Measurement of 3D position of the iKAGRA BS mirror and the BS vacuum chamber

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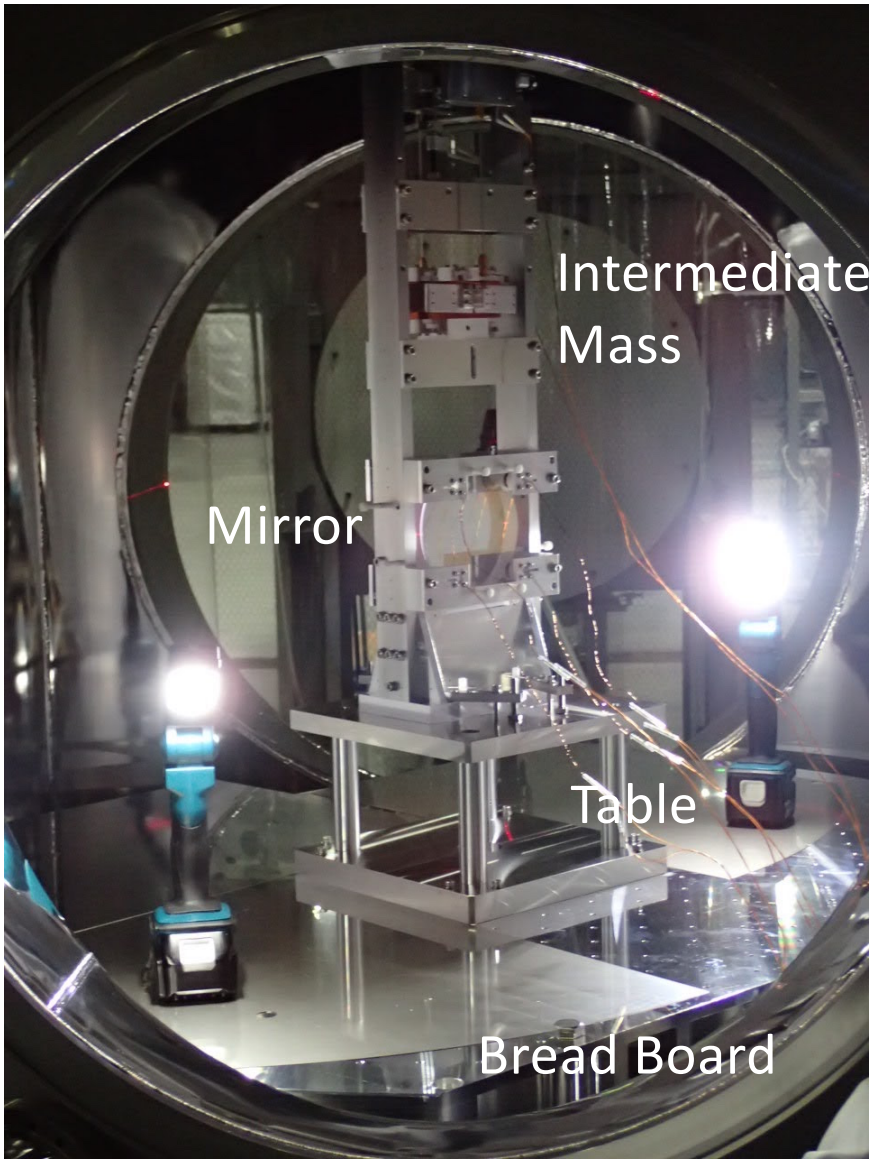
   - Mirror: was located (-1.6mm, -6.2mm, -6.5mm) with reference to the vacuum chamber
   - Vacuum chamber: was located +9.5mm in y axis and rotated 0.4deg clockwise as viewed from above. with reference to the 2 floor points (y+, y-).
4. Summary

