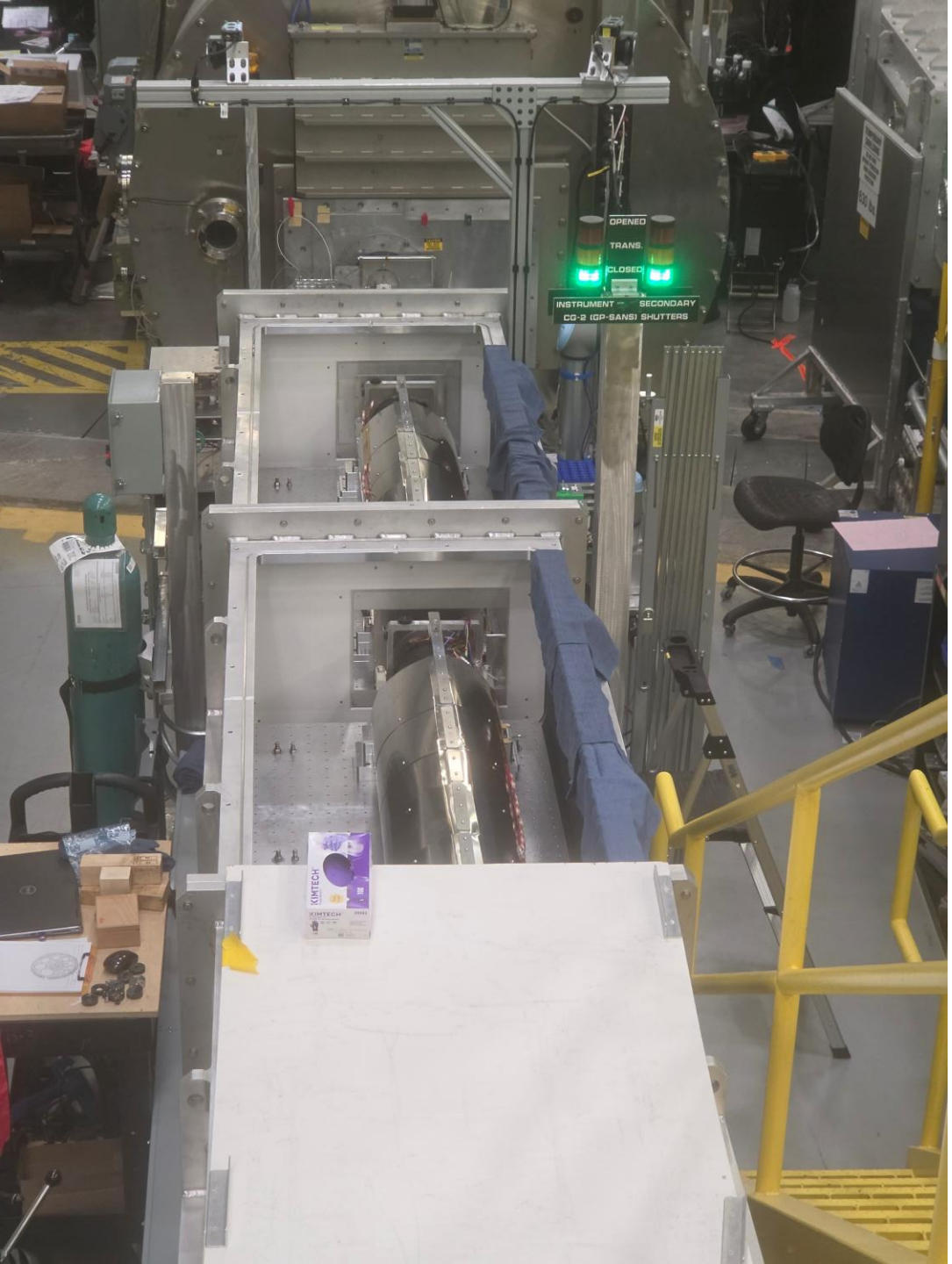
Agenda for August 18th, 2026 nn' zoom meeting

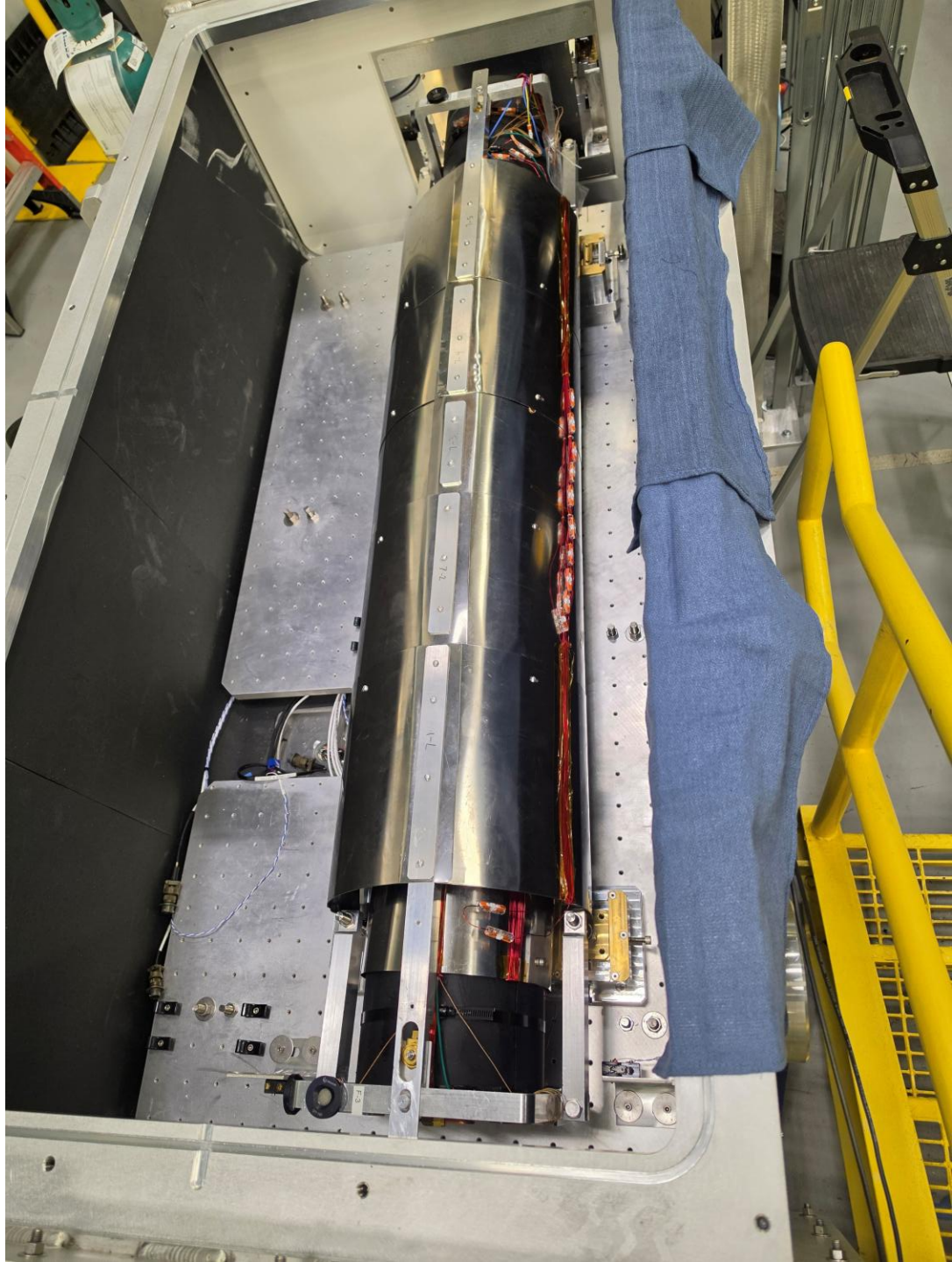
1. Matt Frost 5' Status of paper submission to arXiv and PRD
2. Yuri Kamyshkov 5' Progress of installation of nTMM2 at GP-SANS
3. Yuri Kamyshkov 20' New magnetic field perturbation
4. Alina Moore 10' On-line analysis, data transfer, readout frequency in DAQ
5. Mubi Khan 10' Update from UKY
6. Linus Persson ? on vacations
7. Shaun Vavra 5' New meeting time (poll result discussion)
8. AOB

