

CENTRAL DETECTOR SUB-SYSTEMS

CORE REFERENCE DETECTOR

OVERVIEW AND ASSUMPTIONS

Overview

In order to simplify the development and adaptation of central detector models for the Electron Ion Collider project, a collection of drop-in dynamic components has been developed. These components, which are based on Trimble Sketchup, are dramatically simplified representations of the engineering models and have user configurable settings that allow their dimensions, position and other parameters to be easily altered. For several of the expected configurations, an initial model has been created that contains all of the components in their default configuration. This document provides a list of the components in the Core model, along with all of their initial parameters. Using this document, in conjunction with the [Detector Menagerie](#) of dynamic components, any user should be able to reconstruct this model and then make alterations to suit their preferred configurations.

A separate document will be available that provides a description of each of the components, their configuration options and how they can be best used. As these dynamic components continue to be developed, automatic volume calculations and other features will be added to assist in using them for weight and material calculations.

Keep in mind that these objects are for conceptual design only. While they are very effective for facilitating the exchange of ideas, they do not constitute an engineering design.

Assumptions

The following are design assumptions related to the core magnet. These assumptions governed the construction of the initial model and the component parameters that are included in this document.

- As much as possible will be reused from existing infrastructure; i.e. rail systems, cradle, platform components, etc.
- The hadron calorimeter endcap on the lepton side will remain in the collider hall during maintenance.
- The hadron calorimeter endcap and the electromagnetic calorimeter on the hadron side will remain in the hall during maintenance.
- The cryo-can will be in a fixed position in the collider hall and will be connected to the solenoid cryostat using a flexible cryo-line.
- Based on preliminary engineering designs by Roland Wimmer, we assume that the support structure for the barrel EMCal will be 7.62 cm thick and will be installed between the solenoid cryostat and the barrel EMCal.
- Based on another adaptation of Wimmer's engineering design, we assume a universal support structure for the DIRC that will be 16 cm thick. This may be more substantial than needed in some configurations, but will allow the DIRC support to be used to also support other heavier components within the barrel.

BARREL HADRON CALORIMETER 1

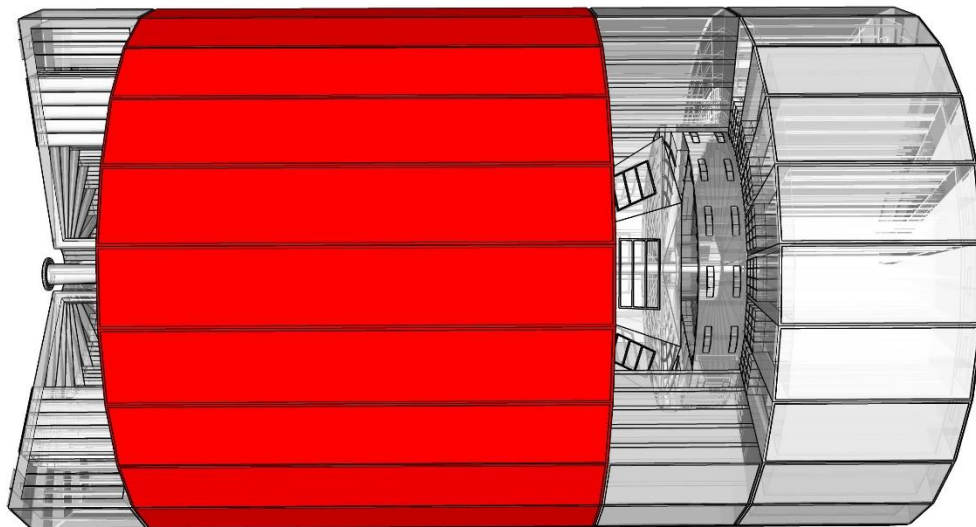


Figure 1: Barrel Hadron Calorimeter 2

Dimensions/Location

<i>Overall Length</i>	380 cm
<i>Bore</i>	130 cm
<i>Radius</i>	230 cm
<i>Offset</i>	10 cm in Lepton Direction
<i>Total Volume</i>	42.98 m ³

Weight Estimates

<i>Element</i>	<i>Basis</i>	<i>Weight</i>
33.95 m ³ of Iron	7,847 kg/m ³	266,420 kg
9.03 m ³ of Plastic	970 kg/m ³	8,754 kg
Cabling		
	Total:	275,174 kg