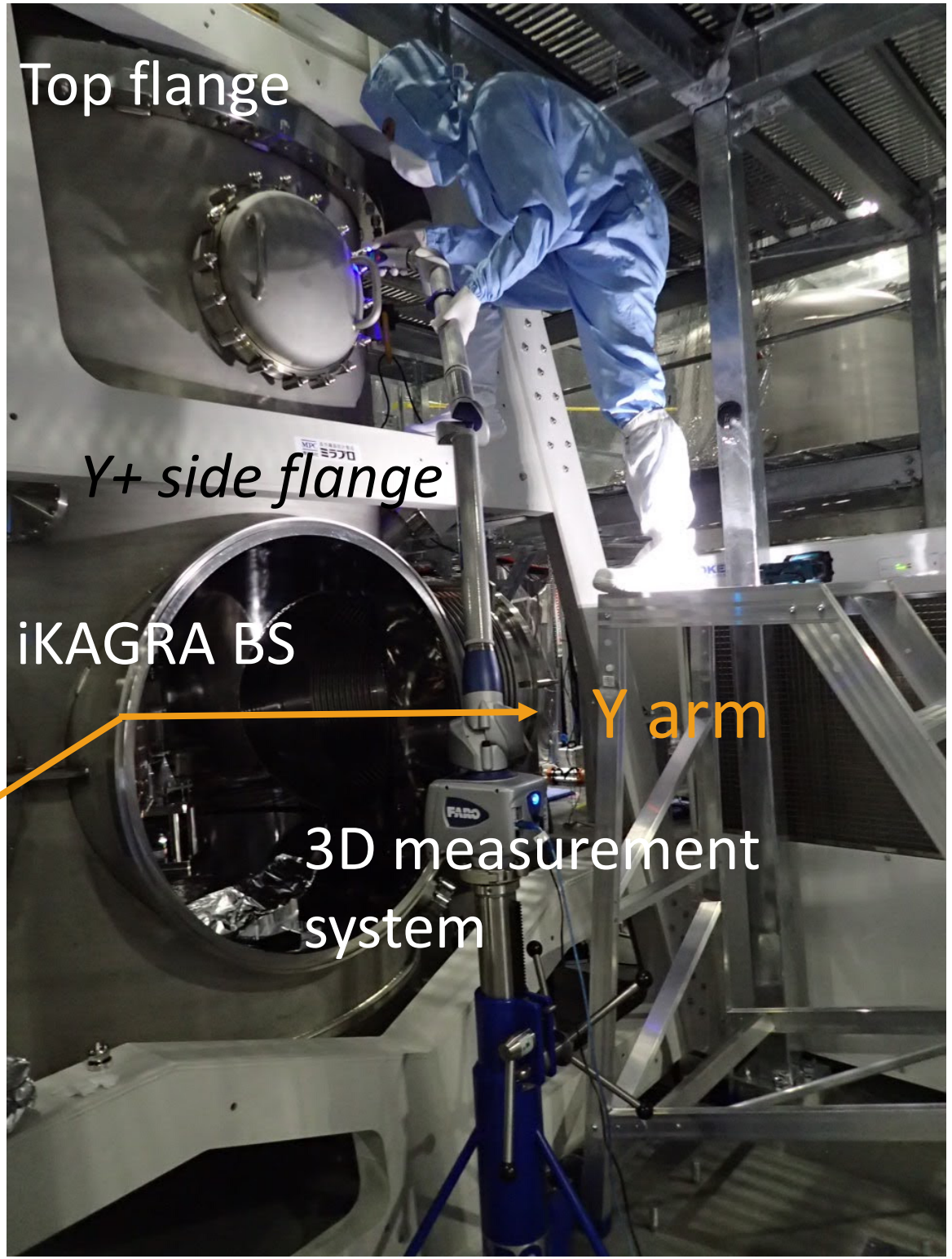
iKAGRA BS suspension

(double pendulum)

