# CERN Summer REU Research Project

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CERN REU Presentations
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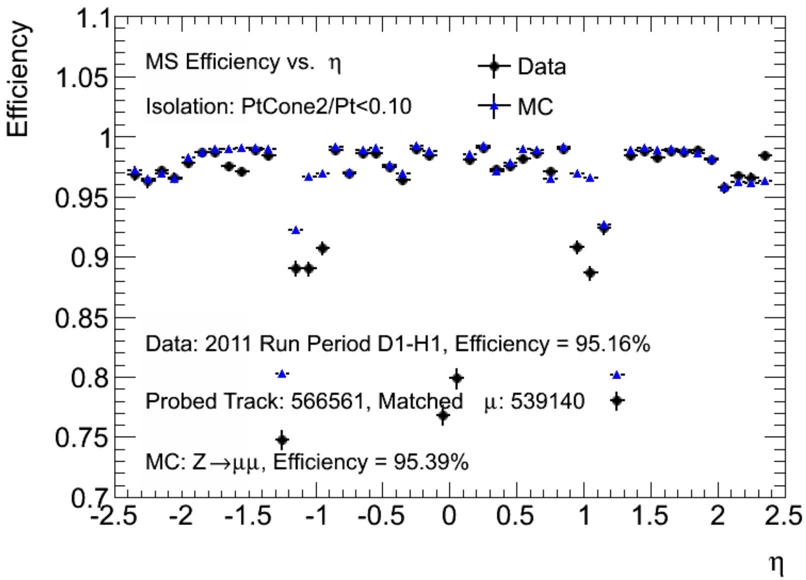
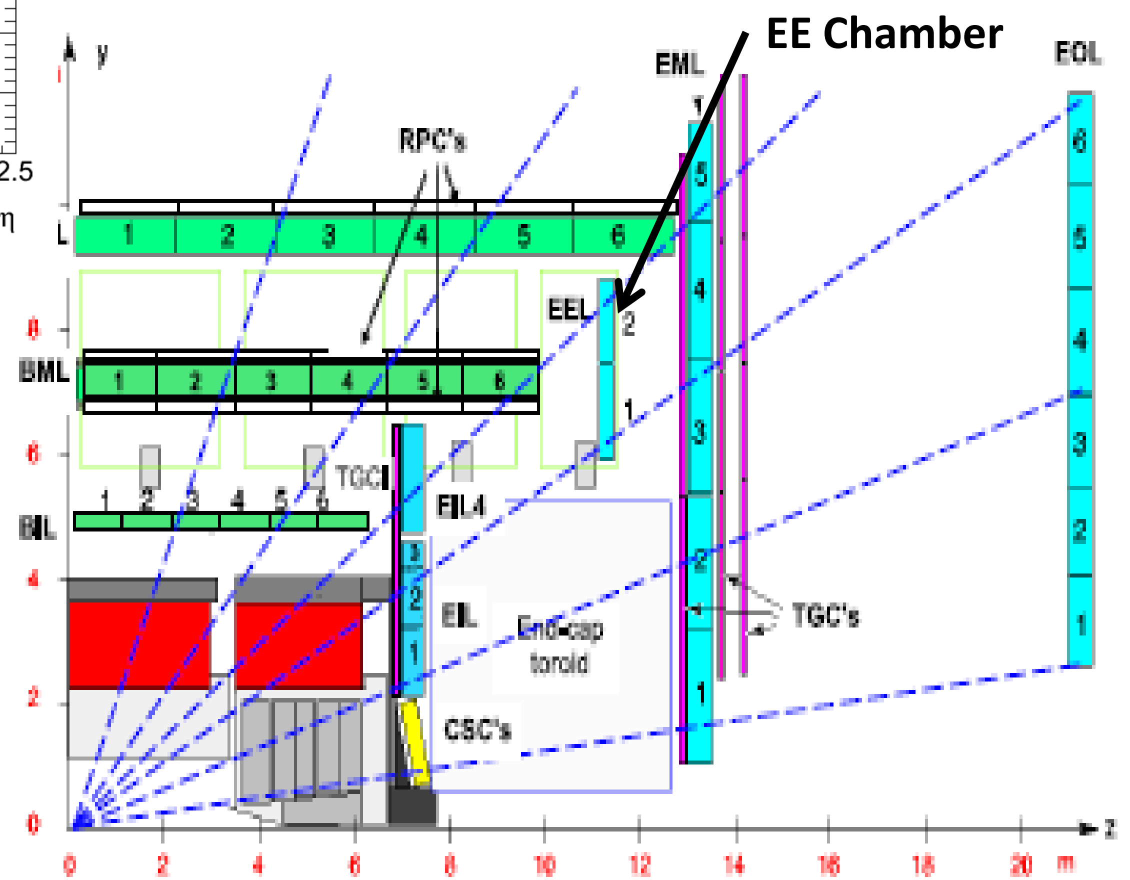
# Importance of the EE Chambers