Power Requirements

<i>Component</i>	<i>Source/Voltage</i>	<i>Amps</i>
Data Not collected		

Heat Dissipation

<i>Removal Mechanism/Medium</i>	<i>BTUs</i>
Data Not collected	

Communications/Signal

<i>Element</i>	<i>Cables/Connections</i>
Data Not Collected	

BARREL HADRON CALORIMETER 2

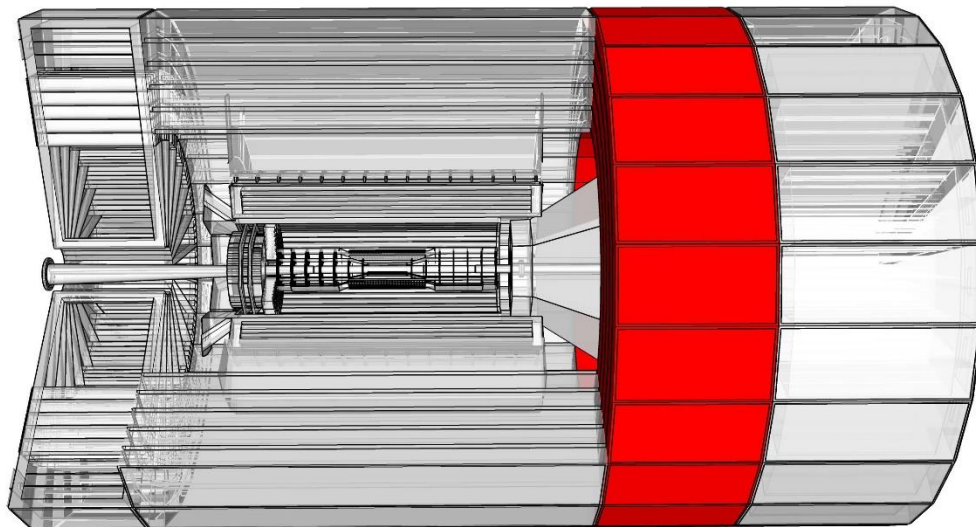


Figure 2: Barrel Hadron Calorimeter 2

Dimensions/Location

<i>Overall Length</i>		120 cm
<i>Bore</i>		130 cm
<i>Radius</i>		230 cm
<i>Offset</i>	240 cm in Hadron Direction	
<i>Total Volume</i>		13.57 m ³

Weight Estimates

<i>Element</i>	<i>Basis</i>	<i>Weight</i>
10.72 m ³ of Iron	7,847 kg/m ³	84,133 kg
2.85 m ³ of Plastic	970 kg/m ³	2,765 kg
Cabling		
	Total:	86,897 kg

Power Requirements

<i>Component</i>	<i>Source/Voltage</i>	<i>Amps</i>
Data Not collected		

Heat Dissipation

<i>Removal Mechanism/Medium</i>	<i>BTUs</i>
Data Not collected	

Communications/Signal

<i>Element</i>	<i>Cables/Connections</i>
Data Not Collected	

LEPTON DIRECTION HADRON CALORIMETER ENDCAP

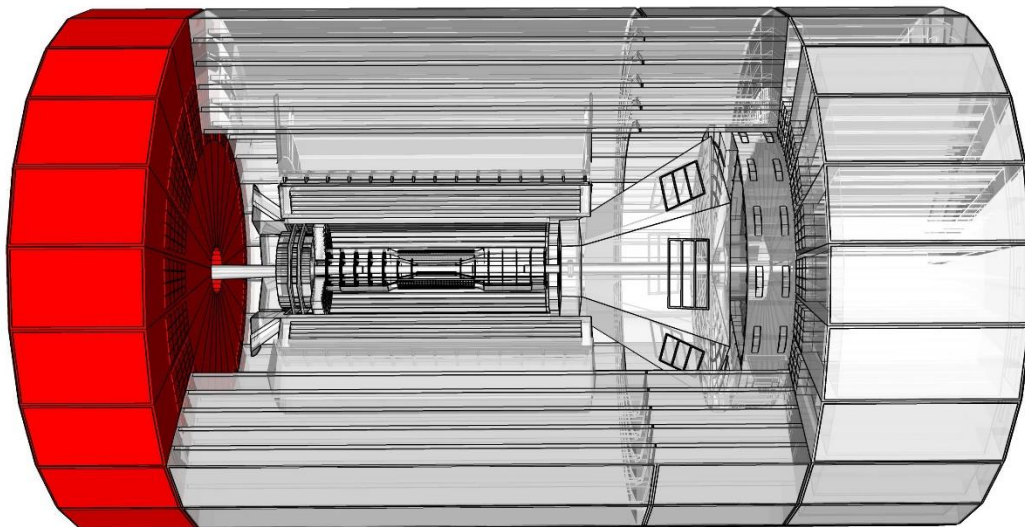


Figure 3: Lepton Direction Endcap

Dimensions/Location

Overall Length	100 cm
Bore	22 cm
Radius	230 cm
Offset	200 cm in Lepton Direction
Total Volume	16.47 m ³

Weight Estimates

Element	Basis	Weight
13. m ³ of Iron	7,847 kg/m ³	102,081 kg
3.5 m ³ of Plastic	970 kg/m ³	3,354 kg
Cabling		
Total:		105,435 kg

