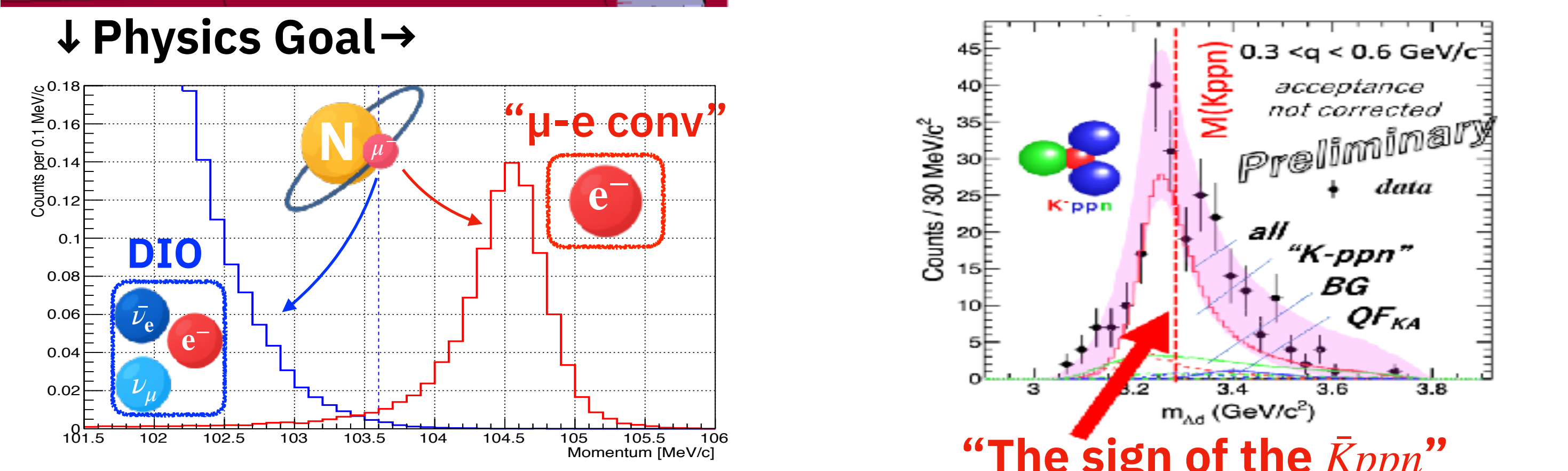
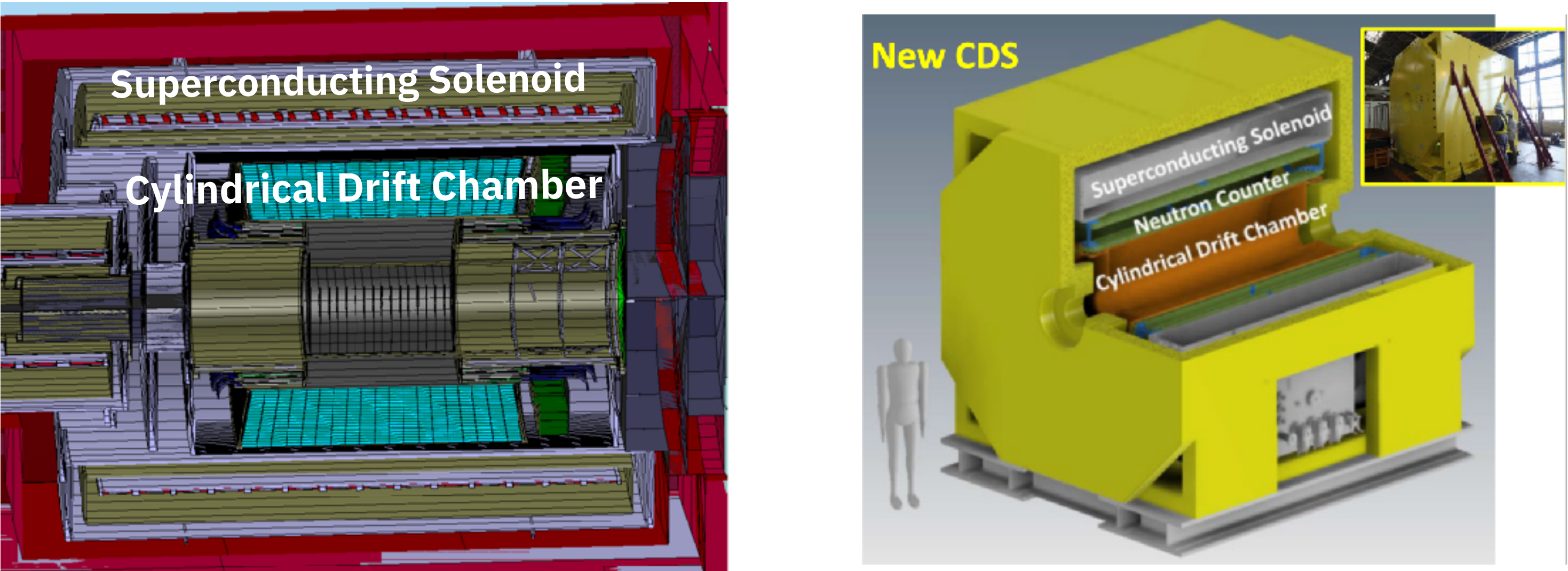


