

Warm Mole Measurements of DC0302 and DC0303 Collared Coils

TS-SSC 90-102
S. W. Delchamps
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Warm harmonic measurements have been performed on collared SSC 17 m Dipole coils DC0302 and DC0303. The measurements were performed in the Industrial Center Building by Fermilab and SSC personnel, using the BNL 24" mole, a 40-turn tangential probe with two 4-turn dipole bucking coils. DC0302 and DC0303 were measured on October 9, 1990 and December 4, 1990 respectively.

Harmonics measurements were made at 26 points (20 inch increments) along the magnet. Data were taken at +10 A and -10 A current. The analysis program MULTI_PROCESS automatically subtracts the data for the two current signs to remove the effect of the earth's field. (However, nearby iron may perturb these measurements since the collared coil is unshielded.) Data were also taken at 0 A, but these data are not considered in this report.

Tables 1a and 1b and Figures 1a and 1b show the transfer function for each magnet as a function of z-position. To obtain these values, I have averaged the +10 A and -10 A data for each z-position, to eliminate the contribution from the earth's field.

Figures 2a and 2b show the normal harmonics for DC0302 and DC0303 averaged over the entire length of the coil. The "error bars" represent the root mean squared spread of values in each harmonic along the coil. Both coils have a fairly large, flat decapole moment of about -2 units. DC0303 shows more average sextupole moment than DC0302. In Tables 2a and 2b are found the numerical values of these coefficients, as well as the skew coefficients. Note the rather large skew quadrupole coefficient of DC0303.

Figures 3a and 3b show the normal sextupole coefficient for DC0302 and DC0303 as a function of position along the coil. DC0302 has a large dip at +3 meters.

Finally, Figures 4a and 4b show the dipole field rotation angle from the vertical (as sensed by the mole's gravity sensor.) It is seen that DC0302 has a pronounced "twist" along its length. DC0303 is better behaved, except for a rather strange behavior near $z = +7$ meters.

For more detailed information on harmonics from these coils, additional plots, numerical values of plotted quantities, etc., please contact me (Steve Delchamps), at x2416, or look in the DC0 series mole data notebook in my office.

Table 1a. DC0302 Transfer Function

| z-position (m) | Transfer Function (gauss/Amp) |
|----------------|-------------------------------|
| 8.09 | 6.649 |
| 7.48 | 8.001 |
| 6.88 | 7.995 |
| 6.27 | 8.002 |
| 5.66 | 8.001 |
| 5.05 | 8.002 |
| 4.44 | 8.005 |
| 3.83 | 8.003 |
| 3.22 | 8.001 |
| 2.61 | 8.000 |
| 2.00 | 7.996 |
| 1.39 | 7.998 |
| 0.78 | 7.997 |
| 0.17 | 7.999 |
| -0.44 | 7.998 |
| -1.05 | 7.996 |
| -1.66 | 7.996 |
| -2.27 | 7.997 |
| -2.88 | 8.000 |
| -3.49 | 8.001 |
| -4.10 | 8.002 |
| -4.71 | 7.997 |
| -5.32 | 7.999 |
| -5.93 | 7.998 |
| -6.54 | 8.000 |
| -7.15 | 7.999 |
| -7.76 | 8.013 |
| -8.36 | 2.725 |

Table 1b. DC0303 Transfer Function

| z-position (m) | Transfer Function (gauss/Amp) |
|----------------|-------------------------------|
| 8.15 | 5.225 |
| 7.54 | 8.019 |
| 6.93 | 8.016 |
| 6.32 | 8.019 |
| 5.71 | 8.021 |
| 5.10 | 8.019 |
| 4.49 | 8.018 |
| 3.88 | 8.019 |
| 3.27 | 8.015 |
| 2.66 | 8.015 |
| 2.05 | 8.014 |
| 1.44 | 8.014 |
| 0.83 | 8.017 |
| 0.22 | 8.016 |
| -0.39 | 8.019 |
| -1.00 | 8.017 |
| -1.60 | 8.016 |
| -2.21 | 8.015 |
| -2.82 | 8.011 |
| -3.43 | 8.006 |
| -4.04 | 8.008 |
| -4.65 | 8.006 |
| -5.26 | 8.008 |
| -5.87 | 8.008 |
| -6.48 | 8.008 |
| -7.09 | 8.009 |
| -7.70 | 8.012 |
| -8.31 | 4.291 |

