COBRA Magnet

W. Ootani

MEG Review Meeting, Jul. 19th, 2005

Outline

- Field Measurement
- Field Monitor
- Fringe Field Problem
- Area Related

Field Measurement

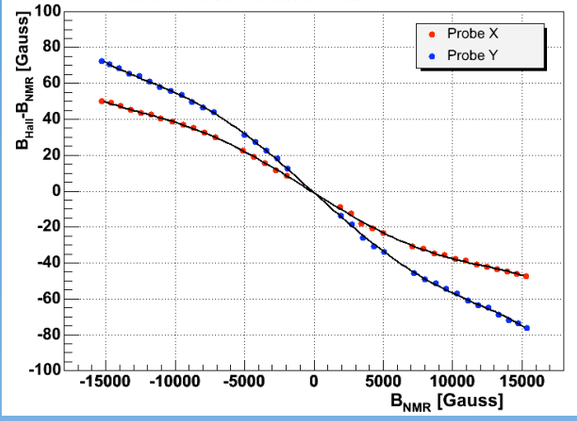
Field Measurement

- Problem in Z-motion of the mapping machine solved.
  - Positioning accuracy for Z-motion < 0.8mm
- Test measurement of the COBRA field with the mapping machine was carried out at the end of March.
  - Several measurements for limited volume.
    - 3D scan around magnet center (6174 points)
    - 2D scan (R-Z) on half R-Z plane (3223 points)
    - 2D scan (R-ϕ) around magnet center (591 points)
  - Mapping machine and control software worked well.
  - Investigation of COBRA field monitor
    - NMR or Hall probe?

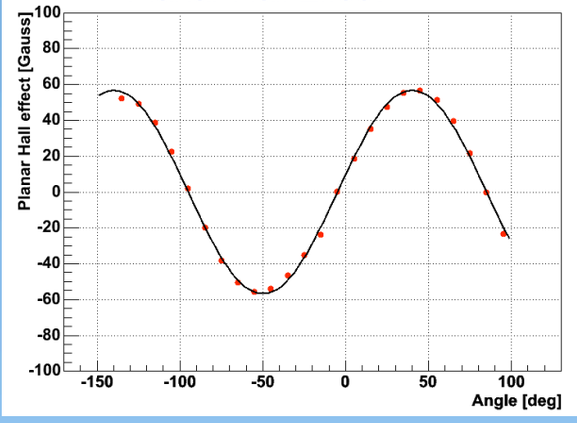
Analysis

- Analysis should include
  - Absolute calibration of the Hall probes
  - Planar Hall effect
  - Distance among the three probes (not included yet)
- Analysis is still going on.

