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

Ramesh Gupta
The above initial design meets the following stated requirements:

Nominal Field – Bo = 0.40T to 0.50T
Field Homogeneity BX, BY = 1x10^{-4}
Good field region BX +/- 20mm, BY +/- 10mm
Nominal Current density in the coil cross section 2 Amps/mm²

Same conductor is chosen as in 35 mm dipole. The number of turns are adjusted.
Transfer function of this dipole is similar to 35 mm aperture dipole (~1% deviation).

• Yoke size increased due to mechanical concern.
• More increase (cost) should wait for mechanical analysis.
The maximum field in the yoke is 0.8 T for 0.4 T central field. Therefore, the need for an increase in yoke size must be justified on mechanical ground.
Preliminary 3-d Analysis of ~90 mm Aperture Dipole

Circular Ends

Racetrack Ends

UNITS
- Length: mm
- MagFluxDensity: T
- MagField: A/m
- MagScalarPot: A
- MagVectorPot: Wb/m
- ElectricFluxDensity: C/m²
- ElectricField: V/m
- Conductivity: S/m
- CurrentDensity: A/mm²
- Power: W
- Force: N
- Energy: J

PROBLEM DATA
- 90mm-e1w, 4T coils
- TOSCA Magnetostatic
- Nonlinear materials
- Simulate 1x1
- 655068 elements
- 317456 nodes
- 3 conductors
- Nodal interpolation
- Activated in global coordinates
- Reflection in XY plane
- Reflection in ZY plane

Field Point Local Curve
Local + Global

Ramesh Gupta
Preliminary 2d and 3d Designs of 90 mm Dipole
April 20, 2007
Slide No. 4
The goal is 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).

Also compare the end field profile of the two magnets.

As expected, the field of 35 mm aperture dipole falls slower than the field of 90 mm aperture dipole. End harmonics in both apertures will be optimized.
Review of End Fields in Various 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 attempt to match ends profiles of 35 mm and 90 mm aperture dipoles, if required.