EIC Yellow Report Workshop

Detector vacuum chamber and SR studies

Charles Hetzel March 20, 2020

Electron Ion Collider – eRHIC

BROOKHAVEN

ENERGY Office of Science

Outline

- Area overview
- Requirements
- Detector Chamber Geometry
- SynRad
- Simulation Results
- Summary

Detector Region Overview



IR Chamber - Requirements

- Primary interface between beams and detector
- Clearance for the particle beams as well as the SR fan
 - Strong focusing quads near IR, upstream dipoles
- Detectors must be placed as close as possible to IP
- Minimize wake fields and longitudinal impedances
- Accommodate shallow crossing angle (25mrad)
- Reduce residual gas pressure to minimize beam-gas interactions
 - High pressure results in high background
- Minimize interaction between beam pipe and collision products
- Average dynamic pressure $< 1 \times 10^{-9}$ torr

Chamber Geometry





Hadron Forward Cross Sections



Hadron Forward Chamber

Electron beam tube tack welded before two halves are welded together

Note:

- Chambers are aluminum
- Flanges are stainless steel



Central Chamber

Tapered aperture

Note:

- Chambers are beryllium and aluminum
- Flanges are stainless steel



Electron Forward Cross Sections





Electron Beam Pipe Impedance



SynRad Regions



Regions are used to define magnetic fields and beam properties

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0	42.0	5.0	-0.001652	-0.0000147	-0.00001	0.00005	
590	8976.7	64481.0	-0.010740	-0.0000283	-25.83700	-28.63400	
650	13272.0	62684.0	-0.012901	-0.0000442	-47.67600	57.76900	
1106.5	85989.0	22867.0	-0.031885	-0.0000143	-40.84000	11.99900	
1187	85826.0	22703.0	-0.031787	0.0000167	42.81600	-9.91030	
1417	67261.0	27493.0	-0.027944	0.0000167	37.90100	-10.91500	
1607	53630.0	31799.0	-0.024769	0.0000167	33.84000	-11.74600	
2082	27033.0	42803.0	-0.017065	0.0000090	11.85900	5.25950	
2142	26327.0	41060.0	-0.016748	0.0000016	0.015070	23.52500	
2995	26096.0	10851.0	-0.015347	0.0000038	3.857400	10.40800	
3055	25406.0	9727.8	-0.015049	0.0000061	7.593200	8.36930	
3451.5	19642.0	4262.7	-0.012597	0.0000072	8.410200	5.09960	
3511.5	18546.0	3694.0	-0.012130	0.0000083	9.826600	4.39550	
4341.5	5838.2	187.7	-0.005220	0.000086	5.779100	-0.18009	
4401.5	5148.3	229.8	-0.004695	0.000089	5.706500	-0.52237	
5091.5	377.3	3588.2	-3.536700	-0.0117850	1.208100	-4.34450	
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SynRad Interface



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https://molflow.web.cern.ch/sites/molflow.web.cern.ch/files/synrad_docu.pdf

Current Electron Lattice



Forward Scatter From Dipole Fan







2mm wall steps



SynRad Results

Flux from core and tails



SR Power on Detector Chamber



Summary

- Preliminary layout of the detector chamber has been completed
- Concept meets the initial physics requirements
- Work to interface with neighboring elements is beginning
- More detailed interfacing with detector components is required
 - Chamber supports
 - Installation and removal
 - Bake out accommodations
- R&D is planned to develop the required fabrication techniques
- Working closely with the detector group on integration issues

Thank you for your attention