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Electrostatic Splitter Test in the C Line

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Date 3/21/79 Time 1330-1430 Experimenters J.W. Glenn and H. Weisberg

Subject Electrostatic Splitter Test in the C Line

OBSERVATIONS AND CONCLUSION

Purpose:

Since 1/9/79 a prototype electrostatic beam splitter has been undergoing reliability testing in the C line, centered at the 373 ft position. The parameters of the splitter are: wire diameter 0.002 in.; wire material 75% Tungsten, 25% Rhenium; wire spacing 0.05 in.; septum length 120 in.; spacing between wire septum and cathodes 1.2 in. (each side); operating voltage 90 kV; operating field 30 kV/cm. The splitter has had HV on almost continuously during normal accelerator operations, with the beam going mainly on one side of the septum. In this study the septum was moved to the middle of the beam for the following tests: effect of beam on leakage current and vacuum; operation of loss monitors; and skew curves with and without HV.

Results:

The splitter produced a clear shadow on the CF383 flag and two well-separated spots at the C target, as had been observed earlier (Figure 1). With a beam intensity of about 3×10^{12} protons per 1.0 sec spill, a change of septum current during the spill was just barely perceptible, and amounted to about 0.01 A. The vacuum readback was $3.0\text{-}3.5 \times 10^{-6}$ torr; it did not change when the beam was turned off for 30 sec.

Beam losses were monitored by ionization chamber loss monitors CL370 and CL378, located near the upstream and downstream ends of the splitter respectively. Figure 2 shows the loss monitor response vs septum skew for these two monitors. The upstream monitor responds only to general background, while the downstream one has a superimposed response to beam loss on the wire septum. When additional upstream losses were produced by inserting flags CF103 and CF204, both loss monitor responses increased considerably as shown. Both increased by about the same amount, suggesting that an electronic or software difference of the two signals would be a sensitive monitor of localized losses at the septum.

Figure 3 shows this difference for the two cases HV on and HV off. Figure 4 is the prediction of a numerical model.

The basic assumption of the model is that multiple Coulomb scattering is the dominant effect, so that most of the protons emerge from the wires without having undergone a strong interaction. The loss monitors respond to the rare protons which do interact; therefore the quantity plotted is the average pathlength in the wires per incident proton per unit beam width. A uniformly distributed beam divergence of 0.20 mrad full width is assumed.

The measurements agree with the model.

