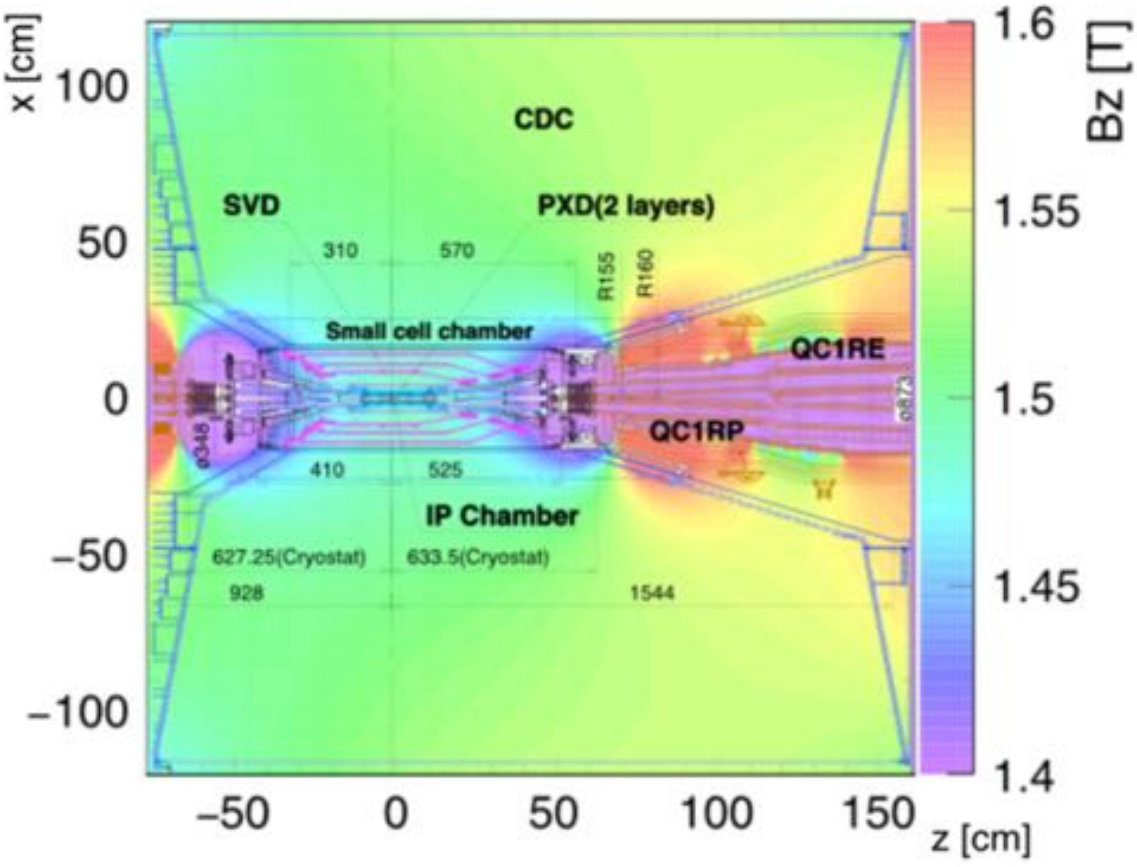
Magnetic field measurement for BelleII

- How does B-field affect physics analysis?
- Momentum measurement
- Trajectory extrapolation
- Particle identification

