# Hall A 12 GeV Raster Calibration

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# Introduction

- The current Hall A raster consists of 4 magents (2X and 2Y) to account for the increased beam energies now available.
- The X magnets should remain in sync and the Y magnets should remain in sync
- The raster current pattern in a triangle wave at ~25kHz
- The read current is sent to an offset-attenuator for each HRS and then to a charge-integrating ADC
- **A fairly detailed tech-note on the raster calibration is currently being prepared by the GMp collaboration.**

# Raster Calibration

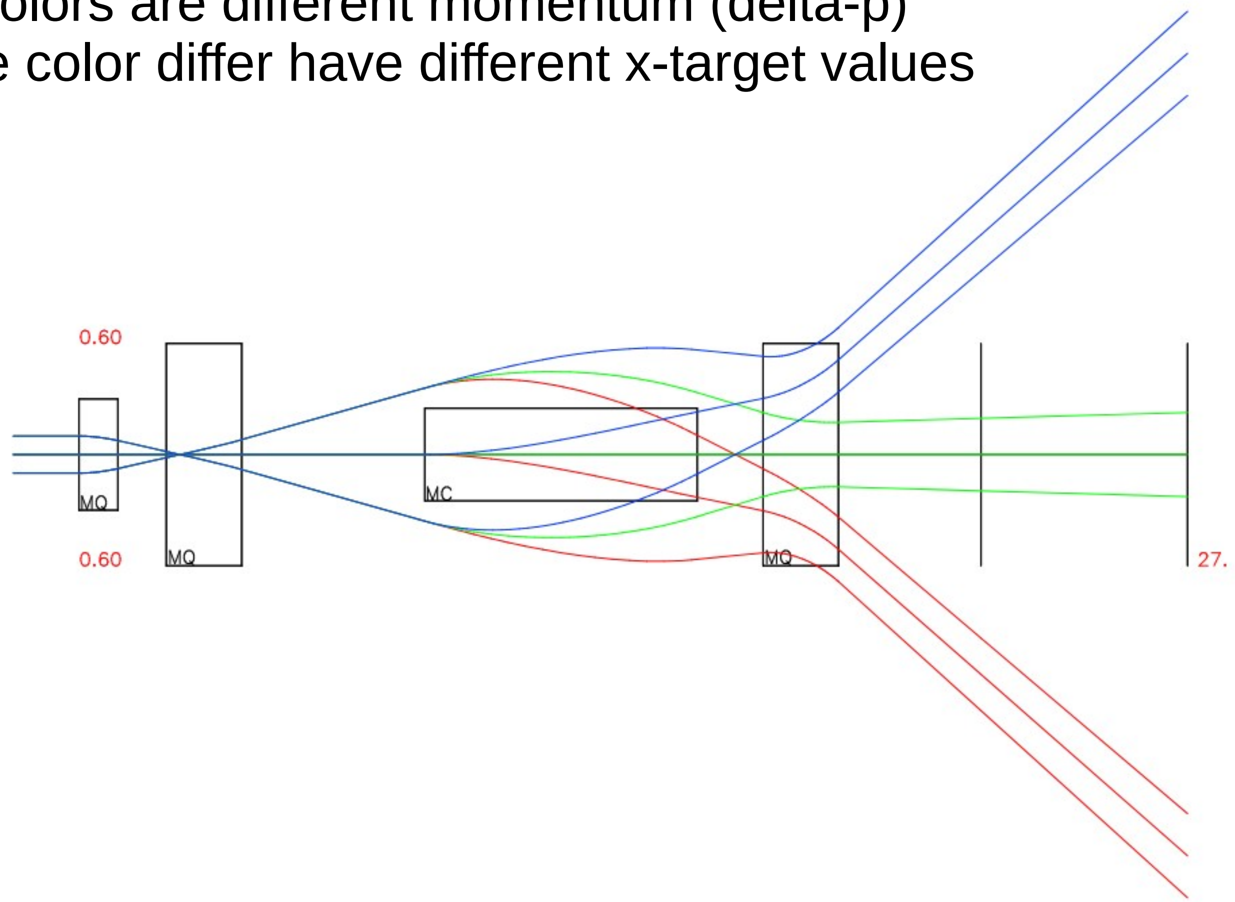
- In my experience, the term 'Raster Calibration' can potentially mean 2 things.
- First, it can refer how the raster size we ask MCC for corresponds to the raster size at the target. This is done on-line using the carbon hole.
- What I will discuss here is the so-called 'Raster (or Extended Target) Corrections', which is performed off-line to correct the reconstructed target quantities.

