- Title

Permanent Magnet Option for Final Focus Quad

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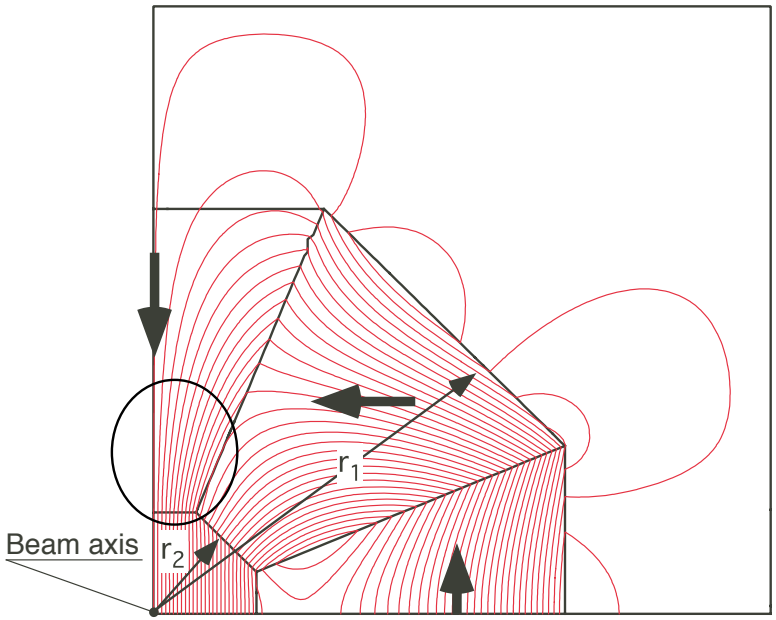
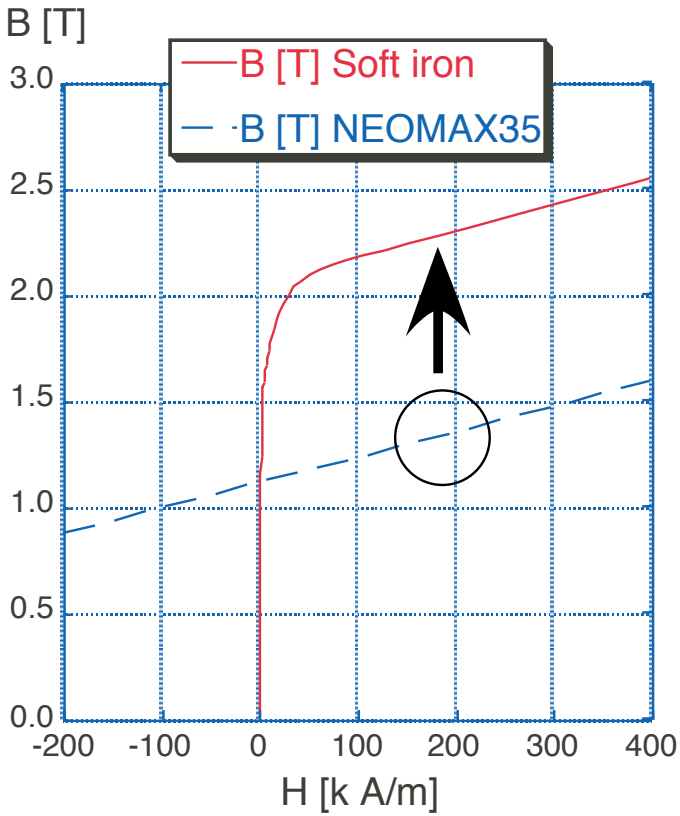
Contents:
- Introduction - Superstrong PMD
- PMQ, iPMQ (saturated iron PMQ)
- 3D calc
- Drawings and photo
- Measured data (preliminary)

- PMD & B-H curve

Halbach's dipole REC magnet.



