

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.

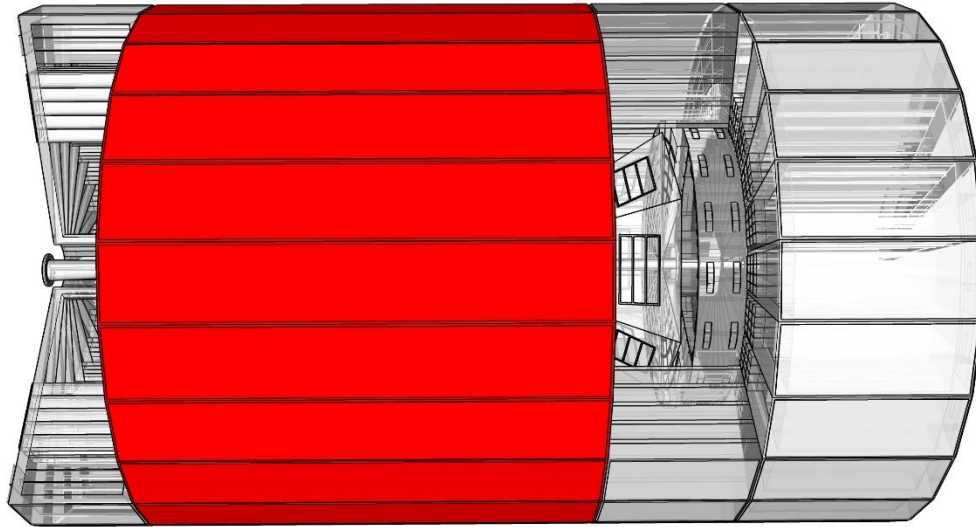


Figure 1: Barrel Hadron Calorimeter 2

Dimensions/Location

Overall Length	380 cm
Lepton Direction Section Length	380 cm
Hadron Direction Section Length	0 cm
Lepton Direction Bore	130 cm
Hadron Direction Bore	130 cm
Radius	230 cm
Offset	10 cm in Lepton Direction
Total Volume	42.98 m ³ (1,518 ft ³)

Weight Estimates

Element	Basis	Weight
1,199 ft ³ of Iron	491 lb/ft ³	588,708 lbs
319 ft ³ of Plastic	59.90 lb/ft ³	19,091 lbs
Cabling		
Total:		607,800 lbs
		303.90 tons

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	

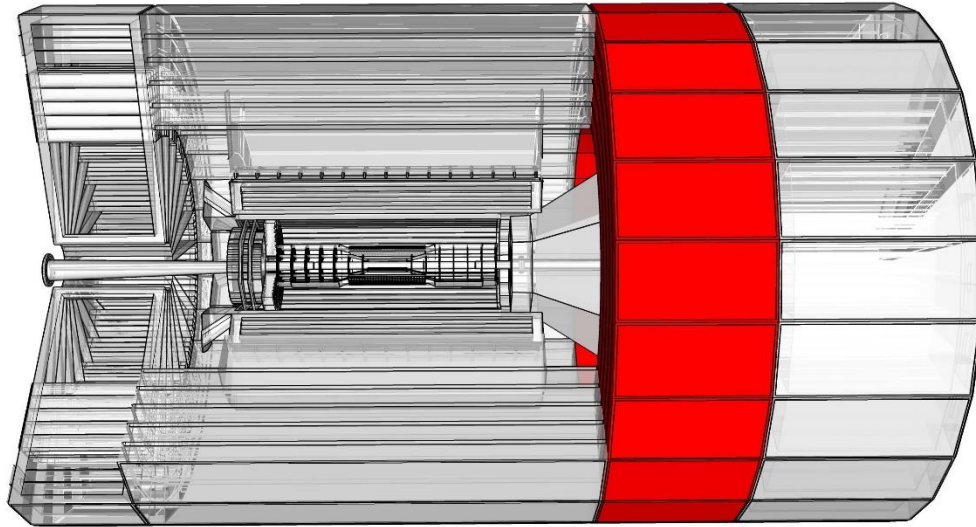


Figure 2: Barrel Hadron Calorimeter 2

Dimensions/Location

Overall Length	120 cm
Lepton Direction Section Length	120 cm
Hadron Direction Section Length	0 cm
Lepton Direction Bore	130 cm
Hadron Direction Bore	130 cm
Radius	230 cm
Offset	240 cm in Hadron Direction
Total Volume	13.57 m ³ (479 ft ³)

