ATF2

Magnets

Status Report on the ATF2 “Final Doublet” quads being made at SLAC from old FFTB “QC3” style quads

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Member of ATF2 Magnet Team

ATF2

Magnets

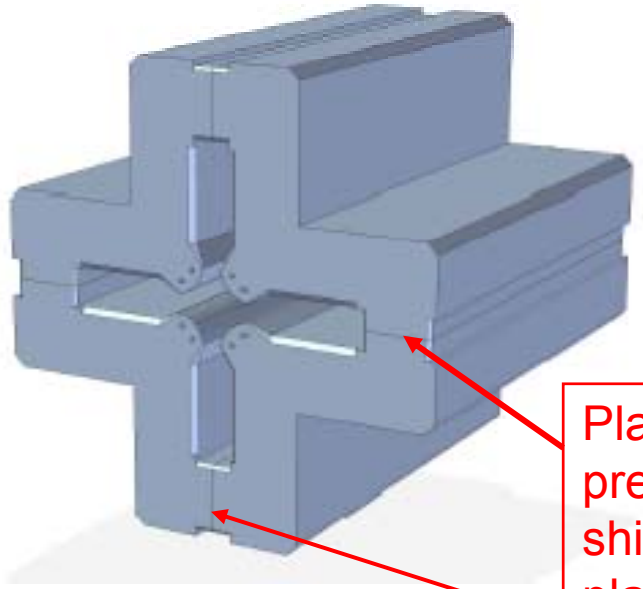
Chosen method for enlarging the FFTB "QC3" quad's bore diameter

Hyperbolic pole-tip is moved, along a radius, further out than it's equation says it should be.

$XY = r^2/2$.

Consequence: the 12-pole component increases, ~17 times predicts POISSON.

ATF2 has very tight tolerances on the multipoles in QD0 & QF1



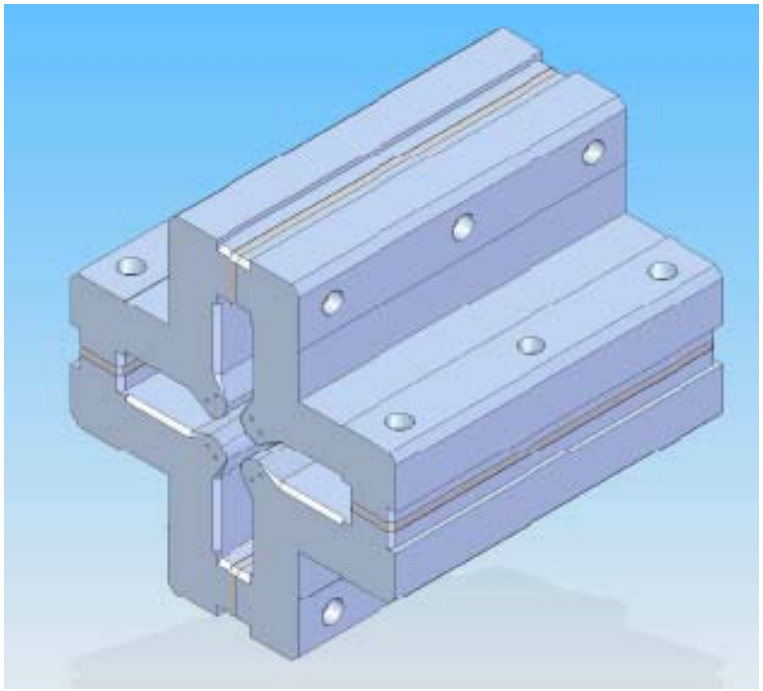
Shim will be low carbon steel, ground to 0.0005" flatness

