

Carleton University Physics Department

PHYS 4608 – Nuclear Physics (Fall 2021)

Course Outline

1. Course calendar description and pre-requisites

Ground state properties of nuclei. Nuclear models, binding energy, properties of excited nuclei. Alpha, beta and gamma decay. Passage of radiation through matter, detectors. Nuclear reactions, cross sections, fission, fusion. Elements of neutron physics.

Pre-requisites: PHYS 3606 or PHYS 3608 or permission of the Department.

2. Instructor contact information

Instructor: Dr. Emily Heath

Email: emily.heath@carleton.ca

Office hours: by appointment

Teaching assistant: Islam El-Gamal

Email: IslamElGamal@cmail.carleton.ca

In accordance with University policy, all communication with instructors and TAs must be via your Carleton email account.

3. Course textbook

John Lilley, "Nuclear Physics Principles and Applications", Wiley & Sons, 2001.

Other references:

Kenneth S. Krane, "Introductory Nuclear Physics", Wiley & Sons, 1988

4. Course website

The course outline and other course information will be posted on the Brightspace website (www.brightspace.carleton.ca). We reserve the right to amend the course outline on the Brightspace website and will inform you if that version changes. In the event of any

discrepancy between this document, and the version currently posted on the website, then the website version on Brightspace will be taken as the definitive version.

If you are unable to access Brightspace or need help with your computing account, please contact the ITS Service Desk at 613-520-3700 or email its.service.desk@carleton.ca

5. Course modality

This is a Hyflex course where students can choose to attend each scheduled lecture in person or online via Zoom. If you plan to attend online then you will require reliable high-speed Internet access and a computer with a webcam and a headset with a microphone.

6. Lectures

Wednesdays and Fridays 14:35 – 15:55 (Eastern Time) in Loeb Building room C164 or online via the Zoom link on the course Brightspace page.

The lectures in this course will be recorded and made available only to those within the class. Please note that recordings are protected by copyright. The recordings are for your own educational use, but you are not permitted to publish to third party sites, such as social media sites and course materials sites.

7. Course grading scheme

The grade for this course is split between homework (40%), in-class presentations (10%) and exams (50%).

7.1 Homework assignments (40%)

Assignments will be assigned approximately every week and a half, for a total of 5 assignments, and posted on CULearn. They should be submitted through CULearn before the deadline.

Working through problems is an essential part of developing a deep understanding of the course material. Students are permitted to discuss concept and strategies related to solving the homework assignments; however, the work handed in must be their own.

Late assignments will not be accepted without a legitimate reason, such as illness or a family emergency.

7.2 In-class presentations (10%)

Each student will make a class presentation on an application of Nuclear Physics. The presentations will take place during the December 3rd and 8th lecture sessions. Students can select from a list of topics that will be provided by the instructor or propose their own (subject to approval by the course instructor).

7.3 Midterm exam (15%)

An online midterm exam will be held on October 22nd during the scheduled lecture time. You may use your notes and textbook during the exam but no other assistance is allowed (eg. accessing the internet is not permitted). After the Fall break there will be a follow-up oral exam (~ 15 min) which will be scheduled outside of the lecture hours during the week of November 1st-5th.

7.4 Final exam (35%)

An online final exam will be held during the final exam period in December. The exam will be 3 hours in duration. More information about the final exam will be provided closer to the final exam date. A follow-up oral exam (~ 15 min) will be scheduled after the exam.

The Carleton University e-Proctoring system may be used in both midterm and final exams, and requires the use of webcams, microphones, and smart phones.

8. Lecture topics and dates

Topic Description	Textbook Sections	Approximate Date(s)
Course intro, terminology, units & dimensions	Chap 1	Sept 8 th
Nuclear properties		Sept 10 th – 15 th
Nuclear structure	Chap 2	Sept 17 th – 24 th
Radioactivity and radioactive decay	Chap 1	Sept 29 th & Oct 1 st
Nuclear instability	Chap 3	Oct 6 th - 13 th
Nuclear reactions	Chap 4	Oct 15 th - Nov 3 rd
Midterm exam – in class		Oct 22 nd
Interaction of radiation with matter	Chap 5	Nov 5 th & 10 th
Radiation detectors	Chap 6	Nov 12 th & 17 th
Nuclear fission	Chap 10	Nov 19 th & 24 th
Nuclear fusion	Chap 11	Nov 26 th & Dec 1 st
In-class presentations: applications		Dec 3 rd & 8 th

9. University Policies

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 B+ = 77-79 C+ = 67-69 D+ = 57-59

A = 85-89 B = 73-76 C = 63-66 D = 53-56

A- = 80-84 B- = 70-72 C- = 60-62 D- = 50-52

F = <50

WDN = Withdrawn from the course

ABS = Student absent from final exam

DEF = Deferred (See above)

Standing in a course is determined by the course instructor subject to the approval of the Faculty Dean. This means that grades submitted by the instructor may be subject to revision. No grades are final until they have been approved by the Dean.

Academic Regulations, Accommodations, Plagiarism, Etc.:

University rules regarding registration, withdrawal, appealing marks, and most anything else you might need to know can be found on the university's website, here:

<http://calendar.carleton.ca/undergrad/regulations/academicregulationsoftheuniversity/>

Academic Integrity

Submitting an examination or an assignment that is copied, in whole or in part, from someone else is considered plagiarism, which is an academic misconduct offence. This includes copying the full solution or any part of the solution from an online resource like Chegg, or from any other type of unauthorized source.

Plagiarism is a serious offence that cannot be resolved directly by the course's instructor. The Associate Dean of the Faculty conducts a rigorous investigation, including an interview with the student, when an instructor suspects a piece of work has been plagiarized. Penalties are not trivial. They can include a final grade of "F" for the course.

