ISR-ES/KP/cc

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ISR Performance Report

RUNS 1116, 1118 and 1125 - Ring 2 - 26 GeV/c - FP and TW

Measurement of Luminosity Bumps with the Magnetic Beam Position Monitor in Intersection 2

Aim

To calibrate the vertical closed orbit bumps used for luminosity measurements using the Magnetic Beam Position Monitor (MBPM) temporarily installed in Intersection 2, Ring 2.

Total cross-section measurements to be made by experiments R 210 and R 211 next year will aim for a precision of better than 1 % and a reproducibility of $\sim$ 0.2 %.

Conclusions

Reasonably reproducible measurements of the beam displacements have been obtained on both the FP and Terwilliger working lines. A comparison of measurements made with the LUMS hysteresis correcting routine and magnet settings made by hand, show no significant difference.

The averaged results suggest that the FP bumps are 2.9 % and TW 3.15 % too large. These values are considerably higher than the results of previous measurements made with scrapers in I3, I5 and I7 [1] (1.2 to 1.5%). In view of the measurements of the $\bar{p}p$ total cross section planned for next year, it is now important to understand if this difference is a genuine difference between I2 and the odd intersection where the scraper measurements have been made or is a result of the different measuring methods.

Measurements and Results

One of the Magnetic Beam Position Monitors normally installed in Intersecion 5, has been temporarily displaced to a position 2 m upstream of intersection 2 on ring 2. The polarity of one of the modulators normally used to apply a local vertical modulation of the beam in I5 has been reversed so that the modulation is no longer local but propagates all round ring 2. The phase of this closed orbit modulatio is such that the amplitude is close to a maximum at the new position of the pick up.

This new arrangement was tested in MD run 1116 using a 5 A stack on an FP working line. It has since been used to make beam position measurements after moving the beam vertically by means of the program LUMS (with the hysteresis correction routine HYST) on both the FP and Terwilliger working lines in order to check the luminosity bumps (Runs 1116 and 1118).

Stacks of approximately 5 A around central orbit were used in all cases and the central orbit Q values checked. The results are shown in figures 1 and 2 and summarized in Table 1.

As the result of this calibration indicated a much larger linear error in the bumps than has been previously measured with scraper measurements in I3, I5 and I7 [1], the measurements were repeated but this time setting the H magnets by hand, having first set them to + 100 % (or - 100 %), and always moving them in the same direction in such a way as to avoid any hysteresis effects. The results are plotted in figures 3 and 4 and, as can be seen from Table 1, are in reasonable agreement with those obtained using LUMS. This agreement together with the linearity and reproducibility of position measurements, even after changing direction of beam movement, suggest that the hysteresis correction of the LUMS program is very effective.

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1) Performance Reports, K. Potter

Measurement of Luminosity Bumps with the I3 Scraper - 15.4.1980
Second test of high precision "LUMS" - 23.10.1975
Measurement of "LUMS" bumps with Terwilliger scheme - 2.4.1975

TABLE 1

Summary of Vertical Bumps calibrations in I2 - Ring 2

Run	Working line	Method of setting bumps	δrms µm	Linear Error in Bumps %
1116	FP	"LUMS" with "HYST"	22	2.94
1118	TW	"LUMS" with "HYST"	21	3.44
1125	FP	by hand	25	2.98
1125	TW	by hand	17	2.88

