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↑ Life Time ... oops

BACKGROUND

Muons decay following

$$\mu^{\pm} \rightarrow e^{\pm} + \nu + \bar{\nu} \qquad (1)$$

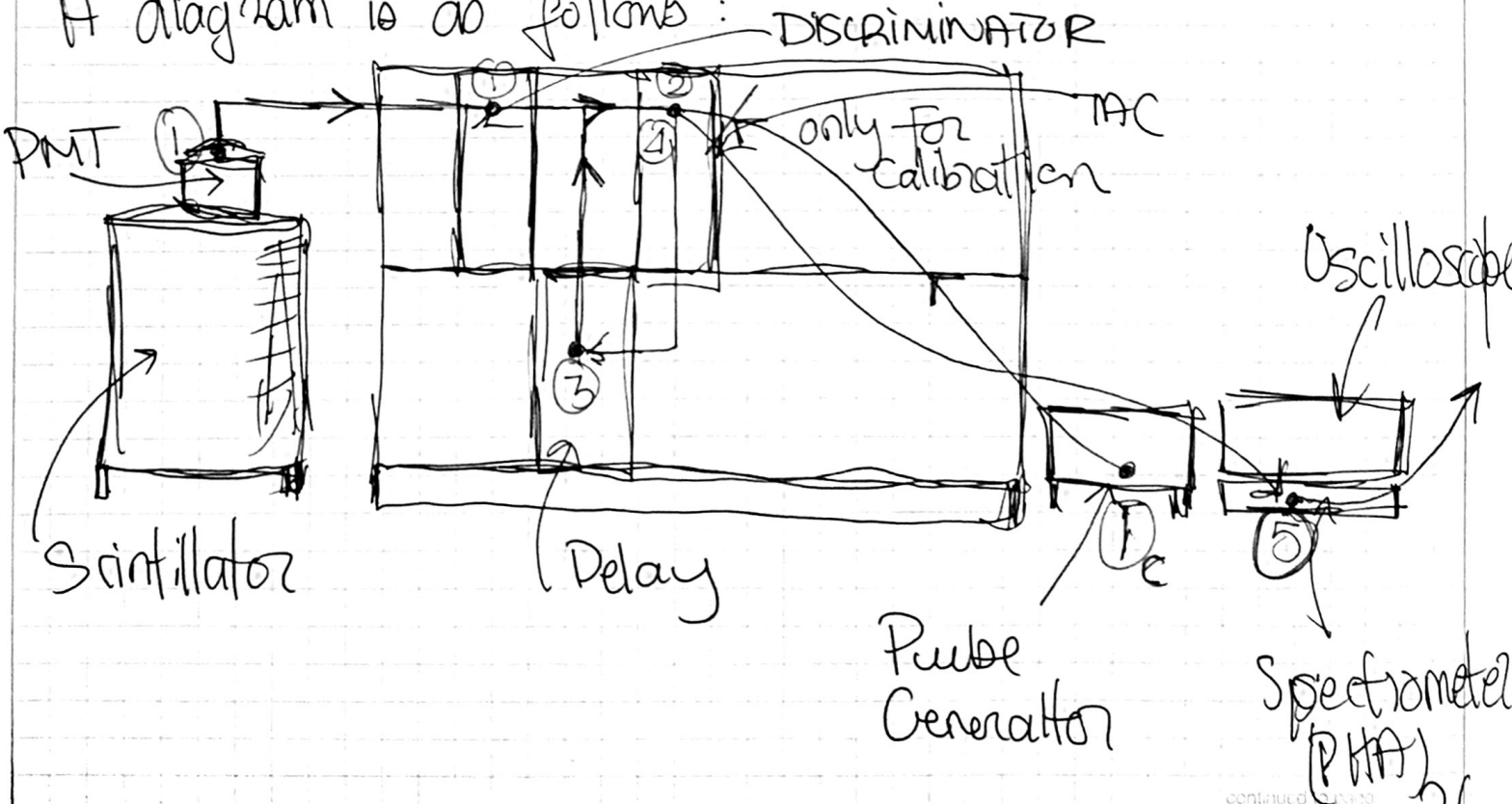
The rate of incoming muons can be modelled by

$$R(t) = R_0 \exp[-t/\tau] \qquad (2)$$

where τ is the e-folding depth/time of the decay rate. Therefore, we call t the mean half-life (life time).
For an exponential distribution, τ is the mean and the standard deviation. So Basically (2) is the relative probability of the decay of a muon.

