

# Measuring the Energy Loss Distribution of Cosmic Ray Muons in a Water Cherenkov Detector

Ad-Lab,

Christopher van Hoecke & Sara Sussman

# The Agenda

# The Muon

The Goal

The Apparatus

Electronic Setup

Results

The Muon

The Goal

The Apparatus

Electronic Setup

Results

The Muon

The Goal

The Apparatus

Electronic Setup

Results

The Muon

The Goal

The Apparatus

Electronic Setup

Results

The Muon

The Goal

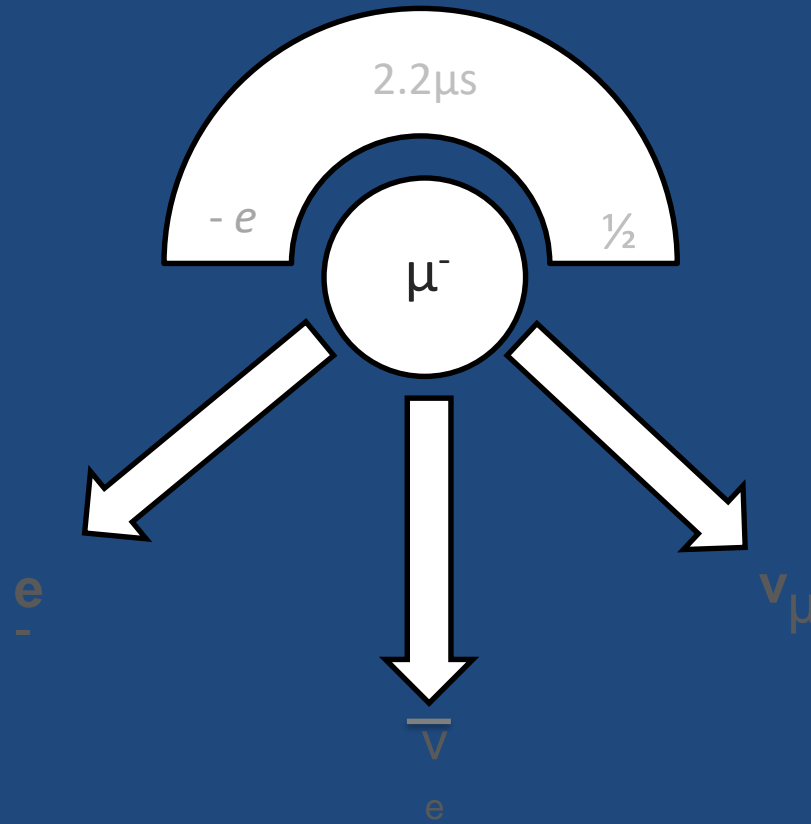
The Apparatus

Electronic Setup

Results

# Muon

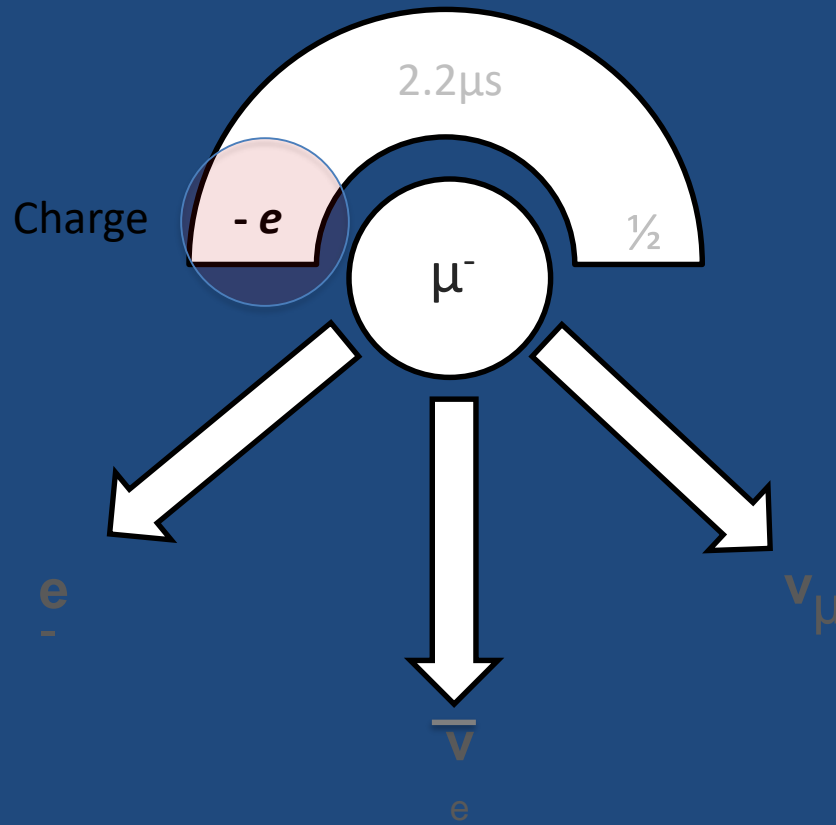
