Physics 729 Selected Topics in Physics (Accelerator Physics) Spring 2015
Instructor: Dr. Don Summers 915-7032 summers@phy.olemiss.edu
Lewis 228 MTh 3:45-5:00 Office Hours: Lewis 221 WThF 2-3
Text: "An Introduction to the Physics of High Energy Accelerators"
by D. Edwards and M. Syphers (available used at www.amazon.com)
Papers: Lepton and Hadron Colliders in Large Circular Tunnels
G. T. Lyons, http://arXiv.org/pdf/1112.1105.pdf
D. Summers et al., http://arXiv.org/pdf/1207.7354.pdf

Topics
Lorentz Force Law, F = q(E + v x B): Acceleration and dipole magnet rings.
Niobium-Titanium(8T) is cheaper than Niobium3 Tin(14T) or YBCO/BSCCO (32T)
Synchrotron Radiation of electrons and protons
Jackson: "Classical Electrodynamics," delta(E)/rev = 0.0000885 E^4 / R
Units: GeV and meters. E x 938 / 0.511 for protons
Synchrotron damping time and antiproton cooling
# Higgs Bosons = Luminosity x Time x Cross Section
Luminosity = f * N^2 / (4pi sigma^2)
f = collision frequency, N = particles/bunch, sigma = beam size
emittance and the beta twiss function --> beam size and angular spread
Beam cooling lowers emittance
Luminosity as a function of beam-beam tune shift and beta*
Focusing with quadrupoles and a FODO lattice. Matrix transport.
Quadrupole triplet focusing, detector length, and beta*
Synchrotron oscillation frequency and longitudinal stability
Circular e+e- --> Z0 Higgs Factory. Producing Higgs boson pairs.
Power pulsed W/Z --> jet jet calorimeter and bunch trains
SuperKEKB asymmetric charm factory
120 TeV proton antiproton collider in a 233km circumference tunnel
p-p versus p-pbar production cross sections of high mass particles
Increasing antiproton production (larger admittance stochastic cooling rings...)
Recycling antiprotions now that synchrotron damping is in play
60 TeV mu+ mu- lepton collider
Muon ionization cooling, quadrupole triplets, and potato slicers
Crab waist crossing and exploitation of small beta*
Crab waist crossing at e+e-, p-pbar, and muon colliders
Telnov condition of crab waist crossing http://arXiv.org/pdf/1203.6563.pdf
Transverse beam pipe instability and T=77K copper

Grading Problems 50%
Scheme Term Paper 50%

Reasonable accommodations for excused absences and for students with
disabilities will be provided.

Learning Objectives: To learn how hadron and lepton colliders work.
To publish new results worked out during the class.