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ISABELLE Project

Technical Note No. 337

Interim Cable Dipole Coil Design

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The dipole coil cross section has been redesigned to take into account the smaller average thickness per turn, $\langle t \rangle$, for the cable currently being supplied by New England Electric. The value of $\langle t \rangle$ at 10 000 psi compression is now 55.0 mils as compared to the 57.4 mils in the original surplus Fermilab cable. This has required a readjustment of the original cable magnet design.[1] However, in order to make use of existing material, the centerpost design remains unchanged. It should be satisfactory to use this design until all the manufacturing systematics are understood, at which point a final design iteration may be necessary.

The interim design is given in Table I and Figure 1. Four additional turns have been added giving a total of 105 per quadrant and yielding a transfer function, warm with infinite permeability yoke, of

$$B/I = 15.64 \text{ G/A}.$$

Table I. Dipole Magnet Coil Blocks ($\langle t \rangle$ = 55 mils, r_{Fe} = 8.655 cm)

Layer	Block	Turns	ϕ_{start}	ϕ_{end}	$\Delta\phi$	r_i(cm)	$\bar{r}$	r_o(cm)
Inner	2	62	0.04°	71.37°	71.33	6.566	6.957	7.348
Inner	1	4	75.99	80.59	4.60	6.566		7.348
Outer	2	28	0.04	28.81	28.77	7.399	7.790	8.181
Outer	1	11	34.46	45.76	11.30	7.399		8.181

The multipoles generated by this configuration are given in Table II. The primed multipoles are defined as

$$b'_n = b_n (4.4 \text{ cm})^n$$

and are dimensionless quantities. All the multipoles are well within the allowed systematic tolerances except b_6, which is approximately one tolerance. The overall field is nonetheless quite good with

$$\frac{\Delta B}{B} \leq 0.3 \times 10^{-4}$$

and

$$\left[\sum_{6}^{\infty} (b_n r^n)^2\right]^{1/2} \leq 0.9 \times 10^{-4}$$

over the 4.4 cm warm bore aperture, assuming b_2 and b_4 trim coils.

1. R.B. Palmer, Report TLM-22 (1981).

Table II. Design Multipoles ($\langle t \rangle$ = 55 mils)

n	$b_n [10^{(n+4)} cm^n]$	Tolerance	$b'_n \times 10^4$	Tol
2	-89	0.35[a]	-17.0	
4	175	4.3 [a]	6.4	
6	64	64	0.4	.46
8	-375	1010	-0.5	1.4
10	1190 x 10^{-14}	16800	0.3	4.6
12	-10500 x 10^{-16}	285000	-0.5	15

[a] trim coil available.

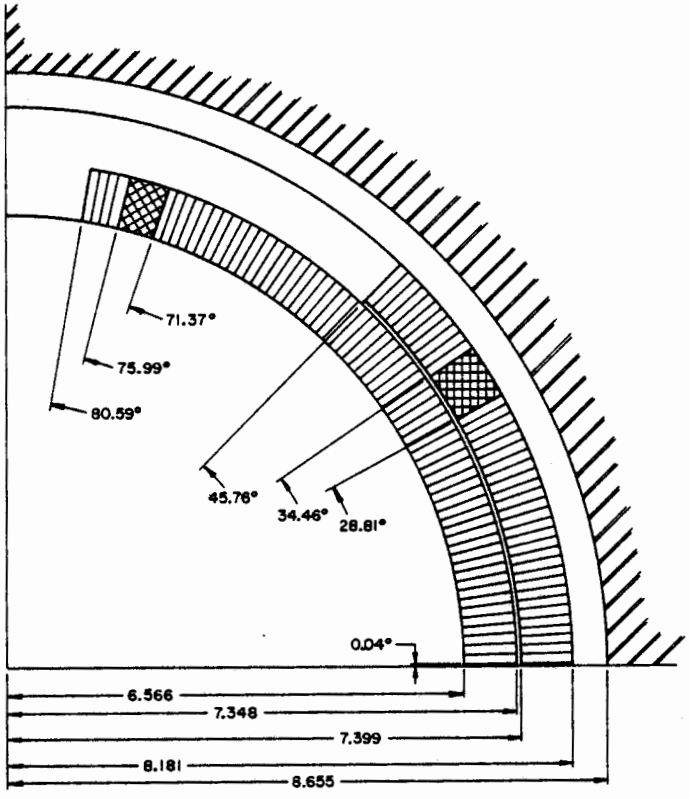

Fig. 1. Coil cross section

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