Racetrack Coil Magnets for Neutrino Storage Ring

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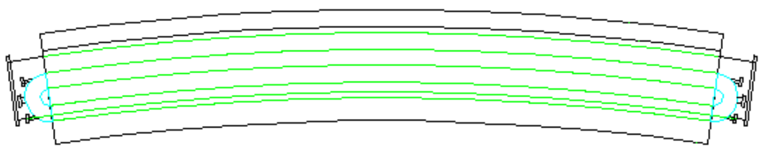
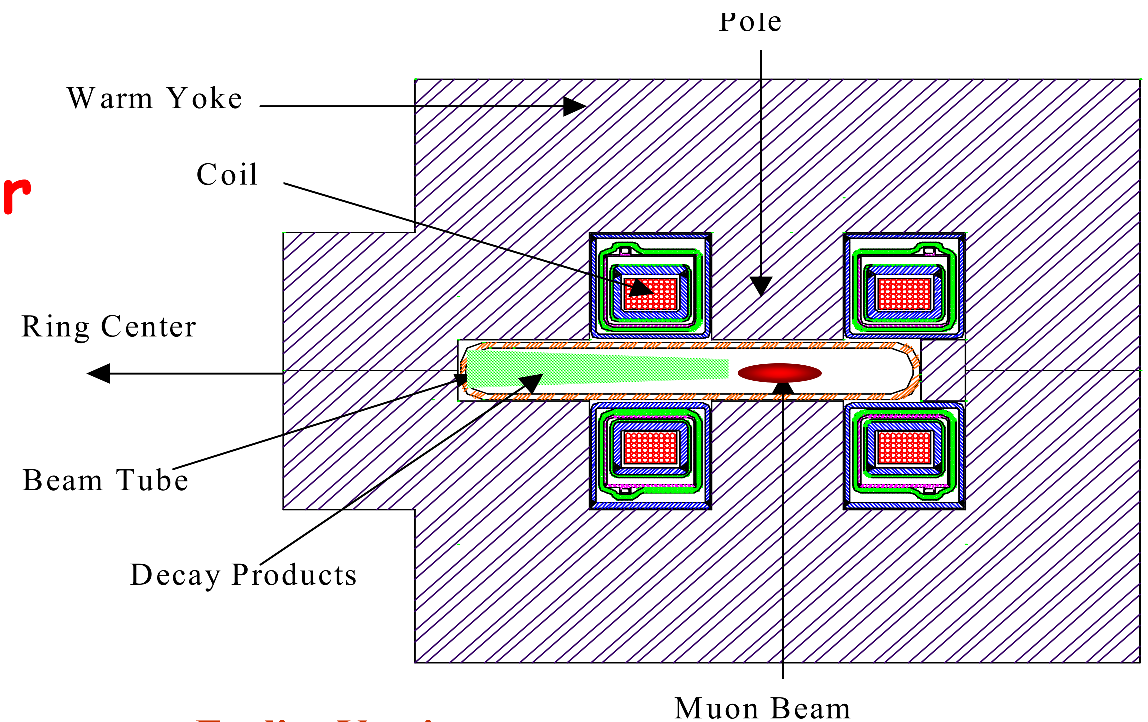
Basic Design Principles

- Nb_3Sn Racetrack coils
- Design Field: 8+ T

  Nominal Operating Field 7 T
- **Decay products clear SC coils at midplane**
- Warm iron
- Compact cryostat
- Low cost

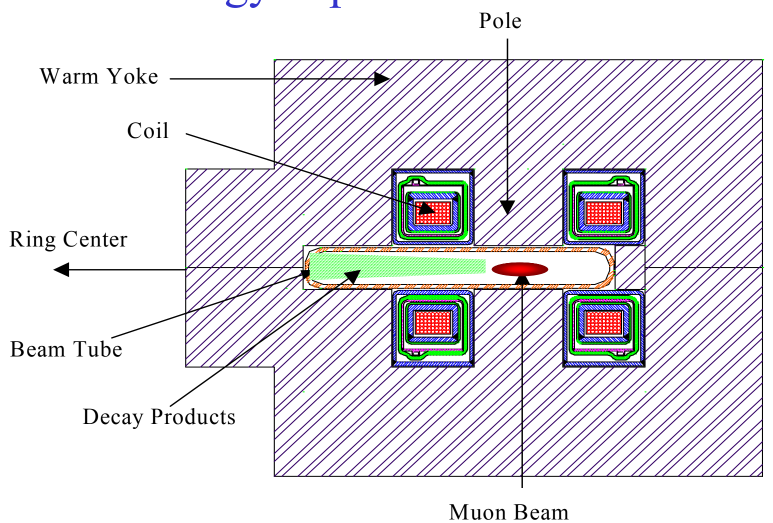




Earlier Version

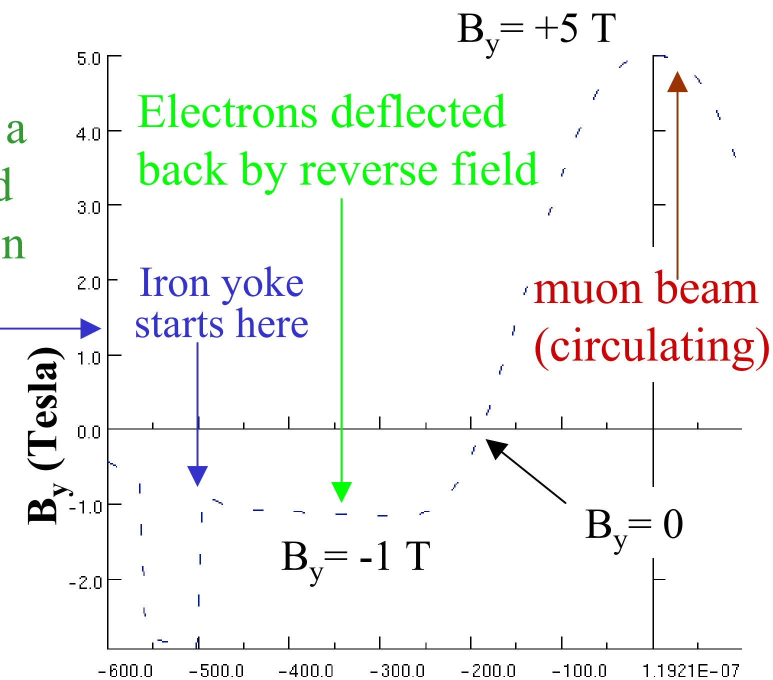
Dipole for ν Storage Ring

One major design consideration: Reduce the amount of energy deposited in cold structure

