MICE Tracker Solenoid Mapping

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NFMCC Collaboration Meeting

Jan. 25, 2009

Motivation

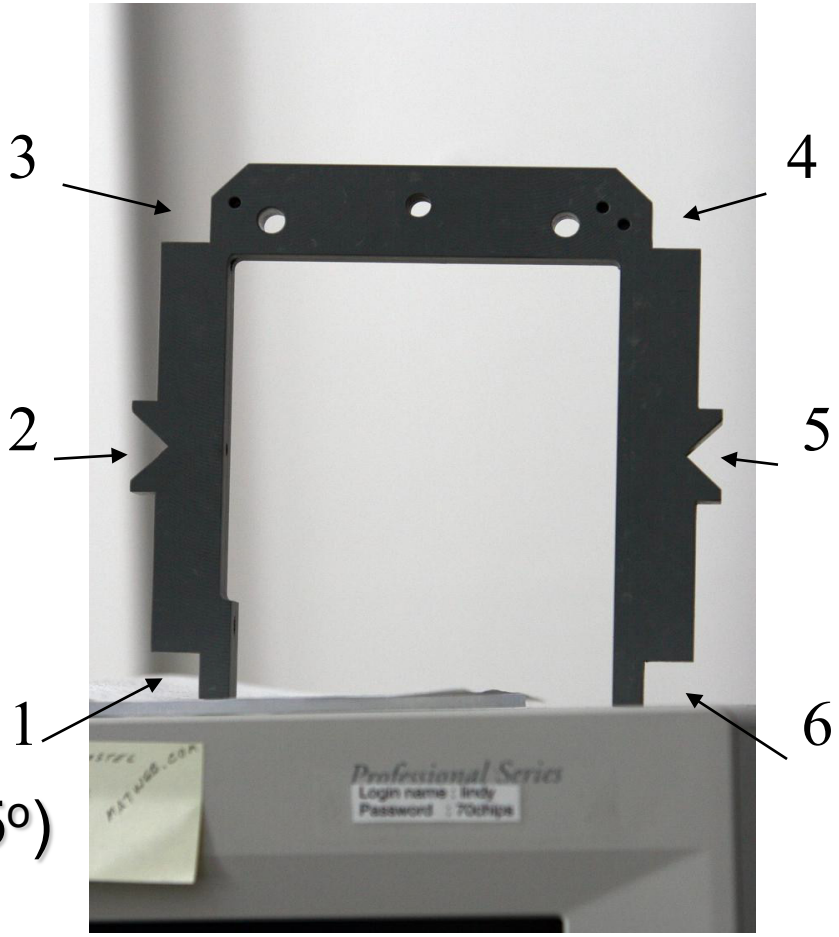
- Spectrometer solenoid provides uniform magnetic field for a scintillating fiber tracker
- Produce field of 4 T to within 1%
- Ziptrack system used in the past, however
  - No GUI
  - Analysis features scattered
  - Multiple languages used (C++, Fortran, Root)
  - Mainly hard-coded

Ziptrack Apparatus

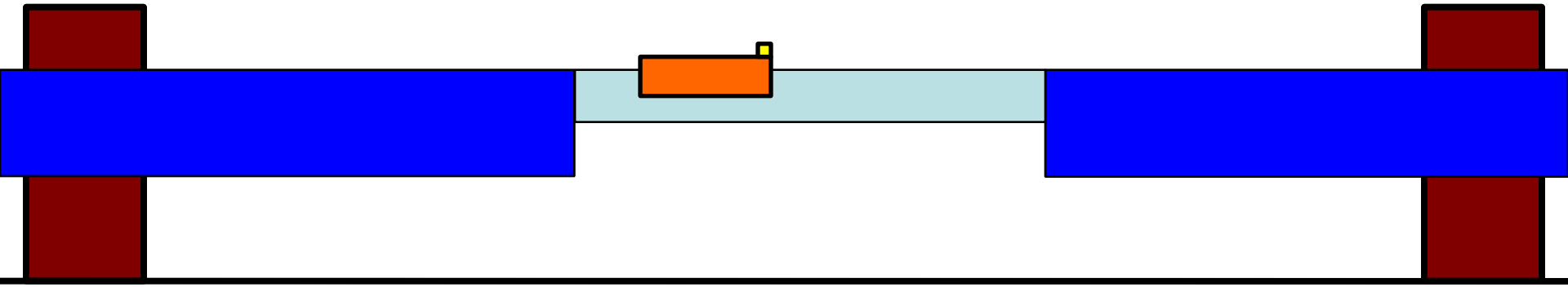
- Ziptrack beam rests on two manipulators (brown and orange towers)
- Cart holding Hall probe sits on silver beam
- Cart moves along the beam (z), manipulators move the beam in (x,y)

