Surveying and alignment of cryostats

11th KAGRA Face to face meeting

(Feb. 6, 2015)

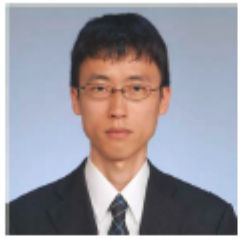
T. Kume and KAGRA cryogenics group

KAGRA Cryogenics Group

Toshikazu SUZUKI
Chief
KEK, Prof.

Takayuki TOMARU
Cryo-Payload
KEK, Assoc. Prof.

Shinichi TERASHIMA
Machining
KEK, Technical Staff



Yusuke SAKAKIBARA
Cryostat, Scattering
ICRR, Grad. Student

Dan CHEN
Cryo-Payload, Q
ICRR, Grad. Student

Nobuhiro KIMURA
Cryostat sub-chief
KEK, Assoc. Prof.

Tatsuya KUME
Surveying, Alignment
KEK, Assoc. Prof.

Iwao MURAKAMI
Welding, Assembly
KEK, Technical Staff

Hiroki TANAKA
Cryo-Payload, Q
ICRR, Grad. Student

Takahiro MIYAMOTO
Cryo-Payload
ICRR, Grad. Student

Kazuhiro YAMAMOTO
Cryo-Payload sub-chief
ICRR, Assist. Prof.

Rahul KUMAR
Simulation, Payload
KEK, PD

Ayako HAGIWARA
CAD
KEK, Technical Staff

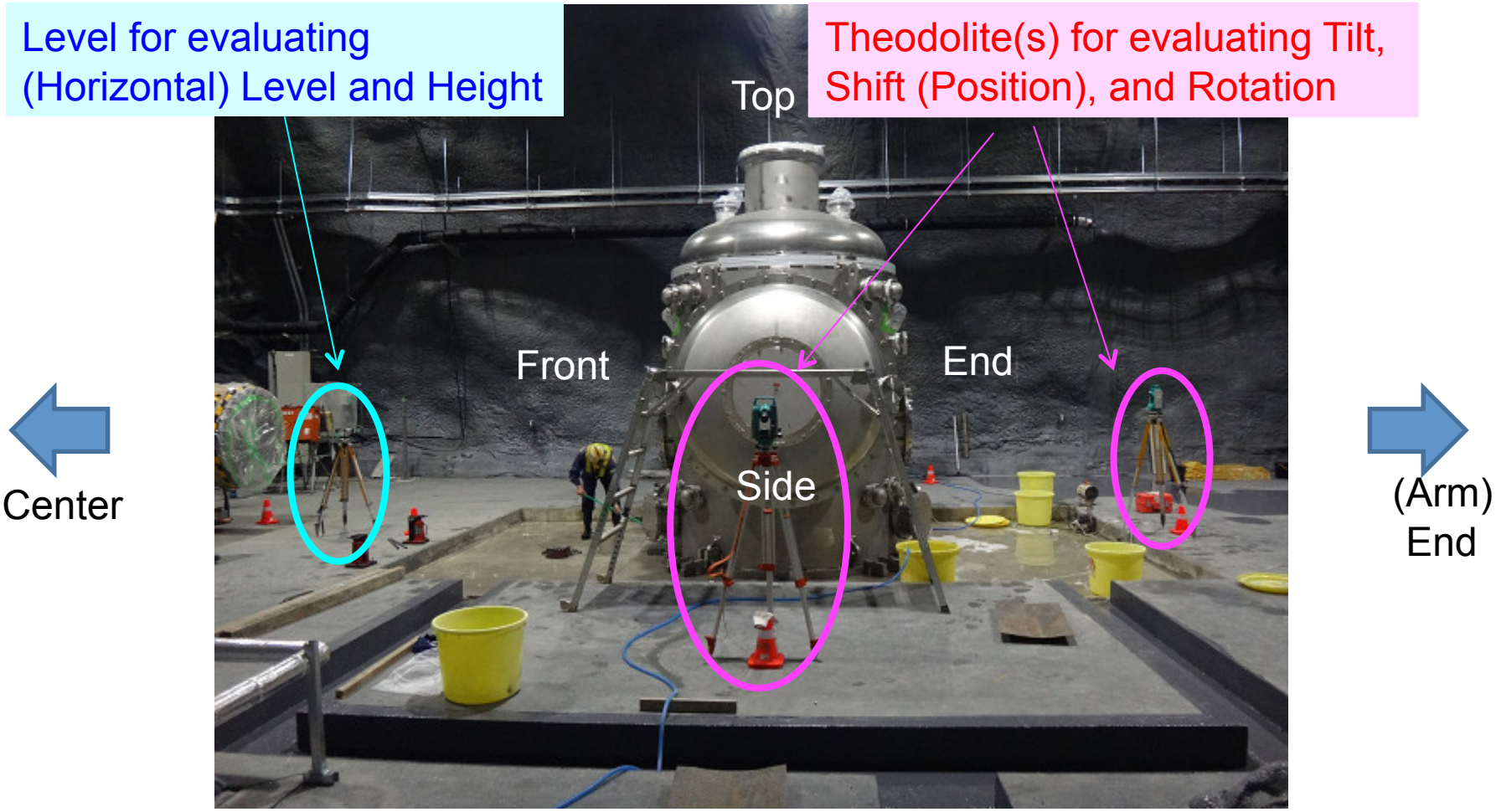
Rookie

Suguru TAKADA
Cryogenics
NIFS, Assist. Prof.