- Accuracy requirement:
- <0.1%

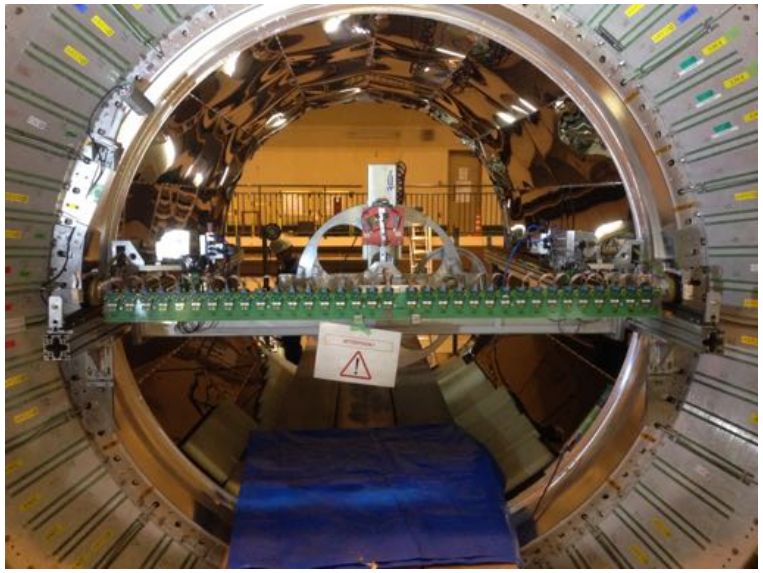
- Method
- 3D Hall probe

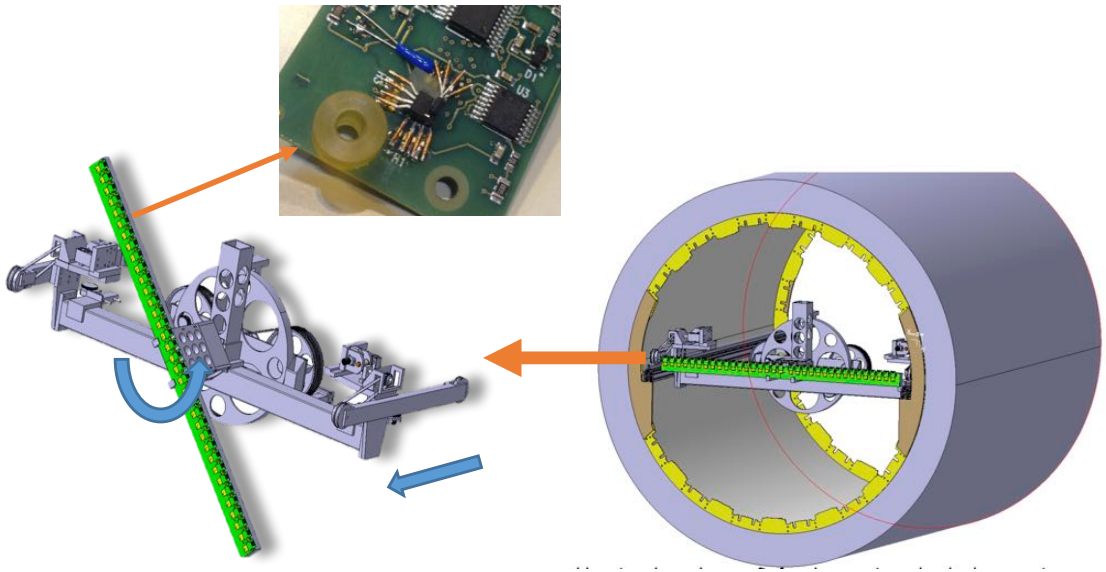
- Procedure
- CDC volume without QCS
- VXD volume with QCS