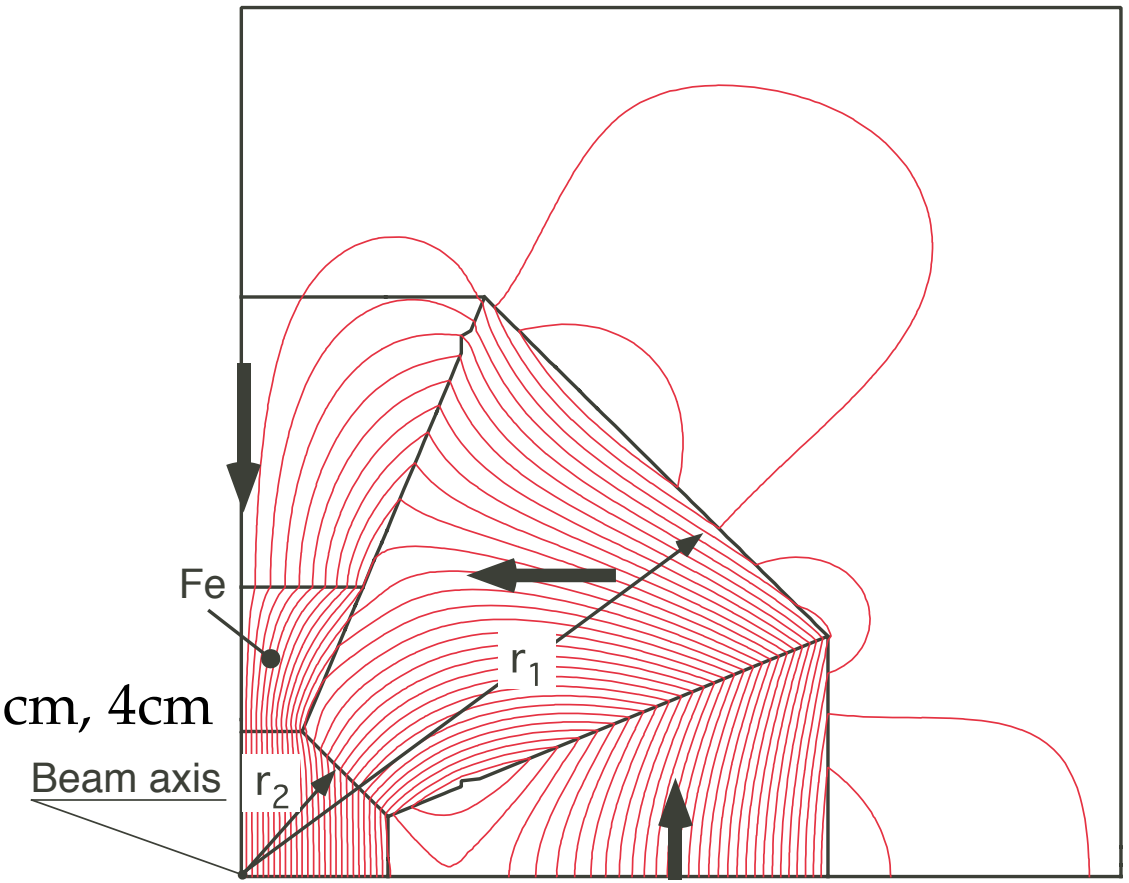


1.37 T @r_1, r_2=1cm, 4cm

$$B=B_r \ln(r_1/r_2) \cos(\pi/M) \sin(\pi/M)/\pi$$

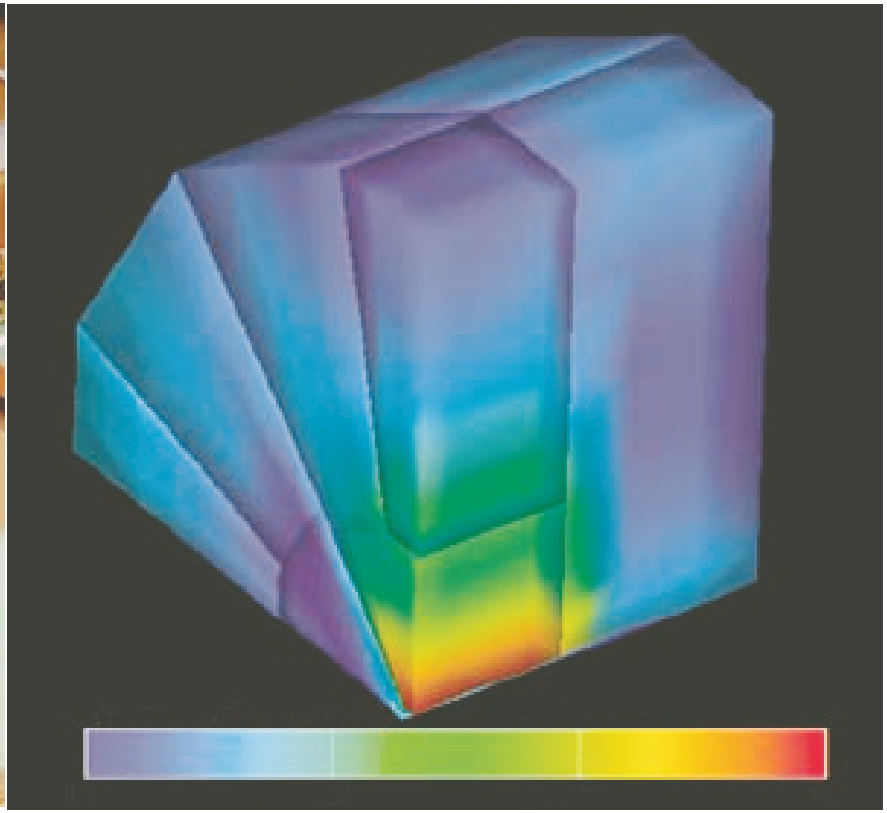
- SuperPMD

Modified Halbach's magnet.



1.64 T @r_1, r_2=1cm, 4cm
(was 1.37T)

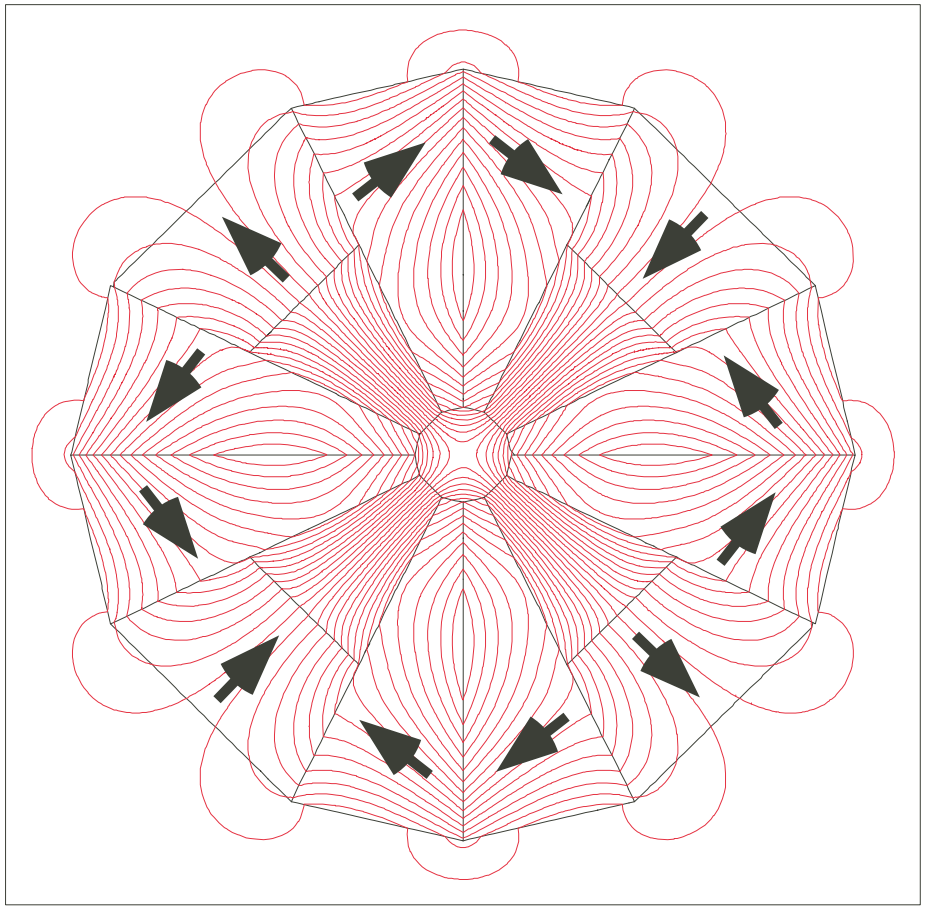
- 4.45T Dipole



Achieved 4.45T @-29°C (3.9T @room temperature)

