

## BEAM SIZE MEASUREMENTS FOR FEB

V. Agoritsas

January 1977

Collider Accelerator Department  
**Brookhaven National Laboratory**

**U.S. Department of Energy**

USDOE Office of Science (SC)

Notice: This technical note has been authored by employees of Brookhaven Science Associates, LLC under Contract No.EY-76-C-02-0016 with the U.S. Department of Energy. The publisher by accepting the technical note for publication acknowledges that the United States Government retains a non-exclusive, paid-up, irrevocable, world-wide license to publish or reproduce the published form of this technical note, or allow others to do so, for United States Government purposes.

## **DISCLAIMER**

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, nor any of their contractors, subcontractors, or their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or any third party's use or the results of such use of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof or its contractors or subcontractors. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

Accelerator Department  
BROOKHAVEN NATIONAL LABORATORY  
Associated Universities, Inc.  
Upton, New York

AGS DIVISION TECHNICAL NOTE

No. 130

~~BEAM BEAM SIZE MEASUREMENTS FOR FEB~~

V. Agoritsas, Y. Y. Lee, R. Witkover

January 13, 1977

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:

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

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

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.

We are indebted to Mr. A. Soukas and Mr. J. Balsamo for their help and Dr. J. Cumming for his help and providing the nuclear chemistry counting facility for us.

Distr: Accel. Dept. S&P

ARBITRARY UNITS.