Cart and Holder

- Cart contains readout electronics
- Holder is mounted on the cart
- Two types of Hall probes used: NIKHEF & Senis
- 6 possible probe positions
  - Bottom right & left
  - Top right & left
  - Middle right & left (rotated 45^{o})
  - All will be used

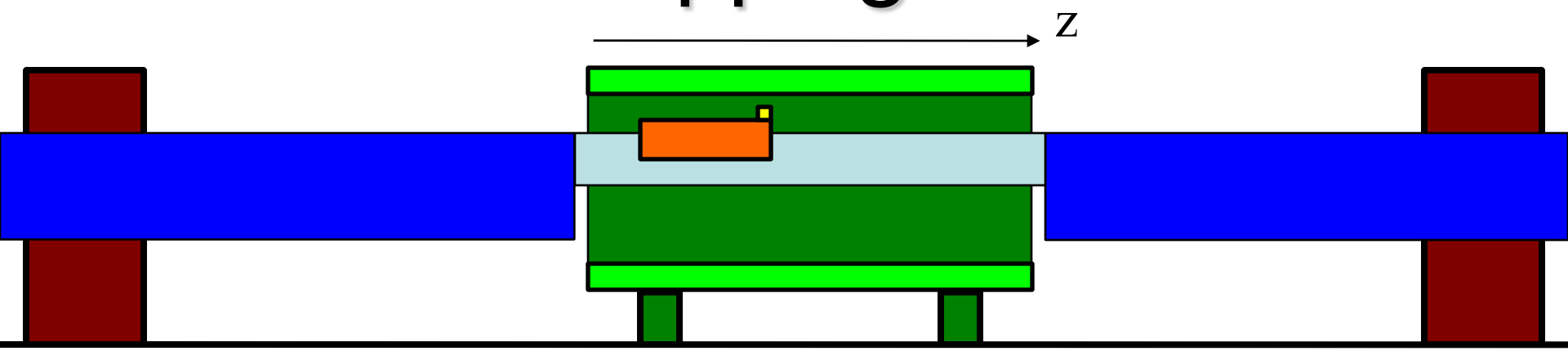


MICE Setup

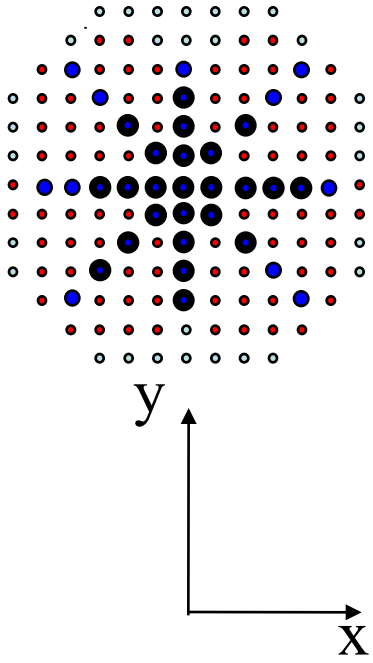


- Special beam (light blue) manufactured for MICE solenoid
  - 3.66m long
- Will accommodate original cart (orange) and probe (yellow)
- Beam inserted and checked for straightness

