# Pion Identification Methods in the $\gamma p \longrightarrow n\pi^+$ Reaction

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# Outline

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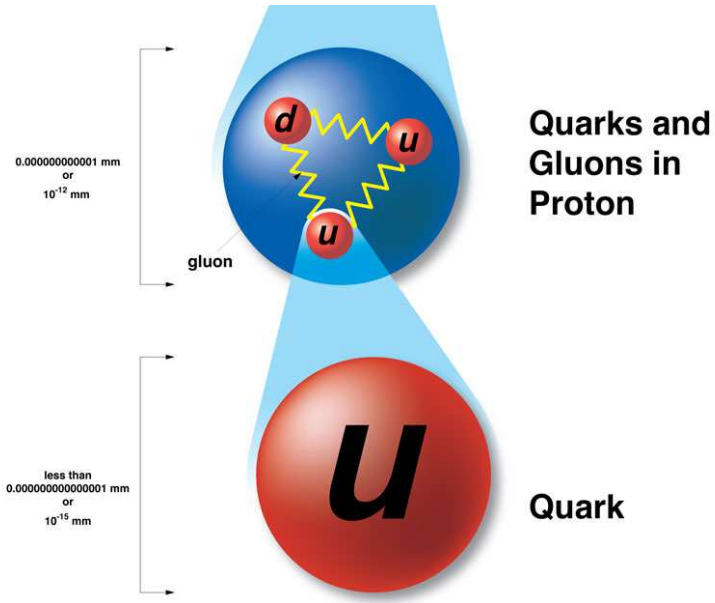
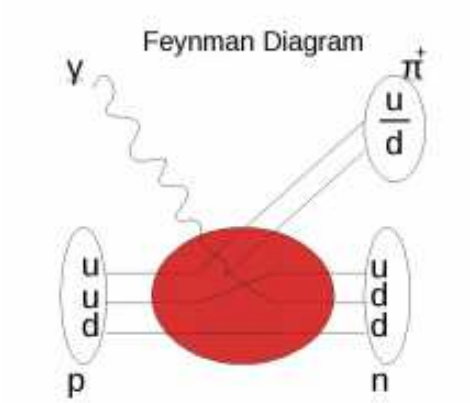
# Quarks

- Quarks are believe to be the elementary particle which make up protons and nuetrons.
- Quarks are never found alone. They are found in groups of two or three
- There are 6 flavors of quarks: Up, Down, Charm, Strange, Top, Bottom
- Baryons: Made up of three quarks (proton, neutron, etc.)
- Mesons: Made up of two quarks (pion, muon, etc.)