# Raster Corrections

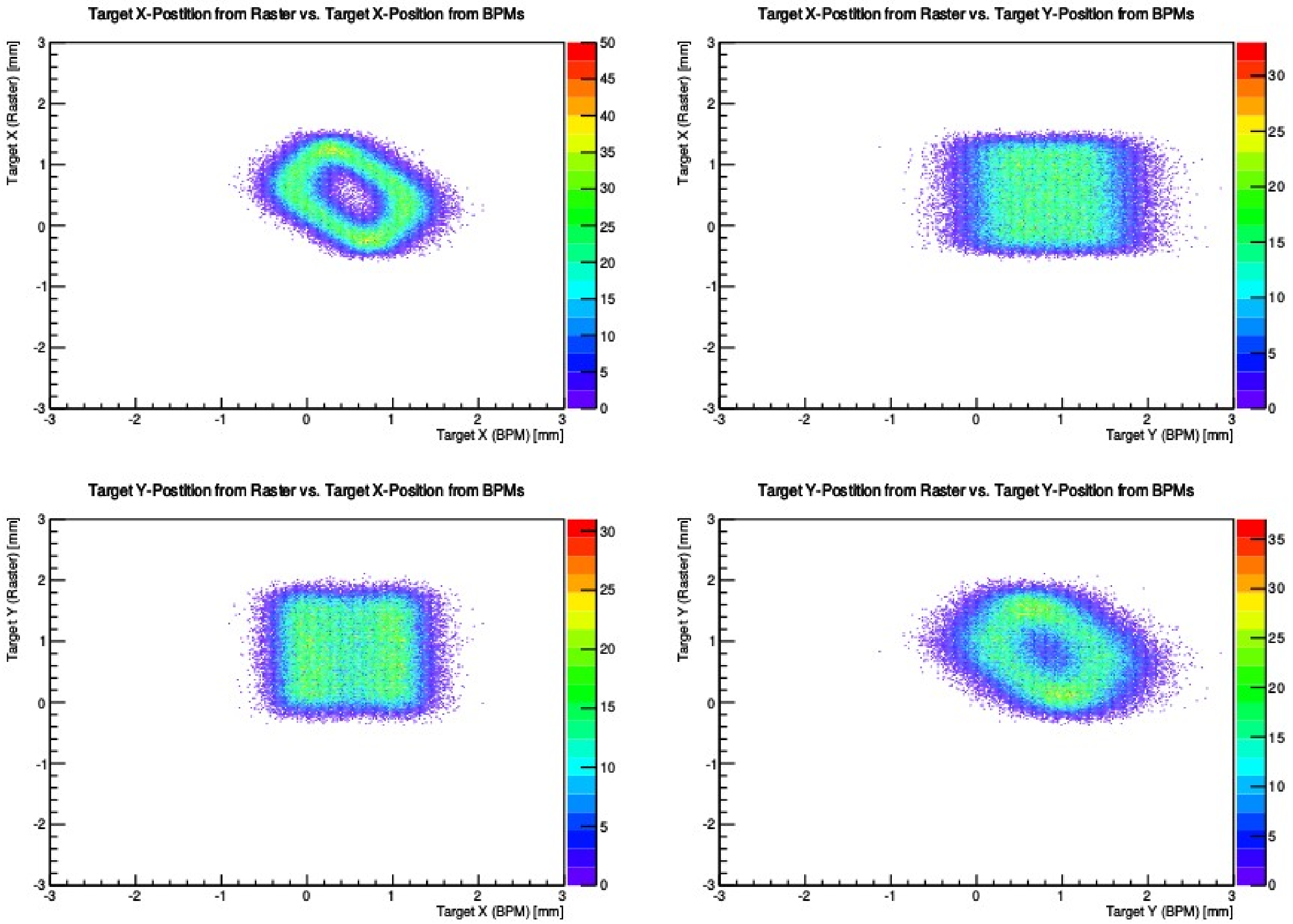
- The corrections consist of 2 separate parts.
  - If the spectrometer x-target value is non-zero, the delta-momentum and theta-target (out-of-plane angle) will be reconstructed incorrectly. The correction will adjust these variables based on the first-order dependence on x-target.
  - In order to determine x-target value for each event, we need to know the beam transverse positions and a function of (z-beam). We then can intersect this beam ray with the reconstructed ray from the spectrometer.
  - If the raster is off, the beam position can be determined using the 2 bpms (just draw a straight line). If the raster is on, however, there is a phase lag between the real position and the position and the position recorded by the bpm. So, the raster current that is recorded for each event will need to be used.

