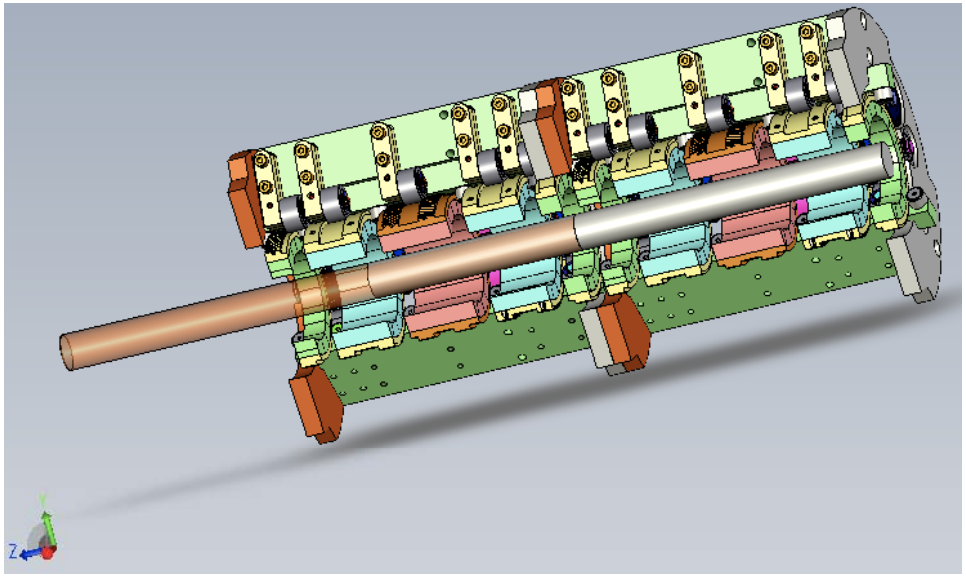
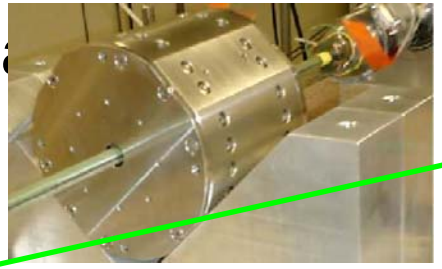
ILC Final Doublet – PM version



Permanent Magnet Study Short History

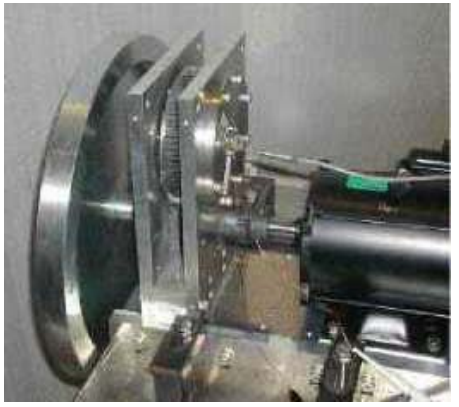
2002~2005 First R&D program for FFQ

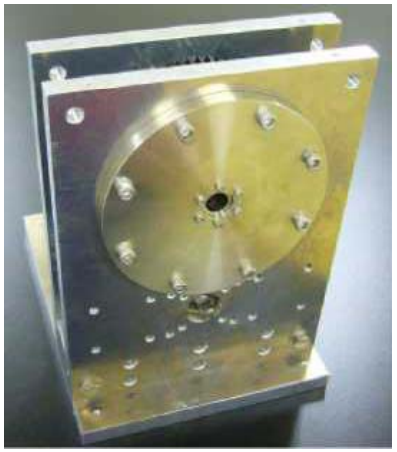
Permanent Magnet Quadrupole for Fina
Lens in a Linear Collider
2002 Fixed strength PMQ
2003 Adjustable PMQ (double ring)
2004 Measurement and fine tuning
2005 Higher gradient at small bore



2006~2009 Second R&D program

Development and Application of PMQ for Linear Collider and Neutron optics
2006 Half scale Model of Rapid Cycling Sextupole
2007~Adjustable PMQ（2nd model）
2008 ...





