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D-Line study

H. N. Brown

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H. Brown, G. Bunce, J.W. Glenn, S. Naase

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D-LINE STUDY

On 31 March and 27 April 1981, we extracted beam to the D line, testing the extraction system and the beam size in preparation for construction of the downstream section of the line. Following the D line from extraction from the AGS[1],

(1) The electrostatic splitter AB1 splits DA from BC, in the horizontal plane.

(2) The electrostatic splitter DB2 splits D from A in the horizontal plane. It was installed for the D line and is not used for ABC running.

(3) The thin Lambertson AP1 kicks D and A upward 8 milliradians.

(4) The thin Lambertson CP1 kicks ABC down 5.9 milliradians.

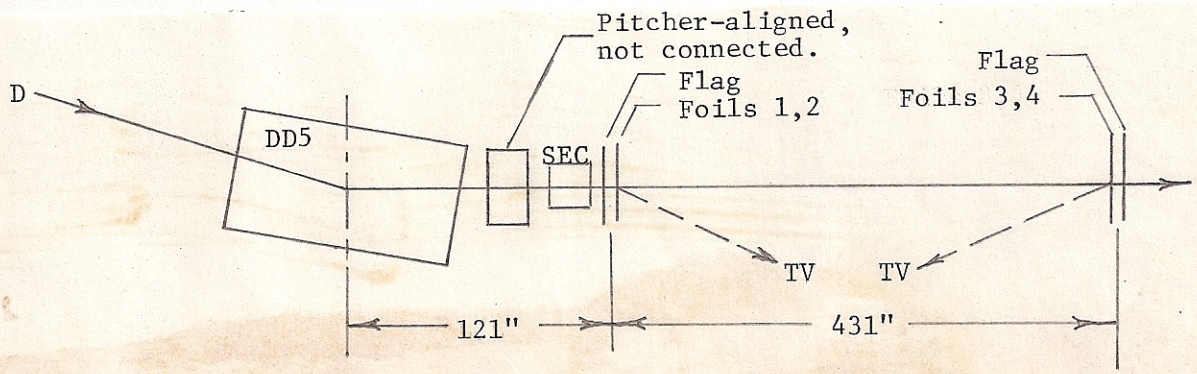
At this point, a flag at CF100 displayed the four separated beam spots.

(5) Two thick Lambertsons, AD2 and AD3, further separated A and D from BC horizontally.

A flag after AD3 displayed the A and D beam spots.

(6) Two thick Lambertsons, DD4 and DD5, further separate D from A horizontally.

DD5 was followed by a secondary emission chamber (SEC) and a scintillation flag viewed by a TV camera (in the March test, these were only roughly aligned). In April, a second flag was added 431" downstream from the first, in order to observe the beam growth, and four foils were exposed, two at each flag, to measure the beam size:



The SEC monitored both halo (beam outside a 2" diameter hole) and total beam, about 10^{12} ppp. First we scanned the beam horizontally to check the halo/total beam response of the SEC and to roughly center the beam horizontally. In this position, without optimization, we observed halo/total = 4%, after correcting for the different electronic sensitivity of the halo (50x). The four foils were mounted as shown in the diagram and were exposed to beam for 1.007 x 10^5 SEC counts.

Figure 1 shows film exposed to the upstream and downstream foils overnight. In both positions, the beam is tilted from the horizontal-36° upstream and 47° downstream with a few degree placement error. (The upstream film is observed looking upstream and the downstream film looking downstream.) The tilt is caused by second order horizontal magnetic fields seen by the protons in the thick Lambertsons which depend in magnitude and sign on the horizontal position of the protons. One of the purposes of the test was to determine whether or not correction by skew quadrupoles would be necessary for this tilt. It is.

The foils were cut into 1/2 cm wide strips along the major and minor axes of the ellipse over an area 3.5 cm x 6.5 cm. The activity of each strip was counted, following standard procedure, with the resulting histograms shown in Figure 2. A background strip, out of the beam region, was counted for each foil.

The observed beam size (FWHM) was

	Major Axis (x)	Minor Axis (y)
Upstream	1.5 cm	$\leq$ .8 cm
Downstream	2.5 cm	1 cm

with conservative errors of ± .3 cm. The expected full intensity beam size at the upstream position would be x = .74 cm and y = .62 cm, FWHM. Thus, this is consistent with observations in other beam lines that the AGS extracted beam is twice as large horizontally as expected and correct vertically.[3]

The downstream foil position corresponds roughly to the position of DD11 in the 20° bend string, to be constructed in D following the last Lambertson magnet. The 20° dipoles will be shimmed to apertures of 1-1/2". This test shows that, after rotation of the ellipse by a skew quad, there is adequate clearance.

By adding the activity measured for the strips, we checked the consistency of the foil measurements and calibrated the SEC. The number of protons seen by the foils was $1.13 \pm^{.06}_{.04} \times 10^{14}$, or 1.12×10^{9} protons per SEC count.

