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ISR Performance ReportRUN 1098 3rd March 1980 Ring 1 - 26 GeV/c - FP LineMeasurement of Luminosity Bumps with the I3 ScraperAim

To make precision measurements of vertical luminosity bumps given by the program "LUMS", using the hysteresis correction routine. The measurements were made with the vertical intersection scraper in I3.

Conclusions

Using the hysteresis correction routine with "LUMS" on the FP working line, Ring 1, gives vertical beam displacements in Intersection 3 which are too large by 1.5 %. For the displacements required in a normal luminosity calibration, this is a linear error and has to be compared with a similar measurement of 1.27 % made in I7 in 1975 ¹⁾. After correction for this systematic error, the residual errors in the beam displacements, as measured by the I3 scrapers, have an r.m.s. scatter of $\pm 6 \mu\text{m}$.

Measurements and Results

The FP line was set-up in Ring 1 using the files recently recreated by P. Bryant. The central orbit value of Q_v was 8.625. As required by the old hysteresis routine of "LUMS", the H-magnets were set to their required closed orbit values by first cycling to + 100 %. (Since this measurement, R. Keyser has changed the hysteresis routine to accept the standard cycling procedure of setting from - 100 %). Single pulses were accelerated to central orbit and their vertical position measured in I3, with the intersection scrapers, using the programs "PROB" and "SCRO". The PIDC was set to its 800 mA scale except for a period when it was inadvertently changed back to its normal 80A scale.

Table I gives the requested vertical beam positions set by "LUMS", Z_0 and the results of the scraper measurements, Z_m . No measurements could be made for nominal beam positions higher than + 1 mm or lower than - 5 mm as the overlap range of the I3 scrapers is only - 5 to + 3 mm. After completing a normal luminosity cycle 0 to + 1 mm, 0 to - 5 mm and back to 0, a repeat large amplitude cycle was made to - 10 mm and back to 0.

The displacement error $Z_m - Z_0$ is plotted against Z_0 in figure 1. All measurements fall on a straight line with the exception of those taken on returning from - 10 mm. It can be assumed that the present hysteresis routine either cannot follow correctly extra cycles or does not handle correctly large excursions. R. Keyser has since found a program error

which could explain the failure to deal correctly with large excursions.

The measurements made on the first luminosity cycle have been fitted to a straight line which has a slope of + 1.54 %, the residual errors from the fit are 6 μm (rms).

The bump file used assumes on central orbit $Q_v = 8.629$ slightly different to the value for the new FP line used for this measurement. Using the information given by P. Bryant 2), the effect of this $\Delta Q_v = - 0.004$ has been evaluated as a bump error of + 0.046 %. Subtracting this effect due to Q_v leaves an error in the beam displacement scale in I3 of + 1.49 % which has to be compared with the same measurement made in I7 in 1975 1) when an error of + 1.27 % was found (fig. 2).

K.M. Potter

- 1) ISR Performance Report, Test of high precision "LUMS", K. Potter
11/8/1975
- 2) ISR Performance Report, The correction of Vertical Closed Orbit Bumps
for shifts in Q_v , P. Bryant - 7/3/1973.

TABLE I

Results of Intersection 3 scraper measurements

Measurement	Set position Z_0 (mm)	Measured position Z_m (mm)	$Z_m - Z_0$ (mm)
1	0	1.5116	1.5116
2	+1	2.5229	1.5229
3	+1	2.5145 x	1.5145
4	0	1.5039 x	1.5039
5	-1	0.4854 x	1.4854
6	-2	-0.5248 x	1.4752
7	-3	-1.5432 x	1.4568
8	-4	-2.5542 x	1.4458
9	-4	-2.5637	1.4363
10	-5	-3.5767	1.4233
11	0	1.4884	1.4884
12	-5	-3.5763	1.4237
13	-10	-	-
14	-2	-0.5923	1.4077
15	0	1.4468	1.4468

Fitted
to
straight
line

x 80 A scale of PIDC

Ring 1, Intersection 3, FP Central Orbit $Q_V = 8.625$
 (Bump File $Q_{V_{co}} = 8.629$)