• Without the EE Chambers we currently have terrible efficiency where the endcap and barrel meet.

• The EE Chambers will provide us with an extra measurement which will help with the Muon Spectrometer efficiency.



# Making the Measurement

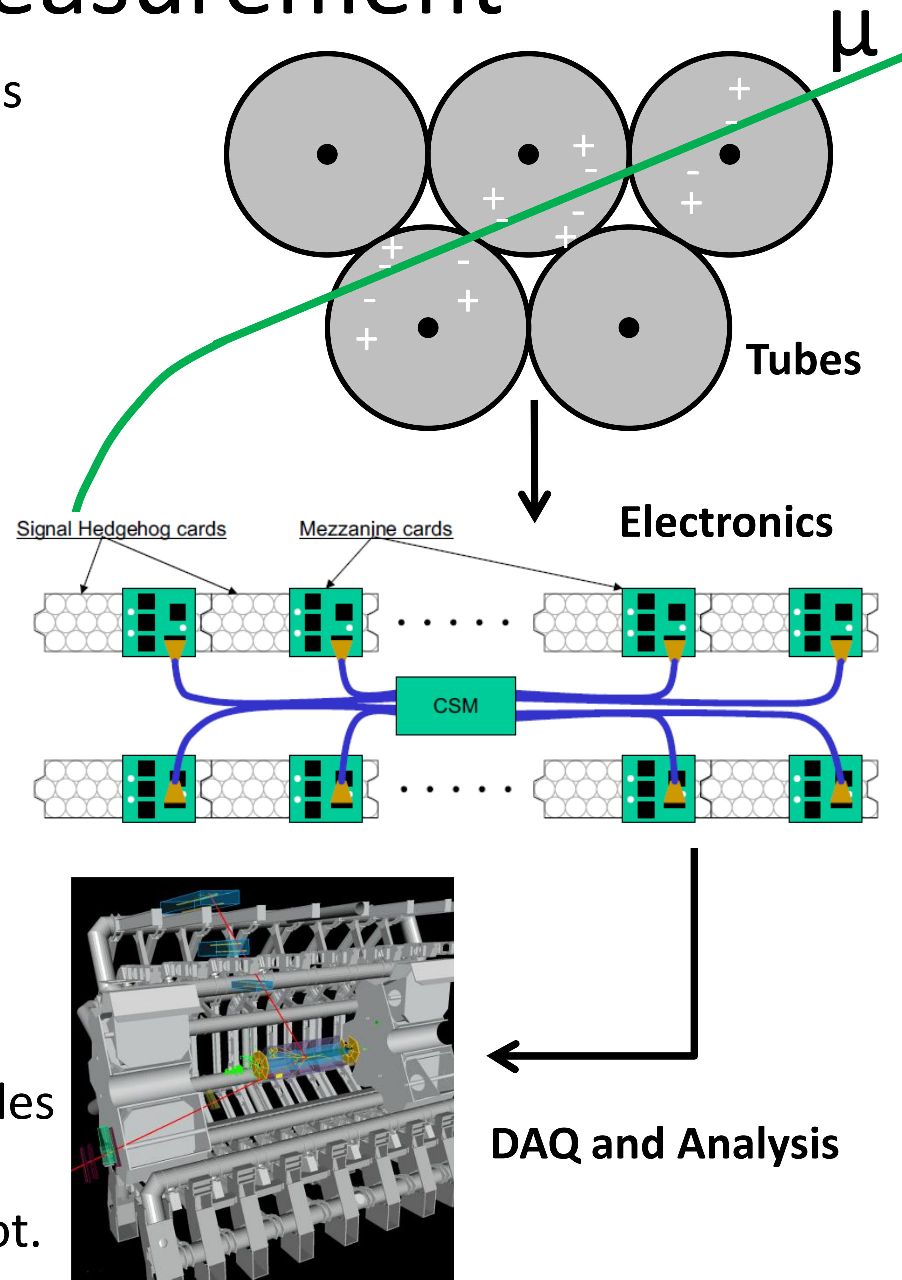
1. The muon ionizes the gas and the electrons float towards the high voltage wire.

