

# Syllabus for Particle Physics (Phys 694)

## Spring, 2008

### Instructor information:

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Office Hours: MWF 11-12

**Course objectives:** This course is, in the words of the course catalog, “an experimental and phenomenological introduction to high energy physics.” A specific and measurable, if somewhat ambitious, “student learning outcome” is as follows: by the end of the course, you, the successful student will

- ... have a basis to read and **understand** the **Review of Particle Physics**, especially the sections on the **standard model and related topics** and **experimental methods**.
- ... know the **experimental basis** of the model.
- ... be familiar with the range of observable **phenomena** related to particle physics.

This goal should be qualified by the caveat that the understanding gained may not extend to the deepest possible level. For example, you might not be able to write down the most general Lagrangian containing every possible renormalizable term obeying  $SU(3)\times SU(2)\times U(1)$  symmetry and then derive the Feynman rules for the interactions of the corresponding particles. But you should have some idea what the previous sentence means, what courses you would take in order to be able to learn how to do such a thing, and what might motivate someone to do so.

### Texts:

- B.R. Martin and G. Shaw, **Particle Physics**, 2<sup>nd</sup> edition, J. Wiley and Sons (1997).
- W.-M.Yao, *et al.* (Particle Data Group), **The Review of Particle Physics**, J. Phys. G 33, 1 (2006) and 2007 partial update for the 2008 edition.

Please note that **The Review of Particle Physics** is available online from <http://pdg.lbl.gov>. It is possible to obtain all parts of the book electronically. We also have some printed copies in the HEP group offices. It is possible to order a printed copy from the Particle Data Group (PDG) if you really want, but it shouldn't really be necessary.

**Course web site:** access via K-State Online.

**Homework problems:** (initial plan, subject to improvement) Homework will be due at the beginning of class on Tuesday. In class on Tuesday, I'll hand out my solutions, and this will be followed by some in-class discussion. Then if you want, you can take your own paper home (but not my solution!), re-do it, and turn it in on Thursday for a final grade. I intend to be fairly strict in enforcing the homework deadlines, just so you don't fall behind and I don't get swamped.

Collaboration in figuring out how to do the homework and cross-checking of results is permitted and encouraged, but you must work out and write up your solutions independently. (No copying!) The homework will be graded on the quality of your reasoning and math and how well they support the result obtained.

Homework problems will be assigned on Thursday. After the first week, I intend to ask for your participation in choosing the problems that will most enhance your understanding. Generally, homework problems will be taken from Martin and Shaw, but sometimes we might choose problems based on the Review of Particle Physics or some other source.

**Reading:** It is important that you read the chapters to be discussed in class before class, for reasons that will become clear.

**“Lectures”:** Rather than give one-way lectures, I intend to run the class as more of a seminar or workshop. Classes will consist mostly of discussion of the text (this is why you must read it!) and working out example problems and key derivations in class.

**Final exam:** There will be one exam at the end to confirm you really can do this work independently. It will be take-home, open-text, and open-notes. No collaboration is allowed on the final, and no outside help is permitted other than the official course texts, your notes, and your own homework from the course. You must be able to work independently in the end – keep this in mind throughout the course! The final will be handed out on the last day of class, and will be due at noon on Wednesday of finals week.

**Course grade:** The course grade will be based ~85% on homework, ~15% on the final exam. (Implication: don't skip any homework, and don't bomb the final!)

**Approximate schedule:** In order to cover particle physics in a single semester, we have to keep a steady pace. We'll start with a review of relativity on the first day, with the HW initial due date on the first Tuesday.

An outline of what we'll cover and some approximate ranges of how long we'll spend on each topic are given in the table below. All references to "Chapter n" or "Appendix x" refer to Martin and Shaw. Since the Review of Particle Physics (RPP) changes its chapter numbering between versions, I refer to its sections by name.

$\geq \frac{1}{2}$ week	Appendix A, Relativistic Kinematics, sections 1 and 2, supplemented by "Kinematics" from RPP.
$\geq 1$ week	Chapter 1, Basic Concepts Appendix B, Amplitudes and Cross-Sections, sec. 1-3.
$\geq 1$ week	Chapter 2, Leptons, Quarks, and Hadrons
$\geq 2$ weeks	Chapter 3, Experimental Methods "Passage of particles through matter" and "Particle detection" sections from RPP. (Possibly also "Accelerator Physics" given time and interest.)
$\geq 1\frac{1}{2}$ wks	Chapter 4, Space-Time Symmetries
1~3 weeks	Chapters 5, 6, 7 (QCD and hadron physics)
2~3 weeks	Chapters 8, 9, 10 (Electroweak physics)
$\geq 2$ weeks	Appendix C, Gauge Theories Plus "Electroweak model" from RPP
~1 week	Chapter 11, Beyond the Standard Model
<4 weeks	More physics beyond the standard model, as time allows, may include leptogenesis, extra dimensions, other "LHC" and "ILC" physics, and other current topics.

The above plan is ambitious, but if we do well then we get to have a lot more fun at the end.

**Help:** Any student wanting individual help is welcome to see me during office hours, or at other times by appointment. You should also try talking to other students in the class.

## **Other important notices:**

Please see <http://www.k-state.edu/provost/policies/course.htm> for the most up-to-date official versions of these notices.

**Students with Disabilities:** Any student who needs a classroom accommodation, access to technology, or other assistance in this course should contact Disability Support Services and/or speak with me as soon as possible.

### **Academic Honesty:**

*"Kansas State University has an Honor & Integrity System based on personal integrity, which is presumed to be sufficient assurance in academic matters one's work is performed honestly and without unauthorized assistance. Undergraduate and graduate students, by registration, acknowledge the jurisdiction of the Honor & Integrity System. The policies and procedures of the Honor & Integrity System apply to all full and part-time students enrolled in undergraduate and graduate courses on-campus, off-campus, and via distance learning. The honor system web site can be reach[ed] via the following URL: [www.ksu.edu/honor](http://www.ksu.edu/honor)*

*"A component vital to the Honor System is the inclusion of the Honor Pledge which applies to all assignments, examinations, or other course work undertaken by students. The Honor Pledge is implied, whether or not it is stated: 'On my honor, as a student, I have neither given nor received unauthorized aid on this academic work.' A grade of XF can result from a breach of academic honesty. The F indicates failure in the course; the X indicates the reason is an Honor Pledge violation."*

To understand what aid is and is not authorized in this class, please read carefully the "Homework" and "Exams" sections above. If anything is unclear about the course policies, the Honor System, the Honor Pledge, the concept of "unauthorized aid", or anything else, please talk to me about it right away.

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