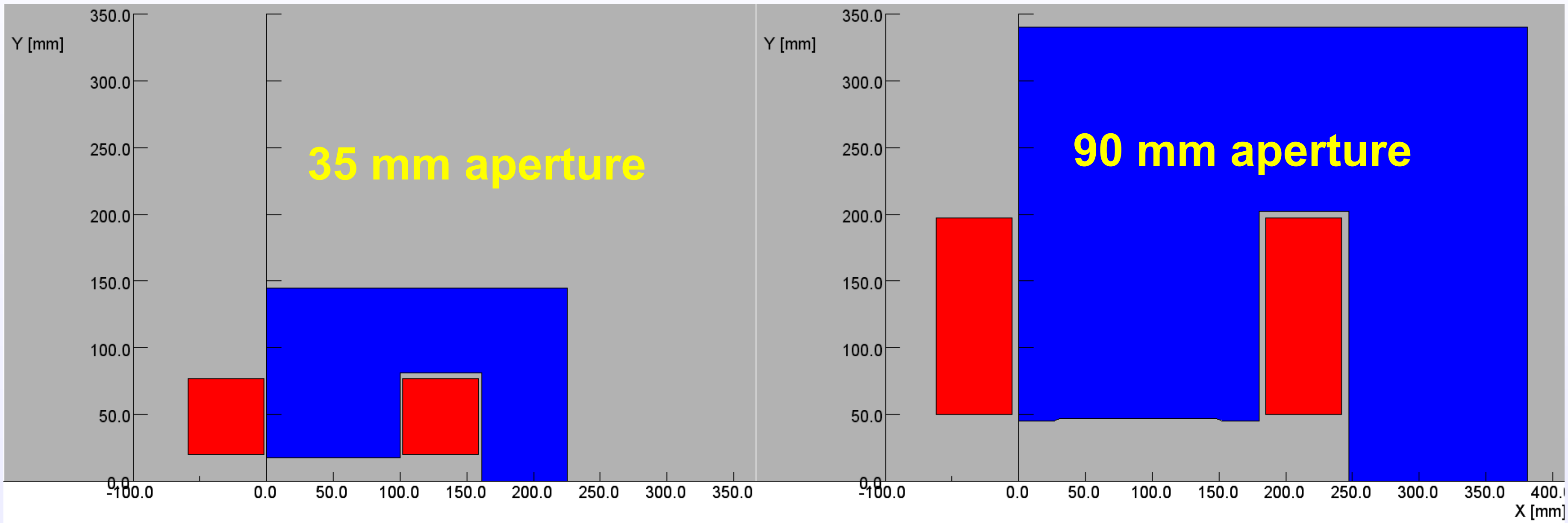
Preliminary 2-d and 3-d Designs of 90 mm Dipole

Ramesh Gupta

Comparison of 35 mm and 90 mm Aperture Dipoles



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

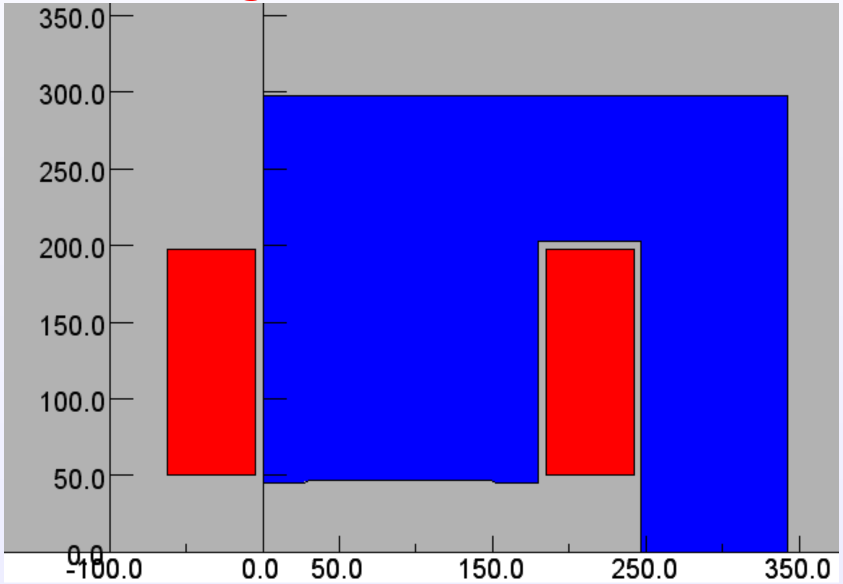
Adjust aperture to match transfer function in case the same power supply is used for both magnets.