---





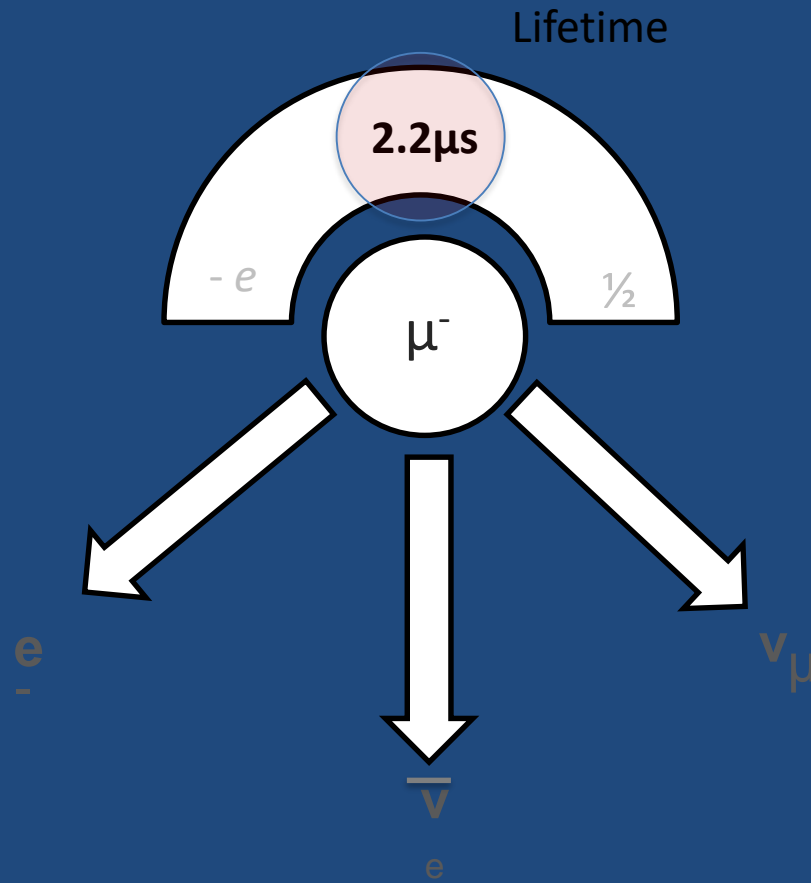
# Muon

---



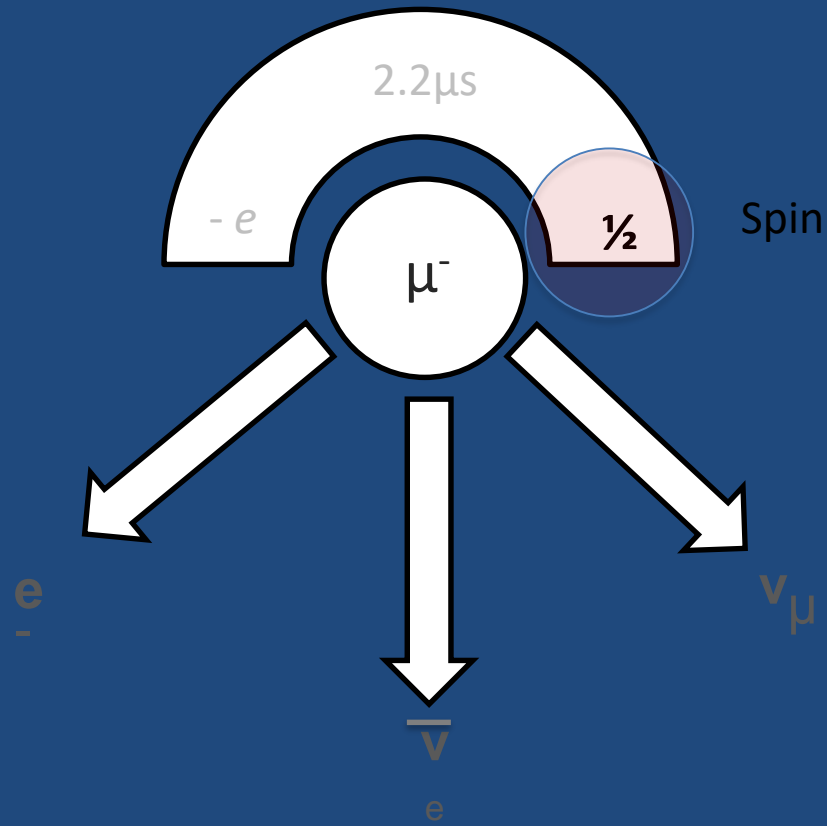
# Muon

---



# Muon

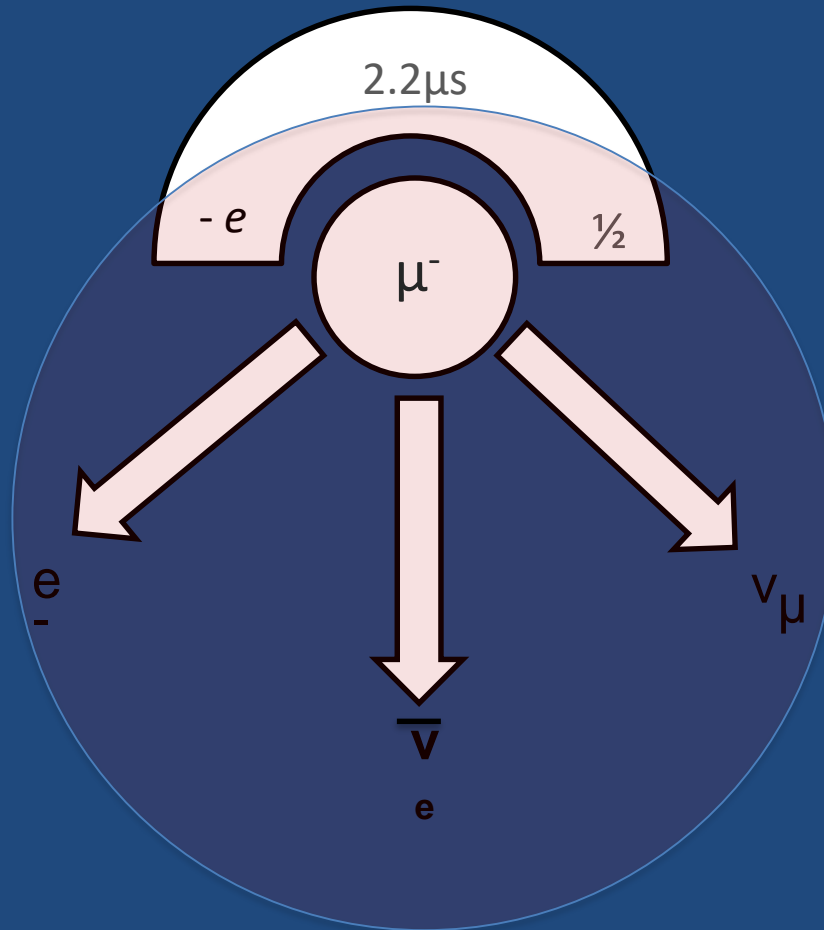
---



# Muon

---

Decay Scheme



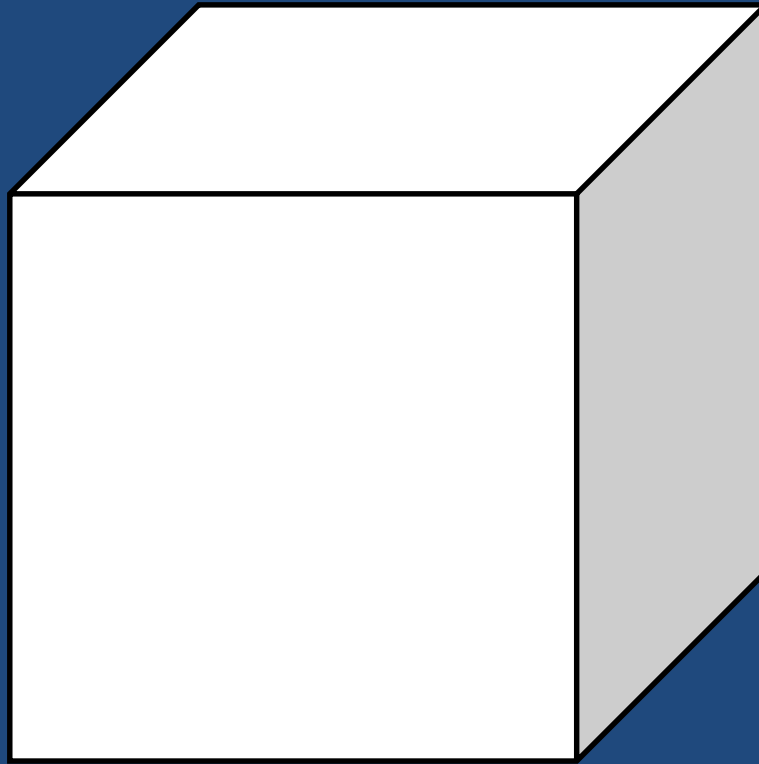
# Goal

---

Obtain Landau distribution of energy loss of charged particles traversing matter

# Apparatus

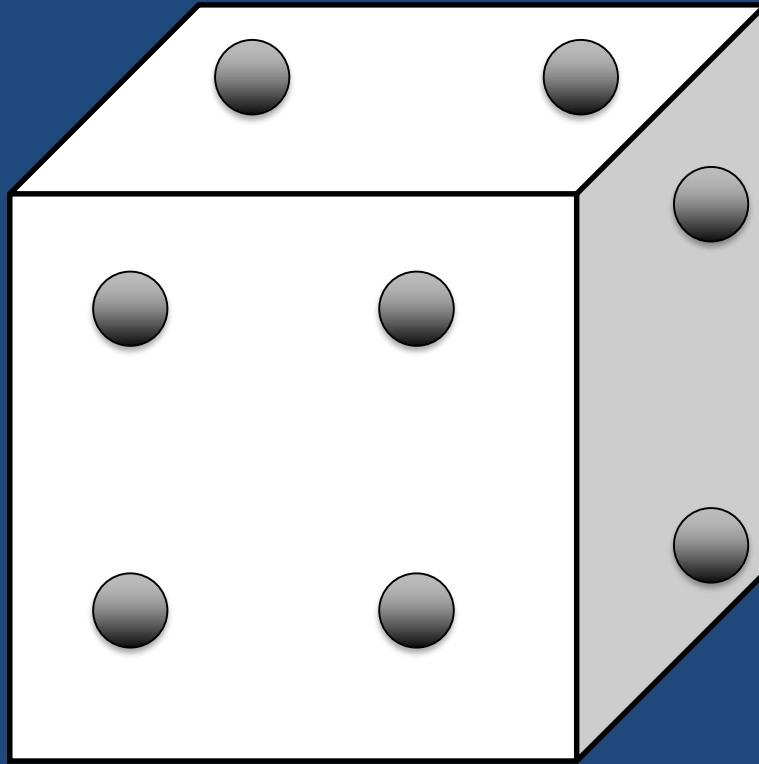
---



$$6.8 \times 10^4 \text{ cm}^3$$

# Apparatus

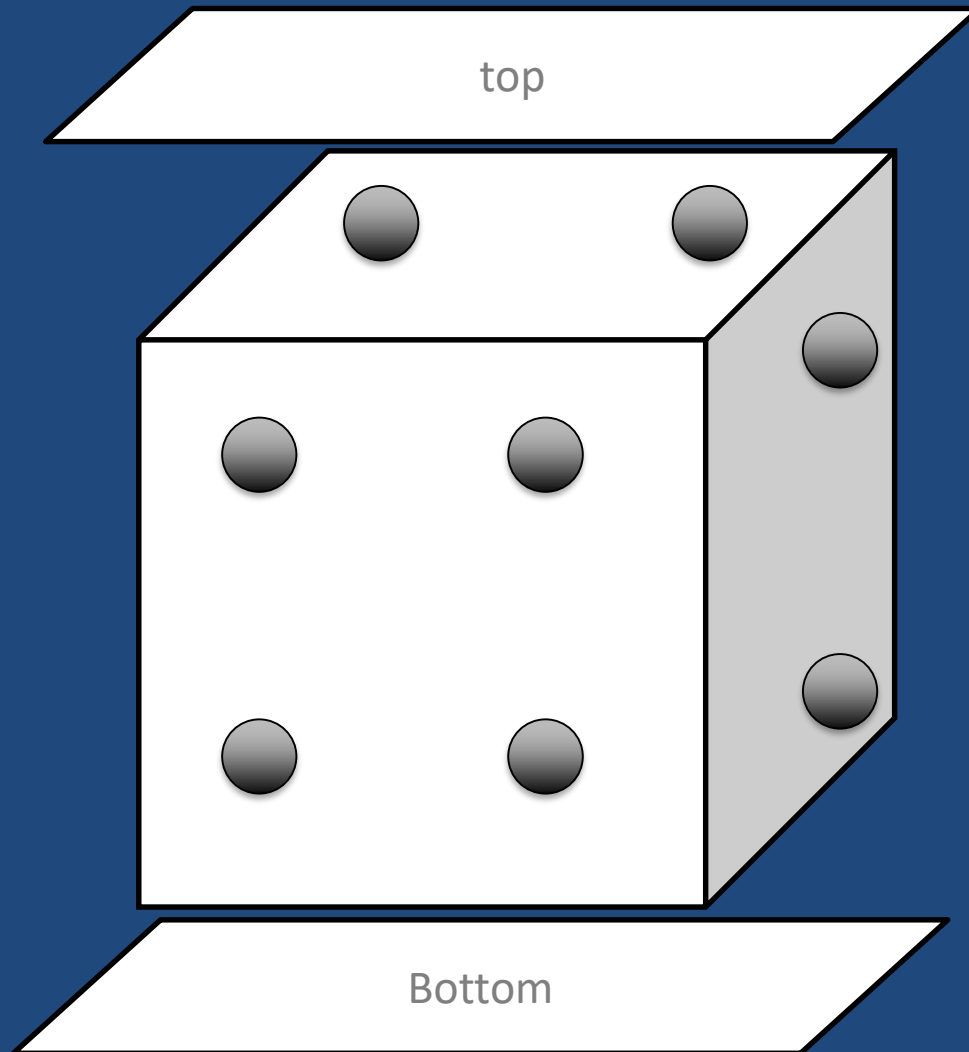
---



