Mole Measurement of DCA312 Collar-Keyed Assembly

TS-SSC 91-151
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Introduction: The DCA312 collar-keyed assembly was actually moled three times. Only the files from the last mole measured were saved. The rest were lost in a disk crash. This memo gives results from the (we hope) final mole of the DCA312 collared coil assembly.

Data Files: The data files for DCA312 are shown in Table 1. There are two files, one containing centering information and the other the ±10 A and 0 A data. Corresponding files on the VAX cluster reside in the directory MDTF01::SSC$ROOT:[SSC].

HP File Name	VAX File Name	Data Contained; Record no.'s
DCA312_005	DCA312_005.READMOLE	1-10 (10A centering data)
DCA312_006	DCA312_006.READMOLE	1-90 (±10A and 0A)

Table 1. Hewlett-Packard and VAX File Names

The VAX files shown in Table 1 have been copied to the project area subdirectory TS_SSSC_PRJ$HROOT:[HARMONICS.MOLE.DCA312]. Here, the centering file is named COLLAR.CEN. The second file is broken into two files, COLLAR.DAT and COLLAR.REM. The .DAT file contains the ±10A data.

Results:

Harmonics. 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[1] 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	-3.12 (cold ~1.78)	0.19	<0.80	1.15
b4	0.40 (cold ~.16)	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	0.04	0..34	<0.04	0.50
b3	0.03	0.19	<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	0.54	0.60	<0.04	1.25
a2	0.17	0.22	<0.32	0.35
a3	0.10	0.07	<0.26	0.32
a4	0.06	0.04	<0.01	0.05
a5	-0.01	0.02	<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 00	<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 DCA312 Compared with SSC Systematic and R.M.S. Multipoles (prime units at 1cm)

[1] 50 mm Collider Dipole Magnet Requirements and Specifications (Fermilab "Yellow Book"), October, 1990.

Like DCA310 and DCA311 [1,2] this magnet has rather large b2 and b4. In the table are shown the predicted cold b2 and b4, based on the changes observed in these harmonics for 50 mm aperture model magnets (see Figure 1 of reference [2].)

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.

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.)

Transfer Function. Table 3 shows the transfer function measured at ±10 A as a function of logitudinal position along the magnet. The earth's magnetic field has been eliminated by an appropriate linear combination of +10 A and -10 A measurement. The expected value of the transfer function of the collared coil assembly is 7.95 Gauss/Amp.

TABLE 3.

z (meters)	Transfer Function (Gauss/Amp)
7.623	2.132
7.014	7.939
6.404	7.916
5.795	7.915
5.185	7.917
4.575	7.914
3.966	7.921
3.356	7.915
2.747	7.915
2.137	7.912
1.527	7.914
0.918	7.914
0.308	7.913
-0.301	7.912
-0.301	7.914
-0.301	7.913
-0.301	7.910
-0.301	7.912
-0.911	7.916
-1.521	7.919
-2.130	7.914
-2.740	7.916
-3.349	7.911
-3.959	7.914
-4.569	7.916
-5.178	7.921
-5.788	7.914
-6.397	7.916
-7.007	7.931
-7.617	2.077

Mole Precision. Table 4 shows the average and rms for the allowed and first two skew harmonics one foot toward the lead end from magnet center (five independent averages were made.)

Harmonic	Mean and RMS units @ 1cm
b2	-3.43±.04
b4	.374±.008
b6	-.053±.011
b8	.060±.010
a1	.42±.39
a2	.05±.10

Table 4. Allowed and First two Skew Harmonics near Magnet Center (Mean and RMS Values over 5 Measurements)

