Nov. 8, 2018
TTC/ARIES Topical Workshop on Flux Trapping and Magnetic Shielding at CERN

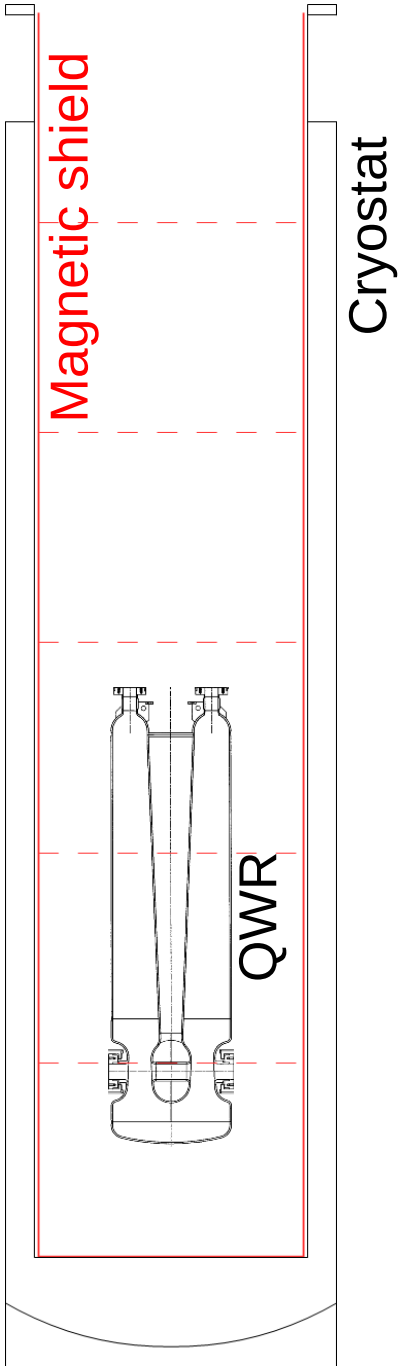
Flux expulsion measurements with QWR at RIKEN

(Magnetic field measurements accompanying VTs of QWR)

Kazutaka Ozeki
RIKEN Nishina Center

(Presented by K. Umemori, KEK)

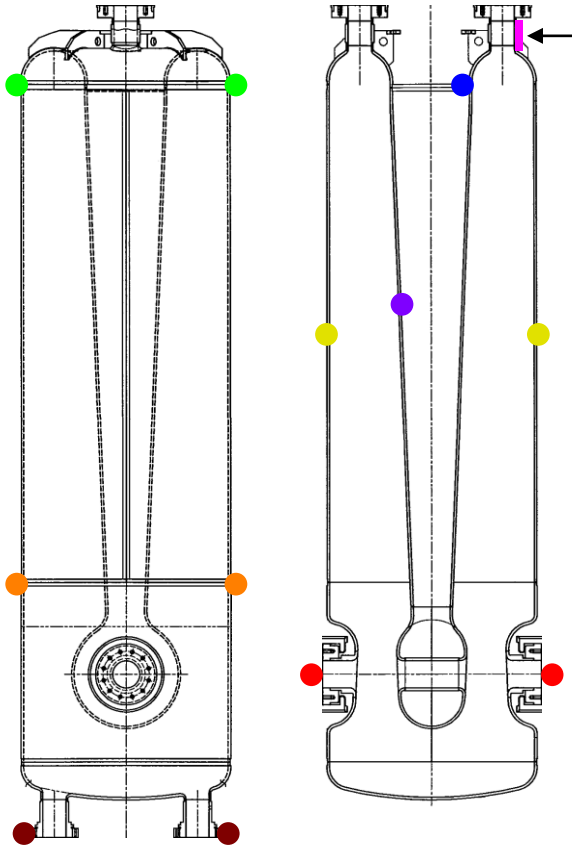
General setup for VTs at RIKEN



Magnetic shield (made by OHTAMA)

- Permalloy for RT is immersed in LHe (4 K)
- OD: 680 mm
- Thickness: 3 mm^{t}
- Height: 3200 mm
- Six cylinders are assembled using halved circular bands

