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BEAM SIZE MEASUREMENTS FOR FEB

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BEAM SIZE MEASUREMENTS FOR FEB

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The fast extracted primary proton beam size was measured between UQ13 (last quadrupole before the neutrino horn) and the neutrino horn. We exposed the wire mesh of 100 X 100 wires per inch in the beam and counted the radioactivity induced by the beam for each wire. Because of the availability we used the nickel alloy mesh. If the wires are reasonably homogeneous, the result should not be affected by the kind of material we use. About 10^{14} protons (20 pulses of $\sim 5 \times 10^{12}$ protons per pulse with > 95% extraction efficiency) were impinged onto the wire. The mesh was taken apart and the individual wires were counted. We used several counters to count the wires, but the efficiency of the counters were the same within a few percents. A wire from each mesh was counted all the time to serve as the normalization. Because of the complexity of the kinds of radio isotopes generated, the correction of the decay rate is not easy to calculate. However, if one normalizes to the single wire, it is automatically taken into account. The measurement was taken in four locations; 53 inches, 74.25 inches, 130 inches and 158.25 inches downstream from the edge of the steel yoke of UQ13. Figures 1 and 2 shows the horizontal and vertical profile of the beam at 53 inches downstream of UQ13. Vertical profiles seems to have asymmetry which is not understood. In Figure 3 we plotted the size vs the location of the measurement. The measured size is half width at the 90% of the peak intensity. Plotted along is the calculated half size of the beam from FEB operations manual. The beam emittance assumed for the calculation was:

$$Ex = 2.416\ \pi\ \text{mm - mrad}$$

$$Ey = 1.864\ \pi\ \text{mm - mrad}$$

As can be seen in the figure, while the general feature of the plot is similar, the actual size is at least a factor of two smaller than the calculated value. From these results, one can make the following conclusion. The optics of the U-line as calculated is consistent with the measurement. However, the emittance of the beam is at least a factor of four smaller than assumed in both the vertical and horizontal directions. The method of measuring profiles used here seems very adequate for accurate measurement of profiles of the pencil beam. The accurate emittance can be calculated by measuring the profile in free spaces in this method.

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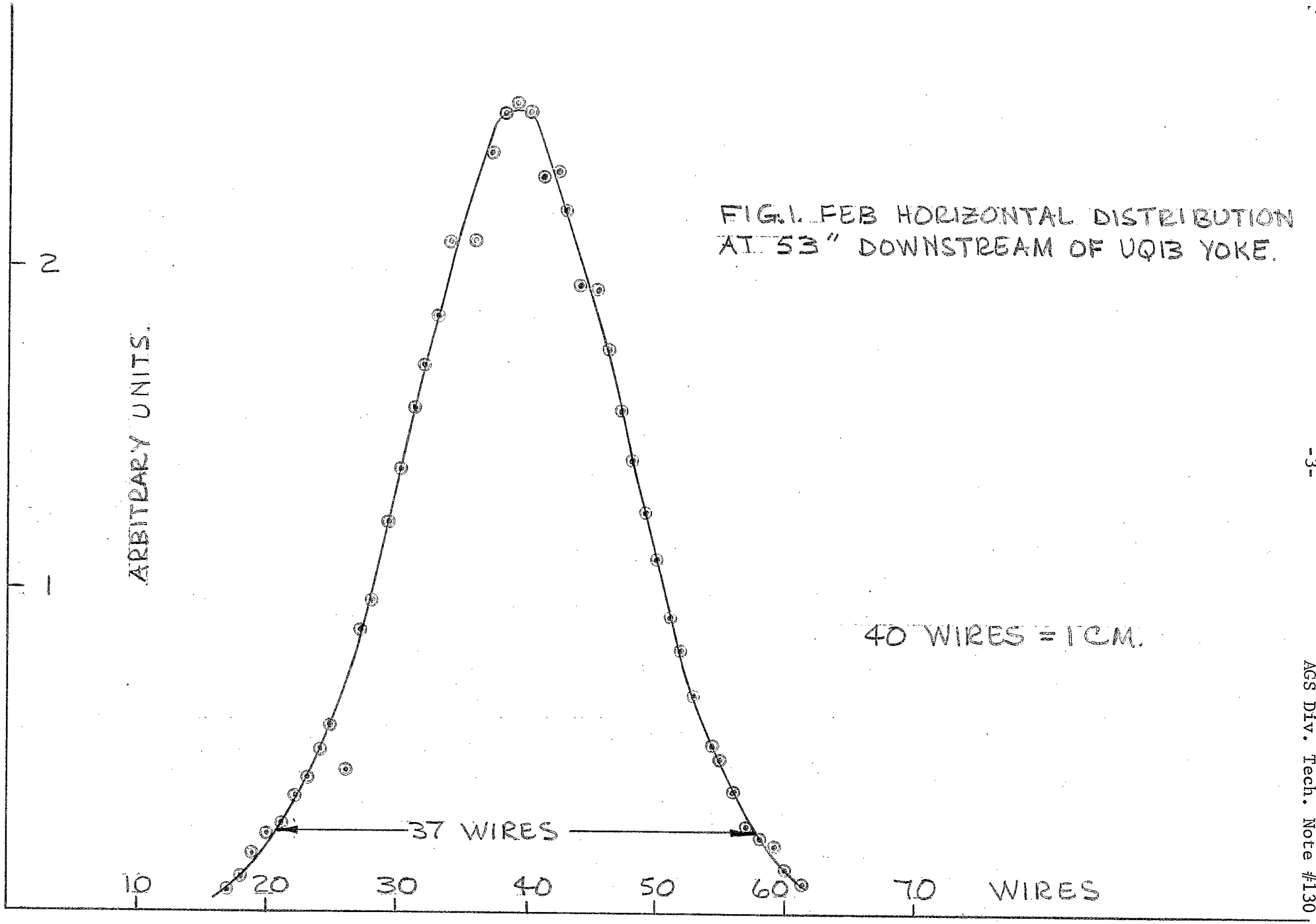