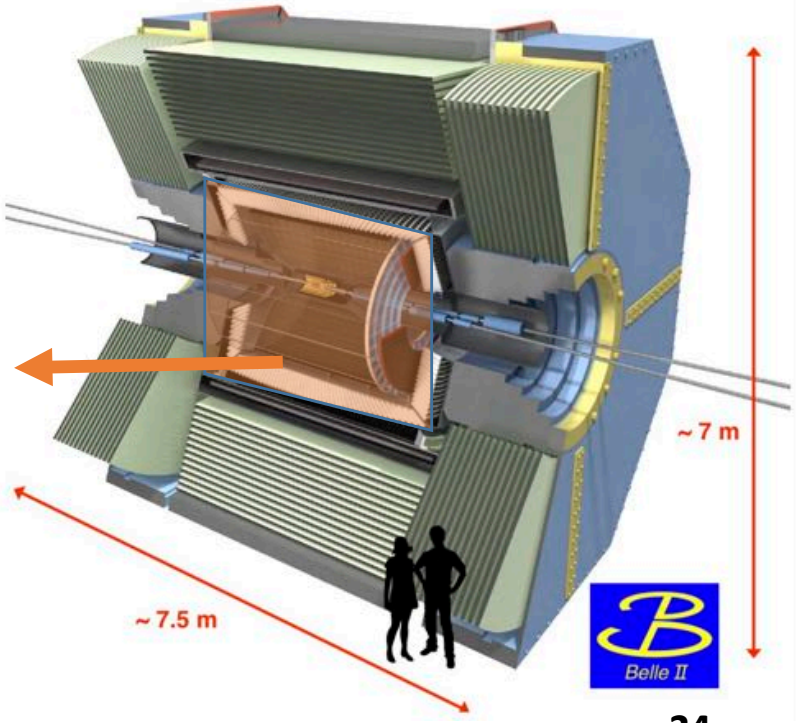


The 1st campaign

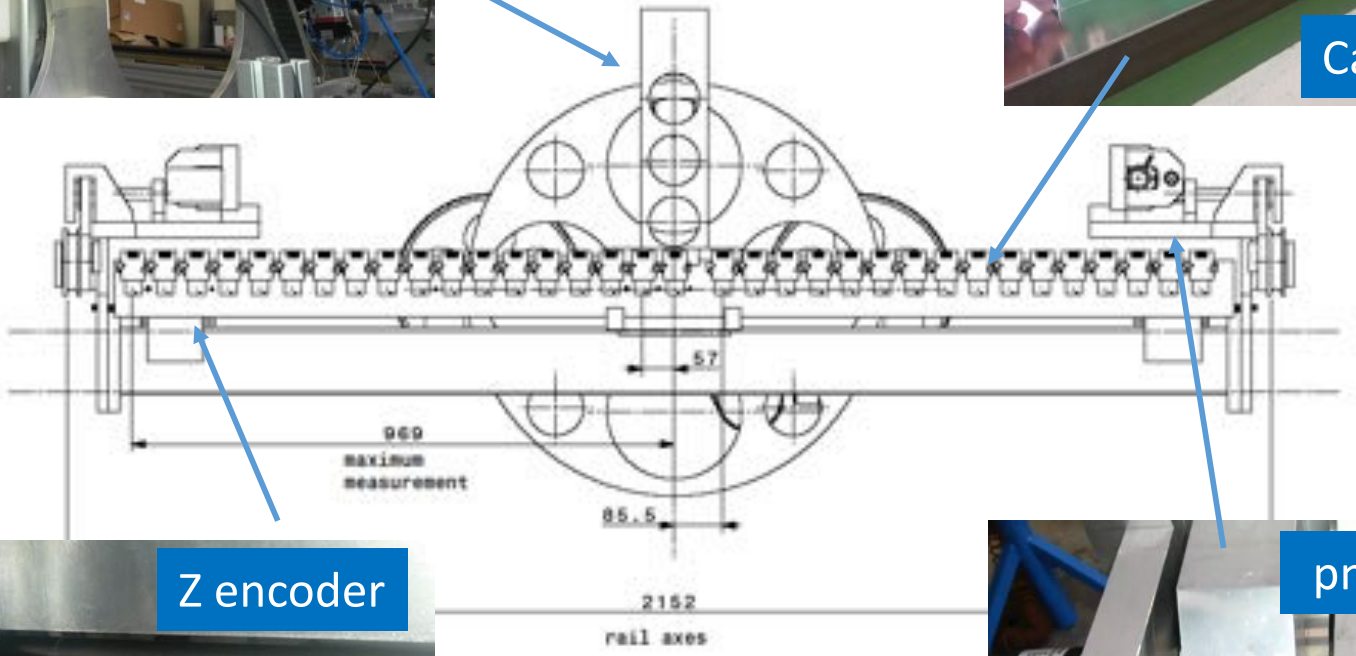
- Mapper is provided by CERN and made of nonmagnetic materials and driven by pneumatic engines.
- B field of 1.5T produced by solenoid only.
- B_z B_r B_ϕ were measured simultaneously by 3D Hall probe.
- Requested accuracy <0.1%.
- 1.4M points were measured totally.

