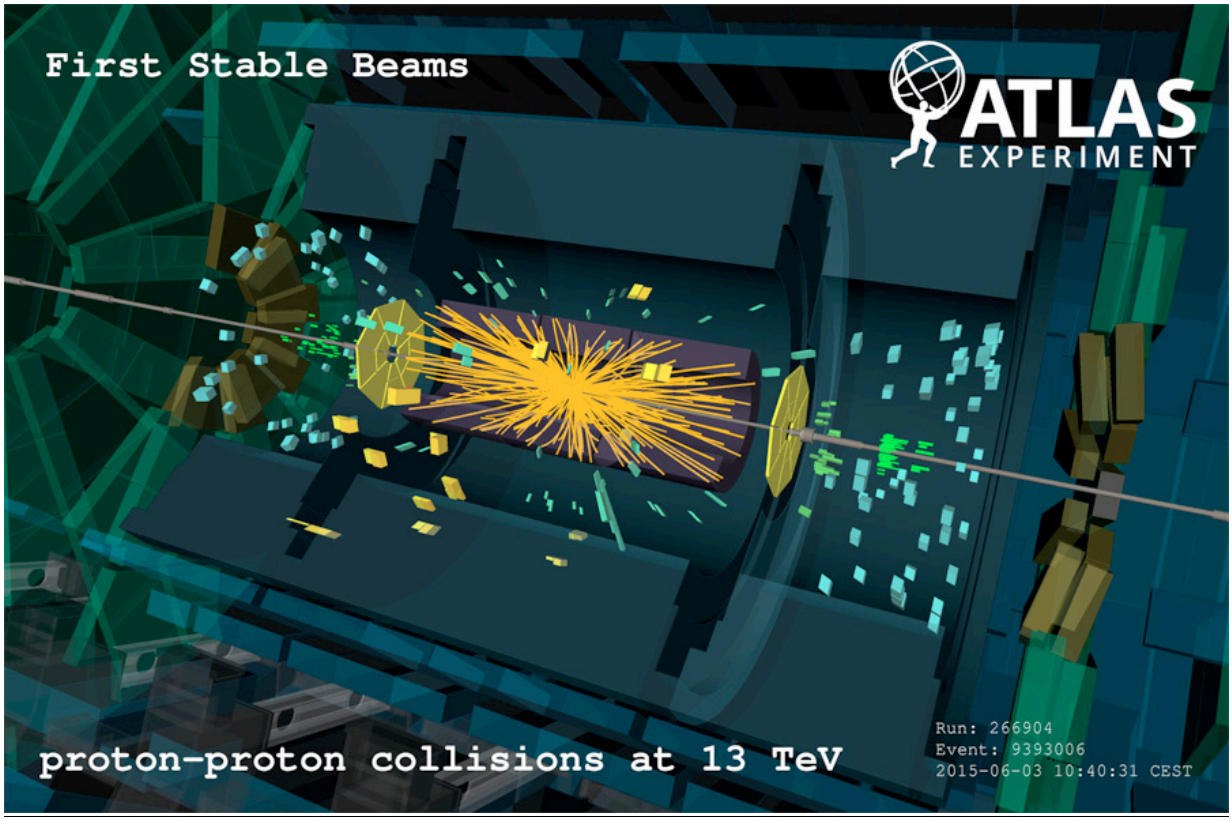
PHYS 5380 – Syllabus
Fall 2016

Course Objective:

Upon completion of this course the students will be able to describe the structure of matter, ranging from atoms and nuclei to quarks and leptons, and the type and strength of forces governing basic interactions among the elementary components of matter. The course will cover particle acceleration and detection techniques and their applications to technologies used in every-day life. There is no single textbook covering this material and the list of books available in the library is appended to this syllabus. Some homework exercises will be taken from Richard Fernow's "Introduction to experimental particle physics". Web based reviews and publications can be used as additional resource. Major components of the final grade will be based on the evaluation of a 30 minutes-long public oral presentation with power-point slides on one of the selected topics. The presentation should cover all elements of the course: explanation of the physical phenomena, observation and detection techniques, how the observations affect our understanding of the universe and the direction of future studies on this subject.



Grading

Homework 40%, Presentation – 40%, class participation – 20%

Grading of seminar presentations will be done in collaboration with the audience.
Sample grading sheet:
Seminar subject:
Speaker:
Rate the following aspects in the range of 1 to 10 with 10 being best:

1) Introduction of the topic. Is the subject important to physics?
2) Organization and logic of the talk:
3) Transparencies: was the presentation clear? what was missing?
4) Questions: was the speaker able to answer questions?

