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11/80 MAGNETIC MEASUREMENTS

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Nelson, Don.

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Magnetic Measurements were carried out to determine if IHM7 could be operated from 1000-1500 Amps and still have acceptable fringe fields in the Bevatron aperture, which IHM7 is adjacent to, without modifying the magnetic shield.

Per John Staples, the maximum acceptable fringe field integrals are:

- 220 Gauss - cm - Dipole
- 86 Gauss - cm/cm - Quadrupole

Magnet measurements were made in the east tangent tank during November 1980, and show that the fringe fields are acceptable, \( \lesssim 100 \) Gauss - cm Dipole and \( \lesssim 10 \) Gauss - cm/cm Quadrupole in the 1450-1500 ampere range. However, in order to achieve these acceptable fields, 300-400 Amperes is required in the IHM7 compensating coil.

For the record, IHM7 main coil cooling circuits must be modified for reliable operation at 1500 Amperes.

Measurements

The results of the magnetic measurements are displayed graphically on Figures 1-5. Errors, accuracy of measurements, and the data acquisition system used are spelled out in Don Nelson's Memo of December 9, 1980, which is attached to this note.

Figure 1 shows the background field integral of IHM7, without excitation, in the east tangent tank as a function of distance from the shield, which is the same as from the edge of the Bevatron Aperture inward. These background field integral measurements were used in the subsequent data reduction to determine the effects of the main coil and the compensation coil on IHM7 fringe fields in the Bevatron aperture.

Figure 2 shows midplane isoremenant field lines in the east tangent tank of the Bevatron with IHM7 not energized. Note how IHM7 affects the tangent tank field.

Figure 3 shows IHM7 fringe field integrals in the Bevatron aperture due only to compensating coil excitation. As expected increasing the compensating coil current increases the magnitude of the fringe field.

Figure 4 shows IHM7 fringe field integrals with 1450 Amps of main coil excitation and various values of compensating coil current. 300-400 Amps in the compensating coil appears to cancel the fringe field produced by IHM7's main coil in the Bevatron aperture.
Figure 5 shows similar information as in Figure 4 but the main coil excitation is 1500 Amps. With 300 Amps excitation, good fringe field cancellation is obtained.

The field integral measurements were made with a 213 cm long coil. Iso­remenant points were obtained with a Hall probe. Magnetic Measurements Data are saved in Magnetic Measurements Engineering Data Book (MME Book No. 546).

DISTRIBUTION:

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A. Lake              M. Tekawa

E. C. Hartwig/L. S. Wagner/W. H. Deuser

Magnetic Measurement Engineering (5)

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MEMORANDUM

To: Egon Hoyer
From: Don Nelson

Subject: Accuracy of Measurements of IHM7 Stray Fields

1. On October 8th, John Staples told me he would like us to measure $\beta_d \alpha$ with a resolution of 0.1 Gm = 100 Gauss cm.

2. On October 15th, you defined (from your notes of an October 6th meeting with J. Staples)
   
   acceptable dipole: \(86 \text{ Gm} = 219 \text{ Gcm}\)
   
   acceptable quadrupole: \(86 \text{ Gm/m} = 86 \text{ Gcm/cm}\).

3. Absolute accuracy is limited to ±0.5% due primarily to uncertainty in the sensitivity of coil L-34.

4. For all measurements except the November 25th measurements resolution of the tabulated data was ±0.001 V or 10 Gcm. (The data stored on tape has more resolution, but with the scatter I observed I judged that more significance was not important.) The accuracy in terms of acceptable dipole (219 Gcm) was therefore ±5% of acceptable dipole.

5. For the November 25th measurements, the DVM range switch was inadvertently set to 1000 V full scale, limiting our resolution to 0.01 V or 100 Gcm (±50% of acceptable dipole).

6. Positioning Accuracy
   
   a. \(x = 0\) is 1.8 cm ± 0.3 cm from magnet iron (see sketch)
   
   b. Coil L-34 was parallel to the "circulating beam" (according to fiducials provided by Glen White) within ±3 cm over a length of ~200 cm = >1.5 m radians.
   
   c. Coil tilt error (deviation from vertical ± 60 m radians) introducing a "cosine error" of 0 to -0.2% $\beta_d \alpha$.
   
   d. Relative positioning accuracy (in the x direction) was ±0.02 cm.
7. Attachments:
   a. Figure showing test equipment and location of coil L-34 @ x = 0.
   b. Table of equipment used for tests.

DHN: cw

cc: W.H. Deuser
    M.I. Green
DATA LOGGER - IHM-7 DATA ACQUISITION SYSTEM

(Drawn December 2, 1980, EAC)
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DATA LOGGER EQUIPMENT LIST - IHM-7

(November 1980)
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