GlueX Start Counter Detector

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Outline

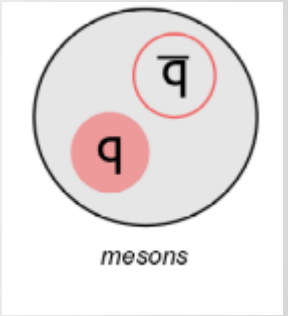
- **GlueX Motivation**
- **GlueX detector summary**
- **Start Counter**
  - Overview
  - SiPM Bias Studies
    - 200 mV above nominal
    - Nominal (~76 V)
    - 200 mV below nominal

Gluex Motivation

- The goal of the GlueX experiment is to provide the data needed to understand the confinement of quarks and gluons in quantum chromodynamics (QCD).

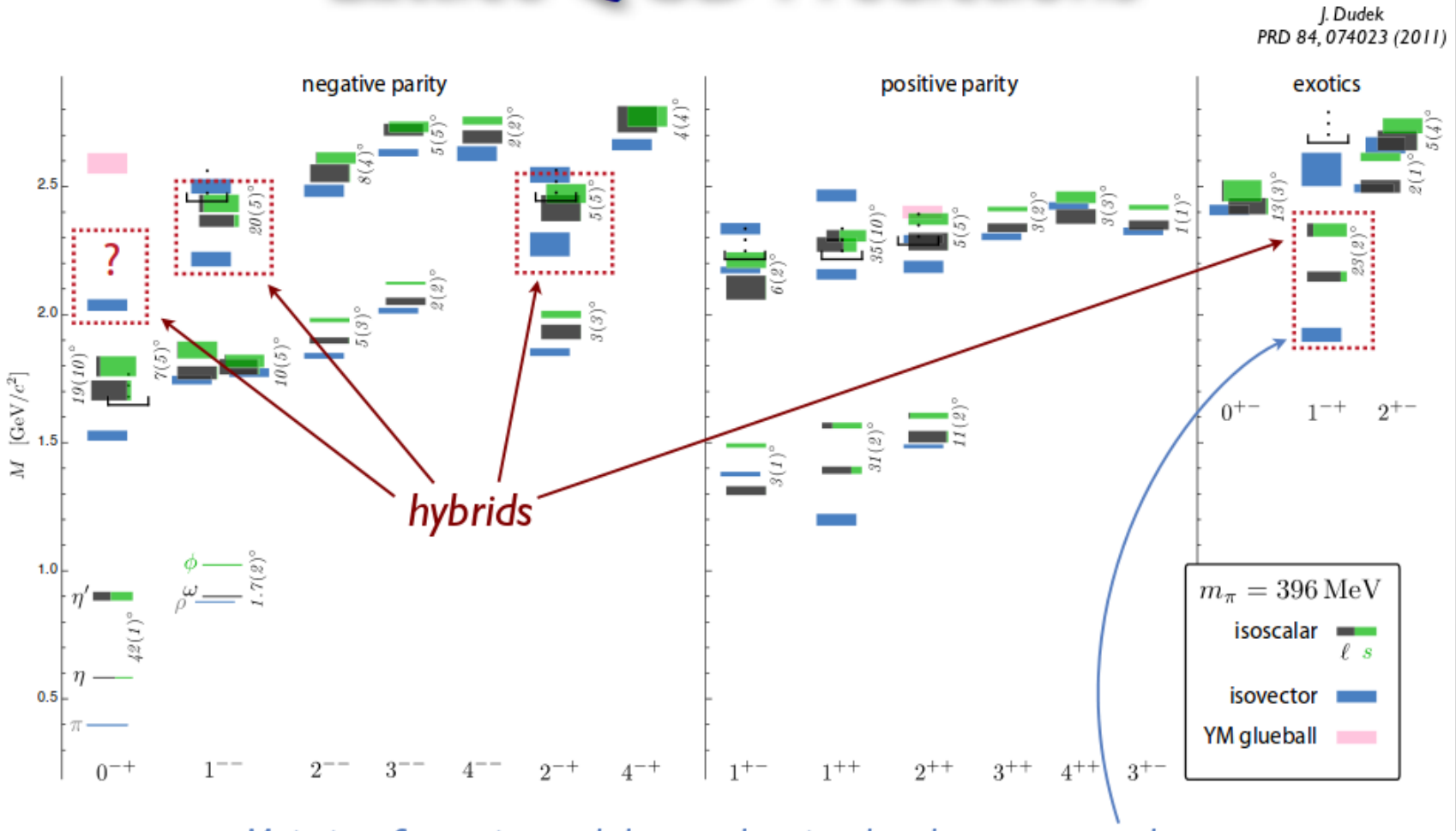
- In the quark model, mesons are bound states of quark antiquark characterized by J^{PC} quantum numbers.

