The SOS Quad in the Right-HRS (RHRS)

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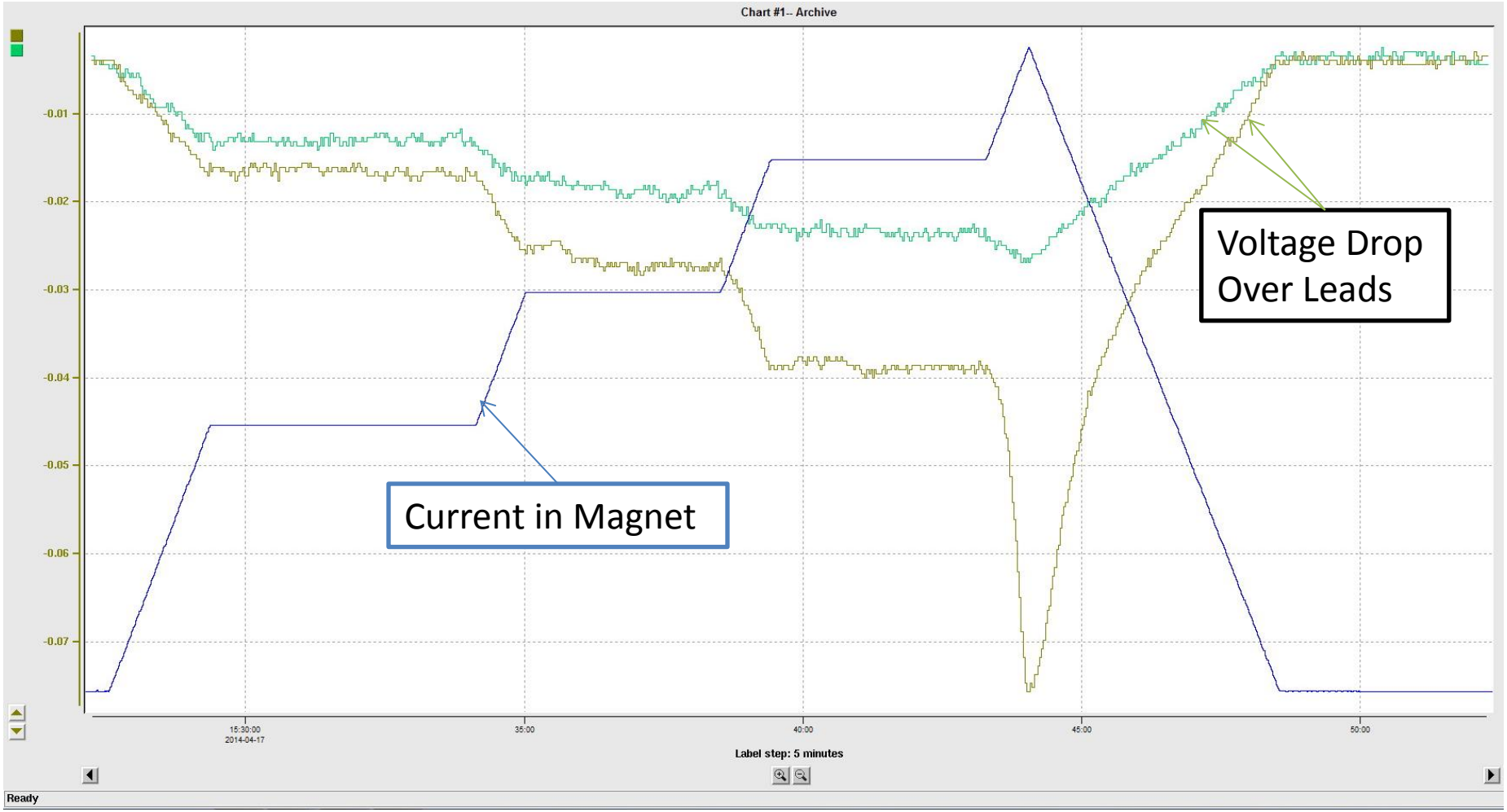
Current Status of the RHRS

- The HRSs (RHRS and LHRS) are QQDQ spectrometers. Quadrupole 1 (Q1) focuses in the dispersive (i.e. bend) plane, while Q2 and Q3 focus in the non-dispersive direction.
- For the RHRS Q1, a rapid, non-linear voltage increase across the two leads was observed with an increase in current.
- Because of this, Q1 has been removed from the RHRS; and it is **not** be used during the current Spring 2015 run.

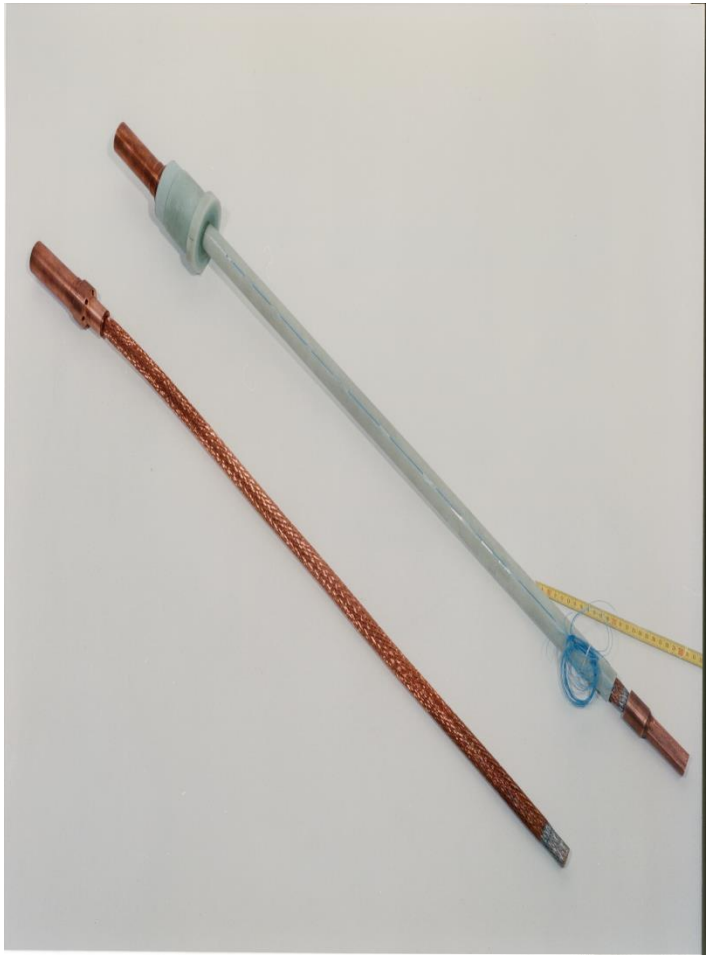
RHRS Q1: Voltage Across Leads

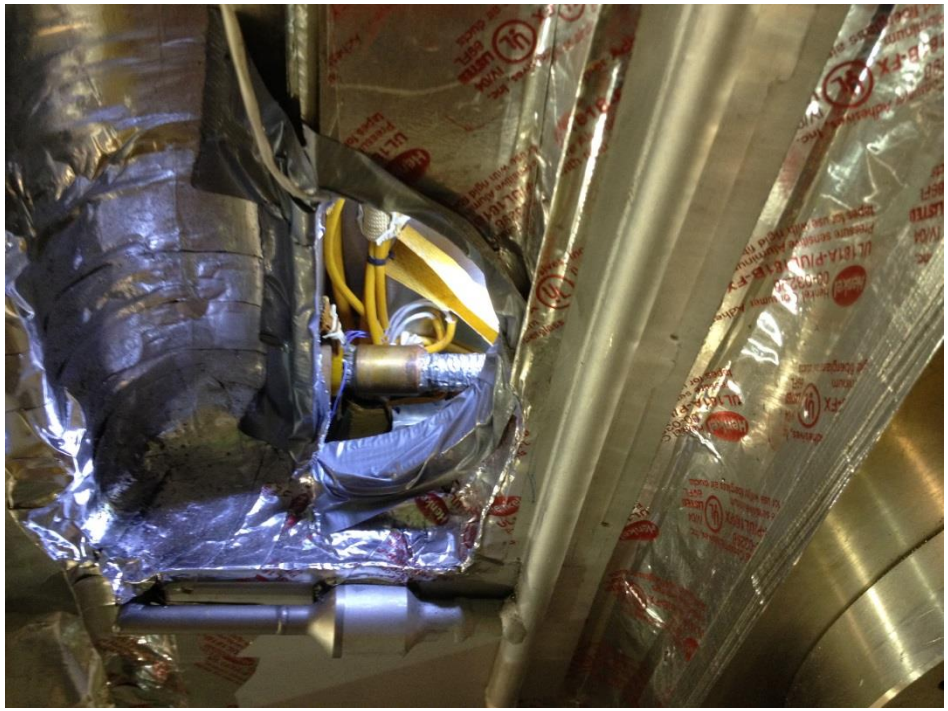


Status of the Q1s

- The old leads on the RHRS Q1 will be replaced with ones similar in construction
- New leads have been ordered.
- The Q1 on the LHRS is showing similar problems, and is thus being limited to 3.2 GeV/c

