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SURVEYING THE EXTERNAL MUON IDENTIFIER
AND THE 15' BUBBLE CHAMBER WITH 250 GeV MESONS

University of Hawaii - LBL Group*; Experiment 155

July 16, 1974

We present in this note the results of an exposure of the 15' bubble chamber and the External Muon Identifier (EMI) to a beam of 250 GeV negatively charged mesons. During this run, which took place on 8 June 1974, there was no magnetic field. The beam was supposed to traverse the bubble chamber and pass out through a 3" vertical x 14" horizontal hole in the 24" thick zinc absorber placed between the superconducting coils of the magnet. The hole was supposedly centered horizontally on the neutrino beam centerline (which is displaced 3.5" east of the hadron beam centerline at that point). The center of the hole was to have been located 3" below the median plane of the magnet coils at the expected height of the hadron beam.

Figure 1a summarizes the bubble chamber measurements of the beam tracks and the prediction of their coordinates as the particles would traverse the multiwire proportional chamber (MWPC) #2. The TVGP spatial reconstruction program used the Pascaud optical parameterization that may not be valid for this run. The no-field tracks had a residual radius of curvature of 4 kilometers.

There are three categories of events displayed in Figure 1a. Those shown as dots are events that interacted with something, spraying MWPC #2 and its neighboring chambers with many particles. The circles with crosses are for those events that produced single sets of encodings in MWPC #2 and which show a strong correlation between the position in the bubble chamber and the position in the MWPC. These are presumably particles that passed undeflected through the hole. Those events in the third category have single encodings and a loose correlation between bubble chamber position and delay-line position. Some of these events may be the result of a known intermittent failure of the digitizer for MWPC #2. The horizontal dashed line of Figure 1a denotes the expected location of the top of the hole in the zinc and the horizontal arrow indicates the expected position of the beam centerline. Clearly neither the beam nor the hole seem to be where we expected them to be. Figure 1b shows the azimuthal distribution of the beam to be centered 0.14° from the nominal relative beam azimuth of 2.5° to the neutrino beam centerline. This measured azimuth of 2.64° (or 46.1 milliradians) agrees exactly with the 46.1 mradians design value of the beam (Marvin Johnson). Figure 1c is the dip distribution which was expected to be centered at zero degrees.

Figure 2a displays the horizontal correlation between the bubble chamber YBC (cm) and the corresponding information from only one end of the delay line, CXA-CPR. Those points that lie close to the straight line, CXA-CPR = 230.5 + 2.54 YBC (cm), scatter about it with an rms deviation of 0.91 clock counts or 3.6 mm.

Figure 2b shows the corresponding correlation in the vertical plane. These same points scatter about the line,

$$\text{CYA-CPR} = 128.0 + 2.47\ \text{ZBC (cm)},$$

with an rms deviation of 0.65 clock counts or 2.8 mm. These "well predicted" points are those that are circled in Figure 1.

Figure 3 summarizes in projection how these points distribute themselves about the best fit lines of Figures 2a, 2b. The shaded blocks are the loosely correlated events.

The conclusions of this analysis are:

1. We can predict with adequate accuracy where a non interacting high energy particle will strike the EMI. In fact, the 250 GeV beam is used as a surveying tool to locate the MWPC's with respect to the bubble chamber fiducials.
2. Furthermore, the demarkation between interacting and non interacting particles of Figure 1a (which approximately locates the top of the hole in the zinc) occurs at ZBC $\approx$-6.1 cm. With improved statistics we will be able to measure the position of the super-

conducting coils relative to the bubble chamber fiducials.

3. The bubble chamber fiducials (ie $\phi = o°$) are centered on the "nominal hadron beam" line of 2.5 degrees or 43.6 milliradians relation to the neutrino centerline.

4. The slopes of the straight lines of Figures 2a,2b compare very well with the reciprocals of the delay line velocity determined by independent methods.

We have addressed outselves in this note primarily to the use of the 250 GeV beam as a surveying tool. We plan, shortly, to study the efficiency of the chambers in situ and to document our findings.

