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4/5/91
PBAR Note #508

Fixing the Closed Orbits in the Debuncher

Without a large number of new trims the best way to fix the closed orbits in the debuncher is to move quads. There are some obvious features in the vertical orbit, Figure 1, that look like they are indeed orbit distortions. The horizontal orbit, Figure 2, also has some systematic features that can be removed by moving a small number of quads. It is likely that removing these orbit distortions will help in improving the aperture. In addition, the second order effects of such large offsets in the closed orbit, like changes in phase advance due to the sextapoles, could improve operations.

VERTICAL ORBIT

The vertical closed orbit can be improved greatly by moving only four quads, one of which is motorized. Figure 3 shows the changes necessary and the final closed orbit. Orbit distortions of about 9 mm are reduced to about 4 mm. Figure 4 shows that by moving a few more devices the orbit deviations can be improved by another factor of two. I may be worth the extra effort to use the orbit shown in Figure 4.

HORIZONTAL ORBIT

The horizontal closed orbit has two distinct features, a large narrow bump near D3Q3 and a broad lump near D5Q0. Figure 5 shows that the broad lump can be removed by moving two quads and adjusting three trims. The rest of the closed orbit can be smoothed out be moving three more quads and adjusting another trim, as is shown in Figure 6.

STUDY PLAN (Two daytime shifts, plus a little extra time)

Before Day Shift One:

1) Capture some protons and use the motorized D6Q7 to verify that the sign is right in P53.

Day Shift One:

2) Make an access and move the quads as shown in Figure 3. Also move D3Q6 to the horizontal position shown in Figure 6. Moving four to seven quads might take one full shift with several surveying crews.
3) Capture some protons and verify that the orbit has improved in the vertical dimension. Also verify that the sign is right for horizontal orbits in P53.

Day Shift Two:.

4) Make an access and move the rest of the quads as listed in Figure 6. Moving four quads might take one full shift.
5) Capture some protons and verify that the orbit has improved.

FIGURE 1

DEBUNCHER ADJUSTED ORBIT (VERTICAL)

Date/Time: 04/05/91 1413 IMPROVED APERTURE AT 53.1

Intensity: UNAVAILABLE

CONSOLE LOCATION 28, Boo-NW
Adjusted Orbit

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BEAM POSITIONS (mm)

D1Q2	-2.04	D20Q	-3.02	D3Q2	-4.01	D40Q	-1.56	D5Q2	-.08	D60Q	1.39
D1Q4	1.88	D2Q18	-4.5	D3Q4	-1.56	D4Q18	-1.56	D5Q4	2.38	D6Q18	3.36
D1Q6	-.08	D2Q16	-3.52	D3Q6	-4.5	D4Q16	.9	D5Q6	-2.53	D6Q16	-1.07
D1Q8	-.08	D2Q14	.41	D3Q8	2.38	D4Q14	.41	D5Q8	-1.07	D6Q14	-1.56
D1Q10	-5.97	D2Q12	.9	D3Q10	3.86	D4Q12	-.58	D5Q10	-1.56	D6Q12	.41
D1Q12	-2.04	D2Q10	1.39	D3Q12	4.35	D4Q10	-1.07	D5Q12	3.86	D6Q10	-1.07
D1Q14	3.36	D2Q8	1.39	D3Q14	2.38	D4Q8	-2.04	D5Q14	-.58	D6Q8	.9
D1Q16	6.33	D2Q6	-3.02	D3Q16	1.39	D4Q6	-5.48	D5Q16	-.58	D6Q6	-8.92
D1Q18	2.38	D2Q4	4.85	D3Q18	-2.53	D4Q4	1.24	D5Q18	-1.07	D6Q4	-4.01
D20Q	-1.56	D2Q2	-2.04	D40Q	-3.02	D4Q2	-2.04	D60Q	1.88	D6Q2	-6.96