FP Ring 2 I_2 MBPM

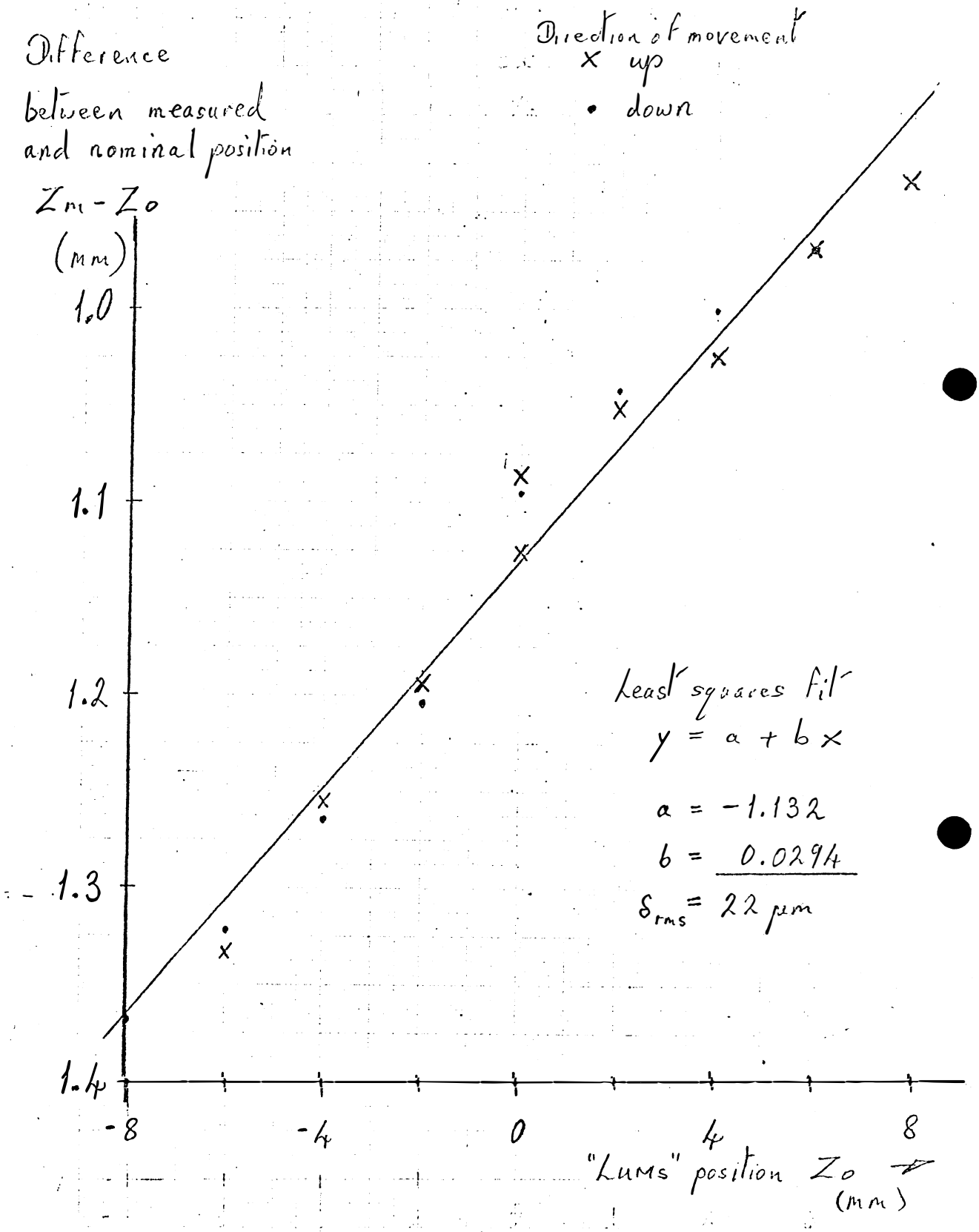

FIG 1 : Comparison of Lums beam displacements with the MBPM.