$$6.8 \times 10^4 \text{ cm}^3$$

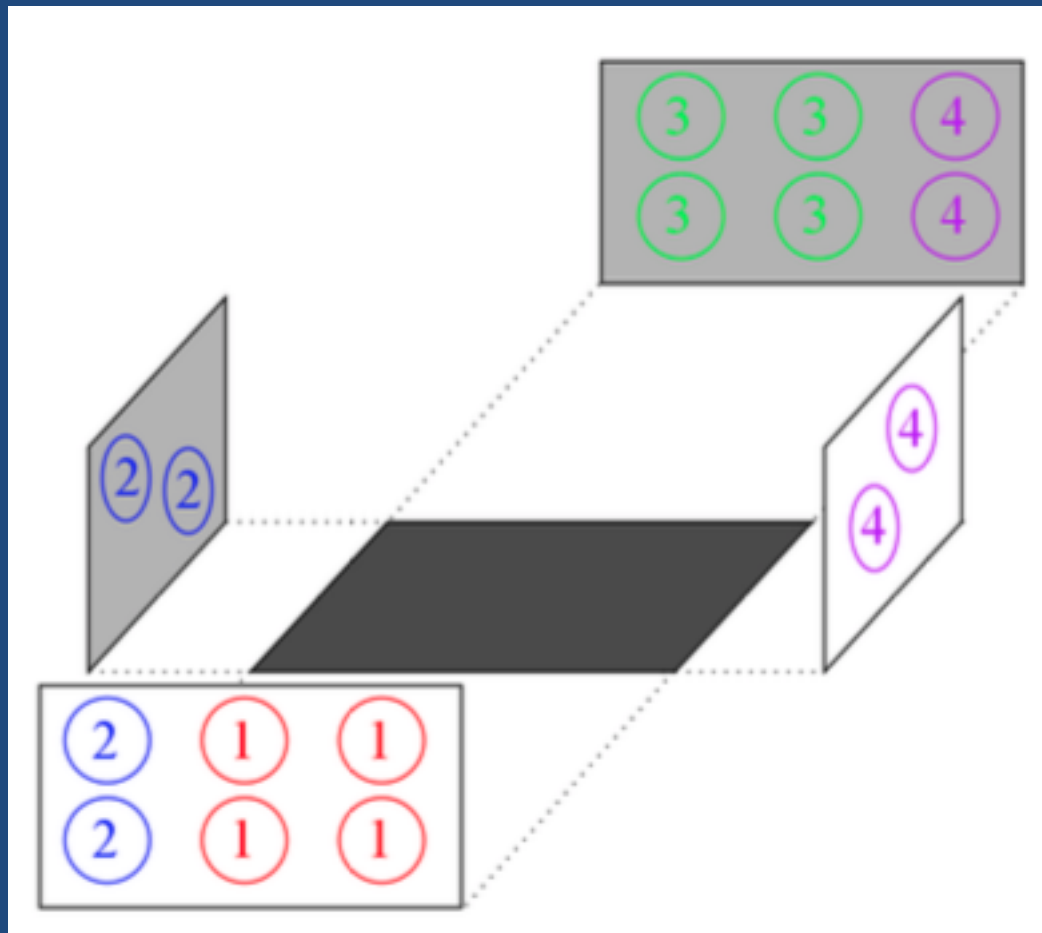
# Apparatus

---



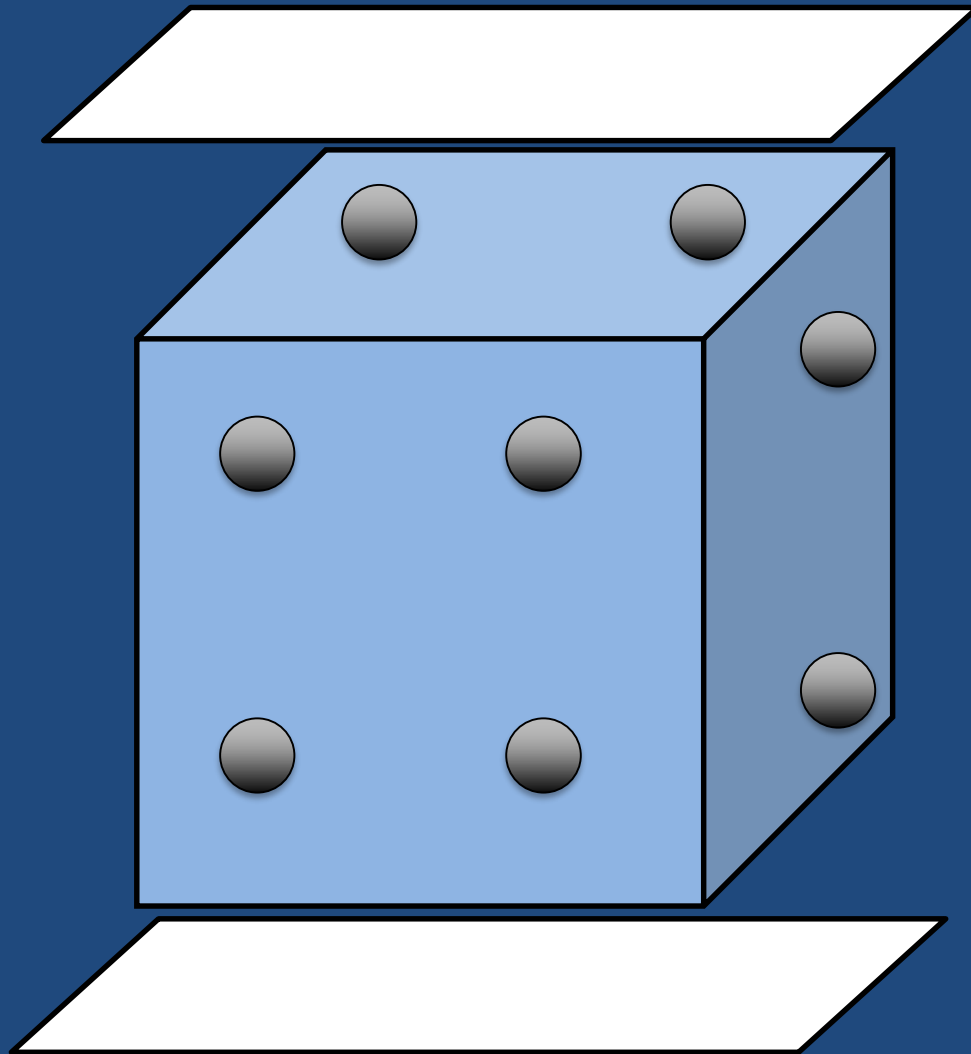


# Apparatus

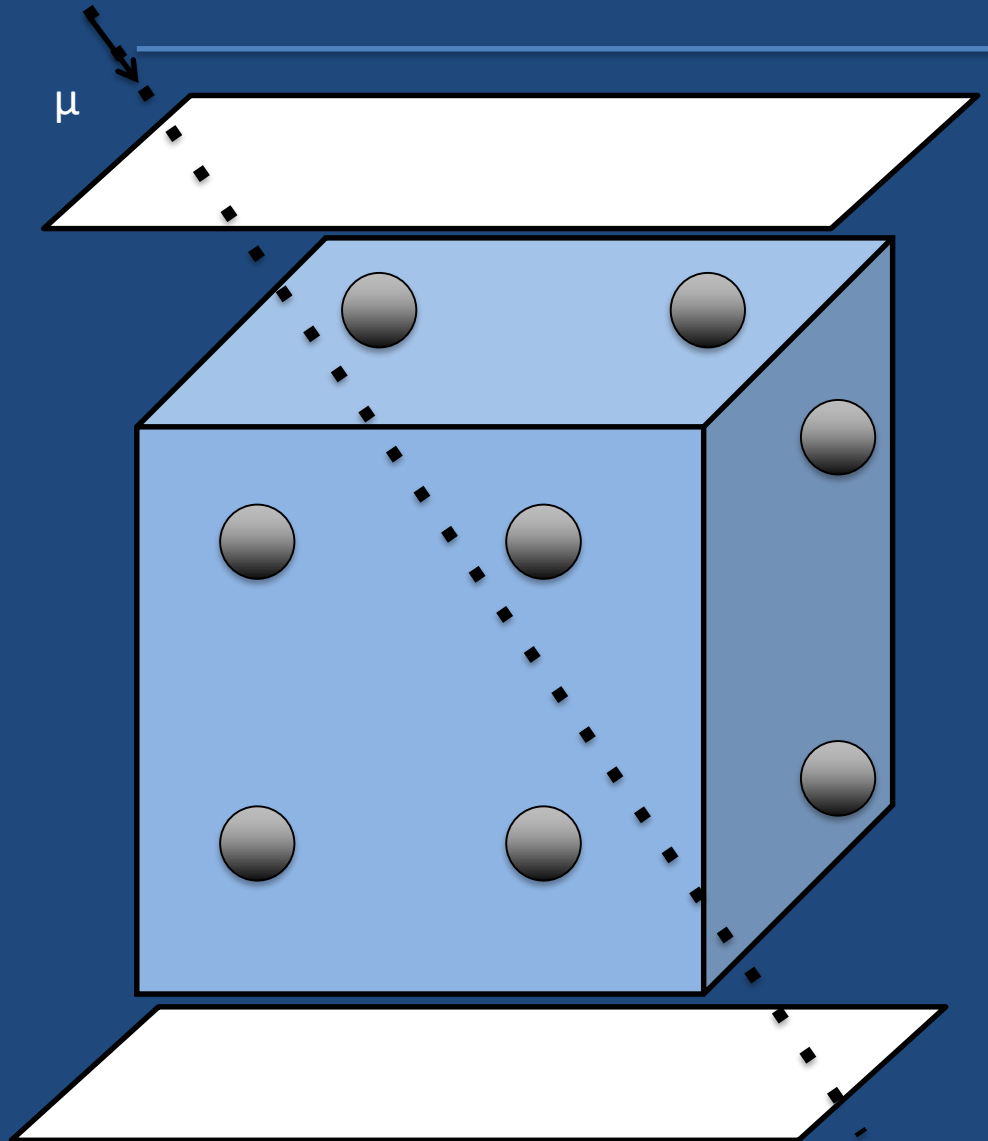


# Apparatus

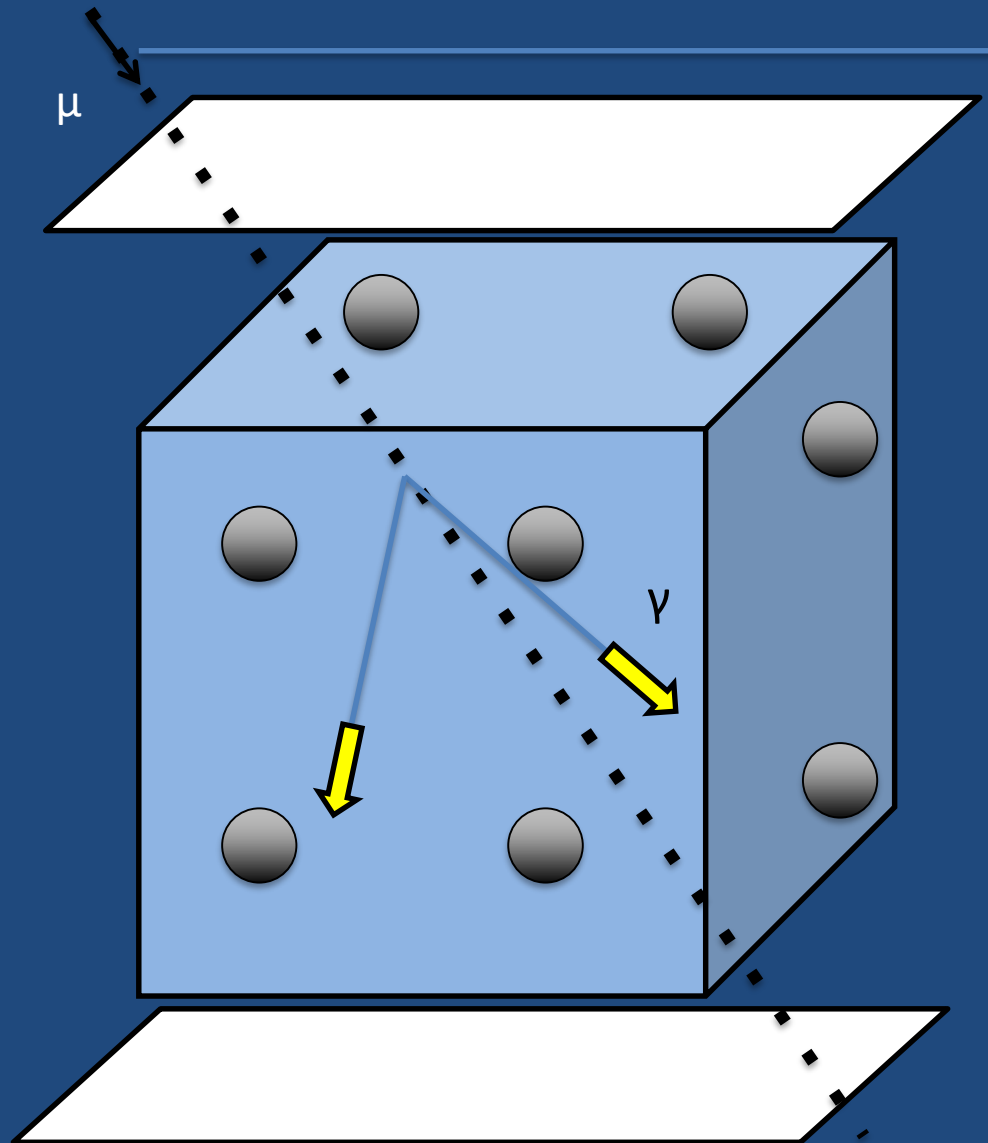
---



# Apparatus



# Apparatus

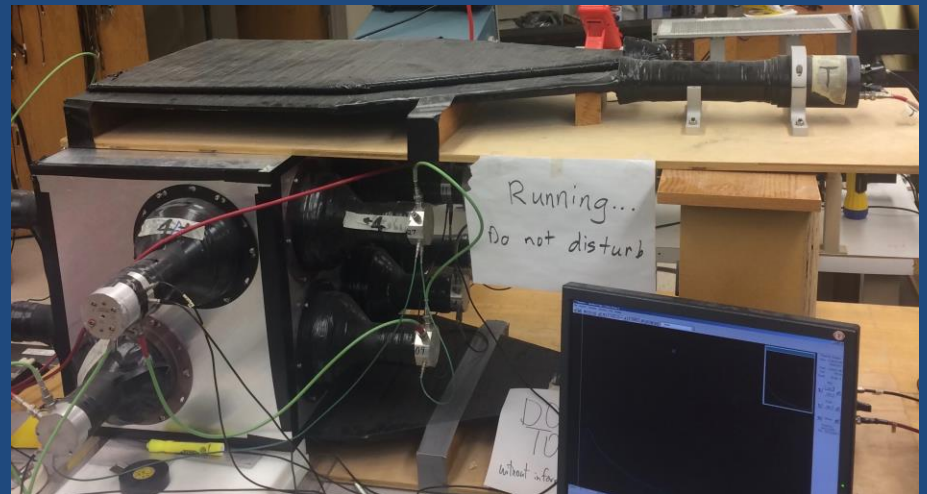


# Apparatus

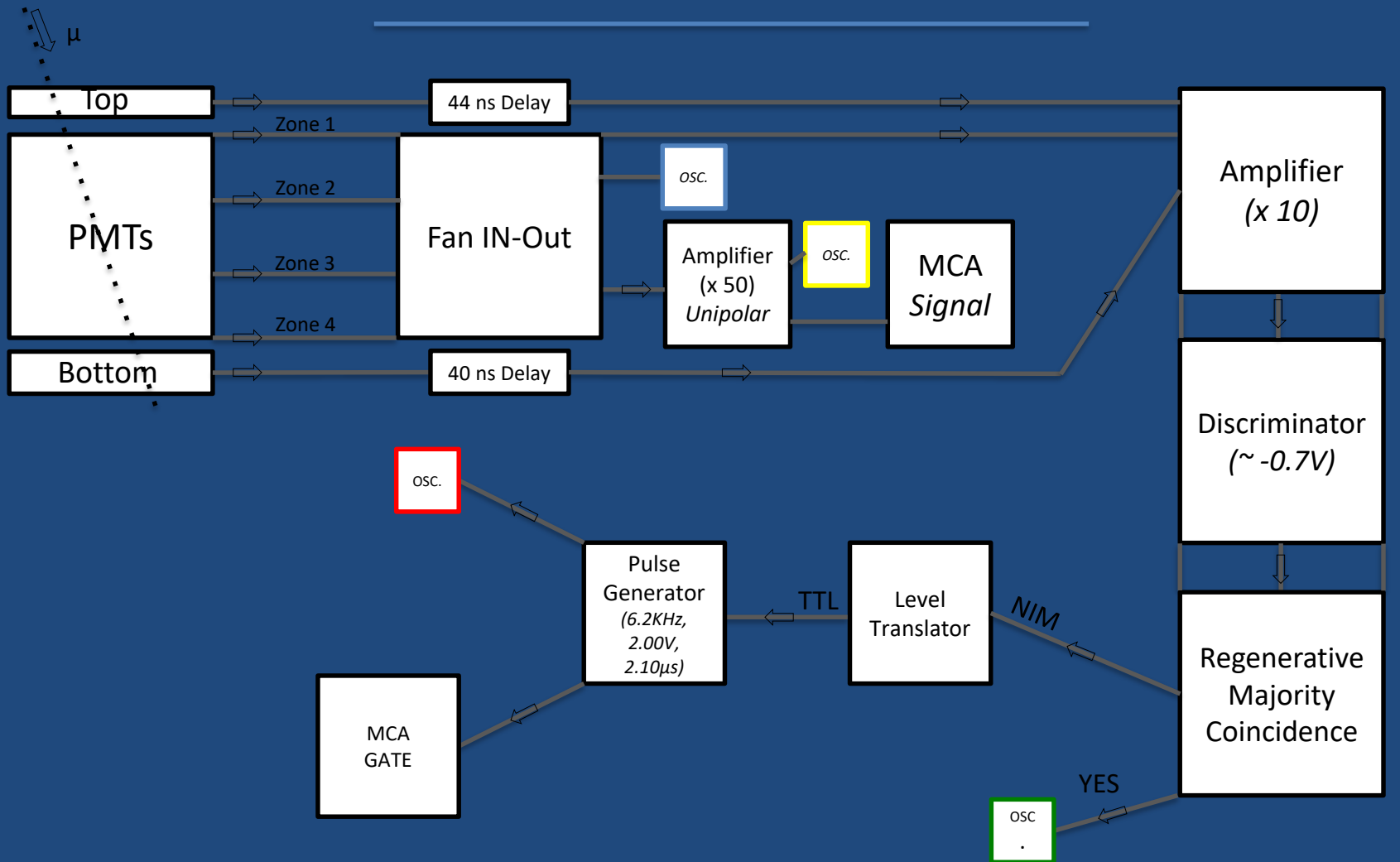
---



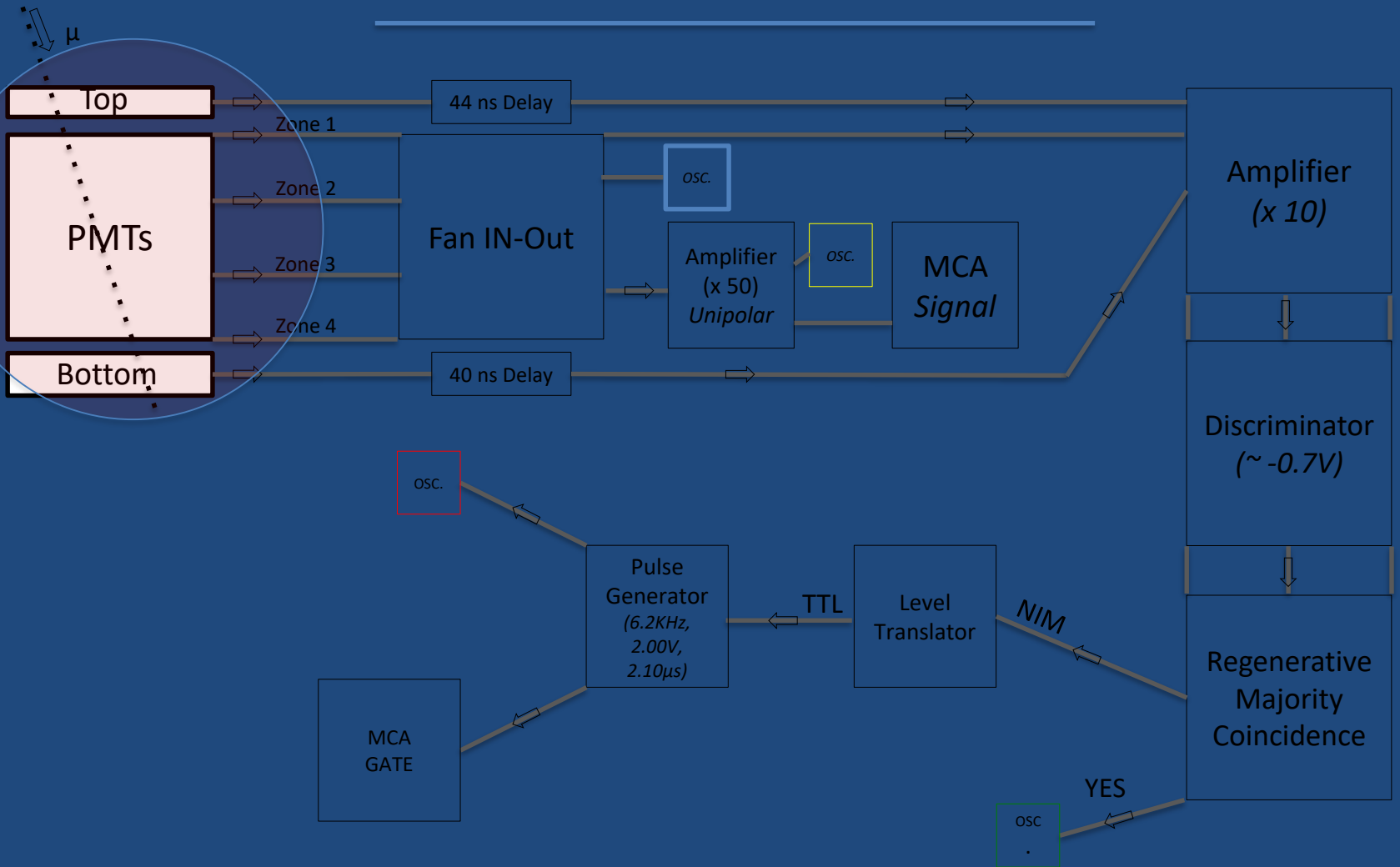
*Ref : Measuring the lifetime of the Muon with water Cherenkov Detector  
Daniel Lievens, Dasom Lee, December 2012*



