

MASSACHUSETTS INSTITUTE OF TECHNOLOGY  
Department of Physics

Physics 8.811

Fall Term 2003

## PROJECT INFORMATION

A major component of this course is a substantial project assigned to each student, which is to produce a proposal for an experiment to learn about physics “beyond the Standard Model.” You must create an experimental proposal with the aim of solving some problem in fundamental particle physics, *i.e.* making a measurement or setting a limit at least an order of magnitude better than current knowledge.

Your proposal must include the following components:

- **Physics Motivation:** You must state clearly the problem your experiment is designed to solve, why this problem is interesting, and what physics will be learned from the results (if appropriate, including what could be learned from a null result.)
- **Previous Work:** You must review the current status of the field regarding the problem you have chosen, and include an appropriate set of references.
- **Experiment Design:** You must describe in some detail the experimental setup, and then explain how it will achieve the results you are aiming for. You must support your arguments with simulation or other studies to make your claims plausible. It’s okay to propose an experiment which is similar to some proposal that already exists “out there”, but your discussion *must* include some original work, *e.g.* simulation studies. Do not feel restricted to standard “HEP-style” experiments.
- **Rough Costing and Scheduling:** You must provide some kind of estimate of costs and schedule. Since this is a physics course rather than a management one, this aspect won’t be over-emphasized, but there should be some sense of reality involved (although feel free to be a little bit ambitious, since this is a fantasy exercise after all!)

One important restriction: *you may not propose an experiment too similar to one you are now working on.* Your proposal must address both different physics questions and employ different experimental techniques with respect to your current thesis or research project.

Your proposal will be peer-reviewed. What this means is that your fellow students will each produce reviews (on both the writeup and the presentation) evaluating strengths and weaknesses of your proposal, and making suggestions for improvement. Note that your grade on the project will *not* be based on your peers’ reviews; however, your own reviews of others’ projects *will* be graded.

## Schedule

- Your “Expression of Interest” is due **Wednesday Sept 10**. This should be just a paragraph sent to me by email describing what you would like to do; it will not be graded. I will give you feedback and try to resolve conflicts in the case that more than one person has chosen the same topic. Please also indicate your availability for presentation dates. By the following week I will organize a schedule of presentations for the second part of the semester.
- Your “Letter of Intent” is due **Wednesday Sept 24**. This should be a 5-10 page document containing more details about your proposed experiment, touching upon all of the components listed above.
- Your proposal draft is due **Thursday Oct 23**. Email or point me to a pdf file for posting on the course web page. This proposal draft should have as many details fleshed in as possible. There is no specific page limit; however be aware that the more concisely you can express yourself, the better—remember, you are trying to convince someone to fund you, so the less work they have to do to get excited about the idea, the more likely it will be that you will get funded!
- Presentations will take place during the following weeks. These will be 1 hour presentations with the remainder of the class time reserved for questions and discussion. You may prepare either transparencies or a computer-based presentation. (A general suggestion: rehearse your presentation before giving it.)

Every other student is responsible for a 1-page “write-in” review, based on the posted written draft of your proposal, due two days before the presentation, as well as a “final” review due at the end of the week of the presentation.
- Your final revised proposal writeup is due on **Tuesday, Dec 9**.

At any time during this process I am happy to provide advice and feedback, i.e. suggestions on ideas and drafts, help with coding simulations, comments on talk rehearsals, etc.

## Suggestions for Topics

This is a list of various possible physics topics. Some of them are quite broad and you would want to focus your proposal. You are by no means limited to this list.

- Electroweak symmetry-breaking; the Higgs boson.
- Supersymmetry.
- Large extra dimensions.
- QCD.
- Quark-gluon plasma.
- Neutrino properties: absolute mass, magnetic moment.
- Neutrino oscillations.
- Relic big-bang neutrinos.
- Double beta decay.
- Baryon number violation.
- CP violation (in B's, leptons), matter-antimatter asymmetry.
- Lepton number violation.
- Dark matter; direct and indirect detection.
- Dark energy.
- Ultra high energy cosmic rays.
- Magnetic monopoles.

**HAVE FUN!!**