

E740 Electromagnetic Calorimeter

Sept 27,

B.C

Central Electromagnetic Calorimeter Calorimeter

② 20% in thickness, substrate $\sim \pm 45^\circ$ (± 1.2 meters) and is cylindrical

③ 4 Longitudinal Segments -	1% Pb	58 cm
of glass + a lead pre	2% SCG1-C	8.7 cm
converter	2% SCG1-C	8.7 cm
	5% SCG1-C	21.75 cm
	10% SCG1-C	43.50 cm
		83.23 cm

④ The new ring bypass assumed to be positioned $r \sim 180$ cm
The central tracker assumed to end at $r \sim 70$ cm

The active em calorimeter in the central region must lie between $70 \rightarrow 180$ cm = 110 cm

⑤ Assume approximately 8 cm interstitial distance between longitudinal segments for saturated avalanche chamber + proximity PM. Assume approximately 3 cm for chamber alone, leads to structures given below:

69.7 - 70.3	Pb Preconverter	1%
70.3 - 73.3	Interstitial Chamber I	
73.3 - 82.0	1st SCG1-C Segment	2%
82.0 - 90.0	Interstitial Chamber II	
90.0 - 98.7	2nd SCG1-C Segment	2%
98.7 - 106.7 cm	Interstitial Chamber III	
106.7 - 128.5 cm	3rd SCG1-C Segment	5%
128.5 - 136.5 cm	Interstitial Chamber IV	
136.5 - 180 cm	4th SCG1-C Segment	10%

⑥ Largest transverse dimension of a segment is ~ 15 cm
With the outer circumference being $2\pi \times 180$ this requirement leads to ~ 60 segments in ϕ . This leads to the sizes of pieces of glass indicated on the following page. $\Delta\phi \sim 60$ and $\Delta\eta \approx 1$ at 90°

⑦ Chambers are gas with wipac structure initially instrumented. These chambers are tube hodoscopes with assumed size of $\sim .7$ cm x $.7$ cm with wires running parallel to the beam and strips of $\sim .7$ cm running in the ϕ direction. These chambers are operated in the saturated avalanche or limited streamer mode

Signpost Sizes

	<u>AX</u>	<u>AZ</u>	<u>Area (sq. ft.)</u>	<u># of Blocks</u>
Layer I	8.7cm	8.7cm	8.7cm (8.6cm)	$\sim 30 \times 60 = 1800$
Layer II	8.7cm	8.4cm	8.4cm (10.3cm)	$\sim 25 \times 60 = 1500$
Layer III	21.8cm	11.2cm	11.2cm (13.4cm)	$\sim 22 \times 60 = 1320$
Layer IV	12.5cm	14.3cm	14.3cm (13.8cm)	$\sim 17 \times 60 = 1020$
				<u>5700</u>

All: 3" PH's (5700 tubes)

Layer I	-	69% coverage
Layer II	-	47% coverage
Layer III	-	30% coverage
Layer IV	-	17% coverage

	<u>Volume/cm³</u>	<u>Weight/piece</u>	<u>Total Weight</u>
Layer I	344 cm ³	1829 gm = 4.03 lbs	7253 lbs
Layer II	808 cm ³	2114 gm = 5.45 lbs	9324 lbs
Layer III	3355 cm ³	16095 gm = 22.24 lbs	27359 lbs
Layer IV	10303 cm ³	34619 gm = 76.25 lbs	77779 lbs
			<u>123715 lbs</u>
			61.9 tons

Price of Glass

	<u>Cost/ea</u>	<u>Cost/piece</u>	<u>Total</u>
Layer I	\$.13	$\sim \$ 70$	126 K
Layer II	\$.12	$\sim \$ 97$	151 K
Layer III	\$.105	$\sim \$ 316$	417 K
Layer IV	\$.092	$\sim \$ 950$	969 K
			<u>1663 K</u>

Price of Photomultiplier

$$\$ 120 \text{ ea} \times 5700 = 684 \text{ K}$$

Photomultiplier base:

$$\$ 20 \text{ ea} \times 5700 \sim 114 \text{ K}$$

$$\text{Cables: } 5700 \times 200 \text{ ft twisted flat} \\ \sim 114 \text{ K}$$

