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Study of the AGS Tune Control, Especially at Extraction

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Subject Study of the AGS Tune Control, Especially at Extraction

Observations

During the first period the high field quads have been programmed in such a way that the working point of the machine was at (ν_x , ν_y) = (8.71 ± 0.01 , 8.80 ± 0.01) during the second half of the acceleration cycle until just before extraction. A further increase of the tunes was not possible due to current limitations of the power supplies. The existing radial shift before extraction caused the tunes to cross at that time. Removing the radial shift at extraction was not possible, while simultaneously keeping extraction losses low (extraction losses are defined as acceptable when H5 < 0.5% and H10 < 1.0%). It was decided that a seperate study of the present extraction set-up was necessary in order to understand this phenomena.

The tunes at extraction with the present extraction set-up (RS7A=-220) are 8.765 horizontal and 8.645 vertical. The tune shift due to the radial shift is 0.12 horizontal and -0.06 vertical. During the second study period an attempt was made to remove the radial shift and to power the high field quads in such a way that the tunes were unchanged. Under these conditions the extraction losses were high and could not be tuned away. Before restoring the machine for HEP an IPM scan and ORBITS were taken for later analysis. The ORBITS showed that besides changing the radius, the residuals in the orbit had changed also, while the IPM scan showed that there was no change in horizontal or vertical beam sizes. It was concluded that the position of the H10 ejector magnet had to be adjusted with respect to the H5 kicker magnet. The exercise was therefore repeated during the third study period. After some tuning it was then possible to extract at high intensity with acceptable extraction losses, typically 0.3% and 0.8% for H5 and H10 respectively. Whether these losses could be reduced even further by more tuning remains an open question at this moment, because of the limited time available during the experiment. In the table below the settings of the different elements are given for the present running (old) set-up and for the final set-up during the study session (new).

Device	old	new
RS7A	-220	0
H10U	2316	2496
H10D	2020	2160
H5AB	3463	3123
H5BB	3410	3070
QHORZ	0	113 A

In figure 1 the difference orbit between the 'new' and the 'old' settings is plotted, showing the huge difference in the 9th harmonic for the cases. In figure 2 the orbits for the two cases are given. The figure shows that the orbit in the 'new' case certainly isn't any worse than in the 'old' case.

Conclusions

It is demonstrated that the radial shift at extraction is not necessary for high intensity machine operation. The H10 ejector magnet has been moved about 4 mm to the outside in the new set-up, which roughly corresponds with the change of the orbit at the H10 position (see figure 1).

Why or if the tunes have to cross before extraction is not yet understood. IPM scans do not indicate that there is exchange of energy between the two transverse planes in either case. Figures 3 and 4 give the IPM scans for the two cases for reference (scans were taken at an intensity of 6 TPPP).