Power Requirements

Component	Source/Voltage	Amps
Data Not collected		

Heat Dissipation

Removal Mechanism/Medium	BTUs
Data Not collected	

Communications/Signal

Element	Cables/Connections
Data Not Collected	

HADRON DIRECTION HADRON CALORIMETER ENDCAP

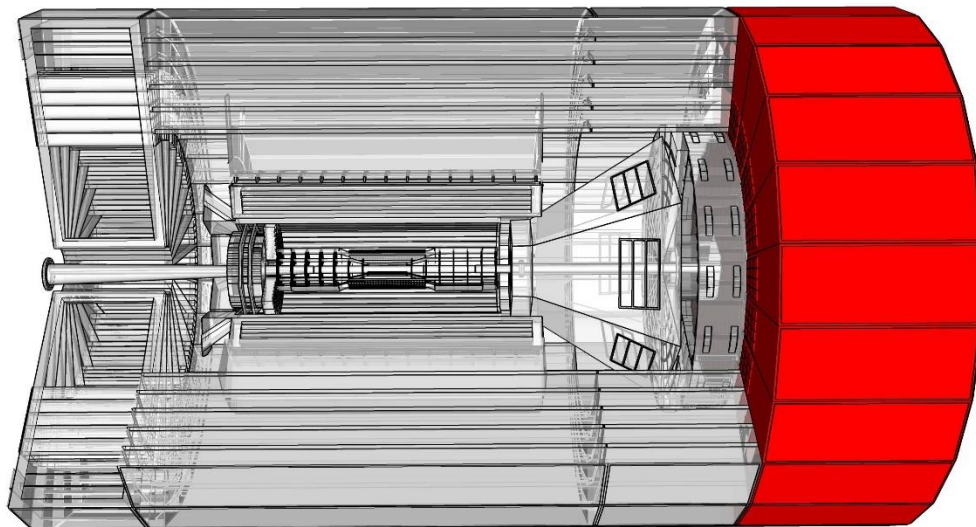


Figure 4: Hadron Direction Endcap

Dimensions/Location

<i>Overall Length</i>	150 cm
<i>Bore</i>	30 cm
<i>Radius</i>	230 cm
<i>Offset</i>	300 cm in Hadron Direction
<i>Total Volume</i>	24.50 m ³

Weight Estimates

<i>Element</i>	<i>Basis</i>	<i>Weight</i>
19.4 m ³ of Iron	7,847 kg/m ³	151,906 kg
5.1 m ³ of Plastic	970 kg/m ³	4,992 kg
Cabling		
	Total:	156,898 kg

Power Requirements

<i>Component</i>	<i>Source/Voltage</i>	<i>Amps</i>
Data Not collected		

Heat Dissipation

<i>Removal Mechanism/Medium</i>	<i>BTUs</i>
Data Not collected	

Communications/Signal

<i>Element</i>	<i>Cables/Connections</i>
Data Not Collected	

SOLENOID CRYOSTAT

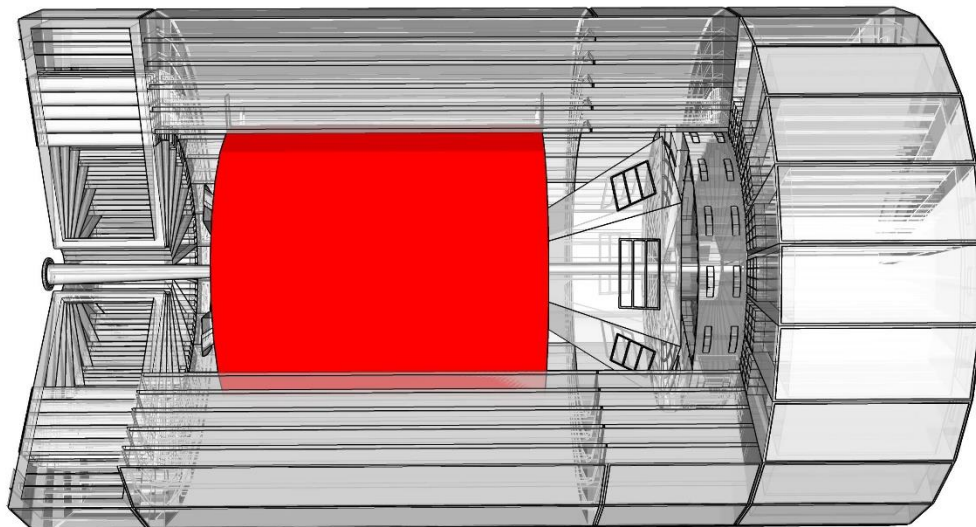


Figure 5: Solenoid Cryostat

Dimensions/Location

<i>Overall Length</i>		274 cm
<i>Bore</i>		90 cm
<i>Radius</i>		130 cm
<i>Offset</i>	1 cm in Hadron Direction	
<i>Total Volume</i>		7.58 m ³