- Transportation from UT
Friday August 14
to HFIR

- Millwrights installed
nTMM magnets in Box 7 & 8
during the weekend

Aug 17


OPENED
TRANS.
CLOSED
INSTRUMENT
SECONDARY
CG-2 (GP-SANS) SHUTTERS
KIMTECH




F-4
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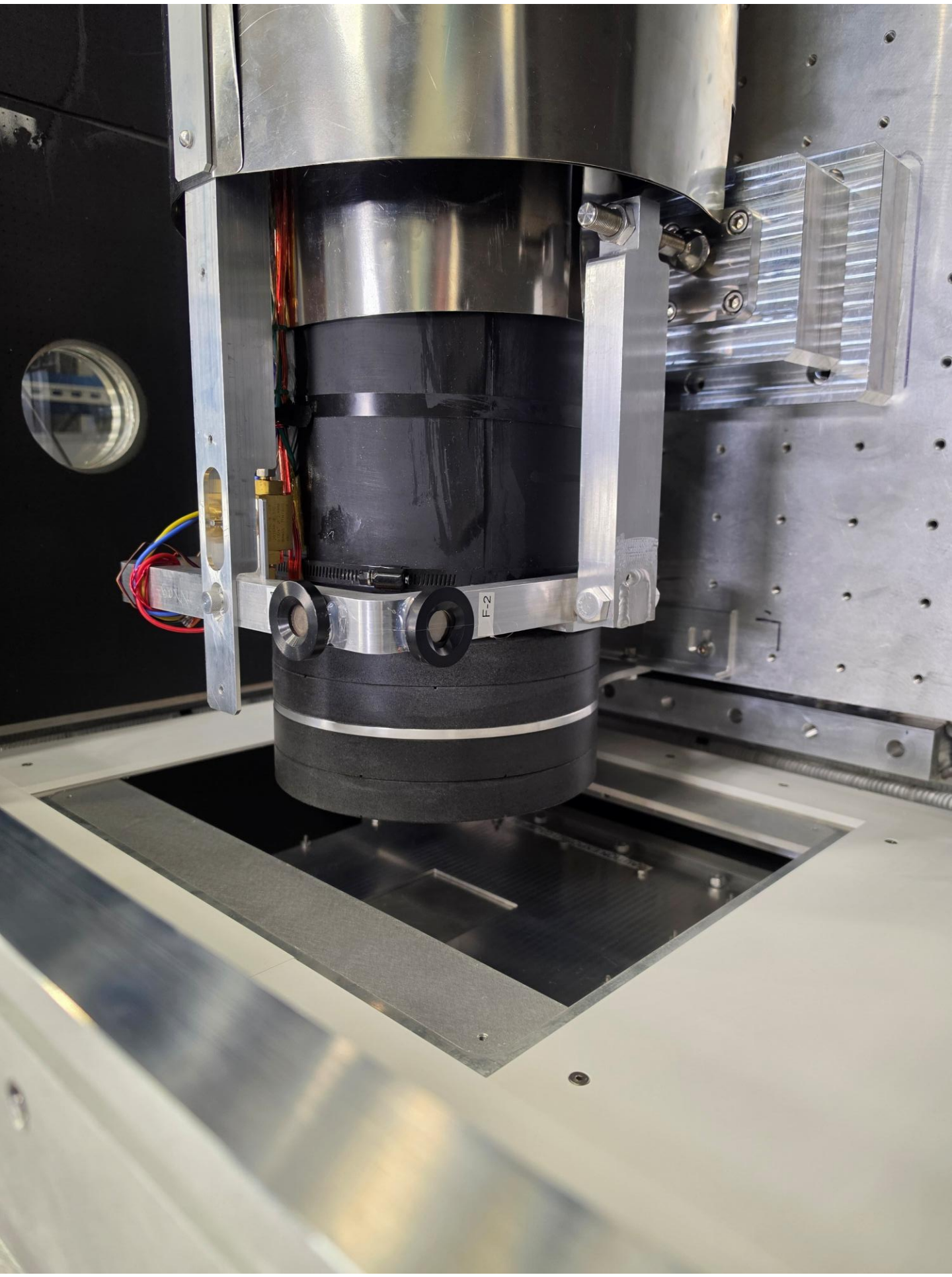
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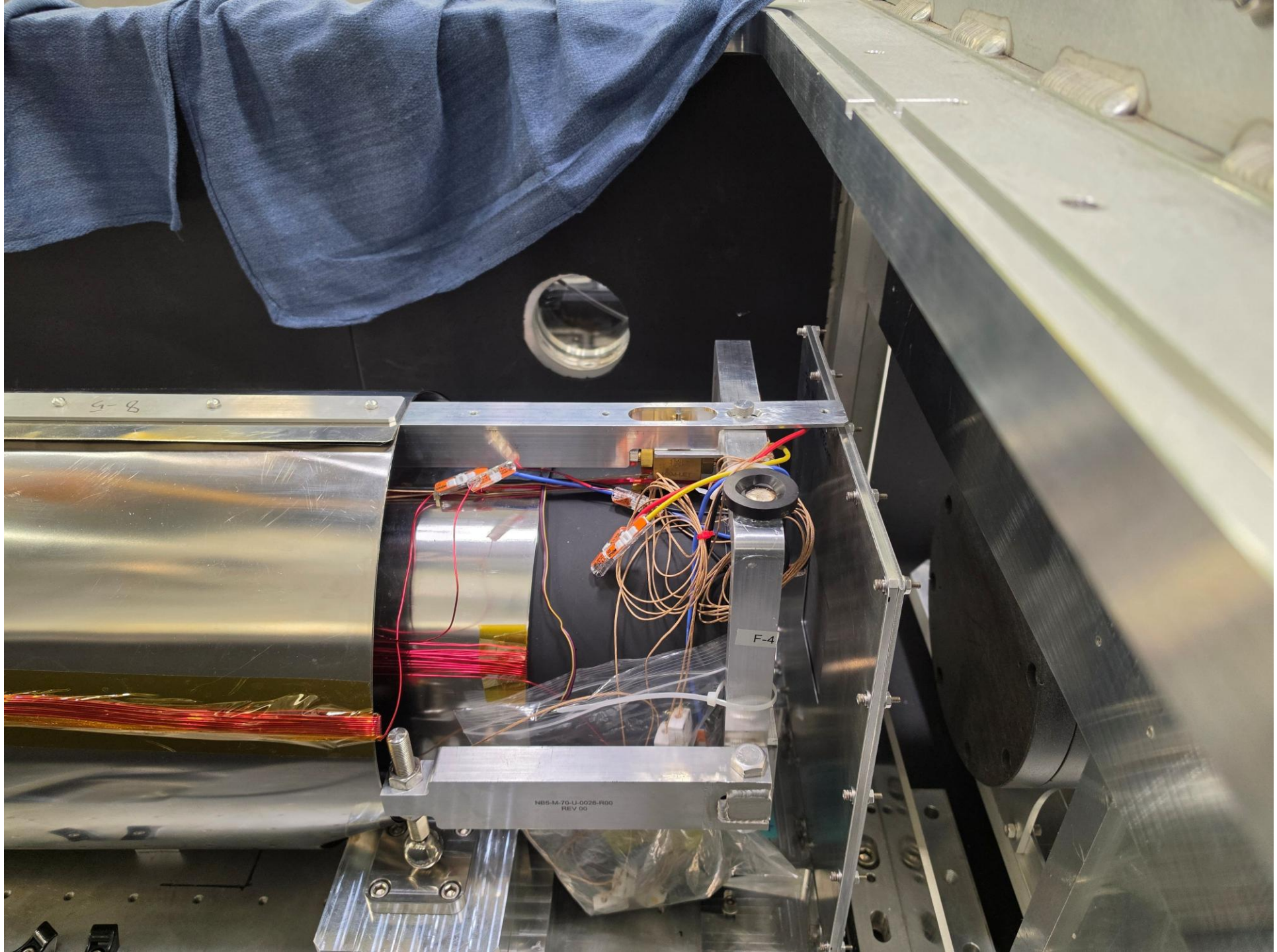
F-4
NB5-M-70-U-0026-R00
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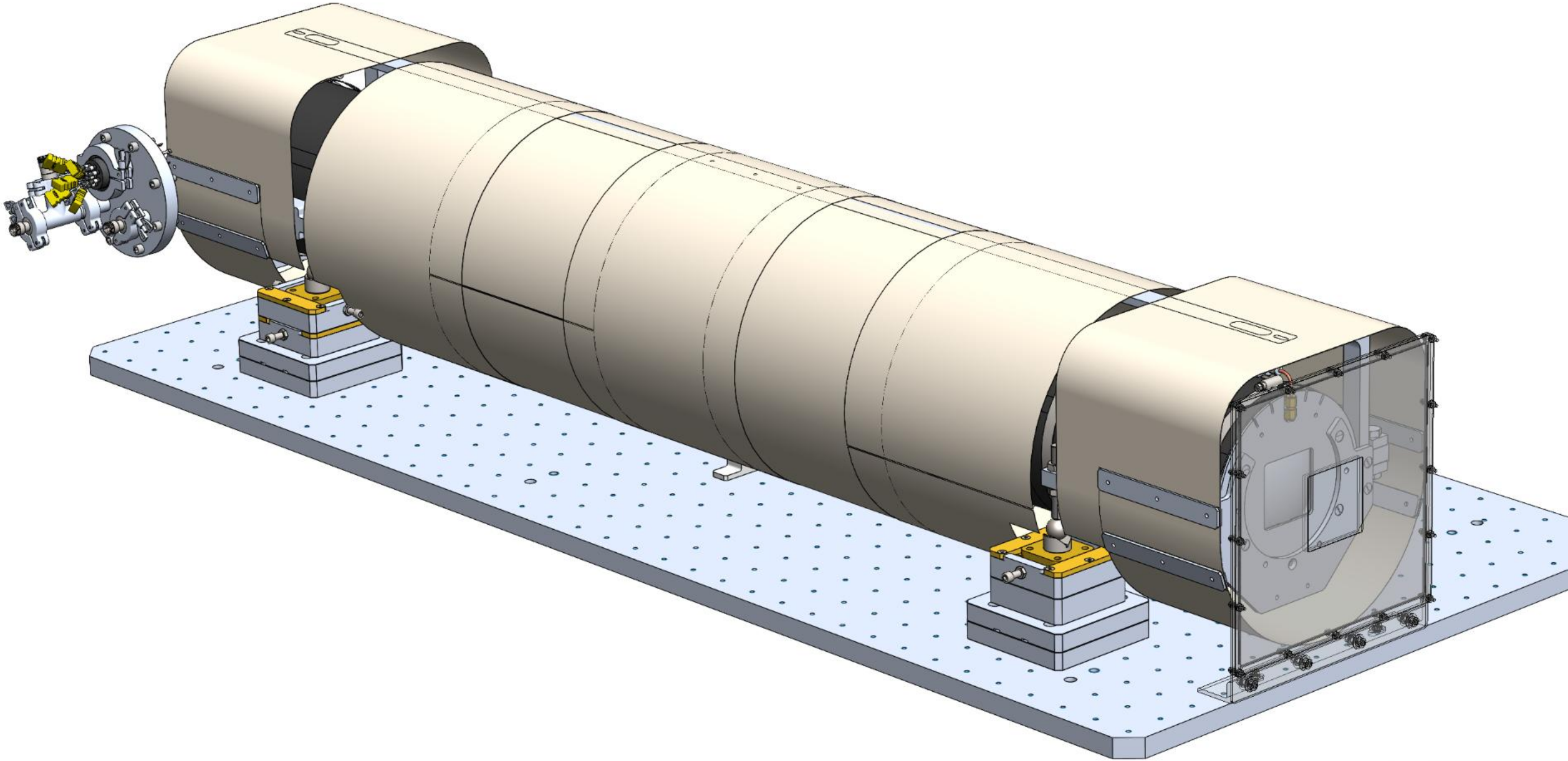
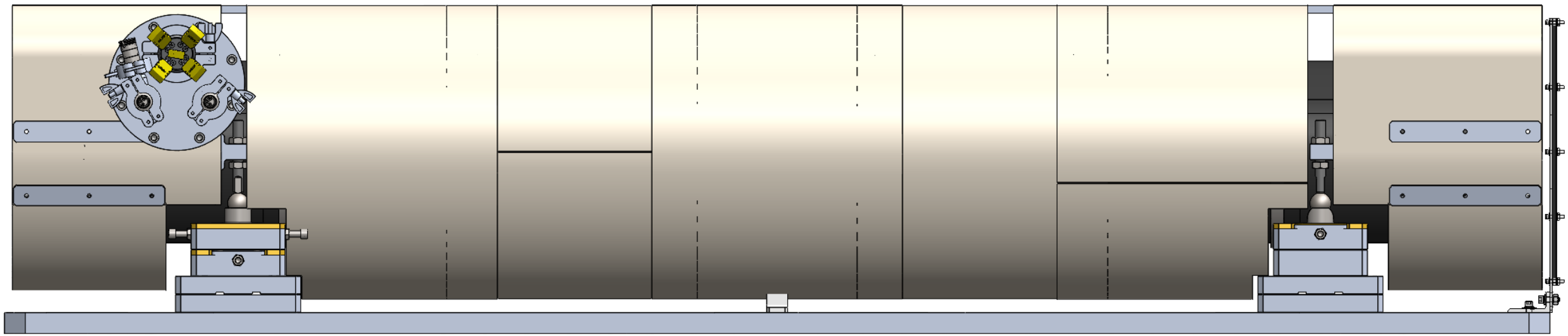
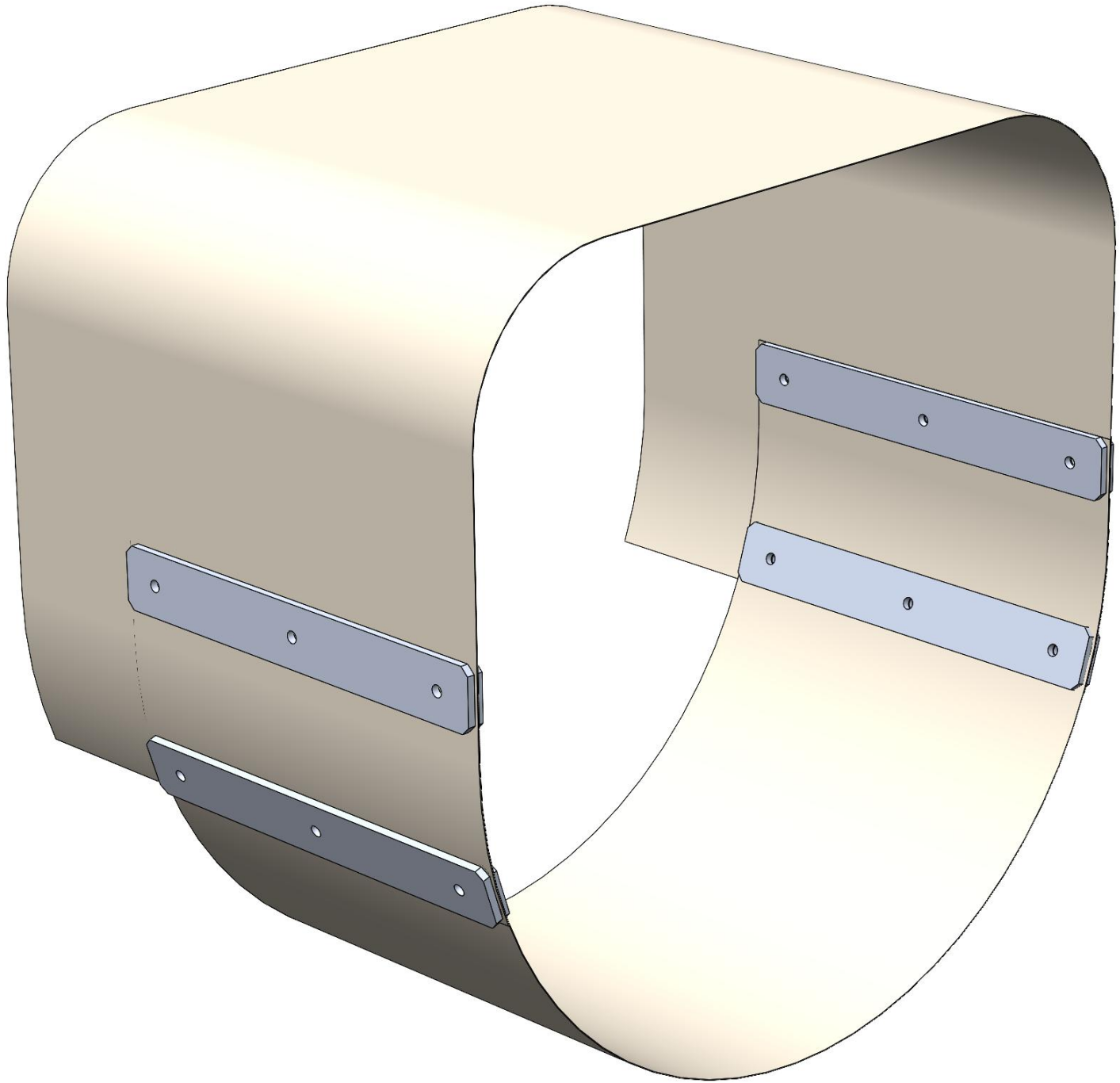