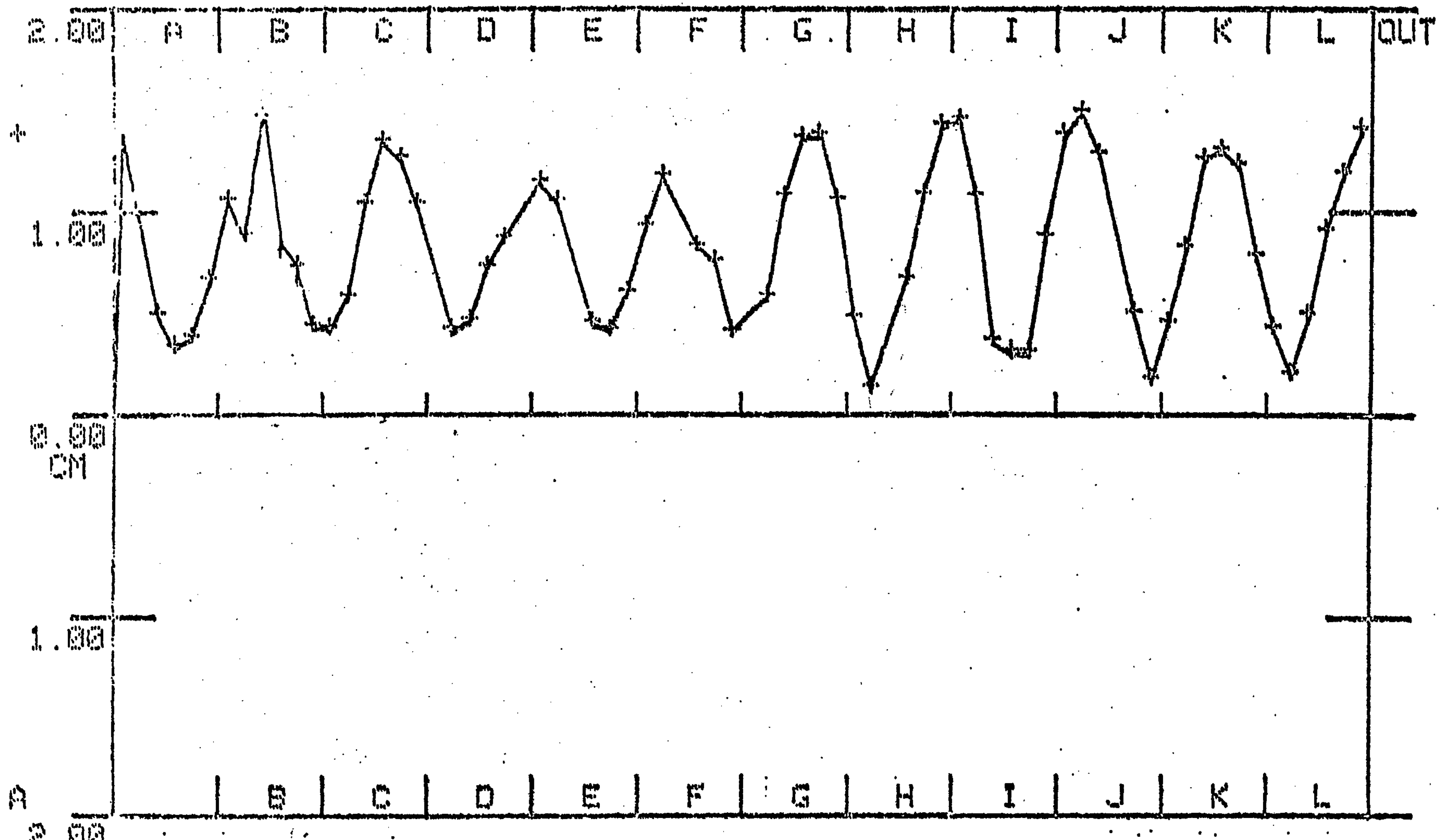
The results of this study suggest that with respect to extractio efficiencies tune shifts due to radial shifts are equivalent to tune shifts due to the high field quads.

The maximum current of the high field quads is insufficient for flexible machine studies. With the radius centred in the high field multipoles (-4 mm with respect to the PUE zero) for instance it is not possible to program the tunes as reported.

