877 MeV N->Delta Running: Simulation and First Results

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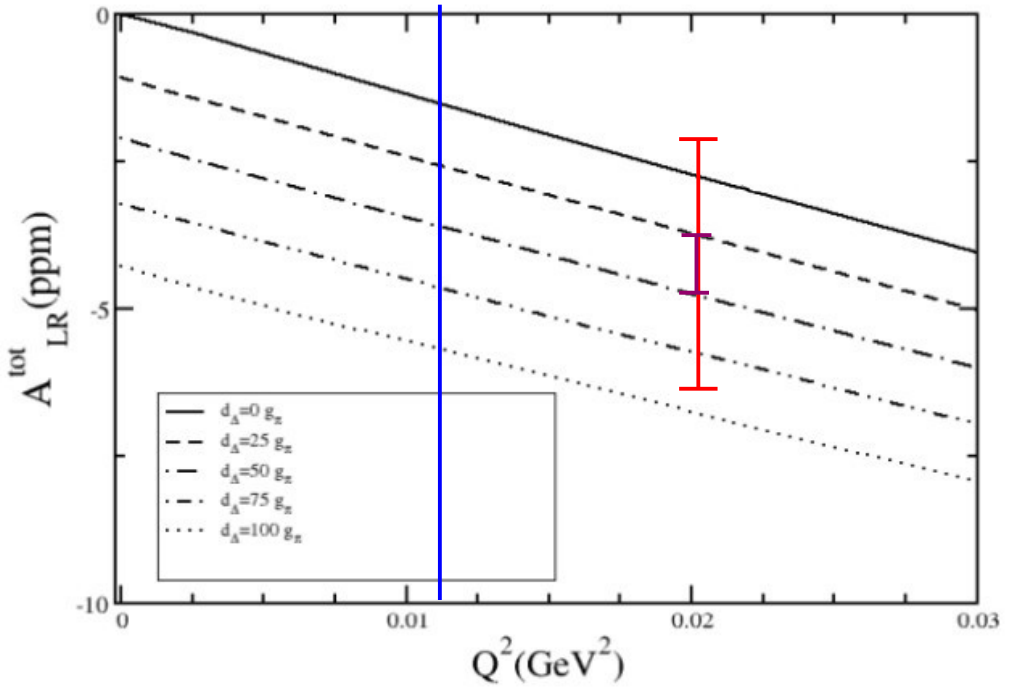
Previous N->Delta Work

Physics motivation:

- Determining the N->delta Asymmetry @ 877 MeV will allow us to extract a value for d_Δ
- d_Δ is a low energy constant that is a measure of hadronic parity violation



Expected error bars:

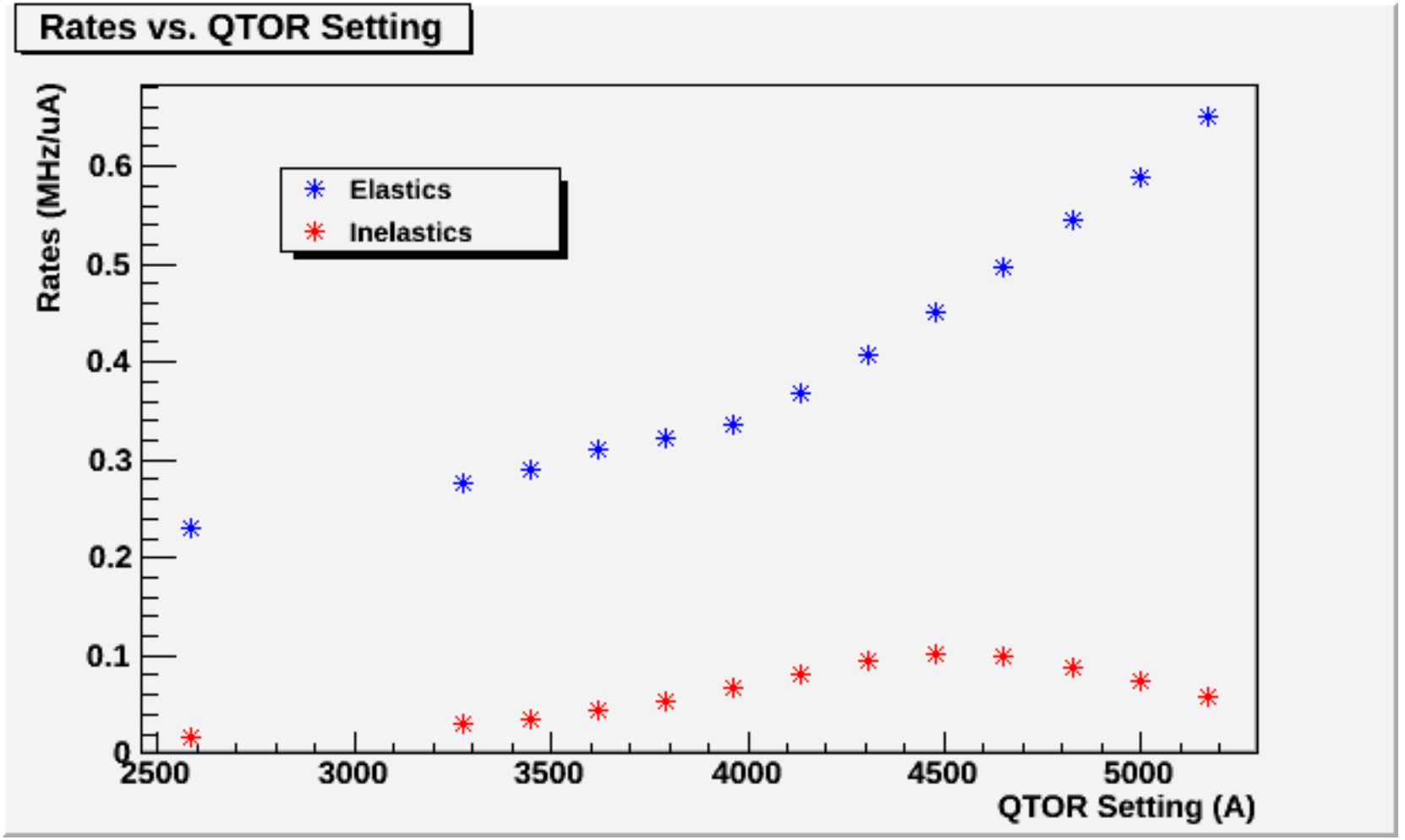
- initial measurement (above) +/- 50g_π
- enough data in hand to constrain inelastic background to Qweak +/- 13g_π

