Einstein’s real complaint about the quantum theory was not that it required God to play dice, but that it failed to “represent a reality in time and space, free from spooky actions at a distance.” I shall use the rhetorical device of a computer-simulated lecture demonstration (a cartoon version of experiments in Vienna) to explain both the appeal of Einstein’s criticism and the remarkable fact that the “reality” he insisted upon is nevertheless impossible.

I will assume no background in quantum physics (or any other physics) but late in the lecture, in convincing you of the impossibility of Einstein’s vision, I will ask you to engage in a kind of reasoning not unlike a (very easy) Sudoku puzzle.

**WHAT HAS QUANTUM MECHANICS TO DO WITH FACTORING?**

Quantum computer science will be introduced in the context of its most sensational algorithm: the highly efficient factoring routine discovered by Peter Shor. I will emphasize those features of Shor’s procedure that puzzled, surprised, and charmed me in the course of my own efforts to better understand how it does its magic. The subject offers some offbeat glimpses of both quantum mechanics and computation.
For the past 25 years, David Mermin has become well known for his work on the foundations of quantum mechanics. He has also worked in solid state physics, statistical mechanics, low temperature physics, mathematical crystallography, and quantum computing.

Quantum theory was developed in the first quarter of the 20th century to account for the behavior of matter at the atomic and subatomic level. It is the most fundamental and successful branch of physics ever developed. In fact it is the foundation on which all of our understanding of the physical world now rests. Its insights are responsible for virtually all of contemporary technology from lasers to computer chips to nuclear physics. It underlies our understanding of the earliest moments of the universe. Although Einstein was one of the founders of quantum theory, he was convinced that it was unsatisfactory. He remarked in a letter to his friend and colleague, Max Born, that the theory was unable to describe a real world existing in time and space, without introducing “spooky actions at a distance.”

When I became editor of “Physics Today” magazine in the mid-1980s, I asked David to become a regular contributor to a new column of opinion called Reference Frame. In the late-1980s I finally persuaded him. Since then he has produced more than 30 witty, beautifully written, insightful columns that entertained our readers. His columns triggered more letters to the editor than just about any other part of the magazine. In 1981 he wrote a hilarious article on how he made the word “boojum” an internationally accepted scientific term. He gave the name to a phenomenon in superfluid liquid helium-3, in which a current “had softly and suddenly vanished away.” (In Lewis Carroll’s poem “The Hunting of the Snark” boojums are dangerous snarks that bring about soft and sudden vanishings.) That article, together with many of his non-technical essays on quantum theory, relativity, and other aspects of physics and mathematics have been collected in his book “Boojums All the Way Through,” Cambridge University Press (1990).

Mermin received three degrees from Harvard University—a bachelor’s in mathematics (1956), a master’s in physics (1957), and a PhD in physics (1961). He became an assistant professor at Cornell University in 1964 and has been there ever since. From 1984 to 1990 he was director of Cornell’s Laboratory of Atomic and Solid State Physics. Since 2006 he has been the Horace White Professor of Physics Emeritus at Cornell. He received Cornell’s Russell Distinguished Teaching Award for the physics courses he developed for non-science majors. The American Physical Society awarded him the first Julius Edgar Lilienfeld Prize for “his remarkable clarity and wit as a lecturer to nonspecialists on difficult topics.” In 1994 he received the Klopsteg Memorial Award of the American Association of Physics Teachers. He has written two books for the general reader on the special theory of relativity, one, “Space and Time in Special Relativity,” at the beginning of his professional life, and the second, “It’s About Time,” Princeton University Press (2005) when he retired after teaching the subject to nonscientists for four decades.

For people who work in statistical mechanics and in particle physics, David is known for the “Mermin-Wagner-Hohenberg Theorem,” a mathematical proof that crystals, superfluids, and some kinds of magnets require three spatial dimensions for their stability and cannot exist in thin two-dimensional films. Low-temperature physicists know about the “Mermin-Ho” relation, which imposes a beautiful and (at the time) unexpected constraint on fluid flow in one of the superfluid phases of liquid helium-3 at ultra-low temperatures. And physicists working on the electronic structure of solids, molecules, and atoms, sometimes use the “Mermin-Lindhard dielectric function” in their calculations.

Mermin is a member of the National Academy of Sciences and the American Academy of Arts and Sciences.

Gloria B. Lubkin
Editor Emerita, Physics Today
Co-chair, Oversight Committee
Fine Theoretical Physics Institute

Program
Spooky actions at a distance?
September 21, 2010 at 7:00 p.m.
Memorial Hall, McNamara Alumni Center

Welcoming Remarks.........Steven Crouch
Dean, College of Science and Engineering

Introduction.................Mikhail Voloshin
Director, William I. Fine Theoretical Physics Institute

Speaker.......................N. David Mermin
Cornell University
Horace White Professor Physics Emeritus

Refreshments to follow in McNamara Atrium

What has quantum mechanics to do with factoring?
Physics and Astronomy Colloquium
September 22, 2010 at 3:35 p.m.
131, Tate Lab of Physics