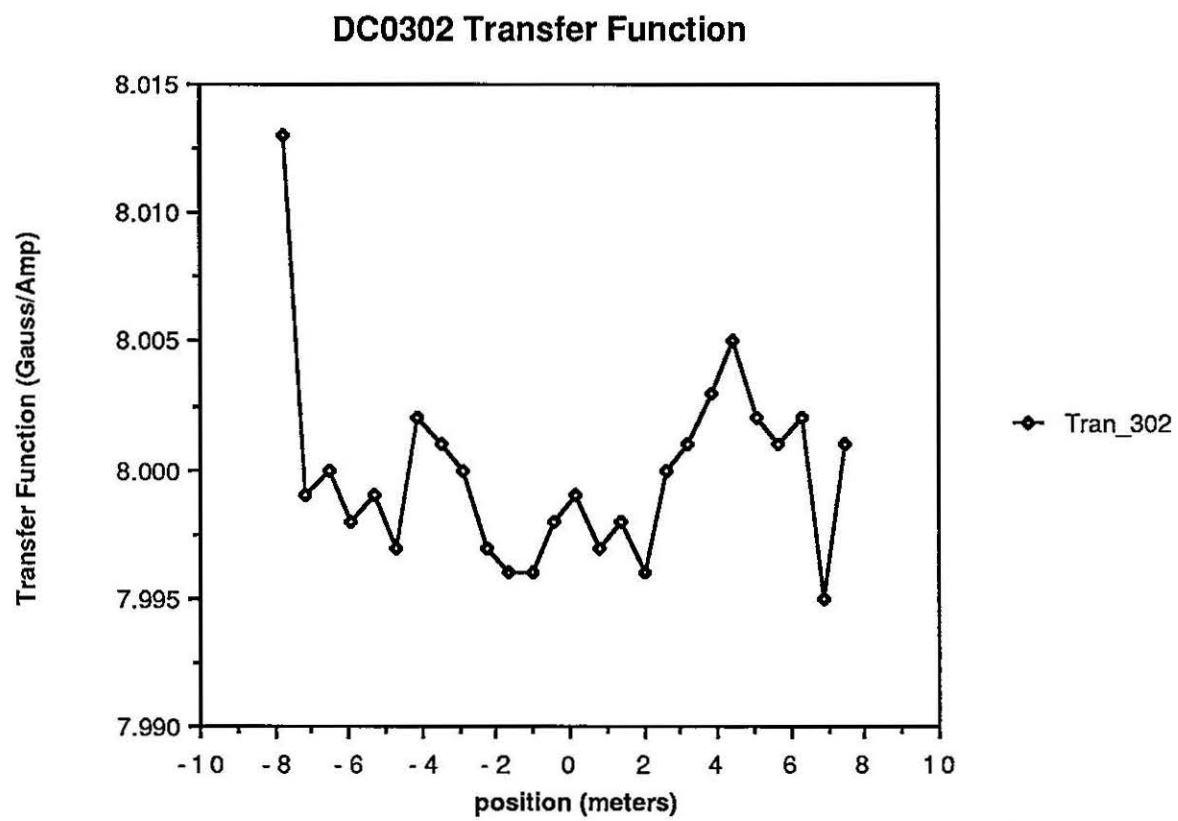


Figure 1a. DC0302 Transfer Function vs. Position

DC0303 Transfer Function

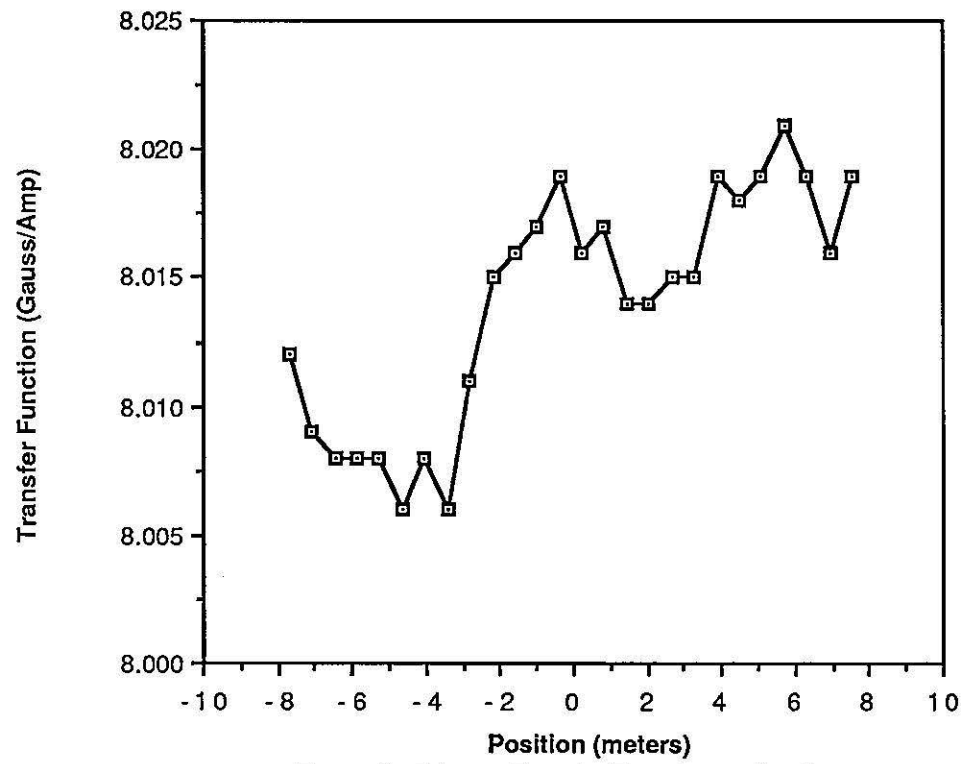


Figure 1b. DC0303 Transfer Function vs. Position

**Table 2a. DC0302 Harmonic Coefficients
(Averaged over the Coil)**

| Harmonic no. | <An> | <Bn> |
|--------------|---------|---------|
| 1 | 0.2699 | -0.0266 |
| 2 | 0.1898 | -0.5486 |
| 3 | -0.0429 | -0.0157 |
| 4 | -0.0901 | -1.9043 |
| 5 | -0.0162 | -0.0066 |
| 6 | 0.0063 | 0.2497 |
| 7 | -0.0086 | 0.0004 |
| 8 | 0.0007 | 0.0235 |
| 9 | -0.0009 | 0.0000 |
| 10 | 0.0127 | 0.1250 |
| 11 | -0.0019 | 0.0007 |

**Table 2b. DC0303 Harmonic Coefficients
(Averaged over the Coil)**

| Harmonic no. | <An> | <Bn> |
|--------------|---------|---------|
| 1 | 1.3392 | 0.3794 |
| 2 | -0.0037 | 1.4846 |
| 3 | 0.0801 | 0.0004 |
| 4 | -0.2163 | -1.7930 |
| 5 | -0.0296 | 0.0068 |
| 6 | 0.0100 | 0.3246 |
| 7 | -0.0014 | -0.0029 |
| 8 | -0.0068 | -0.0143 |
| 9 | -0.0002 | 0.0000 |
| 10 | 0.0192 | 0.1248 |
| 11 | -0.0006 | 0.0034 |

