

PHYSICS 8810

PARTICLE PHYSICS

WINTER 2013

Advanced elementary particle physics including weak, electromagnetic, and strong interactions. Rudiments of experimental devices and techniques at level appropriate to both experimentally- and theoretically-oriented students. Prerequisites: PHY7410, PHY7060 (PHY8850 is strongly recommended). This is a 3 credit course.

Instructor: Prof. Robert Harr **Office:** 262 Physics
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Office Hours: 10:30 - 11:30 Monday and Wednesday, or by appointment.
Web Page: <http://hep.physics.wayne.edu/~harr/courses/8810/w13/>

Textbook: *Collider Physics* updated edition, by Vernon D. Barger and Roger J.N. Phillips, Westview Press, (1991); ISBN 0-201-14945-1. This text is recommended.

The course will follow the text, and appropriate sections for reading will be given at the start of lecture. A bibliography of other useful texts is on the web.

Lectures: MWF 3:00pm to 4:00pm, Physics Research Building, room 185.

You are encouraged to ask questions; if something isn't clear to you, it likely isn't clear to others in the class as well.

Homework: The practice of Physics requires problem solving skills. In this course you will learn and practice problem solving skills with weekly homework assignments. You may discuss and collaborate with classmates on the problems, but the final solution must be your own. Copying of solutions will result in failure for all parties involved. Your solutions will be collected, graded, and contribute to your final grade. Homework must include **explanatory text** and be **neatly written** or it will be given zero credit. The best 5 of 6 homework scores will be used in calculating your grade.

Research Report: Everyone will write a report on a topic that can be investigated using the Pythia Monte Carlo code. The topic will be chosen in consultation with the instructor. All reports are due by the final day of classes, Monday, April 22, 2013. Late reports will NOT be accepted.

Exams: At present, it is planned for the report to take the place of exams.

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|-----------------|-----------------|------|-----------|
| Grading: | Homework | 67% | bi-weekly |
| | Final Exam | 0% | TBA |
| | Research Report | 33% | |
| | TOTAL | 100% | |

The grade scale is as follows:

| | |
|----|------------|
| A+ | 95 -- 100% |
| A | 90 -- 95% |
| A- | 85 -- 90% |
| B+ | 80 -- 85% |
| B | 75 -- 80% |
| B- | 70 -- 75% |
| C+ | 65 -- 70% |
| C | 60 -- 65% |
| F | < 60% |

Policies: Late work is not accepted. The lowest homework score will be dropped. You are allowed and encouraged to discuss problems together, but what you turn in must be your own work -- do not copy problem solutions and turn them in as your own work. As a general rule, your classmates should not see the solutions you will turn in, and you should not see their solutions. Follow [this link](#) to view the English department's statement on plagiarism and a copy of Wayne State's academic integrity policy.

This is a zero-tolerance policy.

Course Content

| Date | Topic | Text |
|--------|---|---------------------|
| 7 Jan | Introduction | 1.1 - 1.2 |
| 9 Jan | Review of rel. QM | 1.3 |
| 11 Jan | Quantum numbers, C, P, angular mom. | |
| 14 Jan | To be rescheduled | |
| 16 Jan | To be rescheduled | |
| 18 Jan | The standard model, Noether's theorem | 2.1 - 2.2, Hw.1 due |
| 21 Jan | MLK Holiday | |
| 23 Jan | QED | 2.2, 7.1 |
| 25 Jan | Yang-Mill's | 2.3 - 2.4 |
| 28 Jan | SU(2), QCD, SU(3) | 2.5 - 2.10 |
| 30 Jan | Higgs mechanism, Gauge sector parameters, masses and mixing | |
| 1 Feb | Feynman rules | |
| 4 Feb | Calculating decay widths and cross sections | Hw.2 due |
| 6 Feb | Hadrons | 3.1 - 3.3 |
| 8 Feb | Lepton and hadron decays | 3.4 - 3.9 |
| 11 Feb | Elastic $e^+ e^-$ collisions | 4.1 - 4.3 |

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|--------|---------------------------------------|---------------------|
| 13 Feb | Inelastic $e^+ e^-$ collisions | 4.4 - 4.6 |
| 15 Feb | νe^- interactions | 4.7 |
| 18 Feb | Partons and e, μ DIS | 5.1 - 5.2, Hw.3 due |
| 20 Feb | ν DIS | 5.3 - 5.5 |
| 22 Feb | Parton distribution functions (PDF's) | 5.6 |
| 25 Feb | Hadron-hadron collisions | 5.7 - 5.9 |
| 27 Feb | | |
| 1 Mar | | |
| 4 Mar | | Hw.4 due |
| 6 Mar | | |
| 8 Mar | To be rescheduled | |
| 11 Mar | Spring Break | |
| 13 Mar | Spring Break | |
| 15 Mar | Spring Break | |
| 18 Mar | | Hw.5 due |
| 20 Mar | | |
| 22 Mar | | |
| 25 Mar | | |
| 27 Mar | | |
| 29 Mar | | |
| 1 Apr | | Hw.6 due |
| 3 Apr | | |
| 5 Apr | | |
| 8 Apr | | |
| 10 Apr | | |
| 12 Apr | | |
| 15 Apr | | |
| 17 Apr | | |
| 19 Apr | | |
| 22 Apr | | Reports due |

Robert Harr

January 29, 2013