

Physics 490 – Modern Physics – Syllabus¹

Fall Semester 2024, University of Hawaii at Manoa

Class: TR, 13:30-14:45, in WAT 113

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Office Hours: Weekly time t.b.d.+ by appointment Grader: Michael Bell

Lecture Format and Rules

- Lectures in-person. Attendance required.
- No cell phone use or texting in class.
- Please interrupt me any time to ask relevant questions. I strongly encourage it.

Course materials

News and materials (such as homework assignments) will be distributed via Google Classroom.

Homework should be turned in on paper at the beginning of the class the day it is due.

There is no need to turn in anything via google classroom.

- **If you were enrolled as of January 20th, you should have already received an email invitation to join google classroom. Please accept this promptly.**
- **If you are not enrolled yet, join google classroom at:**
<https://classroom.google.com/c/NzM2NTI0NDgxNTk5?cjc=parzaop>
You may need the class code, which is: parzaop

Description in Course Catalog

Introduction to nuclear and elementary-particle physics.

Course Description

This class introduces modern elementary particle physics, also known as high energy physics. We will briefly review the status of the field, open questions, and experimental methods. Our main goal will be to understand the Standard Model (SM) of Particle Physics and how it is used to make theoretical prediction. Because the SM describes the interactions of the fundamental constitutions of matter via relativistic quantum fields, we

¹ Version: 1/20/2024.

must use and extend what we have learned in previous classes on special relativity and quantum mechanics. The course will be necessarily be mathematical, but I will attempt to explain everything from the ground up as much as possible.

Particle physics is my own field of research, and I am very excited about teaching this class. Please note that this is my first time teaching Physics 490 and I am using a different textbook than what has been used in the past. The book contains at least one year's worth of material and is in my opinion excellent both for advanced undergraduates and graduate students. In the future I hope to extend this into a yearlong course that will cover the whole book. For the current one-semester course I will have to cover only selected topics from the book, and the exact final list of topics will involve some improvisation depending on how I feel we do as a class in the first weeks.

The textbook by Thomson emphasizes clarity of presentation and theoretical understanding. Thomson purposely avoids the historical approach of many other books. I agree that Thomson's choice is best for optimizing clarity and pedagogy. That said, it means the book lacks a bit of the excitement associated with the many discoveries in the field. We will therefore supplement the book with student presentations. Each student will give a 30-minute presentation on a fundamental experimental discovery in particle physics.

Prerequisites

Formal Prerequisites: Physics 480; or consent. Co-requisite: Physics 480. In practice, you need to be comfortable with quantum mechanics (and hence linear algebra, complex numbers, differential equations, and probability density functions) and special relativity.

Required Materials

Textbook: *Modern Particle Physics*, by Mark Thomson

Homework

Please keep reading the book, following my suggestions in class. There will be weekly sets of written problems, typically due one week after assignment at the beginning of class. Honest collaboration is encouraged, but the **material handed in must be your own work**. Late homework will be accepted only one lecture after it is due, and the score will be reduced by 20%.

Cheating

Utilizing homework solutions manuals or similar help (e.g. websites that may provide you previous exams and homework solutions) will be considered cheating and will be reported.

Learning Goals

- You should understand and will be tested on *topics and material presented in class and/or covered in homeworks*.
- You should be able to independently solve problems of the same difficulty level as the homework.

Evaluation (may be revised – preliminary plan)

Homework	20%
Midterm	30%
Presentation	20%
Final exam	30%

Office hours

I want to get to know you, and help you succeed in the class. I strongly encourage you to come to office hours. These will be scheduled at the optimal time, as determined by the poll.

If you have physics questions, do not ask them via email. Come to office hours to discuss instead! Physics via email is highly inefficient.