like particle accelerators, while the theoretical ones, who include string theorists, think deep thoughts in front of blackboards. Most of the time each side needs the other to get anything done, and one proposition on which they agree is that modern physics has become exceedingly expensive. The world's most advanced physics lab is the Large Hadron Collider, debuting in Europe with a $5.5 billion price tag. As with nearly every big physics experiment anywhere, taxpayers are footing the bill.

While educated as a physicist, Woit had spent most of his career in math. He was able to follow the difficult formulas being used by string theorists and saw a number of problems that weren't being resolved despite the theorists' best efforts. The crucial problem is that it is hard to pin string theory down to a specific set of predictions that vindicate or disprove the theory.

"People have speculative ideas all the time," he says. "And there are two ways they can fail. The first is that there can be an inconsistency involving the idea. But the second is that the idea was so vacuous that you can get anything you want out of it."

String theorists had always been forthright about the problems with their approach. Woit, though, argued that they were getting further from rather than closer to tying up loose ends. "The huge investment of time was producing more and more evidence that string-theory-based unification is an idea that doesn't work," he says.

Woit is by no means the only person pressing the case against string theory. His book was published at the same time as a similarly themed volume by physicist Lee Smolin, which, by virtue of Smolin's insider status in the physics community, probably had more of an impact.

Woit, though, acquired a reputation as a public string skeptic, as well as something of a crusader. When *The Complete Idiot's Guide to String Theory* came out, Woit appeared as a string opponent. He continues to work the themes at his blog, where a typical post will complain that a given press account doesn't acknowledge the extent to which the theory hasn't delivered the goods.

Fans of string theory are well aware that the tide has turned. Michael E. Peskin, a physicist at Stanford University who works in its renowned Linear Accelerator Center, said his very brightest string theory graduate students are having trouble getting work. He isn't particularly troubled by that fact; the popularity of physics theories, he says, "goes back and forth. Sometimes people will be more optimistic, sometimes less so."

Peskin says he believes that, despite any current lack of progress in string theory, nature will eventually be shown to be made of strings, just as the theory predicts. But even if that doesn't happen, Peskin said, string theory will not have been in vain. "It's common in physics for people to have incredibly ambitious ideas that don't pan out but lead to rich mathematical ideas that end up being very useful," he says.

Many mainstream nonstring physicists would agree with much of Woit's critique. But they're also unwilling to engage him, for reasons having more to do with sociology than science. While Woit has a Ph.D. in physics from Princeton, his math job at Columbia, though involving very advanced topics, is a nontenured and thus low-status post, as an instructor rather than a professor. Worse still, from the perspective of academic prestige, he is also responsible for running the math department's computer system. It isn't that he is low in the physics world's pecking order; he isn't even in it.

Princeton's Witten declines to discuss Woit, saying in an e-mail that he prefers to debate these issues only with "critics who are distinguished scientists rather than with people who have become known by writing books."

That sounds like elitism. Physicists, though, defend themselves by saying that in the Internet age, when anyone can put out an opinion about anything, they have to draw limits around who they can get into arguments with. There are only 24 hours in the day.

Which raises the question: Why should anyone take a nonphysicist seriously on such a fundamental physics issue?

Physics itself might hold the answer to that question. John Baez, a UC, Riverside physicist, famously created the Crackpot Index, a tongue-in-cheek but nonetheless useful guide to evaluating scientific claims by nonscientists. For example, it awards one 40 points "for claiming that the scientific establishment is engaged in a conspiracy to prevent your work from gaining its well-deserved fame."

Using Baez's index, it's clear Woit is no crackpot. He doesn't play the role of the persecuted truth-teller. For example, Woit says that Witten is "a genius, who works very hard and who just doesn't want to spend time arguing."

Woit also acknowledges he might be wrong. It's hard to think of an example from the history of science when so many of the field's best people took to a new idea that ended up being utterly mistaken, a fact that Woit himself is the first to admit.

"A lot of really smart guys are doing it, and sometimes I wonder, 'Who am I to be challenging them?'" he says. "The strongest argument in favor of string theory is that Ed Witten thinks it's right." **F**

Not Even Wrong

Two Cultures

Posted on August 22, 2013 by woit

There are two workshops going on this week that you can follow on video, getting a good idea of the latest discussions going on at two different ends of the spectrum of particle theory in the US today.

At the KITP in Santa Barbara there's Black Holes: Complementarity, Fuzz or Fire?. As far as I can tell, what's being discussed is the black hole information paradox reborn. It all started with Joe Polchinski and others last year arguing that the consensus that AdS/CFT had solved this problem was wrong. See Polchinski's talk for more of this argument from him.

If thinking about and discussing deep conceptual issues in physics without much in the way of mathematics is your cup of tea, this is for you (and so, I fear, not really for me). As a side benefit you get to argue about science-fiction scenarios of whether or not you'd get incinerated falling into a black hole, while throwing around the latest buzz-words: holography, entanglement, and quantum information. If you like trendy, and you don't like either deep mathematics or the nuts and bolts of the experimental side of science, it doesn't get much better than this. One place you can follow along the latest is John Preskill's Twitter feed.

Over on the other coast, at the opposite intellectual extreme of the field, LHC phenomenologists are meeting at the Simons Center this week at a SUSY, Exotics and Reaction to Confronting Higgs workshop. They're discussing very much those nuts and bolts, those of the current state of attempts to analyze LHC data for any signs of something other than the Standard Model. Matt Strassler is there, and he is providing summaries of the talks at his blog (see here and here) At this workshop, still no deep mathematics, but extremely serious engagement with experiment. One thing that's apparent is that this field of phenomenology has become a much more sober business than a few years ago, pre-LHC, and pre-no evidence for SUSY. Back then workshops like this featured enthusiastic presentations about all the wonderful new particles, forces and dimensions the LHC was likely to find, with one of the big problems being discussed the "LHC inverse problem" of how people were going to disentangle all the complex new physics the LHC would discover. Things have definitely changed.

One anomaly at the SEARCH workshop was Arkani-Hamed's talk on naturalness, which started off in a promising way as he said he would give a different talk than his recent ones, discussing various ideas about solving the naturalness problem (though they didn't work, but might be inspirational). An hour later he was deep into the same generalities and historical analogies about naturalness as in other talks, headed into 15 minutes of promotion of anthropics and the multiverse. He ended his trademark 90 minute one-hour talk with a 15 minute or so discussion of a couple failed ideas about naturalness, and for these I'll refer you to Matt here.

Arkani-Hamed and others then went into a panel discussion, with Patrick Meade introducing the panelists as having "different specialties, ranging from what we just heard to actually doing calculations and things like this."

Posted in Uncategorized | 30 Comments

Belief in multiverse requires exceptional vision

Posted on August 14, 2013 by woit

Tom Siegfried at Science News has a new piece about how Belief in multiverse requires exceptional vision that starts off by accusing critics of multiverse mania of basically being ignoramuses who won't accept the reality of anything they can't see with their own eyes, like those in the past who didn't believe in atoms, or superstrings:

> *If you can't see it, it doesn't exist. That's an old philosophy, one that many scientists swallowed whole. But as Ziva David of NCIS would say, it's total salami. After all, you can't see bacteria and viruses, but they can still kill you.*
>
> *Yet some scientists still invoke that philosophy to deny the scientific status of all sorts of interesting things. Like the theoretical supertiny loops of energy known as superstrings. Or the superhuge collection of parallel universes known as the multiverse.*
>
> *It's the same attitude that led some 19th century scientists and philosophers to deny the existence of atoms.*

The problem with the multiverse of course is not that you can't directly observe it, but that there's no significant evidence of any kind for it: it's functioning not as a testable scientific explanation, but as an excuse for the failure of ideas about unification via superstring theory. Siegfried makes this very clear, with his argument specifically aimed at those who deny the existence of "supertiny loops of energy known as superstrings", putting such a denial in the same category as denying the existence of atoms. Those who deny the existence of superstrings don't do so because they can't see them, but because there's no scientific evidence for them and no testable predictions that would provide any.

Siegfried has been part of the string theory hype industry for a long time now, and was very unhappy with my book, which he attacked in the New York Times (see here) as misguided and flat-out wrong for saying string theory made no predictions. According to him, back in 2006:

> *…string theory **does** make predictions — the existence of new supersymmetry particles, for instance, and extra dimensions of space beyond the familiar three of ordinary experience. These predictions are testable: evidence for both could be produced at the Large Hadron Collider, which is scheduled to begin operating next year near Geneva.*

We now know how that turned out, but instead of LHC results causing Siegfried to become more skeptical, he's doubling down, with superstring theory now accepted science and the multiverse its intellectual foundation.

The excuse for Siegfried's piece is the Wilczek article about multiverses that I discussed here, where I emphasized only one part of what Wilczek had to say, the part with warnings. Siegfried ignores that part and based on Wilczek's enthusiasm for some multiverse research takes him as a fellow multiverse maniac and his article as a club to beat those without the exceptional vision necessary to believe in superstrings and the multiverse. Besides David Gross, I'm not seeing a lot of prominent theorists standing up to this kind of nonsense, leaving those invested in failed superstring ideology with the road clear to turn fundamental physics into pseudo-science, helped along by writers like Siegfried.

Update: A commenter points to this from Wilczek, noting his lesser multiverse enthusiam than Siegfried's.

Update: Ashutosh Jogalekar at The Curious Wavefunction has a similar reaction to the Siegfried piece.

Update: There's an FQXI podcast up now (see here), with Wilczek discussing the multiverse.

Posted in Multiverse Mania | 72 Comments

Quick Links

Posted on August 13, 2013 by woit

- At HEP blogs you should be reading already, there's Tommaso Dorigo on 5 sigma (with more promised to come), and Jester on the lack of a definite BSM energy scale. Jester puts his finger on the big problem facing HEP physics. In the past new machines could be justified since we could point to new phenomena that pretty much had to turn up in the energy range being opened up by the machine (Ws and Zs at the SPS, the top at the Tevatron, the Higgs at the LHC). Now though, there's nothing definite to point to as likely to show up at the energy scale of a plausible next machine. Jester includes a graphic from a recent Savas Dimopoulos talk characterizing the current situation in terms of chickens running around with their heads cut off, which seems about right.
- The black hole information paradox has been around for nearly forty years, with the story 10 years ago that it supposedly had been resolved by AdS/CFT and string theory. For the past year or so arguments have been raging about "firewalls" and a version 2.0 of the paradox, which evidently now is not resolved by AdS/CFT and string theory. I couldn't tell if there was much to this argument, but the fact that there's a Lubos rant about how it's all nonsense made me think maybe there really is something to it. As usual though, my interest in quantum gravity questions that have nothing to say about unification is limited. For those with more interest in this, I'll just point to today's big article in the New York Times, and next week's workshop at KITP where the latest iterations will get hashed out. For more on the challenge this argument poses to the idea that AdS/CFT gives a consistent picture of quantum gravity, see this recent talk by Polchinski.
- For another challenge to orthodoxy from someone at UCSB, Don Marolf has a new preprint out arguing that strings are not needed to understand holography:

  > *Stringy bulk degrees of freedom are not required and play little role even when they exist.*

Posted in Uncategorized | 9 Comments

Never Give Up

Posted on August 7, 2013 by woit

Alok Jha has a piece in the Guardian yesterday about the failure to find SUSY. His conclusion I think gets the current situation right:

> *Or, as many physicists are now beginning to think, it could be that the venerable theory is wrong, and we do not, after all, live in a supersymmetric universe.*

An interesting aspect of the article is that Jha asks some SUSY enthusiasts about when they will give up if no evidence for SUSY appears:

> *[Ben] Allanach says he will wait until the LHC has spent a year or so collecting data from its high-energy runs from 2015. And if no particles turn up during that time? "Then what you can say is there's unlikely to be a discovery of supersymmetry at Cern in the foreseeable future," he says.*

Allanach has been at this for about 20 years, and here's what he has to say about the prospect of failure:

> *If the worst happens, and supersymmetry does not show itself at the LHC, Allanach says it will be a wrench to have to go and work on something else. "I'll feel a sense of loss over the excitement of the discovery. I still feel that excitement and I can imagine it, six months into the running at 14TeV and then some bumps appearing in the data and getting very excited and getting stuck in. It's the loss of that that would affect me, emotionally."*

John Ellis has been in the SUSY business even longer, for 30 years or so and he's not giving up:

> *Ellis, though confident that he will be vindicated, is philosophical about the potential failure of a theory that he, and thousands of other physicists, have worked on for their entire careers.*
>
> *"It's better to have loved and lost than not to have loved at all," he says. "Obviously we theorists working on supersymmetry are playing for big stakes. We're talking about dark matter, the origins of mass scales in physics, unifying the fundamental forces. You have to be realistic: if you are playing for big stakes, very possibly you're not going to win."*

But, just because you're not going to win, that doesn't mean you have to ever admit that you lost:

> *John Ellis, a particle theorist at Cern and King's College London, has been working on supersymmetry for more than 30 years, and is optimistic that the collider will find the evidence he has been waiting for. But when would he give up? "After you've run the LHC for another 10 years or more and explored lots of parameter space and you still haven't found supersymmetry at that stage, I'll probably be retired. It's often said that it's not theories that die, it's theorists that die."*

There may be a generational dividing line somewhere in the age distribution of theorists, with those above a certain age likely to make the calculation that, no matter how bad things get for SUSY and string theory unification, it's better to go to the grave without admitting defeat. The LHC will be in operation until 2030 or so, and you can always start arguing that 100 TeV will be needed to see SUSY (see here), ensuring that giving up won't ever be necessary except for those now still wet behind the ears.

For another journalist's take on the state of SUSY, this one Columbia-centric and featuring me as skeptic, see here.

Posted in Uncategorized | 60 Comments

The Next Machine

Posted on August 6, 2013 by woit

For the last week or so US HEP physicists have been meeting in Minneapolis to discuss plans for the future of US HEP. Some of the discussions can be seen by looking through the various slides available here. A few days earlier Fermilab hosted TLEP13, a workshop to discuss plans for a new very large electron-positron machine. There is a plan in place (the HL-LHC) for upgrading the LHC to higher luminosity, with operations planned until about 2030. Other than this though, there are no current definite plans for what the next machine at the energy frontier might be. Some of the considerations in play are as follows:

- The US is pretty much out of the running, with budgets for this kind of research much more likely to get cut than to get the kinds of increases a new energy frontier machine would require. Projects with costs up to around $1 billion could conceivably be financed in coming years, but for the energy frontier, one is likely talking about $10 billion and up.
- Pre-LHC, attention was focused on prospects for electron-positron linear colliders, specifically the ILC and CLIC projects. The general assumption was that LEP, which reached 209 GeV in 2000, was the last circular electron-positron collider. The problem is that, at fixed radius, synchrotron radiation losses grow as the fourth-power of the energy, and LEP was already drawing a sizable fraction of the total power available at Geneva. Linear accelerators don't have this problem, but they do have problems achieving high luminosity since one is not repeatedly colliding the same stored bunches.
  The hope was that the LHC would discover not just the Higgs, but all sorts of new particles. Once the mass of such new particles was known, ILC or CLIC technology would give a design of an appropriate machine to study such new particles in ways that not possible at a proton-proton machine. These hopes have not worked

out so far, making it now appear quite unlikely that there are such new particles at ILC/CLIC accessible energies. It remains possible that the Japanese will decide to fund an ILC project, even without the appealing target of a new particle besides the Higgs to study.