M. Kumada et al., CERN Courier, vol. 41, no.7,Sep. 2001, p. 9

- Flux plot

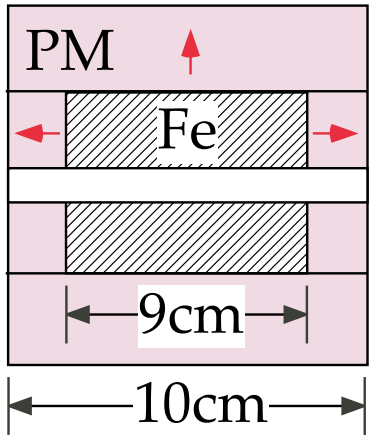


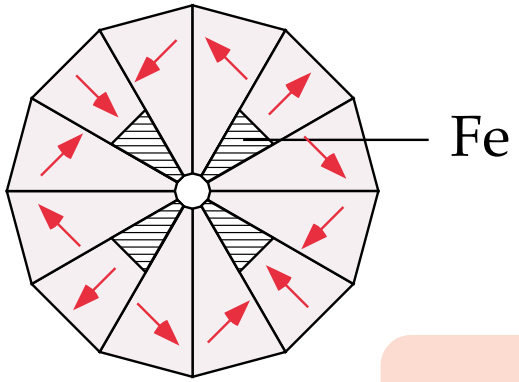
iPMQ12 D=1/12, RR=0.550 Fe=38.0d CYCLE = 7

Field distribution plot will be here.

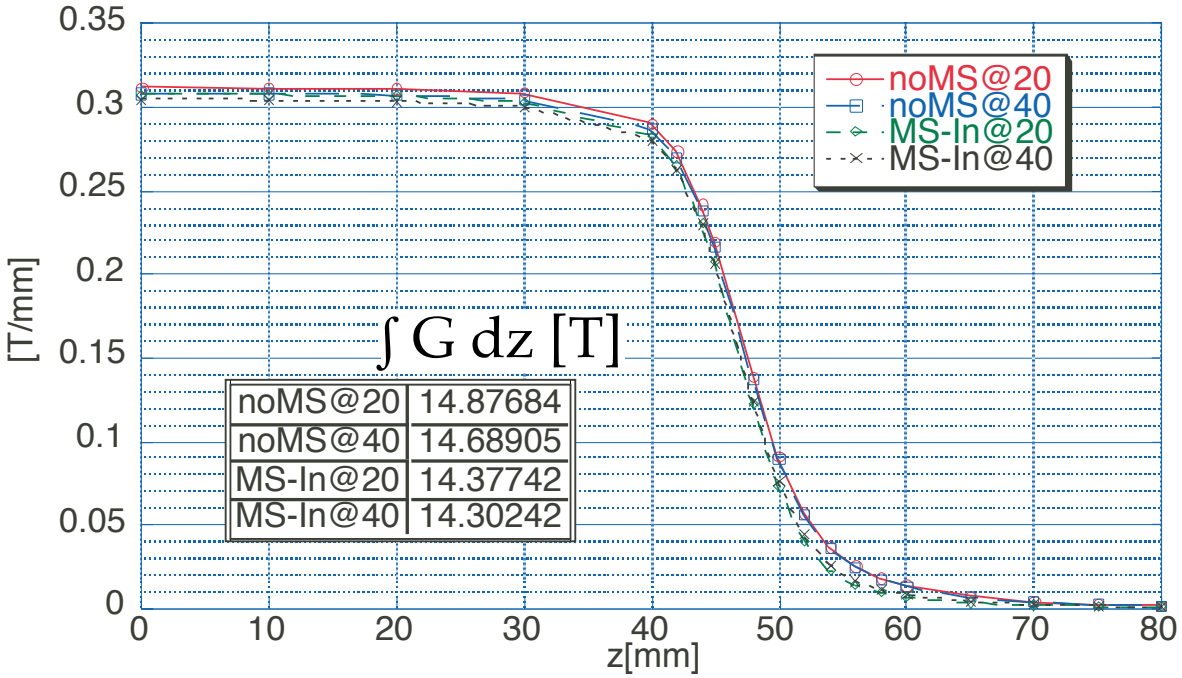
- 3D calculation

12 segments





OD: ø100
(130)
ID: ø14



~3T/cm
12 seg. ø14
(2.1T/cm@ø20)

GL=~14 [T]
(x2=28)