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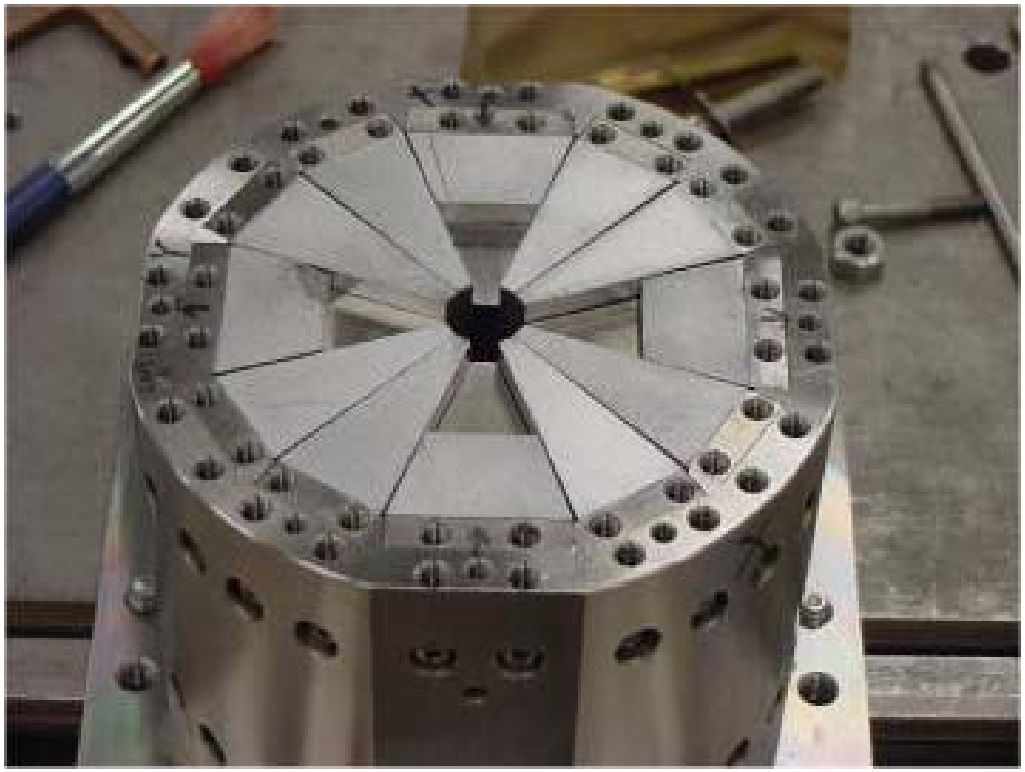
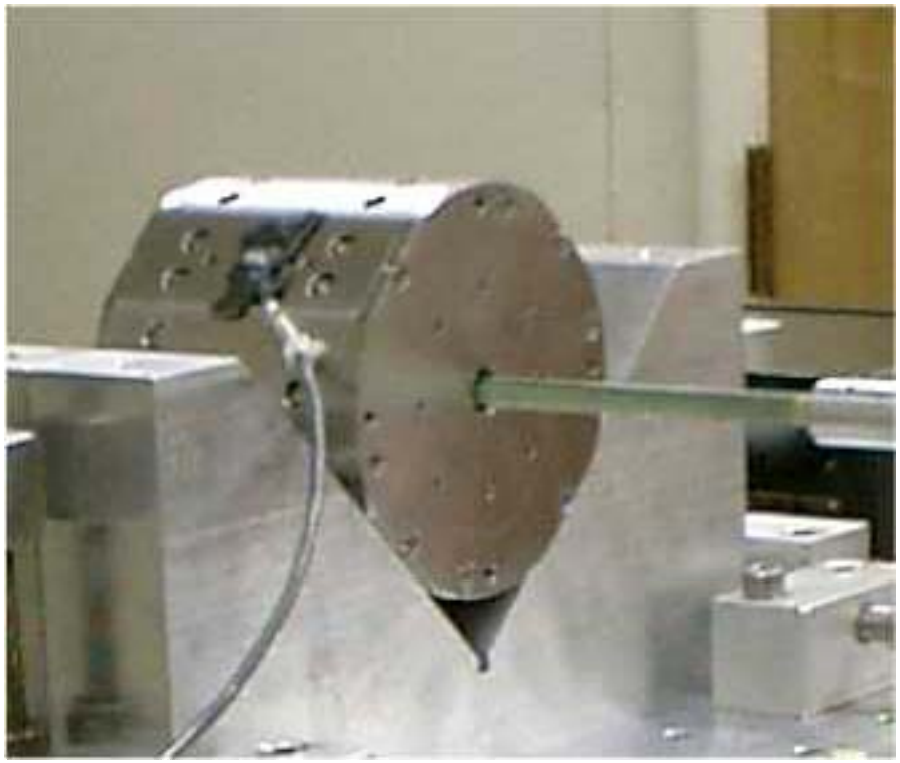
First prototype (fixed field)





