Optimization of Dipole and Three Pole Wiggler Interface

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Progress and Status

As of last meeting on March 23, 2007

Favored Design Options

- Dipole with efficient ends.
- Close in 3 pole wiggle and Dipole.

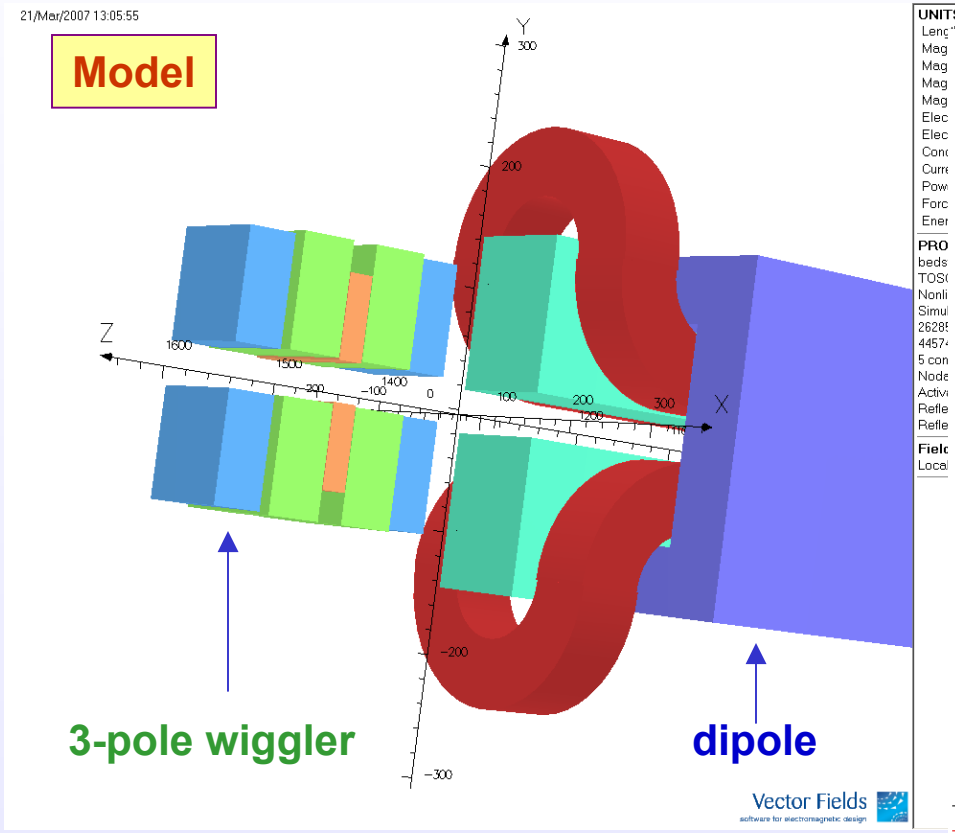
Remaining Issues

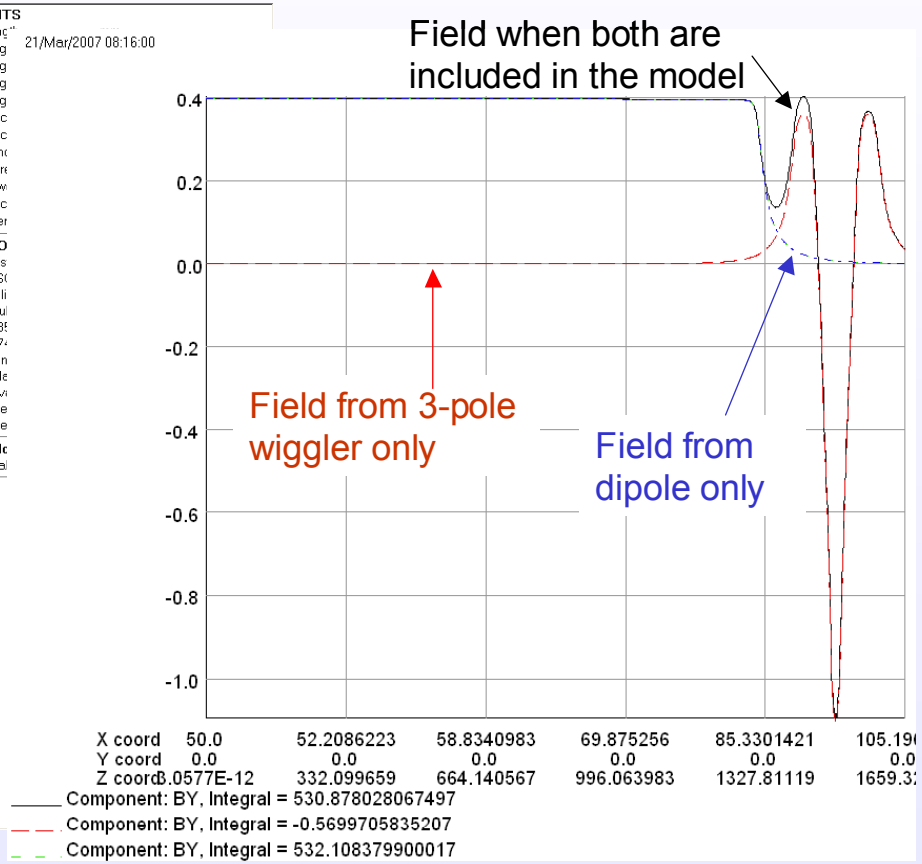
- Interaction or cross talk between the fields of dipole and three pole wiggler.
- Linear superposition of the fields of two magnet : Is it valid or can it be accommodated with correctors in dipole ends.
- Field fall of the efficient end : Is slower fall off acceptable? Can some thing be done to make field fall of faster.