Magnetic field at the top of QWR is also measured

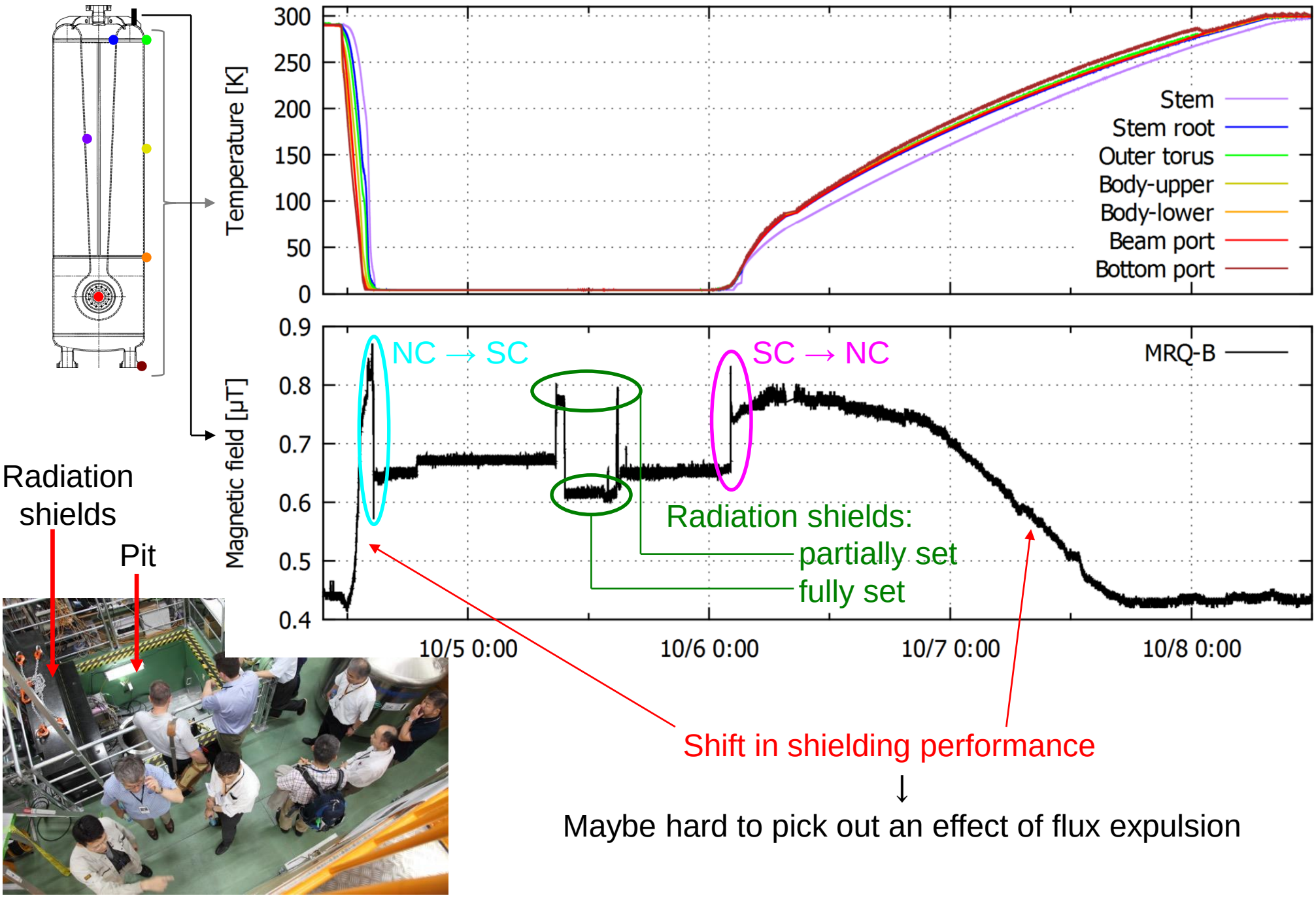


One Fluxgate at top port in vertical direction

●…Thermosensors

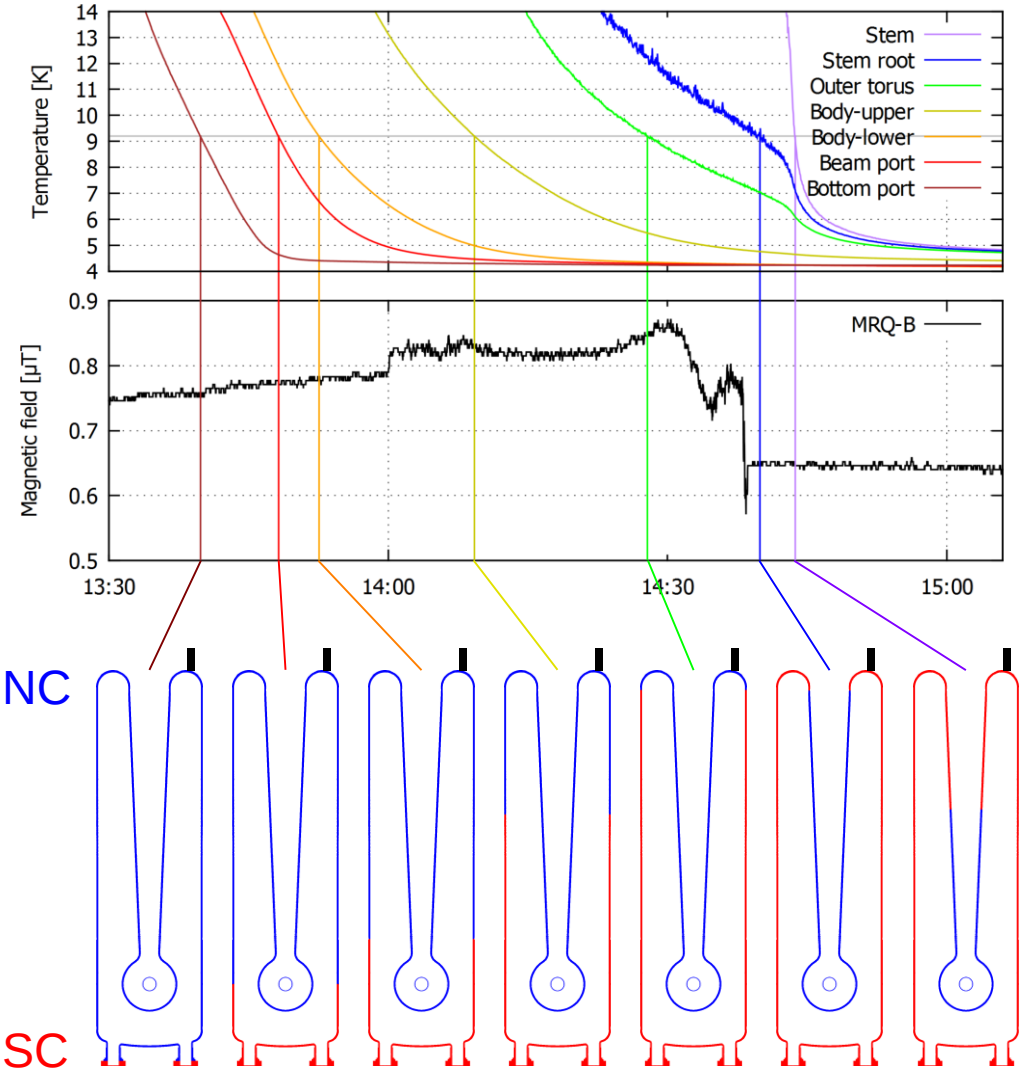
Stem
Stem root
Outer torus
Body-upper
Body-lower
Beam port
Bottom port

An example of field strength record (1)

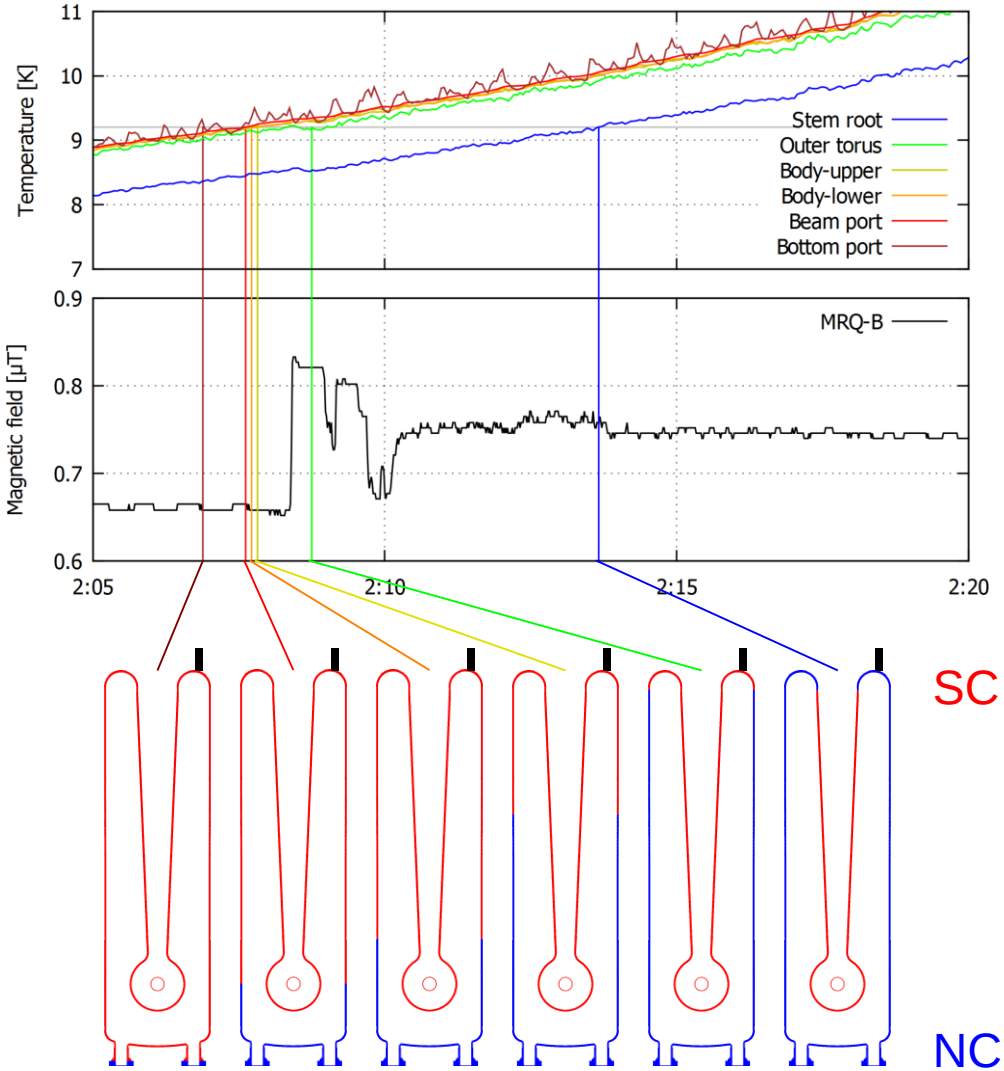


An example of field strength record (2)

