

'Deep Down Things' explores the astonishing world of particle physics

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Particle physicists have developed an amazingly successful theory describing how the universe works on the most fundamental level. This theory, known as the Standard Model and hailed as one of the greatest intellectual achievements of the 20th century, is still only understood and appreciated by a limited number of people who tend to have advanced science degrees. Physicist Bruce Schumm hopes to change that with his new book, *Deep Down Things: The Breathtaking Beauty of Particle Physics*.

Schumm, a professor of physics at the University of California, Santa Cruz, said he was determined to make his book accessible to any interested reader without watering down the science. In *Deep Down Things*, he takes the reader on a fascinating journey into the bizarre, subatomic world of particle physics.

The path at times requires close attention, but Schumm is a witty and eloquent guide, offering patient explanations and helpful analogies, as well as candid acknowledgment of concepts that remain mysterious even to scientists. Ultimately, the reader is rewarded with a view of the fundamental nature of the world as physicists see it and a sense of how strange and counterintuitive, yet scientifically sound, that view is.

Though certainly not the first popular book about particle physics, *Deep Down Things* seems to be the only one to offer a clear, straightforward explanation of the field's current paradigm without veering off into the realm of speculation or spirituality. Schumm, who has spent his career

deeply involved in particle physics research, said there is plenty of material in the science itself to inspire wonder and awe.

"Ever since the development of relativity and quantum mechanics, science has come to have increasingly wondrous and jarring metaphysical implications," Schumm said. "We know that there is a lot more to the universe than meets the eye, and some of what we know scientifically is exceedingly mysterious from a philosophical point of view. But you don't need to go outside of the science to find that sense of wonder and mystery."

One does, however, need to make an effort to understand the science in order to recognize where scientific understanding ends and speculative fantasy or spirituality begins, he said. That line gets blurred, for example, in the recent movie *What the Bleep Do We Know?!*, which takes quantum physics as its starting point and goes well beyond what scientists believe to be true, according to Schumm.

The mathematical underpinnings of physics have long been perceived as an insurmountable barrier preventing the uninitiated from grasping the science on anything other than a superficial level. But Schumm's approach is primarily descriptive and does not require a strong background in mathematics. He presents a few important equations "to demystify them, and just because they are interesting," he said, but the equations are always described in nonmathematical terms.

Nevertheless, the role of mathematics in particle physics is a story Schumm is eager to tell. Much of the book focuses on the remarkable connection between abstract mathematical theory and the physical sciences, explaining how certain arcane results derived by mathematical theorists turn out to be essential to the description of nature at its most fundamental level.

"The connection between abstract mathematics and the physical nature of the world has always stunned me, and the beauty of that is something I wanted to convey," he said.

To Schumm, this relationship is one of the most beautiful and profound revelations of the modern era. In *Deep Down Things*, he gives readers with no specialized knowledge an opportunity to appreciate that beauty and profundity for themselves.

"I realized that nobody had written an exposition of the Standard Model for the nonexpert, and it seemed like an obligation of the field to give back to society the results of this research," he said.

The book concludes with a look at the unanswered questions that physicists will be exploring in the years ahead.

Schumm, who joined the UC Santa Cruz faculty in 1995, is affiliated with the Santa Cruz Institute for Particle Physics at UCSC. He is involved in particle physics experiments at the Stanford Linear Accelerator Center and has also been involved in planning and design work for a next-generation linear collider facility. He received a 2002-03 Excellence in Teaching Award from the UCSC Academic Senate. Schumm earned a B.A. in physics and mathematics from Haverford College and a Ph.D. in physics from the University of Chicago.

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