PHYS 4420: NUCLEAR AND PARTICLE PHYSICS

Spring 2020

Instructor: Prof. Keith A. Ulmer
Email: keith.ulmer@colorado.edu
Office: DUAN F323

Lecture Time: MWF 12:00 – 12:50 pm
Lecture Location: DUAN G2B21
Office Hours: Monday 2:00-3:30 pm, or by appt.

Course Website: All information will be posted on the course Canvas page: https://canvas.colorado.edu/

- Course schedule, syllabus, exam information, lecture notes, grades, homework, and exam solutions

Office Hours: In addition, we can address quick questions immediately after class or by appointment.

Course Overview: Physics 4420 is an elective for senior physics majors. We'll explore the fundamental constituents of matter and the forces that mediate interactions among those fundamental particles. Concepts from quantum field theory will be utilized to describe the propagation of particles and forces as expressed by Feynman diagrams. We'll extend the quantum mechanical methods for computing transition rates to applications in particle decays and scattering processes, and discuss how these experimental results reveal the unified nature of the weak and electromagnetic forces. We'll consider the strong nuclear force that binds atomic nuclei and models for their ground and excited states as well as decays and reactions.

Prerequisites: You must have completed two semesters of Quantum Mechanics (up through PHYS 4410). This course will assume familiarity with the addition of angular momentum, time-dependent perturbation theory, and some special relativity. If you have not taken Physics 4410 yet, please see me.

Required textbooks:


Reading is an essential part of PHYS 4420. Reading the text before class is very important. Lecture is to clarify your understanding and to help you make sense of the material. Reading assignments are posted on the course Canvas website in the Files section. Please plan to ask questions in class about material that is unclear or especially interesting.

Written Homework: There will be a written homework assignment due on Wednesdays at the start of class. The assignments will be posted on our course canvas page. Please hand in your
work at the beginning of class. Solutions will be posted on canvas on the day the homework is due, and thus no late homework will be accepted. If you have an exceptional situation, please discuss it with me. To receive credit, you must show all of your work. You are encouraged to discuss the homework problems with others, but you must turn in our own individual work. Reproducing solutions from any published or unpublished source (including your friend) is considered cheating and will be handled as such.

Exams: There will be one evening midterm exam and a final exam. Locations for each exam will be announced in class and on the course website. The dates and times of the exams are:

- Midterm: March 4, 2020, Benson Earth Sciences 185, 7:30-9:00pm
- Final Exam: May 6, 2020, Duane G2B21, 1:30-4:00pm

There are no makeup or early exams. You may not miss any exam except for reasons beyond your control, approved by the instructor (usually a confirmed medical problem with written documentation). Exams will be closed book, though you may bring one page (two sides) of handwritten notes and a copy of the PDG particle data booklet (so make sure to order one!).

Grading Policy: Written homework (40%), Midterm Exam (20%), Final Exam (40%).

Accommodation for Disabilities: If you qualify for accommodations because of a disability, please submit your accommodation letter from Disability Services to your faculty member in a timely manner so that your needs can be addressed. Disability Services determines accommodations based on documented disabilities in the academic environment. Information on requesting accommodations is located on the Disability Services website. Contact Disability Services at 303-492-8671 or dsinfo@colorado.edu for further assistance. If you have a temporary medical condition or injury, see Temporary Medical Conditions under the Students tab on the Disability Services website.

Classroom Behavior: Students and faculty each have responsibility for maintaining an appropriate learning environment. Those who fail to adhere to such behavioral standards may be subject to discipline. Professional courtesy and sensitivity are especially important with respect to individuals and topics dealing with race, color, national origin, sex, pregnancy, age, disability, creed, religion, sexual orientation, gender identity, gender expression, veteran status, political affiliation or political philosophy. Class rosters are provided to the instructor with the student’s legal name. I will gladly honor your request to address you by an alternate name or gender pronoun. Please advise me of this preference early in the semester so that I may make appropriate changes to my records. For more information, see the policies on classroom behavior and the Student Code of Conduct.

Honor Code: All students enrolled in a University of Colorado Boulder course are responsible for knowing and adhering to the Honor Code. Violations of the policy may include: plagiarism, cheating, fabrication, lying, bribery, threat, unauthorized access to academic materials, clicker fraud, submitting the same or similar work in more than one course without permission from all course instructors involved, and aiding academic dishonesty. All incidents of academic misconduct will be reported to the Honor Code (honor@colorado.edu); 303-492-5550). Students who are found responsible for violating the academic integrity policy will be subject to nonacademic sanctions from the Honor Code as well as academic sanctions from the faculty member. Additional information regarding the Honor Code academic integrity policy can be found at the Honor Code Office website.

Sexual Misconduct, Discrimination, Harassment and/or Related Retaliation: The University of Colorado Boulder (CU Boulder) is committed to maintaining a positive learning, working, and living environment. CU Boulder will not tolerate acts of sexual misconduct, discrimination,
harassment or related retaliation against or by any employee or student. CU’s Sexual Misconduct Policy prohibits sexual assault, sexual exploitation, sexual harassment, intimate partner abuse (dating or domestic violence), stalking or related retaliation. CU Boulder’s Discrimination and Harassment Policy prohibits discrimination, harassment or related retaliation based on race, color, national origin, sex, pregnancy, age, disability, creed, religion, sexual orientation, gender identity, gender expression, veteran status, political affiliation or political philosophy. Individuals who believe they have been subject to misconduct under either policy should contact the Office of Institutional Equity and Compliance (OIEC) at 303-492-2127. Information about the OIEC, the above referenced policies, and the campus resources available to assist individuals regarding sexual misconduct, discrimination, harassment or related retaliation can be found at the OIEC website.

**Religious Holidays:** Campus policy regarding religious observances requires that faculty make every effort to deal reasonably and fairly with all students who, because of religious obligations, have conflicts with scheduled exams, assignments or required attendance. In this class, please inform your instructor in the first two weeks of classes if you anticipate a conflict. See the campus policy regarding religious observances for full details.

*Any information in this syllabus is as accurate as possible at the time of writing. Announcements about changes of any kind will be made in class, and posted on the web, and will take precedence over this syllabus. You are responsible for what is said in class, whether or not you are in attendance.*