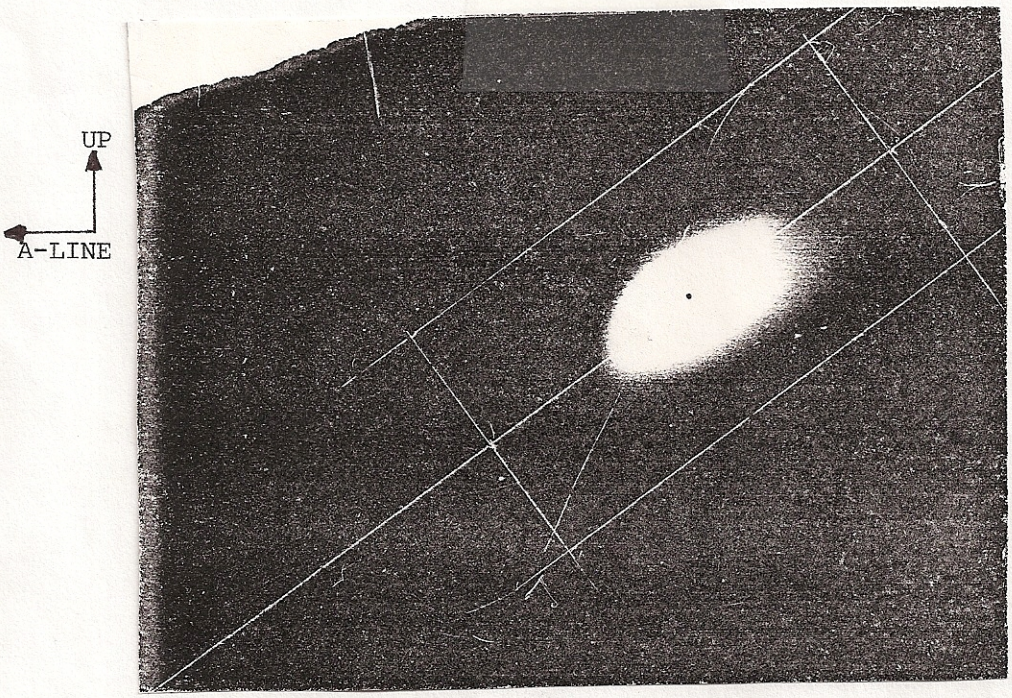
References

1. L. Blumberg, H. Brown, et al., "The AGS Slow External Beam Switchyard", BNL 24508R (1978).

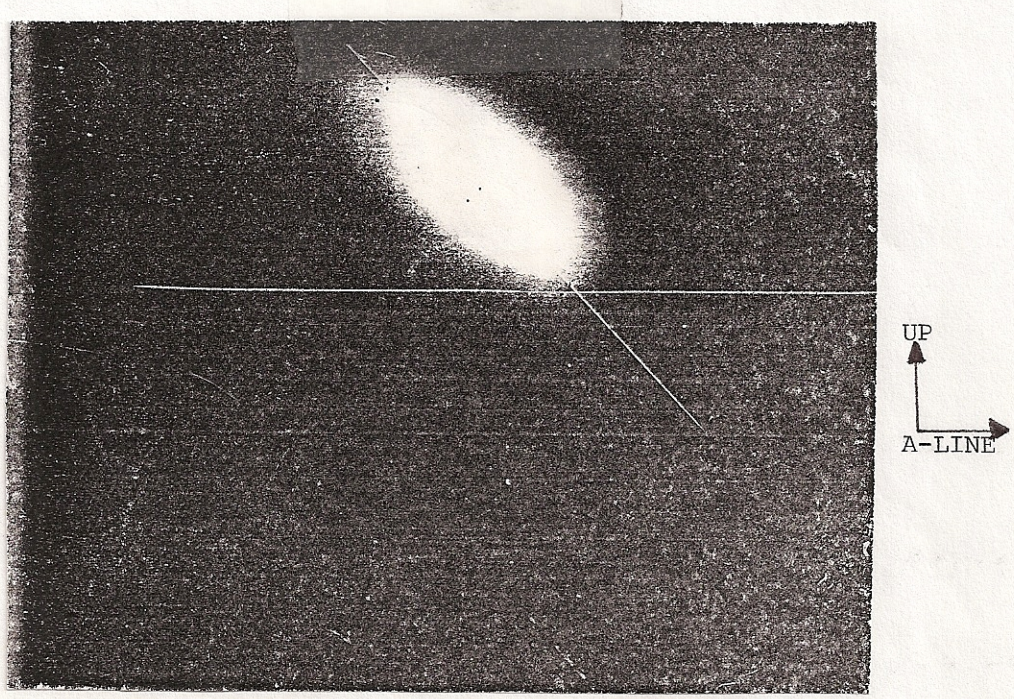
2. V. Agoritsas, "Measurements of High Energy Proton Fluxes Using Foil Activation Techniques", AGS Technical Note 135 (1977).

3. H. Weisberg, "More SEB Emittance Measurements", AGS Technical Note 168, (1981).

Figure 1. Film exposures to foil runs in the D Line. The outlined box indicates the area of the foil used for the activation measurements in the next figure.



Upstream position, looking upstream. The beam is tilted 36° from horizontal.



Downstream position, looking downstream. The beam is tilted 47° from horizontal.

Figure 2. Foil profiles. Schematics indicate position of 1/2 cm strips.