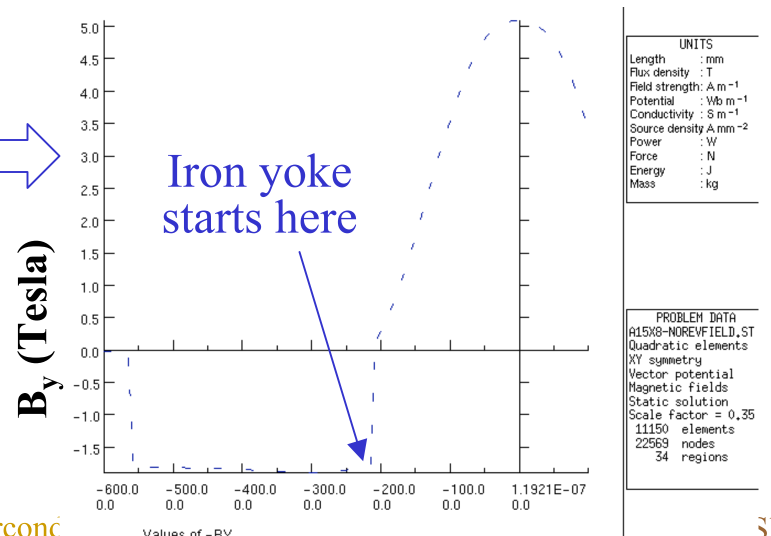


Decay electrons get back towards main aperture by
(a) Reverse field and (b) Magnet saggitta
which knob to use how much may depend on E & B

Design with a reverse field region in Iron



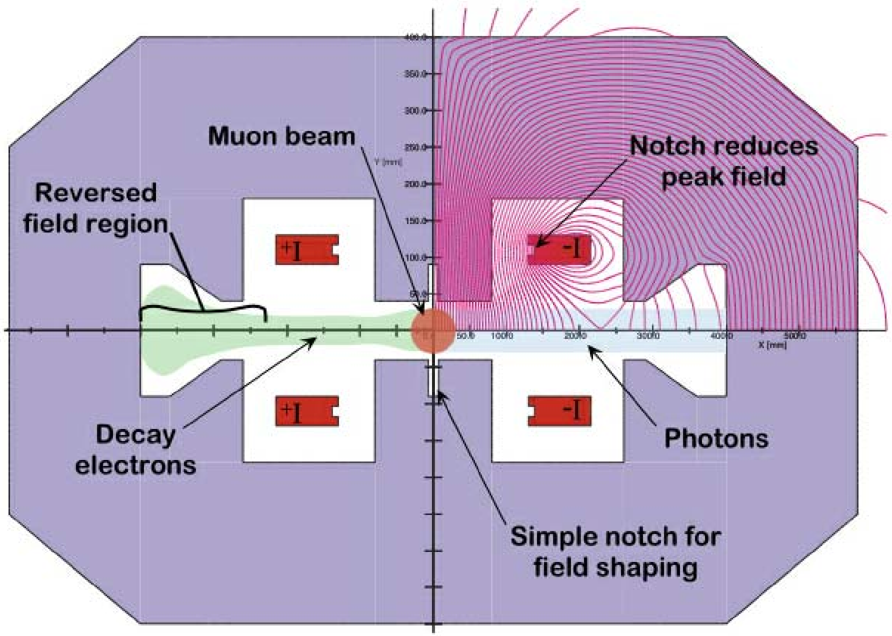
A dipole with no cutout in yoke for a reverse field region. Electrons will hit yoke and create shower



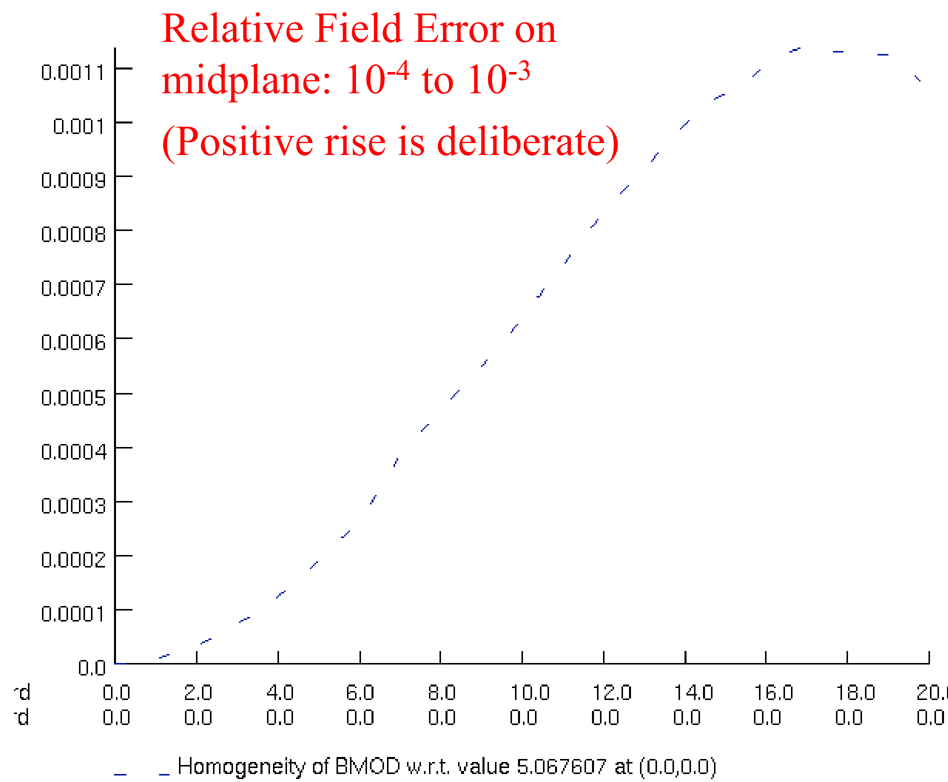
In neutrino storage ring, is ~10% energy deposition acceptable?