➢ **Are we using the same power supply for both?**

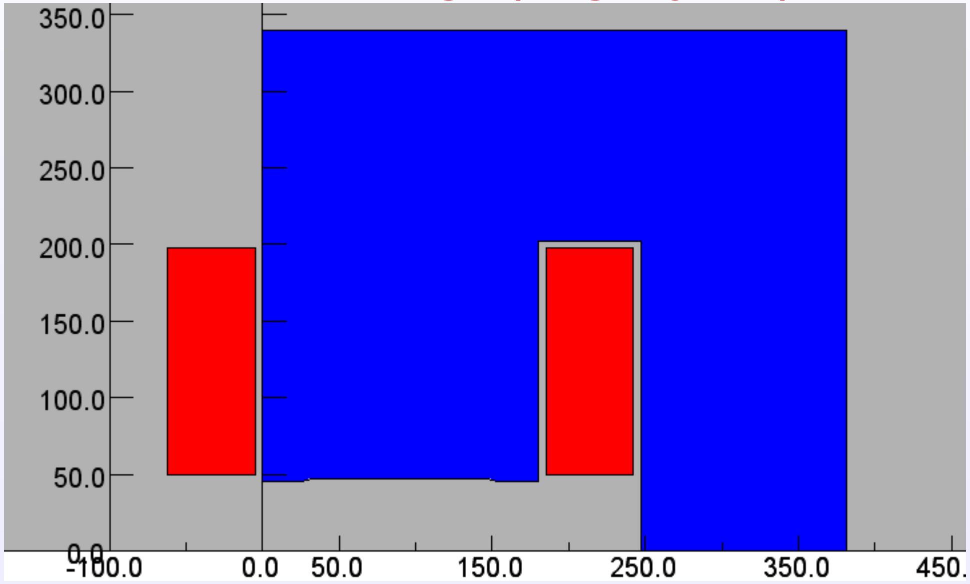
- Same conductor is chosen for both dipoles (number of turns are adjusted) - 16 turns (4 X 4) in 35 mm aperture case and 40 turns (4 X 10) in 90 mm aperture case.
- Transfer function of the two dipoles is similar with a maximum ~1% deviation.
- These constraints are not applicable if two magnets use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

Preliminary 2-d Design of ~90 mm Dipole

Design discussed earlier



Current design (larger yoke)



- **Yoke size increased due to mechanical concern.**
- **More increase (cost) should wait for mechanical analysis.**

Both designs meet the following stated requirements:

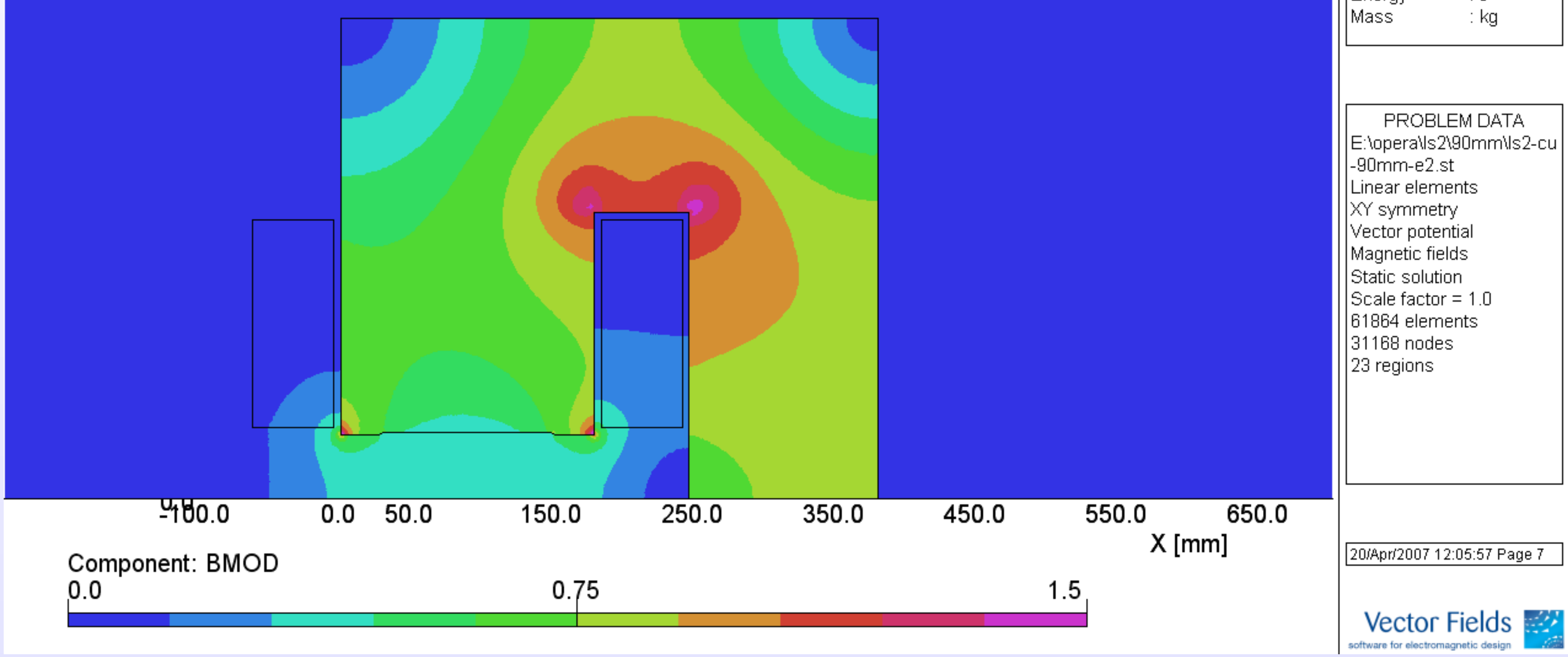
- Nominal Field – Bo = 0.40T to 0.50T
- Field Homogeneity BX,BY=1x10-4
- Good field region BX +/- 20mm, BY +/- 10mm
- Nominal Current density in the coil cross section 2 Amps/mm^2

Yoke Design

The maximum field in yoke is 0.8 T for 0.4 T central field.

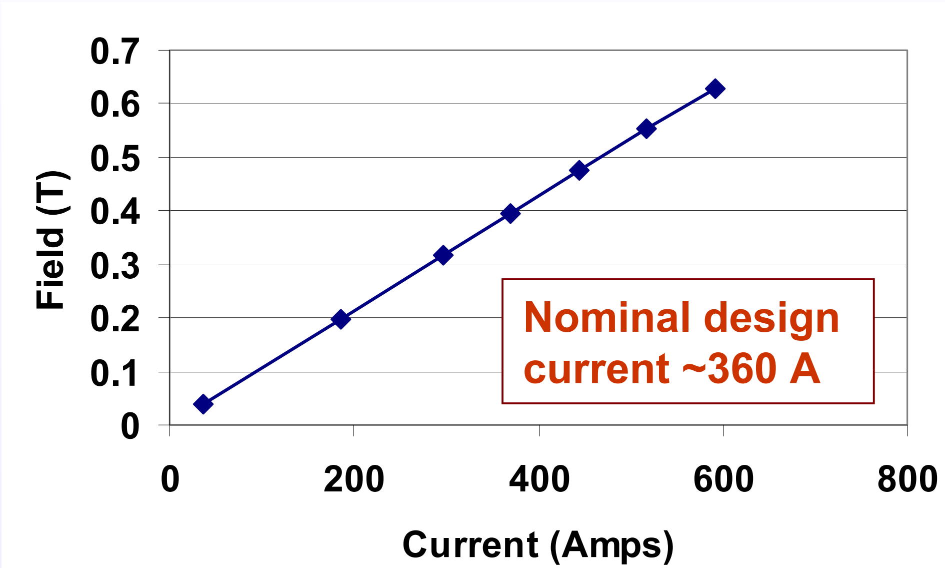
Therefore, the need for further increase in yoke size must be justified on the mechanical ground.

