

PHYSICS 565 - Spring 2016

Introduction to Elementary Particle Physics II

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Office hours: Tuesday 2:00 – 3:00 PM (or by appointment)

Class: Lecture: Tuesday and Thursday 12:00 – 13:15 PM, PHYS 390

Textbook: *Introduction to Elementary Particle Physics*, A. Bettini, 2nd edition

Course Website: <http://www.physics.purdue.edu/phys565>

COURSE OVERVIEW:

This is the second part of a two-semester course sequence to give an introduction to Particle Physics. Focus is given to the experimental features, with phenomenological and theoretical considerations and the interplay between theory and experiment. This is not intended to be a formal course in particle theory. Most students will be concurrently taking a more formal course in field theory (PHYS 662/663). The field theory course will serve as a more formal complement to the treatment given in this class.

The goal of the course is to prepare graduate students for research in particle physics and related areas. The emphasis is on the understanding of the basic concepts and on doing simple calculations.

After a review of Quantum Electrodynamics and Weak Interactions the Standard Model of particles and interactions is described. We will study the current experimental status of the Standard Model of particles and forces, possible theoretical extensions beyond the Standard Model, and related experimental searches. The efforts to construct a theory which unifies all interactions, including gravity, is discussed. The topics covered include CP violation, neutrino physics, QCD, hadron collider physics, data analysis techniques and the role of symmetries.

LECTURES:

The lectures will be used to introduce new concepts. Read the assigned text in advance of the lecture and then again afterwards for optimal comprehension. Your active participation during lectures with questions and comments is strongly encouraged. Please do not hesitate to, or be shy about, asking questions.

We will loosely follow the textbook: Alessandro Bettini, “Introduction to Elementary Particle Physics”, 2nd edition (Cambridge, 2014). I also recommend David Griffiths,

“Introduction to Elementary Particles”, 2nd edition (Wiley, 2008). Bettini’s textbook is more experimentally oriented, while the textbook by Griffiths has more theoretical details. It is not required to have a book but useful for further explanation. Decide for yourself if you want to buy one.

PREREQUISITES:

This course is a continuation of PHYS 564. Therefore, PHYS 564 or an equivalent background in particle physics is assumed. It is expected that you are familiar with particle detection techniques and with Quantum Electrodynamics. Understanding of quantum mechanics at the PHYS 360/PHYS 550 or PHYS 460/PHYS 461 level is required. These courses may be taken simultaneously.

ASSIGNMENTS:

Specific reading assignments will be given supplementing the lecture material covered in class. A tentative reading and homework assignment schedule is posted on the course website. You should read the assigned sections before attending lecture. You can always find an up-to-date version on the course website (Schedule).

HOMEWORK:

Problem solving is an essential as well as an integral part of this course. There will be about 5 homework assignments. The homework is due and has to be brought to the lecture on Thursday of the following week. Homework grades will count approximately 40% towards your course grade. Students may discuss the problems with each other in a general way but should **not** do the homework as a group effort. No carbon copy homework sets are acceptable. Further, the problem solutions should be clearly and neatly written on one side only of standard size paper. Your fellow students should be able to read, follow and understand the solutions. The quality of the presentation counts towards the grade. The problem sets will be written in a format that has your name, PHYS 565, and the due date in the upper right hand corner of the first page and your name and PHYS 565 on each following page. The question should first be written out and then followed by the solution. Assignments will be posted on the course web page.

1. Use 8½ by 11” paper.
2. Write only on one side of the page.
3. Number the pages.
4. Write clearly and neatly.
5. Solutions should be complete, comprehensive and clearly presented.
6. Staple pages together for hand in.
7. Remember to put your name on the front of the first page in hand in.
8. Homework is due in class on the day indicated on the problem set.
9. Please contact your instructor prior to the due date if you need an extension.

EXAMS:

Instead of the usual final exam, a research paper with both written and oral presentations is required. Students will be asked to write a brief review paper and present a twenty-minute seminar on a topic selected from a list. Starting literature will be provided and students will be expected to find additional resources. The seminars will be presented near the end of the semester.

GRADING:

Your course grade will be based on homework and the final term paper, with the approximate weights:

Homework	40%
Final term paper	60%

We will use plus-minus letter grades in the final grading of this course. **The exact cut-offs for letter grades will not be determined until the end of the semester.**

ABSENCES AND EXCUSED GRADES:

Homework sets are due on the dates indicated on the class calendar. Your work is due on time, with the exception of reasonable documented excuses. If you are going to miss an exam, you must notify the instructor **in advance** (preferably one week) so alternative arrangements can be made. Unexcused absences from any exam will be assigned a zero grade; Excused grades will be given only in one of the following circumstances: (1) illness; (2) personal crisis (e.g., automobile accidents, required court appearance, death of a close relative, weather conditions that make it impossible to get to the university); and (3) required attendance at an official Purdue activity (e.g. athletics). You **must** contact your lecturer as soon as possible but **before** the exam and discuss your problem. Appropriate documents (e.g., a written note from a doctor, with his/her name and phone number included) may be needed to judge the merit of the excuse.

SUPPLEMENTAL TEXTS:

Besides our textbook, the following are useful references:

1. D. Griffiths, *Introduction to Elementary Particles*, 2nd ed., Wiley-VCH, 2008, ISBN: 978-3527406012.
2. F. Halzen and A.D. Martin, *Quarks & Leptons: An Introductory Course in Modern Particle Physics*, John Wiley & Sons, 1984, ISBN: 978-0471887416.
3. D.H. Perkins, *Introduction to High Energy Physics*, 4th ed., Cambridge University Press, 2000, ISBN: 978-0521621960.
4. B.R. Martin and G. Shaw, *Particle Physics*, 3rd ed., John Wiley & Sons, ISBN: 978-0470032947.
5. A. Seiden, *Particle Physics: A Comprehensive Introduction*, Addison-Wesley, 2004, ISBN: 978-0805387360.
6. V.D. Barger and R.J.N. Phillips, *Collider Physics*, Addison-Wesley, 1996, ISBN:

978-0201149456.

7. W.R. Leo, *Techniques for Nuclear and Particle Physics Experiments*, 2nd ed., Springer, 1994 ISBN: 978-3540572800.
8. C. Grupen and B. Shwartz, *Particle Detectors*, 2nd ed., Cambridge University Press, 2011, ISBN: 978-0521187954.

Additional Resources:

[Particle Data Group](#)

[The Particle Adventure](#)

[The Particle Detector Briefbook](#)

[Ch. Joram: Particle Detectors](#)

[ROOT](#)

STUDENTS WITH DISABILITIES:

Purdue University is required to respond to the needs of the students with disabilities as outlined in both the Rehabilitation Act of 1973 and the Americans with Disabilities Act of 1990 through the provision of auxiliary aids and services that allow a student with a disability to fully access and participate in the programs, services, and activities at Purdue University. It is the student's responsibility to notify the Disability Resource Center of an impairment/condition that may require accommodations and/or classroom modifications.

EMERGENCIES:

In the event of a major campus emergency, course requirements, deadlines and grading percentages are subject to changes that may be necessitated by a revised semester calendar or other circumstances. Here are ways to get information about changes in this course:

- Course web site: <http://www.physics.purdue.edu/phys565/>
- E-mail: neumeist@purdue.edu (use subject PHYS 565)
- Phone: 494-5198

Attached to the syllabus is an “Emergency Preparedness for Classrooms” sheet that provides additional preparedness information. Please review the sheet and the Emergency Preparedness website for additional emergency preparedness information.