Backward ECAL geometry in DD4hep

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IJClab
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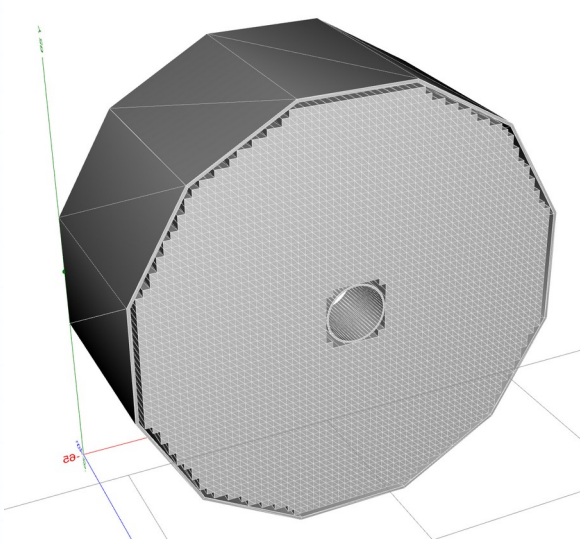
Status

- Z position of electron going end cap calorimeter start at -174cm
- Fix some small bugs and make variable name consistent
- Our branch merged on 10/13, new geometry is available in main repository

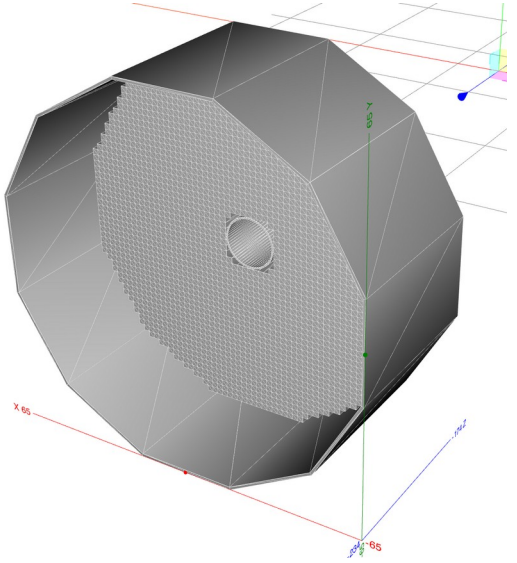
main · 38 branches · 0 tags · Go to file · Add file · Code

3 authors Electron-going endcap ECal: geometry updates (#141) ··· 11cdb68 14 hours ago 394 commits

.github	Ensure magnetic fields and other artifacts are retrieved from cache (#…	3 days ago
bin	bin: use python3 in shebangs	2 months ago
calibrations	Implement forward HCal insert and simplified ECCE LFHCAL (#65)	24 days ago
compact	Electron-going endcap ECal: geometry updates (#141)	14 hours ago
configurations	Implement forward ECal insert (#156)	6 days ago
doc	Updated SciGlass barrel ECal design (#45)	7 days ago
macro	cpplink whitespace changes	5 months ago
reports/templates	Rename initial	3 months ago
scripts	Rename initial	3 months ago
src	Electron-going endcap ECal: geometry updates (#141)	14 hours ago
templates	fix: add explicit NTP (NIST) conditions (20 °C, 1 atm) (#151)	3 days ago
views	views: s/ecce/epic/	3 months ago
.clang-format	cpplink whitespace changes	5 months ago
.gitignore	Updated SciGlass barrel ECal design (#45)	7 days ago
.gitlab-ci.yml	drop EPIC_ECCE_LEGACY_COMPAT (#198)	yesterday
.pre-commit-config.yaml	clang-format fixes	5 months ago
CMakeLists.txt	drop EPIC_ECCE_LEGACY_COMPAT (#198)	yesterday
README.md	cmake: use EPIC_ECCE_LEGACY_COMPAT=OFF (#107)	last month
requirements.txt	requirements.txt	4 months ago



Front side



Back side

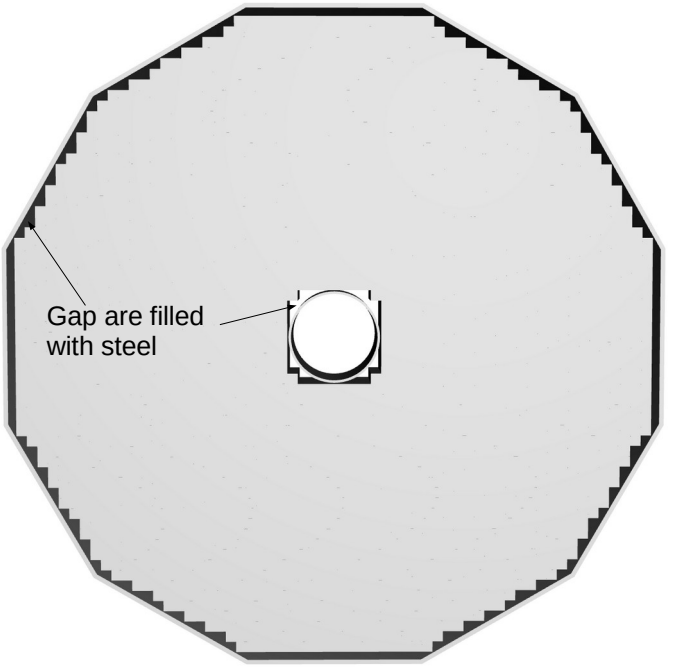
Info of Backward ECAL

	Start from	Thickness	length
Inner support frame (steel)	R = 8 cm	> 0.5cm	20cm
Outer support frame (steel)	R = 64.1cm	> 0.9cm	60cm
Modules		26 x 2 modules along y axis	20cm

