CENTRAL DETECTOR SUB-SYSTEMS FOR INTERACTION POINT 6

1.5 TESLA 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 1.5-Tesla model for Interaction Point 6, 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 1.5 T BABAR Magnet in IP-6. 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 the IP-6 infrastructure; i.e. rail systems, cradle, platform components, etc.
- To be able to reuse the STAR cradle, we offset the 1.5 Tesla magnet by 20 cm in the forward (hadron direction) side. *(This alteration also makes it possible to move this magnet through the doorway of IP-8 once the end caps have been removed.)*
- 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.

1.5 TESLA

IP-6 FIXED CARRIAGE

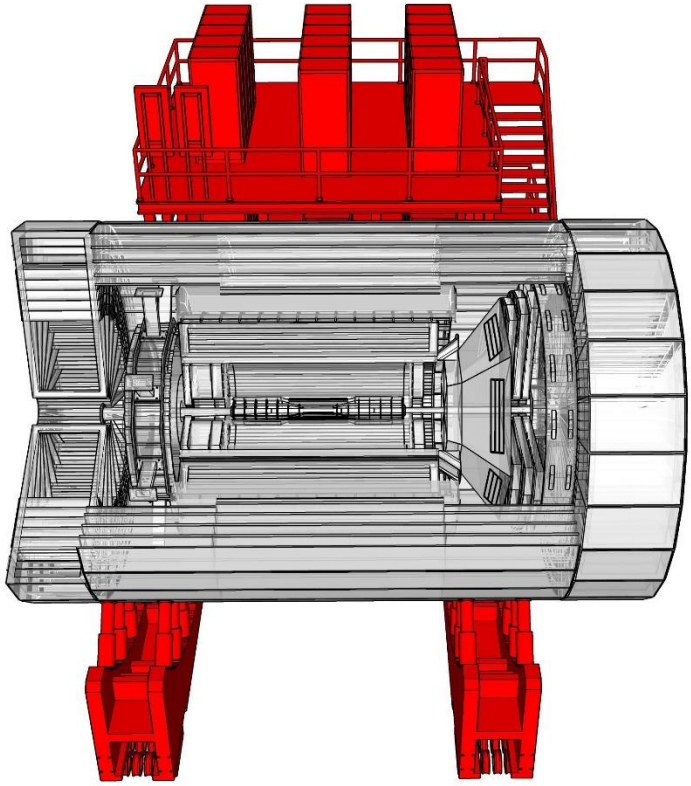

Figure 1: IP-6 Fixed Carriage

Dimensions/Location

N/A

Weight Estimates

Element	*Basis*	*Weight*
209 ft³ of Steel	489 lb/ft³	102,201 lbs
Danfysyk Power Supplies	2 @ 1,874 lbs	3,748 lbs
Computing Racks	39 @ 500 lbs	19,500 lbs
Transformers	4 @ 510 lbs	2,040 lbs
Star Cradle (243 ft³)	489 lb/ft³	118,891 lbs
	Total:	246,380 lbs
		123.19 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	

1.5 TESLA

BARREL HADRON CALORIMETER

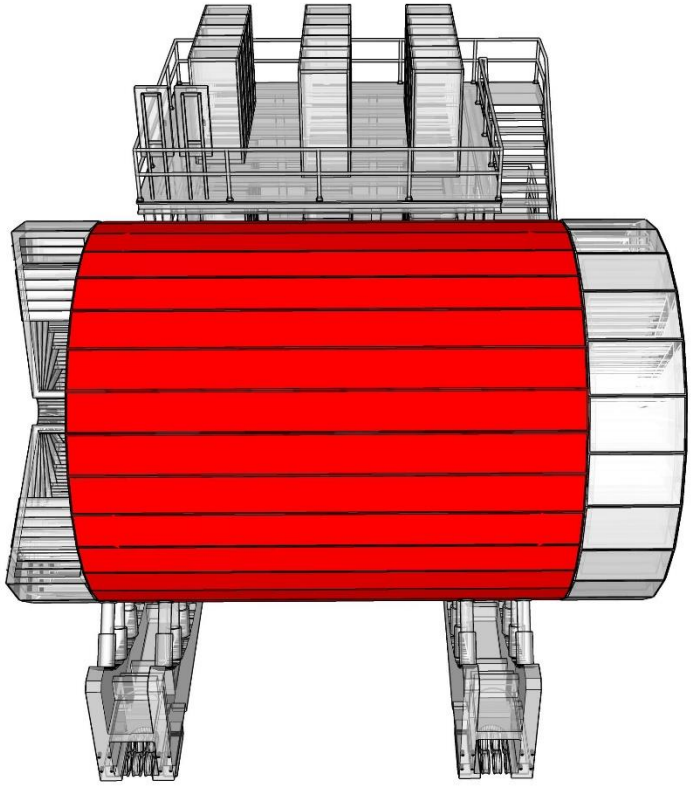

Figure 2: Barrel Hadron Calorimeter

Dimensions/Location

Overall Length	640 cm
Lepton Direction Section Length	170 cm
Center Section Length	300 cm
Hadron Direction Section Length	170 cm
Lepton Direction Bore	194 cm
Center Bore	180 cm
Hadron Direction Bore	194 cm
Radius	267 cm
Offset	20 cm in Lepton Direction
Total Volume	35.95 m^3 (1,269 ft^3)

Weight Estimates

Element	*Basis*	*Weight*
1,003 ft^3 of Iron	491 lb/ft^3	492,398 lbs
267 ft^3 of Plastic	59.90 lb/ft^3	15,968 lbs
Cabling		
	Total:	508,367 lbs
		254.18 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	

1.5 TESLA

LEPTON DIRECTION HADRON CALORIMETER ENDCAP

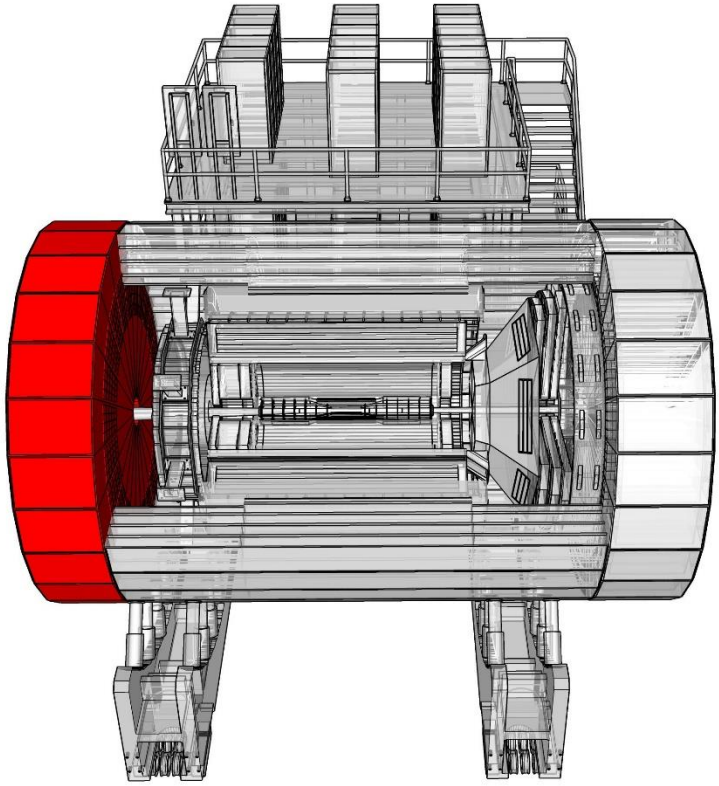

Figure 3: Lepton Direction Endcap

Dimensions/Location

Overall Length	105 cm
Bore	22 cm
Radius	267 cm
Offset	300 cm in Lepton Direction
Total Volume	23.36 m^3 (825 ft^3)

