Permanent Final Quadrupole Magnet Test at ATF2

Kyoto Univ., KEK[A]

Y. Iwashita, M. Masuzawa[A], T. Tauchi[A]

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    - ➡Rotating Coil – 5-Ring-Singlet
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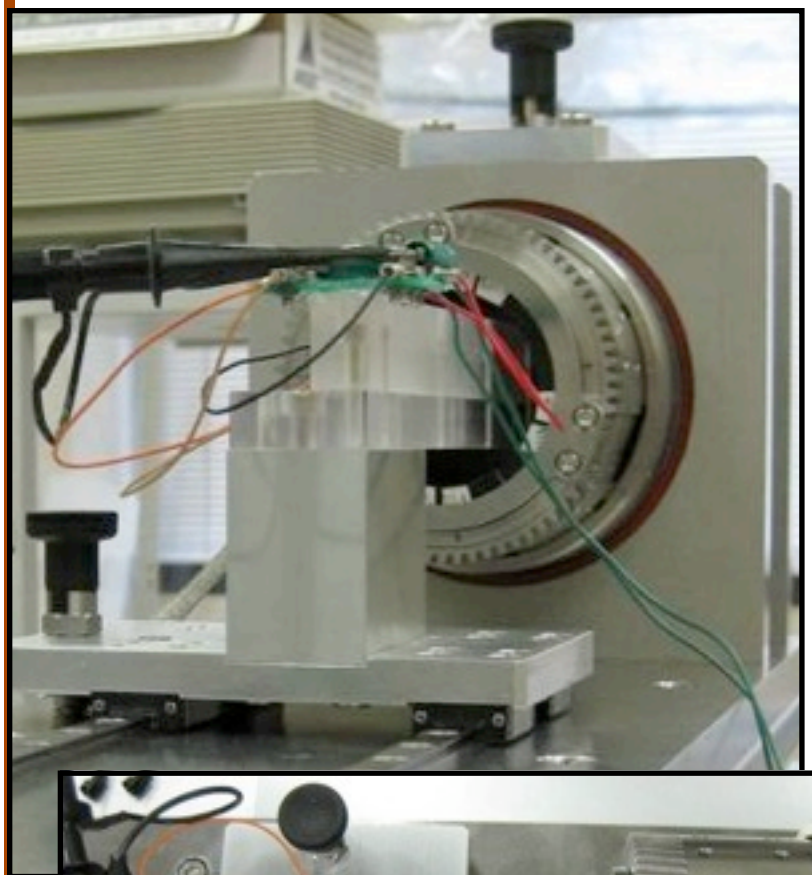
- The Location?

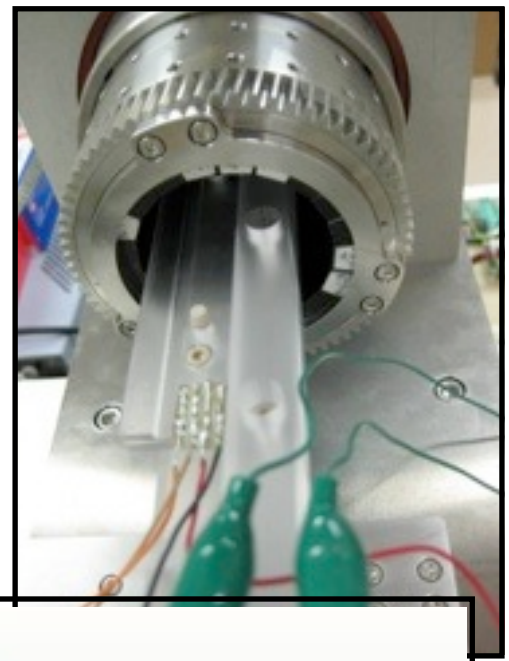
Field Measurement Result

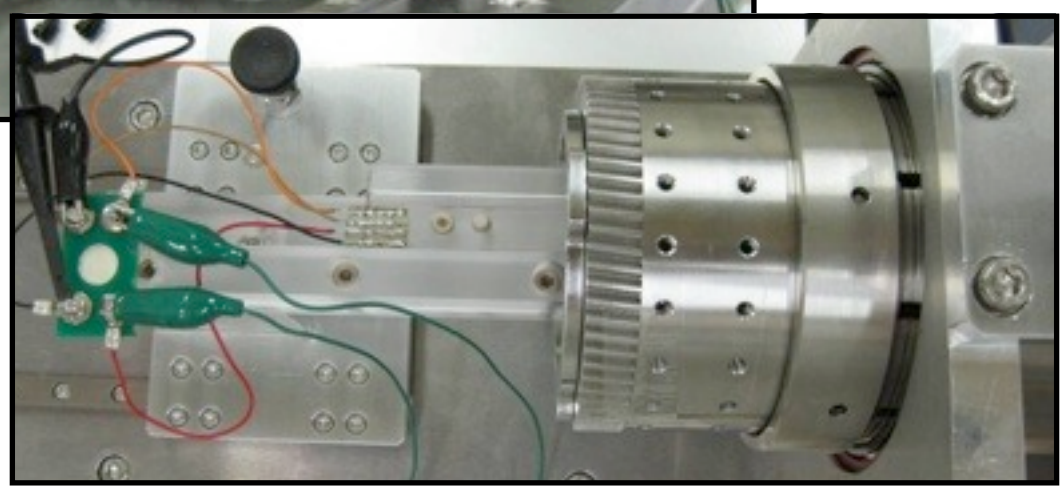
— based on the last year's —

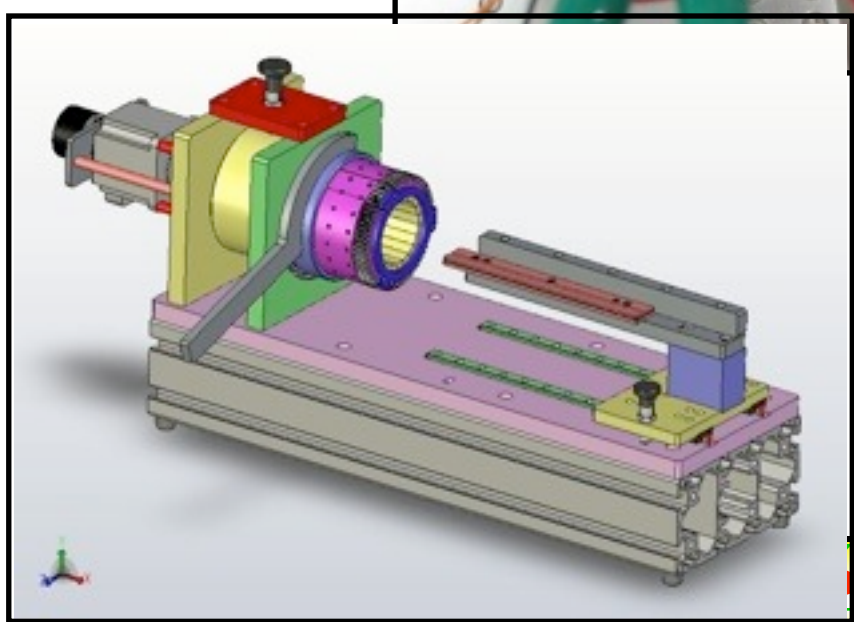
Field Measurement:
Rotating magnet instrument