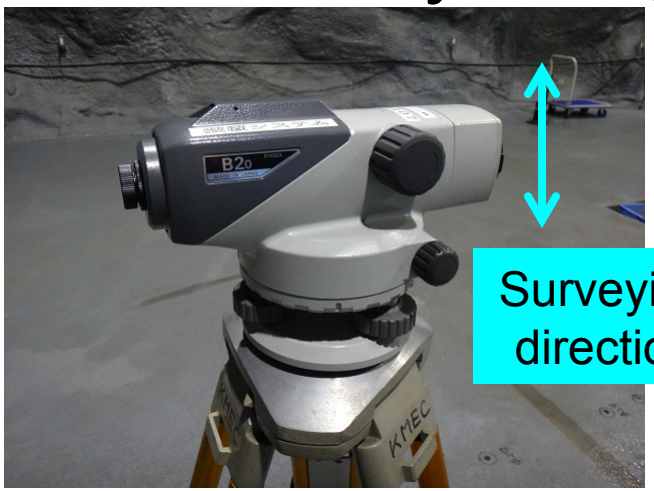
2 Cryostats on both ends of 2 arms

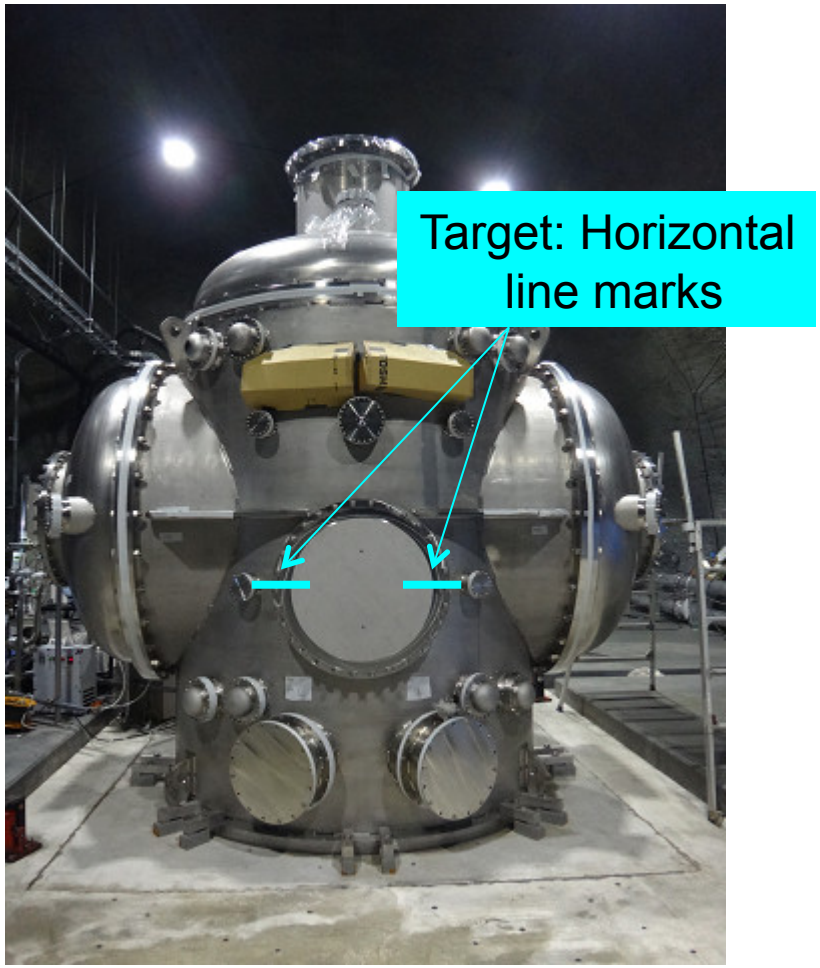
Surveying and alignment of the cryostats

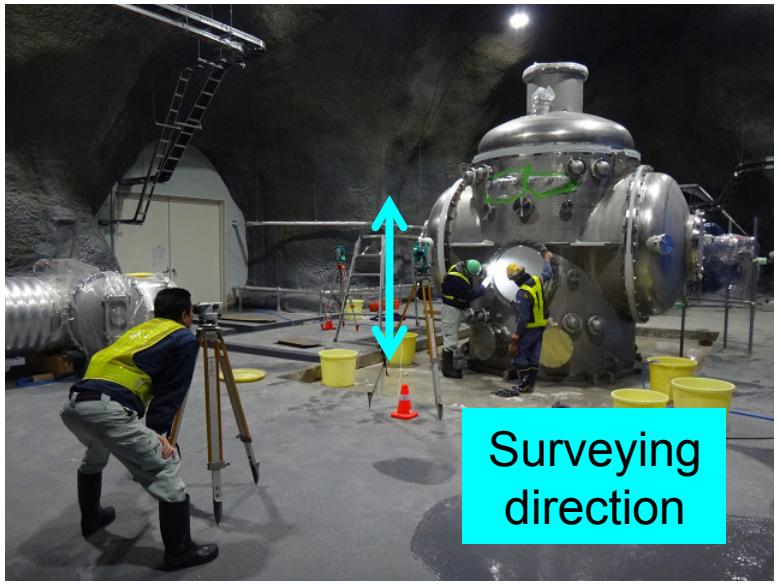
(Jan., 2015, X, Y-ends)



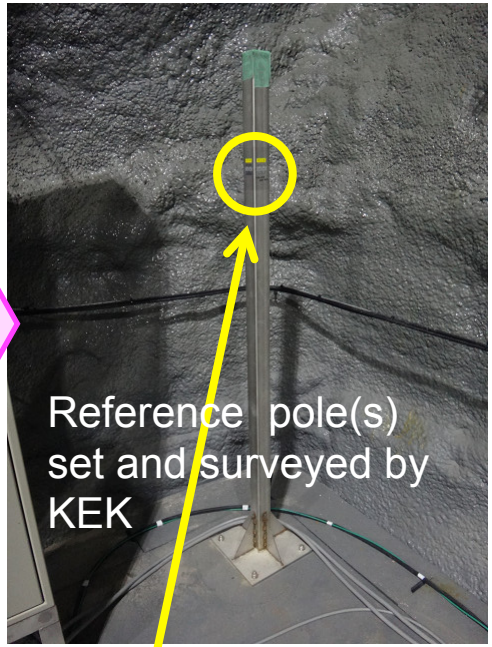
Height and Horizontal level survey by using a level