  $J = L + S, \quad P = (-1)^{L+1}$, and $C = (-1)^{L+s}$



- LQCD and some recent observations expect a richer spectrum of mesons that takes into account not only the quark degrees of freedom but also the gluonic degrees of freedom

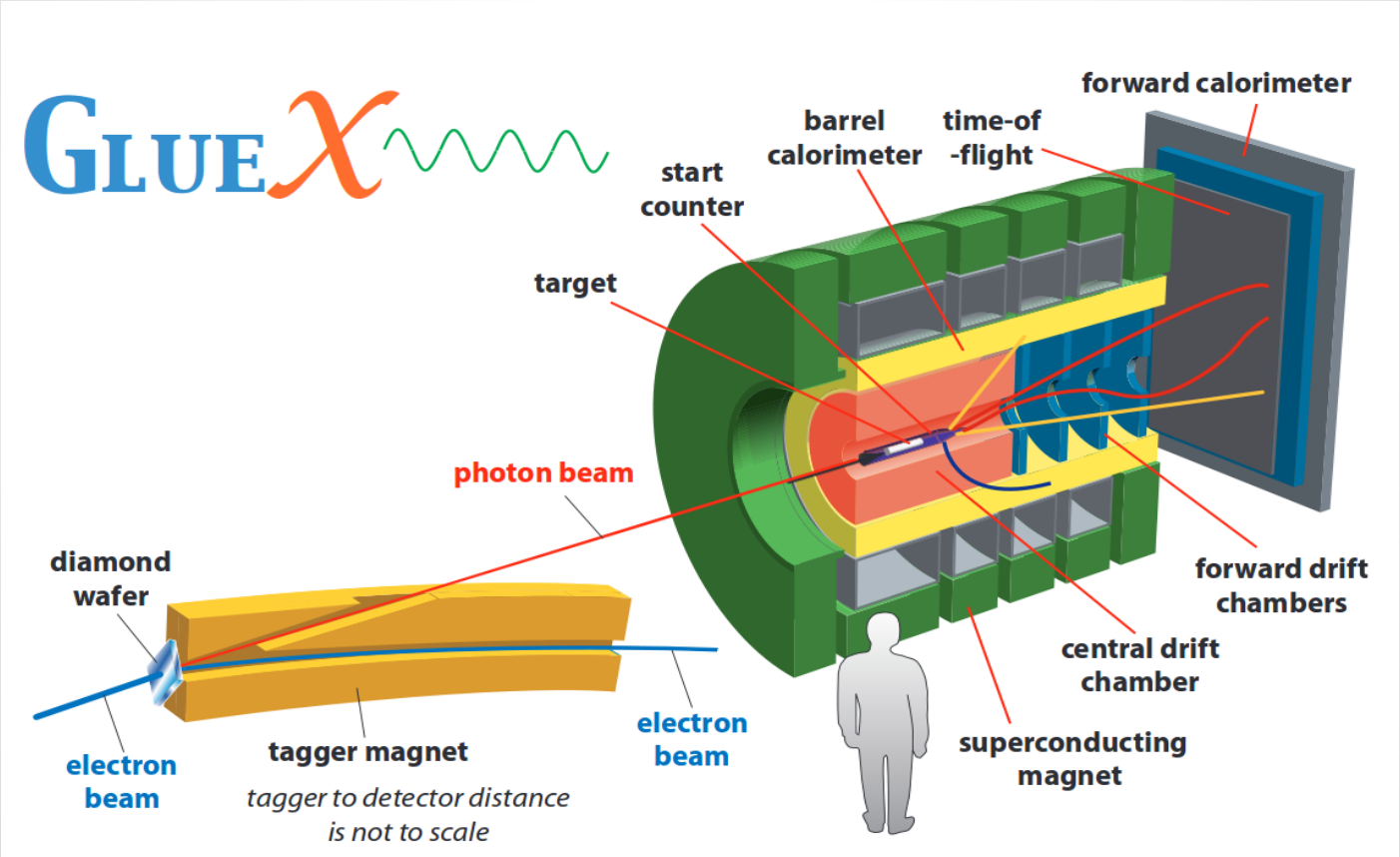
Lattice QCD Predictions



Majority of experimental data to date is related to one state, the π_1.

GlueX detector, and beamline:

9 Gev photons is high enough to access mesons in the mass region of 2 to 2.5 Gev /c^2 where exotic hybrid mesons are expected.



GlueX Detector Summary

- At the heart of the GlueX detector is the 2.2 T superconducting solenoid, which provides the essential magnetic field for tracking.

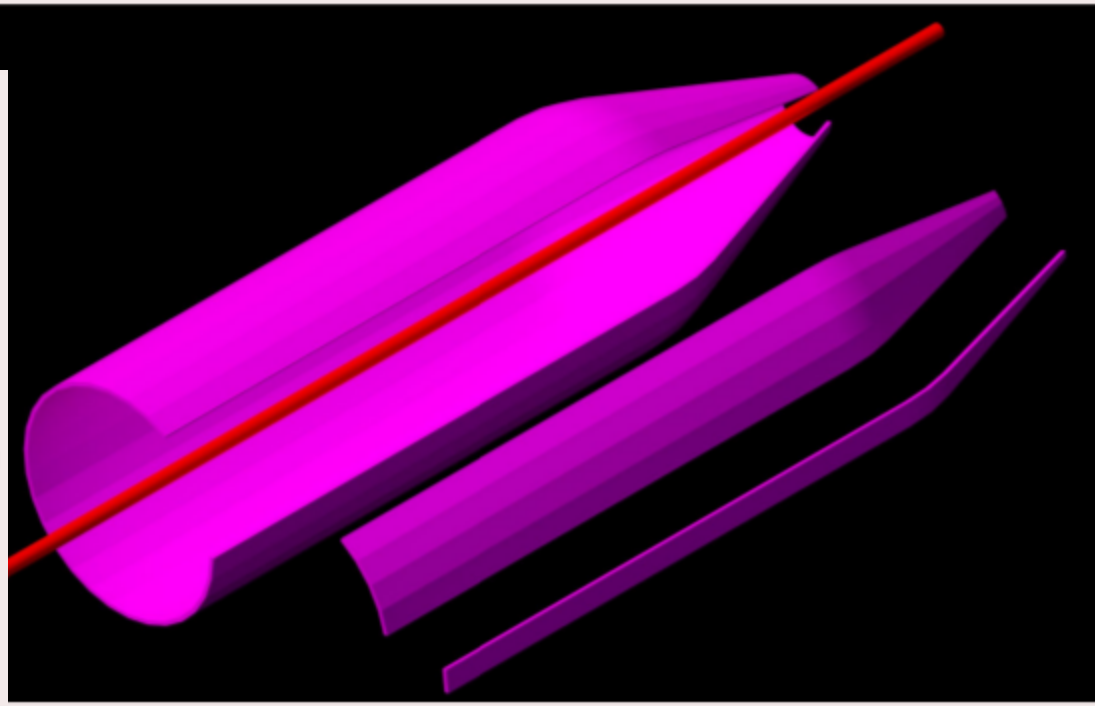
- Charged particle tracking is performed by two systems: a central straw-tube drift chamber (CDC) and four six-plane forward drift chamber (FDC) packages.