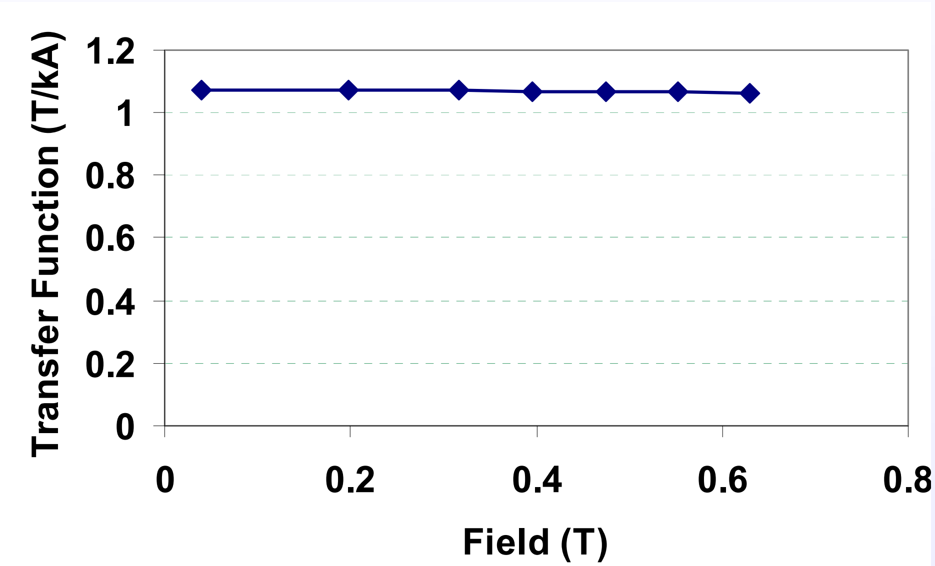
(see more comparison of fields in the next slide)