nn’ zoom meeting August 18, 2026

New Magnetic Field Perturbation at GP-SANS

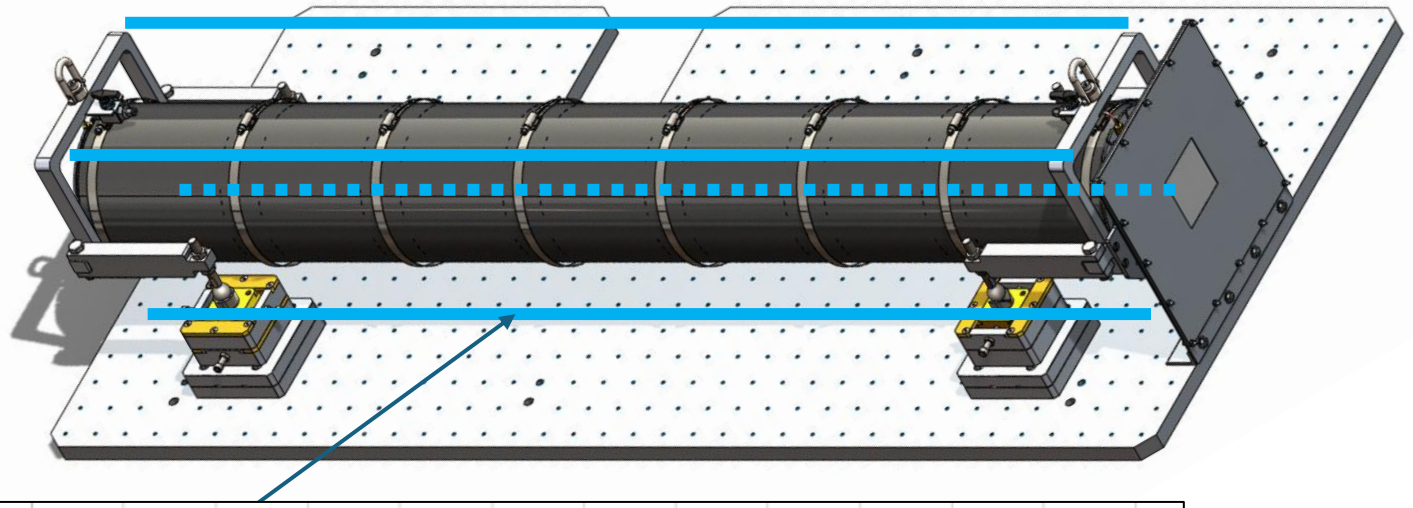
Yuri Kamyshkov

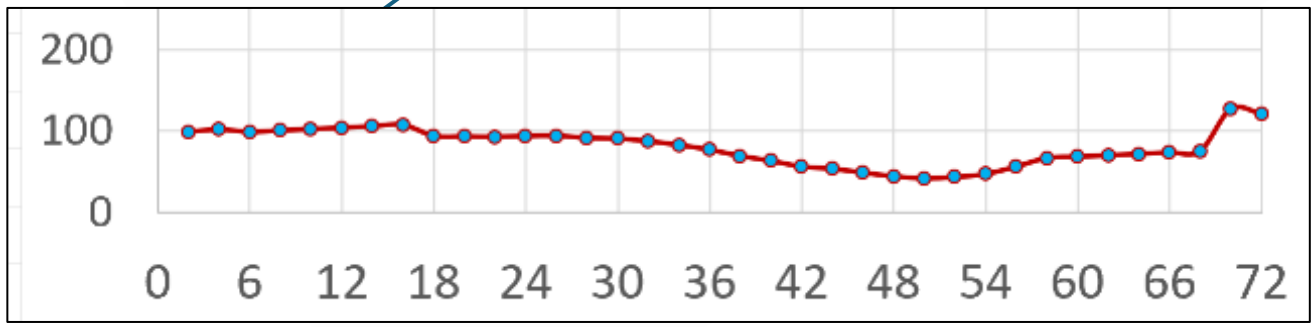
History of environmental magnetic field at GP-SANS beam line

- In 2025 we have learned about large field perturbations when nTMM magnets were already installed in Box 7 & 8
- In early June 2025 we measured $\vec{B}(z)$ along 4 lines close to magnets and decided to install additions μ-shield
- Later when boxes were closed, we perform field measurements outside and around guide boxes 7 & 8
- In 2025 we could not measure field on the beam axis. First quick possibility was in August 2026 only .
- Now, we are learning that NEW 5-T ICE magnet is installed in the middle of the hall with wide spread of B field.
- We performed simple measurements on the beam axis with this ICE magnet OFF and ON.
- It will a new perturbation to our B field if this magnet will be ON during our measurement period Sept 8-12. This perturbation then should be added to our COMSOL field calculations.
- **Worst what could happen if during Sept 9-12 time this ICE magnet will be switch on and off. On every such switch ON and OFF we will need to degauss our magnets. That means a beams stop for ~ 1 hour operation.**

4-lines Magnetic Field measurement around the magnet in June 2025
No second outer magnetic shield installed

Magnet 1 Box 7



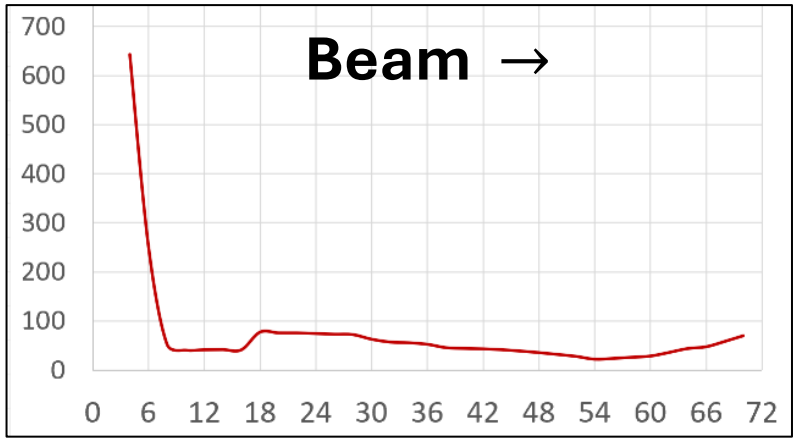


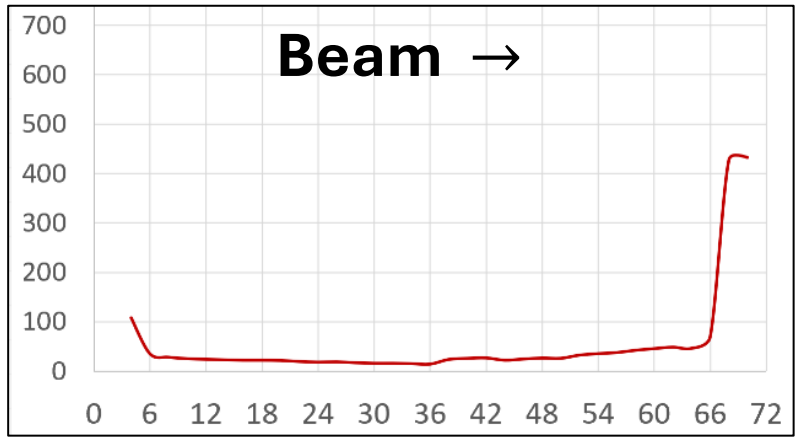
$B_{tot,}\,\mu T$

$inches$

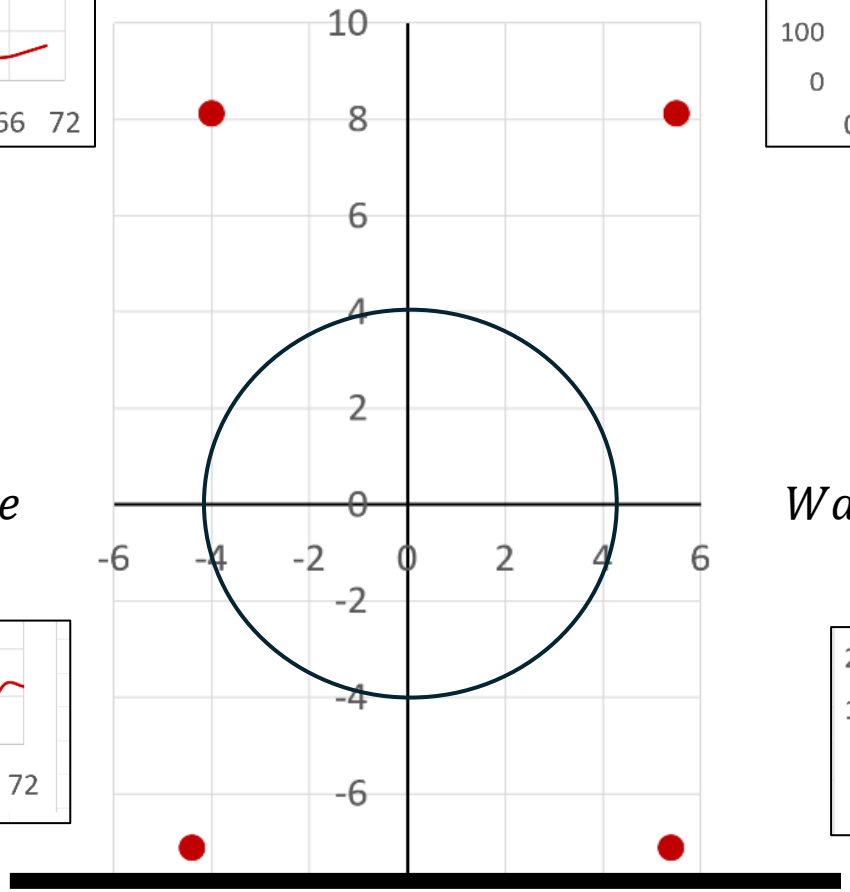
3-D point every
2” along the beam

Total Field



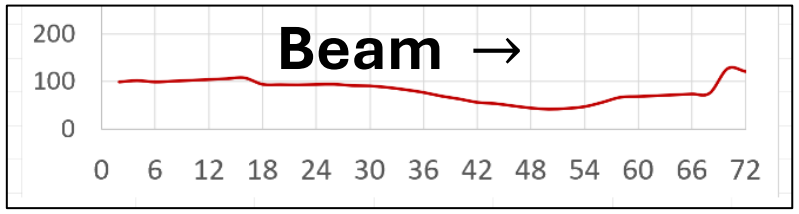


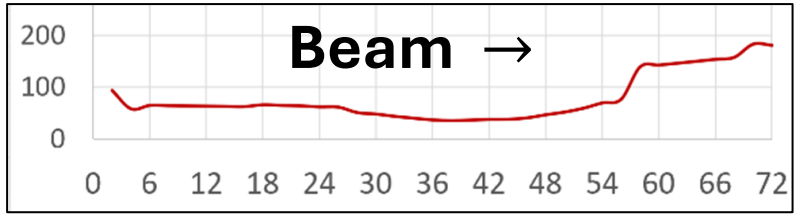
Magnet 1(7)