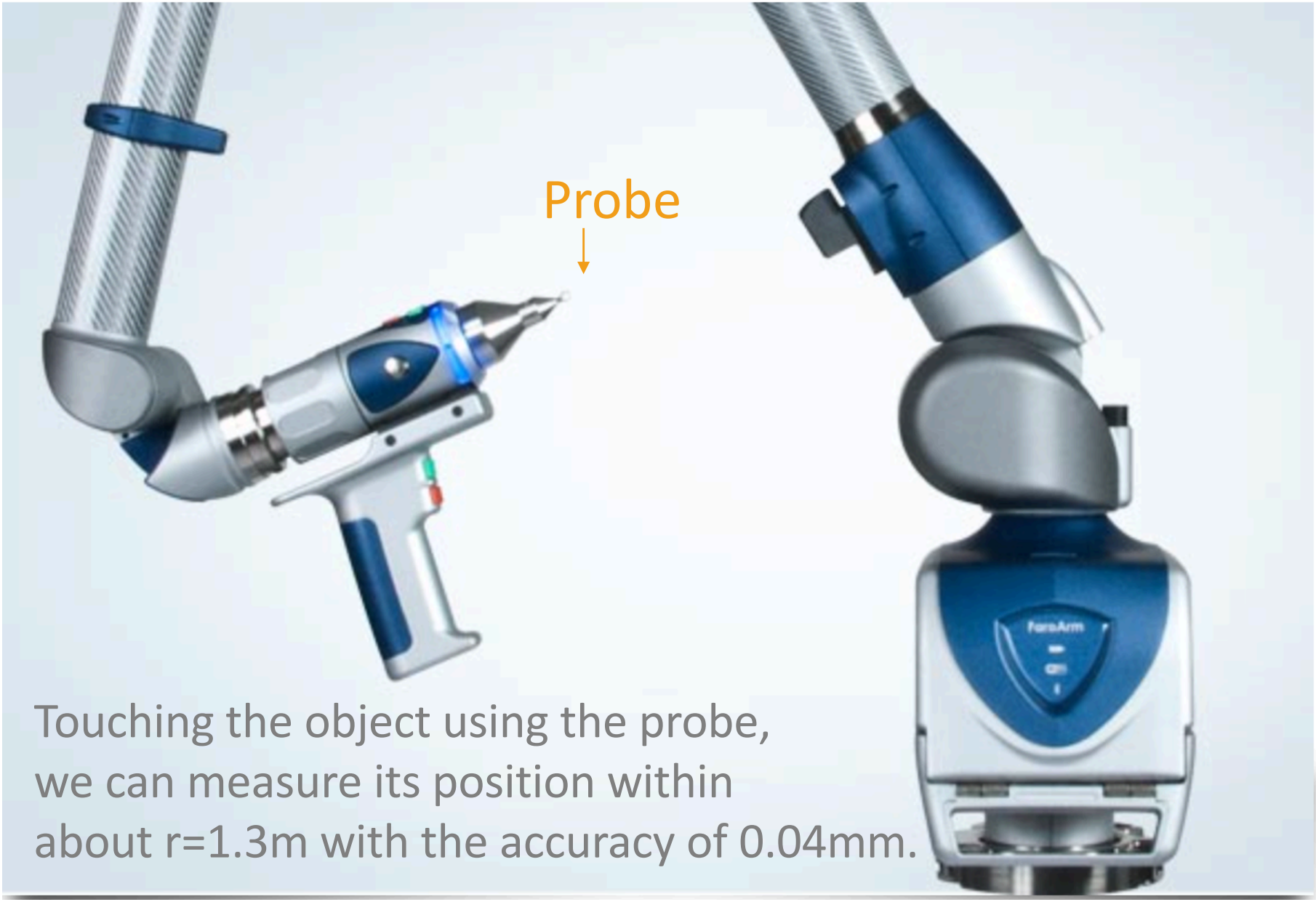
Floor points were used as position reference.
Vacuum chamber was not used as reference.



