Using the SOS Quad in the Right-HRS

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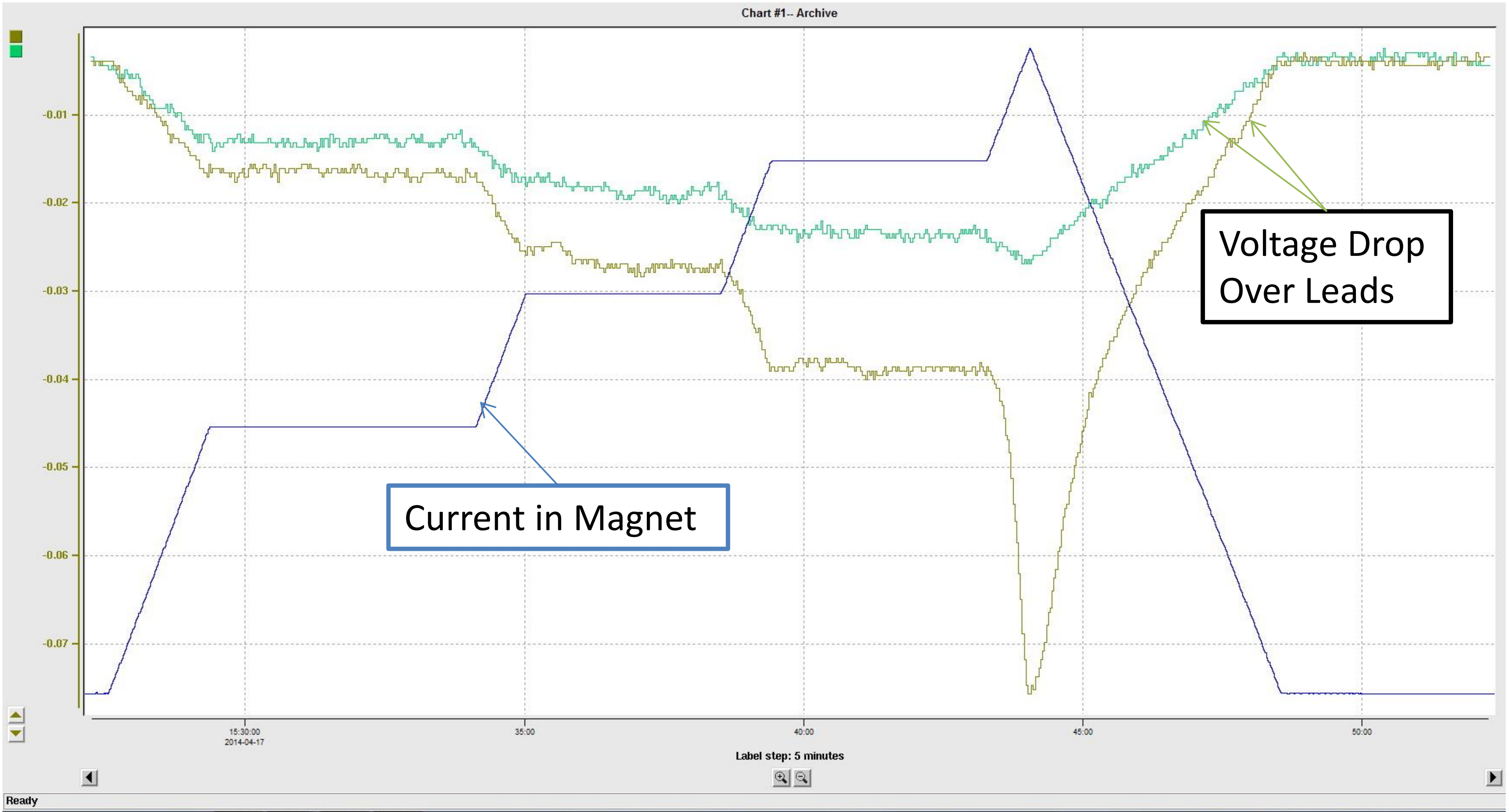
Status of the Right-HRS Q1

- 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. The spectrometer is not operational during the current run and may be unavailable for the 2015 Spring run.