- Photons are detected by the GlueX calorimetry system. It consists of two detectors: a barrel calorimeter with a cylindrical geometry (BCAL) and a forward lead-glass calorimeter with a planar geometry (FCAL). The detected photons can be used to reconstruct π_0 's and η's, which are produced in the decays of heavier states.

- Finally, identification of the beam bunch, which is critical for timing measurements,is performed by a thin start counter that surrounds the target.

Start Counter

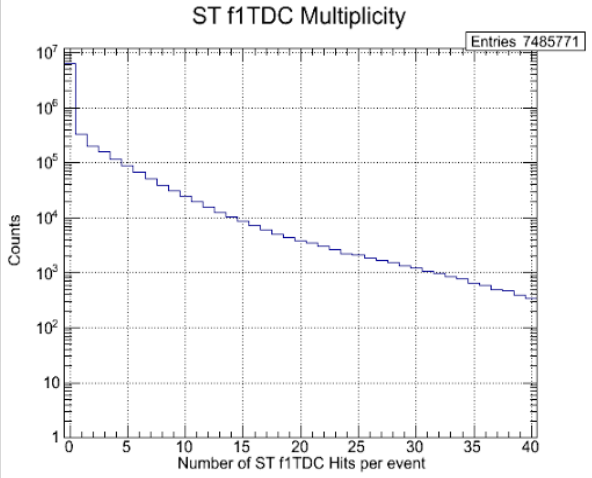
- In coincidence with the tagger the ST will identify the electron beam buckets $\sim 2\,\mathrm{ns}$ apart
- Designed to operate at photon intensities of up to $10^8\,\gamma/s$
- EJ-200 scintillator material with decay time 2 ns and a long attenuation length
- Array of 30 scintillators
- Silicon Photomultiplier (SiPM) detectors comprise the readout system

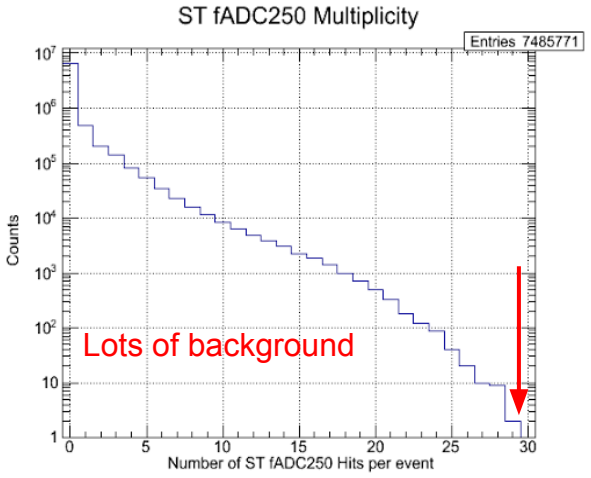


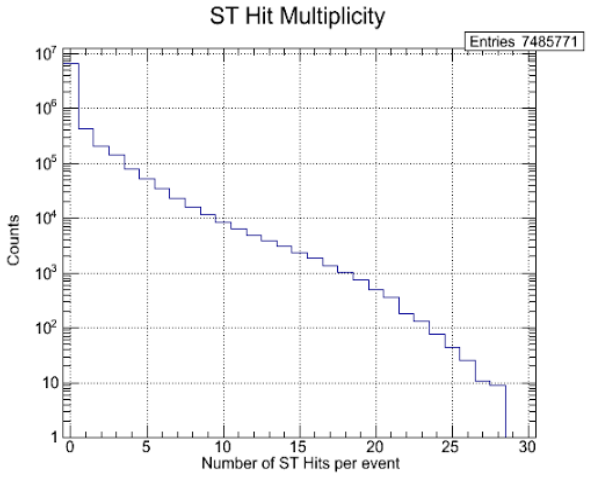
Start Counter Low Level Digihit/Hit Objects