- The LHC has told us the Higgs mass, making it now possible to consider what sort of electron-positron collider would be optimal for studying the physics of the Higgs, something one might call a "Higgs factory". It turns out that a center of mass energy of about 240 GeV is optimal for Higgs production. This is easily achievable with the ILC, but since it is not that much higher than LEP, there is now interest in the possibility of a circular collider as a Higgs factory. There is a proposal called LEP3 (discussed on this blog here) for putting such a collider in the LHC tunnel, but it is unclear whether such a machine could coexist with the LHC, and no one wants to shutdown the LHC before a 2030 timescale.
- Protons are much heavier than electrons, so synchrotron radiation losses are not the problem, but the strength of the dipole magnets needed to keep them in a circular orbit is. To get to higher proton-proton collision energies in the same tunnel, one needs higher strength magnets, with energy scaling linearly with field strength. The LHC magnets are about 8 Tesla, current technology limit is about 11 Tesla for appropriate magnets. The possibility of an HE-LHC, operating at 33 TeV with 20 Tesla magnets is under study, but this technology is still quite a ways off. Again, the time-scale for such a machine would be post-2030.
- The other way to get to higher proton-proton energies is to build a larger ring, with energy scaling linearly with the size of the ring (for fixed magnet strength). Long-term thinking at CERN now seems to be focusing on the construction of a much larger ring, of size 80-100 km. One could reach 100 TeV energies with either 20 Tesla magnets and an 80 km ring, or 16 Tesla magnets and a 100 km ring (such a machine is being called a VHE-LHC). If such a tunnel were to be built, one could imagine first populating it with an electron-positron collider, and this proposal is being called TLEP. It would operate at energies up to 350 GeV and would be an ideal machine for precision studies of the Higgs. It could also be used to operate at very high luminosity at lower energies, significantly improving on electroweak measurements made at LEP (the claim is that LEP-size data sets could be reproduced in each 15 minutes of running). Optimistic time-lines would have TLEP operating around 2030, replaced by the VHE-LHC in the 2040s.
- For more about TLEP, see the talks here. The final talk of the TLEP workshop wasn't about TLEP, but Arkani-Hamed on the VHE-LHC (it sounds like maybe he's not very interested in the Higgs factory idea). He ends with

  > *EVERY student/post-doc/person with a pulse (esp. under 35) I know is ridiculously excited by even a glimmer of hope for a 100 TeV pp collider. These people don't suffer from SSC PTSD.*

Looking at the possibilites, I do think TLEP/VHE-LHC looks like the currently most promising route for the future for CERN and HEP physics (new technology might change this, i.e. a muon collider). Maybe I don't have a pulse though, since I can't say that I'm ridiculously excited by just a glimmer of VHE-LHC hope for a time-frame past my life-expectancy.

A 100 km tunnel would be even larger than the planned SSC tunnel (89 km) and one doesn't have to suffer from SSC post-traumatic-stress-disorder to worry about whether a project this large can be successfully funded and built (In very rough numbers I'd guess one is talking about costs on the scale of $20 billion). My knowledge of EU science funding issues is insufficient to have any idea if the money for something on this scale is a possibility. On the other hand, with increasing concentration of all wealth in the hands of an increasingly large number of multi-billionaires, perhaps this just needs the right rich guy for it to happen.

Someone is going to have to do a better job than Arkani-Hamed in terms of finding an argument that will sell this to rest of the scientific community. His main argument is that such a machine would allow us to improve the ultimate LHC number of "fine-tuning" being at least 10^{-2} to a number like 10^{-4}, or maybe finally see some SUSY particles. I don't think this argument is going to get $20 billion: "we thought we'd see all this stuff at the LHC because we were guessing some number we don't understand was around one. We saw nothing and turns out the number is small, no bigger than one in a hundred. Now we'd like to spend $20 billion to see if it's smaller than one in a hundred, but bigger than one in ten thousand."

Posted in Experimental HEP News | 21 Comments

Latest from the Stacks Project

Posted on July 30, 2013 by woit

My colleague Johan de Jong for the last few years has been working on an amazing mathematical endeavor he calls the "Stacks Project". As boring 20th century technology, this is a work-in-progress document (now nearly 4000 pages), available here. But from the beginning Johan (known to his friends as "the Linus Torvalds of algebraic geometry") has conceptualized this as an open-source project using 21st century technology, including a blog and a github repository.

As of last night, the Stacks Project has many new features, courtesy of impressive work by Johan's collaborator on this, Pieter Belmans. I was going to write something here describing the new features and how cool they are, but a much better job of this has been done by Cathy O'Neil, aka Mathbabe (by the way, if you're not reading Cathy's blog, you should be…). With her permission, I'm cross-posting her new blog entry about this, so, what follows is from Cathy:

The Stacks Project gets ever awesomer with new viz

Here's a completely biased interview I did with my husband A. Johan de Jong, who has been working with Pieter Belmans on a very cool online math project using d3js. I even made up some of his answers (with his approval).

Q: What is the Stacks Project?

A: It's an open source textbook and reference for my field, which is algebraic geometry. It builds foundations starting from elementary college algebra and going up to algebraic stacks. It's a self-contained exposition of all the material there, which makes it different from a research textbook or the experience you'd have reading a bunch of papers.

We were quite neurotic setting it up – everything has a proof, other results are referenced explicitly, and it's strictly linear, which is to say there's a strict ordering of the text so that all references are always to earlier results.

Of course the field itself has different directions, some of which are represented in the stacks project, but we had to choose a way of presenting it which allowed for this idea of linearity (of course, any mathematician thinks we can do that for all of mathematics).

Q: How has the Stacks Project website changed?

A: It started out as just a place you could download the pdf and tex files, but then Pieter Belmans came on board and he added features such as full text search, tag look-up, and a commenting system. In this latest version, we've added a whole bunch of features, but the most interesting one is the dynamic generation of dependency graphs.

We've had some crude visualizations for a while, and we made t-shirts from those pictures. I even had this deal where, if people found mathematical mistakes in the Stacks Project, they'd get a free t-shirt, and I'm happy to report that I just last week gave away my last t-shirt. Here's an old picture of me with my adorable son (who's now huge).

Q: Talk a little bit about the new viz.

A: First a word about the tags, which we need to understand the viz.

Every mathematical result in the Stacks Project has a "tag", which is a four letter code, and which is a permanent reference for that result, even as other results are added before or after that one (by the way, Cathy O'Neil figured this system out).

The graphs show the logical dependencies between these tags, represented by arrows between nodes. You can see this structure in the above picture already.

So for example, if tag ABCD refers to Zariski's Main Theorem, and tag ADFG refers to Nakayama's Lemma, then since Zariski depends on Nakayama, there's a logical dependency, which means the node labeled ABCD points to the node labeled ADFG in the entire graph.

Of course, we don't really look at the entire graph, we look at the subgraph of results which a given result depends on. And we don't draw all the arrows either, we only draw the arrows corresponding to direct references in the proofs. Which is to say, in the subgraph for Zariski, there will be a path from node ABCD to node ADFG, but not necessarily a direct link.

Q: Can we see an example?

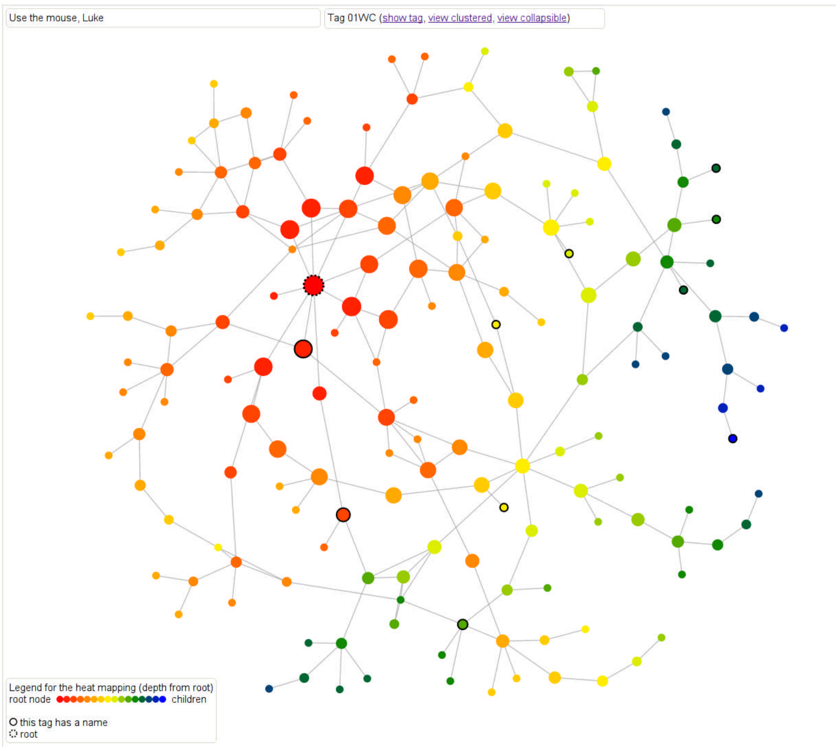
Let's move to an example for result 01WC, which refers to the proof that "a locally projective morphism is proper".

First, there are two kinds of heat maps. Here's one that defines distance as the maximum (directed) distance from the root node. In other words, how far down in the proof is this result needed? In this case the main result 01WC is bright red with a black dotted border, and any result that 01WC depends on is represented as a node. The edges are directed, although the arrows aren't drawn, but you can figure out the direction by how the color changes. The dark blue colors are the leaf nodes that are farthest away from the root.

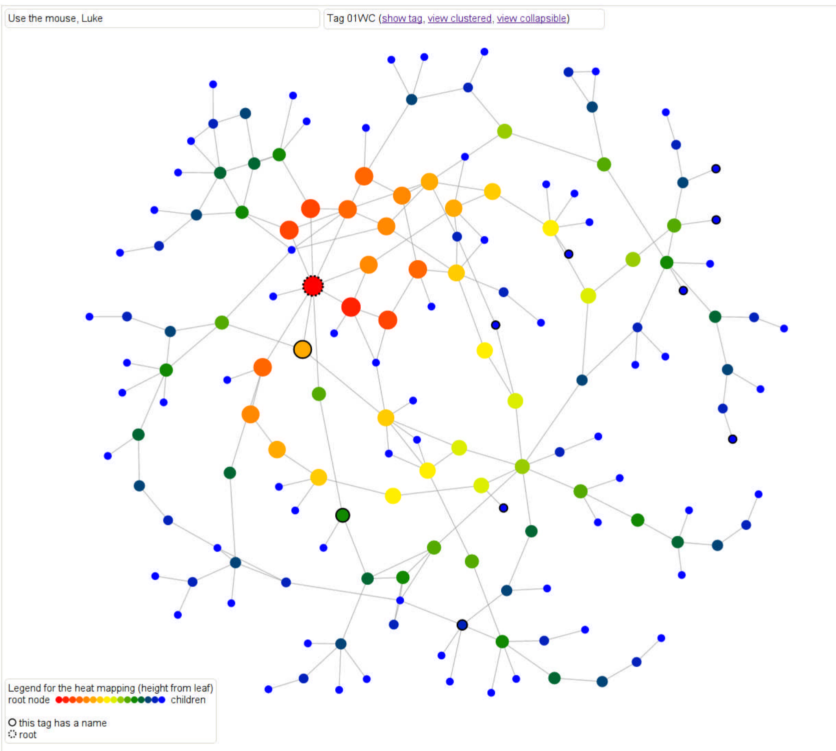
Another way of saying this is that the redder results are the results that are closer to it in meaning and sophistication level.

Note if we had defined the distance as the minimum distance from the root node (to come soon hopefully), then we'd have a slightly different and also meaningful way of thinking about "redness" as "relevance" to the root node.

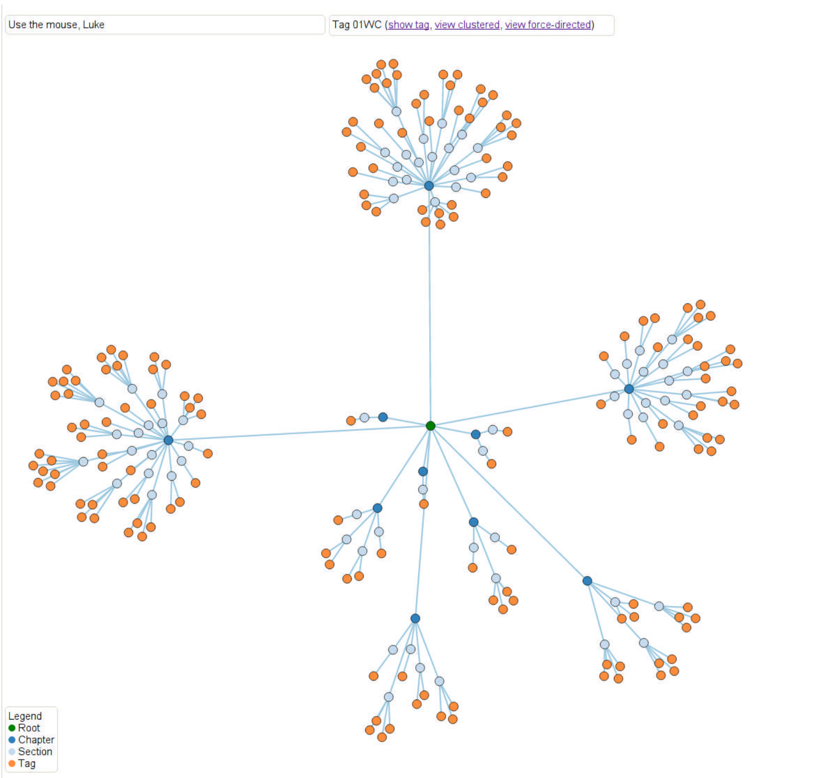
This is a screenshot but feel free to play with it directly here. For all of the graphs, hovering over a result will cause the statement of the result to appear, which is awesome.



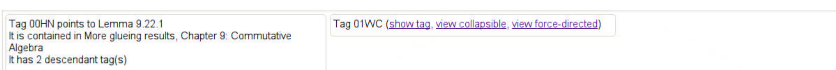
Next, let's look at another kind of heat map where the color is defined as maximum distance from some leaf note in the overall graph. So dark blue nodes are basic results in algebra, sheaves, sites, cohomology, simplicial methods, and other chapters. The link is the same, you can just toggle between the different metric.

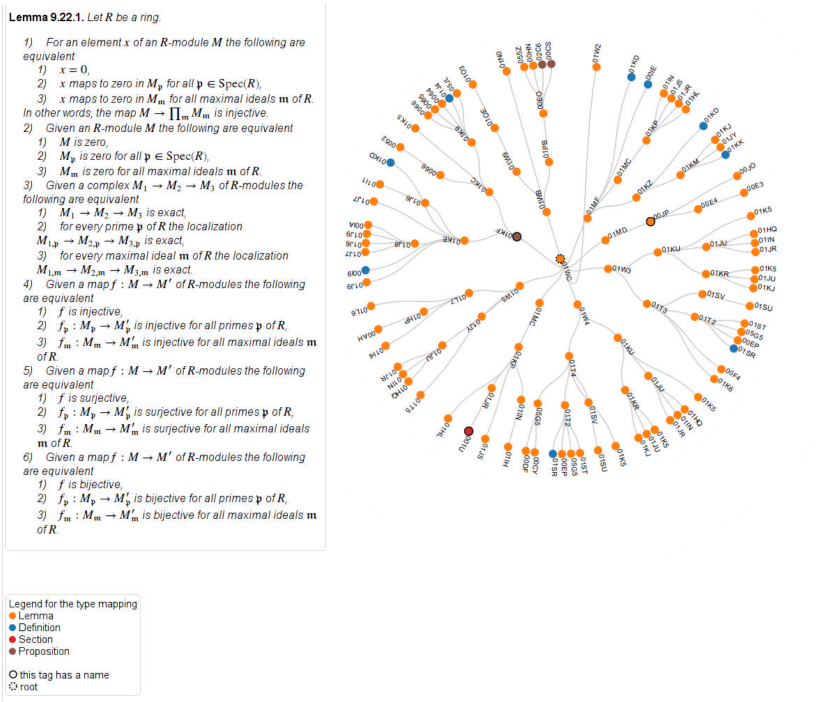


Next we delved further into how results depend on those different topics. Here, again for the same result, we can see the extent to which that result depends on the different on results from the various chapters. If you scroll over the nodes you can see more details. This is just a screenshot but you can play with it yourself here and you can collapse it in various ways corresponding to the internal hierarchy of the project.