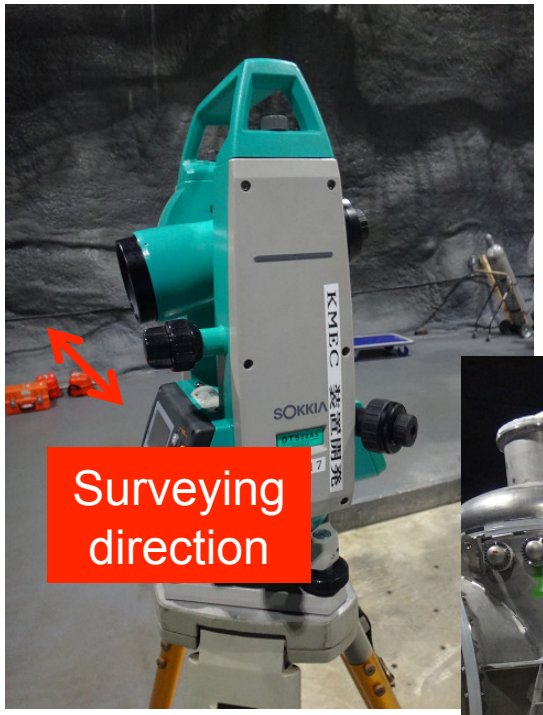
Height (Altitude) reference(s)

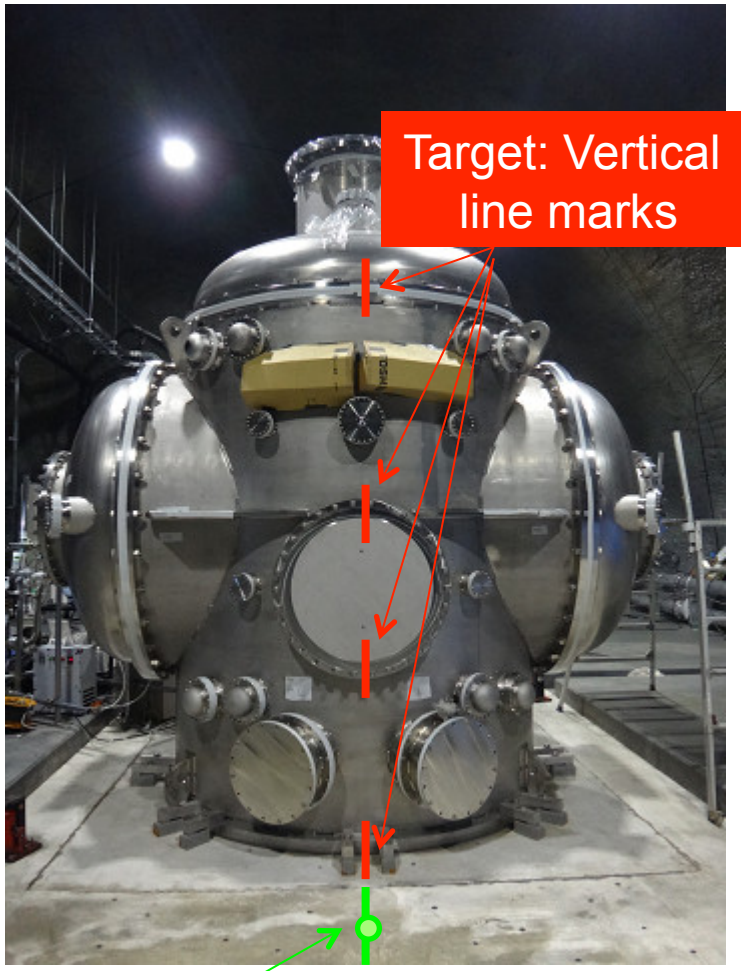


- Absolute height (Altitude) of the pins had been surveyed by Kajima.
- Relative height between the pin and the pole had been surveyed.

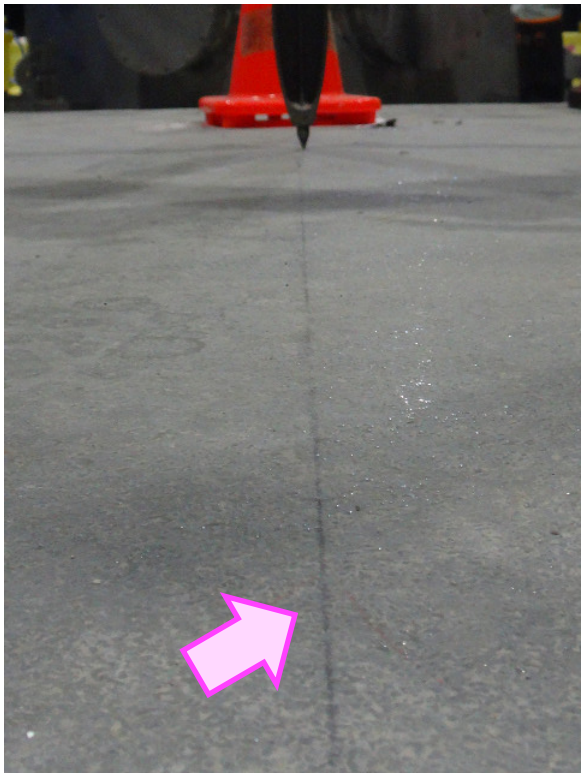
Absolute heights (Altitudes) of the sticker marks can be obtained.