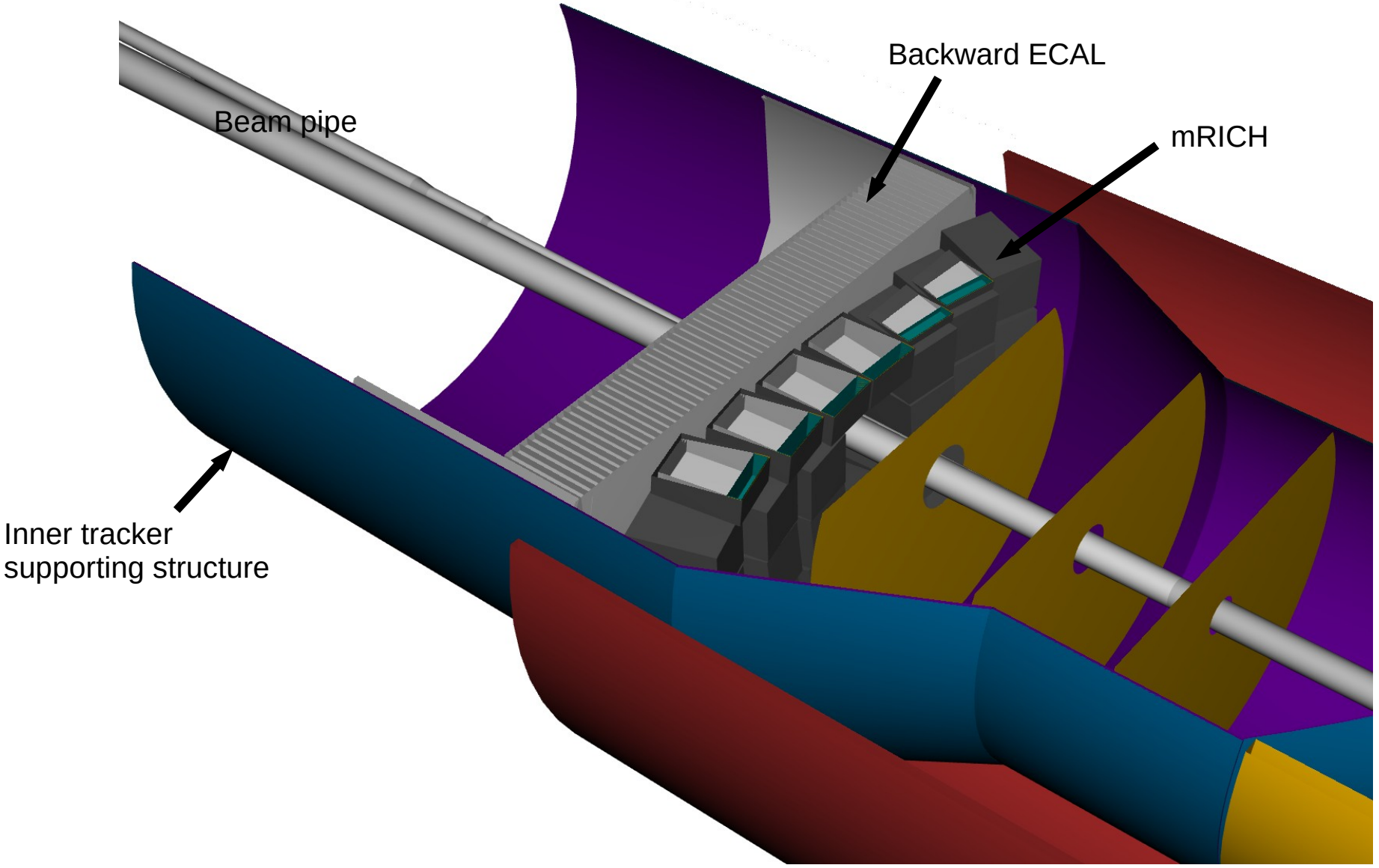
Single module

	Size / thickness	**Material**
Crystal	20x20x200 mm^3	$PbWO_4$
Wrapper	0.05 mm	VM2000
support	0.2 mm	Carbon fiber

