

BOOK REVIEW*The Lightness of Being: Mass, Ether, and Unification of the Forces*

Frank Wilczek (Basic Books, New York, 2008)

ISBN 978-0-465-00321-1

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How can an electron be both a wave and a particle? At the same time? Because it is a quantum field.

That key insight seems to be underappreciated, given the awe and mysticism that permeate most nontechnical discussions of modern physics. Perhaps the root of the problem is that most popularizations of quantum mechanics and of particle physics shy away from quantized fields, the natural language for microscopic phenomena. In *The Lightness of Being: Mass, Ether, and the Unification of Forces*, Frank Wilczek confronts quantum field theory head on, demystifying not only wave-particle duality but also the origin of mass for hadrons (that is, everyday matter).

Wilczek is the Herman Feshbach Professor of Physics at MIT and a co-recipient of the 2004 Nobel Prize in Physics. His research has spanned almost all aspects of theoretical particle physics, with significant forays into condensed-matter physics and dense nuclear matter (condensed quark matter, one might say). Recurring themes are the richness of quantum chromodynamics (QCD) and the alluring ideas of unification. His breadth and depth make him a sought-

after speaker for colloquia and public lectures. Wilczek also contributes an occasional Reference Frame column to *Physics Today*.

The material in *The Lightness of Being* reflects the scope of the author's research. The book consists of three parts: the quantum fields of QCD (the ether that makes mass), gravitation (the ether that feels mass), and unification. Part 1, which traces notions of mass from Isaac Newton's time through theoretical and computational results of the past 40 years, is the most substantial and original; it is rich, modern, and rooted in observed phenomena. Part 2 continues in the same vein as it connects gravity, also an observed phenomenon, to QCD. Part 3 is more conventional, for a popularization of particle physics, in its focus on speculative ideas that (still) await direct experimental tests.

Readers of *Physics Today* will know that Wilczek can write with wit, grace, and an uncanny facility for using lightweight language to express heavy-duty ideas. They will find much of that kind of writing in *The Lightness of Being*. Wilczek addresses subtle ideas with vim and vigor. He avoids some of the jargon of

quantum field theory; for example, he calls the vertex in a Feynman diagram a “hub.” In more ambitious terminology, he refers to space-filling, ever-fluctuating quantum fields—be they electrons, quarks, gluons, or gravity—as “the Grid.” The term is supposed to be short and familiar, evoking the ubiquitous electric grid (and soon-to-be-ubiquitous computing grid). It also, for the expert, cleverly alludes to lattice gauge theory. Indeed, after vividly explaining how the dynamics of QCD and the constraints of Heisenberg uncertainty conspire to create mass from the Grid, Wilczek emphasizes that the picture is backed by lattice QCD computations of “heroic” proportions.

Unfortunately, too much of *The Lightness* is laden with clunky affectation: silly names (a pulsed electron accelerator is called the “ultrastroboscopic nanomicroscope”), sophomoric jokes (“hadron” is “not a typo”), references to pop culture (Wilczek might have called quantum fields “the Matrix ... but the sequels tarnished that candidate”), and many pointless footnotes.¹

In a public lecture the audience may guffaw at such jokes, but on the printed page they fall flat. Wilczek explains physics so well that the inappropriate humor is the biggest unexplained puzzle of the book. It is fine to be silly, even crude, as long as the reader’s path to understanding is made easier. A joke can inform with an unexpected perspective or simply give the mind a pause to refresh. Some of the humor achieves such aims, but too many gags impede the pace of the otherwise fine exposition.

Three appendices, a glossary, and a set of endnotes are crisp and sober. They are excellent.

The Lightness of Being is not unbearable, but it is weighed down with too much clutter to rank as a masterpiece. It’s a pity: Wilczek’s best writing—some of it in this book—is lucid, lively, and illuminating. A tough editor could have reined in the silliness and produced a splendid book. As it stands, readers will find a mixture of thrills and self-indulgence.

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¹ Like this.