Interior Mapping Locations



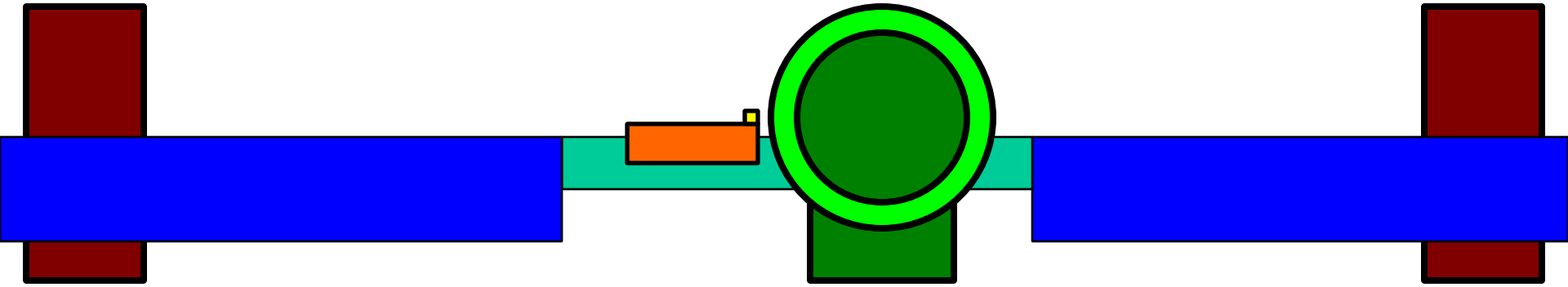
- Beam placed in bore of magnet
- Measurements taken every 3 cm along z, up to 15 cm radially (from magnet center)
- Red & blue dots indicate positions to be probed
- Bold black indicate positions accessible by a probe in multiple cart positions
- See Terry Hart's MICE Note for further detail: http://hep04.phys.iit.edu/mice/notes/notes.html



Coil Configurations

- Spectrometer alone (check field and current specifications)
  - All 5 coils on
  - Each individual coil on
- Spectrometer with shields (check for field non-linearity due to iron)
  - No current
  - ¼ nominal current densities
  - ½ nominal current densities
  - Nominal current densities
  - 1.1x nominal current densities
- After 1.1x, remeasure at nominal, half and no current to check for hysteresis effects

Exterior Mapping Locations



- Ziptrack beam placed outside & perpendicular to end of magnet
- Starting 1 m from end, out 36 cm, measurements taken every 12 cm
- Both ends will be measured
- Total estimated time for mapping is 14 days

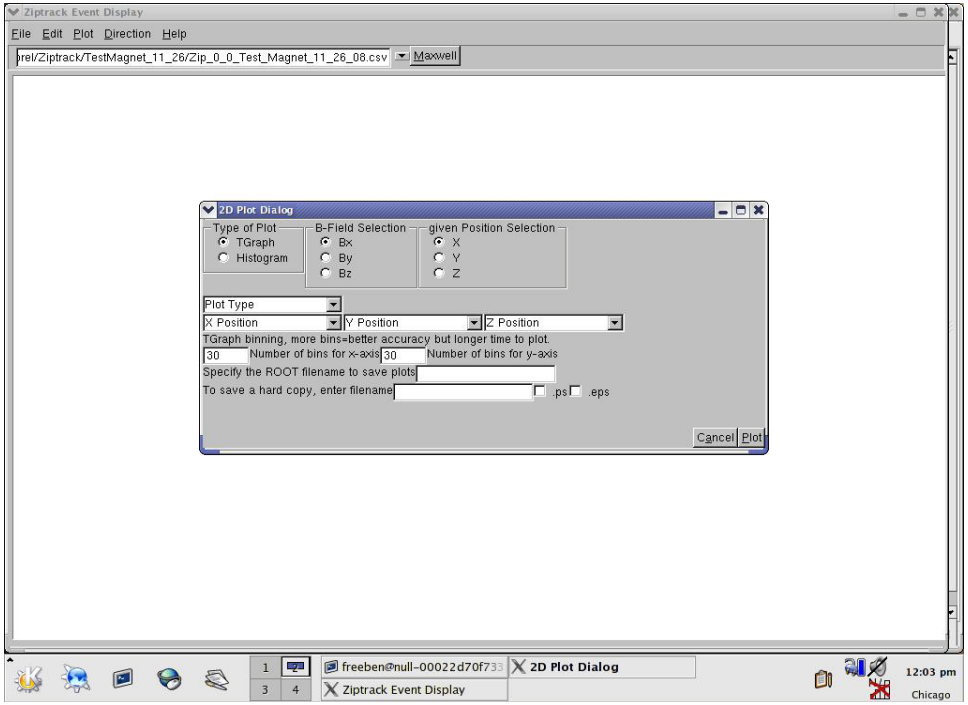
Data Format

- Each data corresponds to single transverse (x,y) position and contains
  - position and field data for each z position (taken down and back along beam)
  - probe position, magnetic field counts and temperature
- Software converts raw data to units of mm and gauss (temperature used in magnetic field conversion)