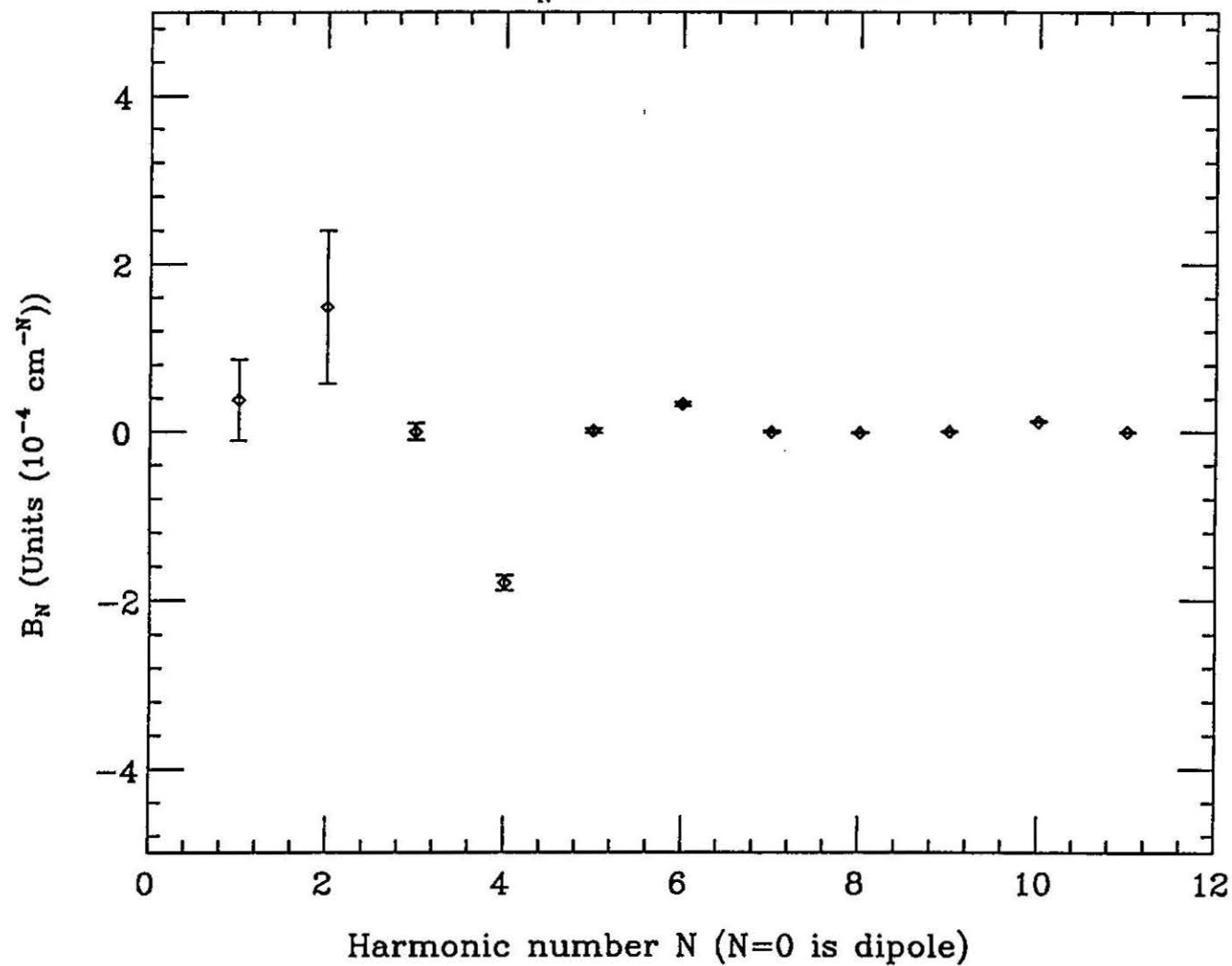
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