

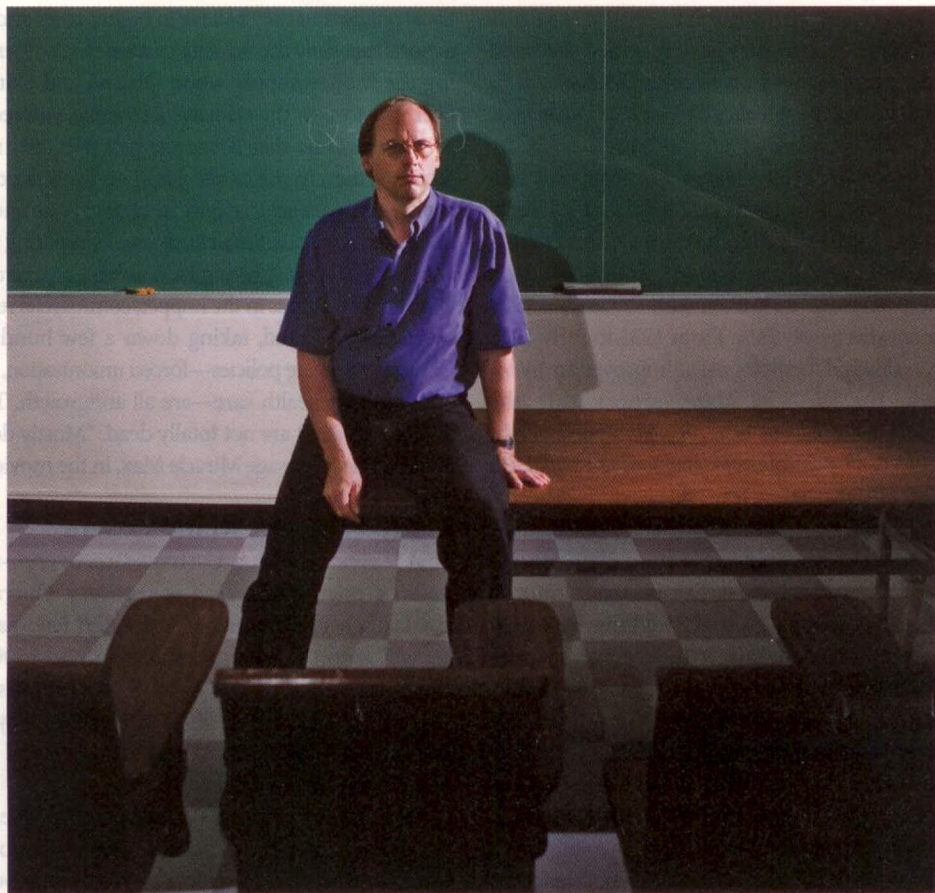
Peter Woit

Digital Rules

String Theory Skeptic

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

By Lee Gomes



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.

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 ex-

tent 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."

"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."

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**