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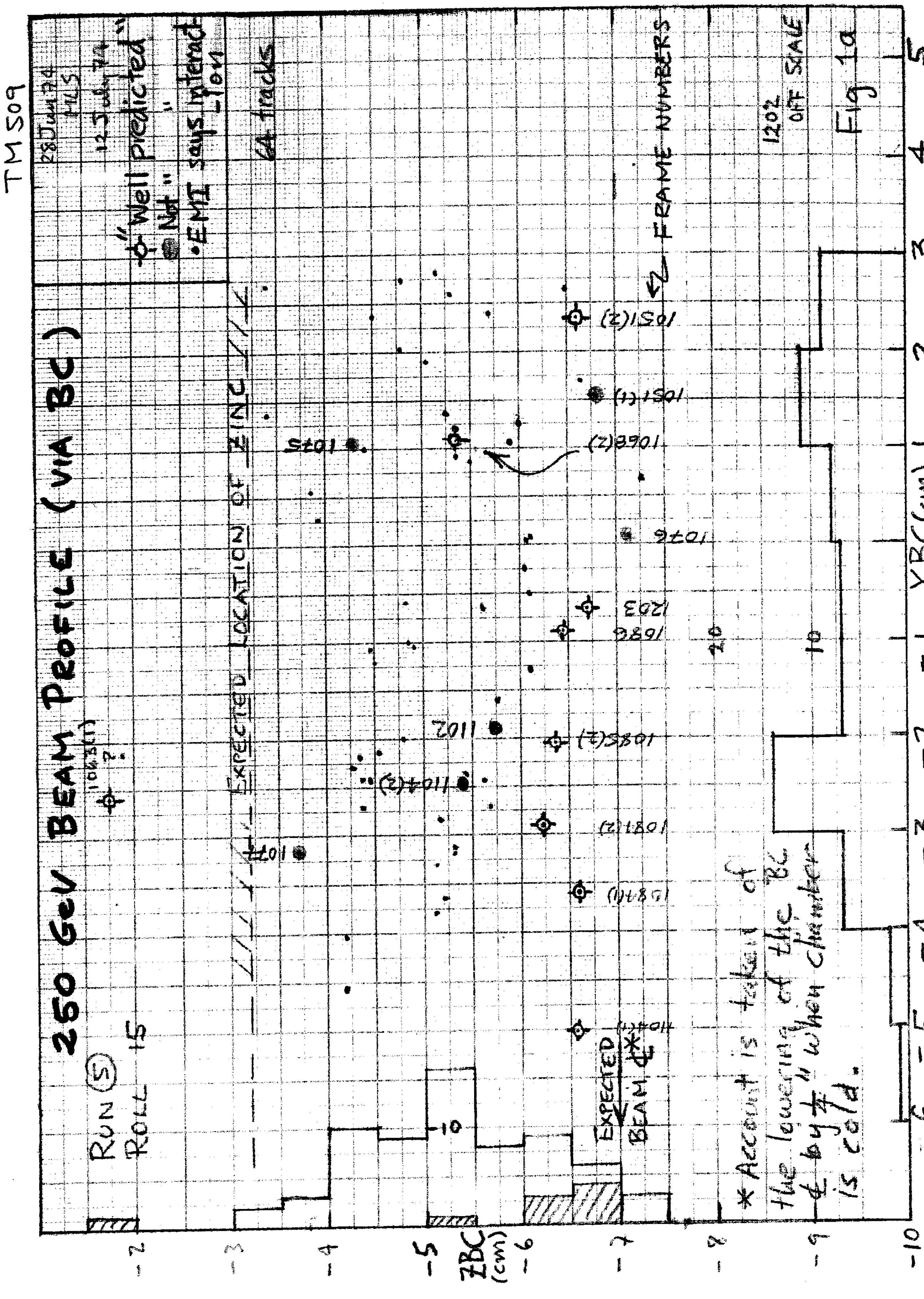

TM509
250 GeV BEAM PROFILE (VIA BC)
RUN 5
ROLL 15
28 Jan 74 HLS
12 Feb 74
"Well predicted"
" Not "
• EMI says interaction
64 tracks
FRAME NUMBERS
1202 OFF SCALE
Fig 1a
EXPECTED LOCATION OF ZINC
EXPECTED BEAM ℄*
YBC (cm)
ZBC (cm)
1051(2)
1051(1)
1068(2)
1045
1046
1203
1086
1102
1085(2)
1104(2)
1081(2)
1044
1084(1)
1104(1)
* Account is taken of the lowering of the ℄ by " when chamber is cold.