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

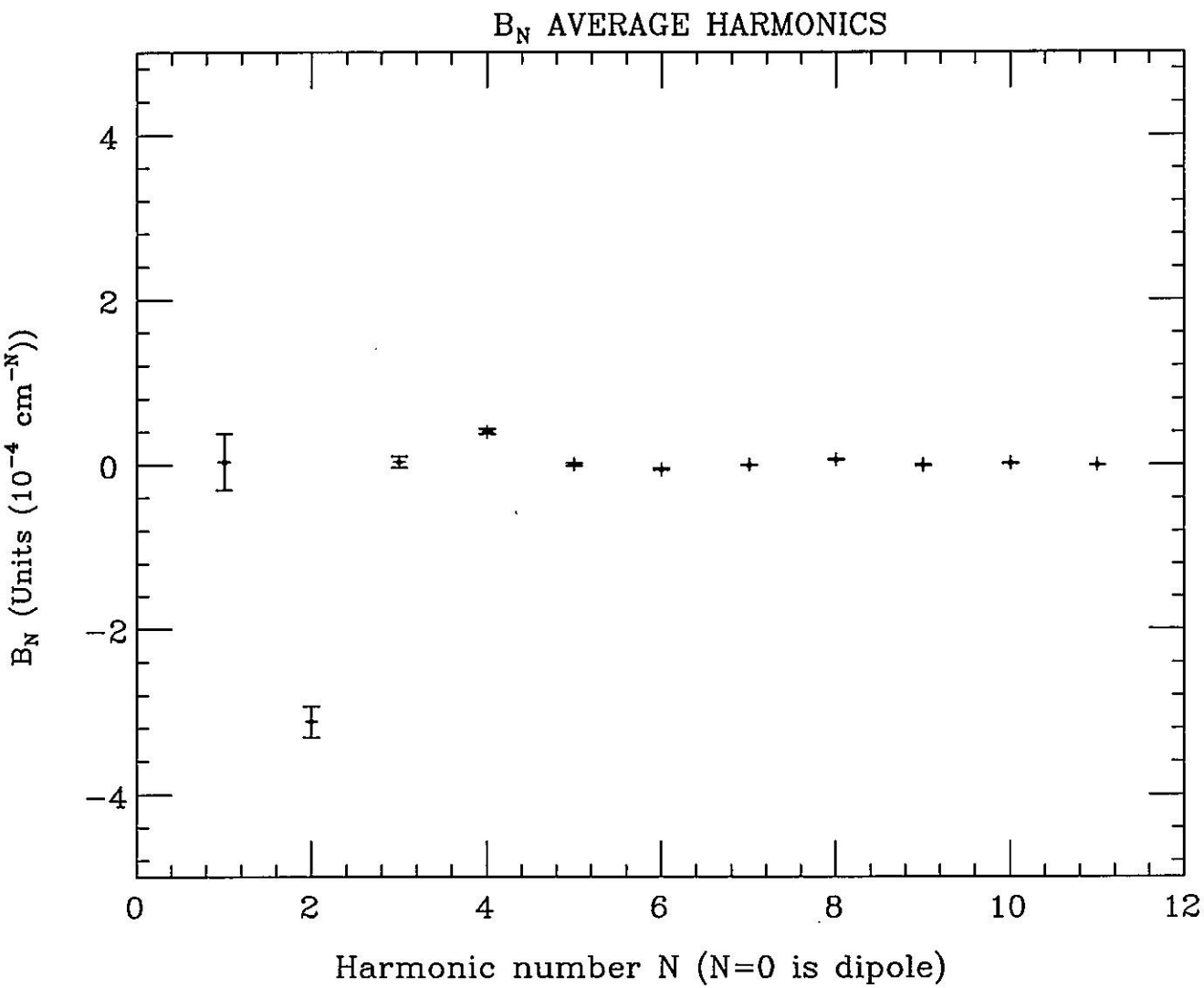

FIGURE 1a

+ DCA312 6 2 Aug 1991 warm