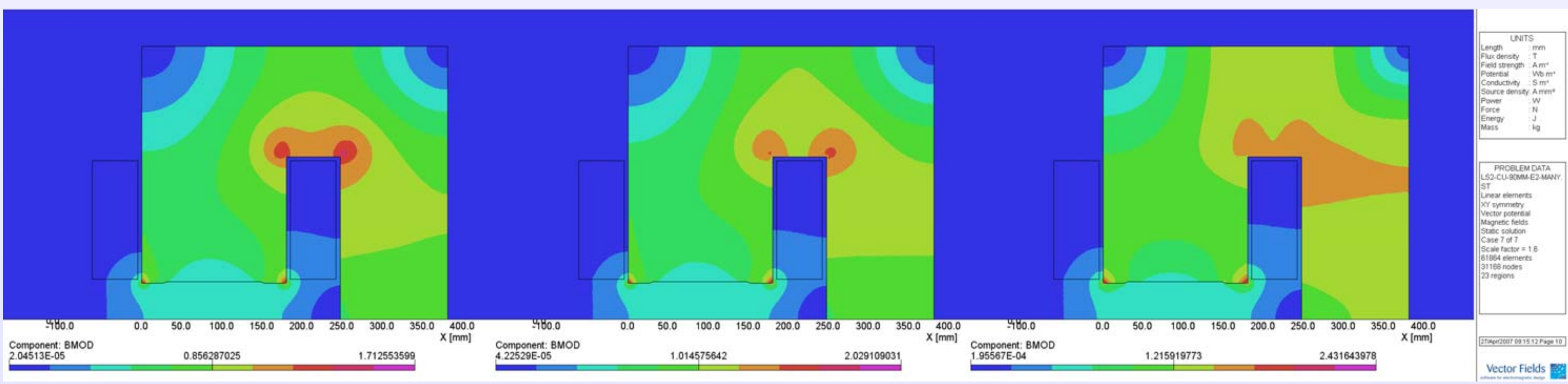


Superconducting
Magnet Division

Iron Saturation in 90 mm Aperture Dipole

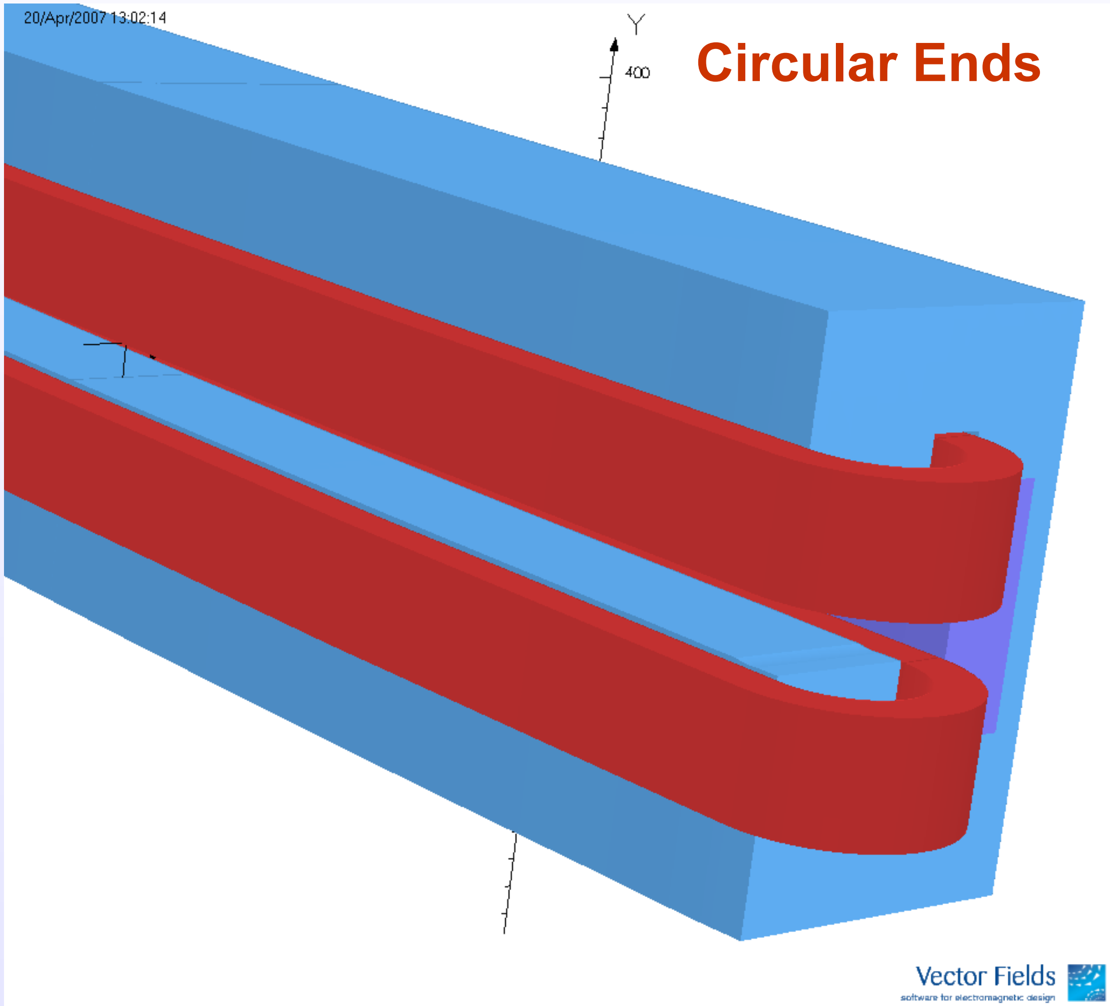