Weight Estimates

<i>Element</i>	<i>Basis</i>	<i>Weight</i>
Volume Coeff (CLEO II)	3,412 kg/m ³	25,845 kg
Cabling		
	Total:	25,845 kg

Power Requirements

<i>Component</i>	<i>Source/Voltage</i>	<i>Amps</i>
Data Not collected		

Heat Dissipation

<i>Removal Mechanism/Medium</i>	<i>BTUs</i>
Data Not collected	

Communications/Signal

<i>Element</i>	<i>Cables/Connections</i>
Data Not Collected	

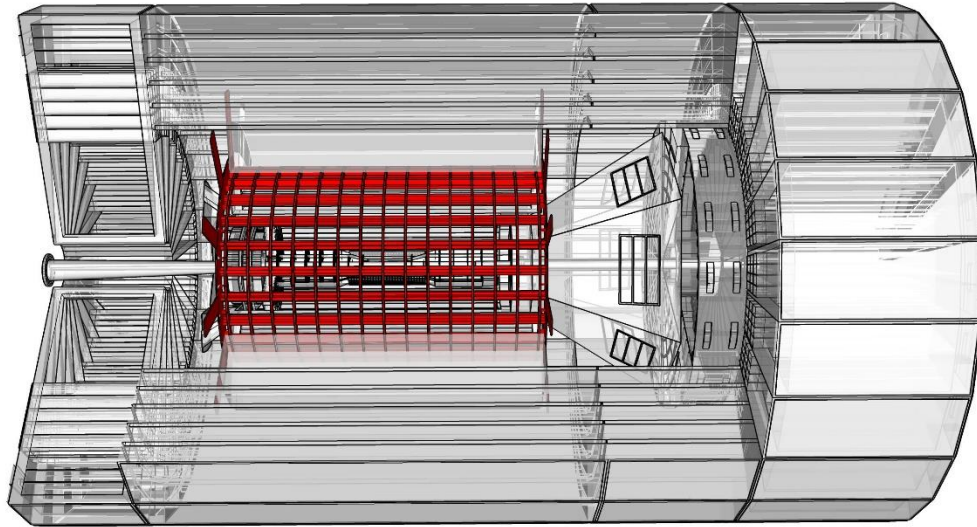


Figure 6: Barrel Support

Dimensions/Location

<i>Structure Length</i>	274 cm
<i>Radius</i>	90 cm
<i>Support Radius</i>	220 cm
<i>Offset</i>	1 cm in Hadron Direction

Weight Estimates

<i>Element</i>	<i>Basis</i>	<i>Weight</i>
Data Not Collected		
Total:		lbs
		tons

BARREL ELECTROMAGNETIC CALORIMETER

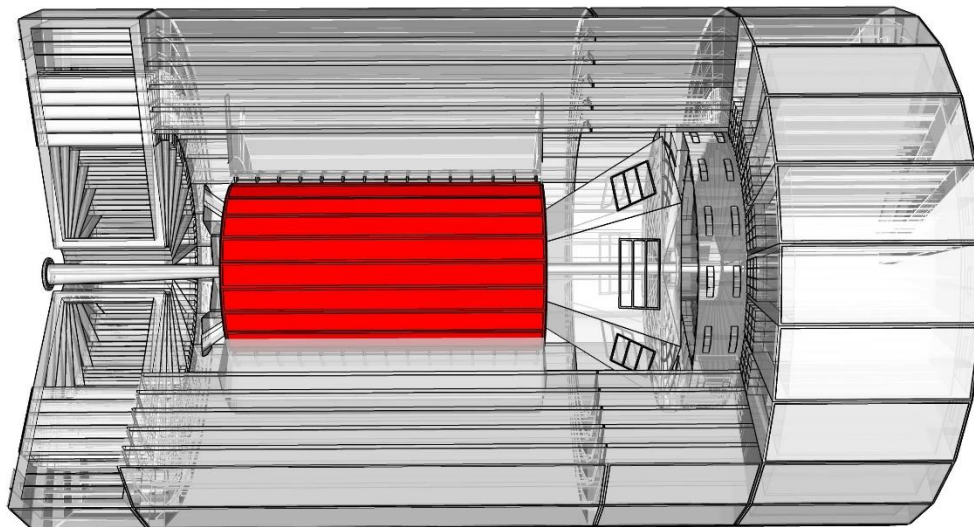


Figure 7: Barrel Electromagnetic Calorimeter

Dimensions/Location

Overall Length		276 cm
Bore		51 cm
Radius		81 cm
Offset	1 cm in Hadron Direction	
Total Volume		3.43 m ³

