



“Physics in Canada”

Book Review

“La Physique au Canada”

Critique de livre

“Do We Really Understand Quantum Mechanics” by Franck Laloe, Cambridge University Press, 2012, pp. 406, ISBN 9781107025011 price 70.95

Quantum mechanics, first formulated by Werner Heisenberg in 1925 (Nobel prize in 1932 ‘for the creation of quantum mechanics’) and further developed soon after by Erwin Schroedinger, Niels Bohr and others, is undoubtedly one of the most successful theories of science. It has provided a complete and incredibly accurate description of the observed physical phenomena in the microscopic world of atoms, electrons, and other subatomic particles. It is responsible for the origin of nanoscale physics, transistors (thereby today’s computers), lasers, information technology, some aspects of chemistry, biology, and discovery of a whole host of novel materials with remarkable quantum properties. Interestingly, modern nanoscale devices have directly confirmed some of the theoretical foundations of quantum mechanics. Most notably, the quantum dots (the so-called ‘artificial atoms’) can be made to display the discrete energy levels of a quantum system, or the quantum corrals that allow a direct visualization of electronic wave functions.

This impressive success of quantum mechanics notwithstanding, we still do not fully understand the basic foundations of the theory. Most of the laws of quantum mechanics defy our common intuition. One therefore relies on various ‘interpretations’ to describe the measurements on quantum systems. The breathtaking progress of our understanding of the properties of quantum systems is largely due to, what is commonly known as the ‘shut up and calculate’ approach. However, it is essential to understand the conceptual issues underpinning this theory, that is actually crucial for, at the very least, most of the developments of modern-day technology. This is the subject of Frank Laloe’s book. In eleven chapters and eleven appendices, the author provides us with a balanced view of the subject and in-depth analysis of the conceptual problems that it entails. The book begins with a brief historical overview of the subject with a description of the status of the state vector. Chapter two deals head on with the conceptual difficulties of quantum mechanics, that includes a clear description of Schroedinger’s cat, and Wigner’s friend. Chapter three describes the ‘EPR paradox’ with the analogy of Gregor Mendel’s peas, and the ensuing discussions by Bohr, Heisenberg and others. The author then proceeds to describe Bell’s theorem and the nonlocality. Quantum entanglement, cryptography, Bose condensate and many other topics are discussed in the chapter titled ‘Experiments’. The final section of the book deals with various interpretations of quantum mechanics, including the hidden variables, a detailed discussion of the Bohmian theory and various other topics.

Despite its title, it is not a popular science book. It is a detailed, highly technical book that often delves into heavy mathematical details to make its case. This book is a valuable

addition to the literature on quantum mechanics. As for the answer to the question posed in the title; *Do We Really Understand Quantum Mechanics*, my answer has to be a resounding 'No'. It is an interesting book for the practitioners of quantum mechanics and for others who are involved with the foundations of quantum mechanics.

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