Racetrack Coil Magnets for Neutrino Storage Ring and Muon Collider

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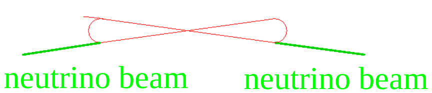
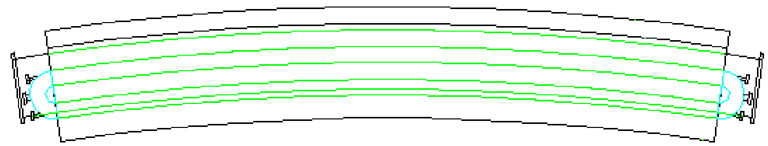
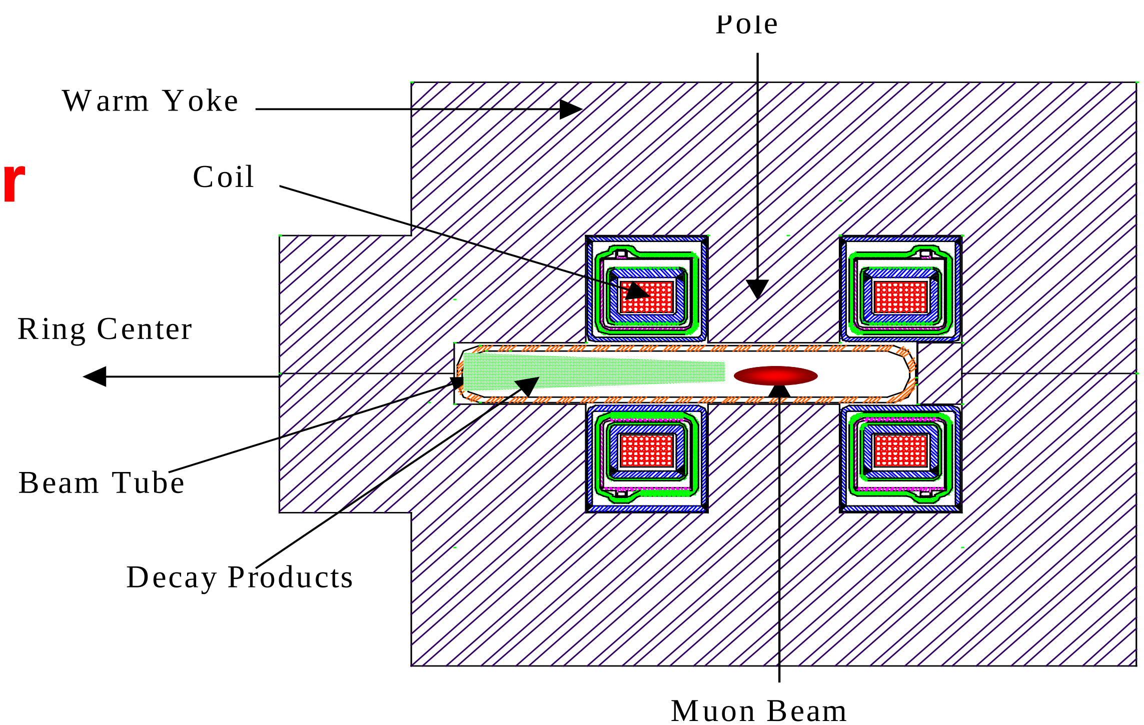


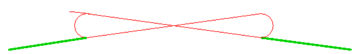
Basic Design Principles

Basic Design Principles from Mike Harrison:

- Nb-Ti Racetrack coils
- Design Field: ~5 T
- **Decay products clear SC coils at midplane**
- Warm iron
- Compact cryostat
- Low cost