There are 2932 modules in total

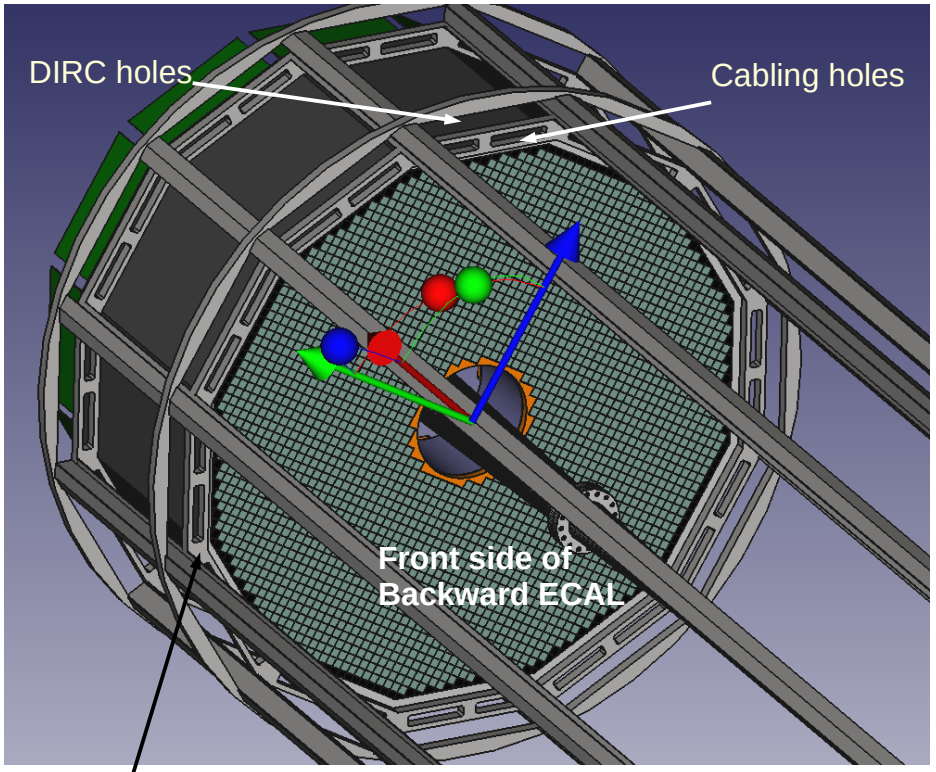


View with other sub detector

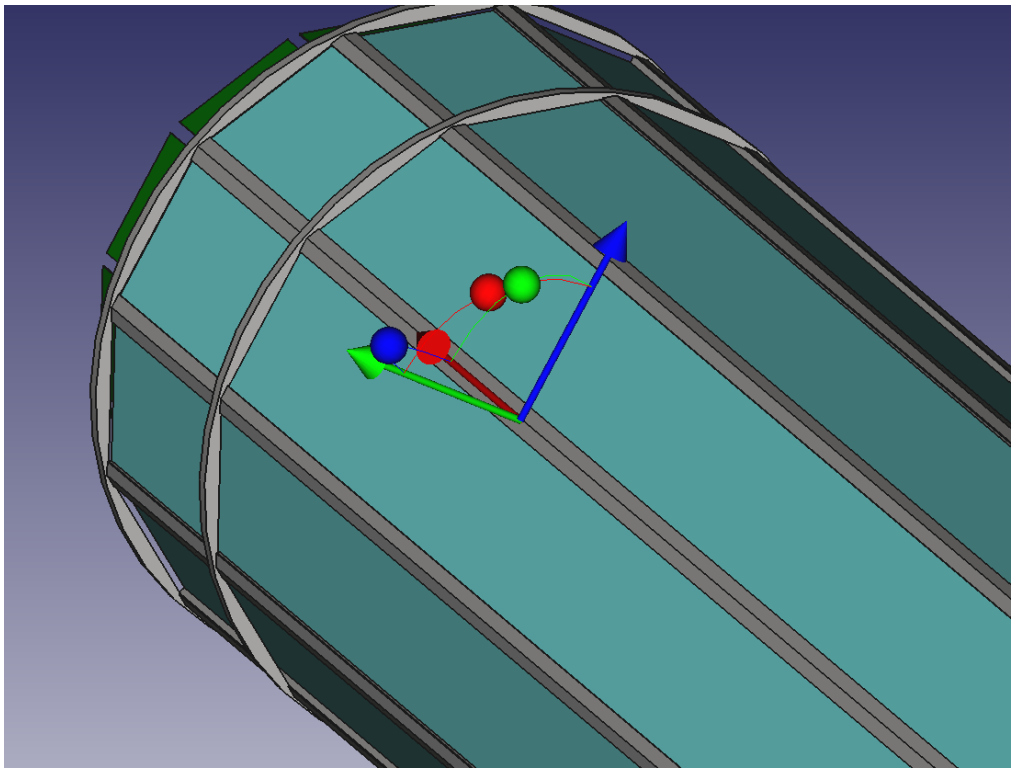


Supporting structure

Supporting structure without DIRC



Supporting structure with DIRC

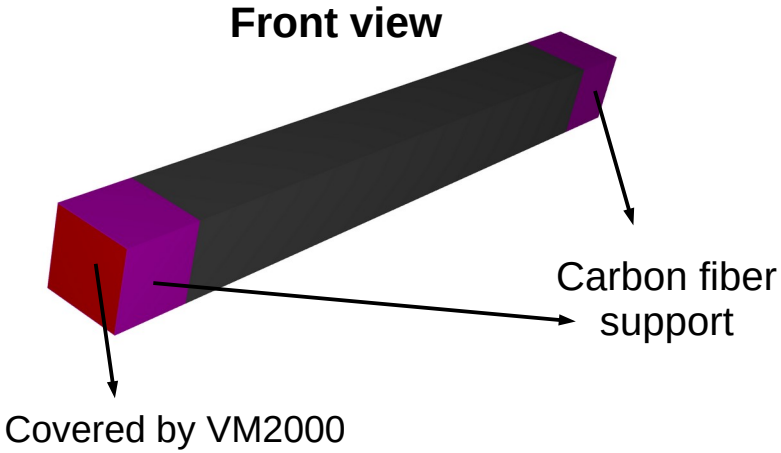


- We initially implemented the support between the ECAL and