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Accelerator Development Department

BROOKHAVEN NATIONAL LABORATORY

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LIMIT ON MULTIPOLE CHANGES IN A 17M DIPOLE DUE TO TRANSPORTATION

P. Wanderer

August 12, 1991

LIMIT ON MULTIPOLE CHANGES IN A 17M DIPOLE

DUE TO TRANSPORTATION

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This note reports magnetic field measurements made on a full-length 40mm-aperture R&D SSC collider dipole. Measurements were made in connection with a round trip between Brookhaven and Fermilab and can be studied for possible changes to the multipole coefficients due to transportation. Due to several limitations in the measurement, the results are best viewed as upper limits.

The cold mass for this magnet, DC0202, was manufactured at Brookhaven, shipped to Fermilab for cryostatting, and then shipped back to Brookhaven for cold testing. The attached Table summarizes the construction features of the magnet. The magnetic field was measured at room temperature before and after shipment, for both shipments. The date, location, and number of the measuremement probe (mole) for each of the measurements are summarized below:

1. Measure cold mass at BNL (6/90, mole B1)
2. Measure cold mass at Fermilab (12/90, mole B2)
3. Measure cold mass at BNL (3/91, mole D1)

Measurements of the integral field over the magnet straight-section are presented in this report. There is no systematic variation with axial position seen in the individual runs. A point-by-point comparison cannot be made because moles of two different lengths were used. The integral results of the four lowest-order terms are presented in the attached graphs. The lowest-order terms are the most sensitive indicators of conductor motion.

Each figure also shows the SSC systematic tolerance, scaled from the 50mm-aperture tolerances. The tolerance is shown as the full "window" allowed for change. In production, the allowed window will be centered at zero, and is taken as the average over the production run.

Two standard corrections have been applied to the measurements. First, corrections have been made for the fact that the centers of the magnet and the measuring coil are not coincident. Second, the effects of the remnant field in the iron have been removed by averaging measurements at positive and negative currents.

There are two important limitations on the accuracy of this comparison: First, three different measuring probes were used. Information on a B1 - D1 intercomparison at 2T is in a separate note (370-11, SSC-MD-258). Based on the

data shown in the referenced note, it is not yet established that measuring errors are small compared to the SSC tolerances. Second, these measurements were made at 0.01T, where signal strength is small. Short-term reproducibility can be judged by comparing successive runs. It is not yet established that these variations are small compared to SSC tolerances.

Conclusion: No significant changes in the multipoles due to transportation are seen in the data. However, the upper limit which can be placed on such changes is about the same size as the SSC tolerances, indicating that increased accuracy is needed. It is anticipated that future measurements can be made more accurate by measuring the magnets at higher field (e.g., 2T) or using a measuring probe with a radius sized to fully utilize the larger space available in a warm magnet.

DC0202 CONSTRUCTION FEATURES

INNER CABLE CU:S.C. = 1.53:1

STANDARD CONSTRUCTION + SHIMS BETWEEN COLLARS AND YOKE

TEST OF TRANSPORTATION EFFECTS (BNL-FERMILAB ROUND TRIP)

LENGTH: 17 m

COIL I.D.: 40 mm

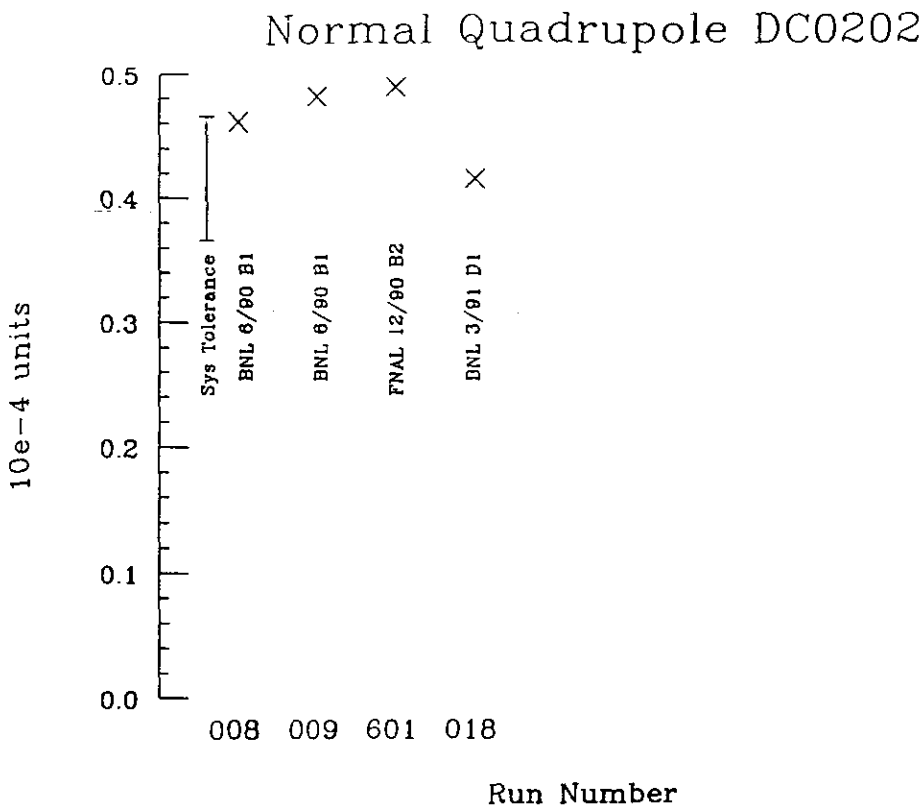
COILS: C358D cross section
kapton-fiberglass cable insulation
pole turn epoxied to next turn near ramp-splice box
41 voltage taps