RHRS Q1 Disassembly





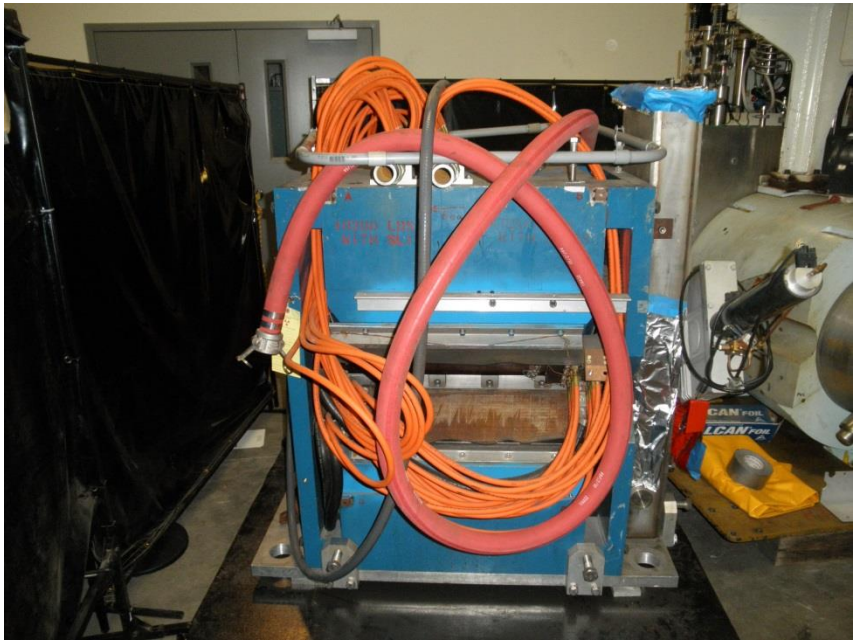
The SOS Spectrometer

- The SOS spectrometer, located in Hall C, had a QD~~D~~ design. The spectrometer operated up to a momentum of ~1.75 GeV/c.
- The SOS quad has a radius of 12.7cm (Q1 radius = 15cm). It has a magnet length of 70cm (Q1 length = 94cm).It was operated to a maximum pole-tip field of ~1T in the spectrometer. The pole tips are planes, rather than curves.
- The dipoles, which shared the same iron yoke, limited the spectrometer momentum.
- So, the quad was not operated at its maximum potential current/field.

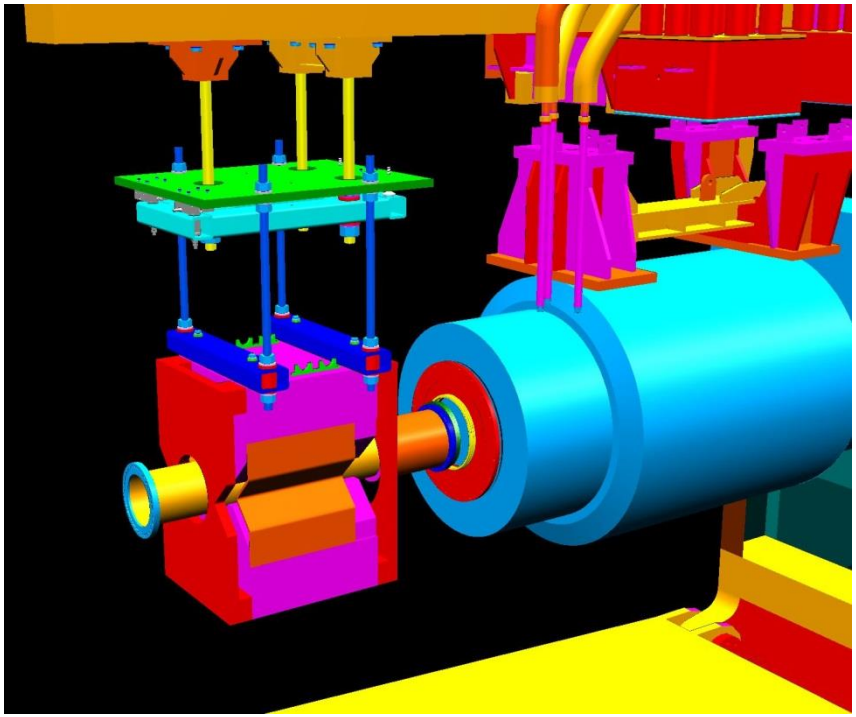
The SOS Quad

Front View

Side View



The SOS Quad in the RHRS



- The SOS quad is now mounted in the spectrometer as shown.
- The magnet requires water cooling, which will be taken from the system already present on the RHRS.
- The power supply for the Q1 has been removed, and a different power supply will be used for the SOS quad.

Selecting the Tune

- Two Options:

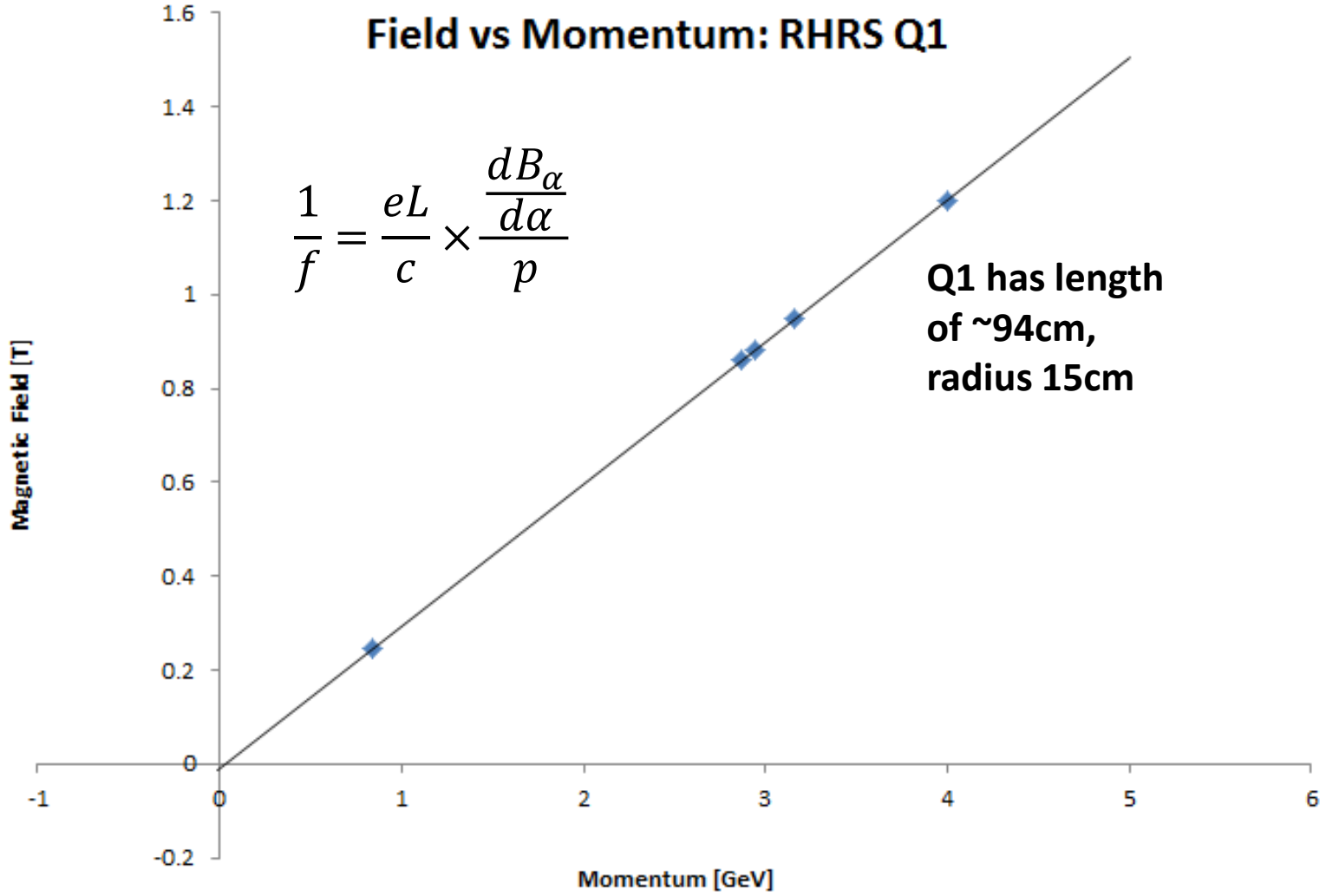
  1) Match old tune.

  – Adjust SOS Quad Bdl. Use previous reconstruction matrix and look at reconstructed y:y' and reconstructed sieve pattern.