***** DIFFERENCE PLOT USING FILE STDD *****

FIGURE 1

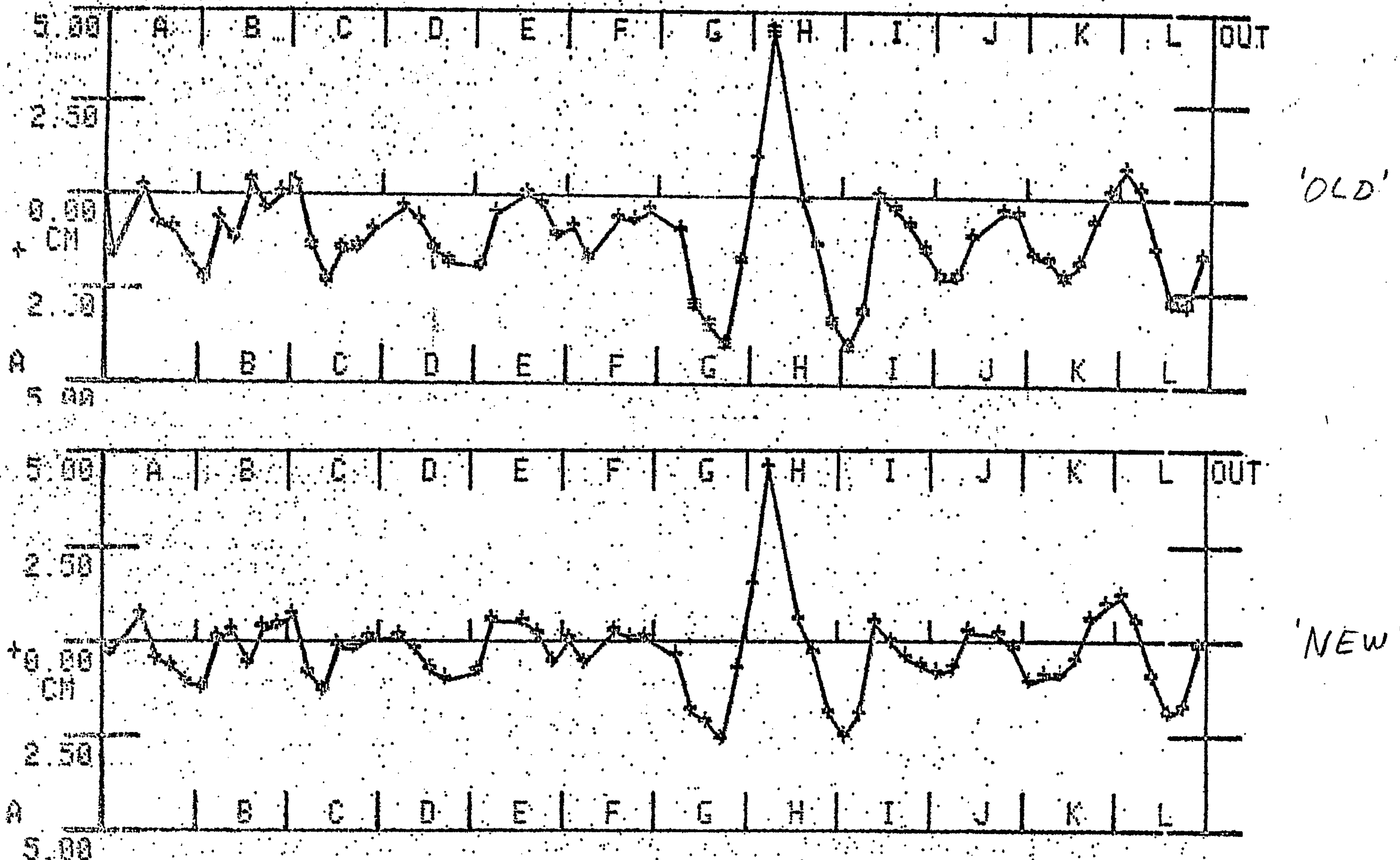
8-APR-86 09:23 HOR. ORBIT @ 444 EXTNL NAVE: 1
NORM BY L20CT = 554 REFER L20CT = 554
AVERAGE DIFF = 0.803



R(RESTART), E(EXIT), S(SAVE FILE), N(NO OUTPUT), L(LOOP), C(NORMC), <CR>(LOOP ONCE):

H	0.93	4.40		-0.17	-1.35	-3.35	H
I	[illegible]	[illegible]	0.01	-0.36	-0.79	-1.45	I
J	-2.16	-2.16	-1.11		-0.41	-0.49	J
K	-1.57	-1.70	-2.17	-1.80	-0.70	0.10	K
L	0.71	0.17	-1.40	-2.82	-2.87	-1.59	L

FIGURE 2



R(RESTART),E(EXIT),S(SAVE FILE),N(NO OUTPUT),L(LOOP),C(NORMC),<CR>(LOOP ONCE):