Weight Estimates

Element	*Basis*	*Weight*
652 ft^3 of Iron	491 lb/ft^3	319,939 lbs
173 ft^3 of Iron	59.90 lb/ft^3	10,375 lbs
Cabling		
	Total:	330,314 lbs
		165.16 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	

1.5 TESLA

HADRON DIRECTION HADRON CALORIMETER ENDCAP

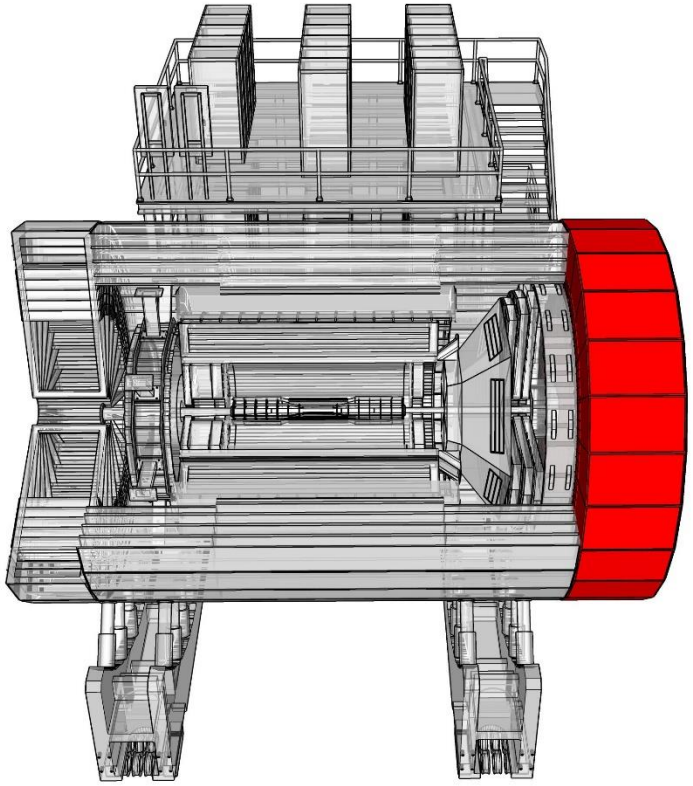

Figure 4: Hadron Direction Endcap

Dimensions/Location

Overall Length	120 cm
Bore	30 cm
Radius	267 cm
Offset	340 cm in Hadron Direction
Total Volume	26.54 m^3 (937 ft^3)

Weight Estimates

Element	*Basis*	*Weight*
740 ft^3 of Iron	491 lb/ft^3	363,496 lbs
197 ft^3 of Iron	59.90 lb/ft^3	11,788 lbs
Cabling		
	Total:	375,284 lbs
		187.64 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	

1.5 TESLA SOLENOID CRYOSTAT

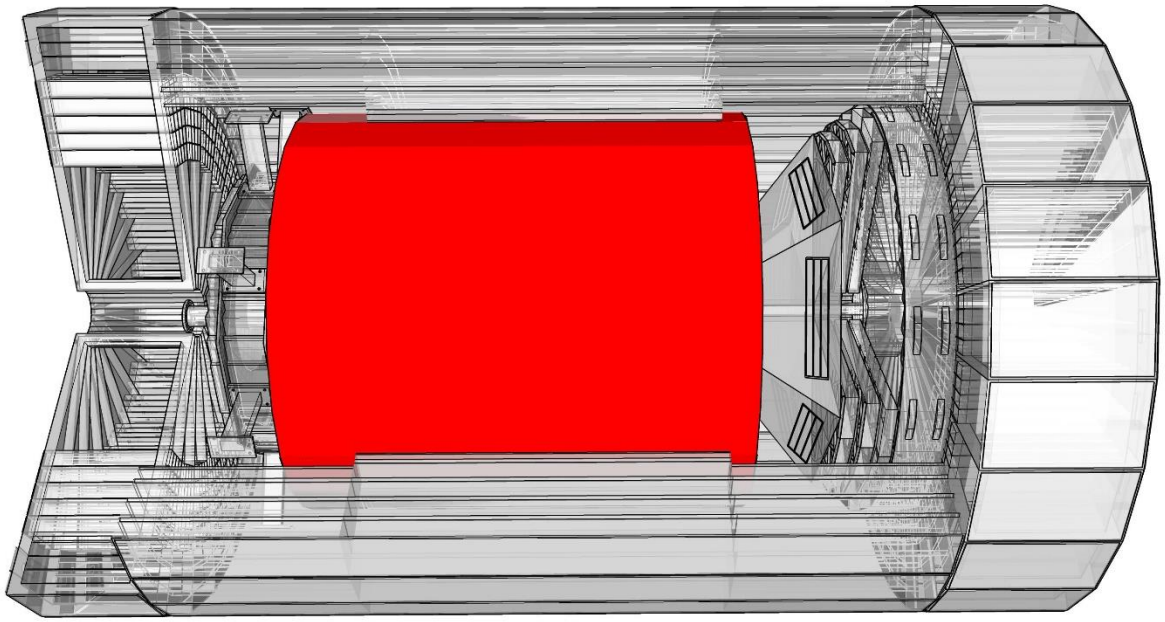

Figure 5: Solenoid Cryostat

Dimensions/Location

Overall Length	385 cm
Bore	142 cm
Radius	177 cm
Offset	0 cm
Total Volume	13.50 m^3 (477 ft^3)

Weight Estimates

Element	*Basis*	*Weight*
Volume Coeff (CLEO II)	213 lb/ft^3	101,579 lbs
Cabling		
	Total:	101,579 lbs
		50.79 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	