the DIRC frame (with holes for tracker cables), but it interferes with the inner tracker support structure.
- We have now commented it out to avoid the interference until a better solution is found.

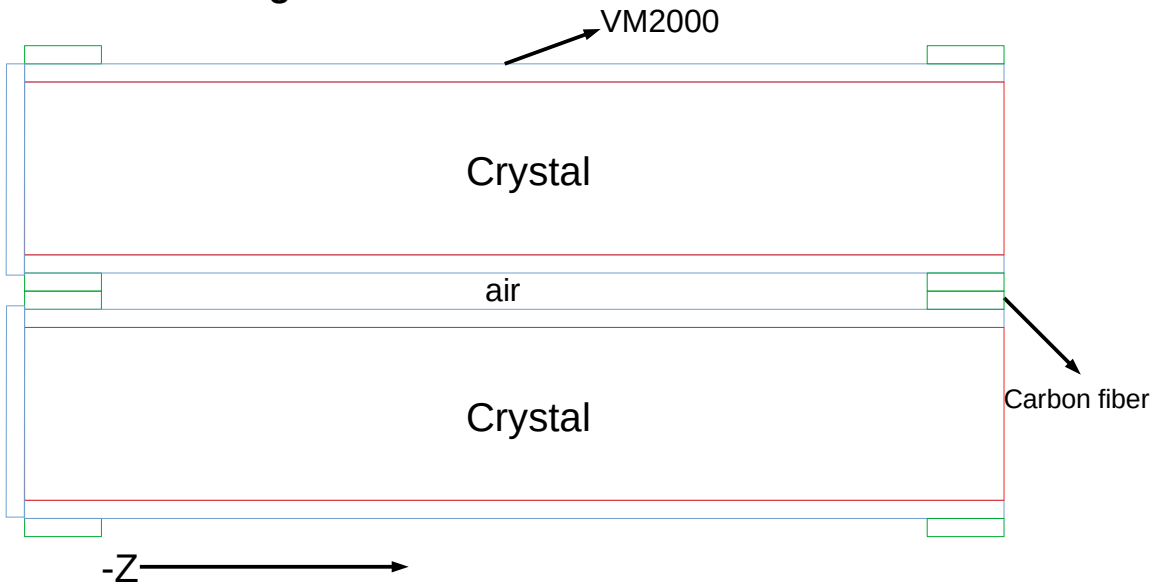
Backup

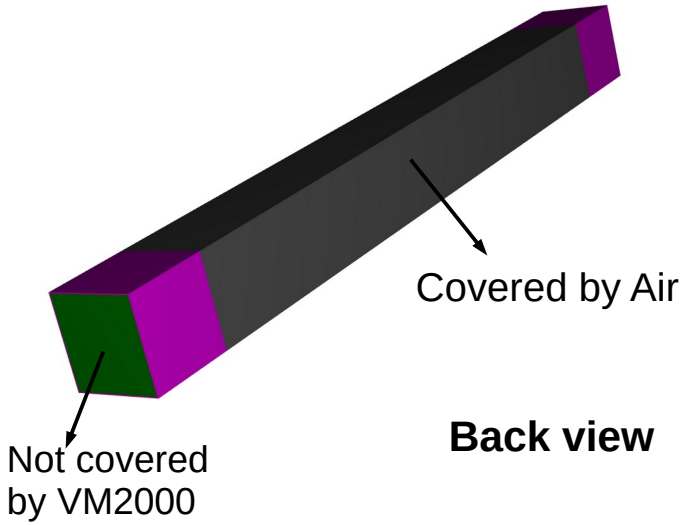
Single module of backward end cap EM calorimeter

