USE OF THE 3.5-MRAD BEAM FOR ELECTRONS

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ABSTRACT

The high-intensity beam of Area 2 is considered for use as an electron beam. It is pointed out that the first septum magnet can be used for sweeping out the charged particles. The beam transport then starts with the second septum magnet which just follows the photon-electron converter. Expected beam intensities are given.

The 3.5-mrad beam, because of its large momentum acceptance, has been discussed as a possible beam for electrons.[1] To have a clean electron beam, it is essential that the photons from π^o's, produced in the target, pass through a magnetic sweeping field before being converted into electrons. With such a scheme Diebold and Hand[2] have estimated that the π^- contamination of the beam can be reduced below 0.1%.

The geometrical constraints at the front end of the 3.5-mrad beam, shown schematically in Fig. 1, make it difficult to introduce such a sweeping field. The sweeping magnet must be introduced before the first element of the beam transport. The photons are converted to electrons after the sweeping region, and these are transported in the normal way. Unfortunately, there is no space for such a magnet before the first septum.

We consider the possibility of placing the converter between the first and second septum magnets. In this case the beam transport starts with the second magnet and the first can be used for sweeping purposes. The photons are taken from the target at 4.2 mrad in this case as defined by the position of the second septum magnet. The bending angle of the second septum which is normally supposed to be 2.75 mrad must now be increased to 6.25 mrad. This bending angle will only be needed for particles up to 130 GeV/c since the flux of electrons is probably too low above this energy to be very useful. The magnet then needs a maximum field integral of 27 kG-meters.

We next consider the displacement of the charged particles swept by the first septum at the entrance to the first quadrupole. Particles of momentum 130 GeV/c are deflected 4.2 mrad × 200 GeV/c/130 GeV/c with the first septum at full power since it can deflect 200-GeV/c particles at 4.2 mrad. Projected to the first quadrupole this is a displacement of 3.6 in. which is more than twice the useful horizontal aperture of the quad ~1.5 in. A collimator at the entrance to this quad would effectively eliminate the swept particles.

We note that the sweeping is not sufficient to prevent the protons in the beam from striking the converter and thus adding to the beam contamination. This will increase the contamination by only a factor of two since the proton flux is roughly equal to the neutron flux which is unavoidable in any case.

In Fig. 2 we show estimates of the electron flux transported by the beam for several conditions. The curve labeled #2 is estimated in the same way as described by Diebold and Hand[2] but using the more realistic acceptance of 2 μsr. For comparison, we also show the Diebold and Hand estimates with curve #1. We note that if the angular distribution $e^{-p\theta/0.200\text{ GeV}}$ is assumed, as suggested by Cocconi,[2] instead of the Hagedorn-Ranft angular distribution,[3] the size of the production angle becomes very important. This is illustrated by the curve labeled #3. In this case, the ability to change the incident proton angle will be important. For comparison, we show the flux expected for production at 1.3 mrad according to the Cocconi prescription with the curve labeled #4. We also note that nearly a factor of two in flux can be gained at the lower energies at the expense of more beam contamination by relaxing the collimation at the intermediate focus since Diebold and Hand[1] assume a 55% transmission at 40 GeV.

In conclusion we indicate the measures that need to be taken to obtain the electron beam:

1. Low Z target
2. Hole through the dump at 4.2 mrad as well as the normal 3.5 mrad
3. Remotely controlled mechanism to insert the radiator between the first and second septum magnets
4. Second septum capable of bending 130-GeV/c particles at 6.25 mrad
5. Independent powering of the three septum magnets.

REFERENCES

[1] R. Diebold and L. Hand, Electron-Photon Beam at NAL, National Accelerator Laboratory 1969 Summer Study Report SS-49, Vol. I, p. 153.

[2] G. Cocconi, Empirical Estimate of Secondary Fluxes Produced by 200-GeV Protons, National Accelerator Laboratory 1969 Summer Study Report SS-61, Vol. I, p. 397.

[3] M. Awschalom and T. O. White, Secondary Particle Production at 200 GeV, National Accelerator Laboratory Report FN-191, June 9, 1969.