1.5 TESLA

BARREL ELECTROMAGNETIC CALORIMETER

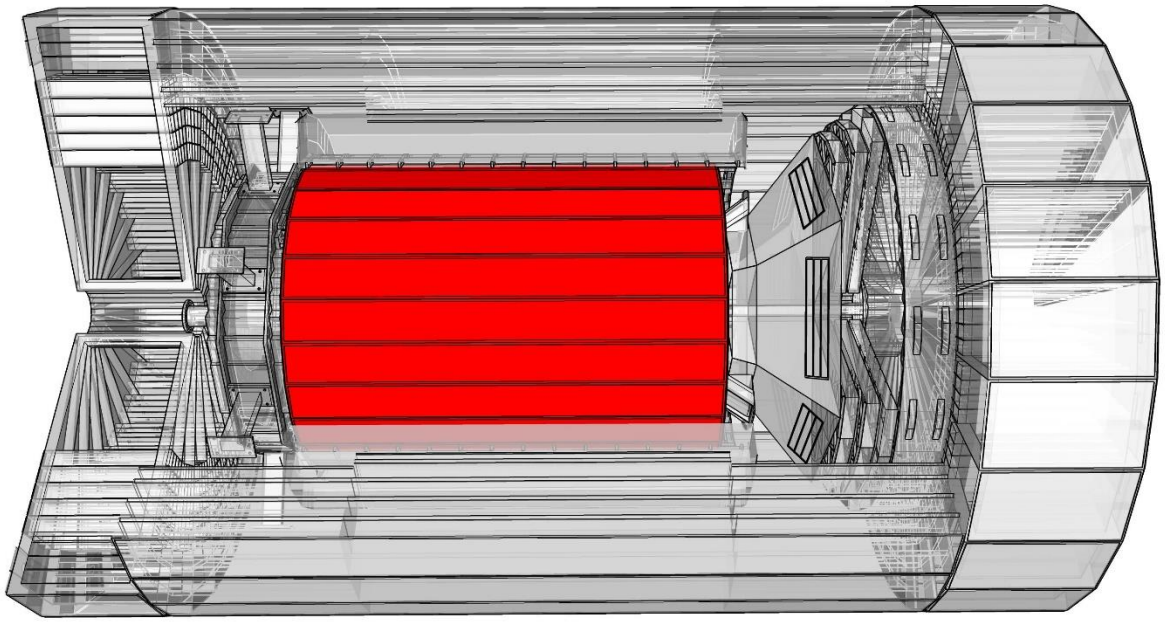

Figure 6: Barrel Electromagnetic Calorimeter

Dimensions/Location

Overall Length	360 cm
Bore	84 cm
Radius	134 cm
Offset	11 cm in Lepton Direction
Total Volume	12.33 m^3 (435 ft^3)

Weight Estimates

Element	*Basis*	*Weight*
Volume Coeff (CERN CMS)	219 lb/ft^3	95,341 lbs
Cabling		
	Total:	95,341 lbs
		47.67 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	

1.5 TESLA DIRC (DETECTION OF INTERNALLY REFLECTED CHERENKOV LIGHT) DETECTOR

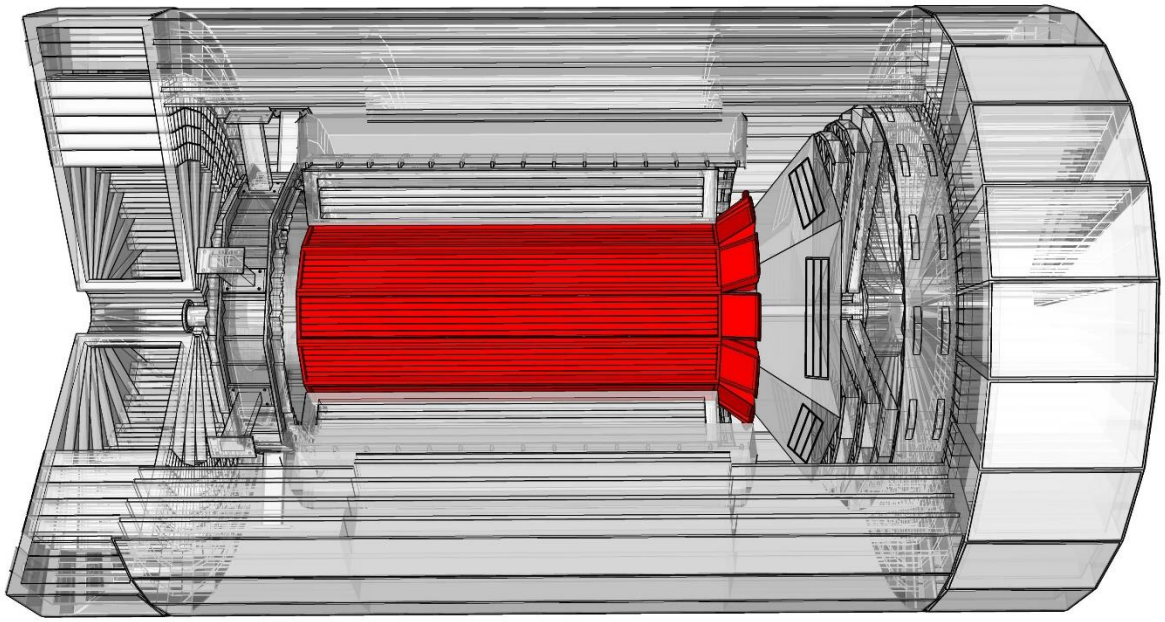

Figure 7: DIRC Detector

Dimensions/Location

DIRC Bar Length	360 cm
DIRC Segment Count	12
Bore	N/A
Radius	81 cm
Offset	169 cm in Hadron Direction
Total Volume	0.42 m^3 (15.00 ft^3)

Weight Estimates

Element	*Basis*	*Weight*
5.37 ft^3 of Carbon Fiber	141 lb/ft^3	757 lbs
22.11 ft^3 of Quartz	97 lb/ft^3	2,144 lbs
Cabling		
	Total:	2,901 lbs
		1.45 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	