← *Ladder side*

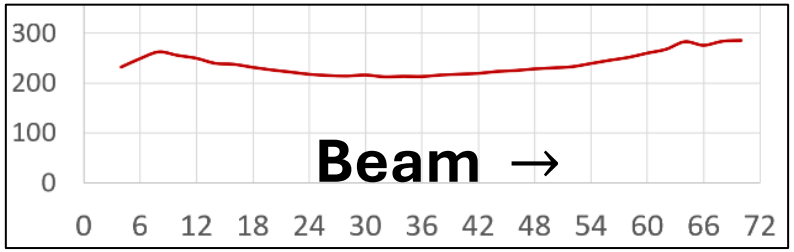
Wall side →

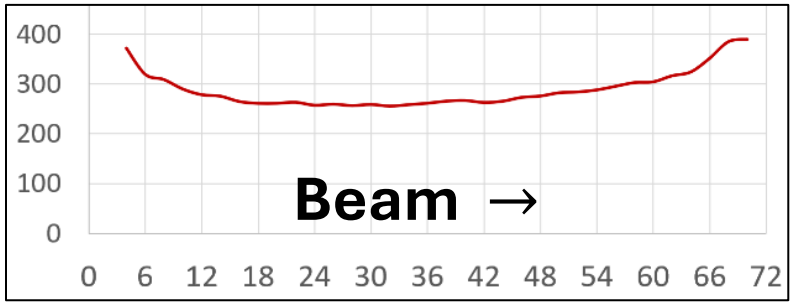




Total Field

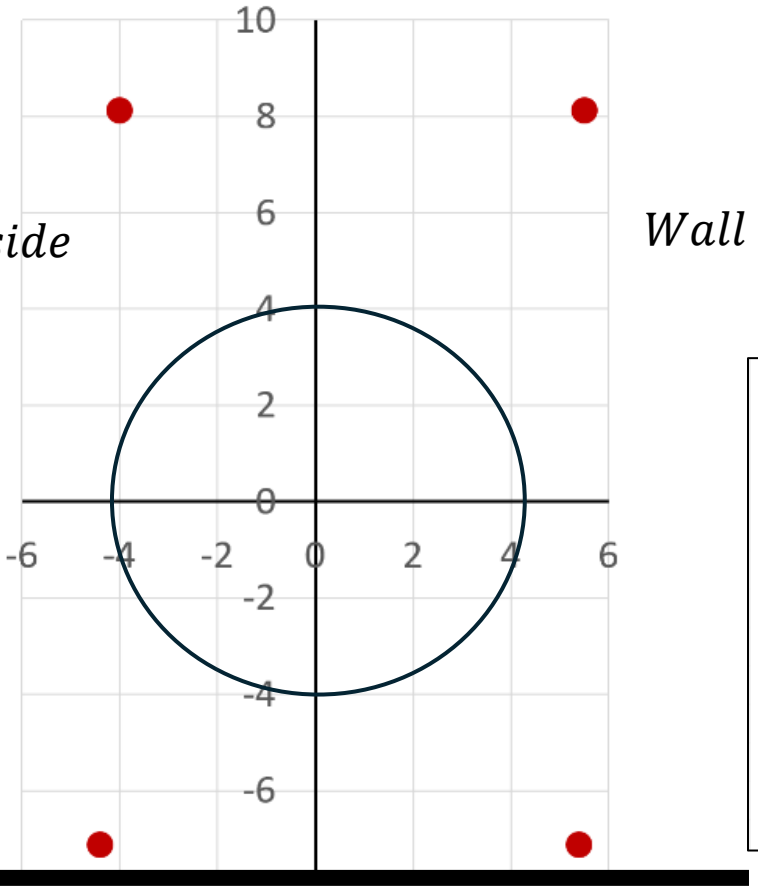
Magnet 2(8)