Overview of progress since last meeting:

- Put a magnetic fence to isolate the field of influence of two warring parties – dipole and three pole wiggler.
- Can we do it, including taken by magnetic the fence (shielding), within the same overall space (90 mm or less).
- Improvement in the fall-off of fringe field of new dipole end.

Review of the Design Presented Last Week



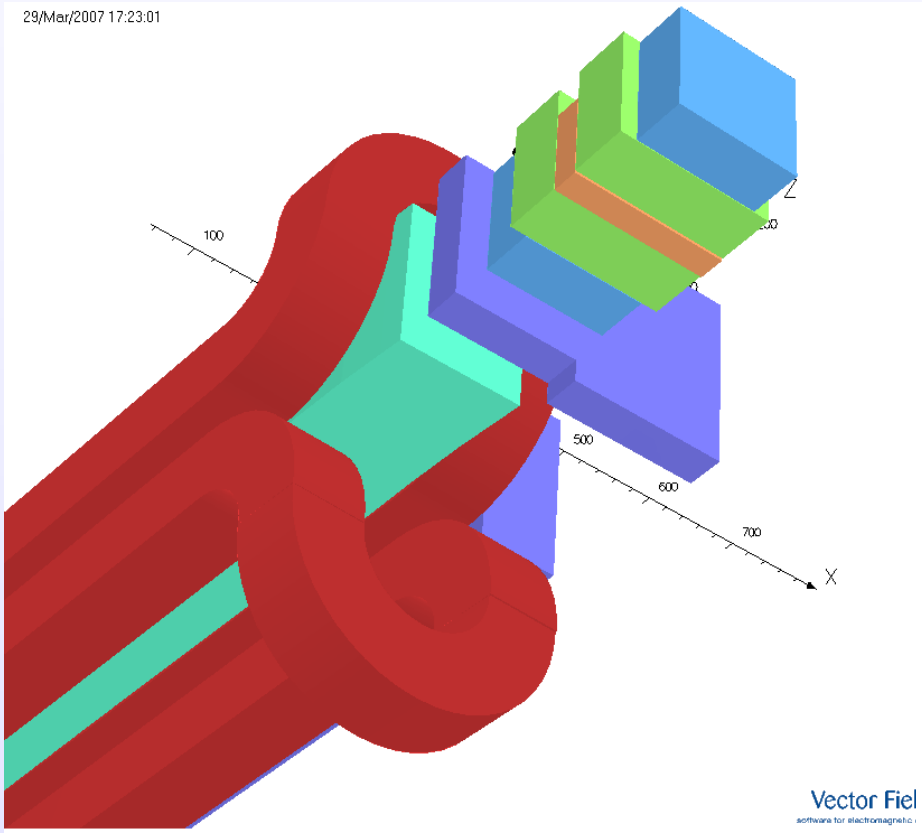


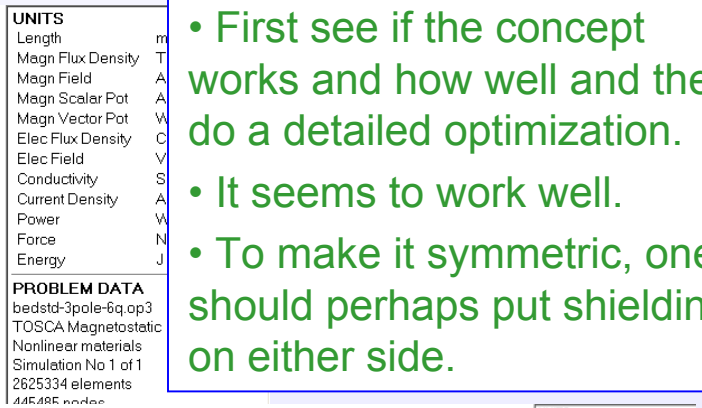
Some interaction between the fields of dipole and three pole wiggler