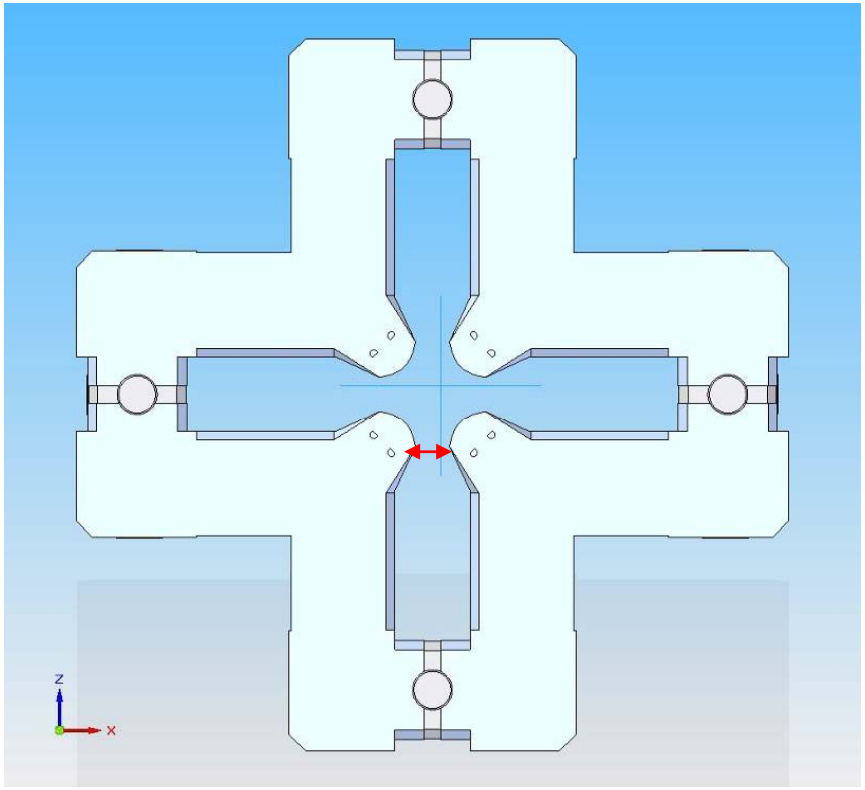
Place a very flat and precise thickness shim in each split plane to "explode" the quad and enlarge the bore diameter.

ATF2

Magnets

Drawings of the modified core with ground shims in place





Sextupole component is very sensitive to poletip being at wrong radius or the poletip being offset "azimuthally"

Adjacent pole distances (red arrow above) adjusted to be same to +/- 0.013mm. Then cores pieces pinned