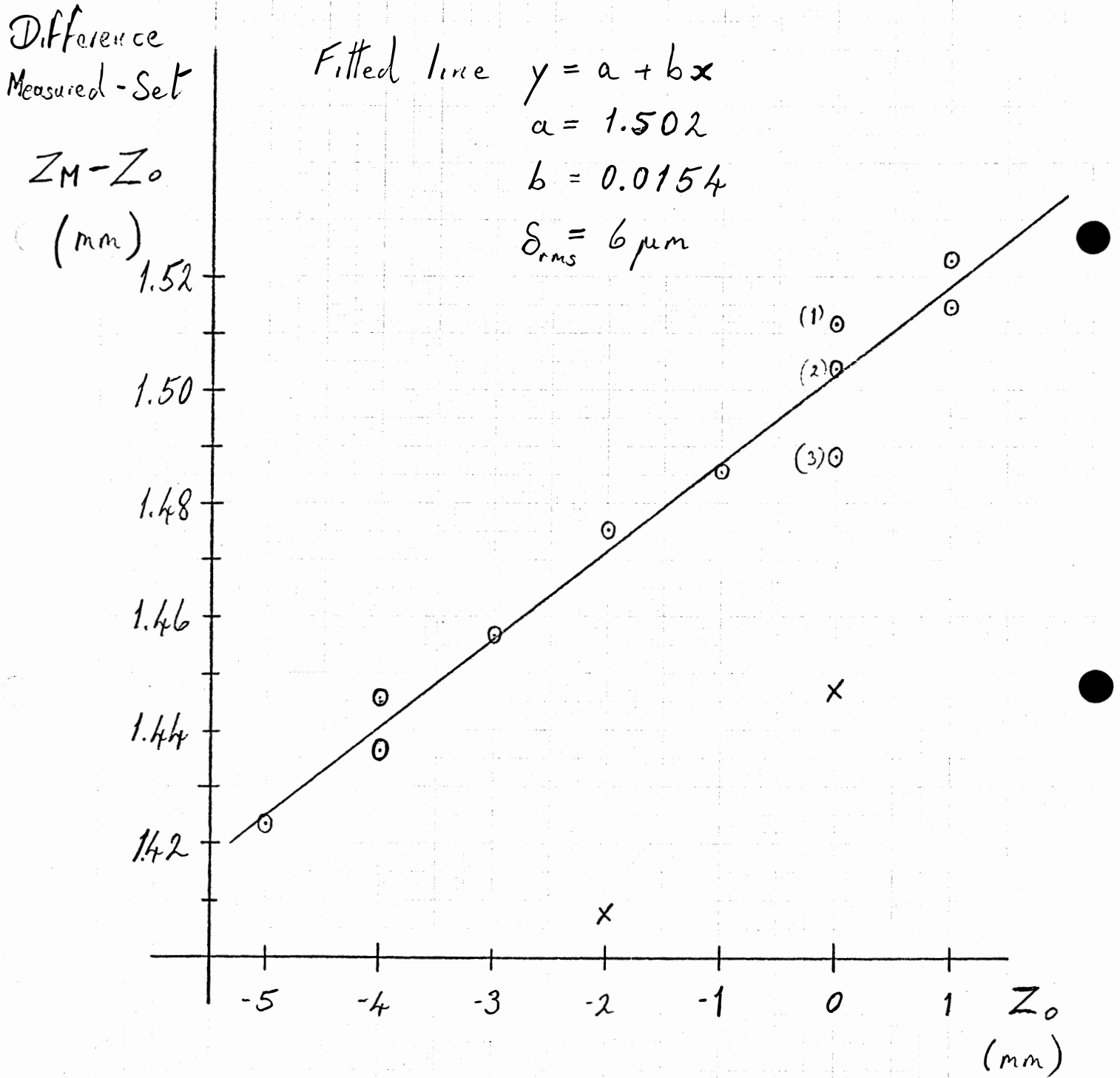


Figure 1: Difference between measured and set displacement in Ring 1 Intersection 3

Intersection 7 Ring 1.