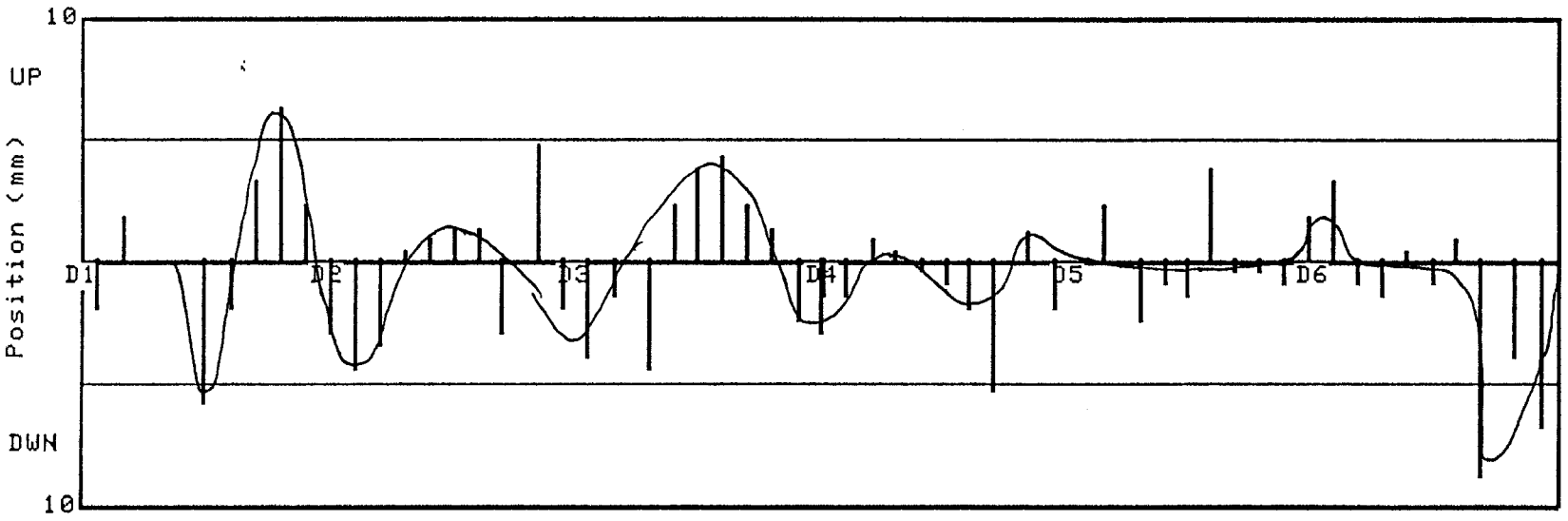


FIGURE 2

DEBUNCHER CLOSED ORBIT (HORIZONTAL)

Date/Time: 04/05/91 1344 IMPROVED APERTURE AT 53.1

Intensity: UNAVAILABLE Deltap/p = -.0005

CONSOLE LOCATION 28, Boo-NW 5-APR-1991 13:43

Adjusted Orbit

BEAM POSITIONS (mm)

D10Q	1.52	D2Q19	2.99	D30Q	2.5	D4Q19	-1.92	D50Q	5.45	D6Q19	-.93
D1Q3	.53	D2Q17	1.52	D3Q3	9.89	D4Q17	.53	D5Q3	3.97	D6Q17	-1.92
D1Q5	-.44	D2Q15	.04	D3Q5	8.9	D4Q15	3.48	D5Q5	8.4	D6Q15	1.02
D1Q7	3.48	D2Q13	-1.92	D3Q7	5.45	D4Q13	-1.92	D5Q7	2.99	D6Q13	.04
D1Q9	-.44	D2Q11	-2.41	D3Q9	-6.85	D4Q11	-1.92	D5Q9	-1.92	D6Q11	-5.86
D1Q11	-1.42	D2Q9	1.02	D3Q11	-3.88	D4Q9	2.99	D5Q11	.53	D6Q9	-1.42
D1Q13	-2.41	D2Q7	4.46	D3Q13	-.44	D4Q7	7.91	D5Q13	1.52	D6Q7	-4.38
D1Q15	-1.92	D2Q5	-3.39	D3Q15	2.01	D4Q5	2.99	D5Q15	-.93	D6Q5	1.52
D1Q17	-1.42	D2Q3	-3.39	D3Q17	-.93	D4Q3	2.01	D5Q17	-5.36	D6Q3	.04
D1Q19	2.01	D30Q	1.02	D3Q19	-1.92	D50Q	5.94	D5Q19	-3.39	D10Q	-.44