Analysis Software

- Four maps (position to field) created: forward direction, backward, average of the two, and difference of the two
- User may select which set they want to look at
- 1D and 2D plots can be made with a number of plotting options (see next slides)
- Plots automatically saved to a root file

Current 2D Plotting Dialogue

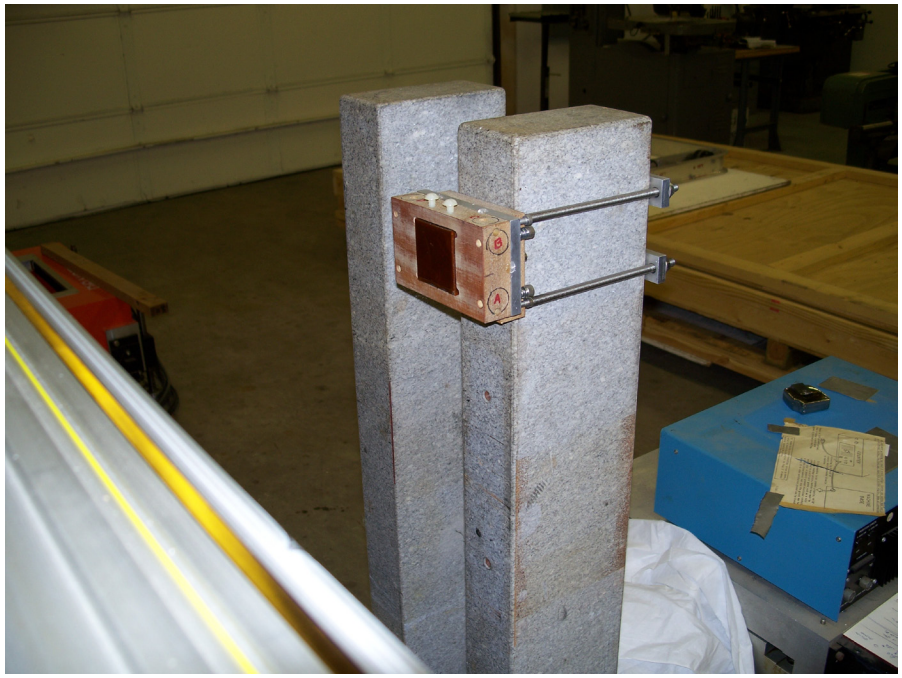


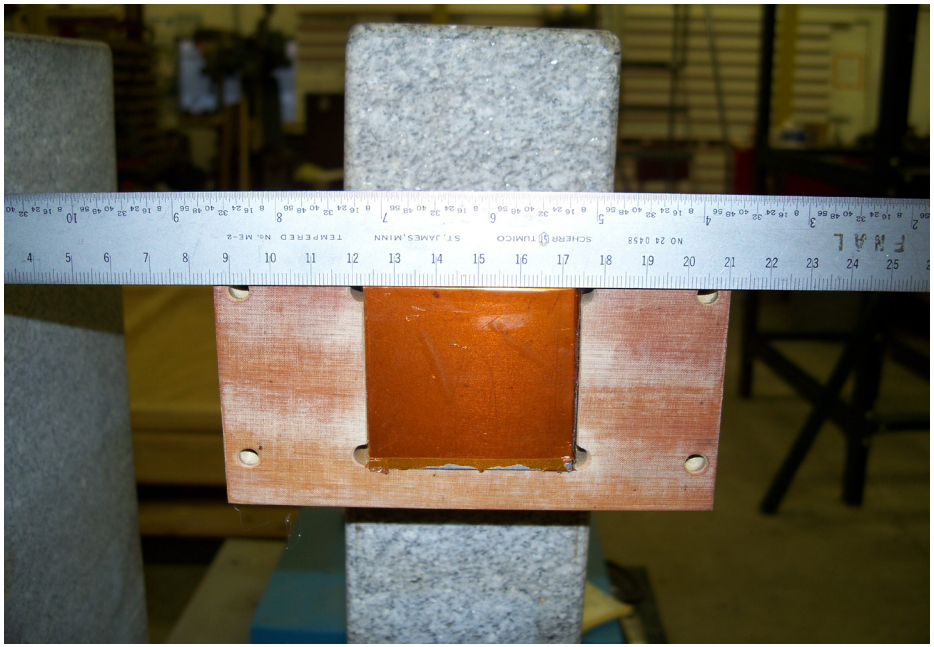
- Change default root file name if desired
- Specify additional saving options if desired (postscript or encapsulated postscript)