COLLARS: antiovalized
Nitronic 40 stainless steel (90 kpsi)
pole turns mechanically seated, collar pack length
one strain gauge collar pack
3-mil shims between collars and yoke, near poles

YOKE: revised design
16 gauge lamination thickness
"monolithic" design
directed flow cooling features

ENDS: bonded stainless steel yoke modules
1.5"-thick end plate
coil axial restraint (bullets, set screws)
End force increased to 3000 lbs (total, each end), just before cooldown

EXCEPTIONS: Frayed insulation for 1" in lower inner coil turn 13, 24' from return end
Others, listed in test plan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10e-4 units
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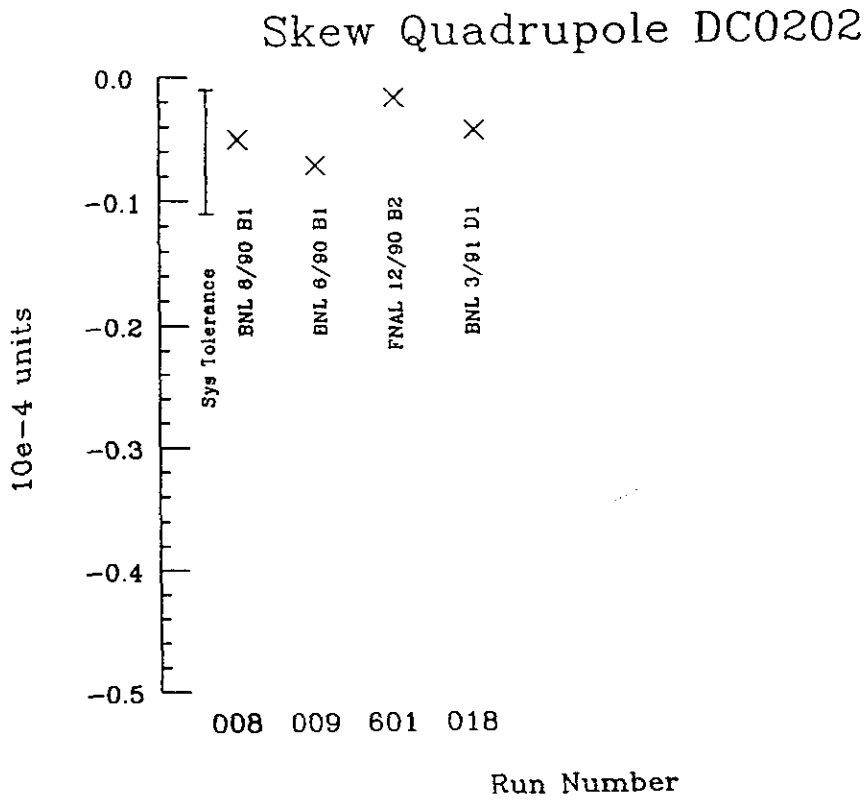
BNL 6/90 B1
FNAL 12/90 B2
BNL 3/91 D1
008
009
601
018