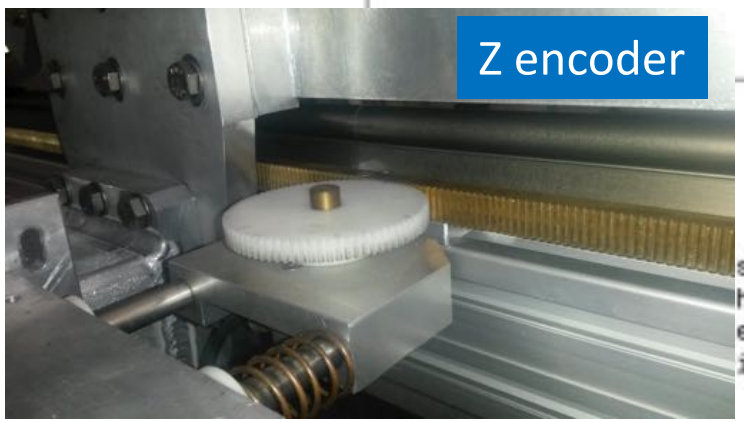


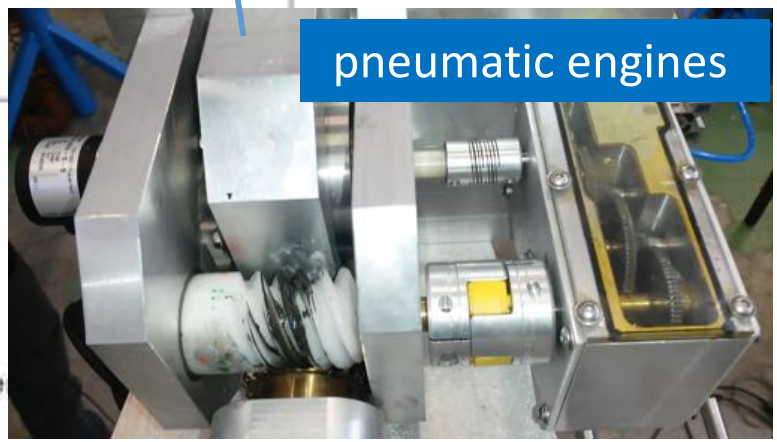




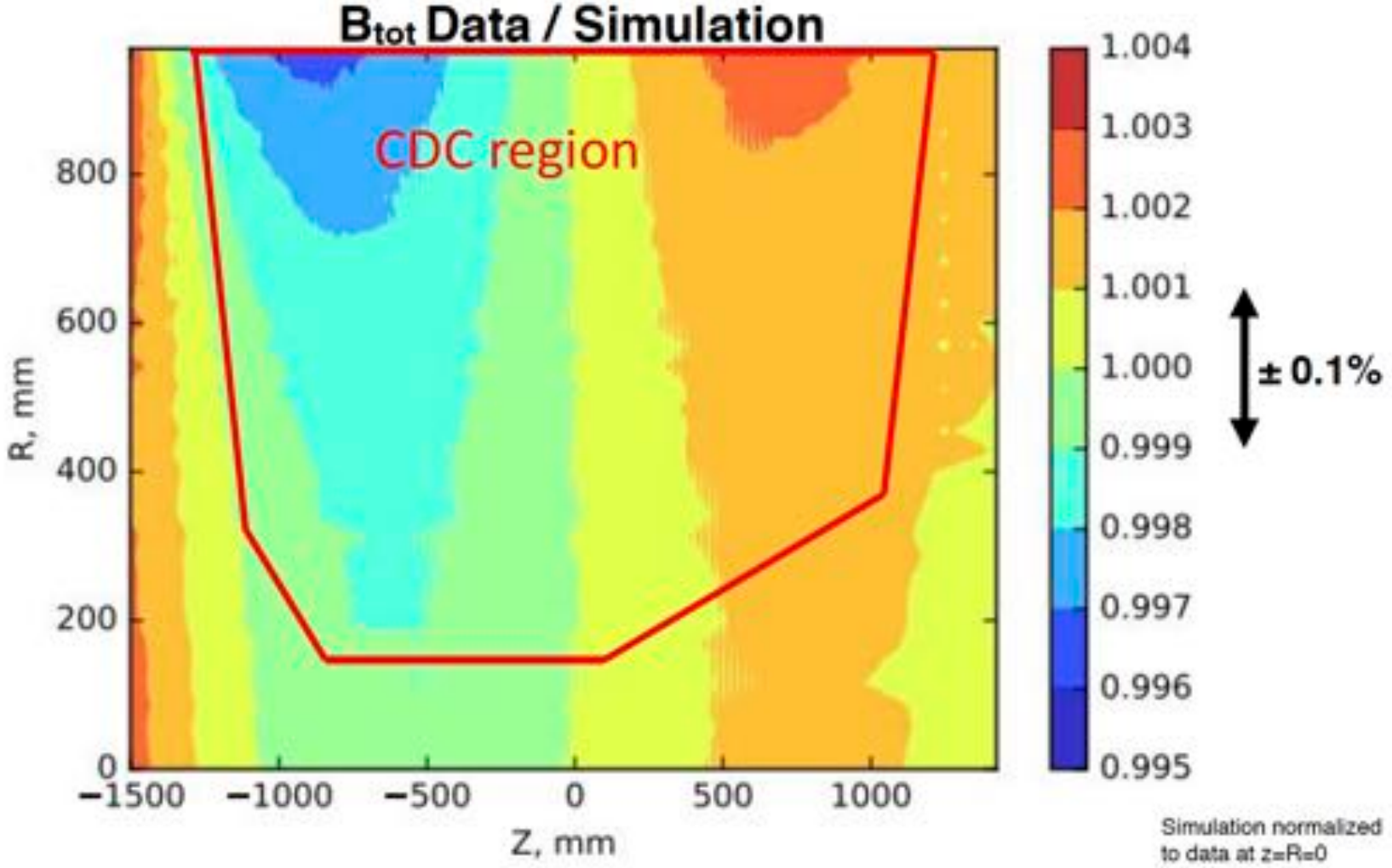
