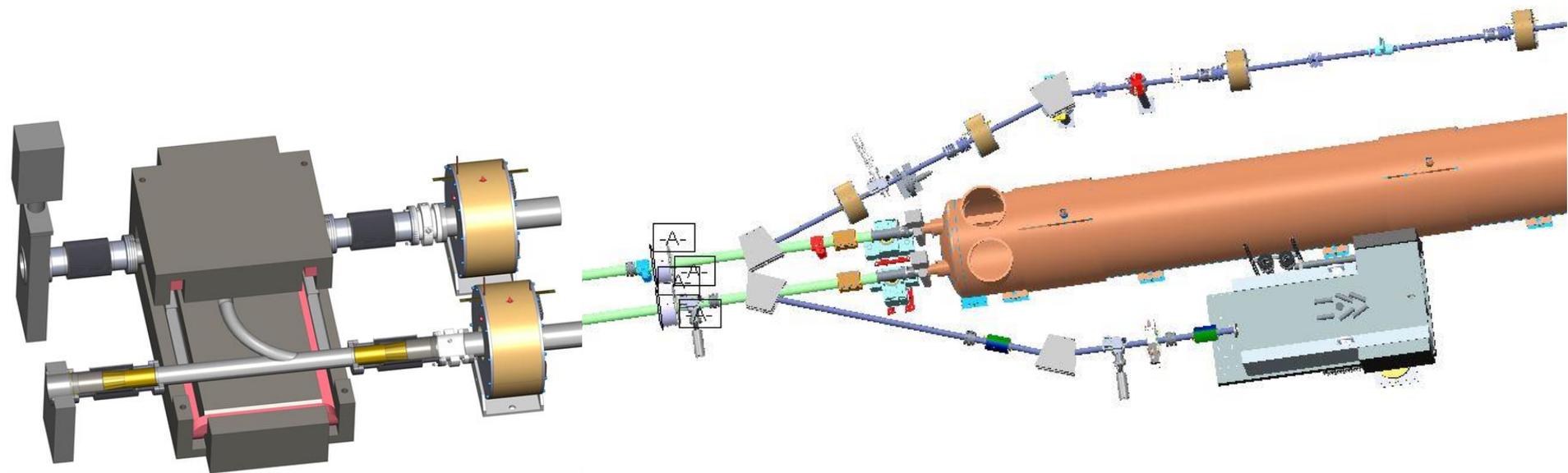
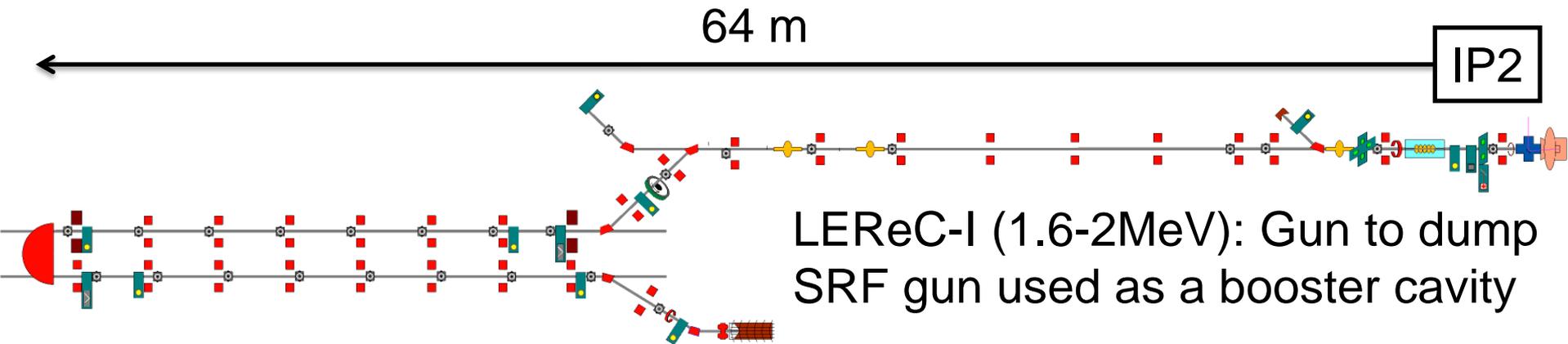


Overall Layout



Low Energy RHIC electron Cooling

LF Solenoids

- **In Contract**

HF Solenoids

- **In Contract**

Instrumentation

- MPF for BPM status.
- **Design review for Profile Monitors and Emittance Slit Scanner Hardware 3/20/15**
- **Detailed design for vacuum chambers, final analysis, SOW, etc.**

Beam Line Vacuum

- The standard bellows design for cooling section has some problems bolting up to BPM – bolt can go in only one way. He prefers to not use studs.

20 & 180 deg Dipoles

Animesh Jain will evaluate the field quality at low field on one of the CEC 45 dipoles. 2nd dipole magnet has been surveyed and is being set up.

Multipoles must be $\leq 10e-3$

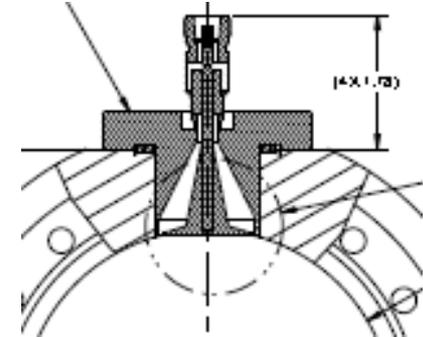
- 20 dipole design is ready for procurement: Solid steel Core. If laminations are required, RFQ will be stopped and modified. Regarding stray field-multipoles, the design is satisfactory. D. Kayran recommended measurement when delivered. SOW has 10/1/15 delivery, quantity – 2
- 180 dipole finish drawings and prepare SOW. Solid steel Core. If laminations are required, RFQ will be stopped and modified.

Reminder: Al Pendzick needs new penetration requirements for 2:00.