NC → SC



SC → NC



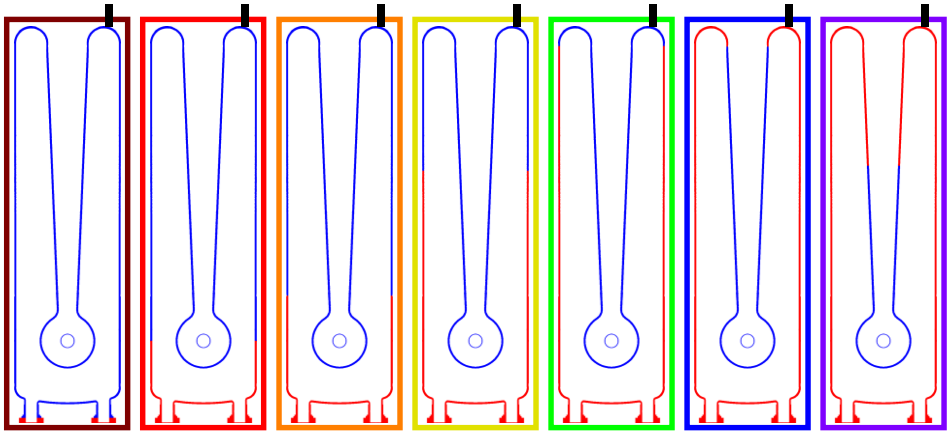
Figuration of peak and Jump down
when top area shifts from NC to SC

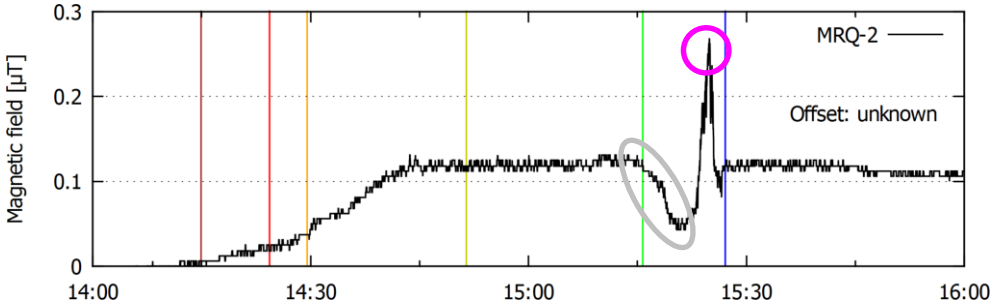
<u>Field strength was decreased after shifting to SC.</u>

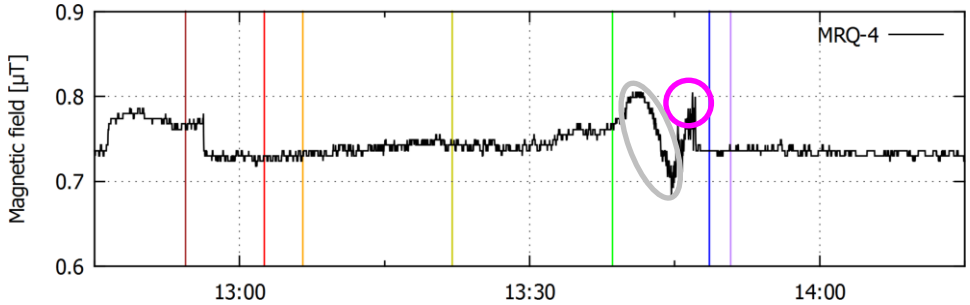
Jump up (and down?)
when top area shifts from SC to NC

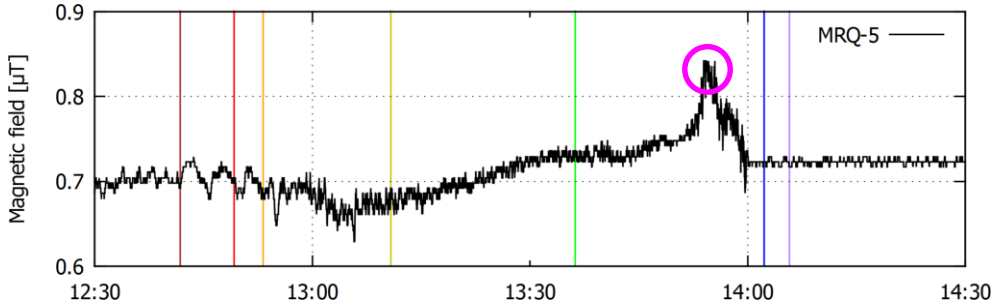
Small jumps…may be influenced by top port?

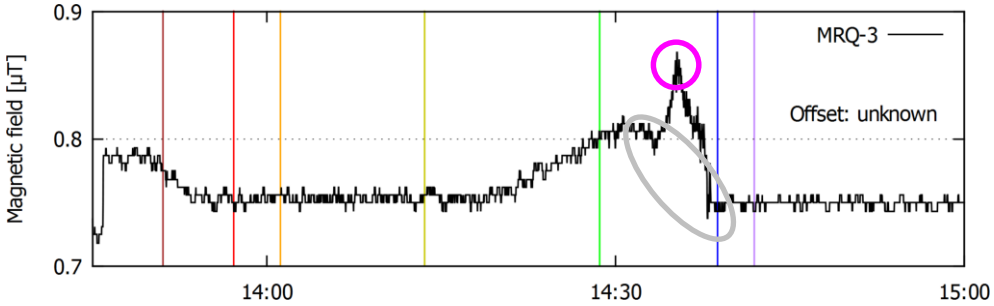
Other examples of field strength (NC→SC)

