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Subject	Detection of radiation from loss of Silicon beam at various momenta

Objectives

Sensitive radiation detectors are to be installed in the Booster and as part of the AGS improvement program to allow observation of low intensity and polarized proton and heavy ion beams, as well as the residual background radiation. The goal of this study was to see if a commercial proportional chamber was sensitive enough to observe losses from a low intensity silicon beam and how low in momentum such losses could be seen.

Procedure

Tests of commercial proportional ion chambers[1] showed that they had sufficient sensitivity to observe losses from an oxygen beam of about 2×10^{10} charges in a relatively quiet area (E-10: 2 mR/hr background) when mounted 8-18 inches from the center of the beam pipe on the median plane. Radiation from the silicon beam was expected to be less due to lower intensity (3×10^{9} typically). It was not clear that there would be sufficient sensitivity at lower momenta since the oxygen losses were at full energy during the spill. We needed to know the resonse in the Booster momentum range.

The HV for the chamber was provided by a Bertan HVPS connected to the outside of the chamber. The signal taken from the inner electrode was fed directly to one channel of a standard "HITL 4-Channel Integrator". This was reset from the AGS T_o pulse at cycle time of 4.15 seconds

The proportional chamber was moved from E-10 to the Beam Catcher location at E-20, where it was expected that beam lost during the cycle would be intercepted. Losses at specific times during acceleration, and therfore different momenta, were caused by turning off the RF at those times. The proprtional chamber was located at the downstream end of the E-20 straight section, 16 inches from the beam pipe center and 2 inches from the furthest extent of the F-1 magnet coils on the beam median plane. The

background was approximately 500 mR/hr as read by HP.

Results

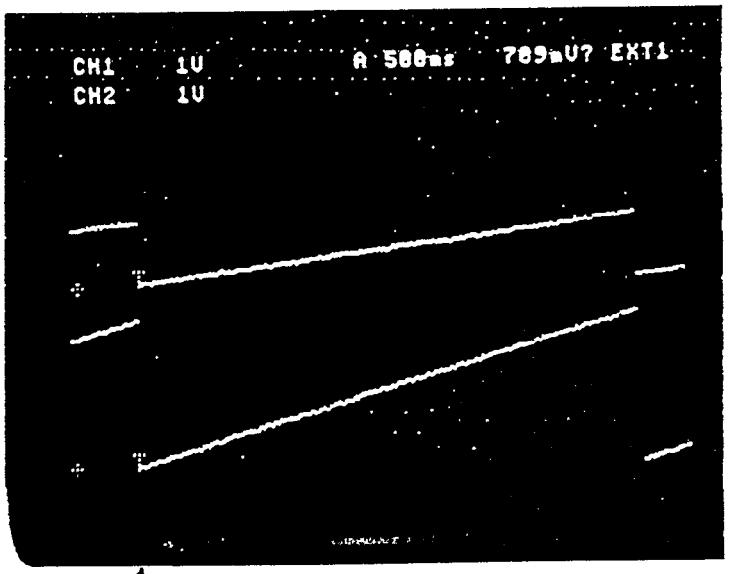
Figure 1 shows the signals from the 2 proportional chambers (P1 and P2) with a bias of -1200 V. The background was measured to be 513 mR/hr, consistant with the HP reading. With a bias of 1300 V this would integrate to approximately a 5 V level, making small losses difficult to resolve. The electronics were modified to reset the integrator every 50 msec during which the background would ramp the voltage to a few hundred mV. Since the losses due to early RF turn-off occurred within a few turns, they would almost always be fully within the window and have the same amplitude as for the longer integration time. This prevented saturation and also gave an approximation to a current-mode readout. Figure 2 shows the output of the "P2" chamber with -1300 Volt bias during the silicon run. A loss at transition (~ 700 ms after T_o and another at the start of spill (~1250 ms) are seen. The large spike is due to residual beam at the end of the spill. The slow continuous losses during extraction are also visible over the background.

The results of the study are shown in Figure 3. RF turn-off started at 14 GeV/c/Nuc and produced large signals down to about 2 GeV/c/Nuc, when it began to fall off rapidly. Moving the Catcher in to 0.65-inches brought the losses back up, indicating that the Catcher had no longer been the limiting aperture. The RF turn-off time was made successively earlier, with the signal falling off again below 0.3 GeV/c/Nuc. The Catcher was moved in again at 0.15 GeV/c/Nuc. The intensity during these tests was approximately 3 x 10^9 charges per pulse; the data is not normalized to intensity.

The data of Figure 3 certainly shows that the silicon beam can easily be observed down to Booster momenta. However since the Catcher was not readjusted for maximum signal for every point, only those just after a move have quantatitive significance. Another study with a heavy ion beam and the Catcher tuned for maximum loss at each momentum should be scheduled for more precise measurements.