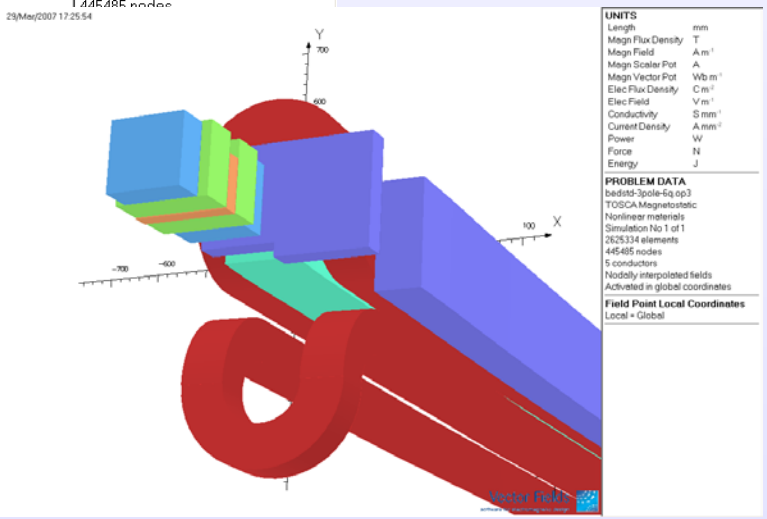
Incorporation of Magnetic Shield

- In this case a 30 mm shield is placed between the 3 pole wiggler and dipole with new ends.
- The clear space on either side of the shield is 30 mm.
- The idea is to reduce the cross-talk between the two magnets.

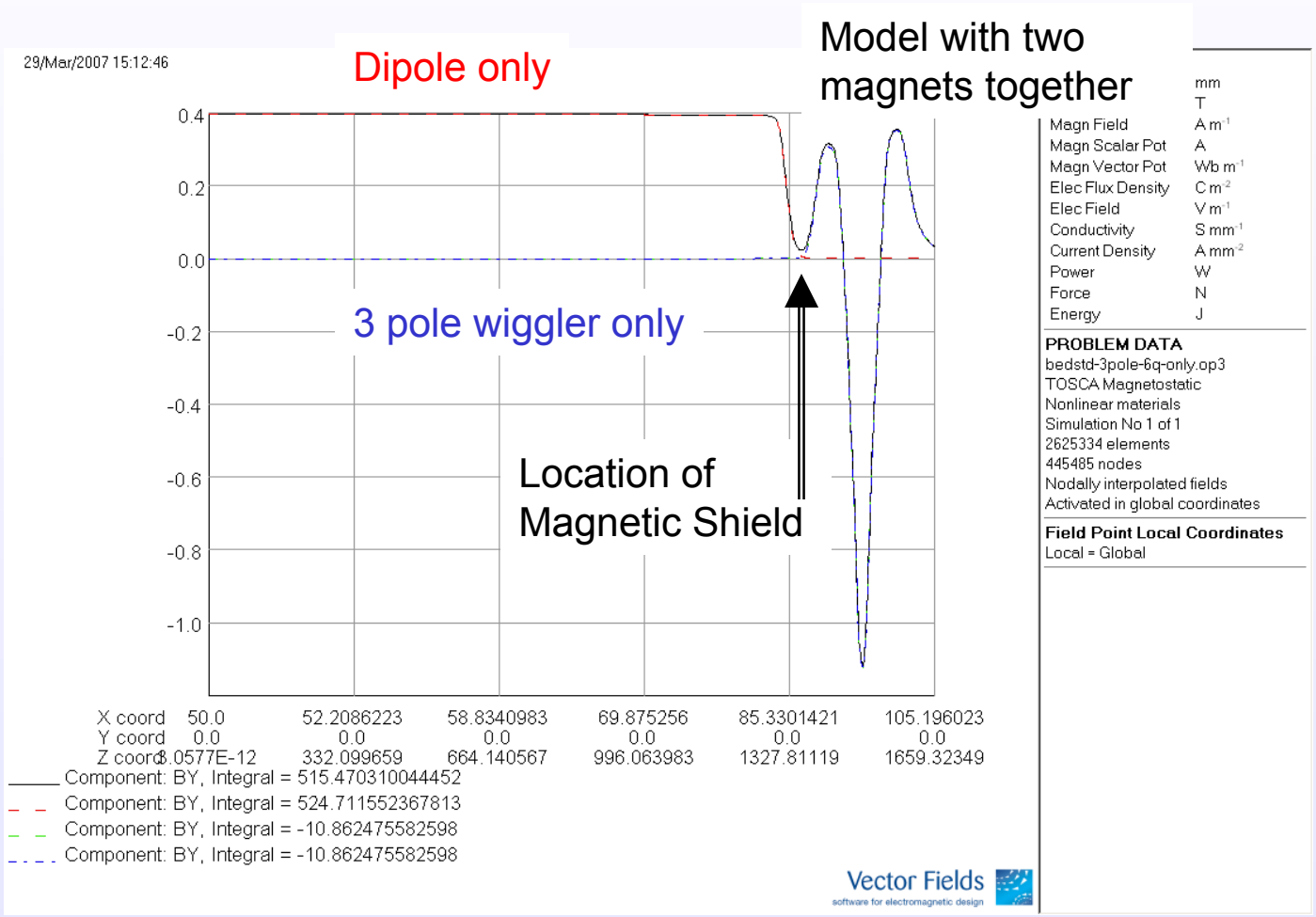
- Smaller shielding (10 mm) was also studied.
- First see if the concept works and how well and then do a detailed optimization.
- It seems to work well.
- To make it symmetric, one should perhaps put shielding on either side.