Finally, we have a way of looking at the logical dependency graph directly, where result node is labeled with a tag and colored by “type”: whether it’s a lemma, proposition, theorem, or something else, and it also annotates the results which have separate names. Again a screenshot but play with it here, it rotates!





Check out the whole project here, and feel free to leave comments using the comment feature!

Posted in Uncategorized | 12 Comments

Bankrupting Physics

Posted on July 28, 2013 by woit

I just spent a depressing and tedious few hours reading through Bankrupting Physics, an English translation of Alexander Unzicker's 2010 Von Urknall zum Durchknall written in German.

When I started reading the thing I wasn't expecting much, but figured it would be some sort of public service to take the time to identify what Unzicker had to say that made sense and what didn't, and then write something distinguishing the two here. After a while though, it became clear that Unzicker is just a garden-variety crank, of a really tedious sort. Best advice about the book would be the usual in this situation, just ignore it, since no good can possibly come from wasting time engaging with this nonsense. I have no idea why any publisher, in Germany or here, thought publishing this was a good idea.

If you must know though, here's a short summary of what's in the book. The first half is about gravitation, cosmology and astrophysical observations. Unzicker's obsessive idea, shared with innumerable other cranks, is that any scientific theory beyond one intuitively clear to them must be nonsense. Similarly, any experimental result beyond one where they can easily understand and analyze the data themselves is also nonsense. He's a fan of Einstein, although thinks general relativity somehow needs to be fixed, something to do with it getting phenomena involving small accelerations wrong. There's endless complaints about how cosmology involves too many parameters, and dark matter/energy shows that physicists really understand nothing.

When he gets to particle physics, we learn that things went wrong back when physicists started invoking a symmetry that wasn't intuitively obvious, isospin symmetry. According to Unzicker, symmetries in particle theory are all a big mistake, "the standard model barely predicts anything", "the standard model can actually accommodate *every* result", and endless other similar nonsense. As for the experimental side of things, he takes a comment from Feynman about renormalization in QED, claims it means that there is no understanding of production of photons at high energy, then uses this to describe as "It's just ridiculous" data analysis at HEP experiments. High energy physics experiments are all just a big scam, with the physicists involved unwilling to admit this, since they've wasted so much money on them.

The last part of the book contains lots of criticism of string theory, etc., much of it parroting my book and blog. According to Unzicker:

> *Woit does a great job in debunking the string and SUSY crap. Unfortunately, he has pretty mainstream opinions with respect to the Standard Model.*

Well, maybe he does get *something* right… I have to admit that one of the things that every so often makes me wonder if I'm completely misguided, and maybe there is a lot more value to strings/SUSY/branes/extra dimensions etc. than I think, is reading rants like Unzicker's.

So, my strong advice would be to do your best to ignore this. Luckily, there's an infinitely better book coming out here in the US at the same time: Jim Baggott's Farewell to Reality, which I highly recommend. It seems likely that the two books will get reviewed together, giving Unzicker far more attention than he deserves. If so, at least this will provide a real-life experiment indicating whether book reviewers can tell sense from nonsense.

Posted in Book Reviews | 34 Comments

Where are we heading?

Posted on July 23, 2013 by woit

Every summer the IAS in Princeton runs a program for graduate students and postdocs called "Prospects in Theoretical Physics". It's going on now, with this year's topic LHC Physics. Much of the program is devoted to the important but complex technical issues of extracting physics from LHC data. Things began though with a talk on Where are we heading? from Nati Seiberg designed to explain to students how they should think about the significance of the LHC results and where they were taking the field.

Most of the talk was about the hierarchy problem and "naturalness", with the forward-looking conclusion the same one that Seiberg's colleague Arkani-Hamed has been aggressively pushing: the main significance of LHC results will be telling us that the world is either "natural" (likely by discovering SUSY) or "unnatural" (in which case there's a multiverse and it's hopeless to even try to predict SM parameters). Given the negative results about SUSY so far, this conclusion pretty much means that the students at the IAS are being told that the LHC results mean it's the multiverse, and they shouldn't even think about trying to figure out where the SM comes from since that's a lost cause. The talk ends with the upbeat claim that this is a "win-win situation": reaching the conclusion that the LHC has shown we can't learn more about where the SM came from will be a great scientific advance and "The future will be very exciting!". Seiberg does at one point make an interesting comment that indicates that he's not completely on-board with this conclusion. He notes that there's a "strange coincidence" that theorists are making this theoretical argument about the necessity of giving up at just exactly the same time in our history that we have run out of technological ability to explore shorter distances. A "strange coincidence" indeed…

For more conventional wisdom along these lines, see Naturally Unnatural from Philip Gibbs, which also argues that what we are learning from the LHC is that we must give up and embrace the multiverse.

Frank Wilczek has just made available on his web-site a new paper on Multiversality. It has the usual arguments for the multiverse, although unlikes Seiberg/Arkani-Hamed he doesn't try to claim that this is an exciting positive development, closing with a "lamentation":

> *I don't see any realistic prospect that anthropic or statistical selection arguments – applied to a single sample! – will ever lead to anything comparable in intellectual depth or numerical precision to the greatest and most characteristic achievements of theoretical physics and astrophysics…*
>
> *there will be fewer accessible features of the physical world for fundamental theory to target. One sees these trends, for example, in the almost total disconnect between the subject matter of hep-th and hep-ex.*

and a "warning

> *There is a danger that selection effects will be invoked prematurely or inappropriately, and choke off the search for deeper more consequential explanations of observed phenomena. To put it crudely, theorists can be tempted to think along the lines "If people as clever as us haven't explained it, that's because it can't be explained – it's just an accident."*

He does see possibilities for understanding more about the SM in two places, the SUSY GUT unification of couplings and axions as an explanation of the smallness of the QCD theta parameter. The last part of the paper is about axion cosmology and anthropics. Wilczek has written about the stories of the 1981 origin of the SUSY GUT unification argument and the 1975 birth of the axion. It's striking that we're 32 and 38 years later without any idea whether these ideas explain anything. A depressing possible answer to "Where are we heading?" would be an endless future of multiverse mania, with a short canonical list of ancient, but accepted ideas about fundamental theory (SUSY Guts, string theory, axions) that can never be tested.

Posted in Multiverse Mania | 52 Comments

News From All Over

Posted on July 20, 2013 by woit

- I confess to mostly finding "philosophy of physics" arguments not very helpful for understanding anything, but for those who feel differently, some new things to look at are a Scientific American article Physicists Debate Whether the World is Made of Particles or Fields or Something Else Entirely, an interview with Jonathan Bain, an interview with Tim Maudlin, a debate between John Ellis, Lawrence Krauss and theologian Don Cupitt about Why is there something rather than nothing?, and the talks at a UCSC Philosophy of Cosmology Summer School. Since the last of these was funded by the Templeton Foundation, it ended with several talks on "Implications of cosmology for the philosophy of religion". These included a detailed argument that the explanation for the laws of nature is "there is a perfect being", contrasting this to another argument favored at the Summer School "the multiverse did it".
- This week the Perimeter Institute will host Loops 13, devoted to loop quantum gravity and other quantum gravity approaches. While it's also funded by Templeton, the organizers seem to have managed to keep God out of this one.
- At CERN, Amplitudes, Strings and Branes is on-going. Philip Gibbs has an amusing argument that this and Loops 13 are The Same Bloody Thing.
- One thing the LQG and Amplitudes people do share is that some of their most important ideas come from the same person: Roger Penrose (who, but the way, would be a good candidate for the Fundamental Physics Prize, although his distaste for string theory might be a disqualifier). There's a long interview with him at The Ideas Roadshow, mainly about his "Cyclic Universe" ideas.
- The Simons Foundation has been publishing some excellent science reporting, and now has an online publication they're calling Quanta Magazine. The latest story there is a very good piece on the search for dark matter from Jennifer Ouellette. The Simons Center at Stony Brook now has a newsletter about their

activities.

- Another on-going conference is one of the big yearly HEP conferences, EPS HEP 2013 in Stockholm. CMS and LHCb have impressive new results about rare B decays, timed for this conference. For the details, see Tommaso Dorigo. There are also CMS and CERN press releases.
  Last year similar but less accurate results were advertised as putting SUSY "in the hospital", which some people objected to, on the grounds that it was already in trouble and this kind of result doesn't make things much worse. Resonaances had the details, summarizing this a "another handful of earth upon the coffin". The CERN press office tries to put the best SUSY spin on this that it can:

  > *One popular theory is known as supersymmetry, SUSY for short. It postulates the existence of a new type of particle for every Standard Model particle we know, and some of these particles would have just the right properties to make up a large part of the dark universe. There are many SUSY models in circulation, and SUSY is just one of many theoretical routes to physics beyond the Standard Model. Today's measurements allow physicists to sort between them. Many are incompatible with the new measurements, and so must be discarded, allowing the theory community to work on those that are still in the running.*

- Finally, for those with mathematical interests who have waded through the above, Terry Tao has a remarkable long expository piece about the Riemann hypothesis, ranging from analytic number theory aspects through the function field case and l-adic cohomology.

Update: For more from Penrose, see this recent talk in Warsaw.

Update: Studies in History and Philosophy of Modern Physics is planning a special issue on the significance of the Higgs discovery, the call for papers is here.

Posted in Uncategorized | 21 Comments

No Joking Matter

Posted on July 8, 2013 by woit

Back now from vacation, and while I was away several people sent me links to point out that string theory promoters definitely aren't taking a vacation. Links here with a few quick comments, followed by something about the issue of making fun of string theorists.

- Lenny Susskind has a quite good new book out about classical mechanics (see here), but the Economist doesn't want to talk to him about this, instead it's the usual string theory promotional effort:

  > *These extra dimensions can be arranged and put together in many different patterns, in a variety of different ways. Not billions, trillions or quintillions of ways, but many more than that. The ways these dimensions are put together into these tiny little spaces determine how particles will behave, what particles will exist, what the constants of nature are—quantities like dark energy or the electric charge of an electron. In string theory all those things are features of the ways that these tiny dimensions are put together. The tiny dimensions are like the DNA of the universe.*

- Last month Cumrun Vafa was in Bangalore, explaining (see here, slides here) among other things about the significance of the web of string dualities that makes up M-theory:

  > *String dualities [are] in my opinion perhaps the most fundamental discovery that physicists have made in a century.*

Note that the past century includes General Relativity (barely), quantum mechanics, gauge theory, the Standard Model, as well as quite a few discoveries in other areas of physics.

- The Strings 2013 conference included the usual public talks promoting string theory. Witten's was String Theory and the Universe, which was pretty much unchanged (minus optimism about SUSY at the LHC) from similar talks he has been giving for nearly 20 years (since 1995 and the M-theory proposal). Linde's was Universe or Multiverse?, about the "new scientific paradigm" of Multiverse Mania. He argues that the virtue of this is that it is "impossible to disprove".
- David Gross's public talk on The Frontiers of Particle Physics had nothing to do with string theory, focusing on explaining the standard model and some of the questions it leaves unanswered. Much more interesting was his outlook talk at the conference which included the usual exhortations about string theory being alive and healthy, flourishing with many new and brilliant string theorists, but also included some material unusual in such a venue and much more challenging for his audience. His reference to connections between string theory and condensed matter physics described this as having been "overhyped by our community". About AdS/CFT, he noted that it "does not provide a satisfactory non-perturbative quantum gravity". He commented on the lack of connection between the talks and HEP physics, saying that it was "important that string theorists not retreat into quantum gravity". About SUSY, he characterized it as "still alive, but not kicking", and he argued that the LHC results of the past year have made more likely the "Extremely pessimistic scenario" of an SM Higgs, no SUSY, no dark matter, no indication of the next energy threshold. Since "HEP is where string theory connects to reality", he made the point to the audience that "if this scenario materializes we are all going to suffer."

  I'm not sure why he picked this date, but he encouraged those with post-1999 Ph.D.s to realize that it was now quite possible that those who came before them had "somehow got it wrong". This was the first time I've seen an influential member of the string theory community raise this possibility and call for people to consider it seriously.

- Sean Carroll deals here with arguments from the "Popperazi" that the string theory anthropic multiverse is pseudo-science by ignoring the serious arguments being made. He has his own definition of what science is, which looks to me to open far more questions than it answers. About string theory unification itself, the question has never been whether it's science, but whether it's an idea worth pursuing given the ways in which it has so far failed. The best argument for continued pursuit of the idea is of course that there aren't obviously better ones around, but this raises its own issues.

Sabine Hossenfelder has a posting about an introduction to a Lawrence Krauss talk where the joke was made that "String theorists have to sit in the back". The context for this was a controversy about the place of women at a discussion involving Krauss hosted by an Islamic group. Like Sabine, I don't want to discuss here that controversy, just agree there's a good case to be made that it's no joking matter. I think she makes a mistake by interpreting the joke as an attack on string theorists (it's a joke, after all, open to many interpretations), but I was struck by her perception of string theorists as an embattled minority under unfair attack, as well as the claim that it's not all right to in any way make fun of them.

The situation these days is clearly very different than it was back in 2004 when I started this blog, partly because of the past decade of failure of string theory unification to get anywhere, partly because of the negative LHC results, partly because of the multiverse, and partly because of the public behavior of some in the string theory community in reaction to criticism. Given the high profile ongoing promotional campaign exemplified above, I don't think we're yet at the point where criticism of string theorists is "kicking them when they're down", and humor is sometimes the best way to make a point concisely. Probably the most incisive criticism of string theory ever made was made in a cartoon, and personally I've never understood how it is even possible to take arguments like Linde's seriously (and am not even sure he does…), so I see a role for humor in charting the continuing story of the collapse of the heavily influential string theory unification paradigm.

Update: If you noticed more than the usual sloppiness, incompleteness and incoherence, maybe it was because this got published early, while I was in the middle of writing it.

Update: The latest on the philosophy of science from Linde (see here), who is at a workshop in Bad Honnef this week.

> *The multiverse is the only known explanation so in a sense it has already been tested*

Is it all right to make fun of this, or should one seriously discuss the scientific merits here?

Posted in Uncategorized | 46 Comments

Not Even Wrong
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Review of "Not Even Wrong" by Peter Woit *and*

"The Trouble with Physics" by Lee Smolin

... for the Journal of Scientific Exploration by Professor Richard Conn Henry

Not Even Wrong **by Peter Woit. Basic Books, 2006. 278 pp. $26.00 / $34.95 (hardcover). ISBN 0-465-09275-6.**

The Trouble with Physics **by Lee Smolin. Houghton Mifflin, 2006. 343 pp. $xx.xx (hardcover). ISBN x-xxx-xxxxx-x.**

Throughout human history, we have had, among us, an intellectual elite whose members kindly advise the rest of us as to “what it all means.” These advisors have, typically, been the priests of the current religion. And we the people have always been glad to have those priests’ potent insight! Genuinely glad, because, although we are not so naive as to expect their advice to be perfect, we are mature enough to know that it is likely the best advice that we are going to get.

So, how are we doing today, in this regard? Well, nothing has changed in the sphere of religious advice, but there is, of course, a significant new element, that of “scientific” insight. Considering the fantastic practical successes of science, combined with the essentially total lack of any practical successes on the side of the priests, it is, perhaps, surprising that most people still do stick with those priests (to get what they feel is the real skinny). How can this be?

I think it is because people naturally sense that everything that we scientists are discovering, important as it is, is essentially superficial. And, it is superficial, in my opinion.

The last truly grand success of physics was in 1925, with the discovery of quantum mechanics. There have been many important advances since then, but nothing of the same epochal character.

Until now? Well, this is a book review! I am reviewing two books that take on superstring theory. If superstring theory turns out to be correct (if that is even possible), then, superstring theory is, just maybe, in the class of quantum mechanics, in terms of its epochal impact.

Both of the books that I am reviewing suggest that that will never happen; that superstring theory is without a future; that it is in fact a failed theory. And both authors are concerned that continued fixation on this failed theory, by professors who won their tenure as its advocates, will retard advances in other directions.