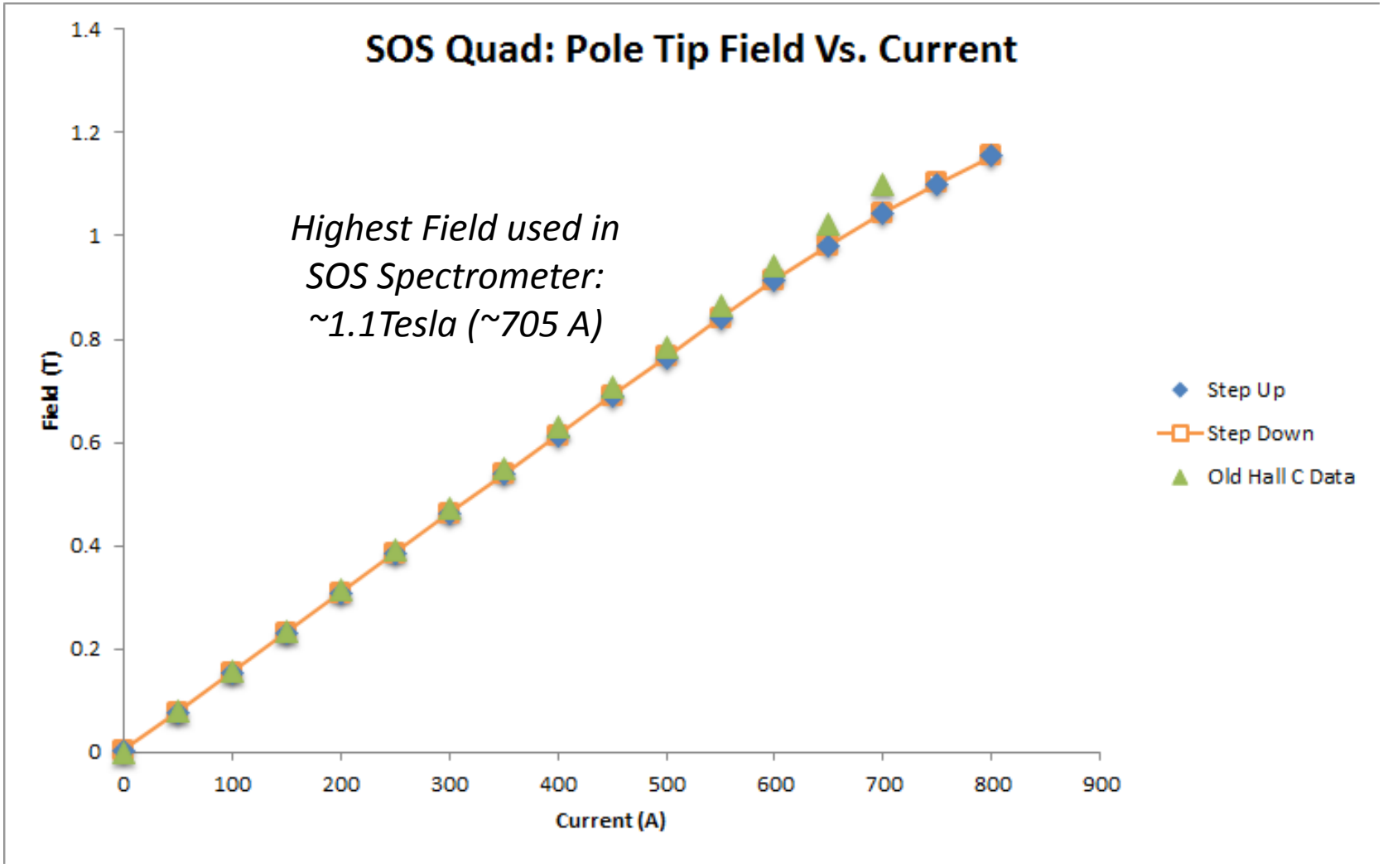
  – 2) Make new tune to maximize acceptance.

  – Adjust SOS Quad Bdl. Look at optics target and sieve pattern at the focal plane (and reconstructed variables with old tune).

Tune for Q1 in RHRS



Pole-Tip Field vs Current in SOS Quad



Initial Guess to Match Q1 Bdl

- Want to scale pole-tip field up at:

  3300 Gauss/GeV

- We measured B vs. I with hall probe:

  15.5 Gauss/Amp

- Thus we want to scale at current at:

  213 Amp/GeV

Simulation Studies of the RHRS

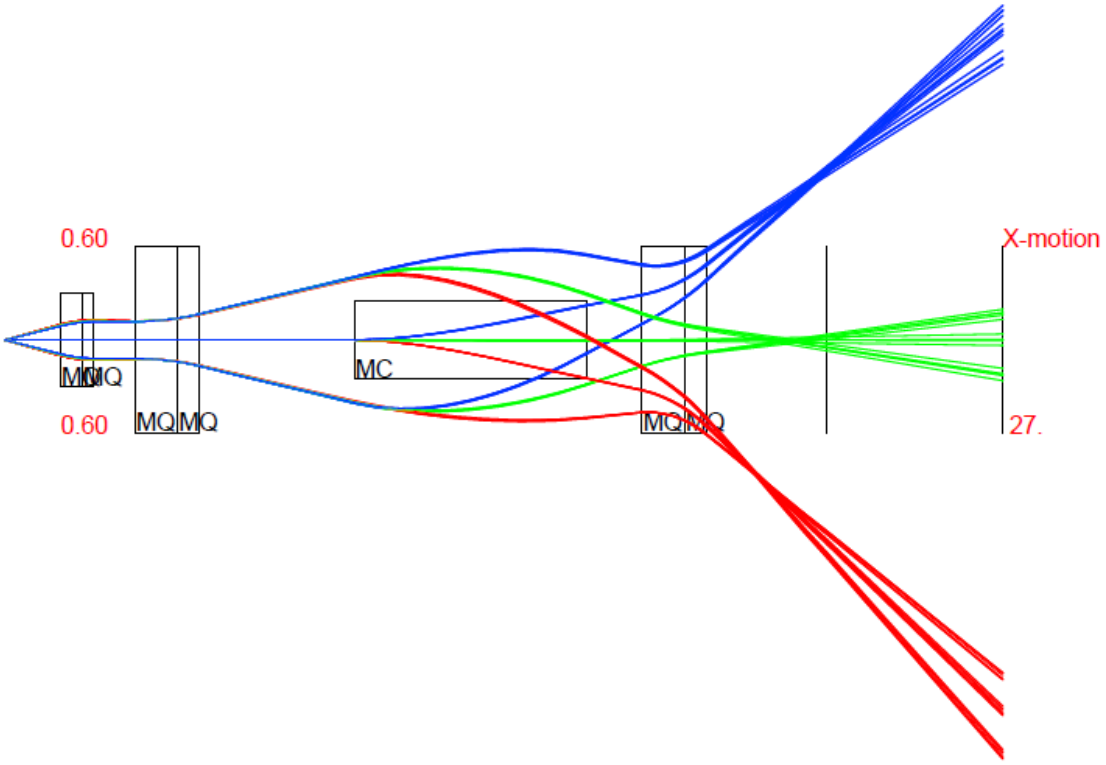
- The program Cosy Infinity was used to model the magnetic elements of the spectrometer.
- I used an idealized quad magnet with limited fringe-field effects for these simulations. More complete simulations using field-maps may be forthcoming in the near future…
- Position and momentum variables after the magnetic element are determined by summing the product of matrix elements to a given order:

$$X_{after} = \sum_{i,j,k,l,m=0}^{i+j+k+l+m=n} c_{i,j,k,l,m}\, X^i Y^j \frac{dX^k}{dZ} \frac{dY^l}{dX} \delta p^m$$

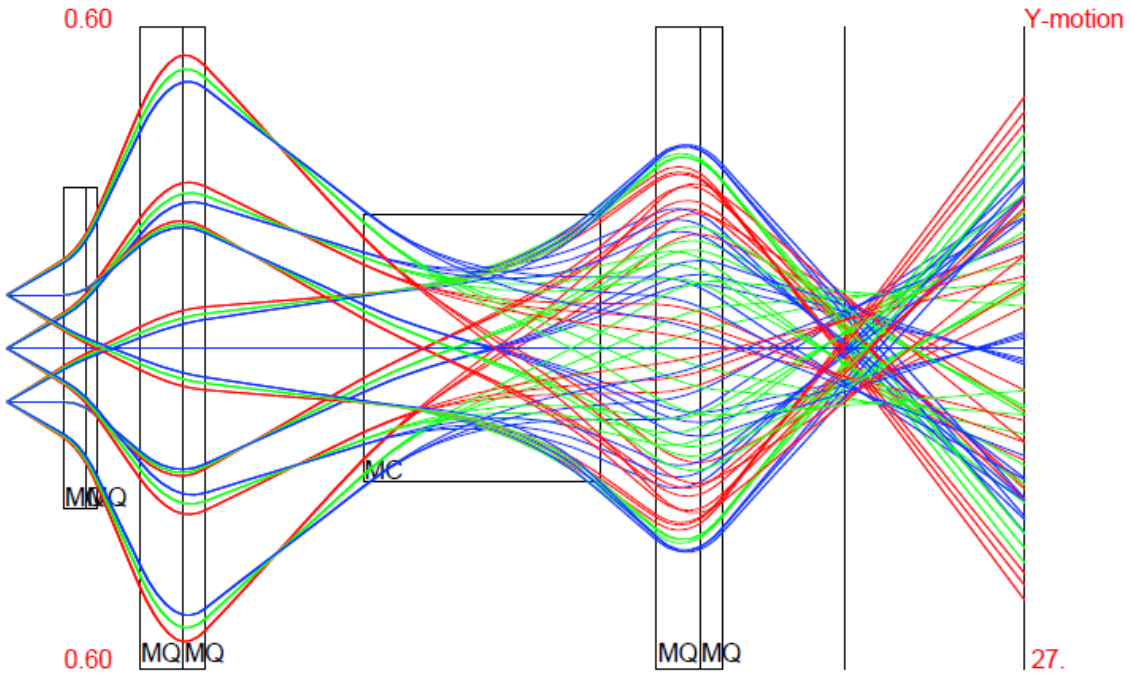
Simulation Studies of the RHRS (cont.)