Goal

- 877 MeV point will be located here

Simulation – Inelastic Peak

No preradiator, only primary electrons



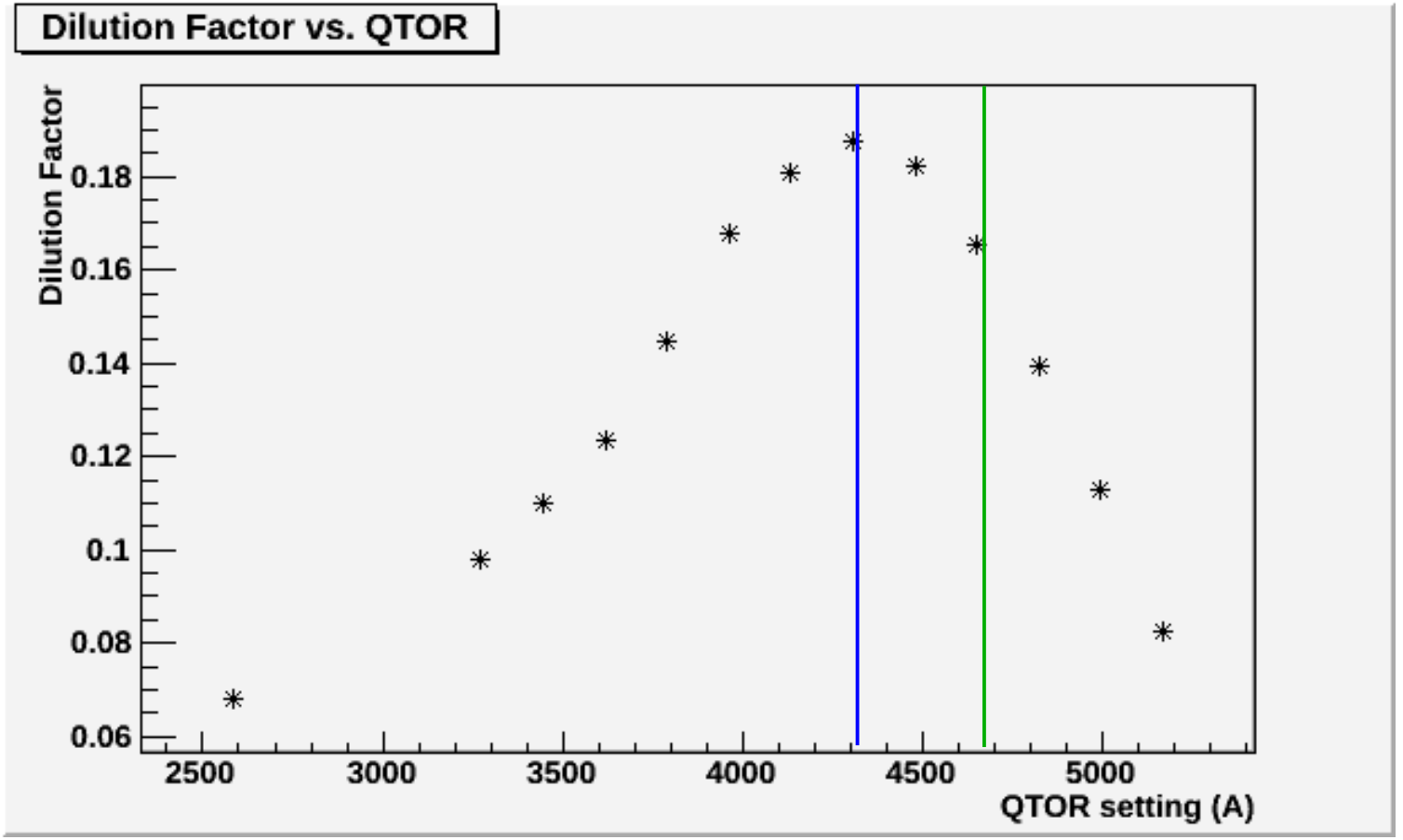
Simulation- Dilution factor

$$f_{inel} = \frac{R_{inelastic}}{R_{inelastic} + R_{elastic}}$$

Inelastic Peak (~18.8%)

Chosen QTOR (~16.5%)

We wanted to have our dilution factor be as large as possible.