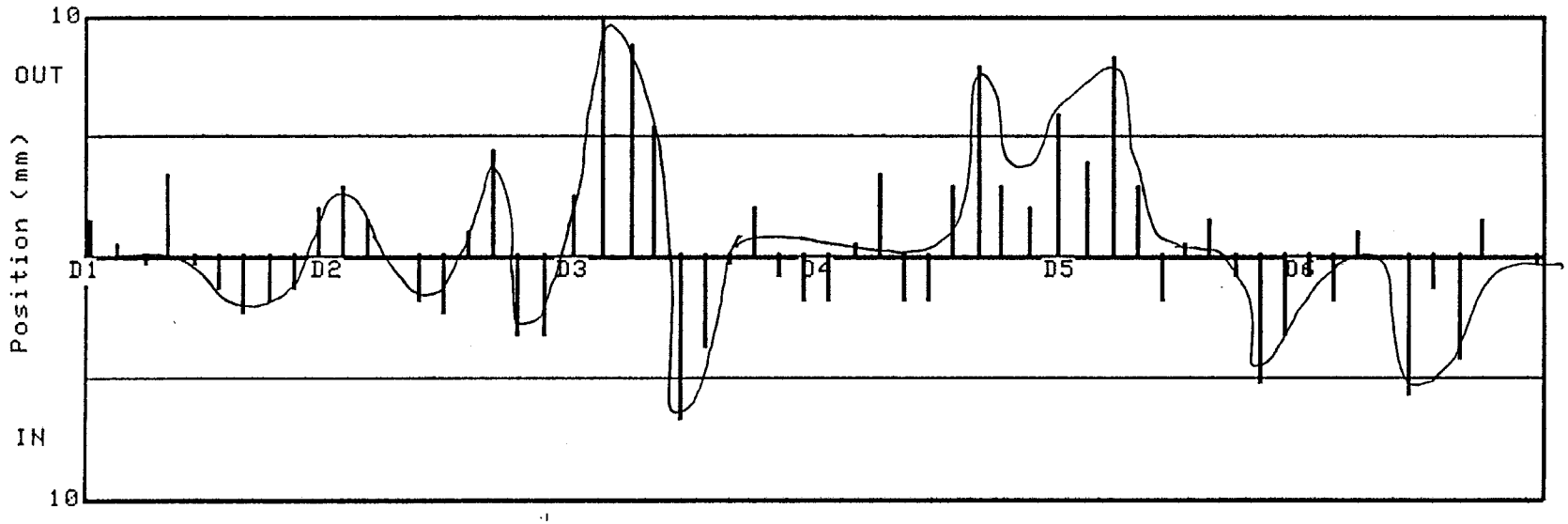
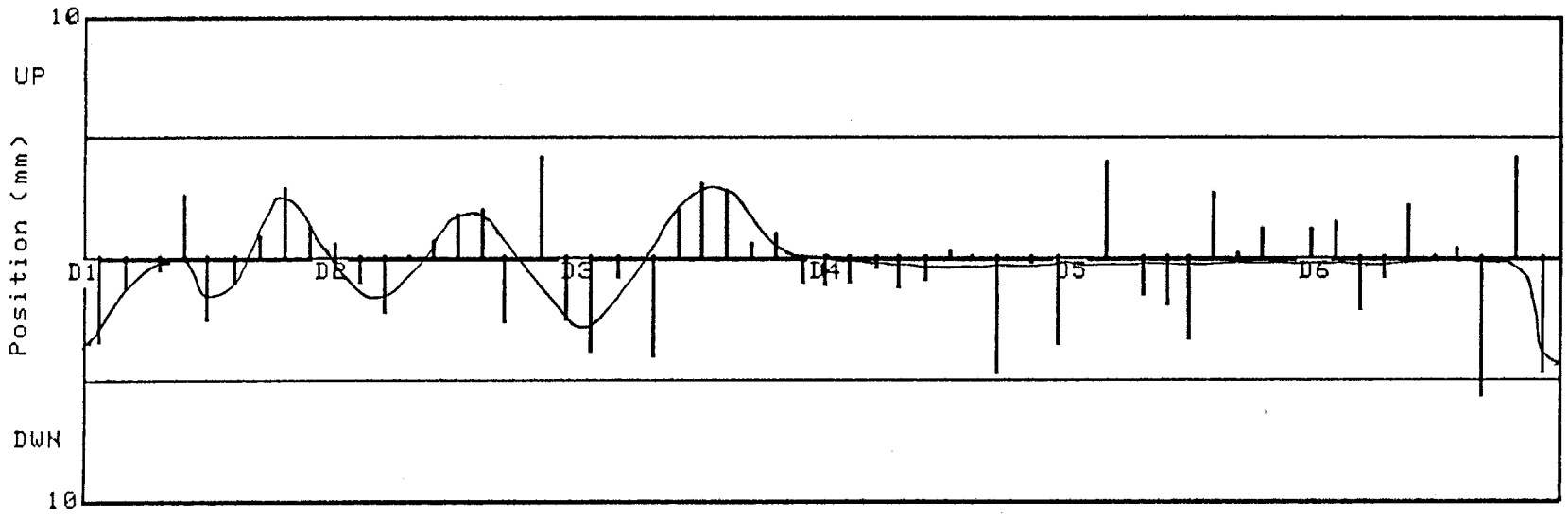