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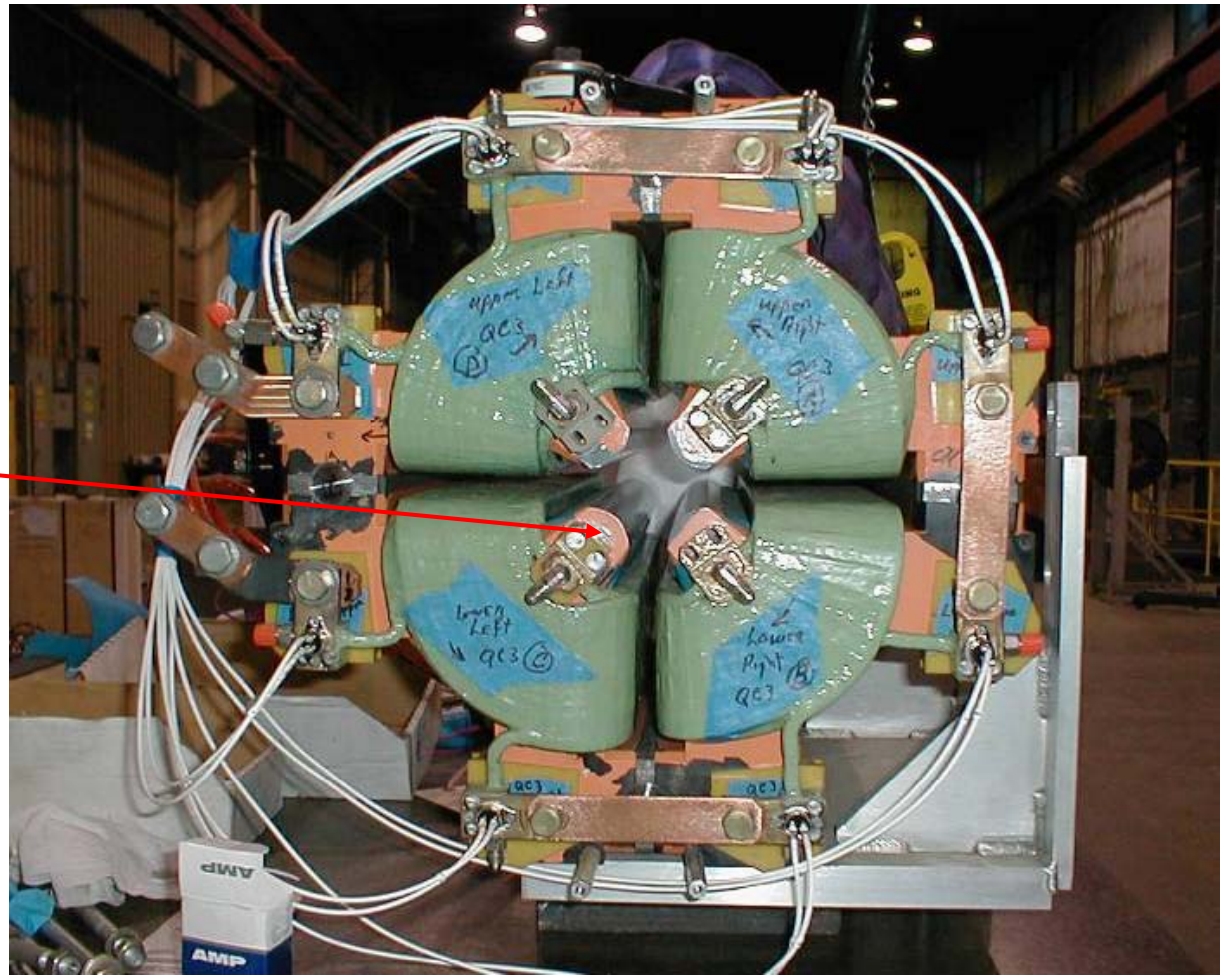
Magnets

Terminal (downstream) end of modified quad

Not much space on poletip ~1.5cm- for my buttons to reduce 12-pole (see later)