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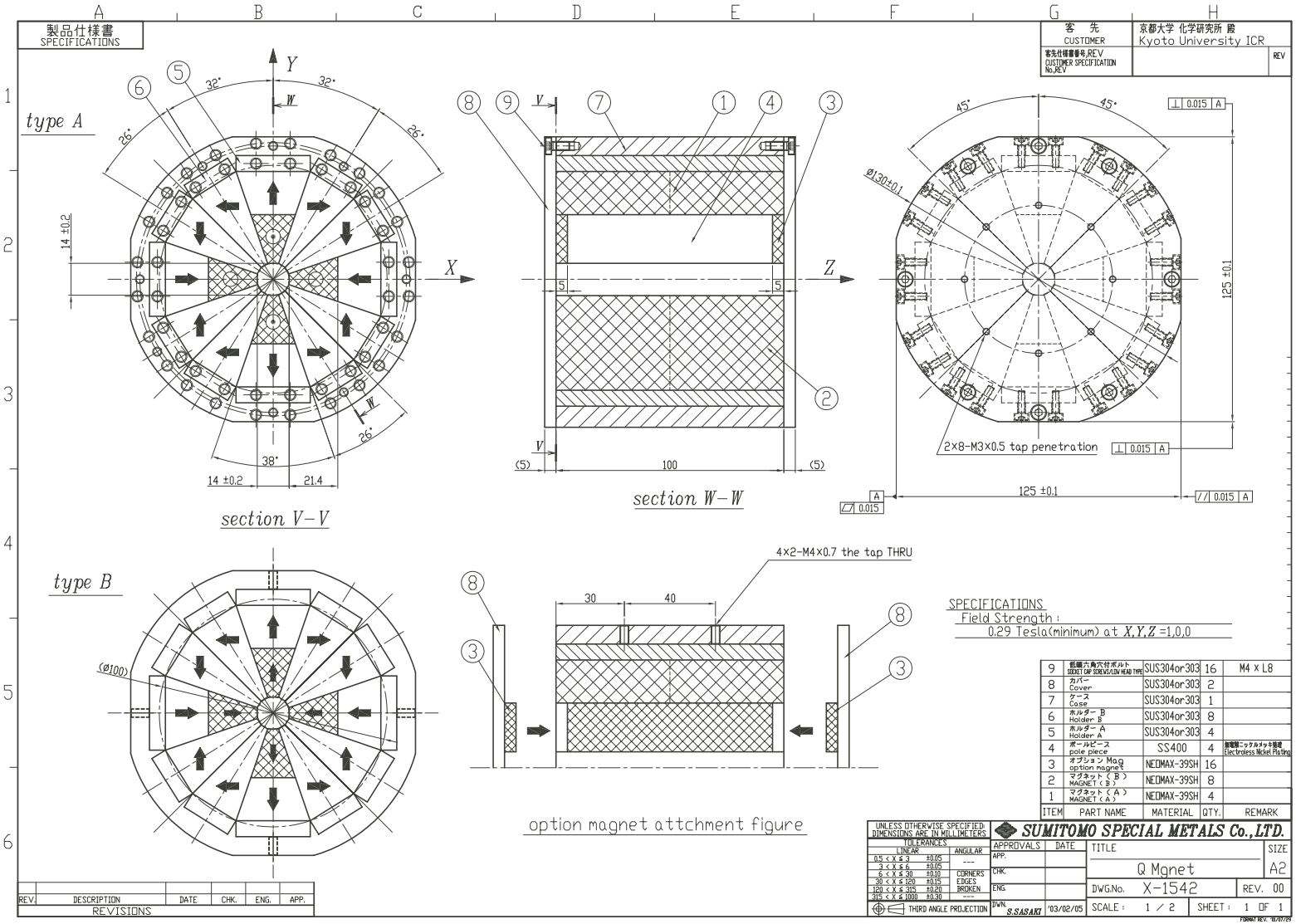
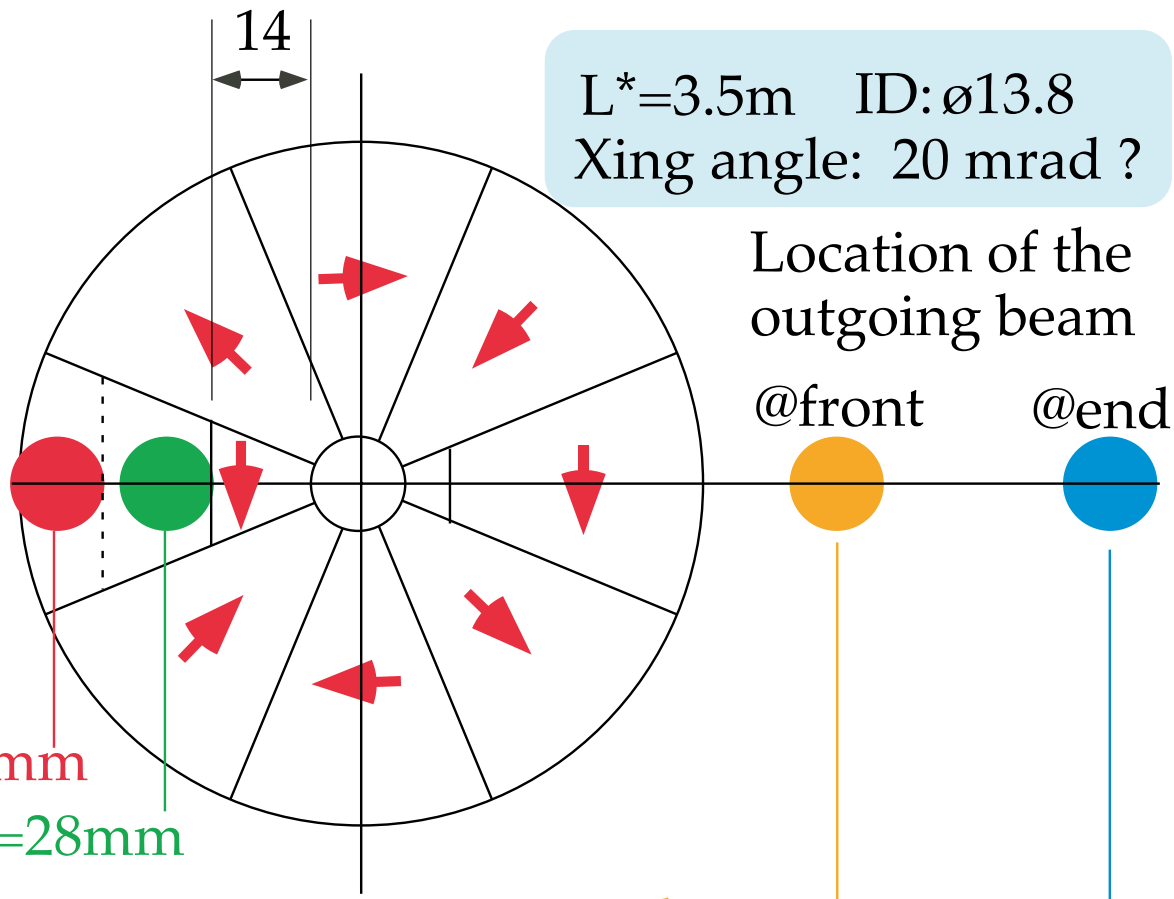
• Drawing



ITEM	PART NAME	MATERIAL	QTY.	REMARK
9	低頭六角穴付ボルト SOCKET CAP SCREW(LOW HEAD TYPE)	SUS304or303	16	M4 X L8
8	カバー Cover	SUS304or303	2	
7	ケース Case	SUS304or303	1	
6	ホルダー B Holder B	SUS304or303	8	
5	ホルダー A Holder A	SUS304or303	4	
4	ポールピース pole piece	SS400	4	無電解ニッケルメッキ被膜 Electroless Nickel Plating
3	オプション MAG option magnet	NEOMAX-39SH	16	
2	マグネット(B) MAGNET(B)	NEOMAX-39SH	8	
1	マグネット(A) MAGNET(A)	NEOMAX-39SH	4	

- Photo

- Margin



L*=3.5m ID: ø13.8
Xing angle: 20 mrad ?

required (JLC):
GL=1.48T/cm x 2m
@ø13.8

required (NLC):
GL=1.44T/cm x 2.2m
@ø20

Achieved: (L=10cm)
G=~2.9T/cm ~2T/cm @ø20
GL=28.5T @ø14 ~20T @ø20

More margin at the end.

