FN-88
2200

SOME COMMENTS ABOUT BEAM-TRANSPORT MAGNETS

M. H. Blewett

September 22, 1967

A very rough summary of the power required for experimental beams being considered for the 200-BeV accelerator, using the magnets listed in Table XIII-1 of the Blue Book, gave figures that seemed to be on the high side.

From a cursory examination of the rough design of these magnets given in Keefe's article (Yellow Book Vol. II, p. 16), it would appear that they have been designed for minimum size, rather than minimum power, and this may be important in some cases. Smaller size may result in lower initial cost of the magnets, themselves, but total costs including power supplies, initial power installation and operating costs, would probably be higher. Further details on the space needed for them would be required to show if this is at a premium.

Some comparisons with existing magnets at CERN (where power costs are high) and at the Argonne ZGS show that, on the average, the power requirements for all CERN magnets of approximately similar apertures and for ANL bending magnets, are about half, or less, those given in the Blue Book; ANL quadrupoles are similar in power needs. However, the weights of the CERN and ANL bending magnets are from 2 to 3 times those in the B.B.; quads are more alike. It should be kept

in mind that the weights given for actual magnets may be larger than the B.B. designs since they include some auxiliary equipment and are not just bare copper and iron weights. Some typical examples are given.

Bending Magnets	Blue Book	CERN	ANL
Aperture	4" × 12"	5.6" × 17"	6" × 15"
Length	80"	2 m	72"
Max. Field	20 kG	18 kG (can be shimmed to 4.4" for over 20 kG)	18 kG
Power	500 kW	140 kW	265 kW
Weight	(H) 8; (C) 13 ton	30 ton	35 ton
Cost	k$ 15.5 - 20 (est.)	k$ 32 (actual)	k$ 46 (actual)
Cost of Power Supply	k$ 26 (est.)	k$ 10 (actual)	k$ 20 (actual)
Cost of Mag. + P.S.	k$ 41.5 - 46 (est.)	k$ 42 (actual)	(see note)

(Note: If the ANL magnet were 4" high, power would be 180-200 kW. The cost and weight of the magnet would be less; total of magnet and P.S. might be about k$ 55)

Bending Magnets	Blue Book	ANL
Aperture	8" x 16"	8" x 24"
Length	80"	72"
Max. Field	20 kG	18 kG
Power	750 kW	285 kW
Weight	(H) 15; (C) 26 t	51 t
Cost	k$ 27 35	k$ 56
Cost of P.S.	k$ 39	k$ 20
Cost of Mag. + P.S.	k$ 66 - 74 (est.)	k$ 76 (actual)

Quadrupoles	Blue Book	CERN	ANL
Bore Diameter	8" = 20 cm	20 cm	10" = 25 cm
Length	60" & 120"	2 m = 80"	72"
Poletip field	11 kG	10 kG	12.7 kG
Power	180 & 360 kW (80" ~ 240 kW)	115 kW	284 kW
Weight	11t & 20 t	9 t	20 t
Cost	k$ 23.5 & 36 (est.)	k$ 16 (act.)	k$ 40 (act.)
Cost of P.S.	10 & 19	10	20
Cost of Mag. + P.S.	k$ 33.5 & 55 (est.)	k$ 26 (act.)	k$ 60 (act.)

The Blue Book also lists special high-power quadrupoles where the iron has been removed from the region of the median plane and the coils act like septa; these designs are fairly similar to the CERN "Figure of 8" quadrupoles. The latter have been made only in lengths of 0.75 m but comparative figures are given below.

	B.B. HP Quads	CERN Fig. of 8 Quads
Bore diameter	8" = 20 cm	20 cm
Length	120 "	0.75 m = 30"
Poletip field	11 kG	10 kG
Power	750 kW	125 kW (120" ~ 500 kW)
Weight	4 t	2.2 t
Cost	k$ 15 (est.)	k$ 8.3 (act.)
Cost of P.S.	39 (est.)	10 (act.)

The cost of the CERN Fig. of 8 Quads is not very different from the cost of similar length standard quads. A 3-meter length standard quad was estimated to cost about k$ 25. With a P.S. of about 500 kW, that might cost about k$ 26, the total cost for magnet and P.S. would be about k$ 51 compared with the B.B. cost of k$ 54.