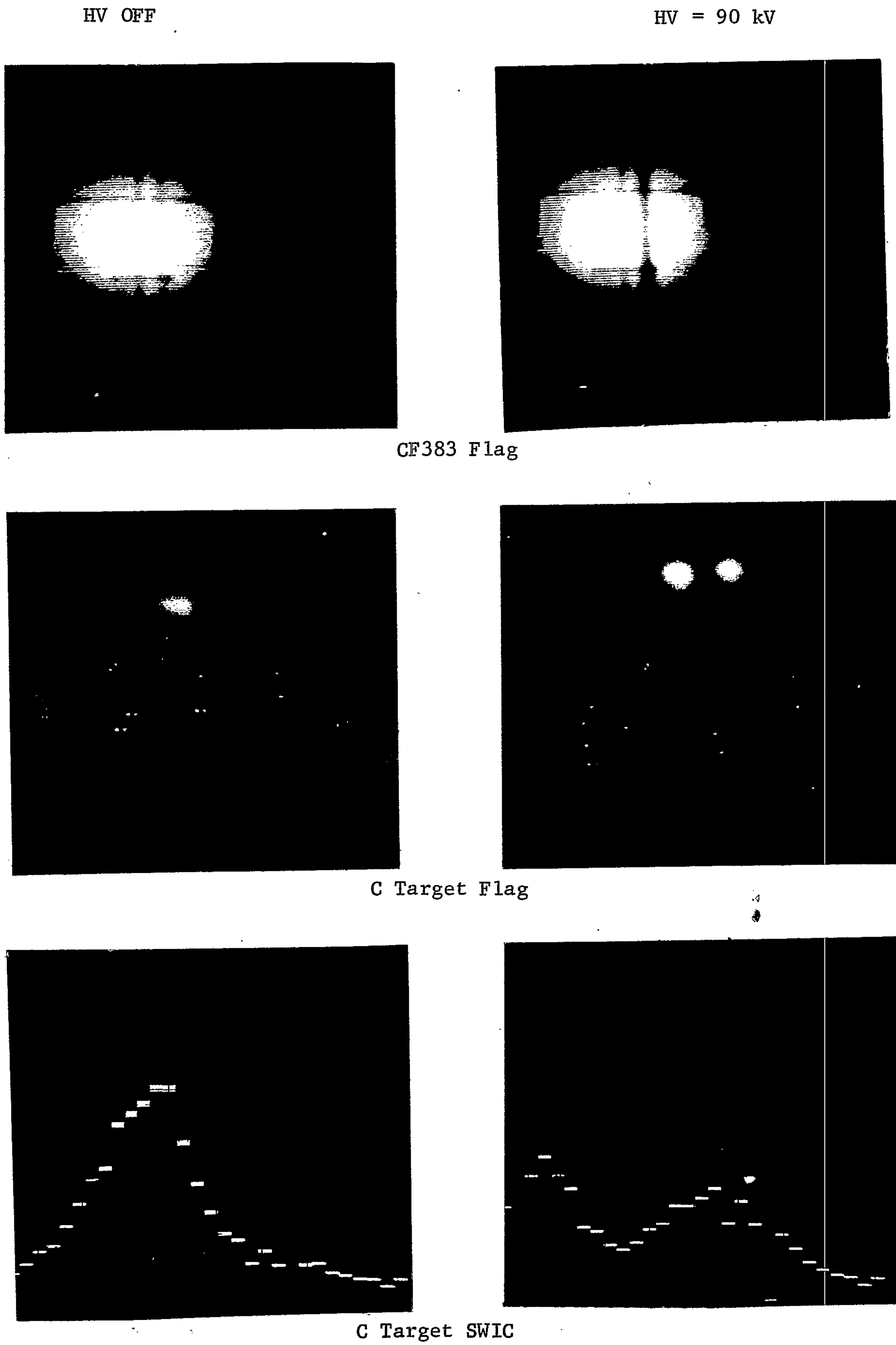

Figure 1. Operation of beam splitter as seen on the CF383 and C Target flags and the C Target SWIC. Observations made 1/9/79. Beam intensity in C line: 2.2×10^{12}.

