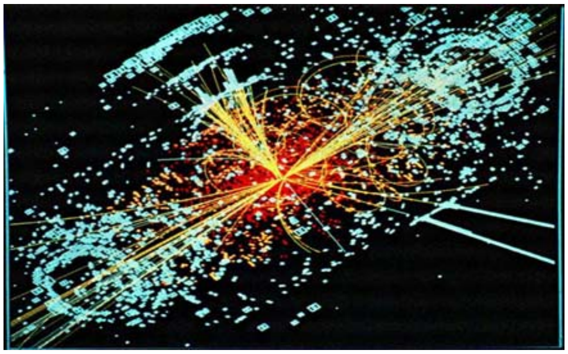
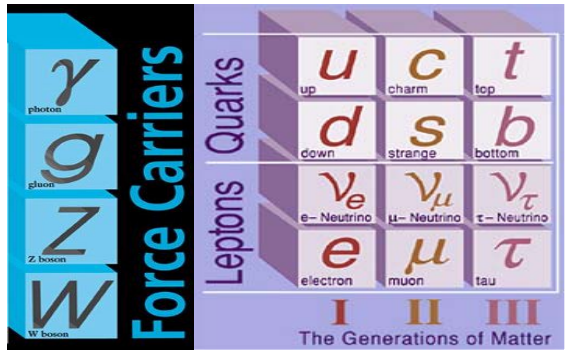
PHYC 542-001: Particle Physics I
Fall 2017





This class is a 3 credit hour graduate course.

Instructor:
Rouzbeh Allahverdi, Physics and Astronomy Room 172, rouzbeh@unm.edu

Time and Location:
M W 11:00-12:15, Physics and Astronomy Room 5

Course Webpage:
http://physics.unm.edu/Courses/Allahverdi/Phys542Fa17/

Requisites:
Solid knowledge of quantum mechanics (including perturbation theory) as well as Lagrangian and Hamiltonian formulations of classical mechanics will be required. Familiarity with quantum field theory will be beneficial but it is not necessary.

Preliminary Outline:
The standard model (SM) of particle physics is a major milestone in our understanding of nature. It describes elementary particles and the three fundamental interactions (excluding gravity) in the framework of spontaneously broken gauge theories. It is a tremendously successful model as its predictions have been tested experimentally with very high accuracy.

The main goal of this course is to familiarize you with the building blocks of and the basic processes within the SM. To this end, perturbative quantum field theory will be introduced at a level that enables you to derive the tree-level Feynman diagrams for basic decay and scattering processes from the SM Lagrangian and calculate respective rates. In addition, special emphasis will be given to gauge invariance and spontaneous symmetry breaking.

Here is an approximate list of topics that I plan to cover:

- QED (Dirac equation, antiparticles, gauge invariance, QED Lagrangian, Feynman rules, basic processes)
- Weak interactions (neutral and charged currents, parity violation and chiral structure of the weak interactions, basic processes)
- Higgs mechanism (Higgs field, spontaneous symmetry breaking, mass generation)
- Electroweak theory (unifying electromagnetic and weak interactions, electroweak Lagrangian, spontaneous breaking of electroweak symmetry, experimental tests)
- CP violation in the weak interactions (quark mixing, CKM matrix, neutrino mass and lepton mixing, PMNS matrix)
- QCD (color, QCD Lagrangian, confinement and asymptotic freedom)

Book(s):

There are many good books that can be used as reference. No single book is required as the mandatory textbook for this course. I plan to use material from the following books in complementary manner:

“Quarks and Leptons: An Introductory Course in Modern particle Physics”
Francis Halzen and Alan Martin, John Wiley & Sons

“Modern Elementary Particle Physics: The Fundamental Particles and Forces?”
Gordon Kane, Addison Wesley

When appropriate, this material will be supplemented by that from other books.

Grading Policy:

The final grade will consist of equal contributions from the following two things:

a) Homework assignments 50% (will be handed out at regular intervals)
b) Final project 50% (a term paper and a short talk on a relevant topic)