RHRS Q1: Voltage Across Leads



Fixing the RHRS Q1

- The old leads will be replaced with ones similar in construction
- Fabrication options are being considered.
- The Q1 on the LHRS is showing similar behavior, and is thus being limited to 3.2 GeV/c

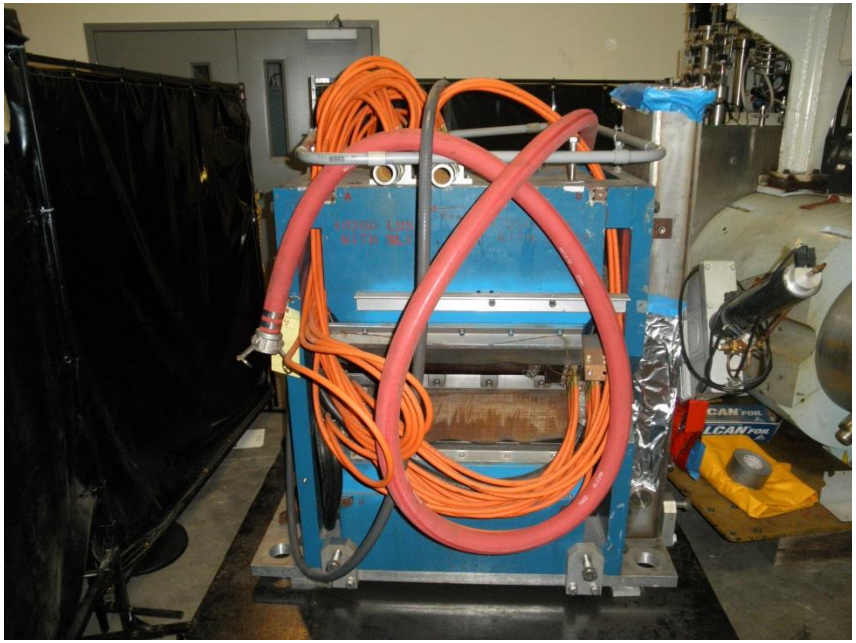
The SOS Spectrometer

- The SOS spectrometer, located in Hall C, had a QDD̶ design. The spectrometer operated up to a momentum of ~1.75 GeV/c.
- The SOS quad has a radius of 12.5 cm (Q1 radius = 15 cm). It was operated to a maximum pole-tip field of ~1T in the spectrometer.
- The dipoles, which shared the same iron yoke, limited the spectrometer momentum.
- So, the quad was not operated at its maximum internal current. It was, however, operated close to the maximum voltage of its power supply.