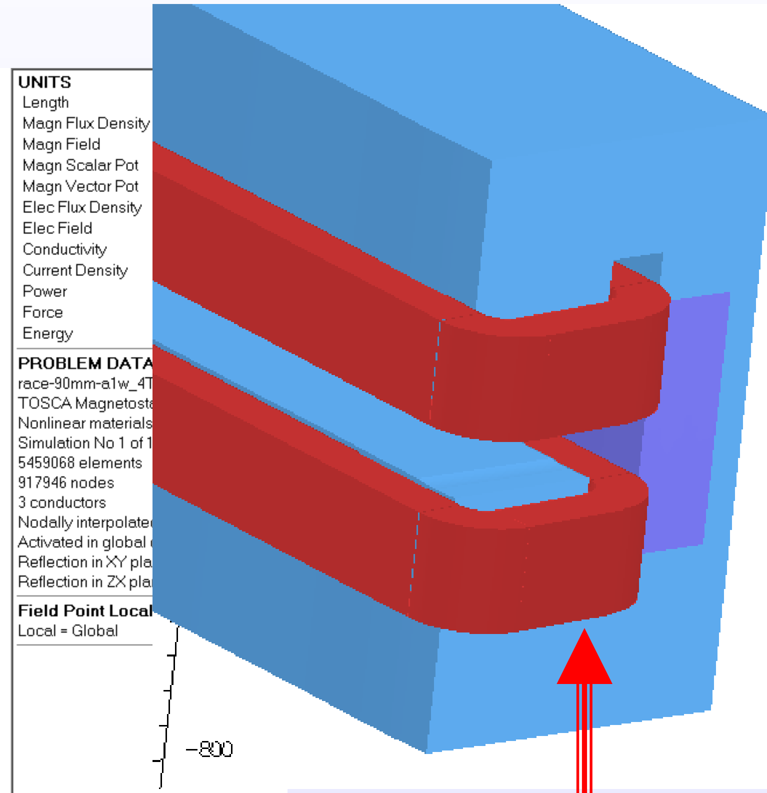




Design field **20% over the design field** **60% over the design field**