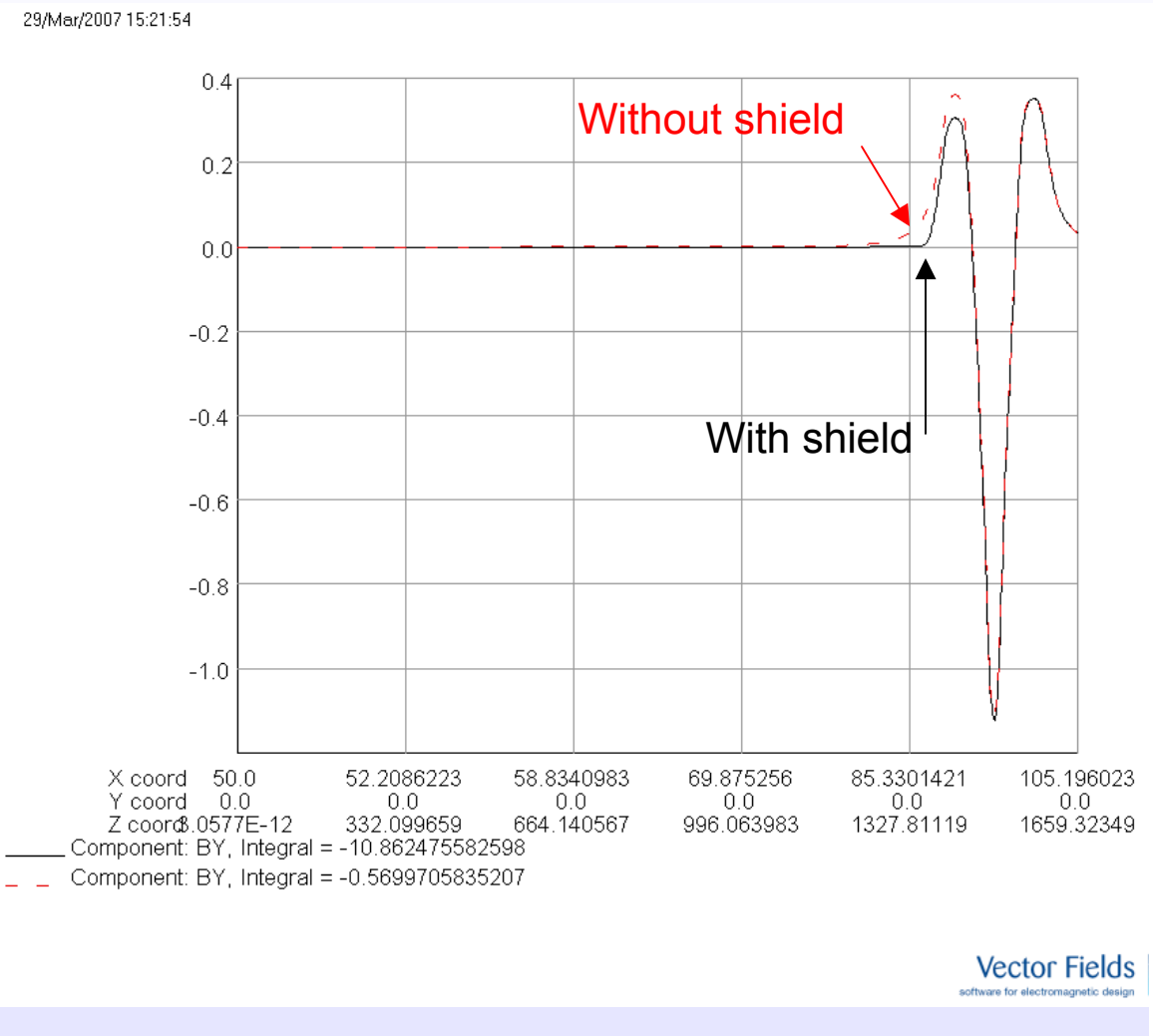


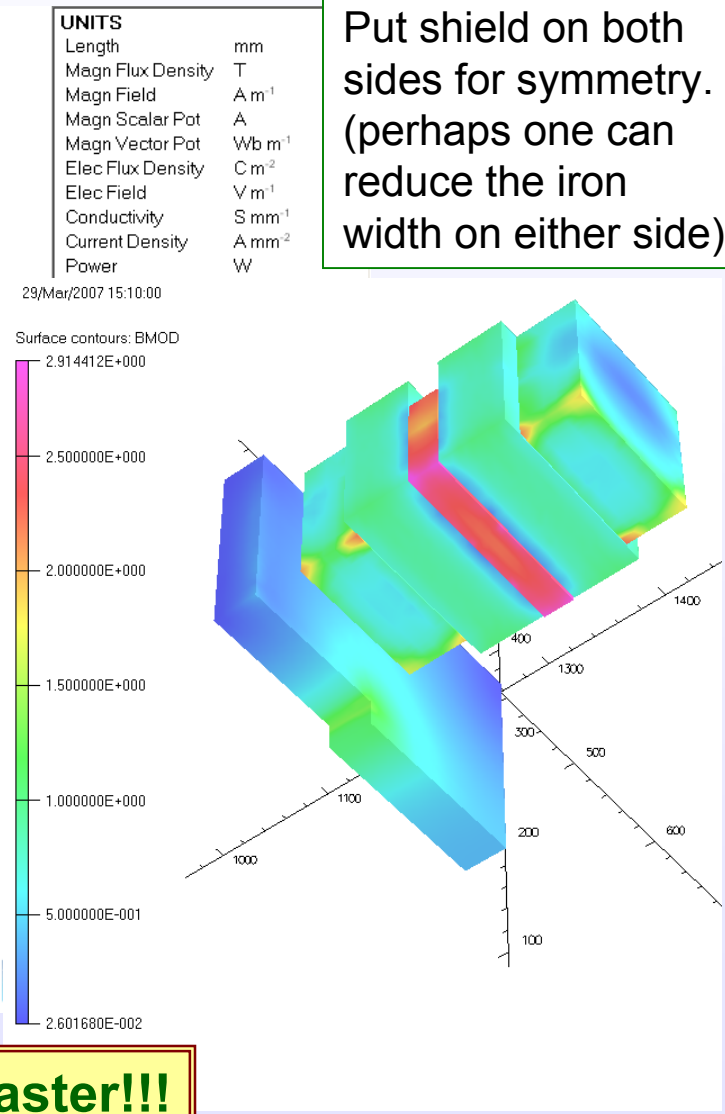
Overlapping Fields?



Magnetic shield clearly draws to a good line of demarcation between the field of influence of two competing parties.