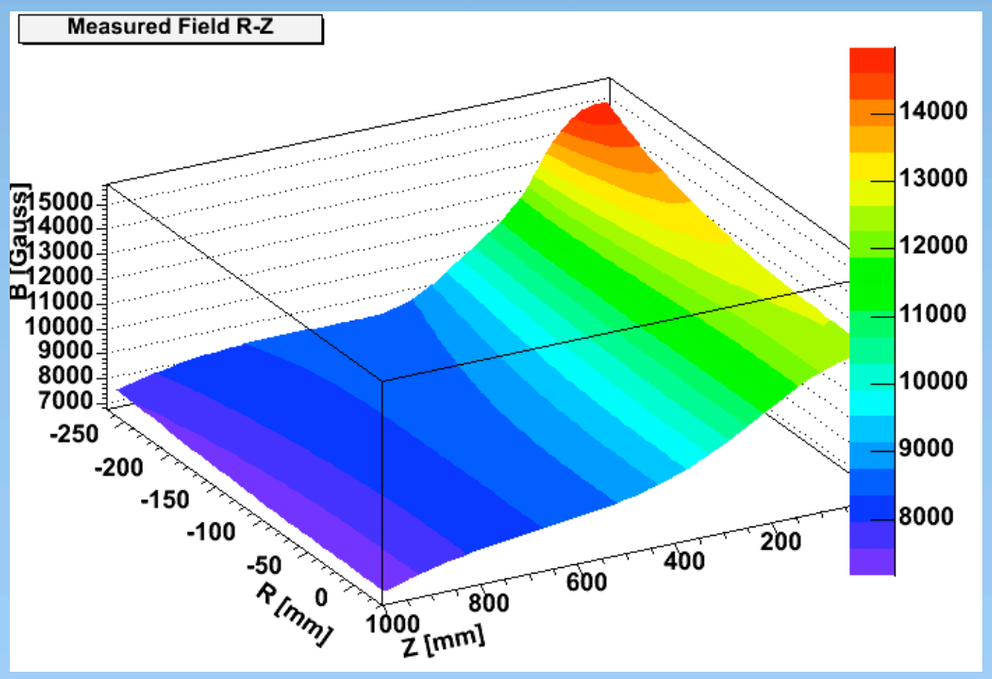
Absolute calibration



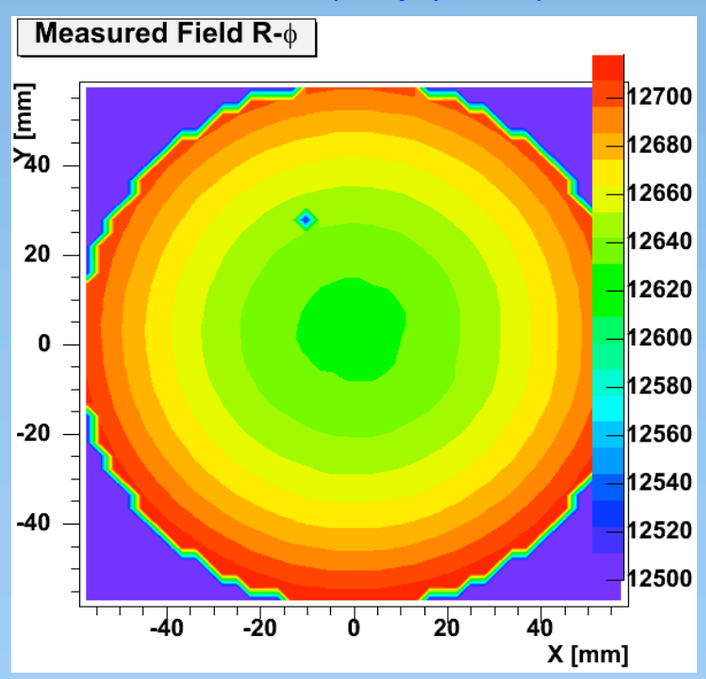
Planar Hall Effect



Measured Field (R-Z plane)



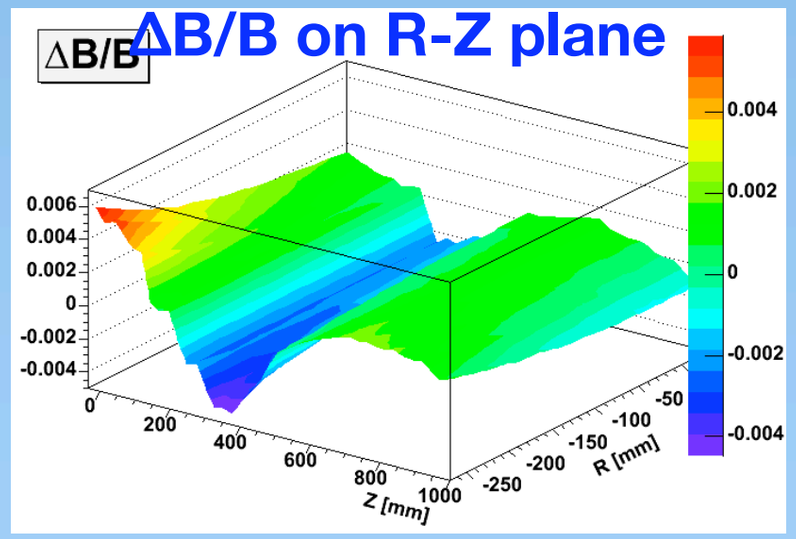
Measured Field (R-ϕ plane)