Tilt and position survey by using a theodolite

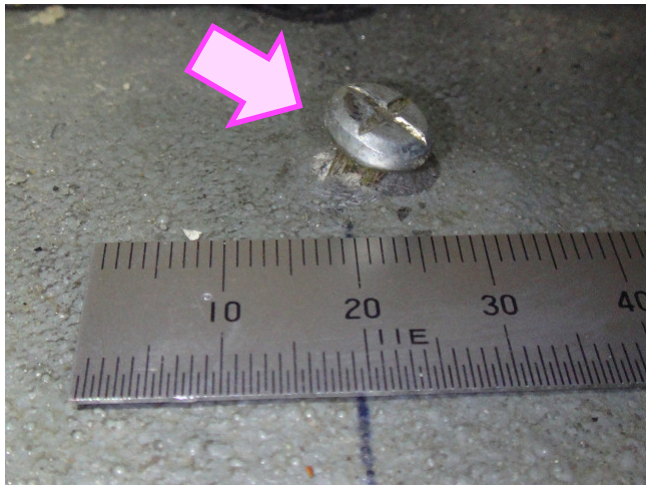




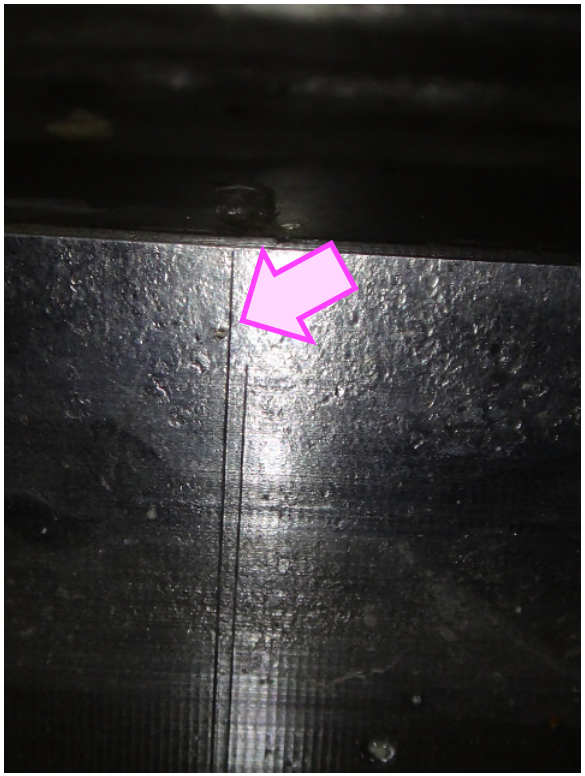
References and target markers for surveying by using a theodolite



Marker line drawn on floor
by MESCO, installer



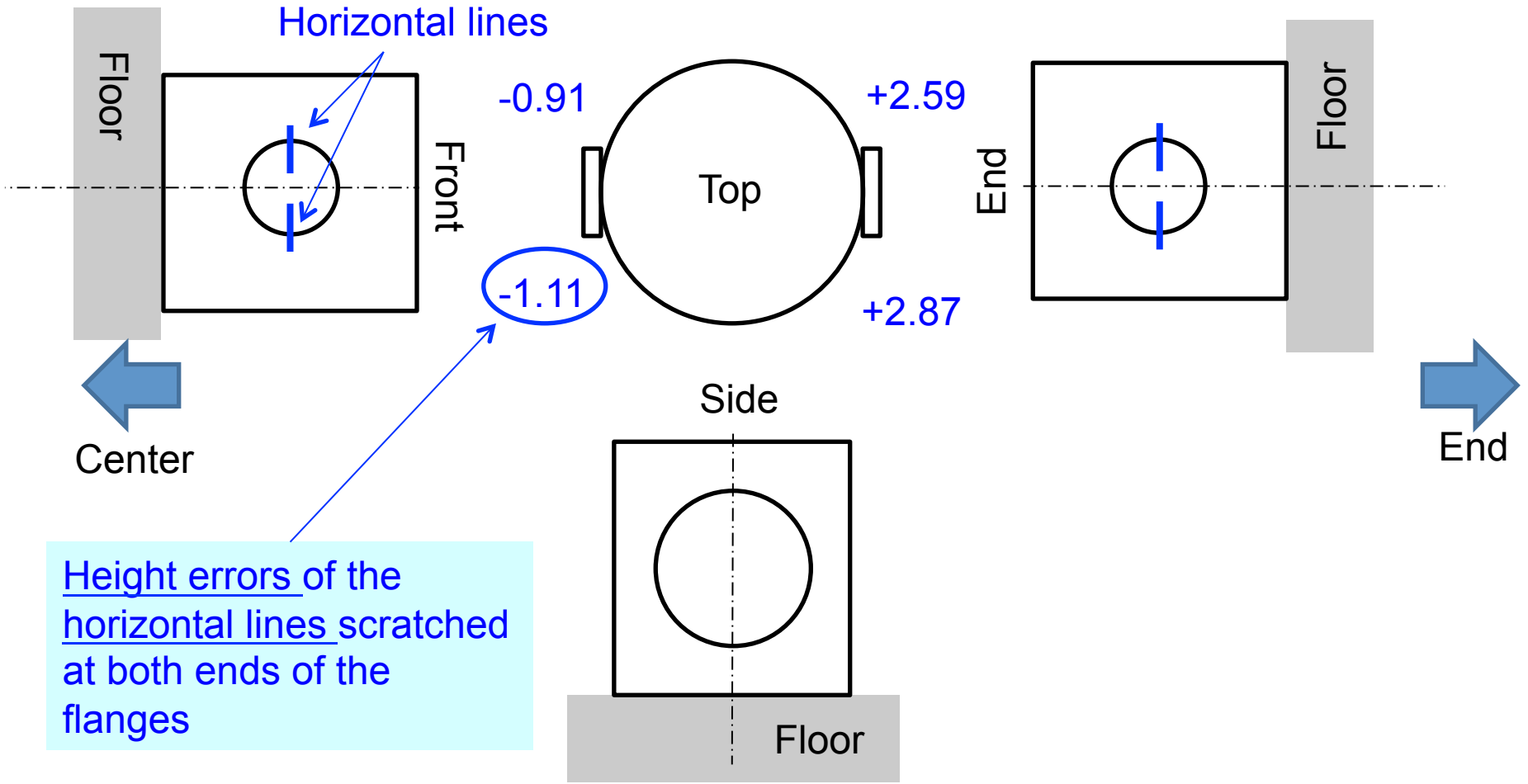
Marker pin knocked on floor
by MESCO



Marker line scratched
on the cryostat
by Toshiba, manufacturer

Initial errors [mm]