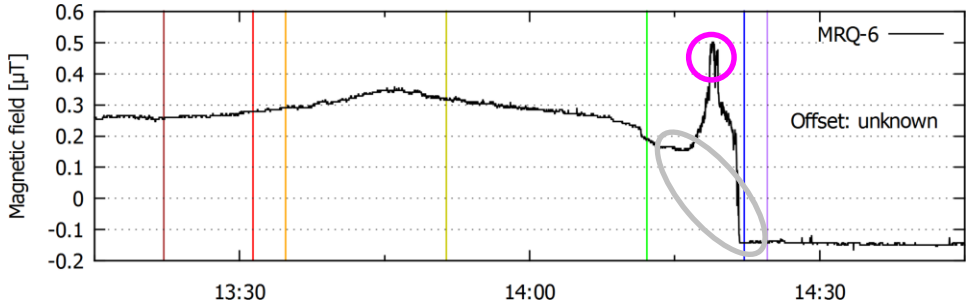










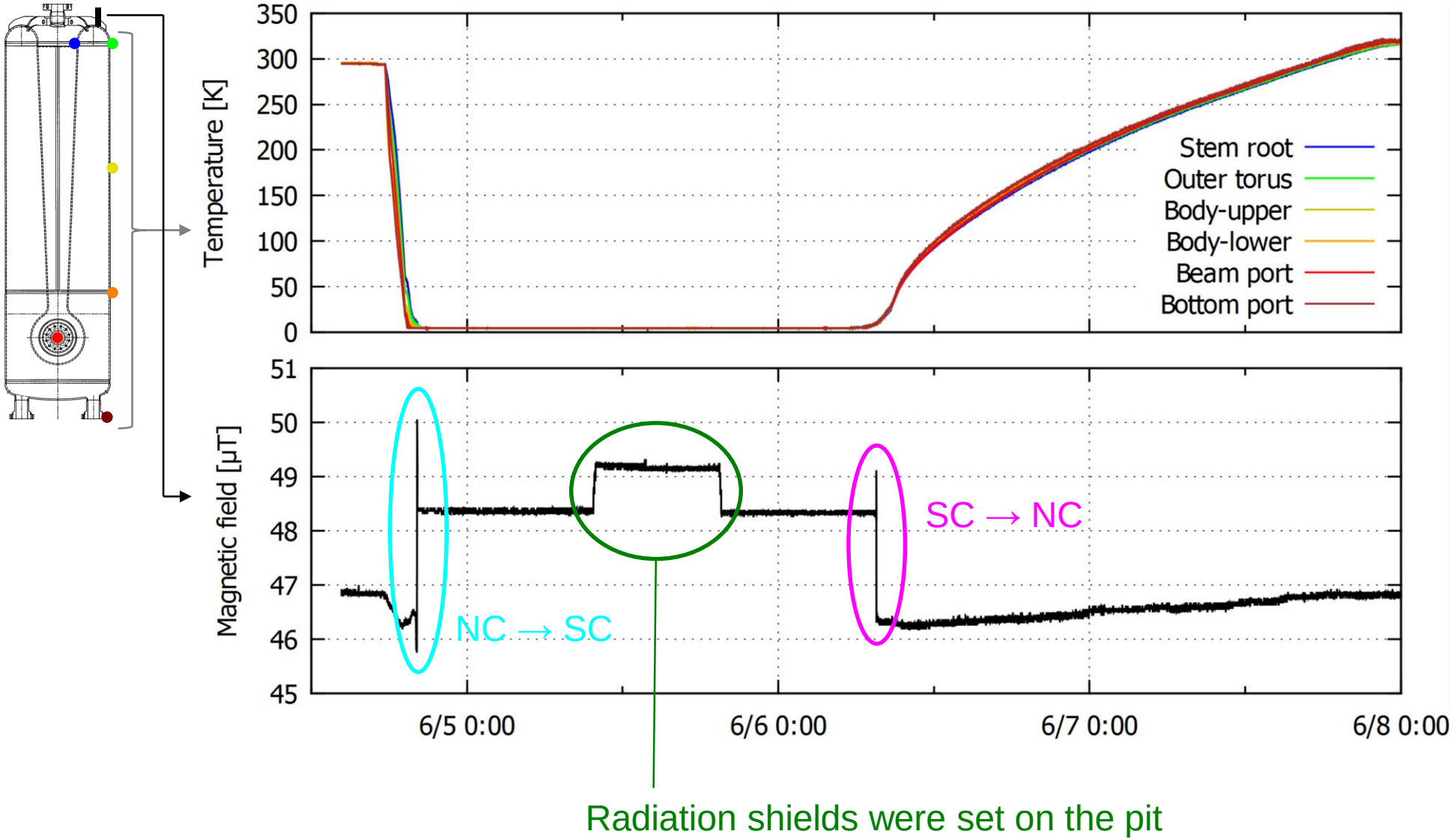


Seems to have less reproducibility ?

Tendency:

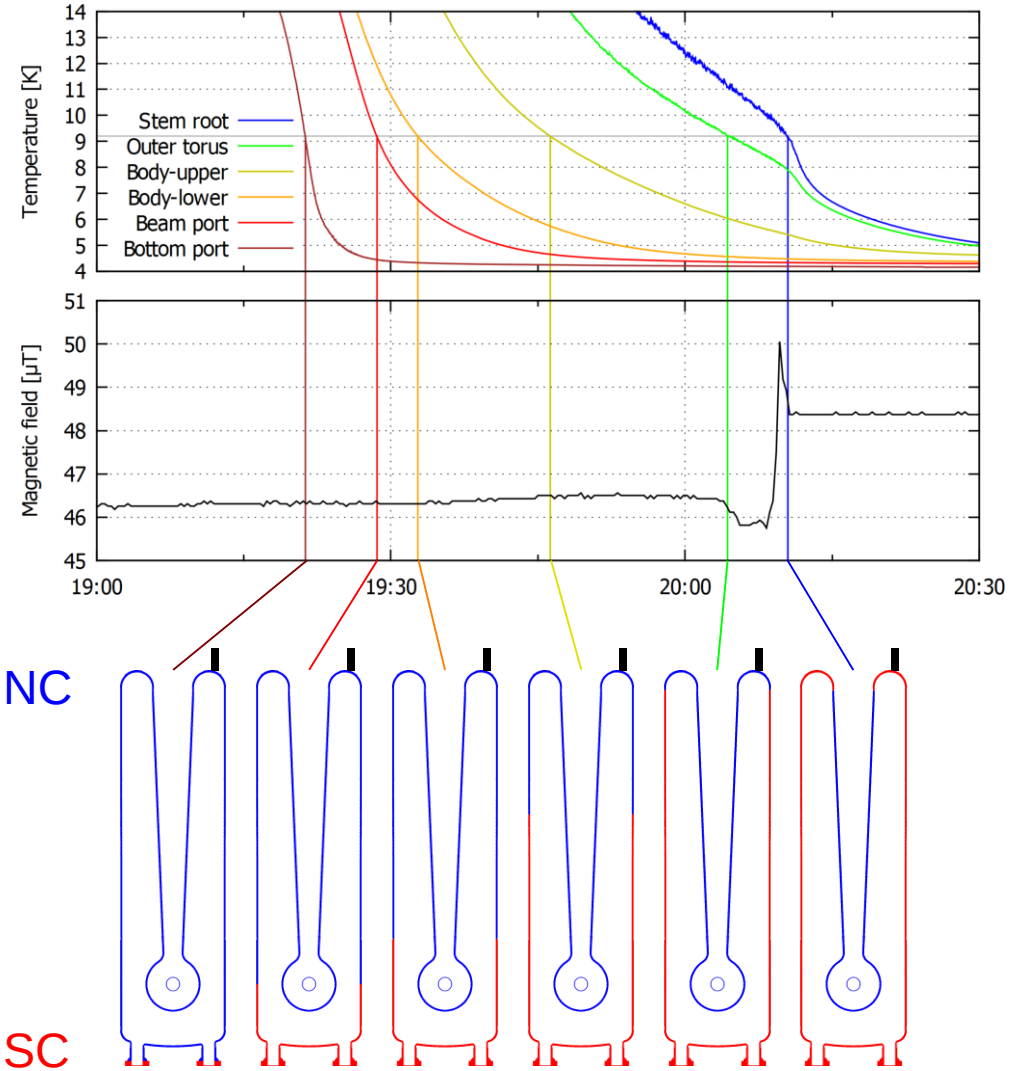
- Moderate decrease and sharp peak when top area shifts from NC to SC. (□→□)
- Field strength was decreased or kept same level after shifting to SC.