References:

1. Proportional Counter Type 45460, LND Inc., Oceanside, NY

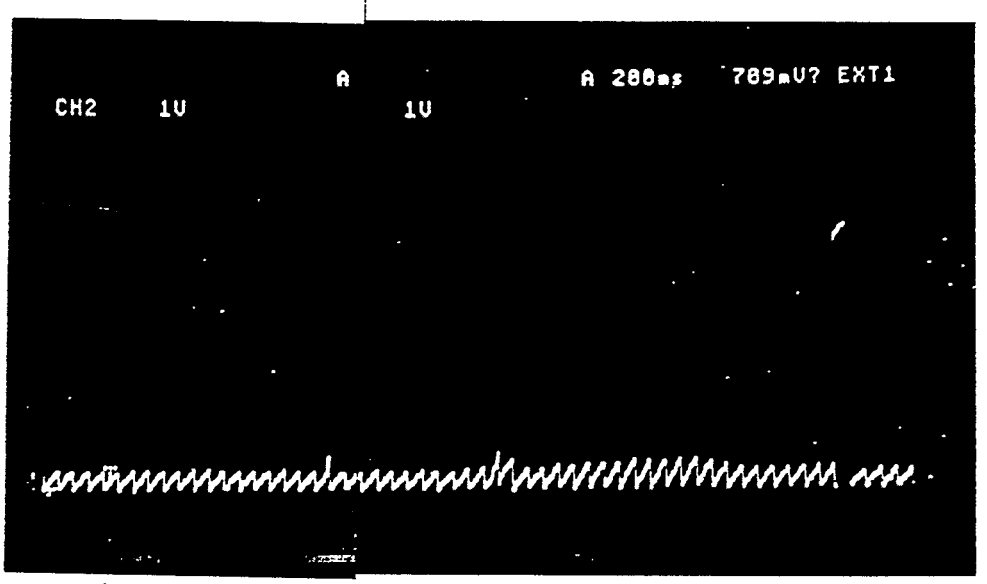


P_1

P_2

T_0

Fig 1.



P_2

T_0

Fig. 2

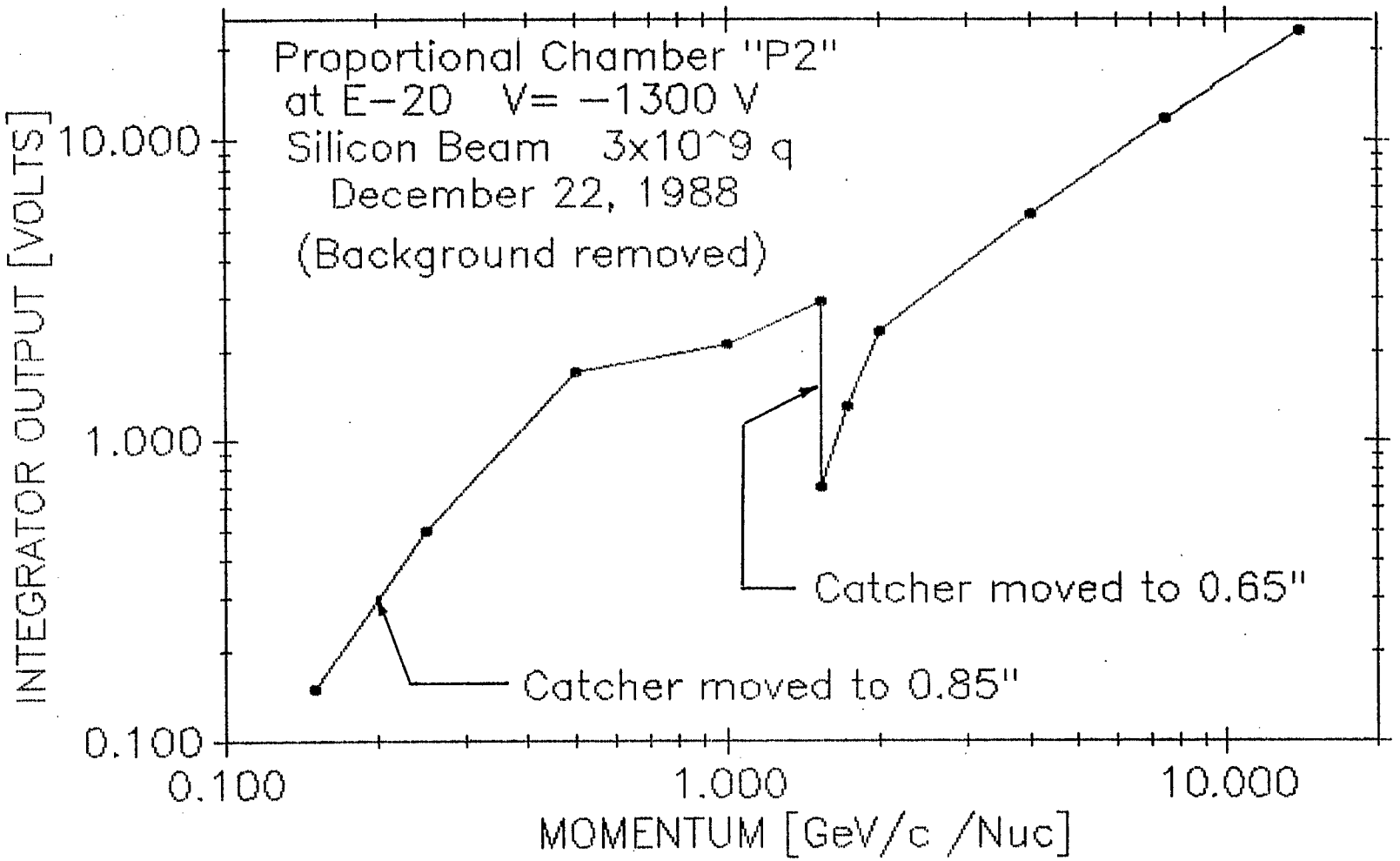

Proportional Chamber "P2"
at E-20 V= -1300 V
Silicon Beam 3x10^9 q
December 22, 1988
(Background removed)
Catcher moved to 0.65"
Catcher moved to 0.85"
INTEGRATOR OUTPUT [VOLTS]
10.000
1.000
0.100
0.100
1.000
10.000
MOMENTUM [GeV/c /Nuc]

Fig. 3