FIG. 1. FEB HORIZONTAL DISTRIBUTION AT 53" DOWNSTREAM OF UQ13 YOKE.

40 WIRES = 1 CM.

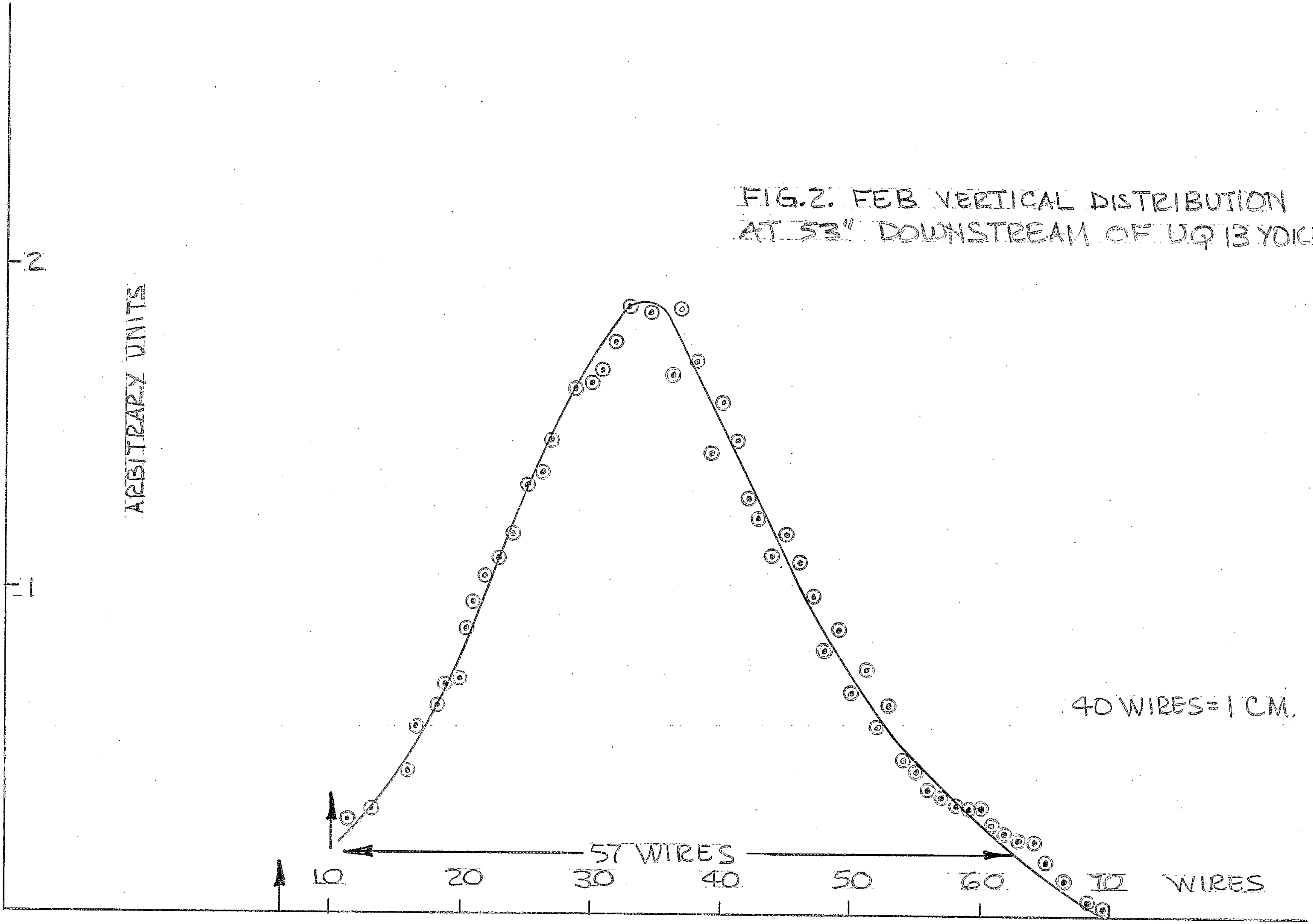