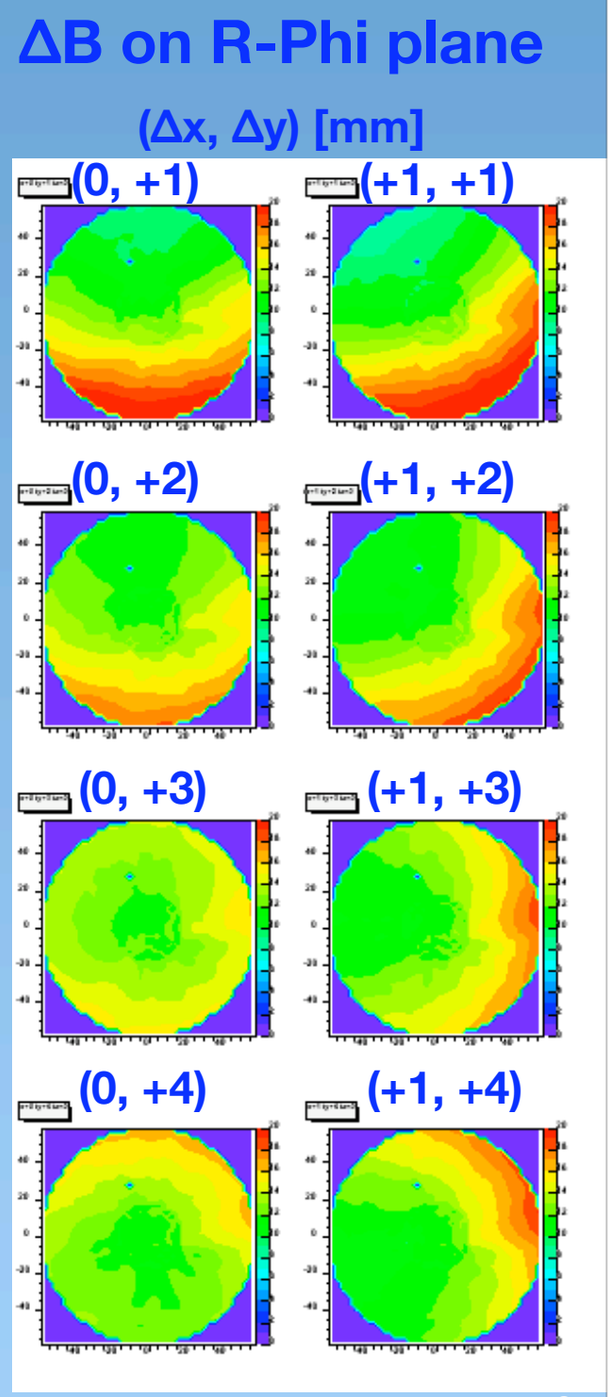


Comparison with Calculation

- Measured field is compared with calculated field.
  - Small discrepancy within ±0.5% is observed .
- Coil center position seems to be shifted relative to cryostat center.
  - Estimated shift (preliminary)

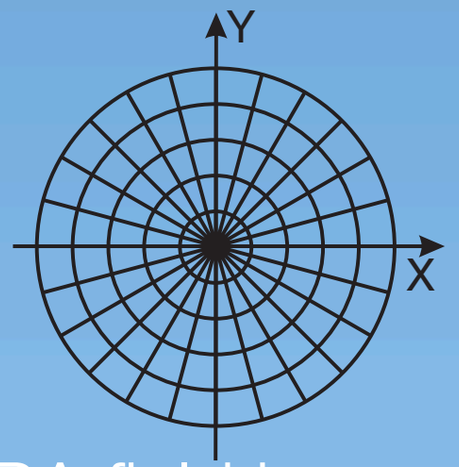
    x~0mm, y~+3mm (upward), z~-3mm (upstream)
- Larger shift than expected. why?
- Effect on the detector performance?
  - Quick MC study shows the effect looks negligible.





Mesh Size in Field Measurement

- It is easier to measure the field at the grid points in the cylindrical polar coordinate system (r, z, ϕ) because the motion of the mapping machine is cylindrical.
- Potential problem with the cylindrical grid.
  - Coarser mesh in ϕ-direction at larger radius
  - ΔL~5cm at R = 30cm if Δϕ~10 deg
  - It shouldn't be a big problem because the COBRA field is expected to be axi-symmetric