Prototype PMQ

Measurement at SLAC

Bore: ø14, OD ø130, L100, GL=28.5T

(290T/m)

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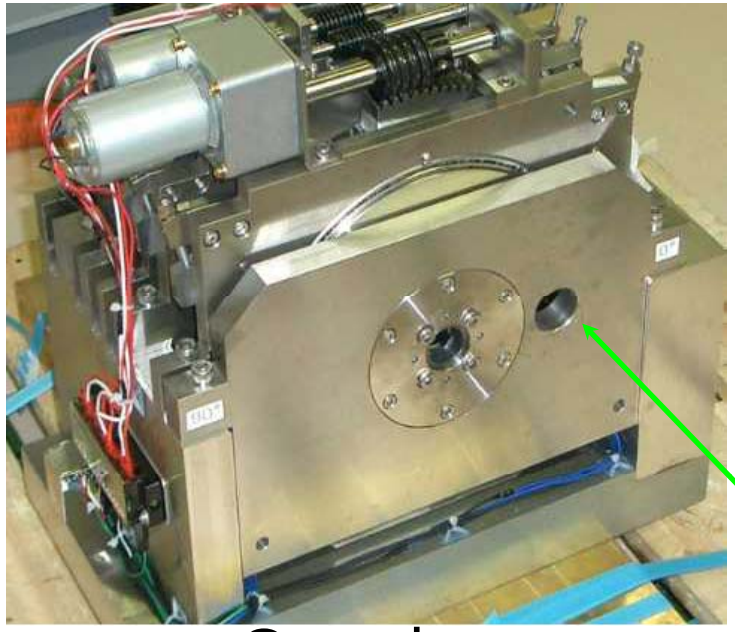
The 20mr Variable FFQ Magnet



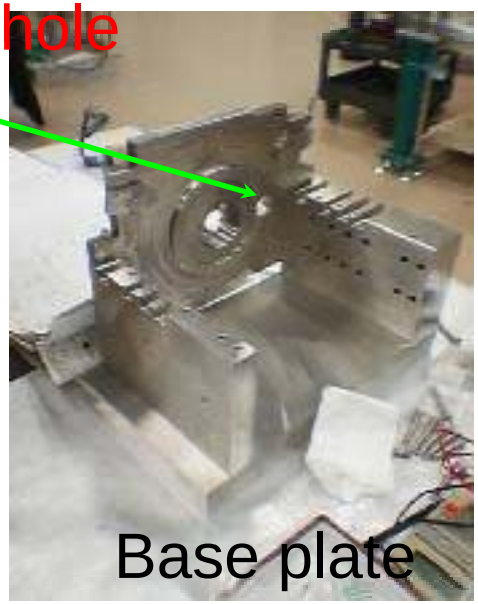
Overview

Bore radius	1cm
Inner ring radii	In 1cm out 3cm
Outer ring radii	In 3.3cm out 5cm
Outer ring section length Physical length	1cm, 2cm, 4cm, 8cm 23cm
Pole material	Permendur
Magnet material (inner ring)	NEOMAX38AH
Magnet material (outer ring)	NEOMAX44H
Integrated gradient (strongest)	24.2T
Integrated gradient (weakest)	3.47T
Int. gradient step size	1.4T