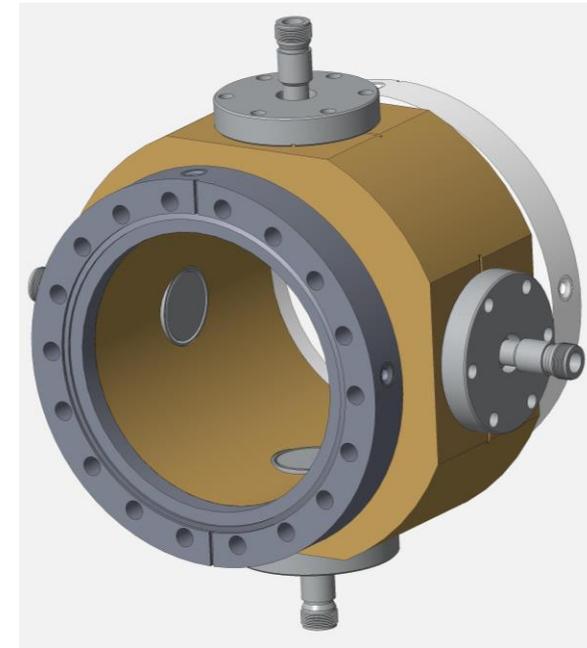
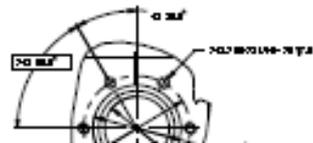
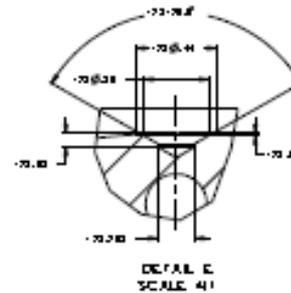
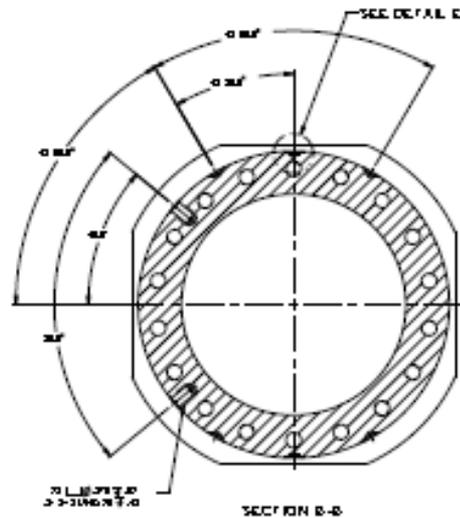
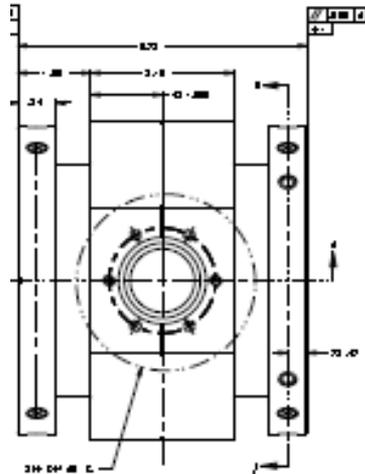
This will include type (RF, instrumentation, power), location (from/to), and area of cable space. The request for this contract must be by March-April in order to have penetrations installed during this shutdown (takes 6 mo. to get jobs done - October).

Orthogonal Installation – simple processing.

- Large Dia. BPM Housings (4.8 ID), 28mm buttons
- Revised fiducal design per M. Ilardo
- N-Type feedthrough, MPF Q7031-1



DETAIL D
SCALE 2X



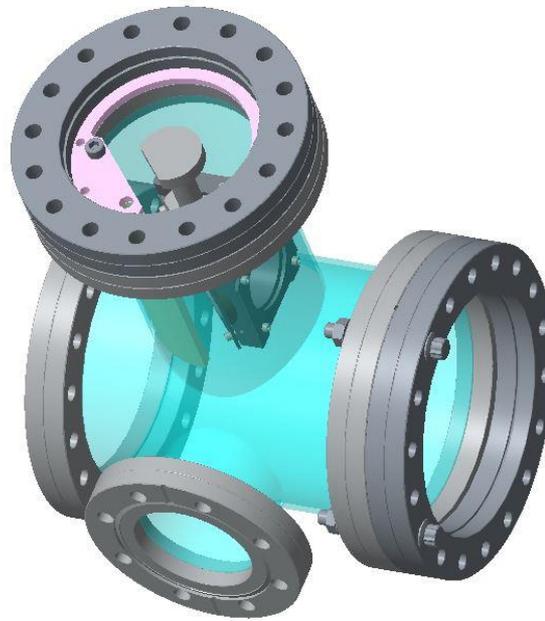
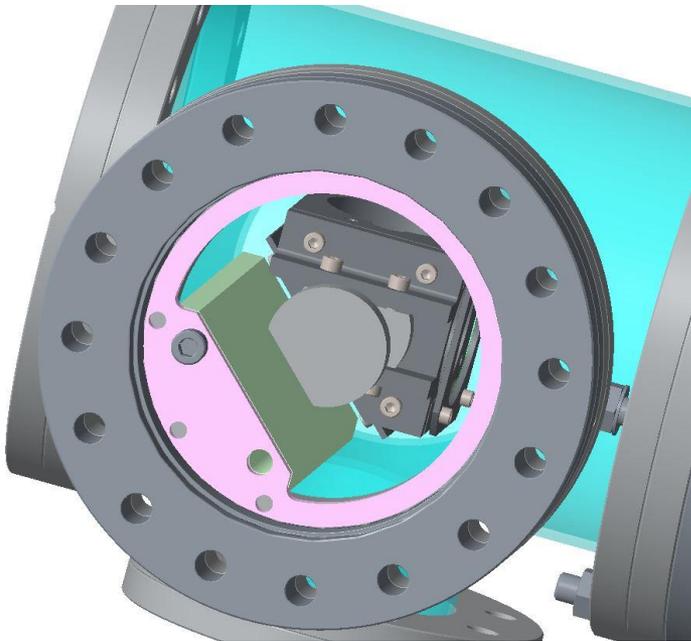
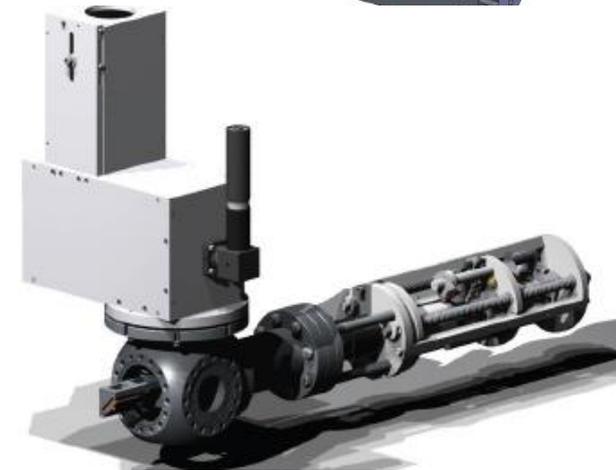
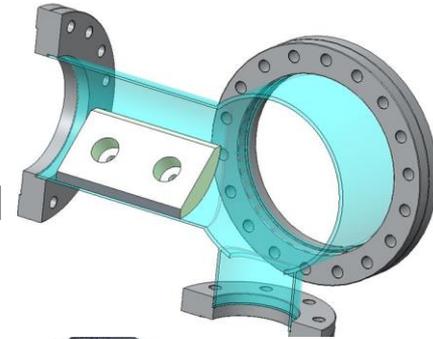
Profile Monitors – New designs for Cooling Section

Ferrite ring mounting point. Low power loss - CMD5005 material.

Ferrite shape is not critical

Peter re-analyzed the chamber. modeled is 1.65" OD, 1.45" ID and 1" high.

Chamber design being finalized and detailed.