- Crystal[lead tungsten] size: 20x20x200 mm^3
- Reflector is VM2000 and the thickness is 0.1mm
- Supporting structure is Carbon fiber and the thickness is 0.4mm (0.2mm around each crystal module)
- Carbon fiber structure only along 20mm at the front and 20mm at the back of the crystals
- Optical property copied from fun4all



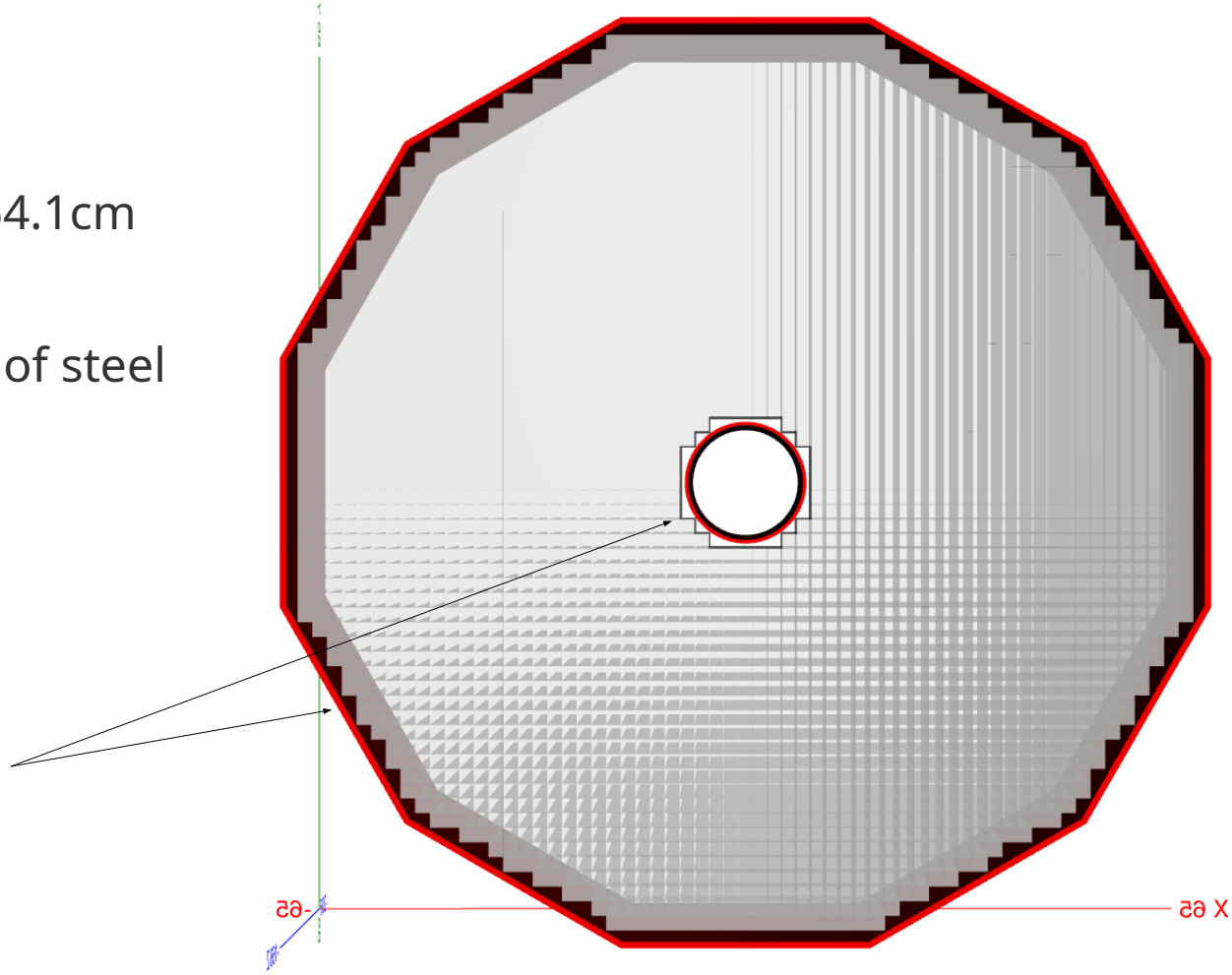
Schematic of single module



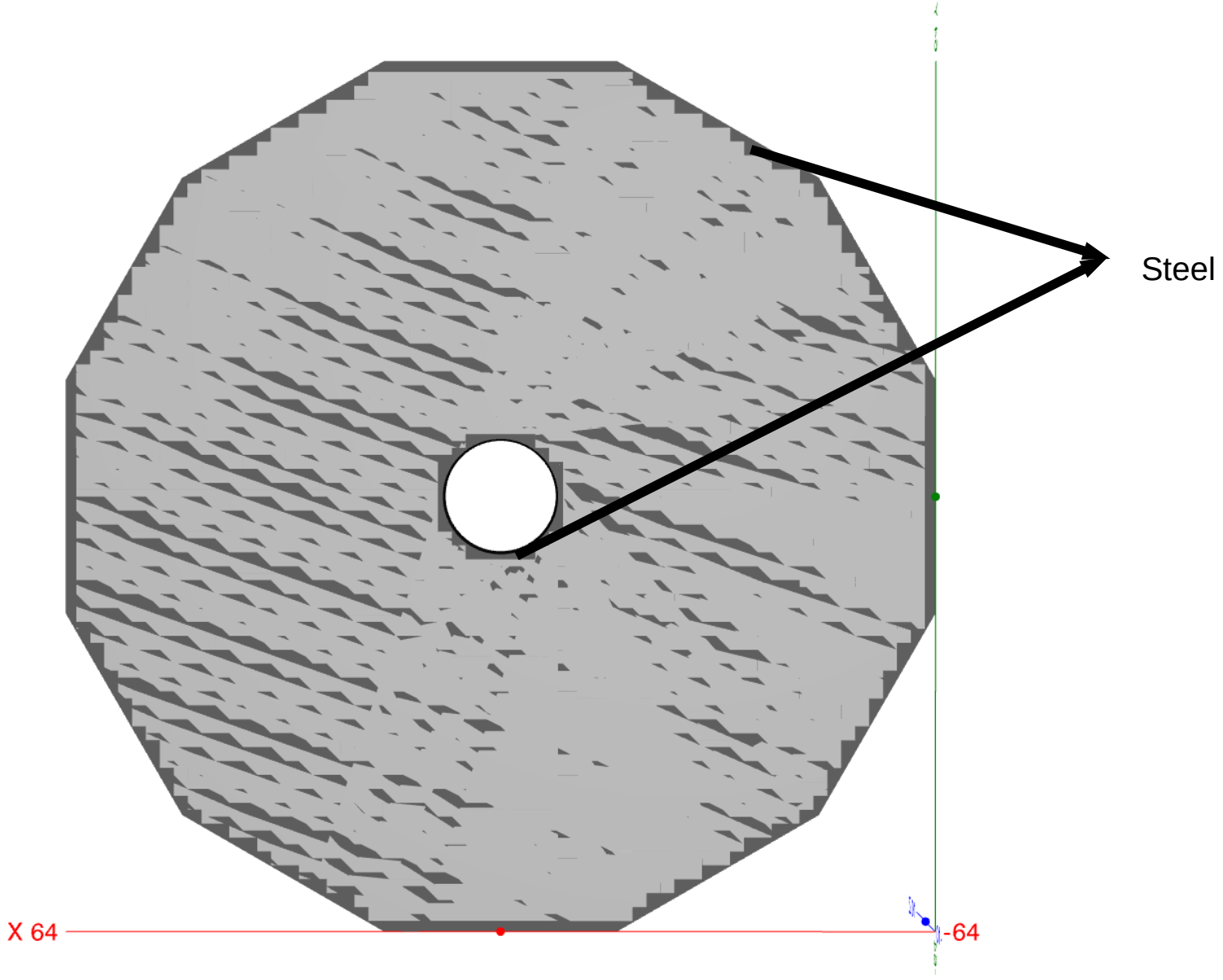