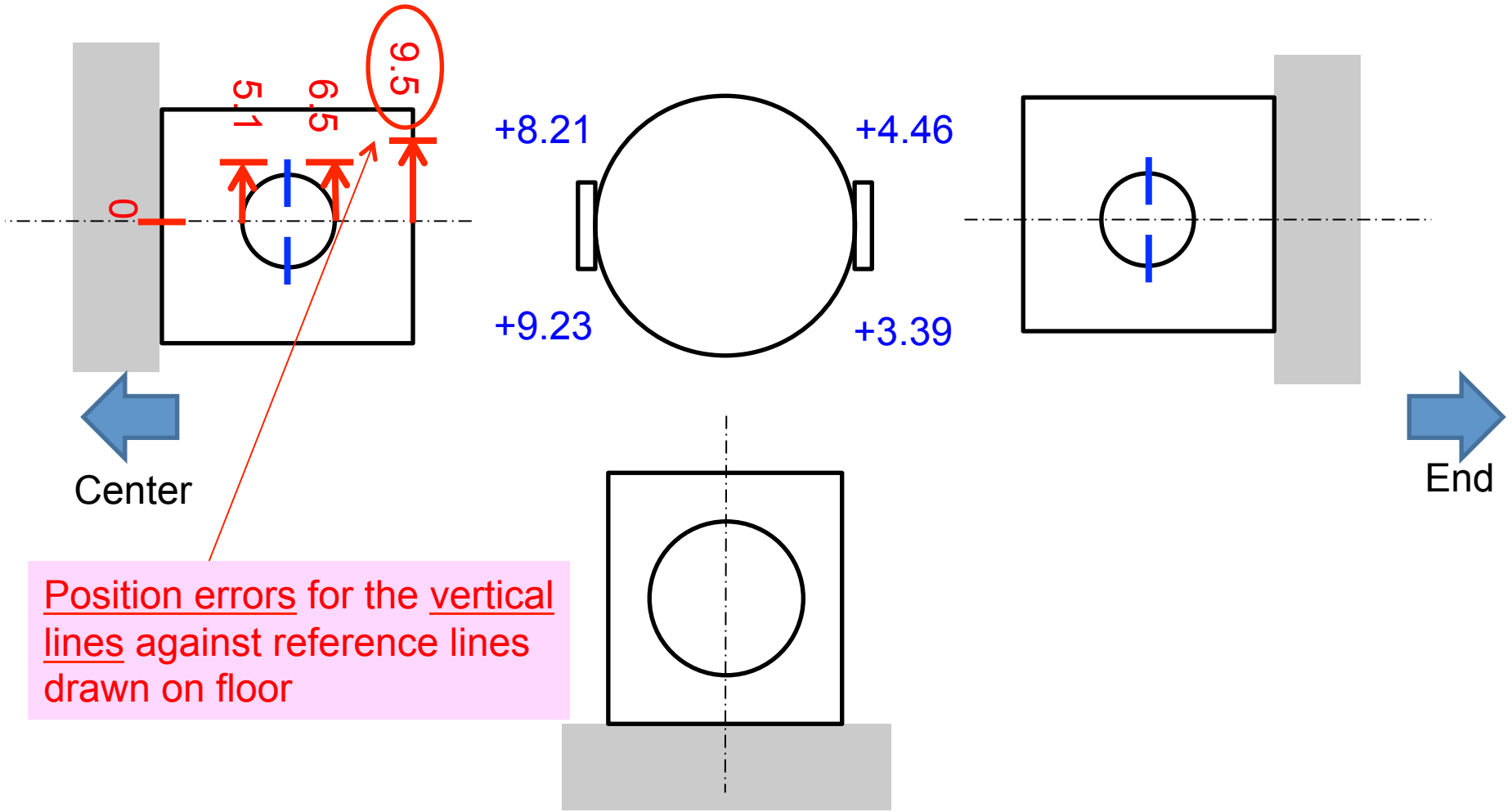
(X-end, Nov., 2014)



Height errors of the horizontal lines scratched at both ends of the flanges

Initial errors [mm]

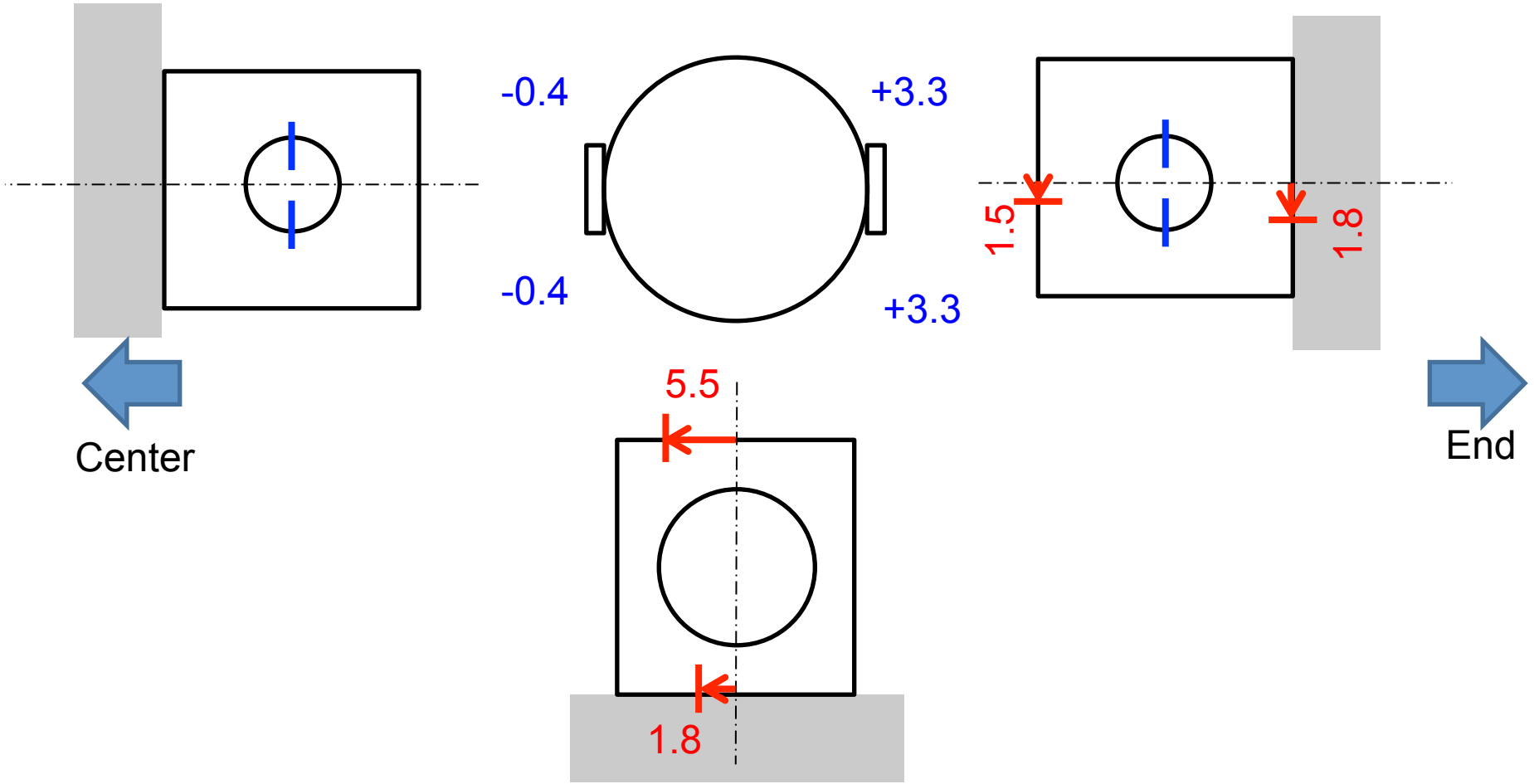
(Y-end, Oct., 2014)