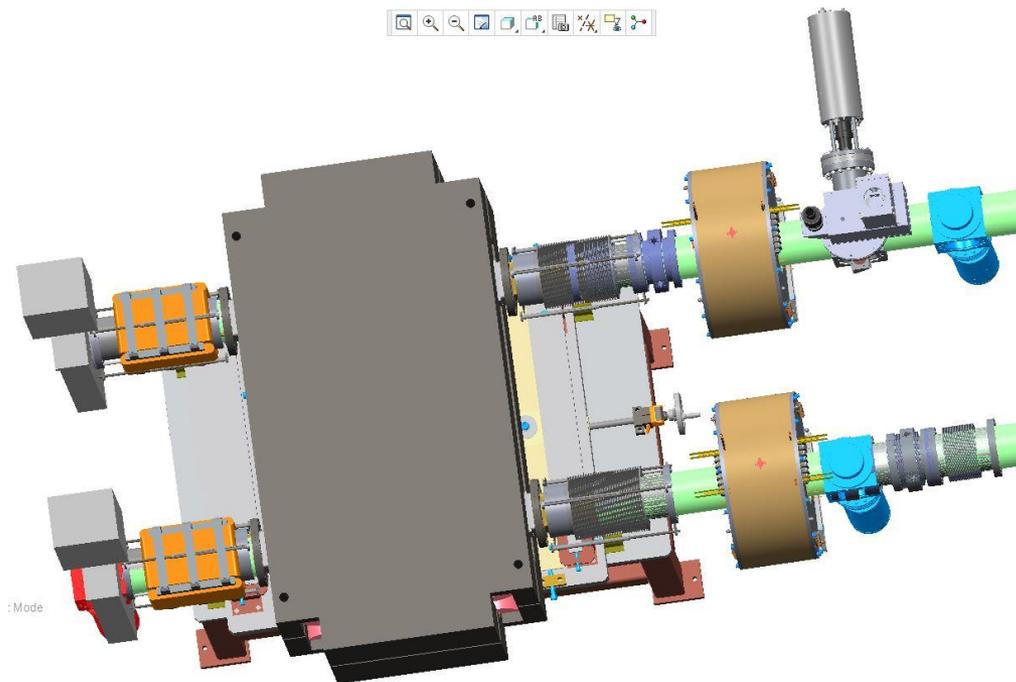


Emittance Slit Chamber

Adjustable bellows assembly

- (welded bellows).

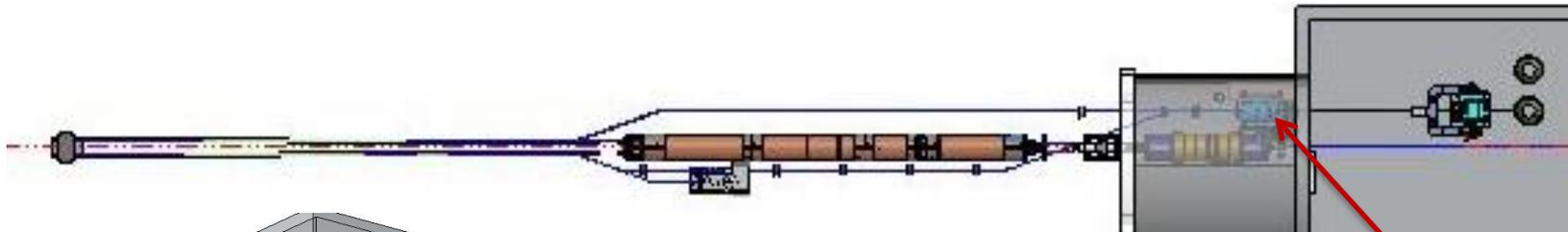
Local Real Estate



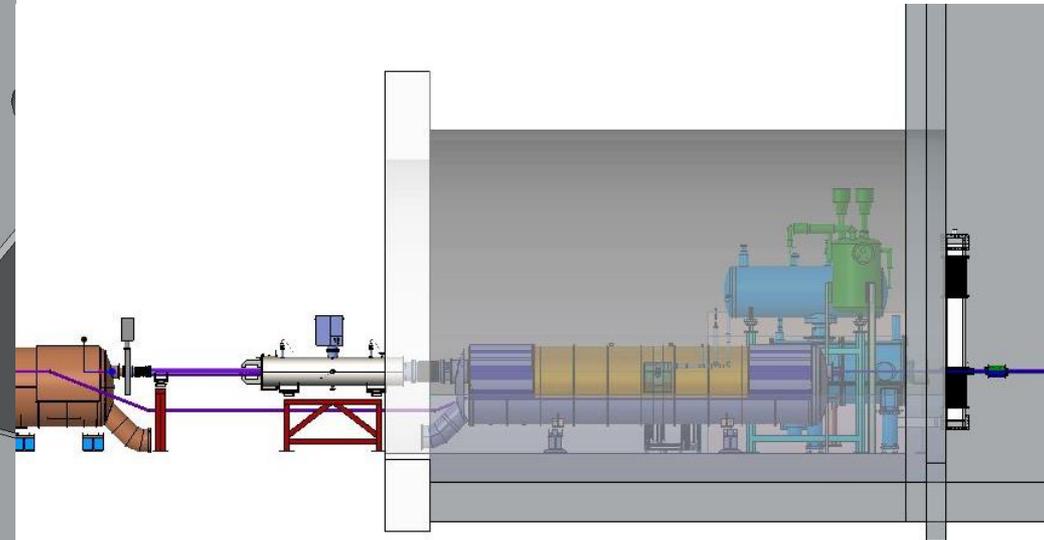
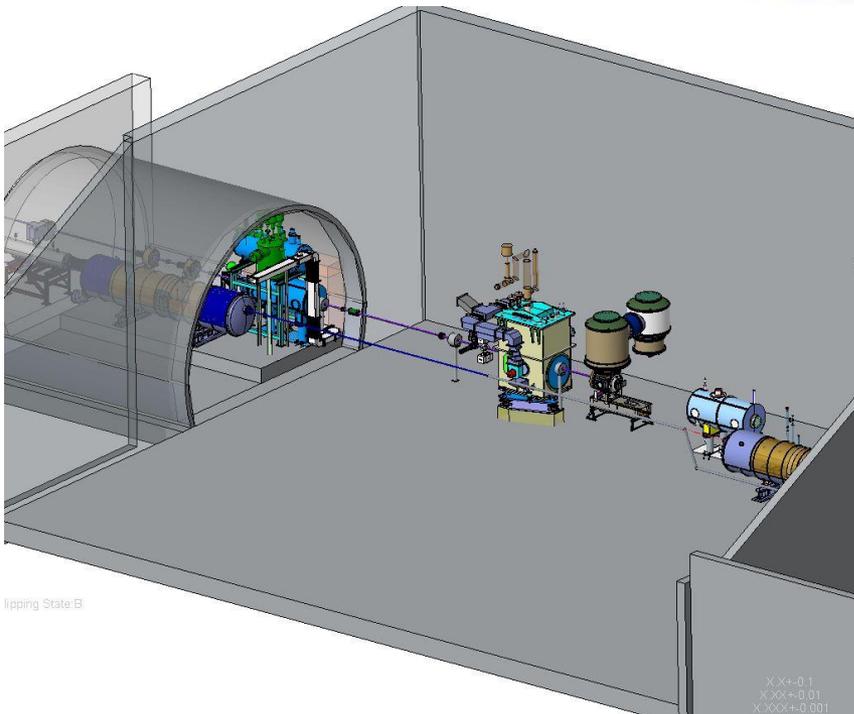
Low Energy RHIC electron Cooling

5 cell cavity location

Location of egun and 5-cell, the beam line length and distance from IR center and tolerance, is being updated by R. Meier.



