Status of Scaling FFAG Phase Rotation ICOOL Simulations

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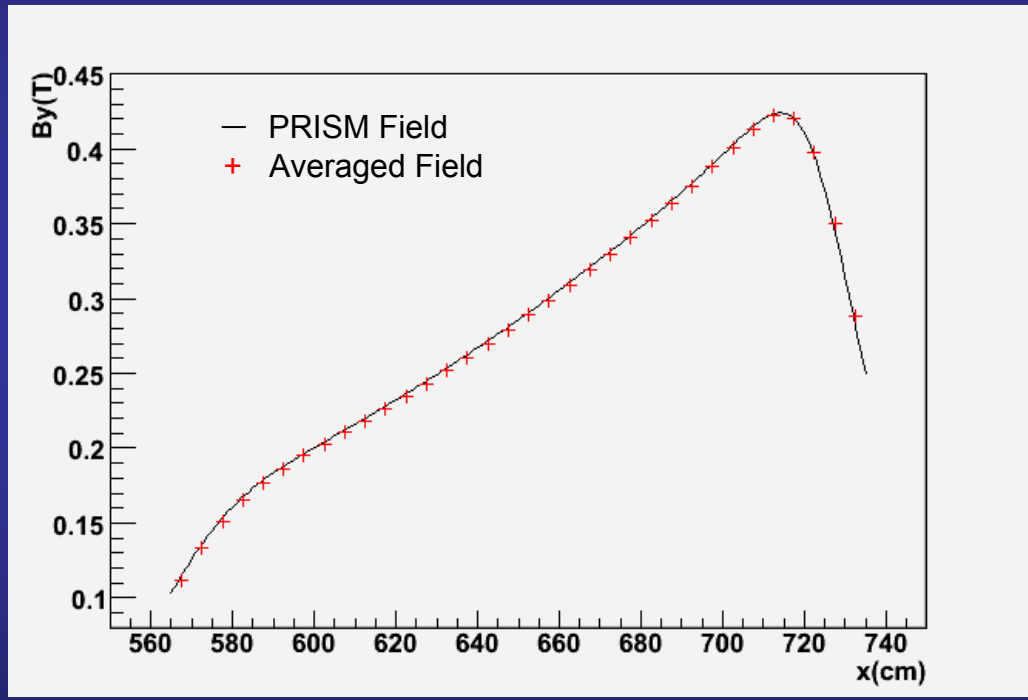
Introduction

- A. Sato was kind enough to give me the OPERA field map of the PRISM magnet.
- Averaged the field map to use with ICOOL
- First simulations in ICOOL with the coarse grid without any cavities.
  - Obtain closed orbit and look at dynamic aperture