Extra beam hole

Inner Ring

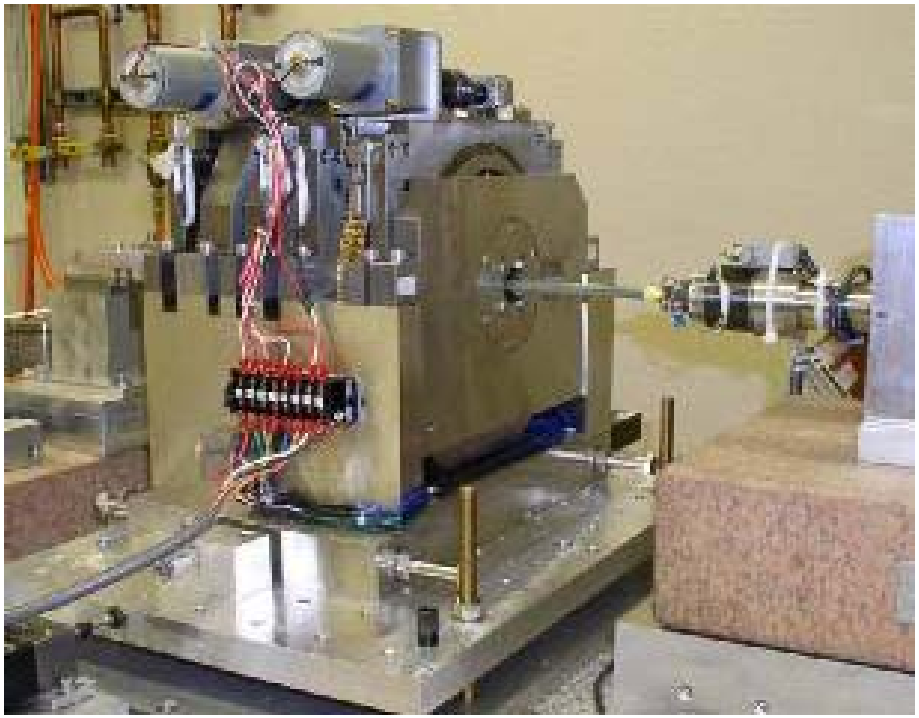
Outer Ring

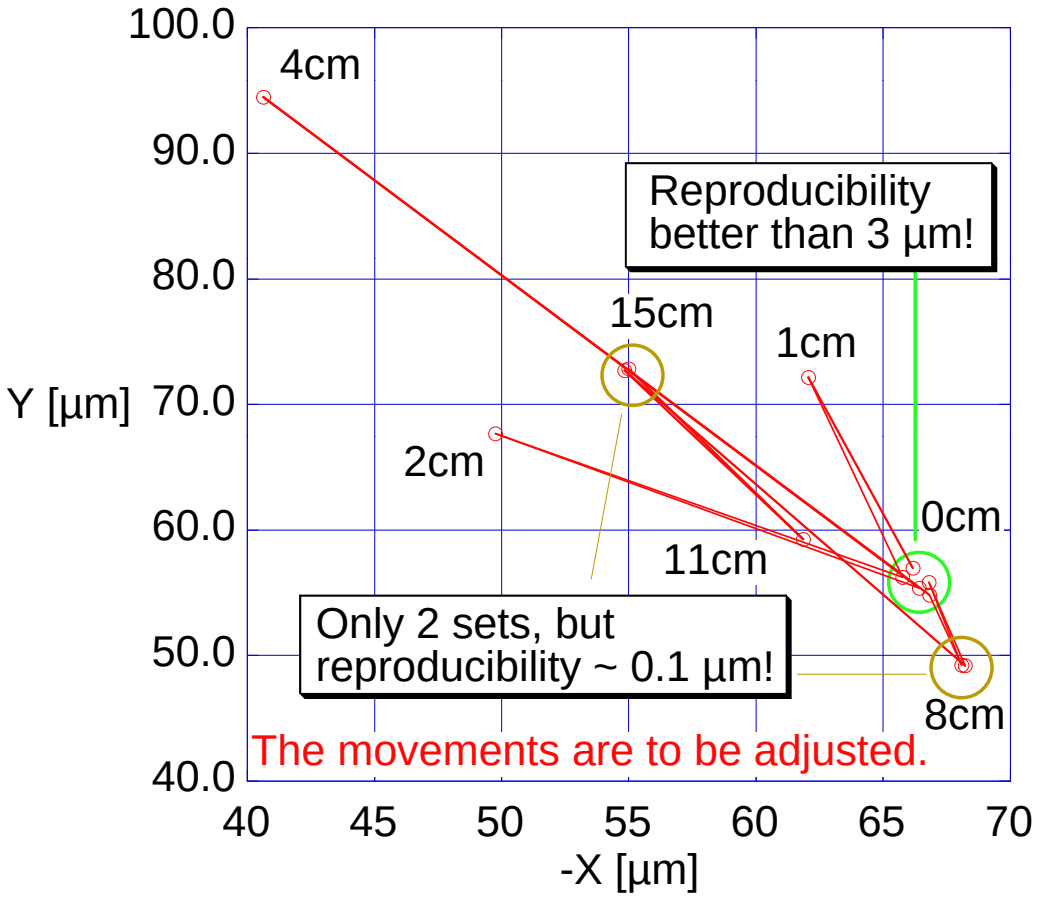


Base plate

Before assembly

Magnetic Center Movement





The cm values show the Switched-On-Length

The center moves several µm for 20% strength change.