Magnetically Optimized Design

Cutout in yoke to optimize field quality: Model used in MARS Studies (Brett Parker)



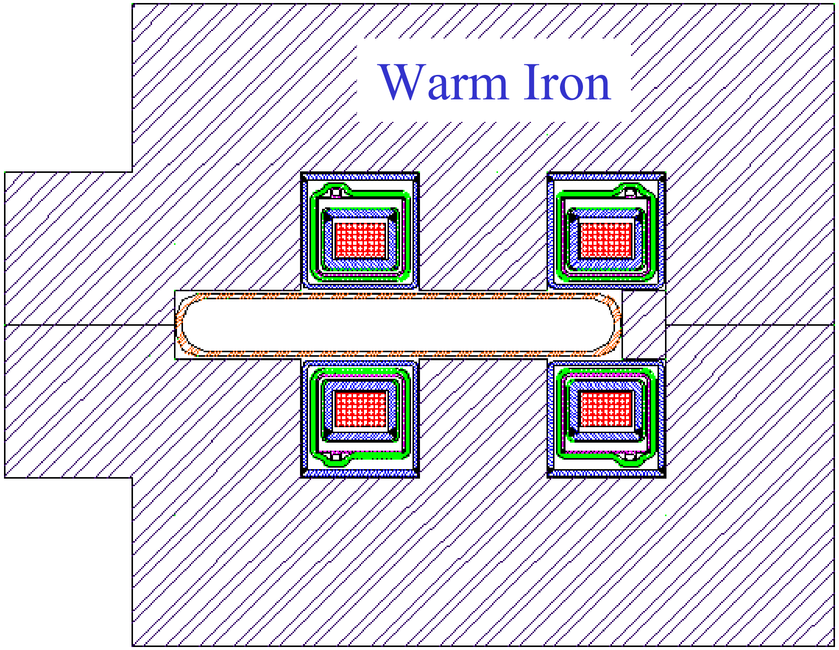
Toy model dipole with improved field harmonics and extended vertical cutout.



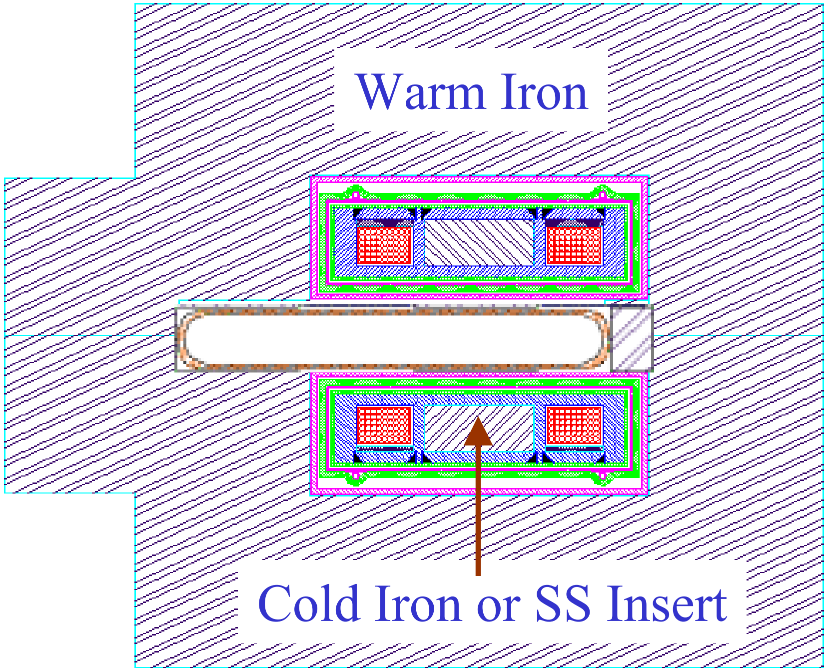
Magnet Design Evolution

Common cryostat for two coil halves:

For a better mechanical and cryogenic design

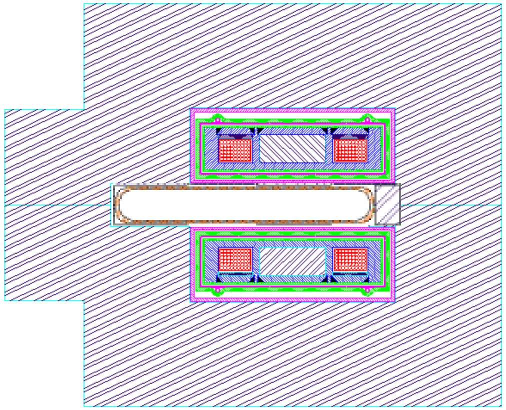


Earlier Version



Current Version

Future Design Work and Other Possibilities



Work on the present configuration continues on:

- Magnetic Design
- Mechanical Design
- Cryostat Design

More design evolution to be based on MARS Studies (Brett Parker)

