Mole Measurement of DCA310 Collar-Keyed Assembly

TS-SSC 91-132
S. Delchamps
June 28, 1991

Introduction: The DCA310 collar-keyed assembly, with end clamps installed at both ends, was moled on June 24th and 25th.[1] This memo presents preliminary results on the harmonics and mole systematics from this measurement. After a summary of data files, measured harmonics are presented and compared to limiting values for the SSC. Figures showing the longitudinal dependece of several harmonics and of the mole horizontal and vertical position in the bore tube are shown.

Data Files: Due to problems with the mole software and hardware, the measurement was broken into several data files, which were then concatenated on the VAX for further analysis. As usual, the first file written was a "centering file." (By mistake, this file was named DCA310_001 instead of the usual DCA310_000.) The other two files contain the +10 A, -10 A, and 0 A data from 26 positions along the length of the collared coil assembly. Table 1 gives a summary of the files used. These files are all contained in the directory MDTF01::SSC$ROOT:[SSC].

HP File Name	VAX File Name	Data Contained
DCA310_000	DCA310_000.READMOLE	1-28 (±10A), 53-66 (0A)
DCA310_001	DCA310_001.READMOLE	Centering data
DCA310_002	DCA310_002.READMOLE	29-52 (±10A), 67-78 (0A)

Table 1. Hewlett-Packard and VAX File Names

The files shown in Table 1 have been copied to the project area subdirectory TS_SSSC_PRJ$HROOT:[HARMONICS.MOLE.DCA310]. Here they have been converted into three reduced files. COLLAR.DAT contains the 52 records of ±10A data. COLLAR.REM contains the 26 records of 0A data. COLLAR.CEN contains the 10 records of centering data.

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[1]TS-SSC 91-131, "Run Plan for Mole Measurement of DCA310 Collared Coil Assembly."

Distribution: J. Carson, J. DiMarco, R. Hanft, W. Koska, M. Lamm, G. Pewitt, J. Strait, M. Wake

Results: The program MULTI_PROCESS was run on the file COLLAR.DAT to obtain the skew and normal harmonics shown in Table 2.

For each harmonic, the average and R.M.S. over ±7 m from magnet center are given. The SSC systematic and random tolerances[2] for each harmonic are shown in the table. The average value over the entire lattice of any harmonic must be less than the Systmatic value given in the table, and no magnet may fall further than three times the Sigma value from the mean.

Pole	Average Value	R.M.S.	SSC Systematic	SSC Sigma
b2	-2.33	0.15	<0.80	1.15
b4	0.28	0.03	<0.08	0.22
b6	-0.05	0.01	<0.013	0.018
b8	0.06	0.01	<0.01	0.0075
b10	0.02	0.00		
b1	-0.15	0.31	<0.04	0.50
b3	-0.02	0.06	<0.026	0.16
b5	-0.01	0.02	<0.005	0.017
b7	0.00	0.00	<0.005	0.01
b9	0.00	0.01		
b11	0.00	0.00		
a1	0.86	0.39	<0.04	1.25
a2	0.39	0.28	<0.32	0.35
a3	-0.39	0.07	<0.26	0.32
a4	0.05	0.04	<0.01	0.05
a5	0.03	0.03	<0.005	0.05
a6	0.00	0.01	<0.005	0.008
a7	0.00	0.00	<0.005	0.01
a8	0.01	0 01	<0.005	0.0075
a9	0.00	0.01		
a10	0.00	0.00		
a11	0.00	0.00		

Table 2. Average and R.M.S. Harmonics for DCA310 Compared with SSC Systematic and R.M.S. Multipoles (prime units at 1cm)

Only the harmonic b8 (normal 18-pole) lies outside the tolerance band. This is the built-in harmonic which is used to infer the radial position of the mole at each longitudinal position in the magnet by its "feed-down" to the unallowed 16-pole, b7. Some skew quadrupole, sextupole and octupole are seen to be present.

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[2]50 mm Collider Dipole Magnet Requirements and Specifications (Fermilab "Yellow Book"), October, 1990.

Additional Figures: Figures 1a and 1b show the average and R.M.S. values of the skew (an) and normal (bn) harmonics over ±7 meters from magnet center.

Figures 2a, 2b, and 2c show the normal sextupole, normal decapole, and skew quadrupole as a function of mole center position (the mole has ~24" active length) with respect to magnet center.

