Syllabus for Particle Physics (Phys 694)
Spring, 2016

Class meeting time and place: MWF 2:30-3:20 p.m., Seaton Hall room 252

Instructor information:
Name: Glenn Horton-Smith
Office: CW032B
Office Hours: TuTh 11-12
Phone: 532-6476
Email: gahs@phys.ksu.edu

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 standard model.
• ... be familiar with a range of observable phenomena related to particle physics.
• ... be able to perform basic quantitative calculations related to particle energy, momentum, cross-section, event rate, and detector performance needed to understand the topics above.

Texts:
• Modern Particle Physics by Mark Thomson (Cambridge University Press 2013).

Course web site: access via K-State Online (canvas.k-state.edu).

Homework problems: Homework will be given every week, and will be due 7 days after you receive it. 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.

Reading: It is important that you read the chapters to be discussed in class before class. (See schedule below.)

Class format: 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:** 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 *Modern Particle Physics* (MPP). Since the *Review of Particle Physics* (RPP) changes its chapter numbering between versions, I refer to its sections by name.

<table>
<thead>
<tr>
<th>Approximate time</th>
<th>Topic</th>
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<tbody>
<tr>
<td>~1 week</td>
<td>Introduction and Underlying Concepts: MPP ch 1 and 2, supplemented by “Kinematics” from RPP.</td>
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<tr>
<td>~1 week</td>
<td>Decay rates and cross sections: MPP ch 3.</td>
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<tr>
<td>~2 weeks</td>
<td>Experimental Methods: “Passage of particles through matter” and “Particle detection” sections from RPP. (Possibly also “Accelerator Physics” if there is time and interest.)</td>
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<tr>
<td>~1 week</td>
<td>The Dirac Equation: MPP ch 4</td>
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<tr>
<td>~3 weeks</td>
<td>QED: MPP ch 5-8</td>
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<tr>
<td>~2 weeks</td>
<td>QCD: MPP ch 9-10</td>
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<tr>
<td>~2 weeks</td>
<td>Weak interactions: MPP ch 11-12 Plus “Electroweak model” from RPP</td>
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<tr>
<td>~1 week</td>
<td>Neutrinos and neutrino oscillations: MPP ch 13 (supplemented by RPP)</td>
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<tr>
<td>~1 week</td>
<td>Electroweak unification: MPP ch 15, 17</td>
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<tr>
<td>~1 week</td>
<td>Physics beyond the standard model, as time allows. This may include leptogenesis, extra dimensions, other “LHC” and “ILC” physics, and other current topics.</td>
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**Help:** Any student wanting individual help is welcome to see me during office hours, or at other times by appointment. You should also talk with other students in the class.

**Conditions requiring academic accommodation:** If you have any condition which will require academic accommodations, please notify the instructor and contact the Student Access Center office. For more information, see the “Statement Regarding Students with Disabilities” below.
Statement Regarding Academic Honesty:

Kansas State University has an Honor System based on personal integrity, which is presumed to be sufficient assurance that, 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 System. The policies and procedures of the Honor 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 website can be reached via the following URL: 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.

For more information refer to the K-State Undergraduate Catalog and the Honor and Integrity System page at http://www.ksu.edu/honor/.

Statement Regarding Students with Disabilities

Students with disabilities who need classroom accommodations, access to technology, or information about emergency building/campus evacuation processes should contact the Student Access Center and/or their instructor. Services are available to students with a wide range of disabilities including, but not limited to, physical disabilities, medical conditions, learning disabilities, attention deficit disorder, depression, and anxiety. If you are a student enrolled in campus/online courses through the Manhattan or Olathe campuses, contact the Student Access Center (http://www.k-state.edu/accesscenter/) at accesscenter@k-state.edu, 785-532-6441; for Salina campus, contact the Academic and Career Advising Center at acac@k-state.edu, 785-826-2649.

Statement Defining Expectations for Classroom Conduct

All student activities in the University, including this course, are governed by the Student Judicial Conduct Code as outlined in the Student Governing Association By Laws, Article V, Section 3, [paragraph A], number 2. Students who engage in behavior that disrupts the learning environment may be asked to leave the class.

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