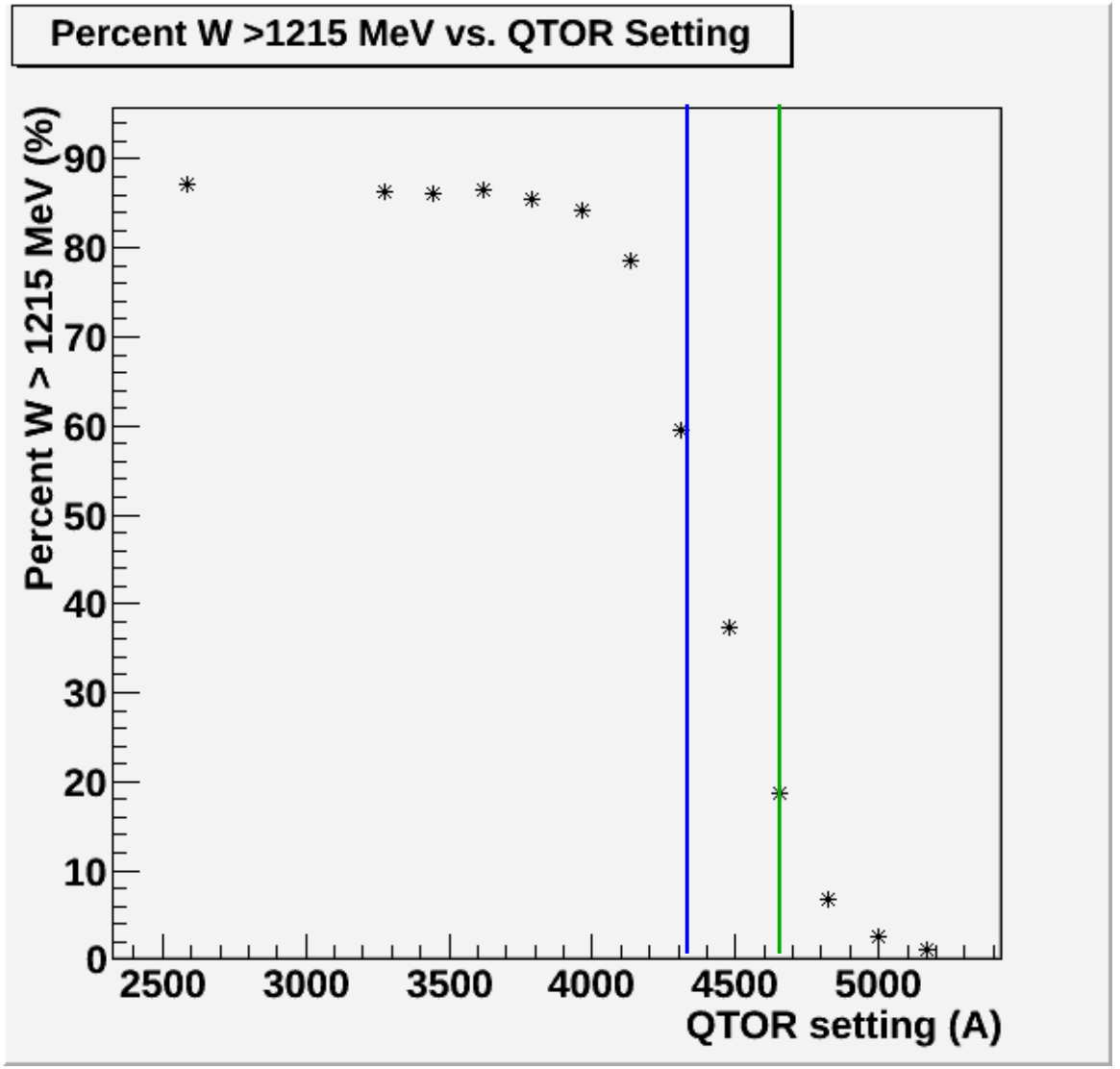


Simulation – 2 Pion Production

Inelastic Peak (~59.5%)

Chosen QTOR (~18.9%)

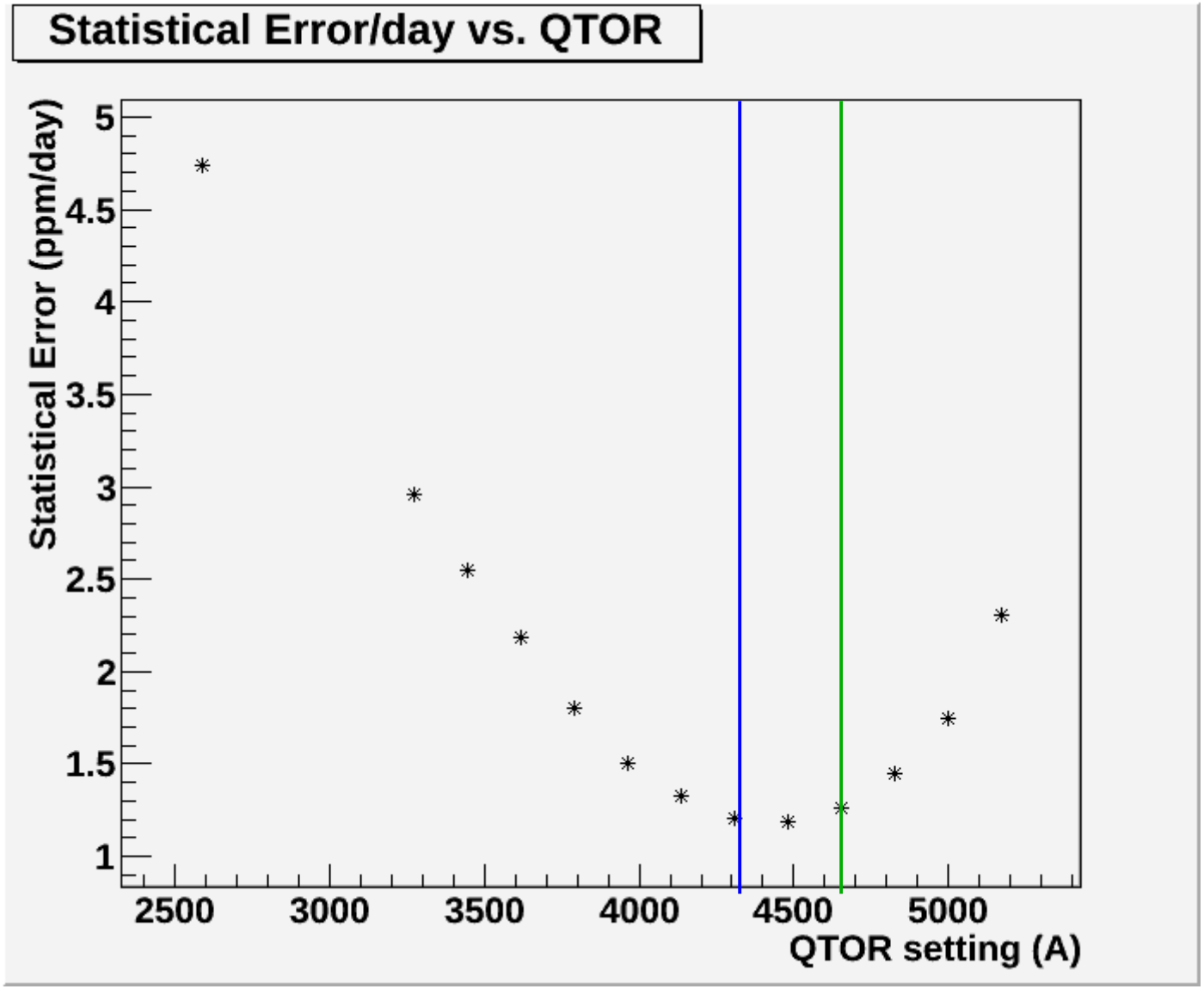
We wanted to avoid having two much contamination due to the unknown asymmetry of the 2 pion production process.