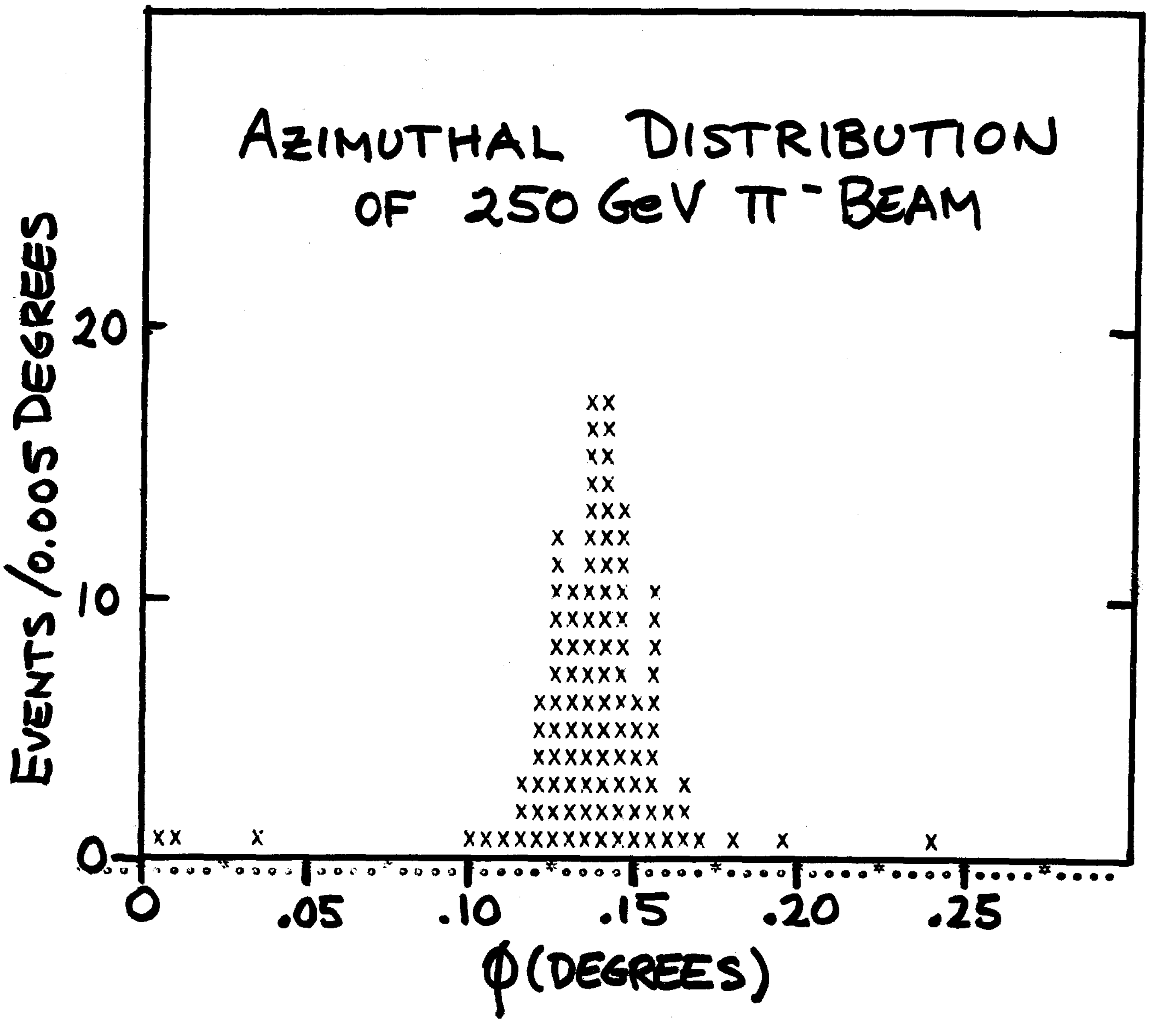

AZIMUTHAL DISTRIBUTION
OF 250 GeV π⁻ BEAM
EVENTS /0.005 DEGREES
20
10
0
0
.05
.10
.15
.20
.25
φ (DEGREES)