Weight Estimates

Element	Basis	Weight
Volume Coeff (CMS)	3,508 kg/m ³	12,045 kg
Cabling		
	Total:	12,045 kg

Power Requirements

Component	Source/Voltage	Amps
Data Not collected		

Heat Dissipation

Removal Mechanism/Medium	BTUs
Data Not collected	

Communications/Signal

Element	Cables/Connections
Data Not Collected	

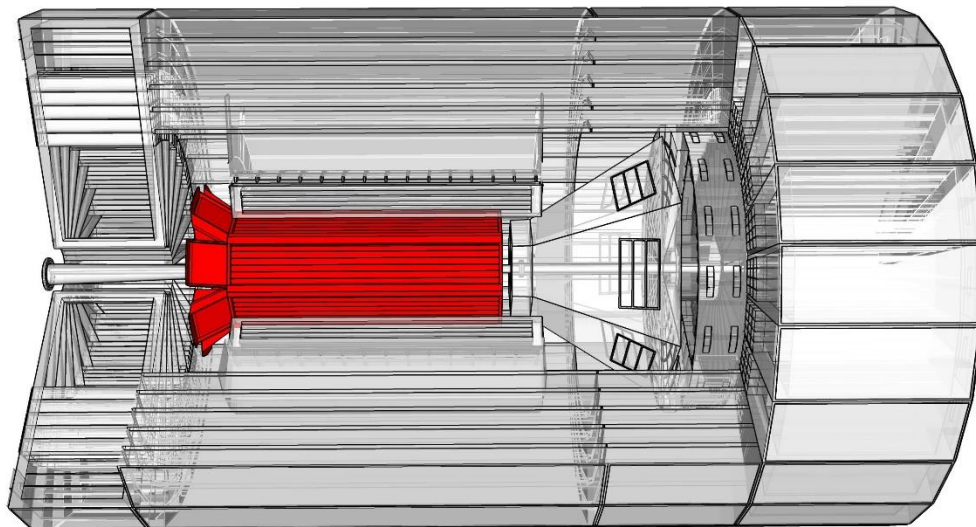
DIRC (DETECTION OF INTERNALLY REFLECTED CHERENKOV LIGHT) DETECTOR

Figure 8: DIRC Detector

Dimensions/Location

<i>DIRC Bar Length</i>	240 cm
<i>DIRC Segment Count</i>	7
<i>Bore</i>	N/A
<i>Radius</i>	46 cm
<i>Offset</i>	137 cm in Lepton Direction
<i>Total Volume</i>	0.35 m ³

Weight Estimates

<i>Element</i>	<i>Basis</i>	<i>Weight</i>
0.07 m ³ of Steel	7,850 kg/m ³	521 kg
0.28 m ³ of Quartz	2,320 kg/m ³	656 kg
Cabling		
	Total:	1,176 kg

Power Requirements

<i>Component</i>	<i>Source/Voltage</i>	<i>Amps</i>
Data Not collected		

Heat Dissipation

<i>Removal Mechanism/Medium</i>	<i>BTUs</i>
Data Not collected	

Communications/Signal

<i>Element</i>	<i>Cables/Connections</i>
Data Not Collected	

LEPTON DIRECTION ELECTROMAGNETIC CALORIMETER

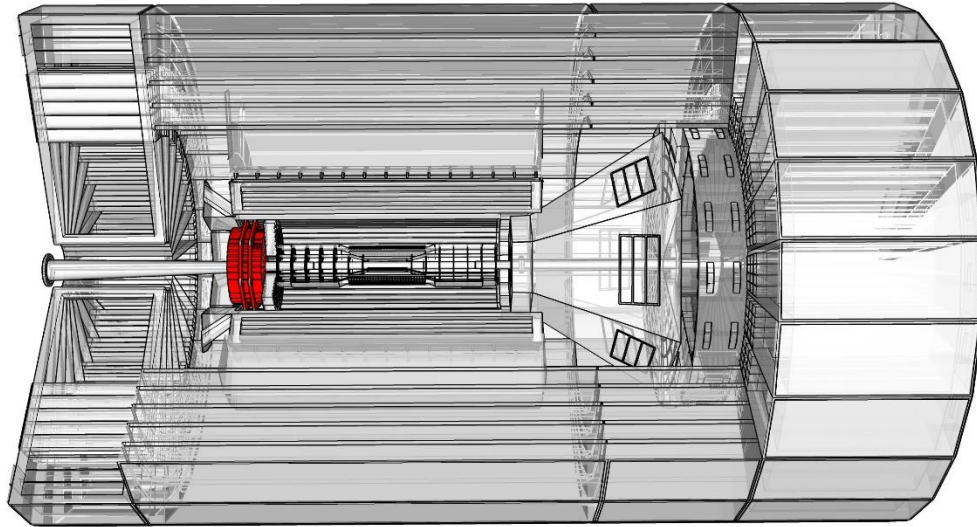


Figure 9: Lepton Direction Electromagnetic Calorimeter

Dimensions/Location

Overall Length		30 cm
Bore		9 cm
Radius		30 cm
Support Radius		34 cm
Offset	110 cm in Lepton Direction	
Total Volume		0.08 m ³