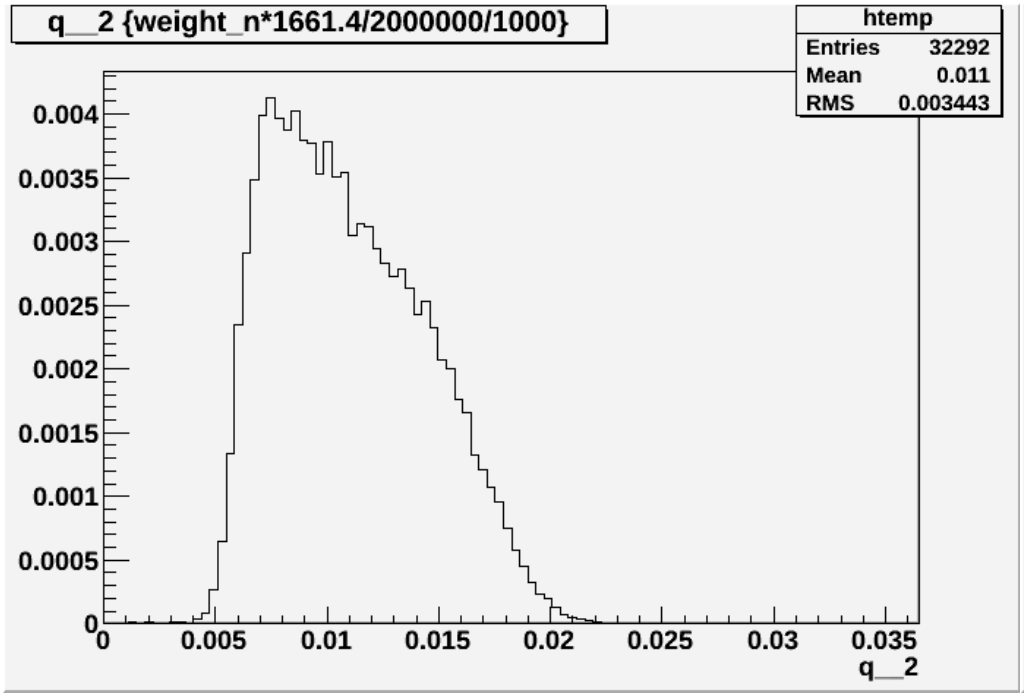
Simulation – Statistical Error / day (@ 90 uA)

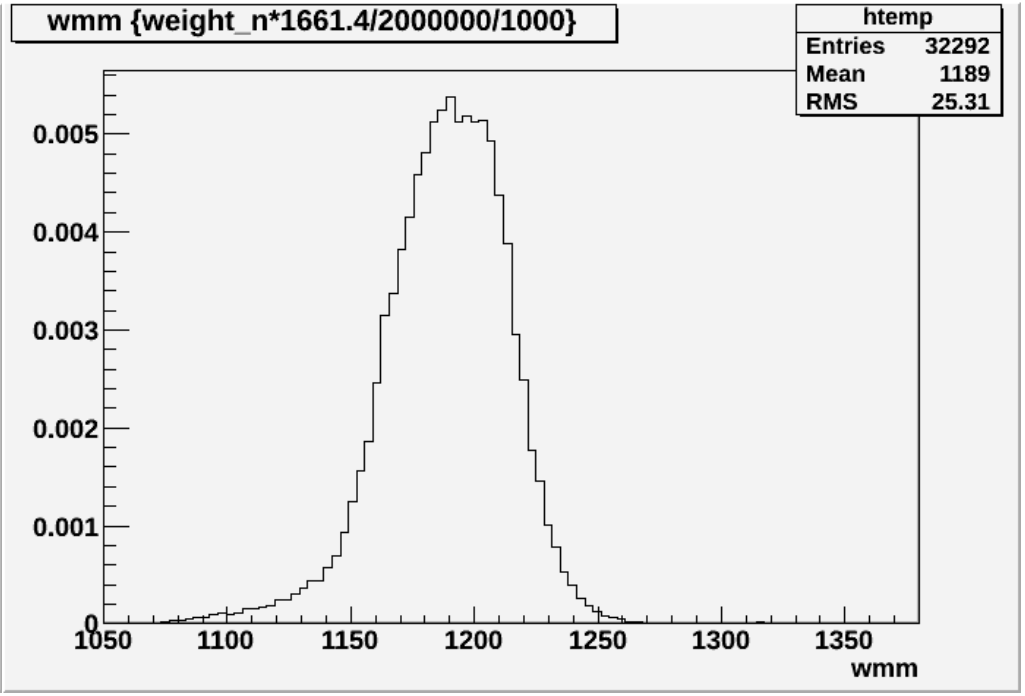
Inelastic Peak
(~1.21 ppm/day)

Chosen QTOR
(~1.26 ppm/day)