data 10. Amps DCA312 Collared coil assembly

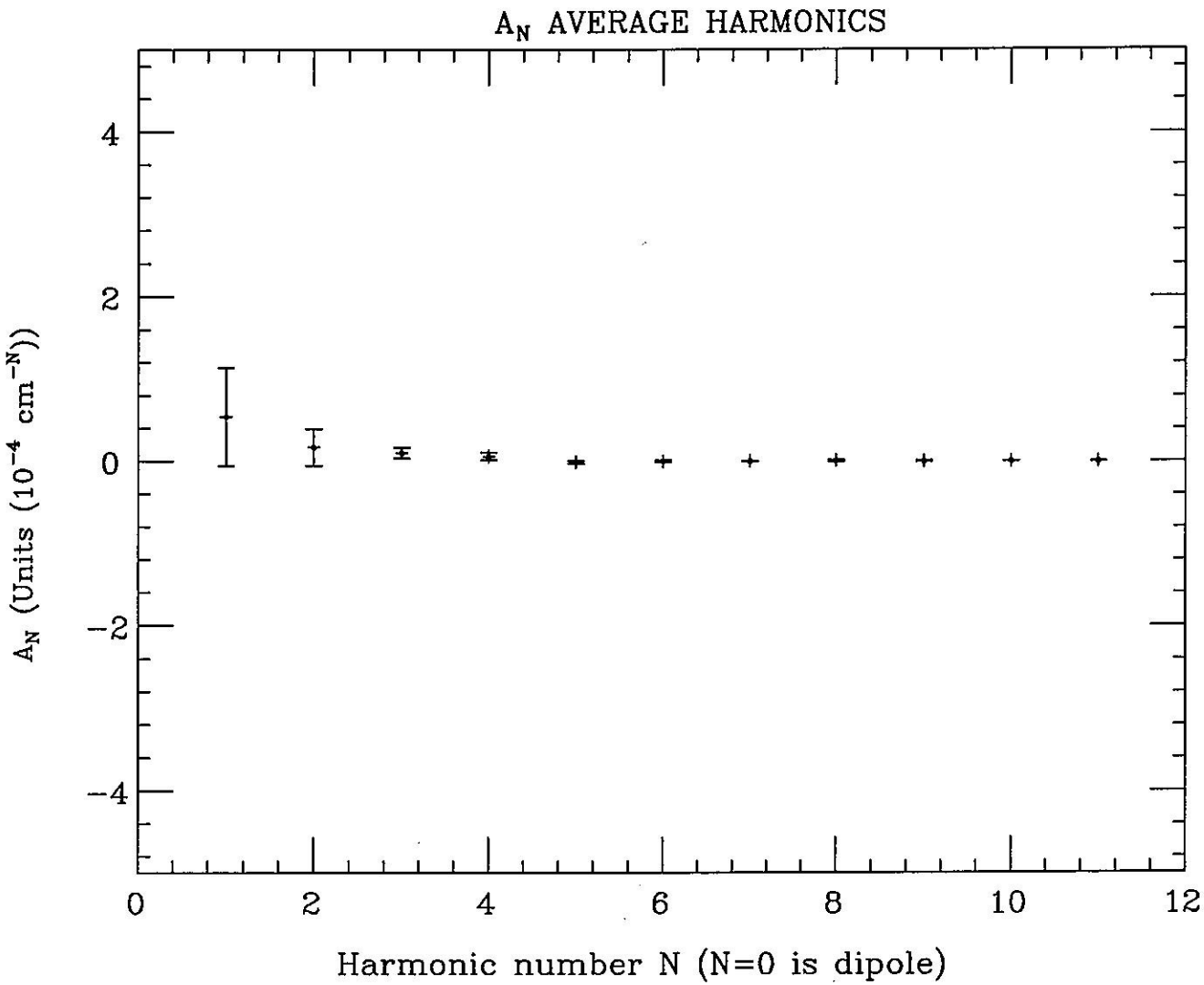

FIGURE 16

+ DCA312 6 2 Aug 1991 warm data 