Physics 771 – Nuclear and Particle Physics

Instructor:	Dr. Christopher Aubin, Small 315A
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Meeting Times:	M W, 11-12:20, Small 152
Office Hours:	Immediately following class, and by appointment
Required Text:	*Introduction to Elementary Particles*, by D. Griffiths.
Recommended Text:	*Introduction to High Energy Physics*, by D. Perkins.

The goal of this course is to get a general idea of the current state of understanding of nuclear and particle interactions. Topics will center on ideas that can be understood with little or no quantum field theory, although at times we will take results from field theory without proof. We will cover the quark model of hadrons, hadronic structure, electroweak interactions of quarks and leptons (and thus of nuclei), and other topics that are relevant to particle physics (such as CP Violation, neutrino oscillations, to name just a few).

Other useful books:

- Particle Data Booklet (`http://pdg.lbl.gov/`): Order the *Particle Physics Booklet* (for free); it has a lot of relevant information. The *Particle Data Book* (also free) is much more detailed, but not needed. All of the particle data is freely available online.
- Non-field theoretic particle texts (theorists):
  - *Quarks & Leptons: An Introductory Course in Modern Particle Physics*, by Halzen & Martin.
  - *Gauge Theories of the Strong, Weak, and Electromagnetic Interactions*, by Chris Quigg.
- Non-field theoretic particle texts (for experimentalists):
  - *Particle Physics, 2nd Ed.*, by Martin & Shaw.
- Field theory:
  - *Introduction to Quantum Field Theory*, by Peskin & Schroeder.
  - *Gauge Theory of Weak Interactions*, by Greiner & Müller.
- Standard Model: *Dynamics of the Standard Model*, by Donoghue, Golowich, & Holstein.

Grade Policy:

Homeworks:	80%
Final Project:	20%

The homeworks are the most important part of this course, as it is by doing physics one learns physics. There will be roughly one assignment every week or two, with anywhere from 2-6 problems, depending on their difficulty. Collaboration on most of these assignments is encouraged, however you must turn in your own work; **cheating will not be tolerated**.

There will be one assignment that will be "promoted" to a take-home exam. The only difference here is that for this assignment you will be expected to work entirely on your own.

The final project will consist of an independent research project of your choice (subject to my approval). This is designed for you to take what you learn in this course and extend it in a direction that you may be more interested in. Before starting the project, you will have to turn in a short (1-paragaph) summary of what you wish to work on. No two students can work on the same project. You will turn in a written paper (5-10 pages) and also give a 20-minute presentation to the class at the end of the semester.

There are five classes that we will be missing throughout the semester, noted below. I propose that we prepare for this in advance by having an extra class on Fridays at the same time as class, 11:00-12:20, when there are no graduate classes scheduled, for the first five weeks of class.

Class Meeting Dates: (Those in bold are canceled.)

August:	27
September:	1, 8, 10, 15, 17, 22, 24, **29**
October:	**1**, 6, 8, 15, 20, 22, 27, 29
November:	3, 5, 10, 12, **17, 19, 24**
December:	1, 3

Important Dates:

Aug. 29, Sept. 5, 12, 19, 26	Make-up classes?
Sept. 29 & Oct. 1:	No Class
Oct. 13:	No Class (Fall Break)
Nov. 5:	Project Ideas Due
Nov. 17, 19, 24:	No Class
Nov. 26:	No Class (Thanksgiving Break)

***Rough* Course Outline:** (Note that chapters are given to let you know roughly where in the texts there is related material, although I will not be following the book as closely as it appears.)

On your own:	**Read Ch. 1 of Griffiths**
2 classes	Introduction & Review; Units, special relativity (Griffiths Ch. 3)
2 classes	Introduction to Particle Interactions (Griffiths Ch. 2, Perkins Ch. 2)
3 classes	Group theory, symmetries, conservation laws (Griffiths Ch. 4, Perkins Ch. 3)
3 classes	Quark model of hadrons (Griffiths Ch. 5, Perkins Ch. 4)
1 class	Scattering/Decays (Griffiths Ch. 6, Perkins Ch. 2)
4 classes	Quantum Electrodynamics (Griffiths Ch. 7, Perkins Ch. 5)
3 classes	Hadronic structure (Griffiths Ch. 8, Perkins Ch. 5)
3 classes	Quantum Chromodynamics (Griffiths Ch. 9, Perkins Ch. 6)
5 classes	Weak interactions, Standard Model and beyond (Griffiths Ch. 10, Perkins Chs. 7,8,9)
Finals time	Presentations