Preliminary 3-d Analysis of ~90 mm Aperture Dipole

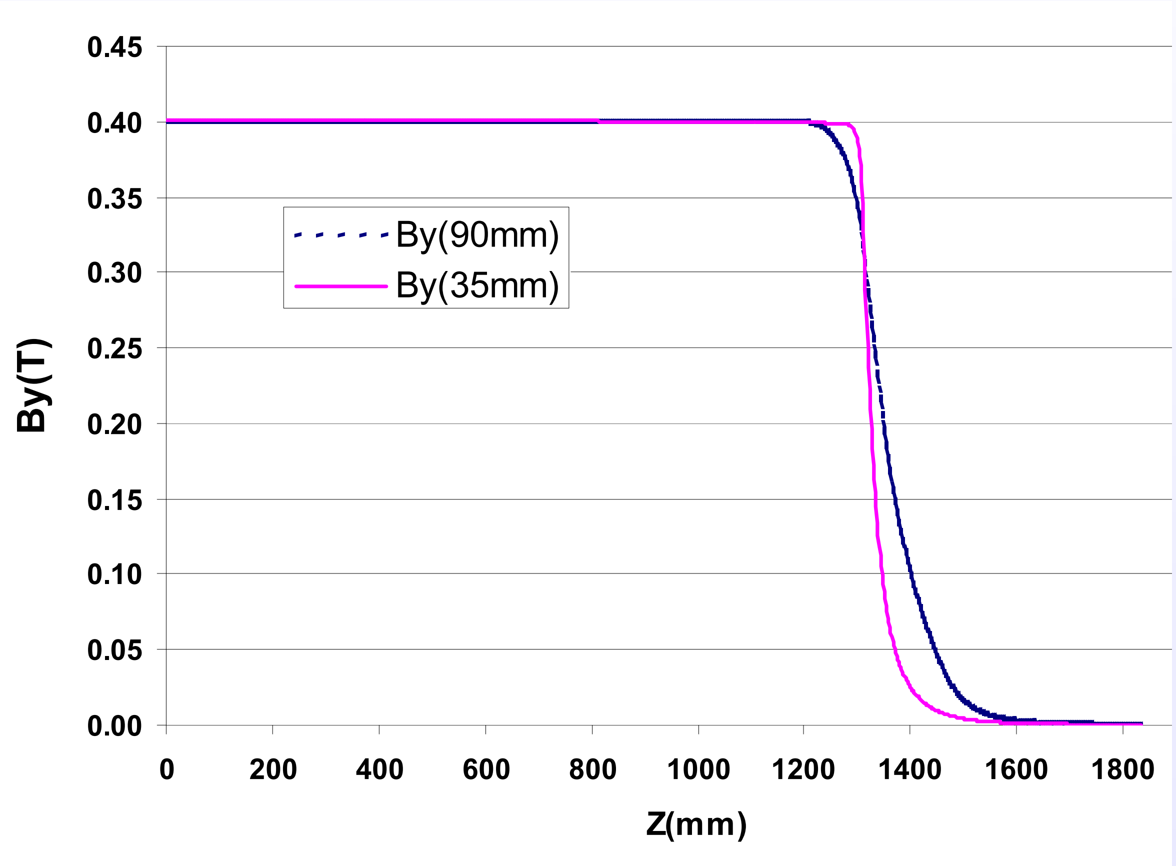




Racetrack Ends

(to reduce the mechanical length of the coil/magnet)