See http://accelconf.web.cern.ch/AccelConf/l04/PAPERS/TUP81.PDF (LINAC'04)

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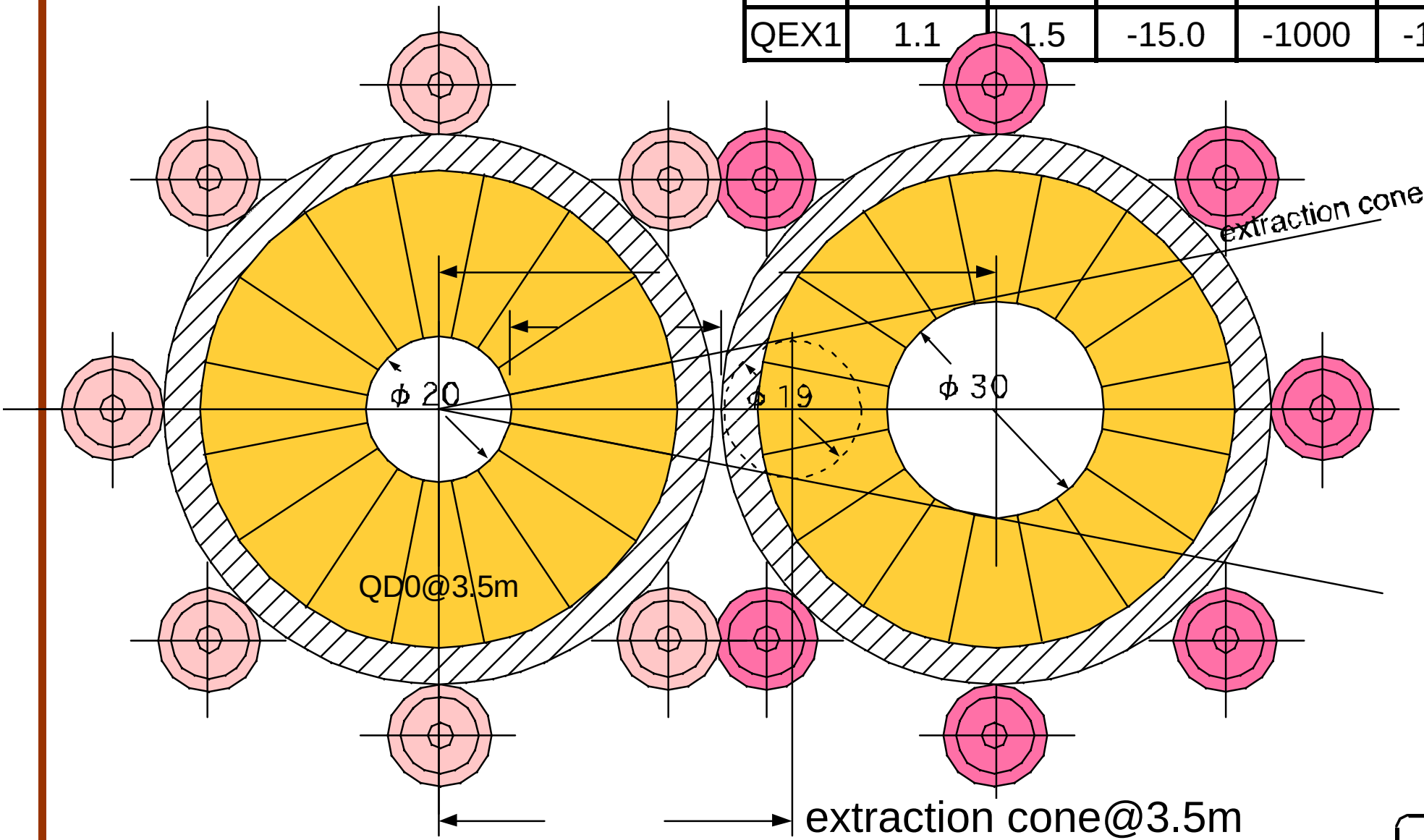
14mr option needs smaller OD

	Eff.L [m]	R [cm]	kG	kG/m	GL [kG]
QF1	2.0	1	8	803	1605
QD0	2.2	1	-14.2	-1416	-3116
QEX1	1.1	1.5	-15.0	-1000	-1060