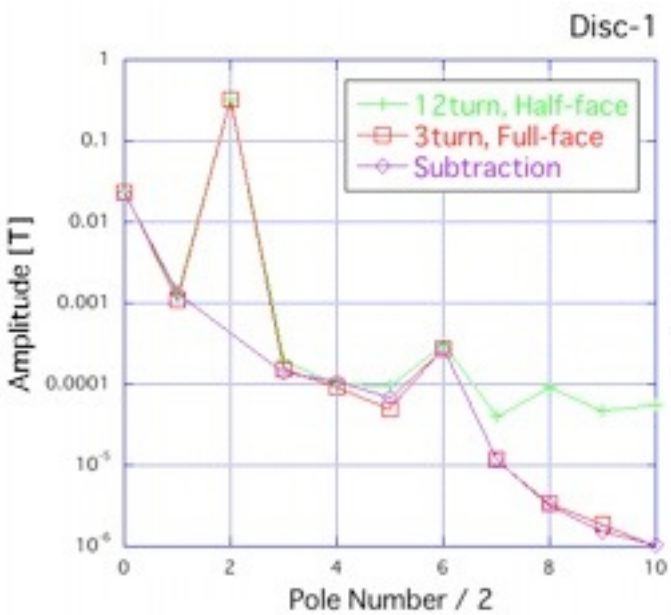
Magnets are rotated to find their magnetic center against the outer shell.

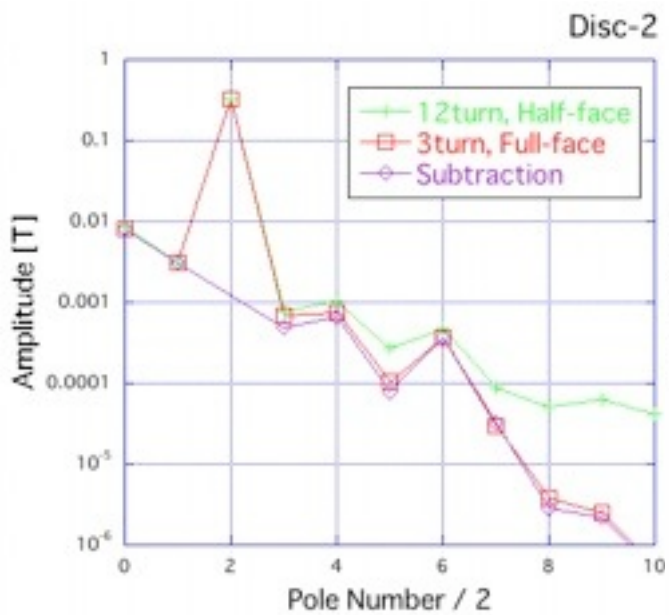


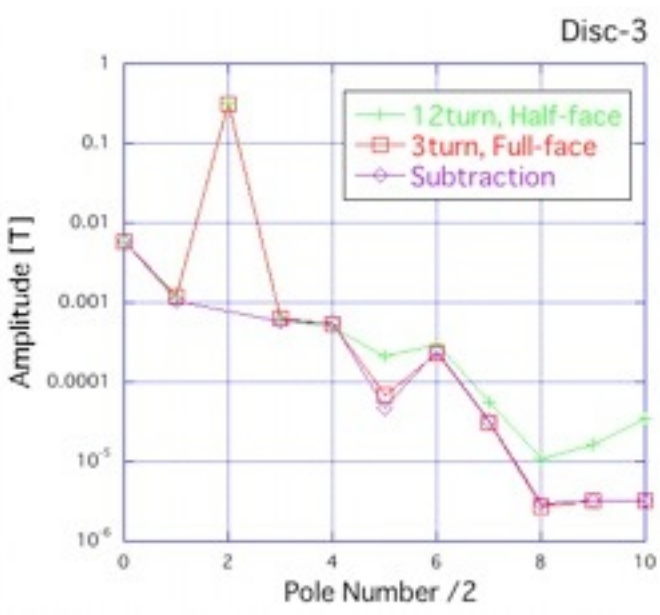


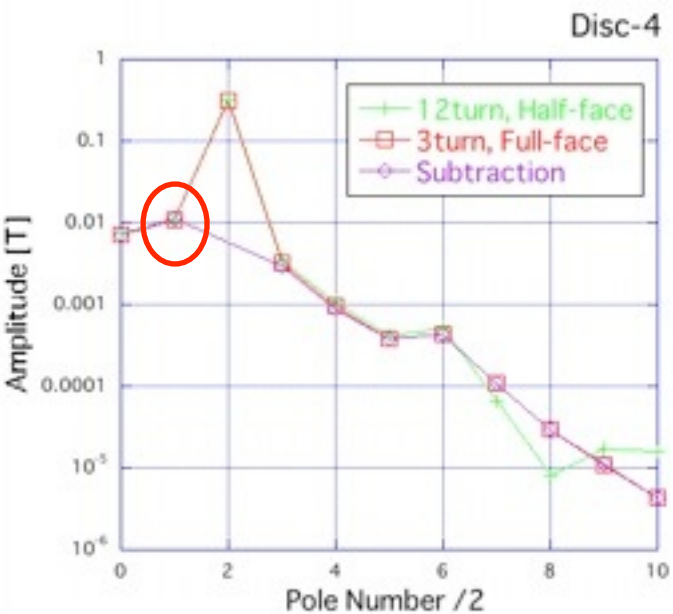


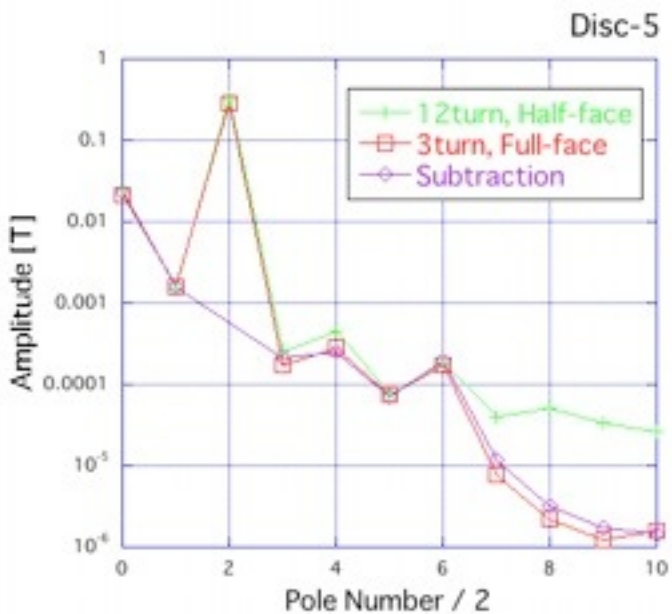
Measurement on Each Magnet











Normalized at r=1cm

Result of the Measurement

Disc	Dipole[G]	Quadrupole[10^3G]	Shift[μm]	Shift(calc.)[μm]
1st	12.4 ± 1.0	3.22 ± 0.05	38.5 ± 3.7	1.05
2nd	31.3 ± 0.1	3.25 ± 0.06	96.3 ± 2.1	0.789
3rd	11.3 ± 0.5	3.19 ± 0.06	35.4 ± 2.2	2.01
4th	110 ± 3	3.18 ± 0.06	346 ± 16	0.988
5th	15.6 ± 0.4	3.07 ± 0.22	50.8 ± 4.9	1.69

- Magnetic center offsets were more than ten times larger than calculations that include individual differences of magnet pieces.
- Assembly errors may be the main cause.
- The fourth disc has the further large offset; it may have a reason other than assembly errors.