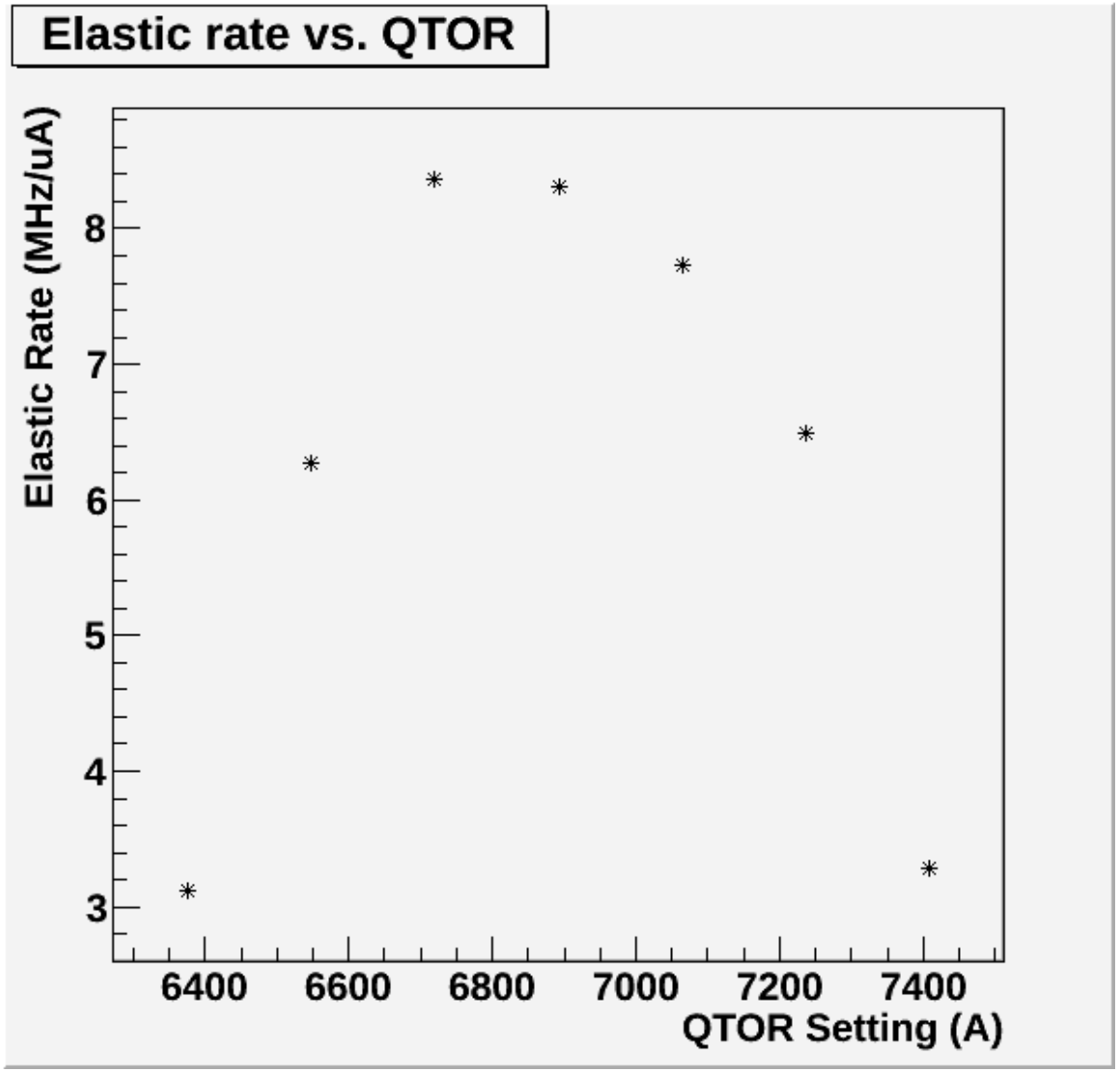


Simulation – Chosen QTOR = 4652 A

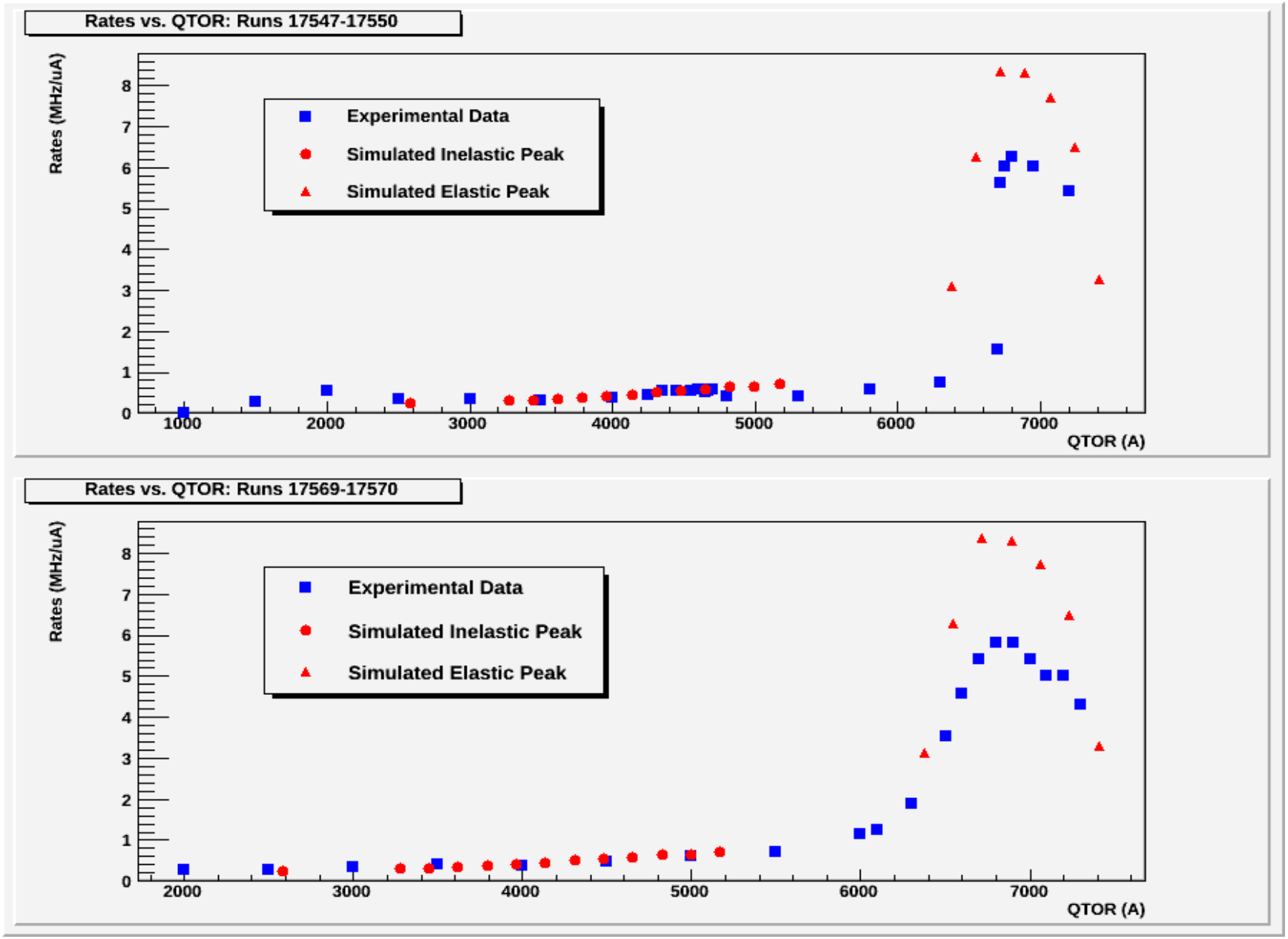




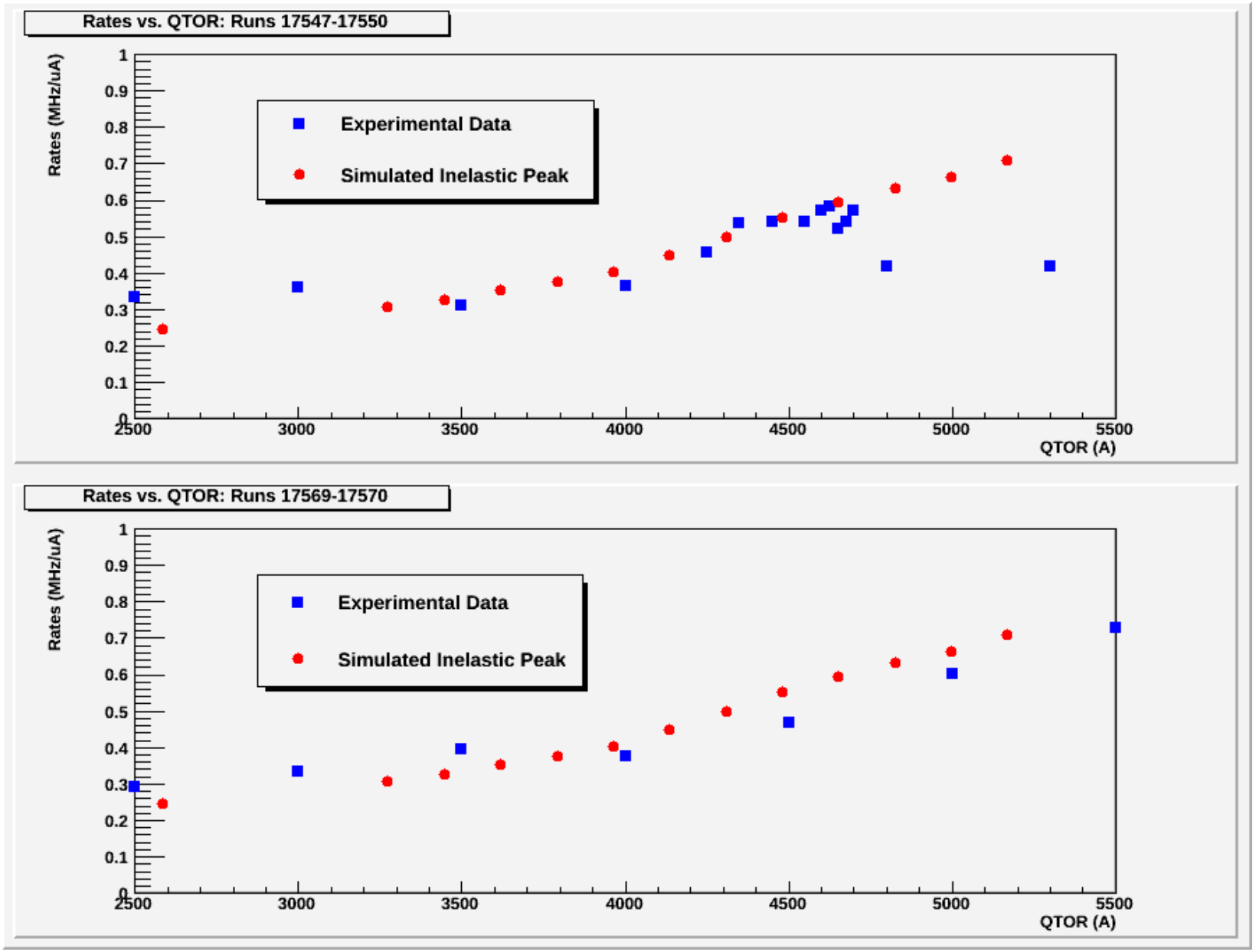
Simulation – Elastic Peak



First Results – Tracking QTOR Scans



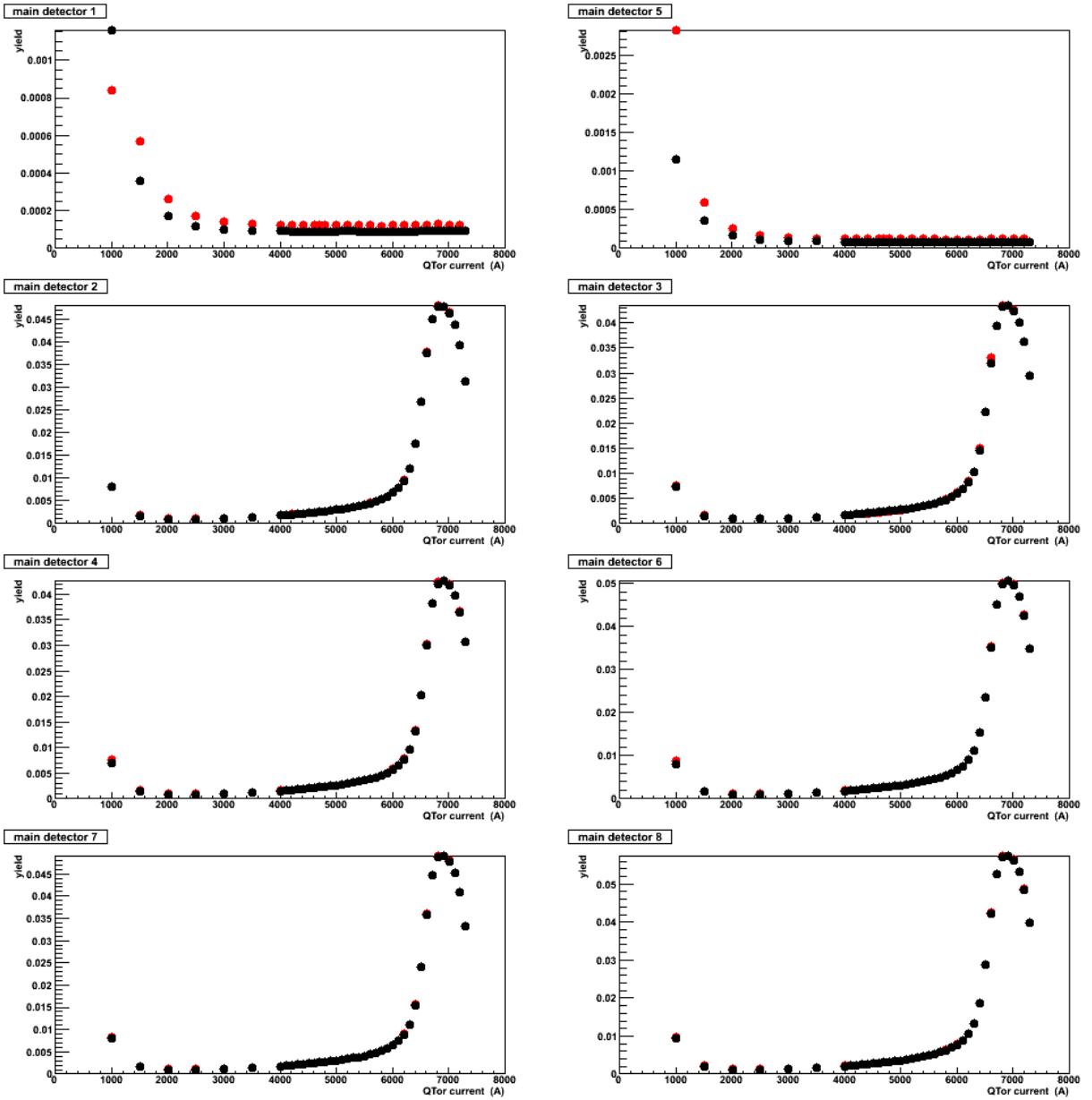
First Results – Inelastic Peak