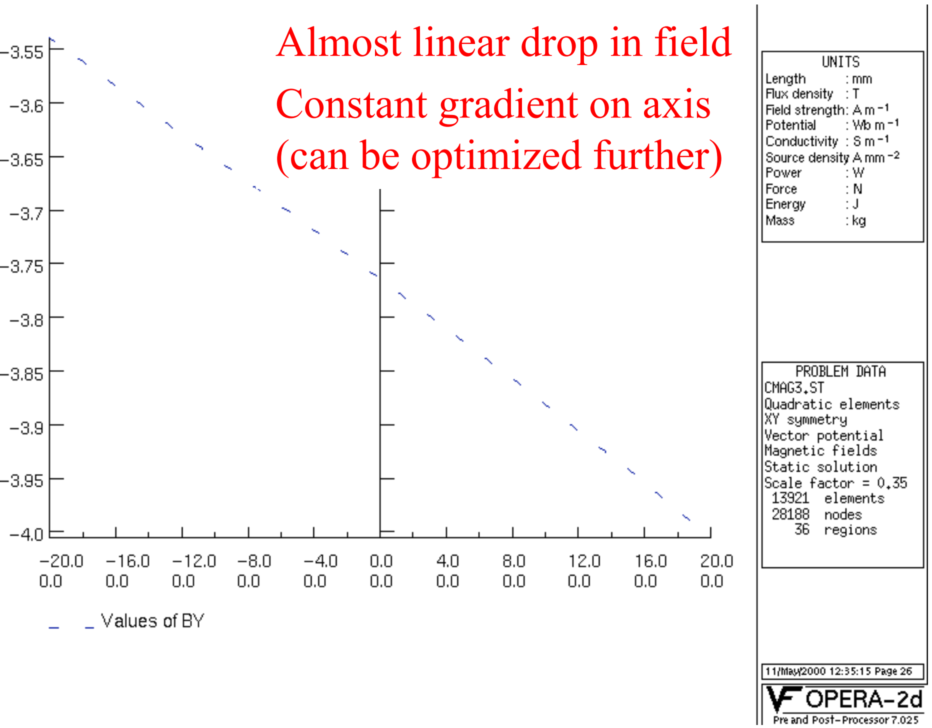
- How many watts are actually deposited in coils, etc. under different scenarios?
- If not much, coils can tolerate a modest temperature rise and still be superconducting
  - The coils can be brought significantly down towards midplane for better efficiency
    - Higher field, lower forces.
- High Field Option (8-10 T Nb_3Sn):
  - More R&D, other designs and technologies, more expansive
  - Another Benefit of Nb_3Sn -- higher Tc, allows higher heat deposition

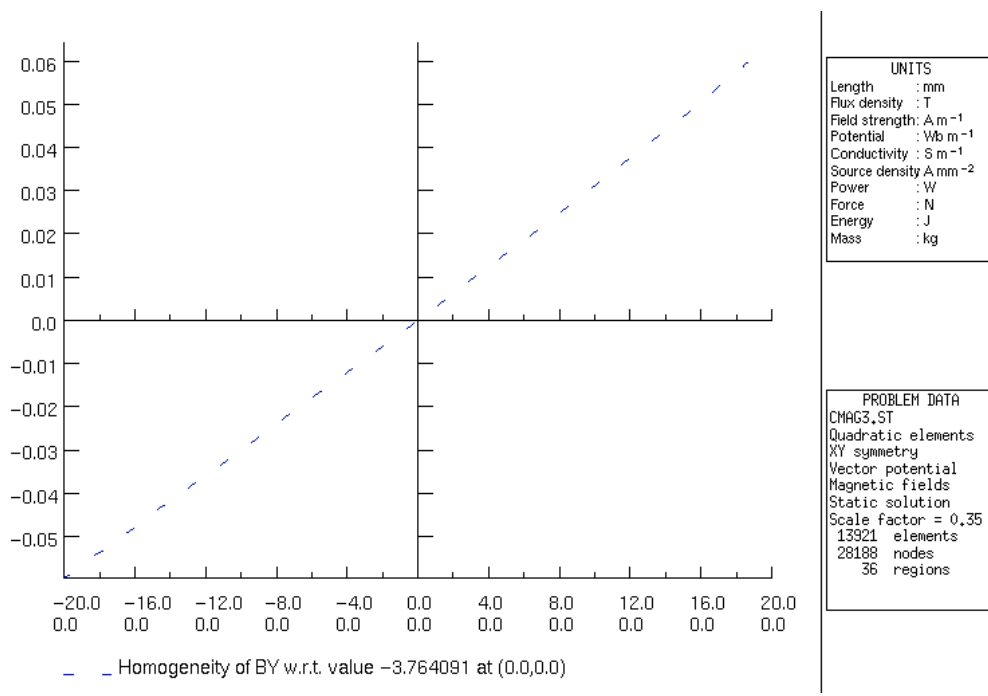
In all cases coils are flat and clear bore tube (original design principles)

Possibility of A Combined Function Magnet Design

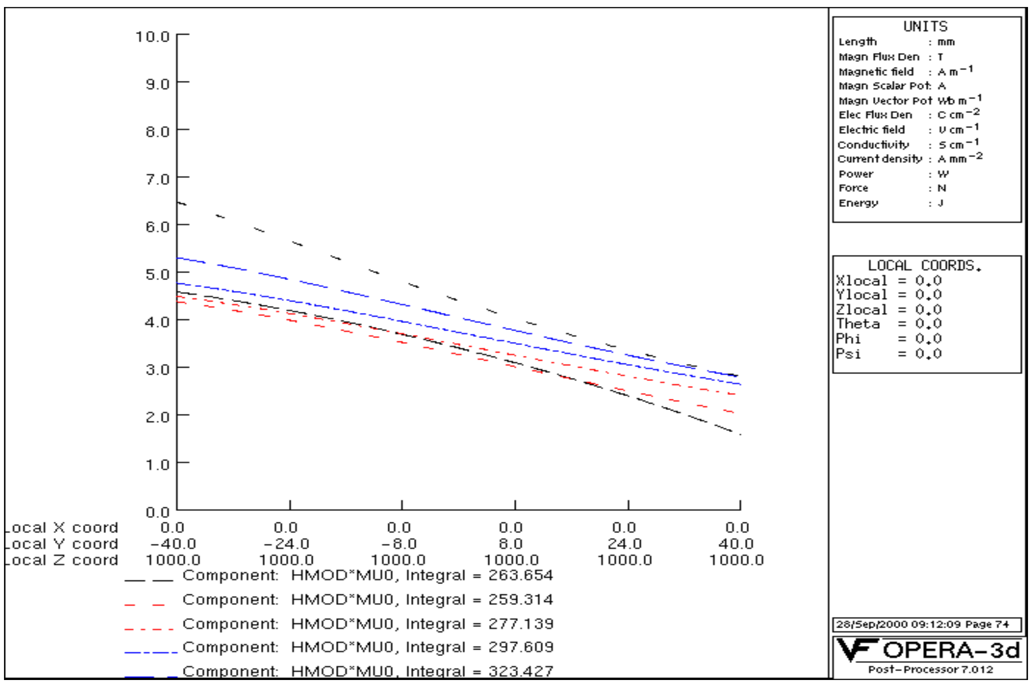
Since, most energy deposition is on one side, the coil on other side can be brought closer to midplane, or one can have a “C magnet”. This generates a combined function magnet, actually with a higher field. But with only of one type of focussing. Imagine a lattice where long dipole have focussing of one kind and the other type of focussing comes from traditional quadrupoles. AP Issues?