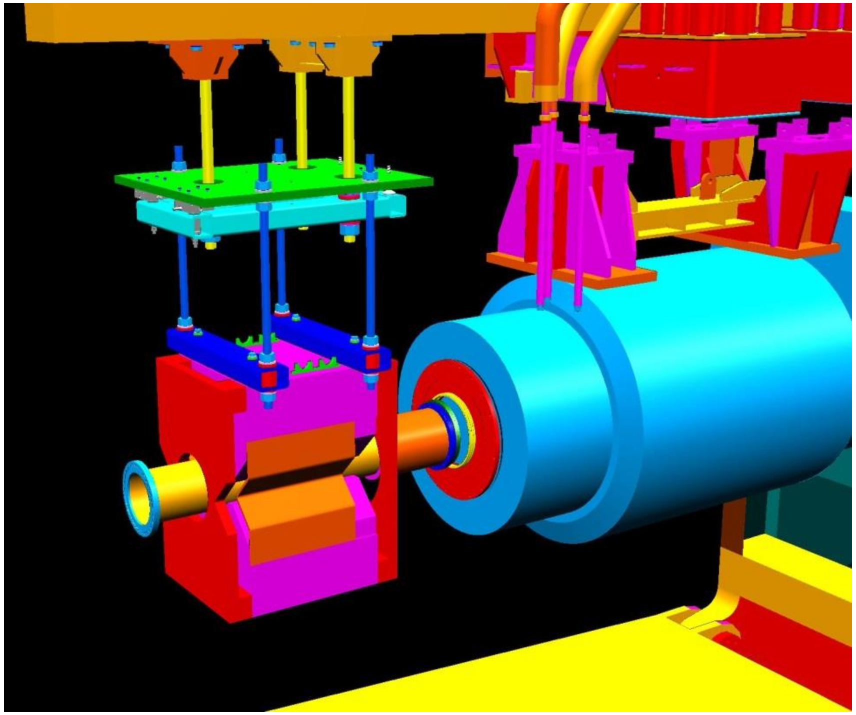
The SOS Quad

Front View

Side View

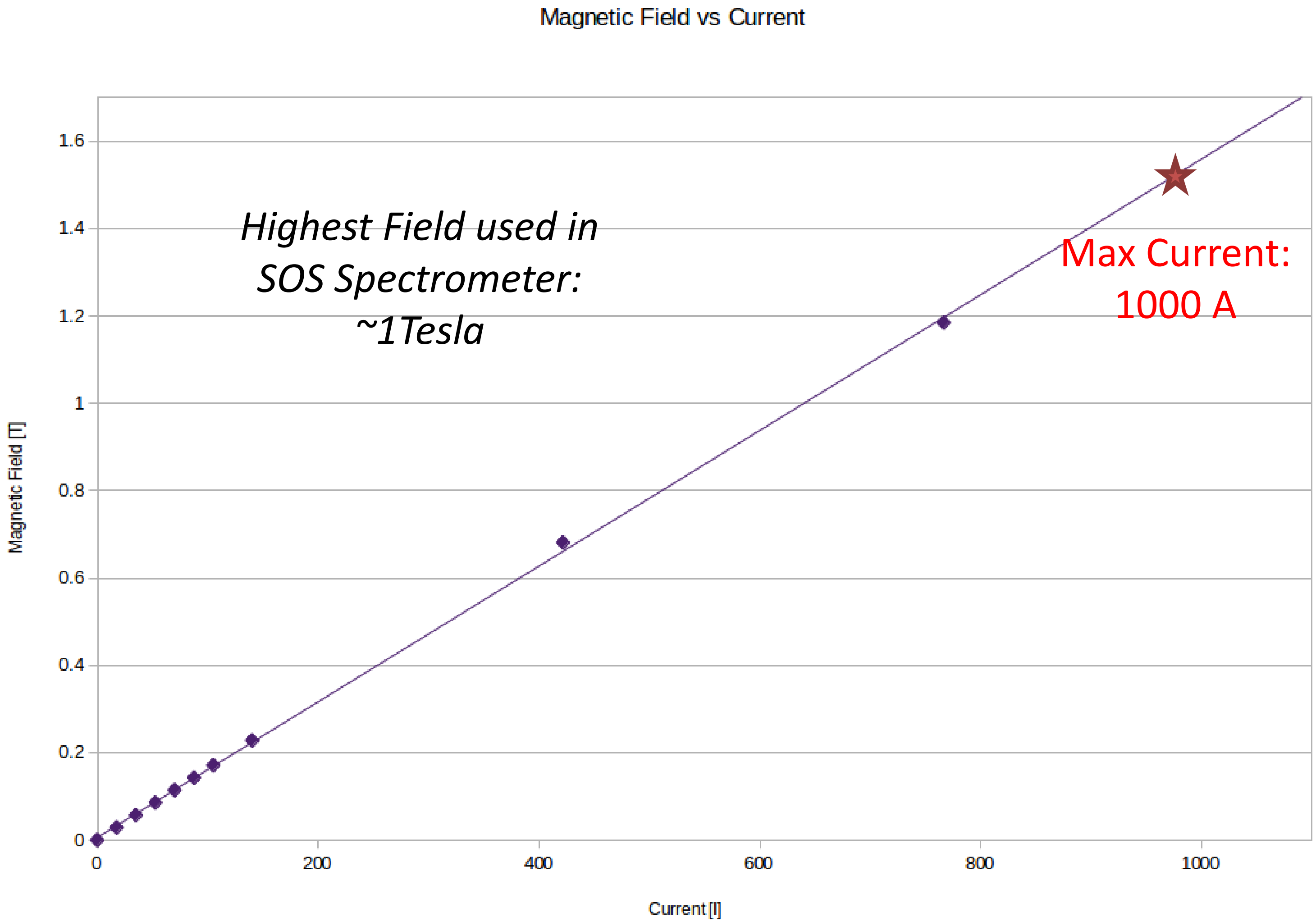


The SOS Quad in the RHRS

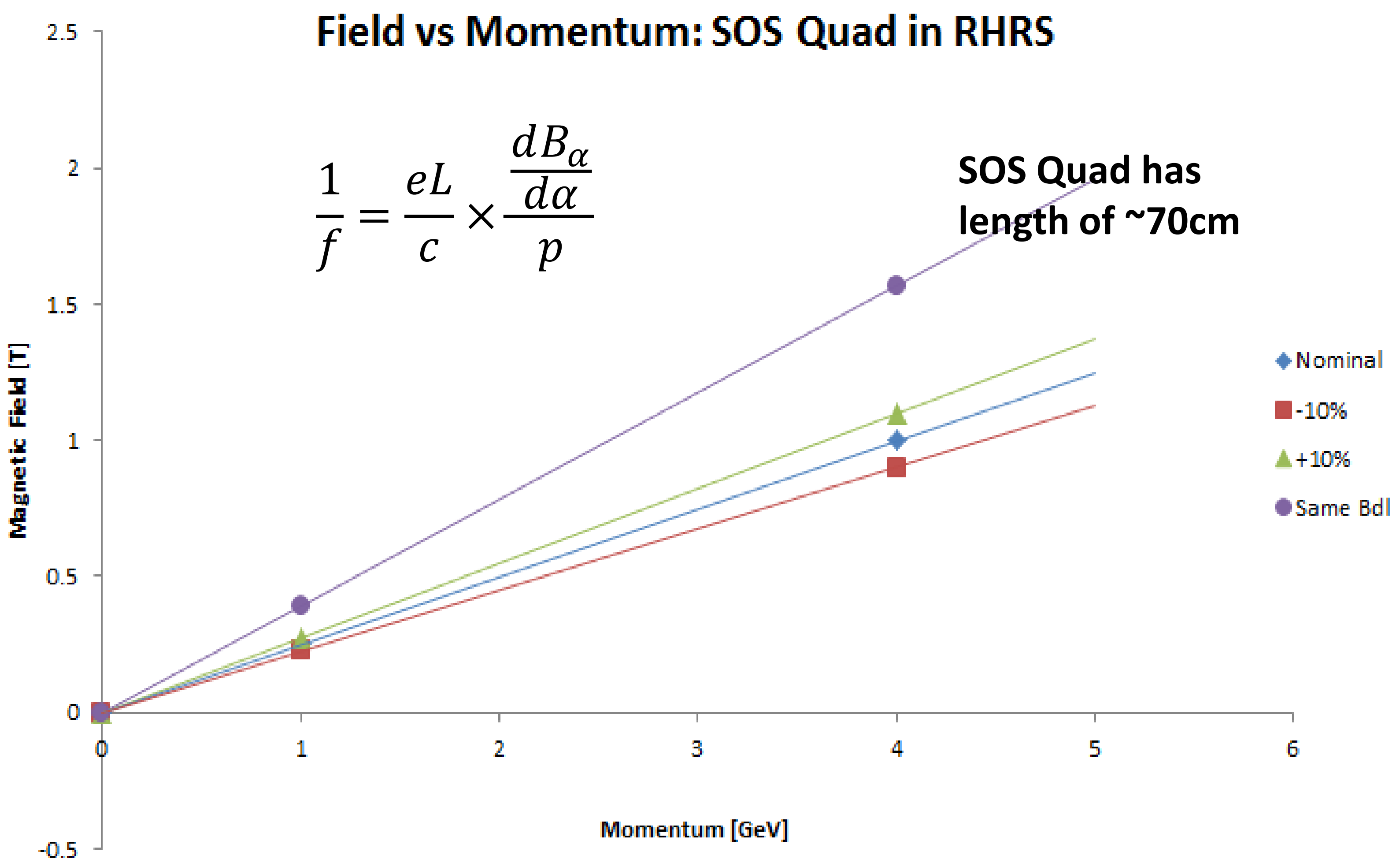


- The SOS quad can be mounted in the spectrometer as shown.
- The magnet will require water cooling, which would be taken from the system on the RHRS.
- The power supply for the Q1 would be removed and a new power supply installed.