- In conjunction with the program SIMC, generated particles are passed to the focal plane of the spectrometer.
- They are then reconstructed to obtain the target quantities: $X`_{tar}$ [$\theta_{tar}$], $Y`_{tar}$ [ϕ_{tar}], δ_{tar} , Y_{tar}
- The effect of replacing the Q1 with the SOS quad on the acceptance and resolution of these target quantities are considered here.

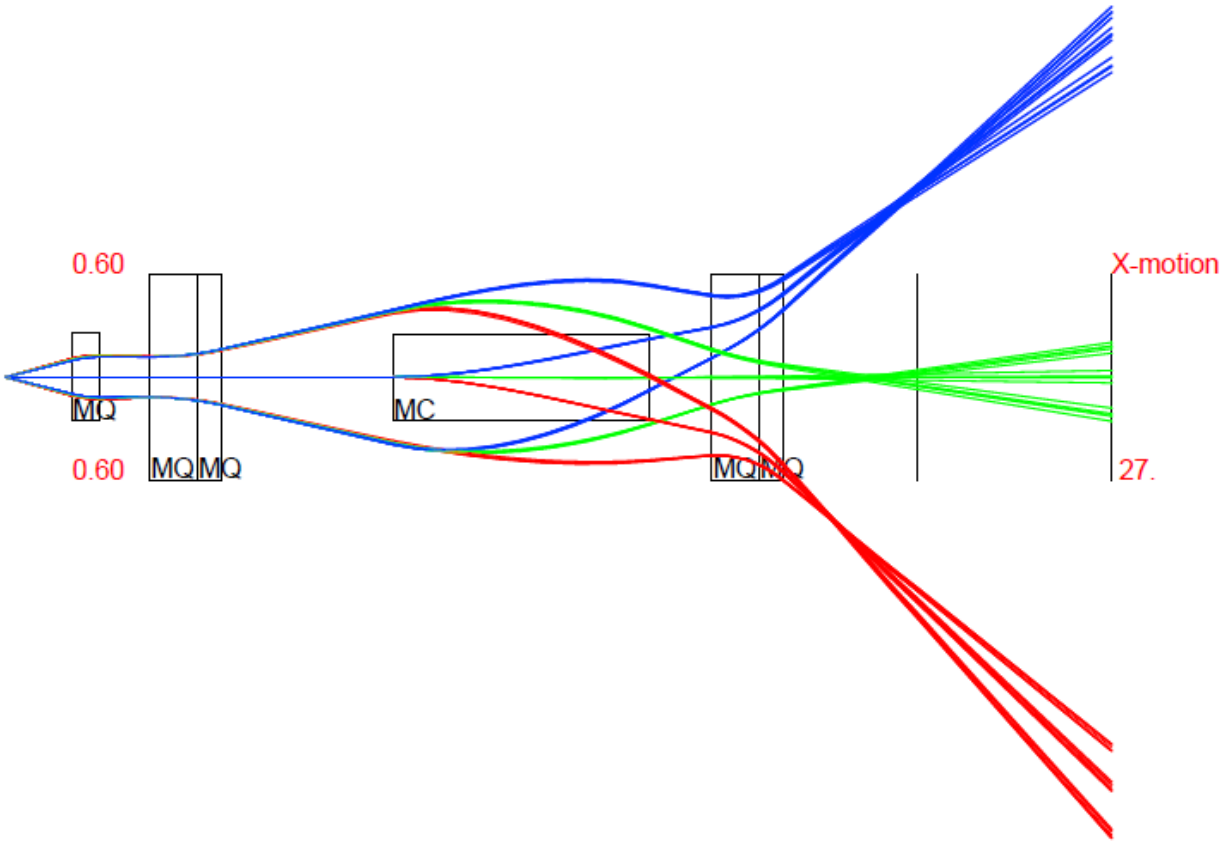
Cosy Infinity Ray-Tracing: Standard RHRS, Dispersive (and Bend) Plane



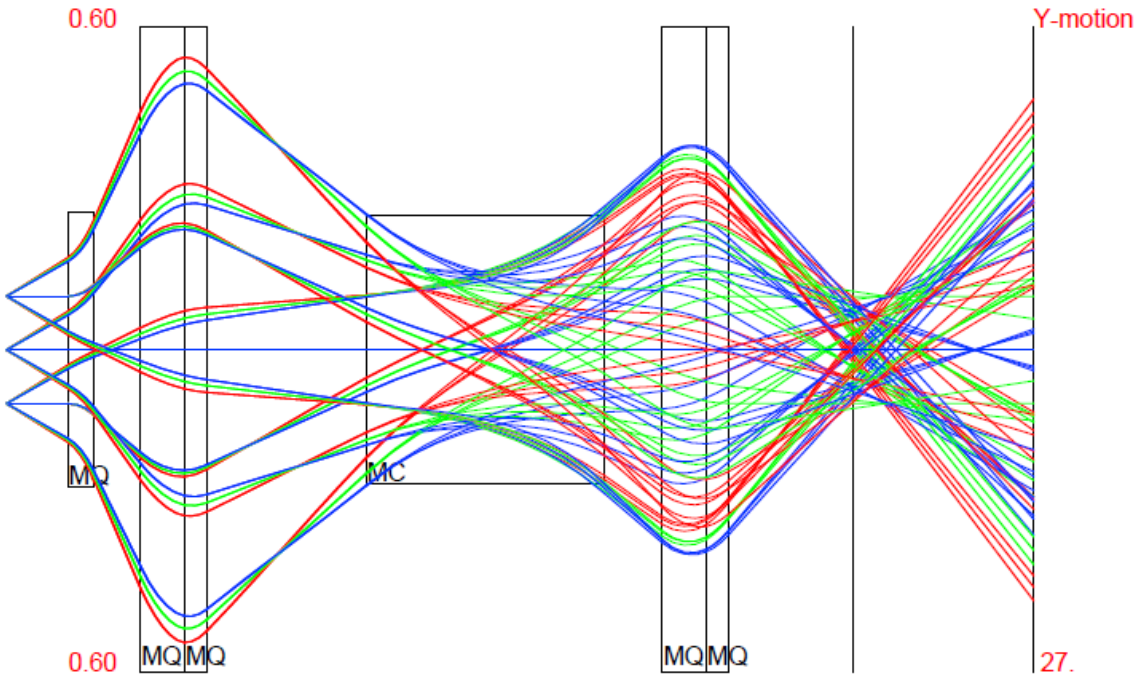
Cosy Infinity Ray-Tracing: Standard RHRS, Non-Dispersive Plane



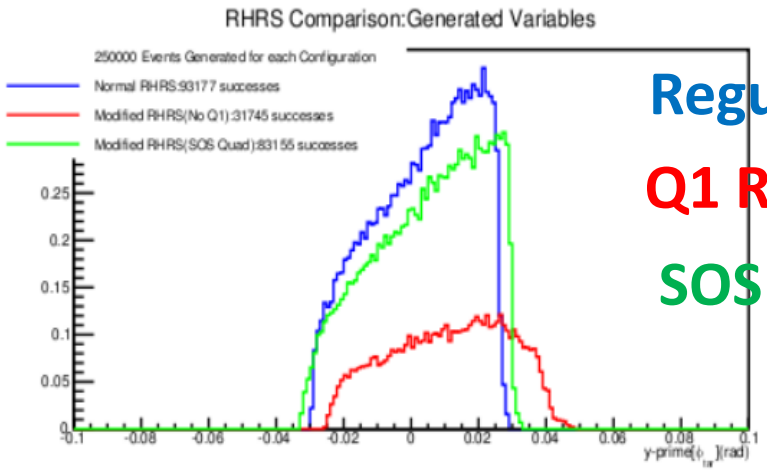
Cosy Infinity Ray-Tracing: RHRS with SOS Quad, Dispersive (and Bend) Plane