# Electronic Setup

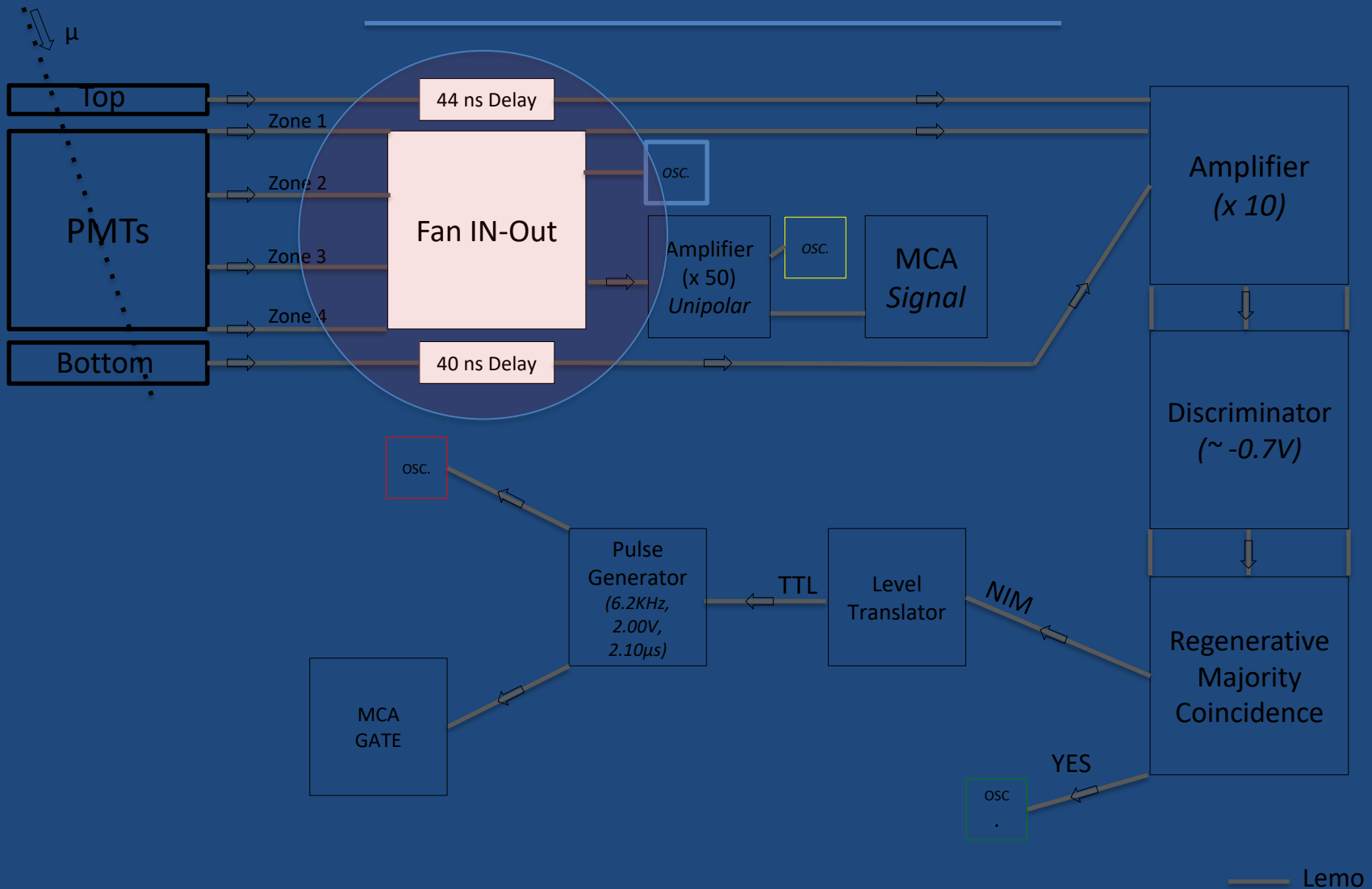


# Electronic Setup



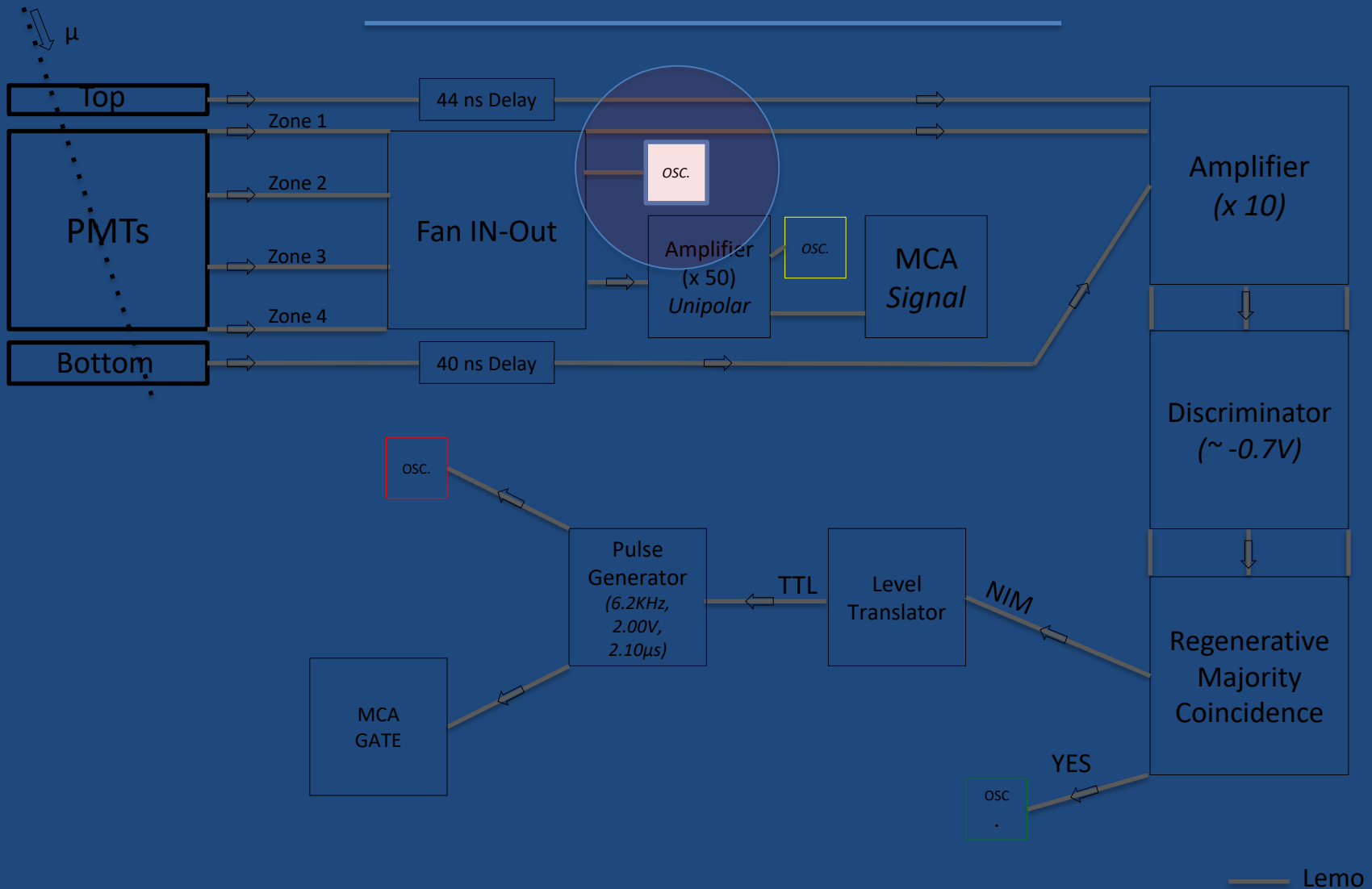
— Lemo

# Electronic Setup



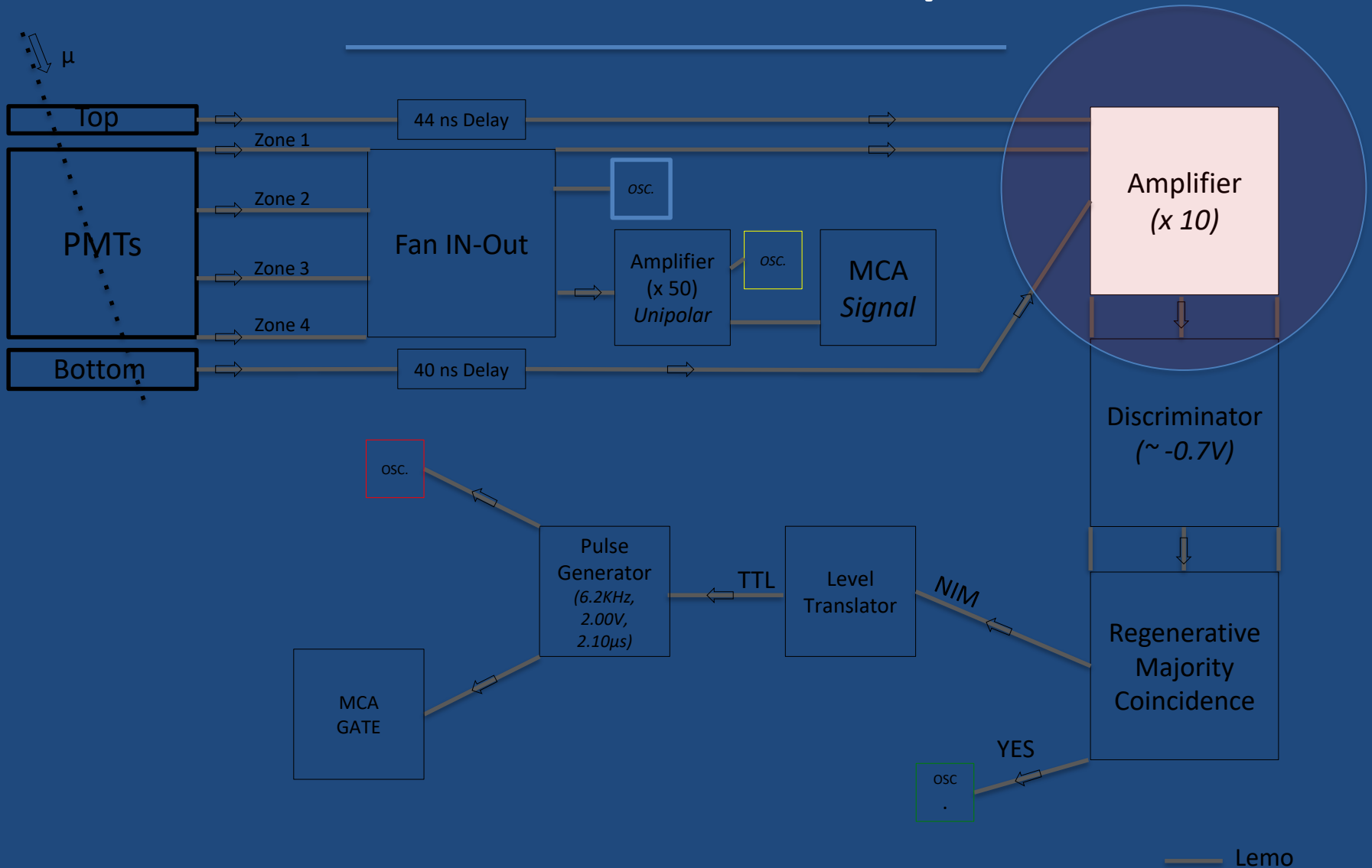


# Electronic Setup

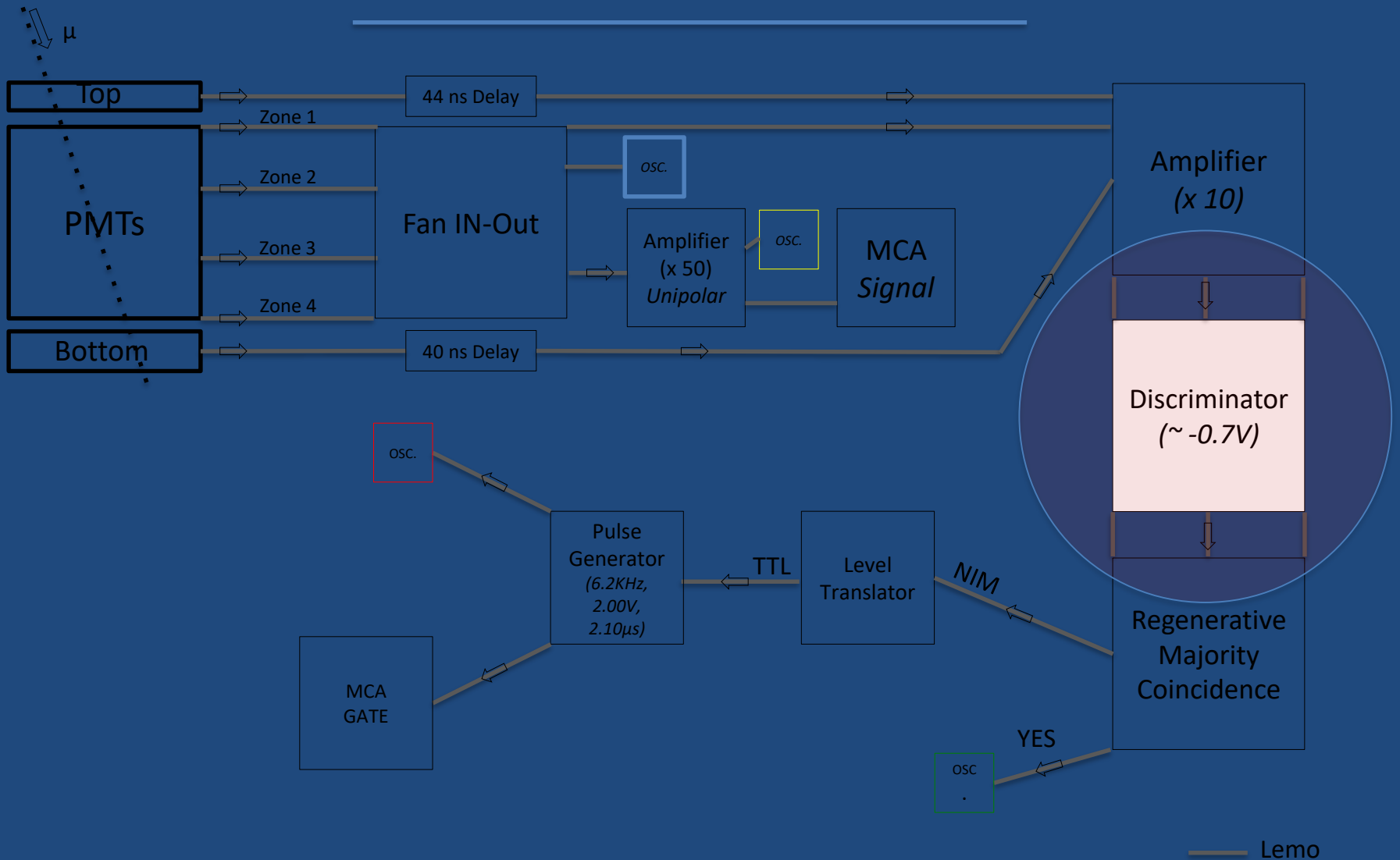




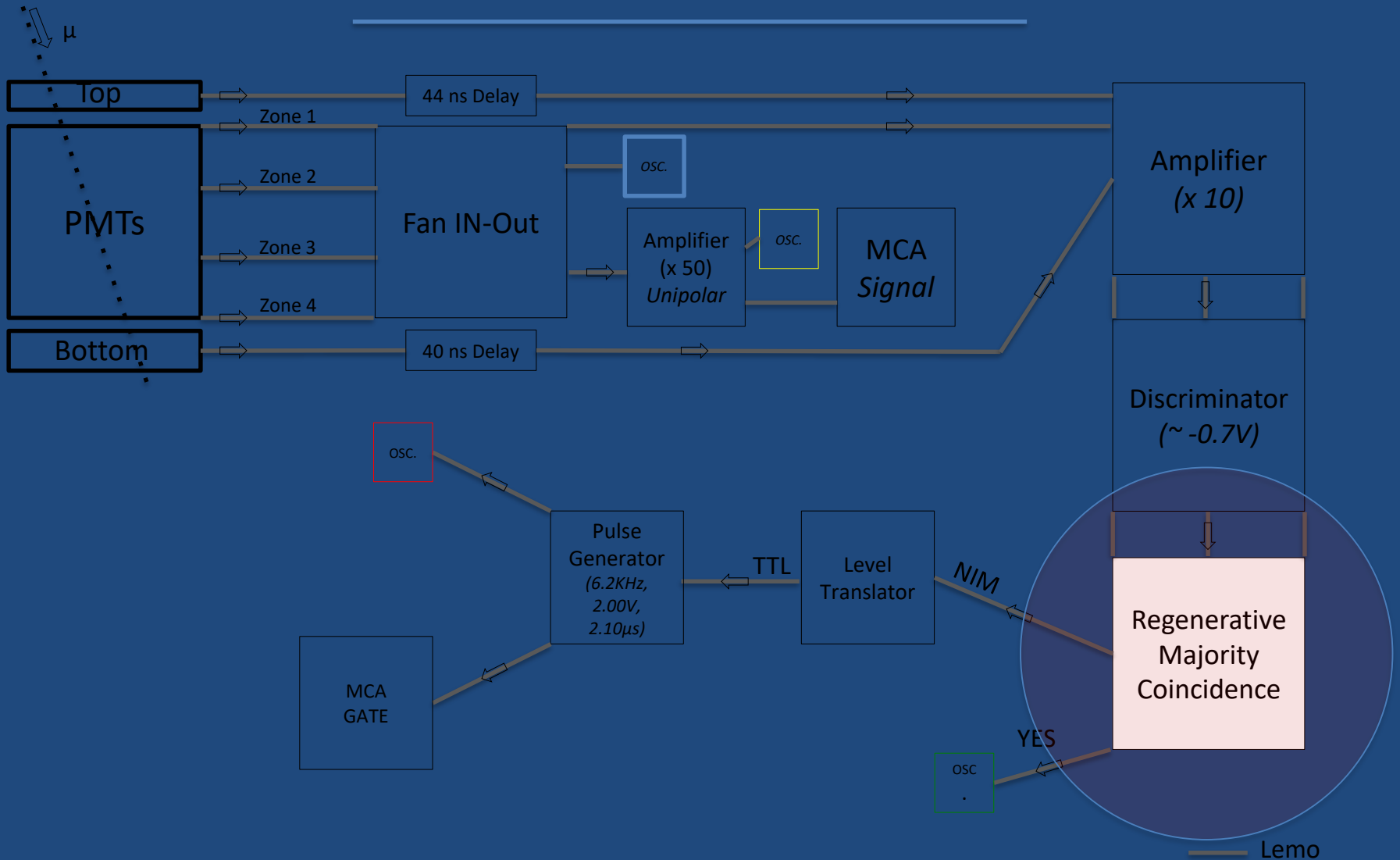
# Electronic Setup



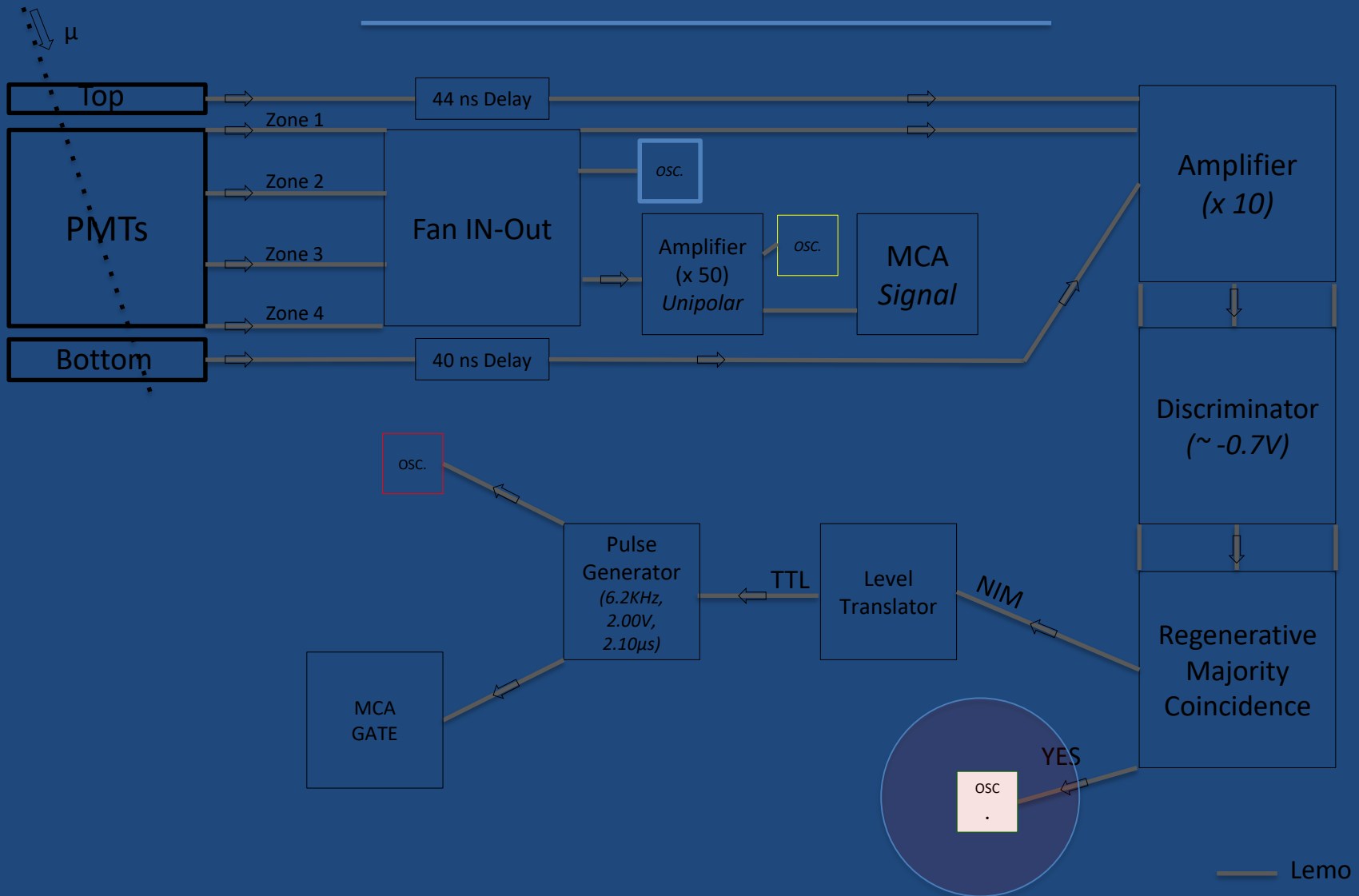