What element of this presentation would you lie to see expanded further

Syllabus

Aug 22 (Mon)	Introduction, historical perspective, discovery of the electron, nucleus and neutron
Aug 24(Wed)	"
Aug 26(Fri)	Quantum mechanics and relativity, particle –wave duality
Aug 29(Mon)	"
Aug 31(Wed)	"
Sep 2(Fri)	Forces and interactions
*Sep 5(Mon)	**LABOR DAY – no class**
Sep 7(Wed)	Particle ZOO: Leptons(electrons, muons, neutrinos) quarks (pions, kaons, resonances) bosons - carrier of the force
Sep 9(Fri)	**"**
Sep 12(Mon)	"
Sep 14(Wed)	Symmetries, conservation laws and quantum numbers: E-p, charge, angular momentum, parity, isospin, G-parity, lepton number, baryon number, flavor, charge conjugation
Sep 16(Fri)	"
Sep 19(Mon)	"
Sep 21(Wed)	Static quark model, relativistic kinematics, lab-vs-cm
Sep 23(Fri)	Dynamics, DIS, parton model
Sep 26(Mon)	
Sep 28(Wed)	CP violation, CKM matrix
Sep 30(Fri)	Weak interactions, the Standard Model, neutrino mixing
Oct 3(Mon)	
Oct 5(Wed)	Higgs
Oct 7(Fri)	Astrophysics connection (composition of the universe, dark matter, dark energy)
*Oct 10(Mon)	**FALL BREAK – no class**
Oct 12(Wed)	Astrophysics questions

Oct 14(Fri)	Feynman diagrams
Oct 17(Mon)	"
Oct 19(Wed)	Particle detectors: charged particles: ionization (emulsion, cloud and bubble chambers, wire chambers - spark, proportional, drift) Limitations on momentum measurements: Energy loss: Bethe-Bloch, dE/dx, radiation length, bremstrahlung, Coulomb scattering, position in space
Oct 21(Fri)	"
Oct 24(Mon)	Calorimetry
Oct 26(Wed)	Particle detectors: neutrals: decays of pi0, Ks, Lambda, photon conversions, neutron interactions
Oct 28(Fri)	
Oct 31(Mon)	Particle identification: TOF, Cerenkov light, dE/dx, muons
Nov 2(Wed)	Readout electronics, trigger
Nov 4(Fri)	Particle detectors – neutrinos
Nov 7(Mon)	
Nov 9(Wed)	Design of ATLAS detector, particle acceleration techniques: electrostatic, RF; cyclotron, synchrotron, linacs, storage rings
Nov 11(Fri)	Student Presentation
Nov 14(Mon)	Student Presentation
Nov 16(Wed)	Student Presentation
Nov 18(Fri)	Student Presentation
Nov 21(Mon)	Student Presentation
***Nov 23(Wed)**	**Thanksgiving – no class**
***Nov 25(Fri)**	**Thanksgiving – no class**
Nov 28(Mon)	Student Presentation
Nov 30(Wed)	Student Presentation
Dec 2(Fri)	Student Presentation
Dec 5(Mon)	Grand Unification, Supersymmetry, superstrings

Subjects for seminar presentations

Dark matter
Dark energy
Magnetic monopole
Neutrino Oscillations/LBNE
Gravitational waves/LIGO
CP violations
Higgs boson
Supersymmetry
Antimatter

Textbooks

* first choice

Elementary level (general)

*Donald Perkins, Introduction to High Energy Physics
Cindy Schwartz, The subatomic ZOO
R.M. Barnett, H. Muhry and H. Quinn, The Charm of Strange Quarks

Medium Level (theory)

L. Okun, Leptons and Quarks
C. D. Coughlan anbd J. E. Dodd, The ideas of particle physics
*David Griffith, Introduction to Elementary Particles
Martinus Veltman, Facts and Mysteries in Elementary Particle Physics

Advanced (theory)

Abraham Seiden, Particle Physics, a comprehensive introduction
F. Halzen and A. Martin, Quarks and Leptons
K. Gottfried and V. Weiskopf, Concepts of Particle Physics
* Gordon L. Kane: "Modern Elementary Particle Physics: Updated Edition"
Chris Quigg, Gauge Theories of Strong, Weak and Electromagnetic Interactions
Bjorken and Drell, Quantum Field Theory
Kerson Huang, Quarks, Leptons and Gauge Fields
B.R. Martin and G. Shaw, Particle Physics
W.N. Cottingham and D.A. Greenwood, An Introduction to the Standard Model of Particle Physics
Byron P. Roe, Particle Physics at the New Millenium

Experimental techniques

* Richard Fernow, Introduction to experimental particle physics
Bruno Rossi, High Energy Physics
Konrad Kleinknecht, Detectors for Particle Radiation
Claus Grupen and Boris Shwartz: "Particle Detectors"
Claude Leroy and Pier-Giorgio Rancoita: "Principles of Radiation Interaction In Matter And Detection" (3rd Edition)

Disability Accommodations: Students needing academic accommodations for a disability must first register with Disability Accommodations & Success Strategies (DASS). Students can call 214-768-1470 or visit http://www.smu.edu/Provost/ALEC/DASS to begin the process. Once registered,

students should then schedule an appointment with the professor as early in the semester as possible, present a DASS Accommodation Letter, and make appropriate arrangements. Please note that accommodations are not retroactive and require advance notice to implement.

- **Religious Observance**: Religiously observant students wishing to be absent on holidays that require missing class should notify their professors in writing at the beginning of the semester, and should discuss with them, in advance, acceptable ways of making up any work missed because of the absence. (See University Policy No. 1.9.)

- **Excused Absences for University Extracurricular Activities**: Students participating in an officially sanctioned, scheduled University extracurricular activity should be given the opportunity to make up class assignments or other graded assignments missed as a result of their participation. It is the responsibility of the student to make arrangements with the instructor prior to any missed scheduled examination or other missed assignment for making up the work. (University Undergraduate Catalogue)