Cosy Infinity Ray-Tracing: RHRS with SOS Quad, Non-Dispersive Plane



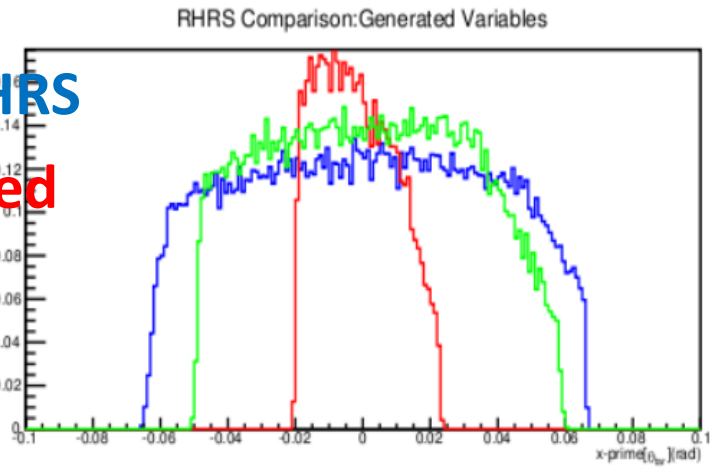
Acceptance Comparison: (e,e’) Elastic

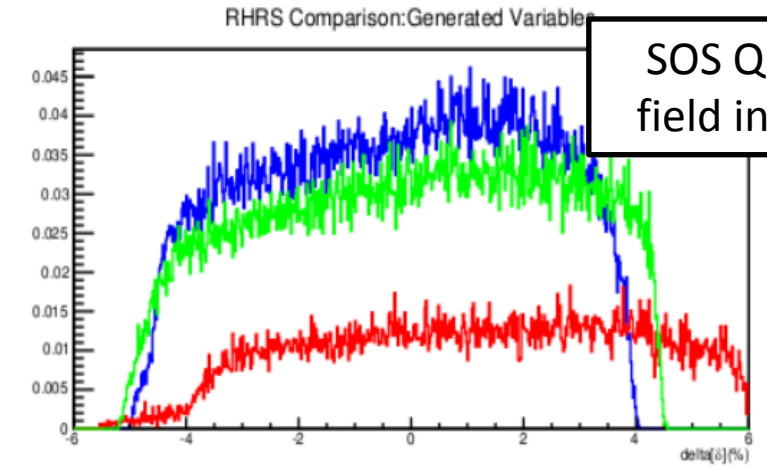


Regular RHRS

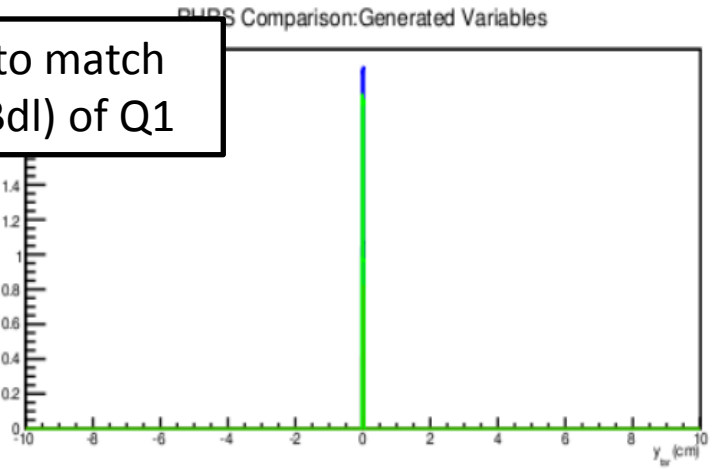
Q1 Removed

SOS Quad



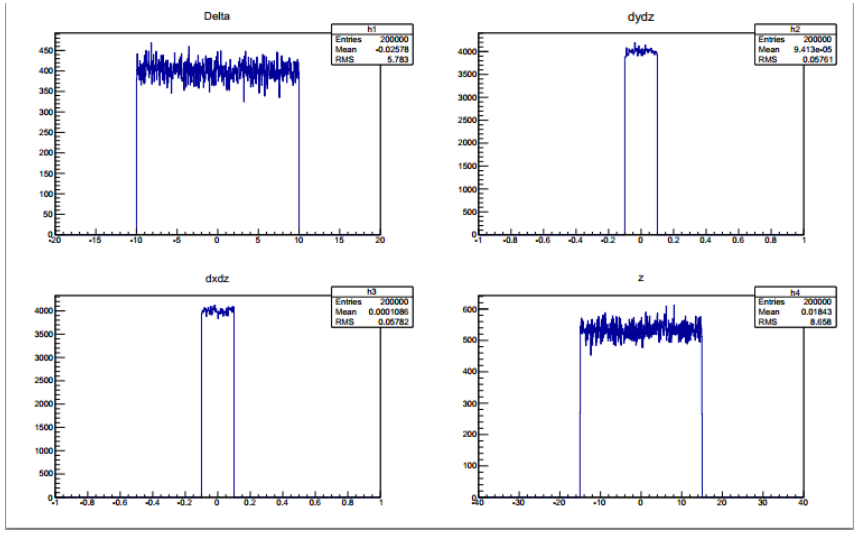


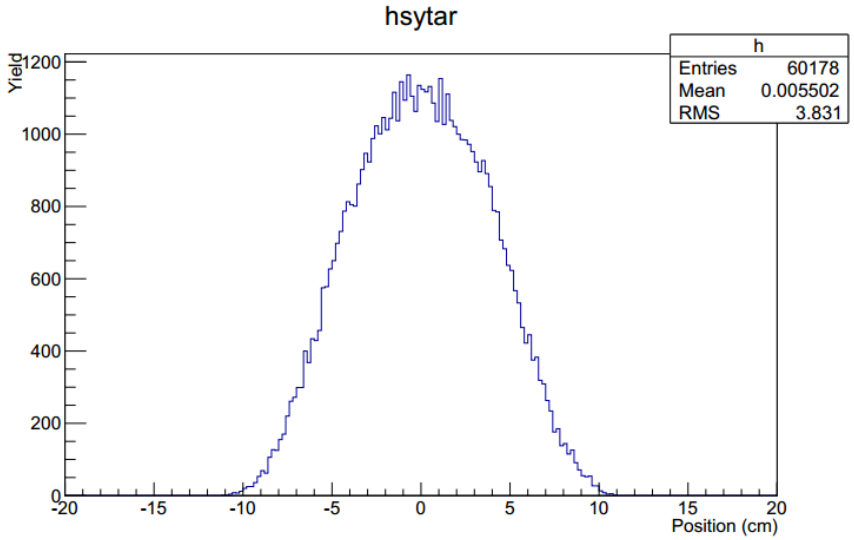
SOS Quad set to match field integral (Bdl) of Q1



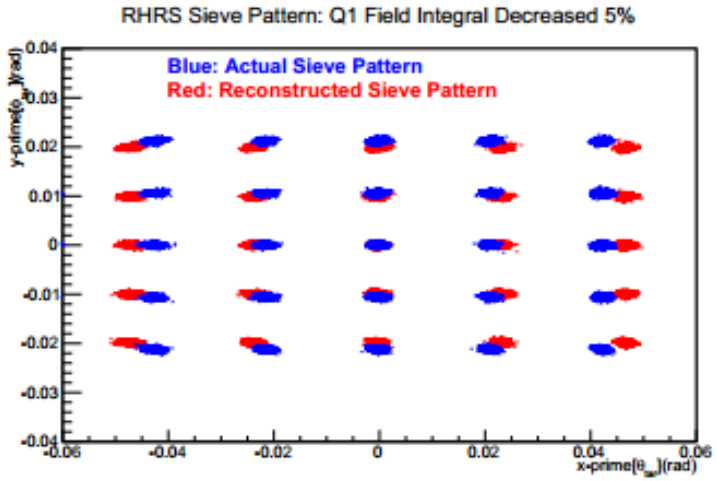
Single Arm Version of SIMC

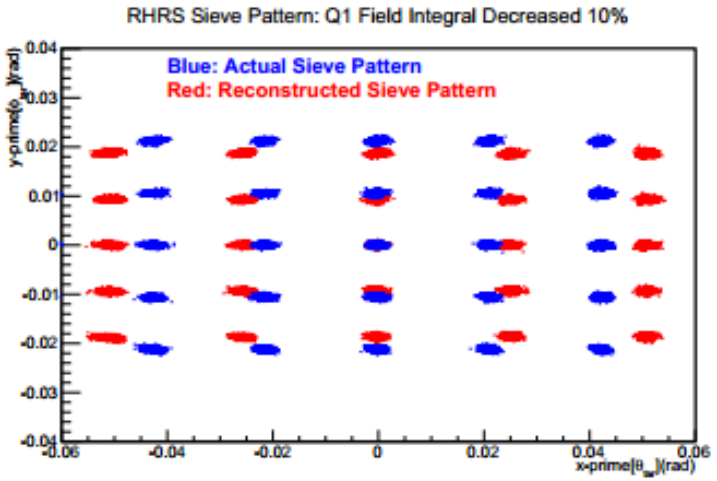
- I recently completed a single arm (phase-space generator) version of SIMC.
- This can be used for single arm acceptance studies, as well as to look at sieve patterns.

