Reading list for the philosophy of quantum mechanics

This is a fairly thorough reading list on philosophy of QM; it contains more material on each topic than is practical for a weekly tutorial, but it may serve as a basis for constructing tutorial reading lists, as a source for further reading or revision, or as a starting point for anyone considering writing a thesis on one of these topics.

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Suggested tutorial topics

General texts

Introductory

D. Albert, Quantum Mechanics and Experience, (Harvard University Press, 1994)

A. Rae, Quantum Mechanics: Illusion or Reality? (Cambridge, 2004)


Slightly more advanced

J.S. Bell, Speakable and unspeakable in quantum mechanics, (Cambridge, 1987)


D. Home, Conceptual Foundations of Quantum Physics, (Plenum, 1997)

D. Wallace, “Philosophy of Quantum Mechanics” (available on Weblearn)

Formalism of quantum mechanics
A handout to accompany the Intermediate Philosophy of Physics lecture course is available on Weblearn.

Some physics textbooks which present the formalism at a suitable level are:

A classic; still relevant and readable.


A bit dry, but more technically careful than some.


Mathematically more careful (but more challenging) presentations may be found in

Beware of Ballentine’s strong views on the ‘true’ interpretation of QM, which are not distinguished from the mathematics!

Unfortunately rather hard to find in Oxford libraries.

Aimed at undergraduate mathematicians.

Again, beware of the author’s strong opinions about the right interpretation!

For a really systematic reference (albeit one rather short on physical insight) see the first few chapters of:


or


For formal details of the mathematics used, shorn of any physical interpretation, try:

N. Young, An Introduction to Hilbert Space (Cambridge, 1988).

The measurement problem

Introductory accounts

D. Albert, Quantum Mechanics and Experience (Harvard University Press, 1992), Chapter 4 (pp. 73-79) and part of chapter 5 (pp. 80-92).


R. Penrose, The Emperor’s New Mind (Vintage, 1990), chapter 6, up to the section “Objectivity and Measurability of Quantum States”, and from the section “Schrodinger’s Cat” to the end (page numbers vary between editions, sorry!)

E Squires, Conscious Mind in the Physical World (Adam Hilger 1990), chapter 11, pp. 177-203.

More advanced discussions


S. Saunders, “What is the problem of measurement?”, available at http://users.ox.ac.uk/~lina0174/Harvard.htm

Nonlocality: the EPR argument and the Bell inequality

Core Reading


M. Redhead, Incompleteness, nonlocality and realism: a prolegomenon to the philosophy of quantum mechanics. (Clarendon, 1987). Chapter 4 (pp. 82-118), esp. sections 4.1, 4.5, 4.6.

**Further Reading**

A careful classification of exactly what the Bell result does and does not show.

T. Maudlin, *Quantum non-locality and relativity: metaphysical intimations of modern physics*. (Blackwell, 1994), especially chapters 1 (pp.6-28), 5 (pp.125-161), 7 (pp.189-222).
A detailed account of Bell's theorem (ch.1) and its implications for causality (ch.5) and for Lorentz covariance (ch.7).

**Original sources**


**Dynamical-collapse theories**

**Core Reading**


**Further Reading**


T. Maudlin, Quantum non-locality and relativity: metaphysical intimations of modern physics. (Blackwell, 1994). Chapter 7 (pp. 189-222).


Many further references on the “counting anomaly” may be found in the paper by Lewis, above.

Reference


Original sources


Hidden-variable theories

Core Reading

D. Albert, Quantum Mechanics and Experience (Harvard University Press, 1992), Chapter 7 (pp. 134-179).

Further Reading

On hidden variables and impossibility proofs in general:


A. Peres, Quantum theory: concepts and methods (Kluwer, 1993). Part II.

M. Redhead, Incompleteness, nonlocality and realism: a prolegomenon to the philosophy of quantum mechanics. (Clarendon, 1987). Chapter 5 (pp. 119-138). (Two careful discussions of the Kochen-Specker paradox and its implications)

On the pilot-wave theory in particular:


S. Goldstein et al, “Are all particles real?”, Studies in the History and Philosophy of Modern Physics 36 (2005), pp. 103-112. Available online via TDNet. (These three papers are all concerned, in various ways, with the ontology of the pilot-wave theory and the apparent irrelevance of the corpuscles. Oddly, the rather powerful case against the theory in the third reference is made by one of its strongest advocates…)

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Historical discussion of the travails of the pilot-wave theory.