Comparison of field profiles with and without shielding for 3 pole wiggler only

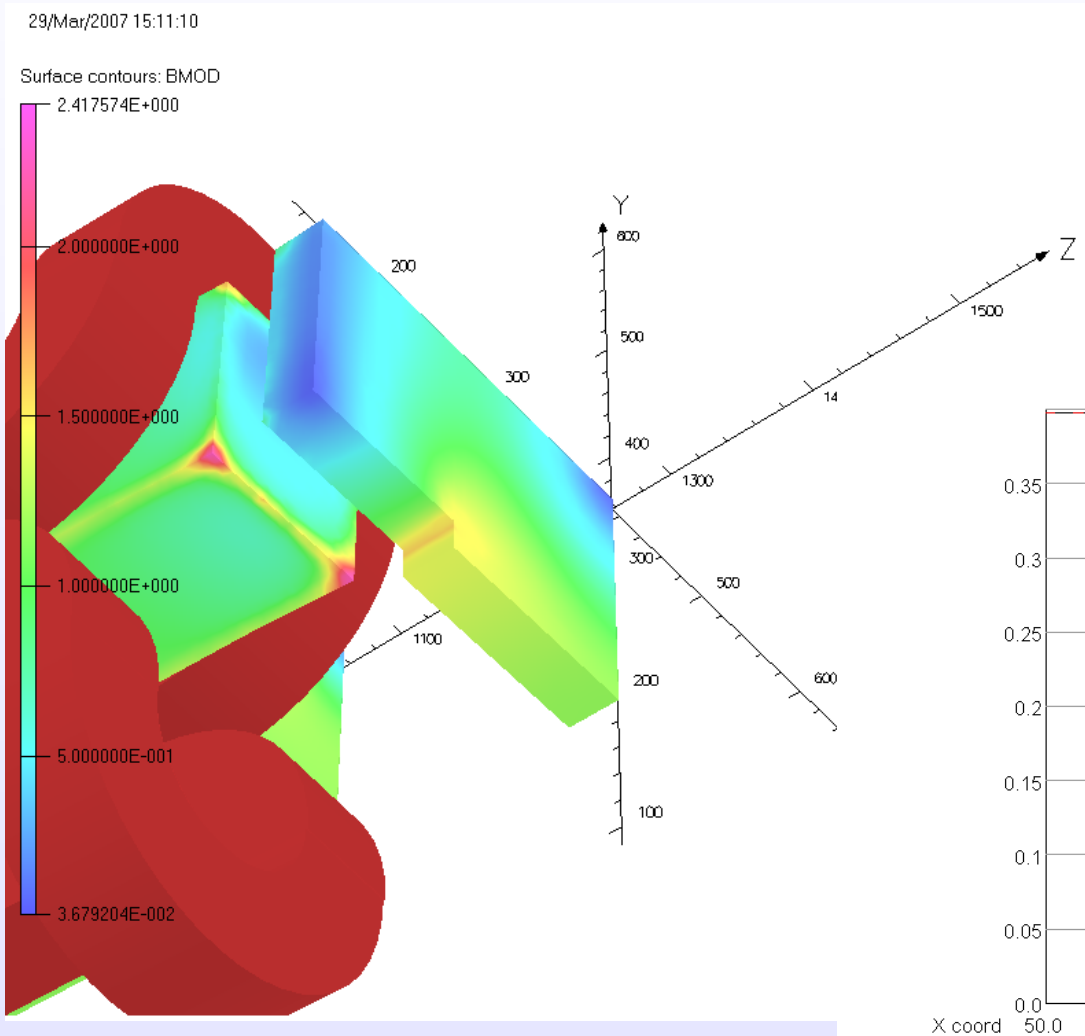




Put shield on both sides for symmetry. (perhaps one can reduce the iron width on either side)

Magnetic Shielding Makes Field Drop Faster!!!

Comparison of field profiles with and without shielding for dipole with new ends

