PHYS 3701 A for Term Fall 2026

ELEMENTS OF QUANTUM MECHANICS

We, the people of the Faculty of Science at Carleton University, acknowledge that our campus is located on the traditional, unceded territories of the Algonquin Anishinabeg people. Miigwetch for your hospitality and stewardship of this territory and the teachings that come from it. We are grateful for this land, the air that we breathe, and the water that sustains us all as well as for the animals, plants and other living beings: these enable us to research, teach, mentor, support, study, and learn. We recognize our responsibility to our natural environment and to reconciliation with Indigenous peoples.

Course Instructor: Yue Zhang
(Associate Professor, Theoretical Physics)

Email: yuezhang13@cunet.carleton.ca

Note: If you have or question or would like to talk with me, you can send an email, visit me during student hours (see below), or approach me after lecture.

For email communications, please include "PHYS 3701" in subject line.

Student Hours: Wednesdays, 12 - 1 pm.

Office Location: 3324 Herzberg Laboratories.

Department/Unit: Physics

Course TAs:
Lauren Enright
(LaurenEnright@cmail.carleton.ca)
Yasaman Shafaee
(YasamanShafaee@cmail.carleton.ca)
Zichael Labomarel
(ZichaelLabomarel@cmail.carleton.ca)

Class Location: Please check Carleton Central for the room location.

Class Times: Wednesdays and Fridays, 10:05 am - 11:25 am.

First lecture date: Wednesday, September 9.

Last lecture date: Wednesday, December 9.

Prerequisites: PHYS 2604, MATH 2000 [1.0] (may be taken concurrently), or MATH 2004 or MATH 2008, and MATH 3705 (may be taken concurrently), or permission of the Department.

Preclusions: n/a

Course Description:
Analysis of interference experiments with waves and particles; fundamental concepts of quantum mechanics, Schrödinger equation; angular momentum, atomic beams; hydrogen atom; atomic and molecular spectroscopy; Pauli principle; simple applications in the physics of elementary particles.

Important Dates:

Important dates and deadlines can be found here: https://calendar.carleton.ca/academicyear/, including class suspension for fall, winter breaks, and statutory holidays.

Topics Covered and Learning Outcomes

Topics to be Covered

- Particle-wave duality, experimental evidence, Planck's Law, de Brogie matter wave, the classical limit.
- Introduction to the Schrödinger equation and wavefunction, operators and experimental observables, statistical interpretation, stationary state.
- Solving a bunch of Schrödinger equation problems in one space dimension (1D), the Heisenberg uncertainty principle.
- Schrödinger equation in three space dimensions, the hydrogen atom, orbital angular momentum, radial wavefunctions, energy levels, atomic transition selection rules, Paschen–Back effect.
- Spin angular momentum, Stern-Gerlach experiment, spin statistics, Pauli exclusion principle, total angular msomentum, Clebsch–Gordan coefficients, Zeeman effect.

Learning Material(s) and Other Course/Lab-Related Resources

I will post lecture notes and assignments in the BrightSpace course page. Please check for updates on a regular basis. Additional email communications will take place as needed.

Students are not required to purchase textbooks or other learning materials for this course. If you still prefer to get a textbook as additional study material, I recommend:

- *Introduction to Quantum Mechanics*, third edition, by David J. Griffiths and Darrell F. Schroeter, Cambridge University Press 2018.

It is available for purchase in the university bookstore, or Amazon (cost ~$90).

Assessments

There will be **6** sets of assignment problems throughout the semester. They will be posted and announced via Brightspace. Submit your work using Brightspace (deadline is typically two weeks after the release date). You are encouraged to study together but write separately. **The work you hand in must be your own.**

The midterm exam will be held during class hour in the week before the fall break. It will be 80 minutes long, closed-book, closed-note exam. A formula sheet will be provided. Using scientific calculator is allowed.

The final exam will be held during the final exam period. It will be 3 hours long, closed-book, closed-note exam. A formula sheet will be provided. Using scientific calculator is allowed.

For the exams it is forbidden to: use unauthorized aids, look up any information online, consult with any other person, or share exam content with anyone.

Grade Breakdown

COMPONENT	GRADE VALUE	DATE
ASSIGNMENT 1	5 %	TBA
ASSIGNMENT 2	5 %	TBA
ASSIGNMENT 3	5 %	TBA
ASSIGNMENT 4	5 %	TBA
ASSIGNMENT 5	5 %	TBA
ASSIGNMENT 6	5 %	TBA
MIDTERM	20 %	October 23rd, 2026
FINAL EXAM	50 %	TBA

Late and Missed Work Policies

Late Work

Late assignments will not be accepted, unless permission is received from the professor for documented reasons, and they must be handed in along with a completed academic considerations form.

Missed Work

If you missed an exam, you must notify the professor within three working days after the date of the exam. Deferred exams will be permitted for documented reasons (illness, injury or other extraordinary circumstances beyond the student's control). For more information see Section 4 of the Academic Regulations of the University.

Academic Accommodations and Regulations

Carleton is committed to providing academic accessibility for all individuals. You may need special arrangements to meet your academic obligations during the term. The accommodation request processes, including information about the Academic Consideration Policy for Students in Medical and Other Extenuating Circumstances, are outlined on the Academic Accommodations website (https://students.carleton.ca/course-outline/).

Grade Definition

In accordance with the Carleton University Undergraduate Calendar Regulations, the letter grades assigned in this course will have the following percentage equivalents:

A+ = 90-100	A = 85-89	A- = 80-84
B+ = 77-79	B = 73-76	B- = 70-72
C+ = 67-69	C = 63-66	C- = 60-62
D+ = 57-59	D = 53-56	D- = 50-52
F < 50	WDN = Withdrawn from the course	
ABS = Student absent from final exam		DEF = Deferred

Statement on Generative Artificial Intelligence (GenAI) Usage

It is strictly prohibited to use AI while working on the problem sets or the class presentation. The problem sets are meant to improve your problem-solving skills and deepen your understanding of the material by actively thinking about it and working through the derivations. Using AI to do the problems will defeat this purpose.
You are allowed to use AI to help you understand the material or to learn about further topics, when not working on problems. However, I would encourage you instead to ask colleagues or come to office hours.

Statement on Academic Integrity

Students are expected to uphold the values of academic integrity, which include fairness, honesty, trust, and responsibility. Examples of actions that that compromise these values include but are not limited to plagiarism, accessing unauthorized sites for assignments or tests, unauthorized collaboration on assignments or exams, and using Generative Artificial Intelligence (GenAI) tools when course assessment instructions indicate such use is not permitted.

Misconduct in scholarly activity will not be tolerated and will result in consequences as outlined in Carleton University's Academic Integrity Policy. A list of standard sanctions in the Faculty of Science can be found here.

Additional details about this process can be found on the Faculty of Science Academic Integrity website.

Students are expected to familiarize themselves with and abide by Carleton University's Academic Integrity Policy.

Student Rights & Responsibilities

Students are expected to act responsibly and engage respectfully with other students and members of the Carleton and the broader community. See the 7 Rights and Responsibilities Policy for details regarding the expectations of non-academic behaviour of students. Those who participate with another student in the commission of an infraction of this Policy will also be held liable for their actions.

Student Concerns

If a concern arises regarding this course, **your first point of contact is me**: Email or drop in during student hours and I will do my best to address your concern. If I am unable to address your concern, the next points of contact are (in this order):

Note: You can also bring your concerns to Ombuds services.