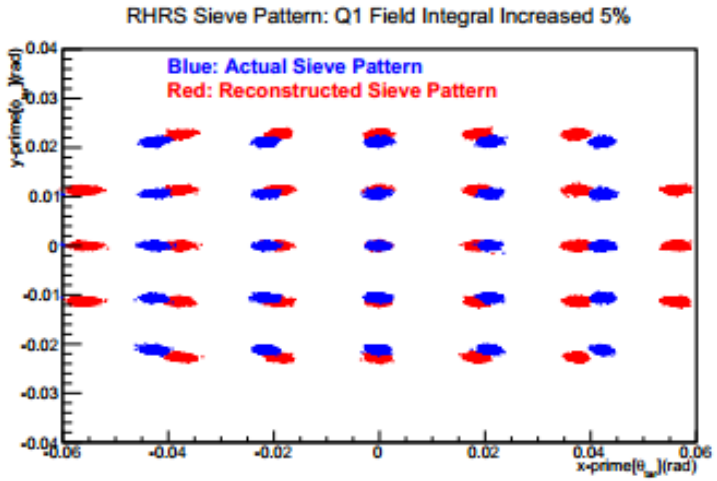


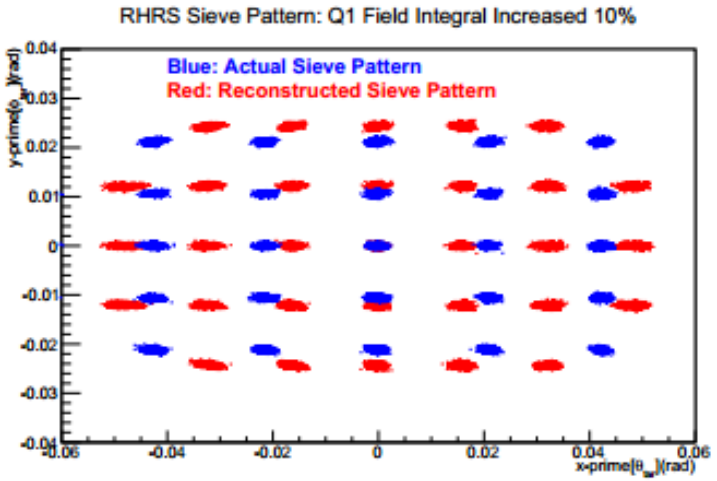


Effects of Mistuning on Reconstructed Sieve Pattern: Simulation

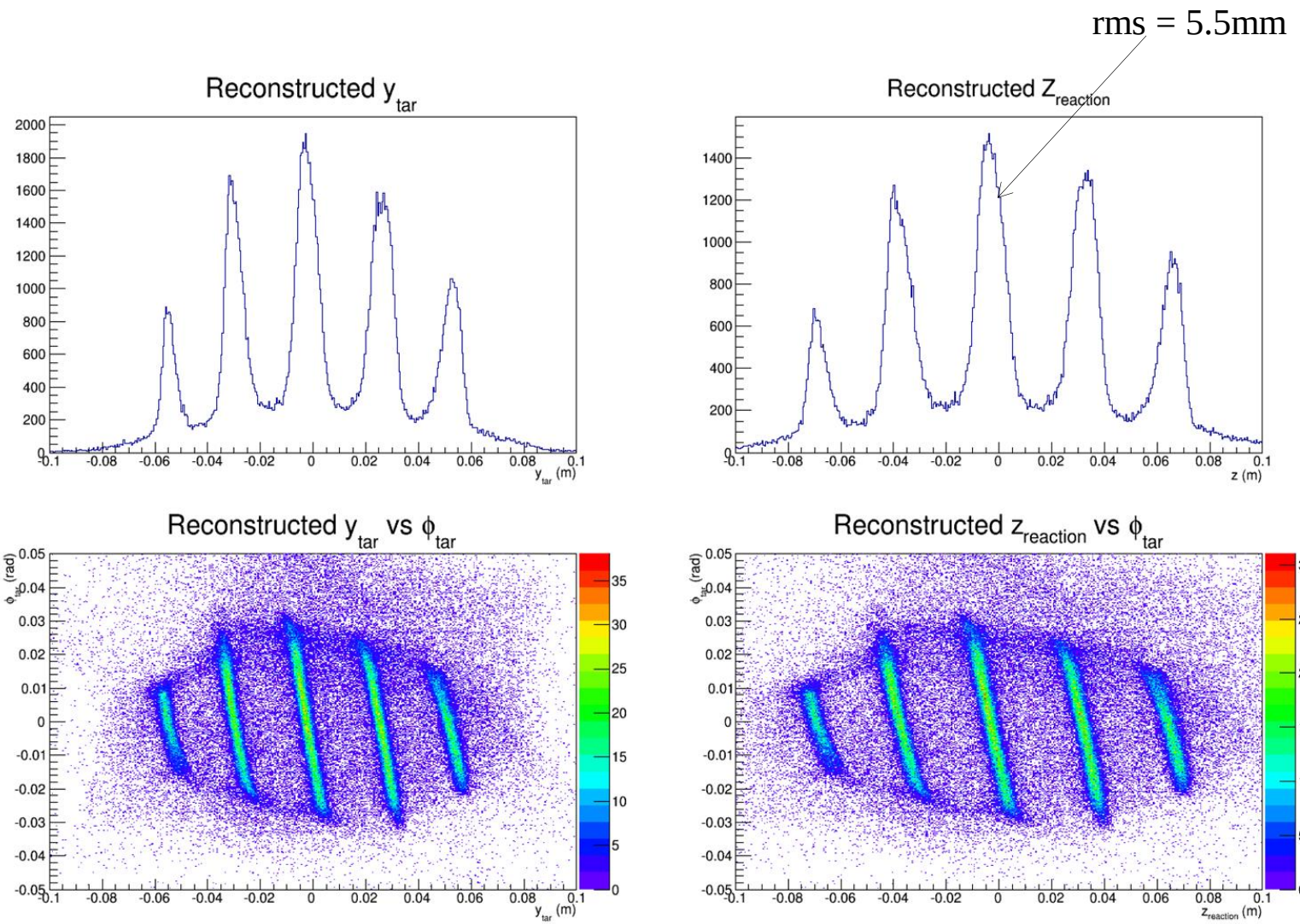




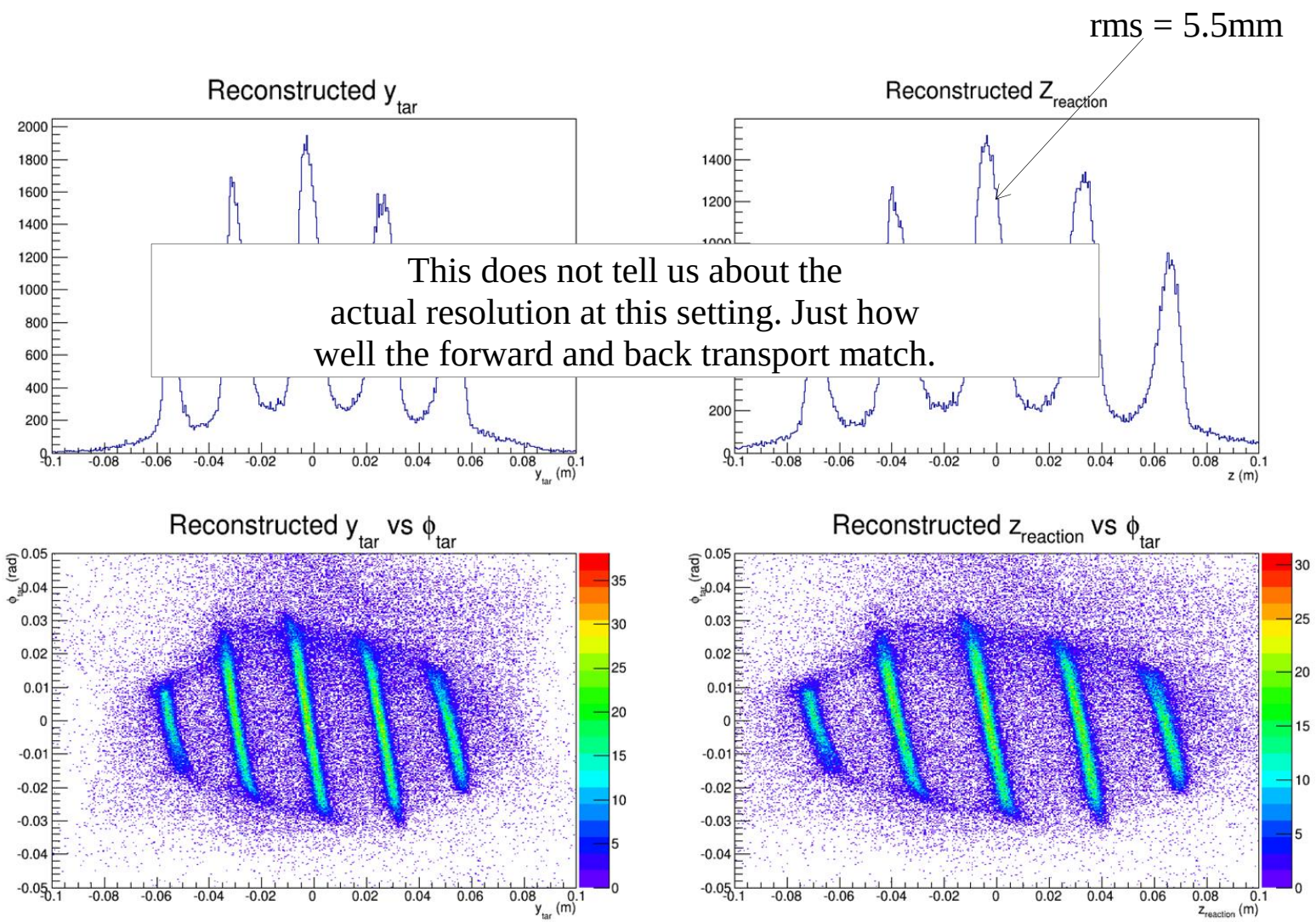




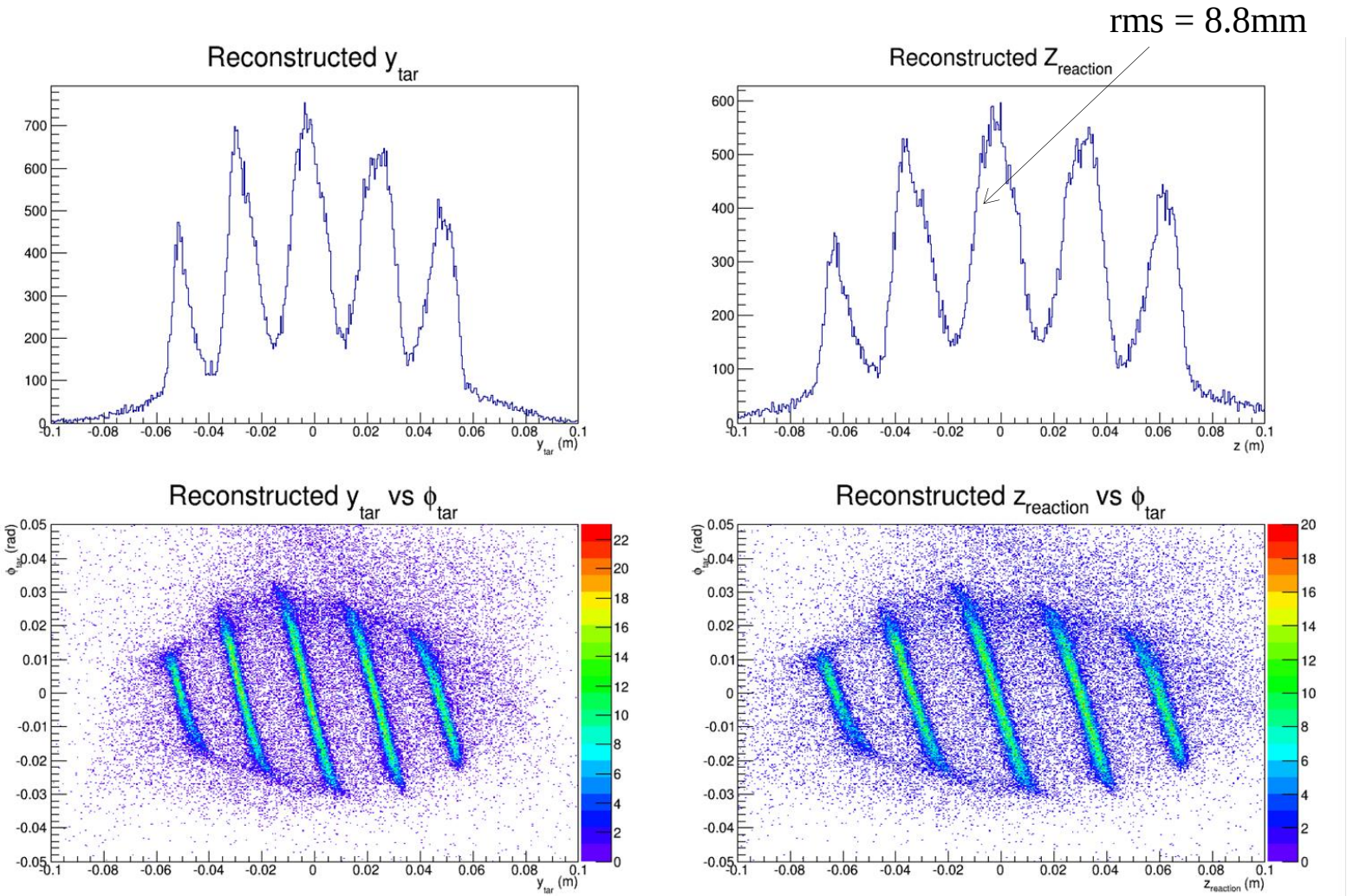
Data with Optics Target: Initial Guess



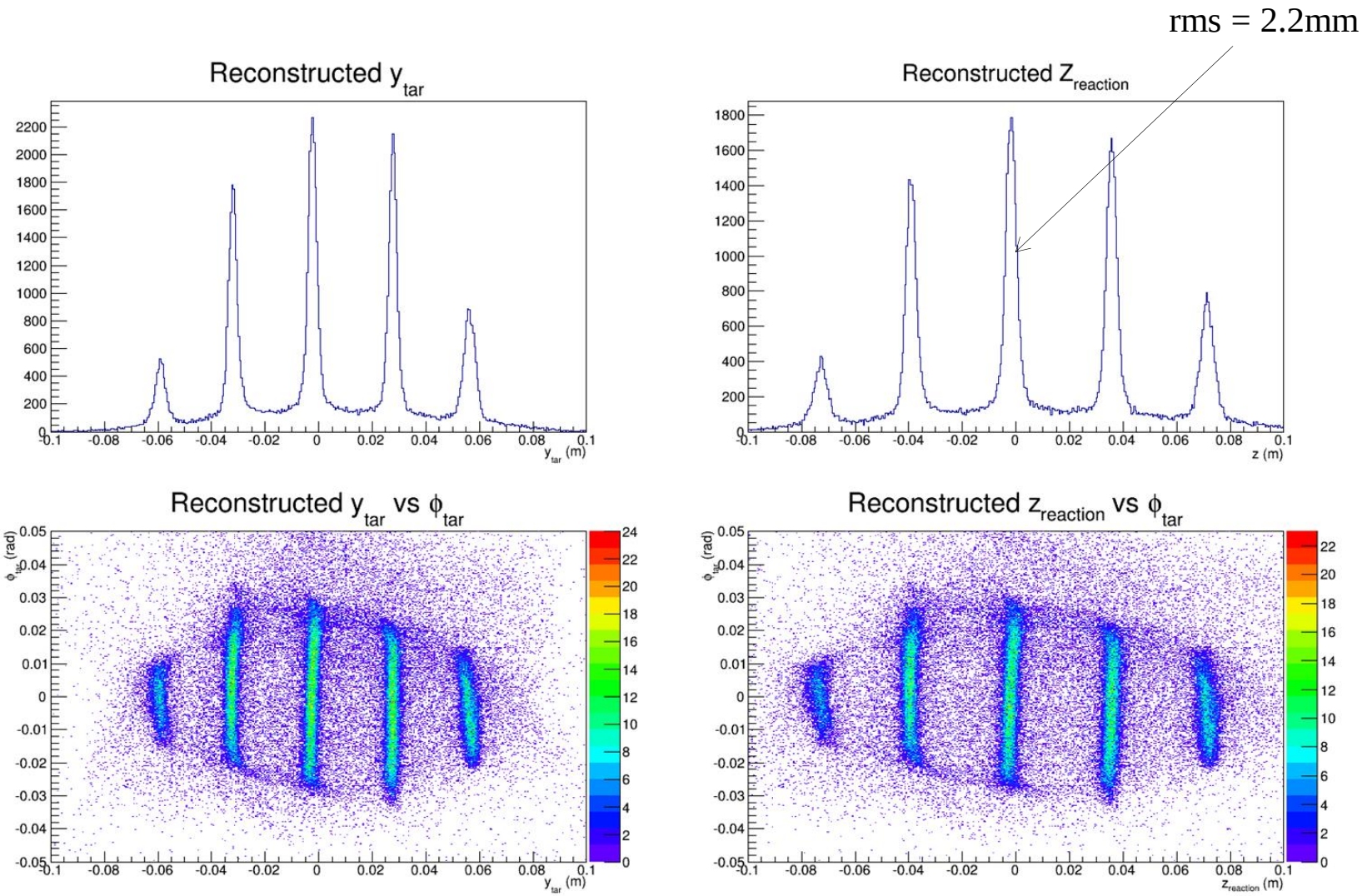
Data with Optics Target: Initial Guess



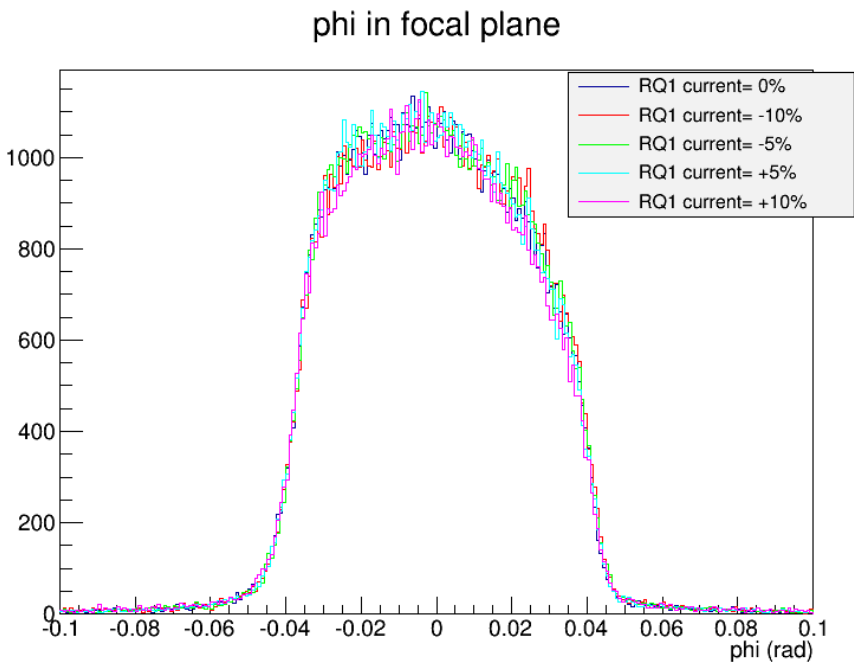
Data with Optics Target: +10%

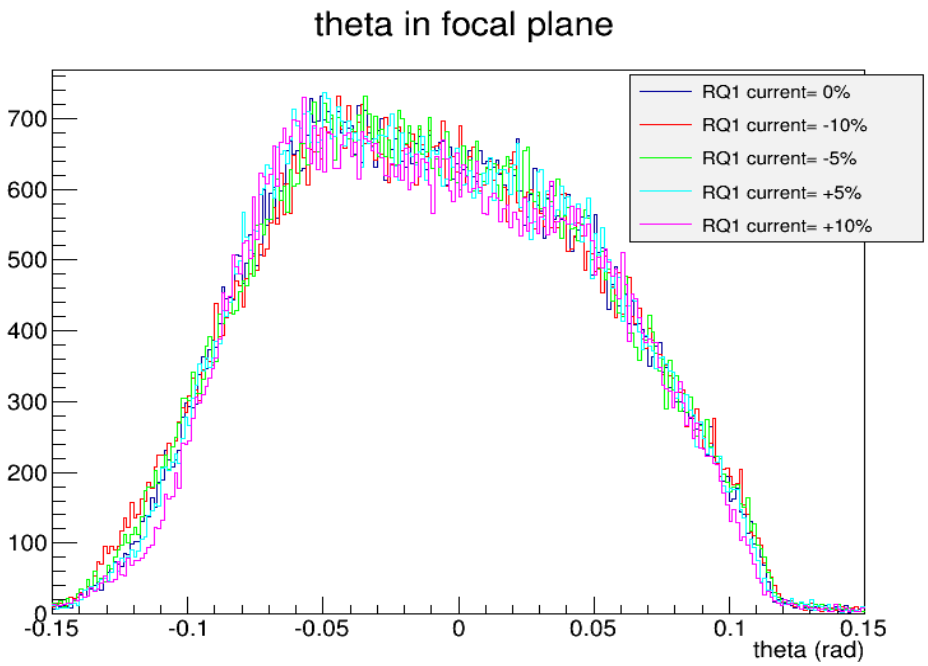