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- SLAC Magnetic Measurements
  Date: 03-13-2003
  Time: 16:19:11

  Project: NLC
  Magnet Type: quad
  Magnet Name: kyoto_pm
  Serial Number:
  Run Number: 2
  Measurement Device: coil dc1bq
  Operator: sa
  Comment: Strength Measurement. After alignment.

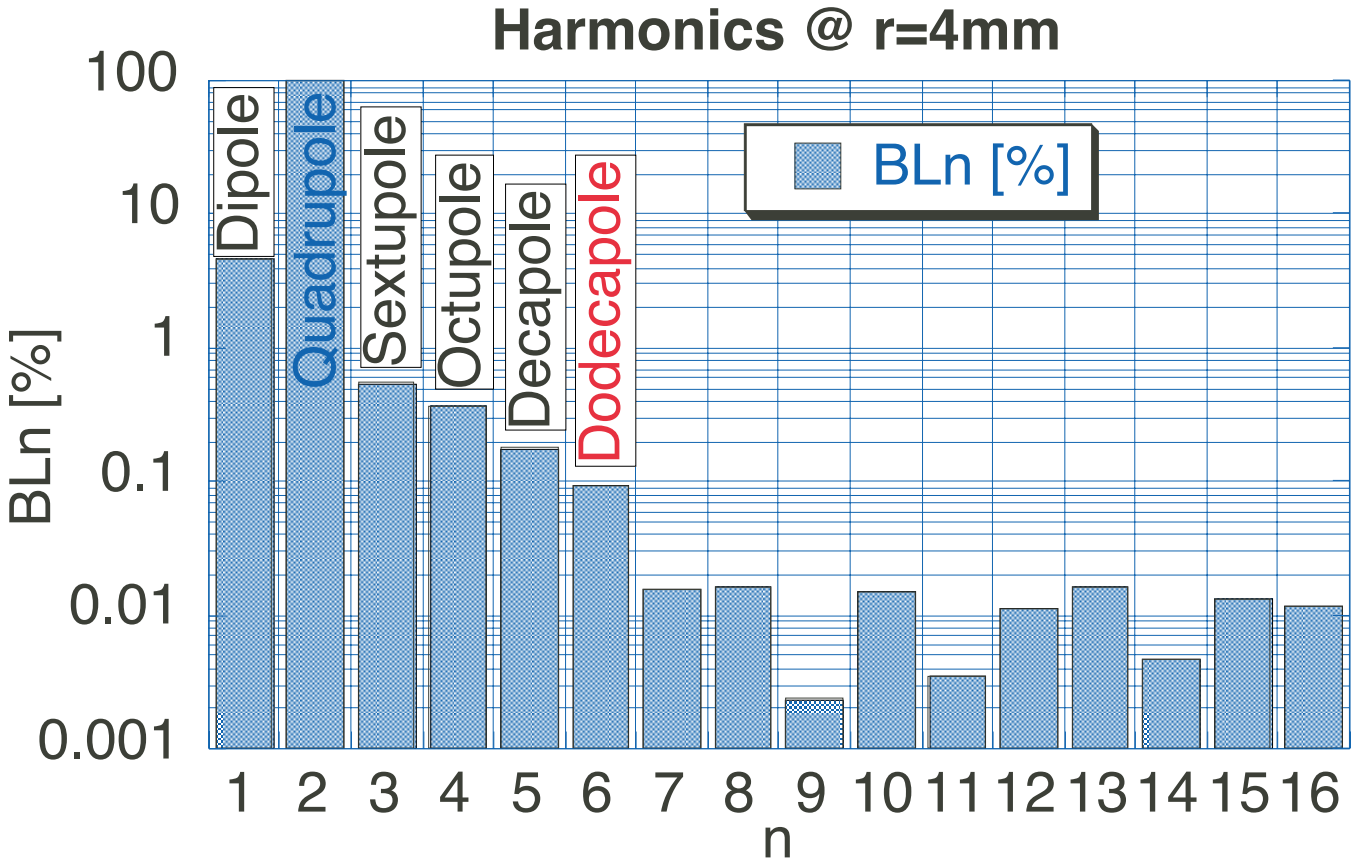
3D Calculated value:
29.7 [T]@20°C

Integrated Gradient

Imag (A)	sigImag (A)	GL (T)	sigGL (T)	GL/I (T/A)	sigGL/I (T/A)
0.000	0.000	28.51865	0.00037	0.0000000	0.0000000
0.000	0.000	28.51755	0.00034	0.0000000	0.0000000
0.000	0.000	28.51701	0.00036	0.0000000	0.0000000
0.000	0.000	28.51650	0.00030	0.0000000	0.0000000
0.000	0.000	28.51614	0.00010	0.0000000	0.0000000