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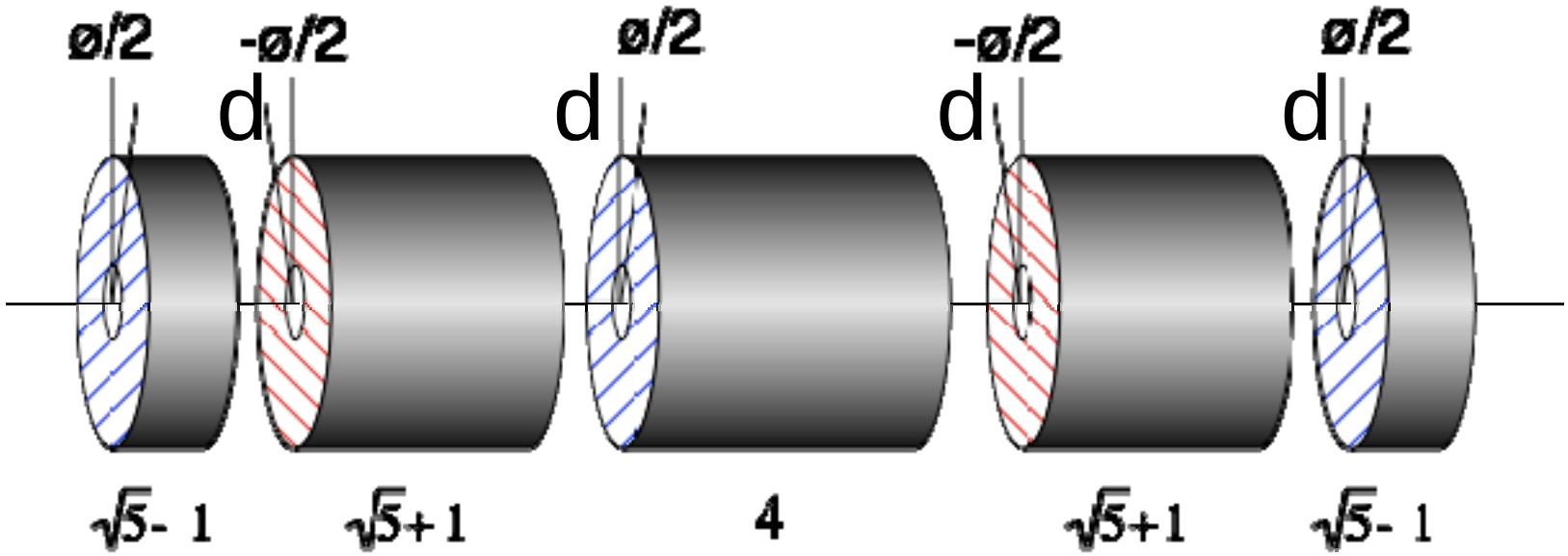
Gluckstern's skewless variable PMQ