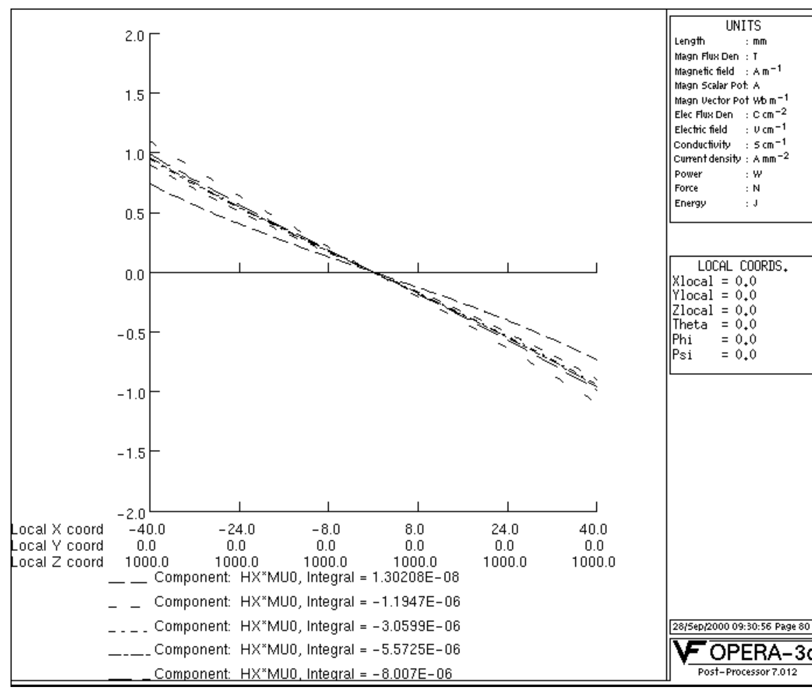
Dipole (F)	QD	Dipole (F)	QD	Dipole (F)	QD