# Electronic Setup



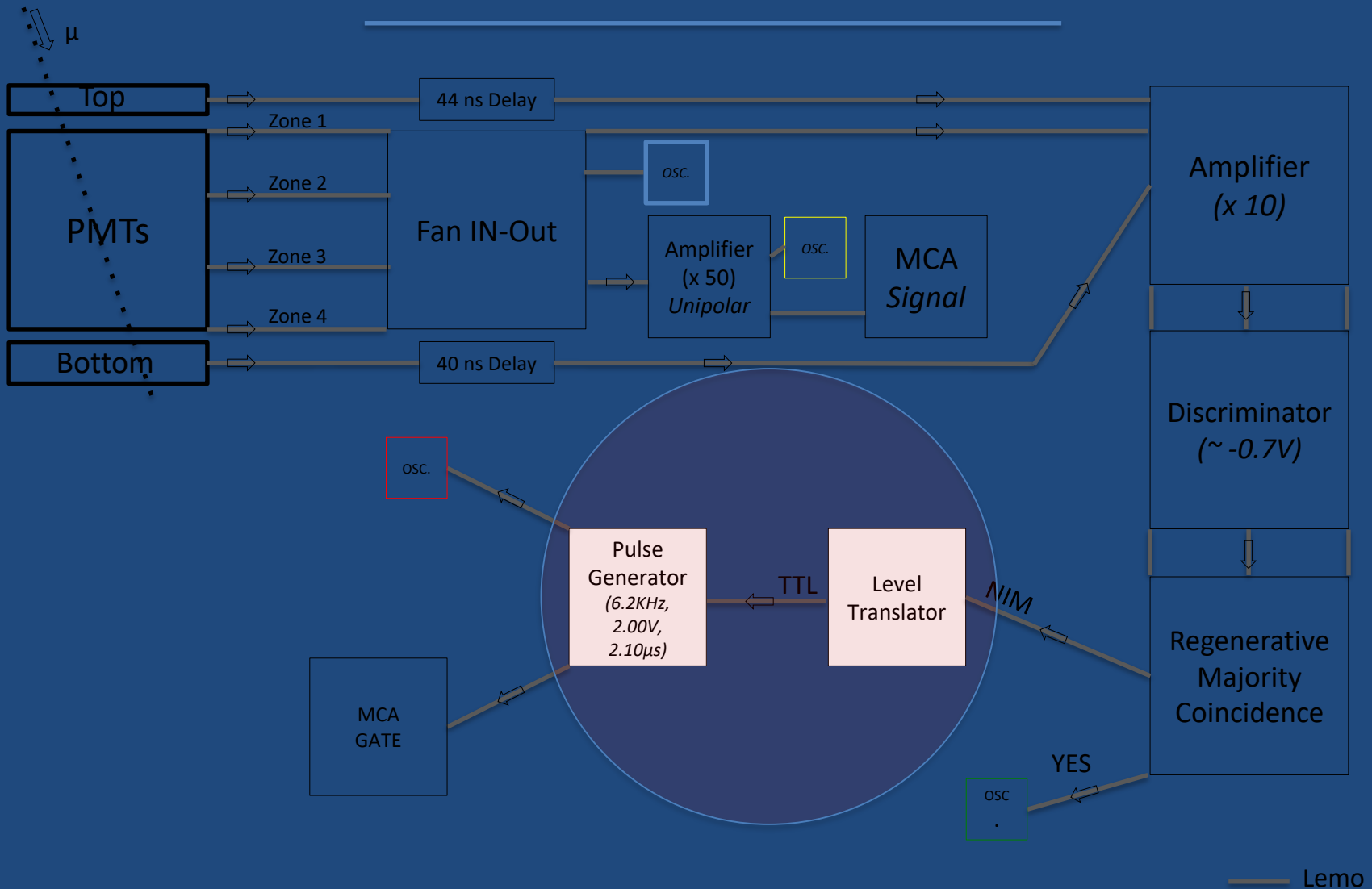
# Electronic Setup



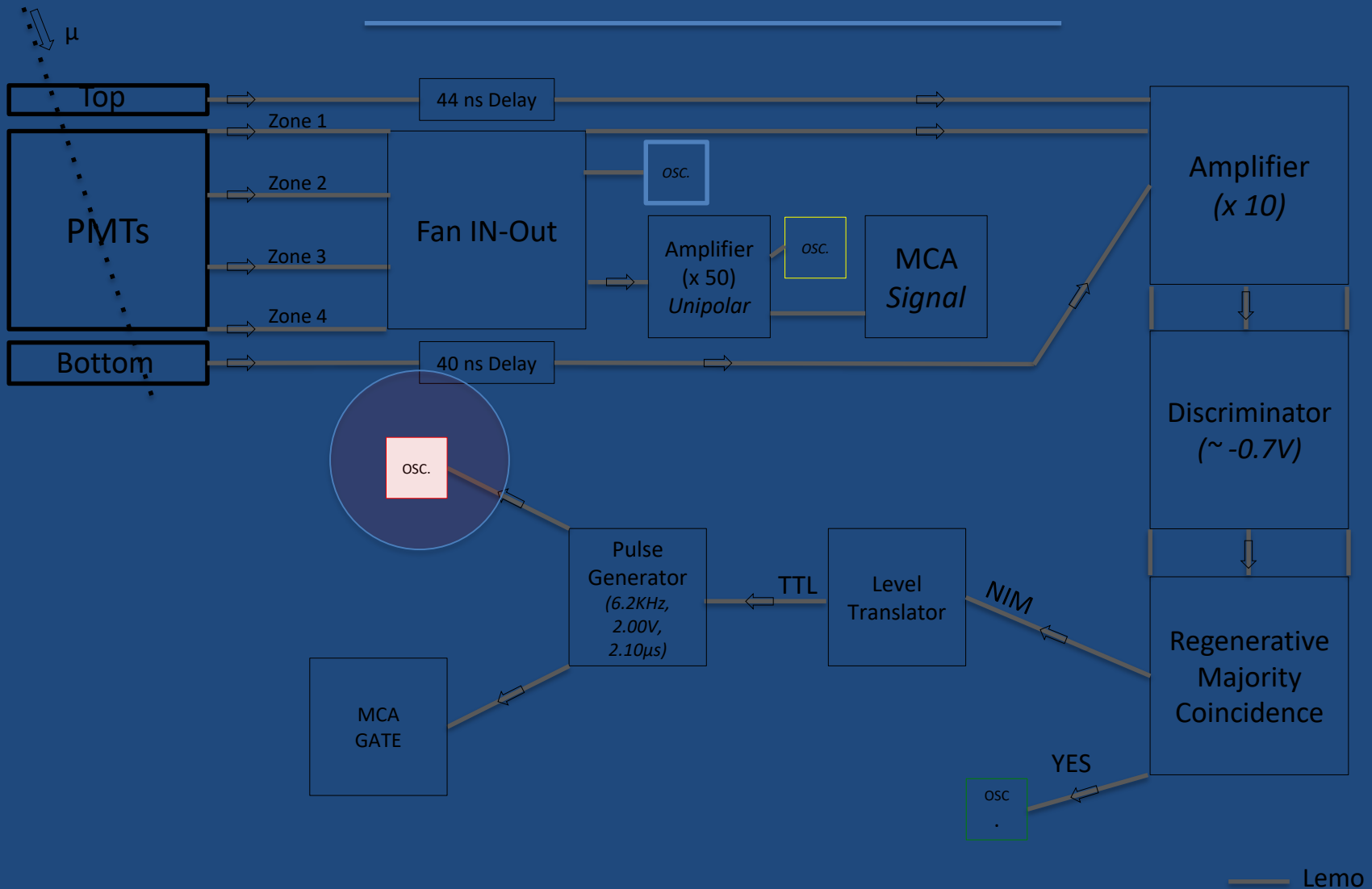
# Electronic Setup



# Electronic Setup

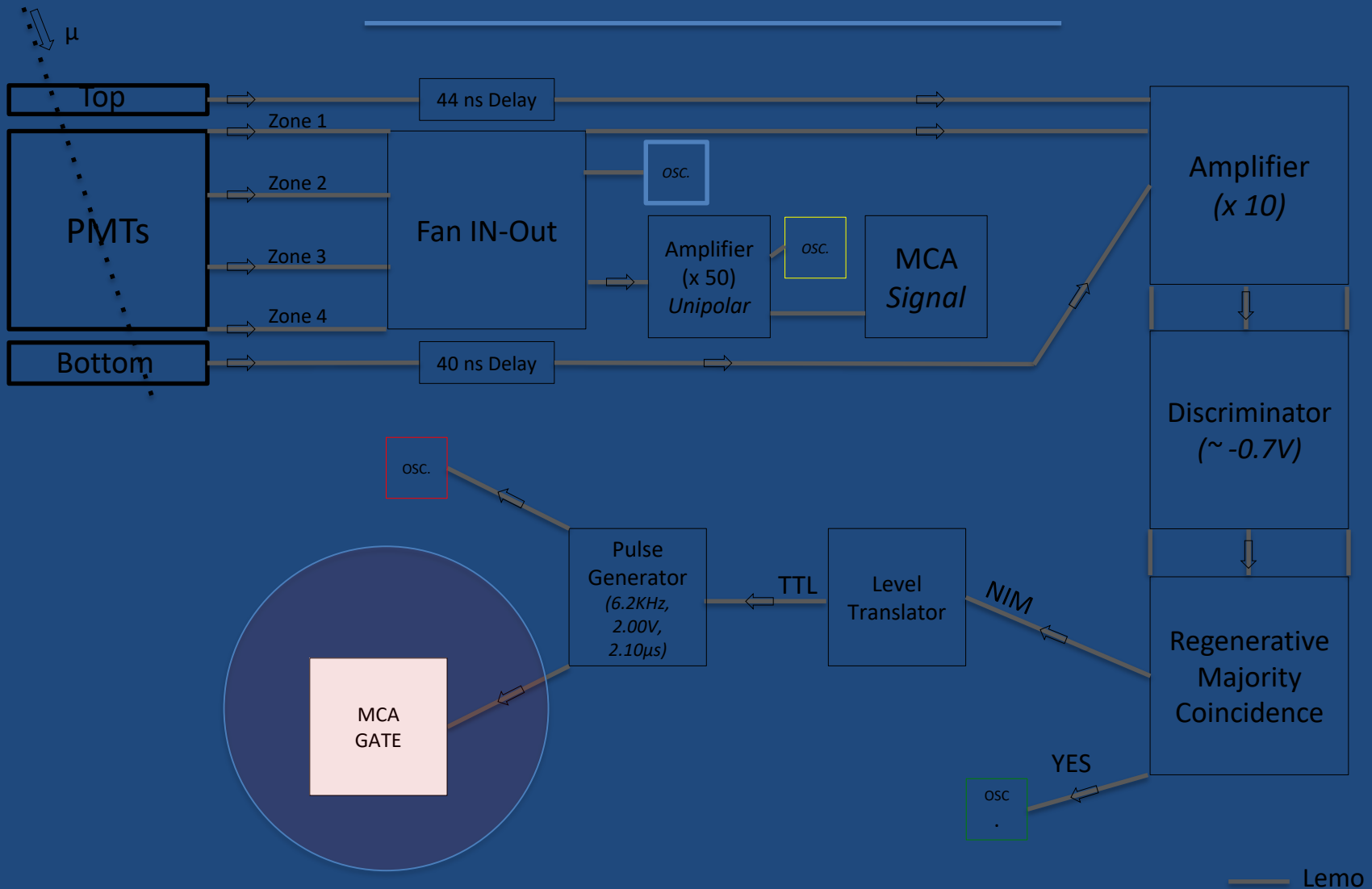


# Electronic Setup

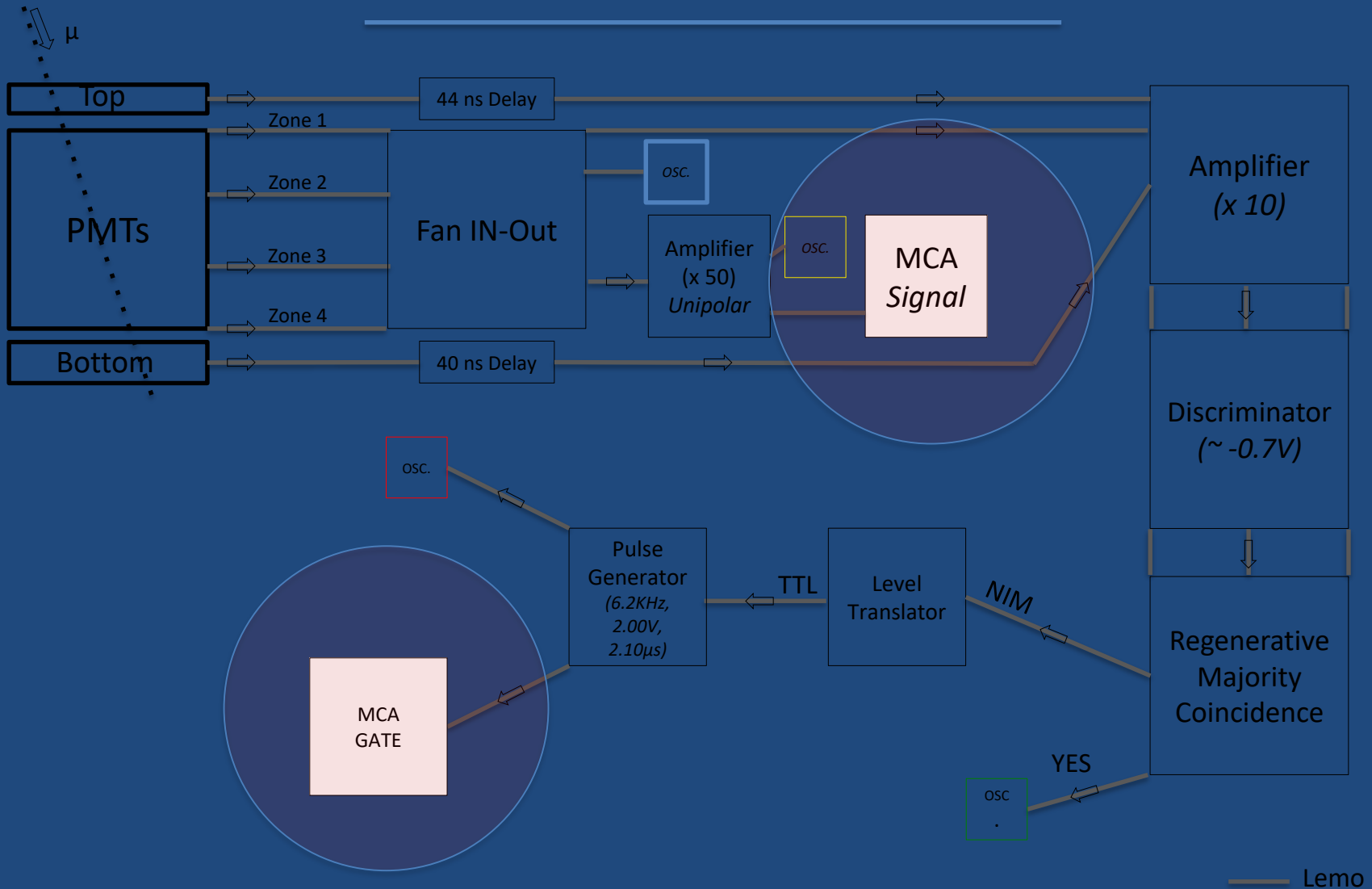




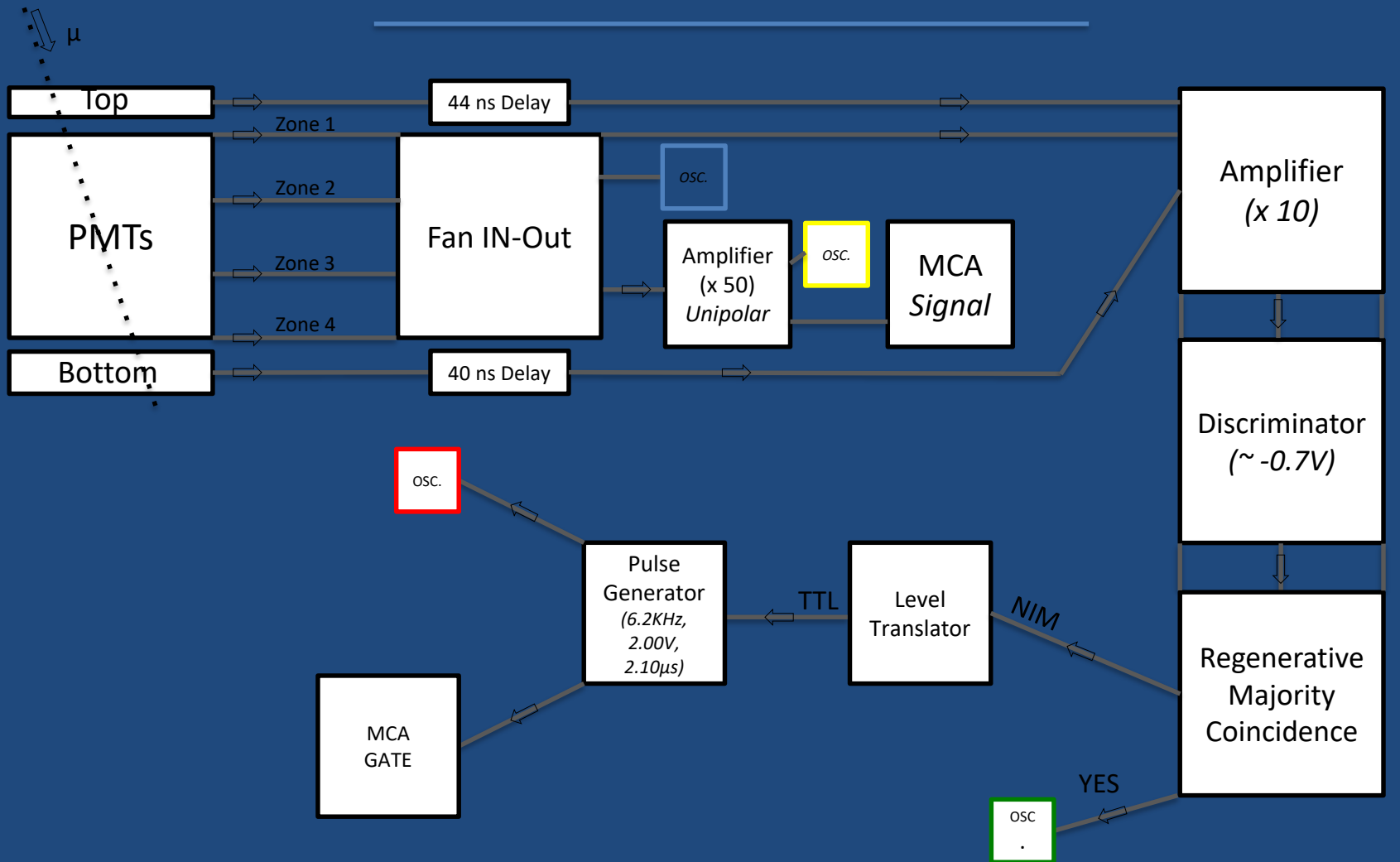
# Electronic Setup



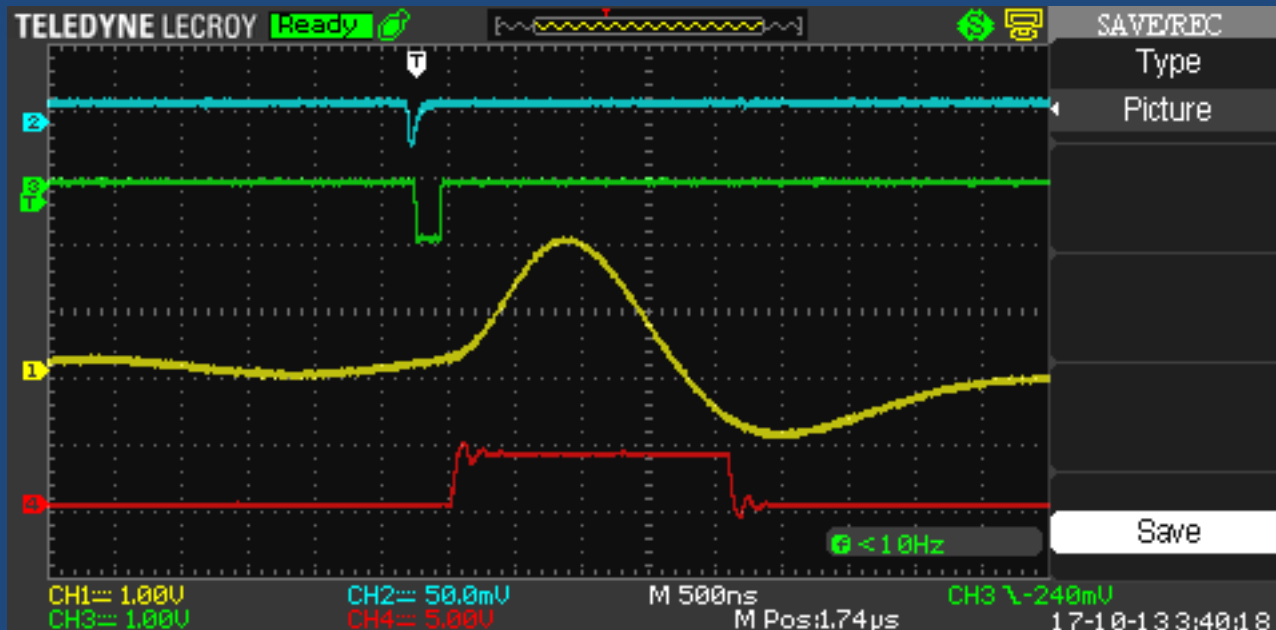