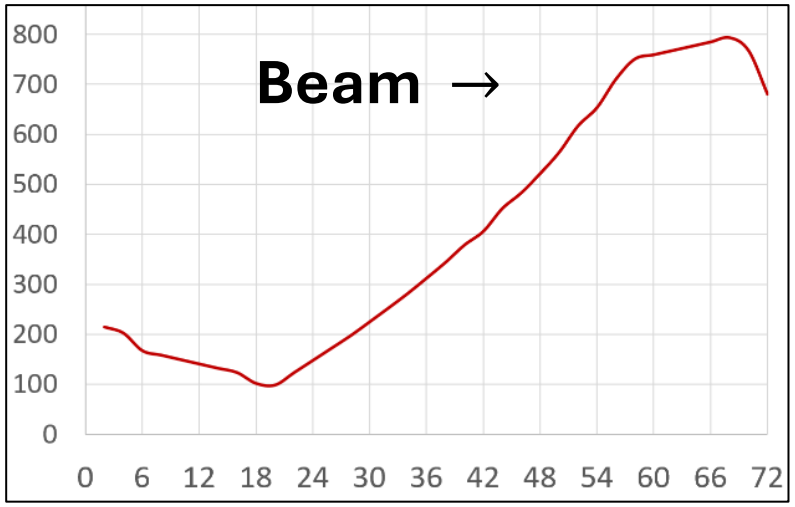


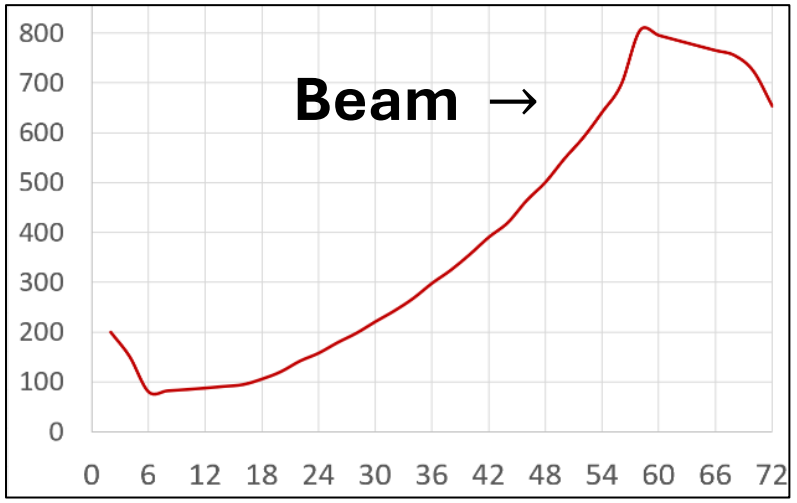


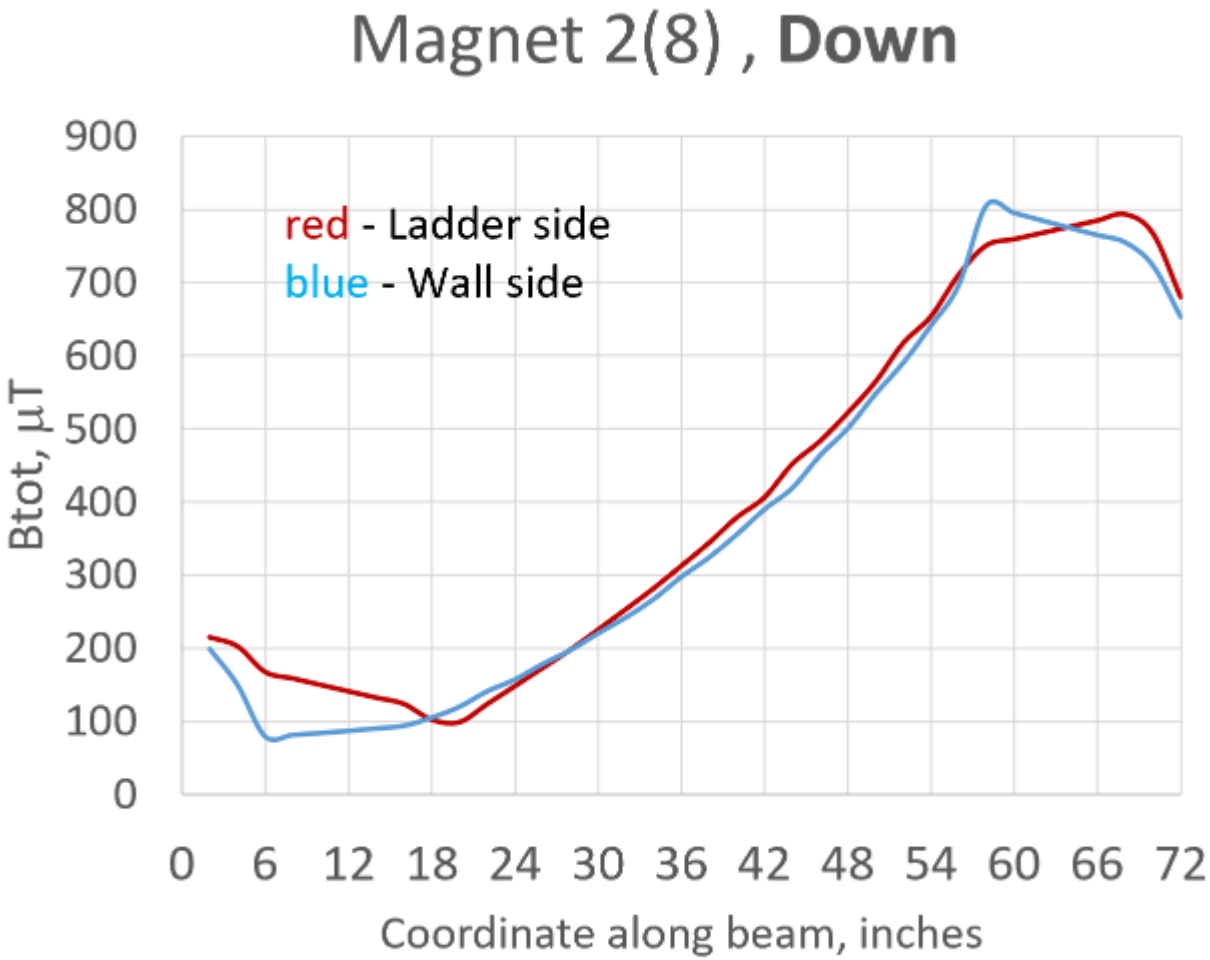
← *Ladder side*

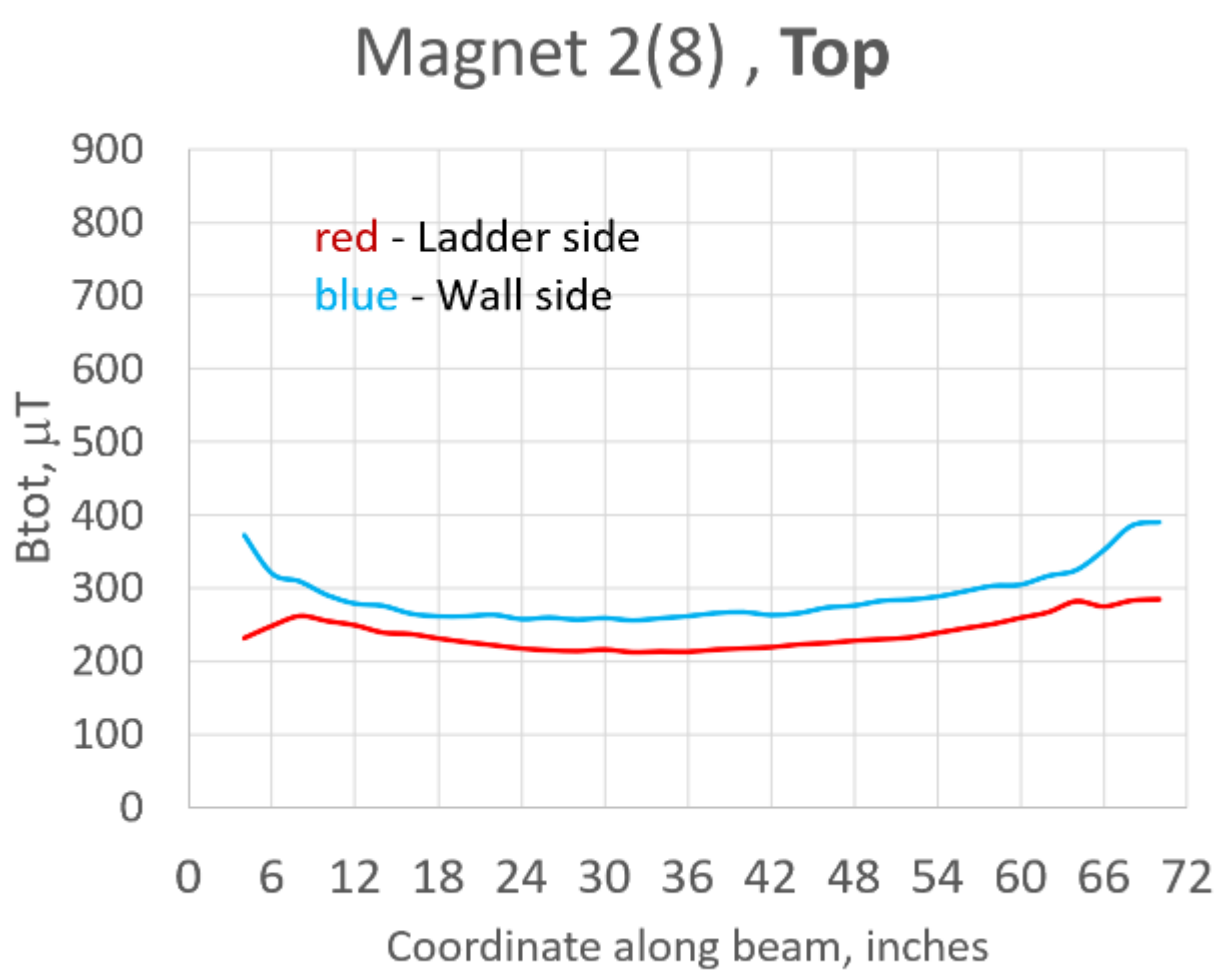
Wall side →



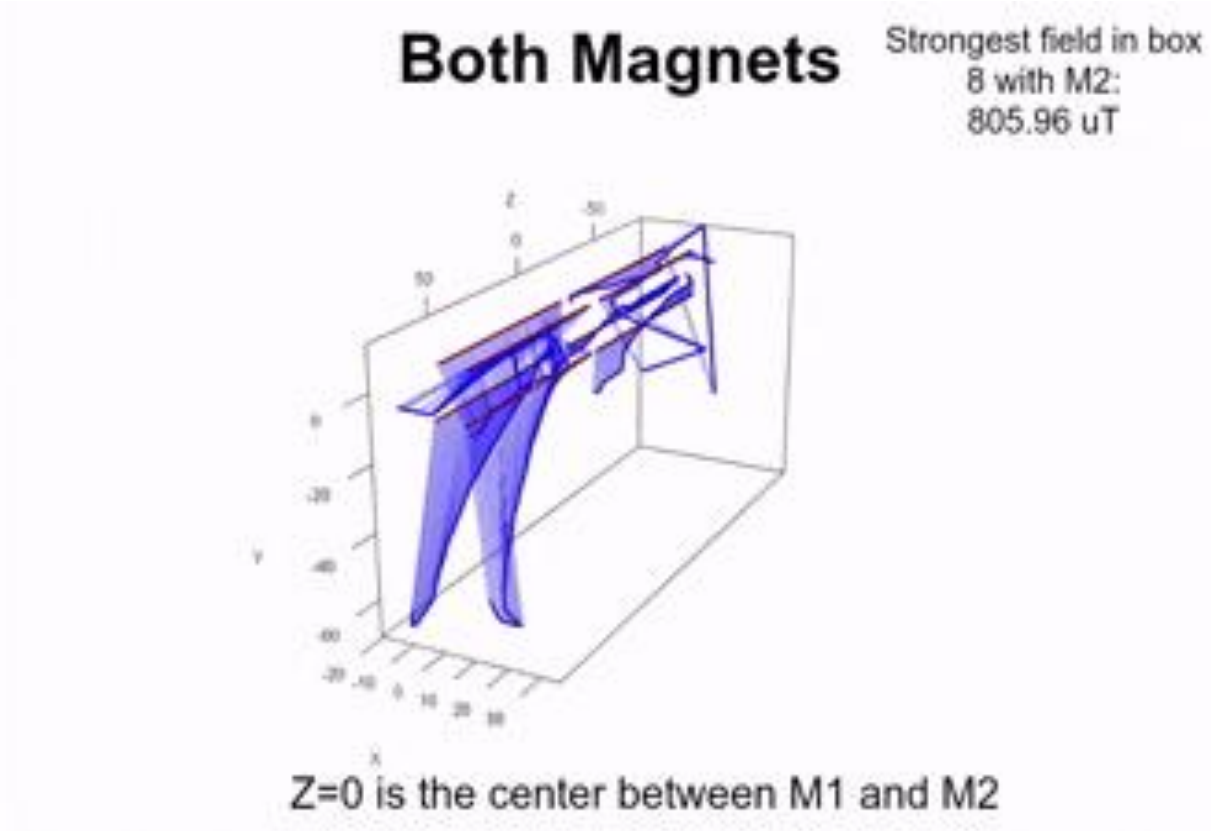








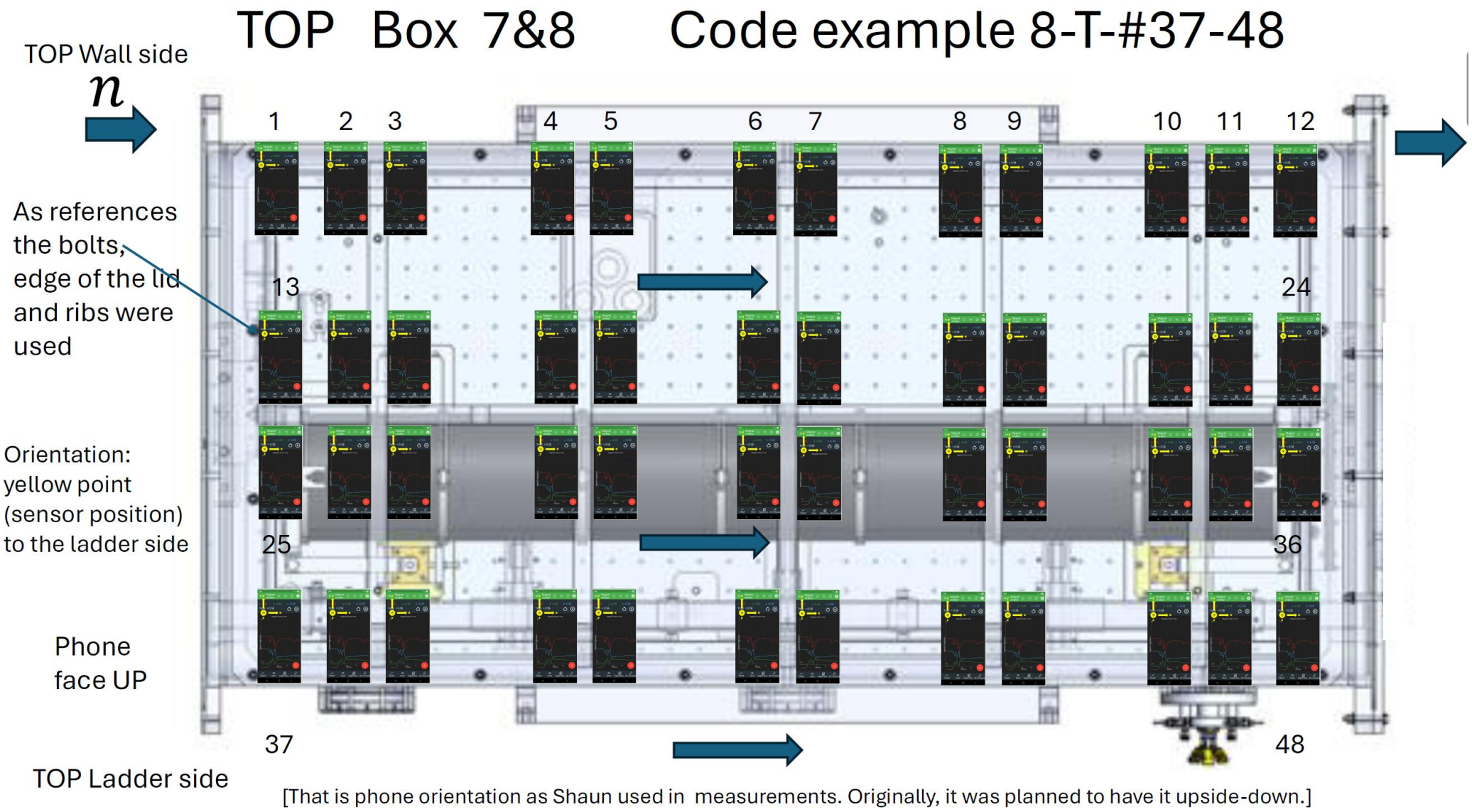
No measurements on the beam axis were available