Position errors for the vertical lines against reference lines drawn on floor

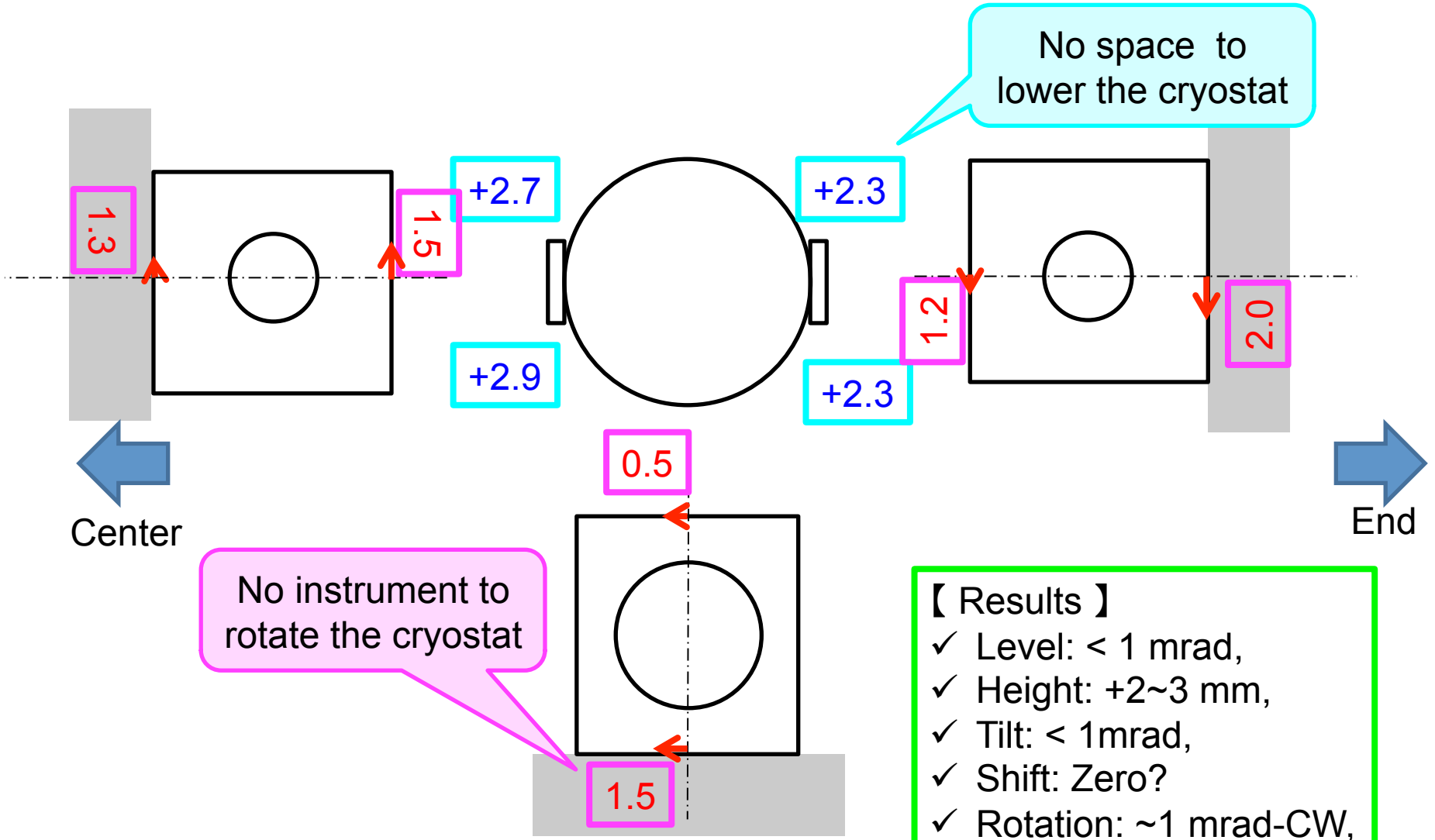
Errors before alignment [mm]

(X-end, Jan. 19, 2015)



Errors after alignment [mm]

(X-end, Jan. 19, 2015)