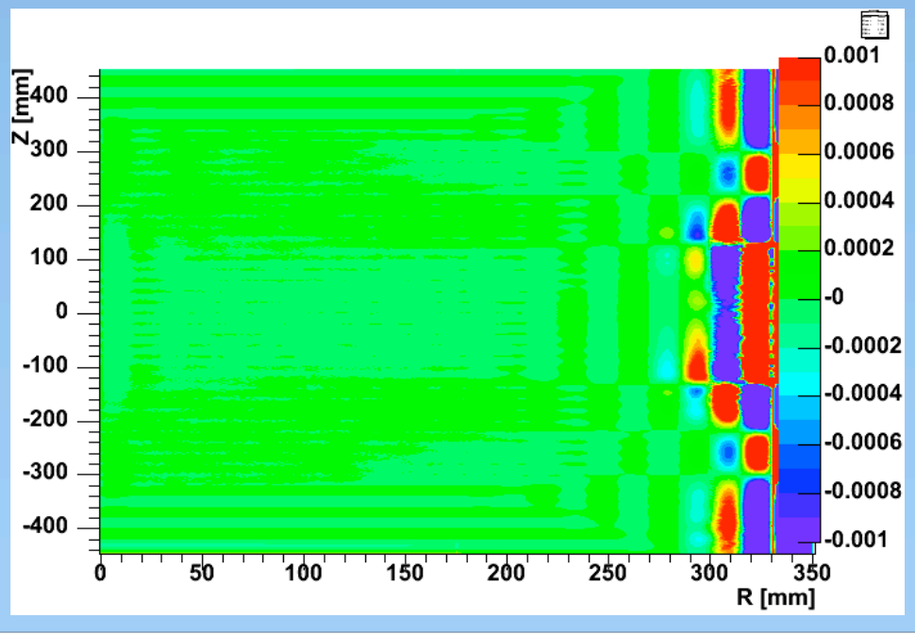


- What is the optimum mesh size in the final measurement?
  - Time slot for field measurement ~ 1 month
  - How to interpolate between measuring points?

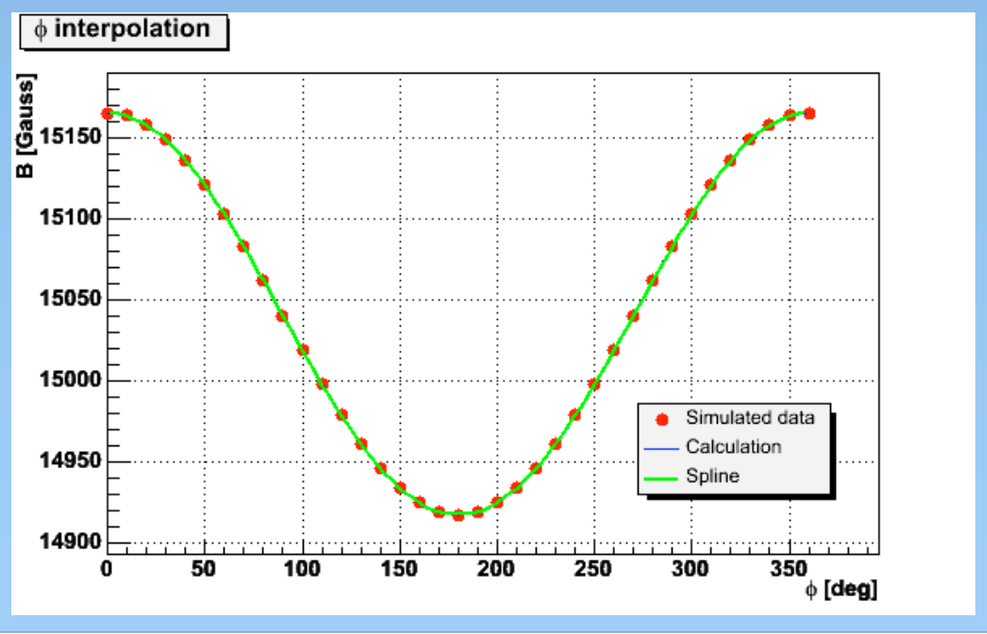
Mesh Size in Field Measurement

- Interpolation between measuring points were tested using calculated field map.
- Cubic spline interpolation
- Interpolation error is negligible for $\Delta Z<2$cm, $\Delta R<2$cm, $\Delta\phi<30$ deg
- How many days we need?
  - 10 to 20 full days with ΔZ=1-2cm, ΔR=1-2cm, $\Delta\phi$=10-20deg
  - One month in total including calibration and other preparation.