Mapping machine for CDC volume







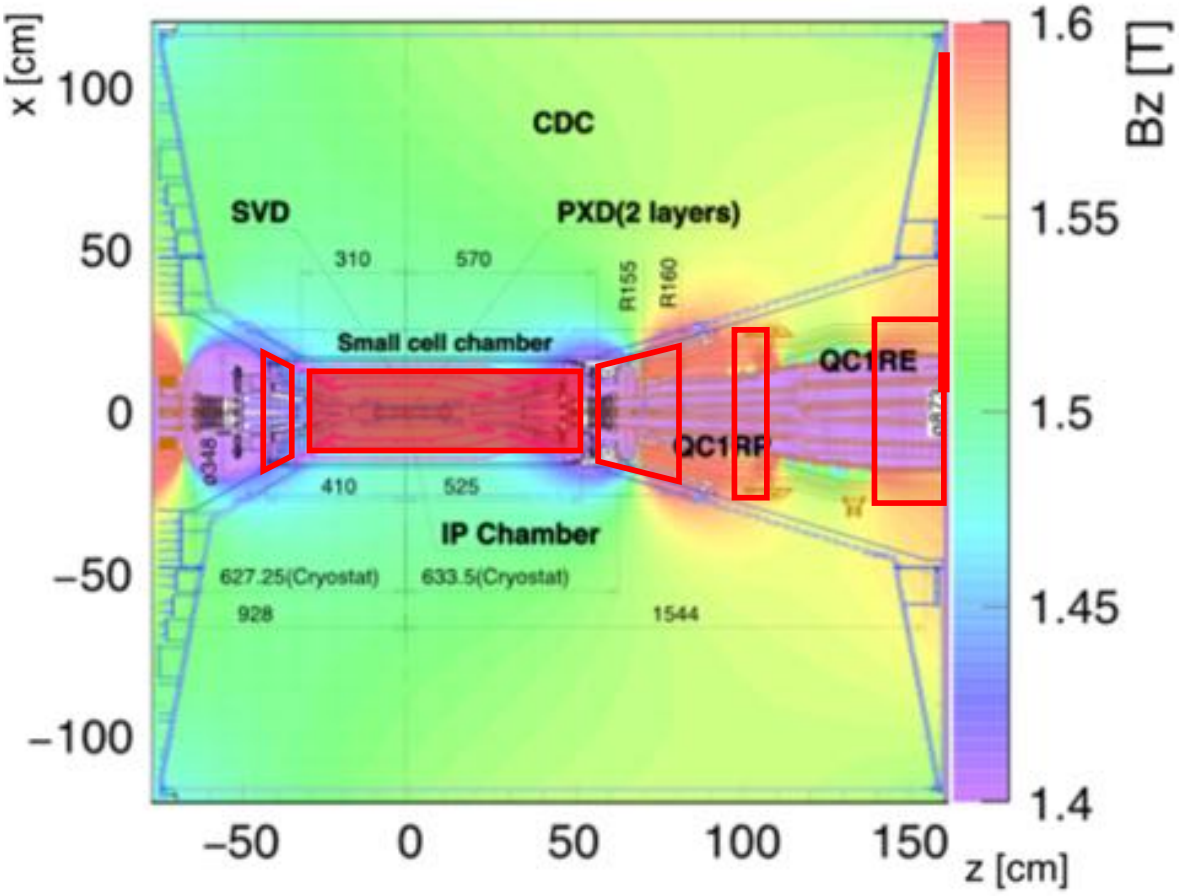
Comparison between meas. & simul.