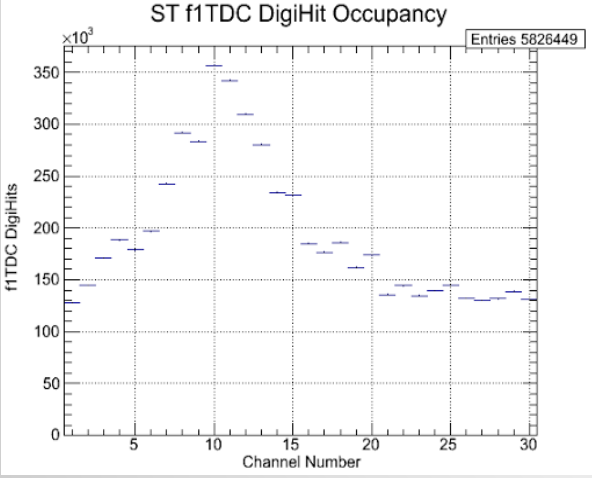
- **Fall Run 2419:**
  - *10 mm CH2 target*
  - *Radiator 2 x 10^{-5} RL*
  - *I_s = 1200 A*
  - *I_b = 100 nA*
  - *~7.5 milion events*
  - *Fcal/Bcal trigger*
- **Spring Run 2931:**
  - *LH2 target*
  - *50 μm diamond radiator*
  - *I_s = 800 A*
  - *I_b = 70 nA*
  - *~ 74 milion event*
  - *Fcal/Bcal*

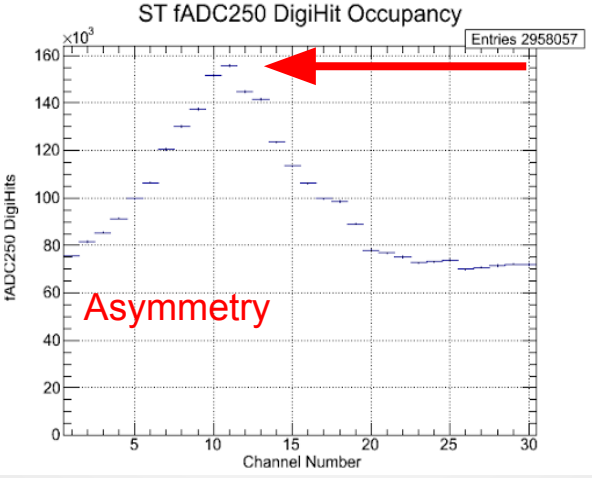
Fall commissioning 2419: *~7.5 m events*