Comparison of Axial Field Profiles of 90 mm and 35 mm Aperture Dipoles

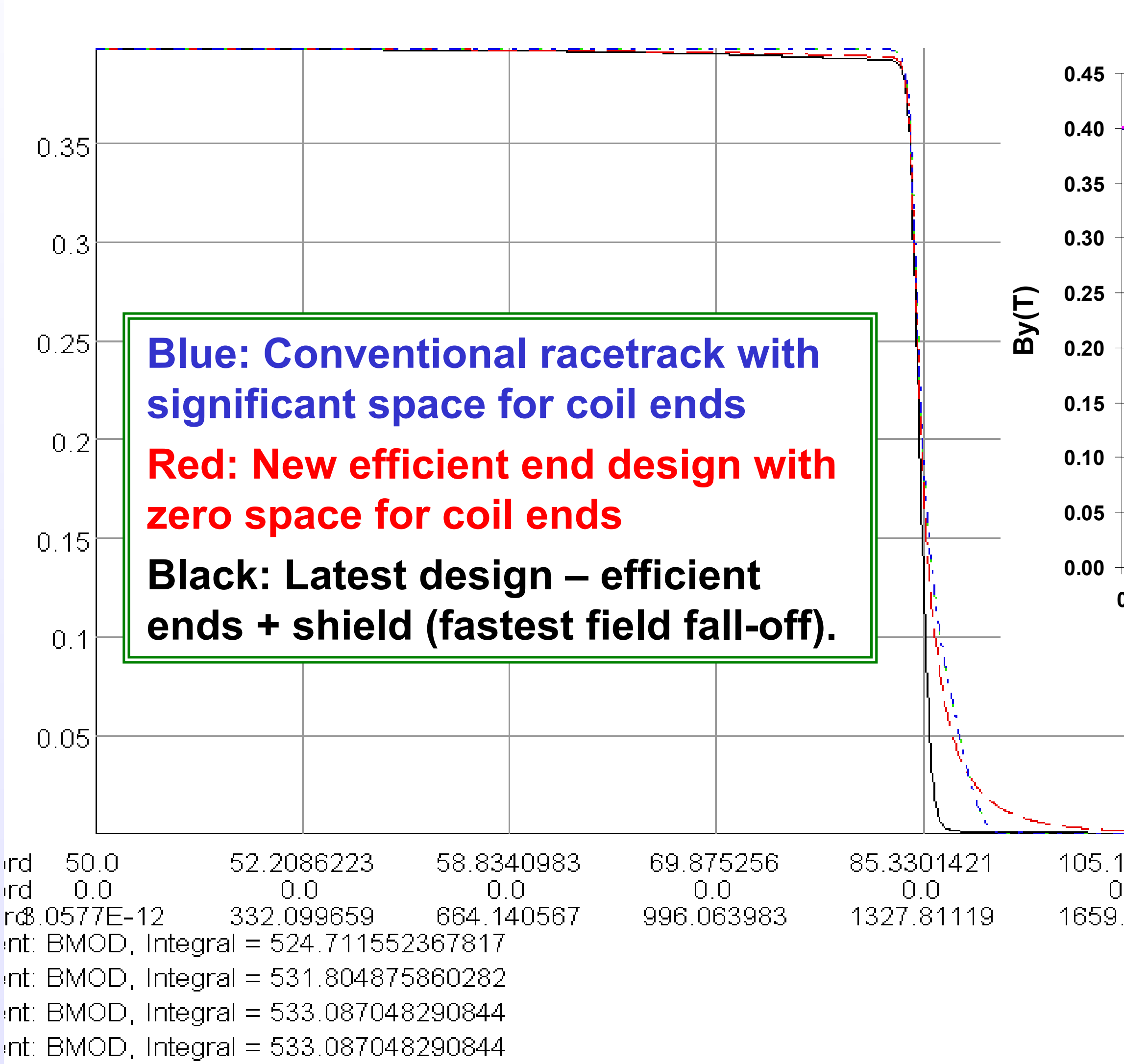


Compare the end field profile of the two magnets. End harmonics will be minimized.

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.

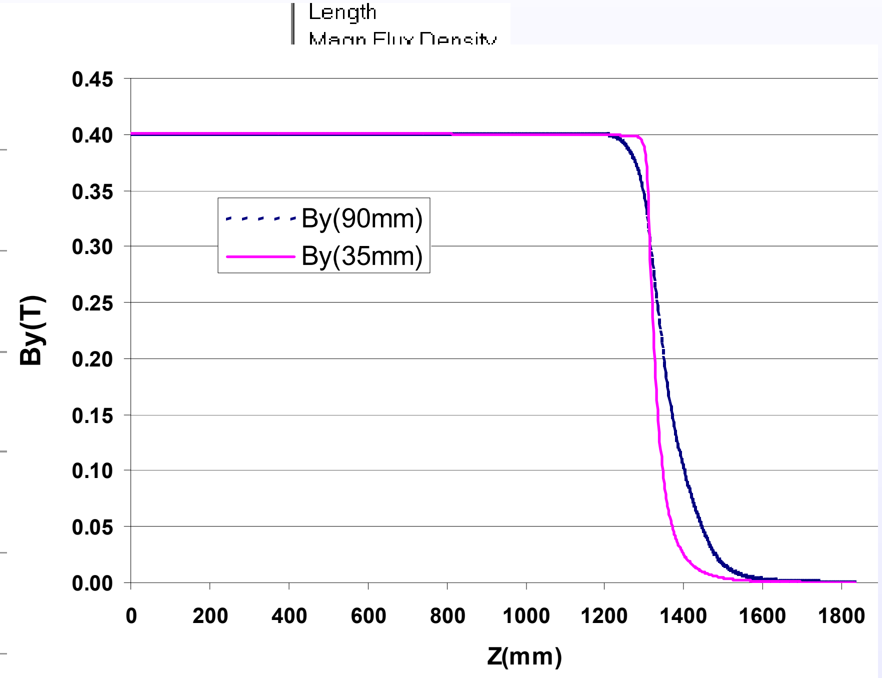
Review of Axial Field Profiles in Various End Designs



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 attempt to reduce the difference between the ends profiles of 35 mm and 90 mm aperture dipoles, *if required.*