Field strength record without magnetic shield (1)

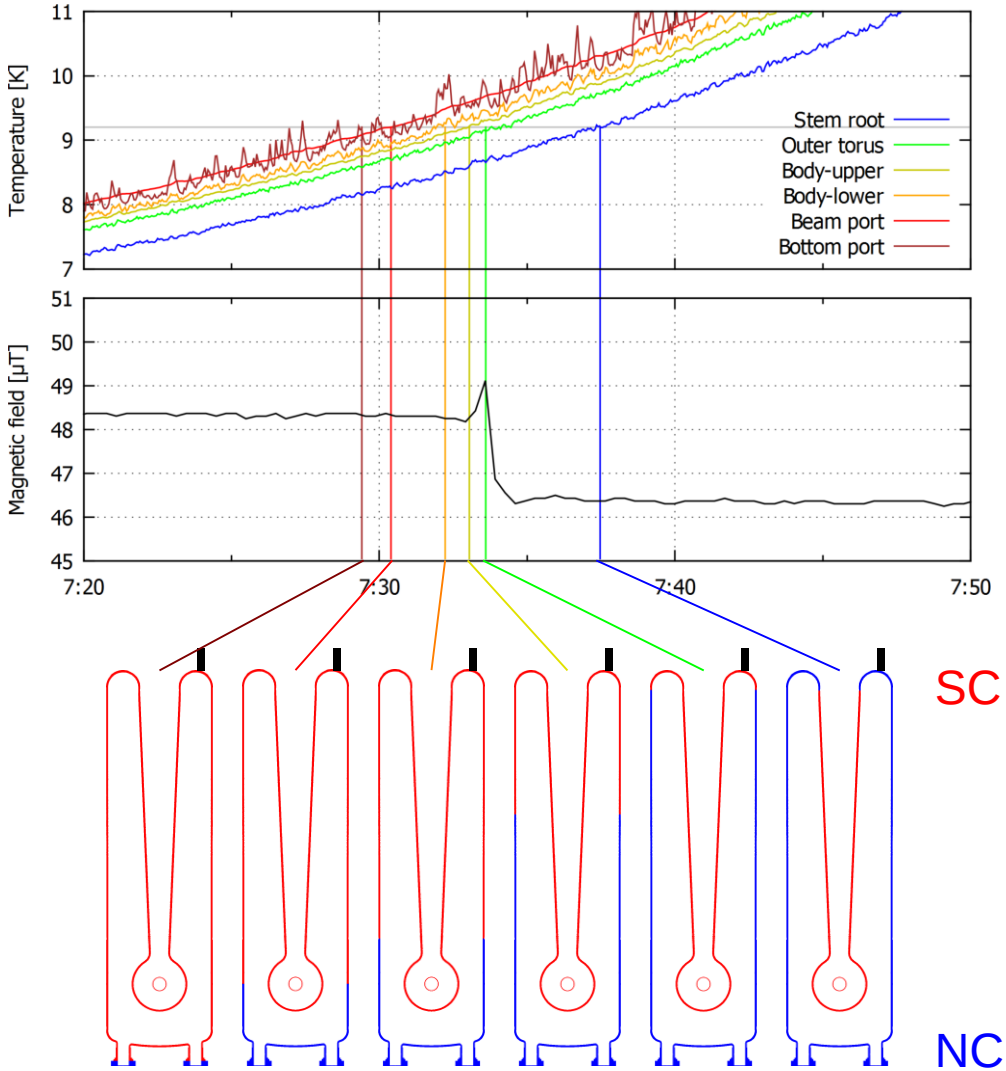


Field strength record without magnetic shield (2)

NC → SC



SC → NC



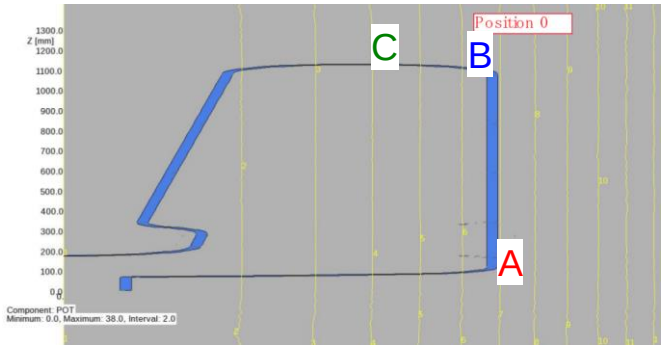
Slight decrease and then jump up/down when top area sifts from NC to SC

Jump up/down when top area shifts from SC to NC

<u>Field strength was increased after shifting to SC.</u>

Magnetic flux simulation

Courtesy of K. Tsuchiya

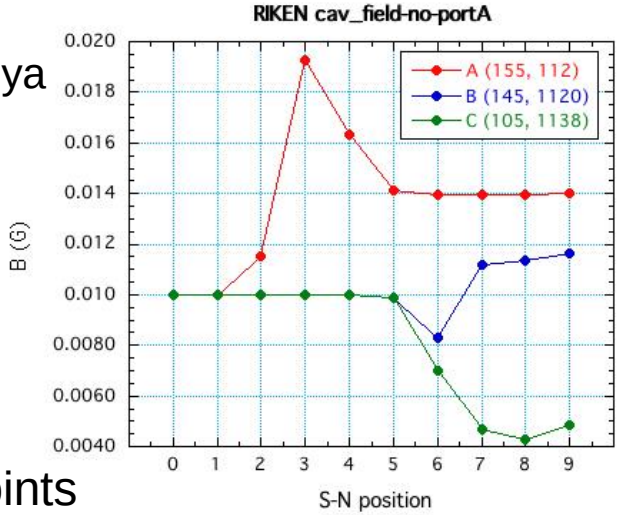


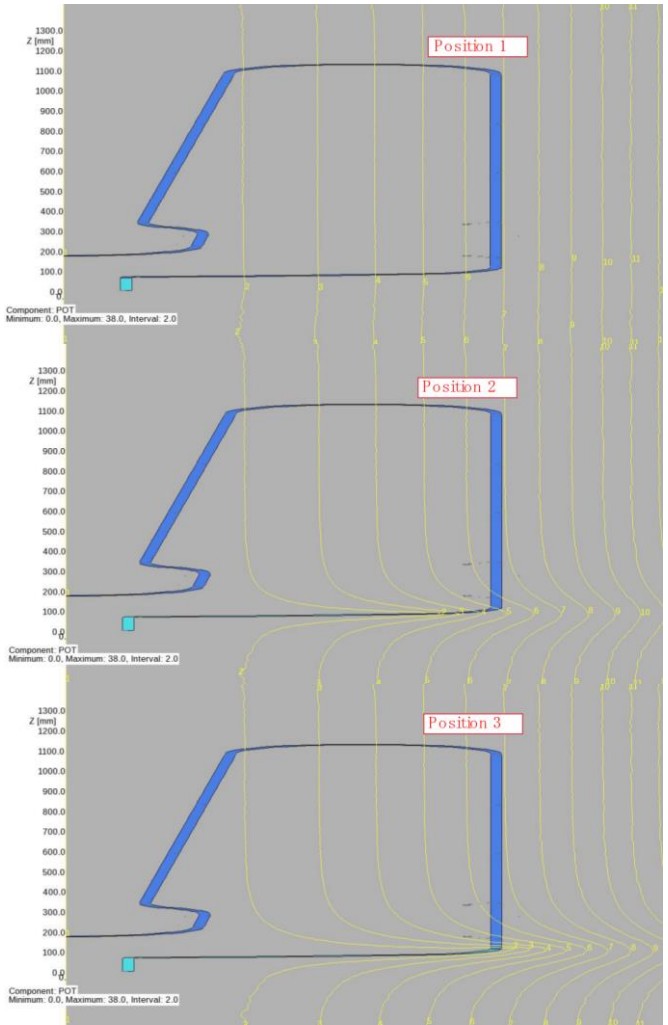
Axial symmetry (no ports)