The sextupole seems to have a systematic "tilt" along the magnet. Its mean value of -2.33 units is somewhat more positive than the most recently built 50 mm aperture model dipole magnets DSA323 and DSA324.[3]) The decapole value is typical of the model magnets. The variations in the skew quadrupole are large compared to its average value. However, it seems to have an overall value greater than zero.

Figures 3a and 3b show the mole position offset from aperture center in mils calculated using the feed-down from the normal 18-pole to the normal 16-pole. (That is, it is assumed that any 16-pole that is present is from such feed-down, and the multi-poles are corrected accordingly.)

For additional information on these measurements, please contact Steve Delchamps at (708) 840-2416 or send E-mail to FNAL::DELCHTS.

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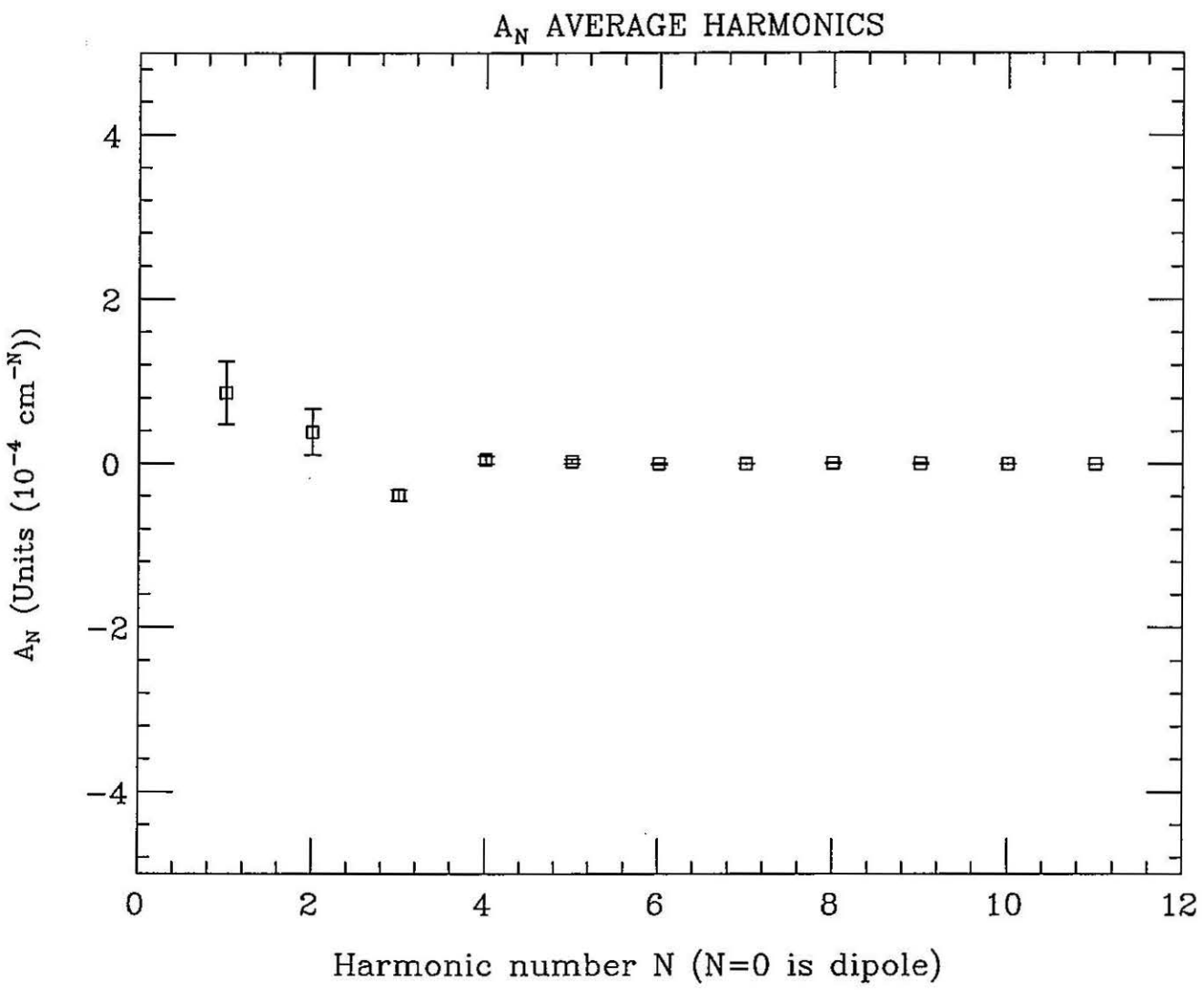
[3]M. Lamm et al., "Magnetic Field Measurements of 1.5 Meter Model SSC Collider Dipole Magnets at Fermilab", presented at the 6/91 Leningrad conference.

