PHYS 234:
Quantum Physics I

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Richard Feynman:
"I think I can safely say that nobody understands quantum mechanics."

John Wheeler:
"If you are not completely confused by quantum mechanics, you do not understand it."

But what does it mean to "understand"?

"Understanding"

Formulation of rules

➔ correct prediction of outcomes of experiments
➔ prediction of new effects

What are the underlying principles of these rules? (minimal assumptions)
➔ simplification of rules
➔ formulate new theories

Why are the rules the way they are?

Classical Mechanics:

Newton's law + …

Variational Principle
(Lagrange & Hamiltonian Formulation)
➔ Field Theory

Interesting philosophical question

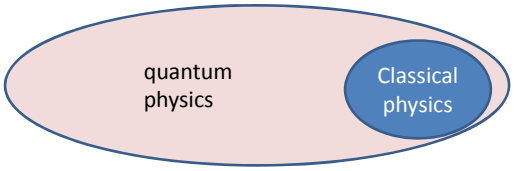
Quantum Mechanics (QM):

Formalism of QM clear ➔ works great!

Research in Progress
➔ attempt to formulate principles without reference to math structure

Interesting philosophical question …

Quantum Mechanics vs. Classical Physics



Many notions of classical physics will become obsolete in quantum physics
➔ they emerge only in some limit (classical limit)

classical physics:
objects have always well defined position and momentum

quantum physics:
no simultaneous position and momentum measurement
➔cannot put one particle into one spot

a measurement does not simply reveal a pre-existing value …

Nils Bohr:
"For those who are not shocked when they first come across quantum theory cannot possibly have understood it."

Course Outline

Background:

1) Going beyond classical physics:
Particles behaving as Waves & Waves behaving as Particles

Basic Formalism

2)Experimental observation of prototype quantum mechanical system:
Stern-Gerlach Set-Up
3) Developing Mathematical Framework that explains observations
4) Applications: Bomb detection & Zeno effect
5) Dynamics in Quantum Mechanics

Statistics:
- probability distributions, expectation values
Linear Algebra:
- finite dimensional complex vector spaces
- operators/matrices
- eigenvalues & eigenvectors

simple differential equations

Advanced Formalism

6) Infinite dimensions: particle on a line
7) particle in step-function potential & harmonic potential
8) Applications in Semi-conductors and Tunneling Microscopy

Analysis involving complex-valued functions

Course Components

1) Lectures

- Lecture Notes become available the day of the lectures (afternoon/evening)
- use of Clickers (mandatory)

2) Text book

- required: McIntyre Quantum Mechanics
- recommended: (see syllabus)

3) Tutorial groups

- deepen understanding of material
- led by a TA, who also marks the assignments

Tutorial group 105 will be divided up onto other groups
(levelling out of remaining groups on Wednesday)

4) Assignments

- weekly assignments
- published Wednesdays
- due following Wednesday in lectures
- will be returned Fridays in Tutorial groups

Learning groups encouraged
make sure you hand in the solution that YOU understand after your discussions with your peers!

Marking Scheme

Scheme 1:

20%	Assignments
5%	Clicker Participation
30%	Midterm Exam
45%	Final Exam

Scheme 2:

20%	Assignments
5%	Clicker Participation
20%	Midterm Exam
55%	Final Exam

the better grade counts!

NOTE:
if you achieve less than 50% of the total of all assignment points, your assignment mark will be set to 0%!

For more details:
check syllabus on the LEARN homepage of our course!

Midterm date:
Tuesday, March 5, 7:00- 9:30 pm

Office hours:

Mondays, 12- 1, and 6-7 pm
QNC 4129

Email communication:

How to reach me and my office:

lutkenhaus.office@uwaterloo.ca

TWO people who can help you

Lisa David
Norbert Lütkenhaus