# Raster Corrections (Part 1)

Different Colors are different momentum (delta-p)
Lines of same color differ have different x-target values



# Raster Corrections (Part 2): Raster On, BPM Phase Lag



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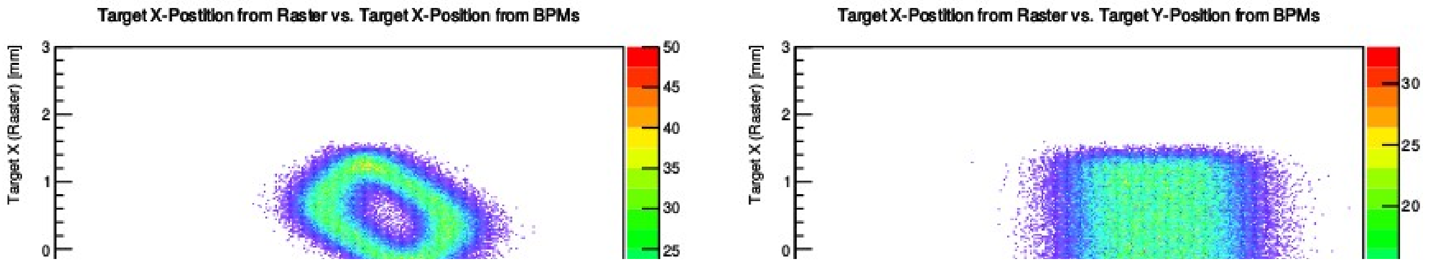
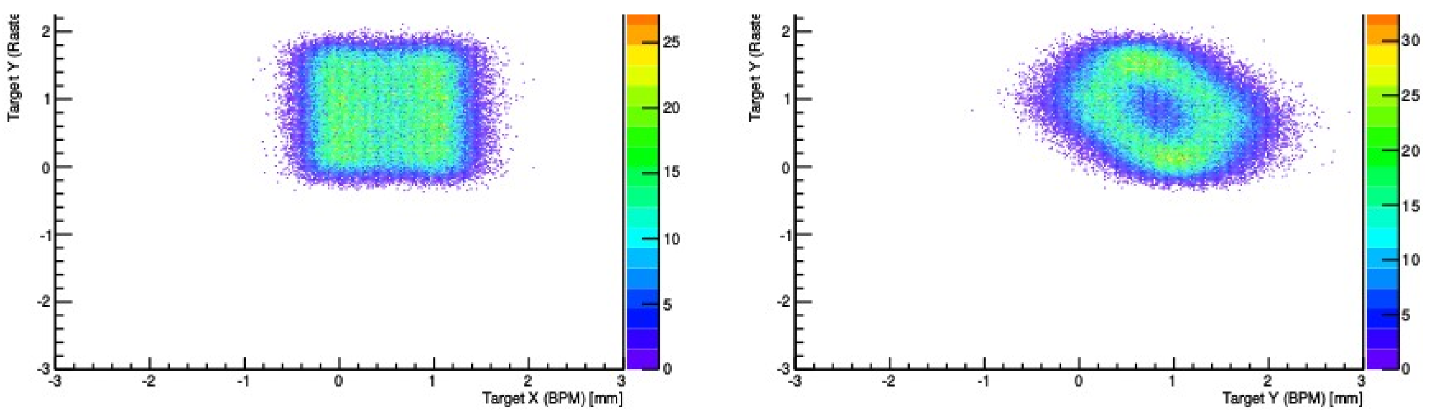