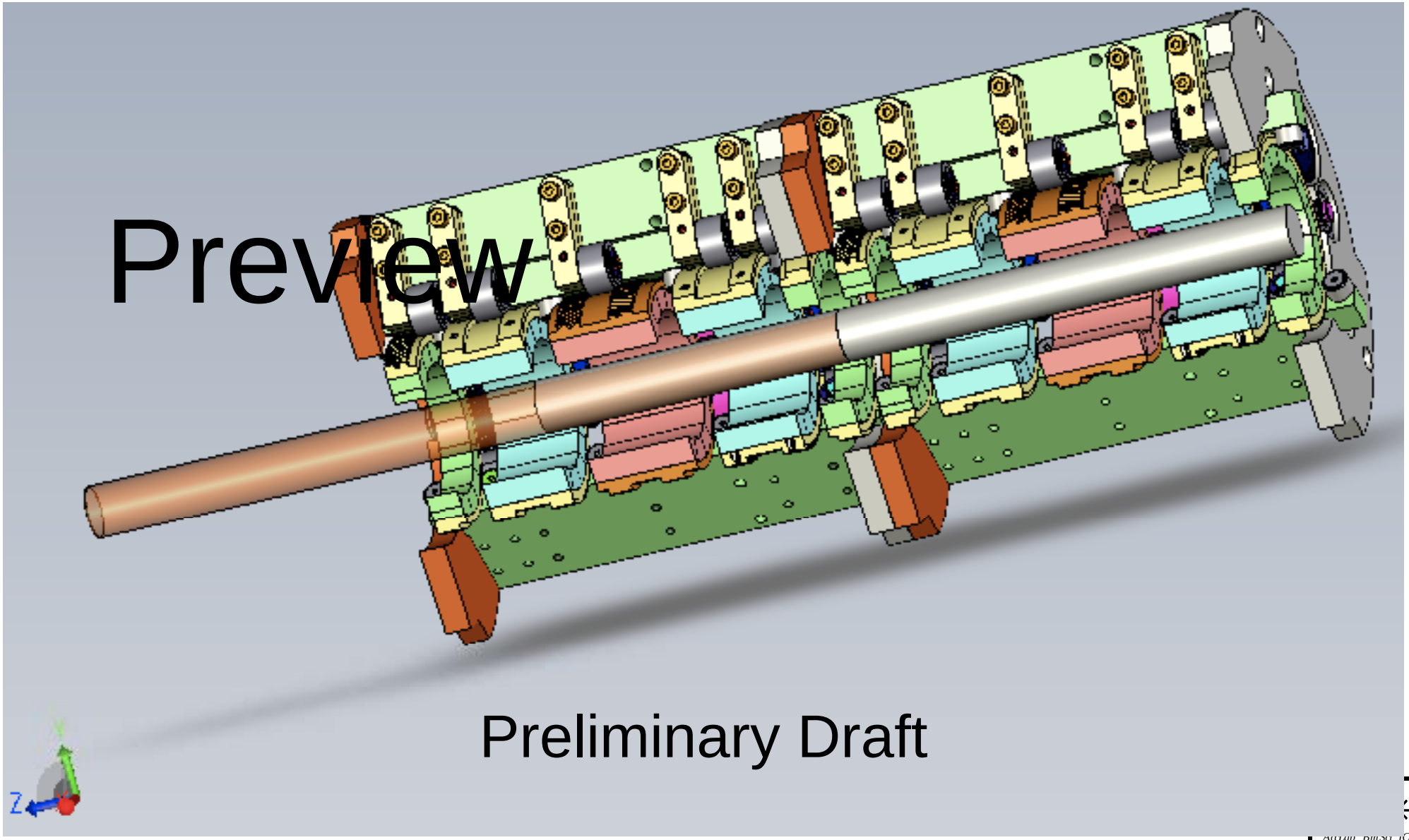


$$M = R \bullet M2 \bullet R^{-2} \bullet M1 \bullet R^{2} \bullet M0 \bullet R^{-2} \bullet M1 \bullet R^{2} \bullet M2 \bullet R^{-1}$$

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

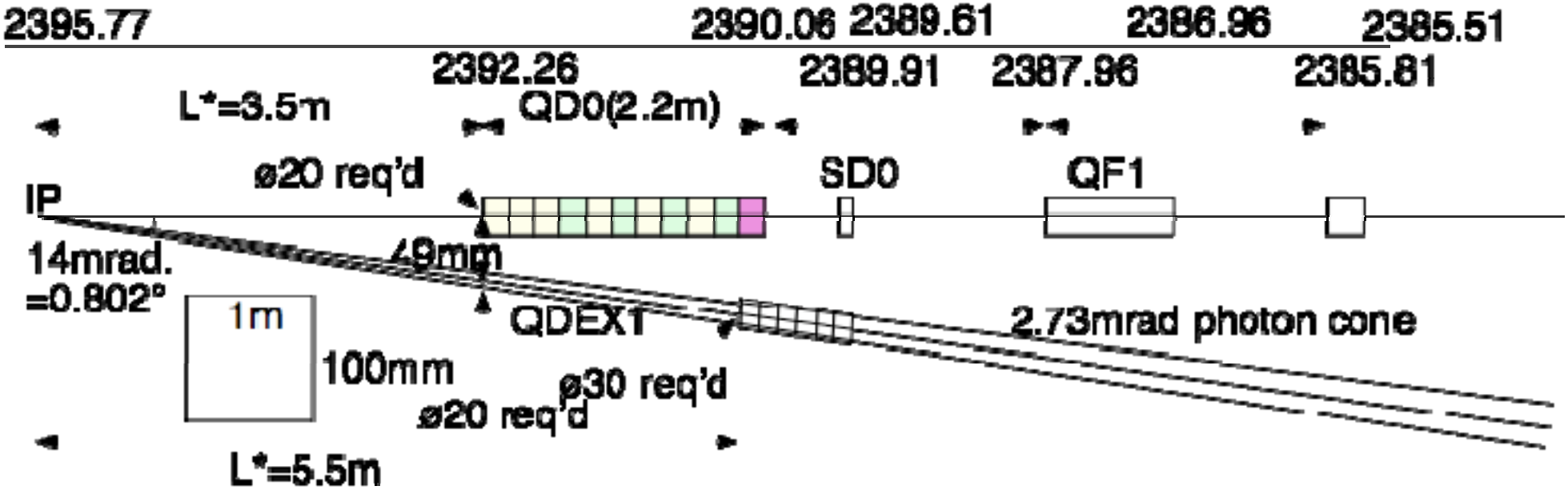
R.L. Gluckstern and R.F. Holsinger: Adjustable Strength REC Quadrupoles, IEEE Trans. Nucl. Sci., Vol. NS-30, NO. 4, August 1983, http://epaper.kek.jp/p83/PDF/PAC1983_3326.PDF

