"Lectures on quantum mechanics" by Steven Weinberg, Cambridge University Press, 2012, pp: 375, ISBN: 9781107028722 (hbk), price: 78.95

As most readers of this review probably know, Steven Weinberg is one of the architects of the Standard Model of particle physics (a part of which is known as the Glashow-Weinberg-Salam model). Indeed, he would be a serious contender for my top-ten list of giants of 20th Century physics. He is also the author of a growing number of meticulously-written books, beginning with his renowned textbook on general relativity and extending to the subject of this review, with notable stops along the way including *The First Three Minutes* and his three books on quantum field theory.

Lectures on Quantum Mechanics (*LQM* henceforth) is based on a one-year graduate course given by Weinberg at the University of Texas at Austin. It shares with its predecessors a minor feature which deserves major praise: an incredibly thorough table of contents, eight pages in length. (The signature Weinberg format is there: chapters and sections, with the list of subjects discussed in each section delineated by little boxes.)

In the preface he makes the observation there are already many excellent books on the subject. This has two implications. First, one must have a strong justification for adding one more book to the list. *LQM* has a unique spin (no pun intended) on the subject, which amply justifies its existence. Second, the book faces the additional challenge of making converts of readers who have already taken or taught graduate-level quantum mechanics and who probably already have a favourite book on the subject. Weinberg mentions the books by Dirac and Schiff as competition; they are deservedly regarded as classics, but my personal go-to reference, by far, is Baym's book (also entitled *Lectures on Quantum Mechanics*), which happens to be the book which was used in my quantum mechanics courses as a graduate student. (Many years later, I met Baym at a conference and showered him with heartfelt praise for his book; I am sure he was not only flattered but also a bit bewildered at such groupie-like hero-worship.) So as I read Weinberg's *LQM*, in the back of my mind was a comparison with that of Baym.

Weinberg's book, as I alluded to above, has a very different take on quantum mechanics, one that will come as no surprise to those who have studied his quantum field theory books. He puts symmetry front and centre, and this emphasis is scattered (again, no pun intended) throughout the book, beginning with the chapter presenting the general principles of quantum mechanics (the latter sections of which are especially worthwhile). For students who will go on to study quantum field theory, exposure to such a thorough and methodical discussion of symmetry in the relatively harmless context of quantum mechanics can only be helpful later on.

The book starts with a historical introduction which will seem superfluous to many readers (since they presumably have already taken an introductory quantum mechanics course), but it is well worth reading for its thoroughness and clarity (properties that are maintained throughout the book). I dare say most of those who pick up *LQM* would learn plenty from a careful reading of this chapter. (That is certainly true of me!)

The book then launches right into central potentials, a bit of a leap compared to many other books, but given the target audience, not a bad idea. The standard subjects are of course all there: the general principles of quantum mechanics, angular momentum, approximation methods (both time-independent and time-dependent), scattering, the quantum theory of radiation. It includes subjects not often found in the classics, or goes into much more detail in its discussion of standard subjects. I mentioned symmetry earlier; other examples are: interpretations of quantum mechanics; the Wigner-Eckart Theorem; the algebraic derivation of the hydrogen spectrum; broken symmetries in quantum mechanics; the adiabatic approximation and Berry's phase; the Eikonal approximation; constrained systems; entanglement.

The chapters on scattering are particularly noteworthy, with the most detailed discussion of the subject I have ever seen in a quantum mechanics textbook. Again, those who will go on to study quantum field theory would do well to go through this treatment first, to see some of the complications (in and out states, for example) in a simpler context.

Will I leave Baym on the shelf and pull out Weinberg (in both cases, the book, not the author) the next time I teach quantum mechanics? I regret to say no, I will not. I must admit the main reason is probably more about me than a comparison of the two books: if I could erase my personal history and start out from scratch, I might well choose Weinberg. However my much greater familiarity with Baym gives it such a head start that the adage "If it works, don't fix it" rules the day.

There is one aspect of Weinberg's book which I find irritating: like his quantum field theory books, formulas that should be familiar look distractingly strange just because of his choice of notation. In particular, he doesn't use Dirac (bra-ket) notation, asserting in the preface that "for some purposes it is awkward". Later on he mentions a specific example of the awkwardness of Dirac notation, and also, in a spirit of full disclosure, gives an example where Dirac notation is particularly convenient. In my mind, the former is truly insignificant, while the latter is a convenience of Dirac notation that pervades the entire subject. In the end, notation is perhaps just a matter of personal taste, but mine (and that of most of the world) is definitely aligned with Dirac.

In summary, Weinberg's LQM will not be the textbook I use the next time I teach quantum mechanics, but I think it will be at the top of the list of secondary references.

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