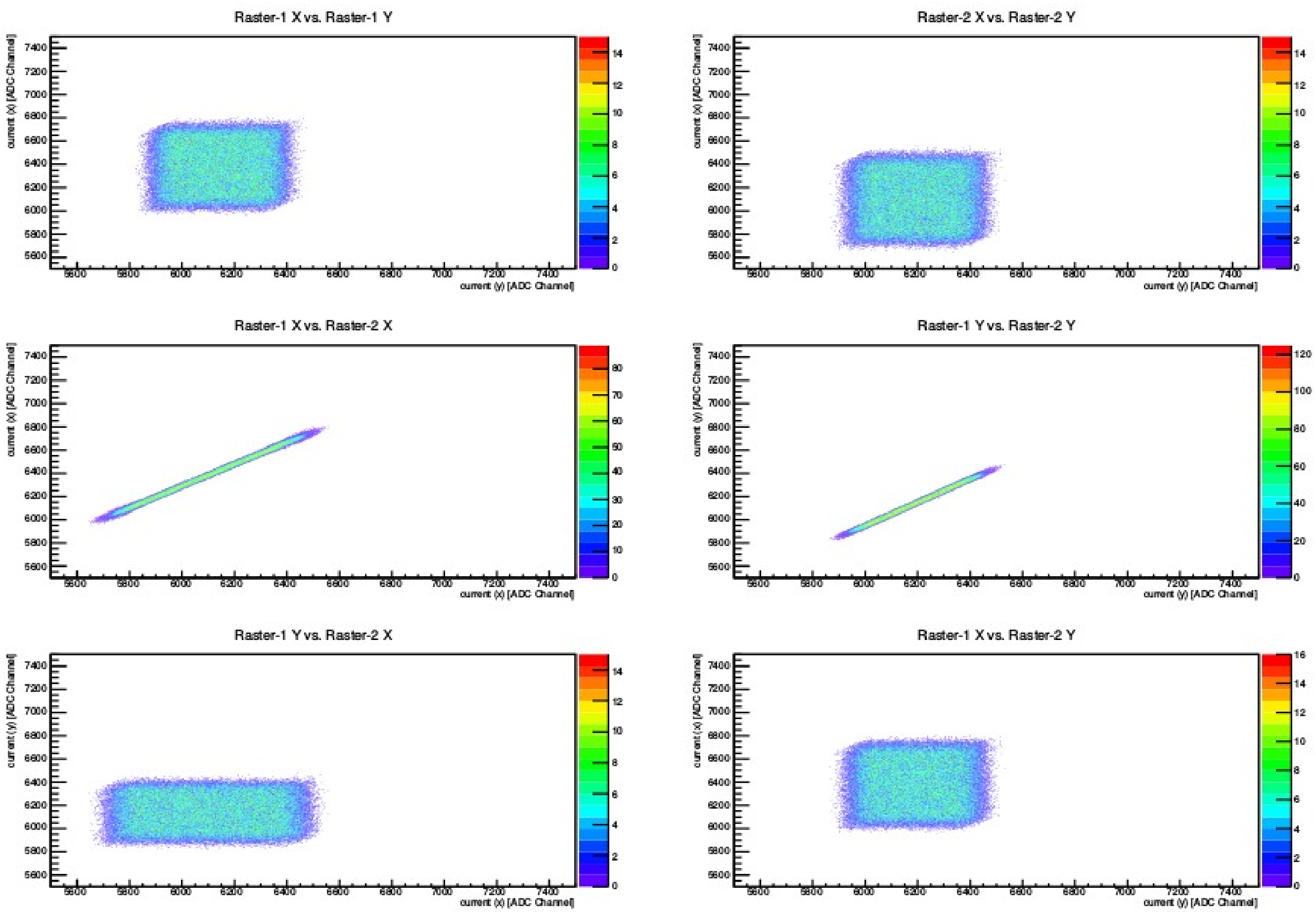

Use BPMs to get average positions.
Then use raster current to to get event-by-event