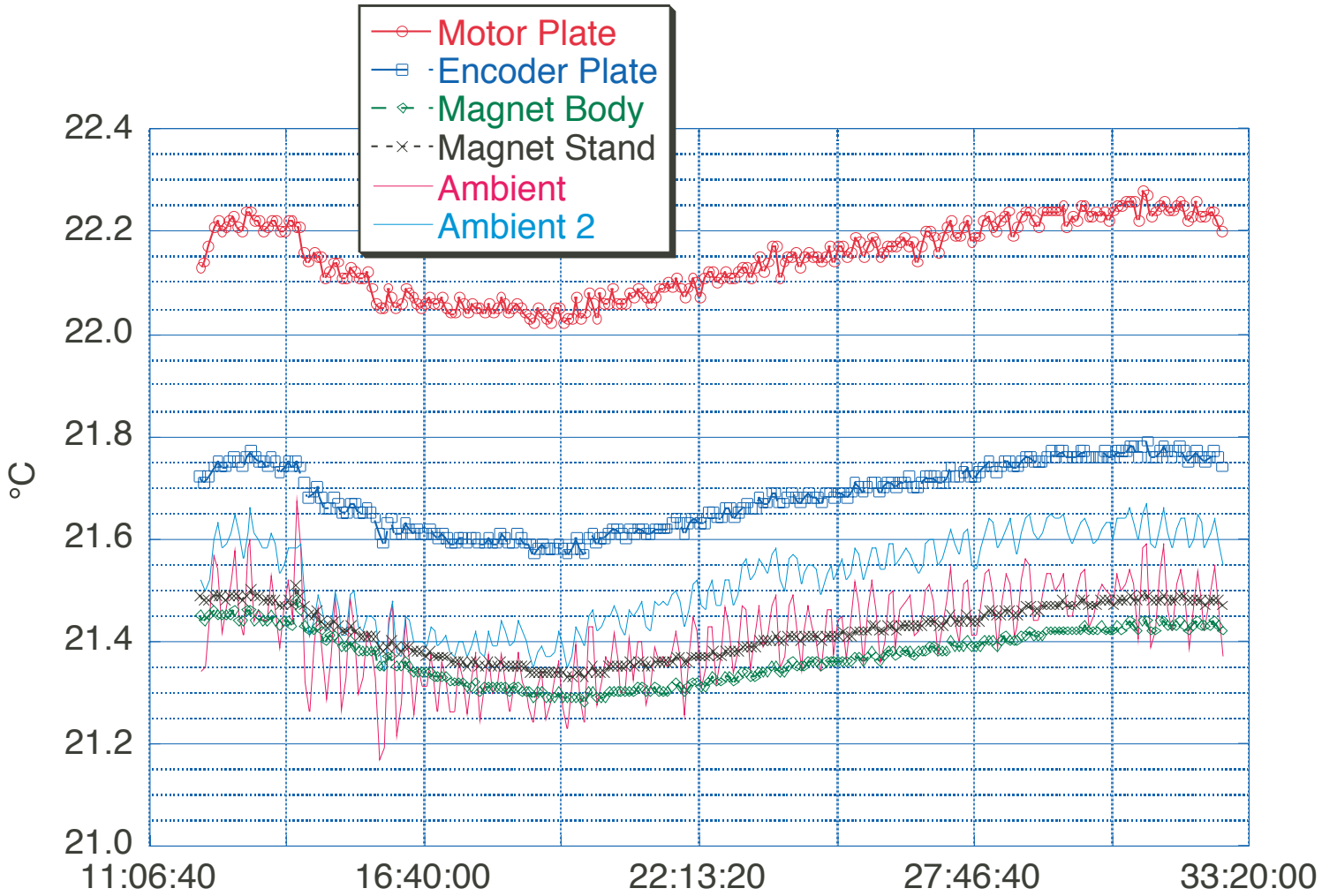
T=21.5°C

- Harmonics



If symmetry of the magnet is perfect, only n=2,6,10... will appear.
n=2(2i-1) [i:natural number]

- Temperature trend



- Magnetic Center

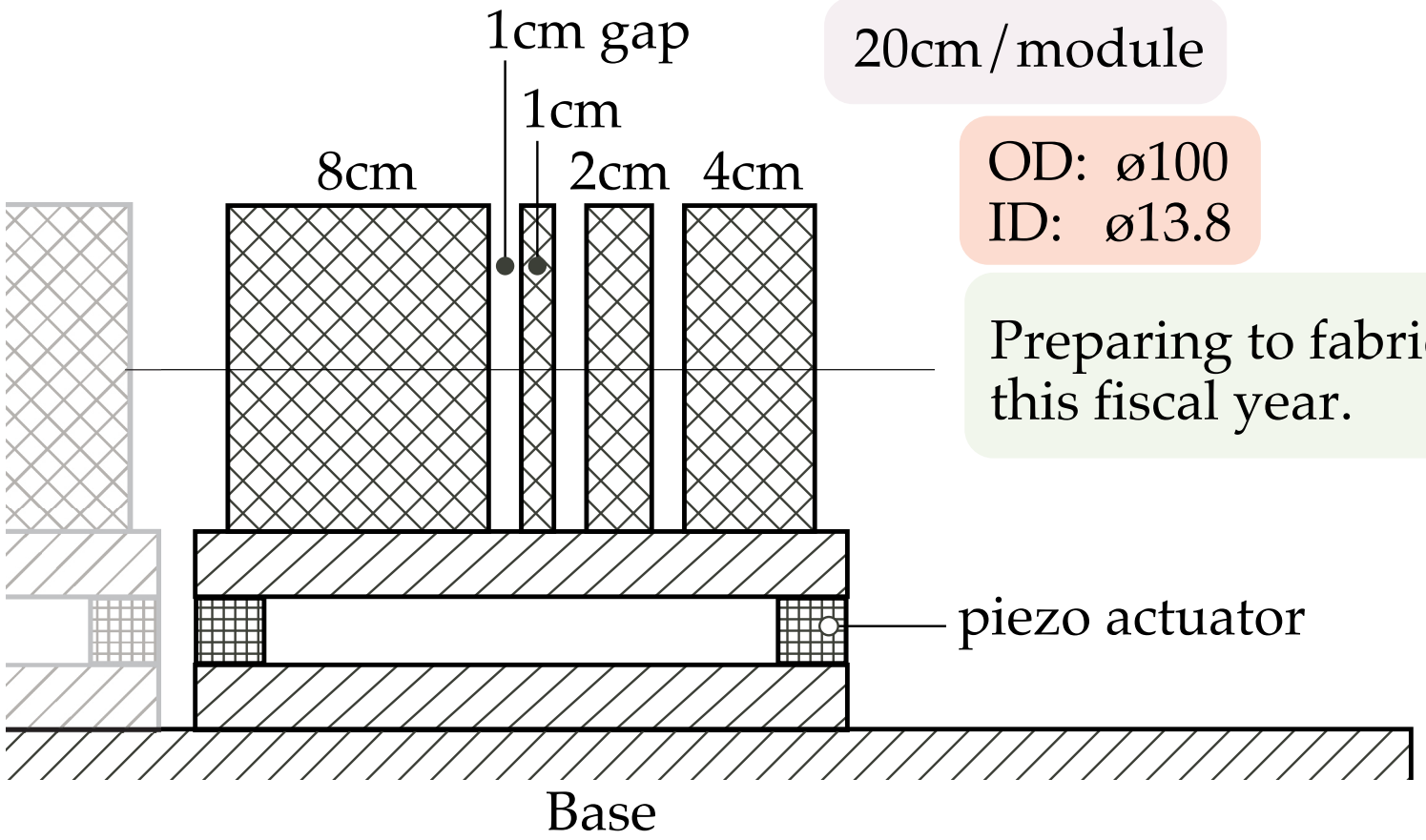
To be filled in ...