Weight Estimates

Element	Basis	Weight
0.1 m ³ of Lead Glass	6,220 kg/m ³	484 kg
0. m ³ of Steel	7,850 kg/m ³	32 kg
Cabling		
	Total:	516 kg

Power Requirements

Component	Source/Voltage	Amps
Data Not collected		

Heat Dissipation

Removal Mechanism/Medium	BTUs
Data Not collected	

Communications/Signal

Element	Cables/Connections
Data Not Collected	

LEPTON DIRECTION TIME OF FLIGHT DETECTOR

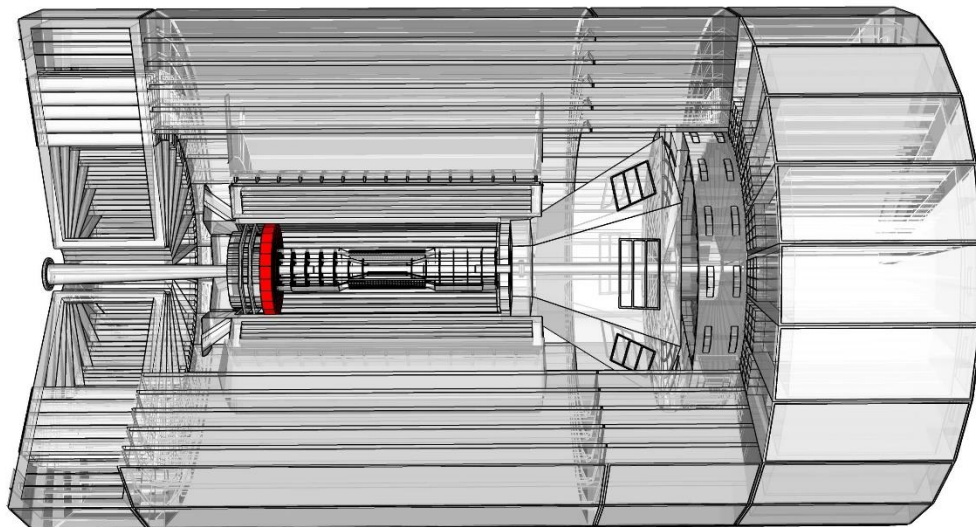


Figure 10: Lepton Direction Time of Flight Detector

Dimensions/Location

<i>Overall Length</i>		10 cm
<i>Bore</i>		10 cm
<i>Radius</i>		37 cm
<i>Offset</i>	100 cm in Lepton Direction	
<i>Total Volume</i>		0.04 m ³

Weight Estimates

<i>Element</i>	<i>Basis</i>	<i>Weight</i>
Volume Coeff (PANDA)	605 kg/m ³	24 kg
Cabling		
	Total:	24 kg