Skew Quad Lattice by Axially Shifting Coils





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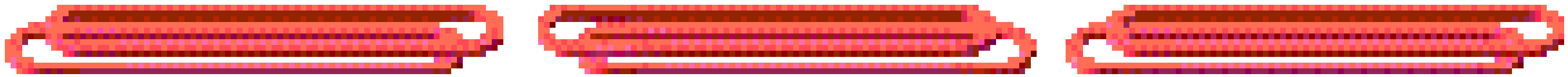
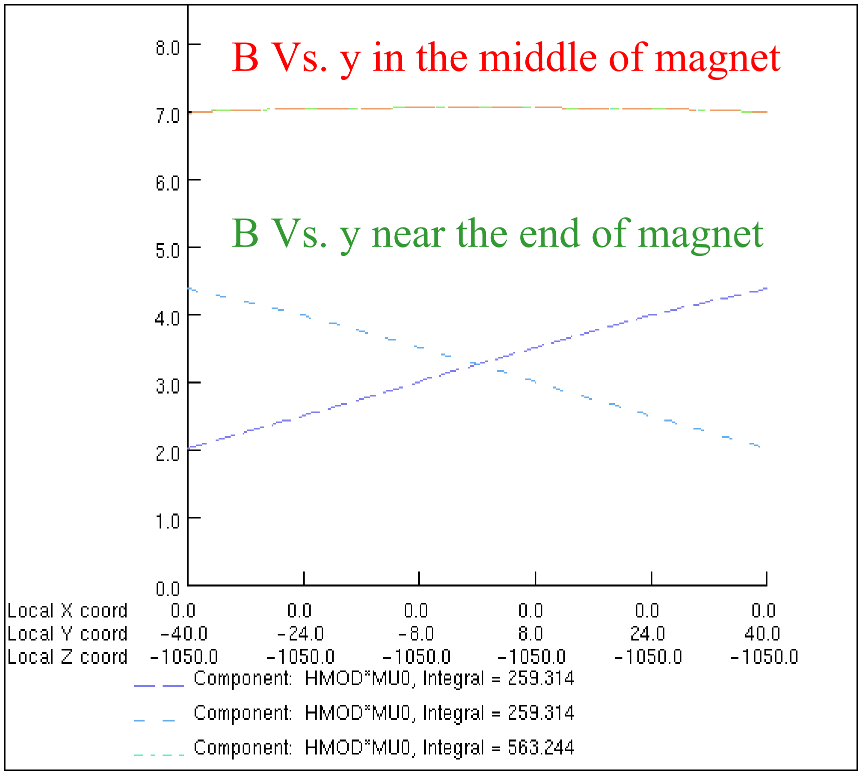
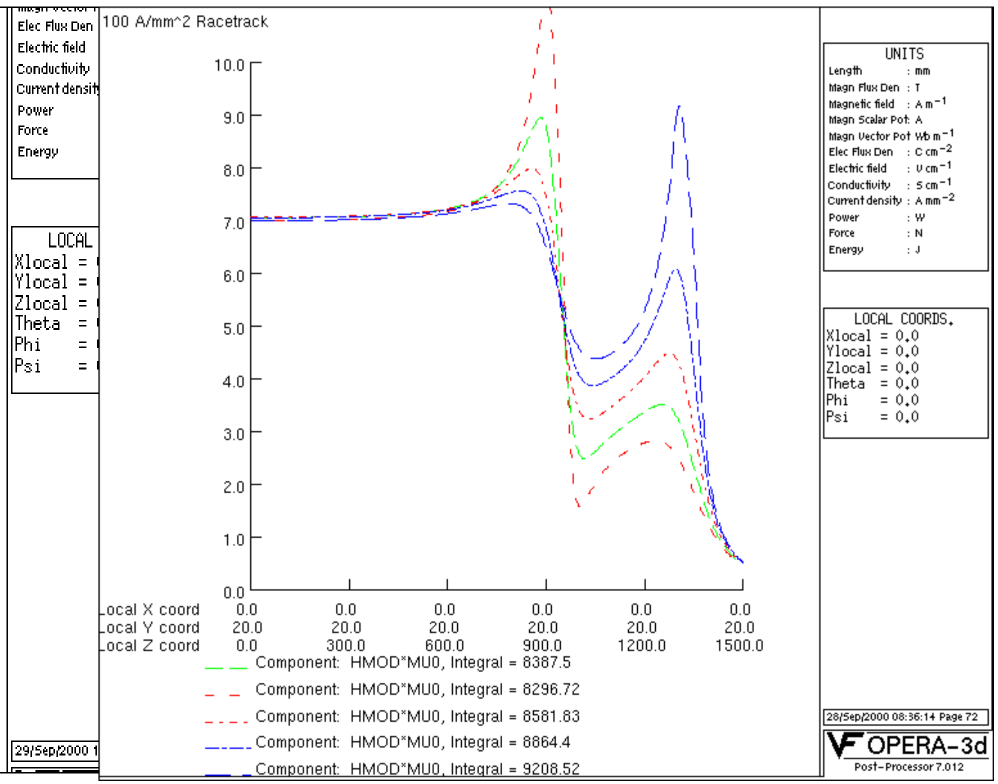
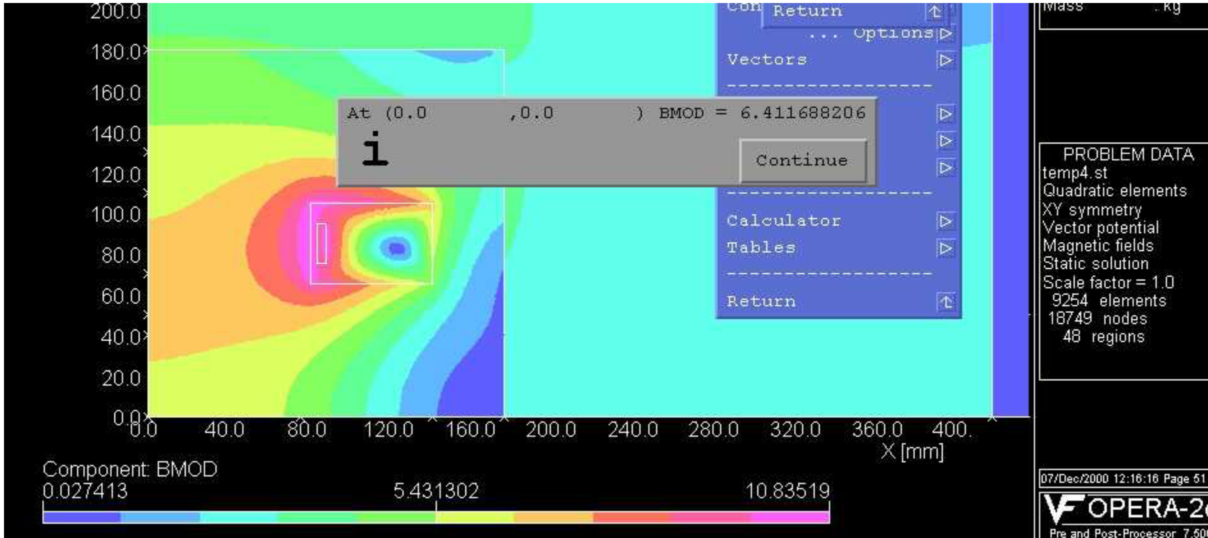


Axial scan of B for various y





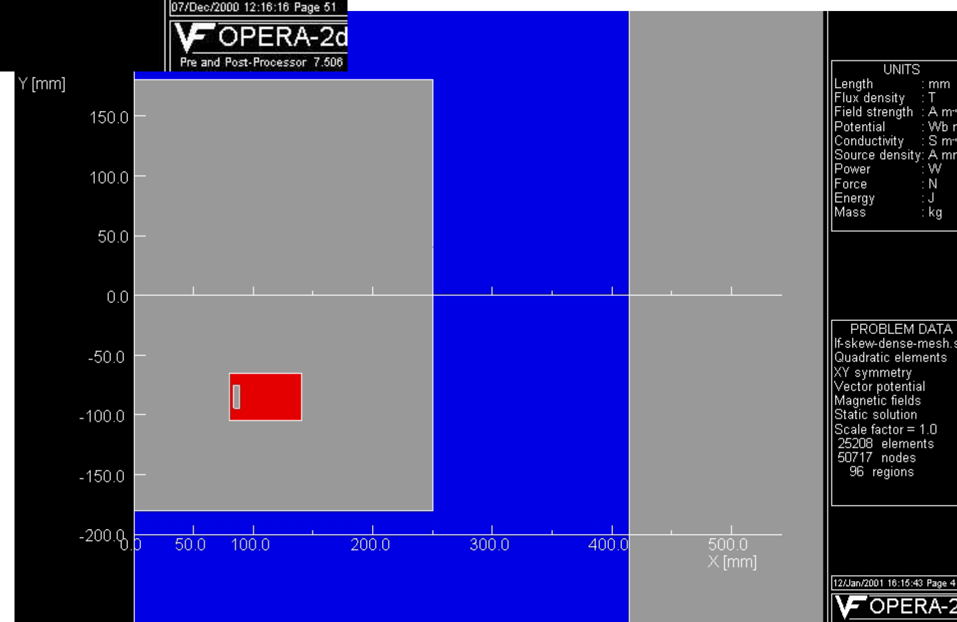
Computer Model for ν-Factory Magnet



Symmetric 1/4 model

1/4 Symmetric Model
(Dipole)