- Appendix

Appendix

- Rough sketch for strength adjustment

Binary switch of F↔D by rotating 90 deg.



20cm/module

OD: ø100
ID: ø13.8

Preparing to fabricate this fiscal year.

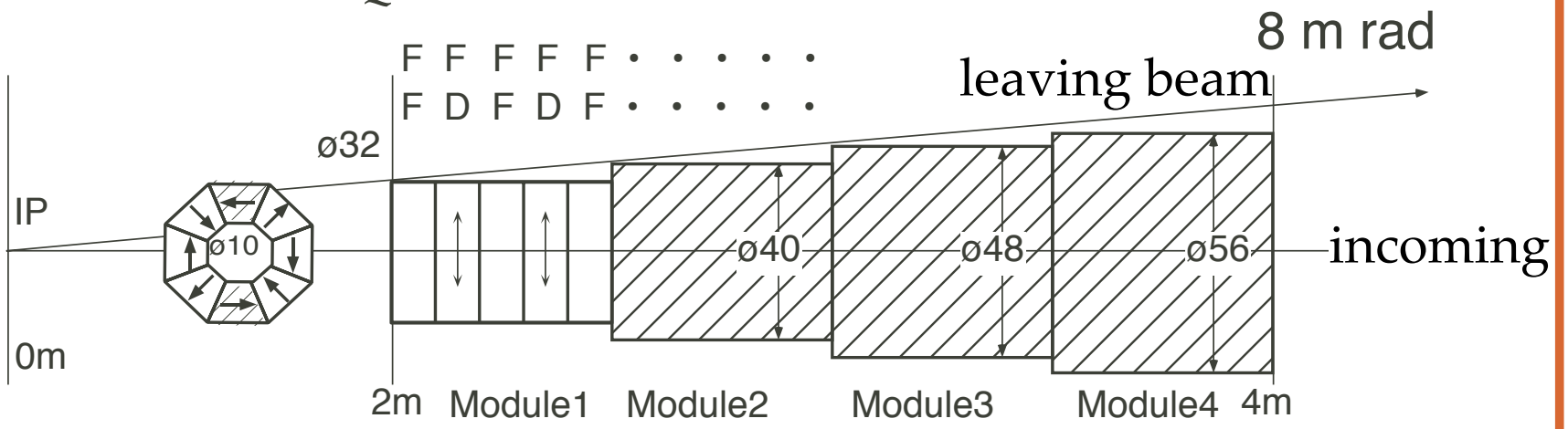
- Some issues

- Strength 1% OK – by Kuroda-san
- Displacement 0.2 nm ?
- Rotation (skew) 3μ rad ?

above two needs temperature compensation

- Multipole component?
- Radiation damage?
- temperature coefficient?

- Final Focus vPMQ



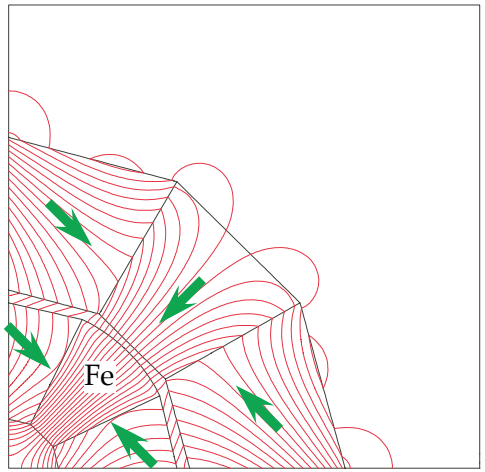
5~10cm / unit —> 20~40units / 2m
... some units may be fixed

Stepwise variable

Higher resolution by binary increment of the length: 1,2,4,... cm

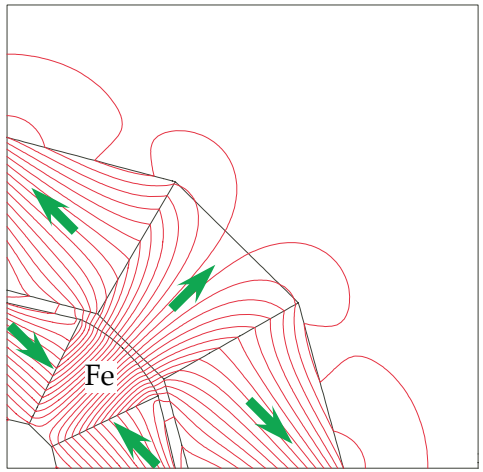
strongest F F F F F F F F F F • • • • •
• • •
middle1 F F F D F D F D F D • • • • •
middle2 F D F D F D F D F F F • • • •
• • •
weakest F D F D F D F D F D • • • • •

} centroid move



0.050	-1531.173
0.100	-3053.411
0.150	-4576.784
0.200	-6101.925
0.250	-7627.250
0.300	-9152.188
0.350	-10675.93
0.400	-12196.75
0.450	-13711.48
0.500	-15216.27
0.550	-16711.60
0.600	-18219.10
0.650	-19844.50
0.700	-21999.26

STORED ENERGY = 77.675 [J/m]