ATF2

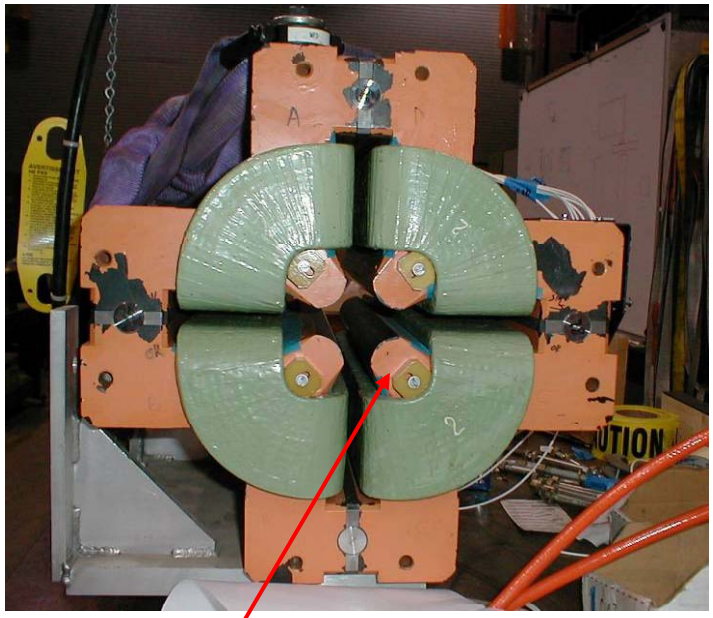
Magnets

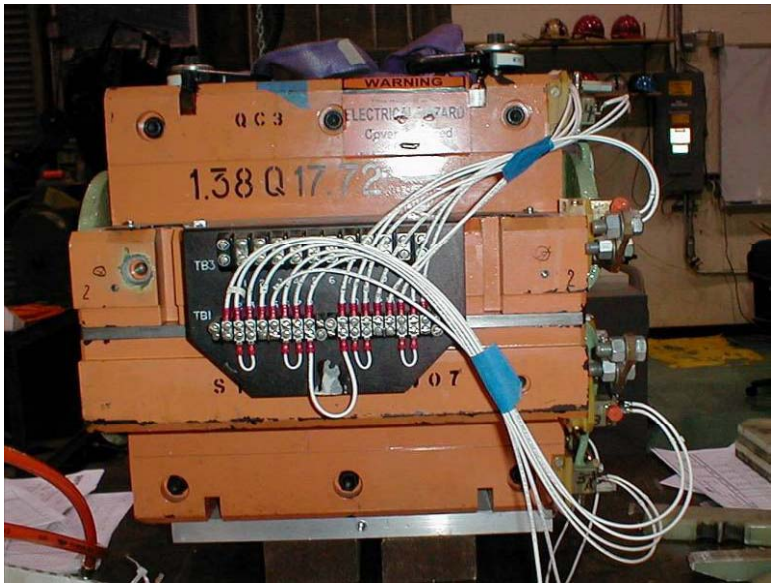
Close up view of modified quad

ATF2

Magnets

Photos of FD quad #1 ready to be measured with rotating coil





More space on poletip at upstream end- BPM has claimed this end plus, MONALISA wants to put a retro-reflector here too!

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Magnets

Summary of required FD quad parameters

- QF1 and QD0 requirements:
- Definition of K1 :

  Gradient = K1 x Brho / Effective length

  At 1.3 GeV, Brho = 4.3363 Tesla-meter

Latest requirements are:

- QF1 K1 = 0.737 and QD0 K1= -1.351
- Integrated strengths: QF1: 3.1959 Tesla; QD0: 5.8584 T
- New aperture: 50.00 mm diameter ; Eff L= 0.475 m;
- Aperture had to to be 50mm to match S band BPM
- Predicted would need 127.9 amps to reach QD0 strength

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Magnets

Thermal behaviour & integrated strength: preliminary data

- Yesterday quickly measured first quad
- Thermal test : run at 150 amps for ~ 1 hour with 2.5 gpm total in 8 water circuits
  - Cooling water temperature increased by 1.6°C [will be less at operating current]
- Integrated strength at 128.2 amps:
  - 5.6875 tesla
  - So will run at 132.1 amps to get required $\int G.dl$

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Compare predictions of multipole content with tolerances from James Jones & S. Kuroda

Magnet Name	Tolerance 6 pole/quad At r=1cm	Tolerance 12 pole/quad	POISSON Prediction 12pole/quad	Tolerance 20pole/quad	POISSON Prediction 20pole/quad
QF1	9.5×10^{-5}	2.46×10^{-4}	18.6×10^{-4}	1.19×10^{-3}	4.18×10^{-6}
QD0	5.26×10^{-5}	3.08×10^{-3}	18.6×10^{-4}	5.98×10^{-1}	4.18×10^{-6}

ABOVE TABLE IS FOR A 50mm diameter bore with the poletips "pulled back", so we expect 12 pole to be larger than with "proper" poletips.

Tightest 12pole/quad tolerance is for QF1.
Tightest sextupole/quad tolerance is for QD0; NOT CLEAR WE CAN MEASURE SUCH A SMALL SEXTUPOLE- apparatus measurement error is larger than 5×10^{-5}. *Will be discussing with our MM group*.