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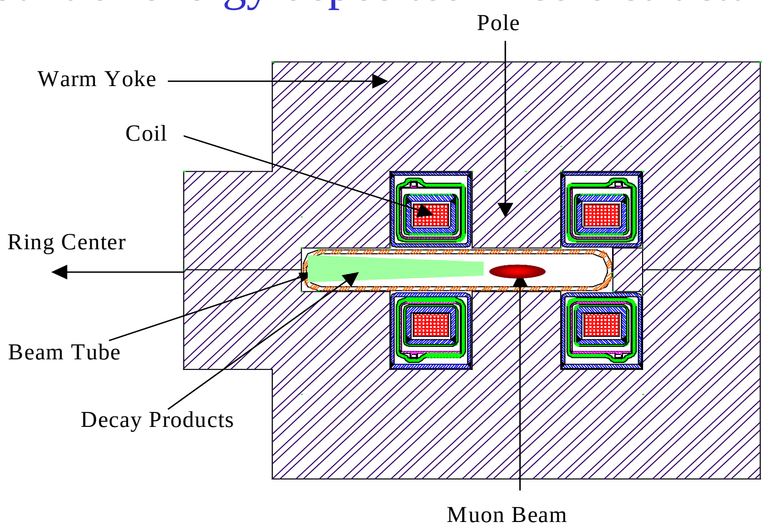
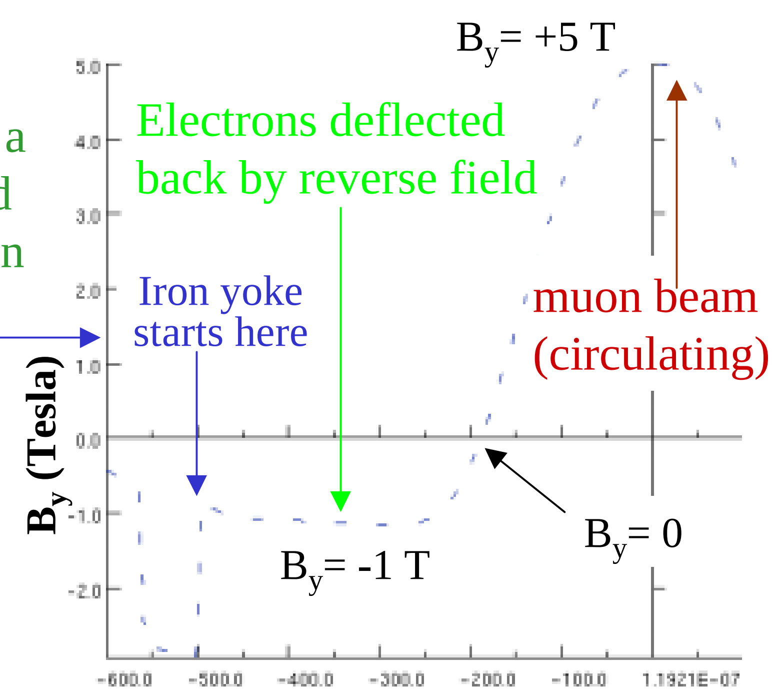
Dipole for ν Storage Ring

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

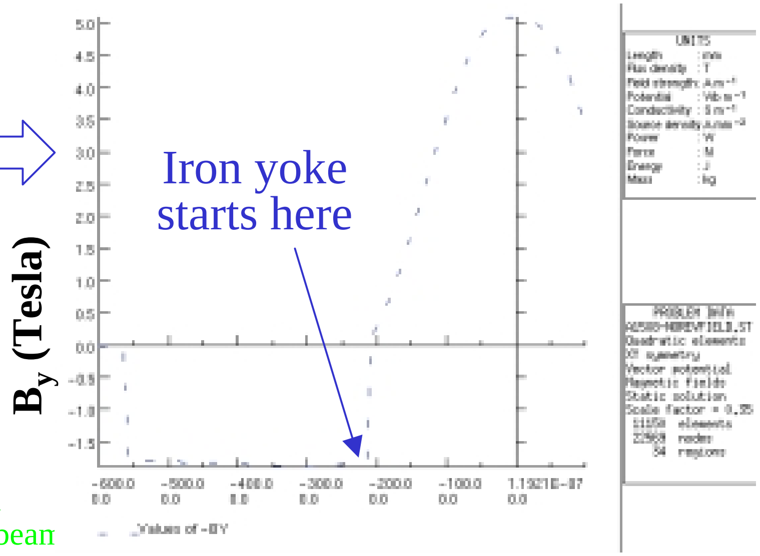


Decay electrons get back towards main aperture by (a) Reverse field and (b) Magnet saggitta which knob to use how much may depend on E & B

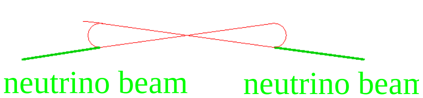
Design with a reverse field region in Iron