1/2 Model
(combined function skew quad dipole)



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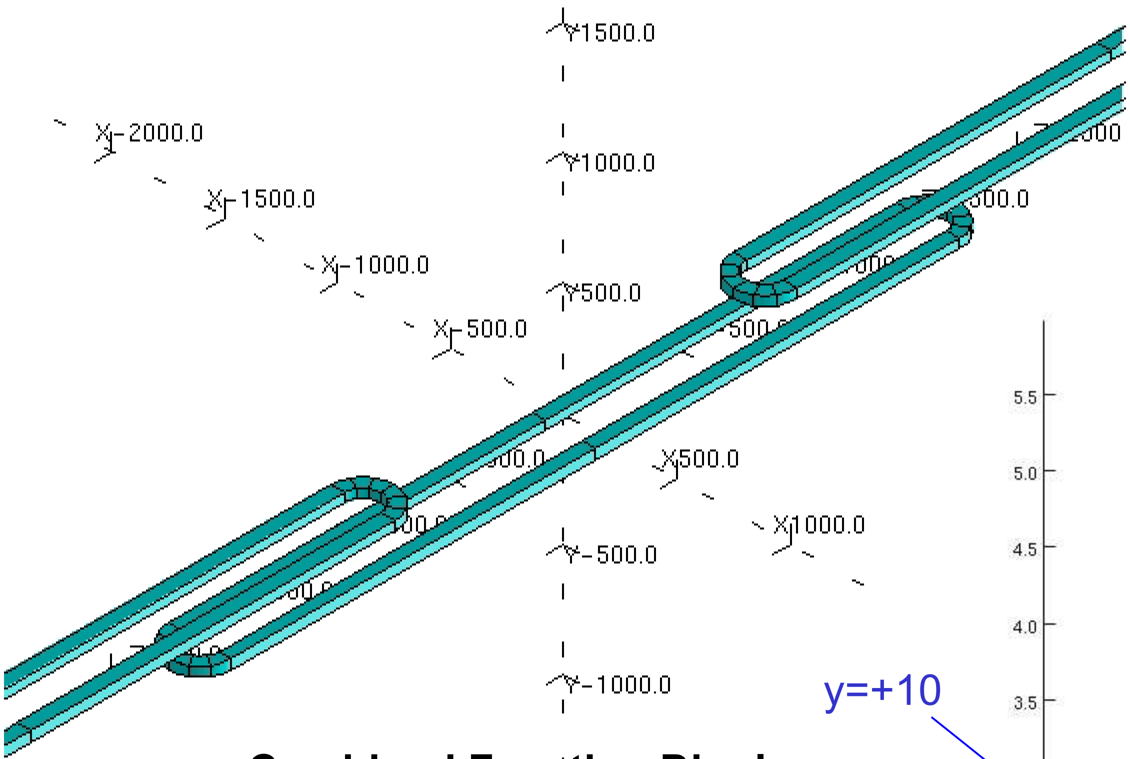
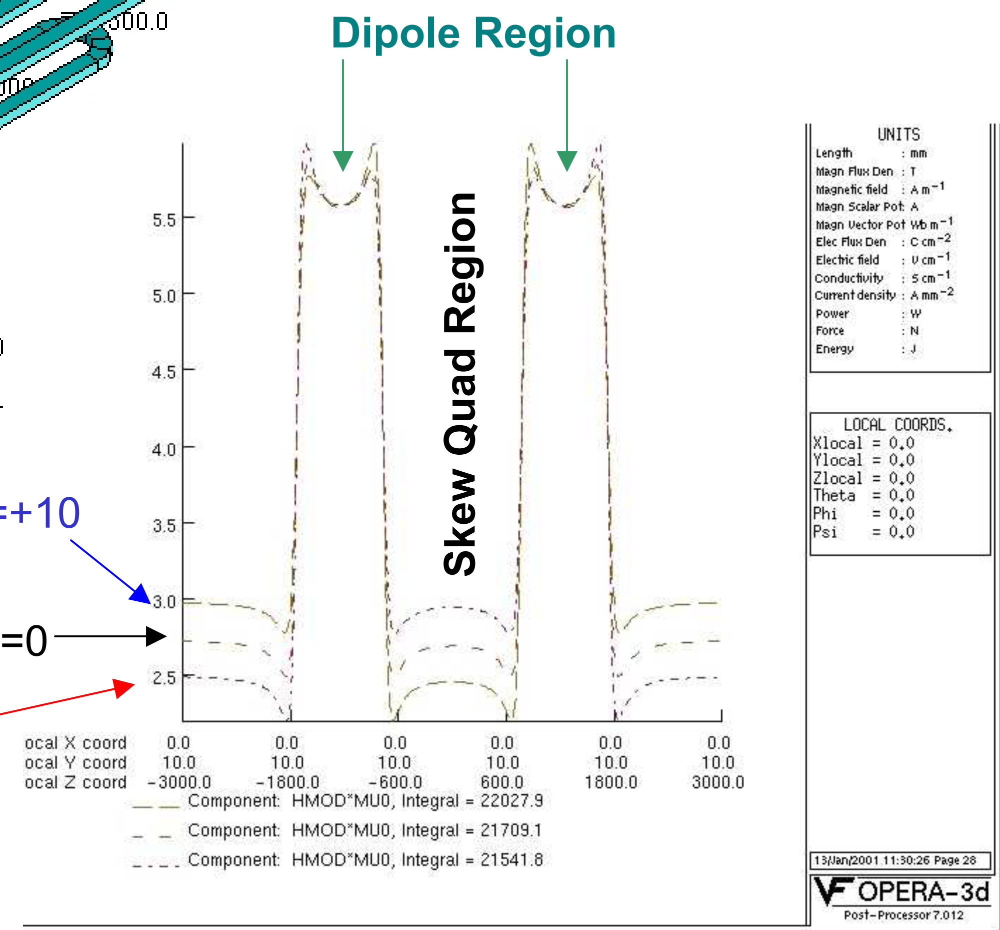
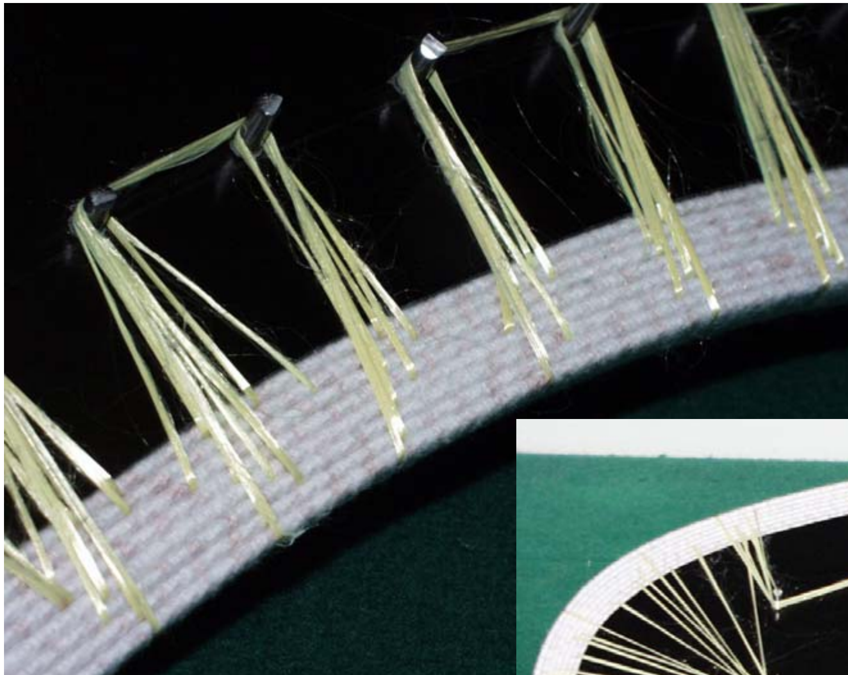
Axial Field Profile in ν-Factory Magnet System