- $|\Delta B|/B > 0.1\%$ in large part of the CDC volume
- Map can be used as input for parameter tuning of Opera model (KEK magnet group)

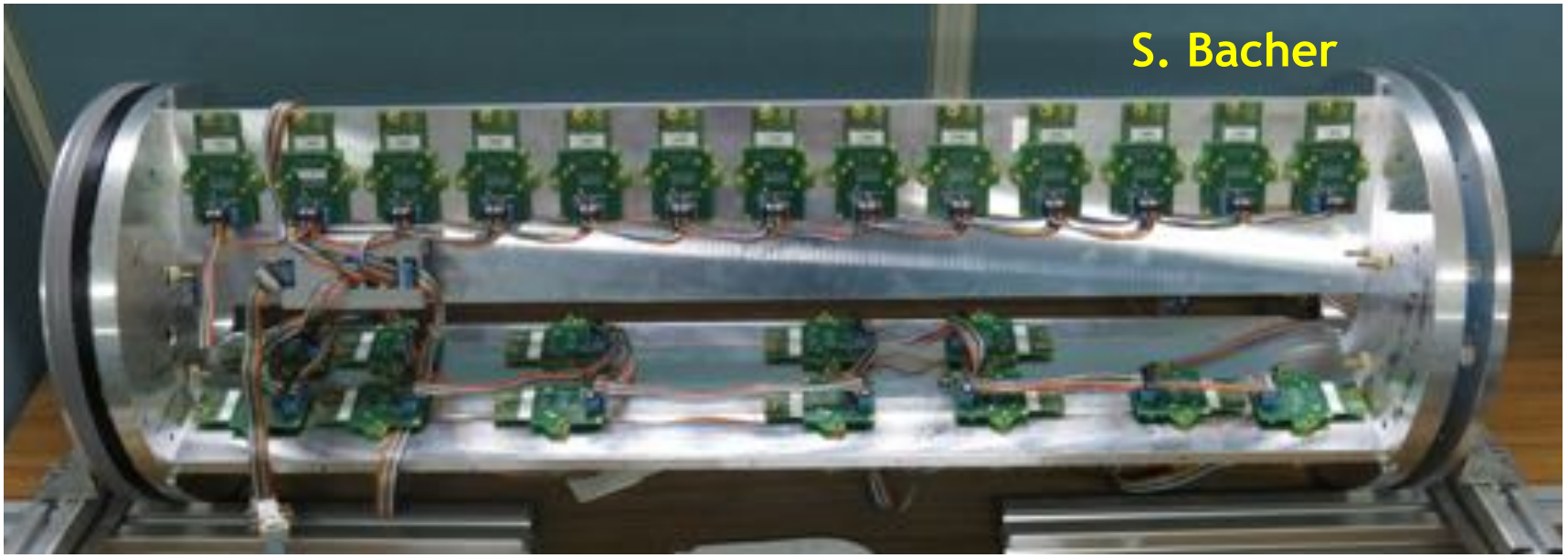
The 2nd B field measurement

Goal of 2nd campaign:
Study effect of **QCS stray fields**

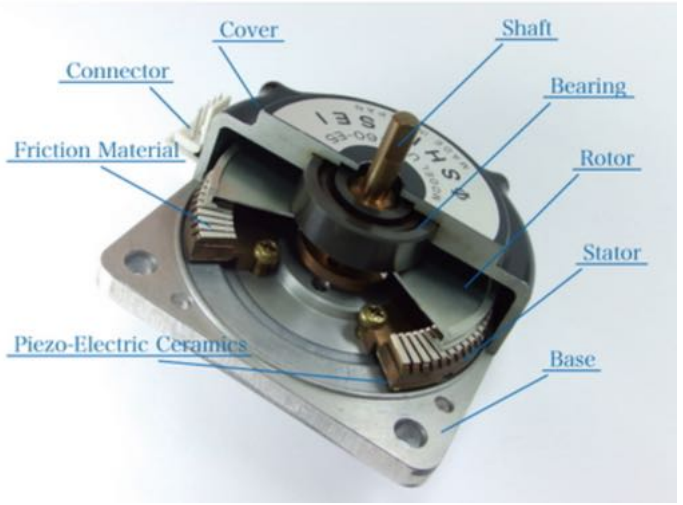


- New mapper was developed for VXD volume (S.Bacher)
  - equip with 44 Hall probes
- 54 Hall probes were mounted in the gap between VXD/CDC and QCSL/R
- 6 Hall probes were installed on the CDC end wall
- Mapping the B-field under different conditions:
  - Belle II Solenoid only
  - Belle II Solenoid + Compensating Solenoids
  - Belle II Solenoid + Compensating Solenoids + Quadrupoles