EXPERIMENTAL SETUP

A diagram is as follows:



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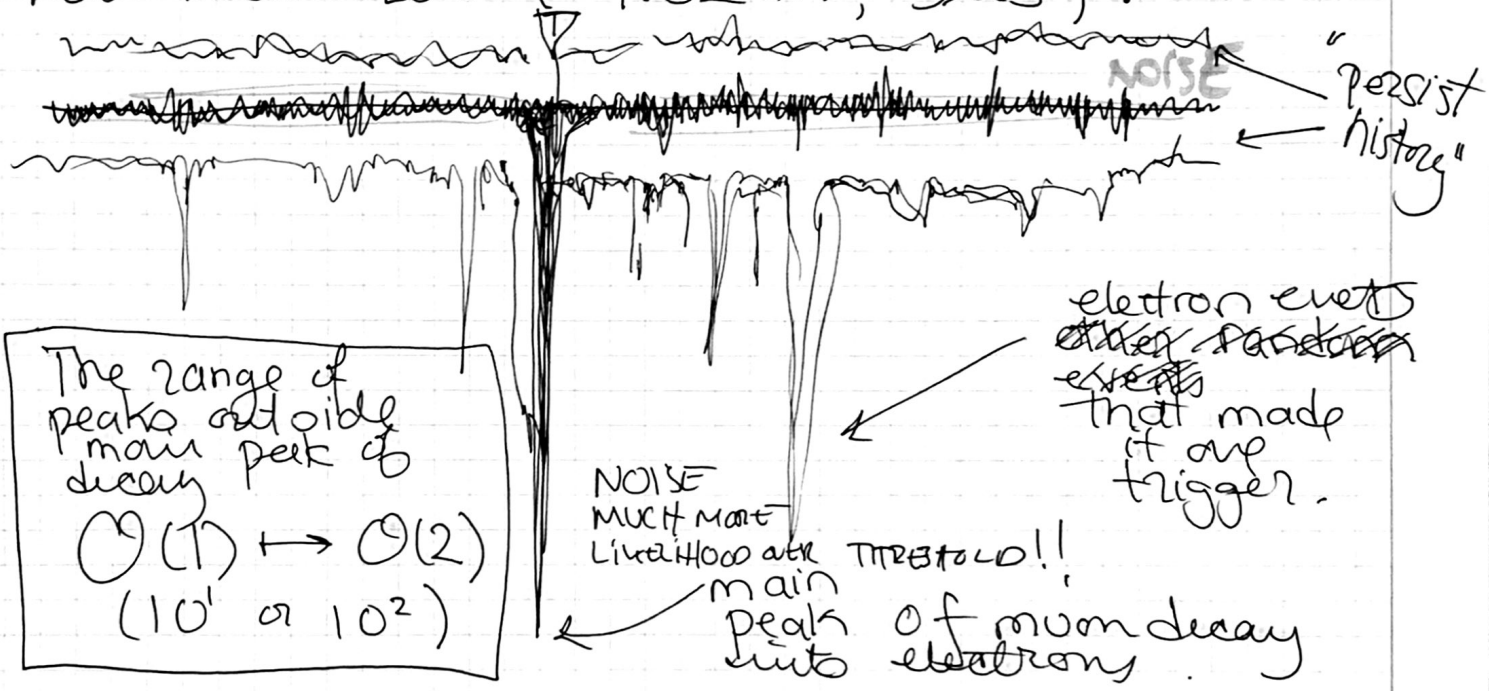
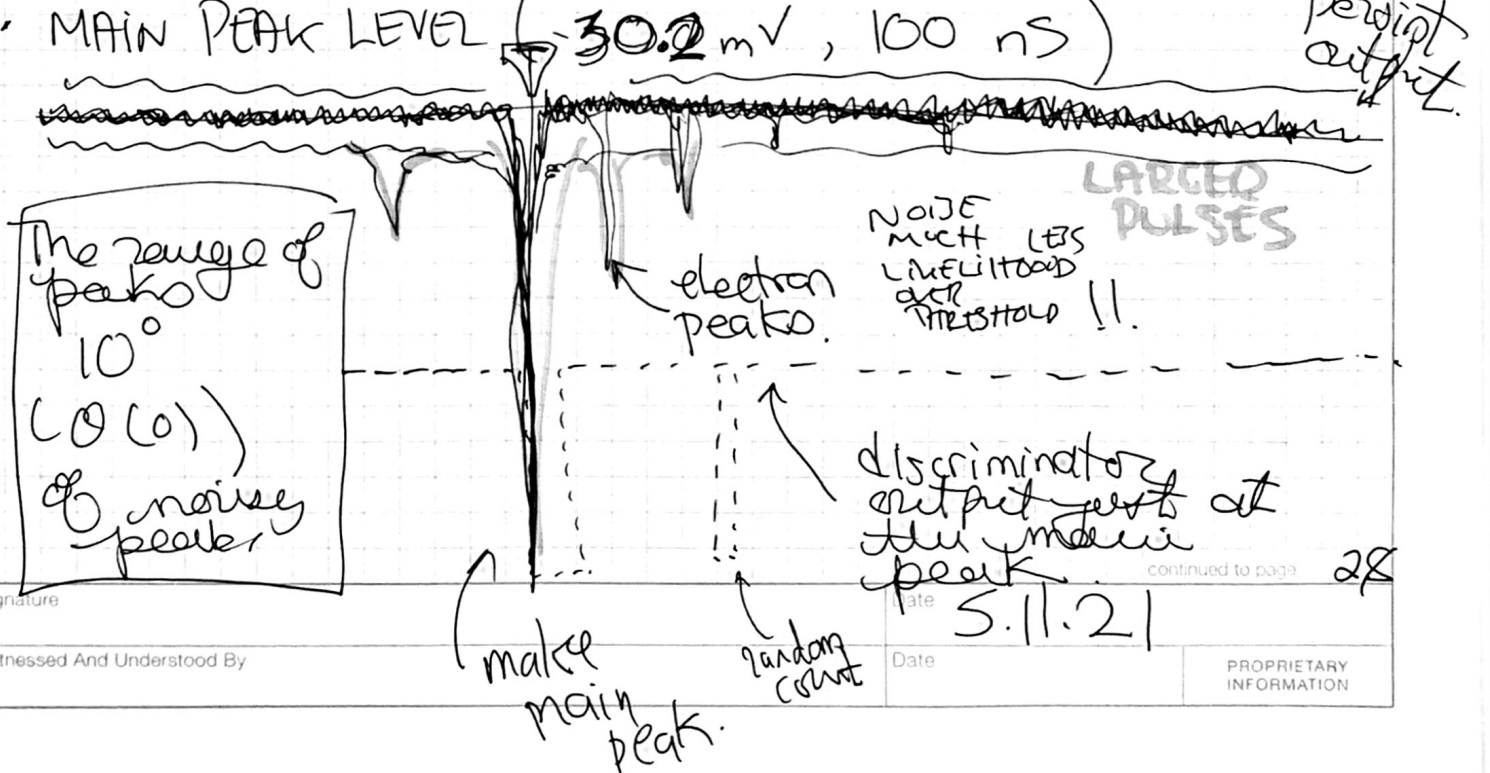
EXPERIMENTAL PROCEDURE

- Measured discriminator threshold voltage: 0.302 V on meter = -30.2 mV from discriminator
- PMT High voltage: Kept at preset, −1800 V.
- NOISE TRIGGER LEVEL (-7.52 mV, 5uS):