FIGURE 3

DEBUNCHER VERTICAL ORBIT CORRECTIONS

04/05/91 1432

	MAGNET	CORRECTION ANGLE mrad	CORRECTION AMP or mm	WEIGHTED SIGMA mm	MAXIMUM EXCURSION SECTOR	PU	mm
	BEGIN			2.998965	6	VPU6	8.92
1	D6Q7	1.176181	4.978569 DN	2.662618	6	VPU6	9.54
2	D6Q2	.3827261	1.552115 UP	2.503659	6	VPU6	6.2
3	D2Q15	.3629046	1.536112 DN	2.393365	6	VPU6	5.81
4	D3Q11	-.2296837	.9722112 UP	2.315327	6	VPU6	5.85



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Adjusted Orbit

FIGURE 4

DEBUNCHER VERTICAL ORBIT CORRECTIONS

04/05/91 1429

MAGNET	CORRECTION ANGLE mrad	CORRECTION AMP or mm	WEIGHTED SIGMA mm	MAXIMUM EXCURSION SECTOR	PU	mm
BEGIN			2.998965	6	VPU6	8.92
1 D6Q7	2.443669	10.34362 DN	2.662618	6	VPU6	9.54
2 D6Q2	-.0279727	.113441 DN	2.503659	6	VPU6	6.2
3 D2Q15	.5803509	2.456524 DN	2.393365	6	VPU6	5.81
4 D6Q4	.8509949	3.112246 UP	2.217029	6	VPU6	5.58
5 D6Q6	-1.050638	3.919467 DN	2.046924	2	VPU4	5.49
6 D3Q3	.6830941	2.711813 DN	1.986501	2	VPU4	5.94
7 D3Q14	-.3152398	1.367909 DN	1.761447	2	VPU4	5.62