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



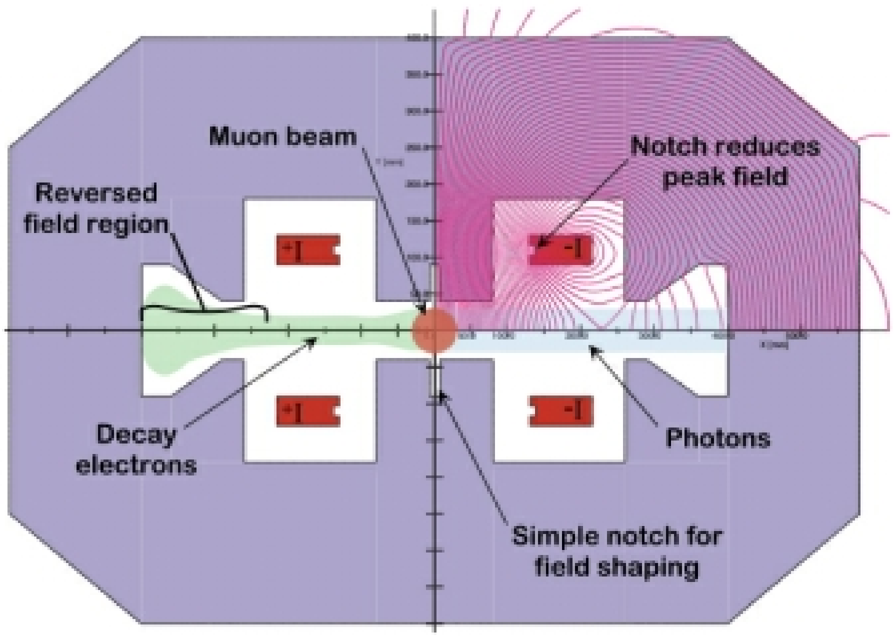
In neutrino storage ring, is ~10% energy deposition acceptable?



Ramesh Gupta, May 11, 2000

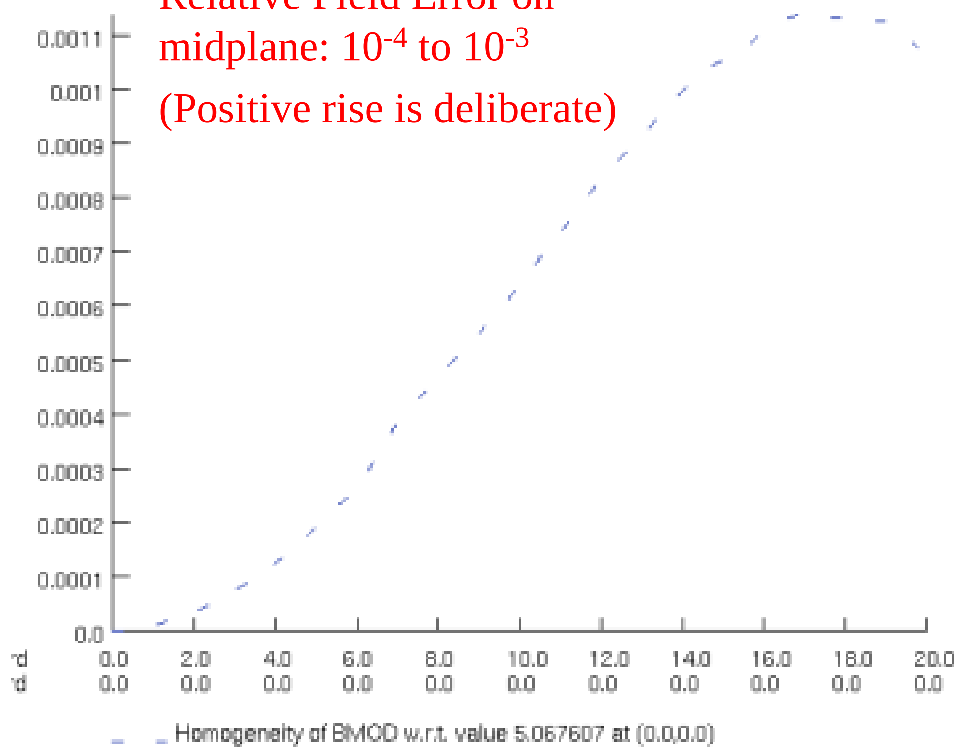
Magnetically Optimized Design

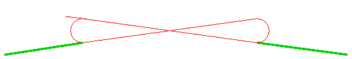
Cutout in yoke to optimize field quality: Model used in MARS Studies (Brett Parker)



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

Relative Field Error on midplane: 10^{-4} to 10^{-3}
(Positive rise is deliberate)

