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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

- The RHIC Proposal section on "aperture" will address the following topics
 Aperture requirements due to intrabeam scattering including chromatic effects β = β (Δp). 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 $b_1 \sim \Delta \beta / \beta$

horizontal dispersion

a₁ 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 $(b_0, b_1, b_2 \text{ subtracted})$ $(\Delta B/B) \leq 2x10^{-4}$ @ 32 mm

for random errors (b_0 , b_1 subtracted)

 $(\Delta B/B)$ < 5x10⁻⁴ @ 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 a0, b0, at each quad
 - random a_1 , or b_1 , at each quad, but combined into 6 group
 - systematic b₂, eat each quad with their wiring grouped into³⁴4. families. The actual need for more than two is being studied.
 - systematic b₃, at each quad grouped into two families. The need for these octupoles may disappear.

ii) Insertions

- random a0, or b0, at each quad
- b2, in/at each BCL and BC2 to correct systematic dipole errors.
- random a₁ at defocussing quads
- random (a1 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.