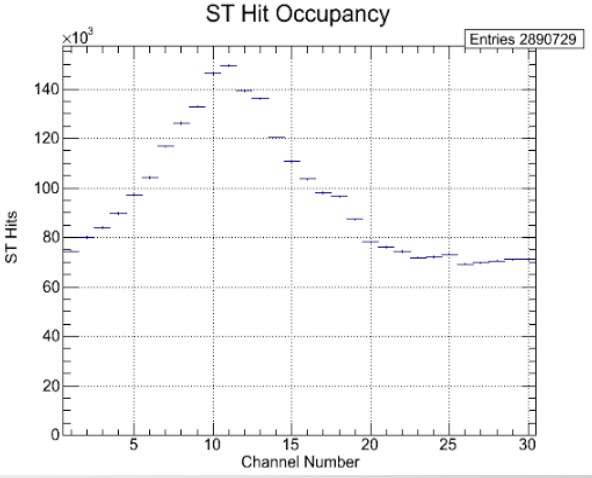




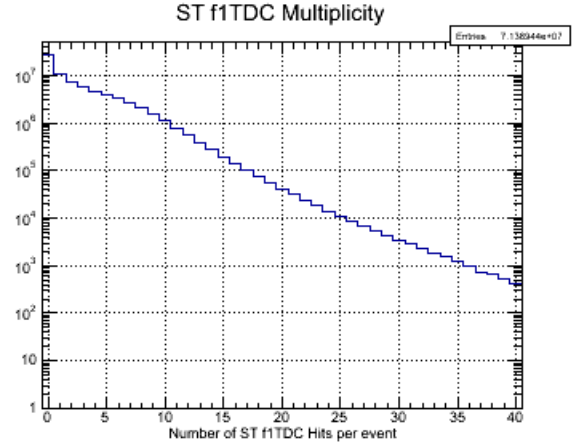


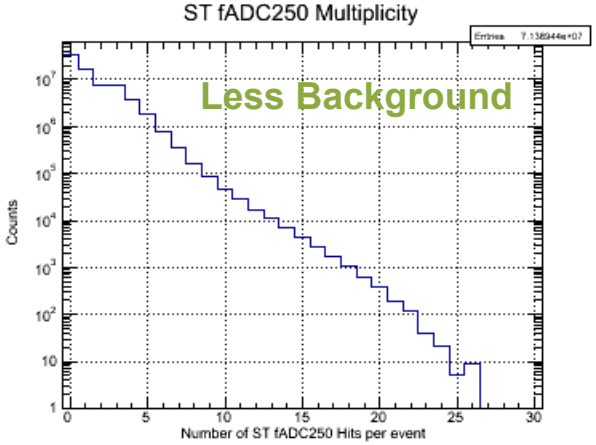


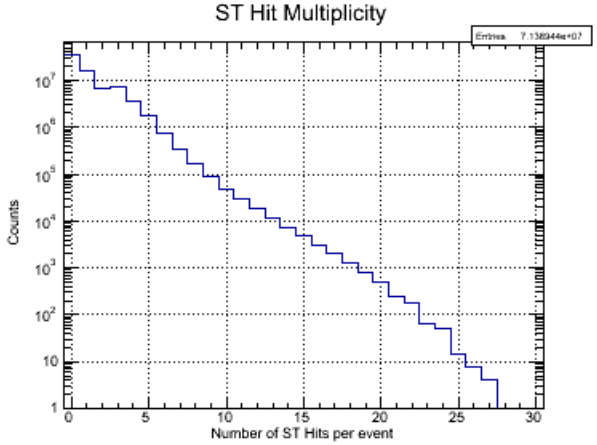


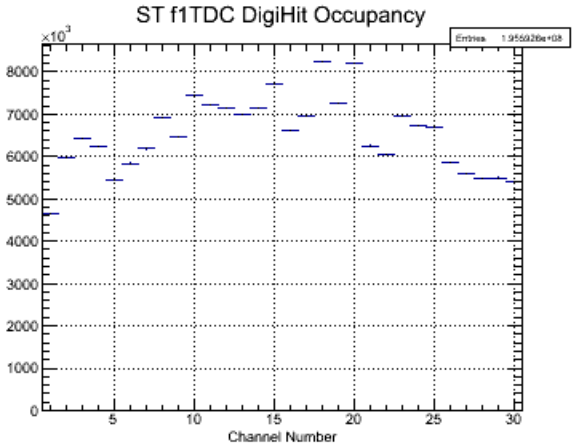


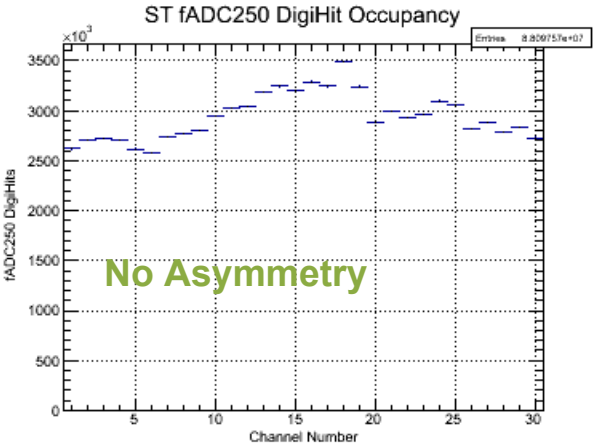
Spring commissioning 2931: *~74 m events*