ATF2

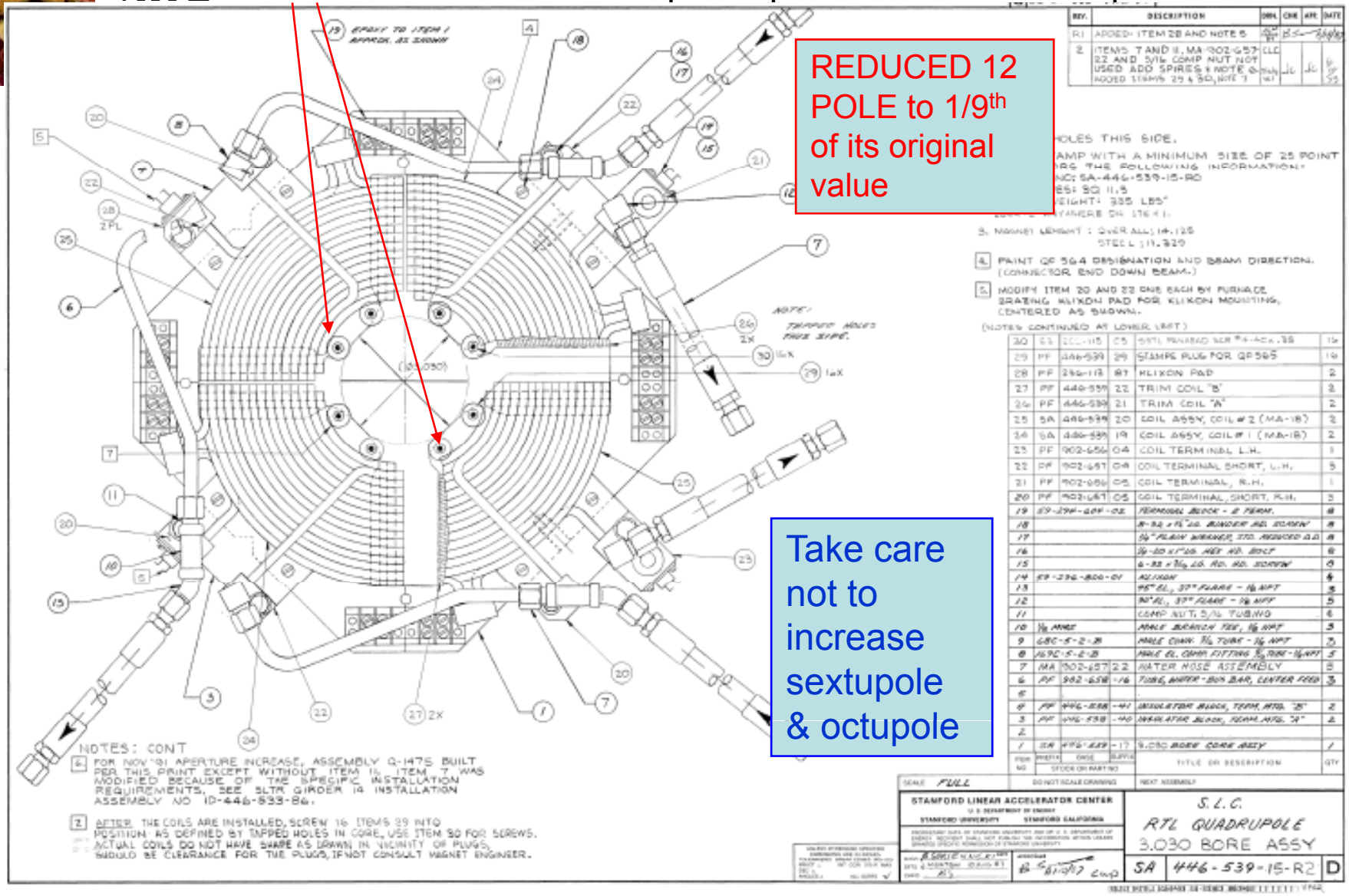
Magnets

Preliminary Multipole Measurements on first enlarged aperture quad

Magnet Name	6 pole/quad At r=1cm	Octupole/quad	12pole/quad	20pole/quad	POISSON Prediction 12pole/quad
#1mst at 128 amp	38 $x10^{-5}$	8.5 $x10^{-4}$	17.3 $x10^{-4}$	5.7 $x10^{-6}$	
QD0 Tolerance	$5.26x10^{-5}$	$1.01x10^{-4}$	$2.46x10^{-4}$	$1.19x10^{-3}$	$18.64x10^{-4}$

12pole & octupole are ~7 times too large. We have at least 2 ways to reduce them: by chamfering poletip ends or by adding steel buttons on poletip end. Determine the button size and position by experiment :more on Spencer's experience with this on next slide.