Weight Estimates

Element	Basis	Weight
379 ft ³ of Iron	491 lb/ft ³	185,908 lbs
101 ft ³ of Plastic	59.90 lb/ft ³	6,029 lbs
Cabling		
Total:		191,937 lbs
		95.97 tons

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 HADRON CALORIMETER ENDCAP

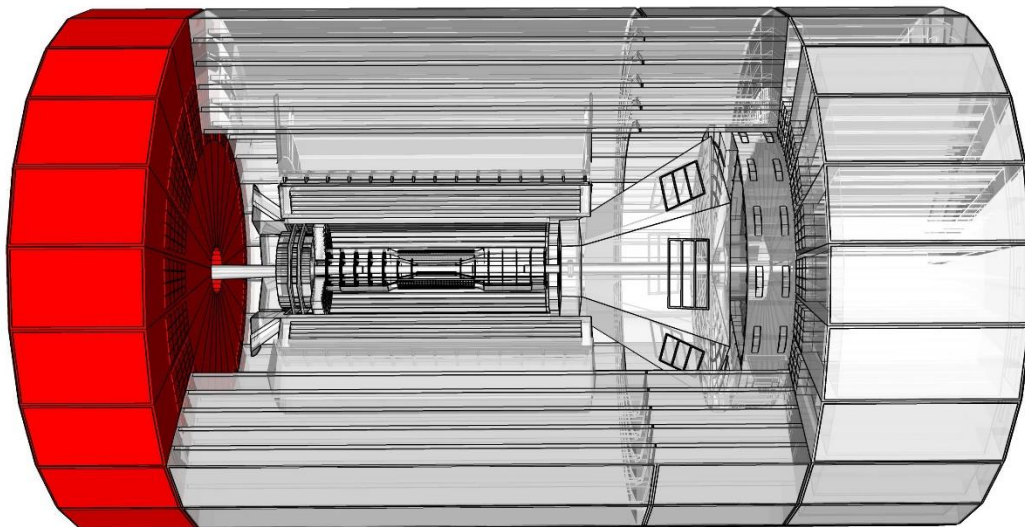


Figure 3: Lepton Direction Endcap

Dimensions/Location

Overall Length	100 cm
Bore	22 cm
Radius	230 cm
Offset	200 cm in Lepton Direction
Total Volume	16.47 m ³ (582 ft ³)

Weight Estimates

Element	Basis	Weight
459 ft ³ of Iron	491 lb/ft ³	225,568 lbs
122 ft ³ of Iron	59.90 lb/ft ³	7,315 lbs
Cabling		
Total:		232,883 lbs
		116.44 tons