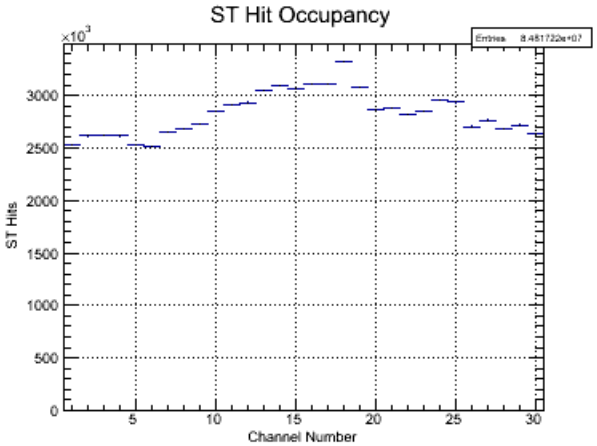










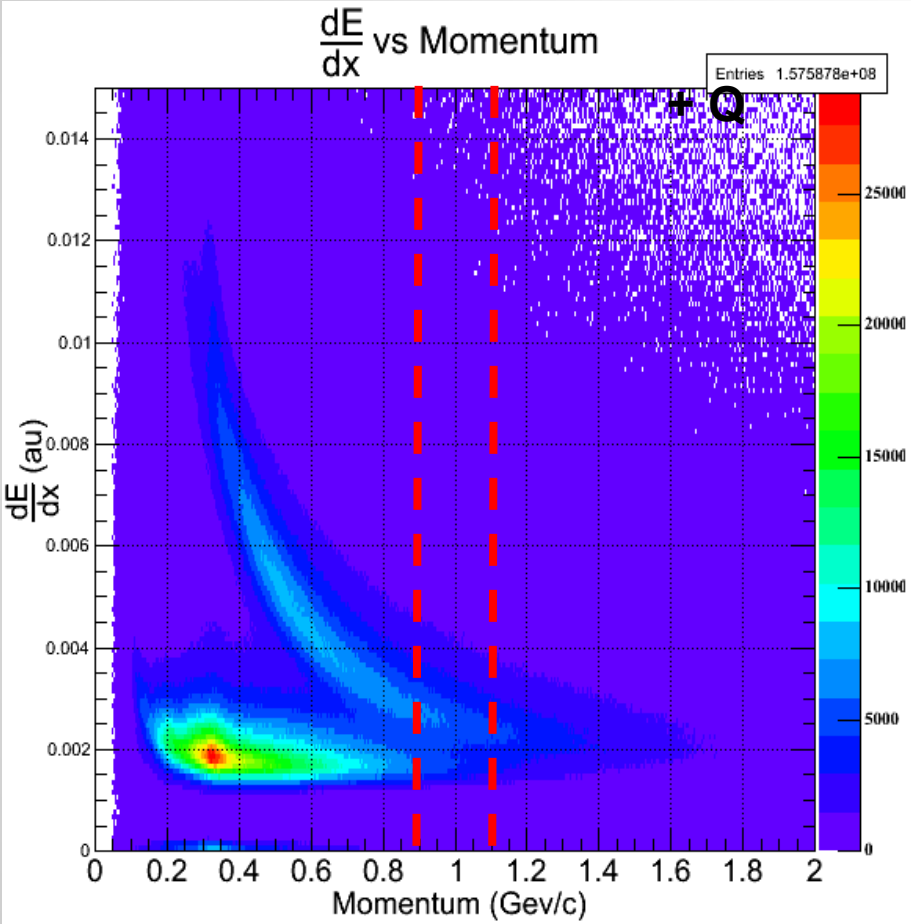


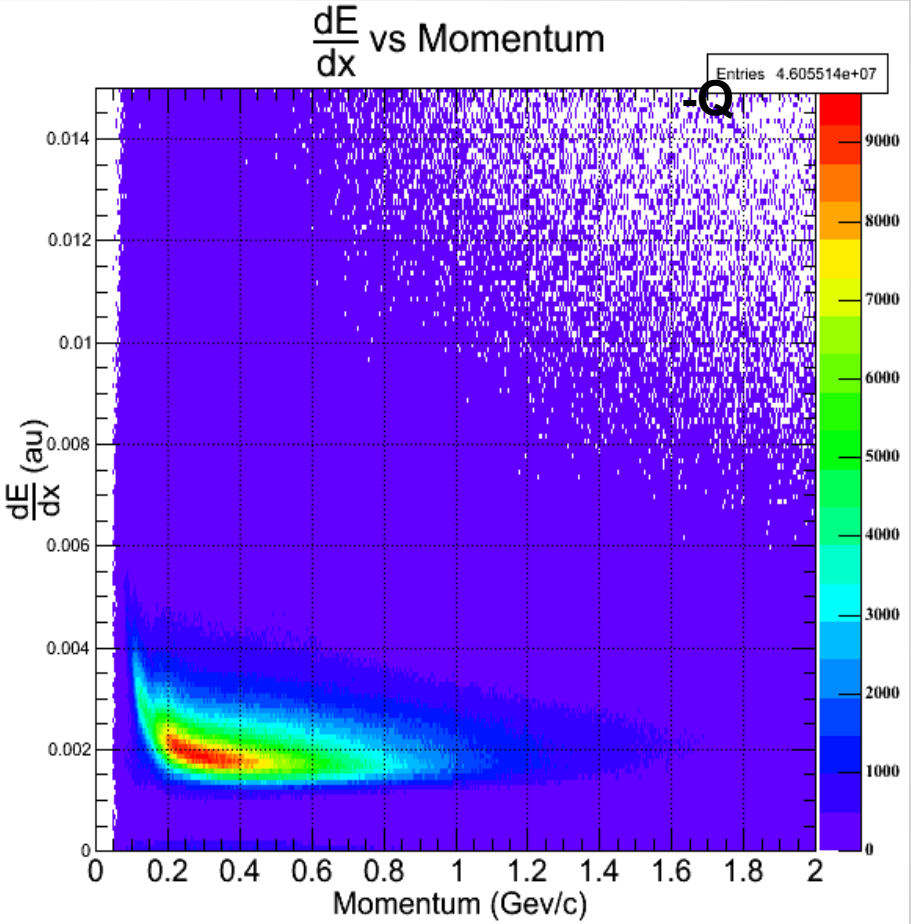
Bias Studies

- **Nominal SiPM bias:** Runs 2931, 2932, 2933, and 2934
  - LH2 target
  - 50 μ diamond radiator
  - *I_s = 800 A*
  - *I_b = 7 nA to 70 nA*
  - *~80 M events, Fcal/Bcal and Fcal trigger*
- **Below nominal SiPM bias by 200 mV:** Runs 3079, 3080, 3081, 3082, and 3084
  - LH2 target/empty target
  - Radiator: *1 x 10^-4 RL*
  - *I_s = 1200 A*
  - *I_b = 38 nA 50 nA*
  - *~ 36 M events, Fcal/Bcal trigger*
- **Above nominal SiPM bias 200 mV:** Runs 3161,3163,3164, and 3165
  - *LH2 target*
  - *Radiator: 1 x 10^-4 RL*
  - *I_s = 1300 A*
  - *I_b = 43 to 145 nA*
  - *~4.5 M events , Fcal/Bcal trigger*