- Specify type (TGraph = interpolation between points)
- Select which field component to plot
- For histograms, select plot type
- Choose location
- Interpolation precision can be changed

Test Magnet

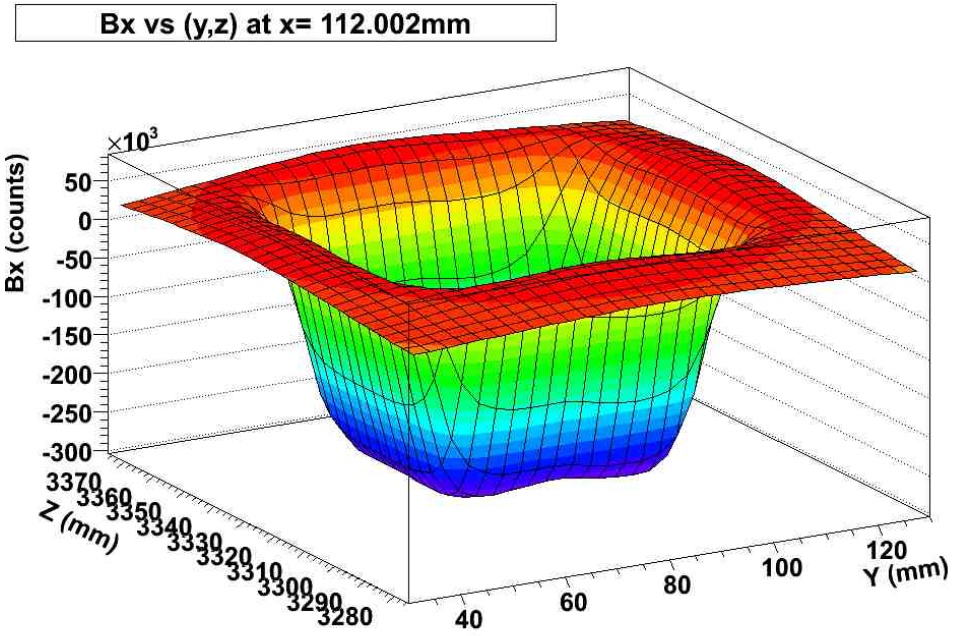
- On November 26th data was taken with a test magnet using the Senis probe





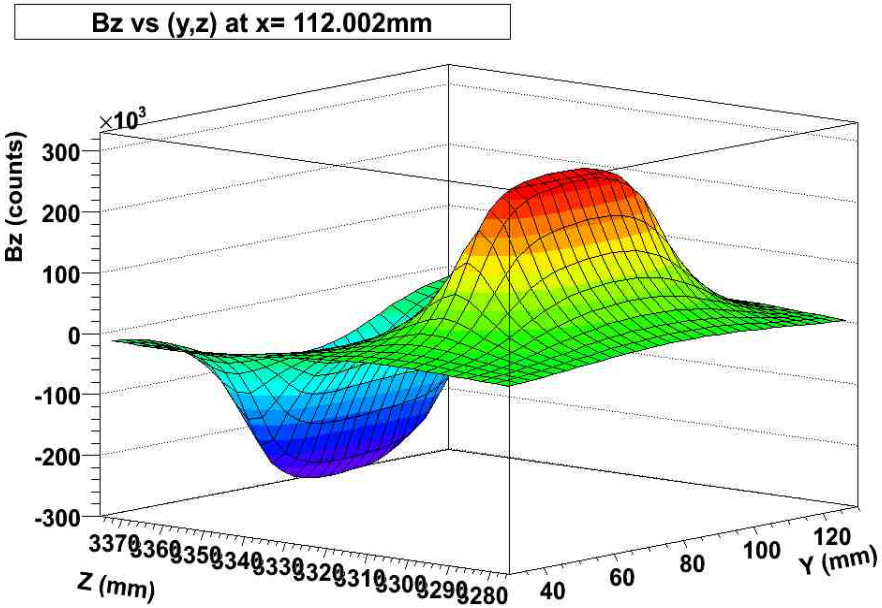
- Purpose was to verify the software could accurately read data and produce results