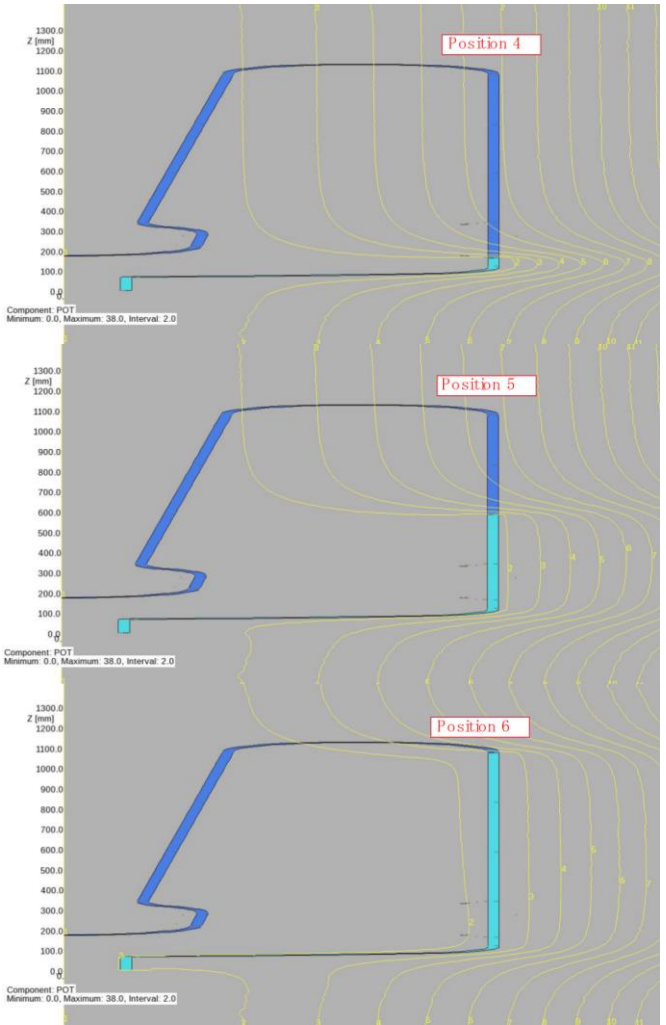
External field = 1 μT

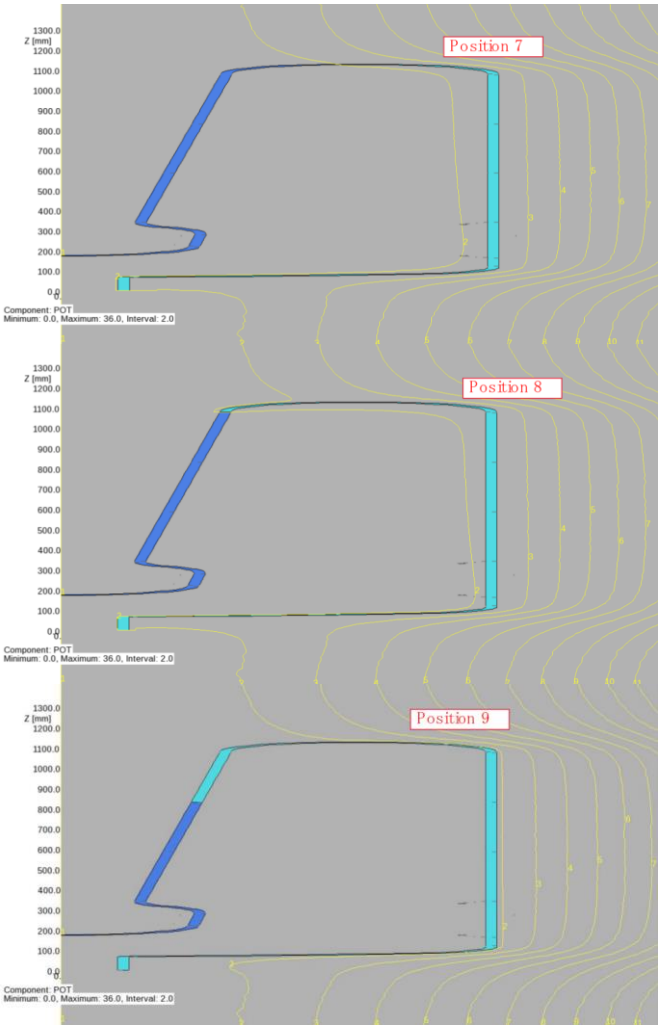
SC area grows gradually
from Pos. 0 (fully NC) to Pos. 9