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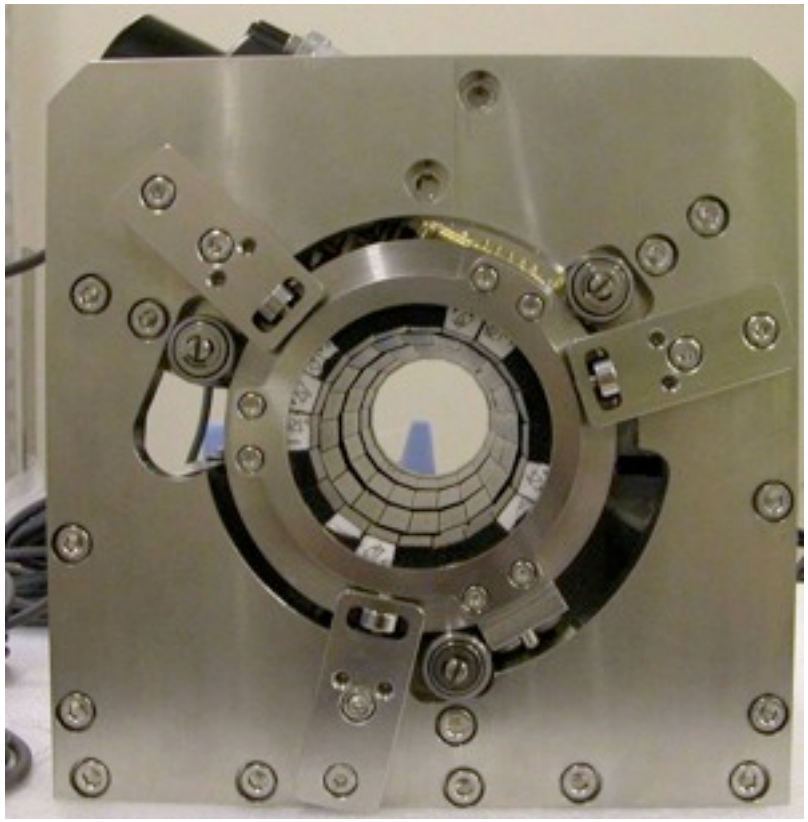
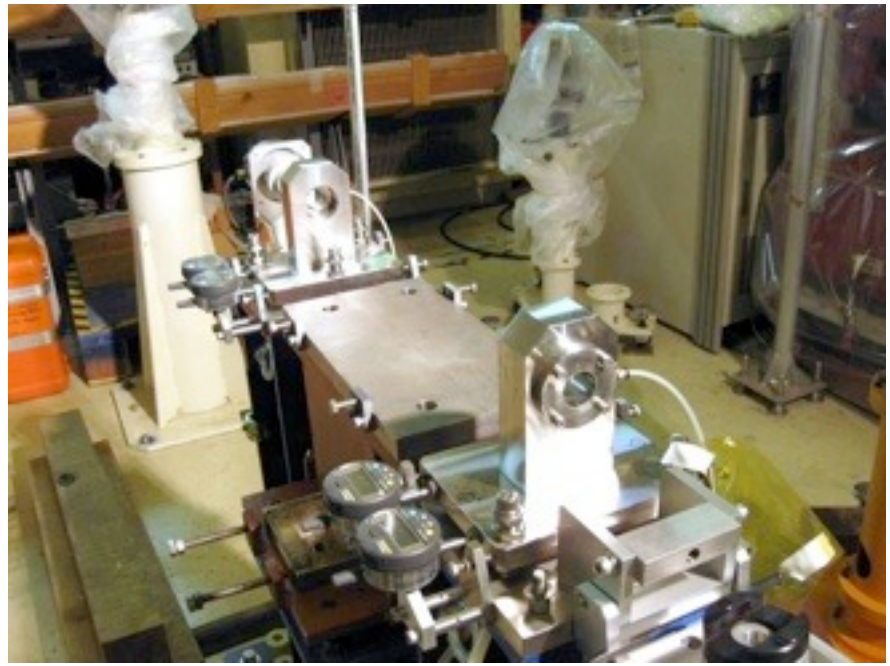
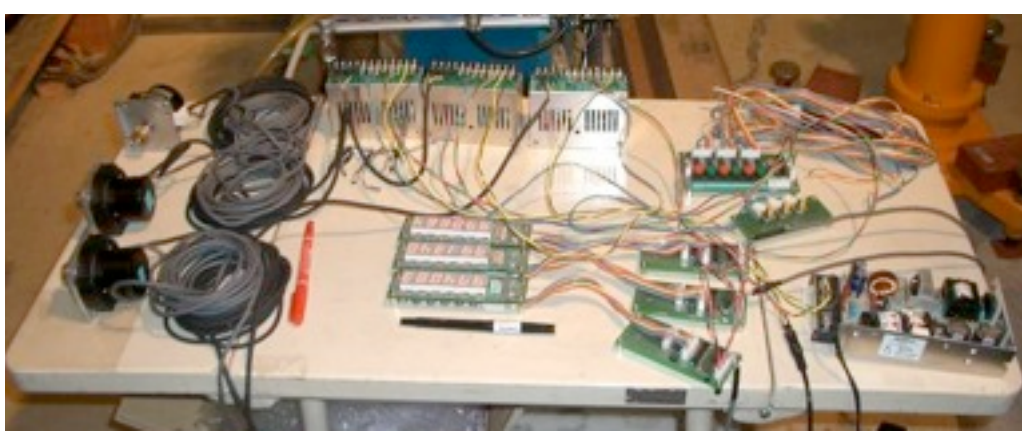
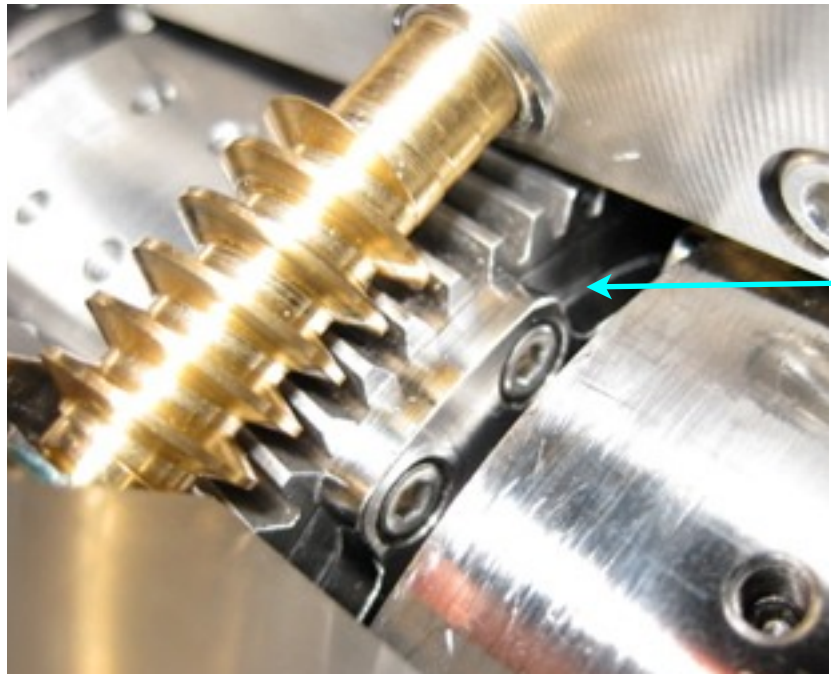
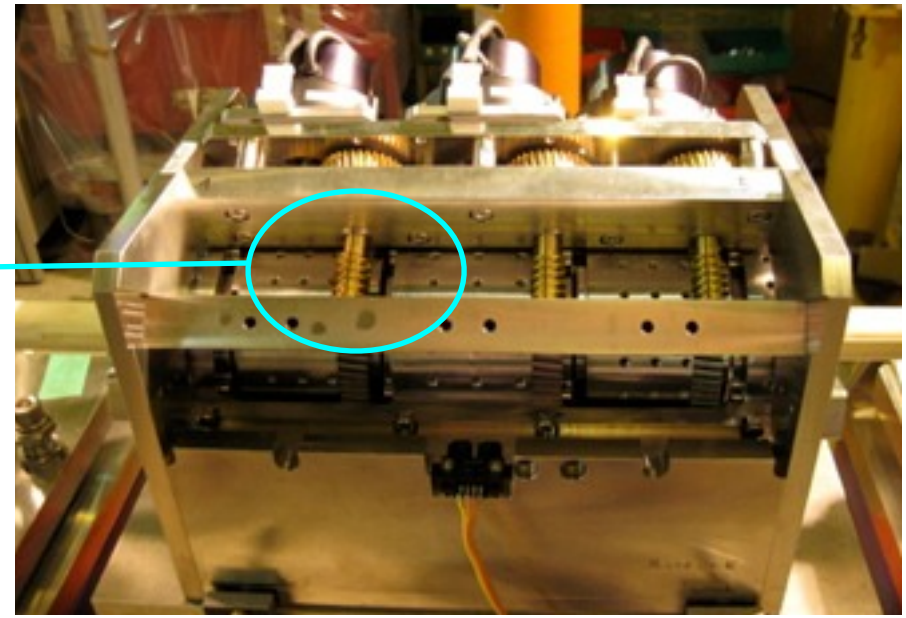
By Rotation Coil