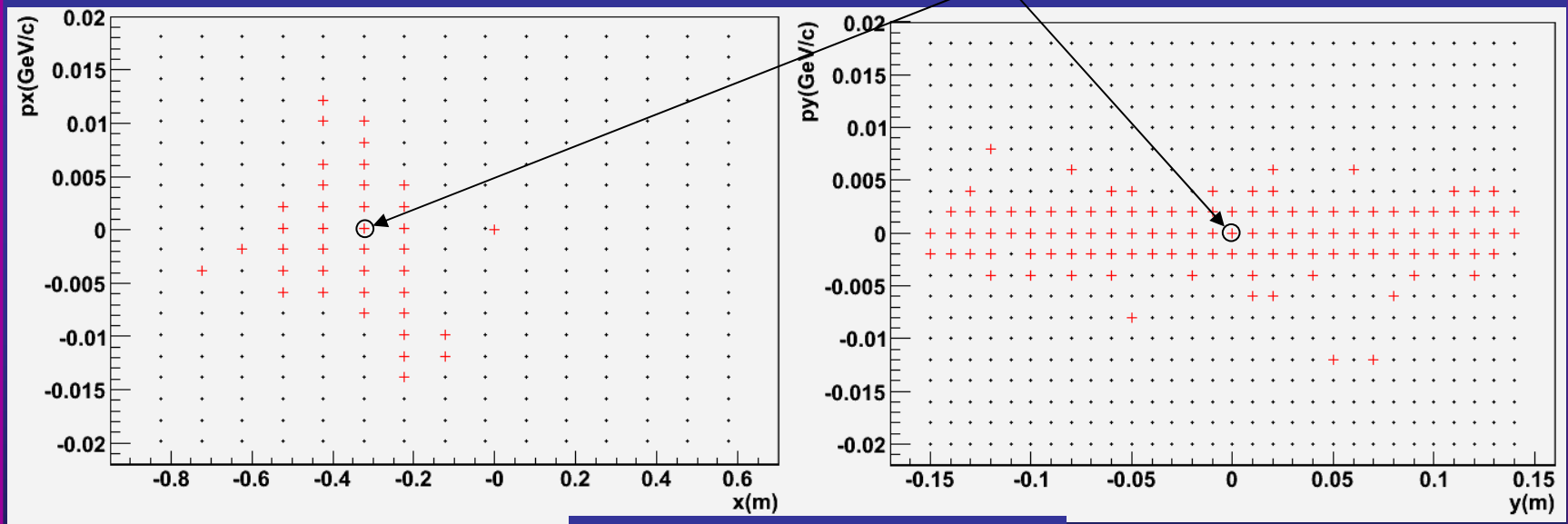
Field Map

- PRISM field map:
  - r from 565 to 735 cm (step=1cm), z from 0 to 17cm (step=1cm) and θ from -18 to 0 deg (step=0.1deg)
- Averaged field map:
  - r from 567.5 to 732.5cm (step=5cm), z from 1 to 17cm (step=2cm) and θ from -17 to 0deg in 1deg increments (theta direction)
  - B_r and B_θ for y=0 was set to 0 and B_θ was set to 0 for θ=0



Dynamic Aperture

- Generated a beam evenly spaced in x, px, y and py
  - $x=x_0$(-0.5m+1m) in 0.1m steps, $y=y_0\pm$ 0.15m in 0.01m steps
  - $pi=pi_0\pm$0.02GeV/c in 0.002GeV/c steps (i=x,y)
  - x_0, y0, pi_0 are the coords of the closed orbit particle.