Power Requirements

<i>Component</i>	<i>Source/Voltage</i>	<i>Amps</i>
Data Not collected		

Heat Dissipation

<i>Removal Mechanism/Medium</i>	<i>BTUs</i>
Data Not collected	

Communications/Signal

<i>Element</i>	<i>Cables/Connections</i>
Data Not Collected	

RICH (RING IMAGING CHERENKOV) DETECTOR

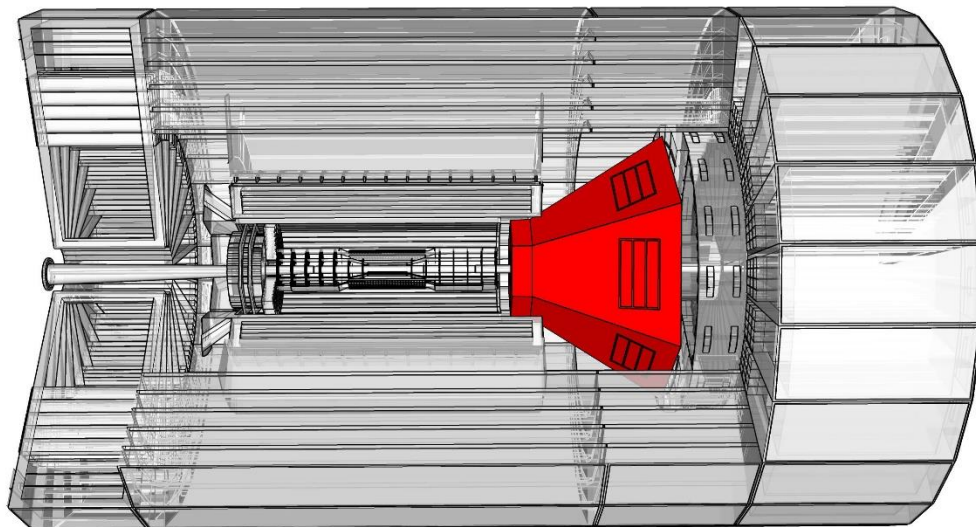


Figure 11: RICH Detector

Dimensions/Location

Overall Length	138 cm
Aerogel Length	18 cm
Aerogel Radius	44 cm
Detector Length	120 cm
Bore	10 cm
E1 (Far) Radius	120 cm
E2 (Near) Radius	45 cm
Offset	250 cm in Hadron Direction
Segment Count	6
Total Volume	2.85 m ³

Weight Estimates

Element	Basis	Weight
Volume Coeff (CLAS LTCC)	185.81 kg/m ³	530 kg
Cabling		
	Total:	530 kg

Power Requirements

Component	Source/Voltage	Amps
Data Not collected		

Heat Dissipation

Removal Mechanism/Medium	BTUs
Data Not collected	

Communications/Signal

Element	Cables/Connections
Data Not Collected	

HADRON DIRECTION TIME OF FLIGHT DETECTOR

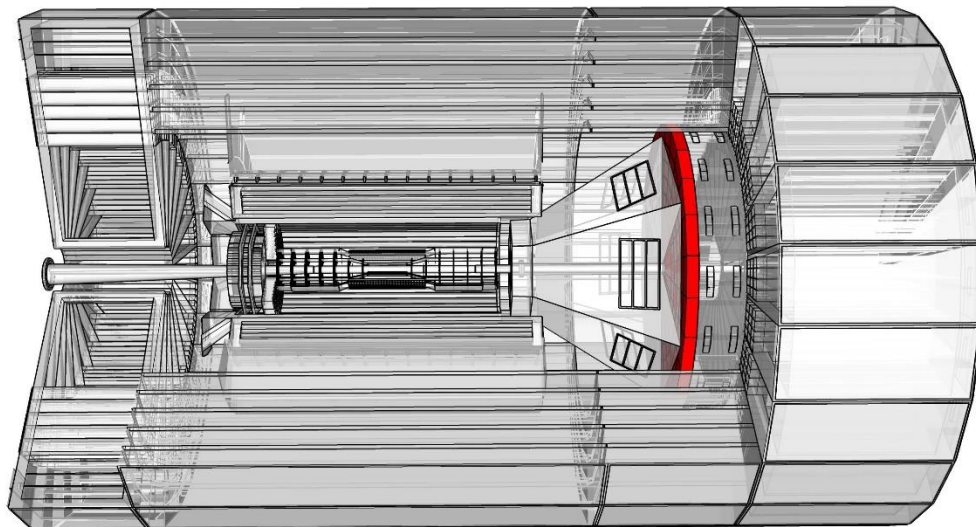


Figure 12: Hadron Direction Time of Flight Detector

Dimensions/Location

Overall Length	10 cm
Bore	20 cm
Radius	130 cm
Offset	250 cm in Hadron Direction
Total Volume	0.52 m ³

Weight Estimates

Element	Basis	Weight
Volume Coeff (PANDA)	605 kg/m ³	314 kg
Cabling		
Total:		314 kg