Figure 1a

DCA310 Warm Mole

1-JUL-91 17:21:10

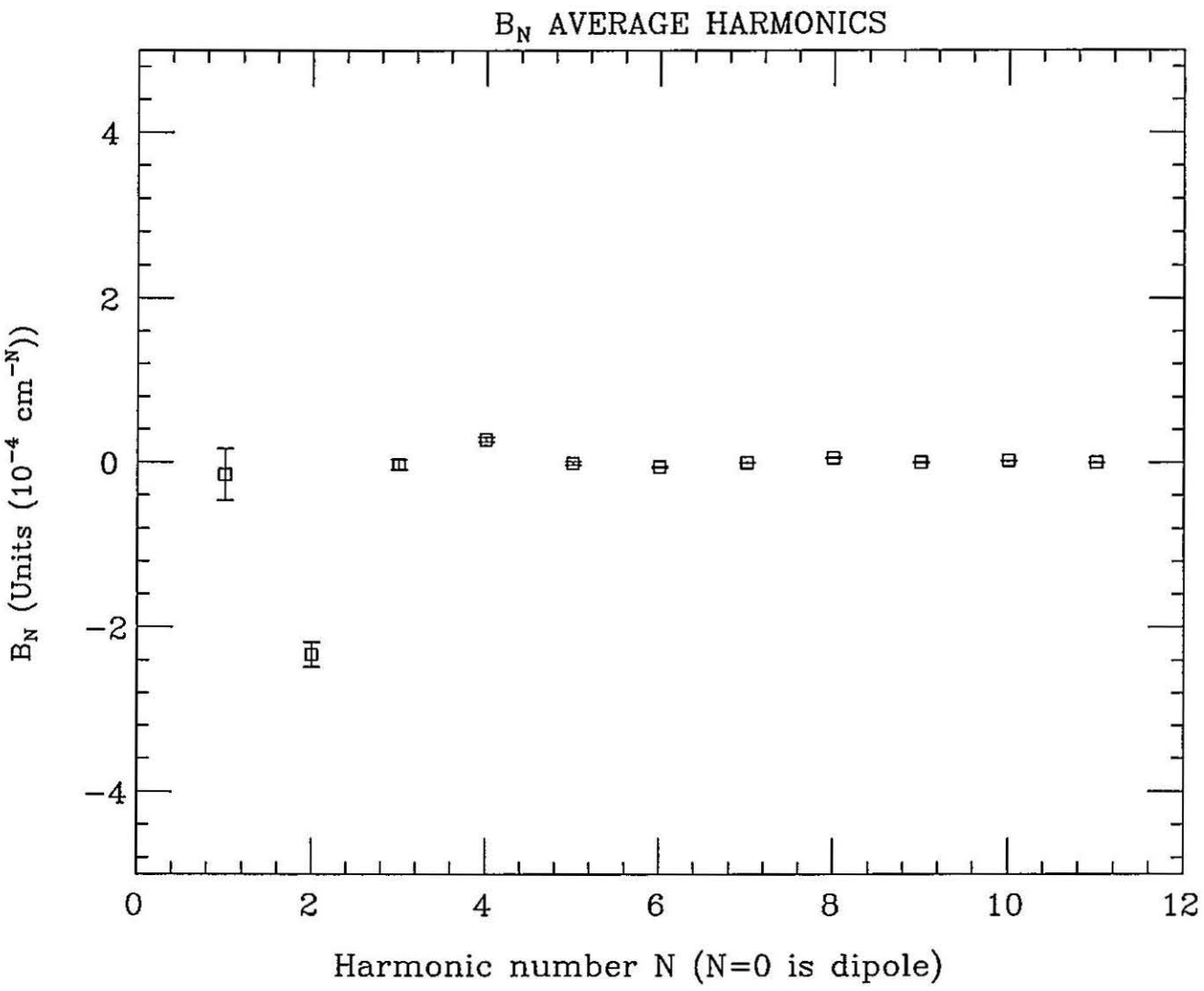


□ DCA310 0 24 Jun 1991 warm data 10. Amps DCA310 Yoked before cold-testing

Figure 16

DCA310 Warm Mole

1-JUL-91 17:21:10

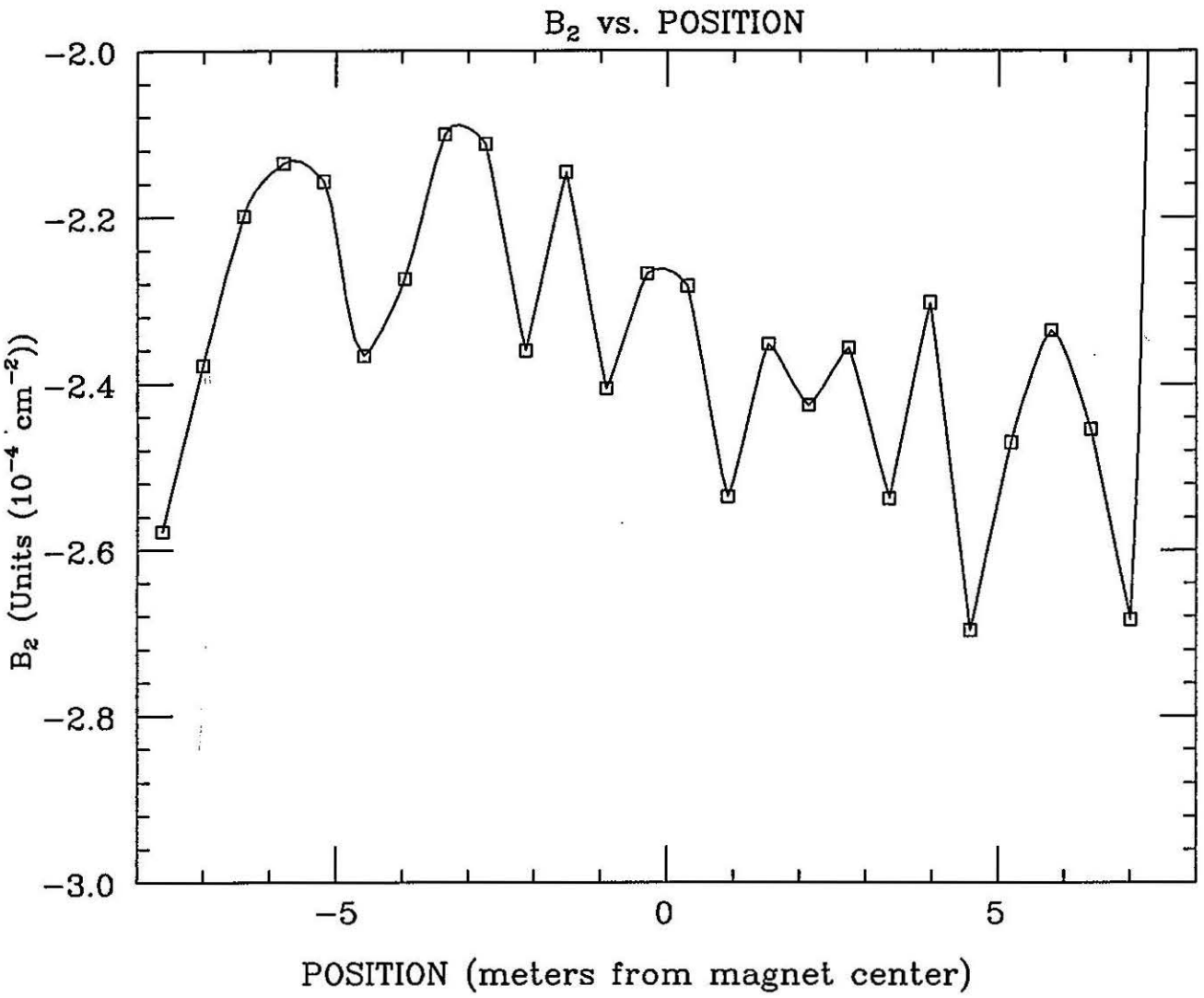


□ DCA310 0 24 Jun 1991 warm data 10. Amps DCA310 Yoked before cold-testing