1.5 TESLA

LEPTON DIRECTION ELECTROMAGNETIC CALORIMETER

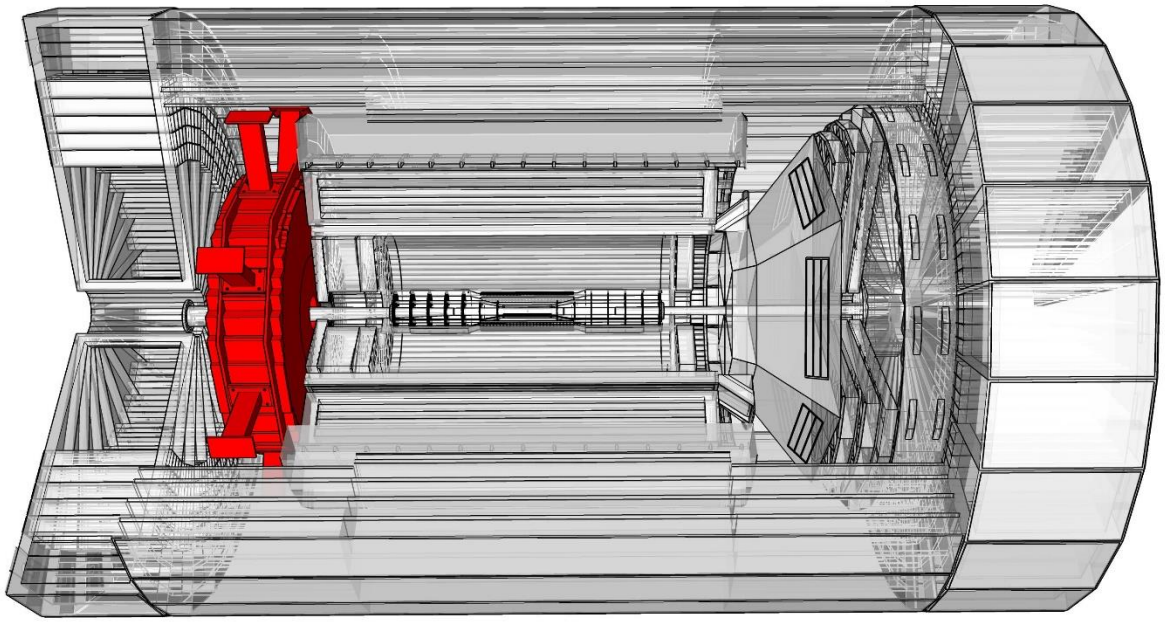

Figure 8: Lepton Direction Electromagnetic Calorimeter

Dimensions/Location

Overall Length	60 cm
Bore	20 cm
Detector Radius	110 cm
Support Radius	194 cm
Offset	195 cm in Lepton Direction
Total Volume	2.21 m^3 (78 ft^3)

Weight Estimates

Element	*Basis*	*Weight*
1.56 ft^3 of Steel Frame	490 lb/ft^3	763 lbs
7.01 ft^3 of Carbon Fiber	141 lb/ft^3	988 lbs
69.32 ft^3 of Lead Glass	388 lb/ft^3	26,895 lbs
Cabling		
	Total:	28,646 lbs
		14.32 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	

1.5 TESLA

LEPTON DIRECTION TIME OF FLIGHT DETECTOR

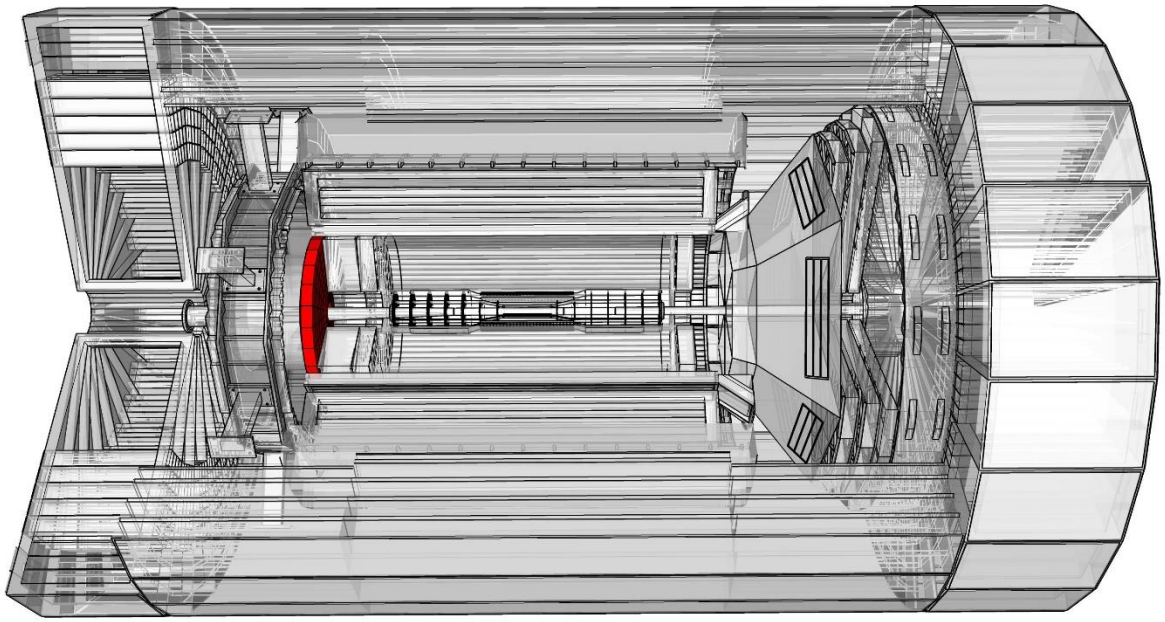

Figure 9: Lepton Direction Time of Flight Detector

Dimensions/Location

Overall Length	10 cm
Bore	10 cm
Radius	71 cm
Offset	180 cm in Lepton Direction
Total Volume	0.16 m^3 (5.48 ft^3)

Weight Estimates

Element	*Basis*	*Weight*
Volume Coeff (PANDA)	37.80 lb/ft^3	207 lbs
Cabling		
	Total:	207 lbs
		0.10 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	

1.5 TESLA CHERENKOV COUNTER

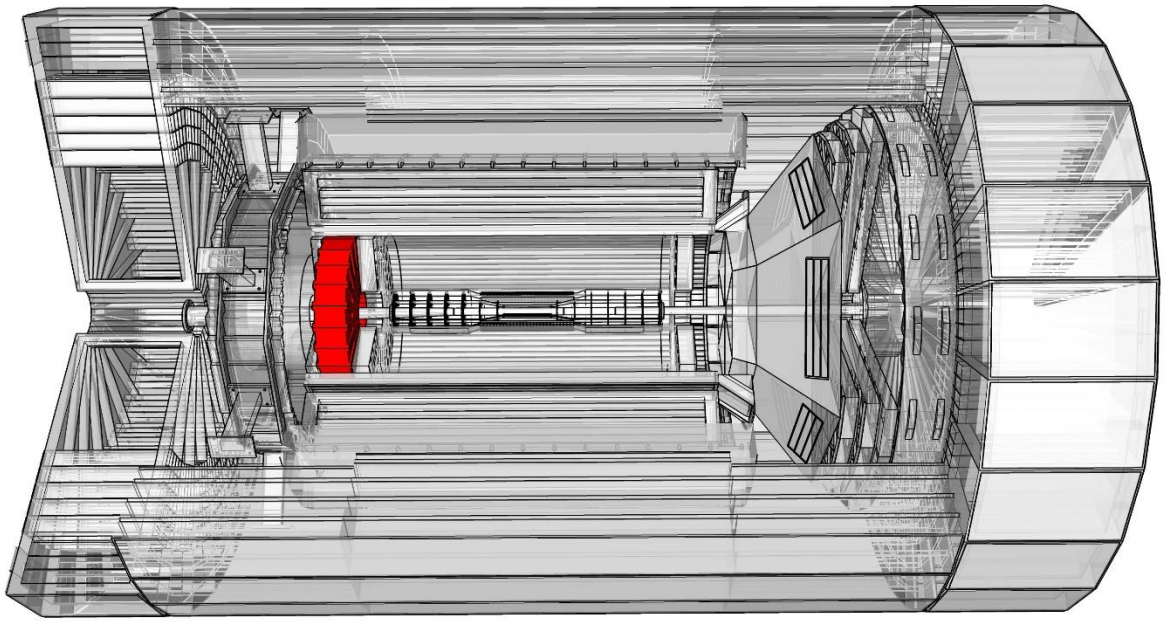

Figure 10: Cherenkov Counter

Dimensions/Location

Overall Length	30 cm
Bore	20 cm
Radius	71 cm
Offset	150 cm in Lepton Direction
Total Volume	0.44 m^3 (15.45 ft^3)