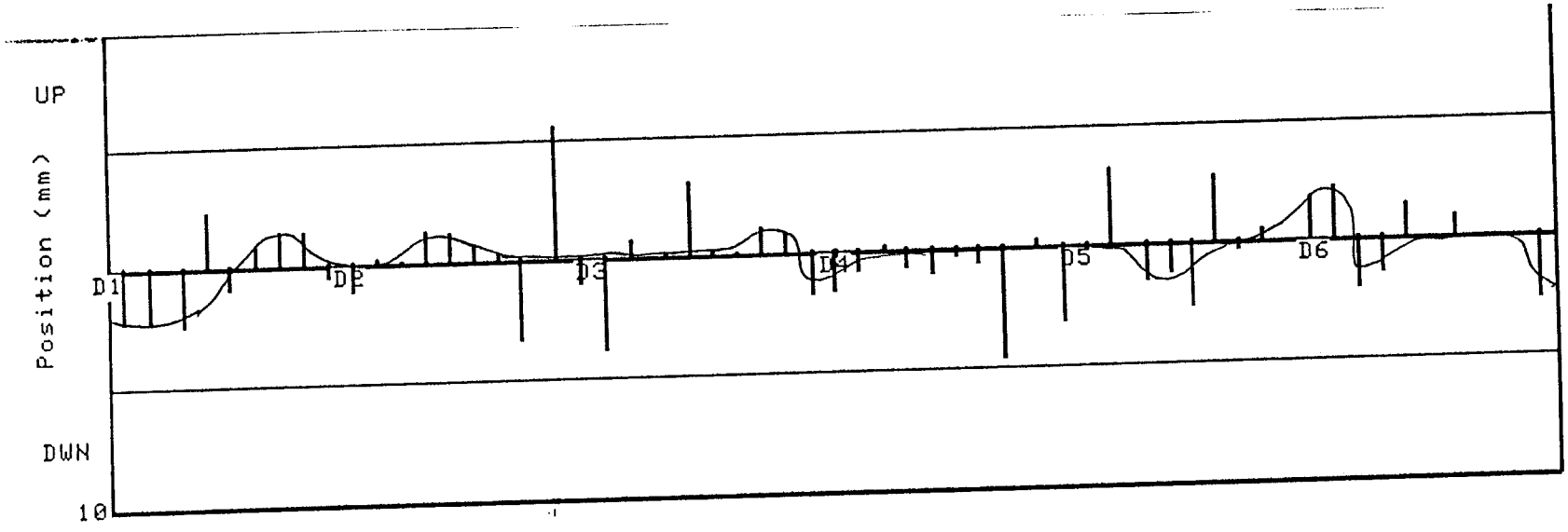

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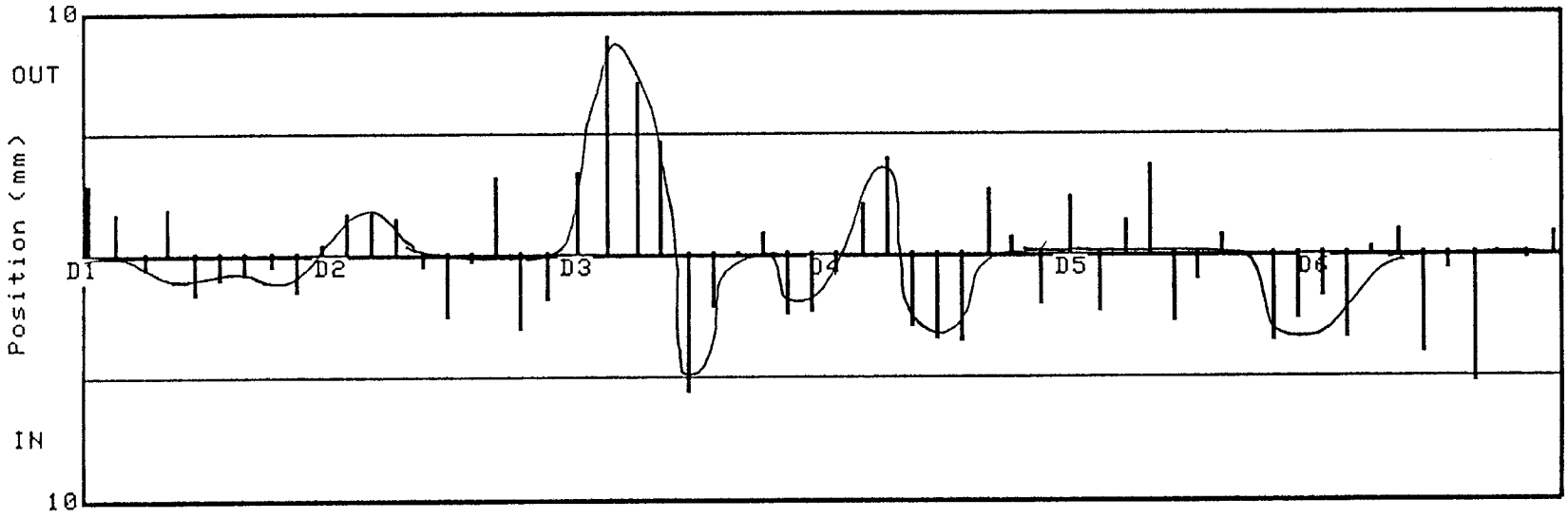
FIGURE 5

DEBUNCHER HORIZONTAL ORBIT CORRECTIONS

04/05/91 1350

	MAGNET	CORRECTION ANGLE mrad	CORRECTION AMP or mm	WEIGHTED SIGMA mm	MAXIMUM EXCURSION SECTOR	PU	mm
	BEGIN			3.493404	3	HPU3	9.88
1	D5Q7	-.6727092	2.847461 IN	3.294707	3	HPU3	9.57
2	D5H1	-1.374449	20.5701 AMP	3.096107	4	HPU7	9.08
3	D4H5	-1.168983	17.36367 AMP	2.978693	3	HPU3	9.44
4	D4Q11	-.4930662	2.087063 IN	2.850125	3	HPU3	8.63
5	D4H3	-.1752637	2.603306 AMP	2.752508	3	HPU3	9.08