$\Delta B/B$ in the simulated interpolation on R-Z plane assuming ΔZ=2cm, ΔR=1.5cm

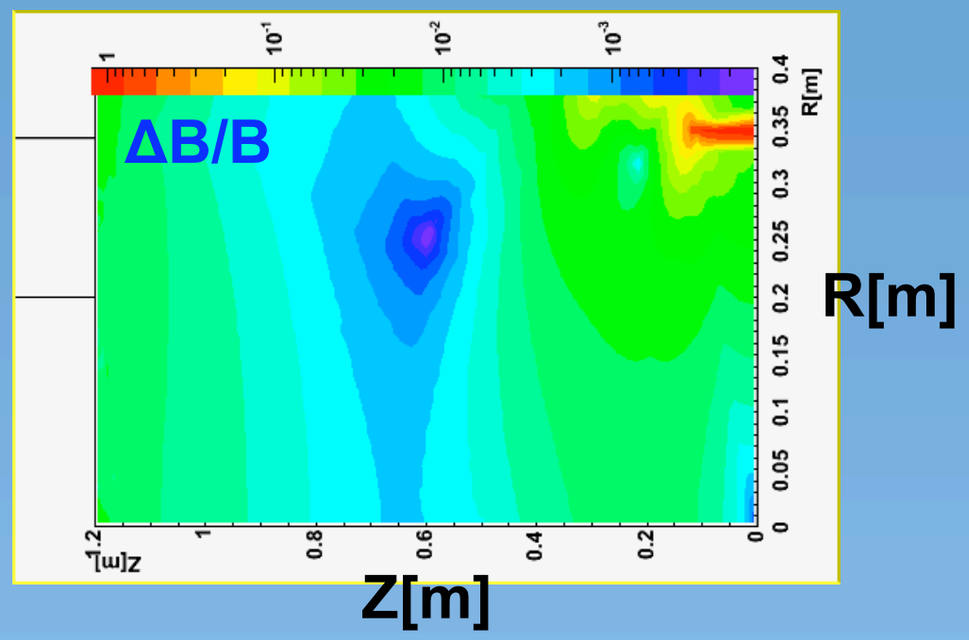


Simulated interpolation in ϕ-direction assuming 5mm shift of mapping machine center and $\Delta\phi$=10deg



How to Monitor COBRA Field?

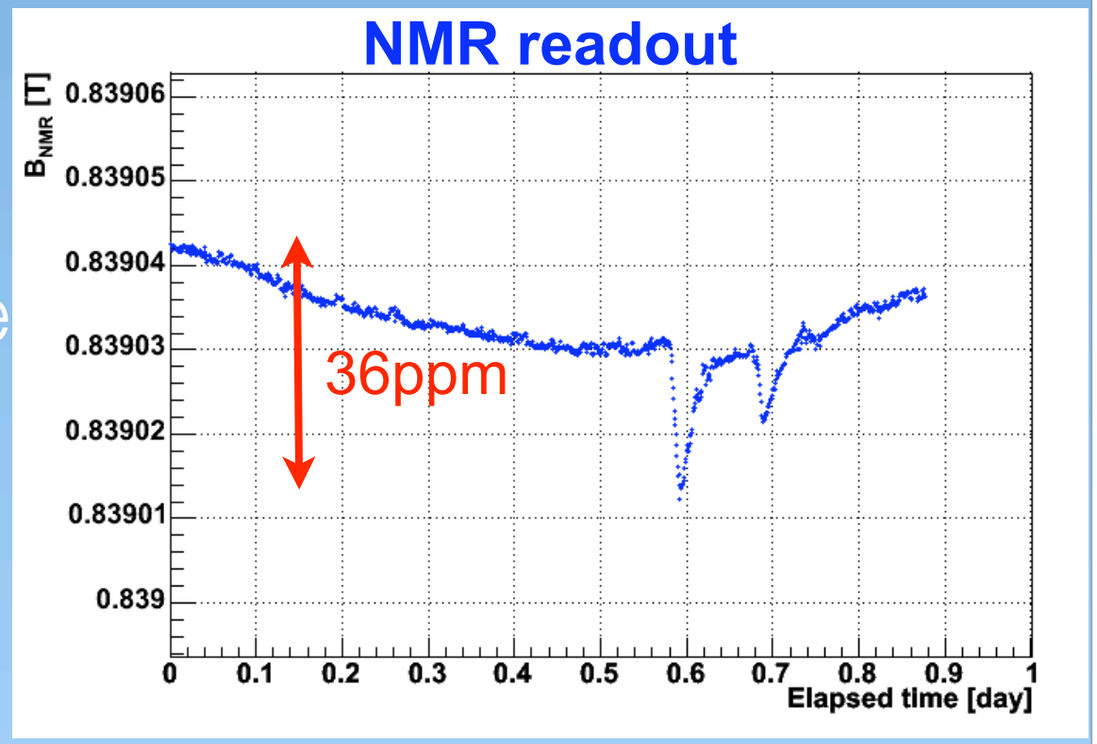
- How to monitor COBRA field stability
  - Current monitoring
  - Field monitoring
    - NMR
    - Hall probe
- NMR and Hall probe were tested.



