understood. The authors concentrate their attention on the one suggested mechanism that has so far received detailed mathematical treatment: radiation from the magnetic poles. Some pulsar records suggest such a mechanism, but many others do not. The only alternative mechanism that has been suggested would be the fast-rotating charged-particle-loaded magnetosphere, but the mathematical problems of such a model are so formidable that no significant inroads towards developing it have been made. The only meaningful analysis would be a fully self-consistent calculation of the electromagnetic field; this calculation would have to include the contribution to the field from the magnetospheric particles that travel on the orbits that this field in turn dictates. Neither axial symmetry nor the nonrelativistic simplifications of magnetohydrodynamics would apply. It is a problem far beyond our reach, and the theoreticians cannot be blamed for shunning it. But nature is not guided by mathematical tractability, and many pulsar observations, especially those of polarization, suggest that one has to face up to this situation.

The most beautiful result coming from the entire set of pulsar investigations, and one that is well described in the book, is the detailed verification of the relativity effects seen in a binary pulsar. Joseph Taylor led the work that utilized the enormous accuracy of the pulsar repetition frequency to show that every relativistic effect that could be expected in a binary of two massive, compact objects can be measured to an accuracy of 1% or better, beating by a large margin the accuracies previously obtained for any general relativity effects. Taylor's work includes, for the first time, the determination of gravitational waves: Their emission is found to be in accurate quantitative accord with the predictions of Einstein's theory.

The book represents the most complete overview of the pulsar field yet published, and the close acquaintance the authors have with the field has enabled them to give a very lucid and readable account.

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Quantics: Rudiments of Quantum Physics

Jean-Marc Lévy-Leblond and Françoise Balibar (Translated from the French by S. Twareque Ali)
North Holland, New York, 1990. 539 pp. $44.95 pb
ISBN 0-444-88120-4

When a spin-up neutron diffracts from a crystal of ^{56}Fe, whose nuclei have zero spin, the differential cross section shows strong diffraction peaks. If the same neutron diffracts from a crystal of ^{59}Co, whose nuclei have spin-1/2, the diffraction peaks ride above a continuous background. In this latter case, a spin-flipped nucleus records that the neutron scattered from it alone; the scattering intensities rather than the amplitudes from the other unflipped nuclei add. This quantum mechanical idea and the experiment that supports it require little mathematics for their description. Waves scatter; waves interfere. Amplitudes add coherently; probabilities add incoherently.

This new introductory quantum mechanics textbook—written by Jean-Marc Lévy-Leblond, a theoreti-

cal physicist at the University of Nice, and Françoise Balibar, a solid-state physicist at the University of Paris, and translated by S. Twareque Ali, professor of mathematics at Concordia University in Montreal—borrows the neutron example and much of its spirit from Richard Feynman's *Lectures on Physics*. Lévy-Leblond and Balibar present the phenomena and principles of quantum mechanics using little mathematics but employing approximately 50 graphs of published experimental data, each with a reference to the original paper (most published after 1960). Many of the experimental results appear in the 173 detailed exercises drawn from real experiments and distributed among the book's seven chapters.

Quantics is the study of quantons: particles or waves behaving quantum mechanically. The words follow in the tradition of mechanics, electronics and photonics: electrons and photons. *Rudiments*, published in France as *Quantique* in 1984, is Volume I of a three-volume series; Volume II, *Elements*, will appear in 1991. *Rudiments* introduces the ideas of quantum mechanics: uncertainty; energy and angular momentum quantization; wave functions; amplitudes and probabilities; potential scattering; and identical particles. The text defines scattering cross sections, the optical theorem, density of states, half life, symmetry and other terms that form the foundation of the application of quantum mechanics. It explores the solutions of differential equations, how those solutions are used and what phenomena they explain, but does not worry about the equations themselves. Here is a 540-page quantum mechanics book with no Schrödinger equation. In fact, it contains no eigenvalue equations at all and no matrix formalism. Yet it provides a wonderful and useful introduction to quantum mechanics.

The one-dimensional plane wave that predicts the behavior of a particle with definite momentum plays a central part in this method of introducing quantum mechanics. A plane wave meeting potential steps, wells, barriers and battlements (uniform potentials) leads to the energy eigenstates of a particle in a box, scattering resonances, the poles of the scattering amplitude and eventually the Breit–Wigner energy distribution. A calculation of tunneling probability leads to a simple explanation of the enormous range of nuclear lifetimes and then to the splittings for a pair of square wells close enough that a particle can tunnel between them. This thread, knitted with that of symmetry, explains the measured behavior of the ground state of the NH_3 molecule with zero, one and two deuterium atoms replacing the hydrogens. This is advanced material at an introductory level—one learns the phenomena and their simple explanations before tackling the full mathematical formalism of quantum mechanics.

The book has flaws. An unfortunate preference for general rather than particular terms makes many of the explanations diffuse and hard to follow. The authors' goal of keeping the ideas of the Feynman lectures while reducing the mathematical formalism succeeds in reducing the mathematics, but unfortunately the imprecise writing reduces the clarity of the ideas.

There are many roads to quantum mechanics. The road that presents first the experimental phenomena of

modern physics and technology, then introduces the fundamental theoretical ideas and results that explain these phenomena and finally reveals the mathematical structure behind these results is one that is not yet broadly paved. Lévy-Leblond and Balibar's book has straightened this road and prepared it for a new generation of texts that will produce a still smoother surface.

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