CONSOLE LOCATION 28, Boo-NW
Adjusted Orbit

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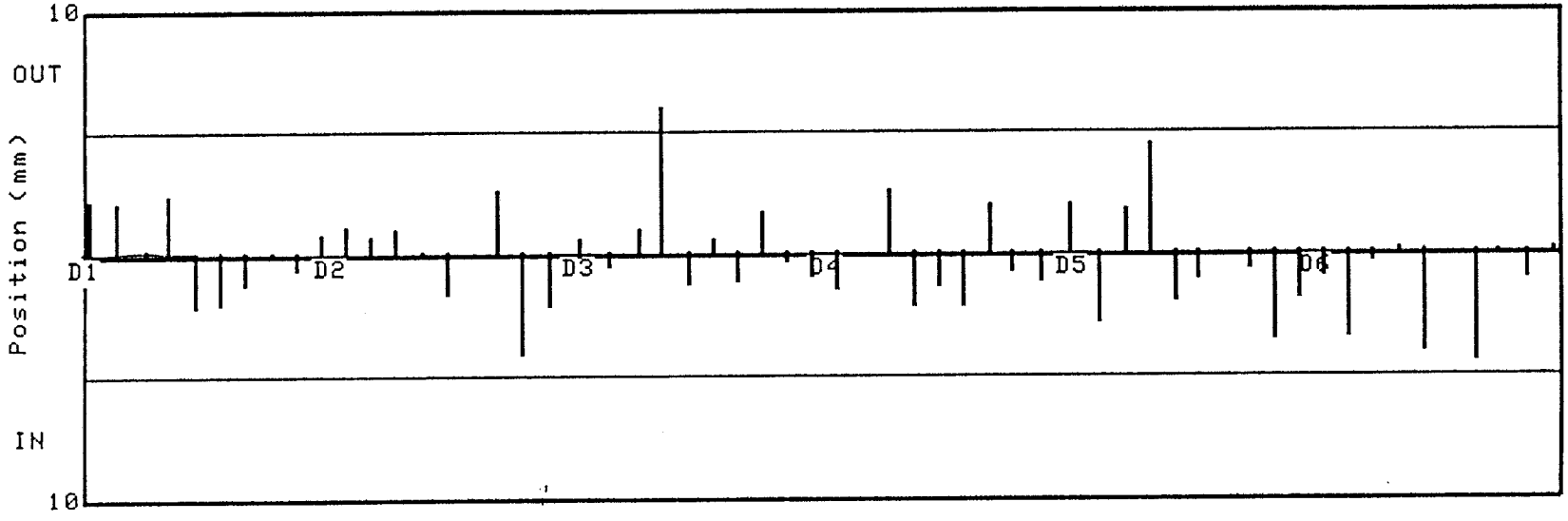
FIGURE 6

DEBUNCHER HORIZONTAL ORBIT CORRECTIONS

04/05/91 1354

	MAGNET	CORRECTION ANGLE mrad	CORRECTION AMP or mm		WEIGHTED SIGMA mm	MAXIMUM EXCURSION SECTOR	PU	mm
	BEGIN				3.493404	3	HPU3	9.88
1	D5Q7	-.6416636	2.71605	IN	3.294707	3	HPU3	9.57
2	D5H1	-1.257636	18.82186	AMP	3.096107	4	HPU7	9.08
3	D4H5	-.9298235	13.81128	AMP	2.978693	3	HPU3	9.44
4	D4Q11	-.489331	2.071253	IN	2.850125	3	HPU3	8.63
5	D4H3	-.4154183	6.170481	AMP	2.752508	3	HPU3	9.08
6	D2Q2	-.5794088	2.349747	OUT	2.580286	3	HPU3	7.01
7	D3Q6	-.7694728	2.862812	OUT	2.224947	3	HPU7	6.27
8	D3Q13	.4055969	1.716821	OUT	2.128057	3	HPU7	7.01
9	D2H1	-.5805165	8.622793	AMP	1.97902	3	HPU7	6.04



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