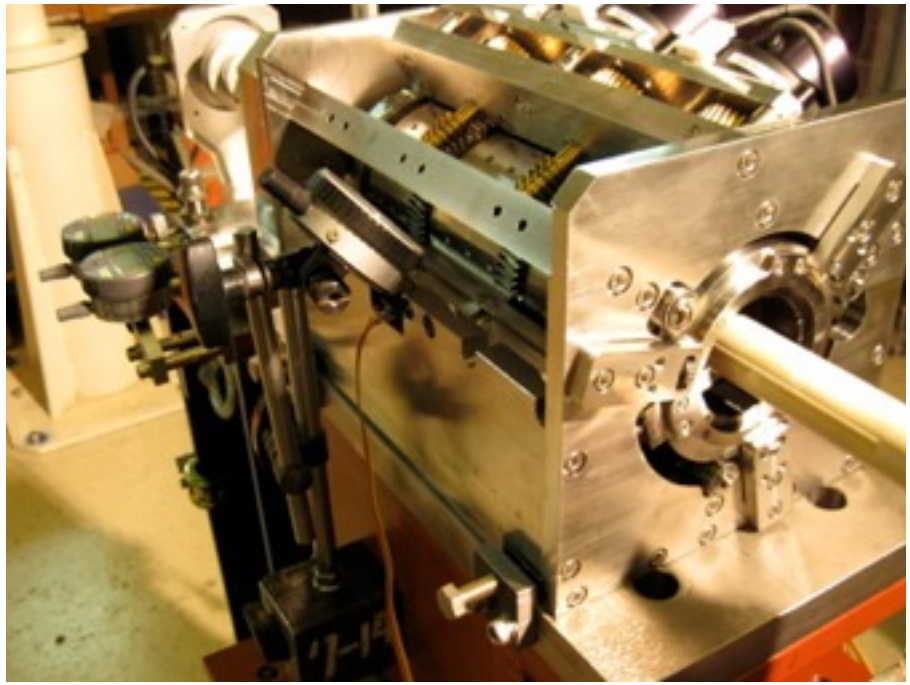


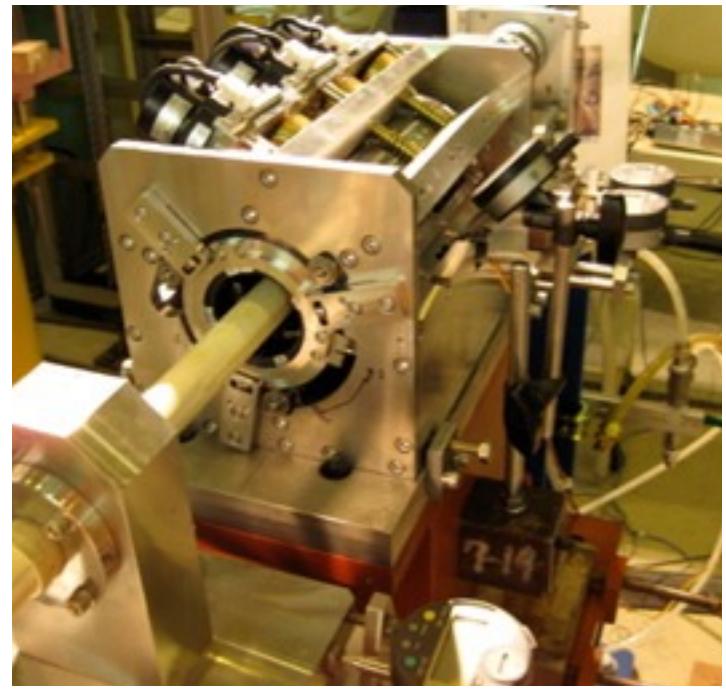












Reproducibility of Quadrupole

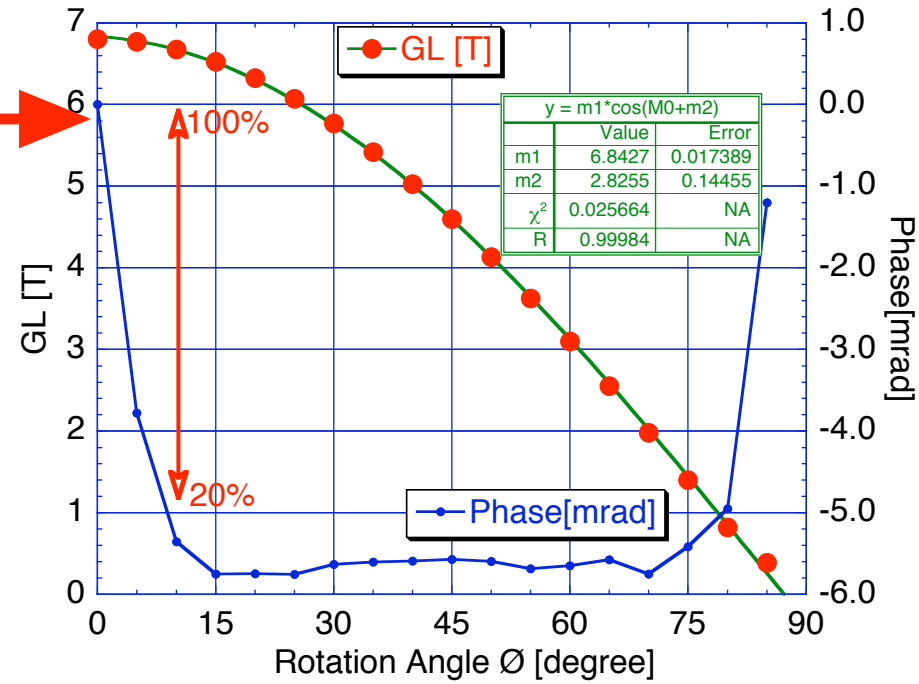
GL for ATF2: 5.85T

Measured at r=11mm

Fitting by

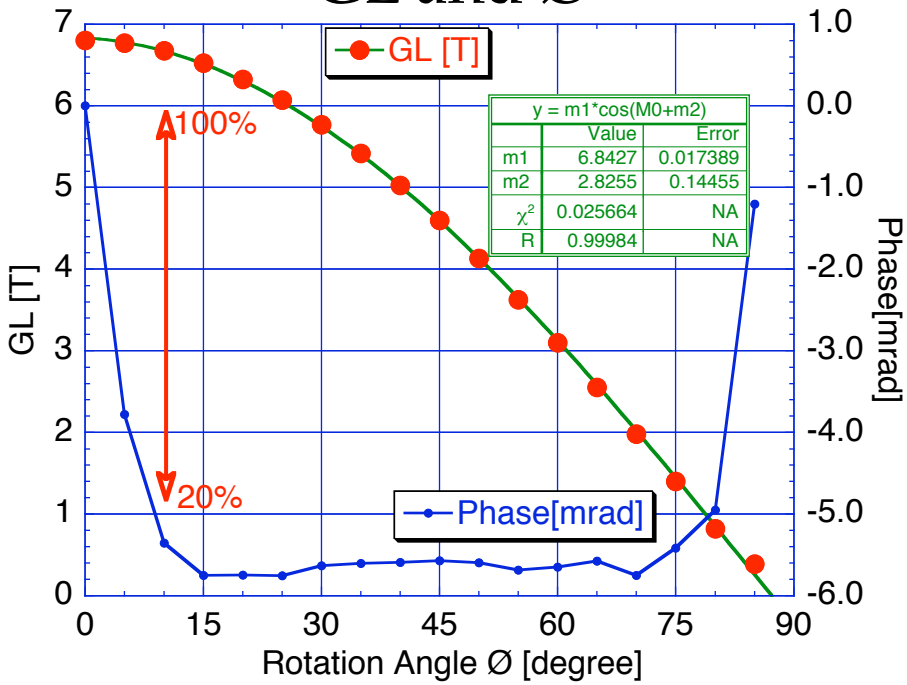
m1 x cos(ø+m2)

(0≤ø≤80°)

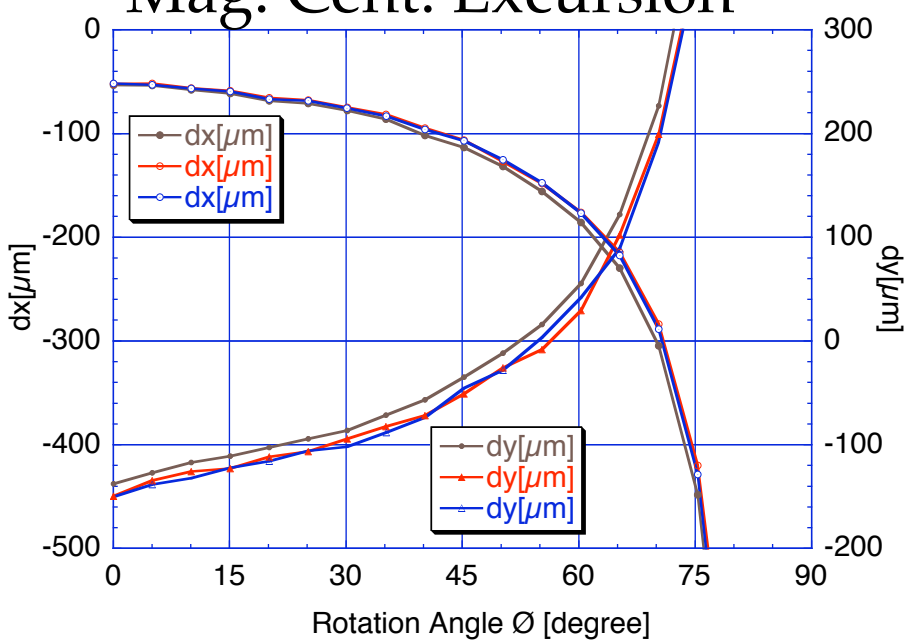


No.	m1 [T]	Error [10^{-3}T]	m2 [mrad]	Error [mrad]
1	6.851	6.9	-48.0	1.06
2	6.846	7.2	-45.1	1.11