Weight Estimates

Element	*Basis*	*Weight*
Volume Coeff (CLAS12 LTCC)	11.60 lb/ft^3	179 lbs
Cabling		
	Total:	179 lbs
		0.09 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	

1.5 TESLA

LEPTON DIRECTION MICRO-PATTERN GAS DETECTOR

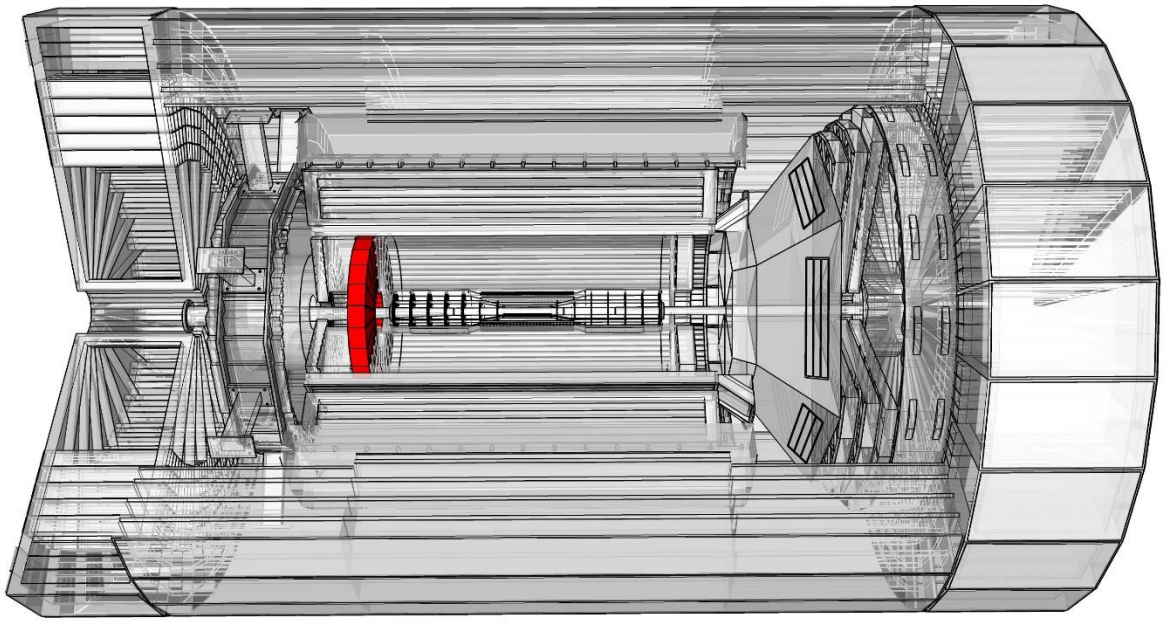

Figure 11: Lepton Direction Micro-Pattern Gas Detector

Dimensions/Location

Overall Length	15 cm
Bore	20 cm
Radius	71 cm
Offset	135 cm in Lepton Direction
Total Volume	0.22 m^3 (7.72 ft^3)

Weight Estimates

Element	*Basis*	*Weight*
Volume Coeff (sPHENIX)	12.50 lb/ft^3	97 lbs
Cabling		
	Total:	97 lbs
		0.05 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	

1.5 TESLA TIME PROJECTION CHAMBER

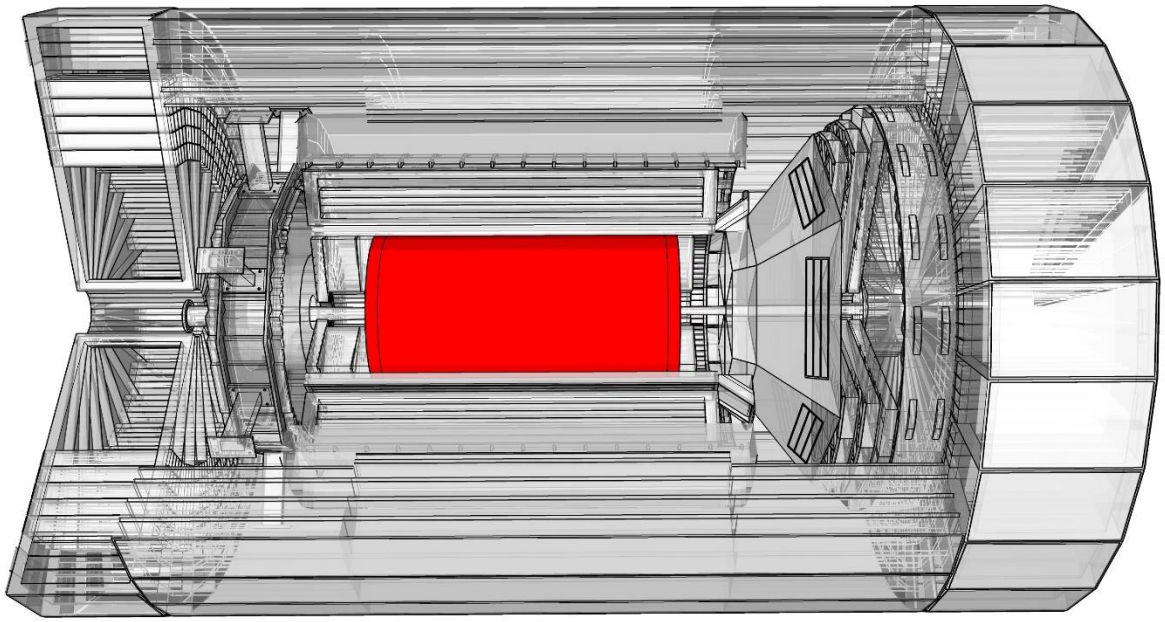

Figure 12: Time Projection Chamber

Dimensions/Location

Overall Length	270 cm
Bore	20 cm
Radius	71 cm
Offset	0 cm
Total Volume	3.94 m^3 (139.02 ft^3)

Weight Estimates

Element	*Basis*	*Weight*
Volume Coeff (PANDA)	6.19 lb/ft^3	861 lbs
Cabling		
	Total:	861 lbs
		0.43 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	