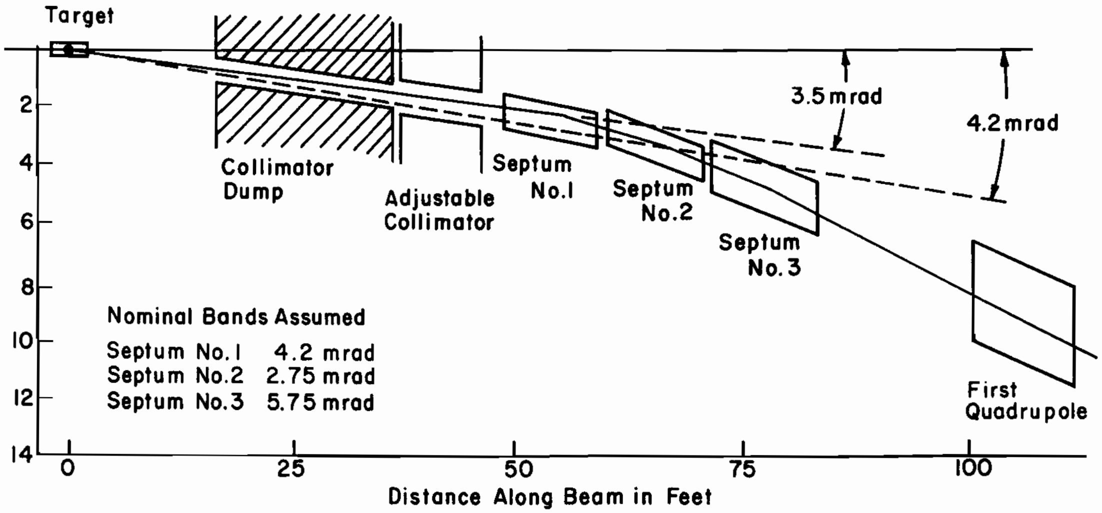

Fig. 1. Sketch of front end of 3.5-mrad beam.

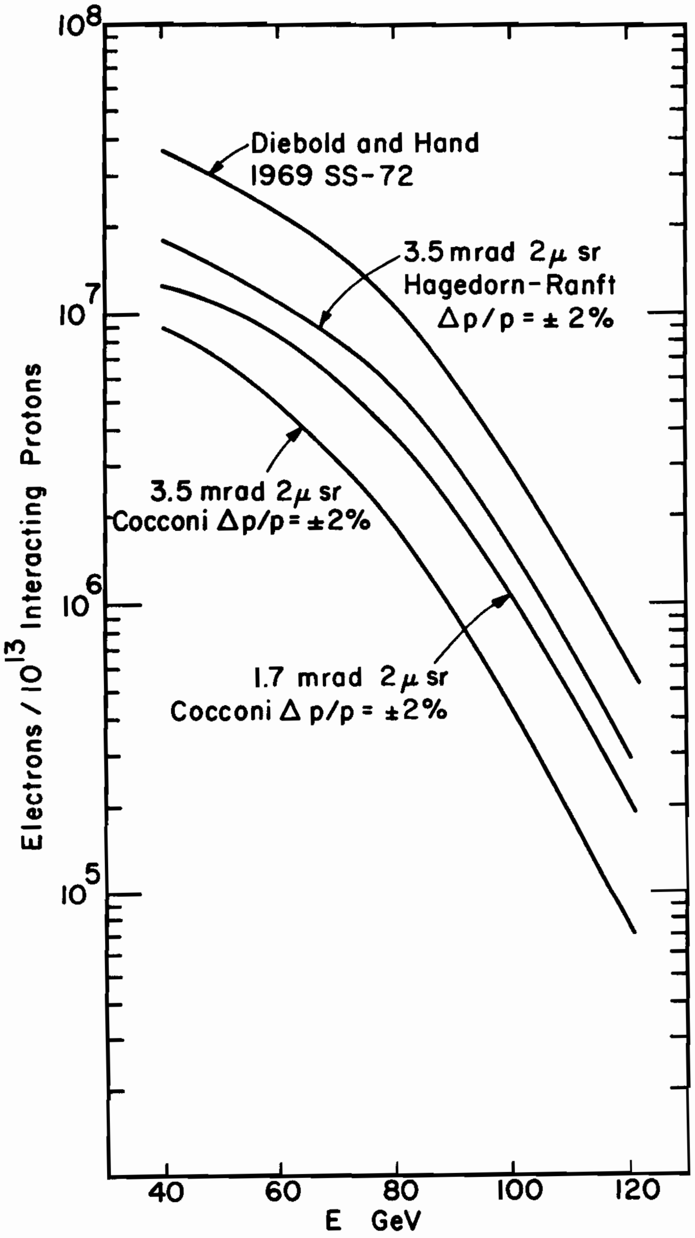

Fig. 2. Estimates of electron yields.