PHSX 451: Elementary Particle Physics Spring 2020

PROFESSOR:	Dr. Alex Bulmahn
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LECTURE:	MWF 2-2:50 pm, Charles H. Clapp Building 231
OFFICE HOURS:	M 10-11, T 10-12, W 10-11, F 11-12, and by appointment
TEXTBOOK:	*Introduction to Elementary Particles, 2nd Edition* David J. Griffiths
PREREQUISITES:	PHSX 301, PHSX 343

Overview

This course will be an introduction to elementary particle physics. We will start by introducing the fundamental particles and fundamental forces of the standard model and discuss some of the history that led to their discovery. Significant time will be spent developing and working with the Feynman rules and calculus that are used to calculate cross sections and particle lifetimes. Relativistic mechanics and solutions to relativistic field equations will be covered as part of this development. Application of the Feynman calculus will be focused to quantum electrodynamics and the weak interactions. Some advanced topics such as neutrino oscillations and CP violation will also be covered.

Learning Objectives

Upon completion of this course you should have gained and understanding of:

- how the fundamental particles interact via the fundamental forces and why we see what we do in nature.
- how symmetries lead to conservation laws and what role they play in particle interactions and decays.
- how to construct a scattering amplitude (and understand what each term means and where it comes from) and use it to calculate cross sections and decay rates.

Grading

Your grade for the course will be based on weekly homework assignments, two in-class midterm exams, and a final exam. **Homework is due at the end of the day on the due date and late homework will be penalized 10% per day late (not including weekends and holidays). Make up exams will only be given in extreme circumstances.** The grading for the course will be broken down as follows:

Homework:	30%
Midterm Exams:	20% each (40% total)
Final Exam:	30%

This course can only be taken with the traditional grading option. The letter grades in this course will be based on a curve, giving you the grade that you earn. The curve will be determined by the performance of the class as a whole, but I do not have a set number of A's, B's, etc. predetermined. *Note: the last day to drop the course via Cyberbear is February 3rd. The last day to drop the course without the Dean's signature is March 24th.*

Course Guidelines and Policies

Student Conduct Code

The Student Conduct Code at the University of Montana embodies and promotes honesty, integrity, accountability, rights, and responsibilities associated with constructive citizenship in our academic community. This Code describes expected standards of behavior for all students, including academic conduct and general conduct, and it outlines students' rights, responsibilities, and the campus processes for adjudicating alleged violations. Full student conduct code.
(http://www.umt.edu/vpsa/policies/student_conduct.php)

Disability Modifications

The University of Montana assures equal access to instruction through collaboration between students with disabilities, instructors, and Disability Services for Students. https://www.umt.edu/dss/default.php If you think you may have a disability adversely affecting your academic performance, and you have not already registered with Disability Services, please contact Disability Services in Lommasson Center 154 or call 406.243.2243. I will work with you and Disability Services to provide an appropriate modification.

Tentative Schedule

Week	Dates	Topic	Reading and Notes
1	1/13—17	Course Introduction, History	Introduction, Ch. 1
2	1/20—24	The Eightfold Way, The Four Forces, Feynman Diagrams	Ch. 1, Ch. 2
3	1/27—31	Feynman Diagrams, Conservation Laws	Ch. 2
4	2/3—7	Neutrino Oscillations	Ch. 11
5	2/10—14	Relativistic Kinematics	Ch. 3
6	2/17—21	Applications of Relativistic Kinematics	Ch. 3 **Midterm Exam #1**
7	2/24—28	Decay Rates and Cross Sections	Ch. 6
8	3/2—6	The Feynman Rules	Ch. 6
9	3/9—13	The Dirac Equation	Ch. 7
10	3/16—20	**SPRING BREAK**	Relax and Recharge
11	3/23—27	Quantum Electrodynamics—Feynman Rules	Ch. 7
12	3/30—4/3	Quantum Electrodynamics—Examples with Leptons	Ch. 7
13	4/6—10	Quantum Electrodynamics—Examples with Quarks	Ch. 7 **Midterm Exam #2**
14	4/13—17	Electroweak Theory, Weak Interactions	Ch. 9
15	4/20—24	Weak Decays	Ch. 9
16	4/27—5/1	Parity, CP Violation, Matter/Antimatter Asymmetry of the Universe	Ch. 4.4, Ch. 12.3
17	5/4—8	**Finals Week** **Final Exam 3:20-5:20 pm Wednesday 5/6**	