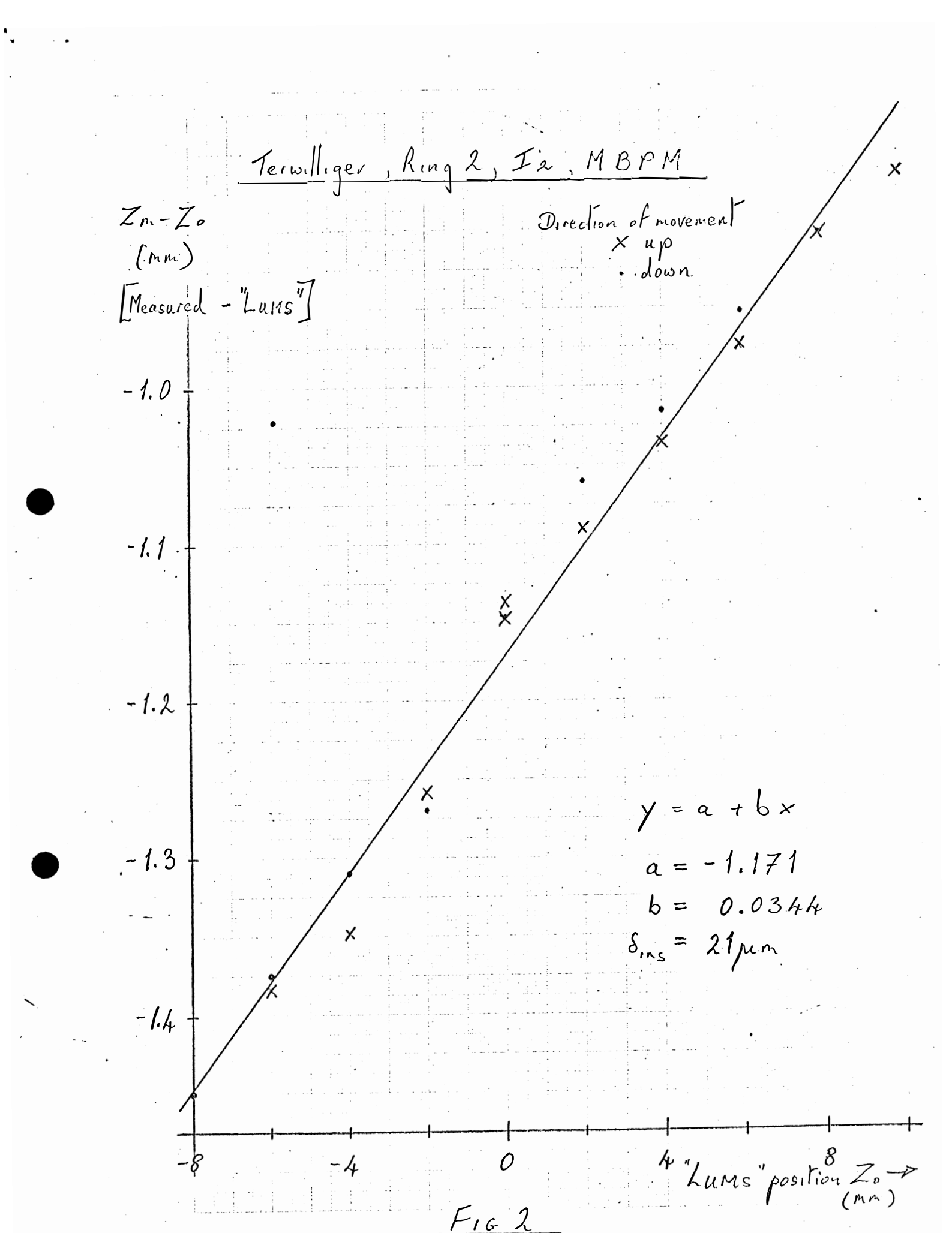
Terwilliger, Ring 2, I2, MBPM
$Z_m - Z_o$ (mm)
[Measured - "Lums"]
Direction of movement
× up
· down
-1.0
-1.1
-1.2
-1.3
-1.4
-8
-4
0
4
8
"Lums" position Z_o (mm)
$y = a + bx$
$a = -1.171$
$b = 0.0344$
$\delta_{ins} = 21\mu m$

FIG 2

TW Ring 2 I2 MBPM

Beam displacements set by hand.