Fig 1b

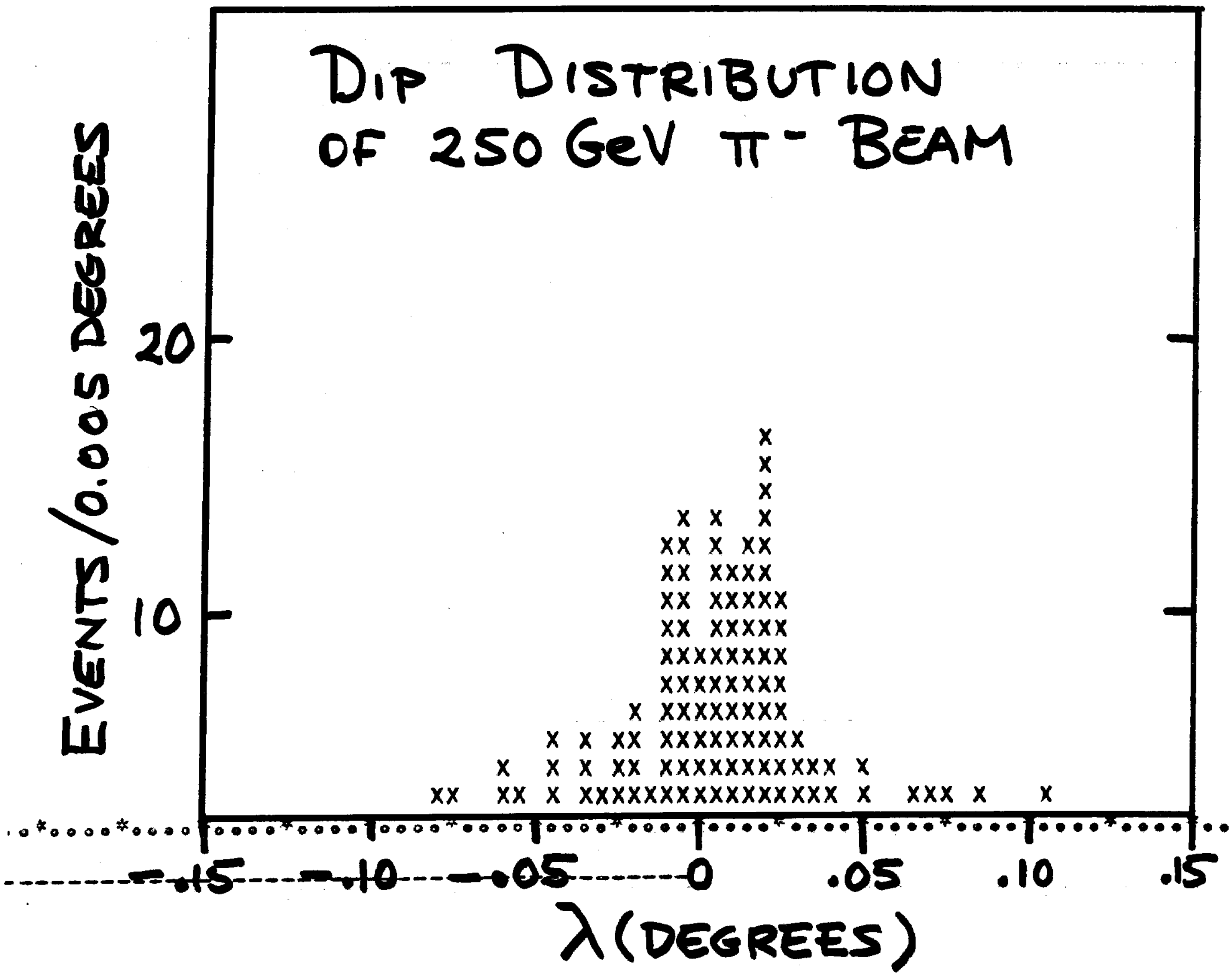