3	6.847	7.1	-48.8	1.08
5	6.858	8.7	-51.4	1.33
mean	6.851	7.5	-48.3	1.15

GL and Ø



Mag. Cent. Excursion



Observations

- GL (100~20%) can be covered.
- Angle adjustment needed.
- Good reproducibility.
- But the value is big
  – needs adjustment.
- Minor mechanical modification improved the friction.

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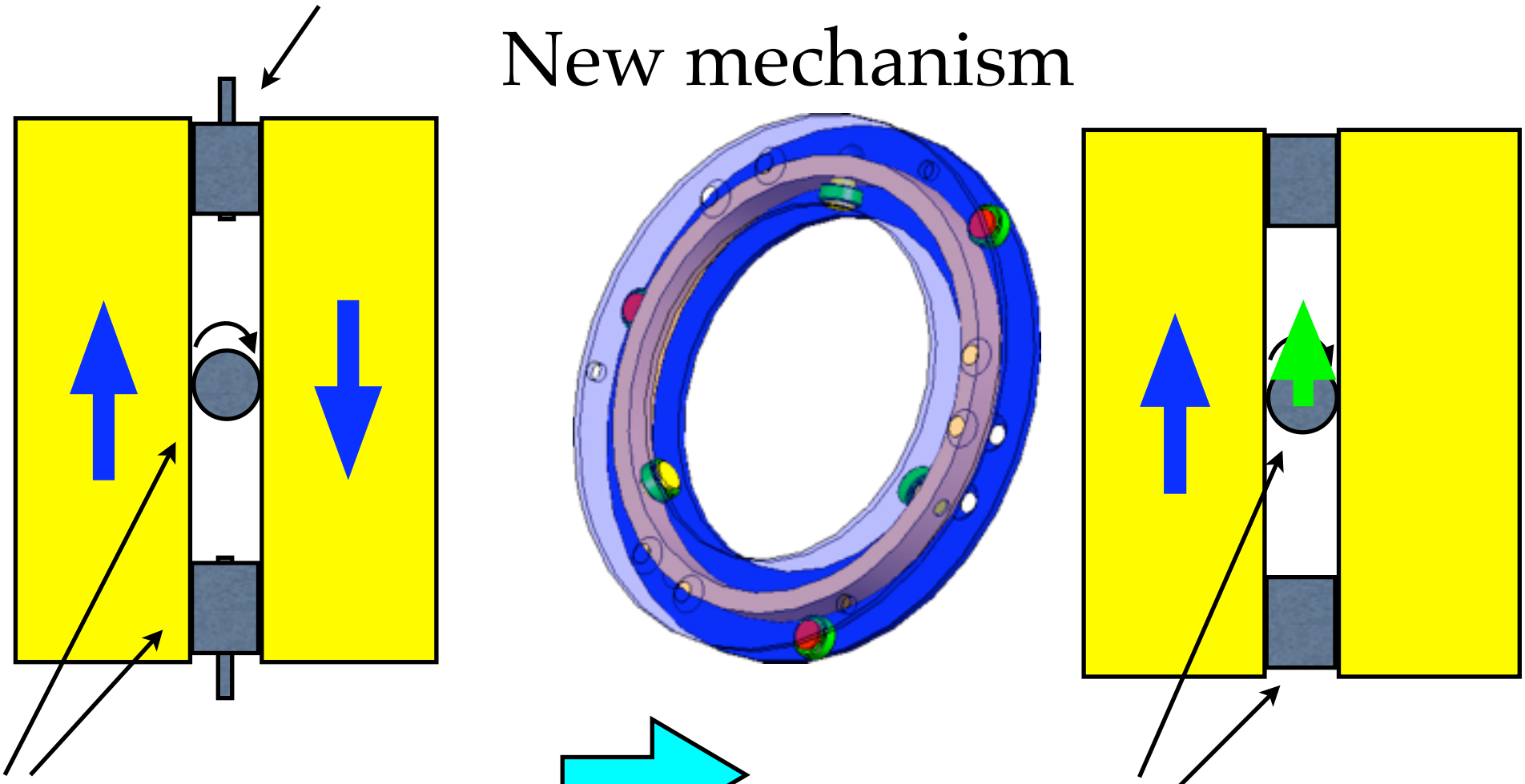
Mechanical Modification