Test Magnet 2D Plots

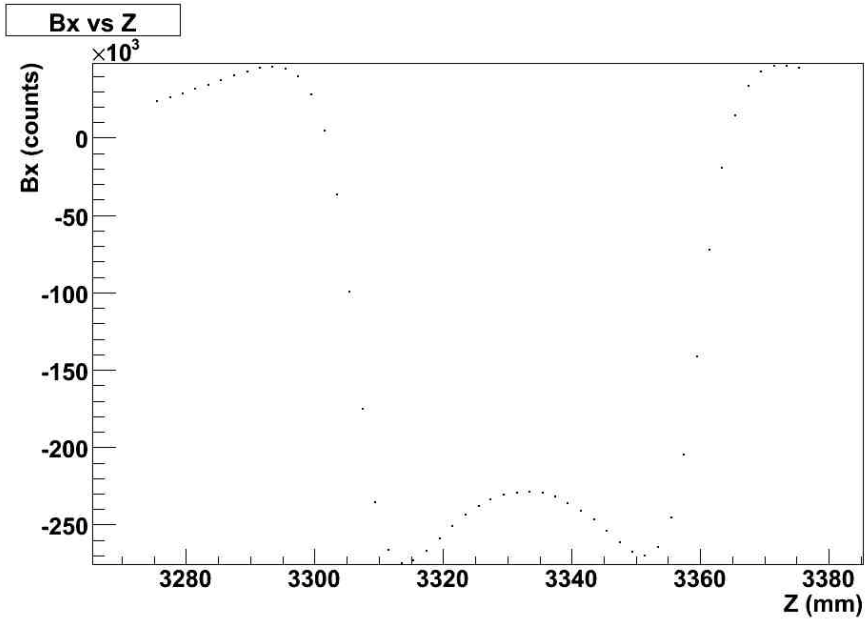


- 208 counts/gauss
- ≈ 0.144 T field
- Consistent with expectations

- Any component can be plotted dependent on any two axes

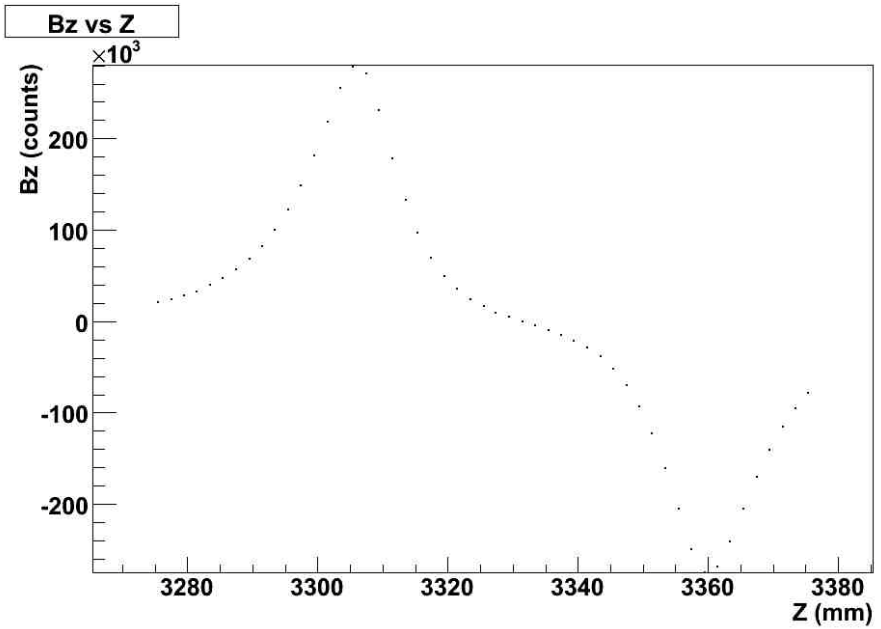


Test Magnet 1D Plots



- Plots from middle of magnet

- Slices of 2D plots
- Specify any two coordinates to plot third



Maxwell Checks

- Software determines divergence and curl to check that they are consistent with zero
- Currently in the process of analyzing
  - Debugging
  - Checking if results make sense
  - Specifying tolerances
  - Identifying trouble areas

Future Plans / Schedule

- Fully implement Maxwell checks
- Debug current features
- Create documentation for software

- MIPP's (Main Injector Particle Production experiment) Jolly Green Giant (a dipole magnet) scheduled to be mapped early-mid February
- MICE's solenoid will be mapped after (early March)