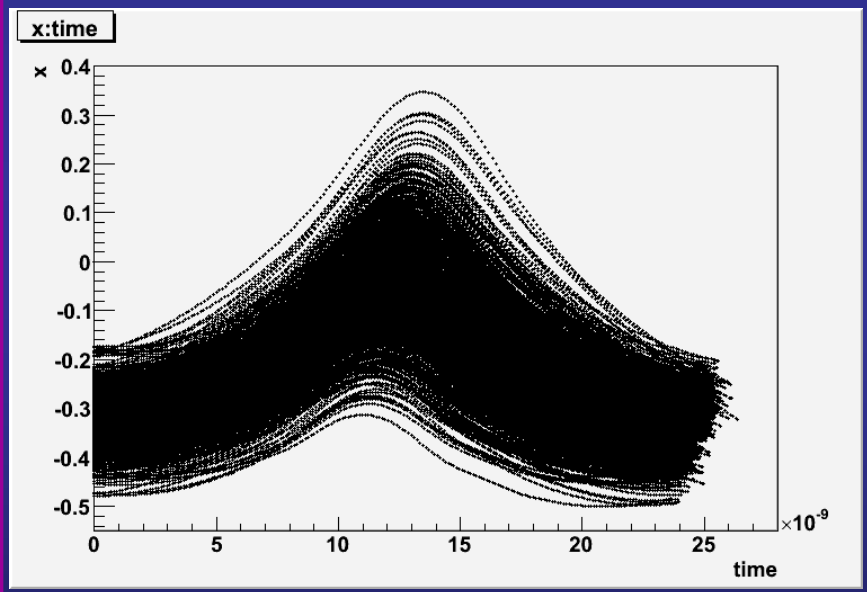


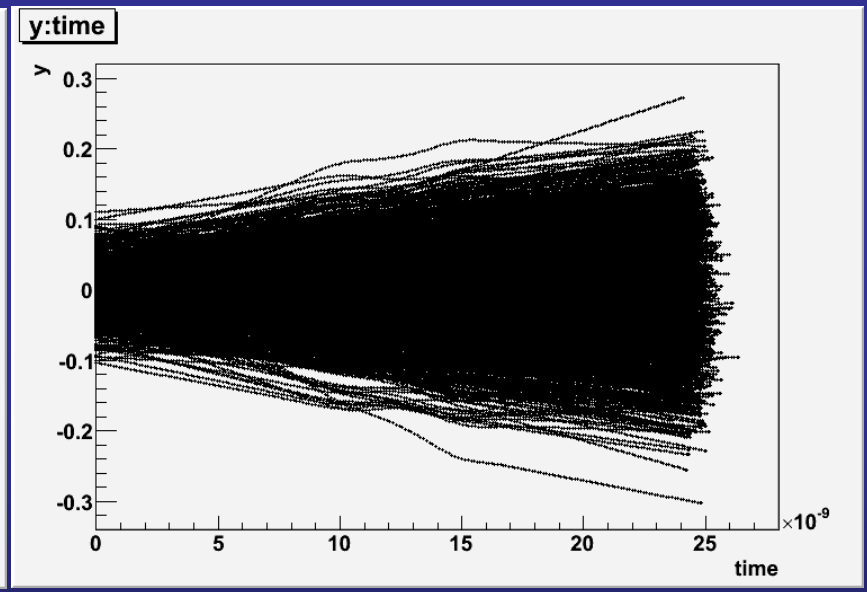
For 5 turns of the ring

Gaussian Beam Tracking

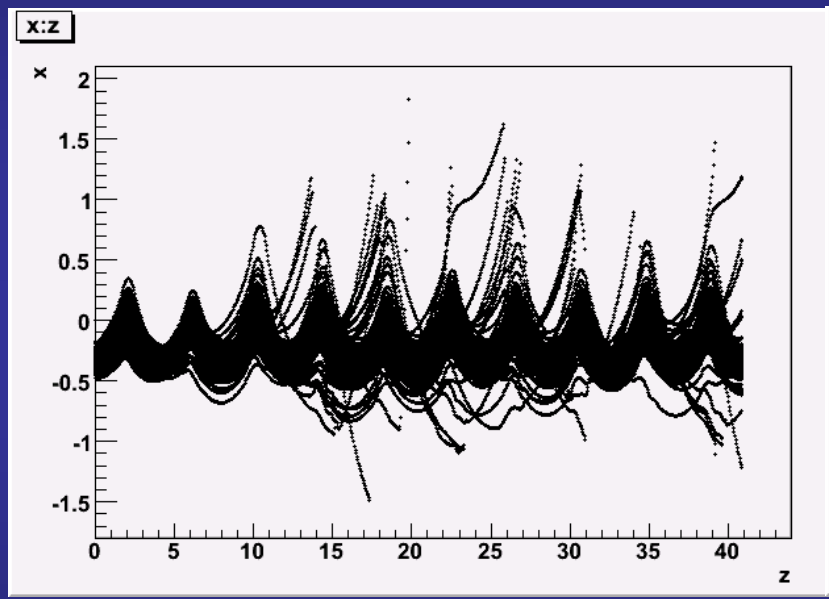
- Generated a Gaussian beam (with no correlations) of 1000 muons using:

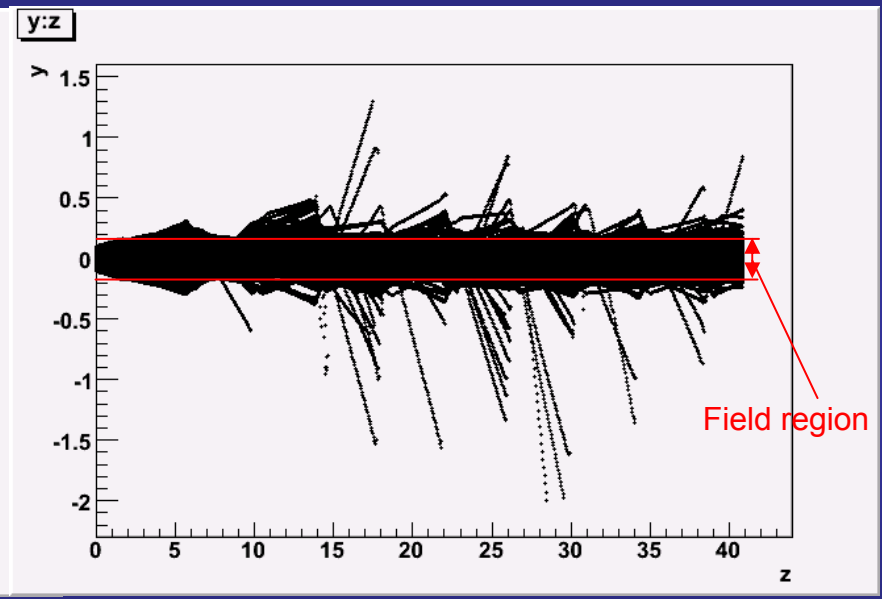
  σ_x=0.05, σ_y=0.035, σ_{px}=0.0025 and σ_{py}=0.002





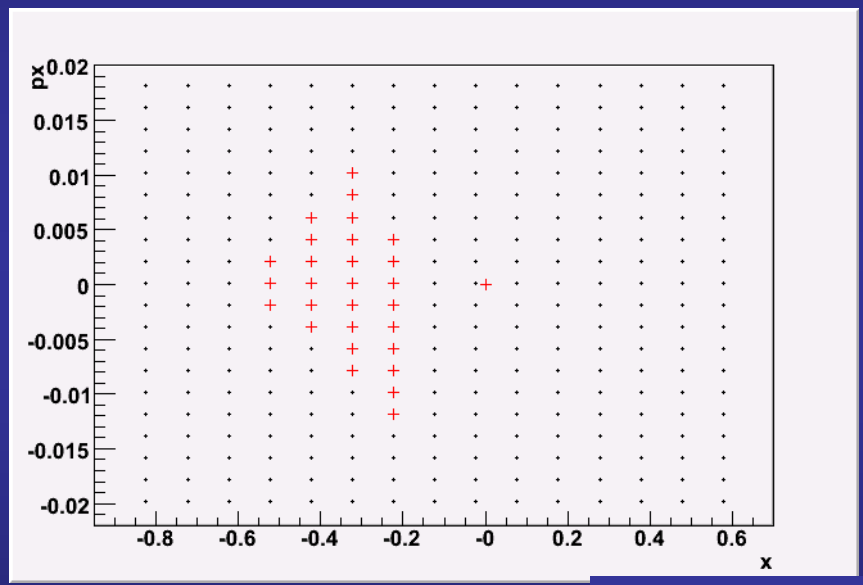
Gaussian Beam Tracking(2)