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

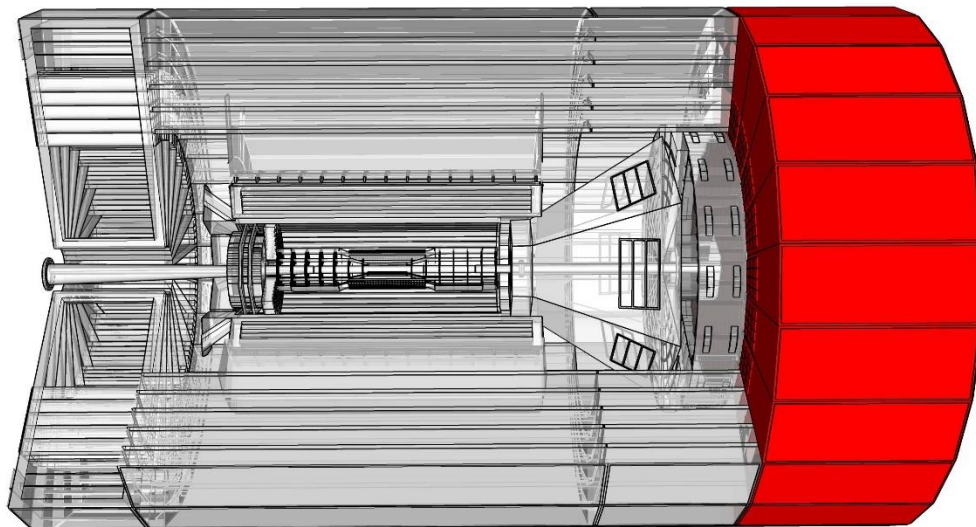


Figure 4: Hadron Direction Endcap

Dimensions/Location

Overall Length	150 cm
Bore	30 cm
Radius	230 cm
Offset	300 cm in Hadron Direction
Total Volume	24.50 m ³ (865 ft ³)

Weight Estimates

Element	Basis	Weight
684 ft ³ of Iron	491 lb/ft ³	335,667 lbs
182 ft ³ of Iron	59.90 lb/ft ³	10,885 lbs
Cabling		
Total:		346,552 lbs
		173.28 tons

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

SOLENOID CRYOSTAT

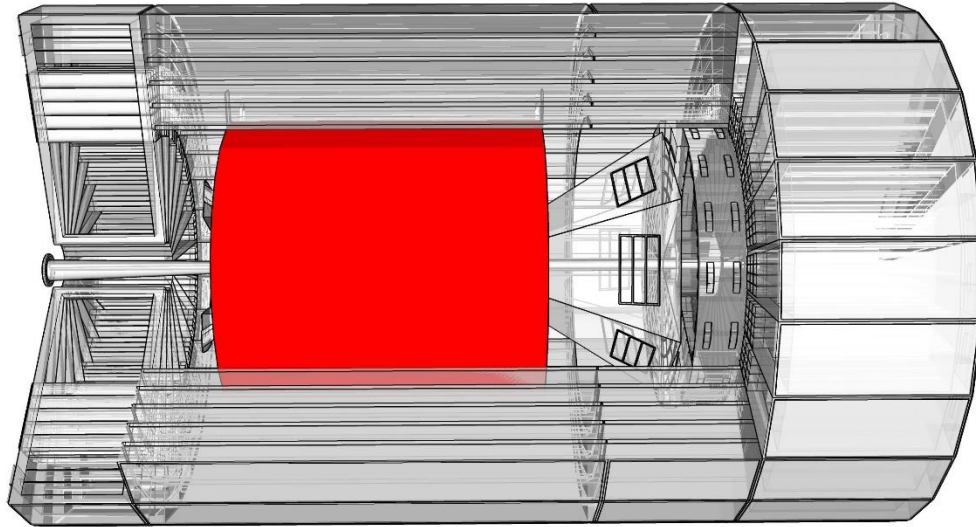


Figure 5: Solenoid Cryostat

Dimensions/Location

Overall Length	274 cm
Bore	90 cm
Radius	130 cm
Offset	1 cm in Hadron Direction
Total Volume	7.58 m ³ (268 ft ³)

Weight Estimates

Element	Basis	Weight
Volume Coeff (CLEO II)	213 lb/ft ³	56,979 lbs
Cabling		
Total:		56,979 lbs
		28.49 tons