BS chamber

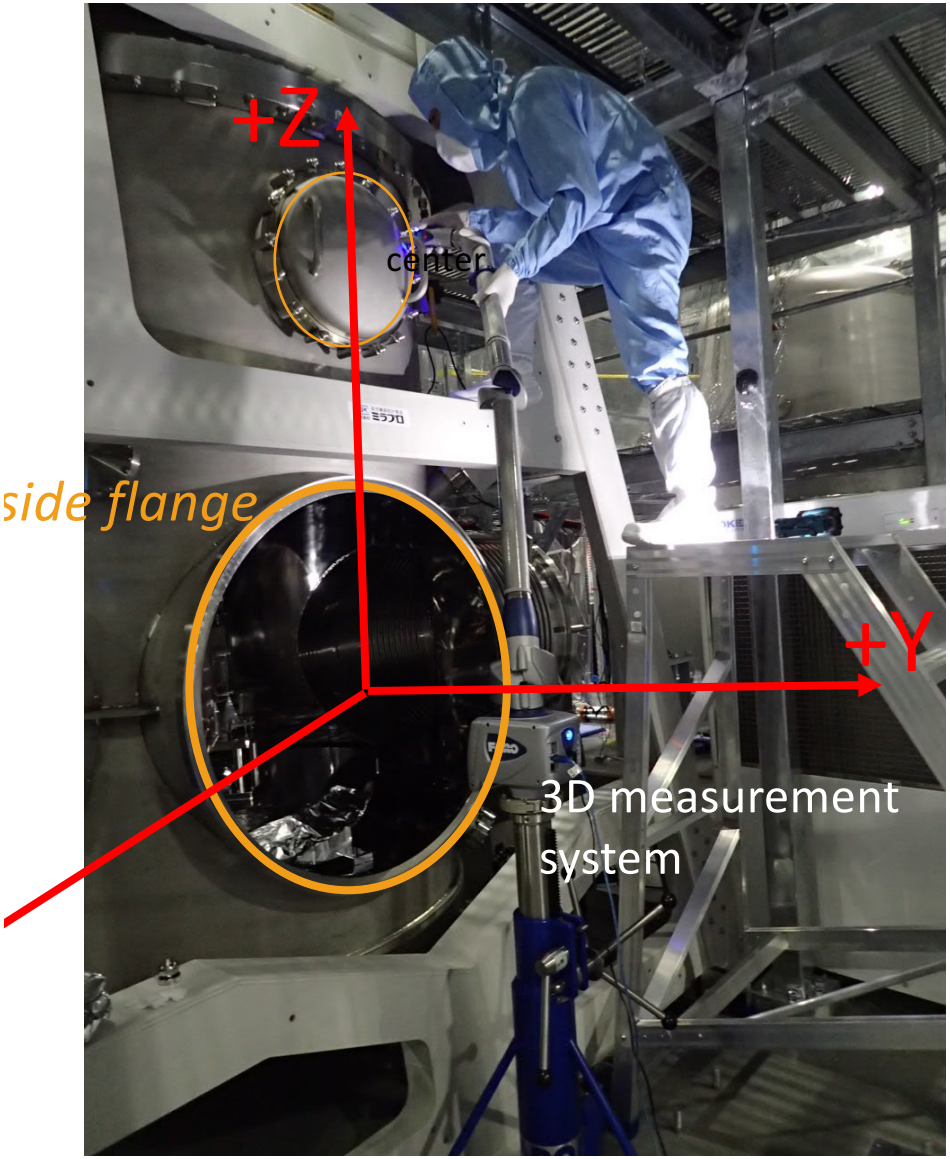

Top flange
Y+ side flange
iKAGRA BS
Y arm
3D measurement system
X arm

2. 3D measurement system



Touching the object using the probe,
we can measure its position within
about r=1.3m with the accuracy of 0.04mm.

Coordinate



1. Measure the Y+ side flange plane. Make it XZ plane.
2. Measure the outer circumference of the Y+ side flange as a circle and define its center as the origin of the coordinate.
3. Measure the periphery of the upper small flange and define its center.
4. Set a line coming from the center of the side flange to it of the upper small flange as Z axis.

3. Results:

	x [mm]	y [mm]	z [mm]	i	j	k	r	err
y+ side flange	0	0	0	-	-	-	1,078.6 (1,080)	
small y+ flange	0	0	1,100.1 (1,100)	-	-	-	449.7 (450)	
y+ floor datum point	-16.8 0.0	1,140.8 1,150	-1,196.9P -1,200+3	-	-	-	-	
BreadBoard	-	-	-396.7	0.003	0.001	1.000	-	
Table	-0.4	-637.8	-396.7	0.707	0.707	0.001	-	
Frame	15.7	-729.9	-206.6	0.722	0.692	0.001	-	
Mirror	-32.1P -30.4	-826.0P -819.6	-6.8 0	-0.713 -0.707	0.701 0.707	0.001 0.000	156.0P 156.0	