5 cell



Compensating and Matching Solenoids

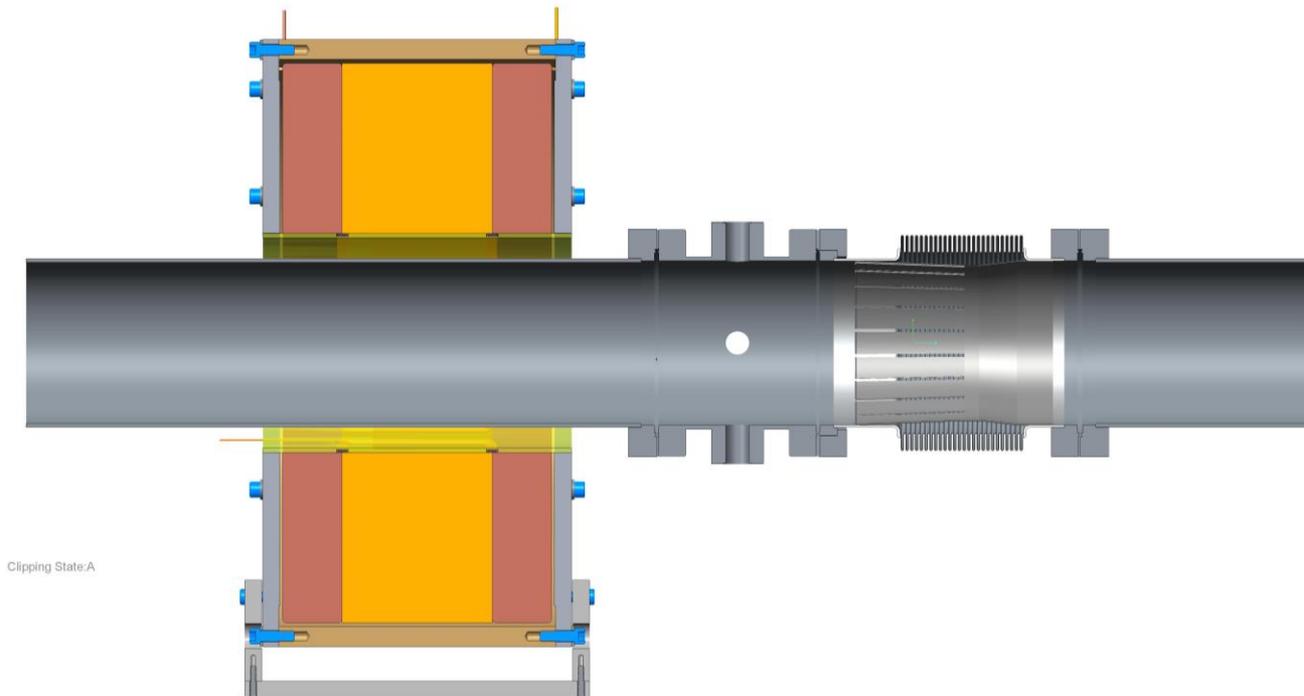
Contract Awarded 9/15/2015 delivery for both

Next Steps:

Design support stand assembly

Magnetic shielding analysis, design prototype mu metal shields and supports.

Magnet measurement fixture plan for prototype and design test fixtures.



20° Dipole Magnet

Drawings checked – Spec/SOW approved (4/1/2015).

Requisition in process

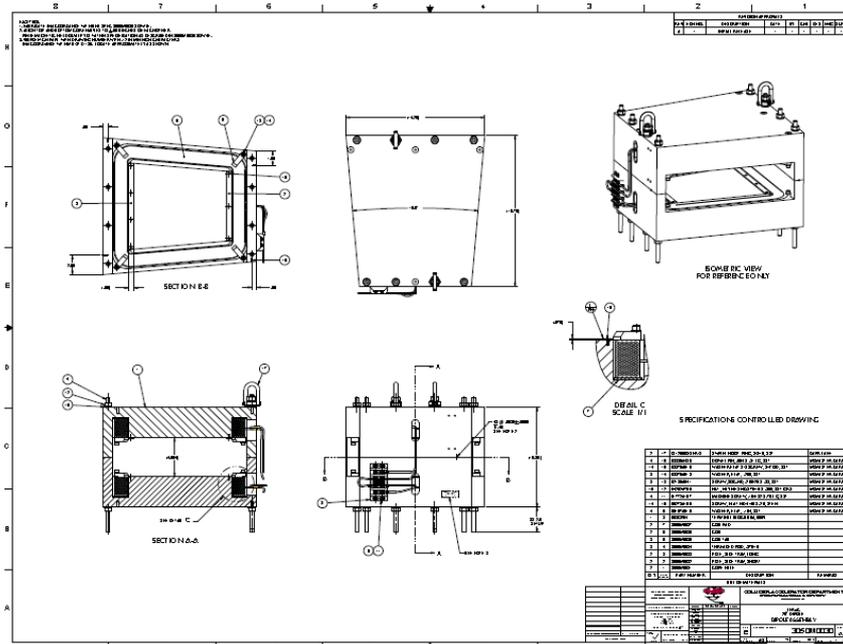
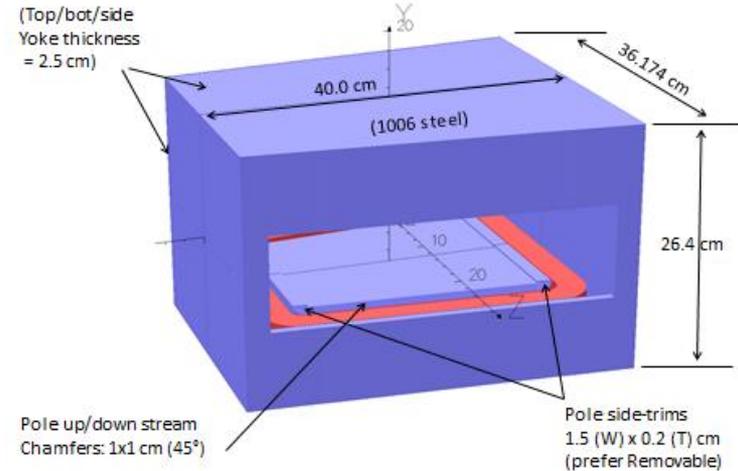
Distance Between Pole Faces = 10.4 cm (4.1 in.)

Magnet Vertical Gap = 10 cm

Vacuum Chamber V Aperture = 9.5 cm (3.74 in.)