End cap calorimeter

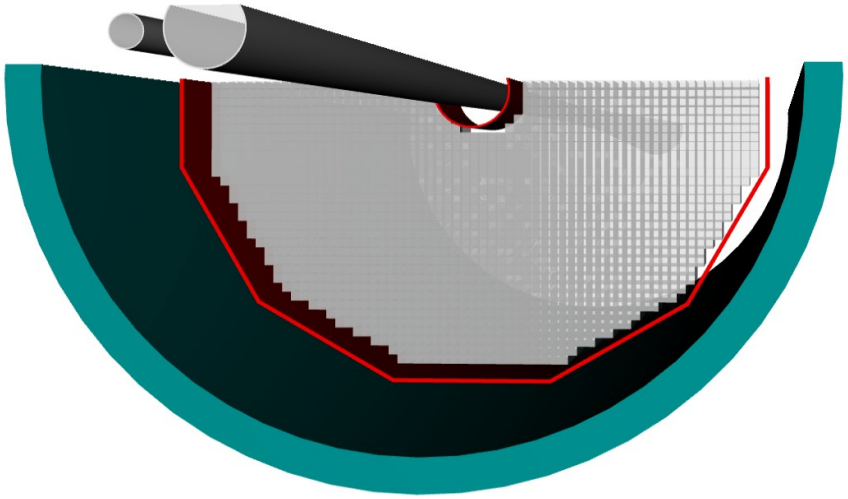
- Crystal Front face @ -166cm
- Modules are placed from 8.5 to 64.1cm from the electron beam axis
- Inner and outer frame are made of steel
- Thickness of inner frame 0.5cm
- Thickness of outer frame 0.9cm
- 2932 modules are placed
- 26x2 modules along y axis
- The gap between modules and inner or outer ring is filled by steel [shown in next slide]
- Passed the overlap check