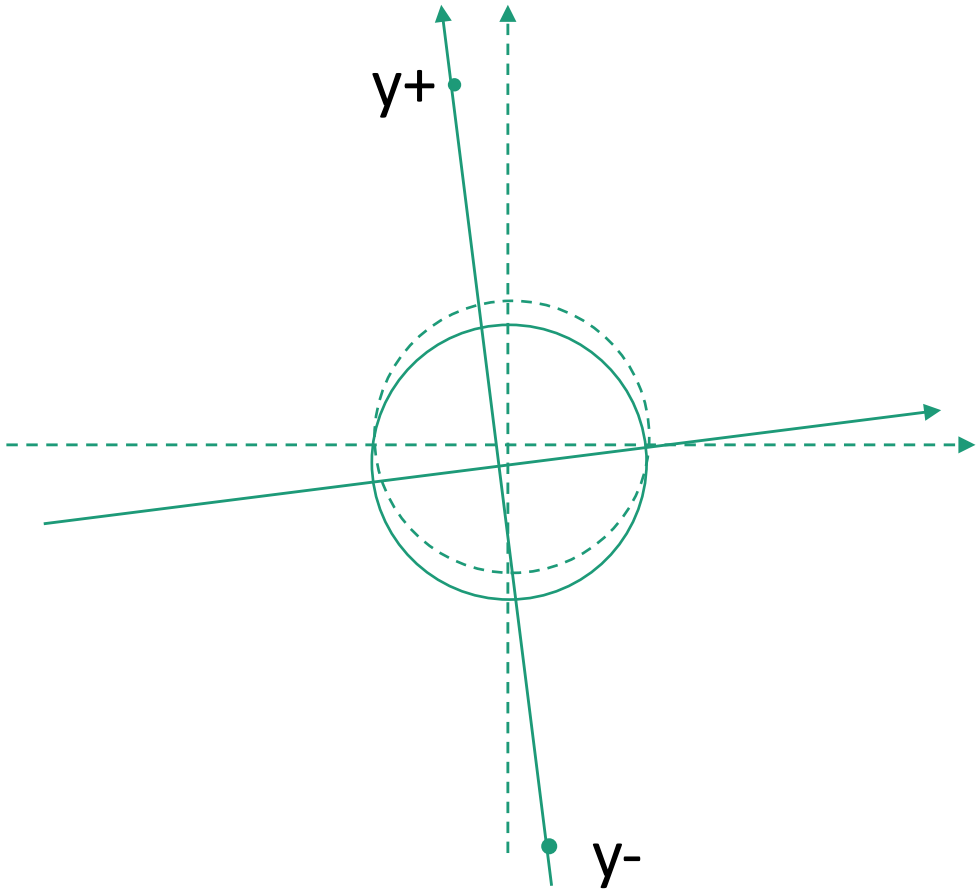
Location of the BS mirror

***z (height)*:** Breadboard, table, suspension frame and the mirror were located about ～6.5mm below the expected position.

***xy*:** Table was located at the center of the chamber within 1mm.
Mirror was located at (-1.6mm, -6.2mm). -6.2mm becomes +3.3mm if we take the chamber position into account.
Suspension frame was located at (-1.1mm, -6.7mm).

***angles*:** Suspension frame was rotated about 1.2deg clockwise as viewed from above.
Mirror was rotated about 0.5 deg CCR as viewed from above.
Resultant angular difference of 1.7deg is consistent with the coil-magnet distance difference of ～3mm.

BS chamber



Planned position:
Measured position:

x: -3.8mm+/-13mm
y: -9.2(y+) or -9.7mm(y-)

Vacuum chamber was shifted about 9.5mm in +y direction and rotated about 0.4deg clockwise as viewed from above.

The BS chamber was relocated on 6th and 7th July 2016.

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BS容器の控え墨位置

川上　様

BS容器の控え墨は，容器中心位置から，
１番ピン＝（2.004，-0.001，-0.012）
２番ピン＝（0.002，2.001，0.013）
３番ピン＝（-1.999，0.001，0.013）
４番ピン＝（0.000，-1.998，0.001）

です（檜林リストの控え墨実測値から計算．単位メートル）．
２番ピンは，現在，SUS板の下になってしまっています．
また，容器中心軸から大口径フランジまでの距離は，この容器の場合は，４方向とも850ミリです．