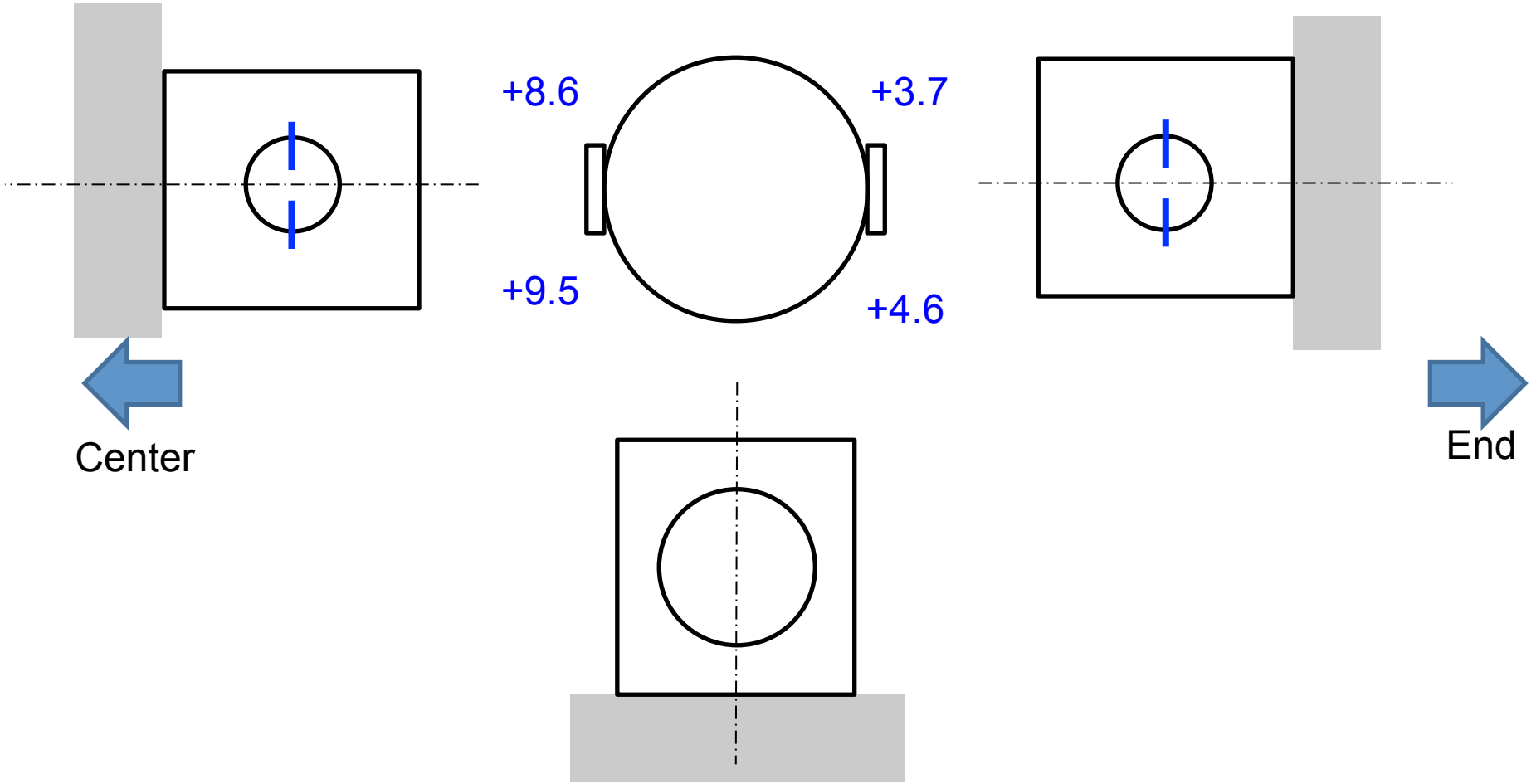


【 Results 】

- ✓ Level: < 1 mrad,
- ✓ Height: +2~3 mm,
- ✓ Tilt: < 1mrad,
- ✓ Shift: Zero?
- ✓ Rotation: ~1 mrad-CW,

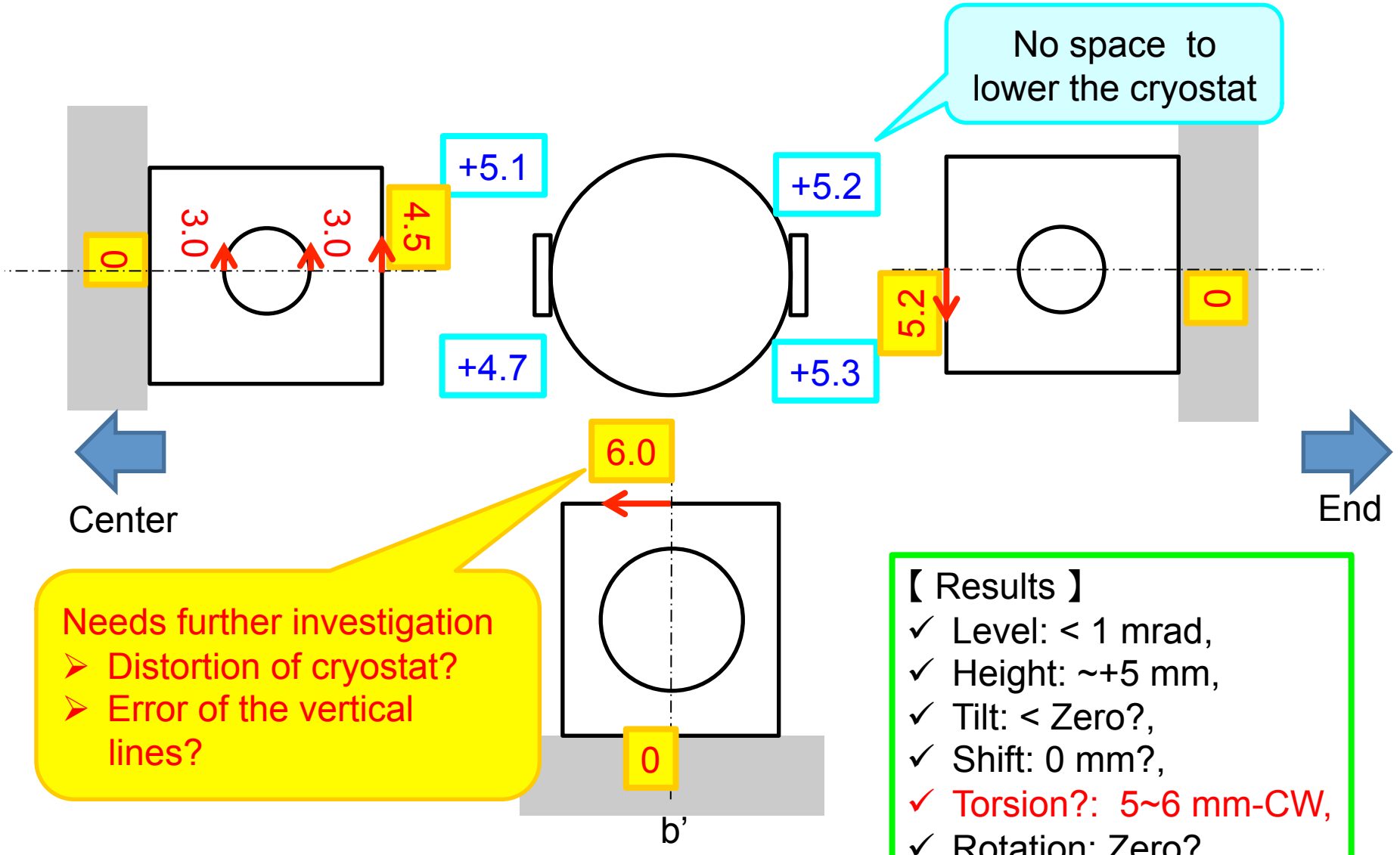
Errors before alignment [mm]