2. The change in the electric field creates a signal which travels down the wire, to the Mezzanine Card.

3. The Mezzanine Card then processes some information using the installed chips.
    - ASD Chip, TDC Chip

4. The output of the Mezzanine Card goes through the Motherboard and to the CSM.

5. The CSM then sends the data to the DAQ where it is reconstructed and must pass other triggers before being saved.




* Before any data is recorded the Trigger decides if this event is worth keeping and either allows the data to be sent to the DAQ or not.

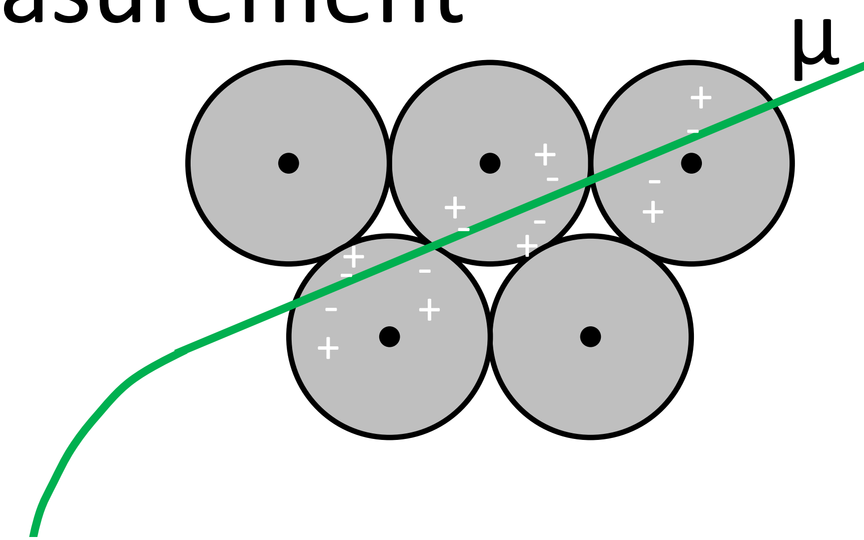
# Making the Measurement

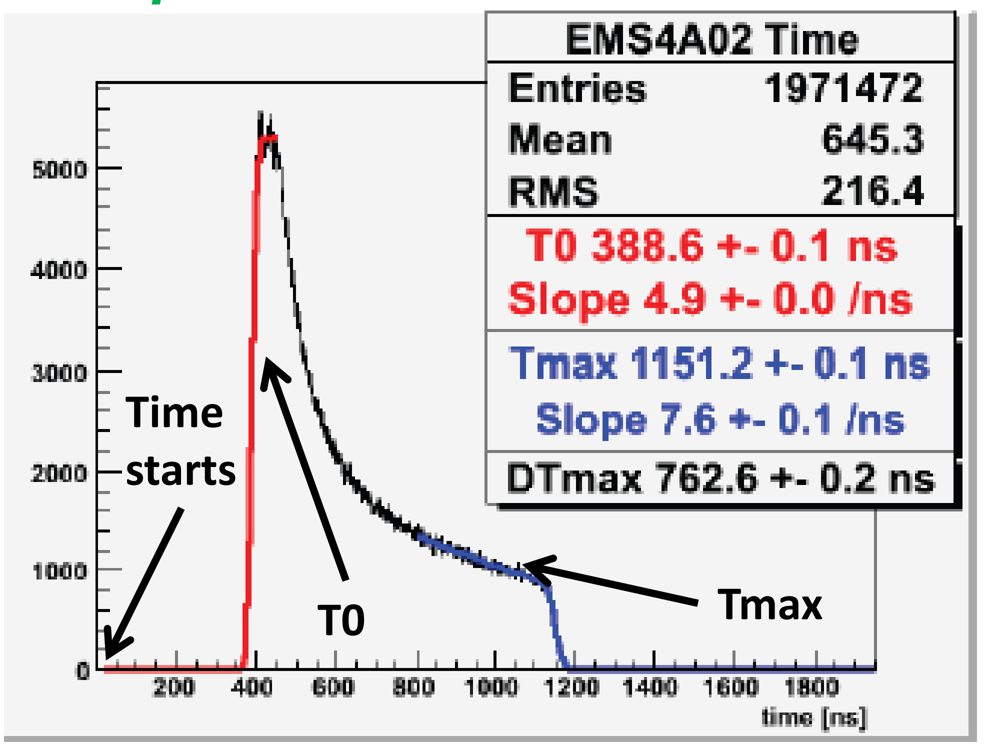
1. The muon will travel through the chamber, where it will ionize the gas in the tubes and start the measurement.

