

HPS/PHIL 93872
Historical Foundations of the Quantum
Theory
TTh 2:00-3:15
209 O'Shaughnessy

Spring 2012

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Office Hours: TTh 12:45-1:45

Texts: All readings for the first two-thirds of the course will be distributed individually in class or electronically. Otherwise, you should obtain a copies of this one book:

Robert Laughlin. *A Different Universe: Reinventing Physics from the Bottom Down*. New York: Basic Books, 2005.

Requirements: Each student will be required to do one presentations to the class, on a topic to be chosen from the syllabus in consultation with the instructor. The presentation will be worth 40% of the final course grade. 10% of the final course grade will be based on class participation. A term paper (minimum fifteen pages) worth 50% of the course grade will complete the requirements for the course, the term paper topic also to be chosen in consultation with the instructor.

Schedule:

Date:	Topic:	Readings:
17 Jan.	Introduction–The Place of History in Foundational Studies. Empirical and theoretical preliminaries	Helge Kragh. <i>Quantum Generations</i> , Chs. 1-4.
19 Jan.	Planck and black-body radiation.	Martin Klein. “Planck, Entropy, and Quanta, 1901-1906.”
24 Jan.	Einstein and the photo-electric effect.	Martin Klein. “Einstein’s First Paper on Quanta.”
26 Jan.	The Bohr model of the atom and spectral series.	Max Jammer. “Regularities in Line Spectra”; “Bohr’s Theory of the Hydrogen Atom.”
31 Jan.	The Bohr-Sommerfeld “old” quantum theory; Einstein on transition probabilities.	Max Jammer. “The Older Quantum Theory.”
2 Feb.	The Bohr-Kramers-Slater theory.	Max Jammer. “The Transition to Quantum Mechanics.”
7 Feb.	Bose-Einstein statistics.	Don Howard. “‘Nicht sein kann was nicht sein darf,’ or the Prehistory of EPR, 1909-1935.”
9 Feb.	Heisenberg and matrix mechanics.	Max Jammer. “The Formation of Quantum Mechanics,” §§ 5.1-5.2.
14 Feb.	Schrödinger and wave mechanics.	Max Jammer. “The Formation of Quantum Mechanics,” § 5.3.

16 Feb.	De Broglie and the origins of pilot-wave theory.	James T. Cushing. "Early Attempts at Causal Theories: A Stillborn Program."
21 Feb.	Complementarity and the indeterminacy principle.	Niels Bohr. "The Quantum Postulate and the Recent Development of Atomic Theory."
23 Feb.		Mara Beller. "The Dialogical Birth of Bohr's Complementarity."
27 Feb.	The Einstein-Podolsky-Rosen argument and and Bohr's reply.	Albert Einstein, Boris Podolsky, Nathan Rosen. "Can Quantum-mechanical Description of Physical Reality Be Considered Complete?"
1 Mar.		Niels Bohr. "Can Quantum-mechanical Description of Physical Reality Be Considered Complete?"
6 Mar.	Von Neumann and the axiomatization of quantum mechanics. London and Bauer on measurement theory.	John von Neumann. "The Measuring Process"; Fritz London and Edmond Bauer. "The Theory of Observation in Quantum Mechanics."
8 Mar.	The invention of the "Copenhagen Interpretation."	Don Howard. "Who Invented the Copenhagen Interpretation? A Study in Mythology."
12-16 Mar.	<i>Spring Break</i>	
20 Mar.	Relativistic quantum mechanics, second quantization, and the origins of quantum field theory.	Silvan S. Schweber. "The Birth of Quantum Field Theory" and "The 1930s."
22 Mar.	Early QFT (continued)	
27 Mar.	Bohm and the revival of hidden variables theories. Gleason, Kochen and Specker, and the no-go theorems.	David Bohm. "A Suggested Interpretation of the Quantum Theory in Terms of 'Hidden' Variables. I and II."
29 Mar.	Bell's theorem and the Jarrett analysis.	James T. Cushing. "A Background Essay."
3 Apr.	Everett, Wheeler, DeWitt and the relative state interpretation.	Hugh Everett. "'Relative State' Formulation of Quantum Mechanics."
5 Apr.	Decoherence.	Elise Crull. "Decoherence for Nonspecialists."

10 Apr.	Decoherence (continued)	Wojciech Zurek. “Decoherence and the Transition from Quantum to Classical—Revisited”; Wojciech Zurek. “Decoherence, Einselection, and the Quantum Origins of the Classical.”
12 Apr.	Reduction, Emergence, Particle Physics and Condensed Matter Physics	Philip W. Anderson. “More Is Different.”; “Emergence vs. Reductionism.”
17 Apr.		Philip W. Anderson. “Is the Theory of Everything the Theory of Anything?”; “Is Measurement Itself an Emergent Property?”
19 Apr.	Against the Reductionist Paradigm	Robert Laughlin, <i>A Different Universe</i> , Chs. 1-5.
24 Apr.		Robert Laughlin, <i>A Different Universe</i> , Chs. 6-10.
26 Apr.		Robert Laughlin, <i>A Different Universe</i> , Chs. 11-16.
1 May.	A Synthetic Perspective	Don Howard. “Reduction and Emergence in the Physical Sciences: Some Lessons from the Particle Physics and Condensed Matter Debate”
9 May	<i>Term Papers Due</i>	