Until very recently, I was a mainstream advocate of superstrings, glibly mouthing the party line: that superstrings produce quantum gravity; that it is the only game in town; and so on. But, I never spent much time teaching it to students. As I explained to the students, “I do like it, but it might not be right. There are other things that are right, that are so fantastic in their implications that I don’t want to waste a great deal of your time on superstrings: I am here of course referring to Special Relativity, General Relativity, and Quantum Mechanics.” I concentrate on teaching these three glories, as being things that we know are true, and that deeply offend our intuition which must therefore be suppressed as simply wrong. That is enough to keep me, and the young people, busy! Don’t bother me with superstrings and M-theory!

What has changed my mind? An evolution. One important step was hearing Raman Sundrum’s wonderful talk at the Albuquerque APS meeting in 2002, in which he clearly brought out that we have no identified avenue to understand the value of the cosmological constant. His exposition produced a big impact on me, because the calculation of the value is so simple, and produces such a horribly wrong answer. The simple calculation is closely analogous to that which produced the ultraviolet catastrophe, which required the quantum to fix. I decided that something just as fundamental as the quantum was needed here, and … forgive me! … I ordered my brain to find it.

What am I talking about? Well, we have NO understanding of how our brains work. But we do have plenty of examples of peoples' brains actually working, and producing, sometimes, great answers. My favorite example, of both failure and success, is our discovery of vectors.

I ask students, "how hard was it, for you, to learn vectors?" They reply, in agreement with my own experience, "not totally easy, but no big deal." Well I then tell them for our human race to discover vectors was very close to impossible. Our greatest mathematician, Gauss, tried his hand, and he failed dismally. And, when Hamilton did succeed, he did so only via a "lightning bolt," as he and Mrs. Hamilton approached Broughm bridge.

Was Hamilton's discovery of quaternions (essentially, vectors) a gift from God? I think not!

Hamilton had, by working on it, "ordered" his brain to find it, and years of growing synapses in his sleep eventually produced it. That is my petty "theory!" I do not believe that we can think anything that is not already wired in our synapses. You have to grow it.

So, my brain, such as it is, has been "under orders" for some years now! Any result? Yes, I think so. Perhaps not the brass ring, but, I think, something! In 2006 April I stumbled across an internet paper by Curt Renshaw pointing out that NASA's planned Space Interferometry Mission (SIM) could test the "contraction of length" predicted as part of Special Relativity. I am very interested in physics outreach and student involvement, and I thought that "Was Einstein Right?" would be a great student experiment for SIM. So, I went through the simple mathematics ... and discovered that the conventional interpretation of length contraction is wrong, and that space is not contracted in the direction of motion, but instead is curled. A different topology.

Well, my paper on the subject is still in the hands of the editors at Physical Review Letters. We shall see!

But there is something else that made me think that superstring theory might be wrong (before reading the two reviewed books), and that is new experimental investigations into the reach of Newtonian gravitation. Many theories of extra dimensions suggest that Newtonian gravitation might fail on scales of about a millimeter! Well, it doesn't. It does not fail down to nanometer scales. This we find from dropping neutrons, and watching them bounce under gravity. Brilliant, and conclusive.

But, the theory can be adjusted, to evade this new result! Well, that is a chief complaint by both our authors, Voit and Smolin: that superstring theory is so plastic that it can fit any experimental results at all, and hence has neither any ability to predict, nor the strength of being falsifiable. It is argued that this means that superstring theory is no more a part of science than is Intelligent Design.

You should probably read these two books in the opposite order to what I did. That is, read "Not Even Wrong" first. It is denser, and it will prepare your mind, filling you with all kinds of good ammunition. And, it accelerates, becoming somewhat polemical toward the end, and thus firing you up for Lee Smolin's rather more accessible book.

Now, what is all this about? Well, over the decades, physicists have had a rough ride, as they attempted to read the book of nature. Sir Arthur Stanley Eddington in 1927 painted a clear picture of how this "progress" occurs: "Scientific discovery is like the fitting together of the pieces of a giant jig-saw puzzle; a revolution of science does not mean that the pieces already arranged and interlocked have to be dispersed; it means that in fitting on fresh pieces we have had to revise our impression of what the puzzle-picture is going to be like. One day you ask the scientist how he is getting on; he replies, "Finely. I have very nearly finished this piece of blue sky." Another day you ask how the sky is progressing and are told, "I have added a lot more, but it was sea, not sky; there's a boat floating on the top of it". Perhaps the next time it will have turned out to be a parasol upside down; but our friend is still enthusiastically delighted with the progress he is making."

So how are superstrings coping with the astonishing discovery of a small non-zero positive cosmological constant (by the guys just down the hall from me, with their colleagues)? Why, finely. To stabilize your six hidden dimensions, you must wrap them with branes, and then, to force a positive cosmological constant, you again wrap, this time with large numbers of anti-branes, and … hey presto! Mission accomplished!

There were how many epicycles in Ptolemy's scheme? And, actually, even more in Copernicus's even more wretched machine. But, in Newton's, arguably one, the value of G. And, in superstrings; well, brace yourself, 10^{500}. The particular one describing our world has not yet been located. Do not hold your breath!

Lee Smolin emphasizes the simplicity of the great results. Special relativity comes from nothing more than changing a sign from + to – in the Pythagorean theorem applied to four dimensions. Smolin points out that he can summarize General Relativity on a single sheet of paper; well, so can I! This is no accident. Eddington: "There are not many things which can be said about curvature not many of a general character. So that when Einstein felt this urgency to say something about curvature, he almost automatically said the right thing."

And as for quantum mechanics, there is nothing simpler. That is exactly why I think that in the case of quantum mechanics, we do not have an "effective theory," but rather, we have the real thing. There is simply no way to make it simpler! I have long been of the opinion that quantum mechanics is not an option, that it flows automatically out of the numerical character of observations. And is therefore not in the least bit mysterious.

Quantum mechanics is just the machinery for discussing observations intelligibly. What we are looking for are the symmetries that give rise to the forces (accelerations) that we observe. My suggestion at the moment is that we will find them in the topology of four-space, not in added dimensions.

But Ed Witten is there, far ahead of me! Seiberg-Witten invariants! Ed has been highly productive in exploring this option, in addition to the superstring path.

It must be difficult for Ed to read the two books I am reviewing (if he has), because really, none of this is his fault. What is he supposed to do, except to try his hardest, which he continues to do? He is smarter than the rest of us, and so, unfortunately, many among us simply look to him for signposts, rather than thinking for ourselves. I am sure that Ed deplores this! But, it is definitely not his fault!

Woit in a nuanced fashion compares Ed with Einstein, pursuing, endlessly, wrong ideas. This is perfectly plausible, given the obtuseness of even a Gauss, as I said! The rest of us do the same in our own smaller spheres.

And where is the answer? Well, maybe, says Smolin, right under your nose! Overlooked! That is something I believe myself, at least as a serious possibility.

Does the next powerful step have to be as simple as special relativity, general relativity, and quantum mechanics? We simply do not know! The superstring people think not; they suspect that truth is a quagmire and that that's all there is to it: a "landscape" of inconceivably vast numbers of chunks of the universe with random physics, and we are in one that looks intelligently designed because if it weren't we could not be here. End of story!

My own hope is that I, or someone else, will find an overlooked symmetry that will result, simply and inevitably, in the standard model with all parameters calculable from first principles. That is the holy grail of physics.

So, are there any other things, right under our noses, that we have not recognized? I say yes, big time. Smolin points to five fundamental problems of physics, but emphasizes that the "greatest mystery of all" is the meaning of quantum mechanics. Then surely most of his book is about this most important problem? Well, no. His treatment of this most important problem is superficial in the extreme. He announces that he is a "realist" and dismisses non-realism (mental universe) on grounds that in the early universe there were no minds! That is, he takes a conclusion (that there was an early universe) and deduces his premise from that!

The only thing that we actually know, is that our minds exist; all else is suspect deduction from what we call "observations." These observations are numbers that occur to us every day and that have patterns in them that we call a world. But, you can test the reality of that world, and it is simply not there: e.g. "Measurements Are the Only Reality, Say Quantum Tests." (Science Magazine, 1995 December 1, page 1439.)

Ho-hum, turn the page of Science, and go back to simply kicking boulders to refute the pesky mentalists!

Most among us are in denial regarding the obvious. The alternatives are untenable, and counterproductive. I heard Brian Greene talk, fascinating on superstrings, but a look of awe as he indicated his leaning toward "many worlds" quantum mechanics. Why don't I like many worlds? Not because the number of worlds makes 10^{500} look like chump change; no, it is because you have introduced your many worlds, with no objective other than to make your electrons real, and yet when you are done … you can't say one word about what your now-real electrons are. It is simply nonsense!

I highly recommend both of these books; they deserve a wide audience.

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Wronger Than Wrong: Not all Wrong Theories are Equal
By Michael Shermer

In belles lettres the witty literary slight has evolved into a genre because, as 20th-century trial lawyer Louis Nizer noted, "A graceful taunt is worth a thousand insults." To wit, from high culture, Mark Twain: "I didn't attend the funeral, but I sent a nice letter saying I approved of it." Winston Churchill: "He has all the virtues I dislike and none of the vices I admire." And from pop culture, Groucho Marx: "I've had a perfectly wonderful evening. But this wasn't it." Scientists are no slouches when it comes to pitching invectives at colleagues. Achieving almost canonical status as the ne plus ultra put-down is theoretical physicist Wolfgang Pauli's reported harsh critique of a paper: "This isn't right. It's not even wrong." I call this Pauli's proverb.

Columbia University mathematician Peter Woit recently employed Pauli's proverb in his book title, a critique of string theory called Not Even Wrong (Basic Books, 2006). String theory, Woit argues, is not only based on nontestable hypotheses, it depends far too much on the aesthetic nature of its mathematics and the eminence of its proponents. In science, if an idea is not falsifiable, it is not that it is wrong, it is that we cannot determine if it is wrong, and thus it is not even wrong.

Not even wrong. What could be worse? Being wronger than wrong, or what I call Asimov's axiom, well stated in his book The Relativity of Wrong (Doubleday, 1988): "When people thought the earth was flat, they were wrong. When people thought the earth was spherical, they were wrong. But if you think that thinking the earth is spherical is just as wrong as thinking the earth is flat, then your view is wronger than both of them put together."

Asimov's axiom holds that science is cumulative and progressive, building on the mistakes of the past, and that even *though scientists are often wrong, their wrongness attenuates with continued data collection and theory building*. Satellite measurements, for instance, have shown precisely how the earth's shape differs from a perfect sphere.

The view that all wrong theories are equal implies that no theory is better than any other. This is the theory of the "strong" social construction of science, which holds that science is inextricably bound to the social, political, economic, religious and ideological predilections of a culture, particularly of those individuals in power. Scientists are knowledge capitalists who produce scientific papers that report the results of experiments conducted to test (and usually support) the hegemonic theories that reinforce the status quo.

In some extreme cases, this theory that culture shapes the way science is conducted is right. In the mid-19th century, physicians discovered that slaves suffered from drapetomania, or the uncontrollable urge to escape from slavery, and dysaethesia aethiopica, or the tendency to be disobedient. In the late 19th and early 20th centuries, scientific measurements of racial differences in cognitive abilities found that blacks were inferior to whites. In the mid-20th century, psychiatrists discovered evidence that allowed them to classify homosexuality as a disease. And until recently, women were considered inherently inferior in science classrooms and corporate boardrooms.

Such egregious examples, however, do not negate the extraordinary ability of science to elucidate the natural and social worlds. Reality exists, and science is the best tool yet employed to discover and describe that reality. The theory of evolution, even though it is the subject of vigorous debates about the tempo and mode of life's history, is vastly superior to the theory of creation, which is not even wrong (in Pauli's sense). As evolutionary biologist Richard Dawkins observed on this dispute: "When two opposite points of view are expressed with equal intensity, the truth does not necessarily lie exactly halfway between them. It is possible for one side to be simply wrong."

When people thought that science was unbiased and unbound by culture, they were simply wrong. On the other hand, when people thought that science was completely socially constructed, they were simply wrong. But if you believe that thinking science is unbiased is just as wrong as thinking that science is socially constructed, then your view is not even wronger than wrong.

Peter Woit on the multiverse as a weapon against religion: “a lousy one and not going to convince anyone”

February 21, 2012 Posted by News under Multiverse, News, Science 11 Comments

At *Not Even Wrong*, Peter Woit comments on Larry Krauss’s recent interest in the multiverse:

> Today’s New York Times has an article by Dennis Overbye about Lawrence Krauss and his new book A Universe From Nothing. Much of the book is an excellent discussion of cosmology and the physics of the vacuum, but it also devotes a lot of effort to discussing the meaningless question of “Why is there something rather than nothing?” and arguing against the invocation of a deity in order to answer it. Krauss is no fan of string theory, which he regards as overhyped, but he seems to have developed an attraction to multiverse studies recently, perhaps motivated by their use in arguments with those who see the Big Bang as a place for God to hang out.
>
> Personally I’ve no interest in arguments about the existence of God, which epitomize to me an empty waste of time. Given the real dangers of religious fundamentalism in the US though, I’m glad that others like Krauss make the effort to answer some of these arguments. I’m less happy to see him and others adopting the multiverse as their weapon of choice in this battle, since it’s a lousy one and not going to convince anyone. In the New York Times piece we’re told:
>
> > “Maybe in the true eternal multiverse there are truly no laws,” Dr. Krauss said in an e-mail. “Maybe indeed randomness is all there is and everything that can happen happens somewhere.”
>
> Given the choice between this vision of fundamental science and “God did it” as explanations for the nature of the universe, one can’t be surprised if people go for the man in the white robes…

Well, if God exists, science follows, but if there are truly no laws, science doesn’t follow.

11 Responses to *Peter Woit on the multiverse as a weapon against religion: “a lousy one and not going to convince anyone”*

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1 **bornagain77** February 21, 2012 at 9:46 pm

People who buy into the common stereotype that all religious people are 'fundamentalists' really need to take time to actually read the New Testament for themselves instead of buying into the stereotype that only a minority of Christians actually reflect. This picture of a angry God who is out to get you is patently false. and In fact the New Testament is actually a very anti-fundamentalist book. Philip Yancey, who grew up in a very 'fundamentalist' environment, gives a very good overview of the 'grace' revealed in the New Testament in this video:

> Philip Yancey "What Good Is God" 1/2
> http://www.youtube.com/watch?v=YEZUF1eMofo

2 **bevets** February 21, 2012 at 10:42 pm

Well, if God exists, science follows, but if there are truly no laws, science doesn't follow.

But then with me the horrid doubt always arises whether the convictions of man's mind, which has been developed from the mind of the lower animals, are of any value or at all trustworthy. Would any one trust in the convictions of a monkey's mind, if there are any convictions in such a mind? ~ Charles Darwin

If my mental processes are determined wholly by the motions of atoms in my brain, I have no reason to suppose that my beliefs are true. They may be sound chemically, but that does not make them sound logically. ~ J.B.S. Haldane

The ultimate irony is that this philosophy implies that Darwinism itself is just another meme, competing in the infectivity sweepstakes by attaching itself to that seductive word "science." Dawkins ceaselessly urges us to be rational, but be does so in the name of a philosophy that implies that no such thing as rationality exists because our thoughts are at the mercy of our genes and memes. The proper conclusion is that the Dawkins poor brain has been infected by the Darwin meme, a virus of the mind if ever there was one, and we wonder if he will ever be able to find the cure. ~ Phillip Johnson

The very notion of physical law is a theological one in the first place, a fact that makes many scientists squirm. Isaac Newton first got the idea of absolute, universal, perfect, immutable laws from the Christian doctrine that God created the world and ordered it in a rational way. ~ Paul Davies

Modern science was conceived, and born, and flourished in the matrix of Christian theism. Only liberal doses of self-deception and double-think, I believe, will permit it to flourish in the context of Darwinian naturalism. ~ Alvin Plantinga

3 **NickMatzke_UD** February 22, 2012 at 2:16 am

> People who buy into the common stereotype that all religious people are 'fundamentalists' really need to take time to actually read the New Testament for themselves instead of buying into the stereotype that only a minority of Christians actually reflect. This picture of a angry God who is out to get you is patently false. and In fact the New Testament is actually a very anti-fundamentalist book.