2. If the event passes the trigger, time starts. There is a short time between T0 and Tmax where data can be taken.

3. T0 is due to the time it takes the signal to travel down the wire.

4. Once Tmax comes, the Mezzanine Card will not longer take data.



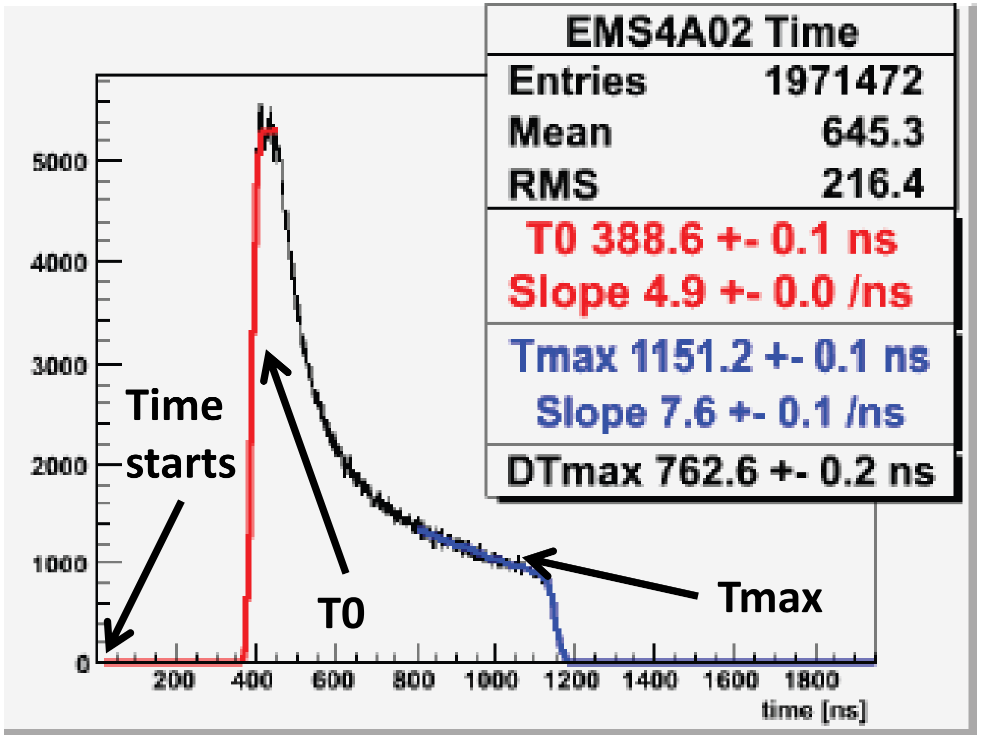
# Making the Measurement

- In order to know where the muon went through the tube we must precisely measure how long it takes the ions to reach the wire and the signal to reach the Mezzanine Card.
    - This is done by plotting the number of hits versus time, which gives us the plot below. The sharp rise corresponds to the fastest time the drift wire could send a signal. This fastest time corresponds to a muon passing directly through the wire. We call this time T0.