Ring Positioning Rollers

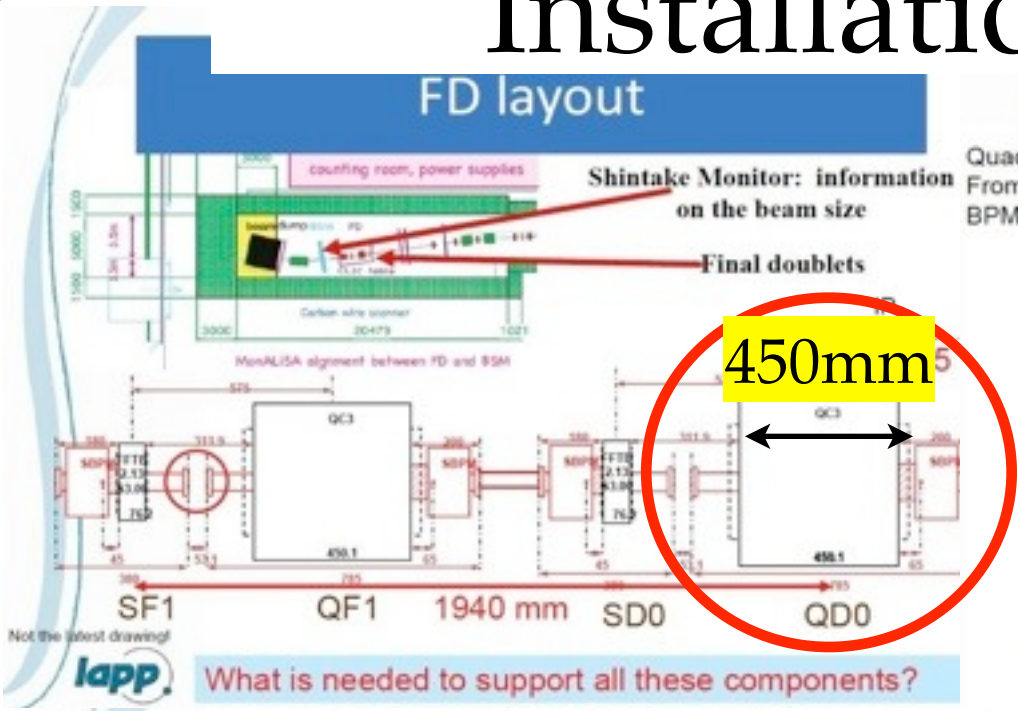
New mechanism

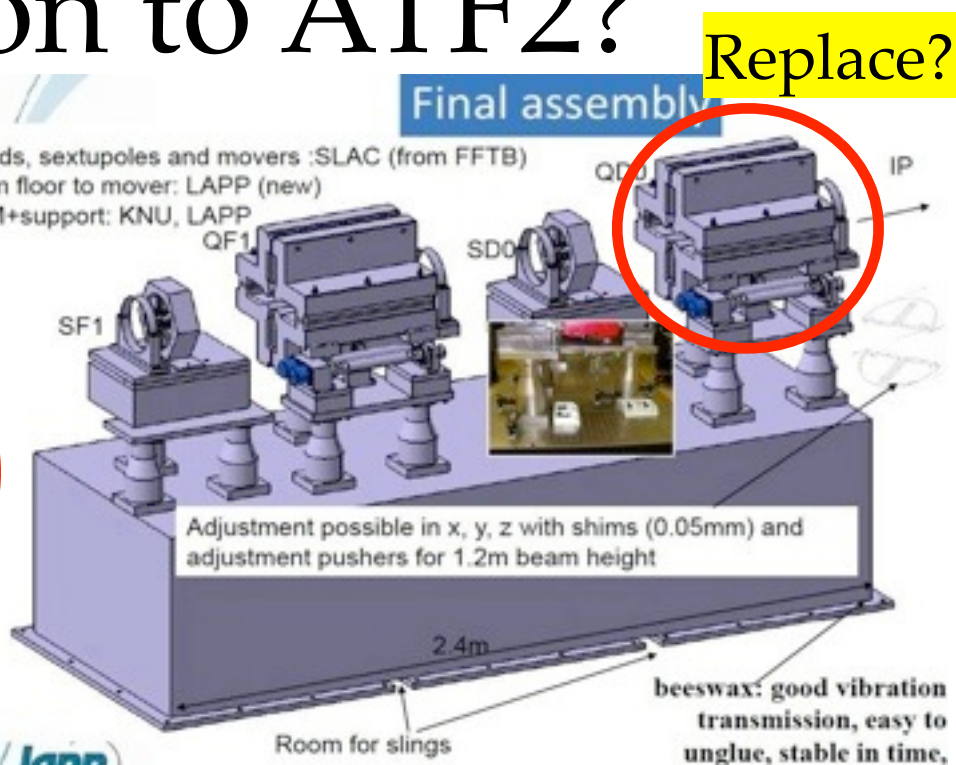


were fixed on the frame

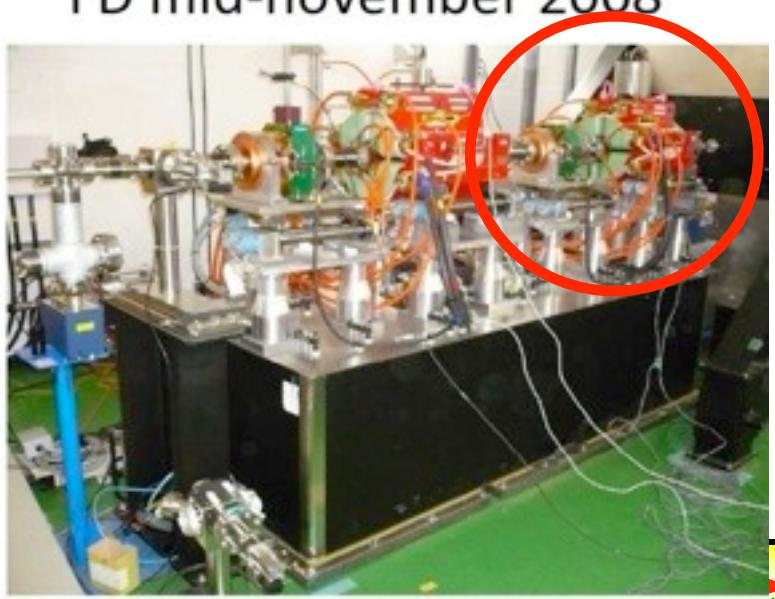
Rotate free from the frame

Installation to ATF2?





