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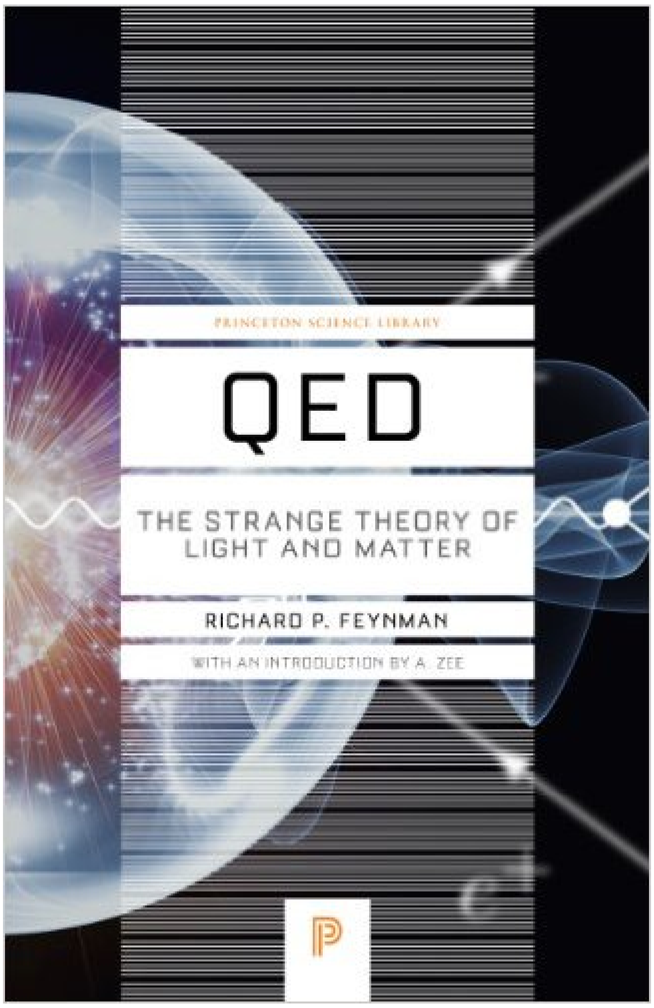
QED: The Strange Theory Of Light And Matter (Princeton Science Library)



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Synopsis

Celebrated for his brilliantly quirky insights into the physical world, Nobel laureate Richard Feynman also possessed an extraordinary talent for explaining difficult concepts to the general public. Here Feynman provides a classic and definitive introduction to QED (namely, quantum electrodynamics), that part of quantum field theory describing the interactions of light with charged particles. Using everyday language, spatial concepts, visualizations, and his renowned "Feynman diagrams" instead of advanced mathematics, Feynman clearly and humorously communicates both the substance and spirit of QED to the layperson. A. Zee's introduction places Feynman's book and his seminal contribution to QED in historical context and further highlights Feynman's uniquely appealing and illuminating style.

Book Information

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Customer Reviews

Caveat - Be sure to read Professor Zee's introduction as well as Feynman's introduction before you read the rest of the book. More about this at the end of this review.In my opinion this is one of the best of Feynman's introductory physics books. He does close to the impossible by explaining the rudimentary ideas of Quantum Electro Dynamics (QED) in a manner that is reasonably accessible to those with some physics background. He explains Feynman diagrams and shows why light is partially reflected from a glass, how it is transmitted through the glass, how it interacts with the electrons in the glass and many more things. This is done via his arrows and the rules for their rotation, addition and multiplication.One reviewer has criticized this book because Feynman does not actually show how to determine the length of the arrows (the square of which is the probability of the action being considered occurring) and the how you determine their proper rotation. True, but as is stated in Feynman’s introduction, this was never the intention of the book. If you want to learn how to create the arrows used in a Feynman diagram and use them to solve even the most rudimentary problem, you have to major in physics as an undergraduate, do well enough to get into a theoretical physics graduate program and then stick with the program until the second year, when you will take elementary QED. You will then have to take even more classes before you can solve harder problems. Clearly, it is not possible to do all this in a 150-page book aimed at a general audience. He does, however, give the reader a clear indication of what these calculations are like, even if you are not actually given enough information to perform one on your own.

This book covers four lectures that explains QED in terms of the path integral method, which was developed by the author. Needless to say, this is authoritative on this approach, but it also remarkably clear and comprehensible. Notwithstanding that, I would recommend slow and careful reading, as you may find a small sequence of statements that seem perhaps a little unjustified. Later, Feynman fronts up to some of these, and explains why he oversimplified to get things going. If you see them first, and this is not unreasonable, I believe you will get more from the text. The first lecture is a general introduction that shows how the path of the photon as a particle can be followed in terms of time-of-flight from all possible paths. The assertion is, the photon is a particle, not a wave, however there is no explanation for why there is a term that I would call the phase. The second lecture is a tour-de force and explains in terms of this particle treatment, why light reflects and diffracts, and is particularly interesting in why light behaves as if it is reflected only from the front and back of glass, whereas it is actually scattered by electrons throughout the glass. The third lecture covers electron-photon interactions, and covers Feynman diagrams and shows why QED is the most accurate theory ever proposed. The fourth lecture may seem a bit of a disappointment. The author tries to cover a very wide range of phenomena, which he terms "loose ends", and in some ways this chapter has been overtaken somewhat, nevertheless it also gives a look into Feynman’s mind, and that also is well worth the price of the book. It is also here that the issue of renormalization is discussed - if you could call Feynman admitting it is "a dippy procedure" a discussion.Why buy the book?

When I was a senior in high school, I asked my physics teacher why light bent when it entered a lens. He responded with an analogy about soldiers marching on a field and entering a marsh. The first soldiers entering the marsh would slow down and "bend" the column until all the soldiers were in the marsh.The analogy made no sense to me because we were talking about light, not soldiers. He responded that light travels in waves and if I viewed the soldiers as a wave front, I could understand his analogy. I left the conversation feeling very stupid for not "getting it." and thinking the analogy had so many holes in it. For example, it didn't explain why the lens was a marsh as far as light goes.It wasn't until I read QED that I realized I didn't get the soldier analogy because my teacher was wrong - light doesn't travel in waves, it travels in discrete little packets called photons.In QED, Feynman opens his first chapter by saying a couple of things. First he tells you that the theory he's going to describe to you has been experimentally verified out to 10 decimal places so it's probably right. He then gives you a quick review of what matter is and then tells you "light comes in particles. Not waves, particles." No wavicles, just little bits of light. He tells you that photons go from place to place, an electron goes from place to place and the electron will sometimes either absorb or emit a photon. From that basis, the rest of the book shows how that model explains why light bends when it enters a lens, why mirrors reflect, why oil slicks show different colors, why peacock feathers iridesce along a with host of other phenomena. He also explains why light has wave-like properties despite the fact that light comes in packets.

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