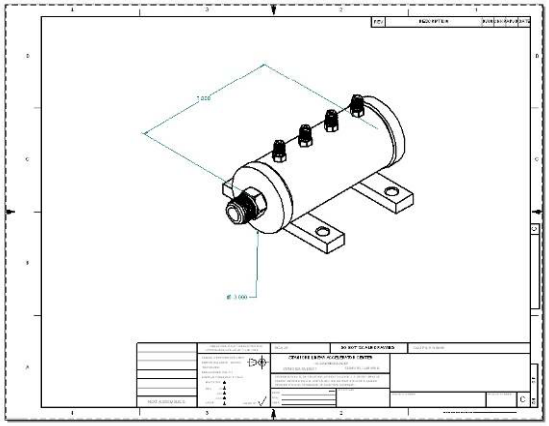
ATF2 Buttons added to an SLC quadrupole to reduce its 12 pole content



ATF2 Water Manifolds for FD Quads – Location?

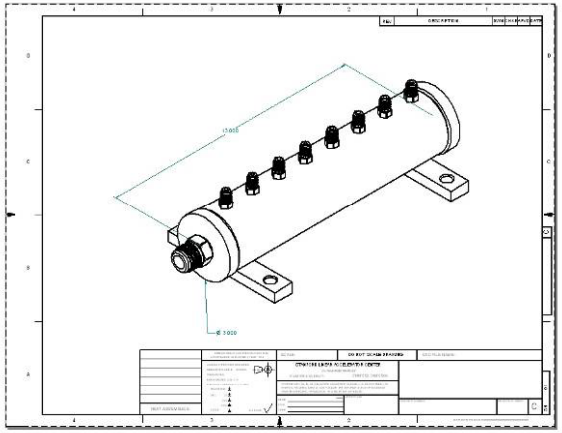
Magnets

Each FD quad has 8 cooling water inputs and
4 outputs which use US standard 37° flare water fittings.
To simplify installation, we propose to use 2 manifolds
for each quad. One 8 way for input and 4 way for output.
Will use JIS 30° flare ¾-14 water fitting to connect to KEK
water system. This fitting will be tapped into manifold body
with ¾-14 PT. It can be connected with hard pipe instead of
JIS 30° flare if desired. The 8 way manifold is 13”L x 3” Dia.



Questions to KEK:
Can this be mounted on accelerator housing to the side
or above magnets? We do not want to mount on quad yoke
or CLIC table to limit vibrations.

Should we modify the manifold design in any way to
accommodate installation or other issues?

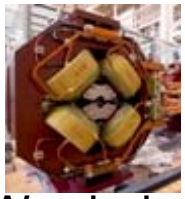


ATF2

Magnets

Height of CLIC Table and distances available to support FD magnets

- ATF2 beamline @ 1200mm above ATF2 floor.
- CLIC Table Top @ 650mm.
- Space for an FD magnet, its mover & support = 550mm.
- Solid Wire Sextupole Core height= 8.919”, magnetic center @ 113.3mm.
- Sextupole mover height from bottom base plate to top V block plate 12” = 304.8mm.
- Total for sextupole: 113.3+304.8=418.1mm, so 550-418.1=131.9mm space to fill to reach beamline.
- Shimmed quad and mover height from bottom base plate to magnetic center= 408.31mm. So 550-408.31=141.69mm space to fill to reach beamline.
- Fine adjustment of magnet/mover height can be done with thin shims beneath T-plate and support spool. This gives adjustment in Y, roll, and pitch. X, Z, and yaw can be coarsely adjusted by loosening base plate to CLIC table bolts and sliding base plate. Support spools were NOT SAVED!
- But how to make up 130-140mm height difference? Thick shims/plate under base plate or taller support spools? THIS NEEDS TO BE DECIDED.