Power Requirements

Component	Source/Voltage	Amps
Data Not collected		

Heat Dissipation

Removal Mechanism/Medium	BTUs
Data Not collected	

Communications/Signal

Element	Cables/Connections
Data Not Collected	

HADRON DIRECTION ELECTROMAGNETIC CALORIMETER

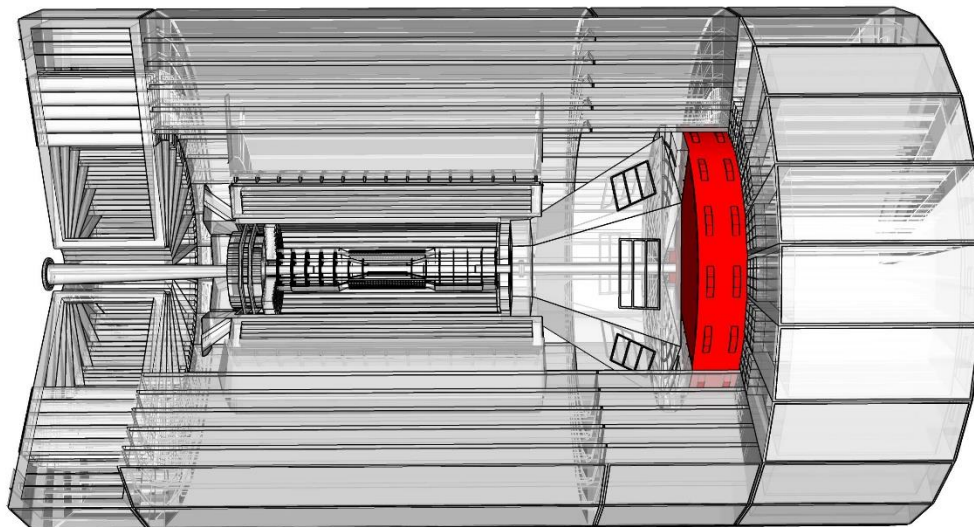


Figure 13: Hadron Direction Electromagnetic Calorimeter

Dimensions/Location

<i>Overall Length</i>	40 cm
<i>Bore</i>	30 cm
<i>Radius</i>	130 cm
<i>Offset</i>	260 cm in Hadron Direction
<i>Total Volume</i>	2.01 m ³

Weight Estimates

<i>Element</i>	<i>Basis</i>	<i>Weight</i>
1.93 m ³ of Lead Glass	6,220 kg/m ³	11,995 kg
0.08 m ³ of Steel	7,850 kg/m ³	645 kg
Cabling		
	Total:	12,640 kg

Power Requirements

<i>Component</i>	<i>Source/Voltage</i>	<i>Amps</i>
Data Not collected		

Heat Dissipation

<i>Removal Mechanism/Medium</i>	<i>BTUs</i>
Data Not collected	

Communications/Signal

<i>Element</i>	<i>Cables/Connections</i>
Data Not Collected	

SILICON VERTEX DETECTOR

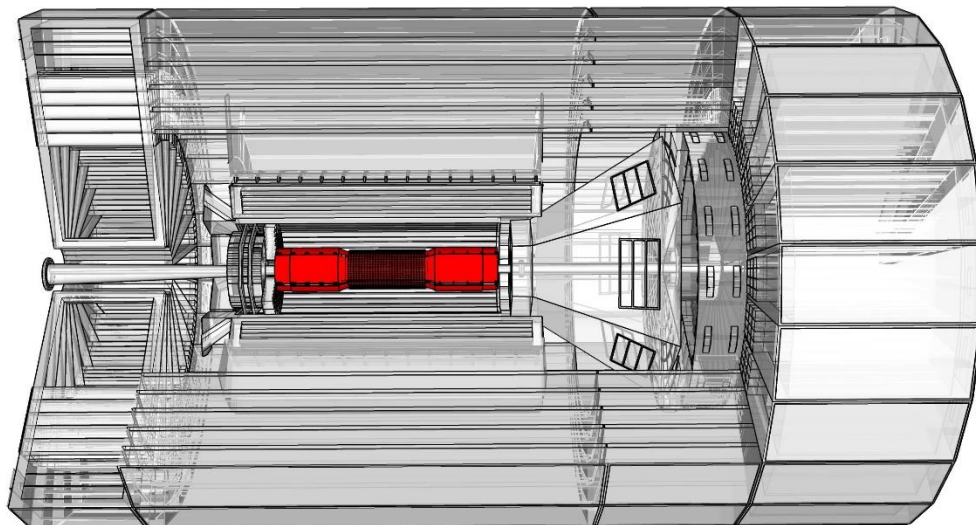


Figure 14: Silicon Vertex Detector

Dimensions/Location

Overall Length	200 cm
Bore	0 cm
Radius	19.8 cm
Offset	0 cm
Total Volume	0.25 m ³

Weight Estimates

Element	Basis	Weight
0.007 m ³ of Aluminum	2,710 kg/m ³	20 kg
0.007 m ³ of Silicon	2,330 kg/m ³	17 kg
Cabling		
Total:		37 kg

Power Requirements

Component	Source/Voltage	Amps
Data Not collected		

Heat Dissipation

Removal Mechanism/Medium	BTUs
Data Not collected	

Communications/Signal

Element	Cables/Connections
Data Not Collected	

CORE

VACUUM CHAMBER



Figure 15: Vacuum Chamber (Top View)

Dimensions/Location

<i>Overall Length</i>	Not Available
<i>Beryllium Length</i>	Not Available
<i>Interior Section Length</i>	Not Available
<i>Lepton Section Length</i>	Not Available
<i>Hadron Section Length</i>	Not Available

Weight Estimates

<i>Element</i>	<i>Basis</i>	<i>Weight</i>
Data Not Collected		
Total:		lbs
		tons

Power Requirements

<i>Component</i>	<i>Source/Voltage</i>	<i>Amps</i>
Data Not Collected		

Heat Dissipation

<i>Removal Mechanism/Medium</i>	<i>BTUs</i>
Data Not collected	

Communications/Signal

<i>Element</i>	<i>Cables/Connections</i>
Data Not Collected	