- Once the trigger decides to take the data there is a certain period after T0 that data can be taken. Ending at Tmax.

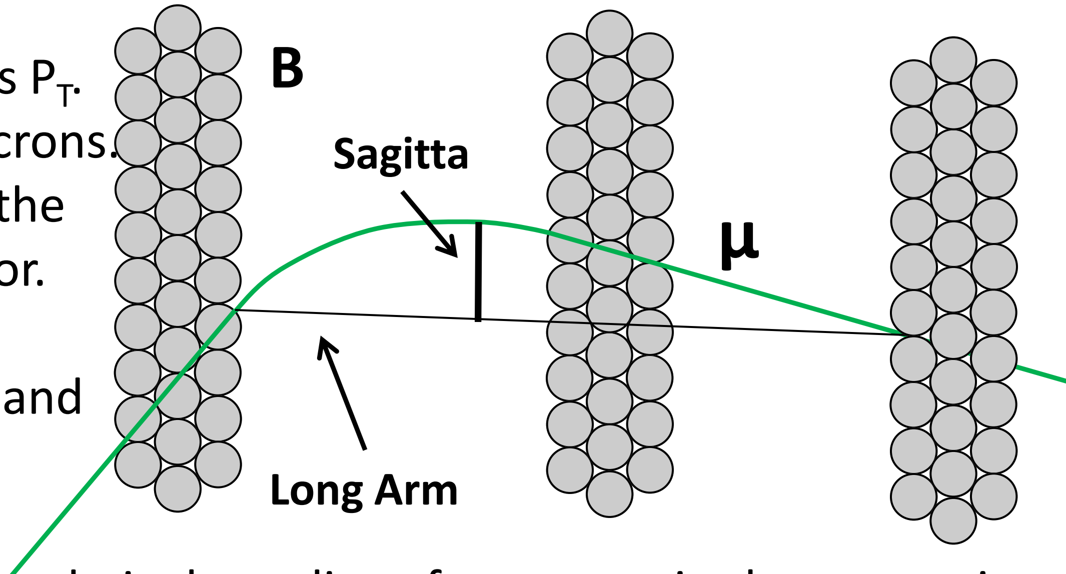
- Depending on how long it takes to receive a signal from the drift wire we know how far away the muon track is from the center of the wire.

**Number of TTC hits vs. Time**



# Tracking Principles

- The Sagitta is used to find the muon's $P_T$.
  - The designed resolution is 50 microns. This was chosen in order to know the $P_T$ of a 1 TeV muon with a 10% error.




- By using the geometry of this system and the equation

$$\frac{Pv}{r} = evB$$

Where P is the transverse momentum and r is the radius of curvature in the magnetic field. The sagitta and the momentum can be related by