End cap calorimeter



End cap calorimeter with DIRC and beam pipe



Material scan

Whole detector material scan (along the front of module) Close to outer frame

+ Material scan between: x_0 = (0.00, 66.00,-167.00) [cm] and x_1 = (0.00, -66.00,-167.00) [cm] :

Num. \ Layer	\ Material Name	Atomic Number/Z	Mass/A [g/mole]	Density [g/cm3]	Radiation Length [cm]	Interaction Length [cm]	Thickness [cm]	Path Length [cm]	Integrated X0 [cm]	Integrated Lambda [cm]	Material Endpoint (cm, cm, cm)
1	Air	7	14.784	0.0012	30528.8407	71998.1725	1.000	1.00	0.000033	0.000014	(0.00, 65.00,-167.00)
2	StainlessSteel	26	55.380	8.3000	1.6774	16.2392	0.900	1.90	0.536592	0.055435	(0.00, 64.10,-167.00)
3	StainlessSteel	26	55.380	8.3000	1.6774	16.2392	1.575	3.48	1.475570	0.152423	(0.00, 62.52,-167.00)
4	CarbonFiber	6	11.968	1.5000	28.0746	51.2277	0.020	3.50	1.476283	0.152813	(0.00, 62.50,-167.00)
5	VM2000	8	15.811	1.4300	25.6110	59.7748	0.005	3.50	1.476478	0.152897	(0.00, 62.50,-167.00)
6	PbWO4	68	170.881	8.3000	0.8903	20.9592	2.000	5.50	3.722903	0.248321	(0.00, 60.50,-167.00)
7	VM2000	8	15.811	1.4300	25.6110	59.7748	0.005	5.51	3.723098	0.248404	(0.00, 60.49,-167.00)
8	CarbonFiber	6	11.968	1.5000	28.0746	51.2277	0.020	5.53	3.723810	0.248795	(0.00, 60.47,-167.00)
9	CarbonFiber	6	11.968	1.5000	28.0746	51.2277	0.020	5.55	3.724523	0.249185	(0.00, 60.45,-167.00)
10	VM2000	8	15.811	1.4300	25.6110	59.7748	0.005	5.55	3.724718	0.249269	(0.00, 60.45,-167.00)
11	PbWO4	68	170.881	8.3000	0.8903	20.9592	2.000	7.55	5.971143	0.344692	(0.00, 58.45,-167.00)
12	VM2000	8	15.811	1.4300	25.6110	59.7748	0.005	7.56	5.971338	0.344776	(0.00, 58.44,-167.00)
13	CarbonFiber	6	11.968	1.5000	28.0746	51.2277	0.020	7.58	5.972050	0.345166	(0.00, 58.42,-167.00)

Whole detector material scan (along the front of module) Close to inner frame

129	CarbonFiber	6	11.968	1.5000	28.0746	51.2277	0.020	54.74	57.682284	2.562104	(0.00, 11.26,-167.00)
130	VM2000	8	15.811	1.4300	25.6110	59.7748	0.005	54.75	57.682479	2.562188	(0.00, 11.25,-167.00)
131	PbWO4	68	170.881	8.3000	0.8903	20.9592	2.000	56.75	59.928904	2.657612	(0.00, 9.25,-167.00)
132	VM2000	8	15.811	1.4300	25.6110	59.7748	0.005	56.75	59.929099	2.657695	(0.00, 9.25,-167.00)
133	CarbonFiber	6	11.968	1.5000	28.0746	51.2277	0.020	56.77	59.929812	2.658086	(0.00, 9.23,-167.00)
134	StainlessSteel	26	55.380	8.3000	1.6774	16.2392	0.725	57.50	60.362040	2.702731	(0.00, 8.50,-167.00)
135	StainlessSteel	26	55.380	8.3000	1.6774	16.2392	0.500	58.00	60.660128	2.733520	(0.00, 8.00,-167.00)
136	Air	7	14.784	0.0012	30528.8407	71998.1725	4.316	62.32	60.660269	2.733580	(0.00, 3.68,-167.00)
137	Aluminum	13	26.982	2.6990	8.8963	39.8672	0.200	62.52	60.682751	2.738597	(0.00, 3.48,-167.00)
138	Vacuum	7	14.784	0.0000	3.66346e+11	8.63978e+11	6.969	69.48	60.682751	2.738597	(0.00, -3.48,-167.00)
139	Aluminum	13	26.982	2.6990	8.8963	39.8672	0.200	69.68	60.705232	2.743614	(0.00, -3.68,-167.00)
140	Air	7	14.784	0.0012	30528.8407	71998.1725	4.316	74.00	60.705373	2.743674	(0.00, -8.00,-167.00)
141	StainlessSteel	26	55.380	8.3000	1.6774	16.2392	0.500	74.50	61.003462	2.774463	(0.00, -8.50,-167.00)
142	StainlessSteel	26	55.380	8.3000	1.6774	16.2392	0.725	75.23	61.435690	2.819108	(0.00, -9.23,-167.00)
143	CarbonFiber	6	11.968	1.5000	28.0746	51.2277	0.020	75.25	61.436402	2.819499	(0.00, -9.25,-167.00)
144	VM2000	8	15.811	1.4300	25.6110	59.7748	0.005	75.25	61.436597	2.819582	(0.00, -9.25,-167.00)
145	PbWO4	68	170.881	8.3000	0.8903	20.9592	2.000	77.25	63.683022	2.915006	(0.00, -11.25,-167.00)
146	VM2000	8	15.811	1.4300	25.6110	59.7748	0.005	77.25	63.683217	2.915090	(0.00, -11.25,-167.00)
147	CarbonFiber	6	11.968	1.5000	28.0746	51.2277	0.020	77.27	63.683930	2.915480	(0.00, -11.27,-167.00)