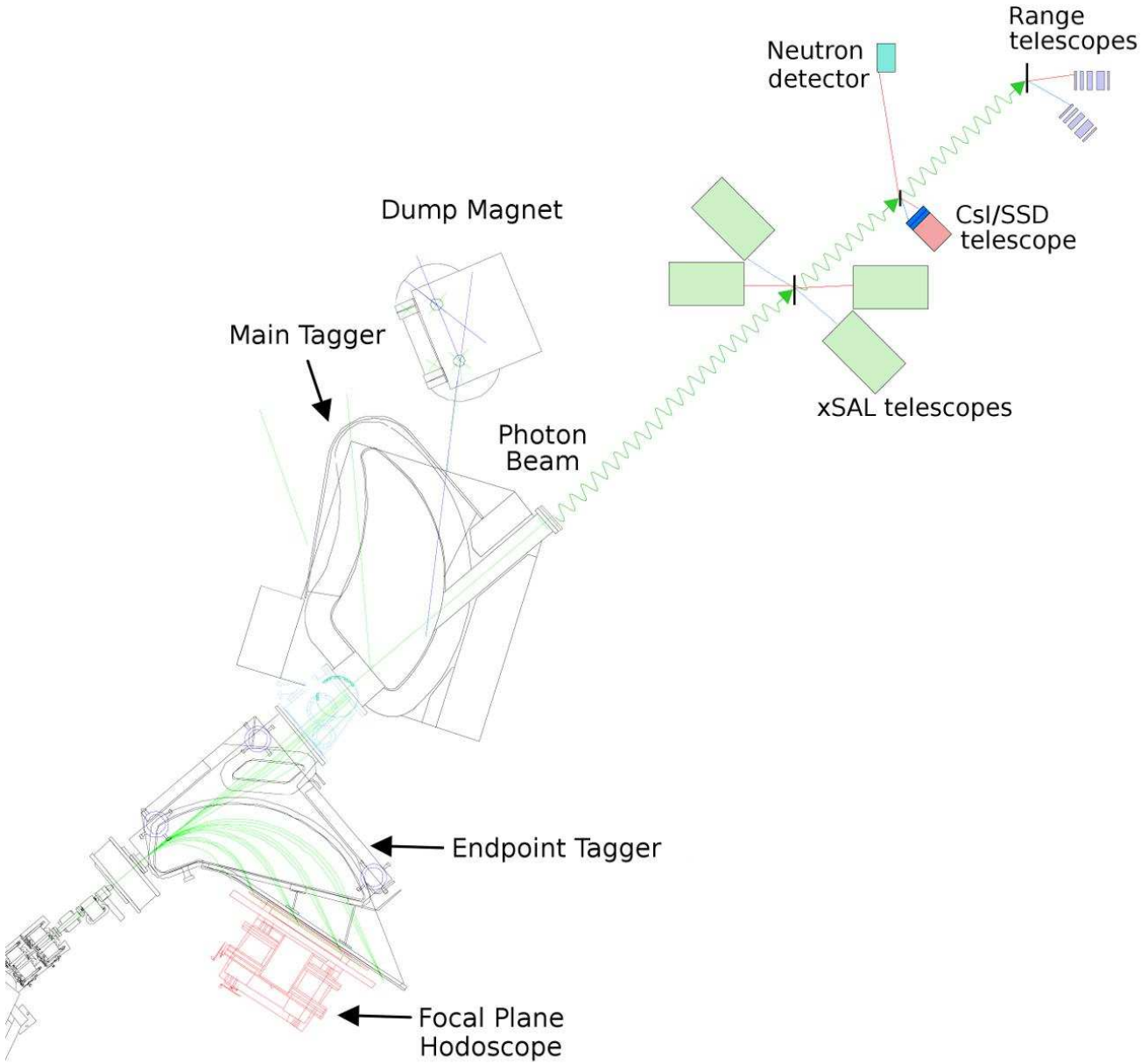


# Pion Photo-Production

- Pion photo-production is the reaction of a photon (quanta of light) with a Baryon such as a proton or neutron.
- In the $\gamma p \longrightarrow n\pi^+$ reaction the photon interacts with the proton to eject an up and creates 2 down quarks. The up and one of the down quarks are ejected as a $\pi^+$.
- Pion photo-production is an ideal reaction to study because it involves the directly rearrangement of quarks.