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

BARREL ELECTROMAGNETIC CALORIMETER

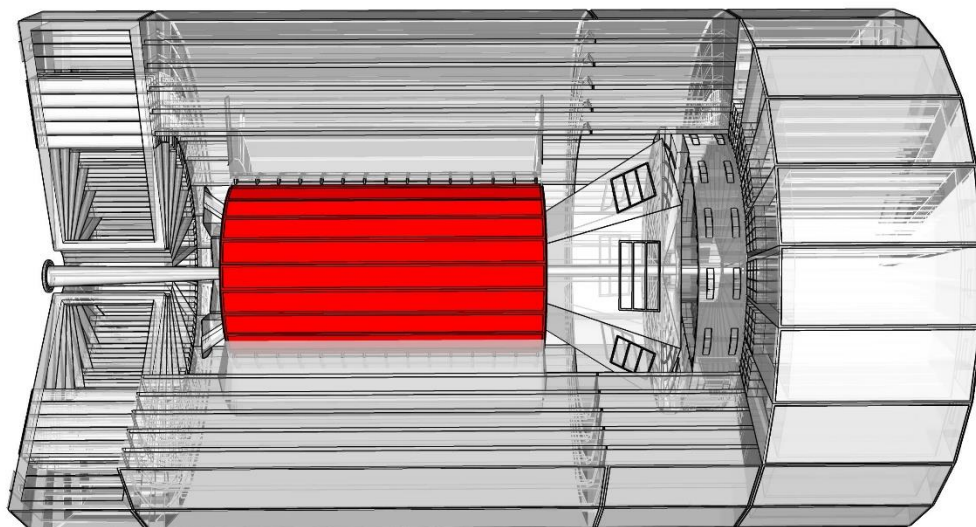


Figure 6: Barrel Electromagnetic Calorimeter

Dimensions/Location

Overall Length	276 cm
Bore	51 cm
Radius	81 cm
Offset	1 cm in Hadron Direction
Total Volume	3.43 m ³ (121 ft ³)

Weight Estimates

Element	Basis	Weight
Volume Coeff (CERN CMS)	219 lb/ft ³	26,555 lbs
Cabling		
Total:		26,555 lbs
		13.28 tons

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

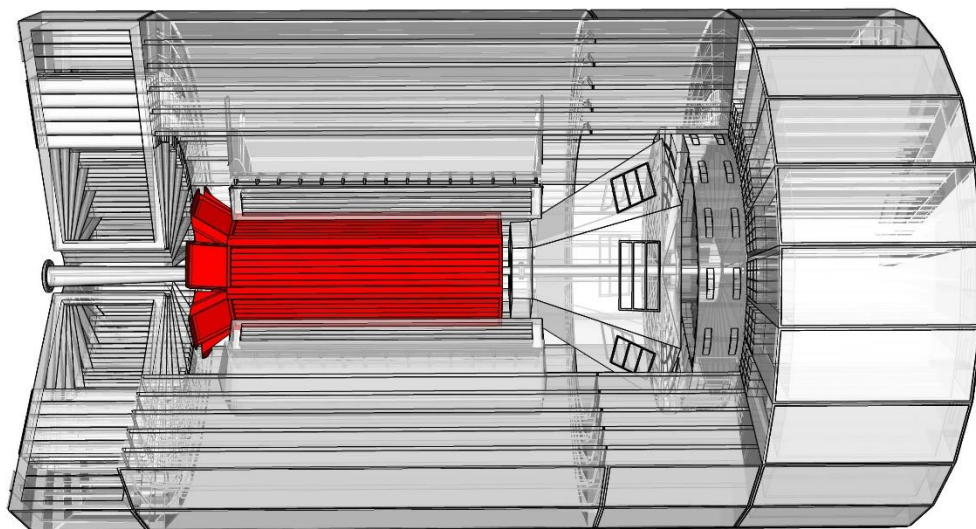


Figure 7: DIRC Detector

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 (12.32 ft ³)

Weight Estimates

<i>Element</i>	<i>Basis</i>	<i>Weight</i>
2.34 ft ³ of Carbon Fiber	141 lb/ft ³	330 lbs
9.98 ft ³ of Quartz	97 lb/ft ³	968 lbs
Cabling		
Total:		1,298 lbs
		0.65 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	