Scaling factor for visibility = 0.08

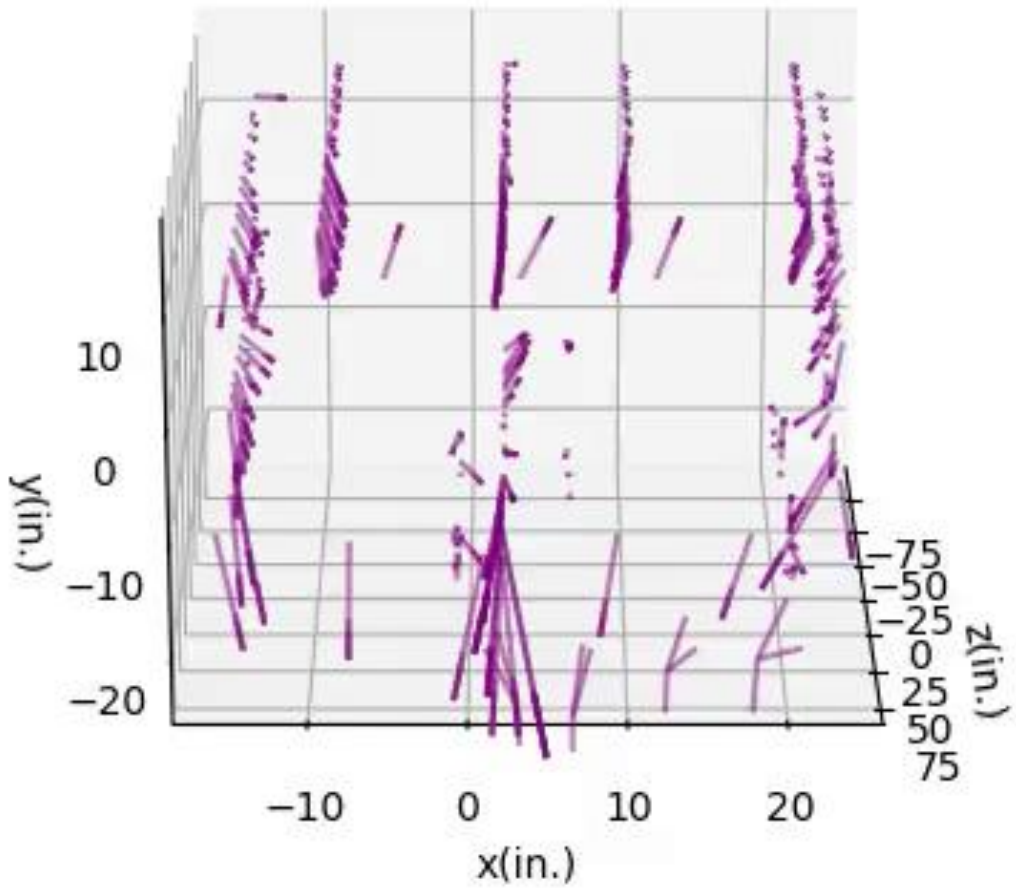
But no measurements on the beam axis

Measurements around closed boxes 7 & 8 with nTMM magnets inside July 2025

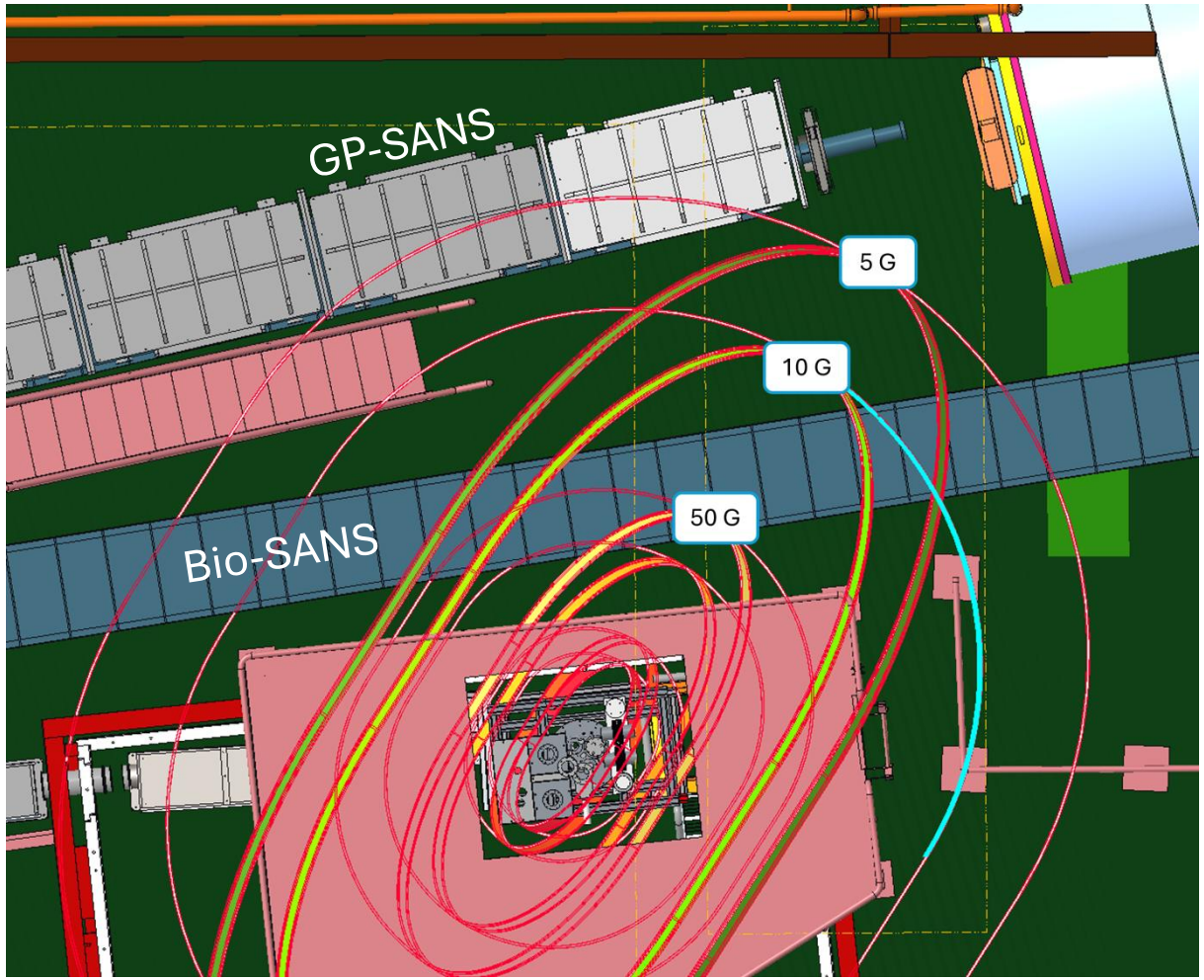


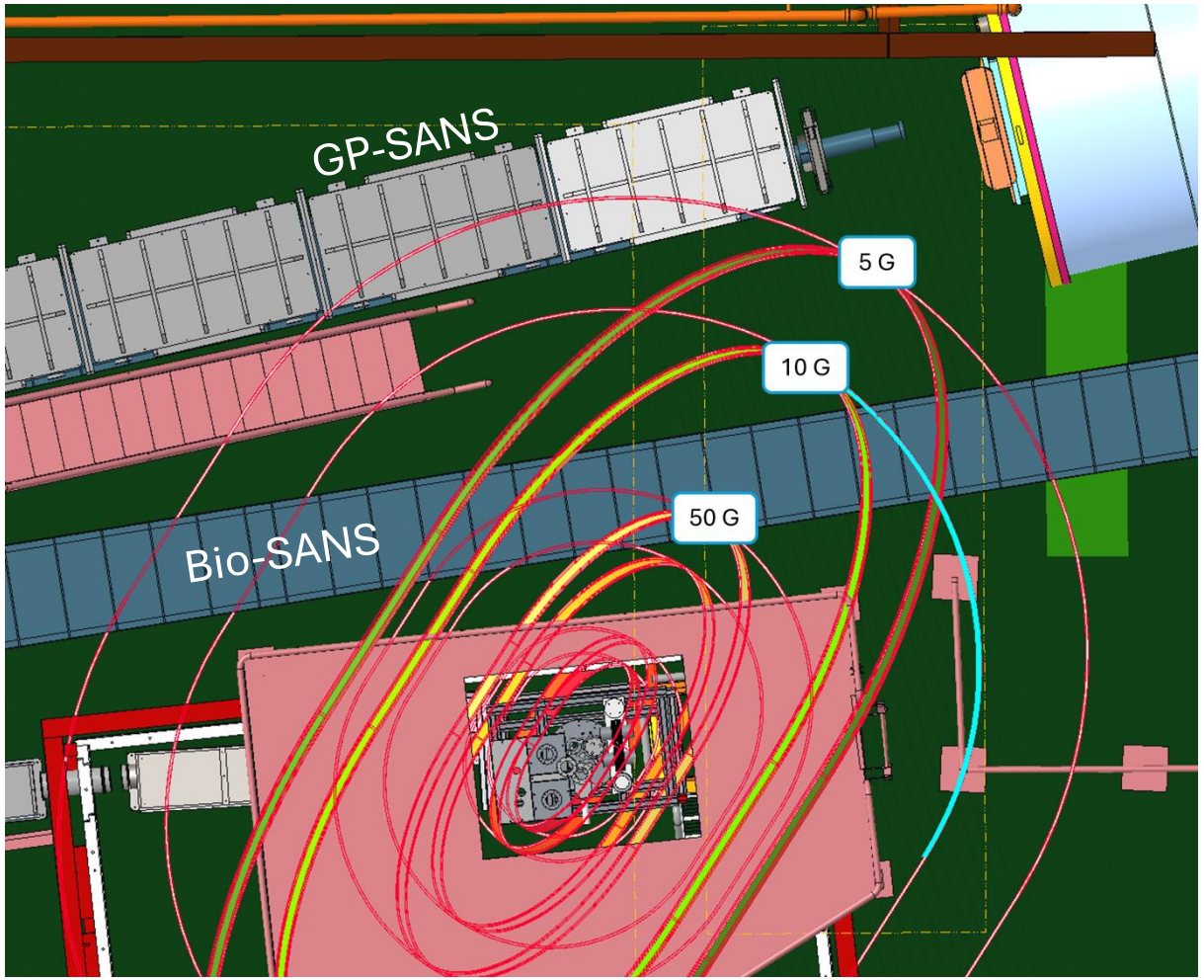
[That is phone orientation as Shaun used in measurements. Originally, it was planned to have it upside-down.]

Beamline B-Field Visualization



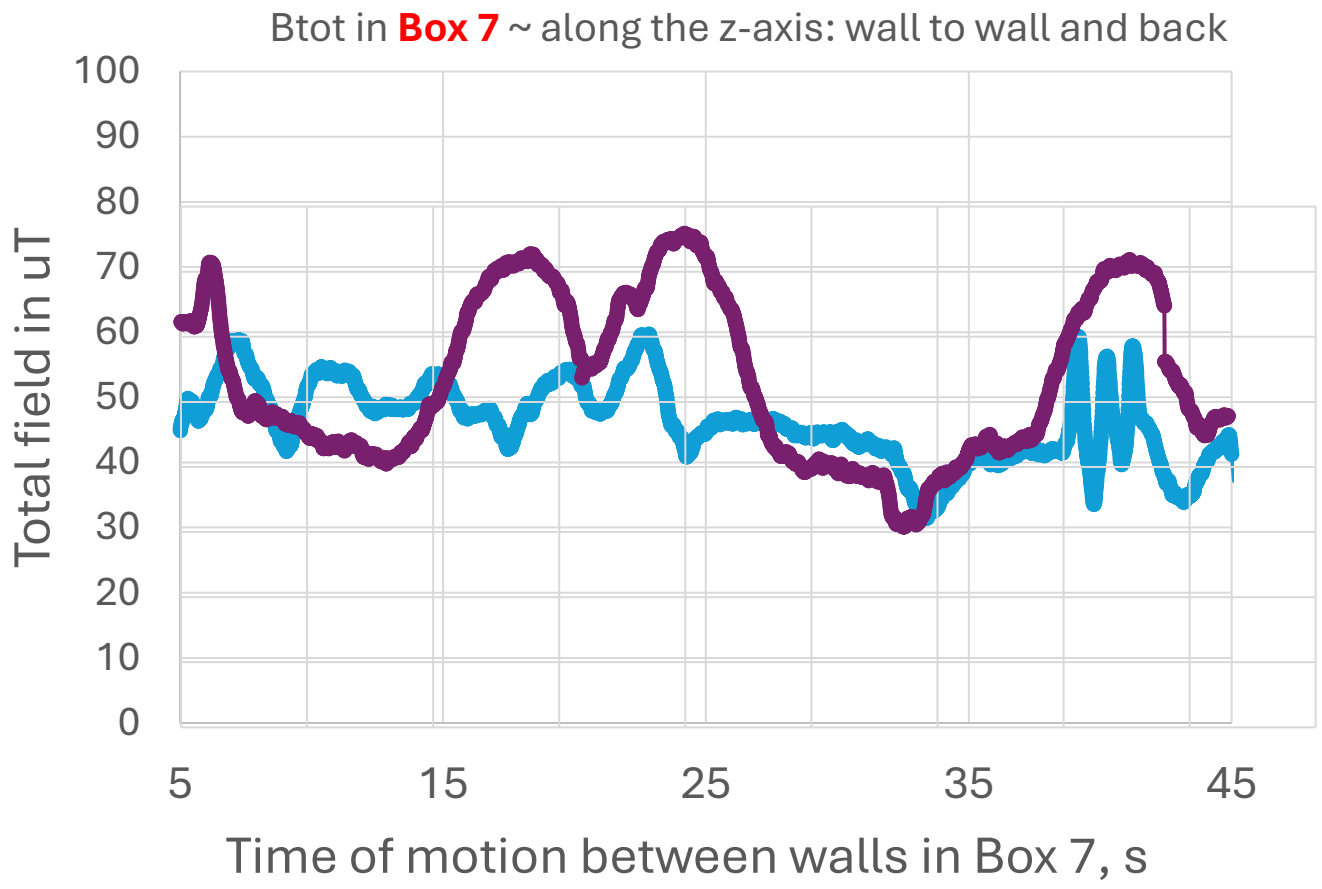
New 5-T ICE magnet in the cold guide hall