A book review of two recent-ish discussions of the Bohm theory, with much useful background.


Comparison of the pilot-wave theory with dynamical collapse theories of GRW type.


Rather more technical detail about the pilot-wave theory.

References and anthologies


Original source


The Copenhagen Interpretation

Core Reading


Bub, J. Interpreting the Quantum World (Cambridge, 1997), chapter 7 (pp. 189-211), esp. section 7.1 (7.2 focusses on much more technical, formal results).

Cushing, J. Quantum Mechanics: Historical Contingency and the Copenhagen Hegemony, (University of Chicago Press, 1994) chapter 3 (pp. 24-41) & possibly also chapters 5-6 (pp. 90-122).

C. Fuchs and A. Peres, “Quantum Theory Needs No ‘Interpretation’”. Physics Today 53(3) (2000), pp. 70-71. See also the letters to the editor in Physics Today 53(9) and
Fuchs and Peres’ reply (both available online at http://www.aip.org/pt/vol-53/iss-9/p11.html).

Further Reading


Original Sources


The Everett interpretation

Core Reading


Further Reading

J. Barrett, *The quantum mechanics of minds and worlds* (Oxford University Press, 1999), especially chapter 3 (and possibly chapter 6). What is essentially a precis of

A clear exegesis of Everett’s original paper and a variety of comments on later versions of the interpretation.


Rather critical review of Barrett’s book.


M. Lockwood, “‘Many Minds’ Interpretations of Quantum Mechanics”, *British Journal for the Philosophy of Science* 47 (1996), pp. 159-88. Available online via TDNet. (See also the many commentaries in the same issue).

Lockwood’s version of the Everett interpretation, emphasising considerations from the philosophy of mind.


Another version of the Many Minds theory.


D. Wallace, “Epistemology Quantized: Circumstances in which we should come to believe in the Everett interpretation”, available online at [http://users.ox.ac.uk/~mert0130/papers/epist.pdf](http://users.ox.ac.uk/~mert0130/papers/epist.pdf).
More detail about the probability problem in the Everett interpretation.

**Original sources**


(An exegesis of the above two papers can be found in D. Wallace, “Everettian Rationality: defending Deutsch’s approach to probability in the Everett interpretation”, *Studies in the History and Philosophy of Modern Physics* 34 (2003), pp. 415-439, available online via TDNet.)

**Decoherence and consistent histories**

**Core Reading**


**Further Reading**


More technical account of Gell-Mann and Hartle’s almost-but-not-quite-Everett interpretation.

R. Griffiths, Consistent Quantum Theory (Cambridge, 2002), especially chapter 27 (pp. 36-370).

Full technical review of the consistent-histories formalism, together with the author’s interpretational gloss on it.


Influential criticism of the idea of using consistent histories as a solution to the measurement problem (the “Bohmian mechanics” part is incidental.)


Another attempt to use consistent histories to solve the measurement problem.


A conceptually motivated account of environment-induced decoherence and its role in the interpretation of quantum mechanics.

References


An exhaustive survey.


Review paper, covering a wide range of developments in environment-induced decoherence.

Other interpretations

Quantum logic


Critique of Putnam.


M. Dickson, “Quantum logic is alive ^ (it is true v it is false)” , Philosophy of Science 68 (2001), Supplement: proceedings of the 2000 Biennial Meeting of the Philosophy of Science Association Part I: Contributed Papers, pp. S274-S287.

Modal interpretations


Information-theoretic interpretations


Fuchs proposes a variant of the Copenhagen interpretation motivated by quantum information theory, in which the quantum state represents only our subjective knowledge about the results of measurements.


Critical assessment of the Fuchs proposal.

Consciousness-based collapse theories


Uncertainty relations