Run Number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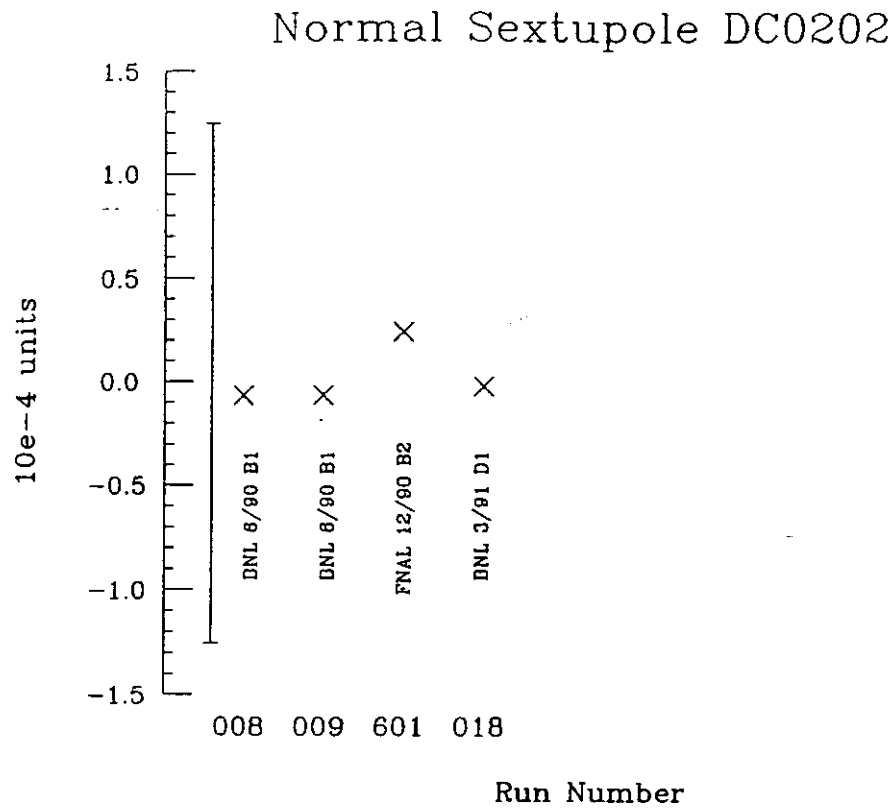
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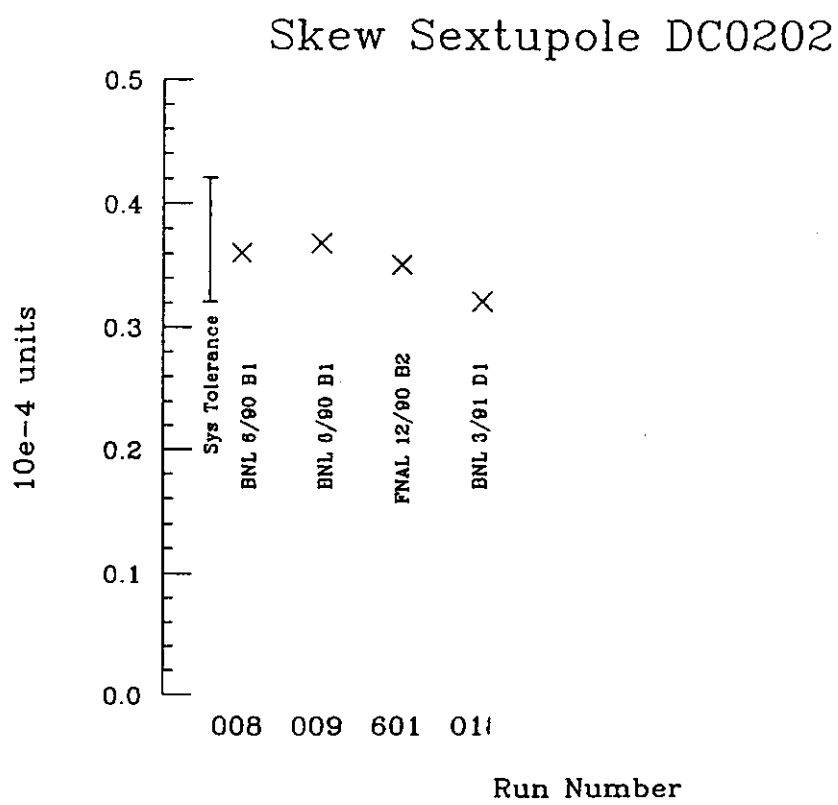
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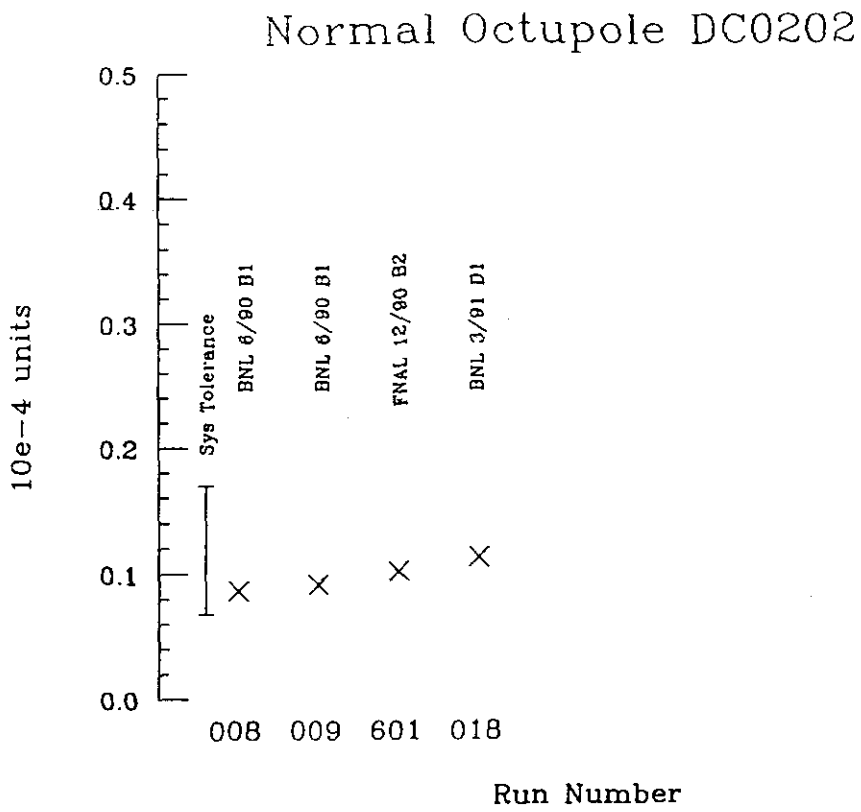
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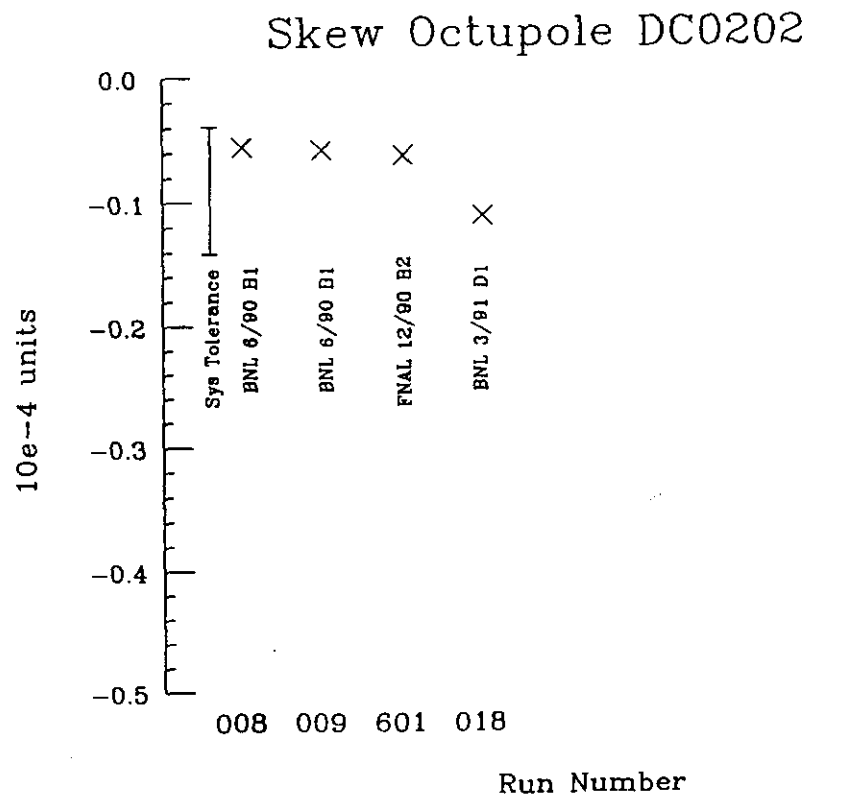
