

Course Syllabus

Course Information

<i>Course Number</i>	PHYS 399 (3 credit)
<i>Course Title</i>	Introduction to Accelerator Physics
<i>Term</i>	Fall 2025
<i>Days & Times</i>	Mon, Wed 1:30-2:45pm
<i>Location</i>	KUY 302

Professor Contact Information

<i>Professors</i>	Siqi Li, Niels Bidault
<i>Email Address</i>	siqili@hawaii.edu , nbidault@hawaii.edu
<i>Office Location & Hours</i>	by email

Course Prerequisites, Co-requisites, and/or Other Restrictions

- 272 and 274, or consent

Suggested Textbooks

- *Particle Accelerator Physics*, Helmut Wiedemann, Springer
- *An Introduction to the Physics of High Energy Accelerators*, D. A. Edwards, M. J. Syphers, Wiley-VCH.

Course Description

This course provides an introduction to the fundamentals of accelerator and beam physics, and is suitable for senior undergraduate students or students from other fields with an interest in accelerator physics. The lectures will begin with a review of the relevant aspects of special relativity and electromagnetic theory as applied to beam properties and acceleration techniques. Throughout the semester, we will cover topics including beam production and acceleration principles, beam dynamics, collective effects, radiation beam, and applications such as free-electron lasers. The lectures will be accompanied by laboratory exercises on relevant and self-contained experimental projects that can be conducted at the UH linac. We will organize a tour to the UH linac.

Class format

This is a combination of lecture and laboratory course. There will be 4 homework assignments and 4 laboratory assignments.

Learning Objectives/Outcomes

This course will focus on the fundamental principles of particle accelerators and beams. Lectures will impart an understanding of fundamental concepts. Laboratory exercises will develop and expand on key concepts. Upon completing this course, students should understand the basic principles of particle accelerators, and how to interpret the measured characteristics of the beams they produce.

Grading

- Each homework assignment and lab: 10%
- Final presentation: 20%.

(Rough) Course Schedule

Aug 25 - Course introduction
Aug 27 - Overview
Sept 1 Holiday
Sept 3 - Overview
Sept 8 - Math and E&M Refresher
Sept 10 -Special Relativity Refresher (HW1)
Sept 15 -
Sept 17 - Particle Emission
Sept 22 -
Sept 24 - Transverse motion (HW2)
Sept 29 -
Oct 1 - Off momentum particles
Oct 6 - Longitudinal motion (HW3)
Oct 8 -
Oct 13 -
Oct 15 Resonances
Oct 20 - Collective effects
Oct 22 - Lab tour. LAB1: ELEGANT beamline simulations (or MADx)
Oct 27 -
Oct 29 - LAB2: quad and dipoles
Nov 3 -
Nov 5 - Beam Diagnostics
Nov 10 - LAB3: beam diagnostics
Nov 12 -
Nov 17 - Synchrotron radiation (HW4)
Nov 19 - guest lecture: survey of accelerators around the world
Nov 24 - FELs
Nov 26 -
Dec 1 - LAB4: FEL 1D simulations
Dec 3 - Tricks of the trade
Dec 8
Dec 10 - Finals review