10. Amps DCA312 Collared coil assembly

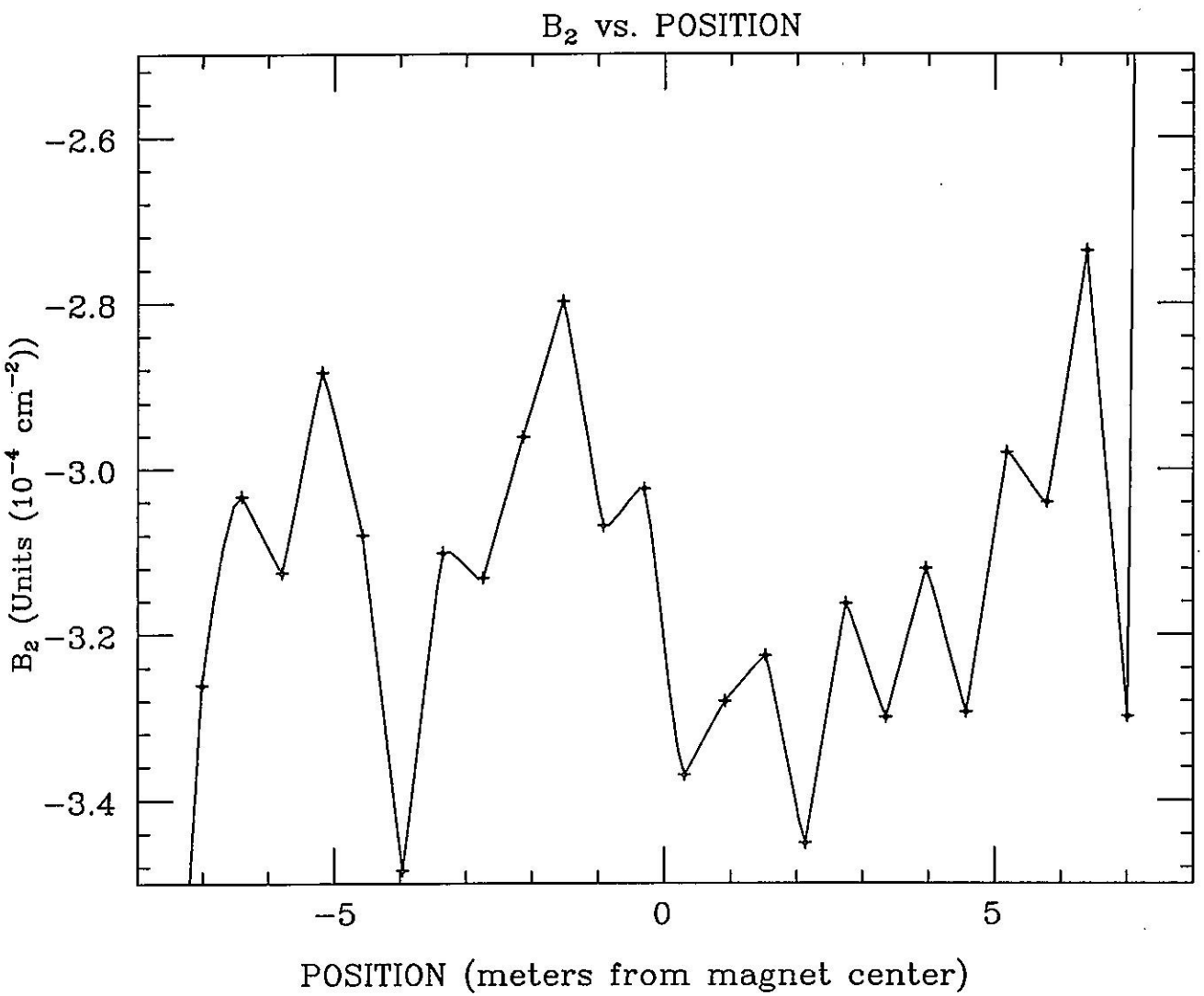

FIGURE 2a

+ DCA312 6 2 Aug 1991 warm data 10. Amps