Wait, what? This statement might make some sense, coming from a liberal or mainline Christian, but coming from you, bornagain77, it's just bizarre. You're a young-earth creationist, if memory serves. It is possible to be a fundamentalist and not be a young-earth creationist — e.g., William Jennings Bryan was an old-earther — but it's pretty impossible to be a young-earth creationist and not be a fundamentalist.

You seem to have some definition of "fundamentalist" in your head that is something like "fundamentalists are mean Christians no one likes". But this is miles from the historical definition. Basically, fundamentalism boils down to the acceptance of Biblical literalism or a strong version of Biblical inerrancy. Google it…

4 **bornagain77** February 22, 2012 at 3:56 am

Nick, you imagine that I'm;

> a young-earth creationist,

Really??? Since I have not ever once held, nor defended, the Young Earth position on UD, and have indeed held, and defended, the Old Earth position several times on

UD, that the days of Genesis are to be interpreted as each being long periods of time, then this goes to show, clearly, that you have projected a unwarranted 'fundamentalist' stereotype onto me, and, Nick, this would make you wrong,, AGAIN!,,, Go Figure Nick!!!, At least your consistent! ;

notes:

> Christian Theodicy in Light of Genesis and Modern Science: William A. Dembski
> Excerpt: The End Of Christianity: Finding A God God In An Evil World
> http://www.designinference.com.....of_xty.pdf
>
> ,,, 'And if your curious about how Genesis 1, in particular, fairs. Hey, we look at the Days in Genesis as being long time periods, which is what they must be if you read the Bible consistently, and the Bible scores 4 for 4 in Initial Conditions and 10 for 10 on the Creation Events'
> Hugh Ross – last part of 'Evidence For Intelligent Design Is Everywhere' video
>
> Hugh Ross – Evidence For Intelligent Design Is Everywhere (10^-1054) – video
> http://www.metacafe.com/watch/4347236
>
> Young Earth vs, Old earth Debate: Kent Hovind vs. Hugh Ross
> http://www.youtube.com/watch?v=WNuHuG517lI
>
> The following articles provide a few critiques of the Young Earth view of evidence (though my main objection to YEC has to do with the contortion that YEC would wish to visit on the constant of the speed of light):
>
>> Do the RATE Findings Negate Mainstream Science? GREG MOORE
>> The RATE conclusions are based on a compounded set of assumptions. These assumptions are not derived from empirical data, but from the young-earth view of Earth history. Until the RATE team can demonstrate the validity of these assumptions, the study findings do little to prove the accelerated decay hypothesis.
>> http://216.177.75.97/resources.....eamScience
>>
>> Helium Diffusion in Zircon: Flaws in a Young-Earth Argument, Part 1 (of 2)
>> http://www.reasons.org/age-ear.....t-part-1-2
>
> Nick, as far as our modern day 'scientific' measurement of time, it may surprise you, very much, to learn that the biblical 'prophetic' calender is more accurate than our modern day 'scientific' calender. The Gregorian calender uses a fairly complex system of leap days to keep accuracy with the sun, whereas, on a whole consideration, the prophetic calender uses a simpler system of leap months to keep accuracy to the sun. When these two systems are compared against each other, side by side, the prophetic calender equals the Gregorian in accuracy at first approximation, and on in-depth analysis for extremely long periods of time (even to the limits for how precisely we can measure time altogether) the prophetic calender exceeds the Gregorian calender. i.e. God's measure of time exceeds the best efforts of Man to scientifically measure time accurately.,, But, as a Christian Theists, why am I surprised about this?
>
>> Bible Prophecy Year of 360 Days
>> Excerpt: Is the Biblical 'prophetic' calender more accurate than our modern calender? Surprisingly yes! Excerpt: The first series of articles will show the 360-day (Prophetic) calendar to be at least as simple and as accurate as is our modern (Gregorian) calendar. In the second part of our discussion we will demonstrate how that the 360-day calendar is perfectly exact (as far as our 'scientific' measurements will allow).
>> http://www.360calendar.com/
>
> Now Nick how is this so??,, Clearly from your 'modern scientific' position, i.e. atheistic-materialism, position, this should be completely impossible from you view point! Is this just another coincidence you will ignore?

5 **wallstreeter43** February 22, 2012 at 5:09 am

Born again, I particularly enjoyed the debate between Ross and hovind
and Ross was right about the word days in the bible. As Ross correctly states the Hebrew word for day is yom and yom can mean day or period of time. It's one of those words that has multiPle meanings.
Heck my parents use the Lebanese version of that word I'll yome or yome and it's

still being used in multiple contexts and definitions.

Hugh Ross is a sharp cookie and he was one of of the pieces of the puzzle for my conversion from theistic evolutionist to ID. Ross also correctly points out that the bible also described the circumference of the earth when other scientists thought the earth was flat.

Nick as far as your memory of bornagain being a yec, I think your memory needs a cleaning.

Back to Hugh Ross the only thing I don't like about him is his opinion that the shroud of Turin is a forgery, but no ones perfect as I agree with most of what he says on just about everything else

6 **bornagain77** February 22, 2012 at 5:20 am

Nick, since you think that 'time' counts against Theism, it is very interesting to point out that the findings of modern science, about the nature of time, are very, very, conducive to a overarching Theistic view of time;

Notes to that effect;

Reflections on the 'infinite transcendent information' framework, as well as on the 'eternal' and 'temporal' frameworks:

The weight of mass becomes infinite at the speed of light, thus mass will never go the speed of light. Yet, mass would disappear from our sight if it could go the speed of light, because, from our non-speed of light perspective, distance in direction of travel will shrink to zero for the mass going the speed of light. Whereas conversely, if mass could travel at the speed of light, its size will stay the same while all other frames of reference not traveling the speed of light will disappear from its sight.

> Special Relativity – Time Dilation and Length Contraction – video
> http://www.youtube.com/watch?v=VSRIyDfo_mY

Moreover time, as we understand it temporally, would come to a complete stop at the speed of light. To grasp the whole 'time coming to a complete stop at the speed of light' concept a little more easily, imagine moving away from the face of a clock at the speed of light. Would not the hands on the clock stay stationary as you moved away from the face of the clock at the speed of light? Moving away from the face of a clock at the speed of light happens to be the same 'thought experiment' that gave Einstein his breakthrough insight into e=mc2.

> Albert Einstein – Special Relativity – Insight Into Eternity – 'thought experiment' video
> http://www.metacafe.com/w/6545941/

,,,Yet, even though light has this 'eternal' attribute in regards to our temporal framework of time, for us to hypothetically travel at the speed of light, in this universe, will still only get us to first base as far as quantum entanglement, or teleportation, is concerned.

> Light and Quantum Entanglement Reflect Some Characteristics Of God – video
> http://www.metacafe.com/watch/4102182

That is to say, traveling at the speed of light will only get us to the place where time, as we understand it temporally, comes to complete stop for light, i.e. gets us to the eternal, 'past and future folding into now', framework of time. This higher dimension, 'eternal', inference for the time framework of light is warranted because light is not 'frozen within time' yet it is shown that time, as we understand it, does not pass for light.

> "I've just developed a new theory of eternity."
> Albert Einstein – The Einstein Factor – Reader's Digest
>
> "The laws of relativity have changed timeless existence from a theological claim to a physical reality. Light, you see, is outside of time, a fact of nature proven in thousands of experiments at hundreds of universities. I don't pretend to know how tomorrow can exist simultaneously with today and yesterday. But at the speed of light they actually and rigorously do. Time does not pass."
> Richard Swenson – More Than Meets The Eye, Chpt. 12
>
> Experimental confirmation of Time Dilation
> http://en.wikipedia.org/wiki/T.....nfirmation

It is also very interesting to note that we have two very different qualities of 'eternality of time' revealed by our time dilation experiments;

> Time Dilation – General and Special Relativity – Chuck Missler – video
> http://www.metacafe.com/w/7013215/
>
> Time dilation
> Excerpt: Time dilation: special vs. general theories of relativity:
> In Albert Einstein's theories of relativity, time dilation in these two circumstances can be summarized:
> 1. –In special relativity (or, hypothetically far from all gravitational mass), clocks that are moving with respect to an inertial system of observation are measured to be running slower. (i.e. For any observer accelerating, hypothetically, to the speed of light, time, as we understand it, will come to a complete stop).
> 2.–In general relativity, clocks at lower potentials in a gravitational field—such as in closer proximity to a planet—are found to be running slower.
> http://en.wikipedia.org/wiki/Time_dilation

i.e. As with any observer accelerating to the speed of light, it is found that for any observer falling into the event horizon of a black hole, that time, as we understand it, will come to a complete stop for them. — But of particular interest to the 'eternal framework' found for General Relativity at black holes;… It is interesting to note that entropic decay (disorderly randomness), which is the primary reason why things grow old and eventually die in this universe, is found to be greatest at black holes. Thus the 'eternality of time' at black holes can rightly be called 'eternalities of decay and/or eternalities of disorder'.

> Entropy of the Universe – Hugh Ross – May 2010
> Excerpt: Egan and Lineweaver found that supermassive black holes are the largest contributor to the observable universe's entropy. They showed that these supermassive black holes contribute about 30 times more entropy than what the previous research teams estimated.
> http://www.reasons.org/entropy-universe
>
> Roger Penrose – How Special Was The Big Bang?
> "But why was the big bang so precisely organized, whereas the big crunch (or the singularities in black holes) would be expected to be totally chaotic? It would appear that this question can be phrased in terms of the behaviour of the WEYL part of the space-time curvature at space-time singularities. What we appear to find is that there is a constraint WEYL = 0 (or something very like this) at initial space-time singularities-but not at final singularities-and this seems to be what confines the Creator's choice to this very tiny region of phase space."

i.e. The event horizons of Black Holes are found to be 'timeless' singularities of randomness, chaos, and disorder rather than singularities of creation and order such as the extreme (1 in 10^10^123) low entropic order we see at the creation event of the Big Bang. Needless to say, the implications of this 'eternality of chaos' should be fairly disturbing for those of us who are of a 'spiritually minded' persuasion!

> Blackholes – The neo-Darwinian 'god of entropic randomness' which can create all things (at least according to them)
> https://docs.google.com/document/d/1fxhJEGNeEQ_sn4ngQWmeBt1YuyOs8AQcUrzBRo7wISw/edit?hl=en_US
>
> Matthew 10:28
> "Do not fear those who kill the body but are unable to kill the soul; but rather fear Him who is able to destroy both soul and body in hell.

7 **bornagain77** February 22, 2012 at 5:25 am

It is also very interesting to note that this strange higher dimensional, eternal, framework for time, found in special relativity, and general relativity, finds corroboration by multiple 'eye witness accounts' in Near Death Experience testimonies:

> 'In the 'spirit world,,, instantly, there was no sense of time. See, everything on earth is related to time. You got up this morning, you are going to go to bed tonight. Something is new, it will get old. Something is born, it's going to die. Everything on the physical plane is relative to time, but everything in the spiritual plane is relative to eternity. Instantly I was in total consciousness and awareness of eternity, and you and I as we live in this earth cannot even comprehend it, because everything that we have here is filled within the veil of the temporal life. In the spirit life that is more real than anything else and it is awesome. Eternity as a concept is awesome. There is no such thing as time. I knew that whatever happened was going to go on and on.'
> Mickey Robinson – Near Death Experience (NDE) testimony
>
> In The Presence Of Almighty God – The NDE of Mickey Robinson – video
> http://www.metacafe.com/watch/4045544
>
> 'When you die, you enter eternity. It feels like you were always there, and you will always be there. You realize that existence on Earth is only just a brief instant.'
> Dr. Ken Ring – has extensively studied Near Death Experiences
>
> 'Earthly time has no meaning in the spirit realm. There is no concept of before or after. Everything – past, present, future – exists simultaneously.' – Kimberly Clark Sharp – NDE Experiencer
>
> 'There is no way to tell whether minutes, hours or years go by. Existence is the only reality and it is inseparable from the eternal now.' – John Star – NDE Experiencer

It is also very interesting to point out that the 'light at the end of the tunnel', reported in very many Near Death Experiences(NDEs), is also corroborated by Special Relativity when considering the optical effects for traveling at the speed of light. Please compare the similarity of the optical effect, noted at the 3:22 minute mark of the following video, when the 3-Dimensional world 'folds and collapses' into a tunnel shape around the direction of travel as a 'hypothetical' observer moves towards the 'higher dimension' of the speed of light, with the 'light at the end of the tunnel' reported in very many Near Death Experiences: (Of note: This following video was made by two Australian University Physics Professors with a supercomputer.)

> Approaching The Speed Of Light – Optical Effects – video
> http://www.metacafe.com/watch/5733303/

Here is the interactive website, with link to the relativistic math at the bottom of the page, related to the preceding video;

> Seeing Relativity
> http://www.anu.edu.au/Physics/Searle/

Here is corroboration of the tunnel from Near Death testimonies,,,

> The NDE and the Tunnel – Kevin Williams' research conclusions
> Excerpt: I started to move toward the light. The way I moved, the physics, was completely different than it is here on Earth. It was something I had never felt before and never felt since. It was a whole different sensation of motion. I obviously wasn't walking or skipping or crawling. I was not floating. I was flowing. I was flowing toward the light. I was accelerating and I knew I was accelerating, but then again, I didn't really feel the acceleration. I just knew I was accelerating toward the light. Again, the physics was different – the physics of motion of time, space, travel. It was completely different in that tunnel, than it is here on Earth. I came out into the light and when I came out into the light, I realized that I was in heaven. (Barbara Springer)
>
> Near Death Experience – The Tunnel, The Light, The Life Review – video
> http://www.metacafe.com/watch/4200200/

As well, as with the 'scientifically/mathematically' verified tunnel for special relativity, we also have scientific/mathematical confirmation of 'tunnel curvature' within space-time, even ‘extreme tunnel curvature’ within space-time to a ‘eternal event horizon’ at black holes;

> The curvature of Space-Time – video
> http://www.youtube.com/watch?v=LoaOHvy5AcA

Even light is bent by this ‘fabric’ of space-time;

> Einstein – General Relativity – video
> http://www.youtube.com/watch?v=vyVUbUrB2YY
>
> Space-Time of a Black hole
> http://www.youtube.com/watch?v=f0VOn9r4dq8

Once again, these consistent findings from science/math, that just so happen to corroborate a consistent characteristic mentioned in NDE testimonies, ‘should’ be fairly disturbing for those of us of a spiritual persuasion,,,,

Moreover, severely contrary to what many atheists would prefer for us to believe, there actually is solid empirical evidence for a ‘soul’ to man that provides a coherent mechanism for traversing to these higher space-time dimensions revealed by our science:

> Cellular Communication through Light
> Excerpt: Information transfer is a life principle. On a cellular level we generally assume that molecules are carriers of information, yet there is evidence for non-molecular information transfer due to endogenous coherent light. This light is ultra-weak, is emitted by many organisms, including humans and is conventionally described as biophoton emission.
> http://www.plosone.org/article.....ne.0005086
>
> Biophotons – The Light In Our Cells – Marco Bischof – March 2005
> Excerpt page 2: The Coherence of Biophotons: ,,, Biophotons consist of light with a high degree of order, in other words, biological laser light. Such light is very quiet and shows an extremely stable intensity, without the fluctuations normally observed in light. Because of their stable field strength, its waves can superimpose, and by virtue of this, interference effects become possible that do not occur in ordinary light. Because of the high degree of order, the biological laser light is able to generate and keep order and to transmit information in the organism.
> http://www.international-light.....hotons.pdf
>
> Are humans really beings of light?
> Excerpt: “We now know, today, that man is essentially a being of light.”,,, “There are about 100,000 chemical reactions happening in every cell each second. The chemical reaction can only happen if the molecule which is reacting is excited by a photon… Once the photon has excited a reaction it returns to the field and is available for more reactions… We are swimming in an ocean of light.”