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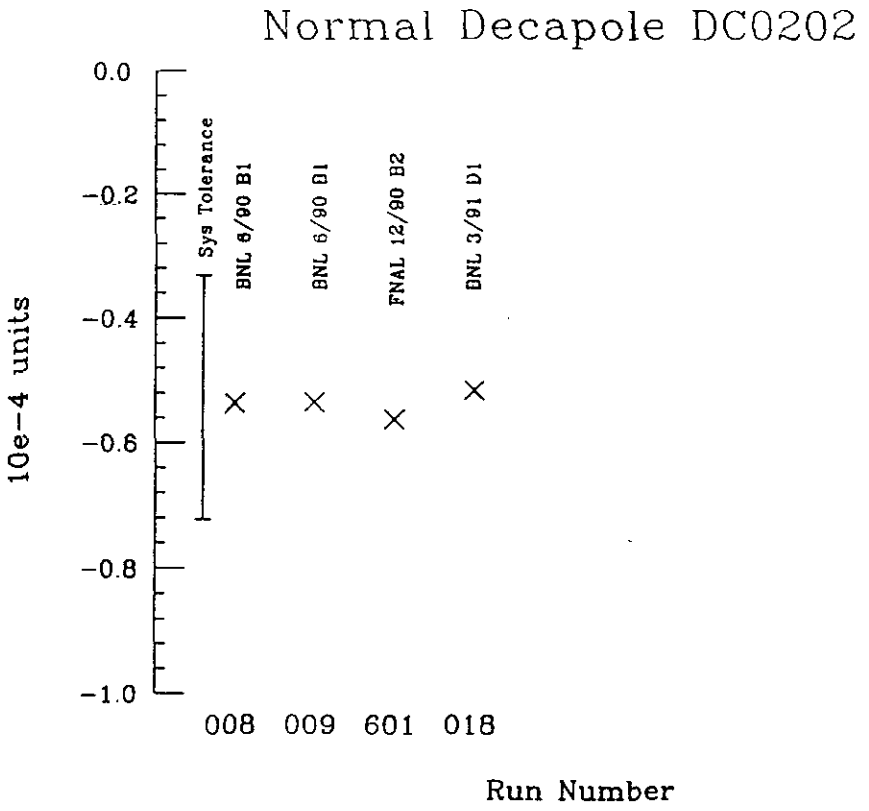
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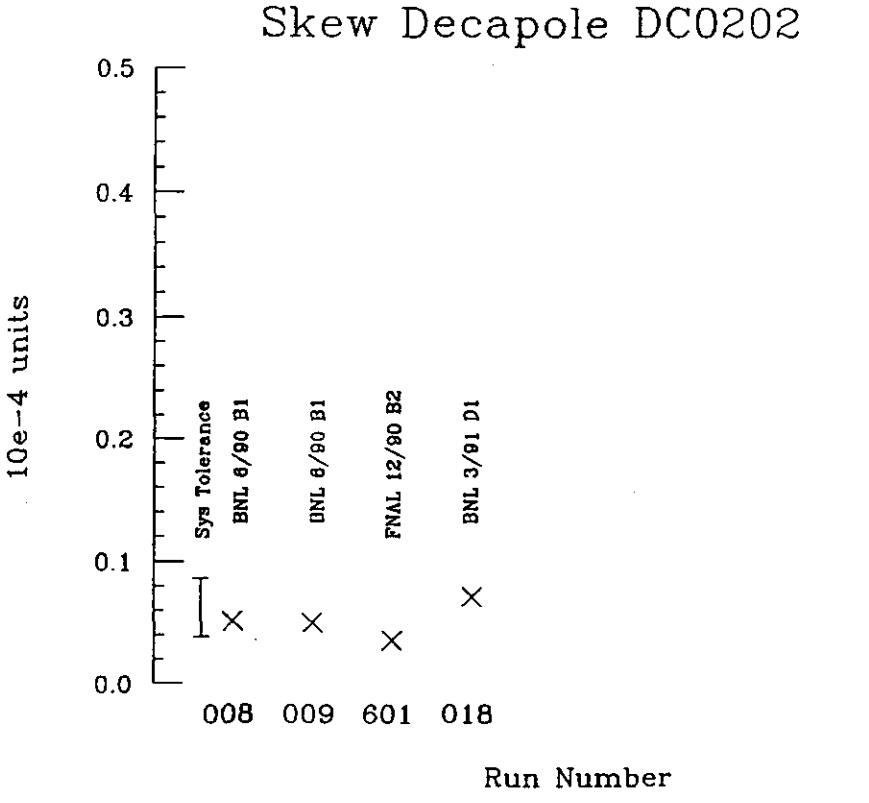
018
Run Number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BNL 6/90 B1
FNAL 12/90 B2
BNL 3/91 D1
008
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Run Number

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