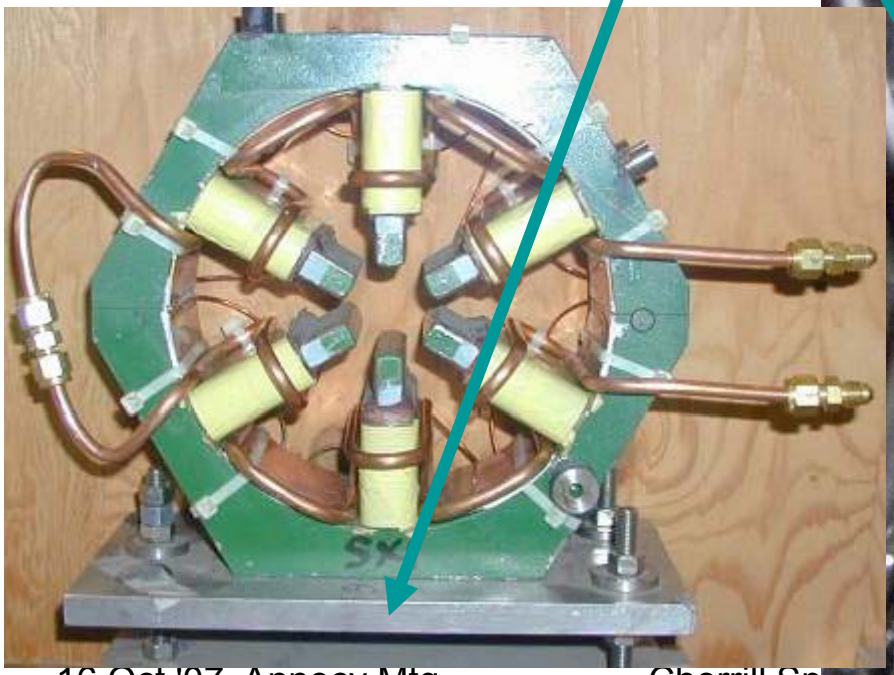
ATF2 Vibration measurements of FD sextupoles.

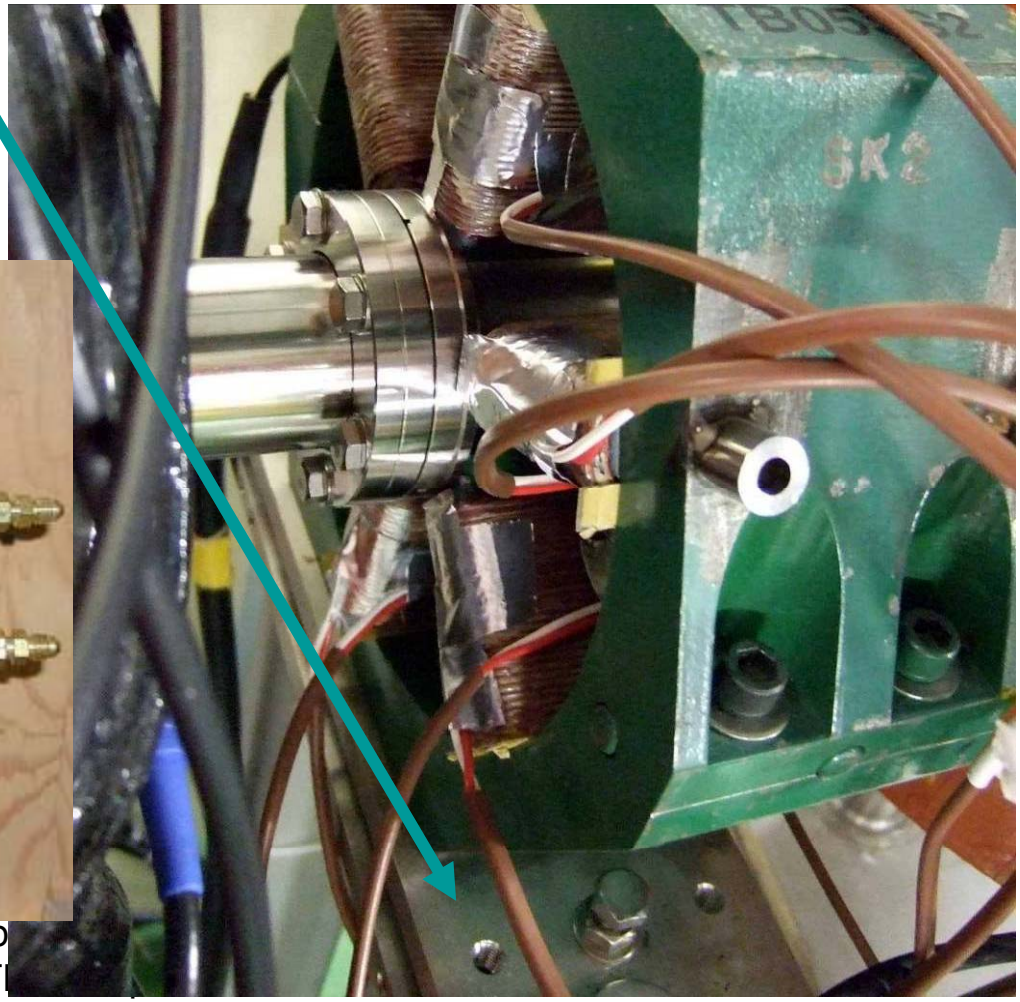
Magnets Installing cooling tube on solid wire sextupoles.