Proton/Pion Separation In The ST: Nominal SiPM Bias

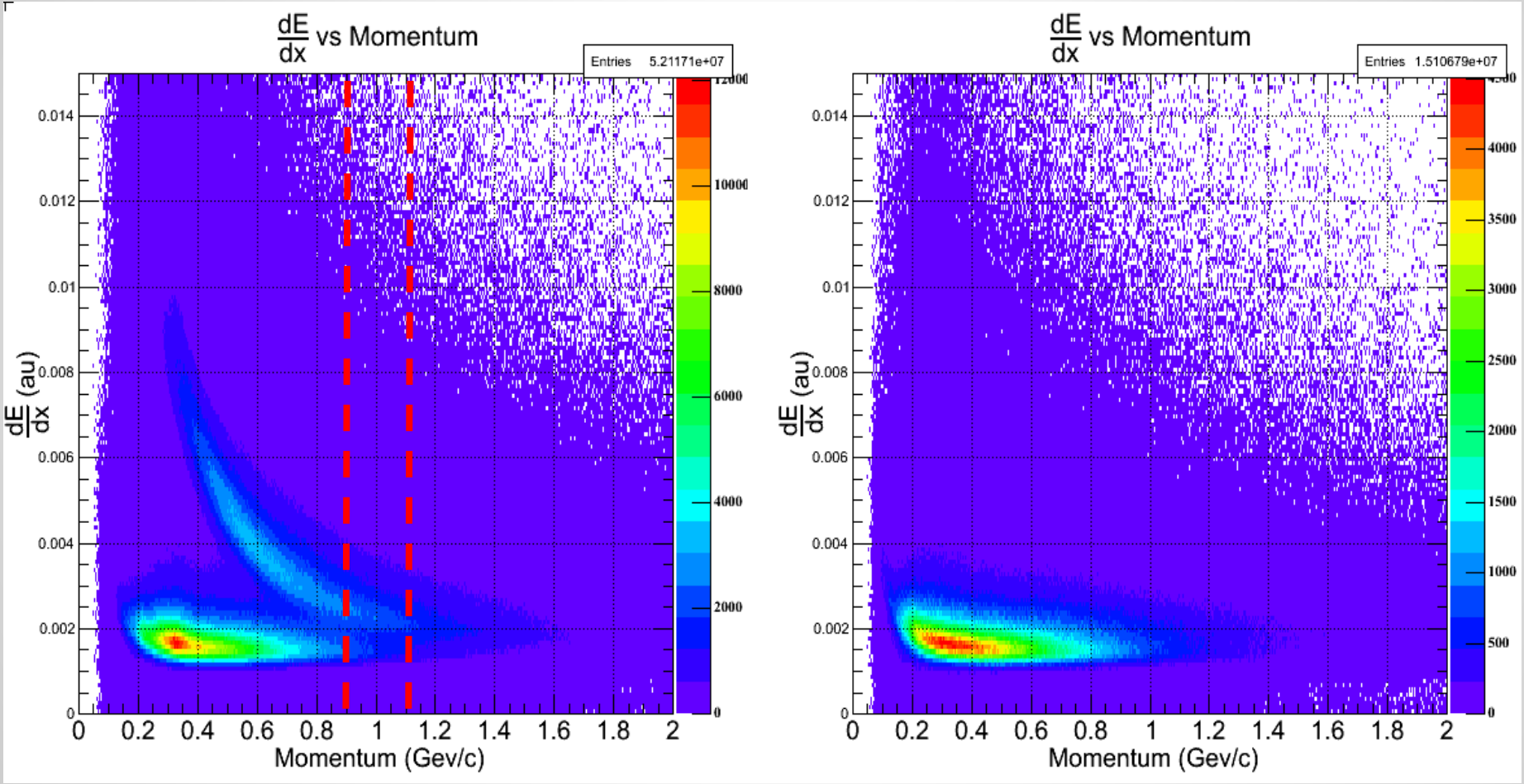
LH2 target, 50 μ diamond radiator, I_s = *800 A* , I_b = *7 nA to 70 nA, ~80 M events, Fcal/Bcal and Fcal trigger*





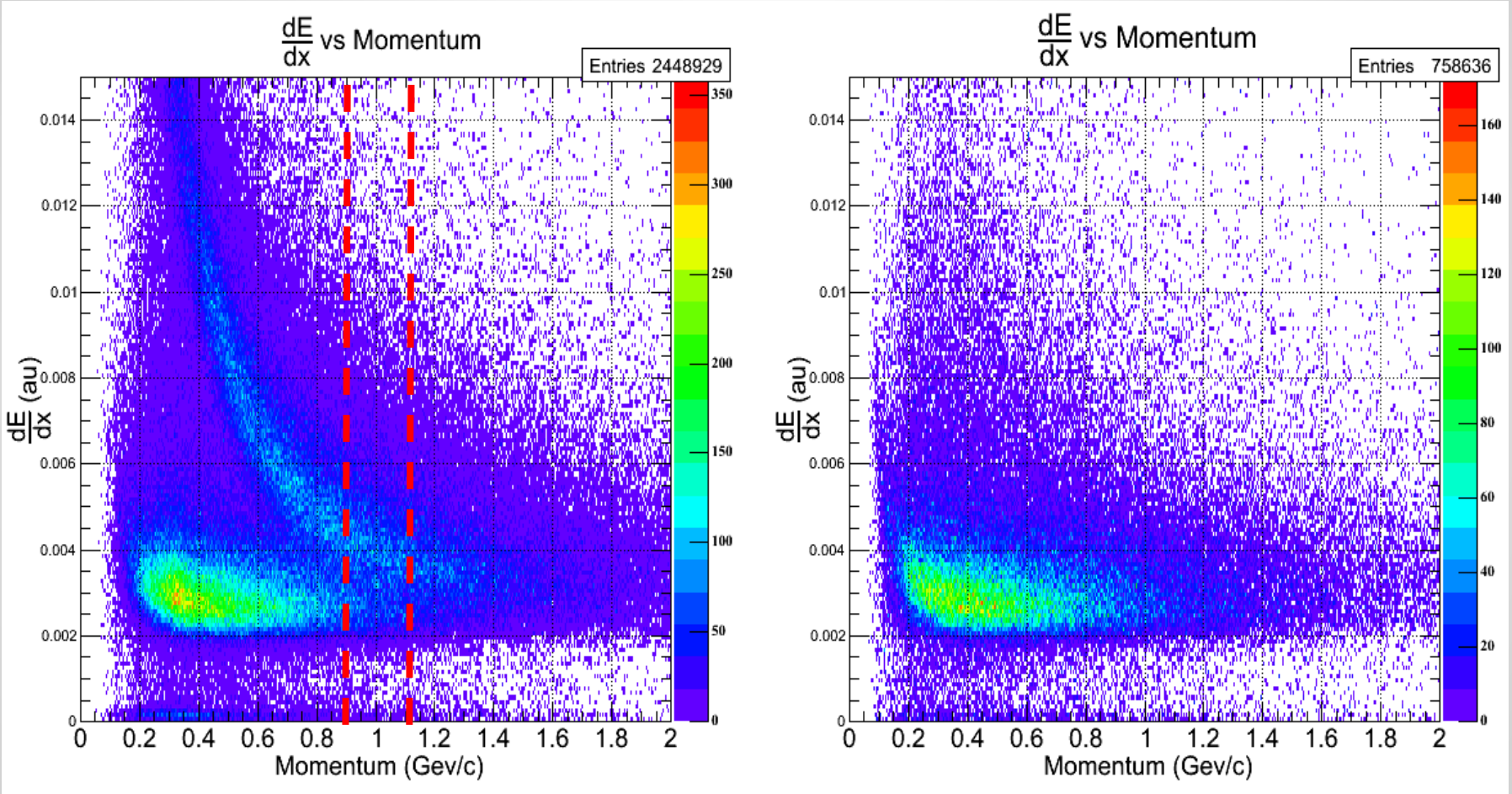
Proton/Pion separation In The ST: 200mV Below Nominal SiPM Bias