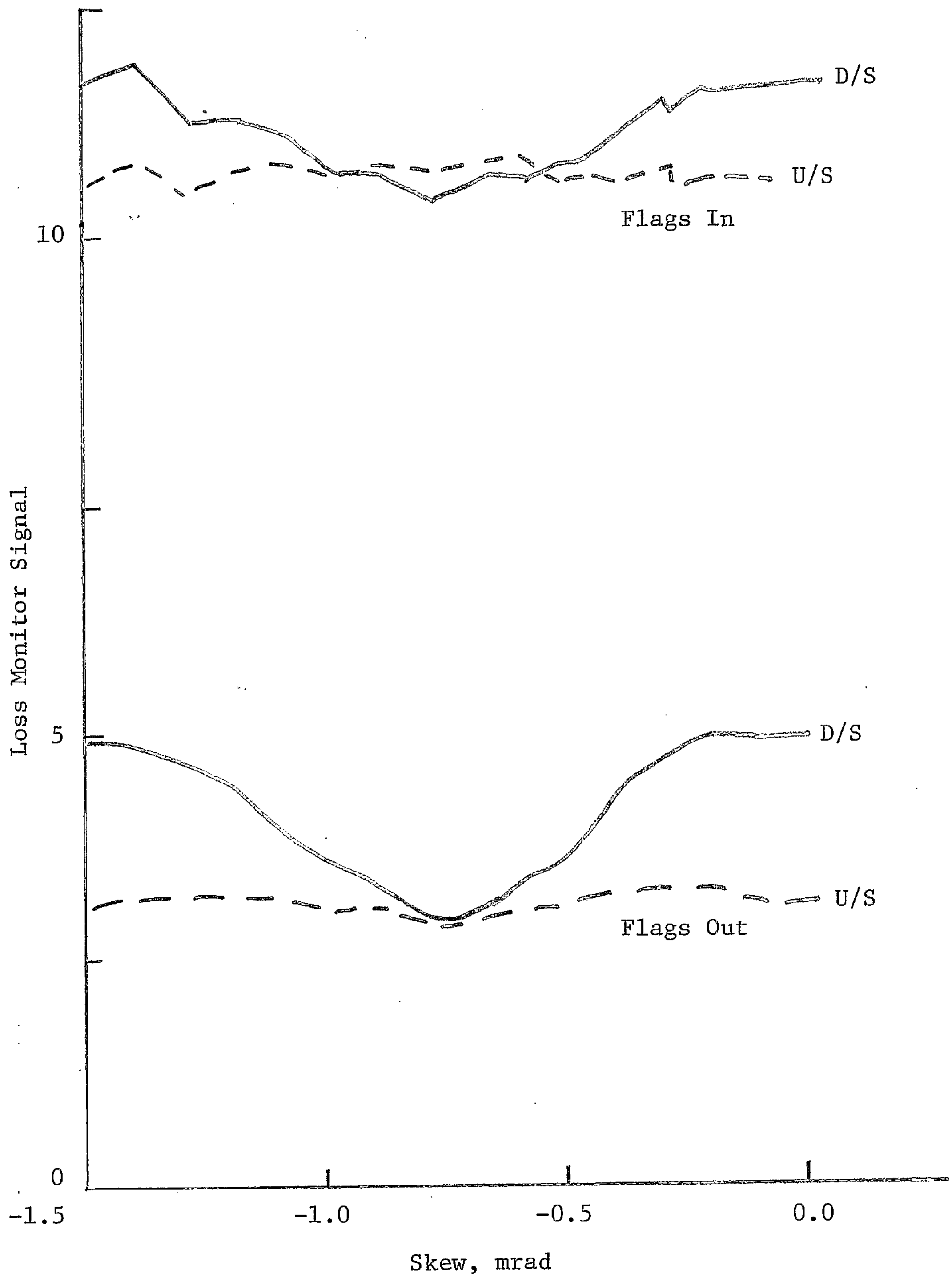

Figure 2. Loss monitor response vs septum skew. Responses are shown both for CL370 (U/S) and CL378 (D/S), and with flags CF103 and CF204 inserted (FLAGS IN) and retracted (FLAGS OUT). One unit of response corresponds to a signal of approximately 0.4 volts across a 0.1 μF integrating capacitance.

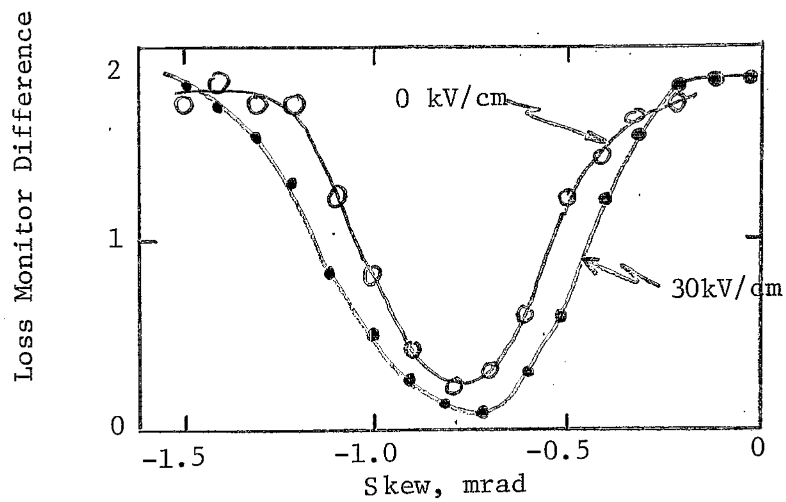

Figure 3. The difference of upstream and downstream loss monitor signals vs septum skew. Responses are shown with HV off and on.

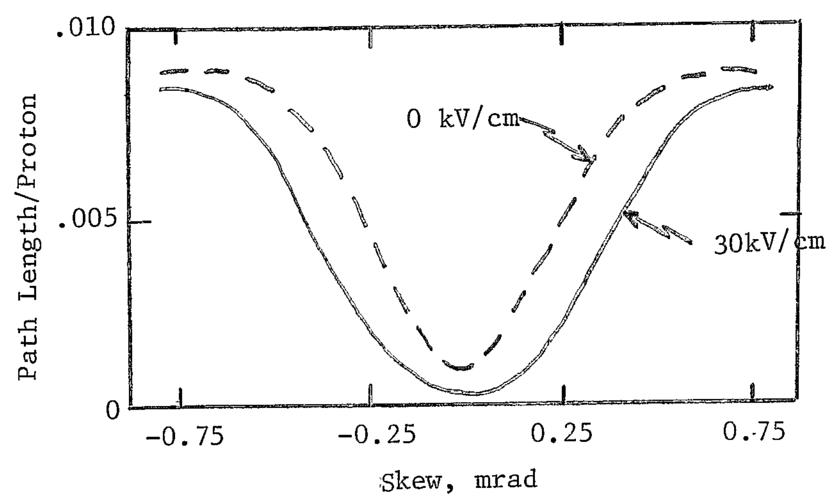

Figure 4. Predicted loss monitor signal vs septum skew. The quantity plotted is the average pathlength in the wires per incident proton per unit beam width, in inches/proton/inch.