Preliminary 2-d and 3-d Designs of 90 mm Dipole

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Comparison of 35 mm and 90 mm Aperture Dipoles

- Same conductor is chosen for both dipoles (number of turns are adjusted) - 16 turns (4 X 4) in 35 mm aperture case and 40 turns (4 X 10) in 90 mm aperture case.
- Transfer function of the two dipoles is similar with a maximum ~1% deviation.
- These constraints are not applicable if two magnets use different power supplies.

Note: 90 mm is the nominal aperture of the dipole.

Adjust aperture to match transfer function in case the same power supply is used for both magnets.

Are we using the same power supply for both?
Preliminary 2-d Design of ~90 mm Dipole

Both designs meet the following stated requirements:
- Nominal Field – $B_0 = 0.40T$ to $0.50T$
- Field Homogeneity $B_X, B_Y = 1 \times 10^{-4}$
- Good field region $B_X \pm 20\text{mm}$, $B_Y \pm 10\text{mm}$
- Nominal Current density in the coil cross section 2 Amps/mm$^2$

- Yoke size increased due to mechanical concern.
- More increase (cost) should wait for mechanical analysis.
The maximum field in yoke is 0.8 T for 0.4 T central field. Therefore, the need for further increase in yoke size must be justified on the mechanical ground. (see more comparison of fields in the next slide)
Iron Saturation in 90 mm Aperture Dipole

Nominal design current ~360 A

Transfer Function (T/kA)

Design field
20% over the design field
60% over the design field

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Preliminary 3-d Analysis of ~90 mm Aperture Dipole

Circular Ends

Racetrack Ends (to reduce the mechanical length of the coil/magnet)
Comparison of Axial Field Profiles of 90 mm and 35 mm Aperture Dipoles

Compare the end field profile of the two magnets. End harmonics will be minimized.

An additional goal has been to match the integral transfer function of the 90 mm aperture dipole with that of 35 mm aperture dipole for the same current (number of turns are different in two).

As expected, the field of 90 mm aperture dipole falls slower than the field of 35 mm aperture dipole.
Review of Axial Field Profiles in Various End Designs

Blue: Conventional racetrack with significant space for coil ends
Red: New efficient end design with zero space for coil ends
Black: Latest design – efficient ends + shield (fastest field fall-off).

We can make an attempt to reduce the difference between the ends profiles of 35 mm and 90 mm aperture dipoles, if required.