DCA312 Collared coil assembly

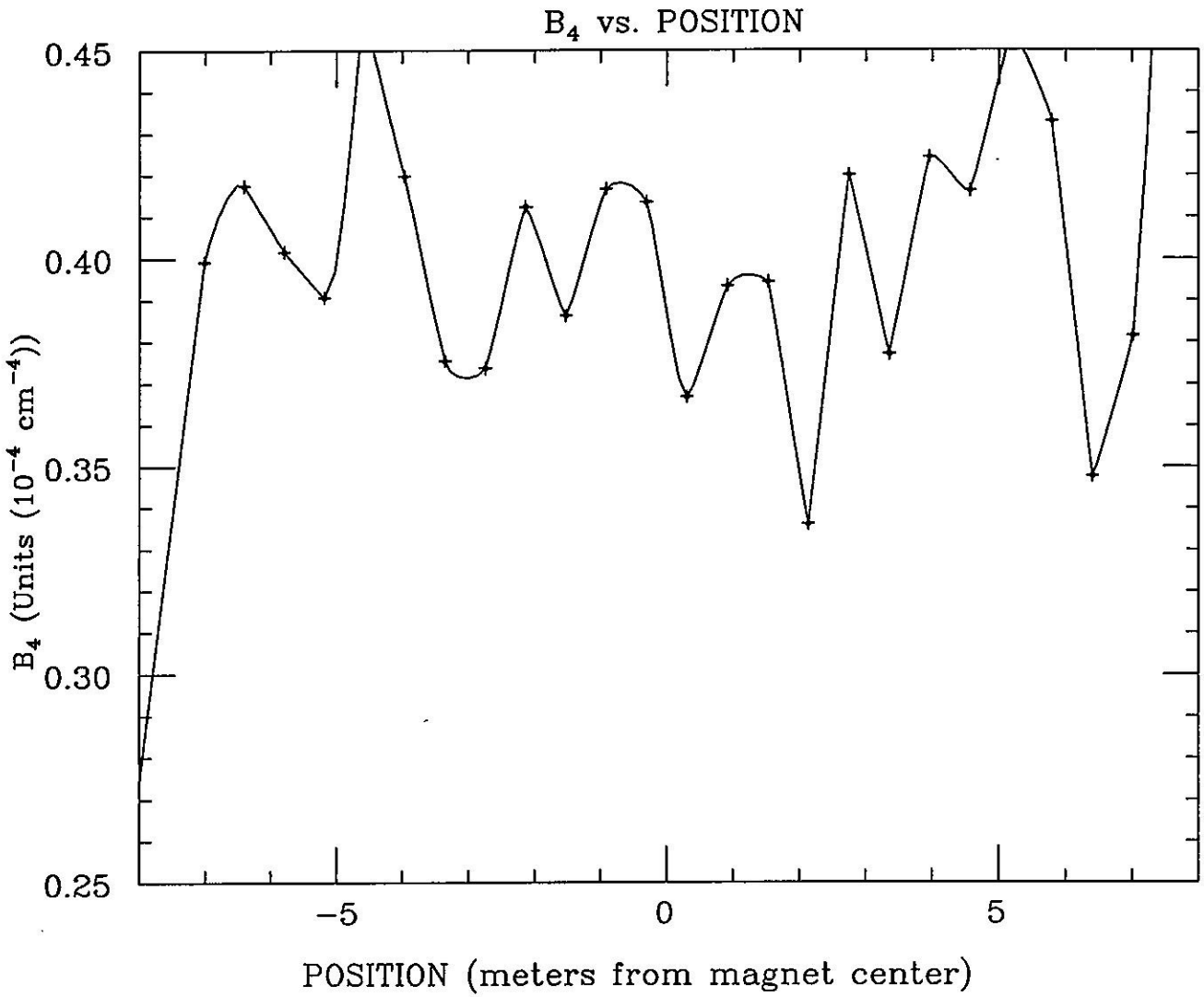

FIGURE 26

+ DCA312 6 2 Aug 1991 warm data 10. Amps DCA312 