Accelerator Department
Brookhaven National Laboratory
Associated Universities, Inc.
Upton, L.I., N.Y.

EP&S DIVISION TECHNICAL NOTE

No. 67

W.J. Willis
August 22, 1973

IDEAS FOR A NEW LOW ENERGY SEPARATED BEAM

David Berley inspired me to think about a high intensity beam. I will set down here some ideas which might be studied in detail.

The effectiveness of an optical element in a plane containing the axis is proportional to the area of beam it occupies, which suggests that if a very short beam is needed, the transverse dimensions of the beam in the electrostatic deflector should be larger. On the other hand, the amount of horizontal bend needed for momentum selection in such a beam is rather easy to obtain, which suggests that this operation should be carried out near foci.

The use of edge focusing from bending can be very effective in keeping the overall length short in these circumstances, and one should take full use of it. A sketch of a beam laid out on these principles is shown in Fig. 1. Fig. 2 shows the kinds of trajectories which I would try to realize in a detailed design. Note the smooth trajectory in the vertical to minimize chromatism.

A production angle of 6° does not sacrifice much flux, and helps get the beam away from the primary direction. Another 20° of bend results from the first bending magnet with a vertically focusing exit edge. There follows an electrostatic deflection in the vertical plane. A large quadrupole doublet follows, with a small vertical bend magnet in between the two focusing elements. Next, there is another vertical electrostatic deflection and the beam enters a bending magnet through a vertically focusing edge. The double focus and mass slit are at the end of this magnet, with the beam at an angle of 46° to the proton beam. The exit face of this magnet acts as a field lens, focusing in the horizontal plane.

I would follow the mass slit by a large magnet with a substantial deflection, around 60°. By edge focusing and gradients, this magnet would produce a focus near its downstream edge. The pole pieces for this magnet could be changed to alter the chara cteristics of this focus according to the needs of the experiment. This magnet, rather than the first stage, provides fine momentum resolution.

I believe such a beam, with a maximum momentum of 800 MeV/c, could be 6 - 7 m long with a very large solid angle ($\sim$ 20 msr.).

One problem in building this beam, is that the gap in the electrostatic separator will probably want to be $\sim$ 25 cm. Since one wants to obtain the $\sim$ 40 kv/cm gradients we are used to with 10 cm gaps, the difficult technology of handling voltages of $\sim \pm \frac{1}{2}$ MV would seem to be required. To avoid this, I would suggest that an electrode on the median plane be introduced, fixed at one polarity with the top and bottom plates at the opposite polarity. One has then to avoid high fields at the ends of this electrode without blocking beam particles. This might be done with a very thin-walled tube of low-Z material (Be) through which the particles may pass as shown in Fig. 3. The vertical deflection magnet must then have a current septum in the median plane, but no particles need strike this since the electrostatic deflection effectively shields it.

