Physics 225A Information

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Welcome to Physics 225A.

This and Physics 225B cover the phenomenology and techniques of contemporary experimental particle physics. My main goal will be to enable you to conceive of new and important experiments that might lead to new breakthroughs, and to enable you to attend a research-level seminar in experimental particle physics, and understand most of the information presented in the seminar.

Another goal is to have fun.

This quarter, we will conduct a 'working review' of what is now referred to as the 'Standard Model'. I will assume you have taken first-year courses, but not quantum field theory.

We will have no textbook, but there will be material available on the web, and notes handed out. There are a lot of books on reserve for you.

After the Standard Model, we will begin a series of 'historical case studies' and topical studies in detector physics that will culminate in understanding the current experimental situation in neutrino oscillations, particularly the work of the 'Super-Kamiokande' experiment. My goal is that you understand how that experiment works, and that you be able to learn for yourself how related experiments do (or will) work. Next, we will do the same thing for CP violation, where there is a lot of current experimental activity.

Next quarter, we will do similar work toward understanding the high-energy frontier of the Standard Model, and perhaps, dark matter.

There will be no written tests. There will be weekly problem sets. In the last week of the course, you are responsible for making a 20-minute presentation, which will be during the class meeting time. In this presentation, you must use transparencies, and you will present either a report on an experiment already completed, or in operation, and described in the literature, or, a report on what you would propose to do for further research, were you to join a new group, like Super-Kamiokande.

For the presentation, imagine your audience is someone who is clever, knows some physics, and has either funded you, or who could provide funding for you. You have to capture their attention, and convert them to a supporter of you. Imagine that their level of physics knowledge is high, but that they are not experts; they want to know the logic of what you are discussing, but you may have to politely simplify jargon for them. Some people who might be your audience are Bill Gates, Steven Jobs, or the NASA administrator Daniel Goldin.

Your presentation should include:

1. A statement of the physical 'effect' you are pursuing: e.g., ν_μ turning into ν_τ, or the Higgs' particle existing, or whether the gravitational interaction violates parity, etc.

2. A short discussion of the broader implications of a positive result.

3. A clear and simple diagram of the apparatus, and the logical function of each piece.

4. A discussion of how much 'signal data,' (usually, number of signal events), and, the 'dominant backgrounds', you expect, or observed.

5. A conclusion about what was seen, or a discussion of prospects to see something interesting soon.

You must submit a one-paragraph proposal to me for your presentation by Monday, October 25. I'll give you feedback, and then, you must submit an outline, with at least three major references, by Monday, November 15. I'll give you feedback by Wednesday, November 24. Your talks will take place the week of December 6-10.

I suggest that you do three things to 'get in the swing' of experimental particle physics: 1) regularly scan the abstracts of 'new' papers at URL's `http://xxx.lanl.gov/list/hep-ex/new` and also `hep-ph`; come ask me if you find an interesting topic you want to discuss; 2) Read a few of the stories in the journal 'Adventures in Experimental Physics,' or a few chapters from 'Nobel Dreams,' which are on reserve; 3) peruse some the sources of news in particle physics, which include the CERN Courier, the SLAC Beamline, and Physics Today.