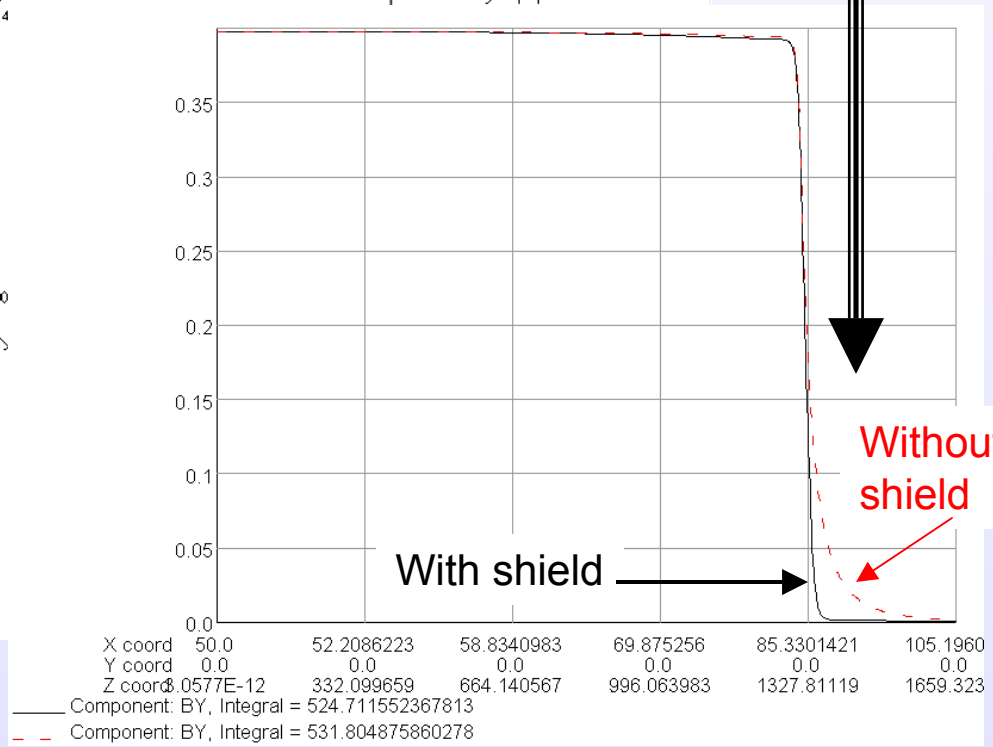


UNITS

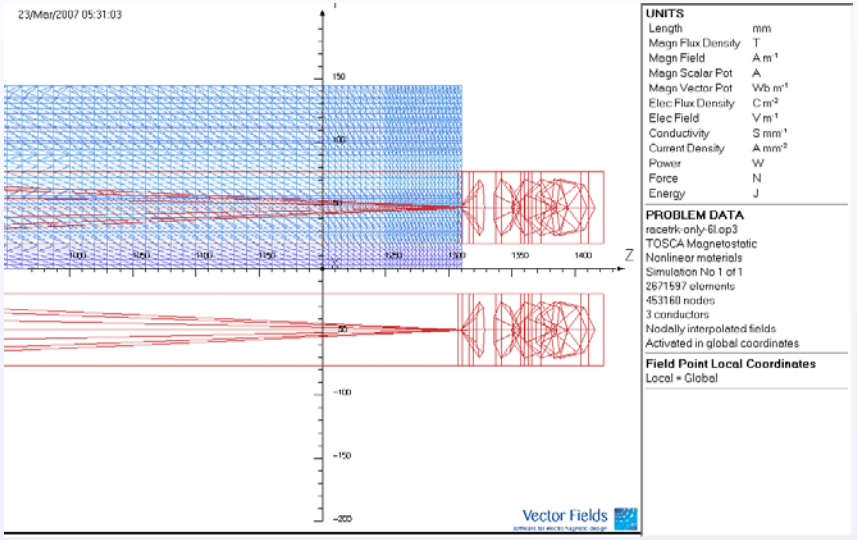
Length	mm
Magn Flux Density	T
Magn Field	A m
Magn Scalar Pot	A
Magn Vector Pot	Wb
Elec Flux Density	C m
Elec Field	V m
Conductivity	S m
Current Density	A m
Power	W
Force	N
Energy	J