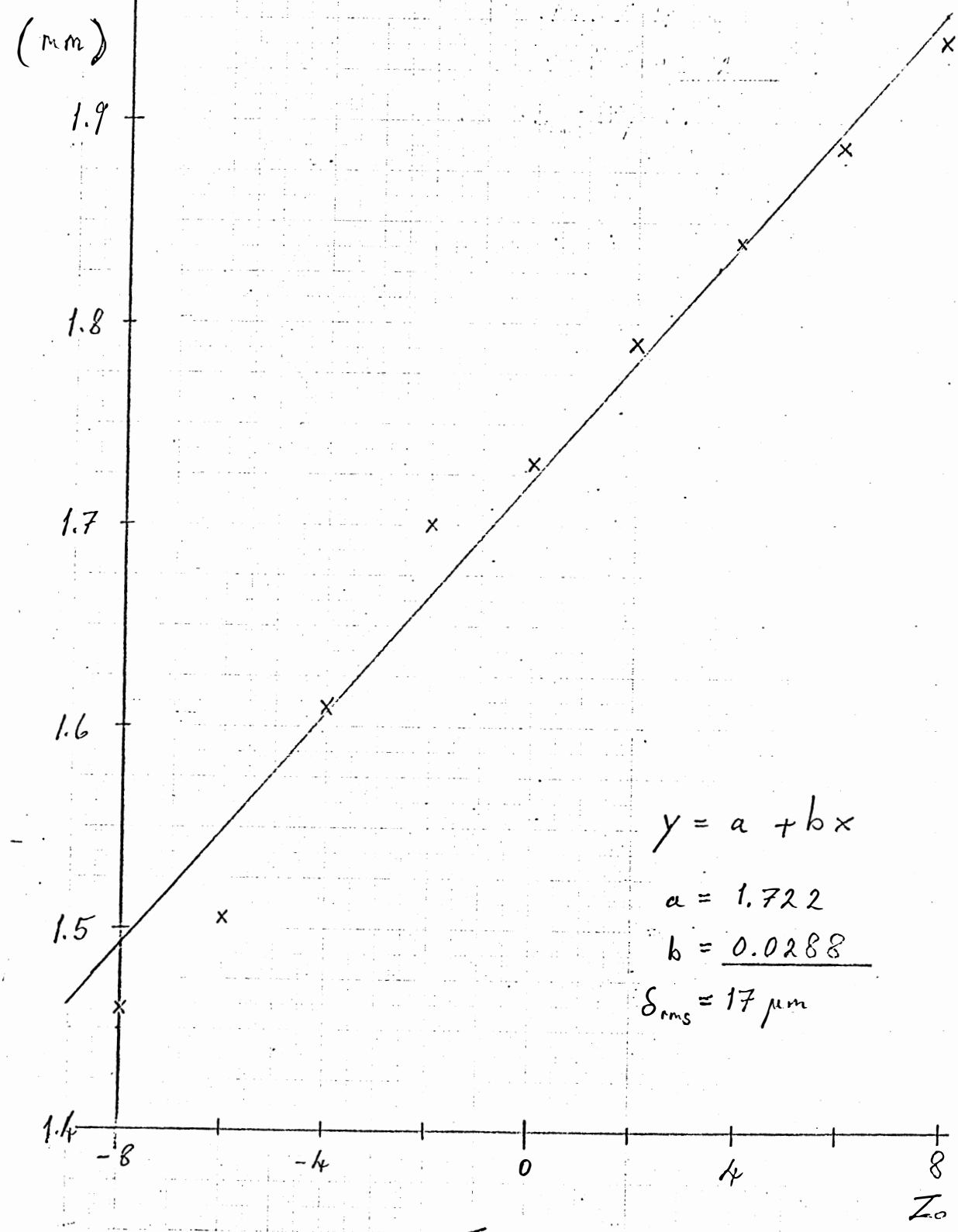

FIG 3

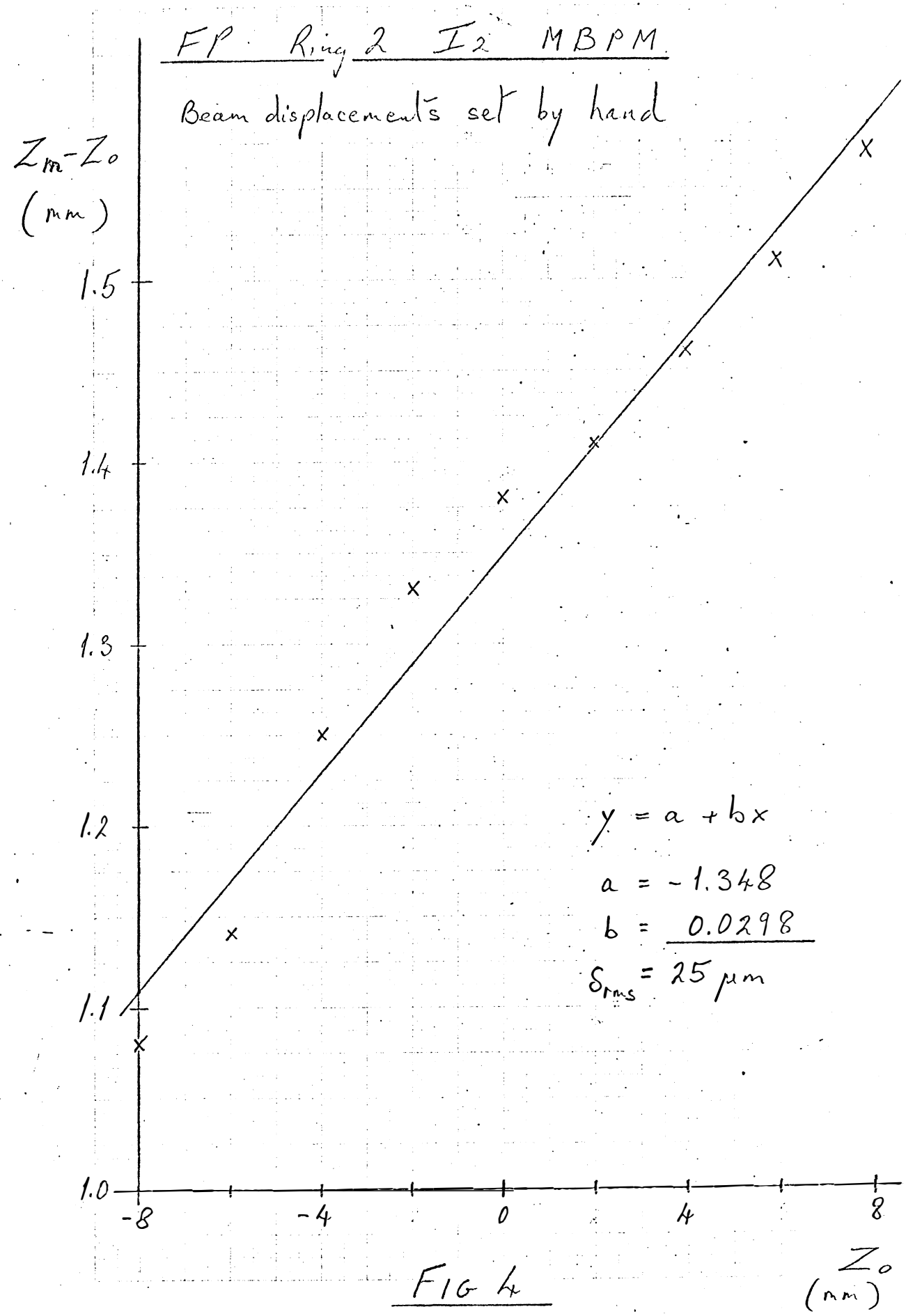
FP Ring 2 I2 MBPM
Beam displacements set by hand
Zm-Zo (mm)
1.5
1.4
1.3
1.2
1.1
1.0
-8
-4
0
4
8
Zo (mm)
y = a + bx
a = -1.348
b = 0.0298
δrms = 25 μm

FIG 4