August 2026 • New 5-T ICE magnet in the hall is OFF

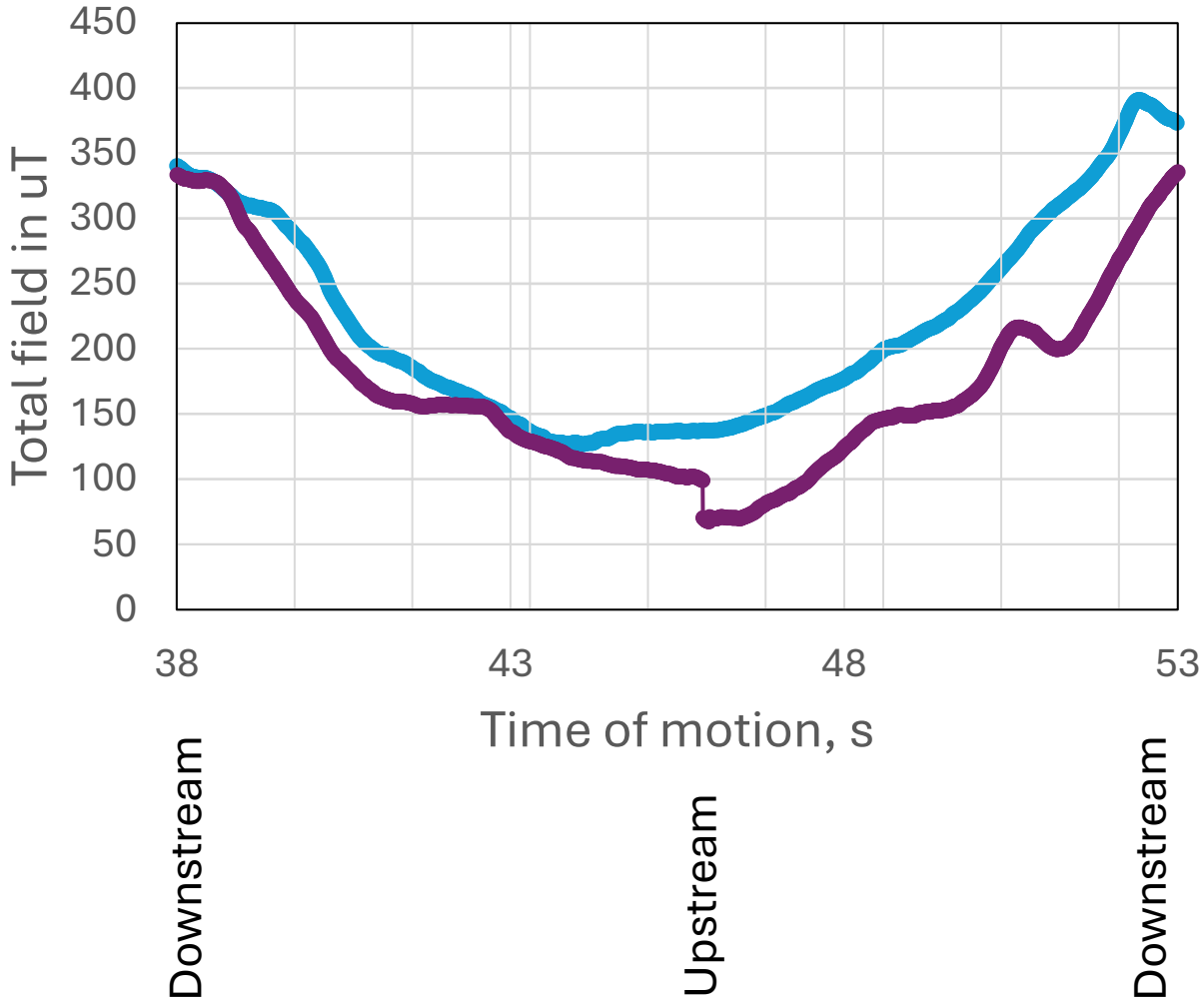
Two simple measurement on the beam axis

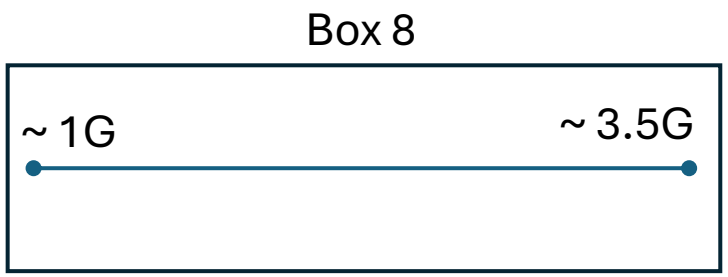


B_{tot} ~ 0.5-0.6 G

New 5T ICE magnet in the hall is OFF

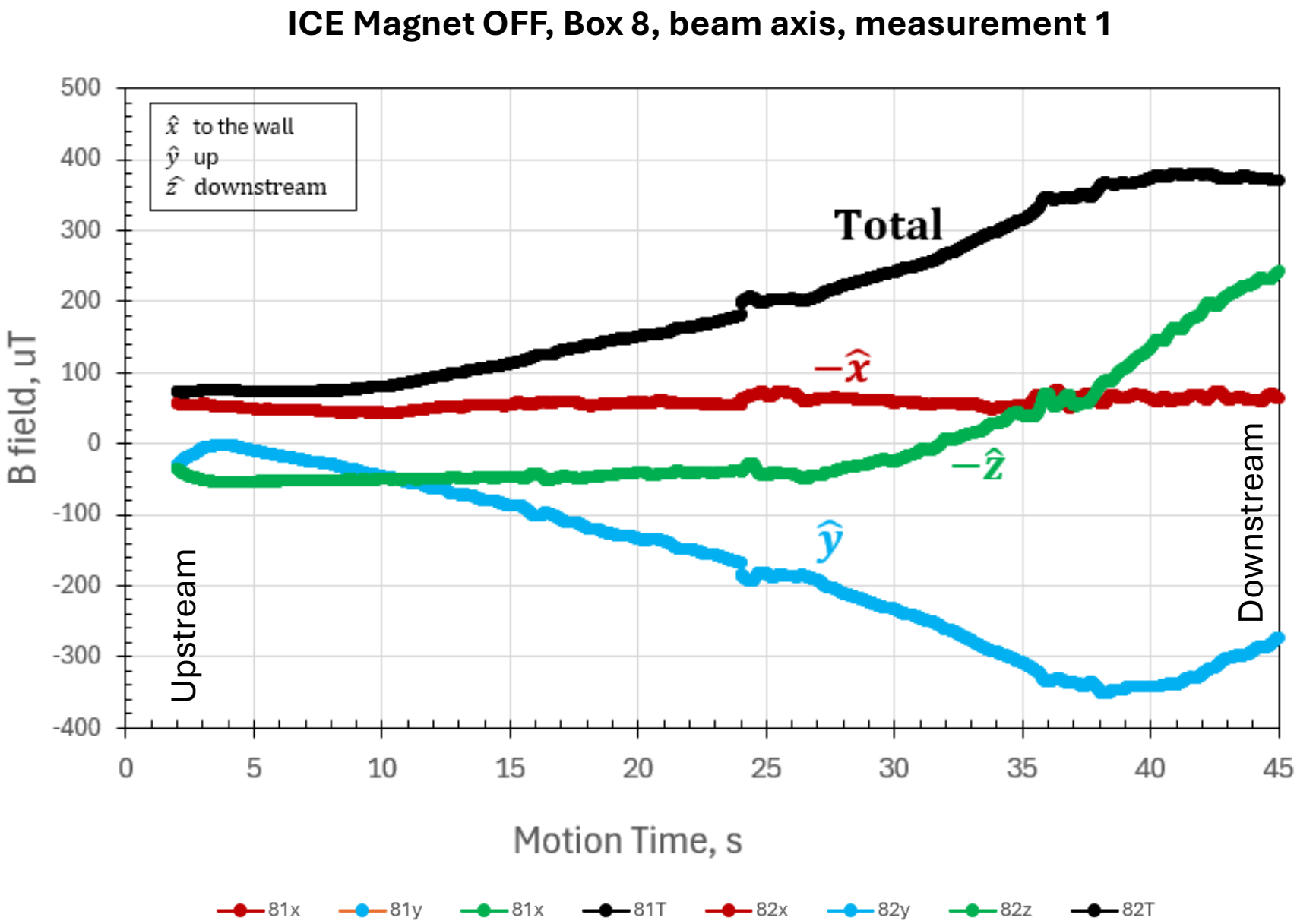
B_{tot} in **Box 8** along beam axis wall to wall. 2 measurements



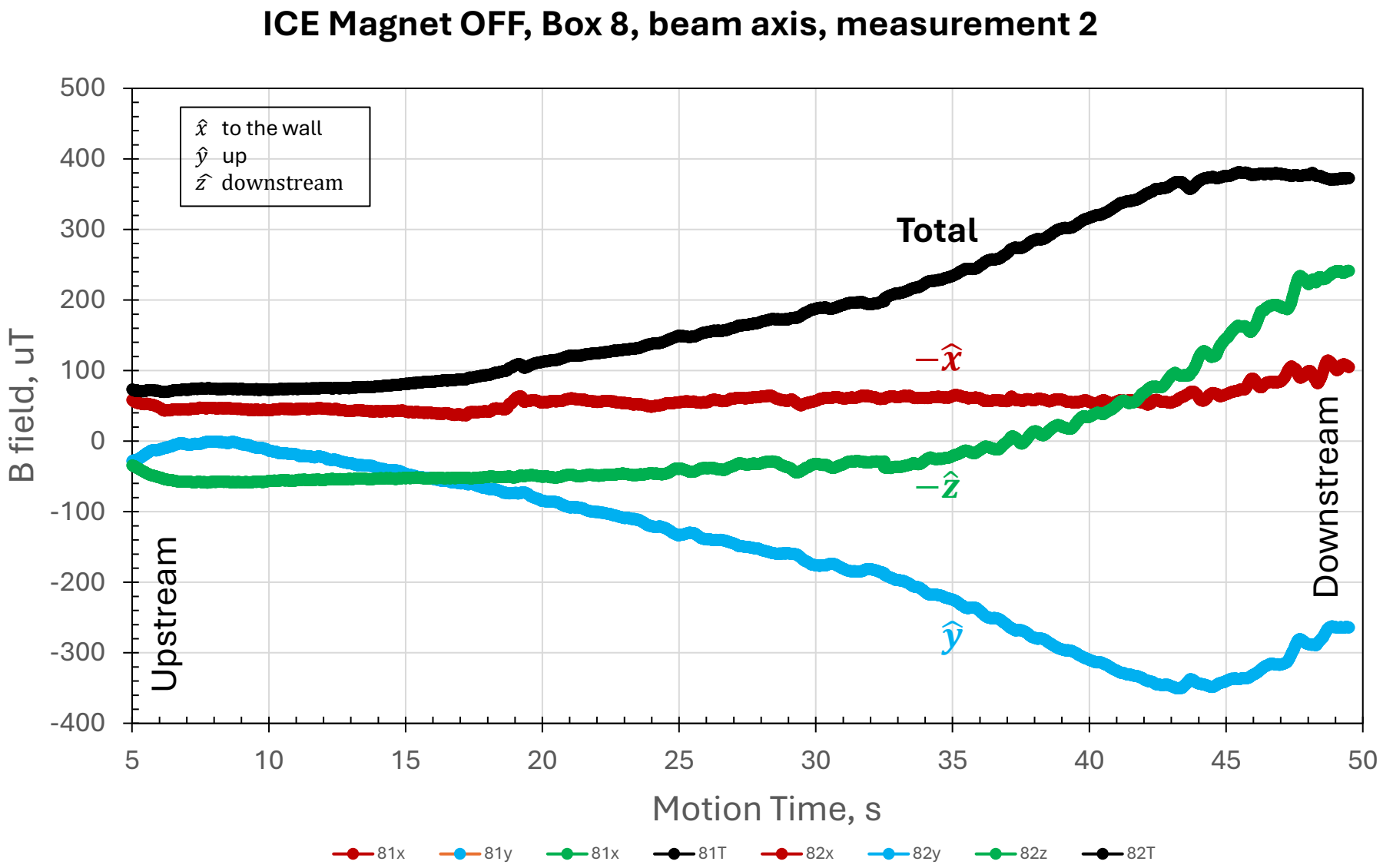


Consistent with old magnetization

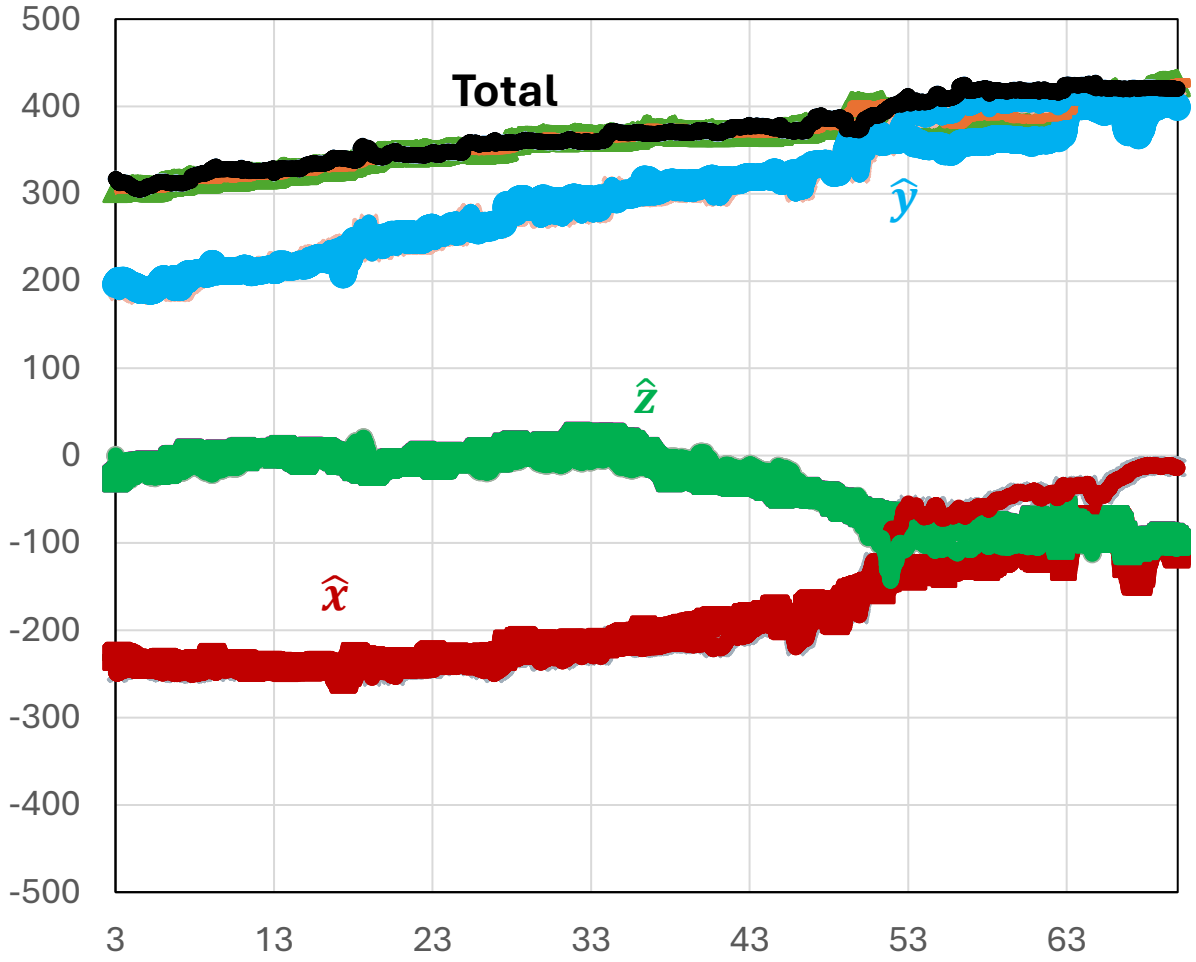
New ICE 5T magnet in the hall is OFF after ON