NMR

- Only one possible location for NMR inside COBRA.
- NMR was not locked anywhere else actually. (both inside and outside)
- Daily calibration?

- It was found that COBRA field is pretty stable.

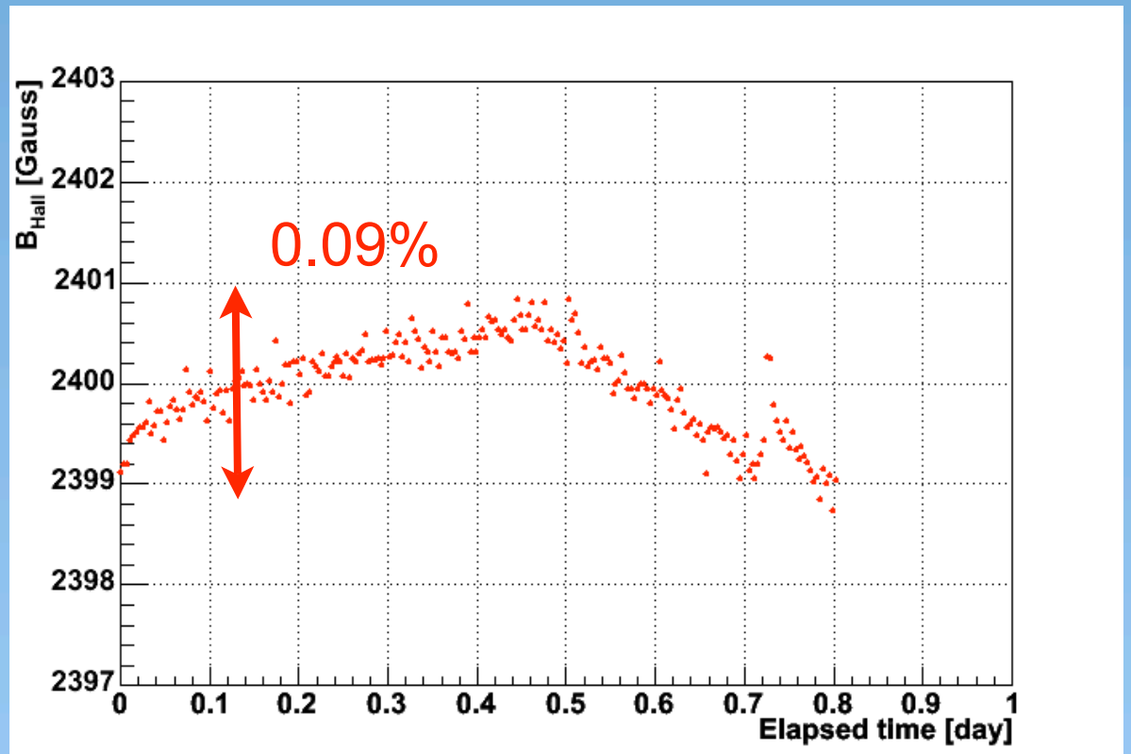


How to Monitor COBRA Field?

Hall probe

- Temperature coefficient
- Need careful calibration

- Stability was measured at the end of the COBRA cryostat.
  - Stability ~0.09% for one day
  - Not so bad
  - This might be improved because of the temperature stabilization inside the detector hut.



