Suggested Supplementary Reading for PHYS453: Foundations of Quantum Mechanics

Mathematical Background

- Whatever linear algebra textbook you used and whatever Prof. M. Vajiac recommends for Linear Algebra 2.
- Bryan Rynne and M. A. Youngston, "Linear Functional Analysis", Springer (2008) – Helpful for understanding some aspects of how continuous variable quantum theory works. We won't need this much except in the section on the classical limit.
- R. Tyrell Rockafellar, "Convex Analysis", Princeton University Press (1970) – Only first few chapters for background on GPTs
- Günter M. Ziegler, "Lectures on Polytopes", Springer (1994) – Only first few chapters for background on GPTs. Also useful for no-go theorems.

Generalized Probabilistic Theories

- Peter Janotta and Haye Hinrichsen, "Generalized probability theories: what determines the structure of quantum theory?", Journal of Physics A: Mathematical and Theoretical, vol. 47 323001 (2014) https://doi.org/10.1088/1751-8113/47/32/323001 preprint: https://arxiv.org/abs/1402.6562 - Not many accessible comprehensive books, so this is a review article.
- Jeffrey Bub, "Bananaworld: Quantum Mechanics for Primates", Oxford University Press (2016) – A good treatment of some recent work trying to derive the structure of quantum theory, with entertaining monkey analogies (Bub has also written a comic book about this, which is not published yet).

Introduction to Quantum Theory

- Benjamin Schumacher and Michael Westmoreland, "Quantum Processes, Systems, and Information", Cambridge University Press (2010) – Many other introductory books exist. This one is the most useful for the approach we will take in this course.

Philosophical Background

- The Stanford Encyclopedia of Philosophy https://plato.stanford.edu is a reliable source for most topics in the philosophy of science and physics.
- James Ladyman, "Understanding Philosophy of Science", Routledge (2002) – Very good on the realism vs. antirealism debate.
- David Z. Albert, "Quantum Mechanics and Experience", Harvard University Press (1992) – A concise treatment of the interpretation of quantum theory from the point of view of a philosopher.
- Peter J. Lewis, "Quantum Ontology", Oxford University Press (2016) – Interpretations of quantum theory from a philosophy point of view.

- Dean Rickles, "The Philosophy of Physics", Polity Press (2016) – Covers foundations of relativity and statistical mechanics as well as quantum theory. Useful for getting a broader overview of philosophy of physics.

Tensor Spaces and String Diagrams

- Bob Coecke and Aleks Kissenger, "Picturing Quantum Processes", Cambridge University Press (2017) – The only book on this that is accessible to undergraduates. They use it to teach a first course on quantum theory. I am still not convinced that's a good idea.

The Generalized Quantum Formalism

- Teiko Heinosaari and Mario Ziman, "The Mathematical Language of Quantum Theory", Cambridge University Press (2012) – This is the best book on this topic, particularly if you want an accessible introduction to the continuous variable case.
- Benjamin Schumacher and Michael Westmoreland, "Quantum Processes, Systems, and Information", Cambridge University Press (2010) – Most of what we need is also in here, specialized to the finite-dimensional case.
- Michael Nielsen and Isaac Chuang, "Quantum Computation and Quantum Information", Cambridge University Press (2000) – And here.

Ontological Models (Epistricted theories, no-go theorems, ψ-ontology, etc.)

- David Jennings and Matthew Leifer, "No Return to Classical Reality", Contemporary Physics, vol. 57, iss. 1, pp. 60-82 (2015) https://doi.org/10.1080/00107514.2015.1063233 preprint: https://arxiv.org/abs/1501.03202 A review article I wrote intended to be accessible to a general physics audience.
- Robert W. Spekkens, "Quasi-Quantization: Classical Statistical Theories with an Epistemic Restriction", in "Quantum Theory: Informational Foundations and Foils", Giulio Chiribella and Robert W. Spekkens (eds.), pp. 83-135, Springer (2015) preprint: https://arxiv.org/abs/1409.5041 Everyone interested in quantum foundations should read some papers by Rob Spekkens.
- Robert W. Spekkens, "Contextuality for preparations, transformations, and unsharp measurements", Physical Review A, vol. 71 052108 (2005). Preprint: https://arxiv.org/abs/quant-ph/0406166
- J. S. Bell, "Speakable and Unspeakable in Quantum Mechanics", 2nd edition, Cambridge University Press (2004). Although mostly of historical interest, Bell still wrote about his theorem more clearly than almost anyone since.
- Matthew Saul Leifer, "Is the Quantum State Real? An Extended Review of ψ-ontology Theorems", Quanta, vol. 3, no. 1, pp. 67-155 (2014). http://dx.doi.org/10.12743/quanta.v3i1.22 A much more comprehensive review article with lots of hairy math. Not for the faint of heart.

The Classical Limit of Quantum Theory

- Maximillian A. Schlosshauer, "Decoherence and the Quantum-To-Classical Transition", Springer (2007) – Accessible and comprehensive treatment of the subject.
- Jess Riedel's blog contains a wealth of information on this topic: http://blog.jessriedel.com

- N. P. Landsman, “Between classical and quantum”, (2005) https://arxiv.org/abs/quant-ph/0506082 - Very comprehensive, but extremely mathematically technical. Not for the faint of heart.

Interpretations of Quantum Mechanics

- Travis Norsen, “Foundations of Quantum Mechanics”, Springer (2017) – New textbook for an undergraduate course. Very good on Bell, de Broglie-Bohm, GRW, and not bad on Everett/many-worlds.
- David Z. Albert, “Quantum Mechanics and Experience”, Harvard University Press (1992) – Concise introduction to interpretations.
- J. S. Bell, “Speakable and Unspeakable in Quantum Mechanics”, 2nd edition, Cambridge University Press (2004) – Several articles advocating for de Broglie-Bohm and GRW.
- Peter J. Lewis, “Quantum Ontology”, Oxford University Press (2016) – Interpretations from a philosophy point of view.
- David Wallace, “The Emergent Multiverse: Quantum Theory According to the Everett Interpretation”, Oxford University Press (2012) – The best recent book on Everett/many-worlds.
- Hans Christian von Baeyer, “QBism: The Future of Quantum Physics”, Harvard University Press (2016) – A concise introduction to what is probably the most popular contemporary interpretation in the Copenhagenish mould.
- Jeffrey Bub, “Bananaworld: Quantum Mechanics for Primates”, Oxford University Press (2016) – Bub develops another Copenhagenish interpretation towards the end of this book.