Pole-Tip Field vs Current in SOS Quad

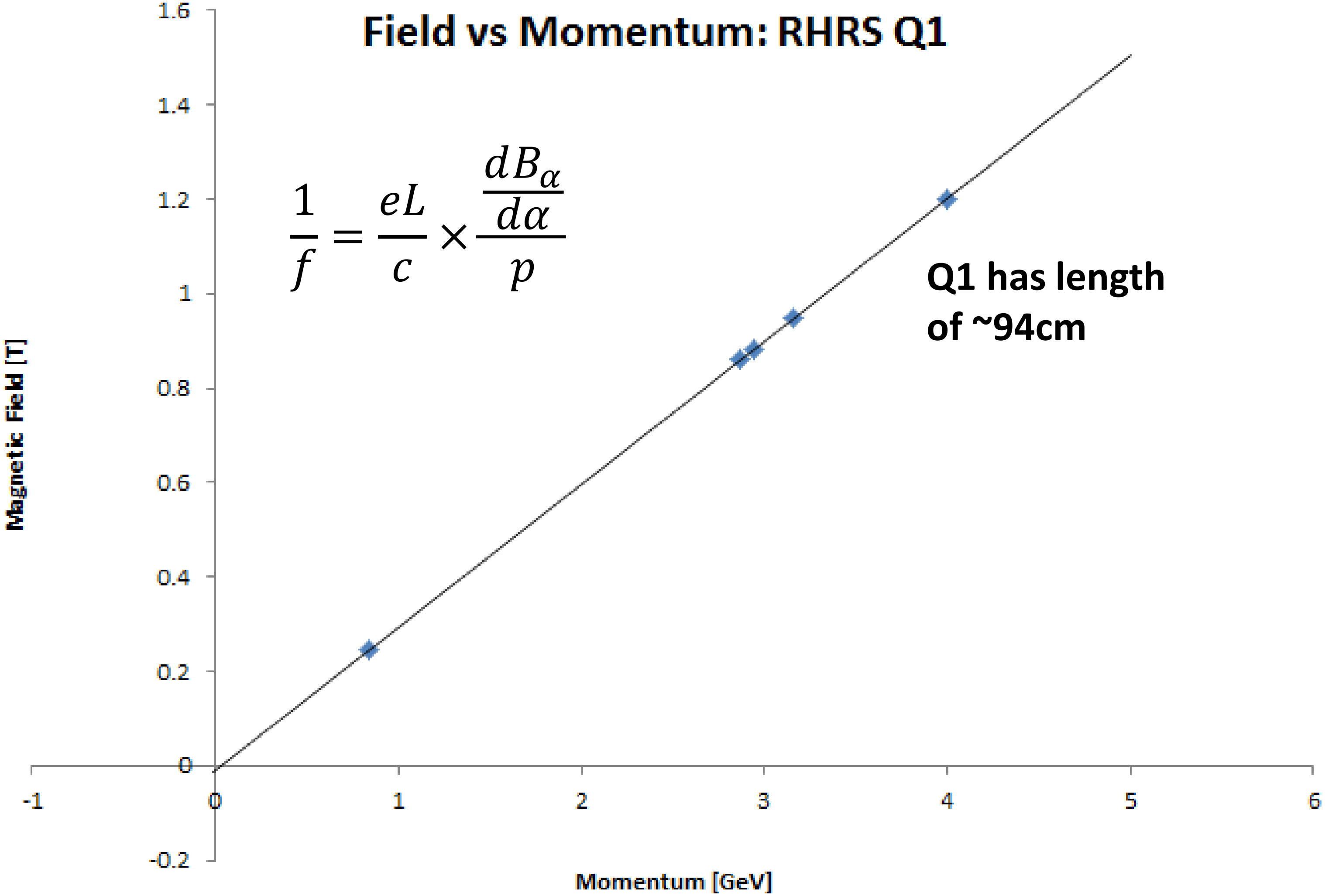


Possible Tunes: SOS Quad in RHRS



$$\frac{1}{f} = \frac{eL}{c} \times \frac{\frac{dB_\alpha}{d\alpha}}{p}$$

Tune for Q1 in RHRS



$$\frac{1}{f} = \frac{eL}{c} \times \frac{\frac{dB_\alpha}{d\alpha}}{p}$$

Q1 has length of ~94cm

Simulation Studies of the RHRS

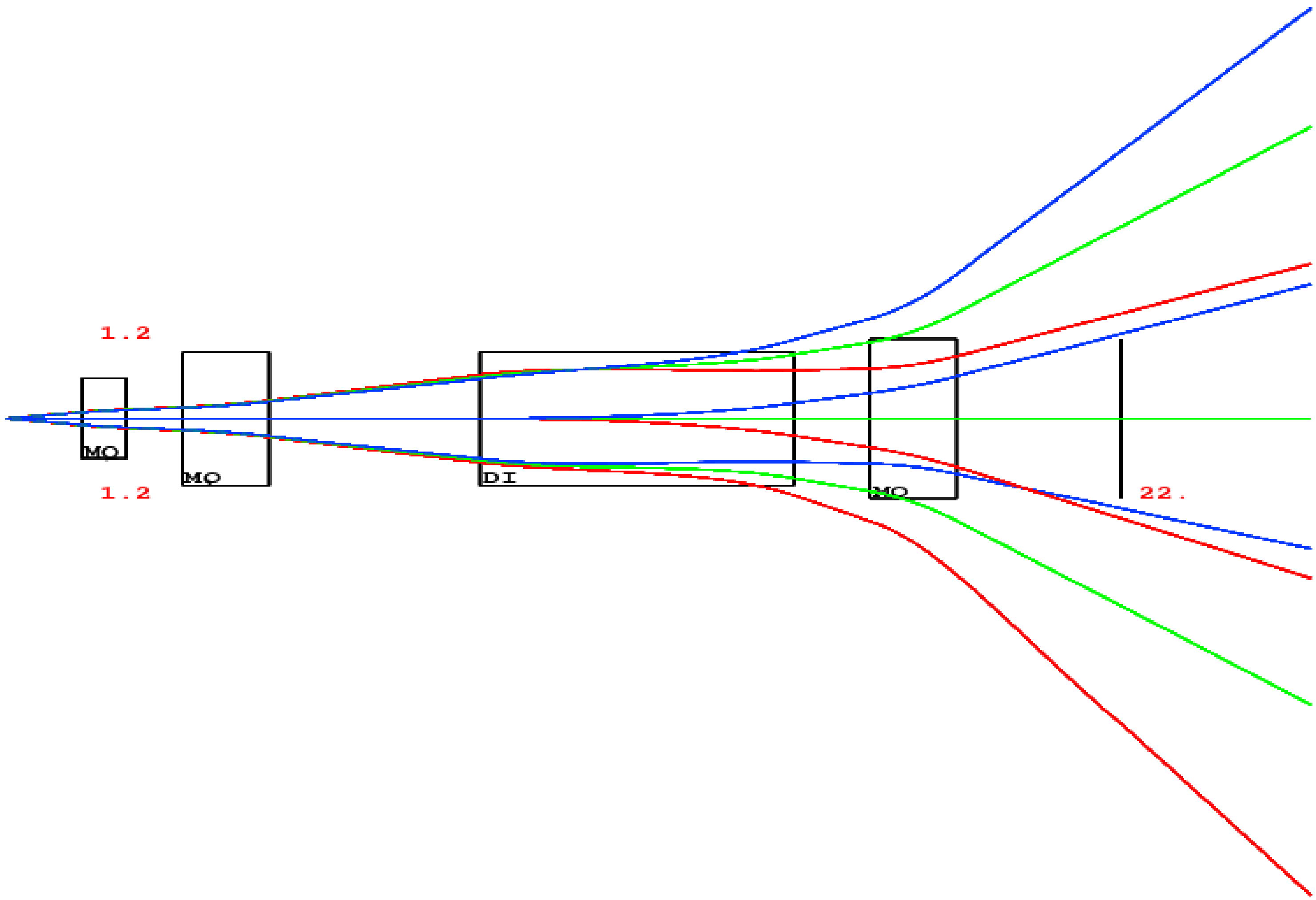
- The program Cosy Infinity was used to model the magnetic elements of the spectrometer.
- I used idealized magnets with limited fringe-field effects for these simulations. More complete simulations using field-maps may be forthcoming in the near future…
- Position and momentum variables after the magnetic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