1.5 TESLA

HADRON DIRECTION MICRO-PATTERN GAS DETECTOR

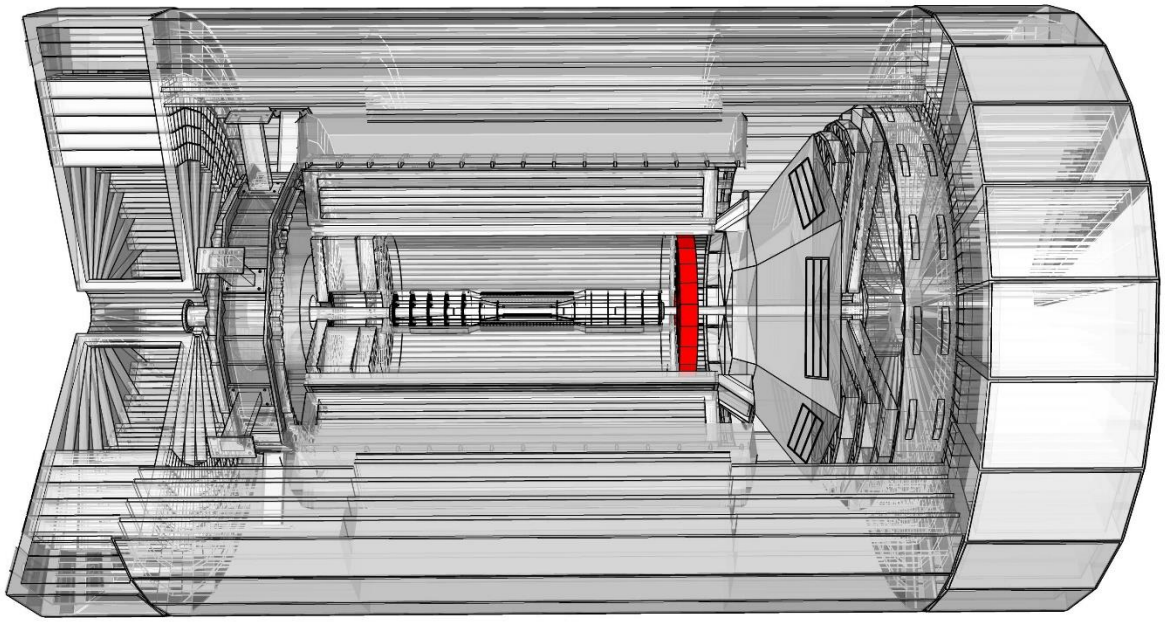

Figure 13: Hadron Direction Micro-Pattern Gas Detector

Dimensions/Location

Overall Length	15 cm
Bore	20 cm
Radius	71 cm
Offset	150 cm in Hadron Direction
Total Volume	0.22 m³ (7.72 ft³)

Weight Estimates

Element	*Basis*	*Weight*
Volume Coeff (SBS GEM)	12.50 lb/ft³	97 lbs
Cabling		
	Total:	97 lbs
		0.05 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	

1.5 TESLA RICH (RING IMAGING CHERENKOV) DETECTOR

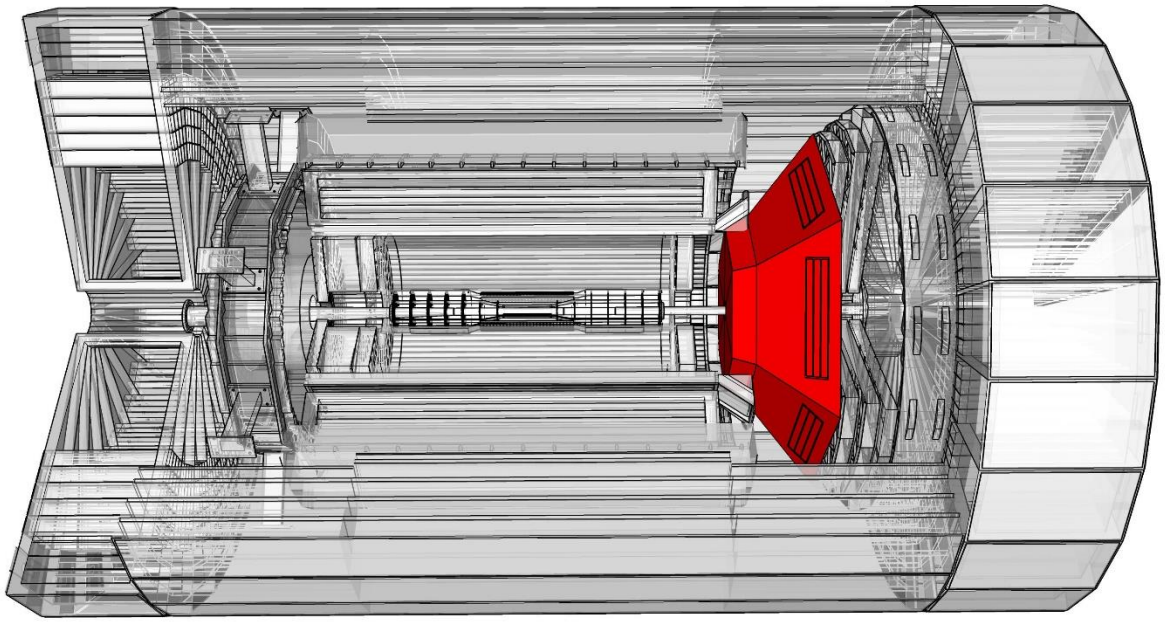

Figure 14: RICH Detector

Dimensions/Location

Overall Length	110 cm
Aerogel Length	40 cm
Aerogel Radius	75 cm
Detector Length	70 cm
Bore	10 cm
E1 (Far) Radius	160 cm
E2 (Near) Radius	77 cm
Offset	260 cm in Hadron Direction
Segment Count	8
Total Volume	3.49 m^3 (123.12 ft^3)

Weight Estimates

Element	*Basis*	*Weight*
Volume Coeff (CLAS LTCC)	11.60 lb/ft^3	1,428 lbs
Cabling		
	Total:	1,428 lbs
		0.71 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	

