ligence. He moves on to refuting more sophisticated arguments, such as the assertion that AI won't have destructive emotional traits if we don't build them into it. He concludes the chapter with a quote by *Slate Star Codex* blogger Scott Alexander: "We should probably get a couple of bright people to start working on preliminary aspects of the problem."

Notably, that chapter is one of the few times that Russell addresses the beneficial uses of AI. Whereas his treatment of contemporary AI ethics issues is commendable, he unfortunately pays little attention to the technologies that are beginning to show promising results. For example, short-term weather forecasts and long-term climate change projections are both improving because of AI technologies that can crunch vast amounts of data.

I would have loved to see Russell take on a question central to the current "not-so-great AI debate," as he calls it: Should we be paying so much attention to superintelligence when humanity is creating enough problems for itself with existing AI? The relentless growth of contemporary AI technologies, such as driverless cars that require electricity-hungry computer servers to store and process data, threatens the climate, our physical safety, and our privacy. Achieving superintelligence within our children's lifetime poses a significantly lower risk than the possibility that they will be rubbing sticks together for fire after surviving catastrophic global warming or a world war.

Russell concludes that researchers should study superintelligence but that focusing too much attention on it may leave other threats in the AI sector understudied and underfunded. Yes, superintelligence skeptics and activists alike would agree that a few brilliant people should think about superintelligence, but this skeptic thinks the emphasis should fall on "a few."

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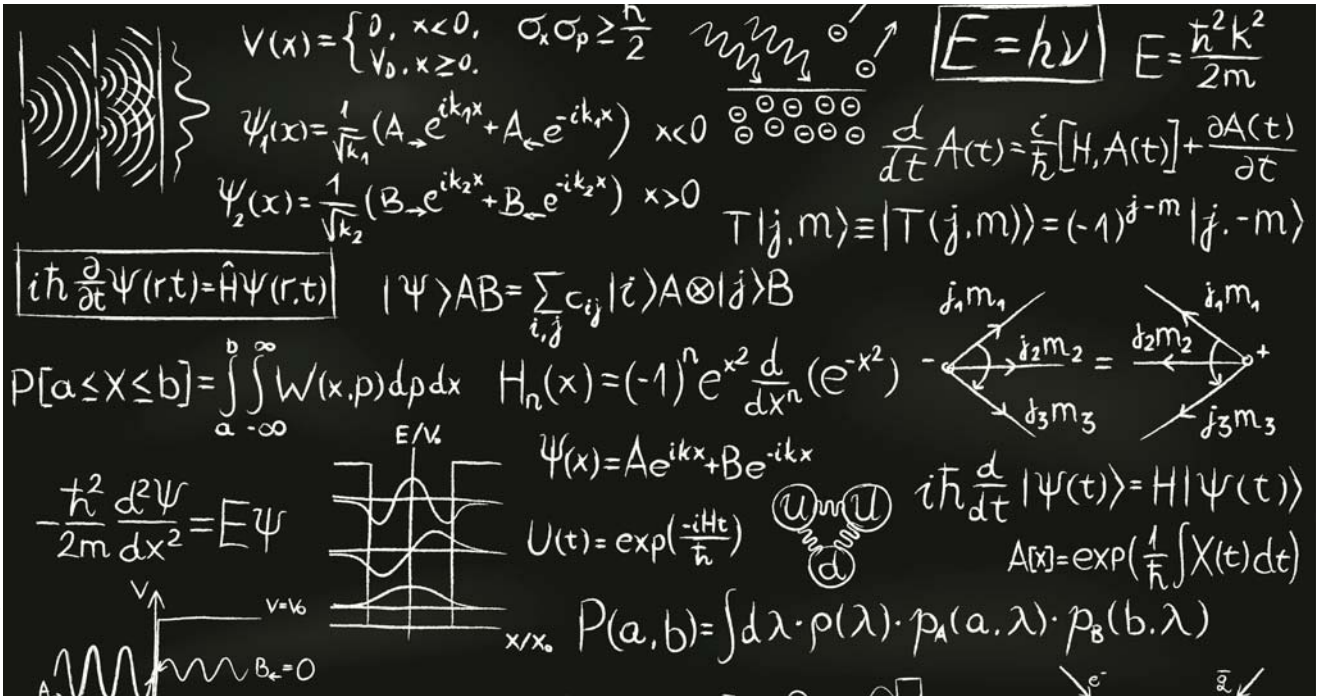