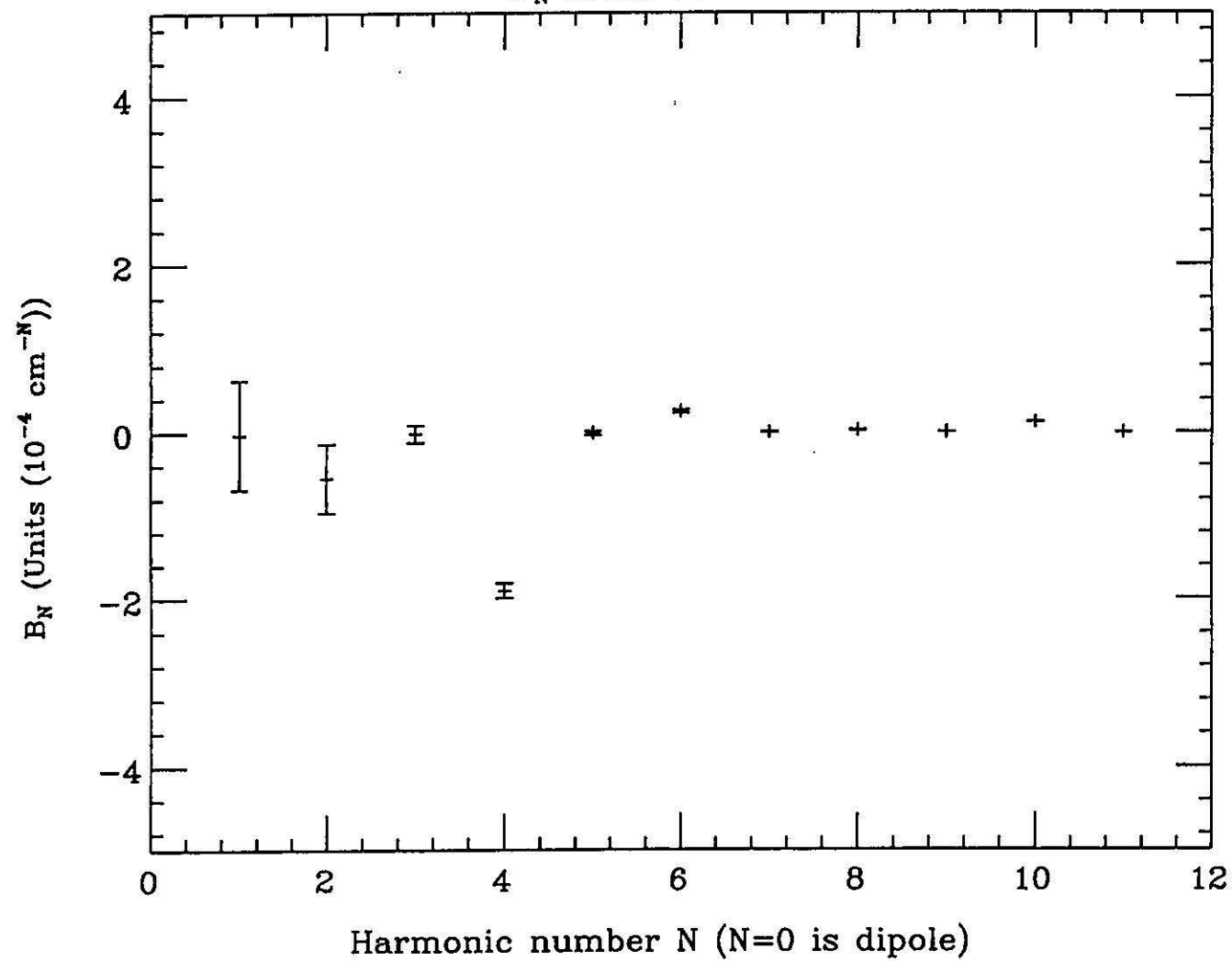
Figure 2b

