BNL-101672-2014-TECH
RHIC/AP/16;BNL-101672-2013-IR

Magnet Errors, Tolerances and Correction Coil System Guidelines

H. Hahn

April 1985

Collider Accelerator Department
Brookhaven National Laboratory

U.S. Department of Energy
USDOE Office of Science (SC)

DISCLAIMER

Magnet Errors, Tolerances and Correction Coil System Guidelines

H. Hahn

4/30/85

H. Hahn

April 30, 1985

MAGNET ERRORS, TOLERANCES AND CORRECTION COIL SYSTEM GUIDELINES

I. The RHIC Proposal section on "aperture" will address the following topics

1) Aperture requirements due to intrabeam scattering including chromatic effects $\beta = \beta(\Delta p)$. Results are for ideal machine without magnet errors based on 2 families of chromaticity correction sextupoles in the arcs.

2) Aperture requirements due to magnet errors. With the magnet apertures fixed, this translates into magnet tolerances.

i) Linear effects

- closed orbit errors
- random gradient errors

b_1 : $\Delta\beta / \beta$

horizontal dispersion

a_1 : coupling

vertical dispersion

ii) Nonlinear effects

Tolerances will be established by tracking studies using a particular error model in which all coefficients are simultaneously present. Therefore, the tolerance on nonlinearities can be expressed by a global criterion. For the arc dipoles:

- systematic errors (b_0, b_1, b_2 subtracted)

  $(\Delta B/B) < 2 \times 10^{-4}$ @ 32 mm

- for random errors (b_0, b_1 subtracted)

  $(\Delta B/B) < 5 \times 10^{-4}$ @ 2/3 coil i.d.

For individual hamonics, expected values (rather than tolerances) will be quoted.

II. The RHIC Proposal section on "Magnet Errors and Correction Coil System" will address the following topics:

1) Predicted systematic errors for dipoles and quadrupoles (hopefully including insertion magnets) due to
   - coil geometry design
   - superconductor magnetization
   - saturation effects
   - eddy currents

2) Expected Random Errors based on Herrera's magnet model with a comparision to experimental data. Separate information for arc (single layer) and insertion (two layer) magnets will be needed.

3) Design of Correction Magnets plus table specifying their location and strength. Present working hypothesis for

   i) Arcs:
      - random a_0, b_0, at each quad
      - random a_1, or b_1, at each quad, but combined into 6 group
      - systematic b_2, at each quad with their wiring grouped into 4 families. The actual need for more than two is being studied.
      - systematic b_3, at each quad grouped into two families. The need for these octupoles may disappear.

   ii) Insertions
      - random a_0, or b_0, at each quad
      - b_2, in/at each BC1 and BC2 to correct systematic dipole errors.
      - random a_1 at defocussing quads
      - random a_1 near Q2 for coupling correction
      - random nonlinear coil at beta-max

4) Numbers and current capabilities of leads

III. The above information will be used for the count of power supplies and the heat load estimates.