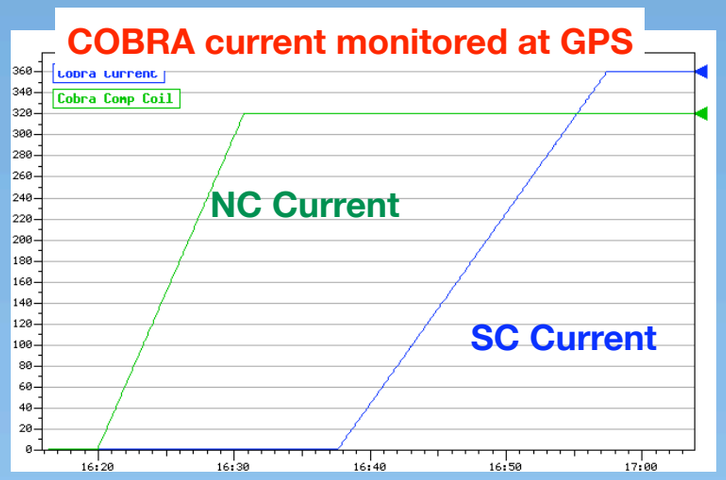
Fringe Field Problem

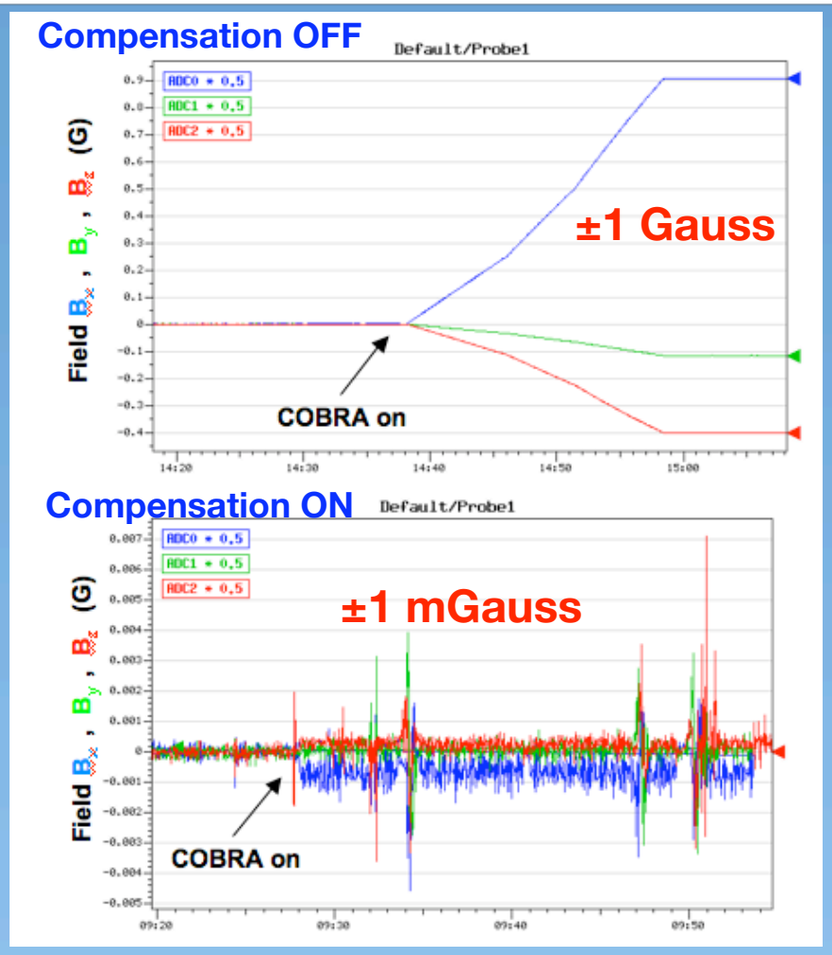
Fringe Field Problem

- First success of the excitation of the COBRA magnet with the accelerator ON!! (Jul. 20th and 21st).
  - There seemed no influence on neighboring beam channels and primary beam line. (Nobody complained at least.)

- Fringe field problems are already solved except for πE3.
- Effect on the detector in πE3 was measured in Jun.
  - The fringe field (~4G) is close to the upper limit of the requirement.
  - Simple shielding is sufficient.
    - Iron plates on one side wall and floor
- How to cope with the other experiments in the πE5?