1. Introduction ~Spectrometer Magnets

COMET@J-PARC E80@J-PARC

μ -e conversion in a muonic atom Investigation of Anti Kaonic Nuclei

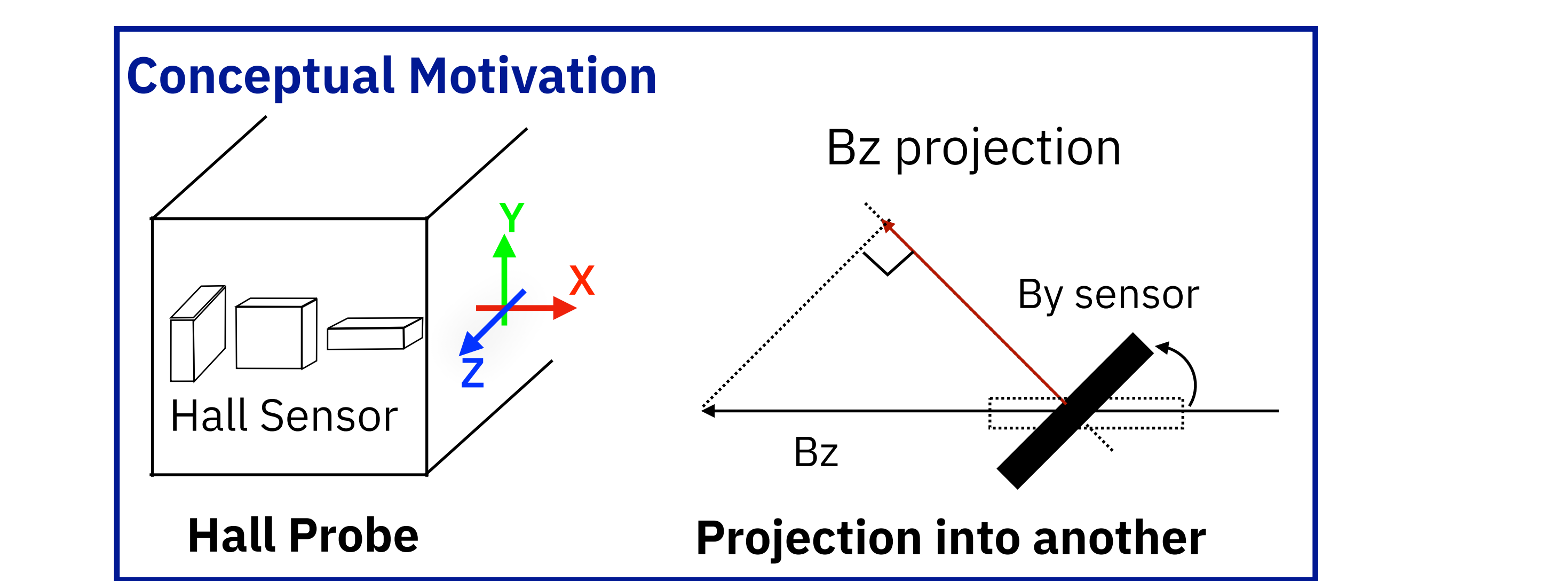


Both experiments use the spectrometer magnets with the same design.