 B_N AVERAGE HARMONICS

◇ DC0303 1 4 Dec 1990 warm data 10. Amps

DC0303 Collared coil

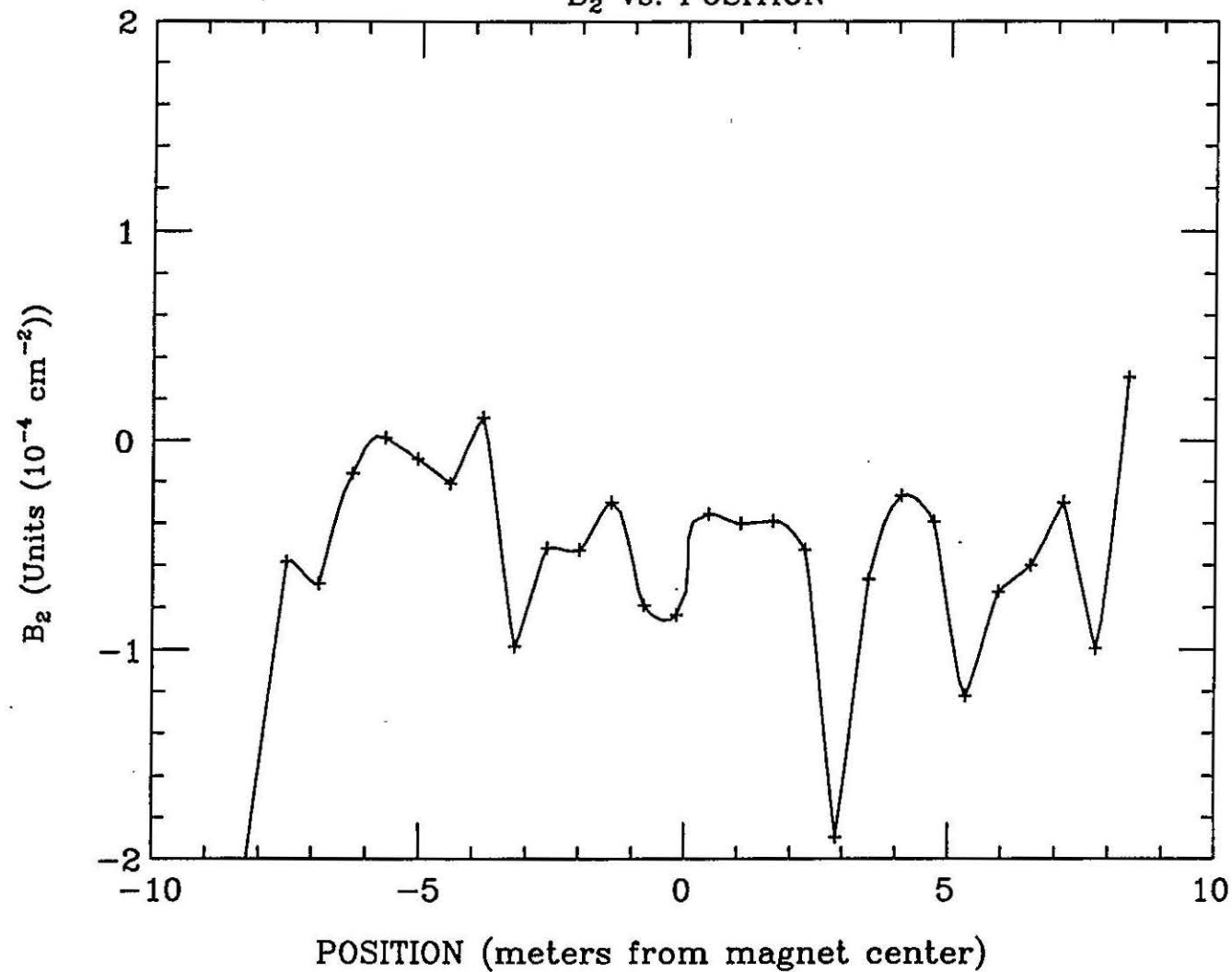
Figure 2a

 B_N AVERAGE HARMONICS