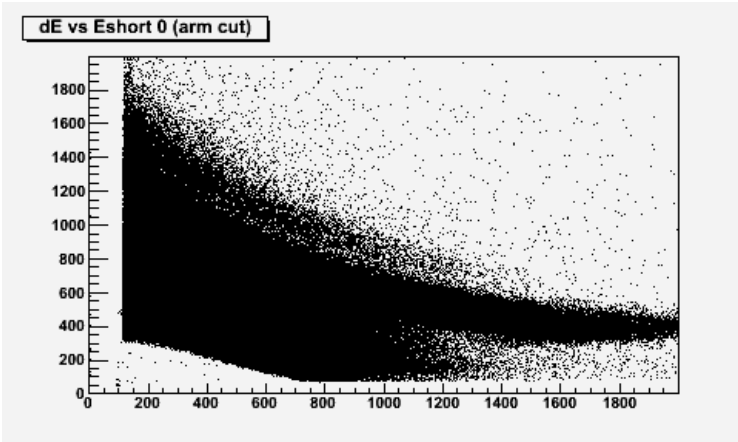
# Setup

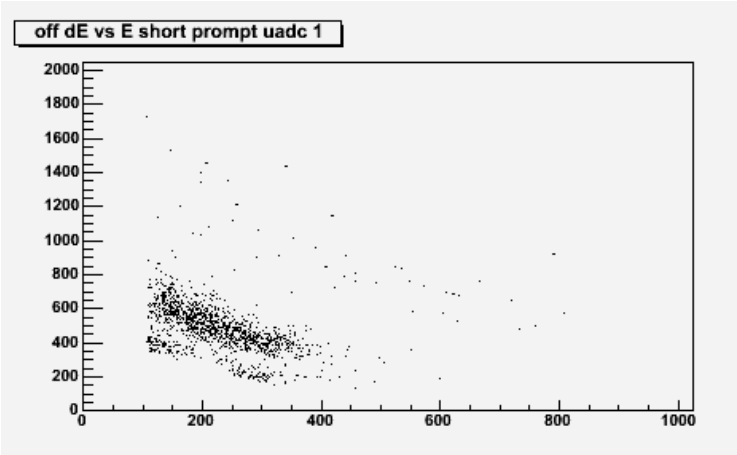

Range
telescopes
Neutron
detector
Dump Magnet
CsI/SSD
telescope
Main Tagger
Photon
Beam
xSAL telescopes
Endpoint Tagger
Focal Plane
Hodoscope

# Outline

# dE vs E short Background

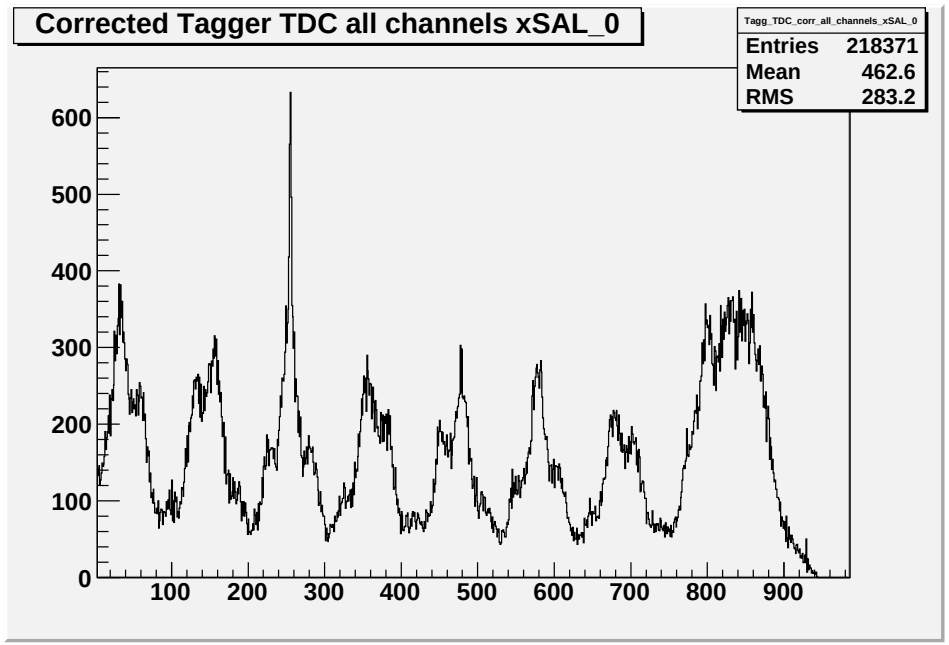
Using the ΔE vs E graph is in effective at isolating pions because the background events drown out the pion events. The left is the raw data, and the right is after a uadc cut.