8 **bornagain77** February 22, 2012 at 5:28 am

And once again this man is ‘swimming in an ocean of light’ finding from science finds corroboration from NDE testimonies;

> Coast to Coast – Vicki’s Near Death Experience (Blind From Birth) part 1 of 3
> http://www.youtube.com/watch?v=e65KhcCS5-Y
>
> Quote from preceding video: ‘I was in a body and the only way that I can describe it was a body of energy, or of light. And this body had a form. It had a head. It had arms and it had legs. And it was like it was made out of light. And ‘it’ was everything that was me. All of my memories, my consciousness, everything.’ -
> Vicky Noratuk
>
> “Miracles do not happen in contradiction to nature, but only in contradiction to that which is known to us of nature.” -
> St. Augustine

Moreover, the finding of quantum entanglement/information, on a massive scale in molecular biology, has falsified the reductive materialistic (atheistic) theory of neo-Darwinism;

> Falsification Of Neo-Darwinism by Quantum Entanglement/Information
> https://docs.google.com/document/d/1p8AQgqFqiRQwyaF8t1_CKTPQ9duN8FHU9-pV4oBDOVs/edit?hl=en_US

Moreover, recent breakthroughs into 'Quantum Biology' easily, even ;naturally', supports the contention of a 'Quantum Soul' to man that lives past the death of our temporal bodies;

> Does Quantum Biology Support A Quantum Soul? – Stuart Hameroff – video (notes in description)
> http://vimeo.com/29895068

Moreover, the quantum entanglement/information that is shown to be, in fact, 'holding us together' (constraining molecular biology to be so far out of thermodynamic equilibrium) at the base molecular scale is, in fact, of a 'higher quality' of higher dimensionality than 4-D space-time itself is:

> 3D to 4D shift – Carl Sagan – video with notes
> Excerpt from Notes: The state-space of quantum mechanics is an infinite-dimensional function space. Some physical theories are also by nature high-dimensional, such as the 4-dimensional general relativity.
> http://www.youtube.com/watch?v=9VS1mwEV9wA

,,,but to continue on with the main topic,,, hypothetically traveling at the speed of light in this universe would be instantaneous travel for the observer going at the speed of light. This is because time, as we understand it, does not pass for them, yet, and this is a very big 'yet' to take note of; this 'timeless' travel is still not instantaneous and transcendent to our temporal framework of time, i.e. Speed of light travel, to our temporal frame of reference, is still not completely transcendent of our framework since light appears to take time to travel from our perspective. Yet, in quantum teleportation of information, the 'time not passing', i.e. 'eternal', framework is not only achieved in the speed of light framework/dimension, but is also 'instantaneously' achieved in our temporal framework. That is to say, the instantaneous teleportation/travel of information is instantaneous to both the temporal and speed of light frameworks, not just the speed of light framework. Information teleportation/travel is not limited by time, nor space, in any way, shape or form, in any frame of reference, as light is seemingly limited to us. Thus 'pure transcendent information' is shown to be timeless (eternal) and completely transcendent of all material frameworks. Moreover, concluding from all lines of evidence we have now examined; transcendent, eternal, infinite information is indeed real and the framework in which 'It' resides is the primary reality (highest dimension) that can exist, (in so far as our limited perception of a primary reality, highest dimension, can be discerned).

> "An illusion can never go faster than the speed limit of reality"
> Akiane Kramarik – Child Prodigy – Music video
> http://www.metacafe.com/watch/4204586

Logic also dictates 'a decision' must have been made, by the 'transcendent, eternal, infinite information' from the primary timeless (eternal) reality 'It' inhabits, in order to purposely create a temporal reality with highly specified, irreducible complex, parameters from a infinite set of possibilities in the proper sequential order. Thus this infinite transcendent information, which is the primary reality of our reality, is shown to be alive by yet another line of evidence besides the necessity for a 'first mover' to explain quantum wave collapse.

> The First Cause Must Be A Personal Being – William Lane Craig – video
> http://www.metacafe.com/w/4813914

etc.. etc.. etc..

Nick, I simply see no conflict between what science has revealed to us about the nature of time and my overall Christian Theistic view of reality!

Quote and music:

“There are more things in heaven and earth, Horatio, Than are dreamt of in your philosophy.”
William Shakespeare – Hamlet

Natalie Grant – Alive (Resurrection video)
http://www.godtube.com/watch/?v=KPYWPGNX

9 **Joe** February 22, 2012 at 10:20 am

Hi Nick,

Strange that you would say something about redefining words when it is obvious that is all your position does-> redefine words to suit your needs.

10 **Axel** February 22, 2012 at 11:34 am

Joe, are you accusing Nick of being an Intelligent Randomer/Chaoser/Haphazarder /Gigakoinkidinkier? For….SHAME! Or mebbe a tad less than Intelligent?

11 **Eric Anderson** February 22, 2012 at 5:28 pm

Take it easy on Nick, folks. He needs to preserve his strength as he might have to go back and help with the public relations again at the NCSE after the Gleick fiasco and Scott’s foot-in-mouth press release relating to the NCSE’s shiny new “anti-science” (I think that’s what they called it?) climate campaign.

/Back to the regularly scheduled programming.

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« Flying Squid Researchers scared to death of the anti-science lobby? »

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Quantum field theory

March 17, 2007

Smolin, Woit, the failure of string theory, and how string theory responds

Filed under: About — Nigel Cook @ 10:49 am

Professor Lee Smolin has been a acked by various string theorists (particularly Aaron Bergmann and Lubos Motl), but now Professor Clifford Johnson has seemingly joined in with Aaron and Lubos in a post where he claims that pointing out the failure of string theory in books is unsatisfactory because it puts "their rather distorted views on the issues into the public domain in a manner that serves only to muddle".

This seems to be a slightly unfair a ack to me. Clifford is certainly trying hardest of all the string theorists to be reasonable, but he has stated that he has not read the books critical of string theory, which means that his claim that the books contain 'distorted views' which 'muddle' the issues, is really unfounded upon fact (like the claims of string theory).

Dr Peter Woit has a nice set of notes summarising some problems with string theory here. These are far more sketchy than his book and don't explain the Standard Model and its history like his book, but the notes do summarise a few of the many problems in string theory. String theorists, if they even acknowledge the existence of critics at all (Wi en has wri en a le er to Nature saying that he doesn't, instead he suggests that string theorists should ignore objections while continuing to make or to stand by misleading claims that string theory 'predicts' gravity, such as Wi en's own claim of that in the April 1996 issue of *Physics Today*), dismiss any problem with string theory as a 'storm in a teacup', refuse to read the books of critics, misrepresent what the critics are saying, so the arguments don't address the deep problems.

For instance, Clifford wrote in a particularly upse ing comment:

"For example, a great deal of time was spent by me arguing with Peter Woit that his o -made public claim that string theory has been shown to be wrong is not a correct claim. I asked him again and again to tell us what the research result is that shows this. He has not, and seems unable to do so. I don't consider that to be informed criticism, but a very very strong and unfair overstatement of what the current state of on-going research is."

Peter Woit explains on page 177 of *Not Even Wrong* (which, admi edly, Clifford is unaware of since he has not read the book!) that using the measured weak SU(2) and electromagnetic U(1) forces, supersymmetry predicts the SU(3) force incorrectly high by 10-15%, when the experimental data is accurate to a standard deviation of about 3%. So that's failure #1.

Moreover, Peter Woit also explains on page 179 that supersymmetry makes another false prediction: it predicts a massive amount of dark energy in the vacuum and an immense cosmological constant, totally contradicted by astronomy and too high by a factor of 10^55 or 10^113 depending on whether the string theory is minimally supersymmetric or a supersymmetric grand unified theory, respectively.

Either way, Dr Woit explains: 'This is almost surely the worst prediction ever made by a physical theory that anyone has taken seriously.' So that's failure #2.

This is not a problem with the standard model of particle physics: comparing string theory to the standard model is false. A student who answers one of the questions on a paper and gets it wrong, derives no excuse from pointing to another who achieved 99%, despite happening to get the same single question wrong. Any assessment by comparison needs to take account of successes, not just errors. *In one case the single error marks complete failure, while in the other it's trivial.*

It's still a a string error, whether the standard model makes it as well, or not as the case may be. String theorists have a different definition of the standard model for this argument, more like a speculative theory than an empirical *model* of particle physics. The standard *model* isn't claimed to be the final theory. String is. The standard model is extremely well based on empirical observations and makes checked predictions. String doesn't.

That's why Smolin and Woit are more favourable to the standard model. String theory if of any use *should sort out any problems with the standard model.* This is why the errors of string theory are so alarming. It is supposed to theoretically sort things out, unlike the standard *model*, which is an empirically based model, not a claimed final theory of unification.

Asymptotia

More Scenes From the Storm in a Teacup, VII

*by **Clifford**, at 2:18 am, March 13th, 2007 in science, science in the media, string theory*

"You can catch up on some of the earlier Scenes by looking at the posts listed at the end of this one. Throughthe course of doing those posts I've tried hard to summarize my views on the debate about the views of Smolin and Woit – especially hard to emphasize how the central point of their debate that is worth some actual discussion actually has nothing to do string theory at all. Basically, the whole business of singling out string theory as some sort of great evil is rather silly. If the debate is about anything (and it largely isn't) it is about the process of doing scientific research (in any field), and the structure of academic careers in general. For the former ma er, Smolin and Woit seem to have become frustrated with the standard channels through which detailed scientific debates are carried out and resolved, resorting to writing popular level books that put their rather distorted views on the issues into the public domain in a manner that serves only to muddle. …"

Everything that happens involves particle physics, so it determines the nature of everything, and is just a few types of fundamental particles and four basic fundamental forces, or three at high energy, where electro-weak unification occurs.

It's be er to have debates and disputes over scientific ma ers that can potentially be resolved, than have arguments over interminable political opinions which can't be resolved factually, even in principle. I don't agree that a lack of debate (until new experimental data arrives) is the best option. The issue is that experiments may resolve the electroweak symmetry breaking mechanism, but they won't necessarily change the facts in the string theory debate one bit. Penrose explains the problem here on pp. 1020-1 of *Road to Reality* (UK ed.):

'*34.4 Can a wrong theory be experimentally refuted?* … One might have thought that there is no real danger here, because if the direction is wrong then the experiment would disprove it, so that some new direction would be forced upon us. This is the traditional picture of how science progresses. … We see that it is not so easy to dislodge a popular theoretical idea through the traditional scientific method of crucial experimentation, even if that idea happened actually to be wrong. The huge expense of high-energy experiments, also, makes it considerably harder to test a theory than it might have been otherwise. There are many other theoretical proposals, in particle physics, where predicted particles have mass-energies that are far too high for any serious possibility of refutation.'

I've wri en a very brief review of Lee Smolin's book on Amazon.co.uk, which for brevity concentrates on reviewing the science of the book that I can review objectively (I ignore discussions of academic problems). Here is a copy of it:

Professor Lee Smolin is one of the founders of the Perimeter Institute in Canada. He worked on string theory in the 1980s and switched to loop quantum gravity when string theory failed.

Before reading this book, I read Dr Peter Woit's book about the failure of string theory, Not Even Wrong, read his blog, and watched Smolin's lectures (available streamed online from the Perimeter Institute website), Introduction to Quantum Qravity, which explain the loop quantum gravity theory very clearly.

Smolin concentrates on the subject from the perspective of understanding gravity, although he helped develop a twisted braid representation of the standard model particles. Loop quantum gravity is built on firmer ground that string theory, and tackles the dynamics behind general relativity.

This is quite different from the approach of string theory, which completely ignores the dynamics of quantum gravity. I should qualify this by saying that although the stringy 11-dimensional supergravity, which is the bulk of the mainstream string theory, M-theory (in M-theory 10 dimensional superstring is the brane or membrane on the bulk, like an N-1 dimensional surface on an N-dimensional material), does contain a spin-2 mode which (if real) corresponds to a graviton, that's not a complete theory of gravitation.

In particular, in reproducing general relativity, string theory suggests a large negative cosmological constant, while the current observation-based cosmological model has a small positive cosmological constant.

In addition to failing there, string theory also fails to produce any of the observable particles of the standard model of physics. This is because of the nature of string theory, which is constructed from a world sheet (a 1-dimensional string when moved gains a time dimension, becoming a 1,1 "worldsheet") to which 8 additional dimensions are added to satisfy the conformal symmetry of particle physics, assuming that there is supersymmetric unification of standard model forces (which requires the assumption that every fermion in the universe has a bosonic super partner, which nobody has ever observed in an experiment). If supersymmetry is ignored, then you have to add to the worldsheet three times as many dimensions for conformal symmetry, giving 26 dimensional bosonic string theory. That theory traditionally had problems in explaining fermions, although Tony Smith (now censored off arXiv by the mainstream) has recently come up with some ideas to get around that.

The failure of string theory is due to the 10 dimensions of supersymmetric superstring theory from the worldsheet and conformal symmetry requirements. Clearly, we don't see that many dimensions, so string theorists rise to the challenge by a trick first performed with Kaluza's 5-dimensional theory back in the 1920s. Klein argued that extra spatial dimension can be compactified by being curled up into a small size. Historically, the smallest size assumed in physics has been the Planck length (which comes purely from dimensional analysis by combining physical constants, not from an experimentally validated theory or from observation).

With 10 dimensional superstring, the dimensions must be reduced on a macroscopic scale to 3 spatial dimensions plus 1 time dimension, so 6 spatial dimensions need compactification. The method to do this is the Calabi-Yau manifold. But this cause a massive problem in string theory, called the landscape. String theory claims that particles are vibrating strings, which becomes very problematic when 6 dimensions are compactified, because the vibration modes possible for a string then depend critically on the size and shape parameters of those 6 compactified dimensions. The possibilities are vast, maybe infinite.

It turns out that there are at least 10^500 ways of producing standard model or vacuum ground state from such strings containing Calabi-Yau manifolds. Nobody can tell if any of those solutions is the real standard model of particle physics. For comparison, the age of the universe is something like 10^17 seconds. Hence, if you had a massive computer trying to compute all the solutions to string theory from the moment of the big bang to now, it would have to work at a speed of 10^483 solutions per second to solve the problem (a practically impossible speed, even if such timescales are available). A few string theorists hope to find a way to statistically tackle this problem in a non-rigorous way (without checking every single solution) before the end of the universe, but most have given up and try to explain particle physics by the anthropic principle, whereby it is assumed that there is one universe for each of the 10^500 solutions to string theory, and we see the one standard model which has parameters which are able to result in humans.

More radical string theorists proclaim that if you fiddle around with the field theories underlying general relativity and the standard model, you can create a landscape of unobserved imaginary universes from those theories, similar to string theory. Therefore, they claim, the problems in string theory are similar to those in general relativity and the standard model. However, this analogy is flawed because those checked theories are built up on the basis of observations of particle symmetries, electrodynamics, energy conservation and gravitation, and they also produce checkable predictions. In short, there is no problem due to the imaginary landscape in those theories, whereas there is a real problem caused by the landscape in string theory, because it prevents a reproduction (post-diction) of existing physics, let alone predictions.

Smolin suggests that the failure of string theory to explain general relativity and the standard model of particle physics means that it may be helpful if physicist get off the string theory bandwaggon and start investigating other ideas. Woit makes the same point and gives the technical reasons.

The problem is that string theory has over the past two decades become a cult topic supported by endless marketing hype, magazine articles, books, even sci fi films. Extra dimensions are popular, and the heroes of string theory have go en used to being praised despite having not the slightest shred of evidence for their subject. Recently, they have been claiming that string theory mathematics is valuable for tackling some technical problems in nuclear physics, or may be validated by the discovery of vast cosmic strings in space. But even the mathematics of Ptolemy's earth centred universe epicycles had uses elsewhere, so this defense of string theory is disingenious. It's not clear that string theory maths solves any nuclear physics problems that can't be solved by other methods. Even if it does, that's irrelevant for the issue of whether people should be hyping string as being the best theory around.

