8 October 2020

1.3 Muon Physics

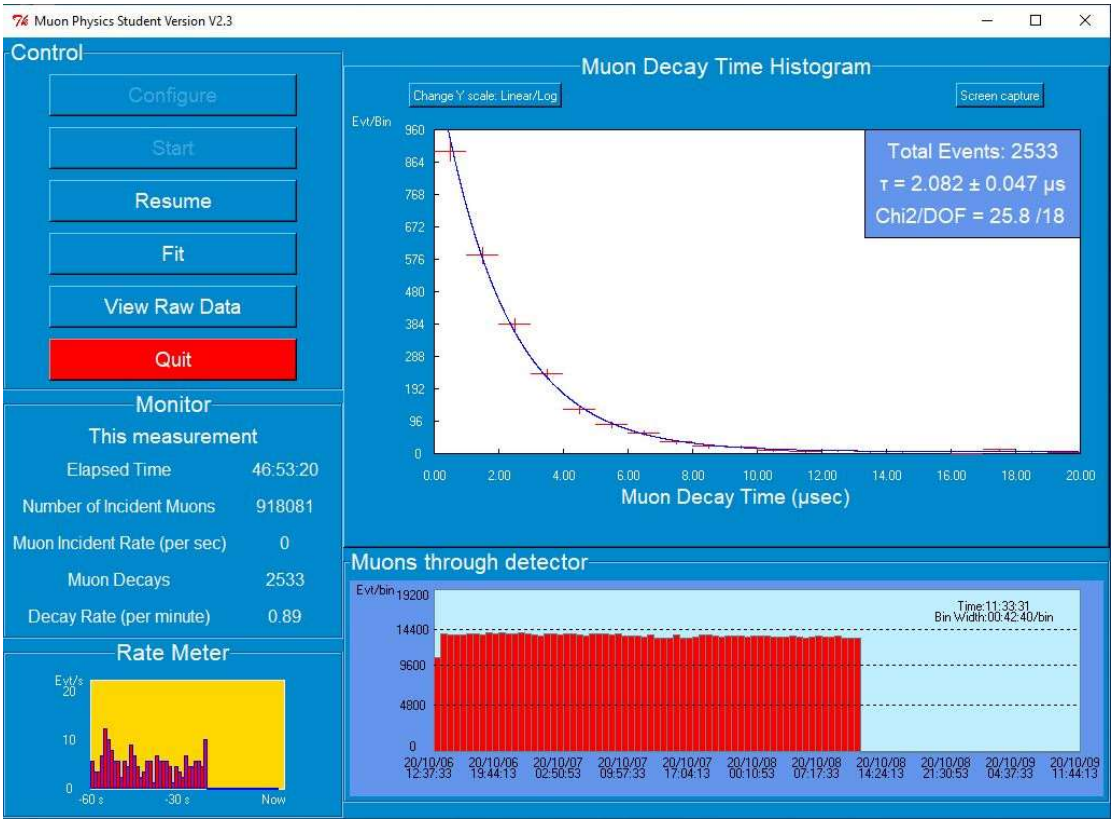
The fourth Pre-Lab:

- Task:
  - Obtain the records of task6, the one with discriminator threshold 400mV
  - Run the remaining part of task5, the one with discriminator threshold 250mV

The fourth lab session: (8 October 2020, 12:05pm)

- Procedure and discussion:

  1) As we have run the equipment and program since the day before yesterday, totally there was over 918 thousand Muons, or Muon-like signals, detected and 2.5 thousand of them decayed as expectation. And the result is a beautiful exponential curve, shown as Figure 1. The final read of threshold of discriminator was 395mV.



  2) With such data, we could calculate the background rate, with discriminator threshold 395mV:

$$P(2,0\ to\ 20) = \int_0^{20} \frac{(rt)^n \times e^{-rt}}{n!} dt = 1.3483e-8$$

$$R_{background} = \frac{P(n,t)}{t} = 0.067\%$$

The background rate is much smaller than the result obtained last session.

Here I would like to correct a previous incorrect result in Note3, that with discriminator threshold 100mV, the probability density is that:

$$P(2, 0\ to\ 20) = \int_0^{20} \frac{(rt)^n \times e^{-r}}{n!} dt = 2.818e - 6$$

$$R_{background} = \frac{P(n,t)}{t} = 14.09\%$$

3) After we pre-processed the data, we set the equipment that discriminator threshold is 250mV. We will get the record tomorrow. Further data analysis will be contained in Post Lab note.

4) To answer the question in lab manual that why we could recognize the life span of a muon we detect as the real life span of a muon, we should know that for a muon, its state is either non-decay or decay. Muons, if not decay, are identical particles. Hence, the possibility of a muon decay in t when created in nature and that of one when detected is the same. That is the reason why we see the records from PMT is the real life span of muon.