Figure 2a

DCA310 Warm Mole

25-JUN-91 12:08:27

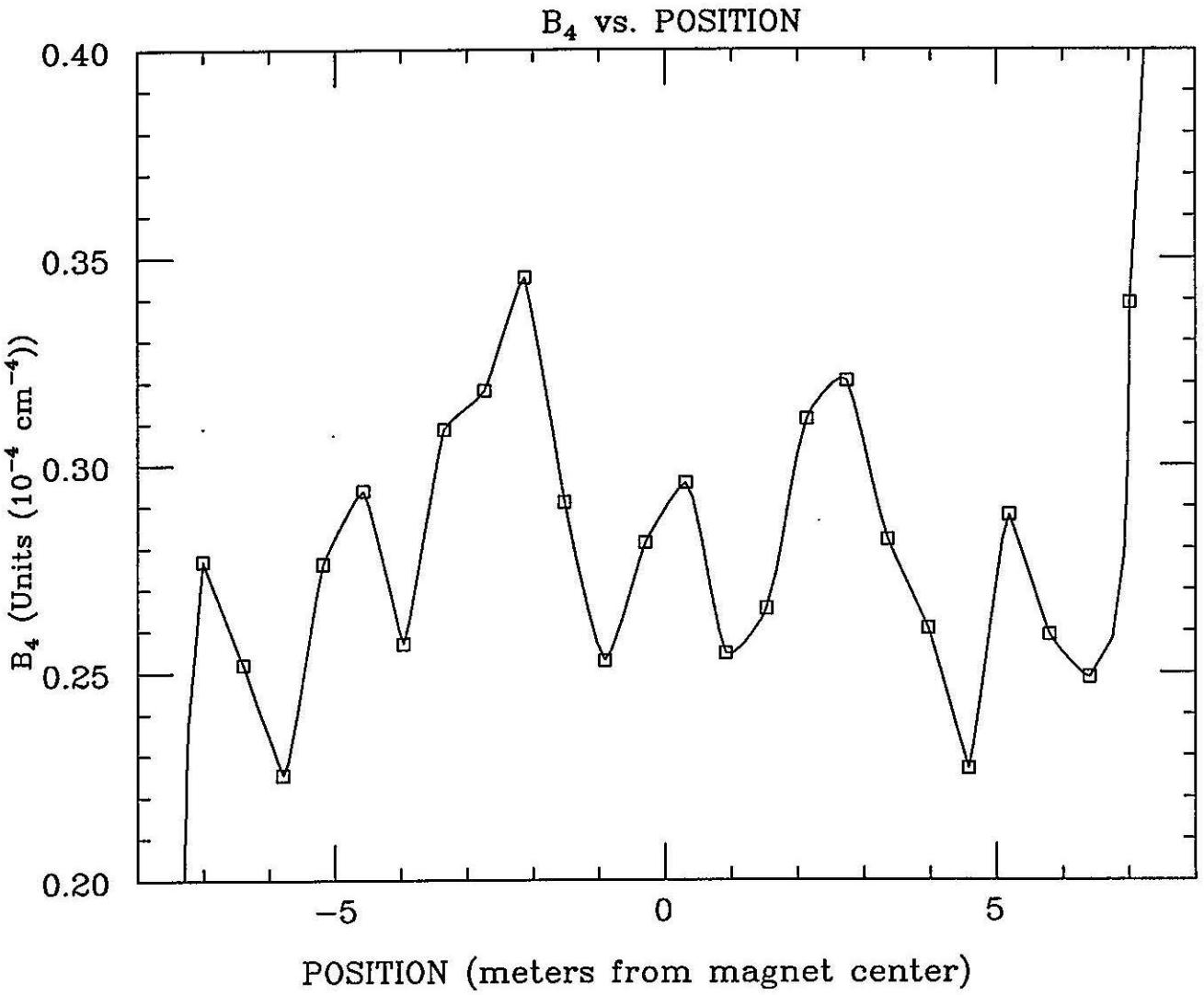


□ DCA310 0 24 Jun 1991 warm data 10. Amps DCA310 Collared Coil Assembly

Figure 26

DCA310 Warm Mole

25-JUN-91 12:08:27

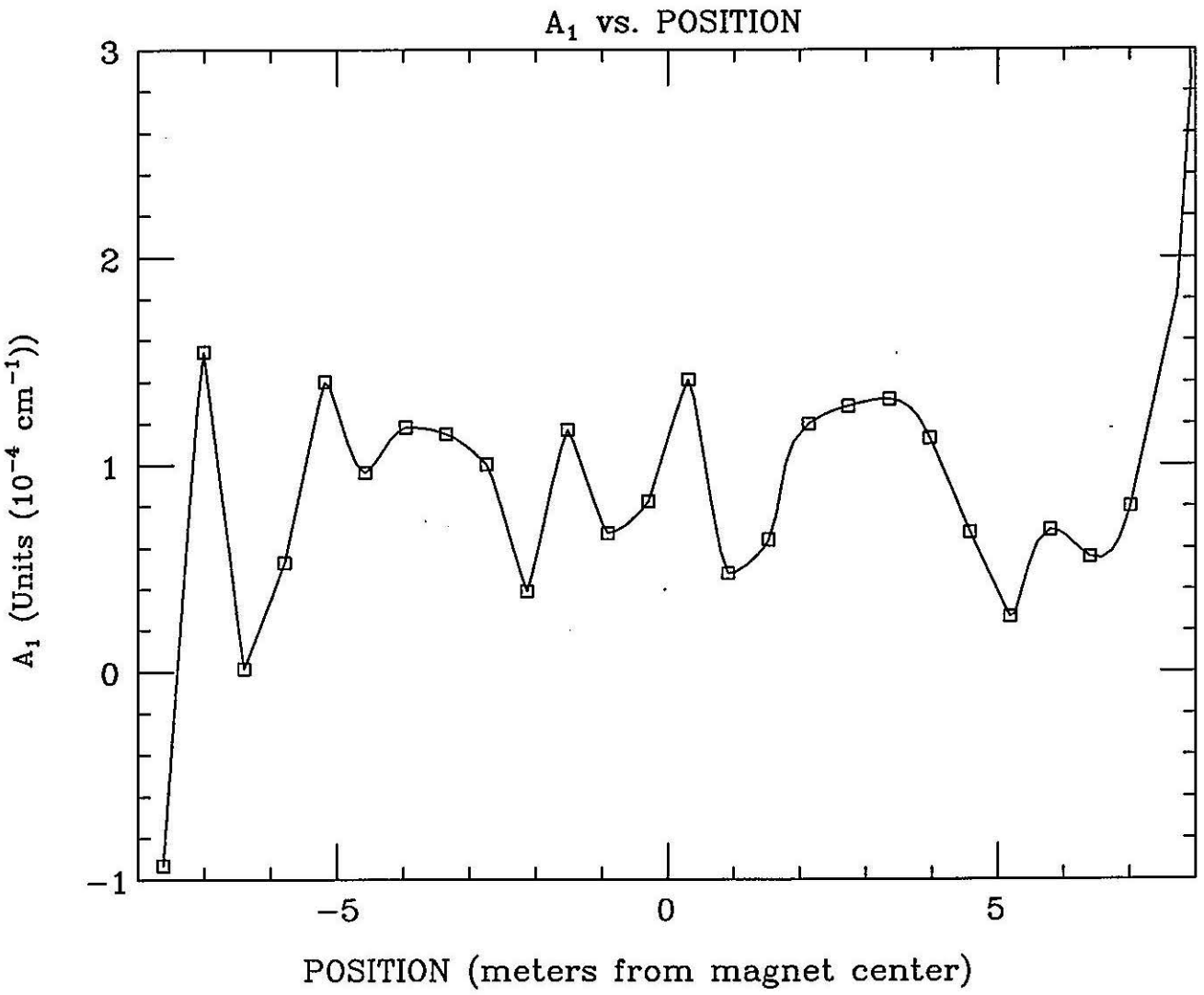


□ DCA310 0 24 Jun 1991 warm data 10. Amps DCA310 Collared Coil Assembly

Figure 2c