First Results – MD Yield QTOR

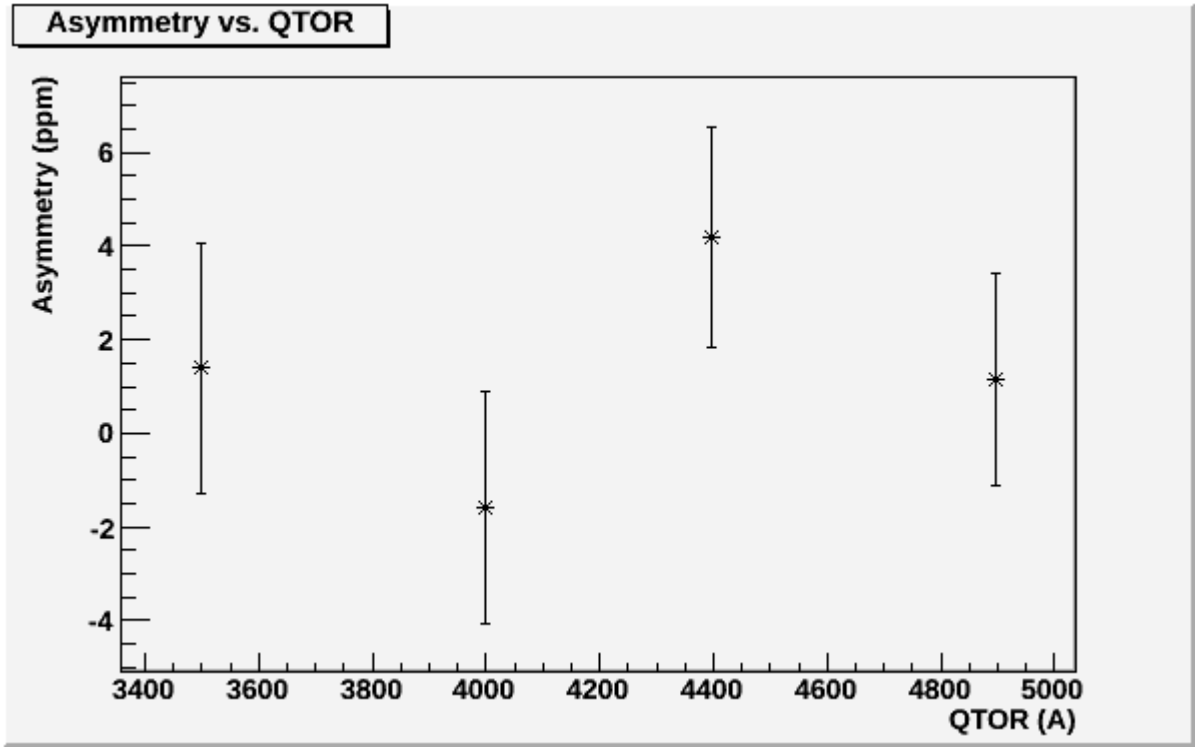
- Mark Dalton's elog 547
- Main Detector Yields in production mode (red-bad halo, black-good halo)
- Was not simulated-- simulations had no preradiator or secondary electrons
- Octants 1 and 5 were blocked with Tungsten shutters

https://qweak.jlab.org/elog/Analysis+&+Simulation/547



First Results – Asymmetry vs. QTOR

- Runs 17744 -17747
- Asymmetry looks relatively flat over QTOR (expected value of -0.3 ppm- shown later)-- No surprises due to 2 pion production in the lower QTOR
- We ran a 2 hr survey @QTOR = 4000 A (4x possible pion production) to check agreement