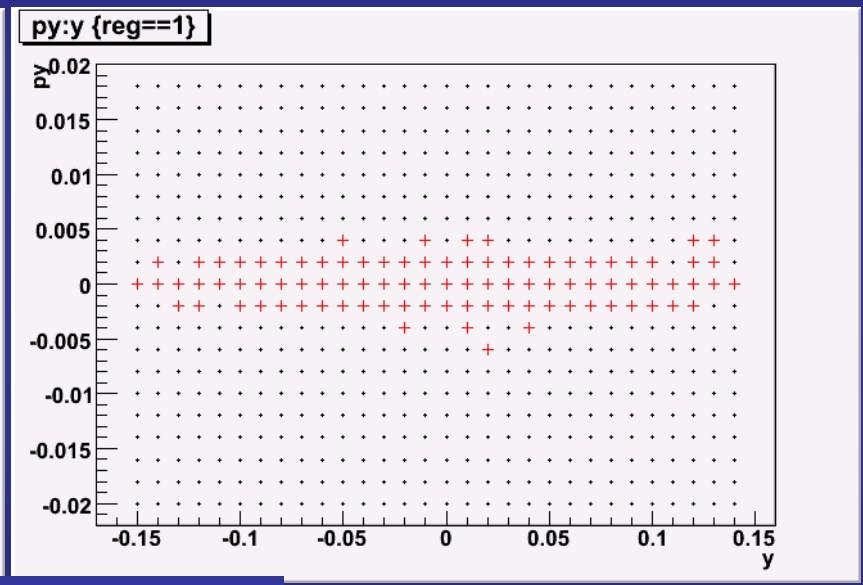




Dynamic Aperture Again

- With an aperture of ±1m in x and ±0.17m in y after each cell.