<https://carleton.ca/registrar/academic-integrity/>

Course Copyright

Classroom teaching and learning activities, including lectures, discussions, presentations, etc., by both instructors and students, are copyright protected and remain the intellectual property of their respective author(s). All course materials, including PowerPoint presentations, outlines, and other materials, are also protected by copyright and remain the intellectual property of their respective author(s).

Students registered in the course may take notes and make copies of course materials for their own educational use only. Students are not permitted to reproduce or distribute lecture notes and course materials publicly for commercial or non-commercial purposes without express written consent from the copyright holder(s).

Academic Accommodations

Text from <https://students.carleton.ca/course-outline/>

Carleton University is committed to providing access to the educational experience in order to promote academic accessibility for all individuals.

Academic accommodation refers to educational practices, systems and support mechanisms designed to accommodate diversity and difference. The purpose of accommodation is to enable students to perform the essential requirements of their academic programs. At no time does academic accommodation undermine or compromise the learning objectives that are established by the academic authorities of the University.

Pregnancy Obligation:

Please contact your instructor with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details, visit the Equity Services website

<https://carleton.ca/equity/wp-content/uploads/Student-Guide-to-Academic-Accommodation.pdf>

Religious Obligation:

Please contact your instructor with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details, visit the Equity Services website

<https://carleton.ca/equity/wp-content/uploads/Student-Guide-to-Academic-Accommodation.pdf>

Academic Accommodations for Students with Disabilities:

If you have a documented disability requiring academic accommodations in this course, please contact the Paul Menton Centre for Students with Disabilities (PMC) at 613-520-6608 or pmc@carleton.ca for a formal evaluation or contact your PMC coordinator to send your instructor your Letter of Accommodation at the beginning of the term. You must also contact the PMC no later than two weeks before the first in-class scheduled test or exam requiring accommodation (if applicable). After requesting accommodation from PMC, meet with your instructor as soon as possible to ensure accommodation

arrangements are made. For more details, visit the Paul Menton Centre website
<https://carleton.ca/pmc>

The deadlines for contacting the Paul Menton Centre regarding accommodation for final exams for the Fall exam period is **November 13, 2020** and for the Winter exam period is March 12, 2021.

Survivors of Sexual Violence:

As a community, Carleton University is committed to maintaining a positive learning, working and living environment where sexual violence will not be tolerated, and where survivors are supported through academic accommodations as per Carleton's Sexual Violence Policy. For more information about the services available at the university and to obtain information about sexual violence and/or support, visit:

<https://carleton.ca/sexual-violence-support>

Accommodation for Student Activities:

Carleton University recognizes the substantial benefits, both to the individual student and for the university, that result from a student participating in activities beyond the classroom experience. Reasonable accommodation must be provided to students who compete or perform at the national or international level. Please contact your instructor with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details, see the policy at

<https://carleton.ca/senate/wp-content/uploads/Accommodation-for-Student-Activities-1.pdf>

Assistance for Students:

Career Services: <https://carleton.ca/career/>

Academic Advising: <https://carleton.ca/academicadvising/>

Co-operative Education: <https://carleton.ca/co-op/>

Centre for Student Academic Support: <https://carleton.ca/csas/>

Writing Services: <https://www.carleton.ca/csas/writing-services/>

Peer Assisted Study Sessions (PASS): <https://carleton.ca/csas/group-support/pass/>

Math Tutorial Centre: <https://carleton.ca/math/math-tutorial-centre/>

Science Student Success Centre: <https://sssc.carleton.ca/>

Freedom of Information and Protection of Privacy:

Carleton University is committed to protecting the privacy of those who study or work here (currently and formerly). To that end, Carleton's Privacy Office seeks to encourage the implementation of the privacy provisions of Ontario's *Freedom of Information and Protection of Privacy Act* (FIPPA) within the university.

In accordance with FIPPA, please ensure all email communication with staff/faculty is via your Carleton email account. To get your Carleton email you will need to activate your MyCarletonOne account through Carleton Central. Once you have activated your MyCarletonOne account, log into the MyCarleton Portal.

Important Dates:

<https://calendar.carleton.ca/academicyear/>

<https://carleton.ca/registrar/registration/dates-and-deadlines/>

Information for COVID-19 measures:

All members of the Carleton community are required to follow COVID-19 prevention measures and all mandatory public health requirements (e.g. wearing a mask, physical distancing, hand hygiene, respiratory and cough etiquette) and [mandatory self-screening](#) prior to coming to campus daily.

If you feel ill or exhibit COVID-19 symptoms while on campus or in class, please leave campus immediately, self-isolate, and complete the mandatory [symptom reporting tool](#). For purposes of contact tracing, attendance will be taken in all classes and labs. Participants can check in using posted QR codes through the cuScreen platform where provided. Students who do not have a smartphone will be required to complete a paper process as indicated on the [COVID-19 website](#).

All members of the Carleton community are required to follow guidelines regarding safe movement and seating on campus (e.g. directional arrows, designated entrances and exits, designated seats that maintain physical distancing). In order to avoid congestion, allow all previous occupants to fully vacate a classroom before entering. No food or drinks are permitted in any classrooms or labs.

For the most recent information about Carleton's COVID-19 response and required measures, please see the [University's COVID-19 webpage](#) and review the [Frequently](#)

[Asked Questions \(FAQs\)](#). Should you have additional questions after reviewing, please contact covidinfo@carleton.ca

Please note that failure to comply with University policies and mandatory public health requirements, and endangering the safety of others are considered misconduct under the [Student Rights and Responsibilities Policy](#). Failure to comply with Carleton's COVID-19 procedures may lead to supplementary action involving Campus Safety and/or Student Affairs.