Smolin's alternative is loop quantum gravity. The advantage of this is that it builds up Einstein's field equation less a metric (so it is background independent) from a simple summing of interaction graphs for the nodes of a Penrose spin network in the 3 spatial dimensions plus time dimension we observe. This sum is equivalent to taking a Feynman path integral, which is a basic method of doing quantum field theory. The result of this is general relativity without a metric. It is not a complete theory yet, and is the very opposite of string theory in many ways.

While string theory requires unobservables like extra dimensions and superpartners, loop quantum gravity works in observable spacetime using quantum field theory to produce a quantum gravity consistent with general relativity. Ockham's razor, the principle of economy in science, should tell you that loop quantum gravity is tackling real physics in a simple way, whereas string theory is superfluous (at least until there is some evidence for it).

Obviously there is more progress to be made in loop quantum gravity, which needs to become a full Yang-Mills quantum theory if gravity is indeed a force like the other standard model forces. However, maybe the relationship between gravity and the other long-range force, electromagnetism, will turn out to be different to what is expected.

For instance, loop quantum gravity needs to address the problem that of whether gravity is a renormalizable quantum field theory like the standard model Yang-Mills theories. This will depend on the way in which gravitational charge, ie mass, is a ached to or associated with standard model charges by way of some sort of "Higgs field". The large hadron collider is due to investigate this soon. Renormalization involves using a corrected "bare charge" value for electric charge and nuclear charges which is higher than that observed. The justification is that very close to a particle, vacuum pair production occurs in the strong field strength, the pairs polarize and shield the bare core charge to the observed value seen at long distances and low energies. For gravity, renormalization poses the problem of how gravitational charge can be shielded? Clearly, masses don't polarize in a gravitational field (they all move the same way, unlike electrons and positrons in an electric field) so the mass-giving "Higgs field" effect is not directly capable of renormalization, but is capable of indirect renormalization if the Higgs field is being associated with particles by another field like the electric field, which is renormalized.

These are just aspects which appeal to me. One of the most fun parts of the book is where Smolin explains the reason behind "Doubly Special Relativity".

Peter Woit's recent book Not Even Wrong has a far deeper explanation of the standard model and the development of quantum field theory, the proponents and critics of string theory, and gives the case for a deeper understanding of the standard model in observed spacetime dimensions using tools like the well established mathematical modelling methods of representation theory.

Both books should really be read to understand the overall problem and possibilities for progress by alternative ideas despite the failure of string theory.

Update: in the comments on Asymptotia, Peter Woit has made some quick remarks from a web cafe in Pisa, Italy. Instead of arguing about the substance of his remarks, Aaron Bergmann and Jacques Distler are repeatedly a acking one nonsense sentence he typed where he wrote a contradiction that a cosmological constant can correspond to flat spacetime, whereas the cosmological constant implies a small curvature. Unable to defend string theory against the substance of the charge that it is false, they are now a acking this one sentence as a straw man. It's completely unethical. The fact that a string theorist will refusing to read the carefully wri en and proof-read books and then choose instead to endlessly a ack a spurious comment on a weblog, just show the level to which their professionalism has sunk. Jacques Distler does point out correctly that in flat spacetime the vacuum energy does not produce a cosmological constant. Instead of spli ing a acking critics of completely failed theories, he should perhaps admit the theory has no claim to be science.

Comments (8)

8 Comments »

1. copy of a comment to

   h p://riofriospacetime.blogspot.com/2007/03/t-minus-3-days-conference-opening.html

   I just looked up the blog post mentioned in the previous comment and the comments are shut down, preventing any response.

   Tony Smith kindly quoted a li le bit I wrote saying something like "the total gravitational potential energy of the universe is on the order *E = MMG/R = MMG/(ct)*, which when equated to *E=Mc*^2 gives Louise's equation"

   However, this was then dismissed by another comment from somebody else, who did not go back and check my comment on the other blog. The point is, I also have a lot more justification, such as the reason why you need to equate the gravitational energy with the rest mass energy.

   Consider a star. If you had a star of uniform density and radius R, and it collapsed, the energy release from gravitational potential energy being turned into explosive (kinetic and radiation) energy is *E = (3/5)(M^2)G/R*. The 3/5 factor from the integration which produces this result is not applicable to the universe where the density rises with apparent distance because of spacetime (you are looking to earlier, more compressed and dense, epochs of the big bang when you look to larger distances). It's more sensible to just remember that the gravitational potential energy of mass *m* located at distance *R* from mass *M* is simply *E = mMG/R* so for gravitational potential energy of the universe is similar, if *R* is defined as the effective distance the majority of the mass would be moving if the universe collapsed.

   This idea of gravitational potential energy shouldn't bee controversial: in supernovae explosions much energy comes from such an implosion, which turns gravitational potential energy into explosive energy!

   Generally, to overcome gravitational collapse, you need to have an explosive outward force.

   The universe was only able to expand in the first place because the explosive outward force, provided by kinetic and radiation energy, which counteracted the gravitational force.

Initially, the entire energy of the radiation was present as various forms of radiation. Hence, to prevent the early universe from being contracted into a singularity by gravity, we have the condition that *E = Mc^2 = (M^2)G/R = (M^2)G/(ct)* which gives GM = tc^3.

****

My earlier comment:

Two ways to get GM = tc^3:

(1)

Consider why the big bang was able to happen, instead of the mass being locked by gravity into a black hole singularity and unable to expand!

This question is traditionally answered (Prof. Susskind used this in an interview about his book) by the fact the universe simply had enough outward explosive or expansive force to counter the gravitational pull which would otherwise produce a black hole.

In order to make this explanation work, the outward acting explosive energy of the big bang, E = Mc^2, had to either be equal to, or exceed, the energy of the inward acting gravitational force which was resisting expansion.

This energy is the gravitational potential energy E = MMG/R = (M^2)G/(ct).

Hence the explosive energy of the big bang's nuclear reactions, fusion, etc., E = Mc^2 had to be equal or greater than E = (M^2)G/(ct):

Mc^2 ~ (M^2)G/(ct)

Hence

MG ~ tc^3.

That's the first way, and perhaps the easiest to understand.

(2)

Simply equate the rest mass energy of m with its gravitational potential energy mMG/R with respect to large mass of universe M located at an average distance of R = ct from m.

Hence E = mc^2 = mMG/(ct)

Cancelling and collecting terms,

GM = tc^3

So Louise's formula is derivable.

The rationale for equating rest mass energy to gravitational potential energy in the derivation is Einstein's principle of equivalence between inertial and gravitational mass in general relativity (GR), when combined with special relativity (SR)equivalence of mass and energy!

(1) GR equivalence principle: inertial mass = gravitational mass.

(2) SR equivalence principle: mass has an energy equivalent.

(3) Combining (1) and (2):

inertial mass-energy = gravitational mass-energy

(4) The inertial mass-energy is E=mc^2 which is the energy you get from complete annihilation of ma er into energy.

The gravitational mass-energy is is gravitational potential energy a body has within the universe. Hence the gravitational mass-energy is the gravitational potential energy which would be released if the universe were to collapse. This is E = mMG/R with respect to large mass of universe M located at an average distance of R = ct from m.

****

What's interesting is that the mainstream doesn't want to discuss science when it comes to alternatives, as Tony Smith makes clear in his discussion of censorship.

They use ad hominem a acks, which is a lazy approach whereby no careful science or disciplined checks are involved. The mainstream however objects if ad hominem a acks are used against it's leaders. For example, Dr Ed Wi en – M-theory creator – was misleading when he claimed:

'String theory has the remarkable property of predicting gravity.' – Dr Edward Wi en, M-theory originator, Physics Today, April 1996.

Dr Peter Woit remarks that the prediction is just a prediction of an *unobservable spin-2 graviton* and *not a prediction of anything to do with gravity that is either already experimentally verified or checkable in the future*:

'There is not even a serious proposal for what the dynamics of the fundamental 'M-theory' is supposed to be or any reason at all to believe that its dynamics would produce a vacuum state with the desired properties. The sole argument generally given to justify this picture of the world is that perturbative string theories have a massless spin two mode and thus could provide an explanation of gravity, if one ever managed to find an underlying theory for which perturbative string theory is the perturbative expansion.' – Quantum Field Theory and Representation Theory: A Sketch (2002), h p://arxiv.org/abs/hep-th/0206135

If you call mainstream M-theory hypers 'liars', 'charlatans', 'crackpots', etc., you find that you are then accused of being a 'science hater'. So they don't like criticism.

To give credit where due, Dr Ed Wi en published a le er in Nature, Nature, Vol 444, 16 November 2006, stating:

'The critics feel passionately that they are right, and that their viewpoints have been unfairly neglected by the establishment. … They bring into the public arena technical claims that few can properly evaluate. … Responding to this kind of criticism can be very difficult. It is hard to answer unfair charges of elitism without sounding elitist to non-experts. A direct response may just add fuel to controversies.'

So Dr Ed Wi en at least doesn't encourage a acks on critics, he just prefers to ignore them. Maybe this is worse for critics with alternative ideas, however, where the choice is controversy or being ignored altogether.

But the mainstream as a whole *does* go far out of its way to use ad hominem a acks on alternatives, hence Lubos Motl's a acks, and many others.

Comment by nc — March 28, 2007 @ 11:58 pm

Reply

2. One new idea which occurs to me: the two types of derivation in the above comment could be combined to prove one or the other. If you can take the first type of derivation as experimentally sound, for example, then that would allow you to theoretically *derive* Einstein's equivalence principle between inertial and gravitational mass.

   Comment by nc — March 29, 2007 @ 12:07 am

   Reply

3. HOW STRING THEORISTS AVOID THE IMPERFECTIONS OF EINSTEIN

   h p://motls.blogspot.com/2007/03/einstein-may-have-started-rot.html Motl: "Einstein may have started the rot"…what string theory is doing is nothing else than continuing in Einstein's program of theoretical physics, while AVOIDING ALL OF HIS KNOWN IMPERFECTIONS."

   Divine Albert taught that the speed of light varied with the gravitational potential but did not vary with the relative speed of the light source and the observer, and in Chapter 22 in his "Relativity" explained why this combination of variability and invariability was not an idiocy. Motl and his brothers string theorists agree that the combination is not an idiocy and conclude that Einstein did not start the rot (someone else, perhaps the late Bryan Wallace h p://www.ekkehard-friebe.de /wallace.htm , must have started it). On the other hand, brothers string theorists suspect that Divine Albert's combination of variability and invariability, although not an idiocy, is still an imperfection. So they always avoid it by looking for sand, sticking their heads and exposing other parts of their bodies.

   Pentcho Valev
   pvalev@yahoo.com

   Comment by Pentcho Valev — April 14, 2007 @ 5:33 am

   Reply

4. "Divine Albert taught that the speed of light varied with the gravitational potential but did not vary with the relative speed of the light source and the observer…" – Pentcho Valev

   Pentcho, you're wrong in claiming that Einstein taught people that the *speed* of light varies with the gravitational potential. He actually taught that the *velocity* of light varies with the gravitational potential.

   The speed remains constant; the *velocity* varies because the direction changes and velocity is a vector, a statement of speed and direction not just speed.

   Here are a couple of quotations collected by Dr Thomas Love of California State University which demonstrate this:

   '… [special relativity requires] the law of the constancy of the velocity of light. But … the general theory of relativity cannot retain this law. On the contrary, we arrived at the result according to this la er theory, the velocity of light must always depend on the coordinates when a gravitational field is present.' – Albert Einstein, Relativity, The Special and General Theory, Henry Holt and Co., 1920, p111.

   '… the principle of the constancy of the velocity of light in vacuo must be modified, since we easily recognise that the path of a ray of light … must in general be curvilinear…' – Albert Einstein, The

Principle of Relativity, Dover, 1923, p114.

All the results of special relativity, the Lorentz transformation, mass-energy equivalence, etc., come from a physical picture of electromagnetism. FitzGerald came up with the contraction in 1889, well before Lorentz, and 16 years before Einstein's first publication. It's undoubtedly a gauge boson exchange radiation effect. Energy is exchanged between charges in Yang-Mills QFT, and any type of gravitational dynamics is likely to have some relationship to the other forces of the standard model of particle physics, so will probably also involve exchange radiation causing the force.

Move in a radiation sea, and the pressure changes introduce a deformation to your fields, contracting their extent in the direction of motion. Since the fields are physically being maintained by exchange radiation endlessly travelling along field's "lines of force", any motion affects the gauge boson radiation, so at high velocities the field behaves and responds relatively slowly, which is the time-dilation effect. E=mc^2 comes just in the way Lorentz said it did, many years before Einstein's SR. Lorentz noticed that J.J. Thomson had shown from electromagnetic theory that the mass of any charged body (ie, a fermion) is inversely proportional to its radius and so the contraction in the direction of motion causes an increase in the mass of a moving charge. This increase in mass is correlated to the increase in energy a moving fermion has! Hence expanding the Lorentz equation for the mass of the moving body by the binomial expansion, you get E=mc^2.

Now for the addition of velocities equation in SR: this is particularly simple in a mechanistic derivation.

You measure velocity as distance/time. When you are moving, say trying to chase a er a light ray using your high speed rocket, you will find that the light ray always *appears* to be moving away from you at 300,000 km/s, regardless how fast you are going relative to the light ray! The reason is that your measuring system for velocity has been distorted by your own contraction in the direction of motion, and time dilation. The faster you are going, the effect of you moving at nearly the speed the ray of light is going is cancelled out by the contraction of your measuring system for distances in the direction of motion etc.

This is a simplified version of what happens in the Michelson-Morley experiment:

'The Michelson-Morley experiment has thus failed to detect our motion through the aether, because the effect looked for – the delay of one of the light waves – is exactly compensated by an automatic contraction of the ma er forming the apparatus…. The great stumbing-block for a philosophy which denies absolute space is the experimental detection of absolute rotation.' – Professor A.S. Eddington (who confirmed Einstein's general theory of relativity in 1919), Space Time and Gravitation: An Outline of the General Relativity Theory, Cambridge University Press, Cambridge, 1921, pp. 20, 152.

Einstein's system is based on what the observer will see in the observable framework and the observer's measuring instruments. Einstein does not explain how the relativity mathematics works in terms of causal mechanisms for what is producing length contraction or time-dilation or apparent impossibilities of observing light going at any speed other than c in vacuo, due to the length contraction and time dilation of the observer, it's just a mathematical system.

You can prove the pythagorean identity in numerous ways, by analogy, and you can't insist that one way is "right" and another is wrong. It really is a waste of time trying to say Einstein was a nu er because his derivation of the FitzGerald-Lorentz equations is mathematically abstract and isn't tied to physical causes and mechanisms. The reason is that there is popular sympathy of the religious kind with the people who claim that the universe is mathematical, mysterious, and lacks any kind of Rube-Goldberg mechanism for each of the mathematical tricks.

That's why I'm kinda worried about Woit and Smolin. They're both kinda crazy, although much more sane than the stringers. Woit writes on p55 of the British edition of *Not Even Wrong*:

"The SU(2) transformation properties of a particle have become known as the particle's spin. This term comes from the idea that one could think of the particle as a spinning particle, spinning on some axis and thus carrying some angular momentum. This idea is inherently inconsistent for a lot of reasons. While the spin is a quantised version of the angular momentum, there is no well-defined axis of rotation or speed of rotation. Spin is an inherently quantum mechanical notion, one that fits precisely with the representation theory of the symmetry group SU(2), but has no consistent interpretation in terms of classical physics."

There's a well defined axis of rotation implied by the Pauli exclusion principle, which makes adjacent fermions in atoms have opposite spins. Of course the individual directions can't be seen, because the electrons are moving chaotically due to the 3+ body Poincare chaos effect. This applies to classical physics (or rather, it should do, although normally classical physics is taught in a way restricted to just two body interactions *by definition* and automatically *by definition* excludes multibody chaotic situations). I just think Woit lost the plot on this one, the speed of rotation from the known spin angular momentum of the electron, of (1/2)h-bar, does does a spin speed plus it imposes constraints on the physical nature of a fermion.