$Q_v (co) = 8.629$

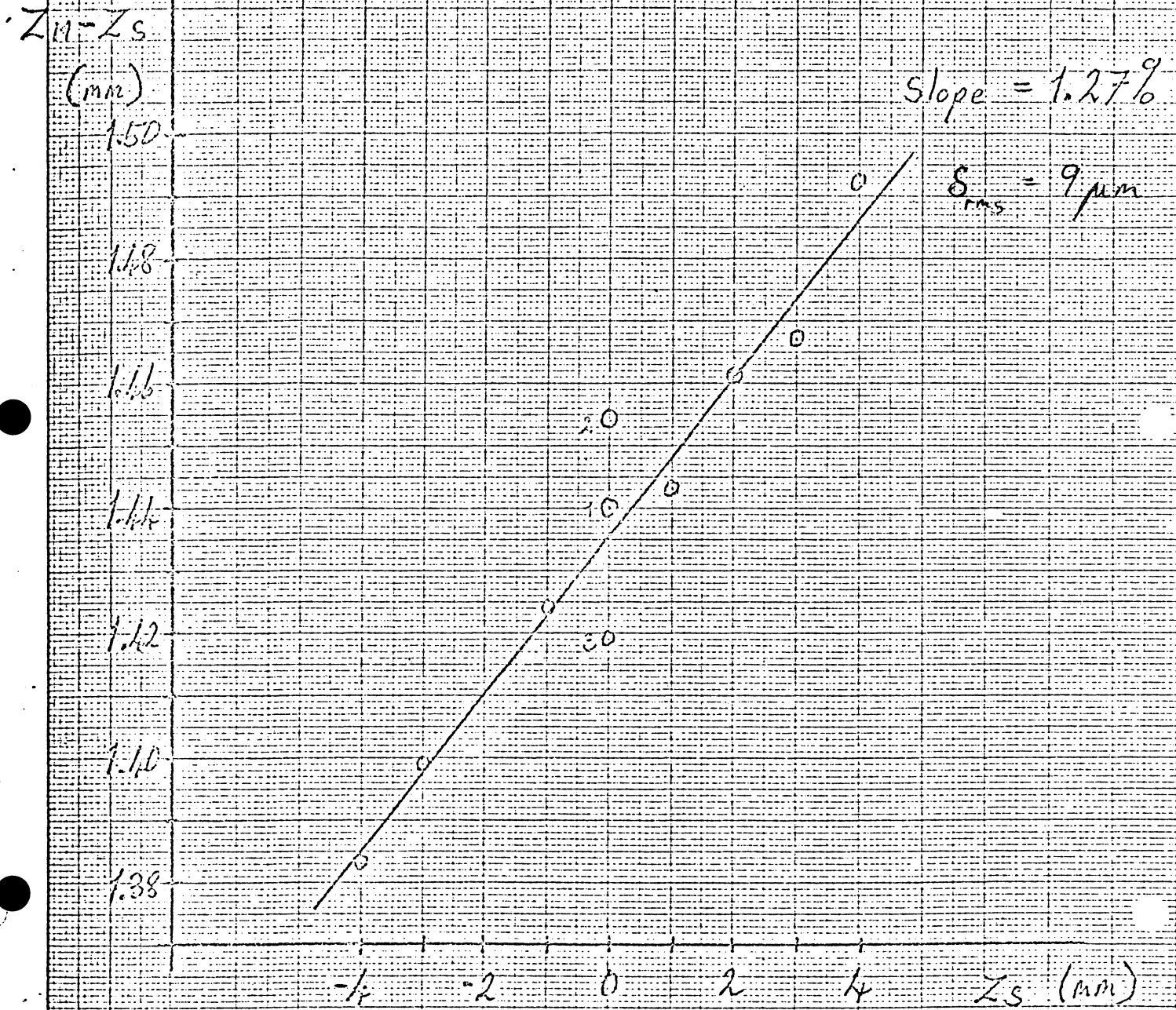


FIGURE 2 : Previous measurement in Ring 1 Intersection 7
(July 1975)