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

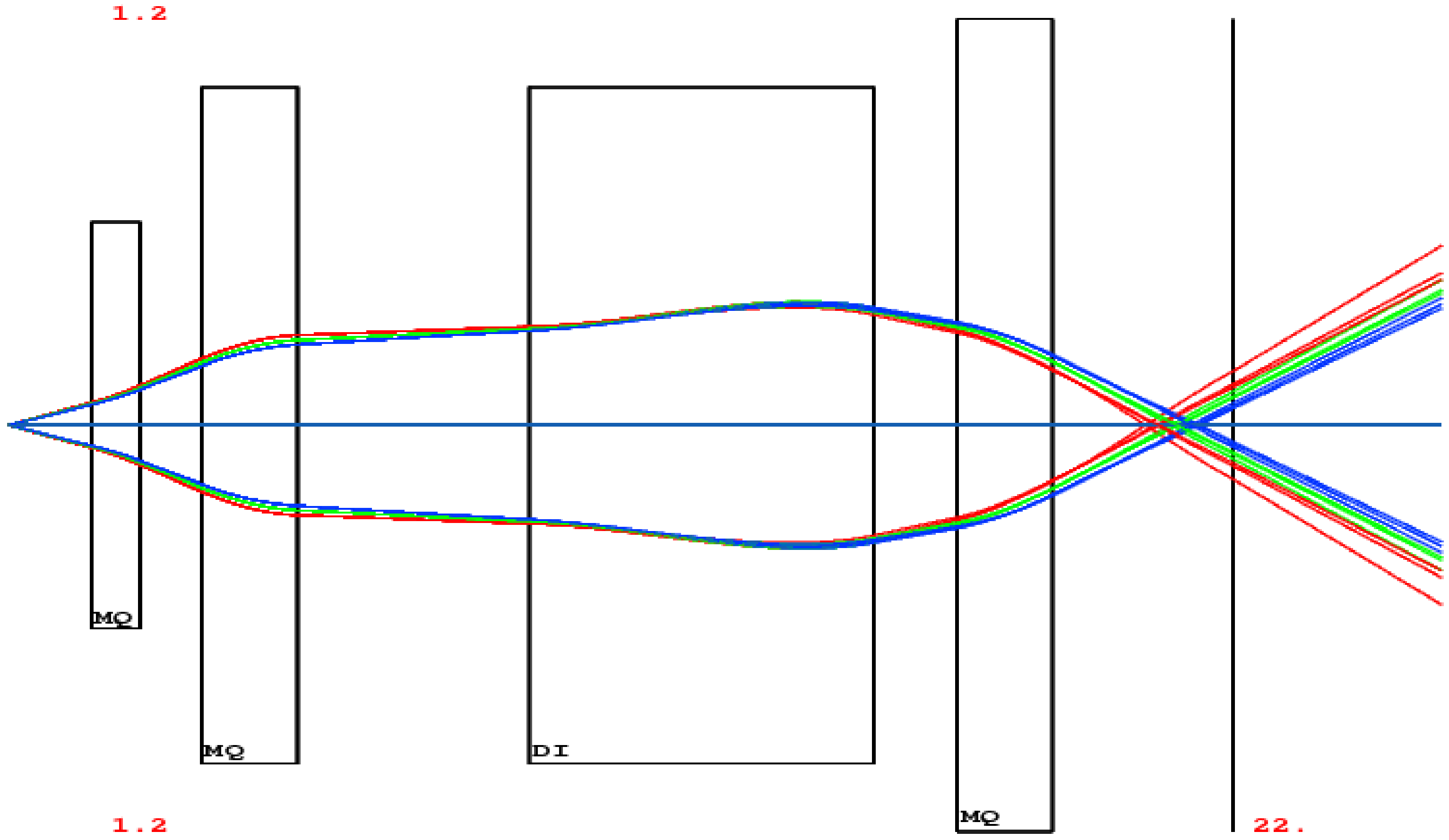
Simulation Studies of the RHRS (cont.)

