Quantum Physics for Poets FREE

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A witty welcome to a weird world

Quantum Physics for Poets

Leon M. Lederman and Christopher T. Hill
Prometheus Books, Amherst, NY, 2011.
$28.00 (338 pp.).
ISBN 978-1-61614-233-9

Reviewed by Robert March

Anyone who is likely to open the covers of *Quantum Physics for Poets* has probably heard that the quantum theory is weird. Leon Lederman and Christopher Hill do not hesitate to tackle that weirdness head on. It is introduced in the very first chapter, even before the exposition of the theory has begun.

The intended audience is clearly the well-educated lay reader who may have read or heard of quantum paradoxes in the popular press and is looking for a more systematic treatment. But I would also recommend this book to undergraduate physics majors who are struggling to master the machinery of quantum physics and would like to have a context in which to put their efforts.

The exposition unfolds in a conventional historical narrative, with a heavy reliance on double-slit interference as a central pedagogical device. The treatment is almost entirely nonmathematical. The writing is lucid and makes good use of the whimsical "borscht circuit" humor for which Lederman is justly famous among his colleagues. A window shopper at Victoria's Secret illustrates the probabilistic behavior of photons and an exploding steakhouse in Kansas City illustrates constructive interference. In keeping with the theme of the book, Schrödinger's cat and the Einstein-Podolsky-Rosen paradox are featured prominently. Some detailed treatments of more complex examples are relegated to an appendix, to avoid interrupting the continuity of the exposition.

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Thumbnail biographies of the principal characters in quantum mechanics are well integrated into the text. Niels Bohr and Albert Einstein get their due canonization, but lesser figures are not neglected. The protean talents of Thomas Young are recounted in detail, and the birth of Schrödinger's equation in a romantic alpine sojourn adds a bit of spice to the story. That equation is properly credited with gaining the acceptance of physicists uncomfortable with the aridity of Heisenberg's matrix mechanics.

The core of the book is a deep discussion of Bell's theorem, proposed and promulgated in 1964 by theorist John Bell at CERN. That focus is altogether appropriate, for it is Bell's theorem, and the experimental confirmations that its crucial inequality is violated, that finally closed the door on any easy way out of quantum weirdness. Simply put, it shows that if any hidden variables exist they must be nonlocal. Entanglement—what Einstein called a "spooky action at a distance"—is observable.

I'm aware that Bell himself had hoped his theorem might provide a means to lay to rest the Copenhagen interpretation of the quantum theory. When the verdict of observation went the other way, he sadly concluded that we really don't know what is going on. The section presenting the theorem makes demands to which some readers may not be able to rise. No higher mathematics is required, but some familiarity with statistics may be helpful. What is called for is the patience and concentration to follow a fairly complex logical argument that supports an odd and somewhat indirect statistical correlation. Of course, those who are not up to it can simply accept the conclusions and move on.

The narrative covers topics of current interest, including the standard model, supersymmetry, and string theory. It concludes with the hot topic of possible applications of quantum entanglement. Those include quantum cryptography, the woefully misnamed quantum "teleportation," and quantum computing. There is one omission that I personally find disappointing: The word "decoherence" never appears. That concept holds that quantum ambiguity requires something approaching a perfectly isolated physical system. The collapse of the wavefunction requires no recourse to the consciousness of an observer. Any interaction with the outside world will do, and one can often measure the "decoherence time" over which it takes place.

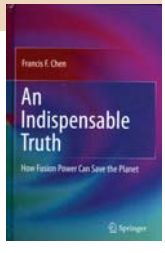
Hill and Lederman have no patience with the New Agers who purport to find in quantum weirdness a deep spiritual message. The authors quote Steven Weinberg, the one physicist of my generation most deserving to be called a sage: "So irrelevant is the philosophy of quantum mechanics to its use that one begins to suspect that all the deep questions are really empty."

Many of us who came to physics seeking deep understanding at first viewed that impasse with despair, which later gave way to acceptance, and finally, as Lederman would have it, to amusement.

An Indispensable Truth

How Fusion Power Can Save the Planet

Francis F. Chen
Springer, New York, 2011.
$49.95 (433 pp.).
ISBN 978-1-4419-7819-6



With *An Indispensable Truth: How Fusion Power Can Save the Planet*, Frank Chen has provided a sweeping perspective on fusion energy. He covers everything from climate change to plasma instabilities. On climate change and energy, the view is best from 30 000 feet: The book provides a good high-level overview of the issues at stake, but some of the details of his conclusions are not clear. On fusion plasma physics, Chen's area of expertise, *An Indispensable Truth* provides an intuitive, up-close explanation of exciting recent advances and future challenges.

The book starts by reviewing the strong evidence that recent climate warming is anthropogenic, as well as the much weaker evidence that the planet may be nearing a tipping point,