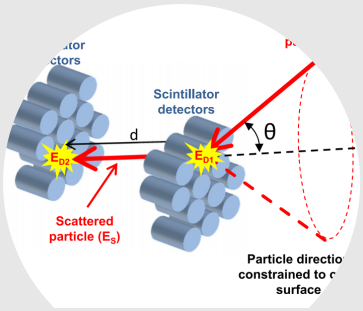

NPRE Laboratory

NPRE 452

Instructor Info

Prof. Angela Di Fulvio
by appointment
Talbot 116
difulvio@illinois.edu

Course Info

Prereq: NPRE 451
Mon & (4 CU) Wed
11:00AM - 11:50AM
3018 CIF

Lab Info

Tue
05:00PM - 08:50PM
101B Talbot/Computer lab

TA Info

Ming Fang
TBD
Talbot 225

Overview

Last edited on 2023/08/17. This laboratory course focuses on current radiation detection methods that exploit modern physics concepts and are applied in radiological science research.
Time: one 1-h lecture sessions and one 4-h laboratory session per week (2CU), one additional 1-h lecture session per week (4 CU).
Credit Hours: 2 (optionally 4).
The course is offered at an undergraduate level at 2 credit-hour (CU) and at a graduate level at 4 CU. Additional requirements for 4 CU: additional simulation-based project on radiation sources, detection or shielding performed and submitted by each student. Visits to external labs will be scheduled in advance and may not occur during class or lab time.

The final oral exam will consist in a presentation of the final lab work and will be held during the last lab session.

Reading Material

Adrian C. Melissinos and Jim Napolitano, Experiments in Modern Physics, 2nd Edition, Academic Press (2003)
B. Kramer, The Art of Measurement (2007)
G. Trigg, Landmark Experiments in Twentieth Century Physics (2011)
R. J. Barlow, Statistics: A Guide to the Use of Statistical Methods in the Physical Sciences (1989)
P. Horowitz, Winfield Hill, The Art of Electronics (2016)
D. Dowsett, P. Kenny, R. E. Johnston, The Physics of Diagnostic Imaging, (2006)
U.S. NRC, Passive Nondestructive Assay of Nuclear Materials (2010)
(4 CU only) MCNP6.2 manual or GEANT4 documentation
Any required journal articles and additional book chapters will be provided on Canvas.

Grading Scheme

60	Lab Reports–these are a required work products and the course cannot be passed without submission of *all* the reports. (2 CU) Each experimental lab report is graded at 70/number of labs (4 CU) Each experimental lab report is graded at 50/number of experimental labs + 20 simulated project
10	Midterm Take-home Exam
20	Final (10) presentation and (10) report of one selected experiment
5	Laboratory notebook
5	Attendance

Grades will follow the standard scale: A+ = 97.5-100; A = 93.5-97.4; A- = 89.5-93.4; B+ = 86.5-89.4; B = 82.5-86.4; B- = 79.5-82.4; C+ = 76.5-79.4; C = 72.5-76.4; C- = 69.5-72.4; D+ = 66.5-69.4; D = 64.5-66.4; E/F <65. Curving is at the discretion of the instructor.

Notes

Make sure you enable notifications on Canvas

Learning Objectives

- Gain experience with experimental techniques employed in contemporary research and industrial laboratories.
- Develop the ingenuity and critical judgment, which are necessary to achieve results in day-to-day experimental research.
- Learn advanced data processing techniques applied to radiation detection.
- Improve scientific writing skills.
- Learn how to use GEANT4 and/or MCNP (depending on license availability) at a basic level.

FAQs

Do we use radioactive sources in this course?

Yes, we do. We will use mostly low-activity check sources, therefore radiation dosimeters are not required. However, please take the general Laboratory Safety Training and the Radiation Safety Training courses at this link: `https://www.drs.illinois.edu/` after enrolling, and before 8/25/22.

Why do we measure radiation?

A precise measurement of radiation is important for many applications. A few examples are the radiation protection of operators working in nuclear power plants, or the characterization of nuclear reactions for physics or astronomy studies.

What is the difference between NPRE451 and NPRE452?

NPRE 452 includes advanced experimental setup that encompass two or more detectors and require substantial data post-processing.

Are lab reports prepared in groups?

No, even if students will share the same acquired data, their analysis and report are performed by individual students.

Can I submit a lab report if I was not present in the lab to acquire the data?

No.

Laboratory Sessions and Reports

Students will perform labs listed in the "Lab schedule" in agreement with the instructor. Each lab may require multiple sessions to be completed, depending on the complexity of the lab and the needed measurement time. Students will not receive thorough written lab documentation but will instead need to understand the physics underlying the experiment, the electronics needed to perform it, assemble the system, process and analyze the acquired data, and comment on the obtained results, as compared to expected outcomes. Graduate students (4 CU option) will be trained in the use of one computer code for radiation transport. Understanding and familiarity with the code will be evaluated through the completion of a final simulated project.

