# MUON LIFETIME (MUO)

*****Monte Carlo Computer Program Required*****

Student's Name_____

Partner's Name_____

**Pre-lab Discussion Questions and sign off sheets**

**Watch the Video on this experiment first & view the Reprints**

It is your responsibility to discuss this lab with a professor or GSI on the first day of your scheduled lab period. This signed sheet must be included as the first page of your report. Without it you will lose 1/3 of a grade for the report (e.g. A- to B+). You should think about and be prepared to discuss at least the following before you come to lab:

1. What is a muon?
2. How and where are the muons in this experiment produced?
3. In deriving the muon lifetime from the measured data, does any correction need be made for the time that the muon travels before it reaches the tank?
4. The cosmic ray flux at sea level, integrated over all angles is approximately one particle per square centimeter per minute, on any horizontal surface. The flux passing in both directions through a *vertical* surface is one-half as much. Use the zenith angle dependence of muon intensity to explain this result. Muons come only from the upper hemisphere (above the horizon).
5. Given the geometry of the detector, 60 cm x 30 cm x 240 cm high, calculate the number of cosmic rays per minute which enter the detector.
6. The fact that Figure 6 of Rossi [Ref. 6] is relatively flat from zero to several hundred g/cm$^2$, means that the number of muons which stop in a fairly shallow detector depends only on the number of grams of the detector. It does not depend on the shape of the detector, nor on the direction of incidence of the muons. For solid angle use $2\pi/3$ steradians ($=\cos^2\theta$ integrated over the upper hemisphere.) Calculate the number of muons that will stop in the detector. Assume the density of the mineral oil is 1 g/cm$^3$.
7. Think how you will analyze the data. What program will you use? What steps need to be done? Discuss your choices with an instructor.

Staff Signature _____
Completed on the *first* day of lab? (circle) Yes / No

**Mid-lab Questions and sign off sheet**

On day 3 of this lab, you should have successfully acquired an over-night muon spectrum with a calibrated time scale. Make a crude measurement of the lifetime. Show your spectrum to a GSI and ask for a signature.

Staff Signature Curve OK; lifetime OK_____
Completed on the *third* day of lab? (circle) Yes / No

**INCLUDE THESE SHEETS AS THE FIRST PAGES OF YOUR REPORT**

 

## *Physics 111 Advanced Lab Student Evaluation of Experiment*

Now that you have completed this experiment, we would appreciate your comments. Please take a few moments to answer the questions below, and feel free to add any other comments. Since you have just finished the experiment it is *your* critique that will be the most helpful. Your thoughts and suggestions will help to change the lab and improve the experiments.

Please be as specific as possible, using both sides of the paper as needed, and turn this in with your report. Thank you!

Experiment name: _____ Date:_____

How was the write-up for this experiment? How could it be improved?

How easily did you get started with the experiment? What sources of information were most/least helpful in getting started? Were the reprints appropriate? Did the Pre-lab discussion help? Did you need to go outside the course materials for assistance? What additional materials could you have used?

What did you like and/or dislike about the experiment?

Would you recommend this lab to fellow student? Why or why not?

What advice would you give to a friend just starting this experiment?

If the course materials were available over the internet (WWW, FTP, etc), would you (a) have access to them and (b) would you prefer to use them this way?

| Please circle the abbreviations of the other labs you have done. | Overall quality of this experiment? |
|---|---|
| ATM BMC BRA COM $CO_2$ GMA HAL<br>HOL JOS LIF LLS MNO MOT MUO<br>NLD NMR OPT OTZ RUT SHE XRA | 1 2 3 4 5<br>Poor Average Good |

 