A New Course for Fall 1999 Quarter (Physics 409)

Synchrotron Radiation and Free Electron Lasers

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Synchrotron radiation is the electromagnetic radiation emitted by high-energy electrons travelling in curved trajectories. Its high intensity, coherence, wide spectral coverage, and other properties (polarization, time structure,..) make synchrotron radiation a powerful tool for basic and applied studies of physical and biological systems. A number of major research institutions using synchrotron radiation have been built in the U.S. and abroad. In the future, the intensity and coherence will be further enhanced by developing free-electron lasers (FELs). This course will provide an introduction to the basic principles of these radiation devices. The course is aimed for senior undergraduate as well as graduate students.

Prerequisites: undergraduate E&M.

Course Contents:

- **Particle and Radiation Beam**
  Particle beam and radiation beam, phase space description, diffraction and wave optics, coherence and brightness

- **Synchrotron Radiation**
  Radiation phenomena and retardation effect, bending magnet radiation, electron storage ring, radiation damping and fluctuation, undulator radiation, spectral and angular distribution, polarization, laser-Thomson scattering, the third-generation light sources

- **Free Electron Lasers (FELs)**
  Interaction of radiation and particle beam, pendulum equation, Maxwell-Vlasov equation, principle of FEL oscillators, high-gain FEL and self-amplified spontaneous emission, electron beam requirements, rf photocathode gun and linear accelerator, particle beam manipulation through FEL interaction