Multiplied ADC's

$$\$ 40 \text{ ea} \times 5700 = 228 \text{ K}$$

Tube Chambers

	<u>Wires</u>	<u>Strips</u>	<u>Total Channels</u>	
Interstitial Chamber I	~ 650	~ 350	~ 1000	
Interstitial Chamber II	~ 750	~ 350	~ 1100	
Interstitial Chamber III	~ 900	~ 350	~ 1250	
→ Interstitial Chamber IV ?	~ 1150	~ 350	~ 1500	← May not be necessary
			<u>4850</u>	

Multiplexed ADC's 30 K 4850 ~ 146K

Add ~ 50K for construction

Cables: 4850 twisted flat pairs X 200 ft = 97K

Total Total Cost of Central E.H. Calorimeter (through the analogue level)

Glass	1,663 K
PM Tubes	684 K
Supports for Detector	100 K
Tube Chambers construction	50 K
Tube Chambers cables	97K
PM Tube Cables +	114K
PM Tube bases	114K
	<u>2822K</u>

PM ADC's	228 K
Tube ADC's	146 K
	<u>3196 K</u>

I End Caps - Electromagnetic Calorimeter Criteria

(a) 21% in thickness, subtends $\sim 45^\circ$ cone

(b) 4 longitudinal segments
of glass + a Pb or W pre-converter

1% Pb
2% SCGT-C
2% SCGT-C
6% SCGT-C
14% SCGT-C

(c) Assume 8cm interstitial distance. This leads to the z structure given below

z

120 $\rightarrow$ 128 cm
128 $\rightarrow$ 136.7 cm
136.7 $\rightarrow$ 144.7 cm
144.7 $\rightarrow$ 153.4 cm
153.4 $\rightarrow$ 161.4 cm
161.4 $\rightarrow$ 177.5 cm
177.5 $\rightarrow$ 195.5 cm
195.5 $\rightarrow$ 254.4 cm

1% Pb / 1st End cap chamber / Spacelayer end cap/c
2% SCGT-C
2nd End cap chamber
2% SCGT-C
3rd End cap chamber
6% SCGT-C
4th End cap chamber
14% SCGT-C

(d) Largest transverse dimension of a segment is 15cm
Smallest reasonable dimension of a segment is 6cm

(e) Chambers are planar. Desirable to have no trapped chambers

End Cap Summary (per end cap)

<u>Glass</u>		<u># Pieces</u>	<u>Weight</u>	<u>Cost</u>
Layer	I	612	6371 lbs	76 K
Layer	II	492	5664 lbs	79 K
Layer	III	336	13552 lbs	170 K
Layer	IV	288	28948 lbs	351 K
		<u>1724</u>	<u>42555 lbs</u>	<u>686 K</u>
			21.3 tons	

Gas tube Chambers (.7cm/tube)

	<u>Wires</u>	<u>Strips</u>	<u>Total Channels</u>
End Cap Chamber 1	520	520	1040
End Cap Chamber 2	485	485	970
End Cap Chamber 3	460	460	920
End Cap Chamber 4	420	420	840
			<u>3670</u>