SOW – 2 magnets by 10/1/2015.

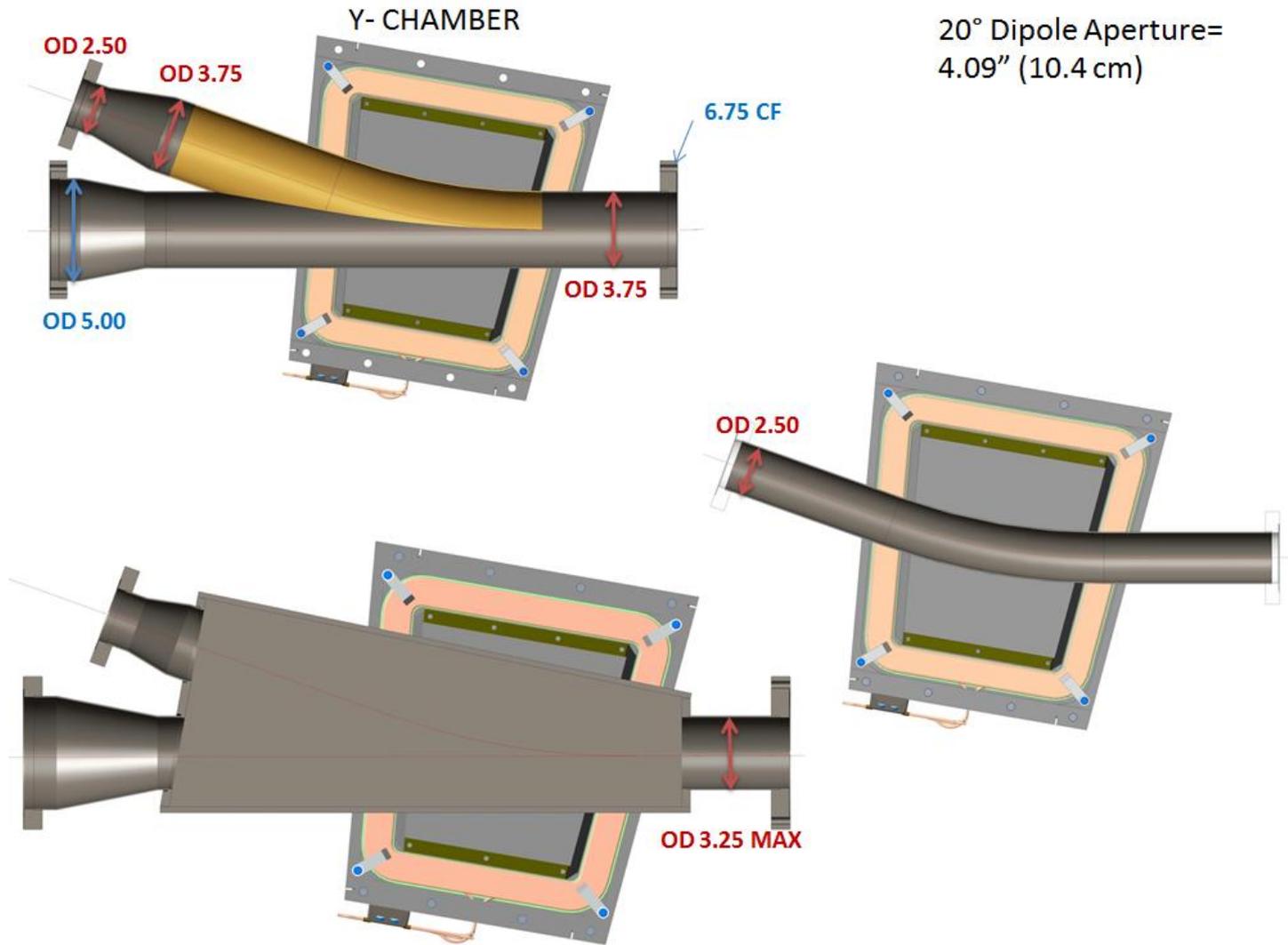
LEReC 20-degree Dipole (Gap clearance=10 cm)
(distance between pole faces =10.4 cm)



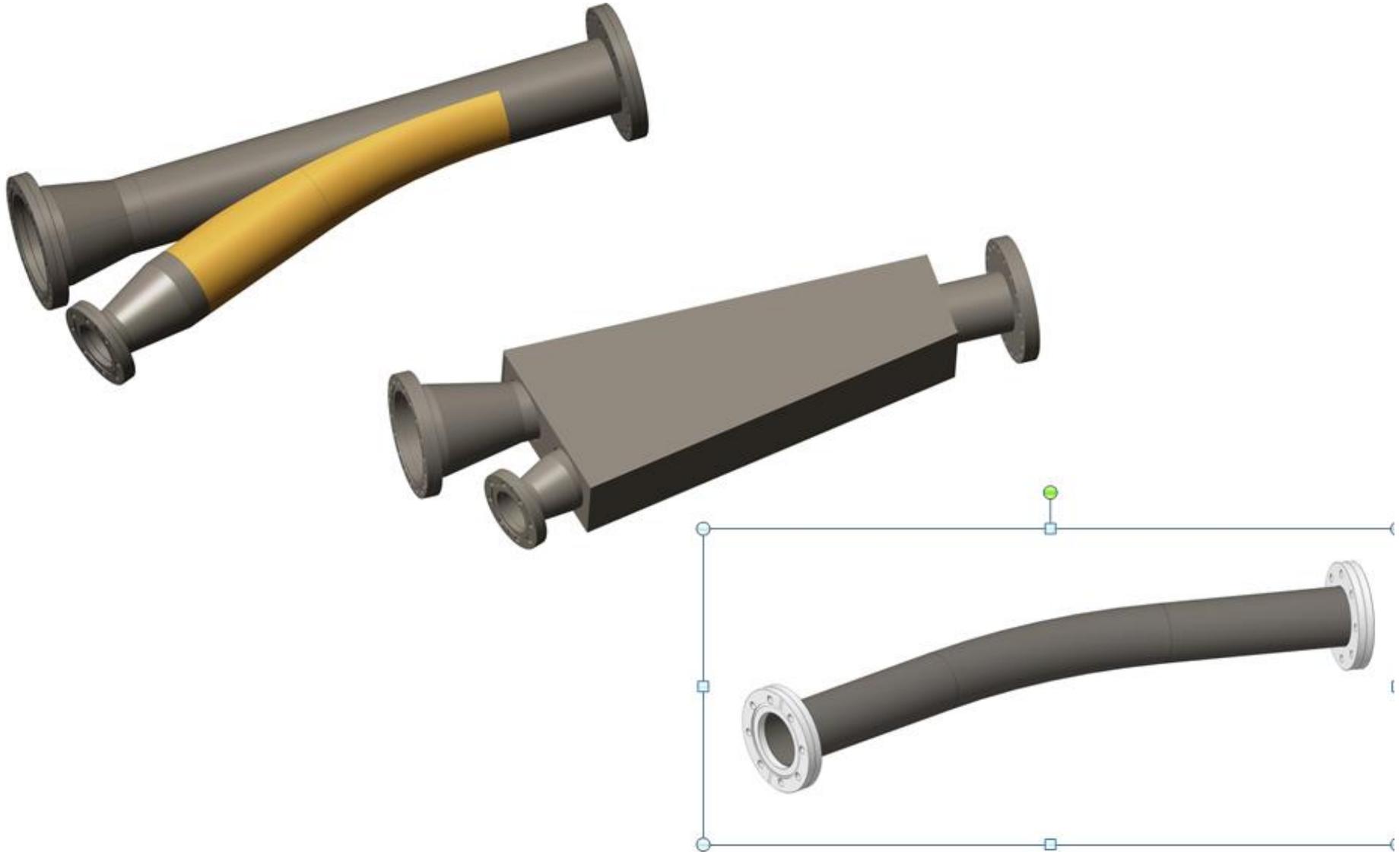
Electron tracking results and field qualities along trajectory
on R=1 cm curved cylinder:

	Ek = 5 MeV	Ek = 1.6 MeV
Current per coil (Amp-turn)	1053.288	393.192
Overall current density (A/mm ²) (overall coil cross-section 3.0x4.8 cm)	0.73145	0.27305
Central Gap Field (Gauss)	251.20	93.73
Half b1-integral (dipole) (G-cm)	3.1982E3	1.1930E3
Half b3-integral (6-pole) (G-cm) [Ratio to dipole integral]	1.803E-2 [5.64E-6]	7.019E-3 [5.88E-6]
Half bending angle from tracking tests (required 10°)	10.013°	10.006°

20° Dipole Magnet



20° Dipole Magnet



Low Energy RHIC electron Cooling

180° Dipole Magnet

Magnetic field quality and repeatability for energy spread measurement.

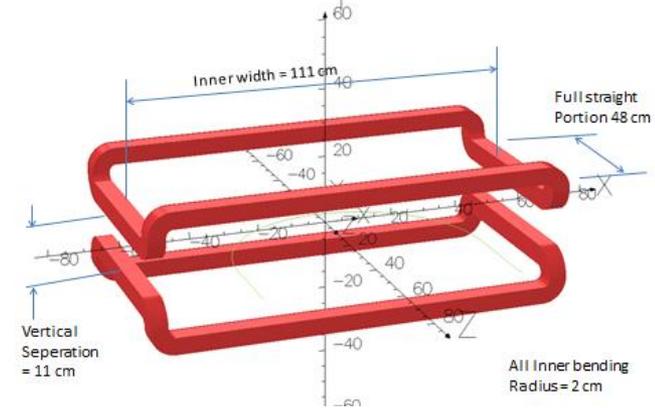
Test using CeC dipole (A. Jain)

Range of motion for magnet core +/- 10cm.

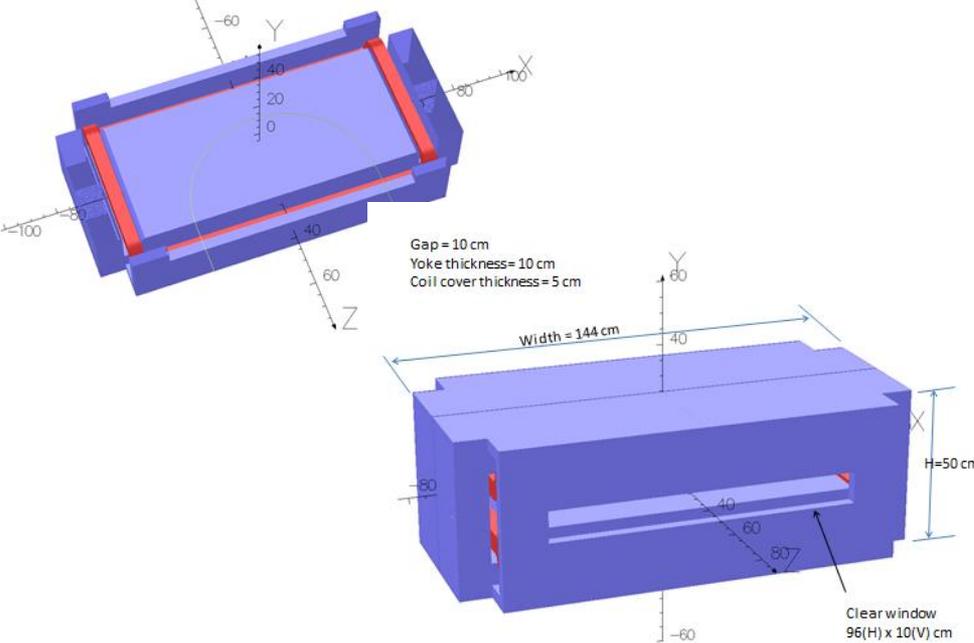
Magnet Vertical Gap = 10.0 cm (3.94 in.)

Vacuum Chamber Aperture = 9.5 cm (3.75 in.)

