



Dance of the Photons: From Einstein to Quantum Teleportation

By Anton Zeilinger

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Einstein's steadfast refusal to accept certain aspects of quantum theory was rooted in his insistence that physics has to be about reality. Accordingly, he once derided as "spooky action at a distance" the notion that two elementary particles far removed from each other could nonetheless influence each other's properties?a hypothetical phenomenon his fellow theorist Erwin Schrödinger termed "quantum entanglement."

In a series of ingenious experiments conducted in various locations?from a dank sewage tunnel under the Danube River to the balmy air between a pair of mountain peaks in the Canary Islands?the author and his colleagues have demonstrated the reality of such entanglement using photons, or light quanta, created by laser beams. In principle the lessons learned may be applicable in other areas, including the eventual development of quantum computers.

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Editorial Review

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Light is the research focus of Zeilinger, a physicist in Austria who studies photons' ghostly quantum behavior. Here Zeilinger introduces the fictional Dr. Quantinger, who assigns two students to experiment on an apparatus that sends photons to separate detectors that they observe. Alice and Bob periodically report their findings, proffer theories to account for the results, listen raptly to Dr. Quantinger's hints about quantum states of light, such as entanglement and polarity, then repair to their detectors to watch more photons. Sometimes Zeilinger suspends this fictional device to address readers directly about the quality of entanglement—the property of pairs of particles, no matter how far separated, whether by the Danube in Alice and Bob's case or by light-years of space, to “know” the quantum state of its partner. This faster-than-light talent of quantum particles bothered Einstein but excites Zeilinger, who describes the technologies that entanglement could in principle permit, such as quantum computers or quantum teleportation. An innovative presenter of a complicated topic, Zeilinger will appeal to the futurists of the science set. --Gilbert Taylor

Review

“Those seeking an accessible popular account of this fascinating field will find their search over . . . Taking some of the most complex ideas from cutting-edge science, Zeilinger provides simple and clear explanations that in no way compromise the fundamental concepts.” ?*Jeremy L. O'Brian, Science*

“From the sewers under Vienna to a whirlwind tour of the great physicists of the twentieth century and their wild ideas, this is a marvelous introduction to the world of quantum physics by one of the most accomplished experimenters working in the field today. Zeilinger takes the reader on a very personal journey while providing a remarkably clear and cogent discussion of the mind-bending world of quantum mechanics and its potential to change the future of technology.” ?*Lawrence M. Krauss, director of the Origins Initiative at Arizona State University and author of Quantum Man: Richard Feynman's Life in Science*

“Anton Zeilinger's *Dance of the Photons* is a delight. The explanations of some of the most subtle and unexpected effects of quantum physics are provided in terms of beautifully simple and charming everyday settings. The true flavor of quantum mechanics is here made accessible, without pain but with considerable good humor.” ?*Roger Penrose, emeritus professor of mathematics, Oxford University, and author, most recently, of The Road to Reality: A Complete Guide to the Laws of the Universe*

“For more than eighty years the bizarre features of the description of nature at the atomic level given by quantum mechanics have puzzled and fascinated the physics community, but it is only in recent years that many of these features have been verified by experiment. This delightful little book, by one of the world's leading practitioners in this area, explains these recent advances in a way that should be accessible even to readers with no physics background.” ?*Anthony J. Leggett, professor of physics, University of Illinois, and winner of the 2003 Nobel Prize in Physics*

“Anton Zeilinger has done more than anyone to unfold the quantum world by fashioning amazing experiments that have allowed nature to speak to us in her own native quantum language. In this clearly and elegantly written book he takes the reader on the journey he and his colleagues have traveled in their interrogations of the quantum world. Along the way he introduces us to the new concept of quantum information and explains its promise to revolutionize how we communicate and compute.” ?*Lee Smolin,*

“Anton Zeilinger's exposition of this puzzling subject is clear and vivid, and backed by a voice of authority that could only come from his being a leading experimenter in the field.” *A. Zee, author of Fearful Symmetry, Einstein's Universe, and Quantum Field Theory in a Nutshell*

About the Author

Anton Zeilinger is a professor of physics at the University of Vienna, where he heads the Institute for Quantum Optics and Quantum Information of the Austrian Academy of Sciences.

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