Philosophy of Modern Physics III/IV

Further Readings

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Some additional introductory texts:

- David Z. Albert *Quantum Mechanics and Experience* Harvard University Press, 1992. (Slanted toward Bohm's theory—and lacking in detail on Quantum Mechanics.)
- Daniel T. Gillespie *A Quantum Mechanics Primer* International Textbook Company, 1973.
- Roland Omnès *The Interpretation of Quantum Mechanics* Princeton University Press, 1994.

Some more historically oriented works—or simply things that could not be considered particularly modern.

- John von Neumann *The Mathematical Foundations of Quantum Mechanics*, Princeton University Press, 1932, 1955.
- P. A. M. Dirac *The Principles of Quantum Mechanics*, Oxford University Press, 1930.
- Richard T. Feynman (+ Leighton and Sands) *The Feynman Lectures on Physics Vol. III* Addison Wesley, 1965.
- J. A. Wheeler and W. H. Zurek *Quantum Theory and Measurement* Princeton University Press, 1983.

Mathematical treatments:

- Geràrd G. Emch *Mathematical and Conceptual Foundations of 20-th Century Physics* Elsevier 1984. (One of the best books around.)

- Barry Simon and Stephen (or Michael) Reed *Functional Analysis* Academic Press 1997. (A classic!—whichever name Read goes by.)

- E. G. Beltrametti and G. Cassinelli *The Logic of Quantum Mechanics* Reading: Addison Wesley, 1981. (Another classic.)

- W. John Wilbur 'On Characterising the Standard Quantum Logics', *Transactions of the American Mathematical Society*, 233, 1977, pp. 265–92.

- G. W. Mackey *Mathematical Foundation of Quantum Mechanics*, Benjamin: New York. 1963. (Mackey's programme has recently been completed in a surprising way by a theorem of Maria Pia Solèr. An account is given in the following reference.)

- S. S. Holland Jr. 'Orthomodularity in Infinite Dimensions: a Theorem of M. Solèr' in *Bulletin of the American Mathematical Society*, 32, no. 2, 1995, pp. 205–34. See also:

- M. P. Solèr 'Characterisation of Hilbert Spaces with Orthomodular Spaces' *Commun. Algebra,* 23, 1995, pp. 219–243.

- G. Cassinelli, E. De Vito, A. Levrero, 'On the decomposition of a quantum state', *J. Math. Analysis and Appl.* 210,1997, pp. 472-483.

- J. M. Jauch *Foundations of Quantum Mechanics* Reading: Addison Wesley, 1968.

- C. Hooker (ed.) *The Logico-Algebraic Approach to Quantum Mechanics* D. Reidel, 1972.

- N. Dunford and J.T. Schwartz *Linear Operators* New York: Wiley Interscience; *Part I: General Theory* (1957); *Part II: Spectral Theory* (1963); and Part III: Spectral Operators (1964). (Still the classic work on the operators that appear in Quantum Mechanics—but probably too encyclopædic for any but the most dedicated.)

- N.I. Akhiezer and I.M. Glazman *Theory of Linear Operators in Hilbert Space* New York: Dover, 1993. (Contains a great deal of unusual information on the position and momentum operators.)

- Peter Mittelstaedt *The Interpretation of Quantum Mechanics and the Measurement Process* Cambridge University Press, 1997.

- J. Bub *Interpreting the Quantum World* (revised ed.) Cambridge University Press, 1999. (The most important book of recent years.)

Specifically on the formal measurement problem.

- Harvey Brown "The Insolubility Proof of the Quantum Measurement Problem" *Foundations of Physics*, 16, 1986, 857–70.
- P. Busch, Pekka Lahti, and P. Mittelstaedt *The Quantum Theory of Measurement* Springer, 1991.
- P. Busch and A. Shimony "Insolubility of the Quantum Measurement Problem for Unsharp Observables" *Studies in History and Philosophy of Modern Physics*, 27B, 1996, 397–404.
- E. Wigner "The Interpretation of Quantum Mechanics" in Wheeler and Zurek (above).

On Hidden Variables, Locality, "Entanglement," and Kochen-Specker.

- Amir D. Aczel *Entanglement*, New York: Four Walls Eight Windows Press, 2001. (Good background—but essentially breathless journalism of the Christmas gift variety.)
- S. Kochen and E. P. Specker 'The Problem of Hidden Variables in Quantum Mechanics' *Journal of Mathematics and Mechanics*, 17, 1967, 59–87.
- M.L.G. Redhead *Incompleteness, Nonlocality, and Realism* Clarendon Press, Oxford, 1987. (The main theorem in this book can also be found in the following paper—)
- P. Heywood and M.L.G. Redhead 'Nonlocality and the Kochen-Specker Paradox' *Foundations of Physics* 13, 1983, pp. 481–99
- D.M. Greenberger, M.A. Horne, and A. Zeilinger 'Going Beyond Bell's Theorem' in *Bell's Theorem, Quantum Theory, and Conceptions of the Universe* (ed.) M. Kafatos, Kluwer Press, 1989.
- Asher Peres *Quantum Theory: Concepts and Methods* Kluwer Press, 1995.
- M. Kernaghan 'Bell-Kochen-Specker Theorem for 20 vectors' *Journal of Physics*, A 27, 1994: L829–L830.
- John Ellis and Daniele Amati (eds.) *Quantum Reflections* Cambridge University Press, 2000.
- Roger Penrose 'On Bell Non-Locality Without Probabilities: Some Curious Geometry' in Ellis and Amati (above).

- J. Zimba and Roger Penrose 'On Bell Non-Locality Without Probabilities: More Curious Geometry' in *Studies in the History and Philosophy of Modern Physics*, 24, 1993, pp. 697–720.
- Roger Penrose *Shadows of the Mind* Oxford: Oxford University Press, 1994. (Especially ch. 5.)
- John Bell *Speakable and Unspeakable in Quantum Mechanics*, Cambridge: Cambridge University Press, 1993.
- J.E. Massad and P.K. Aravind 'The Penrose Dodecahedron Revisited' *American J. Physics*, 67, no. 7, 1999, pp. 631–8.
- P.K. Aravind 'Impossible Colorings and Bell's Theorem' *Physics Letters A*, 262, 1999, pp. 282–6.
- P.K. Aravind 'Bell's Theorem Without Inequalities and only two Distant Observers,' *Foundations of Physics Letters*, 15, no. 4, 2002.

Some Quotes:

I received an early copy of Heisenberg's first work a little before publication and I studied it for a while and within a week or two I saw that the noncommutation was really the dominant characteristic of Heisenberg's new theory. It was really more important than Heisenberg's idea of building up the theory in terms of quantities closely connected with experimental results. So I was led to concentrate on the idea of noncommutation and to see how the ordinary dynamics which people had been using until then should be modified to include it. — P. A. M. Dirac

It will interest mathematical circles that the mathematical instruments created by the higher algebra play an essential part in the rational formulation of the new quantum mechanics. Thus the general proofs of the conservation theorems in Heisenberg's theory carried out by Born and Jordan are based on the use of the theory of matrices, which go back to Cayley and were developed by Hermite. It is to be hoped that a new era of mutual stimulation of mechanics and mathematics has commenced. To the physicist it will seem at first deplorable that in atomic problems we have apparently met with such a limitation of our usual means of visualisation. This regret will, however, have to give way to thankfulness that mathematics, in this field too, presents us with the tools to prepare the way for further progress. — Niels Bohr

No one cares about Hilbert space but everyone cares about the operators on Hilbert space.— Paul Halmos