Saddle coils: cross-section 5 x 6 cm; overall $I = 70.7382 \text{ A/cm}^2$



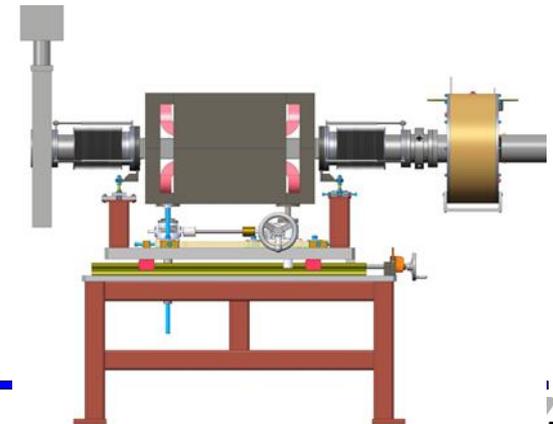
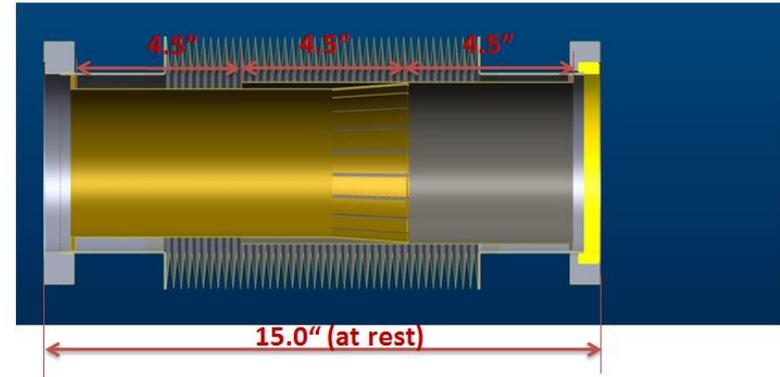
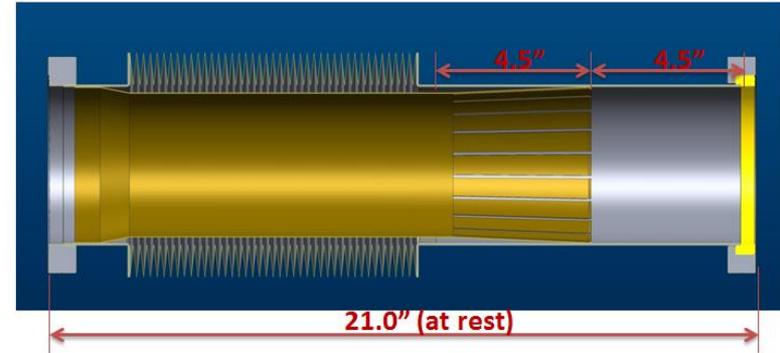
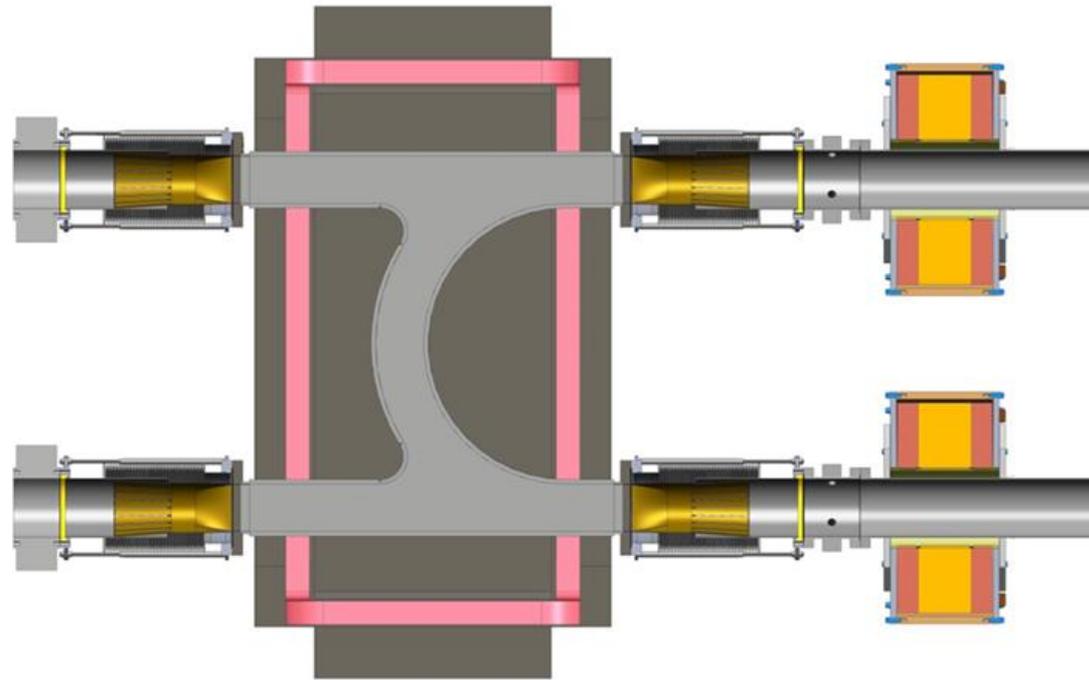
Bottom half:
Pole size: 110 (W) x 50 (L) cm
Side chamfer 1.5 cm (45°)



Electron tracking results and field qualities along entire trajectory on $R=2 \text{ cm}$ curved cylinder:

	$E_k = 5 \text{ MeV}$	$E_k = 1.6 \text{ MeV}$
Total current per coil (Ampere-turn)	2119.146	791.077
Overall current density (A/mm^2) (coil-pack cross-section: 5.0 x 6.0 cm)	0.7064	0.2637
Central Field deep inside magnet (Gauss)	525.21	195.78
Effective Magnetic Length (cm)	109.43	109.57
Full b1-integral (dipole) (G-cm)	5.7471E4	2.1452E4
Full b3-integral (6-pole) (G-cm) [Ratio to dipole integral]	0.132 [2.30E-6]	0.005 [2.44E-7]
Full bending angle as shown in tracking studies (required 180°)	180.002°	180.003°

180° Dipole Magnet



Crossing tube aperture (3.94 in. vertical)

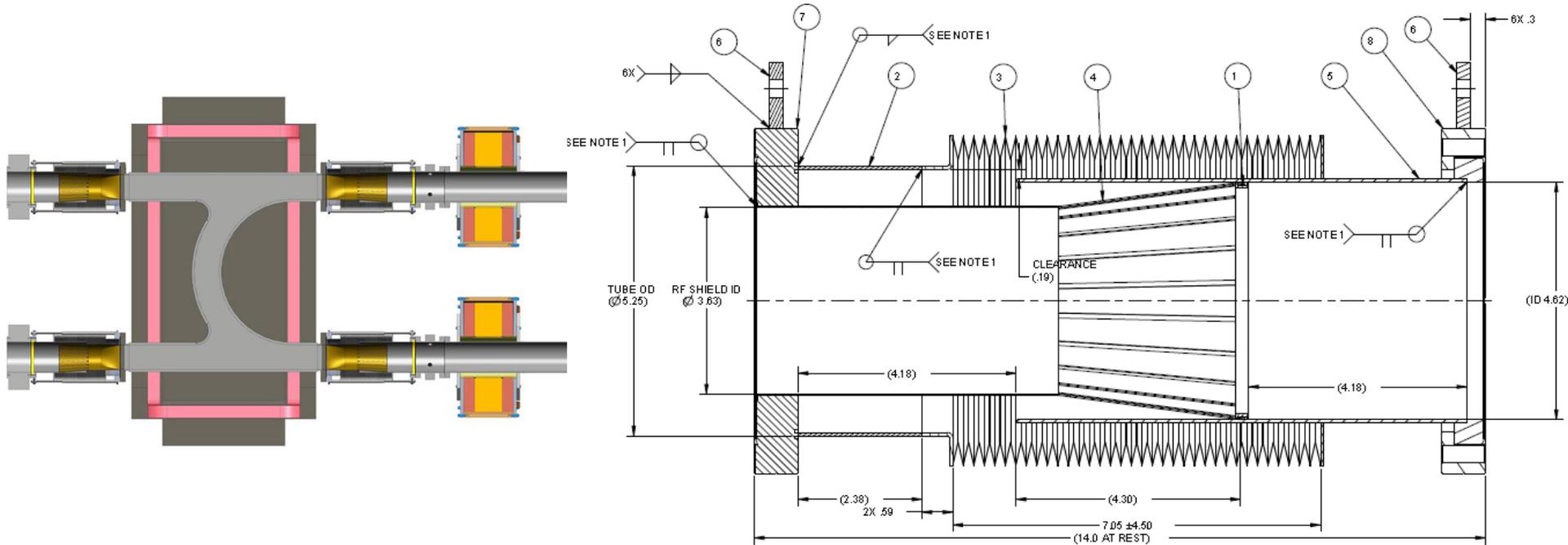
Circular tube?? Vacuum Chamber ID = 9.5 cm (3.75 in.)

