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REPLACES CN#

TITLE: BEAM POSITION DETECTION ALONG THE COLLIDER ARMS

A small position monitor is presented here which meets the Collider specifications for the detection of the beam position along the arms. This is a summary of the points worth noting regarding the operation of this detector.

1. The monitor body is machined out of stainless steel stock, presenting on the outside two accurate rectangular surfaces to be used for alignment purposes. (Fig. 1).
2. The four electrodes and one end plate are also machined out of stainless steel stock; this insures parallelism of the four electrodes with the monitor axis, and eliminates a delicate assembly operation. Brazing of the end plate to the body establishes a short-circuit of the electrodes' far end.
3. The response of one electrode to an impulse of current simulating a beam is shown on Figure 2. The impulse area is equivalent to the charge of 10^8 positrons.
4. Figure 3 is a plot of $(V_1 - V_2 - V_3 + V_4) / (V_1 + V_2 + V_3 + V_4)$ and $(V_1 + V_2 - V_3 - V_4) / (V_1 + V_2 + V_3 + V_4)$ as a function of the horizontal or vertical coordinate of the current impulse. The "slope" of the monitor is found to be 8 mm. Therefore, processing of the electrode signals with a precision of 1% will give us a resolution of 80 μ m (without statistics).
5. When the monitor electrical center is determined in the laboratory an error $\epsilon\%$ results which is due to the width of the impulse used for this measurement. Indeed, such a calibration would present no error should the impulse width be equal to the actual bunch length. One can show that if the processing electronics has an input low-pass filter with a time constant τ , the calibration impulse can be as wide as $2\epsilon\tau$, where ϵ is the largest error one can tolerate for this measurement. Several trade-offs have lead us to pick 15 nSec for τ , and with the impulse of Figure 2 (FWHM = 130 pSec) we get $\epsilon = 0.4\%$. This calibration error amounts to 32 μ m. The residual mechanical error of the calibration fixture can be held down to a fraction of this error by a rotation and averaging technique.
6. The electronics for the detection of the beam position along the collider arms can be of the same type as the one being developed for the linac; it is designed to operate with single bunch charges of $5 \cdot 10^8$ to $5 \cdot 10^{10}$ particles. The monitor described here will most likely be built with strips of 3 cm length (our tests were conducted with strips of 4.3 cm). This is four times shorter than the linac monitors, hence we will get four times less signal and the operation range of the position detectors on the collider arms becomes $2 \cdot 10^9$ to $2 \cdot 10^{11}$ particles per bunch.

Top : input current 40 ma / div.
Bot : electrode response 200 mv / div.
Time base : 100 pSec. / div.

FIG. 2

FIG. 3