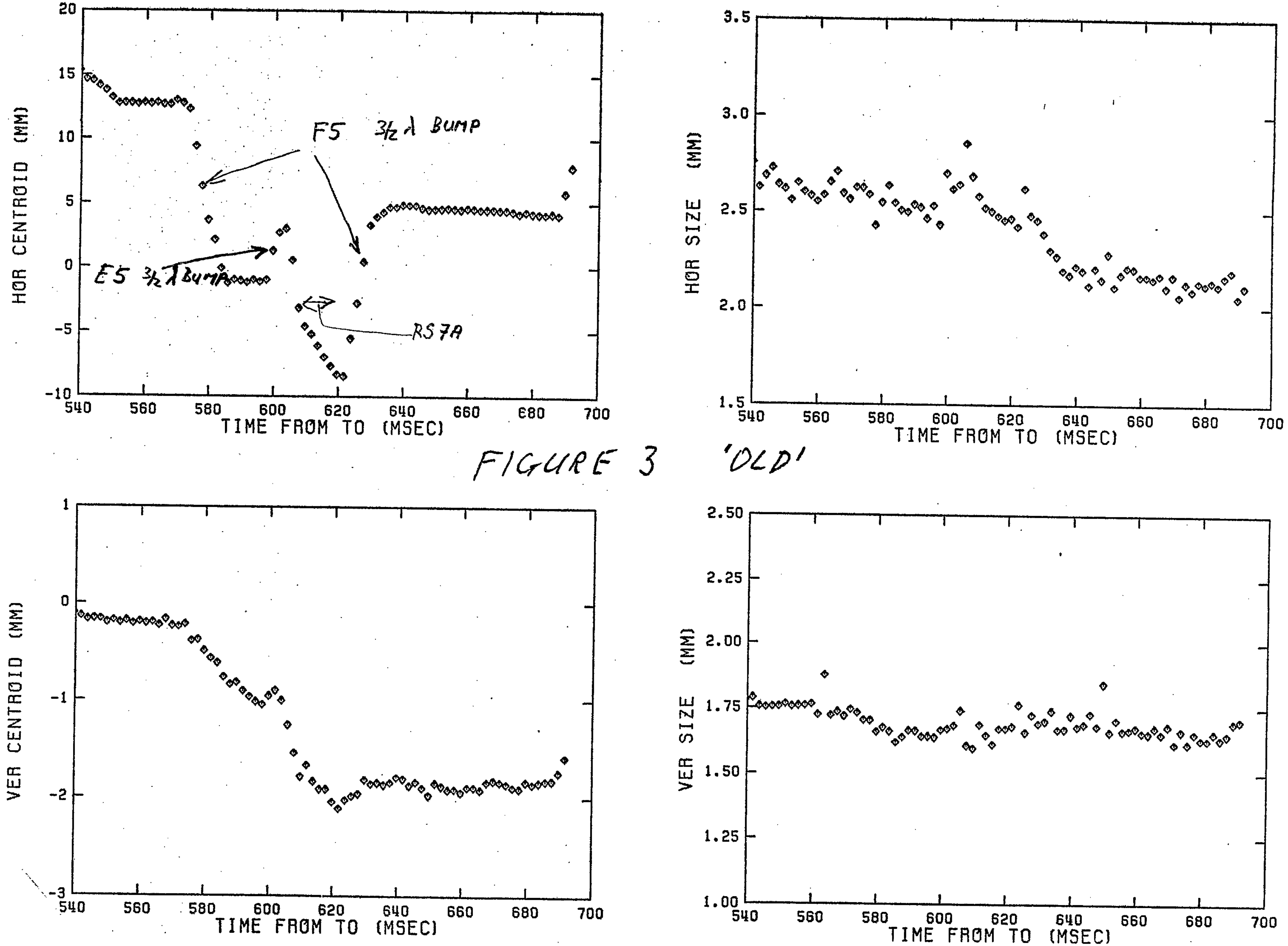

F5 3½λ Bump
E5 3½λ Bump
RS7A
HOR CENTROID (MM)
HOR SIZE (MM)
VER CENTROID (MM)
VER SIZE (MM)
TIME FROM TO (MSEC)

FIGURE 3 'OLD'

