

## Physics Department Senior Design Project Proposal

### Project Mentor:

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### Project Title:

"Development of an Advanced Lab experiment to measure the lifetime of the mu lepton"

Project Type: [  ] Team; Number of students 2 [  ] Honors

### Objective

(What is the science and/or engineering in this project?)

Develop an experiment for the Advanced Lab course to measure the lifetime of a fundamental particle, the muon. The experiment can be done with a single photomultiplier tube. This project is to accumulate and configure the equipment necessary to set up this experiment. Then make the experiment work, and write a set of instructions. Evaluating, and refining the experiments as necessary during the spring semester 2009 when the course is taught will be part of the project. The project may also include a section to develop laboratory demonstrations of Binomial, Gaussian, and Poisson distributions.

### Prior Background

(What is the history of your involvement with this topic, including previous student projects?)

Dr. Wiencke instructed the Advance Lab in 2008 and will be the instructor in 2009.

### Student Expectations

(What are the deliverables (in addition to the lab notebook and reports) for the two-semester project?)

If you enjoyed making the advanced lab hardware work, and also enjoyed digging into the data analysis to really understand the underlying physics, this would be a good project for you. The student will be expected to keep an updated log book and provide a weekly written summary.

### Supervision Plan

(Who will be directly interacting with the student(s), you, a post-doc, grad students, or others?)

Dr. Wiencke will supervise this project. PhD Student, David Schuster, will also be available to help. David was a TA for the advanced lab course and will be a TA for the course in 2009.

### Resources

(What equipment, algorithms, and facilities are available, and what will be assembled as part of the project?)

A PMT, power supplies, and older NIM style electronics, and 5 gallons of liquid scintillator. It will probably be necessary to obtain more scintillator and possibly another PMT for this experiment. There is a considerable quantity of spare equipment available from the Advanced Lab.

### Technical References

(Identify a few key starting points for the student(s); journal citations, prior reports, instruction manuals, etc.)

There are a number of muon lifetime experiments described on the web. (google "muon lifetime")

A classic paper *American Journal of Physics* V38 p1196 (1970) describing the experiment can be found [here](#)

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