

PHY 630

Topics in and beyond the Standard Model of particle physics

Semester/Term: Spring 2022

Credit Hours: 3.0

Instructor Information

Instructor: Richard Hill

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Office Hours: after lecture and by appointment

Course Description

The course covers the structure of the Standard Model, and its experimental tests. The necessary concepts from quantum field theory are developed. Students may choose suggested reading along different tracks, depending on their prior quantum field theory background.

Recommended Materials

The development of the Standard Model through a progression of relativity, quantum field theory, electromagnetic, strong and weak forces, is treated at different levels in a number of textbooks. Reading suggestions will be given from

- Griffiths, *Introduction to Elementary Particles*
- Cheng and Li, *Gauge theory of elementary particle physics*

While the development of factual information about the Standard Model and its experimental tests is the focus of the course, suggested reading on relevant quantum field theory techniques will be given from

- Peskin and Schroeder, *An introduction to quantum field theory*
- Weinberg, *Quantum field theory*, volumes 1 and 2

Activities and Assignments

There will five core topics in the course, each with a corresponding no-time-limit online quiz (40%) and problem set (40%), and a final project/presentation (20%). Homework assignments are an essential part of the course. It is legitimate to discuss problems with other students, consult textbooks or get advice from your instructor. However, the final work must be yours!

Course Assignments

- 5 homework assignments at 8 points each
- 5 online quizzes at 8 points each
- 1 final project/presentation at 20 points

Submission of Assignments

Online via Canvas

Course Grading

Grading Scale for graduate students:	80 - 100% = A
	70 - 79% = B
	60 - 69% = C
	Below 60%= E

Tentative Course Schedule

Week	Date	Topic
1,2	January 11-19	1. Intro., relativistic kinematics, symmetries
3,4	January 25-February 3	2. Quantum field theory and Feynman diagrams
5,6,7	February 8-24	3. QED
	Mar 14-19	Spring Break
8,9,10	Mar 1-24	4. QCD
11,12,13	March 29-April 14	5. Electroweak theory
14,15,16	April 19-28	Beyond the Standard Model / presentations
	April 27	Last day of class

Attendance Policy

Attendance and participation in lectures is expected.

Academic Integrity- Prohibition on Plagiarism (Senate Rules 6.3.1)

Per University policy, students shall not plagiarize, cheat, or falsify or misuse academic records. Students are expected to adhere to University policy on cheating and plagiarism in all courses. The minimum penalty for a first offense is a zero on the assignment on which the offense occurred. If the offense is considered severe or the student has other academic offenses on their record, more serious penalties, up to suspension from the University may be imposed.

Plagiarism and cheating are serious breaches of academic conduct. Each student is advised to become familiar with the various forms of academic dishonesty as explained in the [Code of Student Rights and Responsibilities](#). Complete information can be found on the [Academic Ombud](#) page. A plea of ignorance is not acceptable as a defense against the charge of academic dishonesty. It is important that you review this information as all ideas borrowed from others need to be properly credited.

Senate Rule 6.3.1 (see current [Senate Rules](#)) states that all academic work, written or otherwise, submitted by students to their instructors or other academic supervisors, is expected to be the result of their own thought, research, or self-expression. In cases where students feel unsure about a question of plagiarism involving their work, they are obliged to consult their instructors on the matter before submission.

When students submit work purporting to be their own, but which in any way borrows ideas, organization, wording, or content from another source without appropriate acknowledgment of the fact, the students are guilty of plagiarism.

Plagiarism includes reproducing someone else's work (including, but not limited to a published article, a book, a website, computer code, or a paper from a friend) without clear attribution. Plagiarism also includes the practice of employing or allowing another person to alter or revise

the work which a student submits as his/her own, whoever that other person may be, except under specific circumstances (e.g. Writing Center review or peer review) allowed by the Instructor of Record or that person's designee. Plagiarism may also include double submission, self-plagiarism, or unauthorized resubmission of one's own work, as defined by the instructor.

Students may discuss assignments among themselves or with an instructor or tutor, except where prohibited by the Instructor of Record (e.g. individual take-home exams). However, the actual work must be done by the student, and the student alone, unless collaboration is allowed by the Instructor of Record (e.g. group projects).