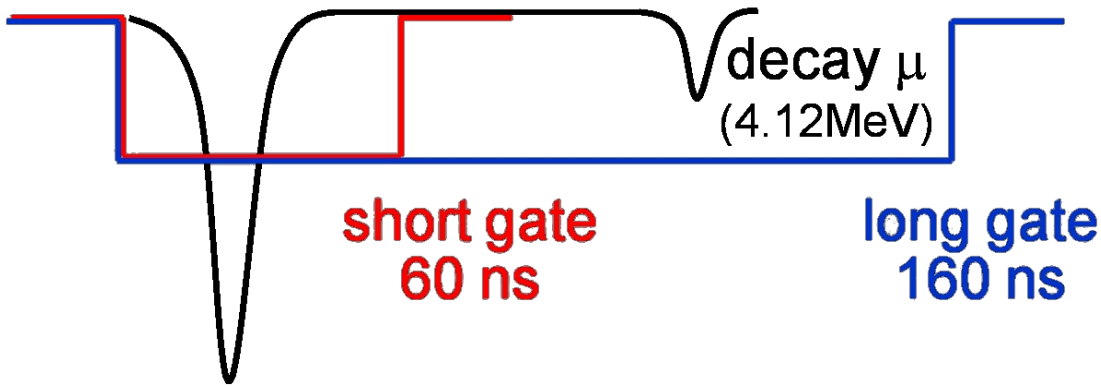
# Detector Tagger Coicidences

To ensure the data is in the energy range we can measure the data is cut to include only events that occur both in the detector and photon tagger.



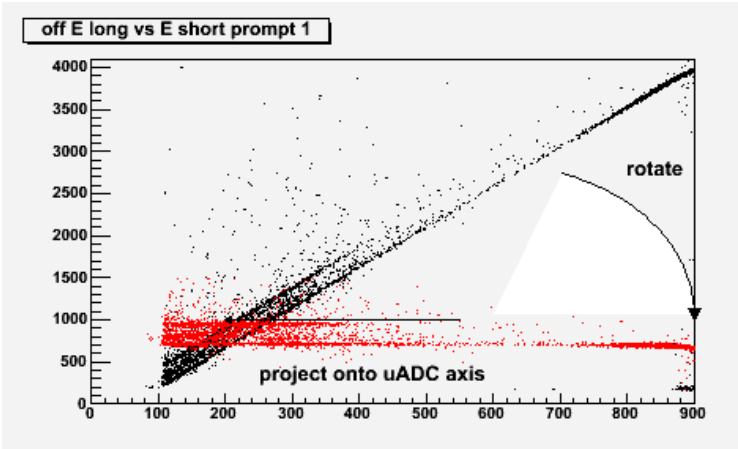
# E long and E short

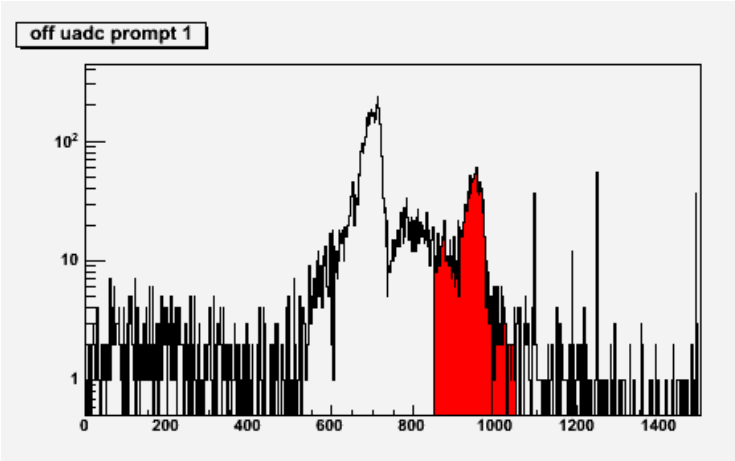
After a mean life of 26ns a pion decays into a muon and gives off additional energy. Using different charge to digital converter (QDC) timing the pion decay can be recorded in one QDC and not the other.



# uadc cut

By graphing the long vs the short gate QDC, the pion events appear as a second line offset for the background events. As a result we rotate and cut on this graph to isolation candidate pion events.



# ΔE vs E short cut

Based on the results of the uadc cut the original ΔE vs E short graph is cut to include only reasonable pion energies.
In the future the uadc cut will be refined based on new data from the ΔE vs E short cut.