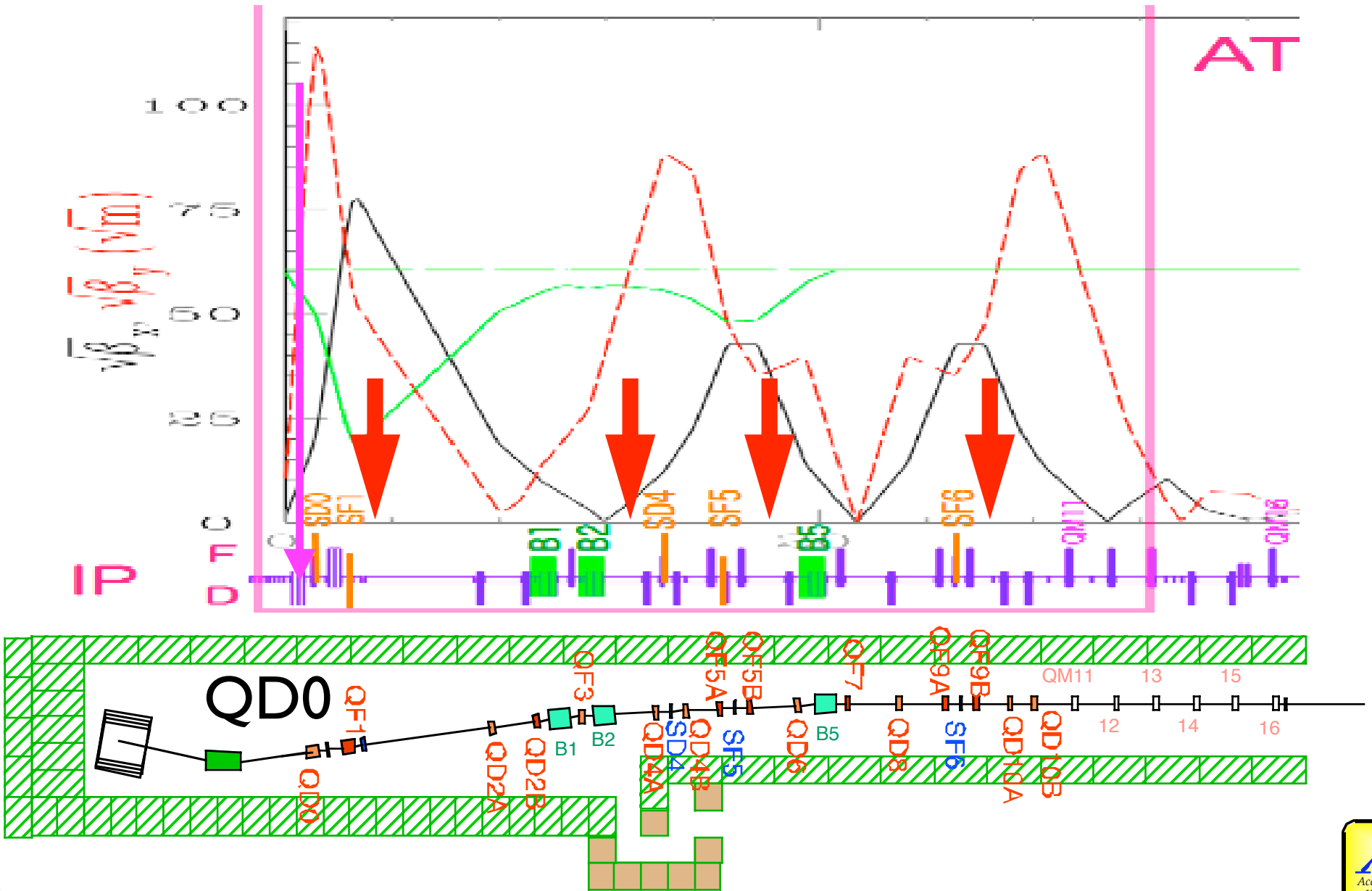
new BPM Needed!



What to be Tested?

- Isn't just magnetic field measurement enough?
  — Only GL is measured by rotation coil.
  (If so, any beam test is waste of time.)
- What can be monitored?
  — Profile (size) by wire scanner
  — Position by BPM
  — Size by Shintake Monitor
- Evaluation: x-y coupling, high order, stability, reproducibility, etc.
- Where the location should be?
  — Avoid interference with others.

Candidates for PMQ Location



Summary

- Mag. center movements, plane tilt showed good reproducibility but large.

  ➡ to be adjusted.

- Mechanically improved for separate rotations.
- Spare parts for mover is available.
- BPM unit should fit in the bore:
  – Vacuum flange has to be fitted lastly.
- Seeking a location.

Appendix

Demagnetization by Radiation

Energy deposit

	GLD	SiD	SiD (by Takahashi)	neutron
BeamCAL	17mW	13mW	29mW	
QD0	94mW	97mW	147mW	10^5 [n/cm^{2}s]
SD0	11mW	11mW	11mW	
QF1	16mW	18mW	15mW	
SF1	0.4mW	0.3mW	1mW	

very preliminary results by T.Abe (university of Tokyo), in private communication

Demagnetization by 14MeV neutron

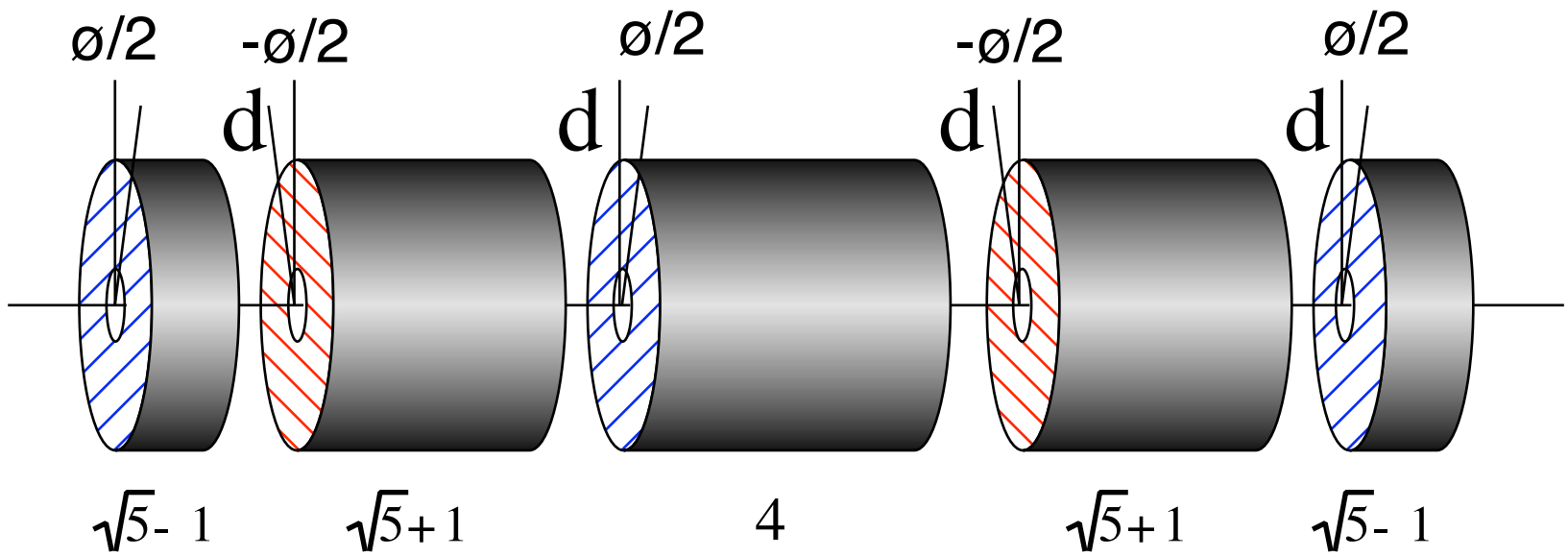
Magnet	Demag. ratio [/1x10^{13}n/cm^2]	iHc [Oe]
47H	10.2%	
44H	1.8%	16
39SH	0.7%	21
32EH	0.3%	30

T. Kawakubo, et al., The 14th Symposium on Accelerator Science and Technology, Tsukuba, Japan, November 2003, pp. 208-210, in Japanese, http://conference.kek.jp/sast03it/WebPDF/1P027.pdf

Continuous 1mo.(2.6x10^{6}s) operation may cause about 0.01[%] of (reversible?) demagnetization on NEOMAX 32EH. (1% for 10 years) ... needs more info.

