

Physics 518, Applications of Synchrotron Radiation  
Instructor of record: Peter W. Stephens, [pstephens@stonybrook.edu](mailto:pstephens@stonybrook.edu)  
Class meeting time: Wednesday, 3:00 – 5:40 PM

The purpose of the course is to familiarize all interested students with the x-ray and electron based experimental techniques available at Brookhaven National Lab and other similar facilities. You will be cognizant of the applications of these cutting edge facilities, and well positioned to use them in your own research.

NSLS-II is the newest and most advanced synchrotron lightsource in the world; it will enable world-leading programs in imaging and dynamics with unprecedented resolution, providing impact in condensed matter physics, materials science and engineering, chemistry, and life sciences. The Center for Functional Nanomaterials is one of five Nanoscale Science Research Centers created by the Department of Energy to investigate, understand, and exploit the unique characteristics of materials and phenomena at the nanometer scale.

This course is suitable for graduate students, postdocs, and advanced undergrads in physical sciences and engineering, as well as students in the life sciences who have a relatively strong background in physics.

Each class will be given by a scientist from Brookhaven National Laboratory on the topic of his/her expertise. Lectures will focus on advanced concepts in synchrotron x-ray and electron-based methodologies for studies of novel materials at the nanometer to atomic scales. Emphasis is on applying fundamental knowledge of these advanced techniques to real-world materials studies in a variety of scientific disciplines.

Each lecture typically focuses on a given subject or technique. Lectures are pretty much independent from one another, although they are being coordinated to insure consistency. Of necessity, we will have broad but not-so-deep discussions on most topics. Instructors will distribute their notes to the class.

Grades will be based on weekly problem sets, one midterm exam, and a final exam.

Lecture topics:

1. Introduction, X-ray interaction with matter
2. X-ray diffraction and crystallography
3. Synchrotron radiation
4. X-ray powder diffraction
5. X-ray spectroscopy
6. Small-angle and wide-angle x-ray scattering
7. X-ray emission spectroscopy and resonant inelastic x-ray scattering
8. X-ray photoelectron spectroscopy
9. Transmission electron microscopy and electron energy loss spectroscopy
10. X-ray imaging
11. X-ray microscopy
12. Field trip – visit to NSLS-II and CFN at Brookhaven Lab