CDC Design Layout

GlueX-doc-979 (version 1)

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Abstract

This document is a summary of the design parameters of the CDC. The design described in this report is for a 150 cm long version.

1 List of Design Parameters

Table 1: Geometry

Active volume inner radius:	10.18 cm
Active volume outer radius:	55.42 cm
Active length:	150 cm
Chamber assembly outer radius:	60.0 cm
Axial layers (1-3):	10.16 to 15.32 cm
Stereo layers (4-7):	15.5 to 22.45 cm
Axial layers (8-12):	23.9 to 32.63 cm
Stereo layers (13-16):	32.81 to 39.76 cm
Axial layers (17-24):	40.81 to 55.42 cm
Thickness per layer (g/cm2):	0.051
Thickness per layer (rad. lengths):	0.0014
Thickness per 24 layers (rad. lengths):	0.035

Table 2: Material

Gas (at 1 at.):	Ar/CO_2 90/10
Gas (at 1 at.):	$Ar/CO_2/CH_4$ 80/10/10 (possibly)
Number of cables : (50-conductor shielded ribbon cables)	$3098/24 = 130$
Positioning accuracy of sense wires (x,y):	$10\,\mu m$
Positioning accuracy of package (z):	$0.5\,mm$
Thickness of inner shell (g/cm2):	0.162
Thickness of inner shell (rad. lengths):	0.0067
Thickness of outer shell (g/cm2):	$1.02\,cm$ of fiberglass
Thickness of outer shell (rad. lengths):	0.031
Strawtube (diameter):	$1.6\,cm$
Strawtube (material):	Aluminized Kapton
Strawtube (thickess):	$100(5)\,\mu m$ Kapton(Al)
Number of sense wires (20 micron gold-plated W):	$3098 \pm 1.5\%$
Upstream Endplate:	$0.9525\,cm$ Al (3/8 plate)
Downstream Endplate:	$0.4\,cm$ Carbon Fiber
Upstream Feedthrus:	Al
Downstream Feedthrus:	Delrin
Plenums:	Plexiglas

Table 3: Location active area

Upstream gas plenum:	$-3\,cm$
Upstream active volume:	$17\,cm$
Downstream active volume:	$167\,cm$
Downstream gas plenum:	$177\,cm$

Table 4: dE/dX capability

Sense wires:	YES
Momentum Range:	$p \leq 450 MeV/c$

Table 5: Operation:

Nominal operating voltage (sense):	$+1900\,V$
Nominal gas gain:	5×10^4
Gas flow:	$5/day$

Table 6: Preamplifier and Readout

Nominal gain:	5×10^4
Noise level:	
Rise time:	$\sim 50\,ns$
Tail compensation:	YES
Cable length to post-amp:	$30\,m$
Discriminator output:	NO
Sense wires:	$125\,MHz$ FADCs

Table 7: Calibration and Resolution

Sense wires (selected charge):	electronic pulser
Perpendicular to wire (σ):	$150\,\mu m$
z-position from stereo (σ):	$2\,mm$
z-position from charge division:	$8\,cm$

Layer	Channels	Radius (cm) (center)	Radius (cm) (end plate)	Stereo (radians)	Δr
1	43	10.984	10.984	0.000	10.984
2	50	12.769	12.769	0.000	1.785
3	57	14.555	14.555	0.000	1.785
4	64	16.340	18.142	0.105	1.786
5	71	18.126	19.765	0.105	1.786
6	78	19.912	21.415	−0.105	1.786
7	85	21.698	23.085	−0.105	1.786
8	98	25.015	25.015	0.000	3.317
9	105	26.801	26.801	0.000	1.786
10	112	28.588	28.588	0.000	1.786
11	119	30.374	30.374	0.000	1.786
12	126	32.160	32.160	0.000	1.786
13	133	33.947	34.849	0.105	1.786
14	140	35.733	36.592	0.105	1.786
15	147	37.519	38.338	−0.105	1.786
16	154	39.306	40.088	−0.105	1.786
17	165	42.113	42.113	0.000	2.807
18	172	43.899	43.899	0.000	1.786
19	179	45.686	45.686	0.000	1.786
20	186	47.472	47.472	0.000	1.786
21	193	49.258	49.258	0.000	1.786
22	200	51.045	51.045	0.000	1.786
23	207	52.831	52.831	0.000	1.786
24	214	54.618	54.618	0.000	1.786

Table 8: This table shows the number of channels in each layer of the 150 cm long version of the CDC. The radius at the center is the wire location halfway between the two end plates. The radius at the endplates is where the wire gores through the end plate. For axial layers, both radii are the same. For the stereo layers, the radius at the endplate is larger than it is at the center.

Layer	Tubes	$\Delta\phi$	x_u	y_u	x_c	y_c	x_d	y_d
1	43	0.1461	10.9840	0.0000	10.9840	0.0000	10.9840	0.0000
2	50	0.1257	12.7691	0.0000	12.7691	0.0000	12.7691	0.0000
3	57	0.1102	14.5546	0.0000	14.5546	0.0000	14.5546	0.0000
4	64	0.0982	16.3402	7.8813	16.3402	0.0000	16.3402	−7.8813
5	71	0.0885	18.1261	7.8813	18.1261	0.0000	18.1261	−7.8813
6	78	0.0806	19.9121	−7.8813	19.9121	0.0000	19.9121	7.8813
7	85	0.0739	21.6981	−7.8813	21.6981	0.0000	21.6981	7.8813
8	98	0.0641	25.0152	0.0000	25.0152	0.0000	25.0152	0.0000
9	105	0.0598	26.8015	0.0000	26.8015	0.0000	26.8015	0.0000
10	112	0.0561	28.5877	0.0000	28.5877	0.0000	28.5877	0.0000
11	119	0.0528	30.3740	0.0000	30.3740	0.0000	30.3740	0.0000
12	126	0.0499	32.1603	0.0000	32.1603	0.0000	32.1603	0.0000
13	133	0.0472	33.9466	7.8813	33.9466	0.0000	33.9466	−7.8813
14	140	0.0449	35.7329	7.8813	35.7329	0.0000	35.7329	−7.8813
15	147	0.0427	37.5193	−7.8813	37.5193	0.0000	37.5193	7.8813
16	154	0.0408	39.3057	−7.8813	39.3057	0.0000	39.3057	7.8813
17	165	0.0381	42.1128	0.0000	42.1128	0.0000	42.1128	0.0000
18	172	0.0365	43.8992	0.0000	43.8992	0.0000	43.8992	0.0000
19	179	0.0351	45.6856	0.0000	45.6856	0.0000	45.6856	0.0000
20	186	0.0338	47.4720	0.0000	47.4720	0.0000	47.4720	0.0000
21	193	0.0326	49.2585	0.0000	49.2585	0.0000	49.2585	0.0000
22	200	0.0314	51.0449	0.0000	51.0449	0.0000	51.0449	0.0000
23	207	0.0304	52.8313	0.0000	52.8313	0.0000	52.8313	0.0000
24	214	0.0294	54.6177	0.0000	54.6177	0.0000	54.6177	0.0000

Table 9: The location of the wires in the CDC. For each layer, we report the number of tubes, the angular rotation $\Delta\phi$ between tubes, and the (x, y) coordinates of the wire at three z positions. The up-stream pair (x_u, y_u) are on the inside face of the up-stream endplate ($z = 0$). The center pair are at the center of the chamber ($z = 0$), and the down-stream pair (x_d, y_d) are on the inside face of the down-stream endplate ($z = 150$). All distances are reported in *cm* and angles in radians.