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Calibration of the G-10 Loss Monitor

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AGS Complex Machine Studies (AGS Studies Report No. 362) Calibration of the G-10 Loss Monitor
Study Period: 8-9 July 1997
Participants: L. Ahrens, W. Van Asselt
Reported by: W. Van Asselt
Machine: AGS
Beam: Protons to g-2
Tools: Jump Target, Loss Monitors
Aim: Calibration of the G-10 Loss Monitor

During the G-2 run the jump target (vertical) was made operational in an attempt to use this target to scrape the beam before it entered the G-10 kicker. There was some beam loss, as seen on the G-10 difference loss monitor, when the beam was bumped into the apertrure of the G-10 kicker for the extraction of the first bunch. A similar loss was not seen with the extraction of subsequent bunches. By shaving the beam with the jump target this loss could be made to disappear. The loss just disappeared when the E-16 loss monitor registered 10 counts as measured with the AGS Loss Monitor program.

In order to estimate the associated beam loss, the jump target was inserted further in steps of 1 mm, until the loss caused by the target could be measured with the F15 current transformer. The beam intensity was about 35 TP during the measurements. Figure 1 shows the beam loss as reported by the E-16 loss monitor for five positions of the jump target. The first point (2500 counts) corresponds with a beam loss of 1.5 % according to the current transformer. It is assumed in the following that the E-16 beam loss for the other points scales proportional to this. This gives a beam loss of $2*10^9$ protons for the case of a 10 count loss at the E16 loss monitor. The amplitude of the 'muxed' analog signal from the G10 difference loss monitor for the case which compares with 10 counts loss at the E16 loss monitor was about 0.5V. From the above results this gives a calibration of $4*10^9$ protons/V of the G-10 difference signal at the extraction momentum.

Further analysis

Assuming a 2-dimensional Gaussian distribution for the transverse beam profile, the amount of beam left in the machine in units of σ can be determined from the loss measurements. This is plotted in figure 2. Since there should be a linear relations between the position of the jump target and these numbers, the result of a linear regression on the data is also plotted in figure 2, showing a reasonable agreement between the two datasets. At the last datapoint the beam just fitted in the aperture of the G-10 kicker, therefore $2*4.1*\sigma$ must be equal to the aperture of the kicker (22 mm), giving a σ= 2.68 mm.

However extrapolation of the data to a σ=0, gives an half beam size of 10 mm and this

has to be corrected downward by 10 % due to the difference in β-functions at the two locations (22.7 m at E-15 and 18.3 m at the downstream end of the G-10 kicker).

In AGS Studies Report 179 [1] a vertical flip target was used to measure the circulating beam size in combination with IPM measurements. The latter showed that shaving in the vertical plane also caused a decrease of beam size in the horizontal plane, apparently due to coupling. It was found that a 4-dimensional gaussian profile gave much better agreement between the experimental results and the model. These measurements were done, however, with beam losses up to 80%, while the present study only looked at the tails of the beam. In addition the momentum in the present study was much higher.

Conclusion

The sensitivity of the G-10 difference loss monitor is measured to be $4*10^9$ protons/Volt at 24 GeV. The method described above may be very useful during future runs for determining trip limits for the G-10 difference loss monitor. Since the jump target was required for these measurements, control of the system from the main control room would be a welcome addition to the system.

Acknowledgement

Thanks to E. Gill and R. Thern for fixing the controls of the jump target.

Reference

1. R.E. Thern, AGS Studies Report 179, March 1985

Figure 1

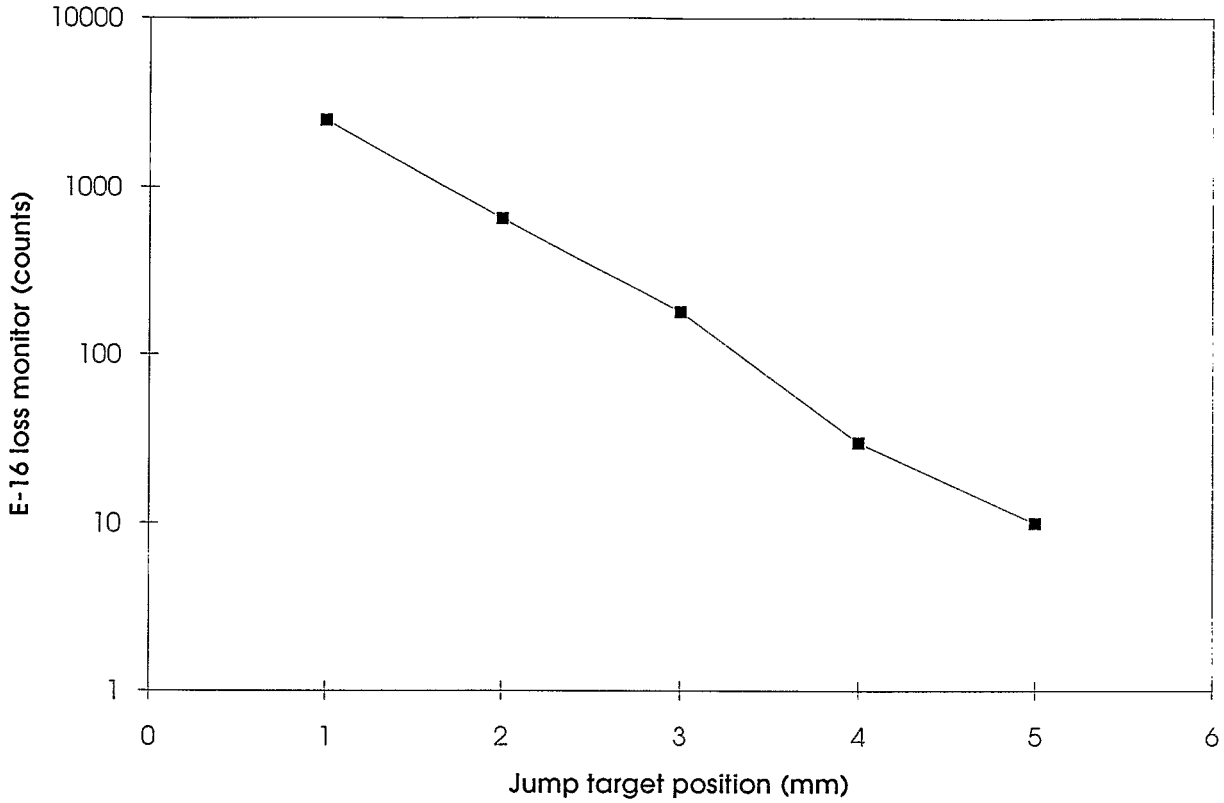

Figure 2