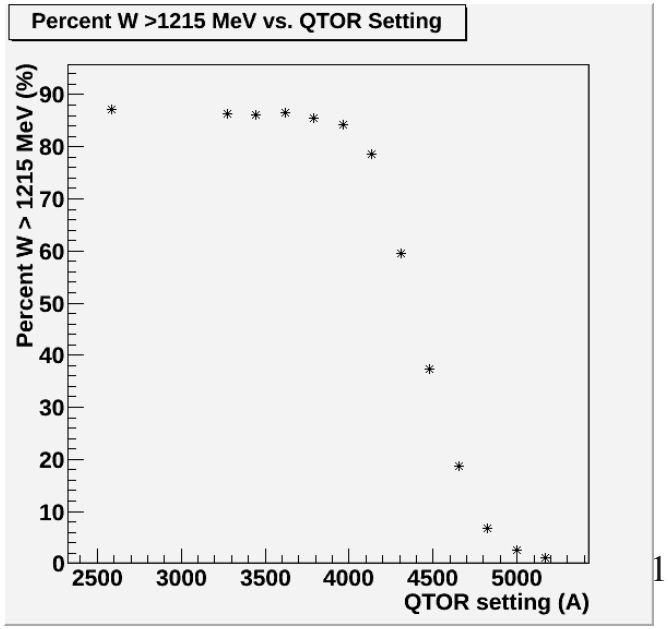


IN_R = -0.42727 ± 0.98135 ppm

OUT_R = 1.49847 ± 1.04338 ppm

(IN + OUT) / 2 = 0.5356 ± 0.716 ppm

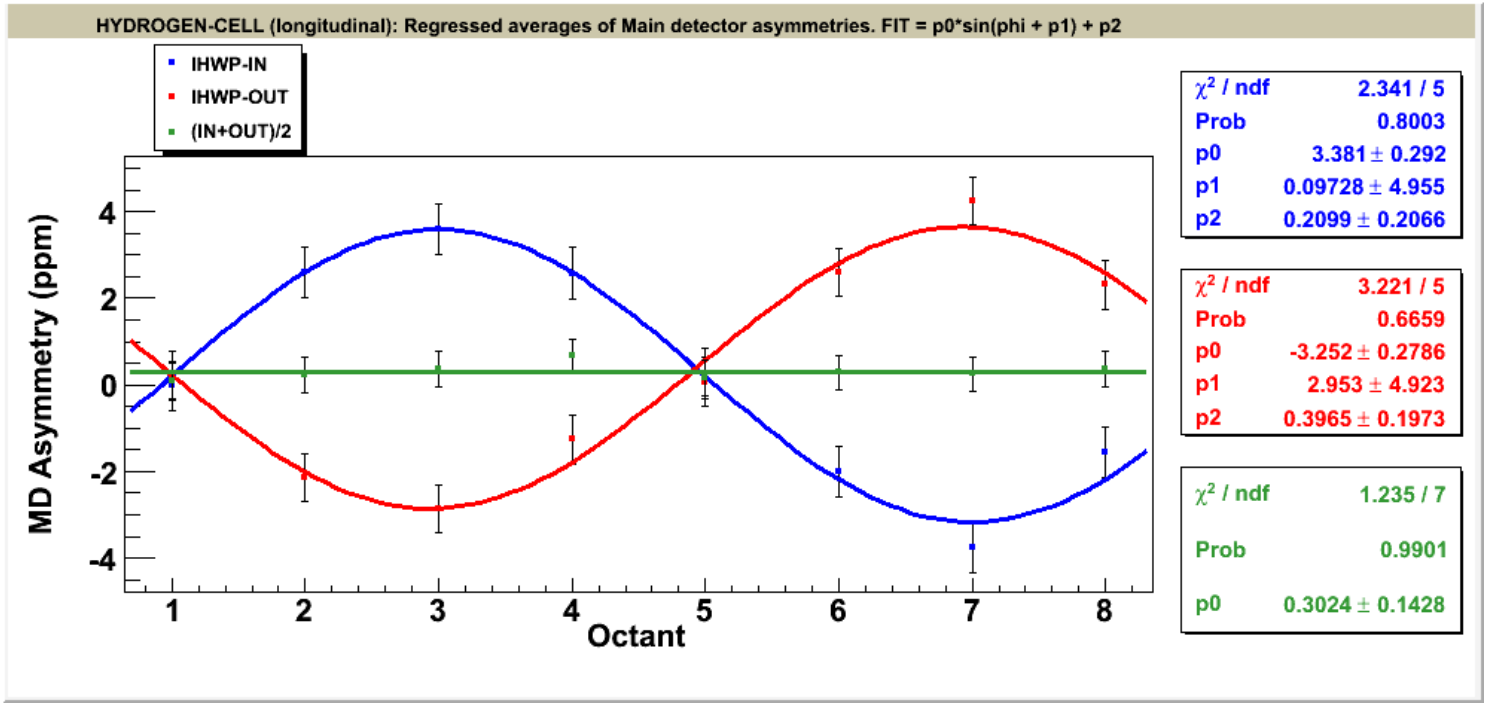
(OUT - IN) / 2 = 0.96287 ± 0.716 ppm



First Results – Large Transverse Asymmetry

- Buddhini's elog 540
- Running at 43% transverse polarization- the transverse asymmetry will be present in data
- Transverse Amplitude: 3.3 ppm
- Moller Peak Asymmetry- test suggested by Mark Pitt to determine suppression factor

https://qweak.jlab.org/elog/Analysis+%26+Simulation/540



First Result – Expected measured Asymmetry

- First: Determine the expected measured asymmetry for $d_\Delta = 0$

$$A_{inel} = \frac{A_m / P - \left(1 - f_{inel}\right) A_{ep}}{f_{inel}}$$

$$A_m = P * \left(A_{inel} * f_{inel} + A_{ep} * \left(1 - f_{inel}\right)\right)$$

- Use the values: P = 0.79 f_{inel} = 0.165 A_{inel} = -1.5 ppm A_{ep} = -0.14 ppm
- This results in A_m ~ -0.3 ppm

First Result – Symmetry Factor

- Expected A_m ~ -0.3 ppm
- We want the false asymmetry due to transverse polarization to be < 0.06 ppm
- Transverse Amplitude: 3.3 ppm

$$\frac{Transverse\ Amplitude}{false\ asymmetry} = \frac{3.3\ ppm}{0.06\ ppm} = 55$$

We want our symmetry factor >55

First Results – Moller Peak Asymmetry Test

- Moller expected PV asymmetry is very small, but has a calculable relatively large transverse asymmetry
- Can be used to determine the symmetry factor of the inelastic running-- has the same polarization as inelastic running
- Run at QTOR =600A for a half hour IN and a half hour OUT to determine the transverse asymmetry of the Moller Peak
- Figure of merit- (Transverse amplitude) / (MD all width)
  - Pitt/Buddhini hclog 265274 (https://hallcweb.jlab.org/hclog/1204_archive/120418120944.html)
- Results to come later

First Results – Asymmetries(Good Halo)

- IN = 0.19031 ± 0.11536 ppm
- OUT = -0.00432 ± 0.11655 ppm
- (IN + OUT) / 2 = 0.09300 ± 0.08199 ppm
- (OUT – IN) / 2 = -0.09732 ± 0.08199 ppm

$$\Delta A_m = 0.08199\ ppm \qquad \Delta A_{inel} = \frac{\Delta A_m / P}{f_{inel}} = 0.63\ ppm$$

First Results

- Statistical Error bar from 877 MeV (±0.65ppm)
- Centered at

  $d_\Delta = 0$ to demonstrate size o error bar, unkown actual value