FIG.2. FEB VERTICAL DISTRIBUTION AT 53" DOWNSTREAM OF UQ13 YOKE

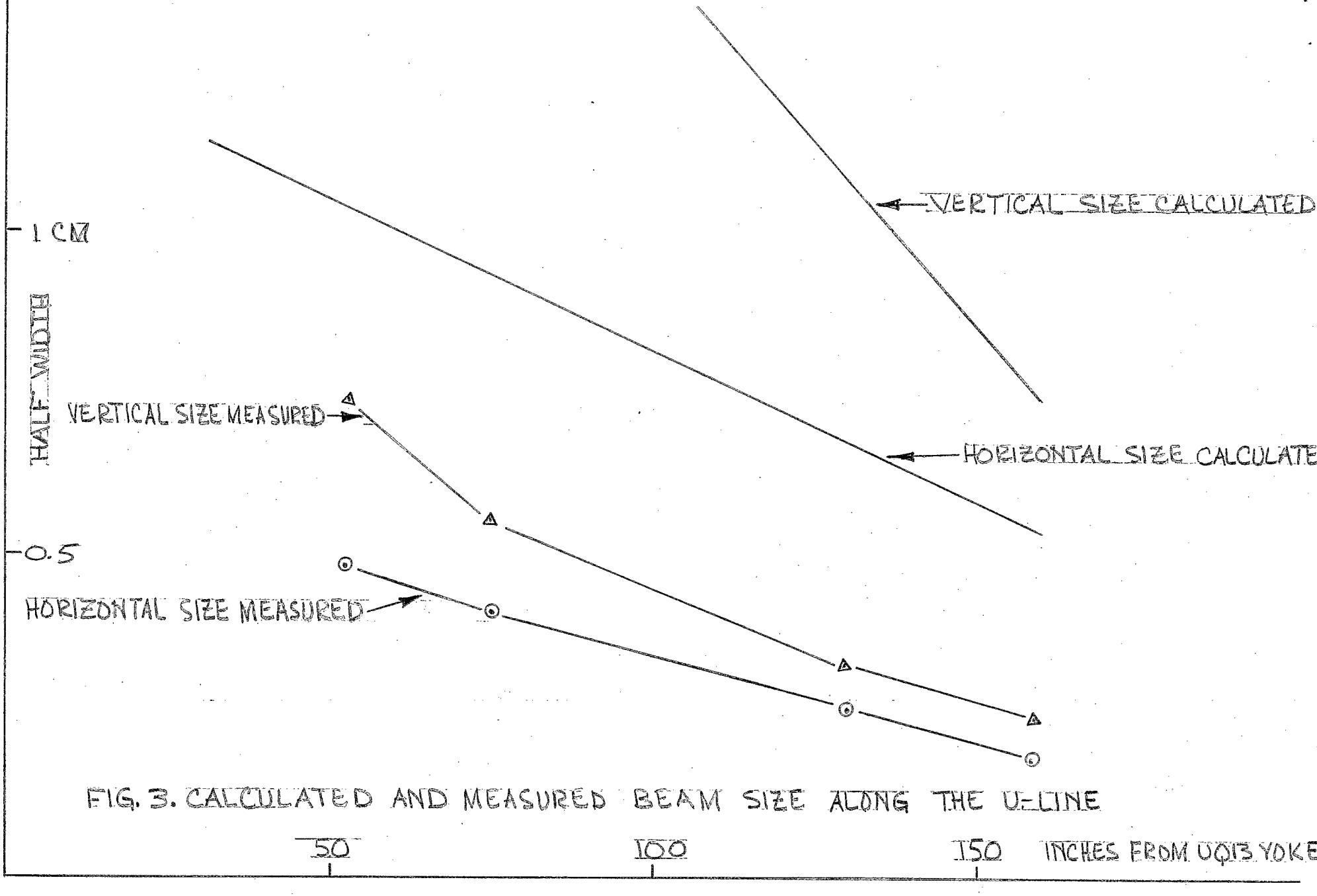

FIG. 3. CALCULATED AND MEASURED BEAM SIZE ALONG THE U-LINE