

May 14, 2012

Physics 622 Final Course Assignment

The final assignment for Physics 662 is to write a proposal for an experiment and to prepare and deliver a presentation making the case for the proposal. You may choose any topic that interests you. A list of possibilities is given below.

Experiments in high energy physics are approved by laboratory directors after their program committees have made recommendations on the proposals that have been received by the laboratory. The program committee is a group of about a dozen physicists from around the world with broad enough expertise and experience to address the relative importance of the physics goals of the experiment as well as the likelihood that the design of the experiment will succeed.

Your written proposal should be a minimum of 6 typed pages, and no more than 12 typed pages, with important figures attached (additional pages).

The written proposal should contain the following with quantitative discussion where possible:

1. Discussion of the physics goals of the experiment, the present world knowledge of the topic, and its impact on other physics (such as through virtual loop contributions to other measurements). Why is this an important experiment to do?
2. Discussion of the experimental technique. What are the backgrounds? How will the backgrounds be suppressed? What are the required measurements and resolutions? What are the systematic errors that limit the measurement?
3. Specification of the accelerator or other facilities needed (energy, particles, targets, luminosity, etc.) Will an upgrade of an existing facility be needed, will a new facility be needed, or is the present capability acceptable?
4. Specification of the detector. Describe the critical detector subsystems (such as vertex detector, tracker, particle identification system, calorimeter, and muon system, if needed.). What is the required level of performance for the systems needed in the experiment?
5. Run plan. How many events do you need to acquire? How many days/months of running will this take? You might want to estimate how many collaborators you will need to pull this off. (Of course this is relevant to the detector work in item 4, as well, unless you are using an existing detector. However, even an existing detector could be rather sophisticated, requiring many collaborators with specialized knowledge.)

(You may find the Particle Data Group web page useful in getting the latest information for your experiment: <http://www-pdg.lbl.gov>)

After you submit your proposal, you will be required to make a 30-40 minute presentation to the program committee and answer their questions. In our case, the program committee is the rest of the class.

A "letter of intent" must be submitted by May 30 indicating the topic you intend to propose with a brief summary. This should be about one page long.

Rules of the Game

You may discuss your proposal among yourselves (this is even encouraged) but in the end, you must write your own proposal.

Schedule

- ASAP – sign up for topic and get it approved
- May 30 - letter of intent
- June 4-6 – written proposal along with oral presentations

Possible topics include the following, or an alternative of interest to you:

- produce a billion Z^0 bosons operating a collider at the Z resonance, and exploit their decays for many measurements
- measure Δm_s from B_s mixing
- improve the top quark mass measurement
- improve the W boson mass measurement
- search for a supersymmetric particle
- search for a new heavy lepton
- search for quark substructure
- measure t anti-t forward-backward asymmetry in hadron-hadron interactions
- study ν_t interactions
- measure CP violation in the neutrino sector
- search for evidence of sterile neutrinos
- search for the decay $\mu \rightarrow e \gamma$
- measure the decay $K^0_L \rightarrow \pi^0 \nu \text{ anti-} \nu$
- search for proton decay
- measure α_s with high precision
- study the Higgs boson
- search for leptoquarks
- search for other hypothesized new particles