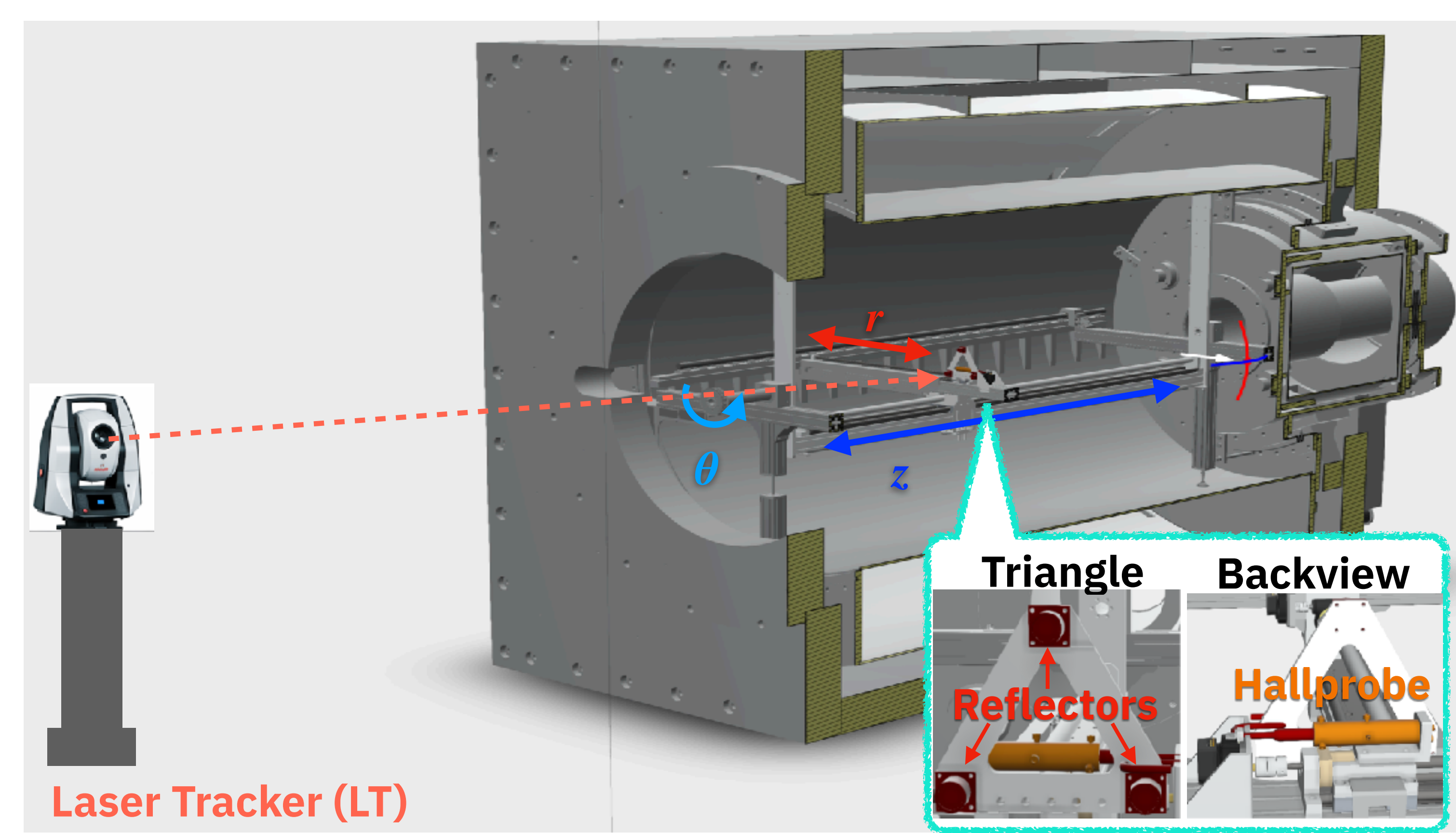
Coil Param		Magnet Param	
Material	NbTi/Cu	The number of coils	14
ratio(NbTi : Cu)	1 : 4.2 ± 0.5	Current	189 A
Wire Diameter	1.2 mm	Mag Filed w/ iron yoke	1.0 T
material length	7 km	Inductance	236 H
layer	7	Stored Energy	4.2 MJ
turns/layer	135	Total material length	98 km
RRR	184		
length	170 mm		
radius	1.07 m		

2. The Goal and Motivation

Measure the B-field with the order of 1e-4 T precision.
The tilt angle of Hallprobe degrades the precision.
→ we have to know angles with the precision of 0.1° (for this magnet)