Estimated Total Cost/end cap

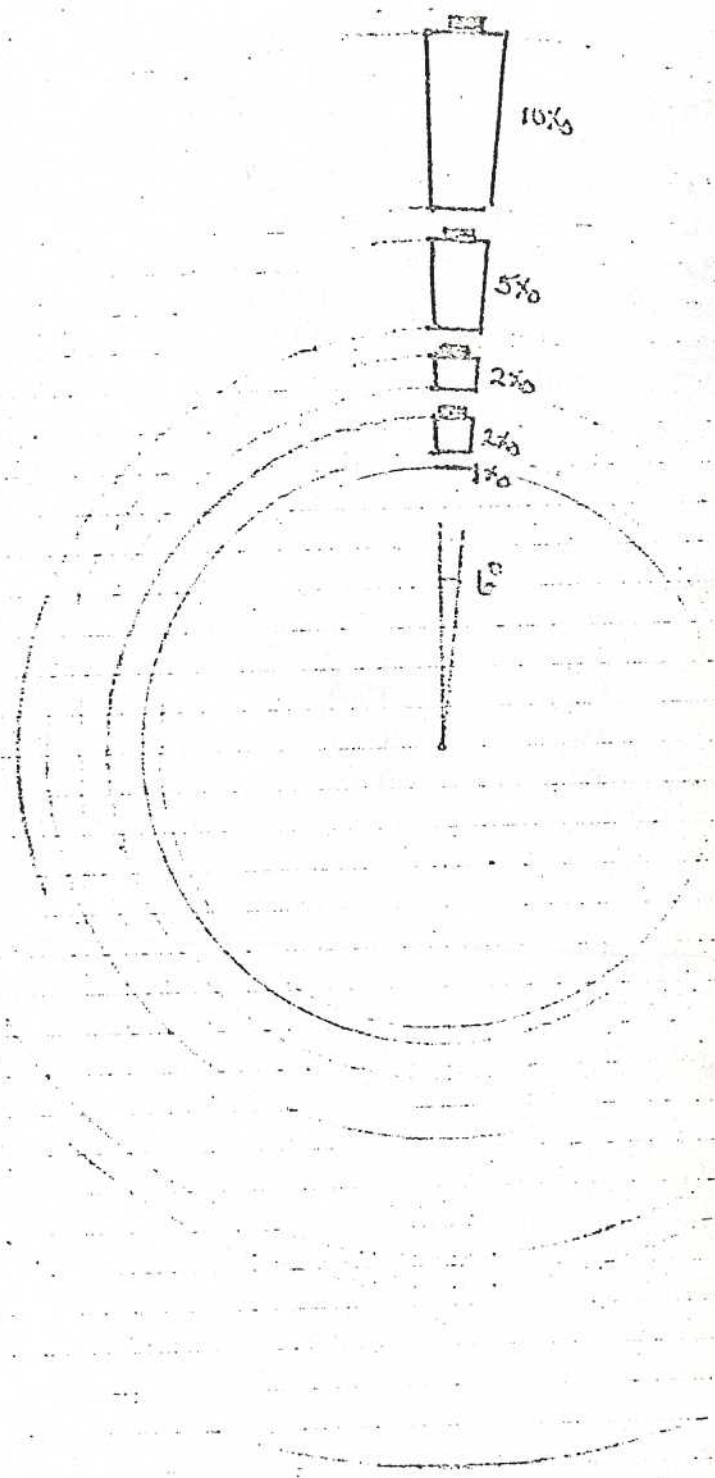
Glass - 686 K
PM's - 207 K
Supports - 75 K
Tube Chambers - 50 K
PM cables - 35 K
Tube Chamber Cables - 75 K
PM Bases - 40 K
1168 K