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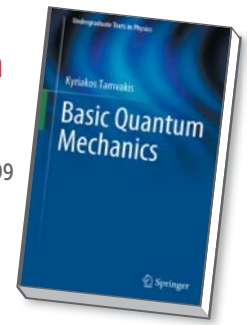
Quantum mechanics textbook teaches through examples

Basic Quantum Mechanics
Kyriakos Tamvakis
Springer, 2019. $74.99 (paper)



At the turn of the 20th century, experimentalists began uncovering mysterious phenomena that were unexplained by classical theories. Physicists put forward groundbreaking new ideas, the consequences of which we are still trying to fully comprehend. The modern version of quantum mechanics was developed in the 1920s through pioneering works by Erwin Schrödinger, Werner Heisenberg, Max Born, and other contemporaries. Since then quantum mechanics has become an integral part of standard academic curricula for university physics, and several canonical textbooks exist on the subject.

Quantum mechanics has gained a reputation for being a difficult subject due in part to both its conceptual differences from classical physics and its difficult mathematical machinery. To deal with those challenges, most students learn about quantum mechanics from

multiple sources, each of which provides different insights.

Kyriakos Tamvakis's new book, *Basic Quantum Mechanics*, offers an alternative to the classic textbooks on the subject, such as those by Albert Messiah and Jun John Sakurai. Tamvakis is an emeritus professor of theoretical physics at the University of Ioannina in Greece and author of another textbook, *Problems and Solutions in Quantum Mechanics* (2005). In his new book, he draws on more than 30 years of experience teaching quantum mechanics and tackling cutting-edge scientific questions at CERN, and he doesn't shy away from detailed calculations. The book is helpful both for students beginning their journey into the fascinating world of quantum mechanics and for lecturers preparing courses. The student-friendly text covers in detail the usual topics in a core undergraduate course and more specialized topics in graduate courses.

The first three chapters form the basic quantum toolbox typically included in an introductory course. Tamvakis starts with the famous double-slit experiment, which, as Richard Feynman eloquently stated, "has in it the heart of quantum mechanics." That example introduces the fundamental notion of the wavefunction and the superposition principle. Once the elementary concepts have been introduced, the main emphasis is on solving Schrödinger's equation. Throughout the book, discussion of theory is followed by detailed examples to help readers develop and hone their problem-solving skills. In total, the book presents about 60 worked examples and 200 exercises.

The middle of *Basic Quantum Mechanics* begins with the mathematical framework and terminology of Hilbert spaces. After introducing state vectors and observables, Tamvakis presents some essential examples, such as the ubiquitous quantum harmonic oscillator, the two-state system, and the particle in a periodic potential. Across seven chapters that cover angular momentum, spin, and central potentials, he discusses three-dimensional motion in detail. The following chapters introduce many-body problems, which are preludes to atomic and molecular physics.

The last few chapters examine approximation methods, symmetry considerations, and scattering theory. Additionally, two of the chapters introduce the quantization of electromagnetic fields and their interactions with matter. The book thus gives a decent overview of the most common laboratory phenomena and basic methods of analysis. The book also digresses on the Aharonov–Bohm effect, Bell's inequality, and Feynman's path-integral formulation. Those advanced topics are likely to stimulate students' interests and curiosity and reward their hard work in learning the foundation.

Basic Quantum Mechanics presents a comprehensive modern alternative to classic books on the topic. Readers will appreciate the balance between theory and worked examples. The detail of the analysis and the self-contained structure make Tamvakis's book a good companion for independent study and a serious candidate for either the primary textbook or supplementary material for undergraduate courses.

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