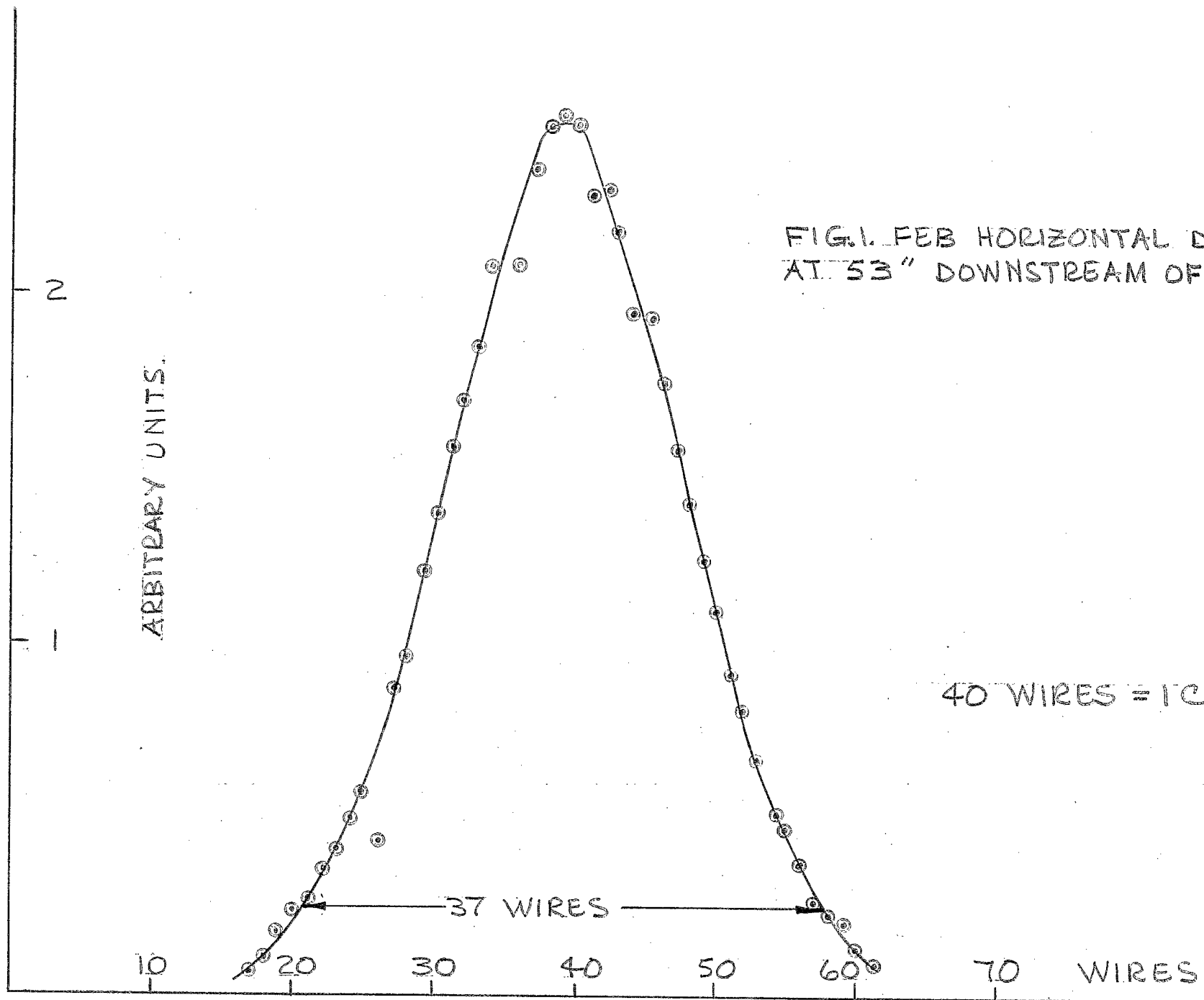


FIG. 1. FEB HORIZONTAL DISTRIBUTION AT 53" DOWNSTREAM OF UQ13 YOKE.

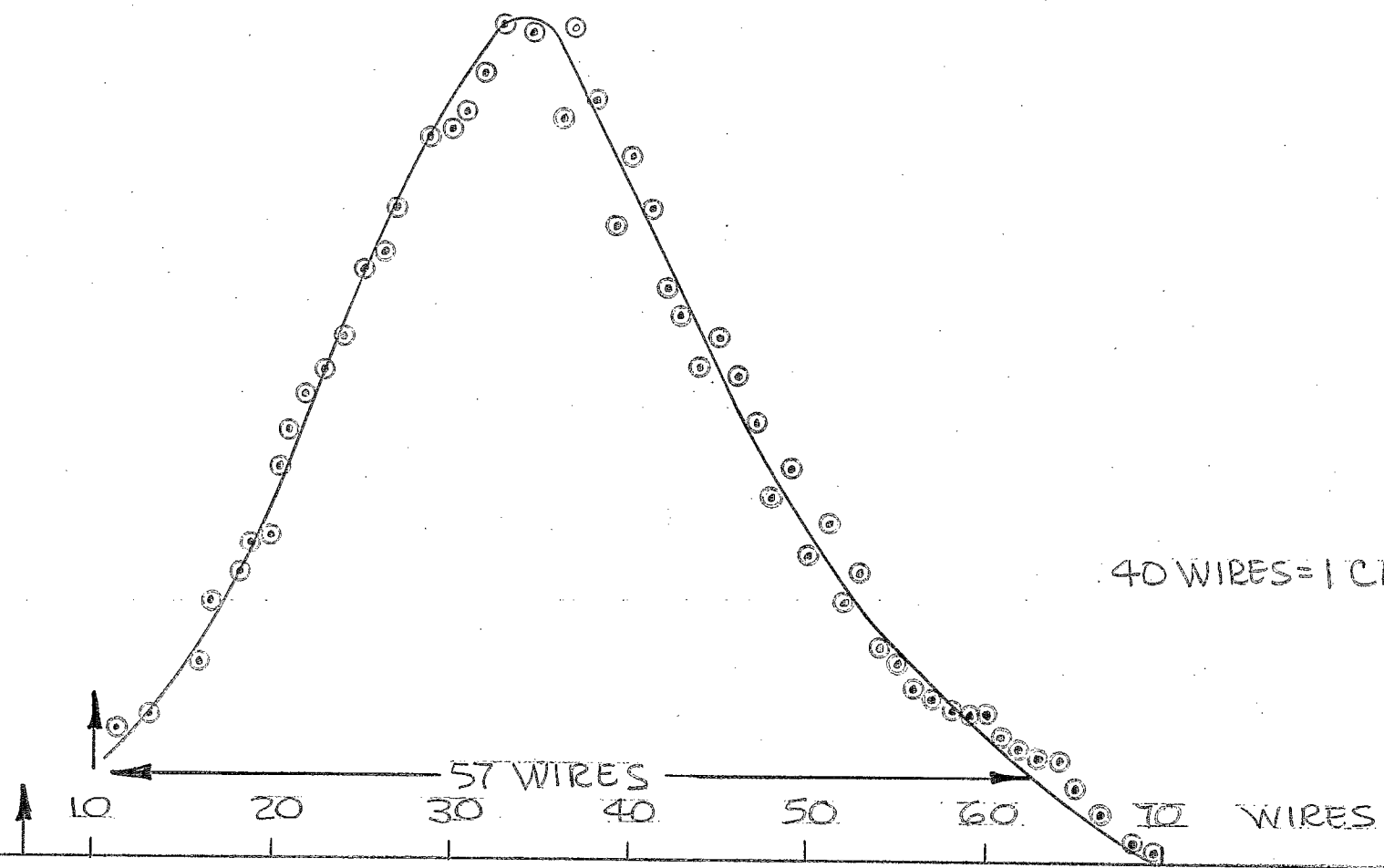
40 WIRES = 1 CM.