PM ADC's 69 K
Tube ADC's 110 K
1347 K

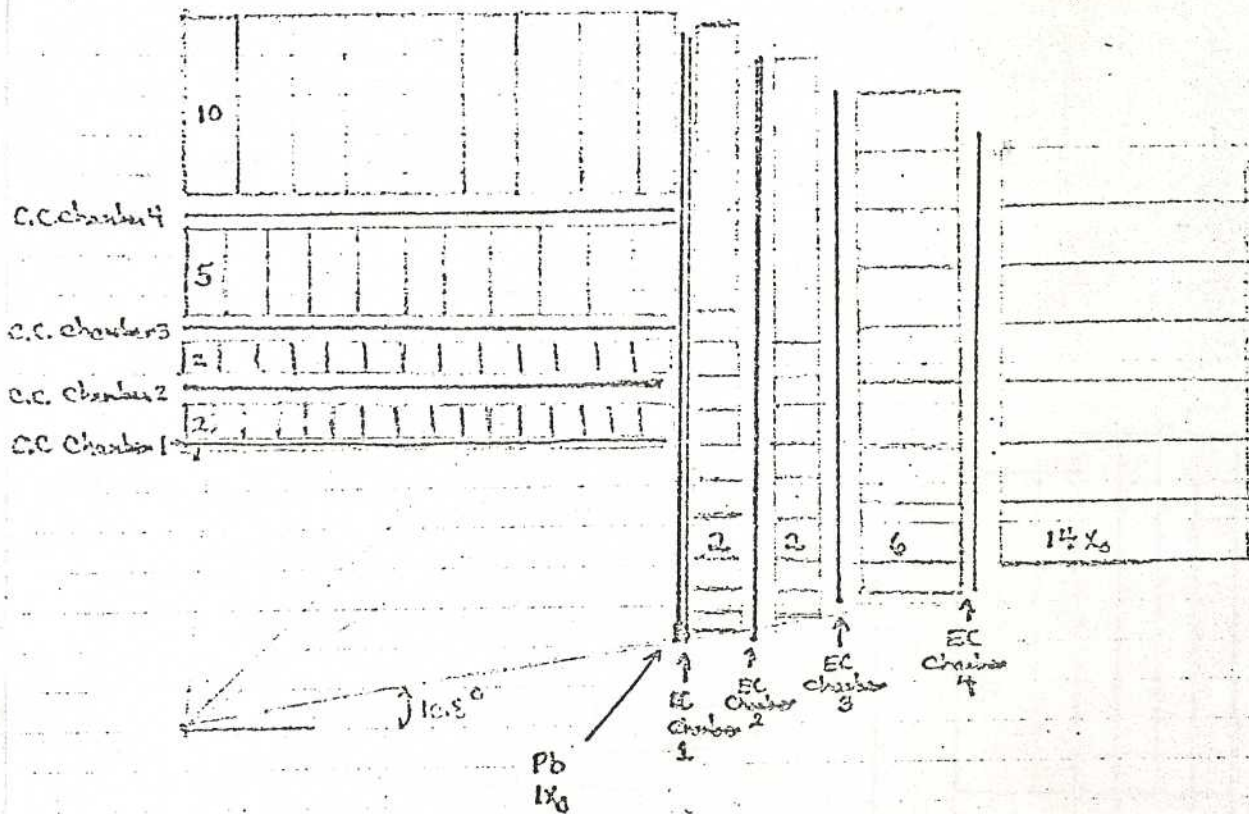
Grand Total Entire E.M. Chamber

Central Electromagnetic
End Caps (2)

3196 K
2694 K
5890 K



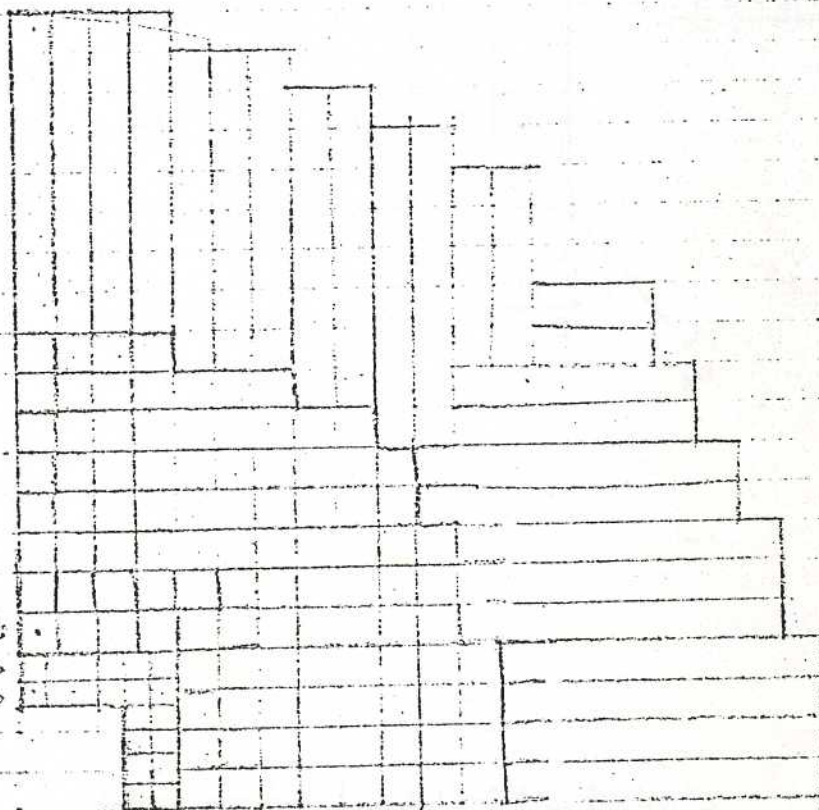
Central Electromagnetic Detector
End View