CORE

LEPTON DIRECTION ELECTROMAGNETIC CALORIMETER

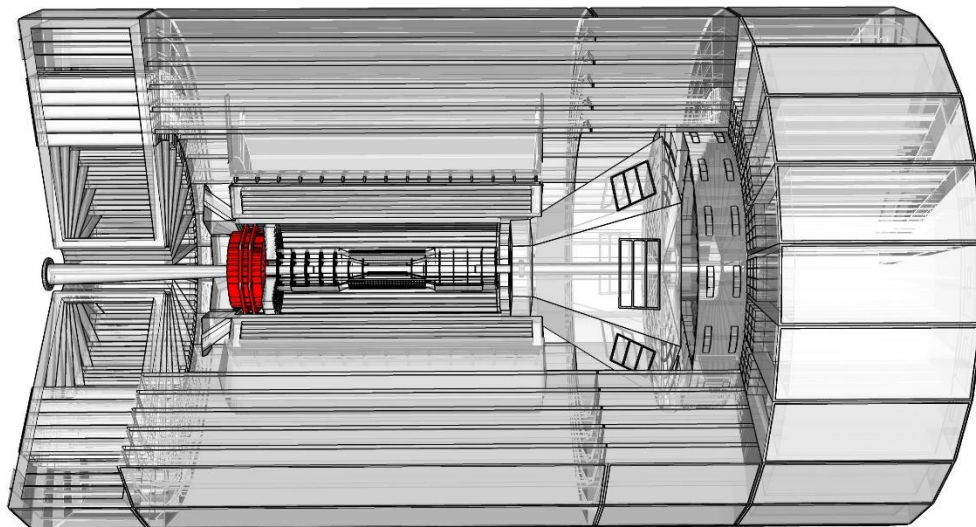


Figure 8: Lepton Direction Electromagnetic Calorimeter

Dimensions/Location

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

Weight Estimates

Element	Basis	Weight
0.05 ft ³ of Steel Frame	490 lb/ft ³	27 lbs
0.25 ft ³ of Carbon Fiber	141 lb/ft ³	35 lbs
2.44 ft ³ of Lead Glass	388 lb/ft ³	948 lbs
Cabling		
Total:		1,010 lbs
		0.51 tons

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

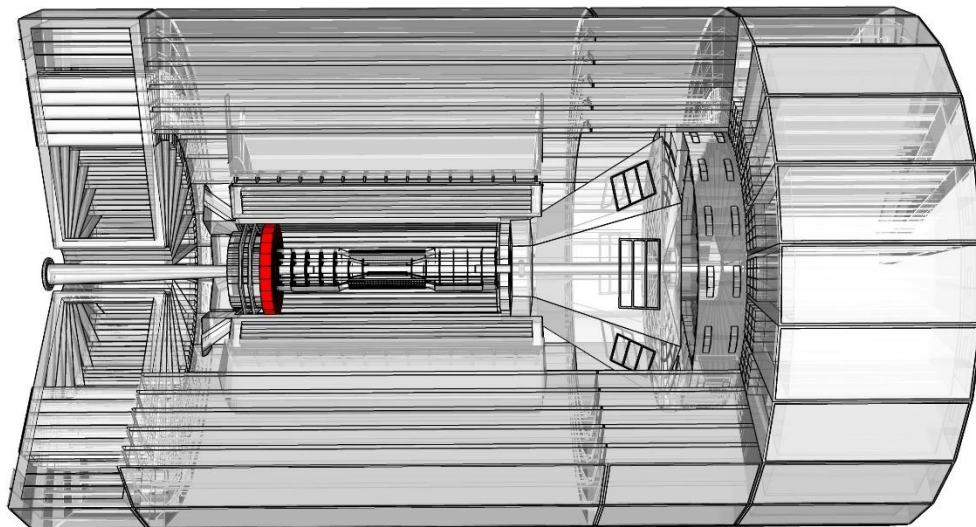


Figure 9: Lepton Direction Time of Flight Detector

Dimensions/Location

Overall Length	10 cm
Bore	10 cm
Radius	37 cm
Offset	100 cm in Lepton Direction
Total Volume	0.04 m ³ (1.41 ft ³)

Weight Estimates

Element	Basis	Weight
Volume Coeff (PANDA)	37.80 lb/ft ³	53 lbs
Cabling		
Total:		53 lbs
		0.03 tons