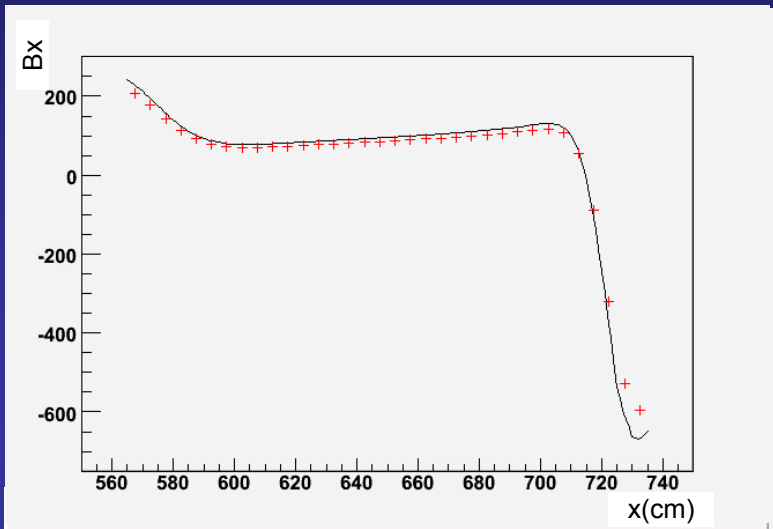


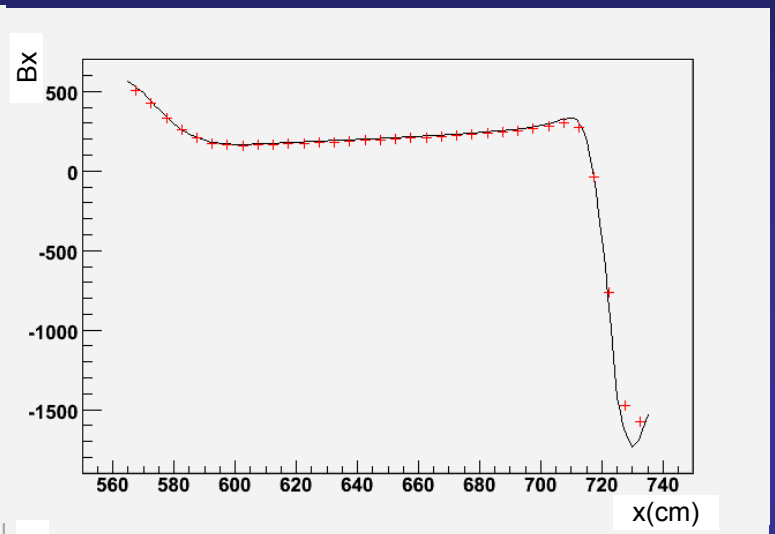


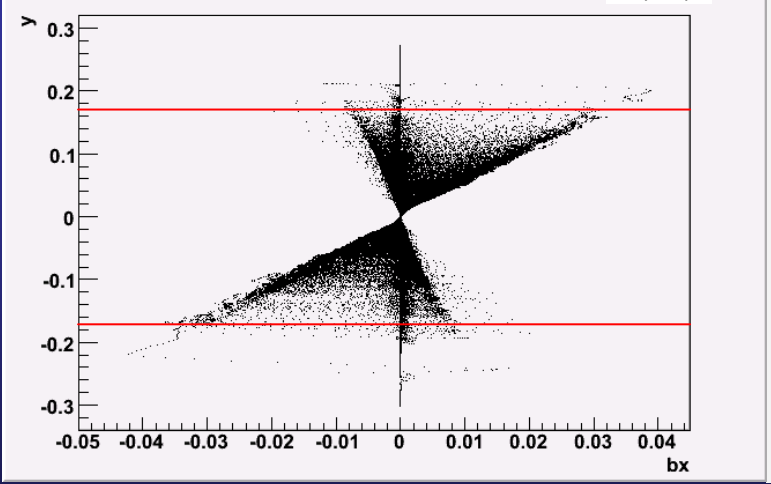
For 5 turns of the ring

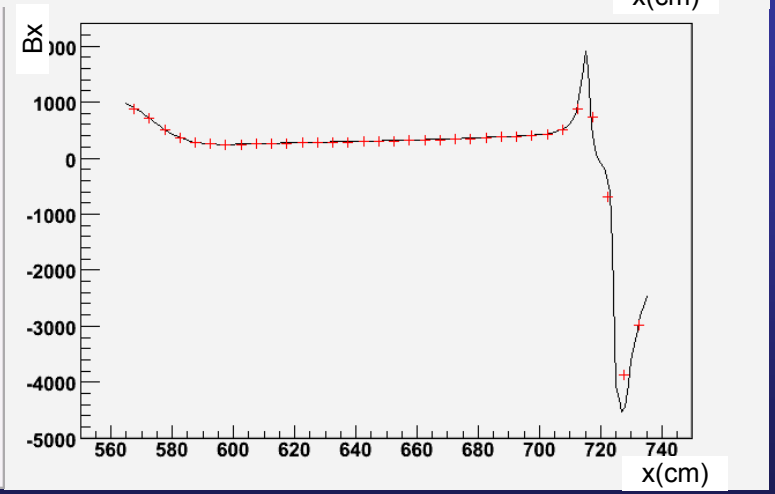
Total number of particles that survive is now ~1/10 of what it was

