

**SPECIAL TOPICS IN EXPERIMENTAL PHYSICS:
X-ray Lasers - Principles and Applications
COURSE 26:755:710
Spring 2021**

Instructor: Dr. Claudiu Stan; claudiu.stan@rutgers.edu; 369 Smith Hall
Office Hours: Wednesday 2:30-3:30pm. *Held over Zoom. See Canvas for the link.*

Class Time & Location:

Lecture: Wednesday 6:00pm-8:50pm,
Classes will start with an online format. *Done using Conferences in Canvas.*

Final Project:

The class has a final project. It must be uploaded on Canvas before the end of the exam period, Wednesday May 5th, 2021.

Materials:

Readings from the scientific literature will be assigned during the class, primarily from journals, which can be accessed online using Rutgers libraries.

Other Required Materials:

- 1) Laptop or tablet for attending online classes, accessing Canvas materials and doing quizzes in class
- 2) Personal device(s) (smartphone, etc.) for generating and uploading short write-ups of your findings after class assignments; the write-ups can be scanned or photographed. Please note that the files must be in one of these formats: pdf, doc, jpg, tif, bmp.

Course Description: This class will introduce students to the world of X-Ray Free-Electron Lasers – the most advanced type of X-ray source available today. X-ray lasers generate extremely intense pulses with pulse durations down to the attosecond regime, allowing the investigation of the dynamics of matter at atomic timescales and length scales. They are finding more and more fundamental applications in physics, chemistry, biology, and material science.

The class will cover the design, properties, and instrumentation of X-ray lasers, and will survey a range of applications in different areas of science. The class will include assignments that develop skills to design experiments at X-ray lasers.

Learning Goals:

- Learn how X-rays are generated and how they interact with matter.
- Learn the principles, properties, and instrumentation of X-ray free-electron lasers.
- Learn about the most important and successful applications of X-ray lasers.
- Develop skills for designing experiments at X-ray laser facilities, and for writing beamline proposals for such experiments.

Topics:

- X-rays: properties, types of sources, classes of applications
- Interaction of X-rays with matter
- X-ray free-electron lasers: principles, history, facilities
- Instrumentation for XFELs
- Applications of XFELs

Course Structure:

Lectures: Part of the lectures will include graded in-class assignments, which will involve calculating or designing experimental parameters. These assignments will be collaborative and guided by the instructor, but the students must submit individually a short file documenting the results and upload it in Canvas. The grading for in-class assignments will be based on this file. Part of the classes will have assigned readings.

Out-of-class assignments: The final assignment will be either a review paper or a proposal for an experiment to be conducted at an X-ray laser. Besides submitting the project, a short presentation will be given in the last class. The midterm assignment is to make a detailed, bullet-style outline for the final project.

Synchronous learning: The class is held online and synchronously. This is because the learning benefit of in-class assignments, which are interactive, will be lost if the lectures are attended asynchronously. *Special arrangements may be possible, but not guaranteed; discuss this with the instructor.*

Grading Scheme:

In-class assignments:	25%
Midterm assignment	15%
Project presentation	10%
Final project	50%

Attendance & Other Course Policies: You are expected to attend all classes. Only absences due to significant special circumstances **with documentation** are excused, such as death in the family or illness with doctors note. Unfortunately, we are unable to accommodate lateness or absences due to traffic.

Because issues do arise, students are permitted two lecture absences.

For religious holidays, please report your absence using the Self-Reporting Absence Application: <https://sims.rutgers.edu/ssra/>. Your absence will be excused and your daily grade (*in-class quiz* or *homework*) will be dropped.

If you are absent from a day of class, you should keep up with the course content by watching the class recording in Canvas, and by doing the assignments given in class.

Student attendance is recorded automatically by Canvas. **Students with more than four absences will automatically receive a failing grade.** If you think attendance may be a problem for you due to outside obligations, please meet with the instructor at the beginning of the semester or prior to your absences to discuss possible accommodations or solutions.

Grade disputes must be brought to the instructor *within 2 weeks of receiving the grade*. For example, a grade complaint about the midterm assignment will not be considered at the end of the semester.