1.5 TESLA

HADRON DIRECTION TRANSITION RADIATION DETECTOR 2

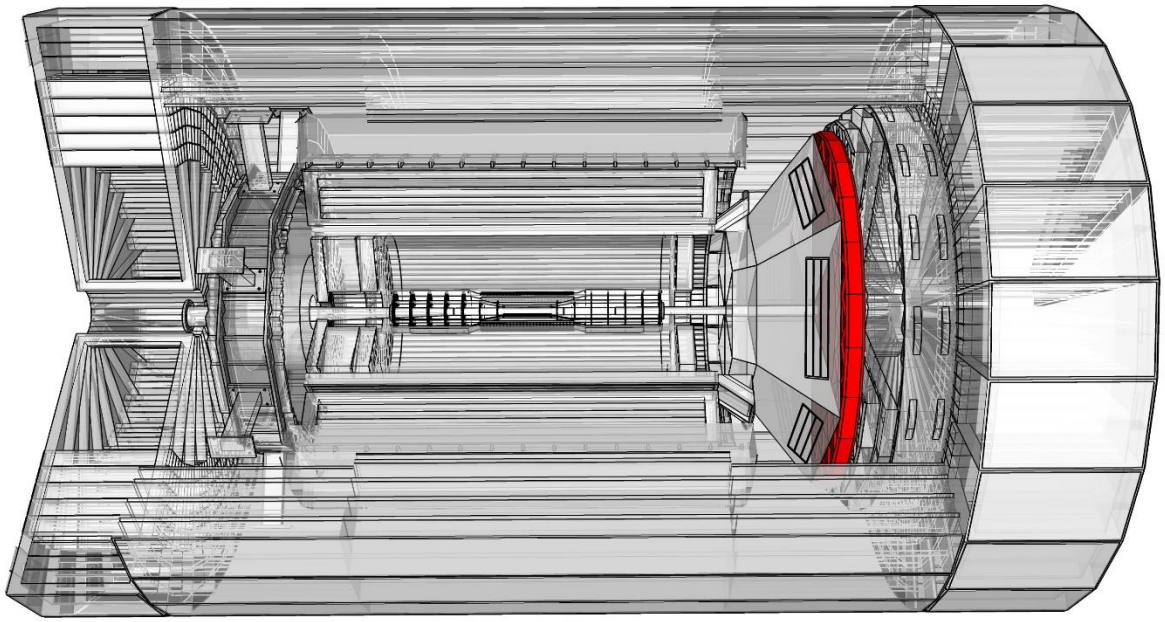

Figure 15: Hadron Direction Transition Radiation Detector 2

Dimensions/Location

Overall Length	15 cm
Bore	20 cm
Radius	160 cm
Offset	260 cm in Hadron Direction
Total Volume	1.19 m³ (41.94 ft³)

Weight Estimates

Element	*Basis*	*Weight*
Volume Coeff (SBS GEM)	14.90 lb/ft³	625 lbs
Cabling		
	Total:	625 lbs
		0.31 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	

1.5 TESLA

HADRON DIRECTION TRANSITION RADIATION DETECTOR 1

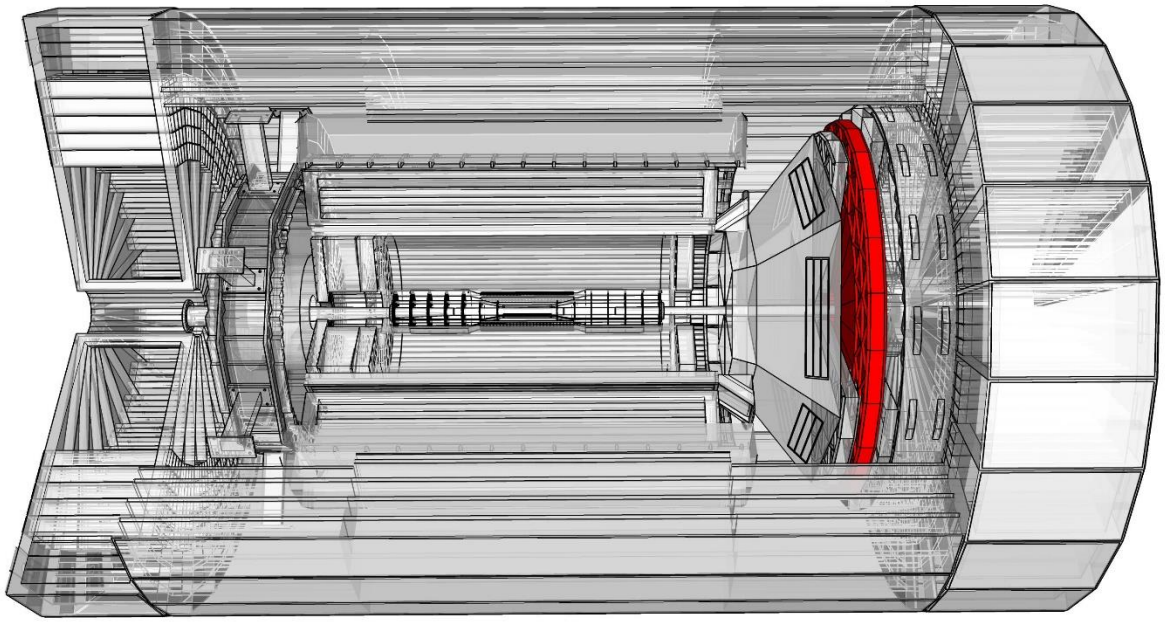

Figure 16: Hadron Direction Transition Radiation Detector 1

Dimensions/Location

Overall Length	15 cm
Bore	20 cm
Radius	170 cm
Offset	275 cm in Hadron Direction
Total Volume	1.34 m^3 (47.43 ft^3)

Weight Estimates

Element	*Basis*	*Weight*
Volume Coeff (SBS GEM)	14.90 lb/ft^3	707 lbs
Cabling		
	Total:	707 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	

1.5 TESLA

HADRON DIRECTION TIME OF FLIGHT DETECTOR

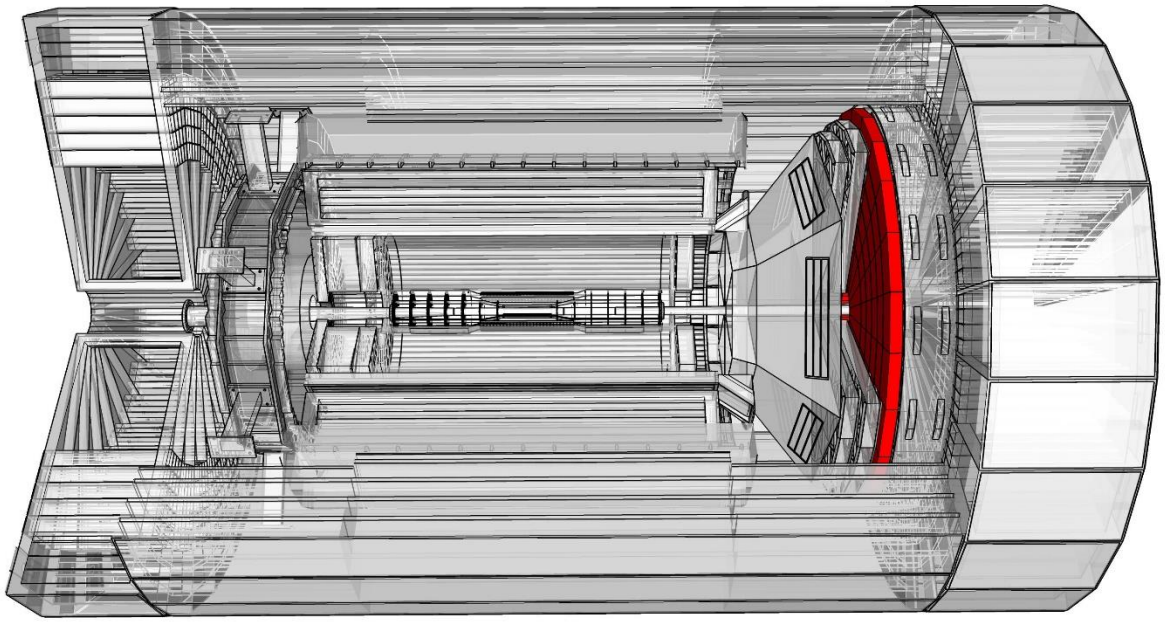

Figure 17: Hadron Direction Time of Flight Detector

Dimensions/Location

Overall Length	10 cm
Bore	20 cm
Radius	180 cm
Offset	290 cm in Hadron Direction
Total Volume	1.01 m^3 (35.50 ft^3)