Field Map Again

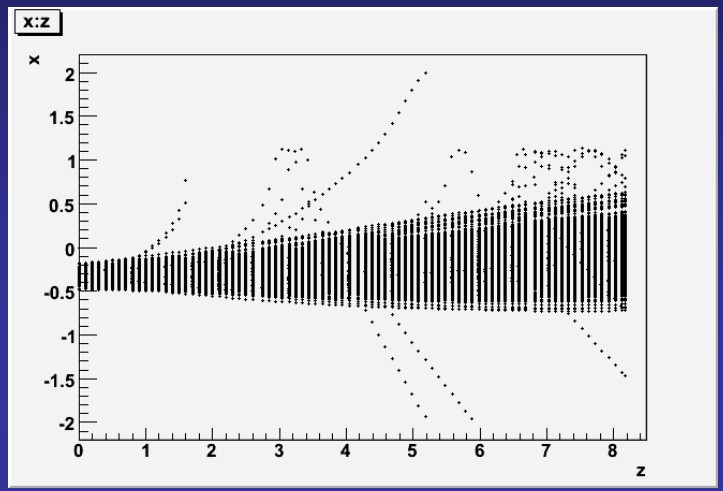


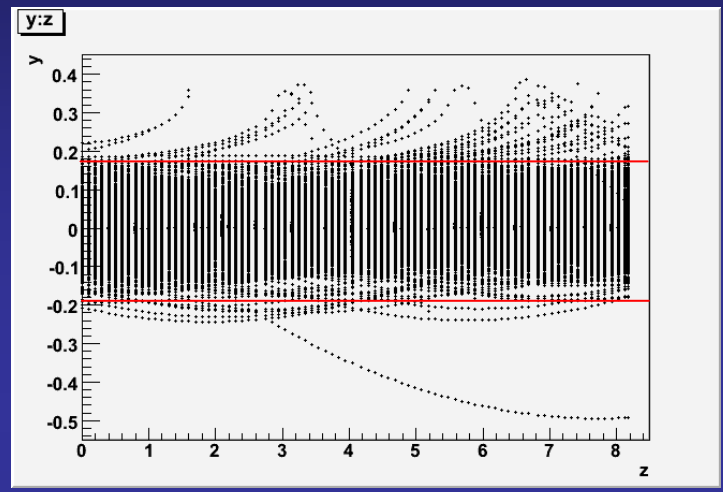


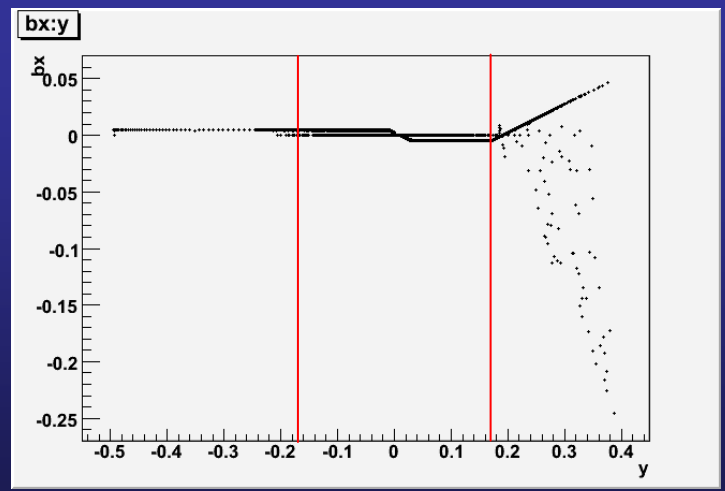




Simple Dipole

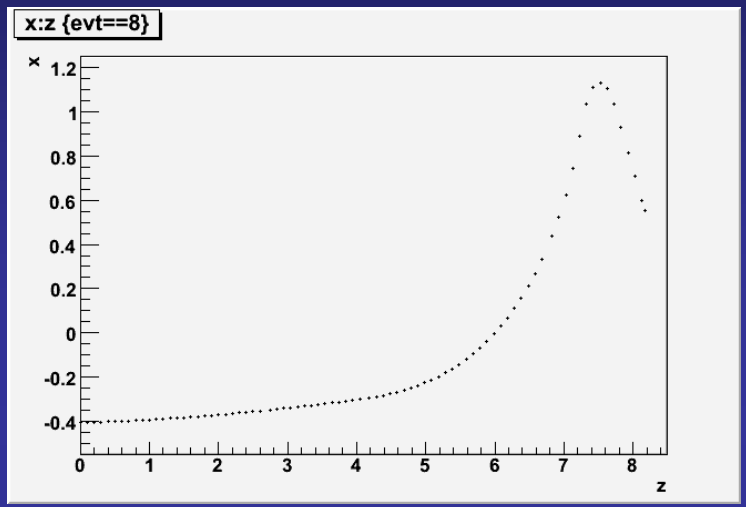


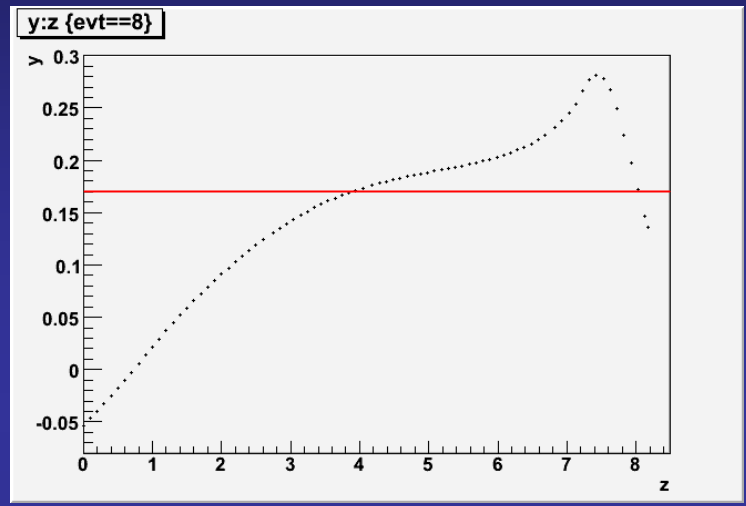


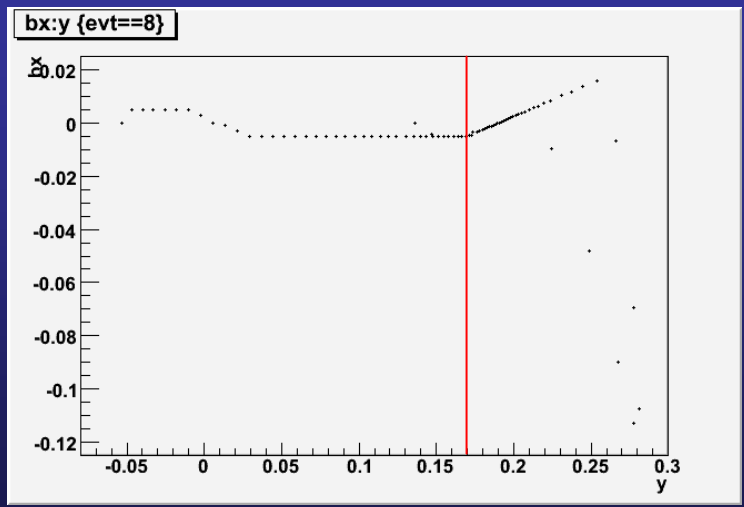


Dipole field with a fixed Bx of 0.005T everywhere expect at y=0.
Same grid spacing and same gaussian beam.

Simple Dipole(2)