Large open 180° vacuum chamber and 20° chamber - beam impedance concerns shield the electron beam path.

Binping Xiao is checking 180° vacuum chamber resonance.

Low Energy RHIC electron Cooling

180° Dipole Magnet

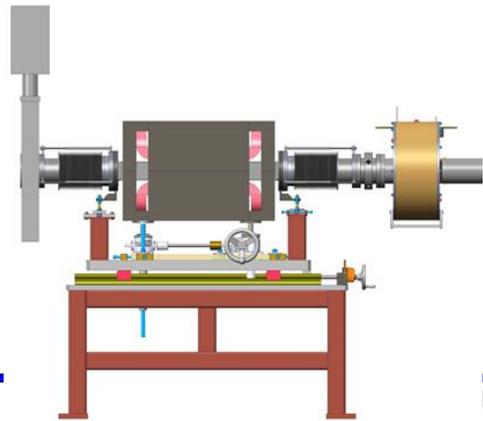


Crossing tube aperture (3.94 in. vertical)

Circular tube?? Vacuum Chamber ID = 9.5 cm (3.75 in.)

Large open 180° vacuum chamber and 20° chamber - beam impedance concerns shield the electron beam path.

Binping Xiao is checking 180° vacuum chamber resonance.



Vacuum Hardware

Large open 180° vacuum chamber and 20° chamber - beam impedance concerns shield the electron beam path.

Binping Xiao is checking 180° vacuum chamber resonance.

Chris Montag is checking aperture – can smaller circular chambers be used for RHIC beam?



Design 180° dipole chamber present for impedance review (KH)

Phase 2: 5 cell cavity positioning (RM)

20° dipole fabrication drawings (KH)

BPM chamber and buttons (V DM)

Beam Line 5” bellows with shields fabrication drawings (GW)

180° dipole fabrication drawings (KH)

Phase 1 and 2 cryogenic system layout (RM)

Beam Instrumentation PM and ES vacuum chambers fabrication drawings (GW)

20° dipole vacuum chamber (KH)

180° dipole magnet and vacuum chamber integration + large sliding bellows (KH)

Beam Instrumentation PM and ES Vacuum Chambers & ferrite insert (GW)

20° and 180° stand drawings (KH) ↘

Beam line solenoid stand (GW) LF Solenoid, BPM, and long pipe are to be independently positioned and surveyed on common stand.

Magnetic Shielding drawing and solenoid magnetic measurement test station (GW)

Cable tray and penetration drawings

Sector 1 Relocation



Sector 1										
YQ1	Meters	Yellow Outer (YO1)			Before Relocation	BI1	Meters	Blue Inner (BI1)		
S	from IP2	Label	Name	Notes	S	from IP2	Label	Name	Notes	
2517.4	38.4 38.7		Start of warm sector 10 Hz GOF Magnet	Y-valve	2517.4		Y-valve	Start of warm sector 10 Hz GOF Magnet		
2515.9	39.8 40m	KKR-1	Quad PU (0.25m, 10") Start LEReC	Not needed, future use?				Start LEReC		
2515.2	40.1	KKR-2	BBQ (PLL) Kicker (1m, 39") (twisted pr push-pull)		2515.1 2514.7	40.9 41.3	MBPM1 MBPM2	LF Schottky resonant PU (BPM) LF Schottky BPM for centering	All one moving assy 53" length	
2513.9	41.5	KKR-2	Head-Tail PU (1m)							
2513.3	42.4	KKR-1	Quad PU (0.25m, 10")	All one moving assy						
2512.6	42.7	KKR-2	BBQ (PLL) PU (1m)	115" length	2513.3	42.8	IPM H	B-Ionization PM Horiz (54")		
					2512.9	43.5	KKR-1	Hybrid Kicker (0.25m)	Not needed, future use?	
2510.7	46.1	TMKH	ARTUS Kicker Horizontal (start) 2m long		2510.5		Electron det. Y	MCP & RHIC ED Vertical		
2508.7	48.1	TMKH	ARTUS Kicker Horizontal 2m long		2510.2	45.7	EDH-ANL	Electron Detector Horizontal	Not Needed	
		EDV	Electron detector Y Pin diodes (4)	Not needed						
	53.1	LM	Lumi-mon (only a cross)	Not needed	2503.6	53.2	GCK+TMKY	ARTUS Kicker Y, 2m (or Bunch-by-Bunch longit damper?) This device was removed for service as of 10-21-13		
2501.75	55	IPM-Y	Y-Ionization PM Vert (58")		2501.6	55.2	GCK+TMKY	ARTUS Kicker Y, 2m (or Bunch-by-Bunch longit damper?)		
	63m 64m		End LEReC U-Turn 1 meter space needed?			63m 64m		End LEReC U-Turn 1 meter space needed?		
									~2 Meters of open space	
									~7 Meters of open space	
						66	R-SC Ceramic PU			
						68.6	R-SC PU	Existing		
						69	R-SC PU New desi	Future		
2483.4	71.5 72.5		Bellows & Vacuum pump End of warm sector	Y-valve	2483.4		Y-valve	End of warm sector		

Sector 1 Relocation



Sector 1									
YD1	Meters	Yellow Outer (YO1)			BI1	Meters	Blue Inner (BI1)		
S	from IP2	Label	Name	Notes	S	from IP2	Label	Name	Notes
2517.4	38.4 38.7		Start of warm sector 10 Hz GOF Magnet	Y-valve	2517.4		Y-valve	Start of warm sector 10 Hz GOF Magnet	
2515.9	40m		Start LEReC		2515.9	40m		Start LEReC	
2515.2					2515.1 2514.7				
2513.9					2513.3				
2513.3					2512.9				
2512.6									
2510.7					2510.5				
2508.7					2510.2				
2501.75					2501.6				
	63m		End LEReC U-Turn		63m			End LEReC U-Turn	
	64m		1 meter space needed?		64m			1 meter space needed?	
	64	KKR-1	Quad PU (0.25m, 10")	Not needed, future use?	40.9	MBPM1	LF Schottky resonant PU (BPM)	Likley abandoned	
	64.3	KKR-2	BBQ (PLL) Kicker (1m, 39") (twisted pr push-pull)		41.3	MBPM2	LF Schottky BPM for centering	Likley abandoned	
	65.7	KKR-2	Head-Tail PU (1m)		43.5	KKR-1	Hybrid Kicker (0.25m)	Not needed, future use?	
	66.6	KKR-1	Quad PU (0.25m, 10")	All one moving assy	66	R-SC Ceramic PU			
	66.9	KKR-2	BBQ (PLL) PU (1m)	115" length	68.6	R-SC PU	Existing		
					69	R-SC PU New desi	Future		
	71.5		Bellows & Vacuum pump						
2483.4	72.5		End of warm sector	Y-valve	2483.4	72.5	Y-valve	End of warm sector	

Sector 2 Modifications



Low Energy RHIC electron *Cooling*