0.050	-39.37500
0.100	-78.65200
0.150	-118.7130
0.200	-161.1860
0.250	-209.1610
0.300	-267.9300
0.350	-345.8640
0.400	-455.7730
0.450	-617.0490
0.500	-859.1620
0.550	-1228.173
0.600	-1802.053
0.650	-2752.933
0.700	-4592.325

STORED ENERGY = 51.305 [J/m]

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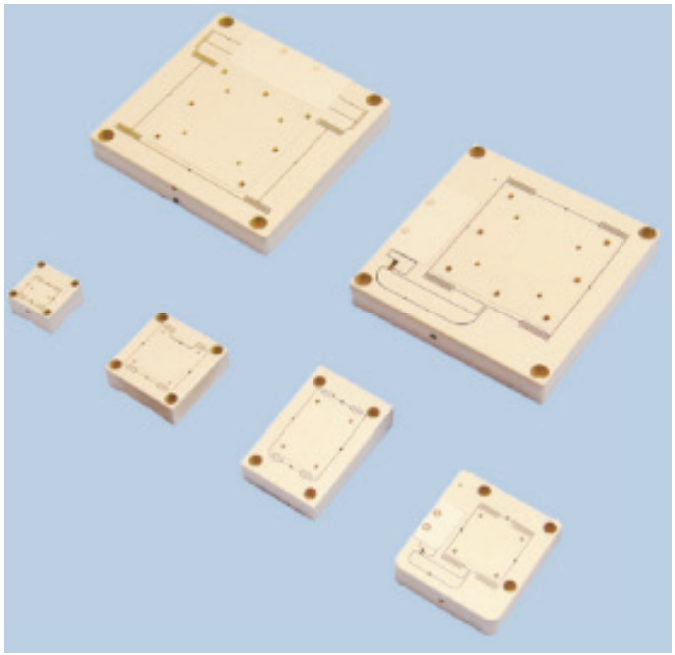
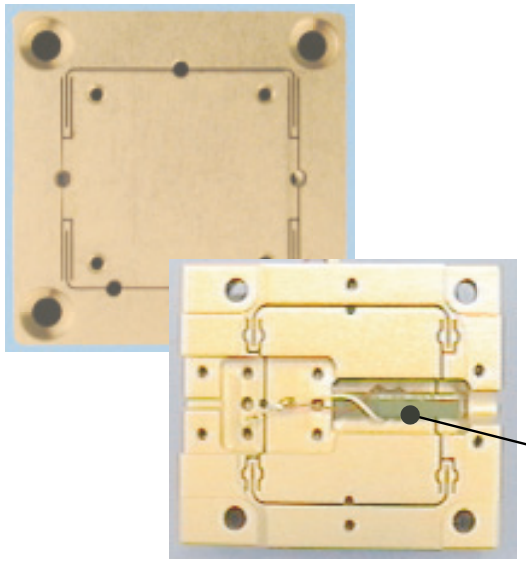
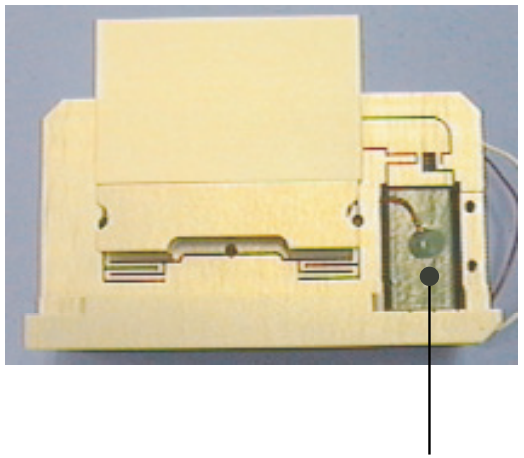
- X-Y stage supplied by NanoControl Co.Ltd.

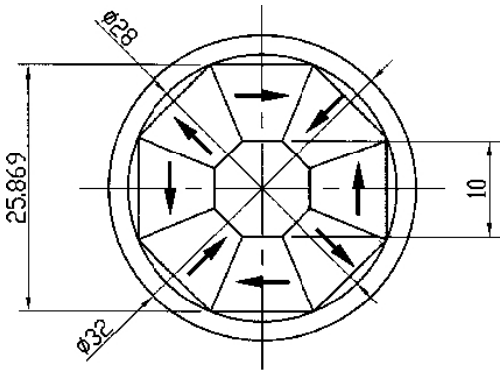


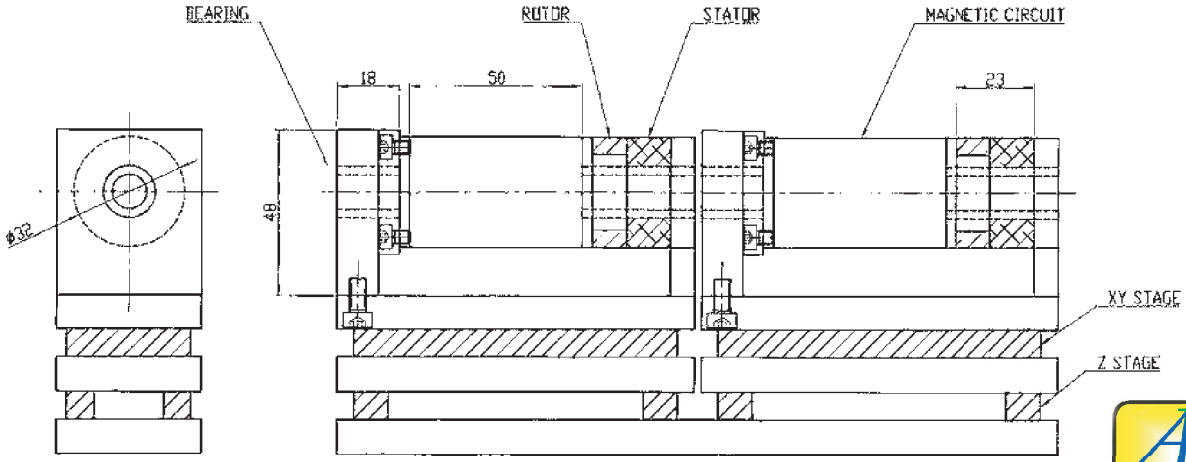




Piezo Actuator
stroke:15μm/2cm

Supersonic Motor or Pneumatic system





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