The range of peaks outside main peak of decay $O(1) \mapsto O(2)$ (10^1 or 10^2)

- MAIN PEAK LEVEL (-30.2 mV, 100 nS)



The range of peaks 10^0 ($O(0)$) of noise peaks

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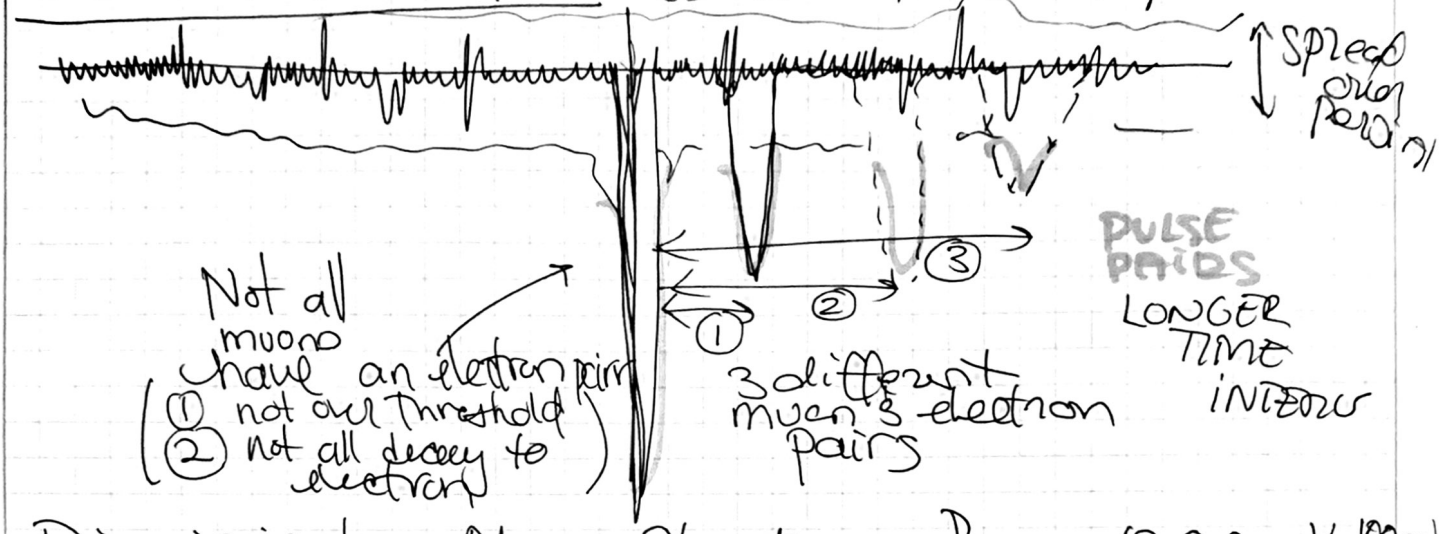
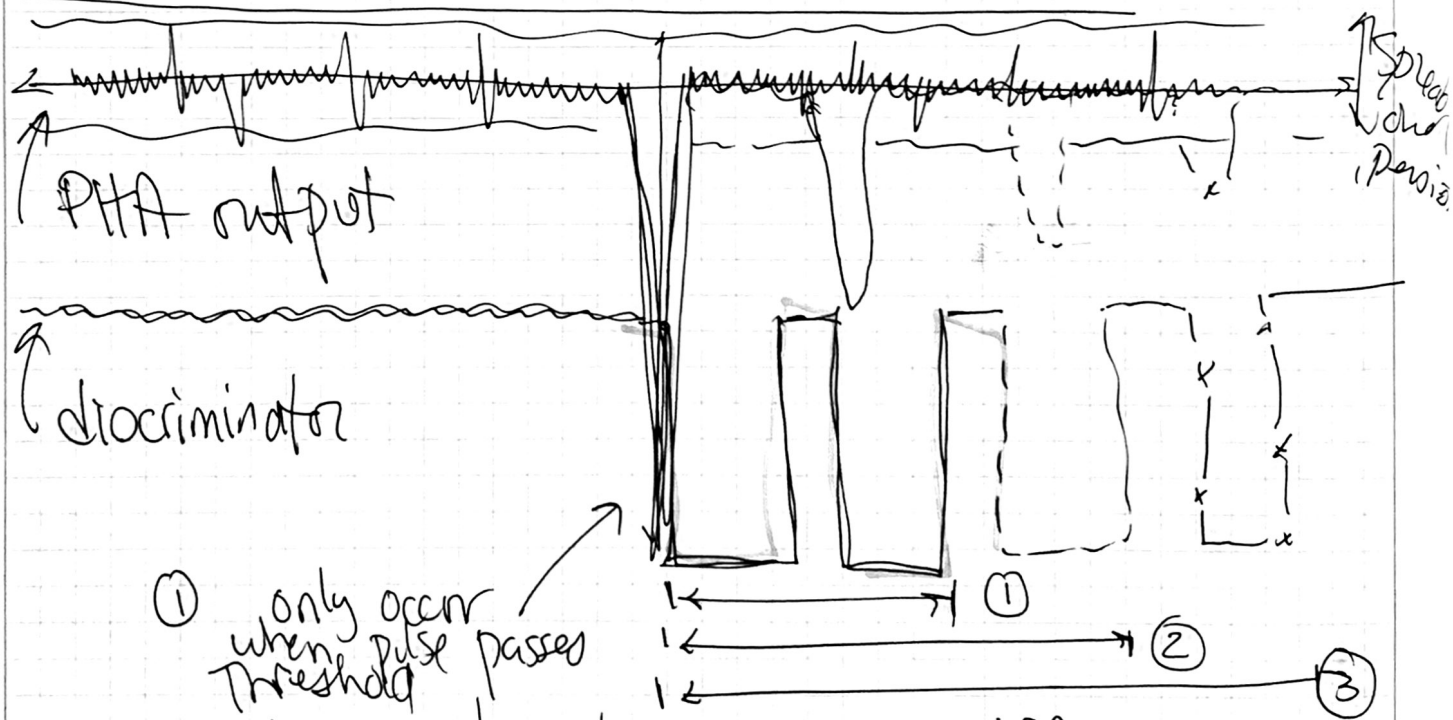
Muon - Electron Pairs (±0.2 mV, 100 ns)



