

Philosophy of Quantum Mechanics Syllabus

Professor: Nina Emery (nina_emery@brown.edu)
Office Hours: Wednesday 2-4pm in 214 Corliss-Brackett House
Lecture: Tuesday and Thursday, 2:30pm to 3:50pm in Wilson 101

Course Description

Physicists have come up with a set of mathematical rules that allow us to predict quantum mechanical phenomena with remarkable accuracy. But while we know how to use this mathematical formalism, our understanding of what that formalism means is quite limited. It is because this mathematical formalism is so difficult to interpret that you have heard extraordinary claims like:

- How physical systems behave depends on whether or not anyone is observing them.
- It is possible for cats to be both dead and alive, and for baseballs to tunnel through walls.
- The universe is continually splitting into different branches.
- The three-dimensional space of our ordinary experience is an illusion.

The course will have three parts. In the first, we will review some surprising experimental results. In the second, we will cover the mathematical formalism and see how that formalism predicts the surprising results. In the third, of the class we will examine the various interpretations that physicists and philosophers have developed for the mathematical formalism.

It is important to understand that this is a philosophy course, not a physics course. Although we will learn some physics along the way, you will be expected to read, write, and argue like a philosopher. (We will assume that you have at least some experience with this, though we will also give both guidelines and feedback as we go.) And our focus throughout will be on the philosophical issues at stake: the nature of explanation and probability in the physical world, how if at all we can make choices between empirically equivalent theories, and the role of appeals to intuition, common sense, and simplicity in science.

Expectations

Website

Announcements will be posted on the course Canvas site. It is your responsibility to check the website regularly and make sure you are receiving announcements via email.

Attendance

You are expected to attend all lectures. If you must miss class for a good reason (e.g due to illness, a family emergency, or a religious observance), please notify your TA. If you miss class without a good reason you will be penalized as follows:

Up to 2 unexcused absences:	-1 point from your final grade (out of 100)
Up to 5 unexcused absences:	-3 points from your final grade
More than 5 unexcused absences:	-10 points from your final grade

Participation

You are encouraged to participate actively in class. Participation includes speaking up during lecture, attending office hours or discussion section, and meeting in person with your TA.

Electronic Etiquette

No laptops, cellphones, or tablets allowed in class except with specific permission from Professor Emery. See the course website for the handout explaining this policy.

Readings

Students must purchase a copy of David Albert's, *Quantum Mechanics and Experience*. Used copies are available on Amazon for just \$6.00. All other readings will be posted on the course website. Note that readings are assigned by week (not by class meeting). You must complete all readings by the beginning of the week for which they are assigned.

Homework assignments

There will be regular short homework assignments that will help test your understanding of the material covered in class. These assignments won't be graded but they will be reviewed in class and must be completed on time.

Short Papers

There will be two 750 to 1,500 word papers due throughout the semester. The short papers will count for 50% of your grade. More guidelines will be posted with the assignments.

Paper 1	Due February 28
Paper 2	Due April 11

Rewrite

You may choose to rewrite one of your papers. If you do so, you must meet with your TA to review your original assignment before completing the rewrite. The rewrite grade and your original grade will be averaged. The rewrite is due on April 25.

Final Project

In late March students will be assigned a topic related to those discussed in class. Along with a small group of your peers you will research the topic and the way in which it impacts our choice of which interpretation of quantum mechanical phenomena to endorse. As a group, you will prepare a brief presentation on their topic to be given during the last week of class. As an individual you will then write a 1,500 to 2,500 word paper on the topic, which will be due on December 15. More guidelines will be posted with the assignment. The final project will count for 50% of your final grade.

Late Assignments

Late assignments will not be accepted unless you have been given an extension by Professor Emery. Extensions will only be granted for illnesses, family emergencies, and religious observances.

Collaboration and Academic Honesty

I highly encourage you to collaborate with your fellow students on any and all assignments for the course, however the work that you submit must be your own. That means you should feel free to get together to discuss the assigned questions with other students, but you should write up your answers on your own, and in your own words. (If you do not understand what this means, ask!) When you do draw on someone else's ideas, you need to give that person proper credit. That means that any time you paraphrase someone else's work you must make it clear that you are doing so, and anything quoted verbatim must be accompanied by a parenthetical citation or a footnote that identifies its source. I do not care what citation format you follow, but you must always include the author's name, the title of the work, and the relevant page number(s). Anything short of that is plagiarism. I take this very seriously, as does the administration.

Extra Assistance

Brown University is committed to full inclusion of all students, as am I. Students who, by nature of a documented disability, require academic accommodations should contact me or speak with Student and Employee Accessibility Services at 401-863-9588 to discuss the process for requesting accommodations.

Anyone needing extra help with writing is urged to take advantage of the Brown University Writing Center.

Tentative schedule

	<i>NB: No class January 28 (Professor Emery is away)</i>	
Week 1	February 2, 4	The two path experiment
Week 2	February 9, 11	The EPRB set-up
Week 3	February 16, 18	Non-locality
Week 4	February 25	Introduction to the formalism
	<i>NB: No class February 23 (Presidents' Day)</i>	
Week 5	March 1, 3	Born's Rule
Week 6	March 8, 10	Linearity and collapse
Week 7	March 15, 17	The orthodox interpretation
Week 8	March 22, 24	Spontaneous collapse theories
	<i>NB: No class March 29, 31 (Spring Break)</i>	
Week 9	April 5, 7	The measurement problem
Week 10	April 12, 14	Bohmian mechanics
Week 11	April 19, 21	Many worlds
Week 12	April 26, 28	Wave function realism
Week 13	May 3, 5	Student presentations