Data with Optics Target: -5%

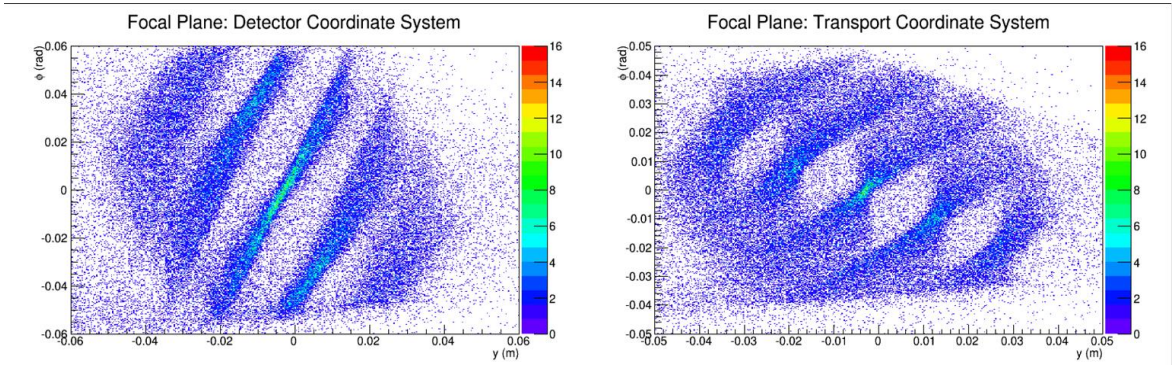


Looking at Acceptance in the Focal Plane

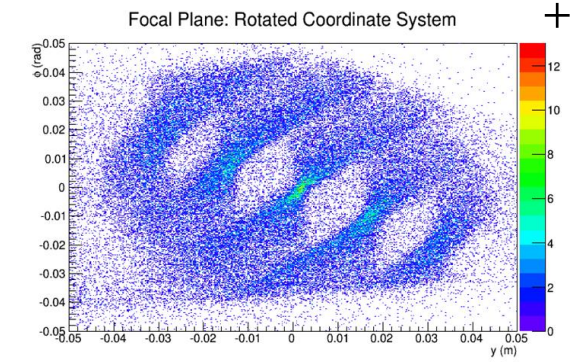


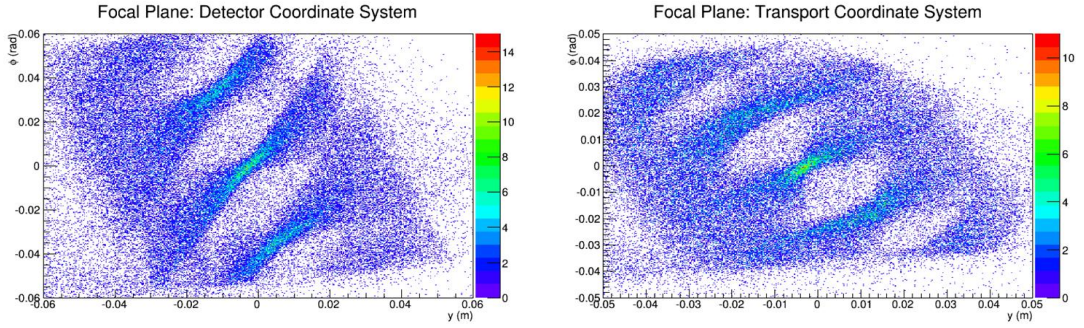


Looking at Acceptance in the Focal Plane

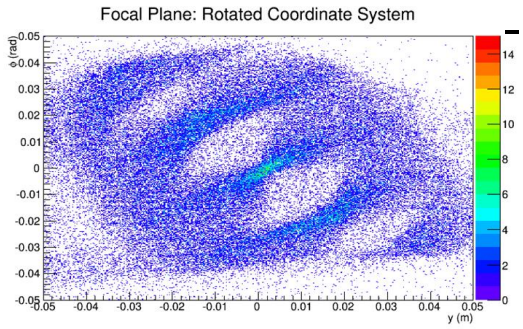


+10%



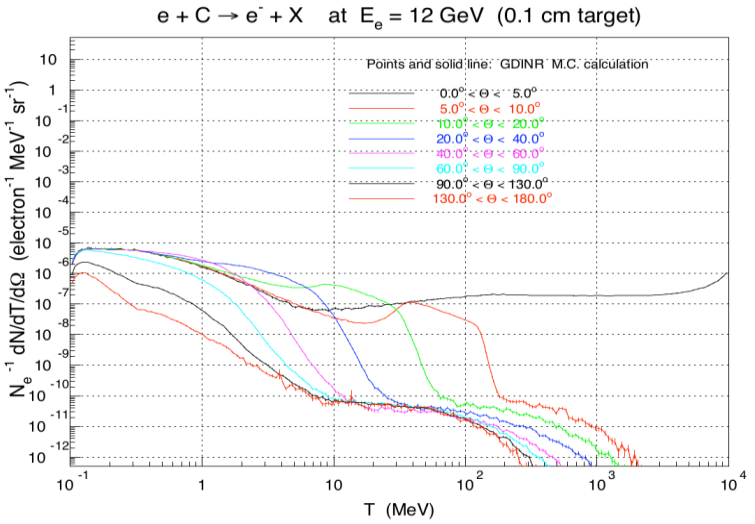


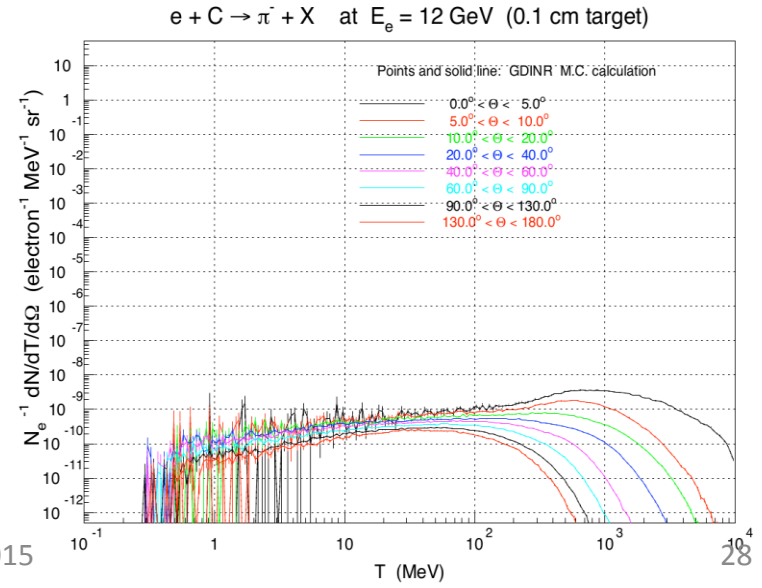
-10%



Potential Angle Calibration: GEM Detector

- Make use of large pion rate (compared to electron rate)
- Place GEM detector between target and spectrometer (no sieve needed)
- Available detector can cover whole entrance of spectrometer. Uses Ar/CO_2 gas and has position resolution of 70-200 microns.





What we are doing this run period

- Standard optics (sieve, optics target, delta scan) for different SOS Quad tunes
- Check dependence of tune on spectrometer momentum setting
- Check if the SOS quad is mis-aligned from the spectrometer axis (Look for any effect on central sieve hole while ramping up current in the SOS Quad)