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Magnet Errors, Tolerances and Correction Coil System Guidelines

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Coil System Guidelines

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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

$$a_1 : \text{coupling}$$

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)

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

-- for random errors (b_0, b_1 subtracted)

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

For individual harmonics, 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 comparison 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 groups
 - 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.