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

RICH (RING IMAGING CHERENKOV) DETECTOR

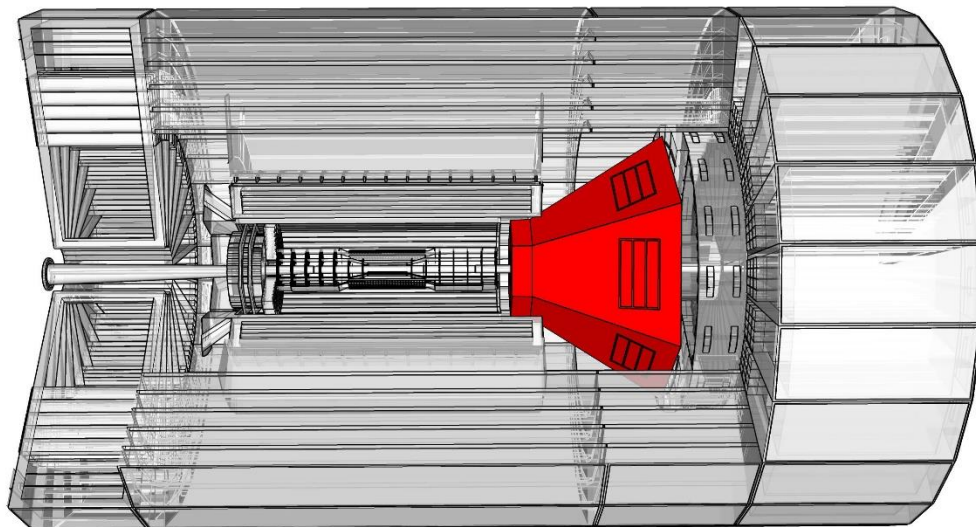


Figure 10: RICH Detector

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 (100.81 ft ³)

Weight Estimates

Element	Basis	Weight
Volume Coeff (CLAS LTCC)	11.60 lb/ft ³	1,169 lbs
Cabling		
Total:		1,169 lbs
		0.58 tons

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

HADRON DIRECTION TIME OF FLIGHT DETECTOR

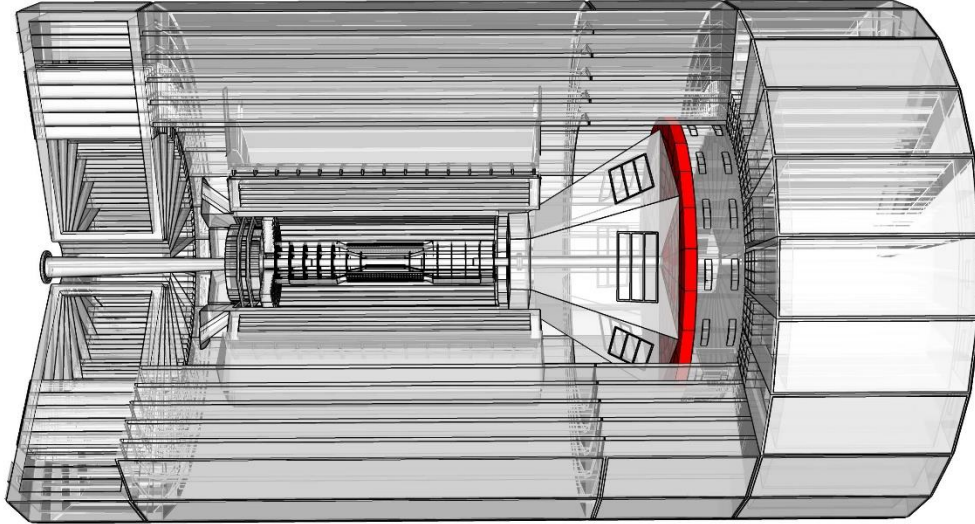


Figure 11: Hadron Direction Time of Flight Detector

Dimensions/Location

Overall Length	10 cm
Bore	20 cm
Radius	130 cm
Offset	250 cm in Hadron Direction
Total Volume	0.52 m ³ (18.31 ft ³)

Weight Estimates

Element	Basis	Weight
Volume Coeff (PANDA)	37.80 lb/ft ³	692 lbs
Cabling		
Total:		692 lbs
		0.35 tons