+ DC0302 1 9 Oct 1990 warm data 10. Amps

DC0302 Collared coil

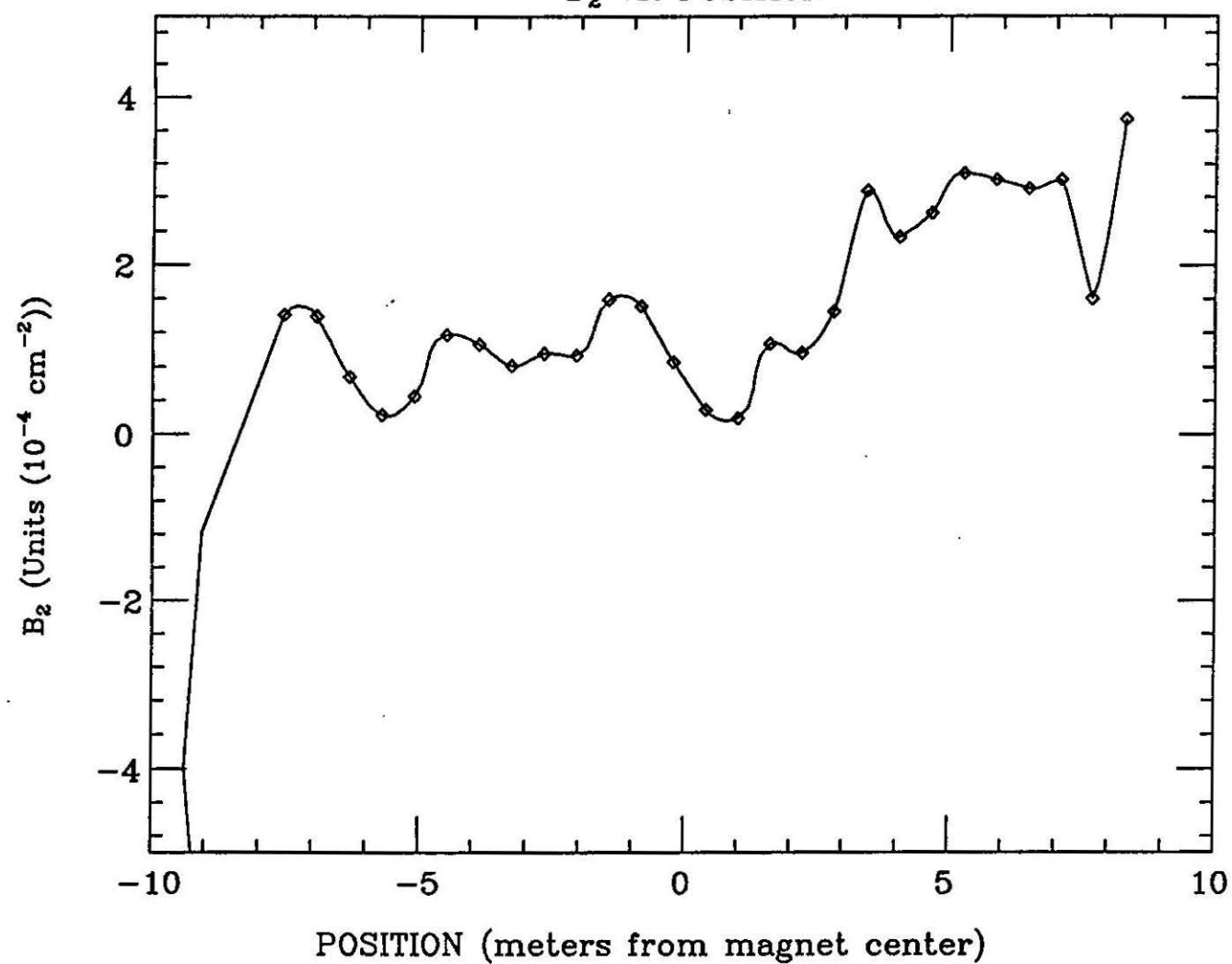
Figure 3a

 B_z vs. POSITION

+ DC0302 1 9 Oct 1990 warm data 10. Amps