Rutgers Academic Integrity Policy: As an academic community dedicated to the creation, dissemination, and application of knowledge, Rutgers University is committed to fostering an intellectual and ethical environment based on the principles of academic integrity. Academic integrity is essential to the success of the University's educational and research missions, and violations of academic integrity constitute serious offenses against the entire academic community. The entire Academic Integrity Policy can be found here: <http://academicintegrity.rutgers.edu/academic-integrity-policy/>

Religious Holiday Policy and Accommodations: Students are advised to provide timely notification to instructors about necessary absences for religious observances and are responsible for making up the work or exams according to an agreed-upon schedule. The Division of Student Affairs is available to verify absences for religious observance, as needed: (973) 353-5063 or DeanofStudents@newark.rutgers.edu.

Accommodation and Support Statement

Rutgers University Newark (RU-N) is committed to the creation of an inclusive and safe learning environment for all students and the University as a whole. RU-N has identified the following resources to further the mission of access and support:

For Individuals with Disabilities: The Office of Disability Services (ODS) is responsible for the determination of appropriate accommodations for students who encounter barriers due to disability. Once a student has completed the ODS process (registration, initial appointment, and submitted documentation) and reasonable accommodations are determined to be necessary and appropriate, a Letter of Accommodation (LOA) will be provided. The LOA must be given to each course instructor

by the student and followed up with a discussion. This should be done as early in the semester as possible as accommodations are not retroactive. More information can be found at ods.rutgers.edu. Contact ODS at (973)353-5375 or via email at ods@newark.rutgers.edu.

For Individuals who are Pregnant: The Office of Title IX and ADA Compliance is available to assist with any concerns or potential accommodations related to pregnancy. Students may contact the Office of Title IX and ADA Compliance at (973) 353-1906 or email TitleIX@newark.rutgers.edu.

For Absence Verification: The Office of the Dean of Students can provide assistance for absences related to religious observance, emergency or unavoidable conflict (e.g., illness, personal or family emergency, etc.). Students should refer to [University Policy 10.2.7](#) for information about expectations and responsibilities. The Office of the Dean of Students can be contacted by calling (973) 353-5063 or emailing deanofstudents@newark.rutgers.edu.

For Individuals with temporary conditions/injuries: The Office of the Dean of Students can assist students who are experiencing a temporary condition or injury (e.g., broken or sprained limbs, concussions, or recovery from surgery). Students experiencing a temporary condition or injury should submit a request using the following link: <https://temporaryconditions.rutgers.edu>.

For English as a Second Language (ESL): The Program in American Language Studies (PALS) can support students experiencing difficulty in courses due to English as a Second Language (ESL) and can be reached by emailing PALS@newark.rutgers.edu to discuss potential supports.

For Gender or Sex-Based Discrimination or Harassment: The Office of Title IX and ADA Compliance can assist students who are experiencing any form of gender or sex-based discrimination or harassment, including sexual assault, sexual harassment, relationship violence, or stalking. Students can report an incident to the Office of Title IX and ADA Compliance by calling (973) 353-1906 or emailing TitleIX@newark.rutgers.edu. Incidents may also be reported by using this link: tinyurl.com/RUNReportingForm. For more information, students should refer to the University's Student Policy Prohibiting Sexual Harassment, Sexual Violence, Relationship Violence, Stalking and Related Misconduct located at <http://compliance.rutgers.edu/title-ix/about-title-ix/title-ix-policies/>.

For support related to interpersonal violence: The Office for Violence Prevention and Victim Assistance can provide any student with confidential support. The office is a **confidential resource** and does *not* have an obligation to report information to the University's Title IX Coordinator. Students can contact the office by calling (973) 353-1918 or emailing run.vpva@rutgers.edu. There is a confidential text-based line available to students; students can text (973) 339-0734 for support.

For Crisis and Concerns: The Campus Awareness Response and Education (CARE) Team works with students in crisis to develop a support plan to address personal situations that might impact their academic performance. Students, faculty and staff may contact the CARE Team by using the following link: tinyurl.com/RUNCARE or emailing careteam@rutgers.edu.

For Stress, Worry, or Concerns about Well-being: The Counseling Center has confidential therapists available to support students. Students should reach out to the Counseling Center to schedule an appointment: counseling@newark.rutgers.edu or (973) 353-5805. If you are not quite ready to make an appointment with a therapist but are interested in self-help, check out *TAO at Rutgers-Newark* for an easy, web-based approach to self-care and support: <https://tinyurl.com/RUN-TAO>.

For emergencies, call 911 or contact Rutgers University Police Department (RUPD) by calling (973) 353-5111.