Philosophy 9221B: Philosophy of Quantum Mechanics

Winter Term 2023	**Instructor: Wayne C. Myrvold**
Mondays, 11:30–14:30	**wmyrvold@uwo.ca**
	Office: Stevenson Hall 4143
	ce Hours: Tue Thu 11:30–12:30, or by appointment

Quantum physics is different from classical physics, and the physics that governs our world is quantum. But what are we saying when we say this? What, if anything, does the empirical success of quantum mechanics tell us about the physical world? It is, to me, a fascinating fact that, though quantum mechanics is at this point nearly 100 years old (the founding papers were published in 1925–1927, and interpretive discussions have been going on much of that time, there is still no consensus on what lessons we should draw from quantum physics.

This course is intended as an introduction to the conceptual problems raised by quantum mechanics, and to the chief approaches to dealing with them. A focus of the course will be the role of probabilities in the theory, and key questions will be the extent to which these probabilities are similar to probabilities in classical physics, and (more interestingly) how they are *different*.

We will begin with an introduction to quantum mechanics: an overview of the sorts of experiments that motivate the development of a non-classical theory, and an introduction to the formalism of quantum mechanics—just enough to get us to the philosophical issues. This will bring us to the question of "hidden-variables." We will cover Bell's theorem and the Bell-Kochen-Specker theorem. We will discuss the theorems that show how quantum probabilities differ from classical, and in particular, the Pusey-Barrett-Rudolph (PBR) theorem. Next we will consider the major approaches to interpretive issues: the hidden-variables programme, exemplified by Bohmian mechanics; the dynamical collapse programme; Everettian, or "many worlds" interpretations; and, finally, arguments from Bohr and from some present-day quantum information theorists to the effect that there is no interpretational problem at all.

It is expected that a range of backgrounds will occur among students in the course, from those with little or no background to some who have taken one or more courses in quantum mechanics. No previous knowledge of quantum mechanics will be assumed; all relevant background will be introduced in class. Mathematical formalism will be kept to a minimum, as the focus of the course is on the conceptual issues. The minimum amount of mathematics required for an informed discussion of the conceptual issues is, however, nonzero, and students must be willing to acquire the conceptual tools requisite for thoughtful and informed engagement with the issues.

Texts

The main text will be a set of notes provided by the instructor, which will be updated throughout the term and which will be made available on the course OWL site.

In addition, I will be assigning a number of articles by the chief protagonists in the quantum debates. These will be made available through the course OWL site.

Requirements:

Attendance and active participation in class discussions, problem sets, one take-home test, term paper. Students will do class presentations on their term-paper topics.

Students not taking the class for credit are welcome to audit, but those doing so must make a commitment to attending all classes and doing the assigned reading.

Evaluation:

Problem sets (assigned sporadically)	15%
Take-home test	20%
Term paper presentation	5%
Term paper (draft)	5%
Term paper (final)	55%
	100%