なお，他の容器についても同様な計算を，今，まとめています（檜林リストに追記しています）．

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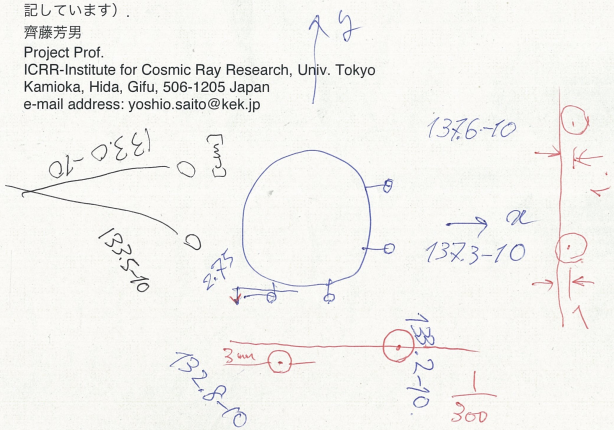
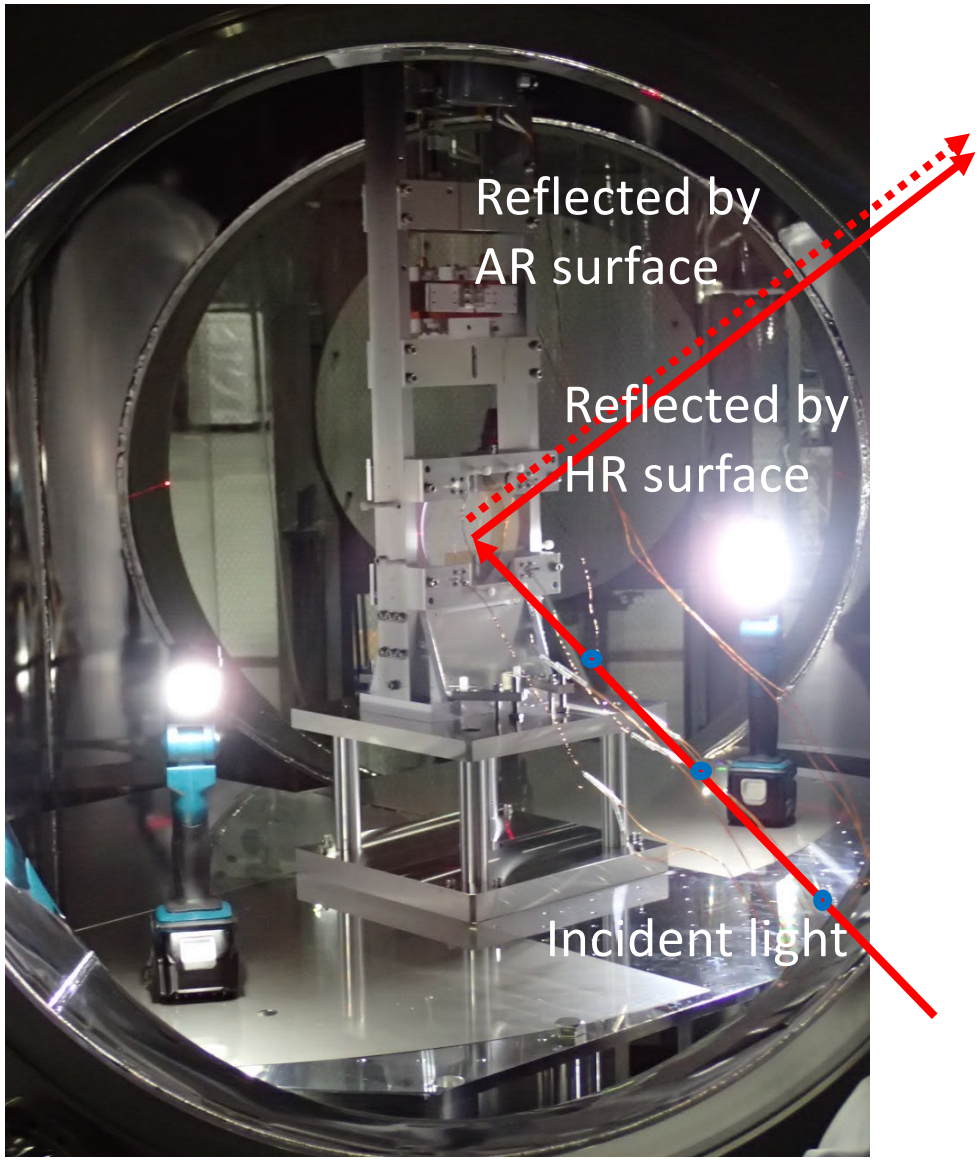


Checked the position with a tape measure.

Optical path of optical lever

- Just out of curiosity, we tried measuring the optical path of optical lever.
- Some positions on the ray were measured and fitted to a line. (For such kind of measurement, it is better to prepare targets.)
- Preliminary result:
  On the mirror surface, the ray reflected at about 7mm left (=y+, x+) and 10mm below the center of the mirror.



4. Summary

- 3D position measurement at Type-B chamber was demonstrated.
- As a result, 1cm displacement of the BS chamber with the floor datum points was found.
- We need to check the location of other vacuum chambers.
  This week, MESCO measures chamber location.
- Even if they find no problem with the chamber location with reference to each floor datum points, we still cannot eliminate the possible inconsistency of floor reference points.
- Systematic frame of reference is necessary.