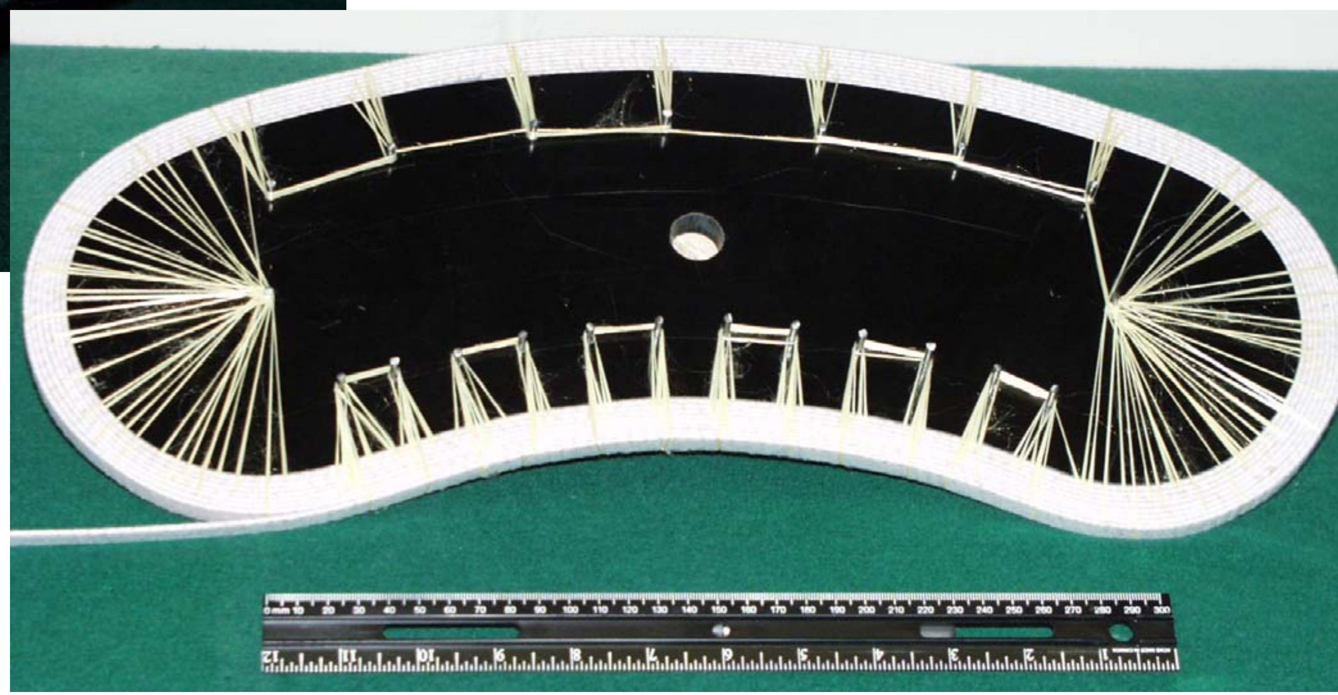
Combined Function Dipole and Skew Quad Region



Saggitta in Nb3Sn React & Wind Dipole



Curvature in reverse direction is held by thin Kavlar strings.



John Escallier