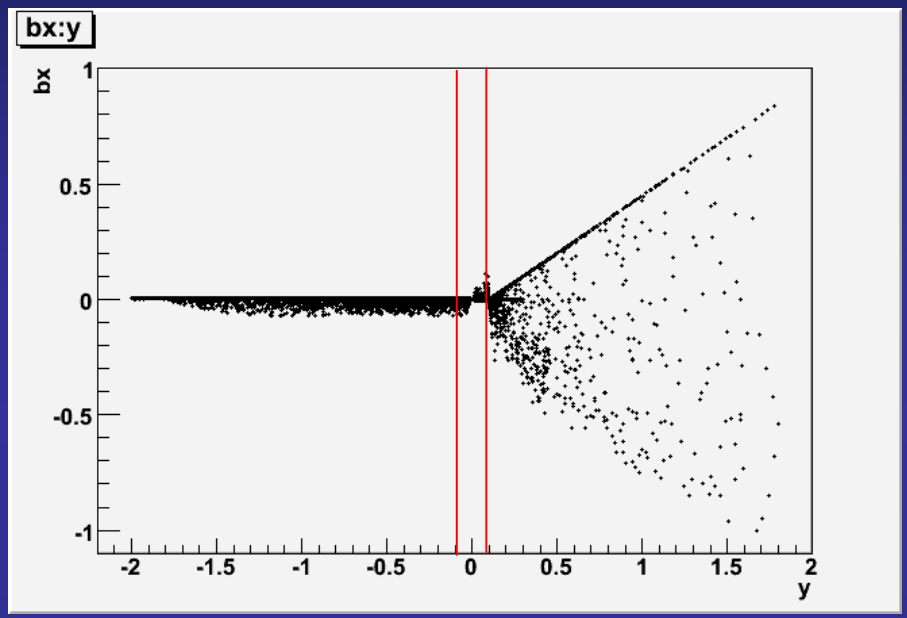


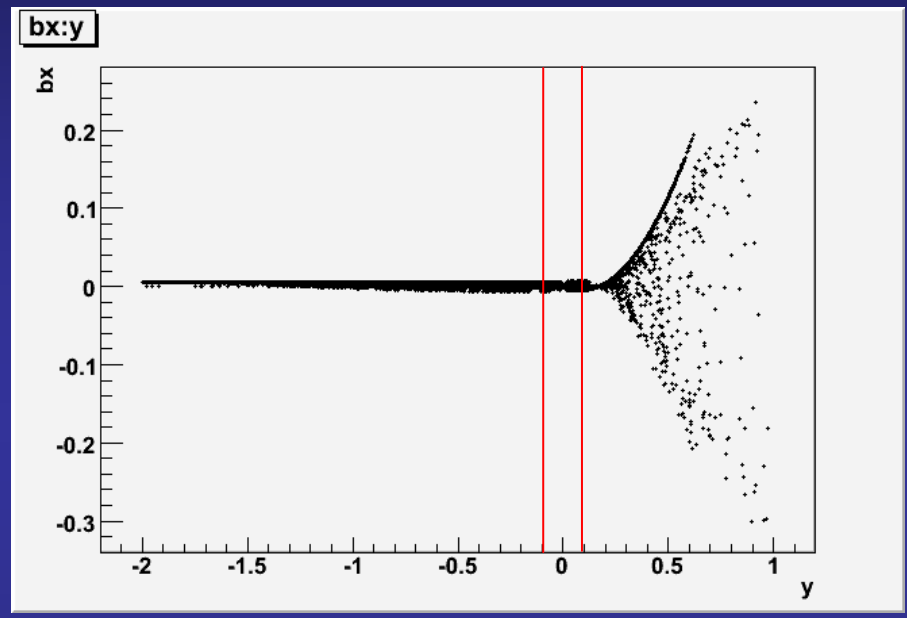




For one particle

Simple Dipole with a circular beam



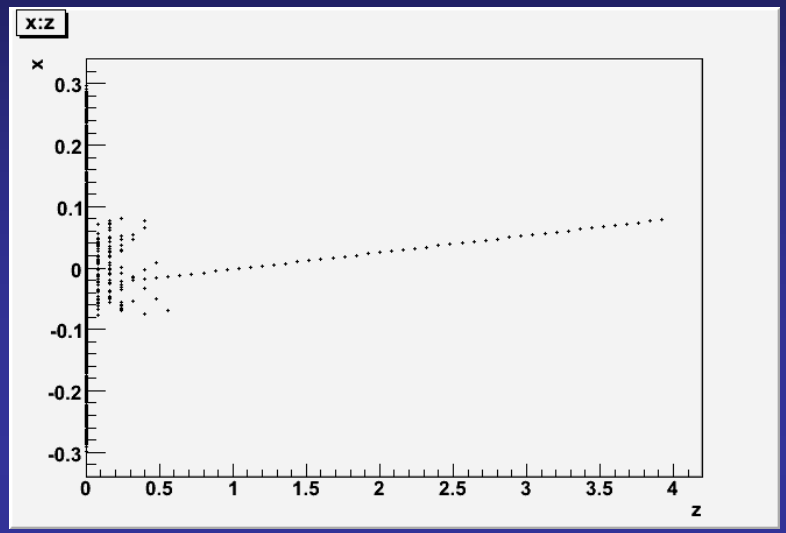


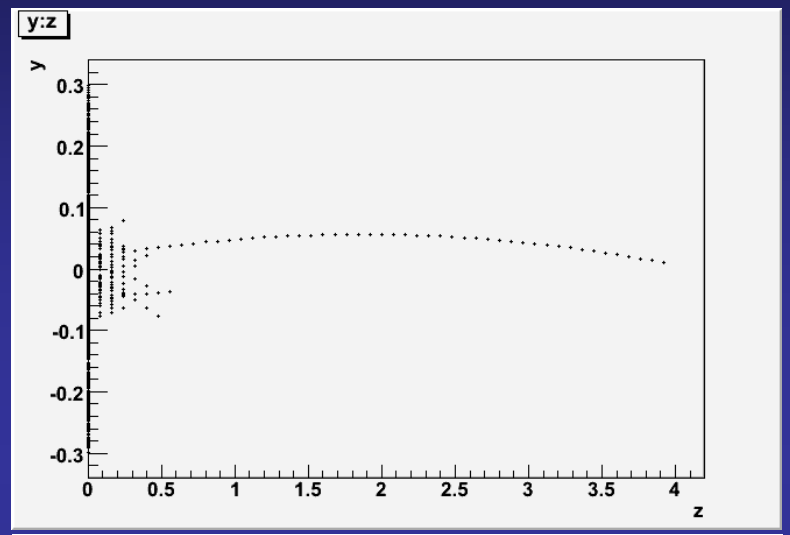
Linear interpolation

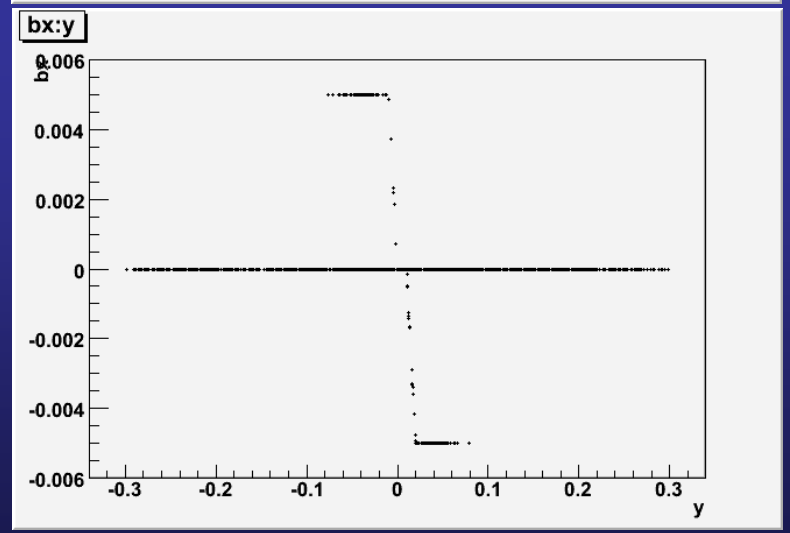
Quadratic interpolation

Circular beam. The field region in y is now ±0.09m

Simple Dipole with a circular beam







Circular beam. The field region in y is ±0.09m but the region of the simulation is now 0.08m in radius.

Plan

- Solve interpolation problem!
- Include rf cavities with saw-tooth waveform and phase them correctly.
- Look at phase-rotation with a generated gaussian beam of mean momentum of 0.068GeV/c.
- Scale this up for a beam with mean momentum of 0.2GeV/c
- Use the MARS-15 10GeV protons on a Tantalum target input file.