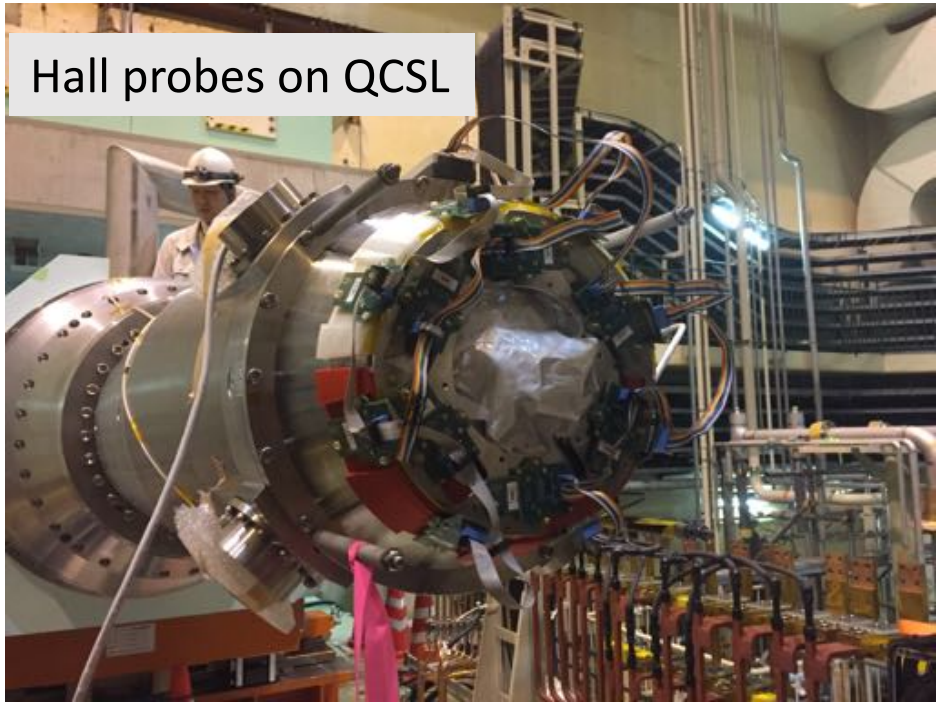
VXD mapper

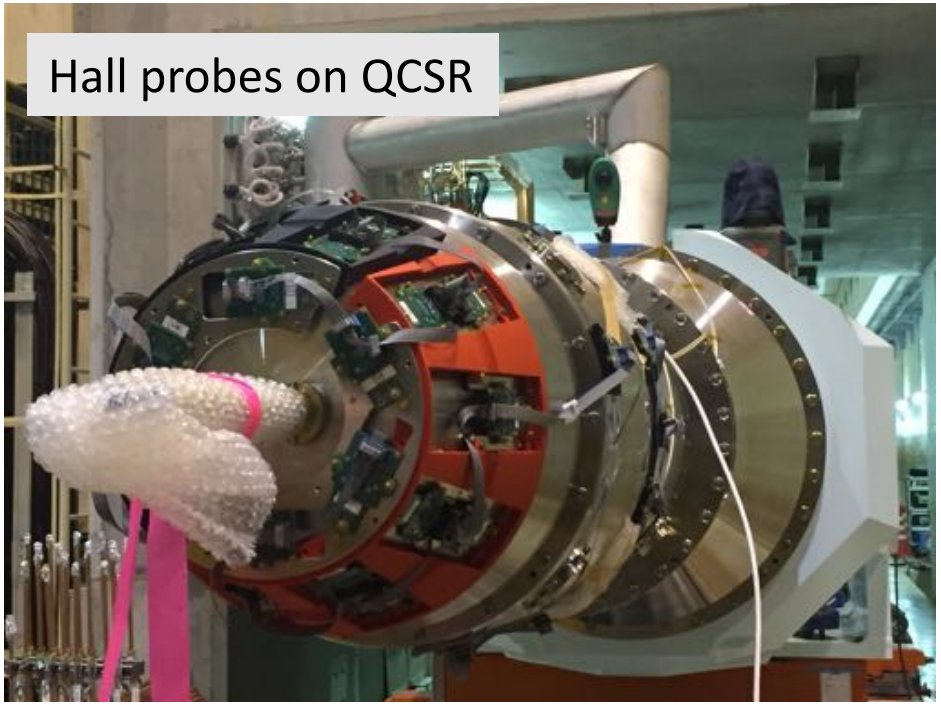


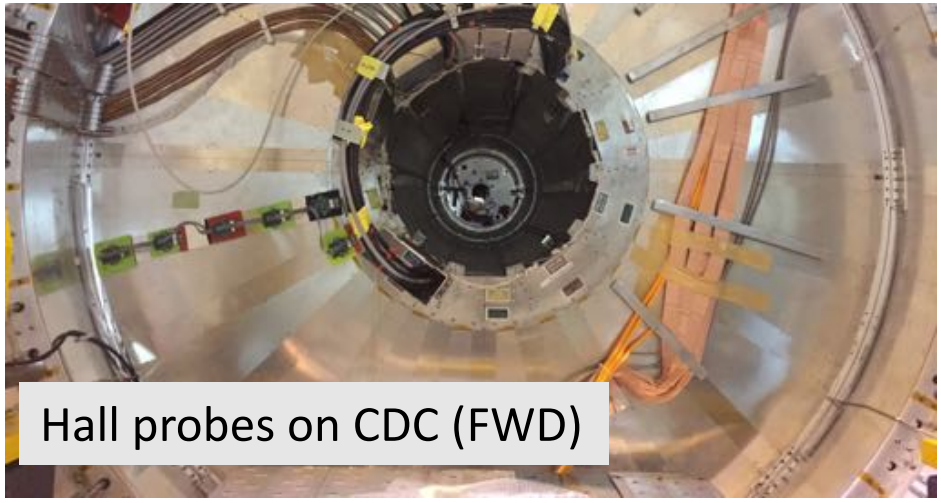
- Made of non-magnetic material
- Driven by Ultrasonic Motor that has large holding power without using gears
- Stable operation in strong magnetic field environment
- Use standard VXD installation rings

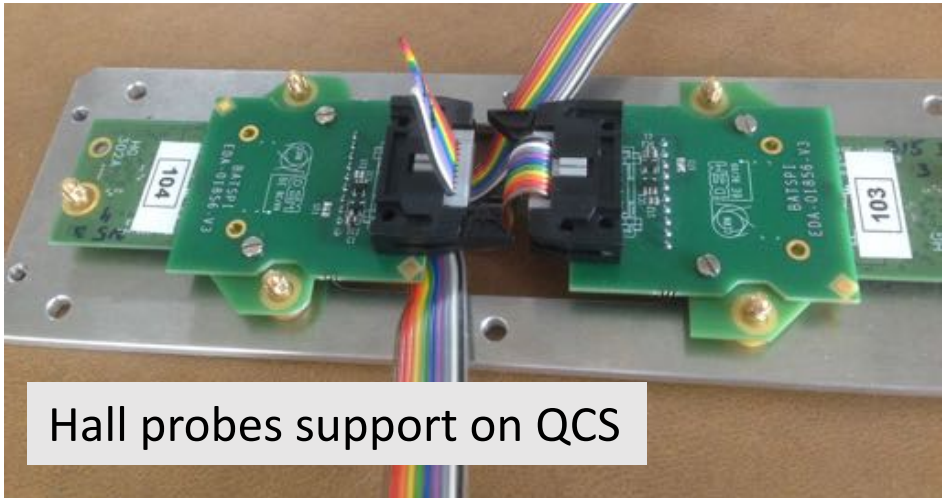


Sensors on QCS and CDC


Hall probes on QCSL


Hall probes on QCSR


Hall probes on CDC (FWD)