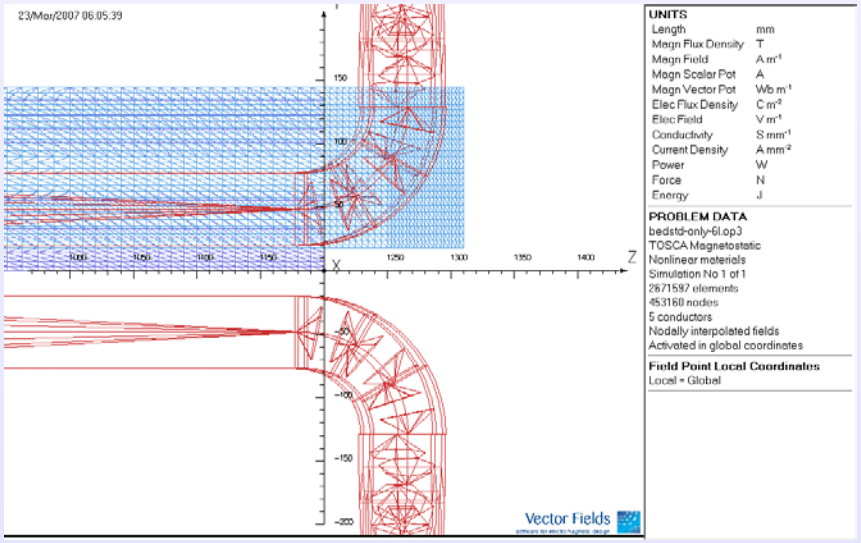
PROBLEM DATA
bedstd-only-6q.op3

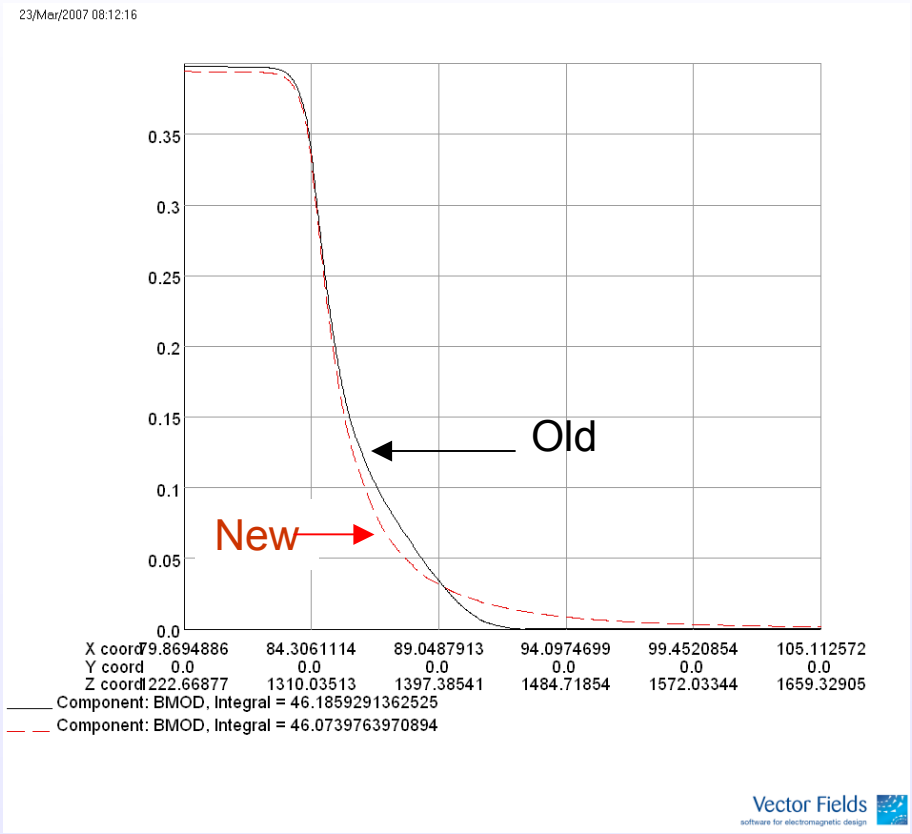
Note a sharp improvement in the field fall off



This (faster fall off) is a significant improvement over last design (see below)