A, B, C
…Abs. field strength plotting points



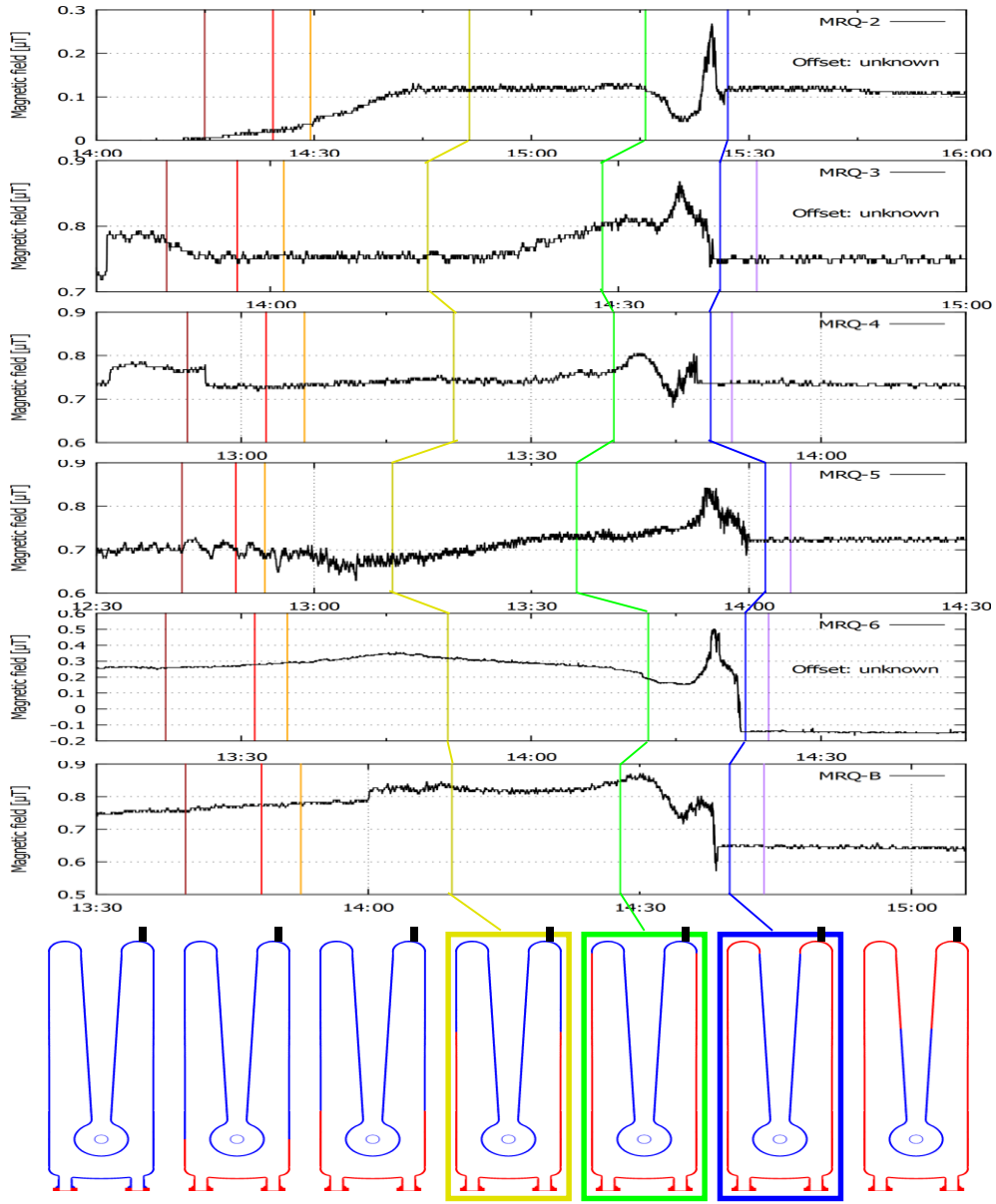


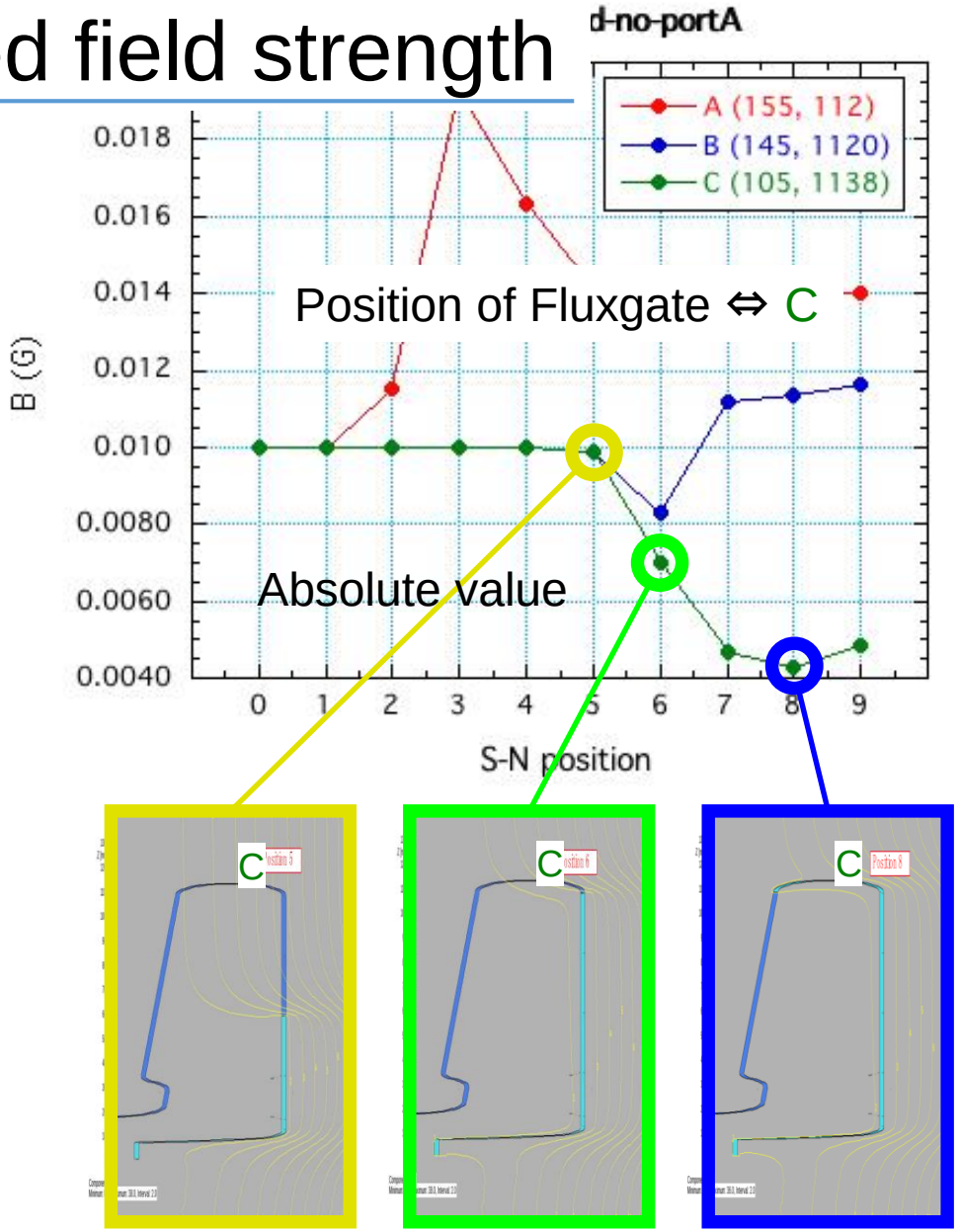




Comparison with measured field strength

Vertical only





Moderate decrease was reproduced.
Sharp peak was not reproduced. (influence of top port ?)
Triaxial field strengths (at least, vertical and radial directions) need to be measured.