Central and End Cap Electromagnet

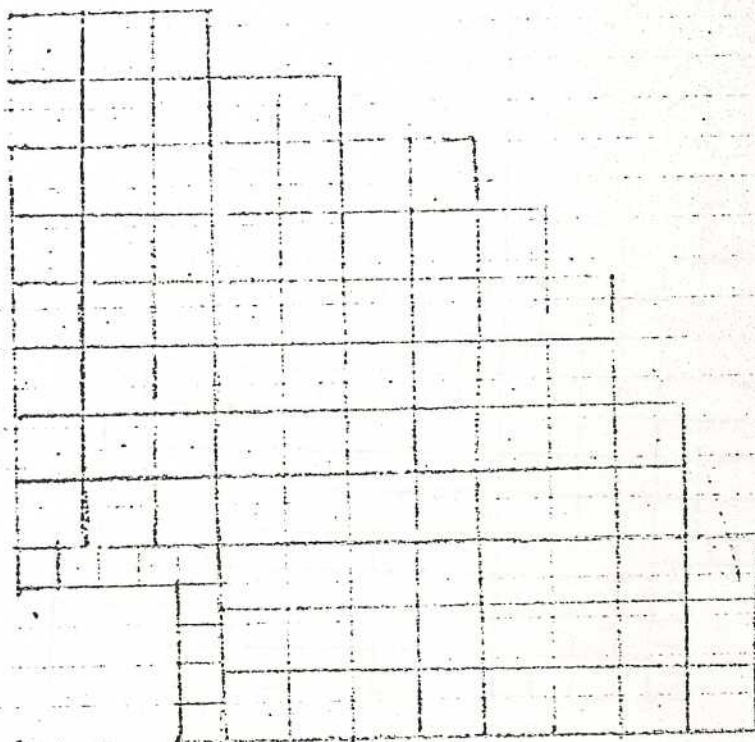
Top View

Δη
15 →
19 →
21 →



Layer II

# of Pieces/qty	Size	Volume	Weight/ea	Price/ea
20	6cm x 6cm x 8.7cm	313 cm ³	2.3 lbs	\$24
107	9cm x 9cm x 8.7cm	705 cm ³	5.2 lbs	\$75
20	12cm x 9cm x 8.7cm	938 cm ³	11.7 lbs	\$520
2	13cm x 9cm x 8.7cm	4933 cm ³	3.5 lbs	\$470
2	45cm x 9cm x 8.7cm	3525 cm ³	26.1 lbs	\$360
2	27cm x 9cm x 8.7cm	2114 cm ³	15.6 lbs	\$220
<u>153</u>				
x 4				
612				



Layer III

Piece/row

9
75
84
X 4
336

Pieces

26cm x 9 x 9cm
26cm x 15cm x 15cm

Volume/cu

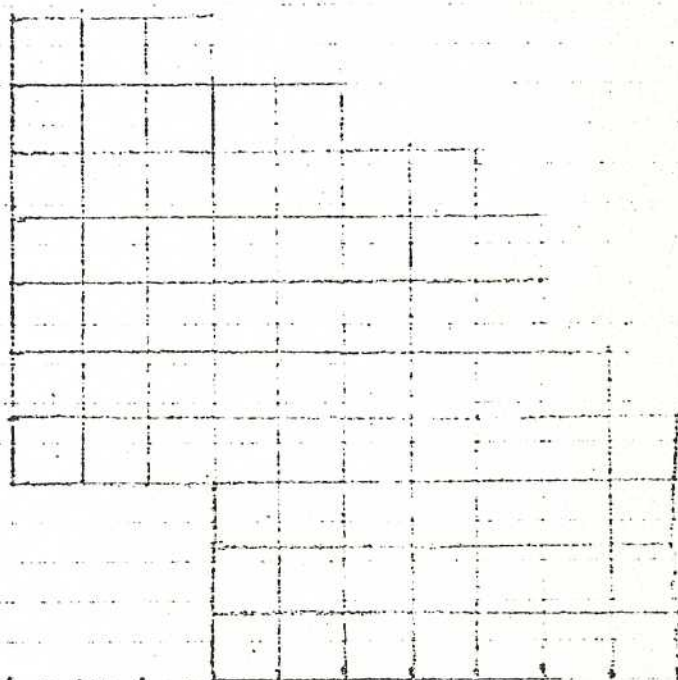
2106 cm³
5850 cm³

Weight/lbs

15.6 lbs
43.3 lbs

Price/cu

\$232
\$540



Layer IV

Recess/col	Size	Volume/ea	Weight/ea	Price/ea
71	15cm X 15cm X 6cm	13725 cc	102 lbs	1285.
<u>X 24</u>				
284				