Worried about vibration, will measure at SLAC with adjustment base attached.

Questions to KEK: Will sextupoles pulled from ATF ext. to be used in FD have adjustment bases when installed?

Will these adjustment bases be bolted to plate on top of mover?



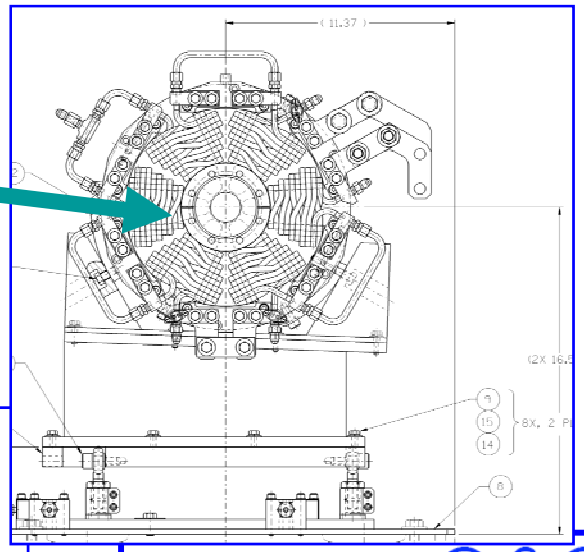


ATF2

Magnets

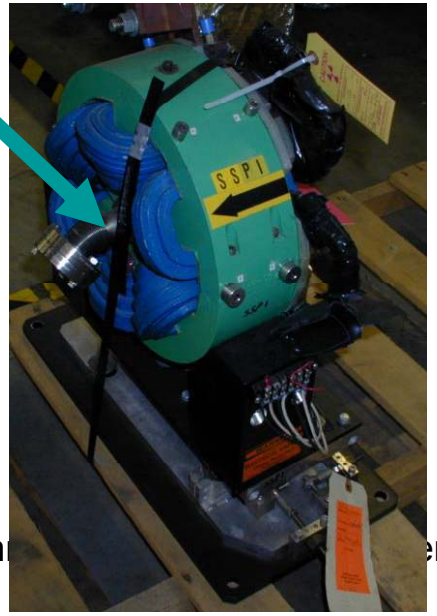
Q-BPM support for FF SX magnets

Height to magnetic center one SX magnet and stand is ~279.4mm.



Needs to be 220mm

Height to magnetic center of SX and stand is ~234.5mm, have 2 magnets with these stands.



Q-S-Q sections

- Q-BPMs for SX magnets will be supported in holding-up style.
- The footprint of SX has to fit the Sugararasan's adjuster plate which is identical to the ones for QE
- I propose to put an "offset table" and attach BPM mount and SX on it. This is an example in my thc