DCA310 Warm Mole

25-JUN-91 12:08:26

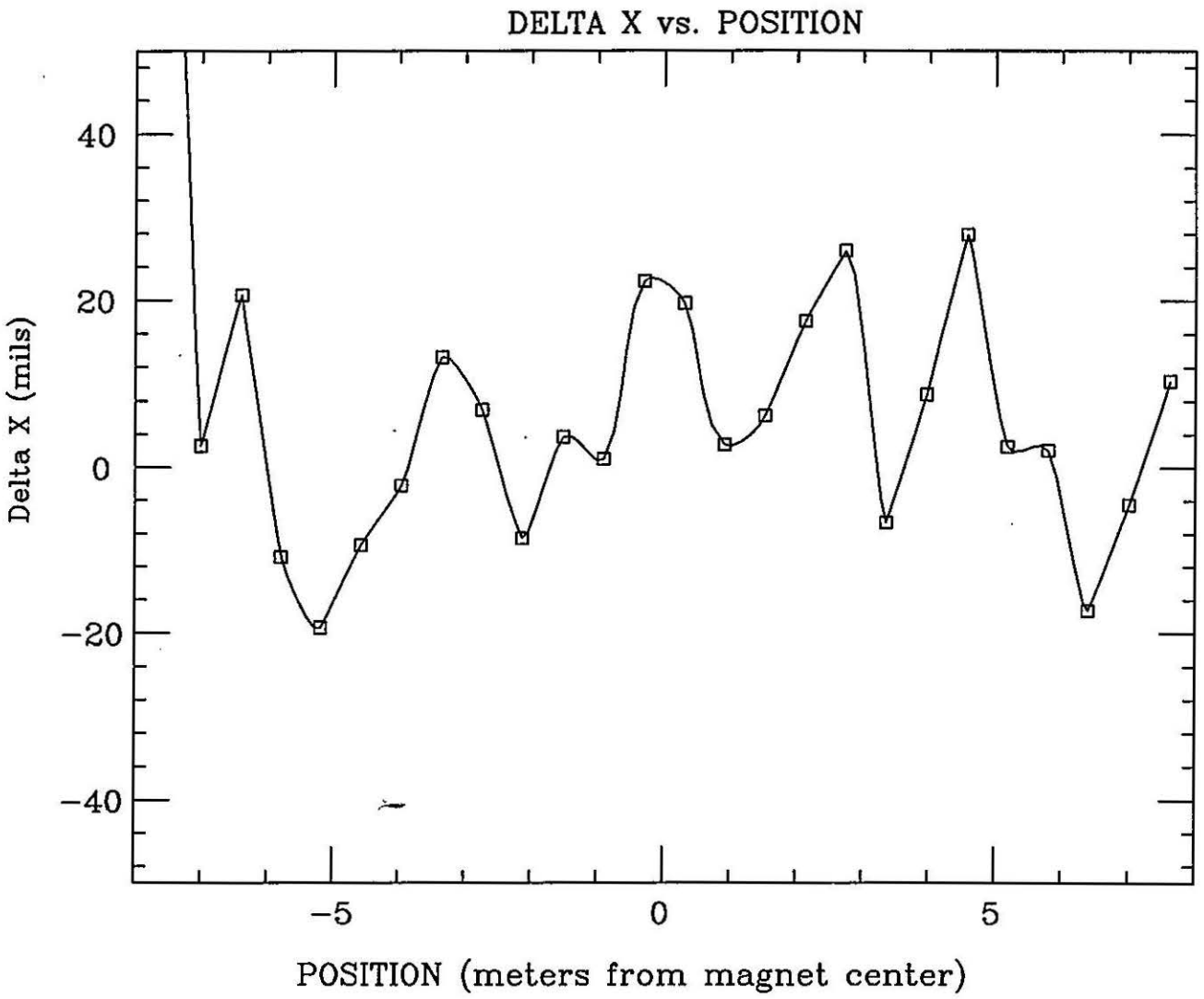


□ DCA310 0 24 Jun 1991 warm data 10. Amps DCA310 Collared Coil Assembly

Figure 3a

DCA310 Warm Mole

25-JUN-91 12:08:27

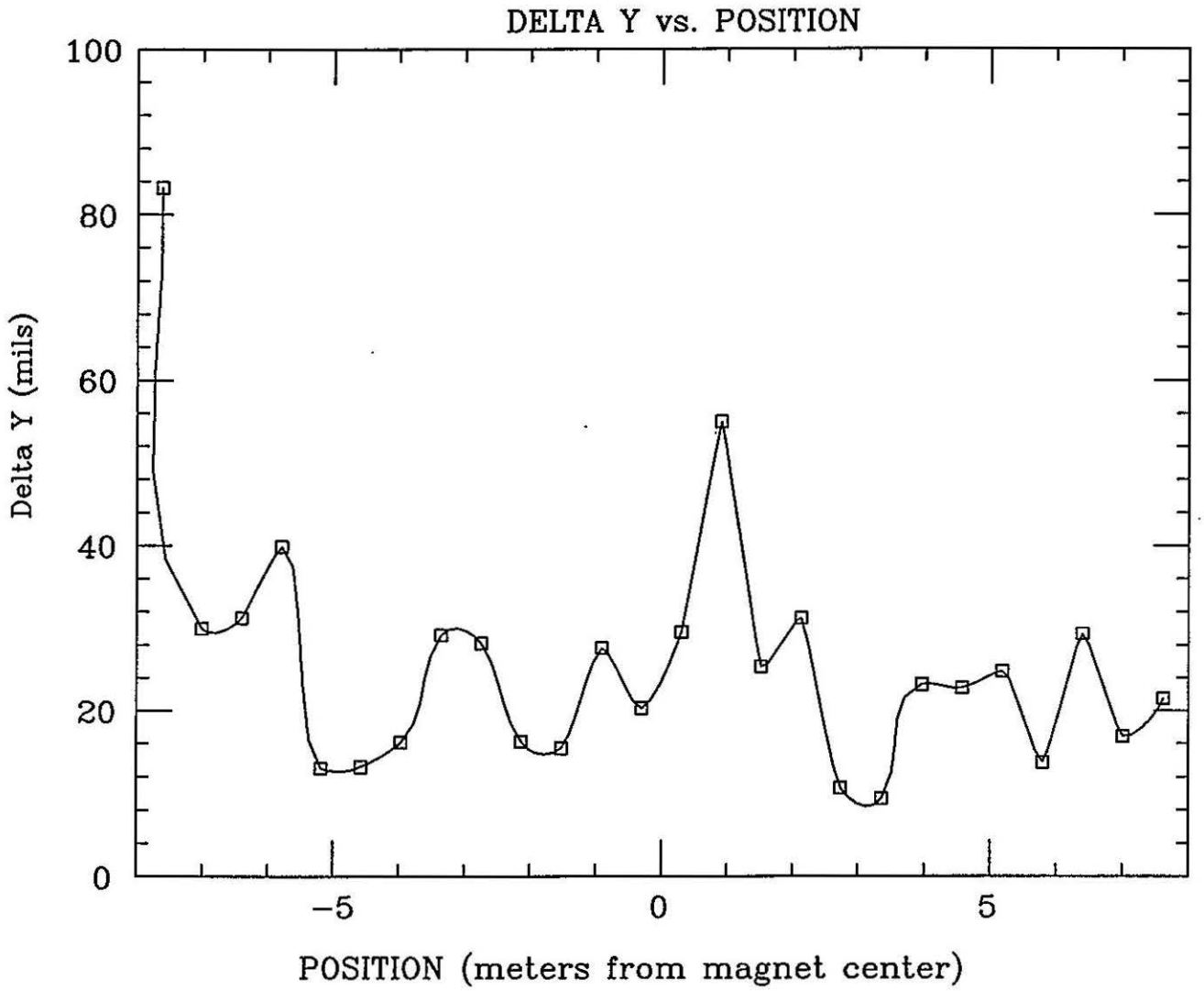


□ DCA310 0 24 Jun 1991 warm data 10. Amps DCA310 Collared Coil Assembly

Figure 36