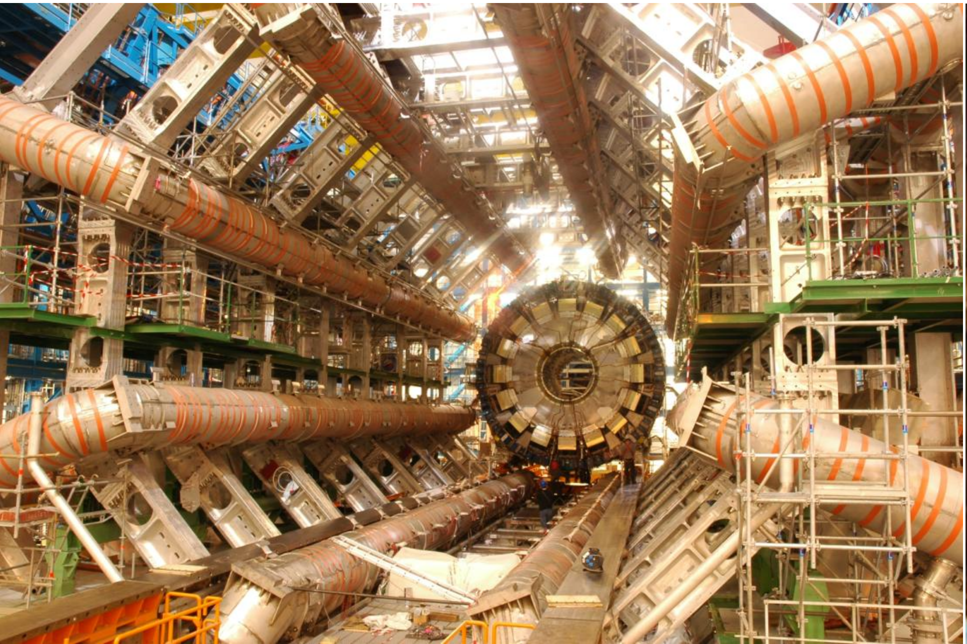
$$S = \frac{eB\,L^2}{8P}\ .$$

- From this equation we can see some important relations needed when designing a detector.
  - $S \sim {}^{1}/_{P}$
  - $S \sim L^2$
  - $S \sim B$

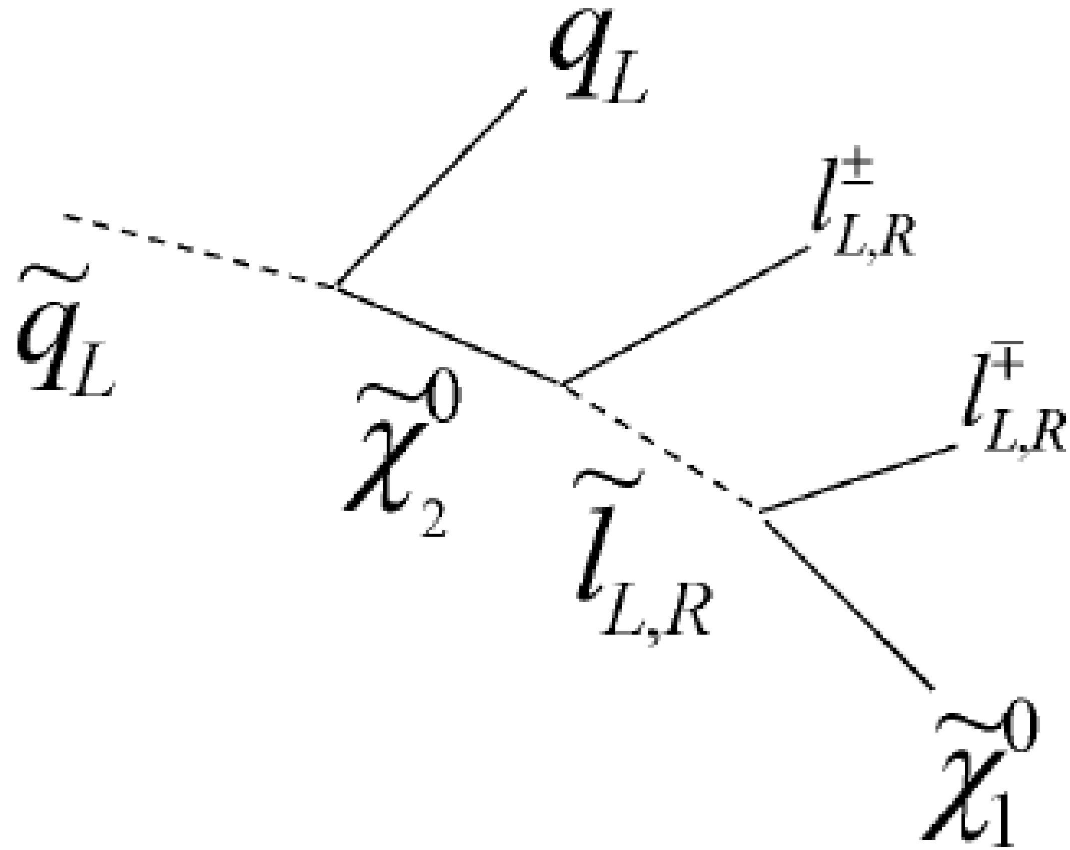
# Tracking Principles
## Multiscattering