Discriminator Muon-Electron Pairs (±0.2 mV, 100 ns)



FINAL PMT VOLTAGE: -1800 V. UNCHANGED.

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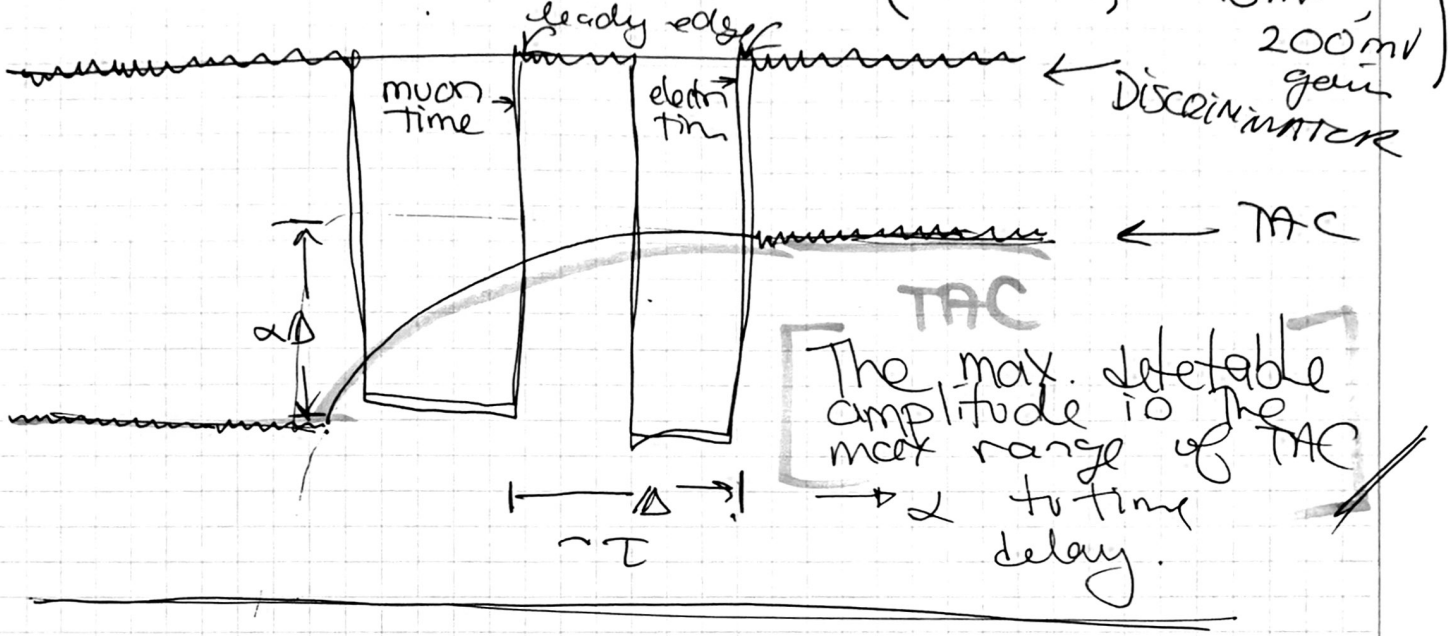
TAC OUTPUT & DISCRIMINATOR (250 ns, -20.0 mV, 200 mV gain)



TAC

The max. detectable amplitude is the max range of TAC → α to time delay.

PULSE DELAY	CHANNELS (START / STOP)	α
(1) 7.60 ± 0.20 μs	230	
(2) 2.40 ± 0.2 μs	70	
(3) 10.20 ± 0.2 μs	318	
(4) 13.30 ± 0.2 μs	419	
(1) 10.80 ± 0.2 μs	335	
(2) 14.80 ± 0.20	460	
(3) 8.30 ± 0.2	257	
(4) 5.40 ± 0.2	~~184~~ 165	
(5) 2.20 ± 0.2	64	

(calibration data)

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① if: no delay box ⇒ no diff. between start & stop triggers so whole pulse method breaks.

② if: stop ↔ start ⇒ just recording delay.

$$\exp[+/\tau] = \exp[+/(\tau+\Delta t)]$$

$$\sim \exp[-1/c]$$

multiplicative

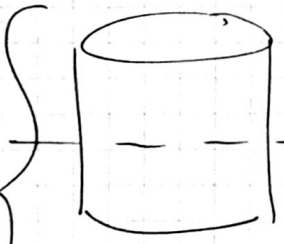
just include top as we only really got to measure muons (really decaying entering from the top

absorbed into R_0 of $R_0 e^{-t/\tau}$

$\pi(\frac{4}{2})^2 + \frac{4}{2}(4 \cdot \pi)$

$\approx$ [illegible] muon/min

only top ⇒



we measured 1381 ± [illegible] per 6×10⁵ sec

→ Both 10^3 order ✓

1381 / 5250 / 1 ≅ 0.26 muons/cm²/min.

which is an percentage error of [illegible] 0.046 25% error

53 $\frac{\text{muon}}{\text{min}}$ * $\frac{\text{min}}{\text{muon}}$ × muon

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- ~~13.81 muons / min decay into electrons~~
- ~~14 min / muon~~ ~ 13 muons and 60/13 = 4.6 seconds/ between pulses

Predicted accidental:

$$f_{acc} = R(1 - e^{-RT})$$

$T = 20\,\mu s =$

$R = 13201$ muon/min

$(e^x \approx 1 + x + x^2 + \dots)$

$\approx R^2 T$

≈ 0.49

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