Material scan

Whole detector material scan (along the center of module)

Close to outer frame

+ Material scan between: x_0 = (0.00, 66.00,-170.00) [cm] and x_1 = (0.00, -66.00,-170.00) [cm] :

Num. \ Layer	\ Material Name	Atomic Number/Z	Mass/A [g/mole]	Density [g/cm3]	Radiation Length [cm]	Interaction Length [cm]	Thickness [cm]	Path Length [cm]	Integrated X0 [cm]	Integrated Lambda [cm]	Material Endpoint (cm, cm, cm)
1	Air	7	14.784	0.0012	30528.8407	71998.1725	1.000	1.00	0.000033	0.000014	(0.00, 65.00,-170.00)
2	StainlessSteel	26	55.380	8.3000	1.6774	16.2392	0.900	1.90	0.536592	0.055435	(0.00, 64.10,-170.00)
3	StainlessSteel	26	55.380	8.3000	1.6774	16.2392	1.575	3.48	1.475570	0.152423	(0.00, 62.52,-170.00)
4	Air	7	14.784	0.0012	30528.8407	71998.1725	0.020	3.50	1.475571	0.152423	(0.00, 62.50,-170.00)
5	VM2000	8	15.811	1.4300	25.6110	59.7748	0.005	3.50	1.475766	0.152507	(0.00, 62.50,-170.00)
6	PbWO4	68	170.881	8.3000	0.8903	20.9592	2.000	5.50	3.722191	0.247930	(0.00, 60.50,-170.00)
7	VM2000	8	15.811	1.4300	25.6110	59.7748	0.005	5.51	3.722386	0.248014	(0.00, 60.49,-170.00)
8	Air	7	14.784	0.0012	30528.8407	71998.1725	0.020	5.53	3.722387	0.248014	(0.00, 60.47,-170.00)
9	Air	7	14.784	0.0012	30528.8407	71998.1725	0.020	5.55	3.722388	0.248015	(0.00, 60.45,-170.00)
10	VM2000	8	15.811	1.4300	25.6110	59.7748	0.005	5.55	3.722583	0.248098	(0.00, 60.45,-170.00)
11	PbWO4	68	170.881	8.3000	0.8903	20.9592	2.000	7.55	5.969008	0.343522	(0.00, 58.45,-170.00)
12	VM2000	8	15.811	1.4300	25.6110	59.7748	0.005	7.56	5.969203	0.343605	(0.00, 58.44,-170.00)
13	Air	7	14.784	0.0012	30528.8407	71998.1725	0.020	7.58	5.969203	0.343606	(0.00, 58.42,-170.00)

Single module material scan (along the crystal axis)

+ Material scan between: x_0 = (10.00, 10.00,-160.00) [cm] and x_1 = (10.00, 10.00,-200.00) [cm] :

Num. \ Layer	\ Material Name	Atomic Number/Z	Mass/A [g/mole]	Density [g/cm3]	Radiation Length [cm]	Interaction Length [cm]	Thickness [cm]	Path Length [cm]	Integrated X0 [cm]	Integrated Lambda [cm]	Material Endpoint (cm, cm, cm)
1	Air	7	14.784	0.0012	30528.8407	71998.1725	6.000	6.00	0.000197	0.000083	(10.00, 10.00,-166.00)
2	VM2000	8	15.811	1.4300	25.6110	59.7748	0.003	6.00	0.000294	0.000125	(10.00, 10.00,-166.00)
3	PbWO4	68	170.881	8.3000	0.8903	20.9592	20.000	26.00	22.464542	0.954360	(10.00, 10.00,-186.00)
4	Air	7	14.784	0.0012	30528.8407	71998.1725	13.998	40.00	22.465001	0.954555	(10.00, 10.00,-200.00)
0	Average Material	68	170.585	4.1507	1.7805	41.9044	40.000	40.00	22.465001	0.954555	(10.00, 10.00,-200.00)

Status and next step

- The geometry is ready and checked locally.
- The new geometry commit to branch:
  140-the-build-of-electron-going-end-cap-emcalorimeter-geometry
- Next step:
  - Improve the description of the calorimeter outer frame, including space for central detector cables, etc
  - Increasing the coverage around the beam pipe based on the updated flange dimensions