When a student's assignment involves research in outside sources or information, the student must carefully acknowledge exactly what, where and how he/she has employed them. If the words of someone else are used, the student must put quotation marks around the passage in question and add an appropriate indication of its origin. Making simple changes while leaving the organization, content, and phraseology intact is plagiaristic. However, nothing in these Rules shall apply to those ideas, which are so generally and freely circulated as to be a part of the public domain.

Please note: Any assignment you turn in may be submitted to an electronic database to check for plagiarism.

Academic Integrity – Prohibition on Cheating (Senate Rules 6.3.2)

Cheating is defined by its general usage. It includes, but is not limited to, the wrongfully giving, taking, or presenting any information or material by a student with the intent of aiding himself/herself or another on any academic work which is considered in any way in the determination of the final grade. The fact that a student could not have benefited from an action is not by itself proof that the action does not constitute cheating. Any question of definition shall be referred to the University Appeals Board.

Academic Integrity – Prohibition on Falsification/Misuse of Academic Records (SR 6.3.3)

Maintaining the integrity, accuracy, and appropriate privacy of student academic records is an essential administrative function of the University and a basic protection of all students. Accordingly, the actual or attempted falsification, theft, misrepresentation or other alteration or misuse of any official academic record of the University, specifically including knowingly having unauthorized access to such records or the unauthorized disclosure of information contained in such records, is a serious academic offense. As used in this context, "academic record" includes all paper and electronic versions of the partial or complete permanent academic record, all official and unofficial academic transcripts, application documents and admission credentials, and all academic record transaction documents. The minimum sanction for falsification, including the omission of information, or attempted falsification or other misuse of academic records as described in this section is suspension for one semester.

Course Material Copyright Statement

The University of Kentucky [Code of Student Conduct](#) defines Invasion of Privacy as using electronic or other devices to make a photographic, audio, or video record of any person without their prior knowledge or consent when such a recording is likely to cause injury or distress.

Meetings of this course may be recorded. All video and audio recordings of lecturers and class meetings, provided by the instructors, are for educational use by students in this class only. They are available only through the Canvas shell for this course and are not to be copied, shared, or redistributed.

As addressed in the Code of Student Conduct, students are expected to follow appropriate university policies and maintain the security of linkblue accounts used to access recorded class materials. Recordings may not be reproduced, shared with those not enrolled in the class, or uploaded to other online environments.

If the instructor or a University of Kentucky office plans any other uses for the recordings, beyond this class, students identifiable in the recordings will be notified to request consent prior to such use. In anticipation of such cases, students may be asked to complete an “authorization of use” form by a faculty member.

Video and audio recordings by students are not permitted during the class unless the student has received prior permission from the instructor. Any sharing, distribution, and or uploading of these recordings outside of the parameters of the class is prohibited. Students with specific recording accommodations approved by the Disability Resource Center should present their official documentation to the instructor.

All content for this course, including handouts, assignments, and lectures are the intellectual property of the instructor and cannot be reproduced or sold without prior permission from the instructor. A student may use the material for reasonable educational and professional purposes extending beyond this class, such as studying for a comprehensive or qualifying examination in a degree program, preparing for a professional or certification examination, or to assist in fulfilling responsibilities at a job or internship.

Academic Policy Statements

Please refer to the University [Academic Policy Statements](#) :

- [Excused Absences and Acceptable Excuses](#)
- [Religious Observances](#)
- [Verification of Absences](#)
- [Make-Up Work](#)
- [Excused Absences for Military Duties](#)
- [Unexcused Absences](#)
- [Prep Week and Reading Days](#)
- [Accommodation Due to Disability](#)
- [Non-Discrimination Statement and Title IX Information](#)

Resources Available to Students

Please refer to the University [Resources Available to Students](#) :

- [Bias Incident Support Services](#)
- [Computer Labs](#)

- Counseling Center
- Disability Resource Center
- Libraries
- Martin Luther King Center
- Non-Discrimination / Title IX
- Office of LGBTQ* Resources
- Veterans Resource Center
- Violence Intervention and Prevention (VIP) Center