# Electronic Setup



# Electronic Setup



# Oscilloscope



## Legend

- Gate
- PMT pulse amplified 50x
- Coincidence
- Fanned in PMT

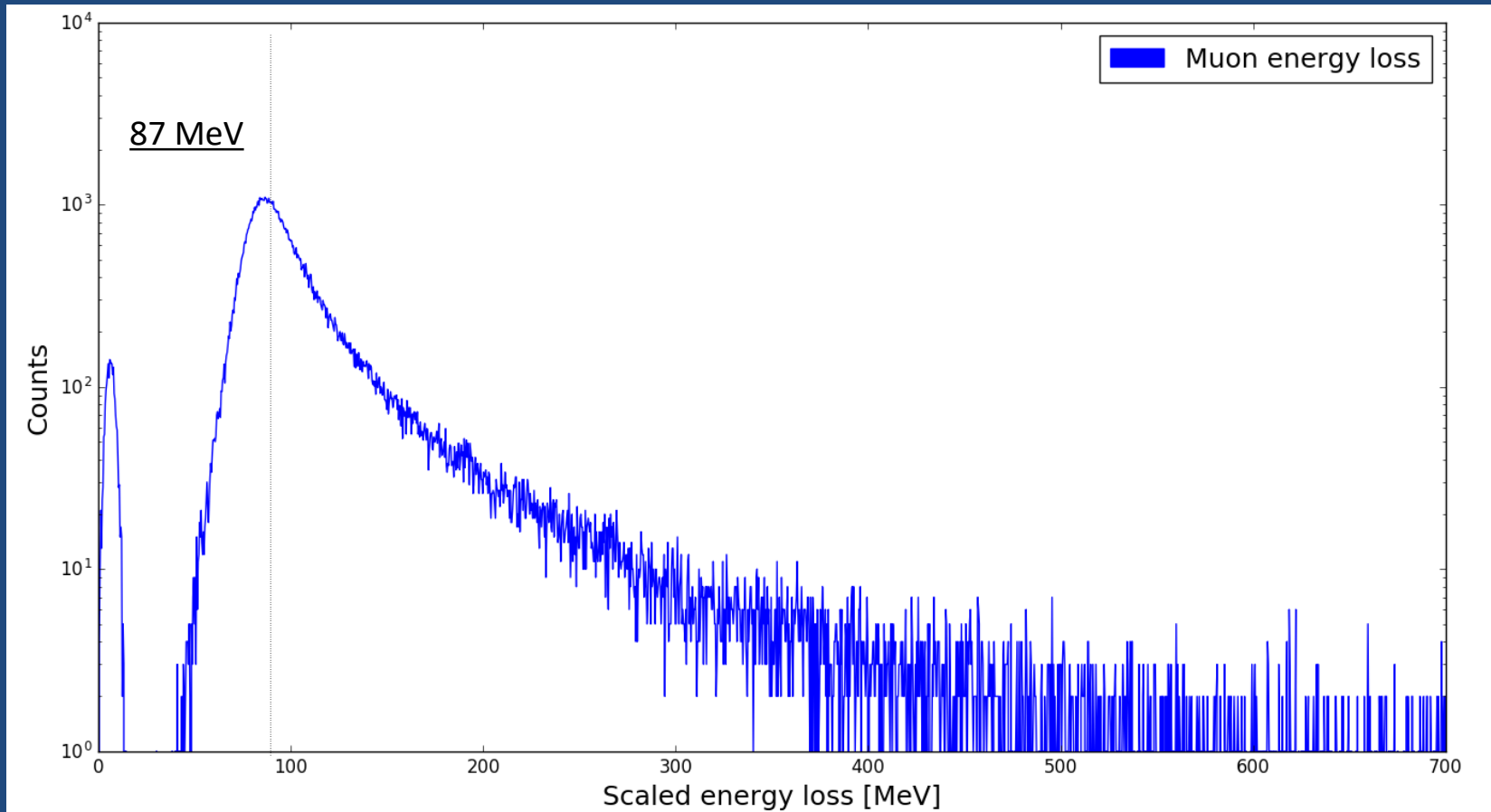
# Theoretical

---

$$1.992 \text{ (MeV / cm)} \times 45 \text{ cm} = \\ 90 \text{ MeV}$$

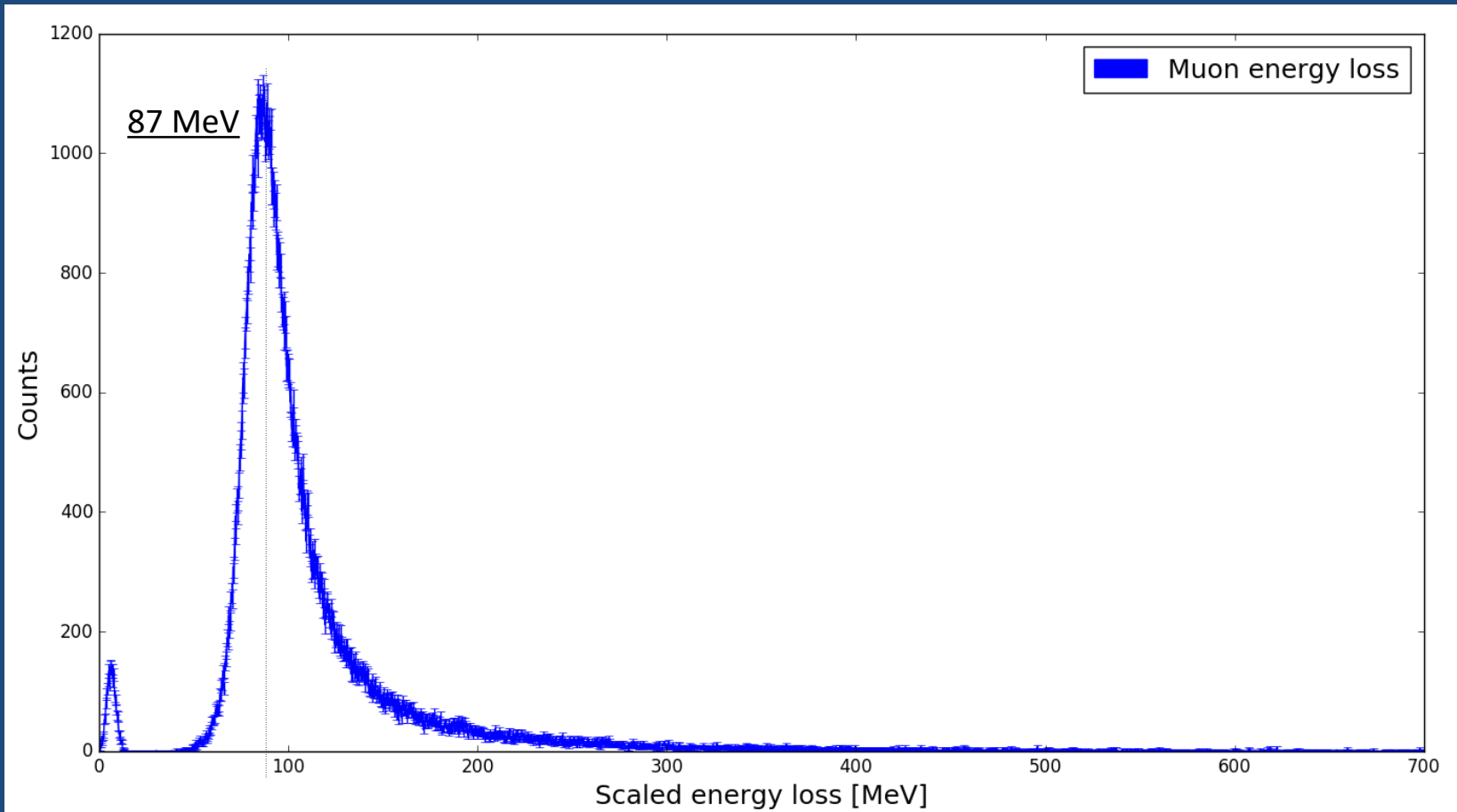
# Landau

---



# Landau

---