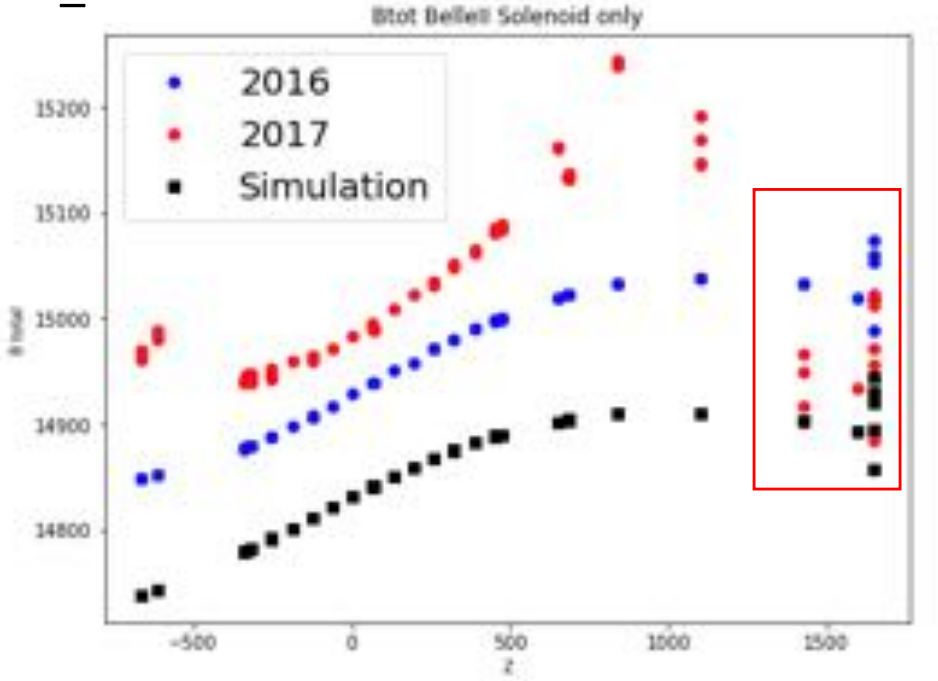


Hall probes support on QCS

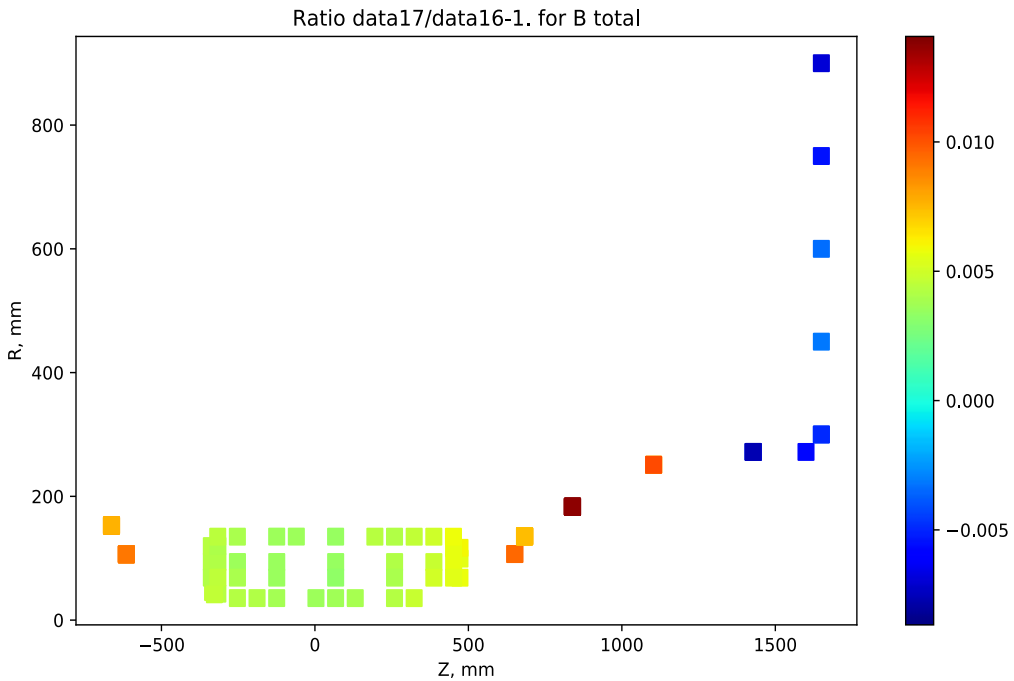
Comparing with 1st measurement

Belle II Solenoid only

B_tot



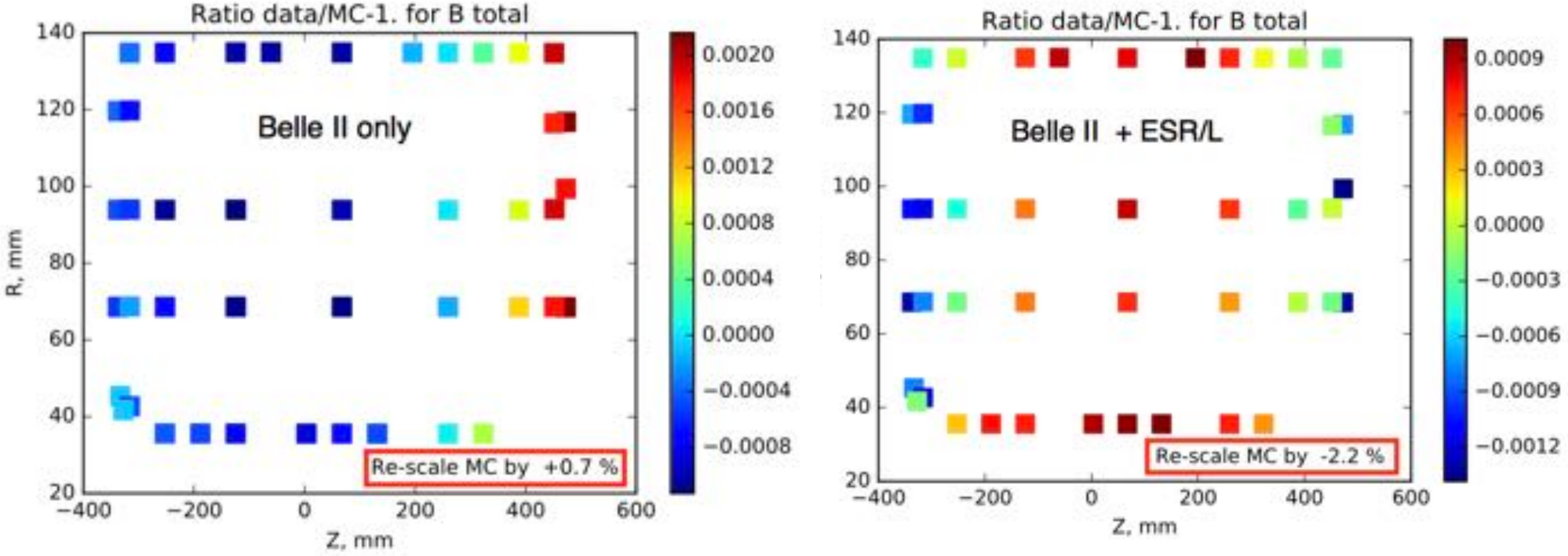
Ratio -1



- Absolute value and z-dependence somewhat different compared to 2016
  - B-field direction? (remember 2016 sign was flipped)
  - presence of magnetic materials in QCS cryostats?
- Needs further studies and discussions with QCS magnet group
  - they also see discrepancy between their measurement and calculation

Comparison of data/simulation

S. Glazov



- After applying appropriate scale factors (+0.7% / -2.2%) shape of B field in VXD volume is reasonably well described by simulation
- The discrepancy is increased in the area near to QCS, it is supposed to be due to the presence of magnetic materials in QCS cryostats
- Will try to include material effects in calculation