Distribution: B1 Limited

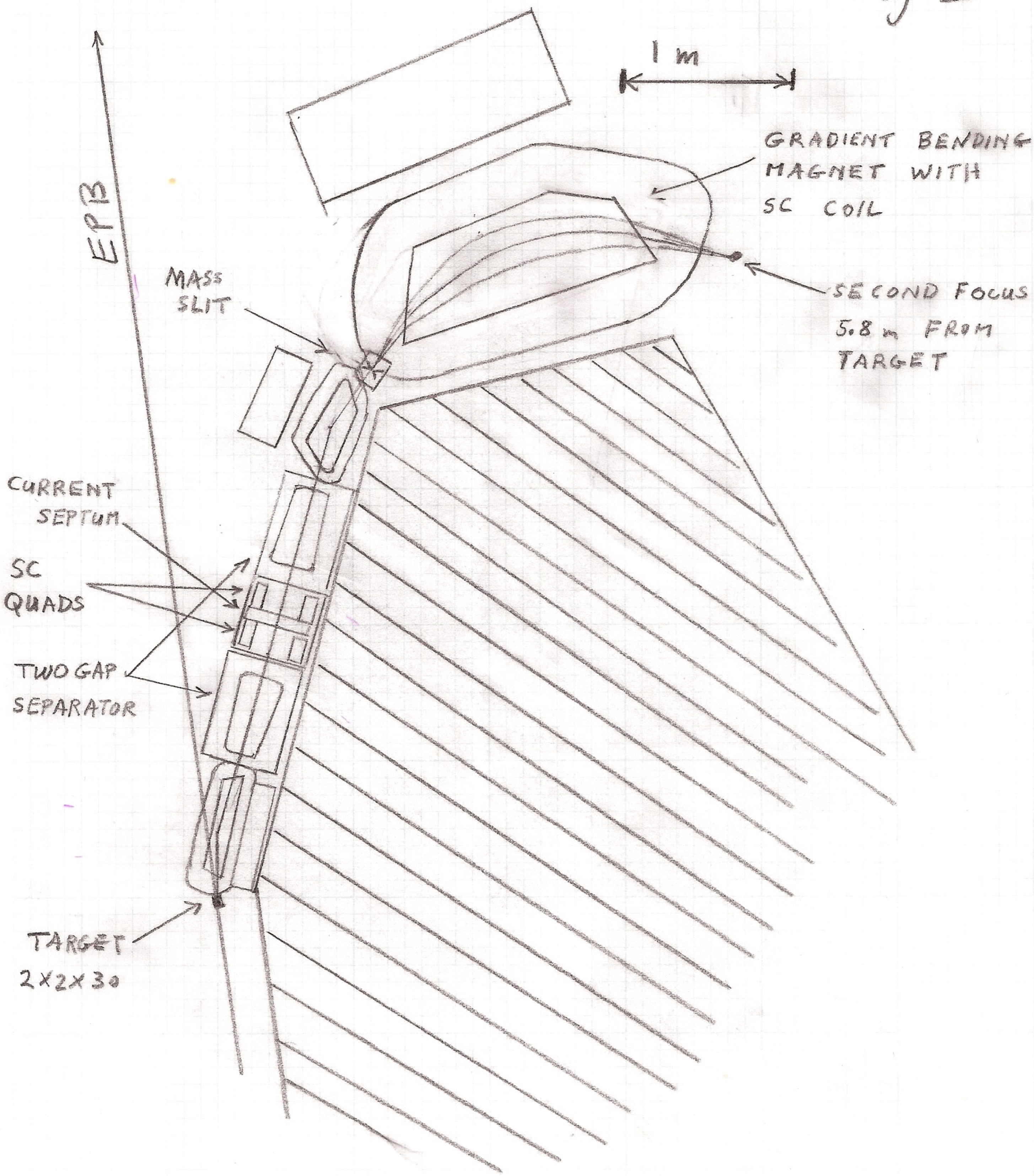
BROOKHAVEN NATIONAL LABORATORY

BY_______________DATE________ SUBJECT_______________________________________ SHEET No.______OF_______

CHKD. BY_______DATE_______ _______________________________________ JOB No.___________________

_______________________________ DEPT. OR PROJECT___________________________ ___________________________

Fig 1