- 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.

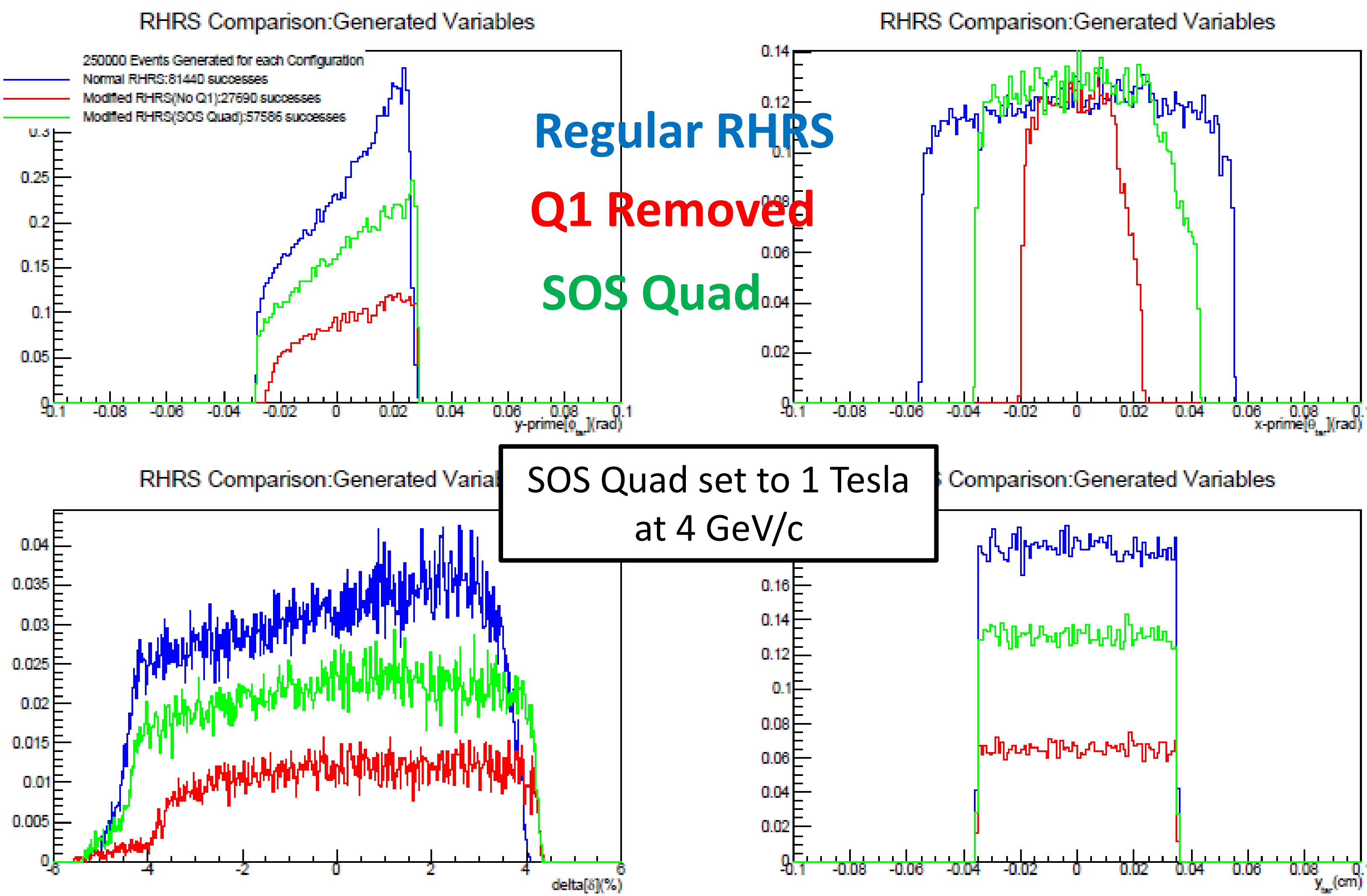
Cosy Infinity Ray-Tracing: Dispersive (and Bend) Plane



