REDUCTION OF BEAM LINE POWER

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September 11, 1967

Lach Beam

1. The first 80 ft. of the beam has bending magnets with these apertures 8" × 14", 8" × 36", 8" × 36", 8" × 36", 6" × 55", 8" × 14", 8" × 14"; then follows two 4" × 12" magnets.

   The maximum vertical excursion of the beam is 4.3 cm. The beam exceeds 4.0 cm excursion for only 8 m of its length, 3.0 cm for 32 m and 2.5 cm for 70 m.

   Comment

   (a) No magnet need exceed 4" vertical aperture

   (b) The use of septum magnets at the front end will reduce the horizontal apertures needed downstream

2. Quadrupoles of 4" × 8" and 12" diameter are used in the design. In the ECFA 70-150 GeV/c design (g2-98) maximum size quadrupole is 4" and one half the number of elements are used.

   Comment

   The use of thin septum magnets at the front of the beam followed by small aperture quadrupoles (~2") as soon as the beam is separated from EPB would reduce the size of all elements. In Lach's design the initial set of quadrupoles define the size of the beam.

Neutrino Beams

4" × 60" quadrupoles have been used in the design and in the power estimate. No reduction in aperture is practical. Toohig mentions that 30" long quadrupoles would be adequate rather than 60", but the effect on neutrino flux is not given.

Manning Beam

The power consumption is in the spectrometer magnets; large bending angles are required for this type of experiment. The apertures of the magnets are 4" × 8" and for the spectrometers 4" × 40".

Wilson (G 11 - 256)

Using a peak pole tip field of 10 kG Wilson concludes that at 100 GeV/c the desirable aperture is a doublet or triplet is 10 cm. This aperture is based on maximum intensity for acceptance--not a requirement, surely, in every situation.

Target Station B

Most of the bending is done at the front end yet this consumes only 5 MW compared with 30 MW for the beam lines. Clearly the beams need redesigning. In Longo's beam, (Y1-137) the first doublet has 2" diameter acceptance and a $3\ 10^{-6}$ ster solid angle. Maschke's doublet has a similar solid angle, but a 1" diameter. The limitary apertures in a well-designed beam are at the first lens. Consequently all apertures in Longo-beams A2 and B-2, B-3, B-4 can be reduced by a factor of two.

Low Momentum Beams

These beams do not use a lot of power.

Conclusion

I believe a factor ≥ 2 reduction in power consumption is possible by redesign of beams. A useful starting place--would be to design a Longo beam using Maschke quadrupoles at the front using TRAMP.