After completing each laboratory session, students are expected to write a report of each experiment. Although you are encouraged to discuss the report with fellow students, all lab reports need to be written individually. The deadline for submitting the lab report depends on the type of lab, submission dates are specified on Canvas. In a case of extenuating circumstances that will prevent you from submitting the report on time, please contact the instructor as soon as you are aware of them. Ten points will be subtracted per day (the highest possible score is 100 points), for all late reports. Plagiarism prevention software will be used to compare submitted reports against a database of academic papers to identify areas of overlap between the submitted assignment and existing papers. Advanced report writing guidelines are available on Canvas.

Laboratory Notebook

A laboratory notebook needs to be maintained by the student. An electronic or paper version of the notebook will be graded by the instructor.

Diversity and Inclusivity Statement

All members of this class are expected to contribute to a respectful, welcoming and inclusive environment for every other member of the class.

Accommodations for Students with Disabilities

Students with learning needs that require special accommodation are encouraged to contact the instructor and the Disability Resources and Educational Services (DRES) at +1 (217)333-4603 or disability@illinois.edu, as soon as possible, to make an appointment to discuss your learning needs and to obtain an accommodation letter, if needed. Please note that accommodations are not retroactive to the beginning of the semester, but begin the day you contact your professor with a current letter of accommodation from DRES.

Academic Integrity

The Code of Policies and Regulations Applying to All Students will be applied in all instances of academic misconduct committed by students. This applies to all exams, presentations, assignments and materials distributed in this course. Students are expected to present and submit original written reports, which truthfully represent the time and effort devoted into the work. Plagiarism is an ethical violation in which students copy text, HW solutions, and/or tables/graphs from other sources. Students caught plagiarizing will be subject to an academic integrity violation that can result in reduced or failing grade for a lab or the class, and expulsion from UIUC.

Class Schedule

08/21 *M*	Introduction
08/28 *M*	Positron-Electron Annihilation and Positron Annihilation Lifetime Spectroscopy
09/04 *M*	Positron-Electron Annihilation and Positron Annihilation Lifetime Spectroscopy
09/11 *M*	Time-of-flight spectroscopy and organic scintillation detector characterization through neutron scattering based experiments (DTL)
09/18 *M*	Time-of-flight spectroscopy and organic scintillation detector characterization through neutron scattering based experiments (DTL)
09/25 *M*	Neutron Spectroscopy Through Foil Activation (DTL)
10/02 *M*	Neutron Spectroscopy Through Foil Activation (DTL)
10/09 *M*	Neutron Multiplicity Counting
10/16 *M*	Neutron Multiplicity Counting
10/23 *M*	Standoff Gamma-ray Imaging
10/30 *M*	Standoff Gamma-ray Imaging
11/06 *M*	Standoff Neutron Imaging
11/13 *M*	Special Lecture on Final Projects and Visits
11/20 *M*	Fall Break
11/28 *M*	Special Lecture on Final Projects and Visits
12/04 *M*	Special Lecture on Final Projects and Visits

Lab Schedule

Lecture	08/24	*W*	Python for radiation detection
Lab #1	08/31	*W*	Positron-Electron Annihilation and Positron Annihilation Lifetime Spectroscopy
Lab #1	09/07	*W*	Positron-Electron Annihilation and Positron Annihilation Lifetime Spectroscopy
Lab #2	09/14	*W*	Time-of-flight spectroscopy and organic scintillation detector characterization through neutron scattering based experiments (DTL)
Lab #2	09/20	*W*	Time-of-flight spectroscopy and organic scintillation detector characterization through neutron scattering based experiments (DTL)
Lab #2	09/27	*W*	Neutron Spectroscopy Through Foil Activation (DTL)
Lab #3	10/04	*T*	Neutron Spectroscopy Through Foil Activation (DTL)
Lab #3	10/11	*T*	Neutron Multiplicity Counting
Lab #3	10/18	*T*	Neutron Multiplicity Counting
Lab #4	10/25	*T*	Group Project
Special Lab	11/01	*T*	Visit to OSF - rad therapy
Lab #4	11/08	*T*	Group Project
Lab #4	11/15	*T*	Group Project
Lab #4	11/22	*T*	Break
Special Lab	11/29	*T*	Visit to Argonne National Lab
	12/06	*T*	Group Project

OpenLab presentation agenda

Wednesday, Dec. 14, 9:00 – 11:00 a.m. in Talbot 101A
Each group will have 30 minutes to present and we will have 30 minutes of Q&A. Q&A will pertain concepts learned during the semester, application-related questions learned at ANL, solving simple quantitative problems on past labs.

Structure of the presentation is: Background, motivation and introduction, methods, results, discussion and conclusions.

COVID-19 Announcement

Following University policy, all students are required to engage in appropriate behavior to protect the health and safety of the community to minimize the spread of COVID-19