Collared coil assembly

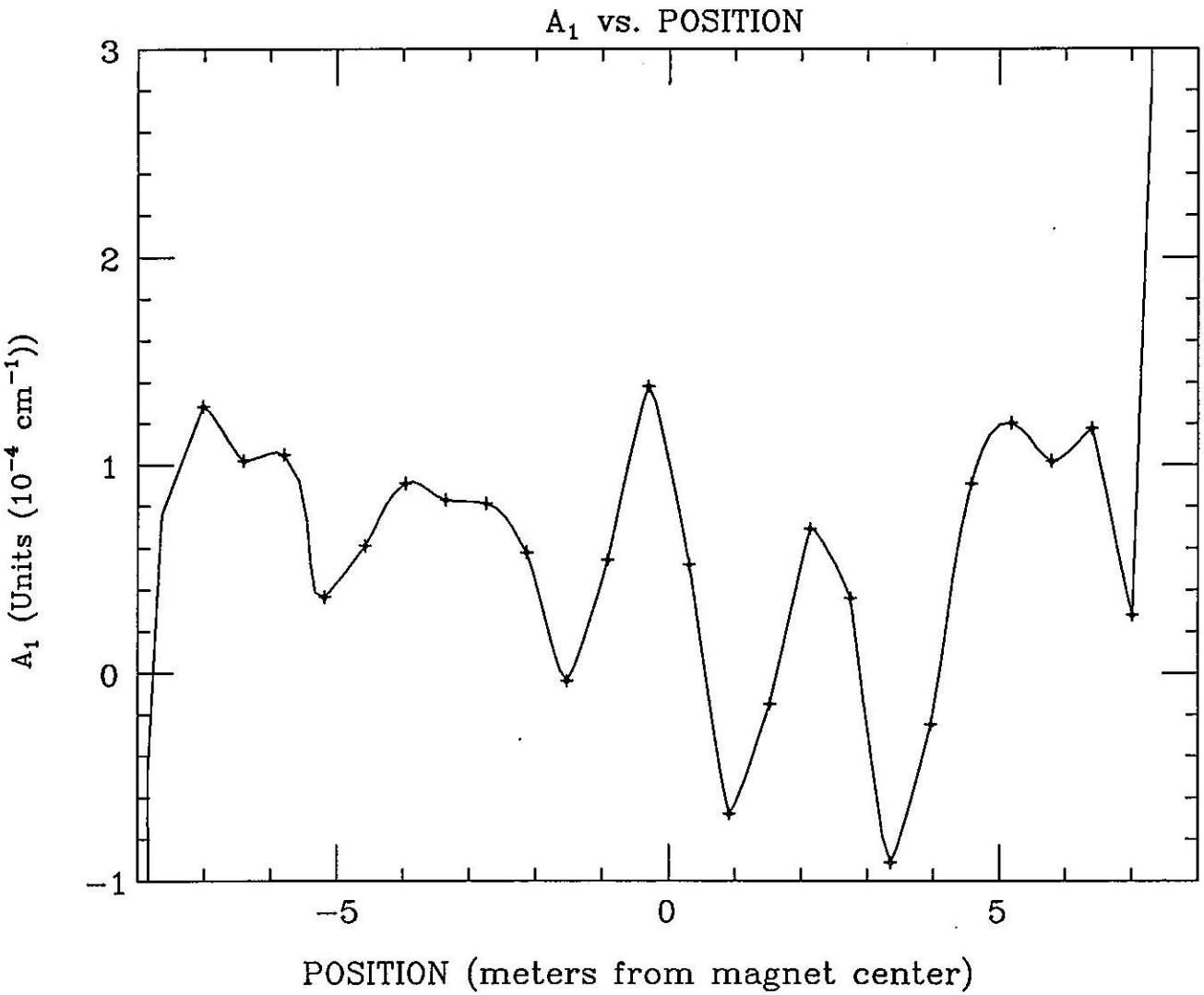

FIGURE 2c

+ DCA312 6 2 Aug 1991 warm data 10. Amps DCA312 Collared coil assembly