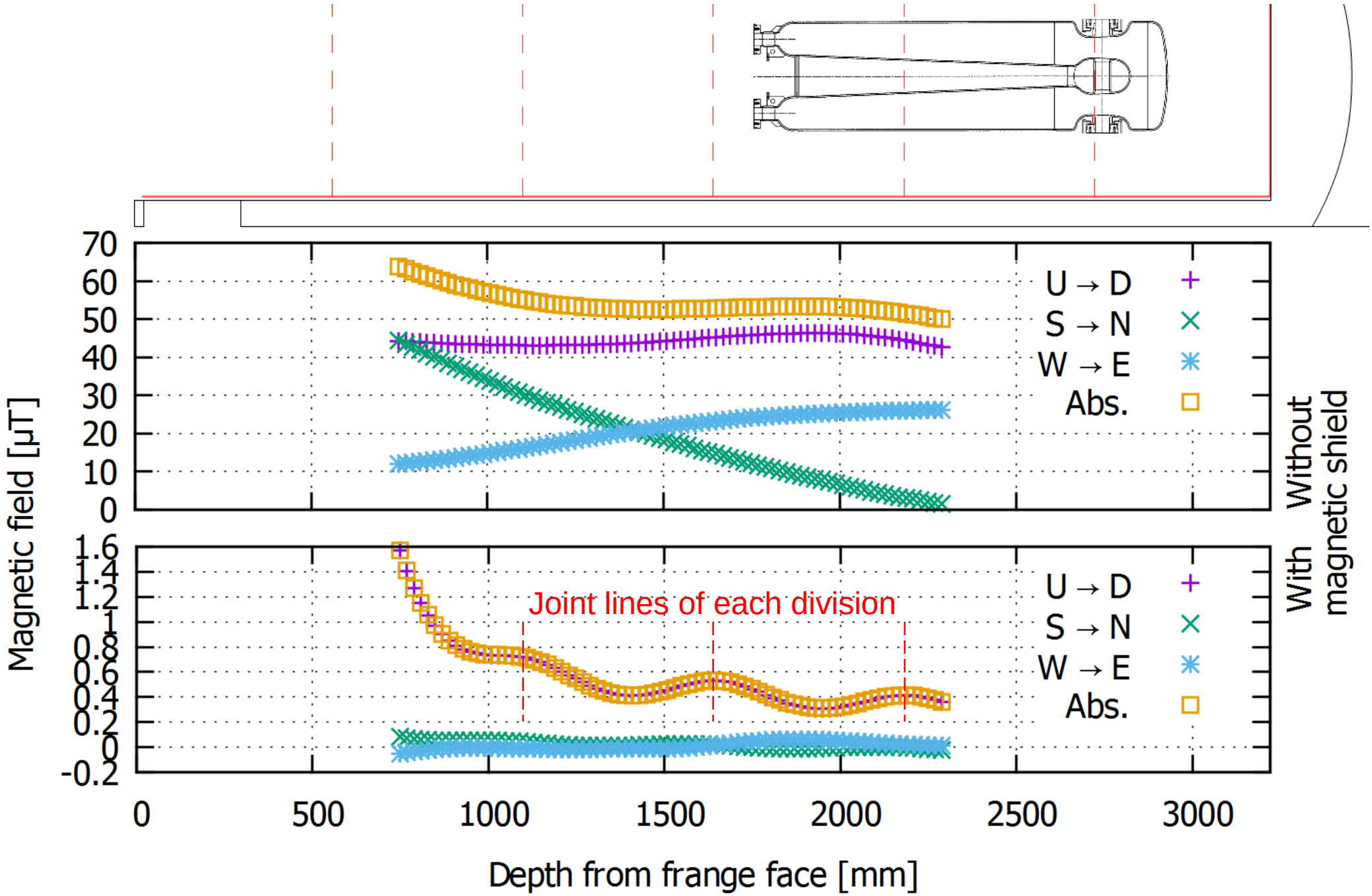
Summary

- For ongoing VTs of QWRs at RIKEN, magnetic field strength is measured.
  - Magnetic shield for RT is cooled down to 4 K.
    For flux expulsion experiment, magnetic shield at RT may be desirable.
  - VT without magnetic shield was also performed.
    w/ magnetic shield…field strength was <u>decreased or kept same level</u> after shifting to SC.
    w/o magnetic shield…field strength was <u>increased</u> after shifting to SC.

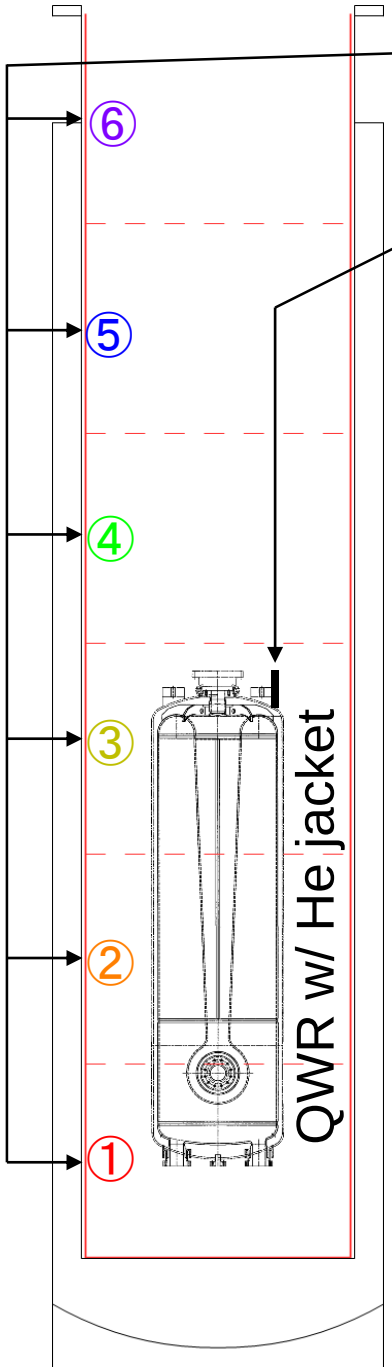
- Field strength was plotted in association with growing SC area.

- Magnetic fields with various NC-SC fronts were computed.
  - Moderate decrease in field strength at top area was reproduced.
  - Sharp peak in field strength at top area was not reproduced.

Shielding performance at room-temp.

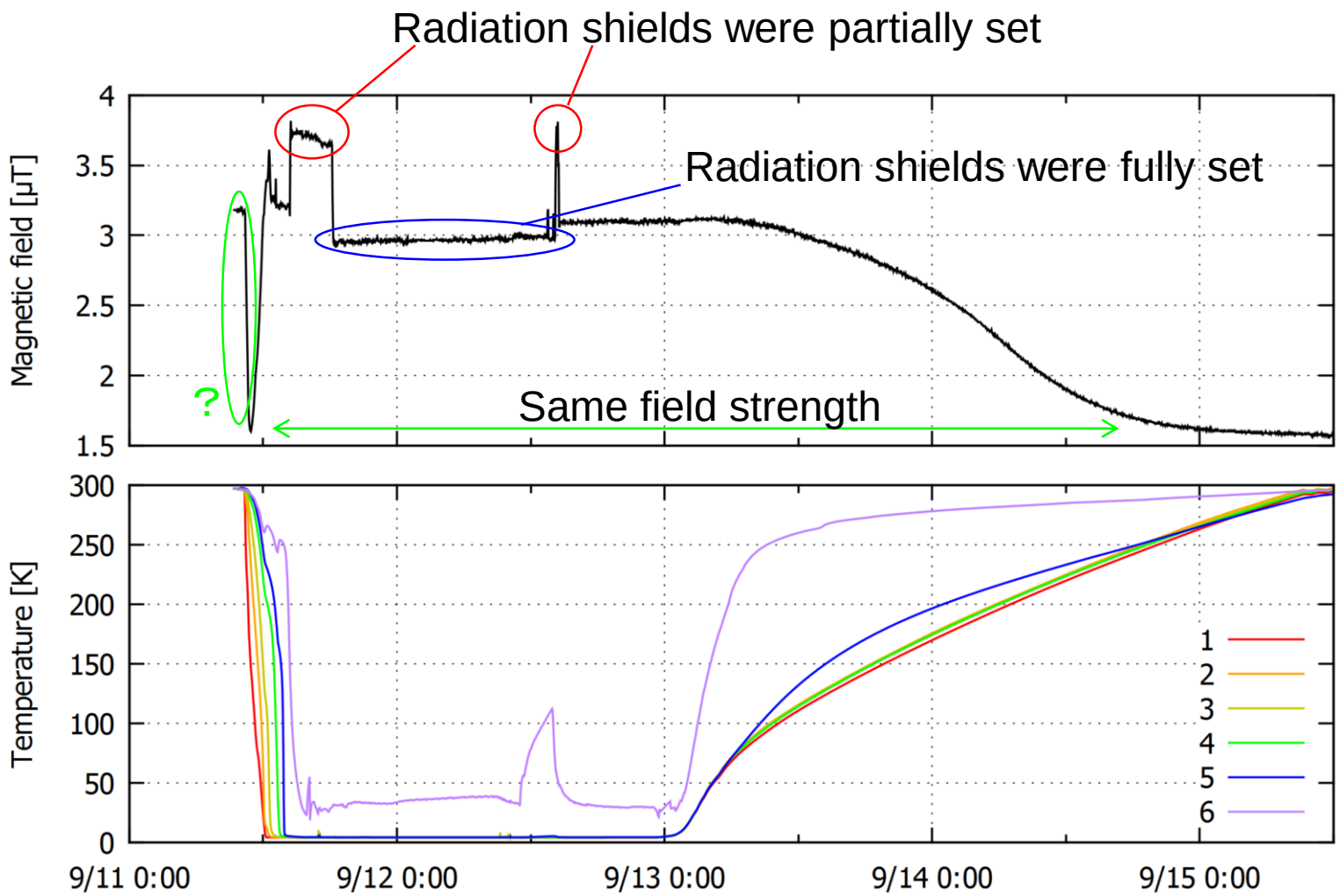


Shift in shielding performance at cryo-temp. (1)



Si-diodes were attached to each division of magnetic shield
One Fluxgate in vertical direction

NOTE) Offset of Fluxgate is unknown



Shift in shielding performance at cryo-temp. (2)