

Physics 417/517

Title: Introduction to Particle Accelerator Physics

First Offered: Fall 2009

Meeting Times: 11:00-12:15 Tuesdays and Thursdays

Meeting Place: Ocean/Phys 303

Recommended Text: Klaus Wille; Physics of Particle Accelerators, Oxford University Press

Office Hours: 3:00-4:00 Thursday, Ocean/Phys 213

Introduction to the historical development and applications of particle accelerators to the fields of nuclear physics, particle physics, material sciences, and medical therapy; and an introduction to the design and physics of particle accelerators. Aspects of linear accelerators, circular accelerators such as cyclotrons, betatrons, synchrotrons, and storage rings; and recirculated linacs are covered. Topics include linear and non-linear single particle motion in accelerators and the electromagnetic radiation emitted by relativistic particles in accelerators. Up to date descriptions of the most modern particle accelerators will be included, as well as applications such as fixed target nuclear physics arrangements, colliding beam accelerators for high energy physics research, advanced storage ring sources of X-rays, advanced neutron sources, radiation and radioactive material sources, and cancer therapy devices.

Course Topics:

- Historical Development of Accelerators
 - Elementary linear accelerators
 - Cyclotron
 - Betatron
 - Microtron
 - Synchrotrons
 - Modern storage rings

- Accelerator Design and Physics
 - Relativistic particle dynamics in electromagnetic fields
 - Magnets in particle accelerators
 - Linear single particle beam dynamics
 - Non-linear single particle beam dynamics
 - Radiation by relativistic electrons

- Applications of Particle Accelerators
 - Nuclear Physics
 - Particle Physics
 - X-rays for Material Science Research
 - Neutrons for Material Science Research
 - Electron Linacs for Cancer Radiation Therapy
 - Advanced Cancer Therapy by Proton Accelerators

Prerequisites: PHYS 319 and 320 and an understanding of Linear Algebra at the level of MATH 316

References: Particle Accelerator Physics, Vol. I (Wiedemann, Springer) Introduction to Particle Accelerators (Edwards and Syphers, Wiley)

Grading: Homework Problems 40%; Mid-term 25%; Final 35%