DC0302 Collared coil

Figure 36
 B_2 vs. POSITION



◇ DC0303 1 4 Dec 1990 warm data 10. Amps

DC0303 Collared coil

Figure 4a

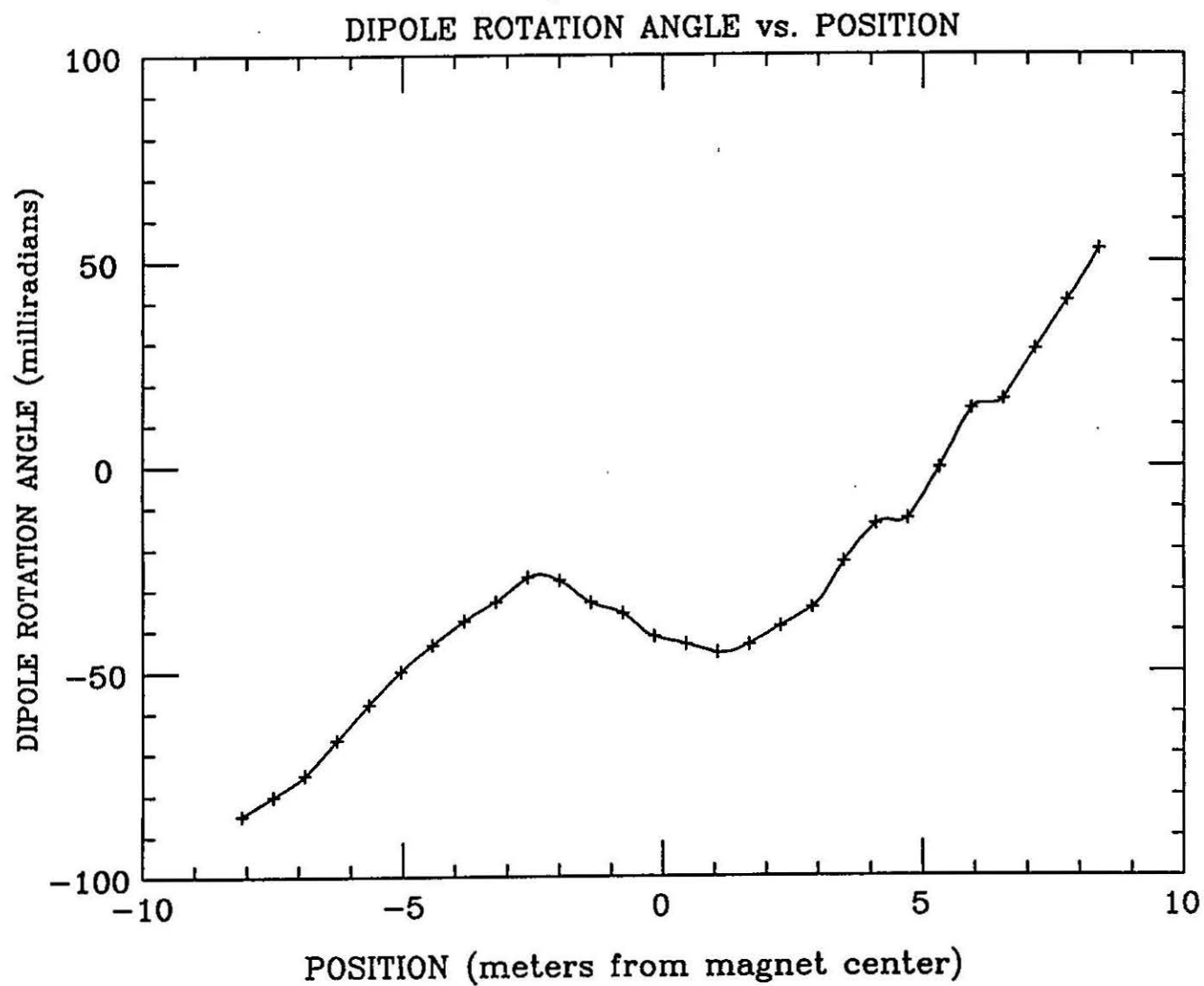