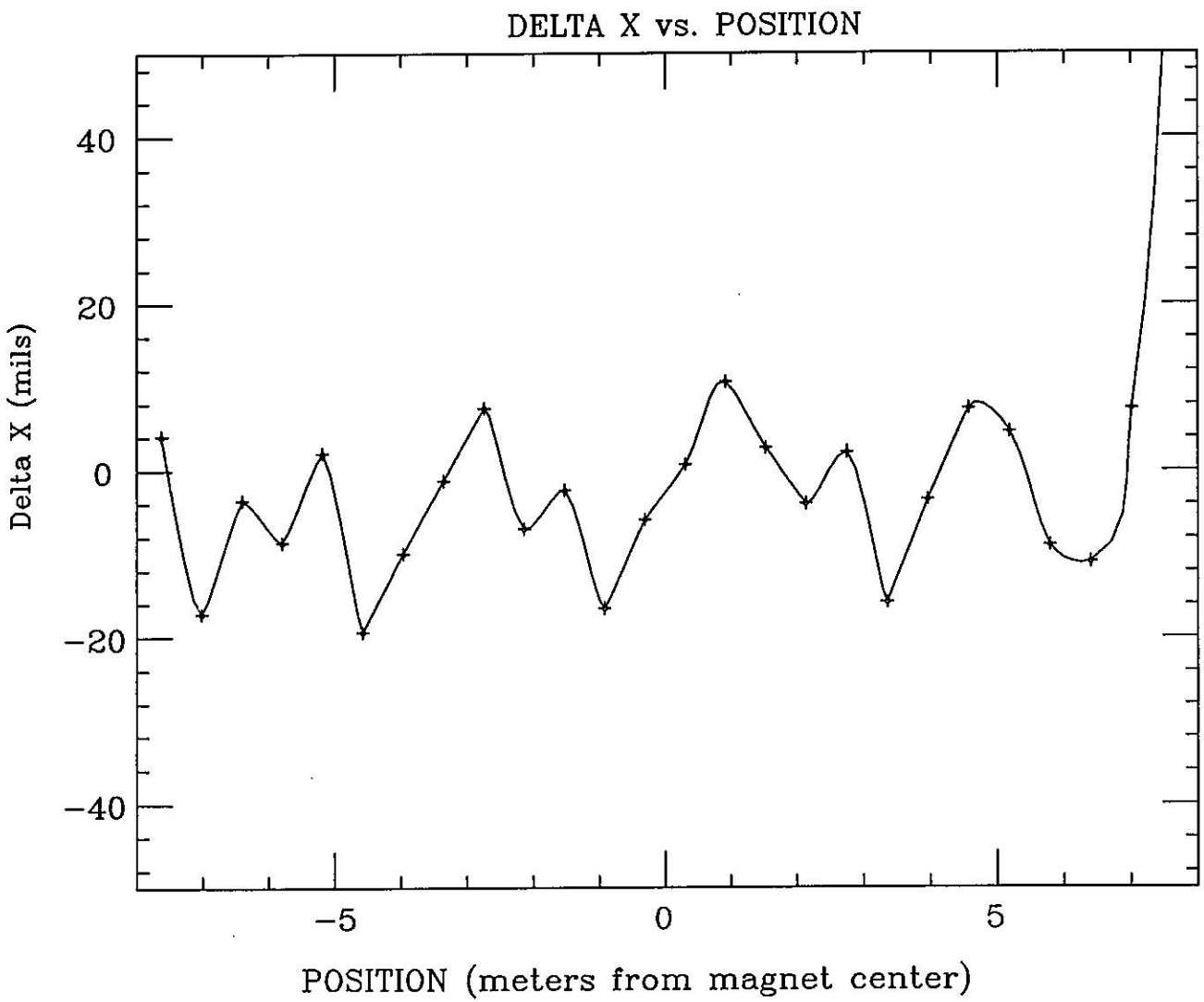

FIGURE 3a

+ DCA312 6 2 Aug 1991 warm data 10. Amps DCA312 Collared coil assembly