LH2 target/empty target, Radiator: *1 x 10^-4 RL, I_s = 1200 A, I_b = 38 nA 50 nA, ~ 36 M events, Fcal/Bcal trigger*

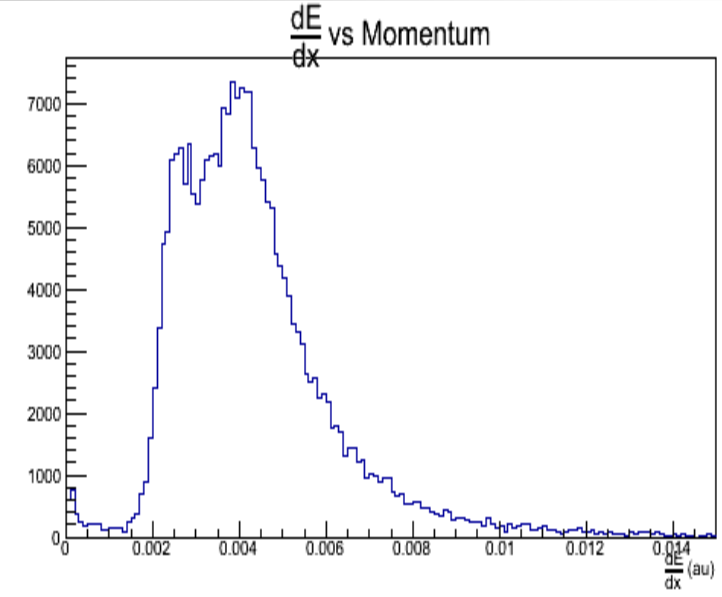


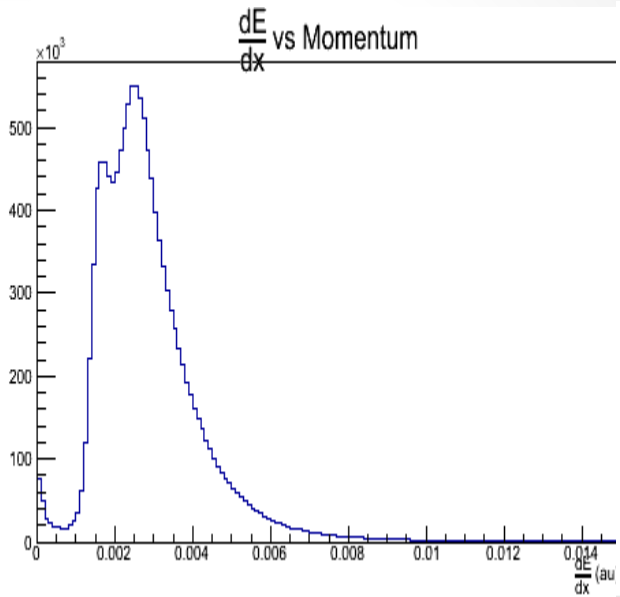
Proton/pion Separation In The ST: 200 mV Above Nominal SiPM Bias

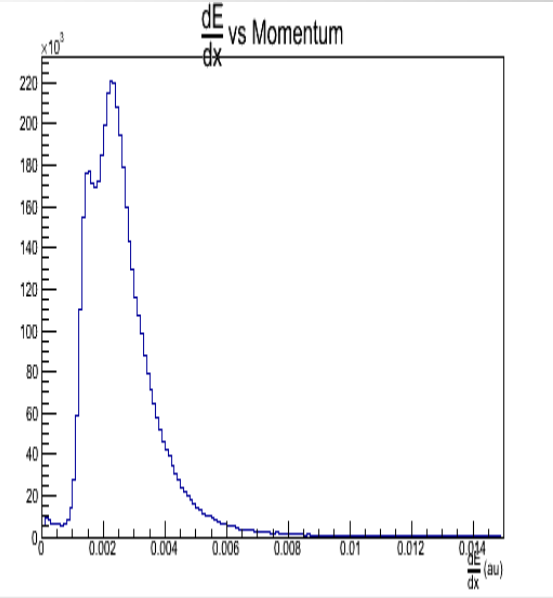
LH2 target, Radiator: 1 x 10^-4 RL, I_s = 1300 A, I_b = 43 to 145 nA, ~4.5 M events , Fcal/Bcal trigger



Y Projection while cutting in momentum : 0.9 < P < 1.1







Above Nominal
Pion peak = 0.00265
Proton peak = 0.00388

Nominal
Pion peak = 0.00167
Proton peak = 0.00251

Below Nominal
Pion peak = 0.00149
Proton peak = 0.00230

Summary

- GlueX physics data is expected 2016/2017.
- ST online monitoring plugin update is ongoing
- Preliminary SiPM bias studies have been conducted
- More to Come

Backup Slides