

# SCIPP Internship, July 2005

## Project Objectives & Responsibilities

### ***Experiment: Muon Lifetime***

Principal Investigator: **Melanie**, Co-investigators: Megan, & Grayson

Repeat last year's experiment using common lab equipment

- Review last year's reports
- Setup HV scintillator detectors (HV, dist, cables, NIM, DAQ)
- Plateau detectors and measure singles rates, coincidence rates, & efficiency
- Use Excel to determine the muon "Lifetime" or decay constant from data.

### ***Programming: FPGA, NI-DAQ, & Quarknet***

Principal Investigator: **Michael** Co-investigators: Jennifer & Grayson

Build, program, compare and contrast all 3 DAQ electronics boards and modes of analysis.

- Setup computer programming environments for: LabView, BASIC, Xilinx, Verilog.
- Become familiar with each language.
- Program NI-DAQ using LabView to measure decay times and report to file
- Program the FPGA board using Verilog to measure muon decay events and report to file.
- Set up and operate the Quarknet DAQ board. Analyze the data.

### ***Construction: Scintillator Detectors***

Principal Investigator: **Jennifer**, Co-investigators: Pedro, & Megan

Build a set of 4 scintillator detectors with low voltage tubes and bases that we can take back to PRHS for continuing experiments.

- Design, cut and polish new light guides.
- Prepare scintillator panels supplied by SLAC
- Assemble (glue) Scintillator panel to light guide to PM mounting tube
- Assemble and wrap light-tight.
- Test and measure singles rates, coincidence rates, and efficiency of each.

## **Data Analysis: Statistics, & Hypothesis Testing**

Principal Investigator: **Pedro**, Co-investigators: Micheal, & Melanie

Use Excel or MathCad and binomial & Gaussian statistics to analyze data from detectors.

- Analyze scintillator data to “plateau” the detectors and estimate the uncertainty of any rate measurements used to do this.
- Analyze decay time data to determine the muon “Lifetime” or decay constant and estimate the uncertainty of the determined value.
- Use the data to statistically test hypotheses such as: “Filling the cavity with books increases the muon capture rate”.

## **Silicon Detectors**

Principal Investigator: **Grayson** Co-investigators: Jennifer & Pedro

Help grad students in regular testing program for silicon detectors for deployment in the GLAST space telescope.

## **Website**

Principal Investigator: **Megan** Co-investigators: Michael & Melanie

Update Outreach website

- Redesign existing website
- Add new reports
- Add new resources and hyperlinks
- Add Balloon Fest Automated Registration system

## **Reports:**

Principal Investigator: **All:**

Lab Books, Presentations, Formal Reports, & Personal Comment Reports

- Good experimental records must be kept at all times.
- Regular (biweekly) reports will be presented to the group so that all will be informed of current progress.
- Formal reports will be published on the website.
- Personal reports of problems, resolutions, and growth are required by the funding agency and will also be published on the website.

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## Final Objectives

### **Muon Lifetime Experiment**

- Complete experiment
  - Should we use the Quarknet or the SLAC board to provide digital signal?
  - Can we get by without plateauing the scintillators?
- Get & analyze data
  - Are we set to analyze the data output by the FPGA?
  - Do we know how to do an exponential line fit and log plot?
  - Do we know how to estimate the goodness of fit for the exponential?
- Present findings
  - Plan on at least one more opportunity to present your findings, probably on Wednesday.

### **Website**

- Fully document your experience and the results of this summer's internship (i.e. bios, essays, pictures, presentations).
- Write How-To essays with pictures and graphs showing next year's interns as well as other web visitors how to:
  - Build & test scintillators
  - Plateau scintillators: procedure to estimate optimum tube voltage, get and analyze count data, estimate expected singles, coincidence and accidental rates, find plateau of coincidence vs discriminator level.
  - Program and operate the Quarknet board and the FPGA boards
  - Analyze plateau count data (statistical sampling error)
  - Analyze decay time data (exponential line fit and log plot)
- Plan to present a walkthrough of the newly completed website by Thursday.
- Plan to make any last changes on Friday.

### **Equipment Pkg for School**

- Identify a complete set of equipment (scintillators, boards, power supplies, cables, software, manuals, & documentation) that will be necessary to do the Muon lifetime experiment at PRHS.
  - 4 new scintillator detectors (low voltage) in new crate housing unit.
  - Existing Quarknet, SLAC and Berkeley boards in housing with 3 small scintillators, power supply and breadboarded counter circuits.
  - FPGA board, cables, software, manuals, etc.
  - Two 5-foot scintillators from SLAC (high voltage with bases)
  - ?
- Package it up for safe shipment
- Transport it to PRHS (The two crates will need transport back to Paso by one or more of you)

## **Clean-up**

- Put away all lab equipment, cables, and tools where they were found.
- Clean up the lab area.
- Move any needed files to the RET ftp website and delete all other user or data files off of the computers in the lab.