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

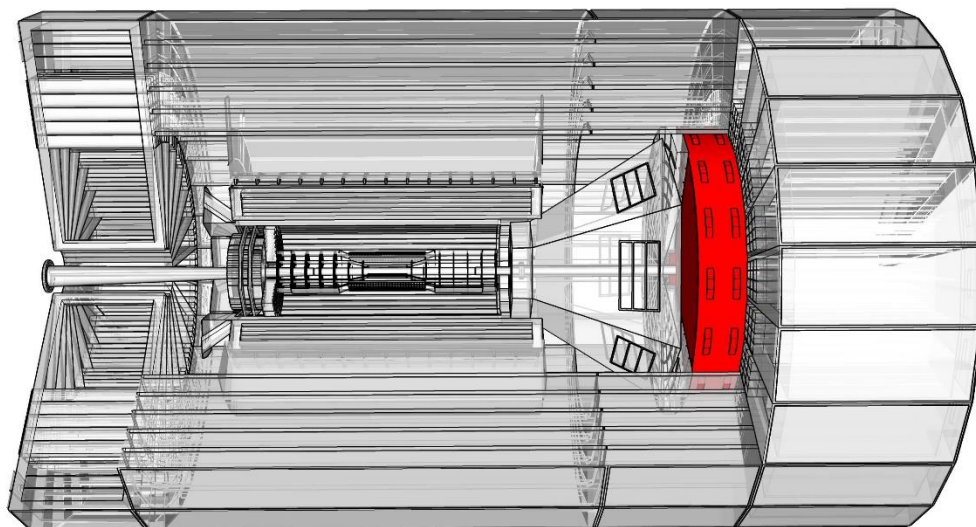


Figure 12: Hadron Direction Electromagnetic Calorimeter

Dimensions/Location

Overall Length	40 cm
Bore	30 cm
Radius	130 cm
Offset	260 cm in Hadron Direction
Total Volume	2.01 m ³ (71 ft ³)

Weight Estimates

Element	Basis	Weight
1.42 ft ³ of Steel Frame	490 lb/ft ³	696 lbs
6.39 ft ³ of Carbon Fiber	141 lb/ft ³	901 lbs
63.19 ft ³ of Lead Glass	388 lb/ft ³	24,519 lbs
Cabling		
Total:		26,116 lbs 13.06 tons

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

SILICON VERTEX DETECTOR

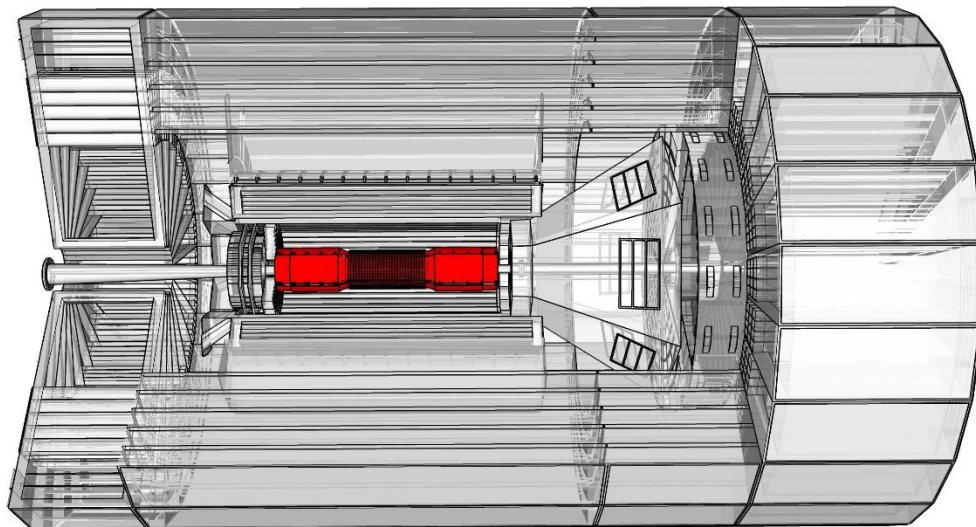


Figure 13: Silicon Vertex Detector

Dimensions/Location

Overall Length	200 cm
Bore	N/A
Radius	19.80 cm
Offset	300 cm in Hadron Direction
Total Volume	0.25 m ³ (9 ft ³)

Weight Estimates

Element	Basis	Weight
0.26 ft ³ of Aluminum	169 lb/ft ³	44.10 lbs
0.26 ft ³ of Silicon	145.00 lb/ft ³	37.84 lbs
Cabling		
Total:		81.94 lbs
		0.04 tons

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 14: Vacuum Chamber (Top View)

Dimensions/Location

<i>Overall Length</i>	645.28 cm
<i>Beryllium Length</i>	146.05 cm
<i>Interior Section Length</i>	243.90 cm
<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	