3. Field Mapper System (FMS) overview

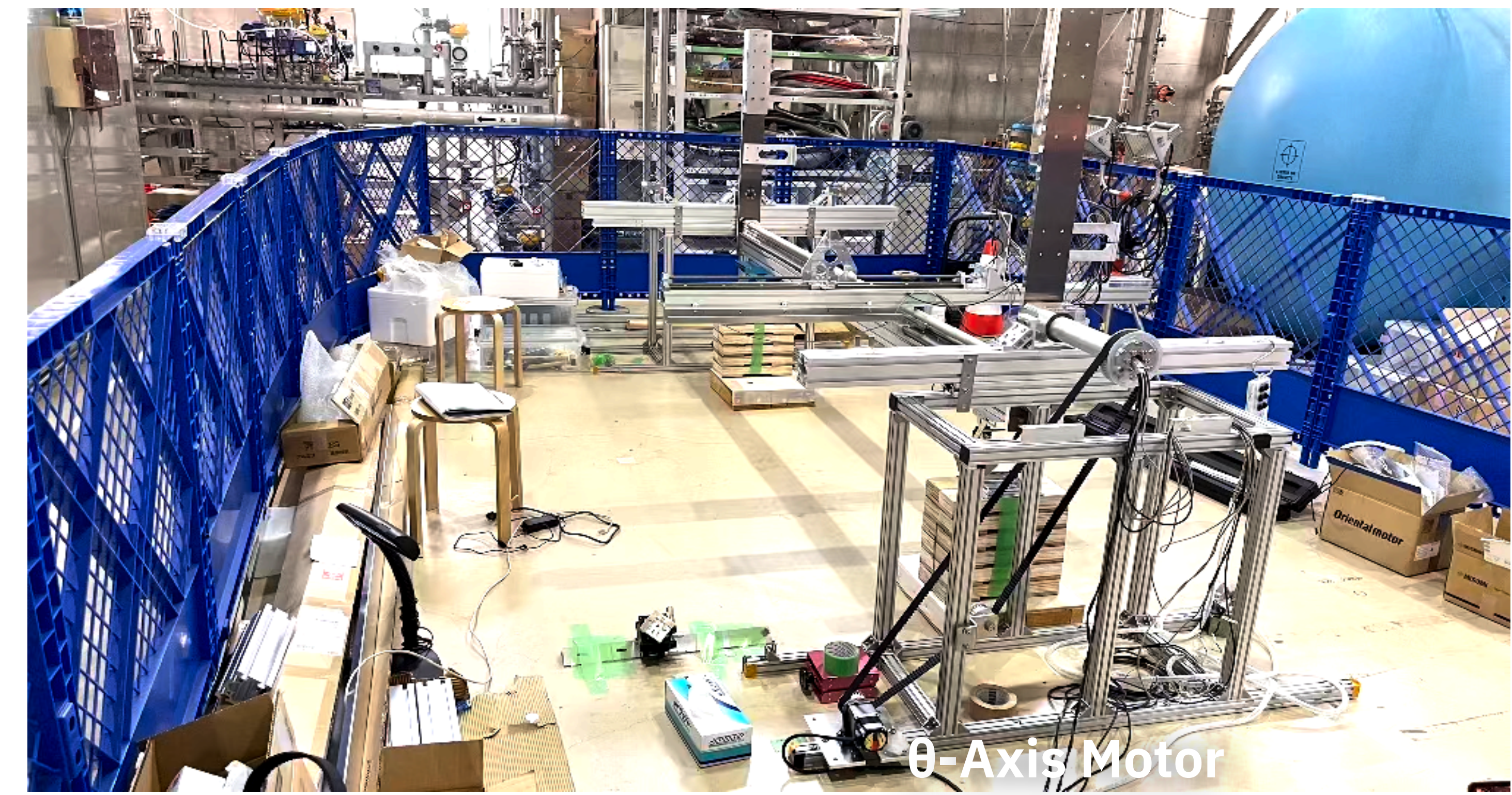


- Motor-driven structure**
 - r axis: ultrasonic motor
 - z axis: ultrasonic motor(w/ gear)
 - θ axis: stepping motor
- 3 reflectors**
 - 3 reflectors & a Hall probe are fixed to the triangle (side: 150 mm).
 - The orientation of the Hall probe can be measured.
- Operation Scheme**
 - Move motors→Point the laser to reflectors→Measure coords and B-field
 - The integrated control software automates all scheme.
 - It estimates the coords of each reflector from motor rotation count.