FIG. 2. FEB VERTICAL DISTRIBUTION  
AT 53" DOWNSTREAM OF UQ 13 YOICE

ARBITRARY UNITS

2

1



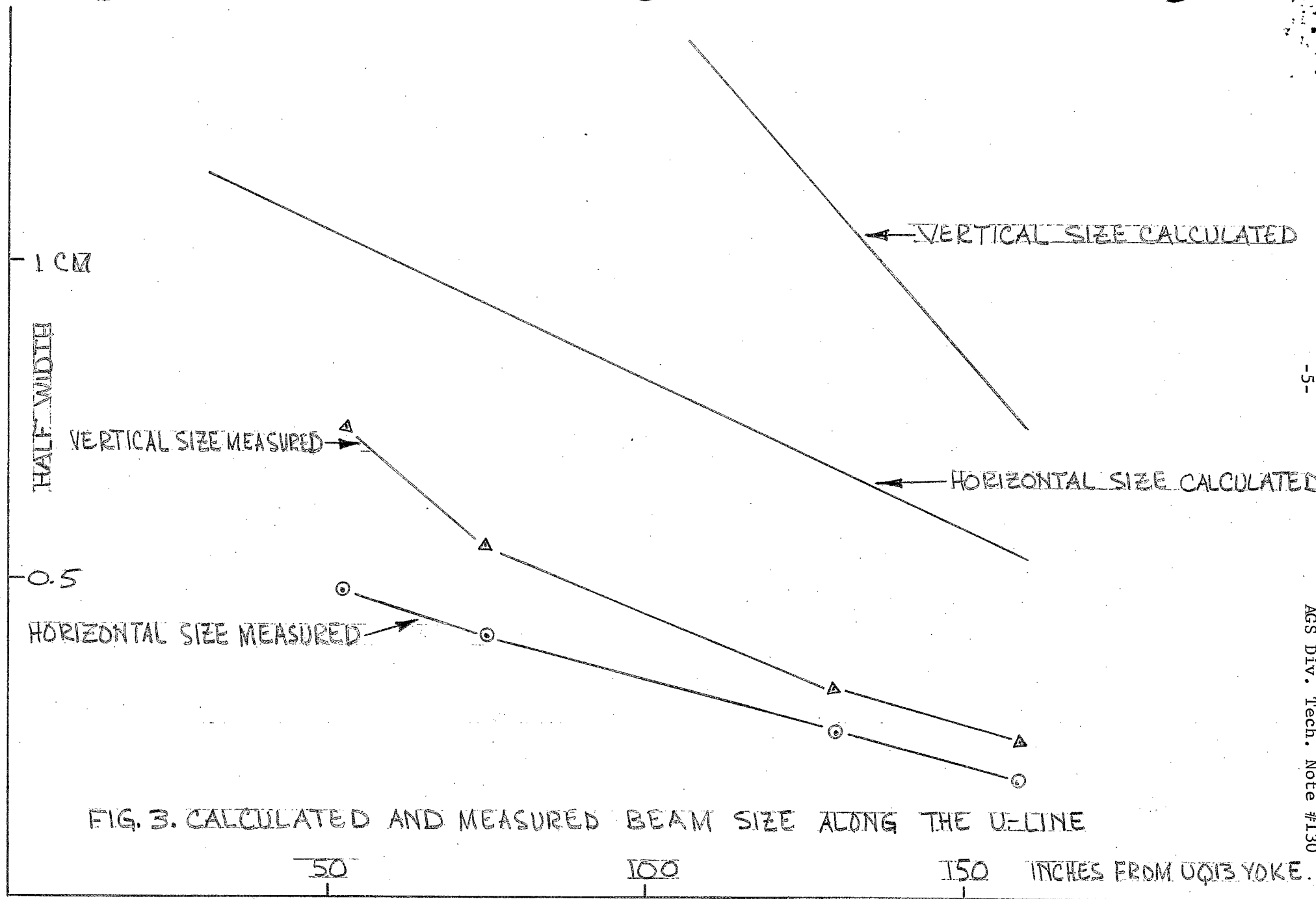


FIG. 3. CALCULATED AND MEASURED BEAM SIZE ALONG THE U-LINE  
 50 100 150 INCHES FROM UQ13 YOKE.