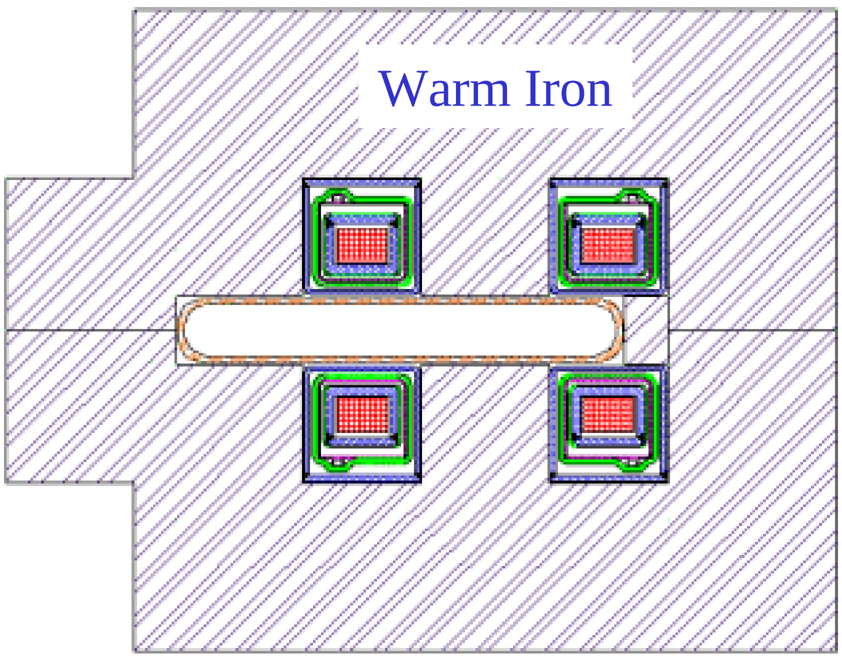




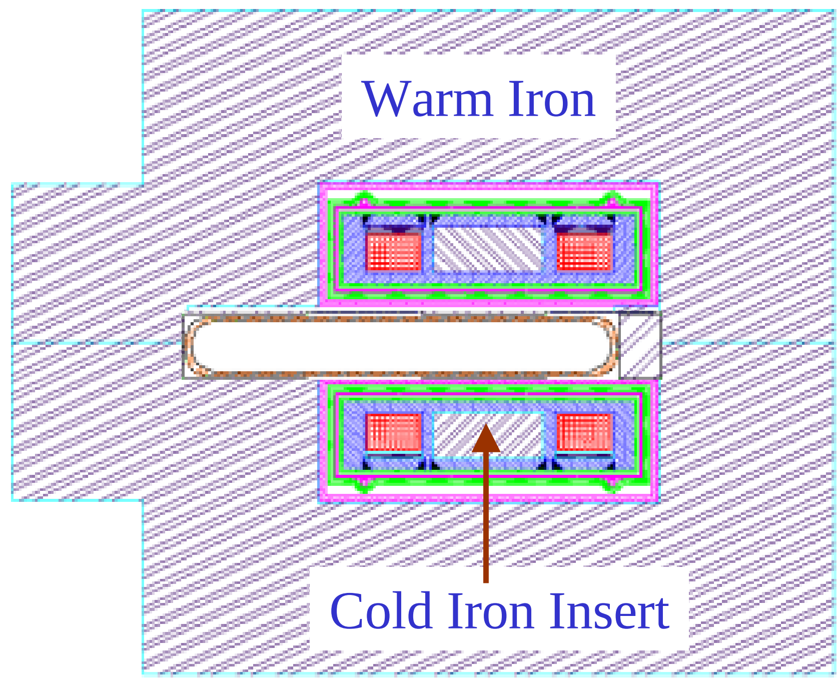
Magnet Design Evolution

Common cryostat for two coil halves:

For a better mechanical and cryogenic design



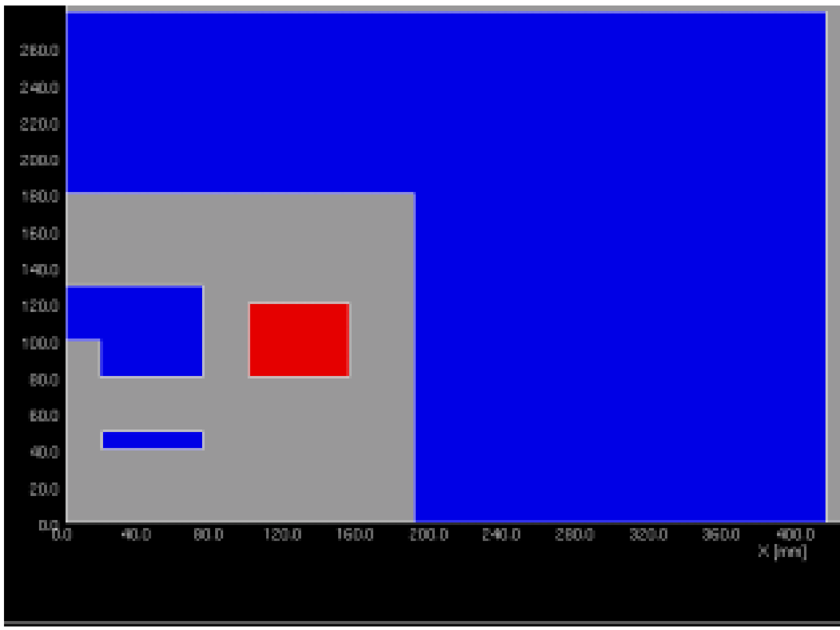
Earlier Version

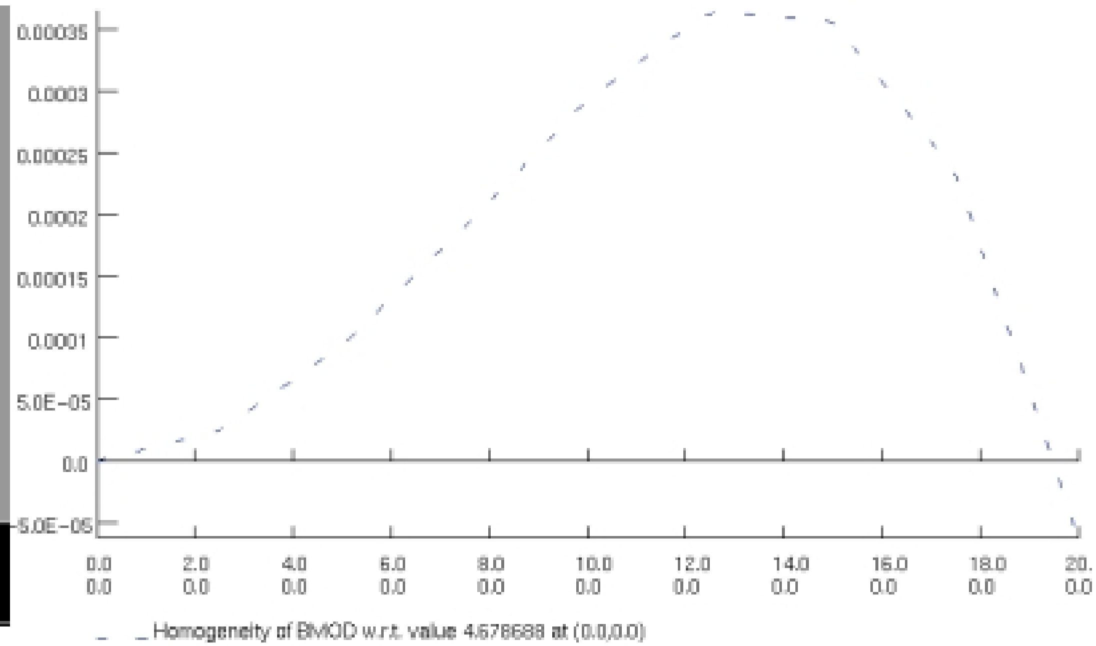


Current Version

Magnetically Optimized Design

Preliminary optimized design for field quality

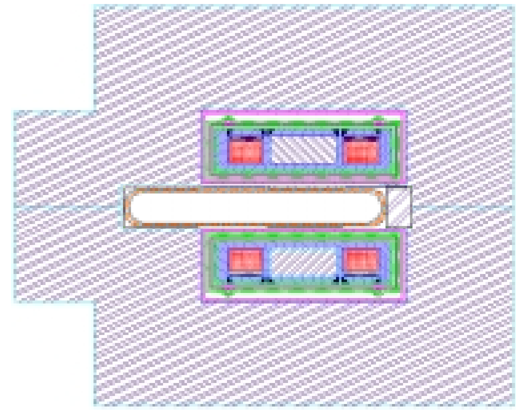




Relative Field Error on midplane: ~10^{-4} to 10^{-3}

(Positive rise on midplane is deliberate)

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

Almost linear drop in field

Constant gradient on axis
(can be optimized further)