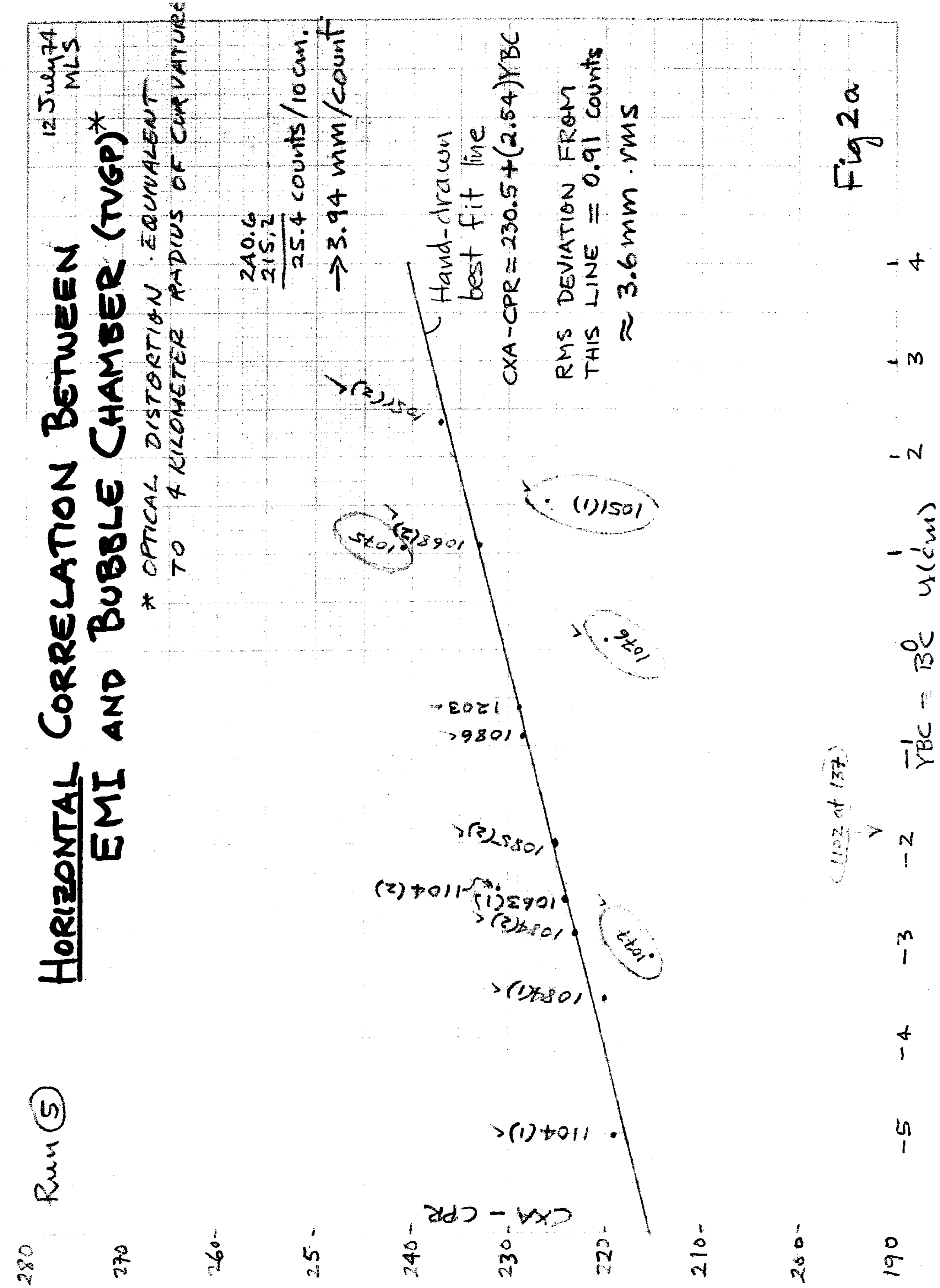