(Y-end, Jan. 23, 2015)



Errors after alignment [mm]

(Y-end, Jan. 23, 2015)



【 Results 】

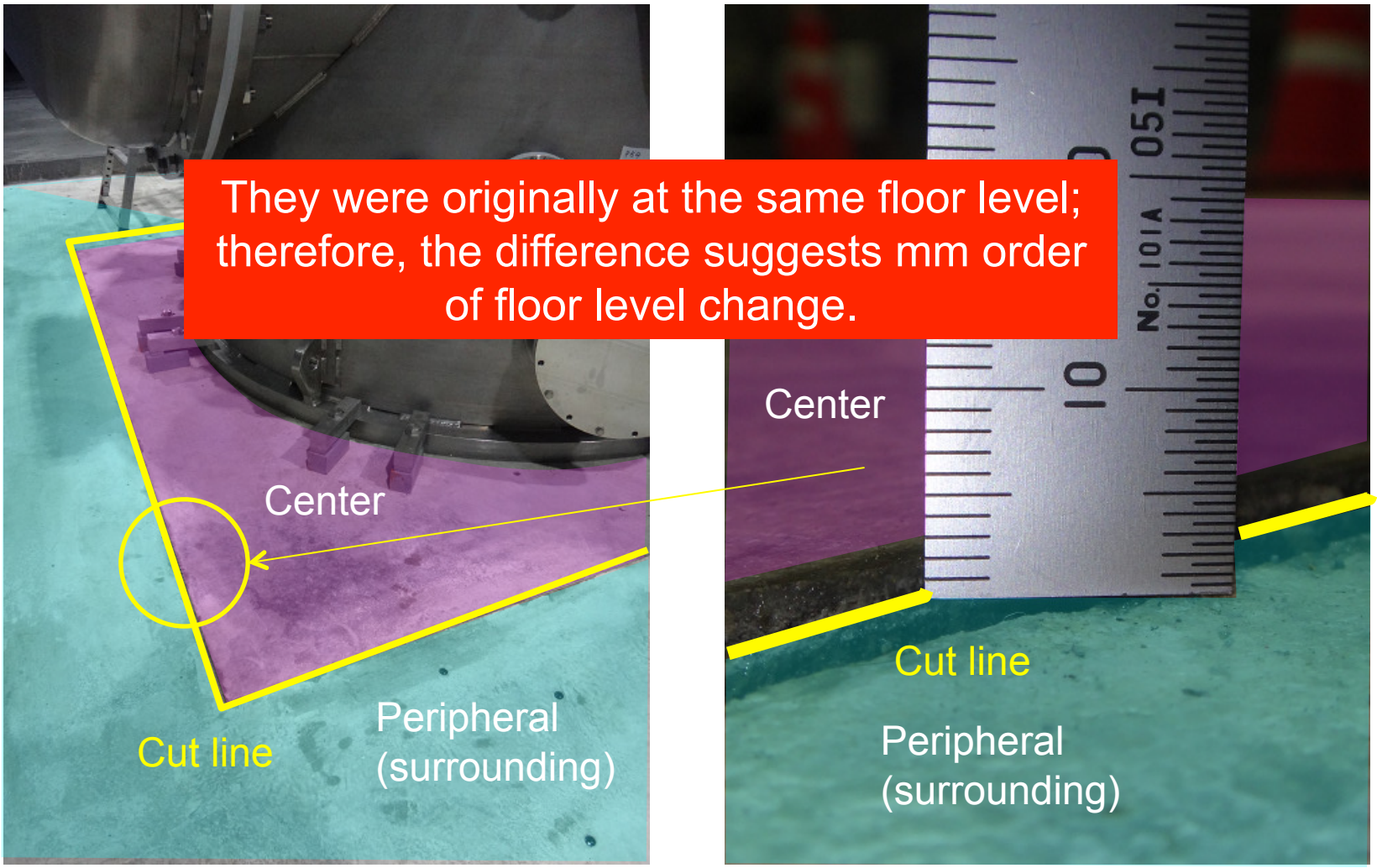
- ✓ Level: < 1 mrad,
- ✓ Height: ~+5 mm,
- ✓ Tilt: < Zero?,
- ✓ Shift: 0 mm?,
- ✓ Torsion?: 5~6 mm-CW,
- ✓ Rotation: Zero?

Summary: Errors after alignment [mm]

(X, Y-end, Jan. 23, 2015)

	X-end	Y-end
Requirements	Sub-mm (< 1 mm, < 1 mrad)	
Level	< 1 mrad	< 1 mrad
Height	+2~3 mm	+5~6 mm
Shift	Zero?	Zero?
Tilt	< 1 mrad	<1 mrad?
Rotation	~1 mrad-CW	<1 mrad?
Other(s)	-	5~6 mm of torsion?
Judge	So-so, Rotation and Height alignment	Further investigation

Step (floor height difference) along the cut line on floor (Y-end, Jan. 23, 2015)



Example for the floor, on which the cryostat had been set at the Y-end, there can be observed 2～3 mm of step. The center is higher than the peripheral.

Plan (Survey and alignment)

- Cryostats installed at X and Y Front (Feb., 2015)
- Duct-shields (Feb.-Mar., 2015 and 2016)
- Cryo−Payloads (FY2016-2017)
- Total cryo-system (construction-maintenance?)