8-APR-[illegible] 09:22 484 .IPD   PMPL:03/18/86 11-APR-86 13:[illegible]:05

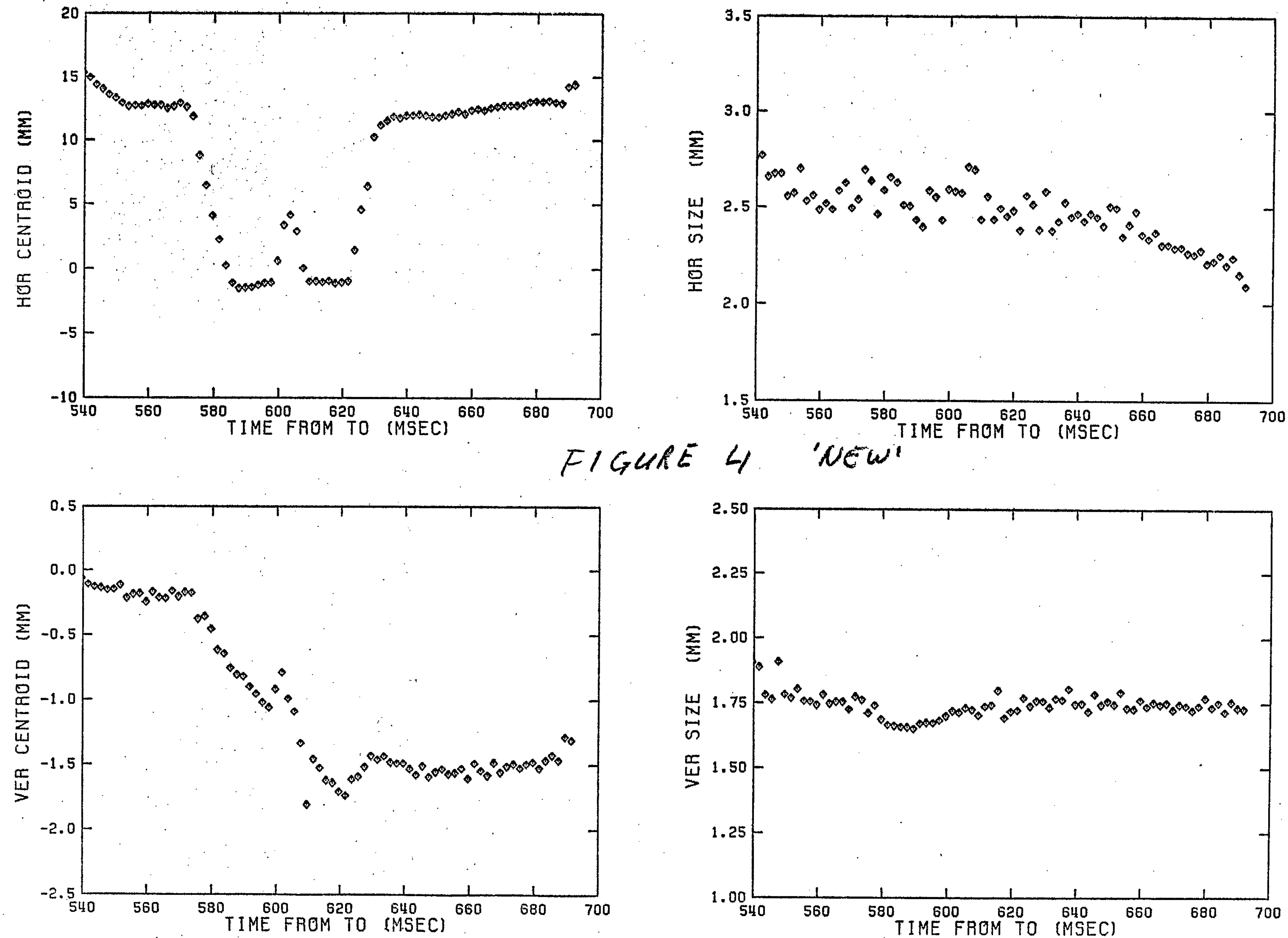


FIGURE 4 'NEW'