What Woit means by "inherently quantum mechanical notion" is probably something like "beyond any hope or possibility of being understood in causal or mechanistic terms". Dr Thomas Love however points out that wavefunction collapse doesn't really occur when you measure something: that's just a mathematical lie created by switching between time-independent and time-dependent versions of the Schroedinger equation when you make a measurement and affect the system by making that measurement (there's a world of difference between a measurement affecting what you are measuring, and a measurement making something change from a metaphysical indeterminancy state to an absolute, definite state). To me, the spin of a particle physically cannot be indeterminate until it is measured, because in iron atoms the magnetism doesn't occur due to orbital motions of electrons, but due to electron *spin alignments.* So the fact we have magnets proves that spin is a real feature; you don't need to measure spin to see evidence of it, just measure magnetism.

The mathematical obfuscation of special relativity for physical mechanisms was not really "rot" because at least special relativity gives the correct answers for situations where accelerations are absent (admi edly, that's a big limitation since accelerations are needed to start and stop all forms of motion, not to mention gravitation!). The rot in physics really started with Bohr and Heisenberg's Copenhagen Interpretation which Einstein, Polansky and Rosen fought as best they could.

Bryan Wallace simply wasn't pu ing forward useful ideas to get around the difficulties. Like many others, he could see that a lot of the religious Einstein worship (based on people loving what they can't understand physically, and linking relativity to the occult, instead of treating it as a mathematical system based on assumptions which allow it to work for its restricted scope of non-accelerating situations) wasn't a good thing.

In particular, Wallace analysed NASA interplanetary radar data and discredit the principle of relativity directly. It's pre y obvious that light speed is absolute in an absolute (imaginary) frame of reference: the reason why the speed of light when measured in vacuum seems to be always 300,000 km/s is due to the contraction or time dilation effects affecting the measuring instrument when that is in motion, chasing a er the light or whatever.

The cosmic background radiation shows a preferred absolute direction.

R. A. Muller showed from the +/-0.003 K redshi and blueshi in the 2.7 K microwave background (the variation forms a cosine relationship to our absolute direction) that the Milky Way is going at 600 km/s towards Andromeda, publishing this is his Scientific American article:

Muller, R. A., "The cosmic background radiation and the new aether dri ", Scientific American, vol. 238, May 1978, p. 64-74

Abstract

U-2 observations have revealed anisotropy in the 3 K blackbody radiation which bathes the universe. The radiation is a few millidegrees ho er in the direction of Leo, and cooler in the direction of Aquarius. The spread around the mean describes a cosine curve. Such observations have far reaching implications for both the history of the early universe and in predictions of its future development. Based on the measurements of anisotropy, the entire Milky Way is calculated to move through the intergalactic medium at approximately 600 kms. It is noted that in a frame of reference moving with the original plasma emi ed by the big bang, the blackbody radiation would have a temperature of 4500 K.

Nobody cared about that, even though it went into the Scientific American! The general reaction was: "So if you assume the cosmic background radiation field is an absolute frame of reference, you can derive absolute motion. So what?"

The idea that the public in general gives a damn about special relativity is wrong. In any case, Einstein says that general relativity – which is background independent and thus compatible with any metric, not just Lorentz invariance – is the correct theory, not special or "restricted" relativity:

'The special theory of relativity … does not extend to non-uniform motion … *The laws of physics must be of such a nature that they apply to systems of reference in any kind of motion.* Along this road we arrive at an extension of the postulate of relativity… *The general laws of nature are to be expressed by equations which hold good for all systems of co-ordinates, that is, are co-variant with respect to any substitutions whatever (generally co-variant).* …'

– Albert Einstein, 'The Foundation of the General Theory of Relativity', Annalen der Physik, v49, 1916.

No newspaper published this on the front page in 1916 with a headline like "Einstein says special relativity is bunk in general!", because relativity only got into the newspapers in 1919 when general relativity was verified by deflection of starlight.

What you find is that few people know what general relativity is about beyond the mathematical structure. If you treat these things as purely mathematical systems, then physical facts are all too easily dismissed as philosophical speculations. This is the problem. Einstein never presented either special or general relativity as a physical theory with causal mechanisms because he was too far into Mach's philosophy that only stuff the observer measures is real. He did make a mess of things when he stated:

'According to the general theory of relativity space without ether is unthinkable.'

– Albert Einstein, Sidelights on Relativity, Dover, New York, 1952, p23.

Problem was, Einstein did not have the data required about the various force fields (the standard model of particle physics) when he was trying to solve the problems, and that was only developed (a er a lot of experimentation with particle physics) in the 1970s.

Theories must be based on experimental facts. Once you start trying to build a theory which unifies speculative spin-2 gravitons with speculative Planck scale unification, by means of adding speculative extra dimensions, supersymmetric partners, an increase of tunable standard model parameters from 19 to 125 or more, etc., you're no longer doing physics. That's where mainstream physics is today, without even mentioning the cosmology crisis with evolving dark energy, etc.

I'm writing up a textbook presenting the facts, but the more I learn about the current crisis and the way that even people like Drs Woit and Smolin actually think about physics, the clearer it becomes that even if string theory sinks, physics is not the scientific subject I thought it to be when a kid. Instead, physics is all about prejudices of one form or another, and closed-mindedness. It's too much about elite power politics, not li le concerned with facts. That's not new of course, things are always difficult.

Comment by nige — April 14, 2007 @ 9:10 am

Reply

5. Nige wrote: "Pentcho, you're wrong in claiming that Einstein taught people that the speed of light varies with the gravitational potential. He actually taught that the velocity of light varies with the gravitational potential. The speed remains constant; the velocity varies because the direction changes and velocity is a vector, a statement of speed and direction not just speed."

   h p://www.pi .edu/~jdnorton/papers/OntologyOUP_TimesNR.pdf "What Can We Learn about the Ontology of Space and Time from the Theory of Relativity?", John D. Norton: "…ALREADY IN 1907, A MERE TWO YEARS AFTER THE COMPLETION OF THE SPECIAL THEORY, [einstein] HAD CONCLUDED THAT THE SPEED OF LIGHT IS VARIABLE IN THE PRESENCE OF A GRAVITATIONAL FIELD; indeed, he concluded, the variable speed of light can be used as a gravitational potential."

   h p://www.logosjournal.com/issue_4.3/smolin.htm Lee Smolin: "… SPECIAL RELATIVITY WAS THE RESULT OF 10 YEARS OF INTELLECTUAL STRUGGLE, YET EINSTEIN HAD CONVINCED HIMSELF IT WAS WRONG WITHIN TWO YEARS OF PUBLISHING IT."

   h p://www.physlink.com/Education/AskExperts/ae13.cfm "So, IT IS ABSOLUTELY TRUE THAT THE SPEED OF LIGHT IS NOT CONSTANT in a gravitational field [which, by the equivalence principle, applies as well to accelerating (non-inertial) frames of reference]. If this were not so, there would be no bending of light by the gravitational field of stars….Indeed, this is exactly how Einstein did the calculation in: "On the Influence of Gravitation on the Propagation of Light," Annalen der Physik, 35, 1911. which predated the full formal development of general relativity by about four years. This paper is widely available in English. You can find a copy beginning on page 99 of the Dover book "The Principle of Relativity." You will find in section 3 of that paper, Einstein"s derivation of the (variable) speed of light in a gravitational potential, eqn (3). The result is, c' = c0 (1 + V / c2) where V is the gravitational potential relative to the point where the speed of light c0 is measured."

   h p://math.ucr.edu/home/baez/physics/Relativity/SpeedOfLight/speed_of_light.html "Einstein went on to discover a more general theory of relativity which explained gravity in terms of curved spacetime, and he talked about THE SPEED OF LIGHT CHANGING in this new theory. In the 1920 book "Relativity: the special and general theory" he wrote: . . . according to the general theory of relativity, the law of the constancy of the velocity of light in vacuo, which constitutes one of the two fundamental assumptions in the special theory of relativity [. . .] cannot claim any unlimited validity. A curvature of rays of light can only take place when the velocity of propagation of light varies with position. Since Einstein talks of velocity (a vector quantity: speed with direction) rather than speed alone, it is not clear that he meant the speed will change, but the reference to special relativity suggests that he did mean so."

Pentcho Valev
pvalev@yahoo.com

Comment by Pentcho Valev — April 26, 2007 @ 5:44 am

Reply

6. **NC's note in response to above comment:** Pentcho, I've modified this comment by editing out some of the superfluous material in the quotes which make them unreadably off-topic and irrelevant. I've explained to you that the effect of gravity in general relativity is change the direction of light, which means changing the velocity, not the speed. If your car is going 100 miles per hour and changes direction without changing speed, its velocity changes.

   Your quotation of John D. Norton indicates he doesn't understand the distinction between vectors like velocity and scalars like speed, because he is completely wrong. Your quotation of Lee Smolin is interesting polemics. The quote you give from h p://www.physlink.com/Education/AskExperts/ae13.cfm is completely inaccurate physics: Einstein's 1911 paper is wrong. Your quotation from h p://math.ucr.edu/home/baez/physics/Relativity/SpeedOfLight/speed_of_light.html just shows how that site is confused about Einstein's general relativity, first claiming to be quoting Einstein saying the speed of light depends on gravity, then giving a quotation where Einstein clearly and correctly states that the velocity (not speed) depends on gravity.

   Consider now a black hole. Light can't escape from it (the Hawking radiation mechanism has light produced just beyond the event horizon due to pair production, with one charge in the pairs of charges created falling into the black hole). Is this because light which is moving in the outward radial direction in a black hole is slowed down and can't escape?

   What happens here is crucial. R. V. Pound and G. A. Rebka Jr. in 1959 proved that light is redshi ed by gravity, as predicted by general relativity by sending gamma rays upwards in a 22.5 metres high tower and measuring the shi in gamma ray energy using the extremely sensitive Mößbauer effect, see h p://en.wikipedia.org/wiki/Pound-Rebka_experiment

   So you send gamma rays or light upwards against gravity, and it loses energy. It is not deflected by gravity in this case, because the light is travelling parallel to (i.e., along) radial gravitational field lines. The question is whether gravitationally redshi ed light is slowed down, and blueshi ed light speeded up. In the longitudinal Doppler effect with sound in air, this doesn't happen because the whistle sound from a receding train travels at the same speed towards you that it would in the air regardless of the train's recession speed. The physics of the Doppler shi is that the wavelengths of the sound are stretched at the boundary from the whistle cavity containing air moving with the train, to the surrounding air.

   The light wave has its oscillations perpendicular to the direction that light propagates. The Doppler effect doesn't occur with light with the mechanism that occurs in sound waves. Whereas the sound wave speed is independent of the speed of the sound emi er, that may not be the case for light waves.

   In particular, we know that light loses energy and is redshi ed when it travels away from a heavy mass. The question is physically how that redshi occurs. General relativity is a mathematical model, not a physical mechanism. So it doesn't say what happens.

   In special relativity, it's taken as impossible to measure any effect of motion on the velocity of light in a vacuum (obviously, light travels at slower speed in dense glass or water because of the interactions of the electromagnetic fields in light with those of the electrons and nuclei in the glass or water). The reason is that to measure velocity of light, you are measuring the ratio of distance to time, and both distance and time are subject to local modifications in the measuring instrument.

Material contracts in the direction of motion, clocks slow down. This is why the Michelson-Morley experiment failed to measure absolute velocity of light. However, you can measure absolute velocity in the cosmic background radiation, as proved by R.A. Muller, ‘The cosmic background radiation and the new aether dri ’, *Scientific American,* vol. 238, May 1978, p. 64-74: ‘U-2 observations have revealed anisotropy in the 3 K blackbody radiation which bathes the universe. The radiation is a few millidegrees ho er in the direction of Leo, and cooler in the direction of Aquarius. The spread around the mean describes a cosine curve. Such observations have far reaching implications for both the history of the early universe and in predictions of its future development. Based on the measurements of anisotropy, the entire Milky Way is calculated to move through the intergalactic medium at approximately 600 kms.’

Notice that this +/- ~3 mK anistropy in the CBR is millions of times **bigger** than the tiny anistropy accepted as evidence for inflation by crackpots and cranks in the mainstream, who ignore the far bigger and more important anistropy and its consequences completely in their discussions of it. So there is a frame of absolute motion in the cosmic background radiation if you take physics seriously and want to try to find it, instead of hyping failures as if it is some kind of proof that topics you don’t want to discuss (for sociological physics tea party reasons), don’t exist.

Anyway, the question to focus on is what happens when a ray of light travelling radially outward from a mass is redshi ed by gravity. Is it slowed down? Is redshi associated with slowing of light speed, and blueshi associated with speeding up?

In view of the failure of Maxwell’s aether to explain light properly (see my recent posts on this blog for example), the best way to firmly establish facts is to do experiments. The amount of redshi of light is normally too small to be measured as a velocity change. However, one exception is the cosmic background radiation, which is the most redshi ed light there is. It is redshi ed from an emission temperature of 3000 K at 300,000 years a er the big bang to 2.7 K today. Hence, redshi has reduced the energy carried by cosmic background radiation photon by a factor of 1,100 or so, and if there is a velocity reduction with redshi then the velocity of the cosmic background radiation would be down from 300,000 km/s to about 270 km/s, a difference which should be easy to measure.

All you need is a long tube with a detector at one end and a shu er (possibly based on a high speed revolving metal disc with a hole in it) at the other end. The shu er could let a brief burst of cosmic background radiation to enter, and the delay time in reaching the detector would inducate the speed. Problem sorted! However, the experiment would be tricky. The tube would probably need to be big, and placed in space to avoid interference. There might be problems designing a suitable shu er to let the cosmic background radiation enter at one end of the tube in brief pulses that can be timed. One option is to have a normal light bulb outside the tube, so that a burst of visual light enters at the same time as the cosmic background radiation, and is detected by a detector at the detection end of the instrument, beside the microwave background radiation sensor. The comparison of the delay times for the light from the non-receding bulb, with the highly redshi ed cosmic background radiation, would confirm if redshi is accompanied by a speed change.

It is possible that all light redshi s are accompanied by a corresponding speed decrease. General relativity is known to be incomplete for many reasons (see recent posts on this blog) so it doesn’t give the mechanism for what is occurring.

Comment by nige — April 27, 2007 @ 12:13 pm

Reply

7. I will just add to Pentcho Valev that most of the crackpot claims that relativity has varying velocity of light seem to derive from people who haven’t read the papers properly thinking that v is velocity,

whereas in many papers Einstein uses it for frequency as well.

Hence Einstein's equation for frequency shi of light due to gravity looks like a velocity change to people who get easily confused. E = hf is Planck's energy-frequency equivalence for quanta, but that is o en wri en E = hv, with v being frequency. In electromagnetism things easily become confusing for beginners because E is electric field strength (volts/metre) and quite o en has to be used for energy (Joules). Since energy is a scalar while E is a vector, the E of electric field strength can be wri en in bold print, and E for energy just in italics.

Even in elementary school the units can play havoc, with the unit of time being the second, s, and s also being used for distance, ostensibly to avoid confusion with the derivative symbol d. So ds means the differential element of s. It would be confusing to write dd for the differential element of d, because it would look like d^2 longhand. Obviously this is vital for a spacetime metric, where you don't want to use x, y, z, or r which have other definitions, but generally it is be er to use say r for distance if it is radial distance, or x, y, z, instead of using s, which causes a lot of confusion because in dimensional analysis you then have time represented by s, while when not using dimensional analysis distance is represented by s. Feynman said that all the energy units which exist are proof that physicists are as irrational as anybody. But it's not just energy units which maximise the moronic confusion …

Comment by nige — May 8, 2007 @ 11:32 am

Reply

8. "Instead of spli ing a acking critics of completely failed theories, he should perhaps admit the theory has no claim to be science."

   Very embarrassing. This final sentence in the post is presumably missing the word "hairs", which would fit nicely between the words spli ing and a acking. Alternatively, perhaps the word spli ing should be removed. I'll fix it when I've time.

   Comment by nc — June 5, 2007 @ 10:11 pm

   Reply

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