SP 11037A

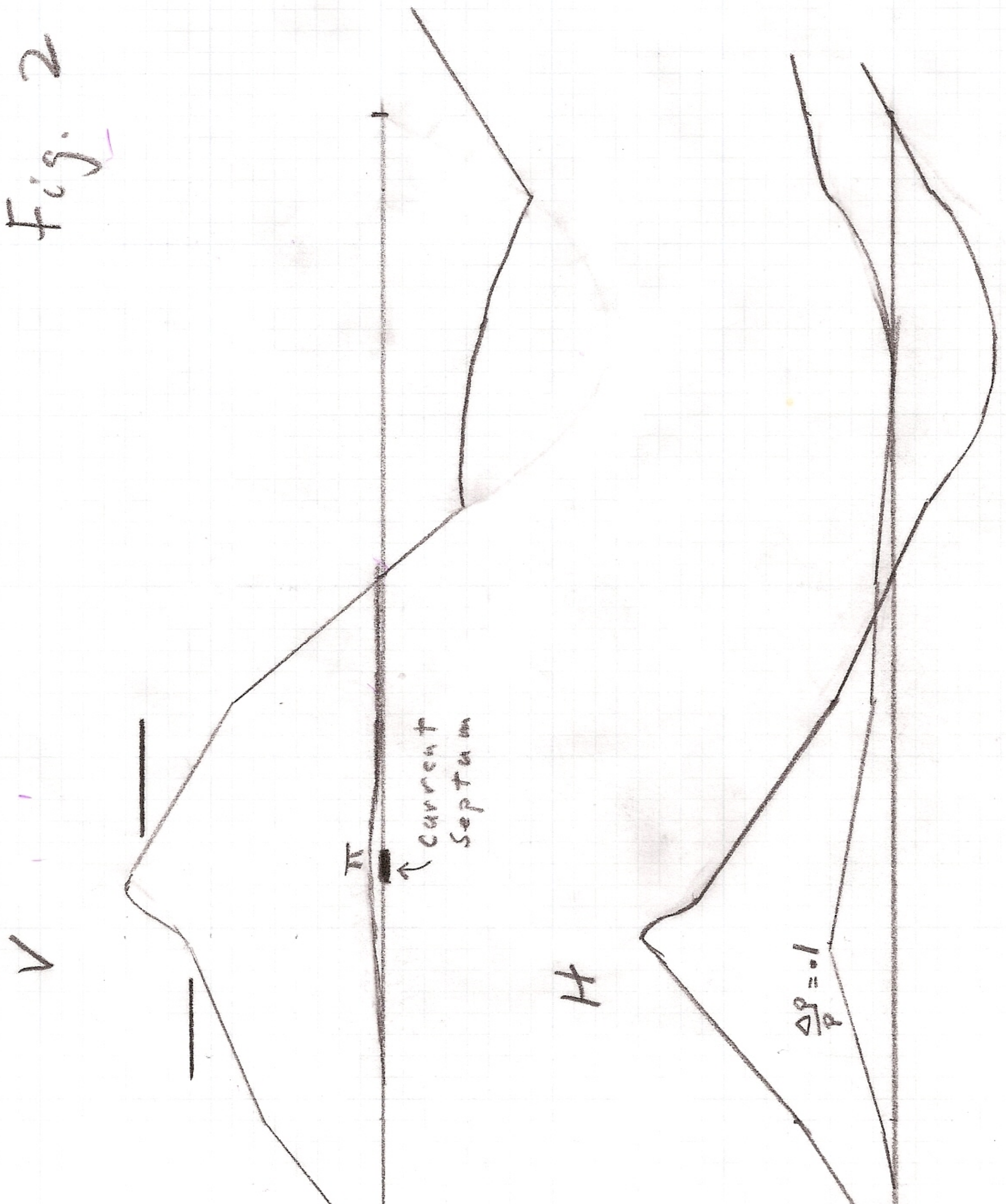


Fig. 2

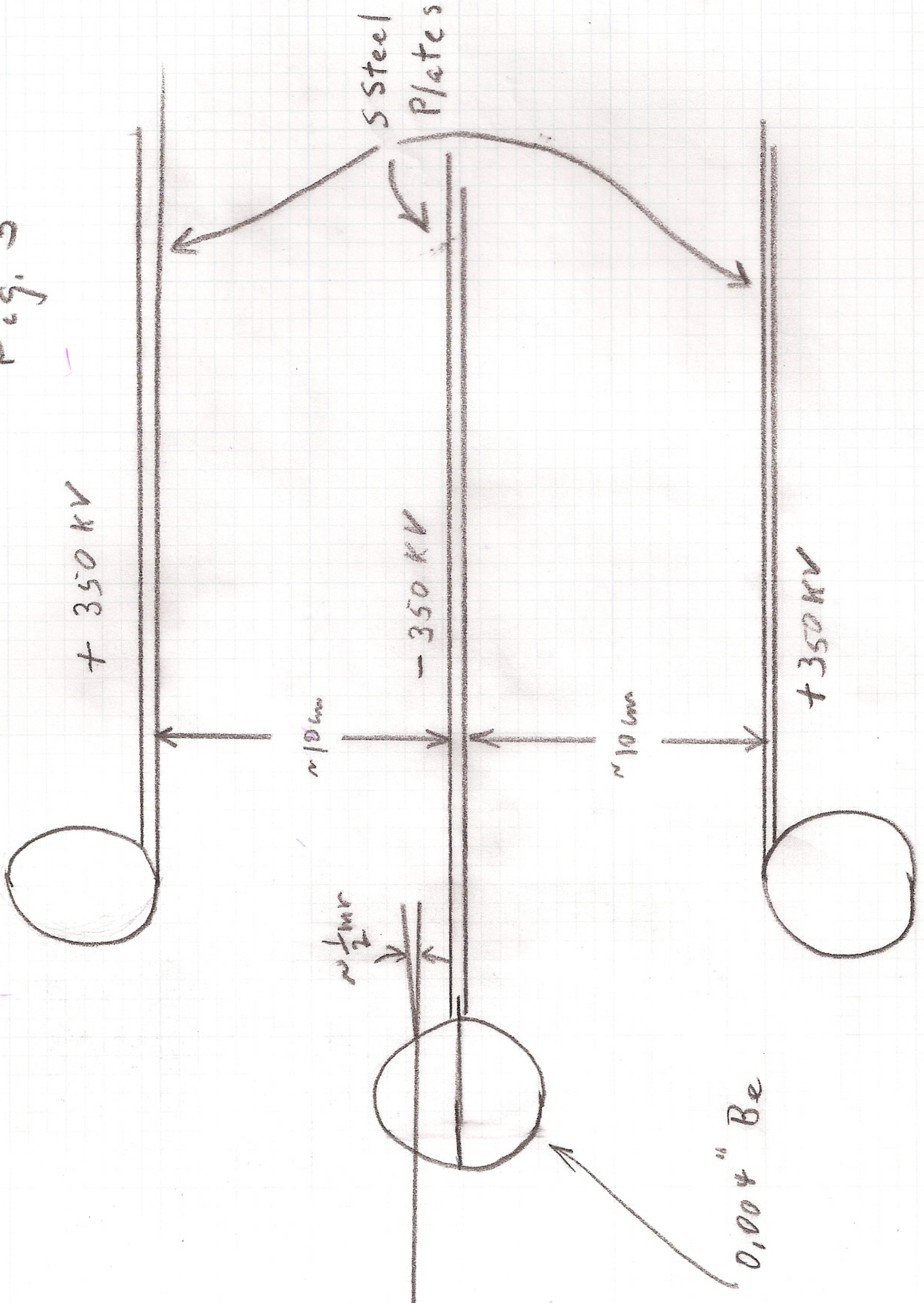
BROOKHAVEN NATIONAL LABORATORY

BY________ DATE________ SUBJECT________ SHEET No.____ OF____

CHKD. BY________ DATE________ ________ JOB No.________

________ DEPT. OR PROJECT________ ________

Fig. 3



SP 11037A