DIP DISTRIBUTION
OF 250 GeV π⁻ BEAM
EVENTS/0.005 DEGREES
20
10
-.15
-.10
-.05
0
.05
.10
.15
λ (DEGREES)

Fig 1C



Run (5)
HORIZONTAL CORRELATION BETWEEN EMI AND BUBBLE CHAMBER (TVGP)*
12 July 74 MLS
* OPTICAL DISTORTION EQUIVALENT TO 4 KILOMETER RADIUS OF CURVATURE
240.6
215.2
25.4 counts/10 cm.
→ 3.94 mm/count
Hand-drawn best fit line
CXA−CPR = 230.5 + (2.54) YBC
RMS DEVIATION FROM THIS LINE = 0.91 counts
≈ 3.6 mm rms
CXA − CPR
YBC − BC u (cm)
1104(1)
1084(1)
1084(2)
1063(1)
1104(2)
1085(2)
1086
1203
1076
1068(2)
1075
1051(1)
1051(2)
1077
1102 at 137

Fig 2a

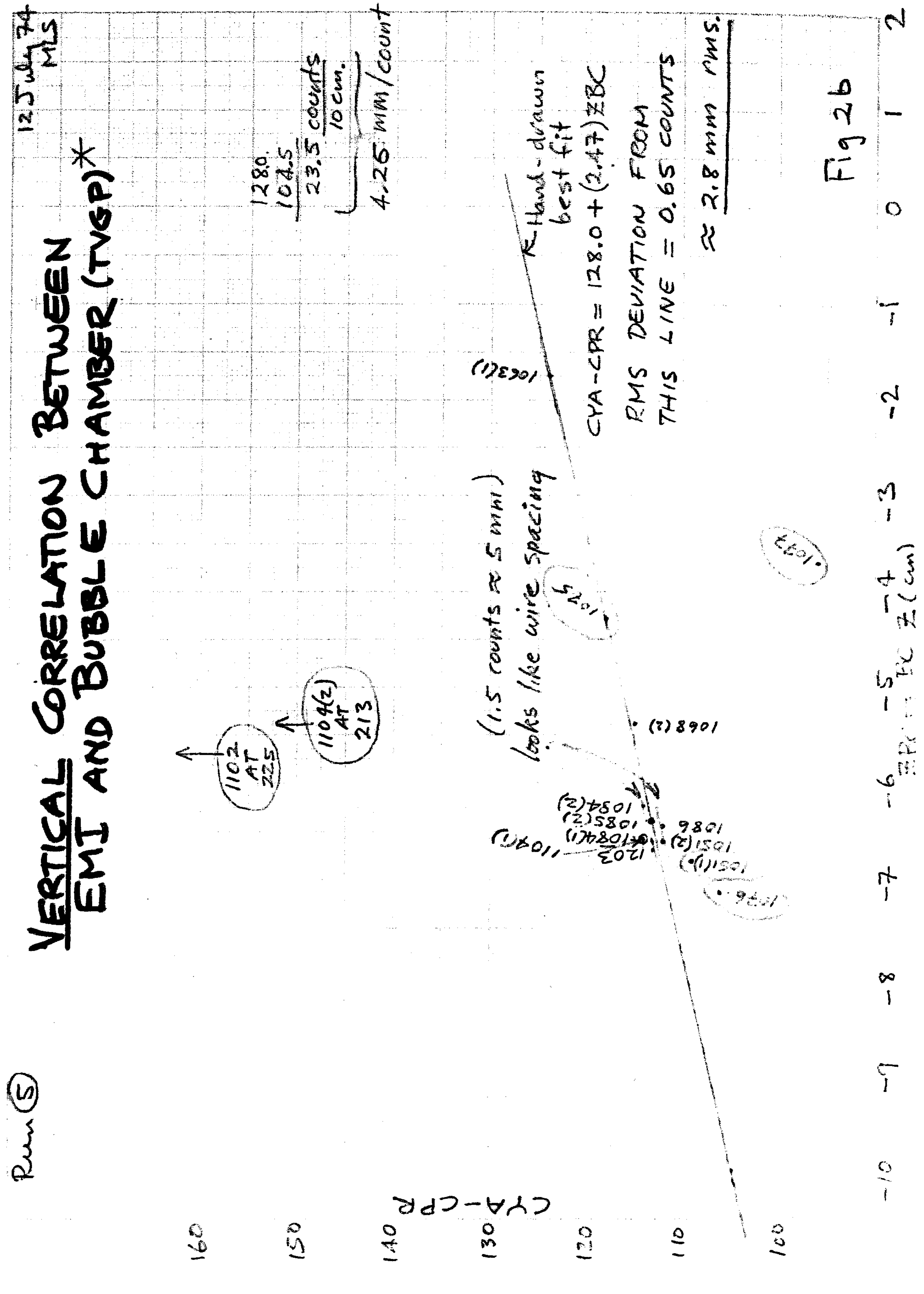

VERTICAL CORRELATION BETWEEN
EMI AND BUBBLE CHAMBER (TVGP)*
12 July 74
MLS
Run (5)
128.0
104.5
23.5 counts / 10 cm.
4.26 mm/count
Hand-drawn best fit
CYA-CPR = 128.0 + (2.47) Z BC
RMS DEVIATION FROM THIS LINE = 0.65 COUNTS
≈ 2.8 mm rms.
(1.5 counts ≈ 5 mm)
looks like wire spacing
1102 AT 225
1104(2) AT 213
CYA-CPR
Z BC (cm)

Fig 2b