Large Bore ATF2 design: Two Five-Ring-Singlets



Single Ring Train Configuration

	Eff.L [m]	R [cm]	kG	kG/m	GL [kG]
QF1	2.0	1	8	803	1605
QD0	2.2	1	-14.2	-1416	-3116
QEX1	1.1	1.5	-15.0	-1000	-1060



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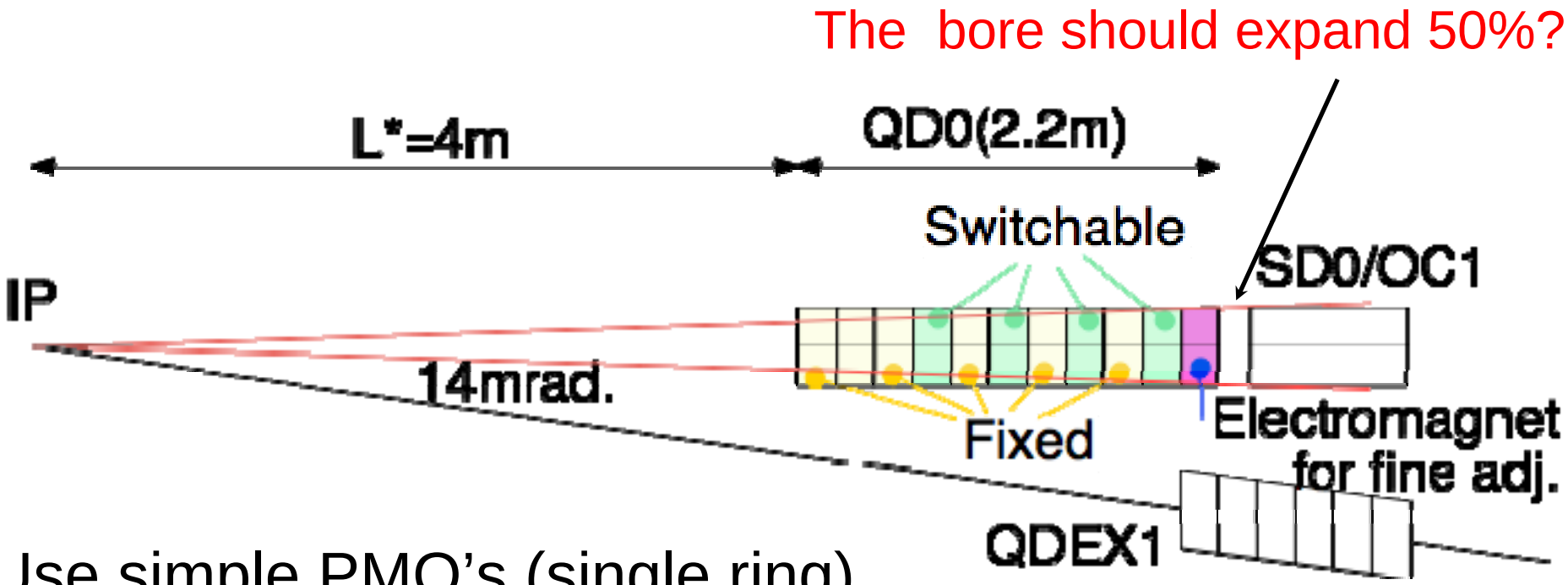
A Possible Configuration with Simple PMQ



- Use simple PMQ's (single ring).
- 20% strength will be achieved by flipping 40% PMQ's.
- The step size can be reduced by subdividing the PMQ's.
- Fine adjustment by electromagnet.
- The center shift should be investigated for this config.
- ø20mm bore enough all along the 2.2m QD0?

Summary of BG

- There is **no vibration source** in PMQ.
- 1st variable PMQ was based on double-ring structure (for 20mr) and evaluated.
- 2nd one (for 14mr) will have **5-ring-singlet structure** whose skew effect can be canceled with appropriate ratios in lengths.
- The strength can be changed **continuously**.
- A prototype will be fabricated in JFY2007.
- It will be measured in 2008~2009.
- The current project ends JPY2009.

目的：PM0-QD0において可変時の磁場中心の変動幅のビーム実験による計測

必要な施設：ＡＴＦ２

人員：４人（岩下 + 学生 + KEKstaff + PD1人）

年次計画案：
2007年：ATF2用ボアø50で製作 (ILC用ø20)
2008年：磁場測定 PD￥４M
2009~2012年：EM-QD0と置換してビーム実験？
　FFTB Mover使用
2012～2015年?：ビーム実験

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