DCA310 Warm Mole

25-JUN-91 12:08:27



□ DCA310 0 24 Jun 1991 warm data 10. Amps DCA310 Collared Coil Assembly

Magnet DCA310
Collared Coil

z (meters)	Transfer Function (Gauss/Amp)	Transfer Function Angle (degrees)	B stray (Gauss)	B stray Angle (degrees)
7.619	1.989	0.4	0.625	222.2
7.010	7.935	0.4	0.623	227.4
6.400	7.919	0.2	0.640	225.4
5.791	7.913	-0.1	0.600	222.0
5.181	7.911	-0.2	0.556	213.6
4.571	7.914	-0.1	0.494	201.5
3.962	7.914	-0.3	0.439	204.3
3.352	7.915	-0.5	0.447	212.4
2.743	7.918	-0.5	0.507	213.4
2.133	7.910	-0.5	0.432	223.2
1.523	7.920	-0.4	0.461	215.6
0.914	7.913	-0.4	0.437	222.6
0.304	7.920	-0.3	0.408	218.9
-0.305	7.916	-0.4	0.369	219.8
-0.915	7.916	-0.4	0.294	197.5
-1.525	7.909	-0.6	0.234	185.2
-2.134	7.906	-0.8	0.243	189.2
-2.738	7.918	-0.9	0.106	223.9
-3.353	7.908	-1.0	0.147	248.4
-3.963	7.923	-1.1	0.151	215.1
-4.573	7.921	-1.3	0.133	220.8
-5.182	7.920	-1.5	0.199	252.1
-5.792	7.911	-1.7	0.277	254.4
-6.401	7.911	-1.9	0.388	263.0
-7.011	7.942	-2.3	0.360	248.1
-7.621	2.032	-2.5	0.340	240.2