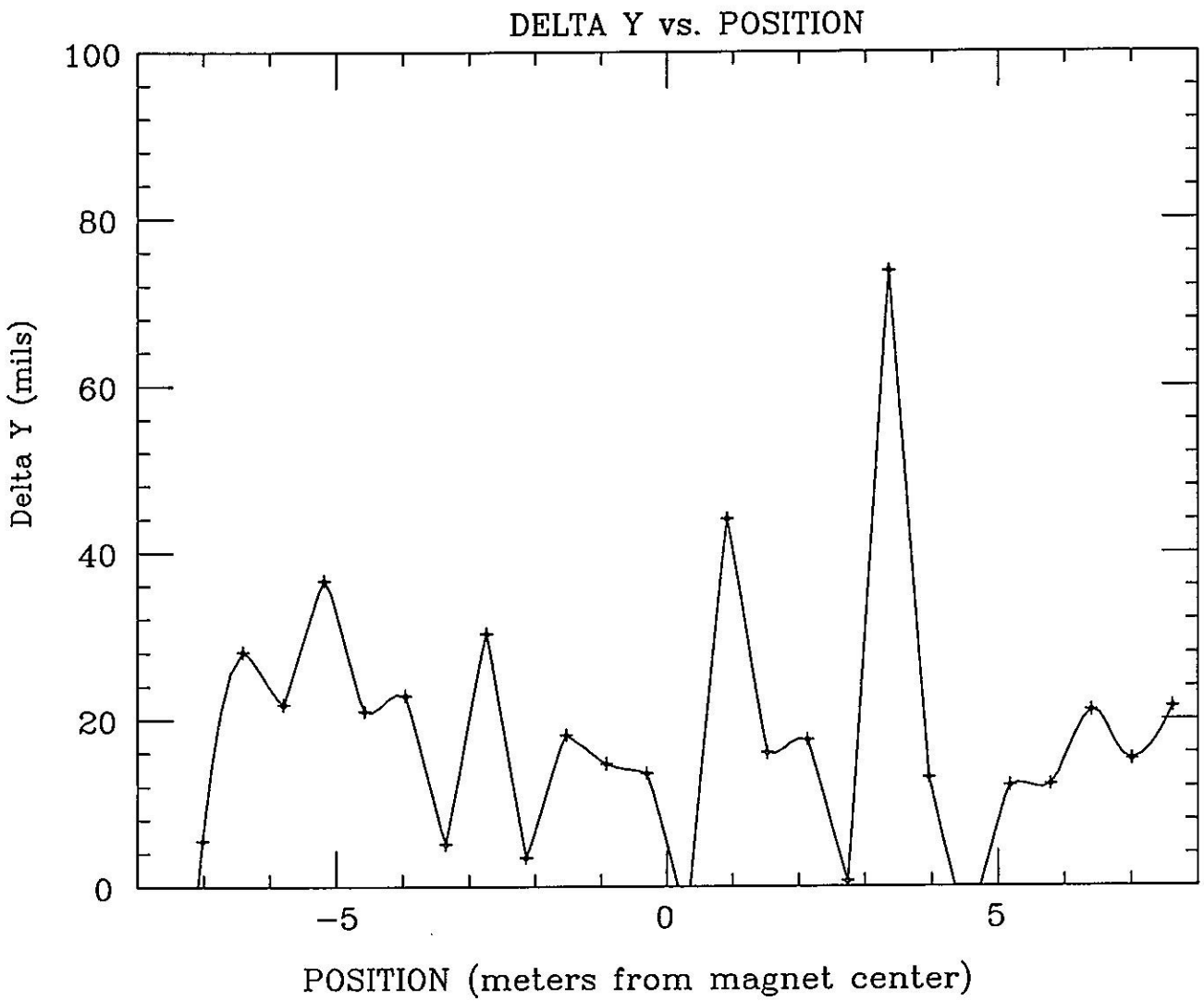

FIGURE 3c

+ DCA312 6 2 Aug 1991 warm data 10. Amps DCA312 Collared coil assembly