# Preliminary Error Analysis

---



# Discriminator

---

Threshold **fluctuates** how much data is taken into account

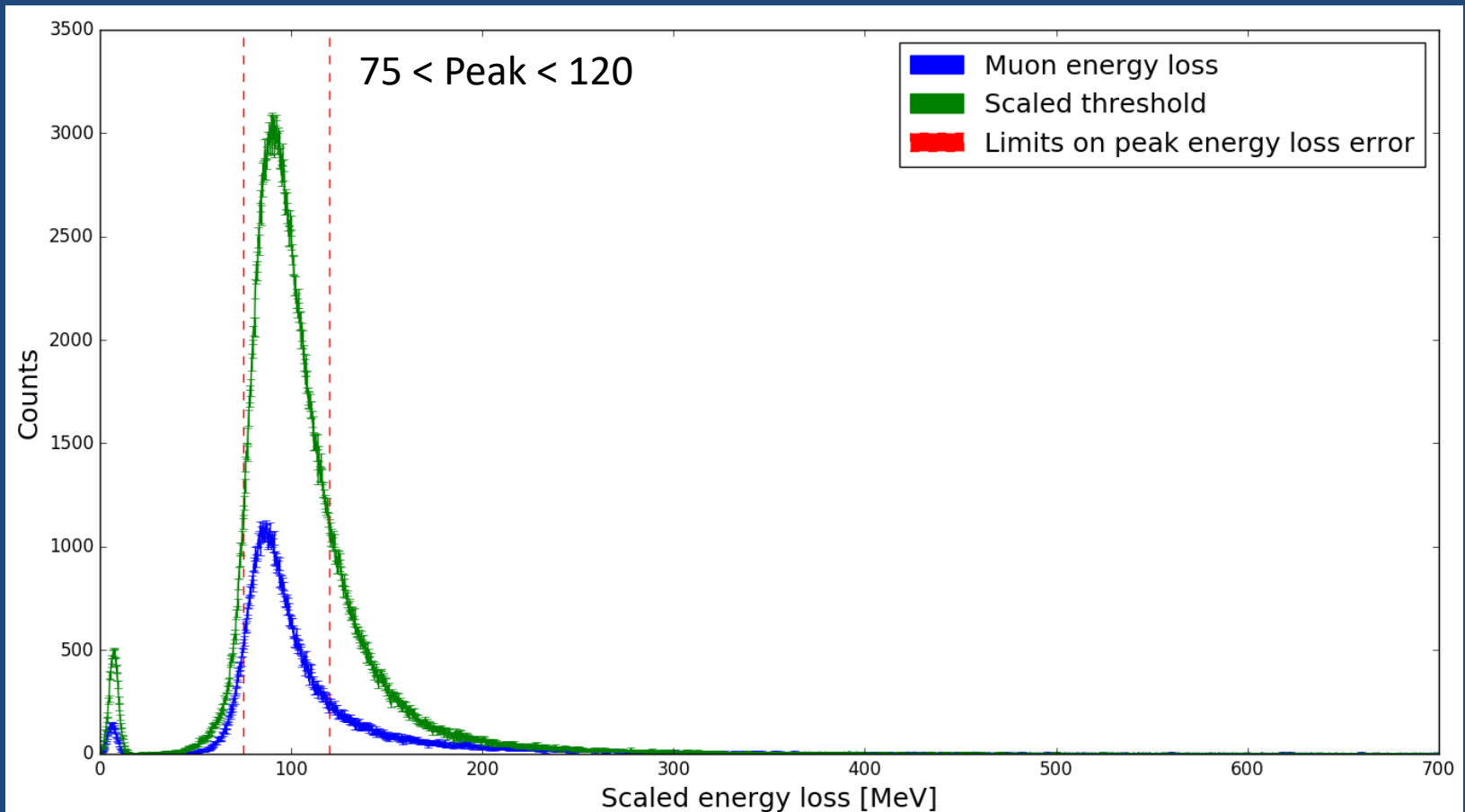
By taking everything **above** a certain threshold gives us a noise & desired distribution **base**

Allowing us to find **constant** noise and **scale** according to time

Find our peak at  **$75 < \text{Peak} < 120 \text{ MeV}$**

# Comparing

---



# Acknowledgement

**Thanks** Lab Director **Larry Sulak** and Lab Teaching Fellows **Yaokun Situ, Dan Arcaro** and **Duan Yutong**, all of whom taught us and gave us good advice.

**Special thanks to Yaokun Situ**, who allowed us to come in to the lab for extra hours of work time.

# Landau

---