change around center.



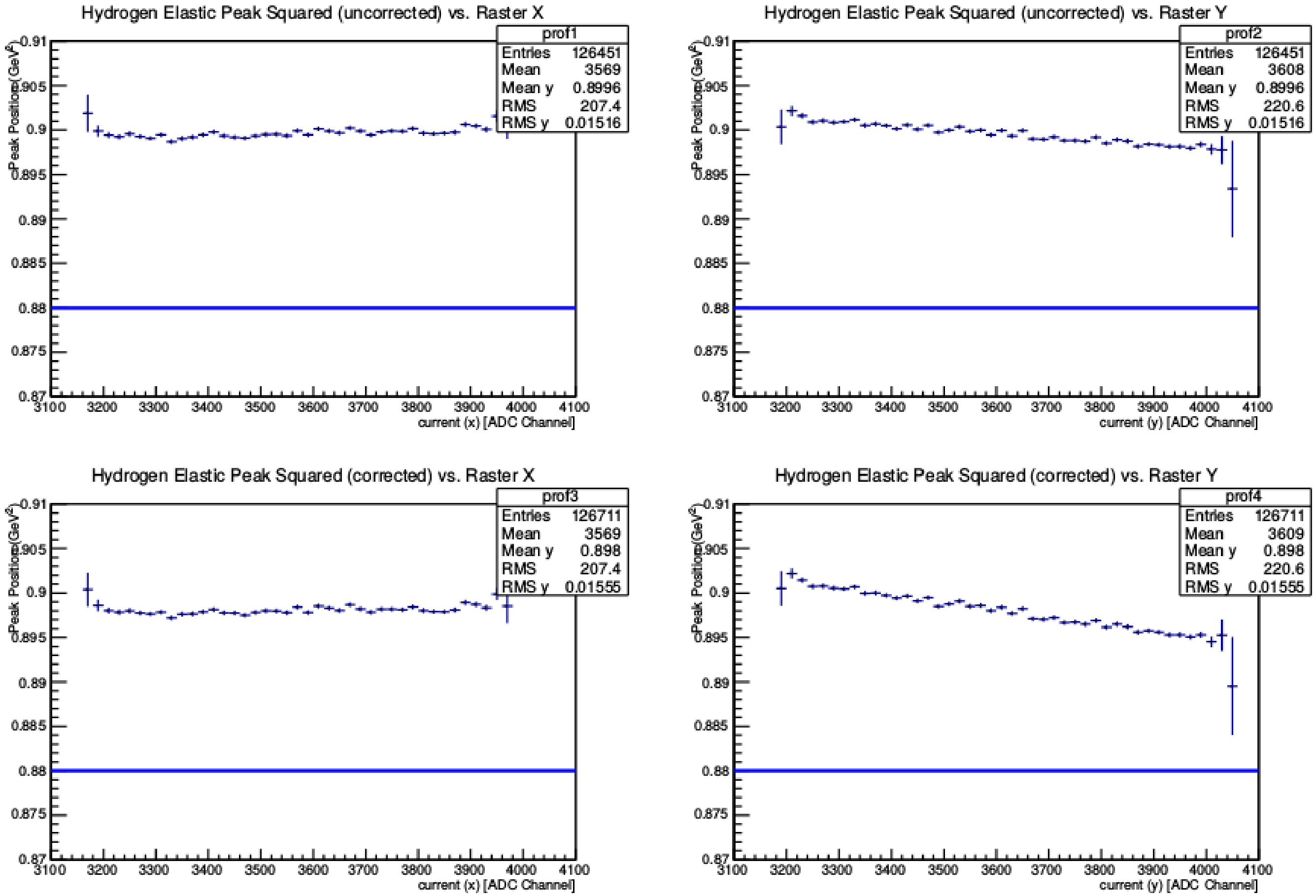
# How to get Raster ADC to position [mm/channel] conversion?