Weight Estimates

Element	*Basis*	*Weight*
Volume Coeff (PANDA)	37.80 lb/ft^3	1,342 lbs
Cabling		
	Total:	1,342 lbs
		0.67 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	

1.5 TESLA

HADRON DIRECTION ELECTROMAGNETIC CALORIMETER

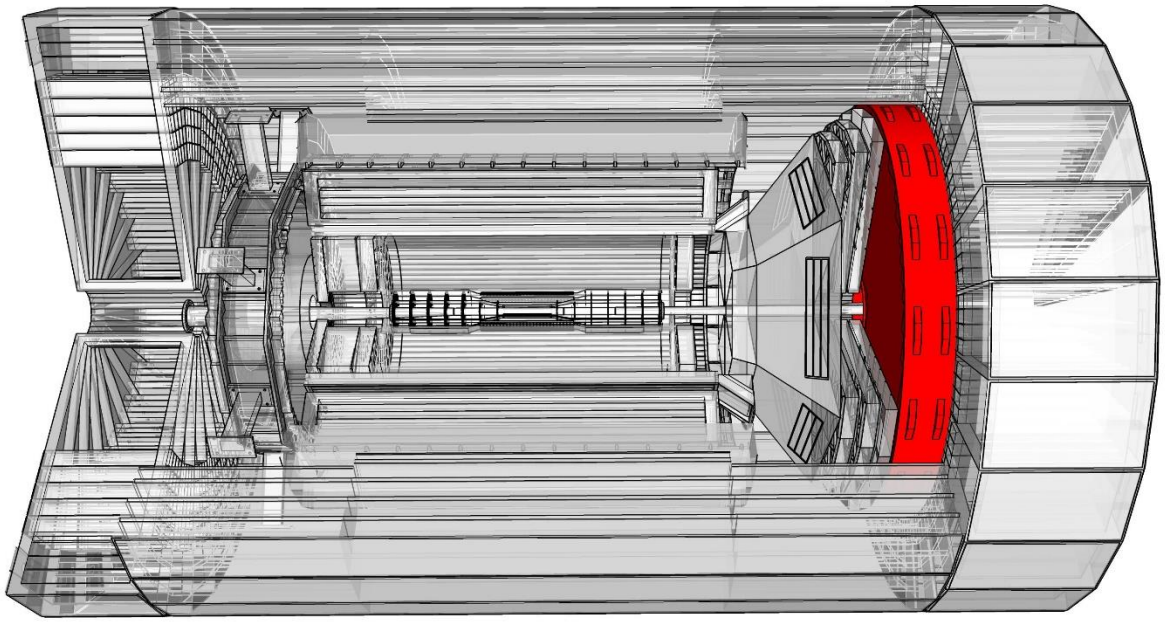

Figure 18: Hadron Direction Electromagnetic Calorimeter

Dimensions/Location

Overall Length	40 cm
Bore	30 cm
Radius	193 cm
Offset	300 cm in Hadron Direction
Total Volume	4.57 m^3 (161 ft^3)

Weight Estimates

Element	*Basis*	*Weight*
3.23 ft^3 of Steel Frame	490 lb/ft^3	1,581 lbs
14.52 ft^3 of Carbon Fiber	141 lb/ft^3	2,047 lbs
143.56 ft^3 of Lead Glass	388 lb/ft^3	55,703 lbs
Cabling		
	Total:	59,331 lbs
		29.67 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	

1.5 TESLA SILICON VERTEX DETECTOR

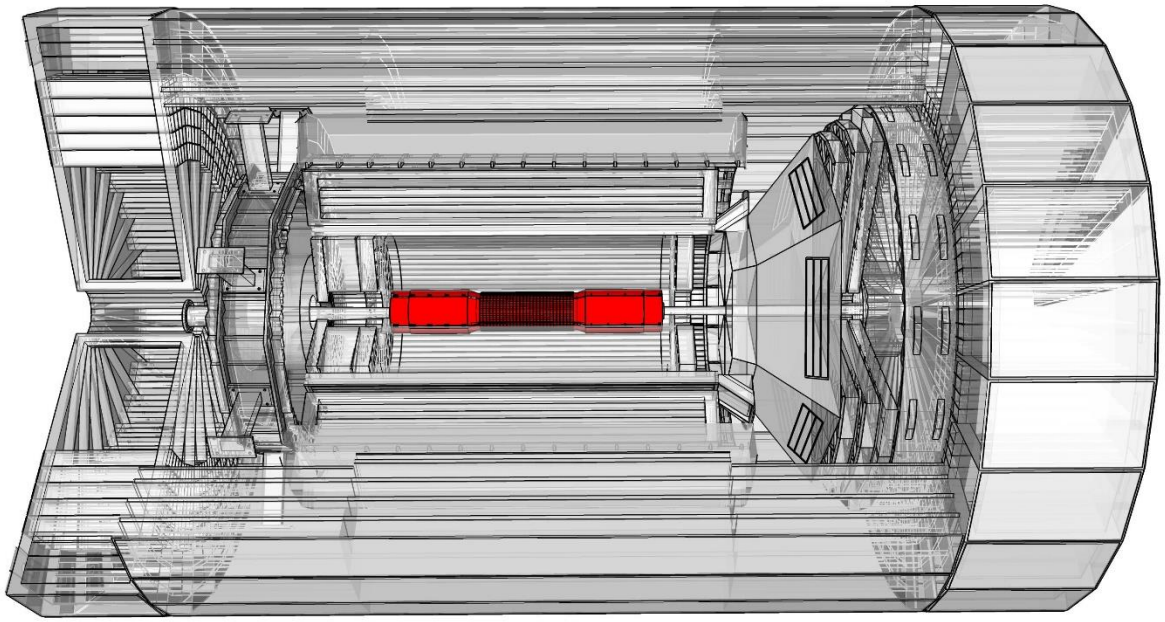

Figure 19: Silicon Vertex Detector

Dimensions/Location

Overall Length	244 cm
Bore	N/A
Radius	19.80 cm
Offset	0 cm
Total Volume	0.30 m³ (11 ft³)

Weight Estimates

Element	*Basis*	*Weight*
0.32 ft³ of Aluminum	169 lb/ft³	53.81 lbs
0.32 ft³ of Silicon	145.00 lb/ft³	46.17 lbs
Cabling		
	Total:	99.97 lbs
		0.05 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	

1.5 TESLA VACUUM CHAMBER

Figure 20: Vacuum Chamber (Top View)

Dimensions/Location

Overall Length	Not Available
Beryllium Length	Not Available
Interior Section Length	Not Available
Lepton Section Length	Not Available
Hadron Section Length	Not Available

Weight Estimates

Element	*Basis*	*Weight*
Data Not Collected		
	Total:	lbs
		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	