- Multiscattering occurs when a muon's path is altered as it travels through a dense medium.

- Multiscattering can skew our analysis, thus the detector cannot be too dense.
    - Filling the tubes with gas instead of some solid material.
    - Having air core magnets instead of stronger iron core magnets.




# Neutralino Search



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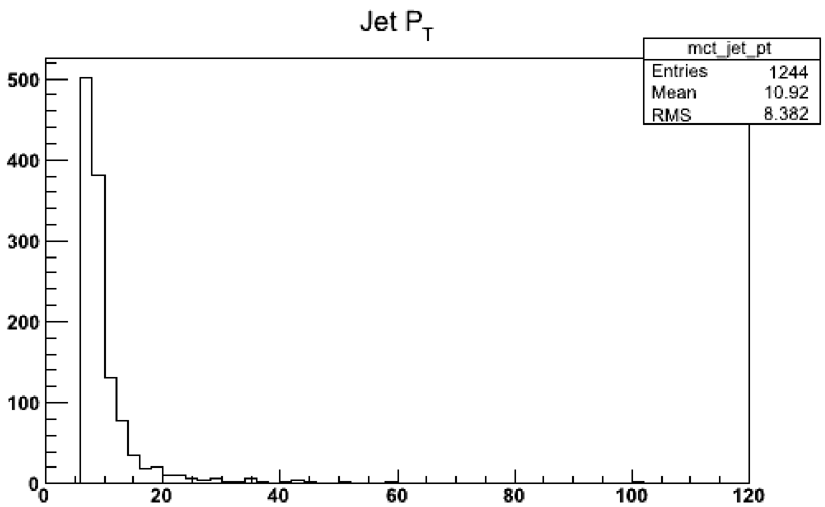


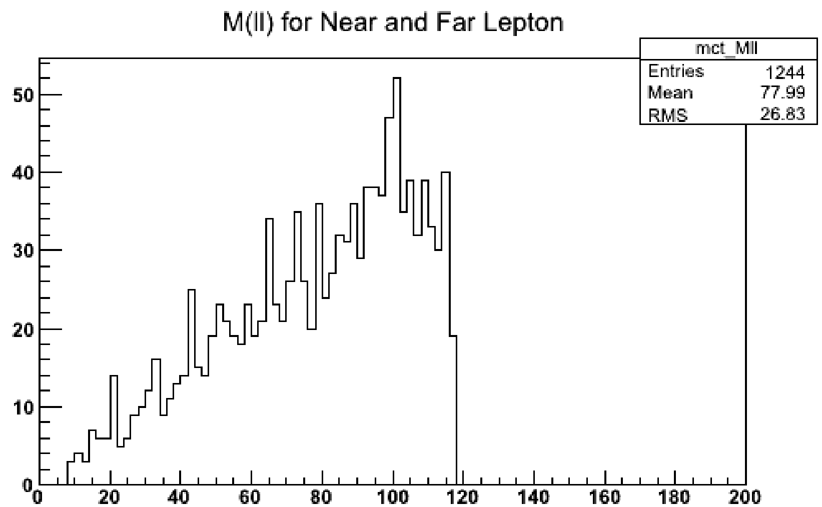


- Distributions can differ with different phase spaces.
- Common SUSY search cuts:
    - Large missing transverse energy
    - Around 4 jets recquired

# Venice


# Rome