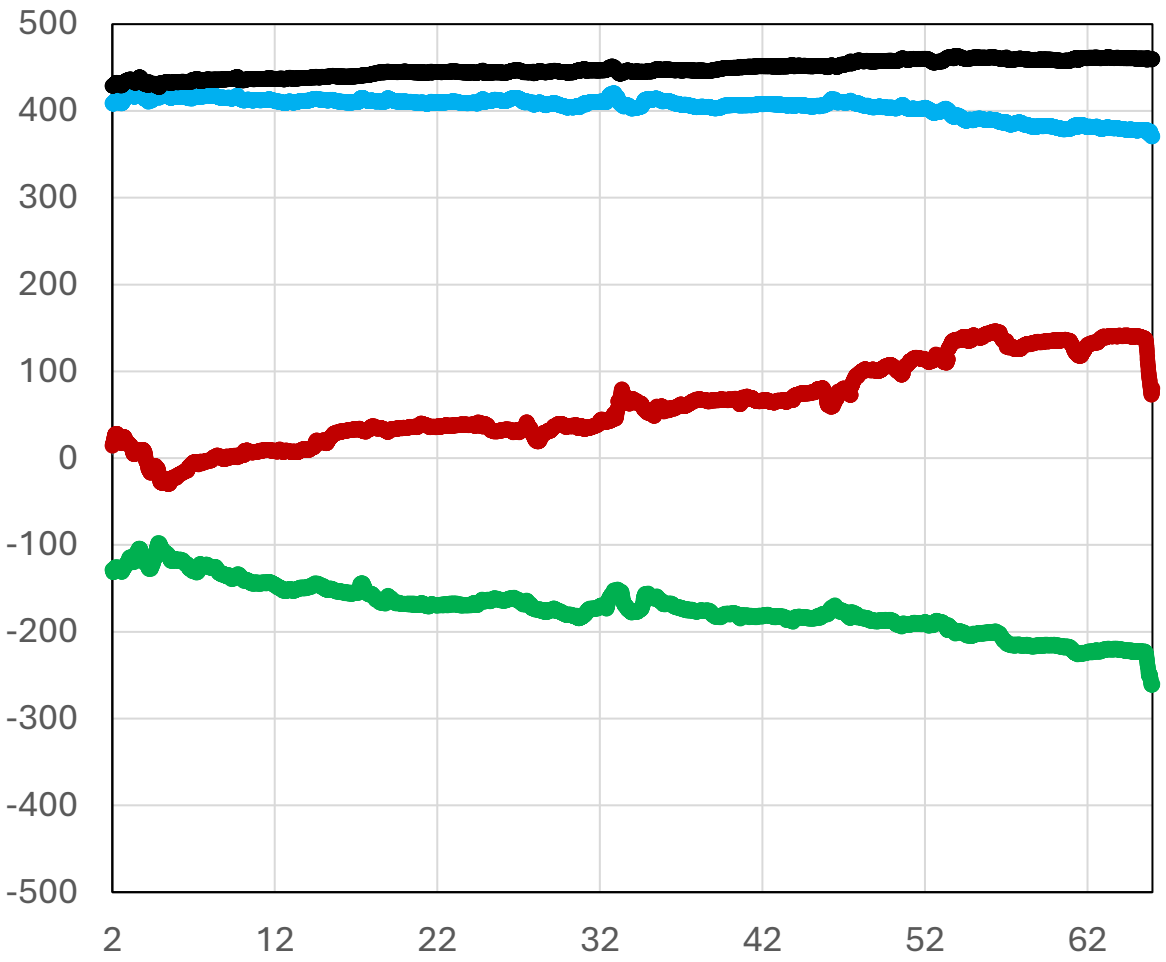
New ICE 5T magnet in the hall is OFF after ON



Two scans in Box 7 beam axis ICE is ON



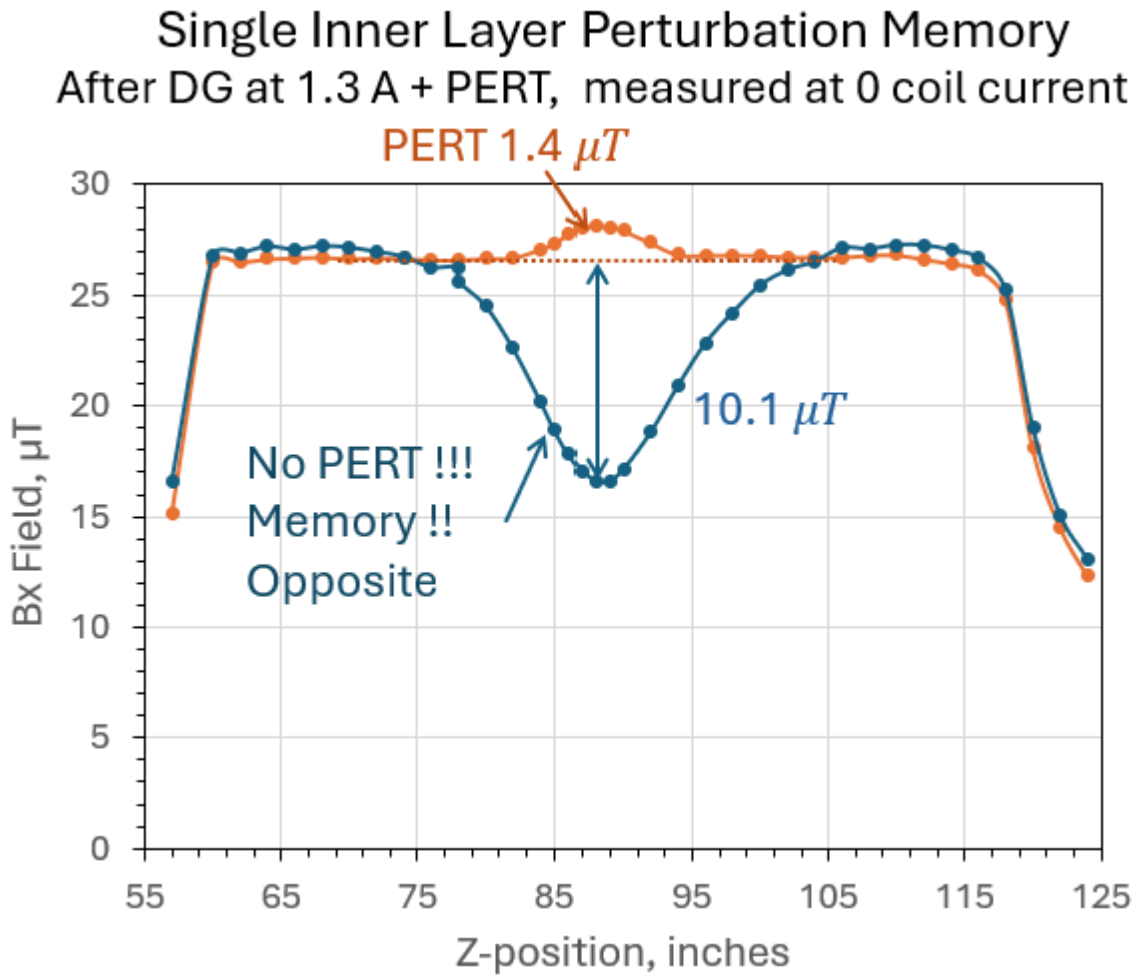
Scan in Box 8 beam axis ICE is ON



Also, between GP-SANS and Bio-SANS Total field is ~ 10 Gauss

Magnetic Memory of μ metal

- Degaussing of mu-metal should be performed with the magnet and perturbation state close to operational !
- Our standard mode of degaussing should be with all PERT and average $\vec{B}$
- In degaussing the shielding remembers the perturbation with opposite sign →



Summary of shielding factors from μ-prototype

All measurements are after standard degaussing with coil current 1.3 A (~ 25 Gauss)

Configuration	Diameter, inch	Eff, Thick, mm	Seen PERT μT	SF	"μ_{eff}"
1μ inner layer	7.5	0.46	16.1±1.8	32.6± 3.8	13,317
2μ inner layer	7.6	0.90	4.51 ± 0.61	116.2±16.1	24,050
1μ outer layer	9.0	0.38	27.6 ± 3.7	19.0±2.6	11,220
2μ outer layer	9.1	0.76	7.9 ± 1.1	66.3±9.4	19,794

Double layer seems have higher μ probably due to effective space between these layers
Layer thickness calculated effectively accounting for sheets overlay

- Two double-shield layers configuration was not measured for SF in mu-prototype:
  - no enough mu-metal was available
  - field suppression would be too small to be measured

Combining shielding factor of inner and outer layers

Gubser's formula

Single Layer Equation

$$S_i^T = \frac{\mu_i t_i}{2R_i}$$

Dual Layer Equation

$$S_i^T = S_1 + S_2 + (S_1 * S_2) * \left(1 - \left(\frac{R_1}{R_2}\right)^2\right)$$

Multi-Layer General Formula

$$S = 1 + \sum_{i=1}^{n} S_i^T + \sum_{i=1}^{n-1} \sum_{j>i}^{n} S_i^T S_j^T \left[1 - \left(\frac{R_i}{R_j}\right)^2\right] + \sum_{i=1}^{n-2} \sum_{j>i}^{n-1} \sum_{k>j}^{n} S_i^T S_j^T \left[1 - \left(\frac{R_i}{R_j}\right)^2\right] \ldots\ldots$$

S_i: Shielding Factor for layer i. Where 1 is the innermost layer.

μ: Material permeability

t: Material thickness

R: Inside Radius

Let's take double two-layer

$$S_1 = SF_i = 116$$

$$S_2 = SF_O = 66$$

$$SF_T = 4{,}400$$

This shielding factor are meeting nTMM requirements of field uniformity < 0.01 G for old and new perturbations.

- μ-prototype simulated via COMSOL should show similar SF in all configurations by tuning μ-values for outer and inner shields.

- These μ-values should be used in realistic geometry of experiment with all simulated perturbations to produce $\vec{B}$ (z) for realistic sensitivity.

- **Worst what could happen if during Sept 9-12 time ICE magnet will be switch on and off. On every such ON/OFF switching we will need to degauss our magnets. That means a beams stop for ~ 1 hour degaussing operation.**

Mubi Khan
University of Kentucky

August 18, 2026

	Configuration	Diameter, inch	Seen PERT μT	SF	μ_{eff}
only	1μ inner layer	7.5	16.1±1.8	32.6± 3.8	13,317
only	2μ inner layer	7.6	4.51 ± 0.61	116.2±16.1	24,050
only	1μ outer layer	9.0	27.6 ± 3.7	19.0±2.6	11,220
only	2μ outer layer	9.1	7.9 ± 1.1	66.3±9.4	19,794

Prototype measurement

SF	μ
32.72	9686.17
115.78	17035.40
19.60	7743.00
66.38	13186.33

From Comsol

- The formula for μ_{eff} is not accurate for our configuration. It was only used to get a ballpark idea of μ
- These values can be used to calculate the total Shielding Factor