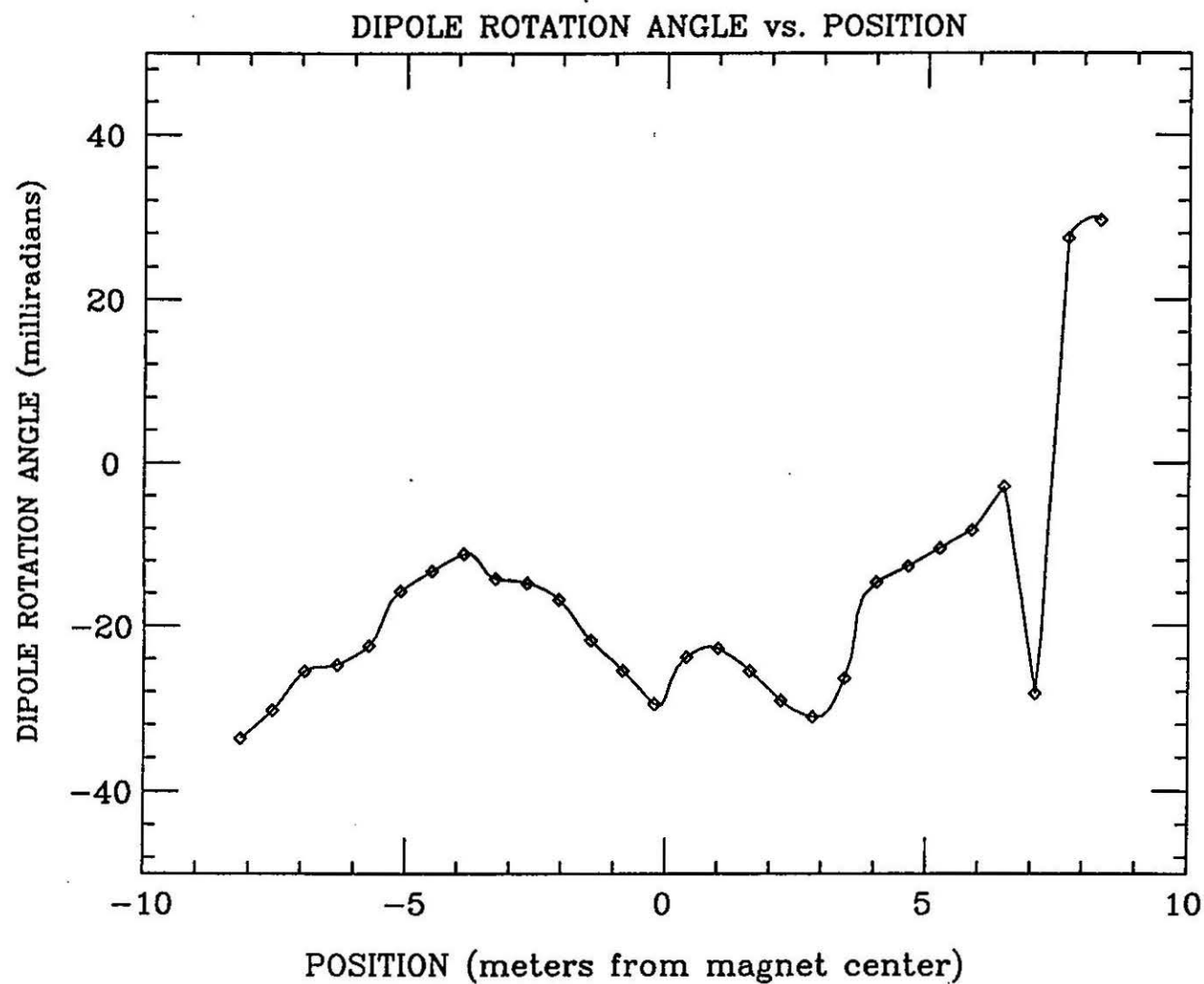


Figure 46



◇ DC0303 1 4 Dec 1990 warm data 10. Amps

DC0303 Collared coil

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