- First make sure rasters are in sync. If they are, we can treat as 1 raster.
- 3 methods to get conversion factor:
  - Compare size recorded by bpm to size of raster (in ADC channels). Simple. Not perfect, but may be good enough for our purposes
  - Compare to carbon hole (diameter is known to be 2mm). Not too hard. How precisely is diameter known?
  - Look at reconstructed y_tar vs. raster current. More work. But should give best results.

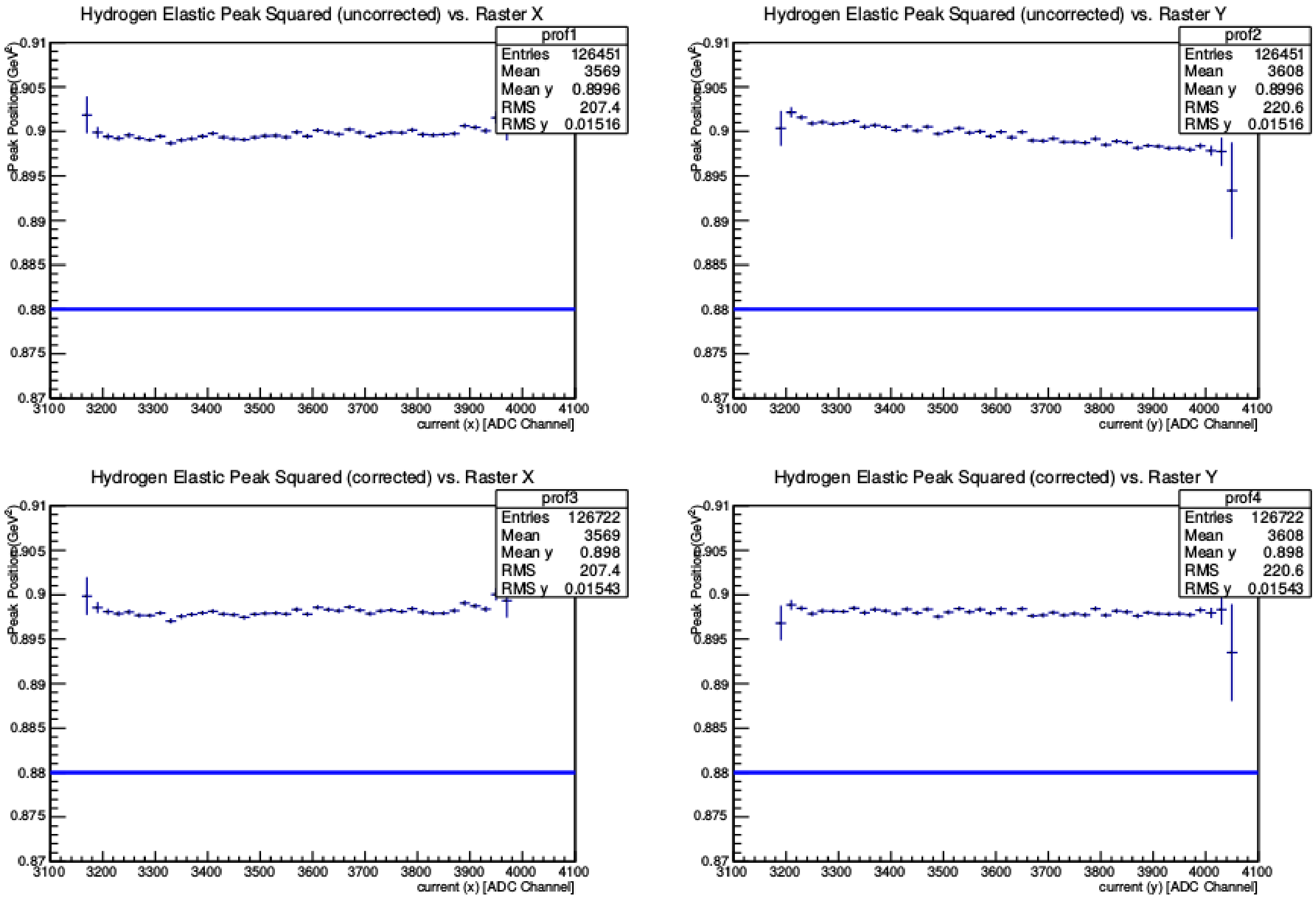
# Raster Sync


Raster-1 X vs. Raster-1 Y
Raster-2 X vs. Raster-2 Y
Raster-1 X vs. Raster-2 X
Raster-1 Y vs. Raster-2 Y
Raster-1 Y vs. Raster-2 X
Raster-1 X vs. Raster-2 Y

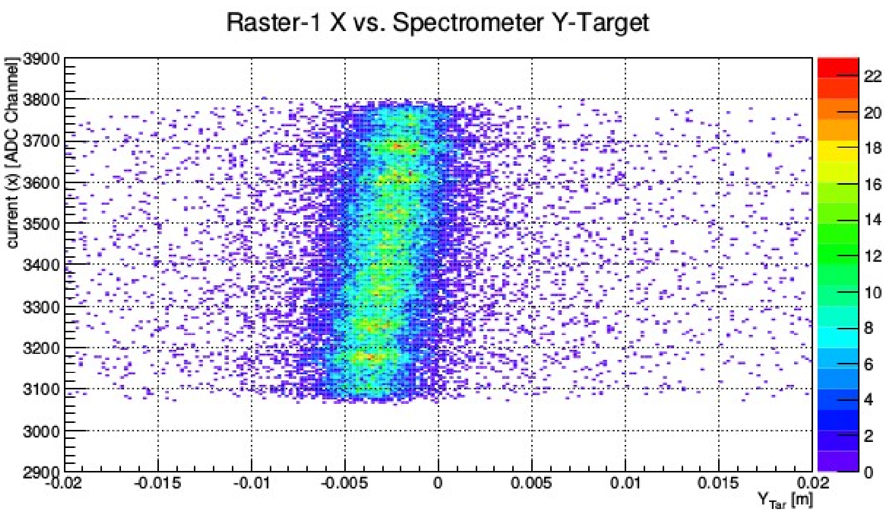
# Method 1 Results: **Wrong** ADC to Position Conversion Sign