4. FMS Hardware

Requisites (for Hallprobe tilt angle Recon)

- Linearity == 100 μ m**
 - There're a certain amount of deadzone for LT
- Reproducibility == 1 mm**
 - mainly for E80, it closes its end cap



⚠ **Mechanical Instability**
For the deadzones, the coords are reconstructed from the interpolation.
→ The rigidity ($\doteq$ linearity) of the arm matters

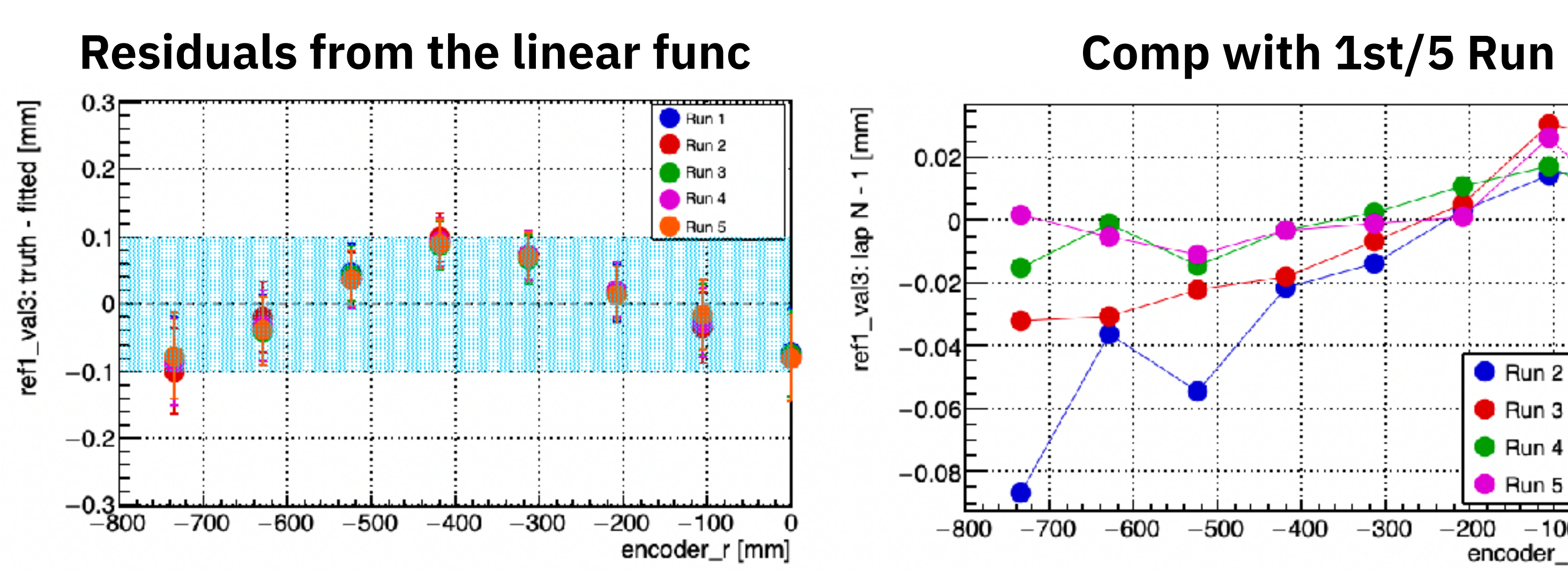
- ### Implementation History
- The timing belt (Shown above)**
 - The slipping btw the teeth
 - 0.5° of instability (== 8 mm at the edge)
 - The gear**
 - reached the target performance!

5. Performance Test

- ### The Method
- Experiment**
 - Scan R& θ axis 5times
 - The order: R scan → θ by 1 step → ... → (R by 100 mm, θ by 36°)
 - ※ Step forward along z and repeat above after rotating 360°
 - Analysis**
 - Compare with the 1st Run (reproducibility)
 - Linear Fitting each 3 coordinates along R axis (linearity)
 - ▶ The parameter is the encoder count (== pulses USM recieved)

The Result

※ The plots shown below are the analyzed data of the gravitational coords of LT at horizontal θ as a typicla plot
※ encoder_r = 0 → at the center of R, -800 → at the edge of R



In any θ , the residual of the linear fit and difference by runs fit within the target value.
Also any drifting behavior by runs has not been observed.

6. Summary

FMS has a live-position measurement function for the reconstruction of Hallprobe tilt angle.
The control software for automated operation has been developed.
The hardware commissioning has been successfully done.