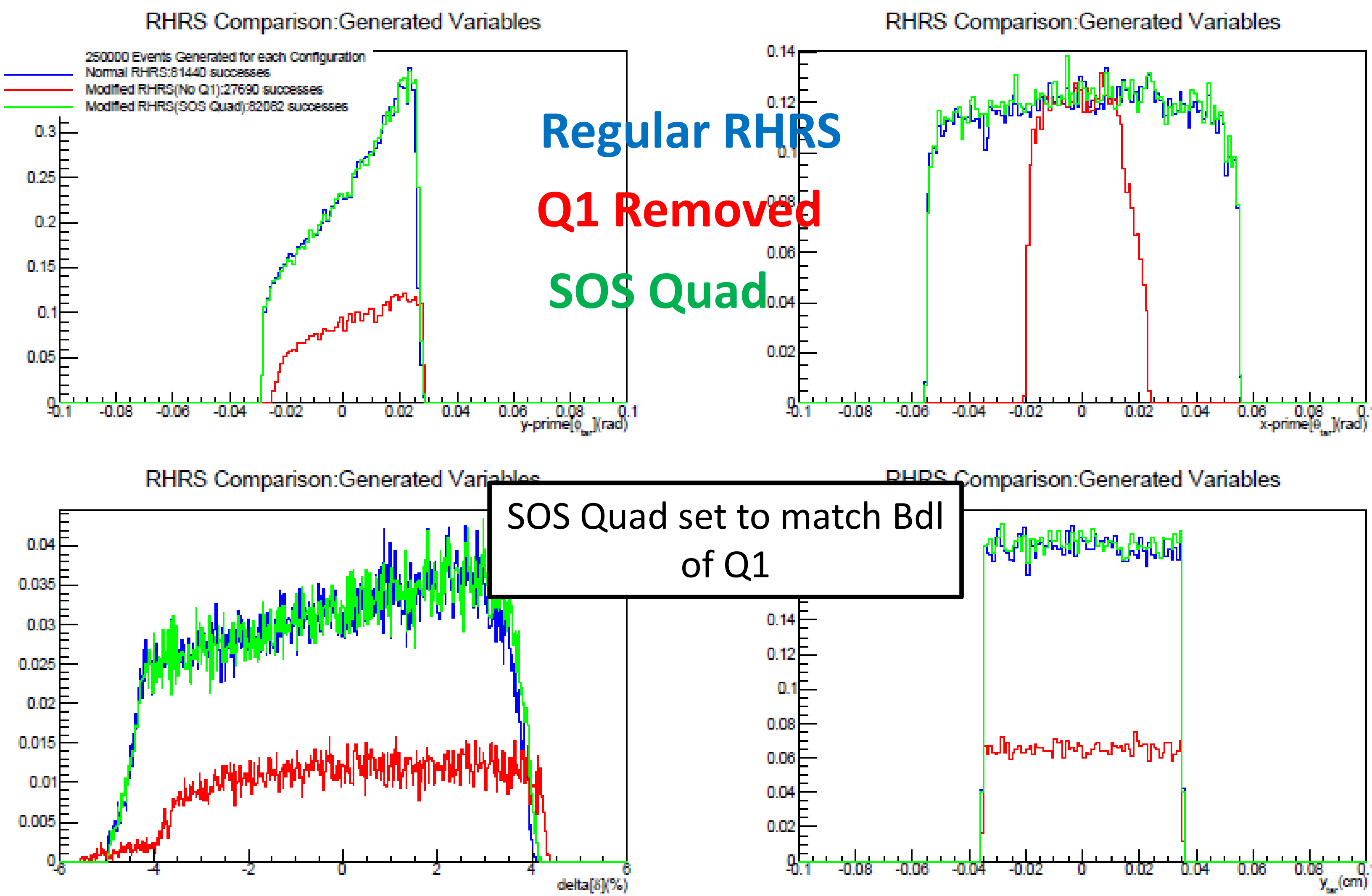
Cosy Infinity Ray-Tracing: Non-Dispersive Plane



Acceptance Comparison



Acceptance Comparison



Future Work

- Some preliminary work has been conducted on the effect of the SOS quad on the resolution of the spectrometer. The resolution appears to have the same order-of-magnitude.
- In the simulations shown, the SOS quad was placed with its center at the same position as Q1. The effect of moving the quad by up to ±15cm can be studied.
- Better models of the magnetic elements in the spectrometer would allow for a fuller understanding of the acceptance/resolution.
- Tuning all magnets at the same time to optimize acceptance/resolution can be done using Cosy.