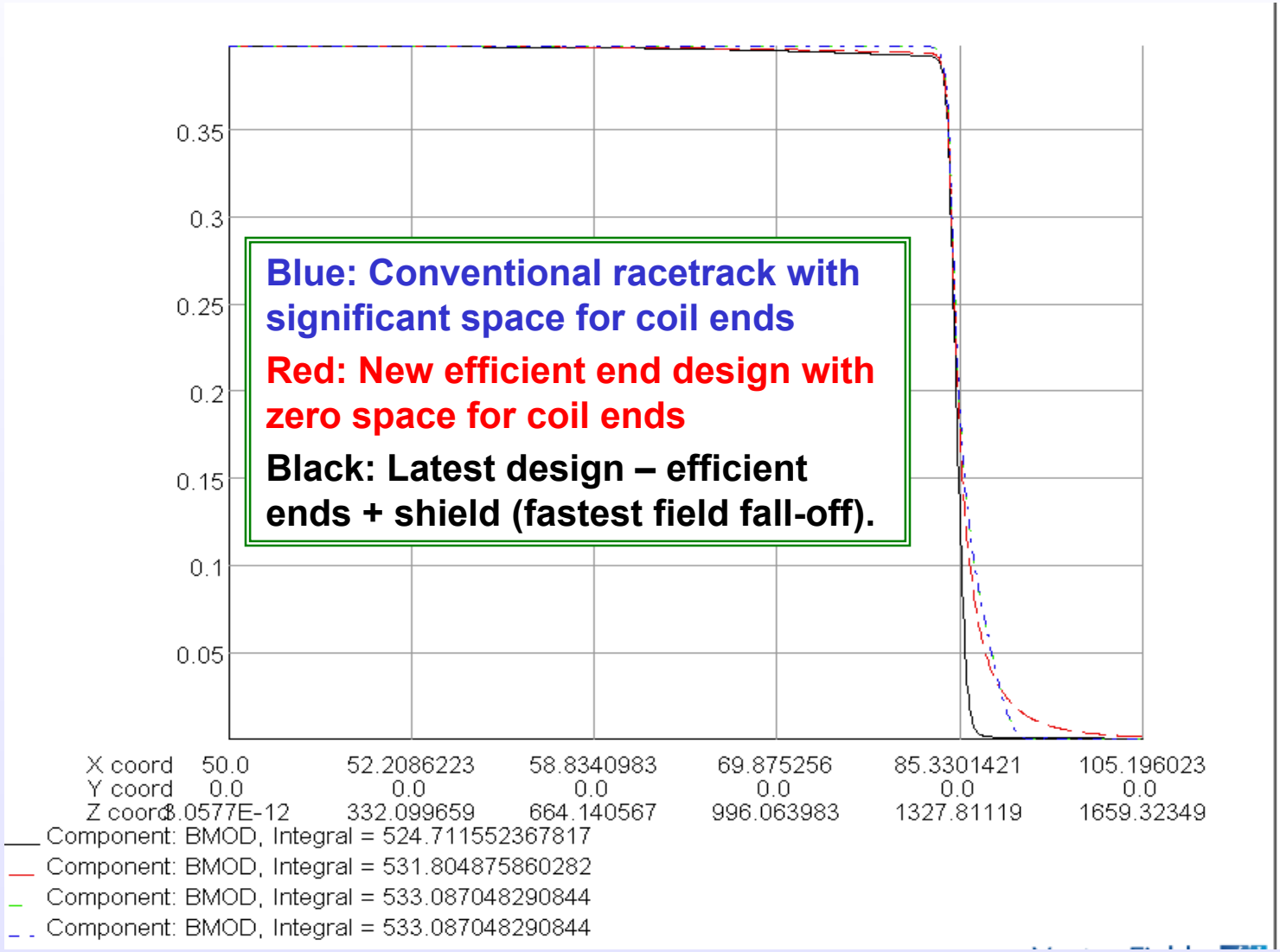






- There is no loss in magnetic length in releasing the space occupied by coil ends.
- End fields are similar in both cases.
- **Are we ready to accept this deduction in real estate as valid now (or we wait till April 15th)?**

Comparison of the End Fields in Various Designs



Length	mm
Magn Flux Density	T
Magn Field	A m^{-1}
Magn Scalar Pot	A
Magn Vector Pot	Wb m^{-1}
Elec Flux Density	C m^{-2}
Elec Field	V m^{-1}
Conductivity	S mm^{-1}
Current Density	A mm^{-2}
Power	W
Force	N
Energy	J

PROBLEM DATA
racetrk-only-6l.op3
TOSCA Magnetostatic
Nonlinear materials
Simulation No 1 of 1
2671597 elements
453160 nodes
3 conductors
Nodally interpolated fields
Activated in global coordinates

Field Point Local Coordinates
Local = Global

Summary

- New dipole end and magnetic shielding seems to be helping the overall design of NSLS2 storage ring.
- Significant space can be released and cross talk can be managed.
- In principle, one can obtain similar benefits in quadrupole and sextuopole magnets. Since there are many of those in the machine, impact of such designs can be significant.