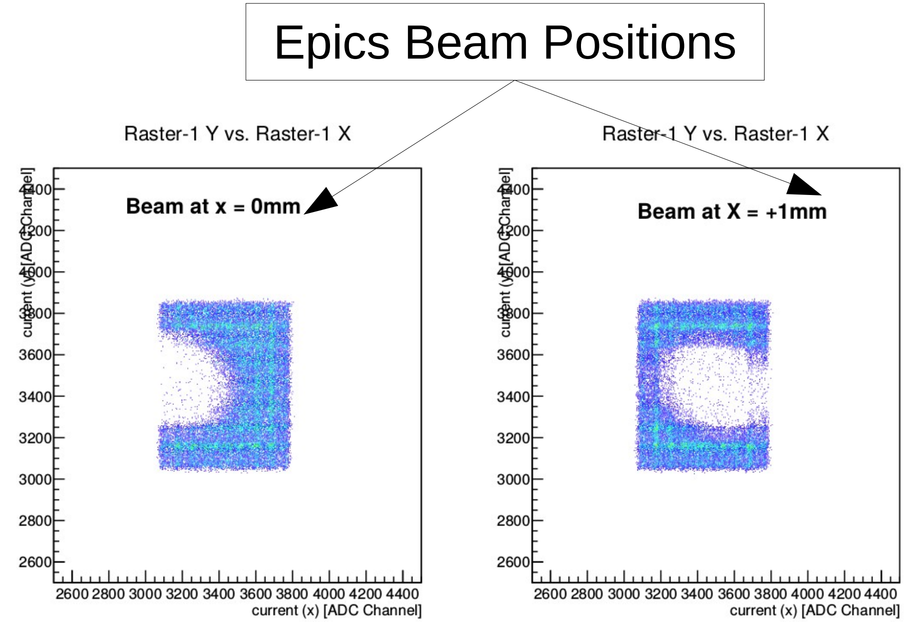


# Method 1 Results: **Correct** ADC to Position Conversion Sign

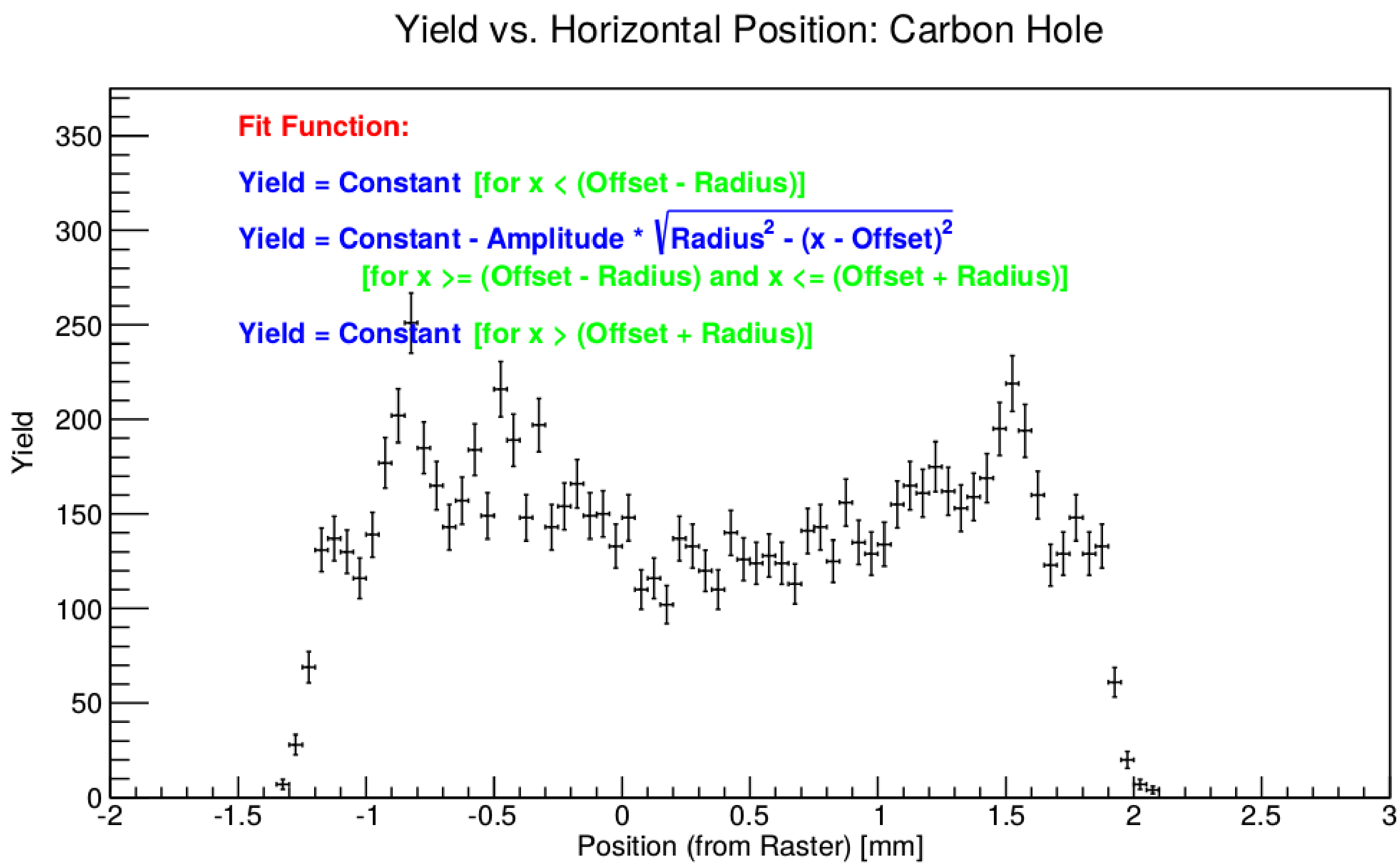


# What about sign in horizontal direction?



# Checking Method 1 using Carbon Hole



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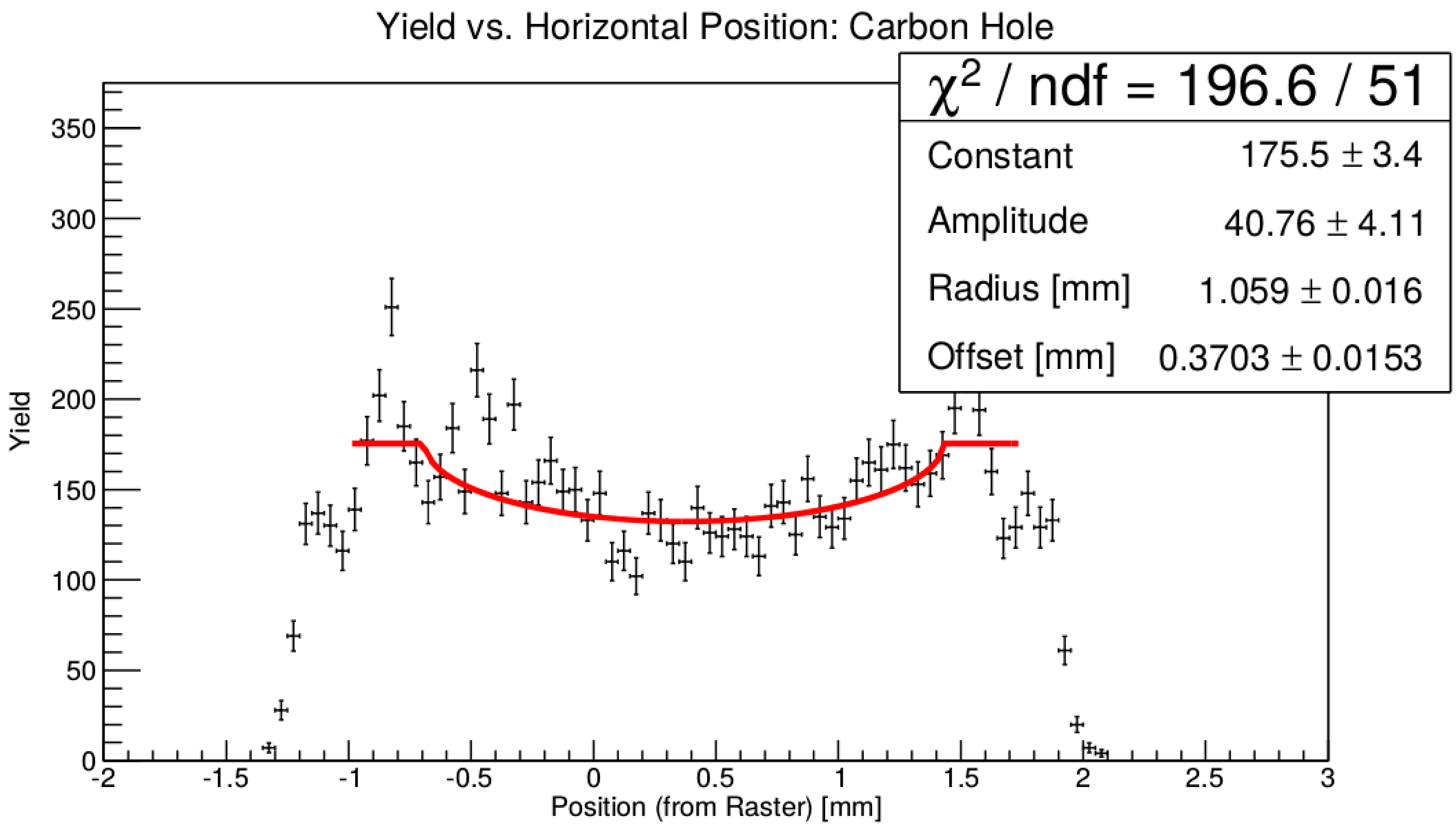
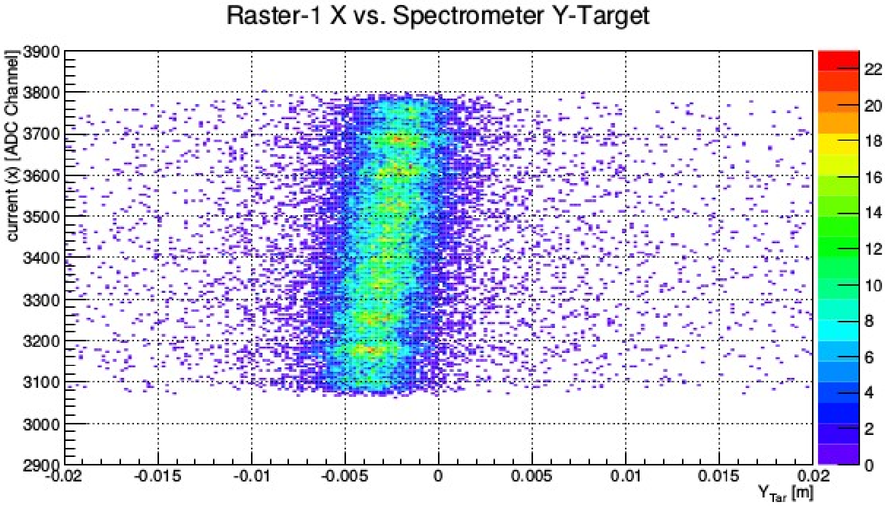


# Method 3: Reconstructed Y_tar on Carbon Foil




- See B. Craver, “Beam Position Calibration for GnE”, Nov. 2008

$$m_x \equiv \left(\frac{I}{\text{B.tr.fT.y}}\frac{1}{\cos\theta}\right)$$

$$m_y \approx m_x \cdot \frac{\left(\frac{\sigma_y(\text{BPM})}{\sigma_y(\text{Raster})}\right)}{\left(\frac{\sigma_x(\text{BPM})}{\sigma_x(\text{Raster})}\right)}$$