Gluckstern's adjustable PMQ

Gluckstern's skewless variable PMQ



$$M = R \bullet M2 \bullet R^{-2} \bullet M1 \bullet R^{2} \bullet M0 \bullet R^{-2} \bullet M1 \bullet R^{2} \bullet M2 \bullet R^{-1}$$

$$\text{4x4 matrix: } M=\begin{pmatrix} Mxx & O^5 \\ O^5 & Myy \end{pmatrix} \text{ when d=0.}$$

R.L. Gluckstern and R.F. Holsinger: Adjustable Strength REC Quadrupoles, IEEE Trans. Nucl. Sci., Vol. NS-30, NO. 4, August 1983, http://epaper.kek.jp/p83/PDF/PAC1983_3326.PDF

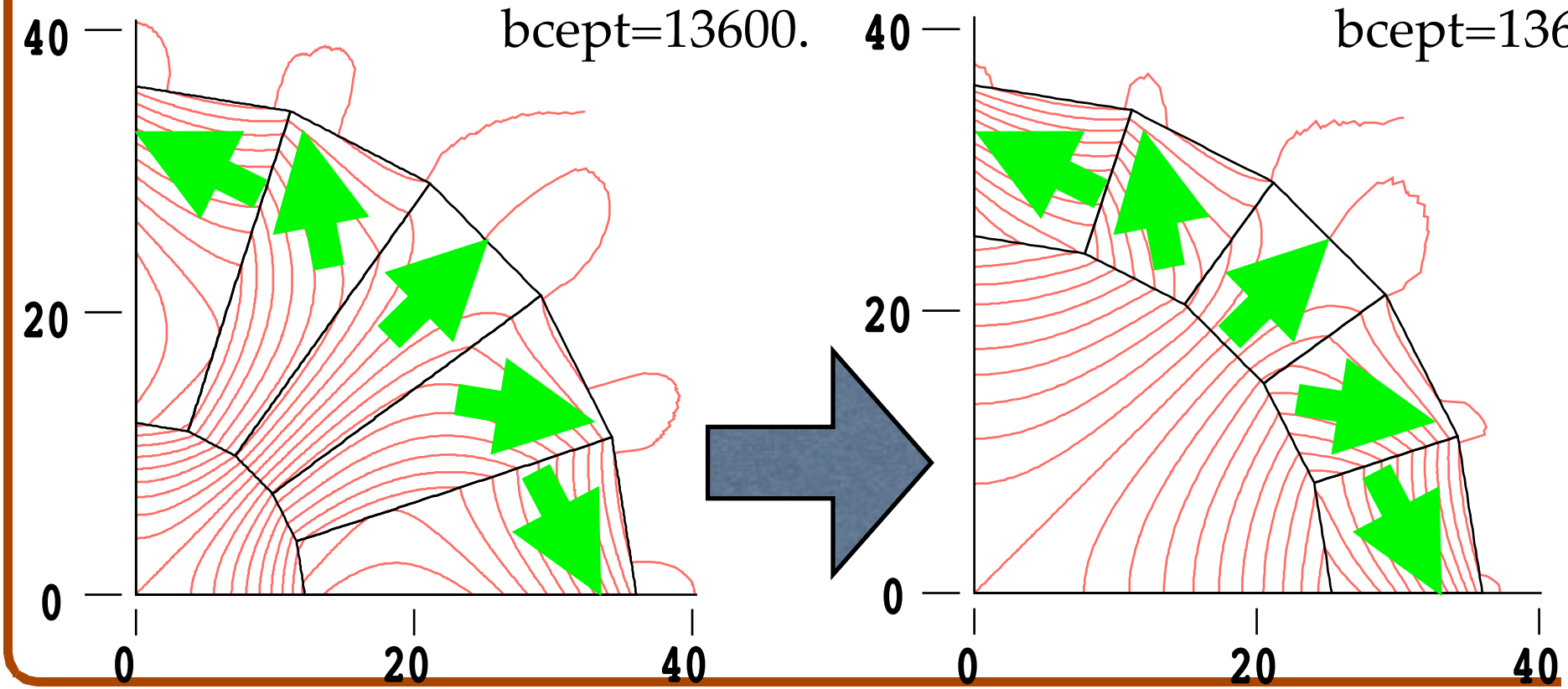
Test at ATF2 – replace QD0

Req'd spec for QD0: L=45cm, ø50mm, G=13T/m

OD: ø72 (=2x(56-20)) GL=5.85 T

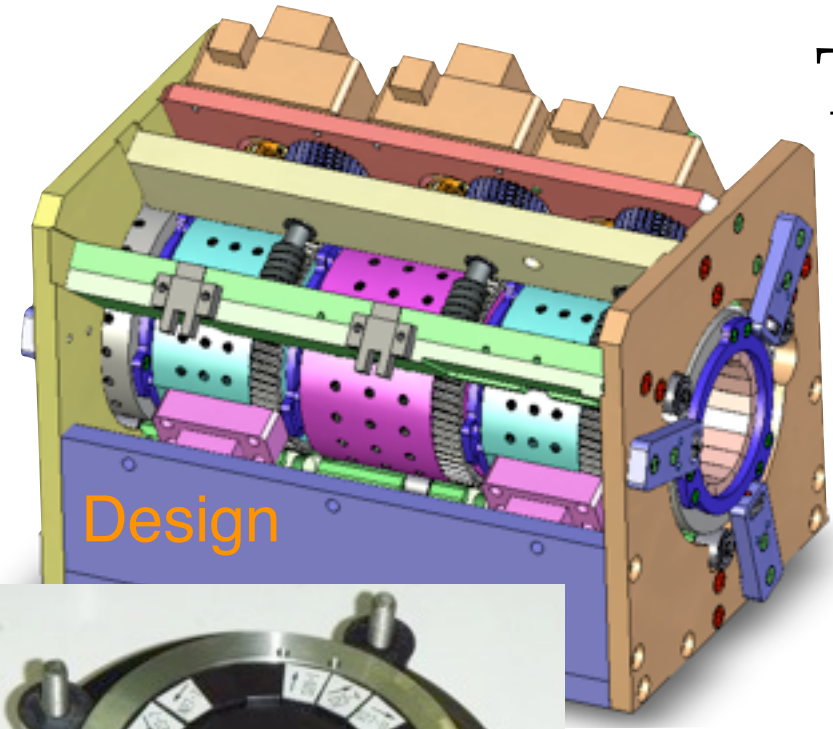
140T/m @ ø24 48H hcept=-12890, bcept=13600.

30T/m @ ø50 48H hcept=-12890, bcept=13600.



Gluckstern's 5-ring PMQ Singlet(2):

"Continuously Adjustable" PMQ fabricated



Disc(20mm)

The 5-ring singlet PM-FFQ