COBRA Status Broadcast



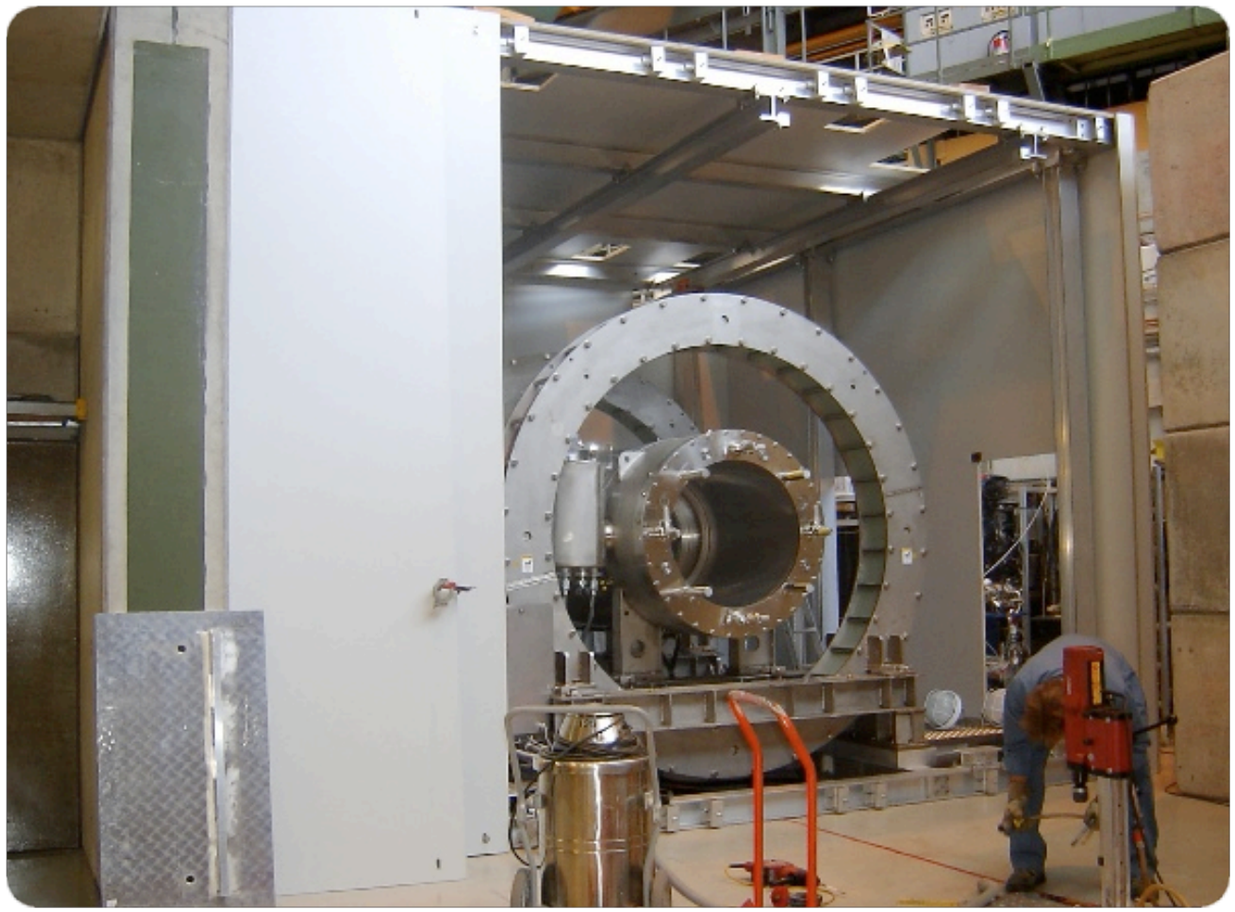


Pictures courtesy of H.Luetkens of μSR group

- The COBRA magnet status is now broadcasted over the network to the neighbors.
  - MSCB module developed by S. Ritt and R. Schmidt.
- The active compensation system of the GPS in πM3 already succeed to use the status info. (thanks to H.Luetkens of μSR group)

Area Related

Detector Platform and Hut



- Detector platform and hut were installed.
- Things to be done
  - Cabling
  - Lamp inside hut
  - Air conditioning
  - Oxygen monitor
  - Monitoring camera

Another Platform

- The second platform was installed at the end of the zone.
- Magnet controller, cooling water system, compressors and air conditioning system for the detector hut will be placed.
- Made of steel
  - The effect on the COBRA field is negligibly small.