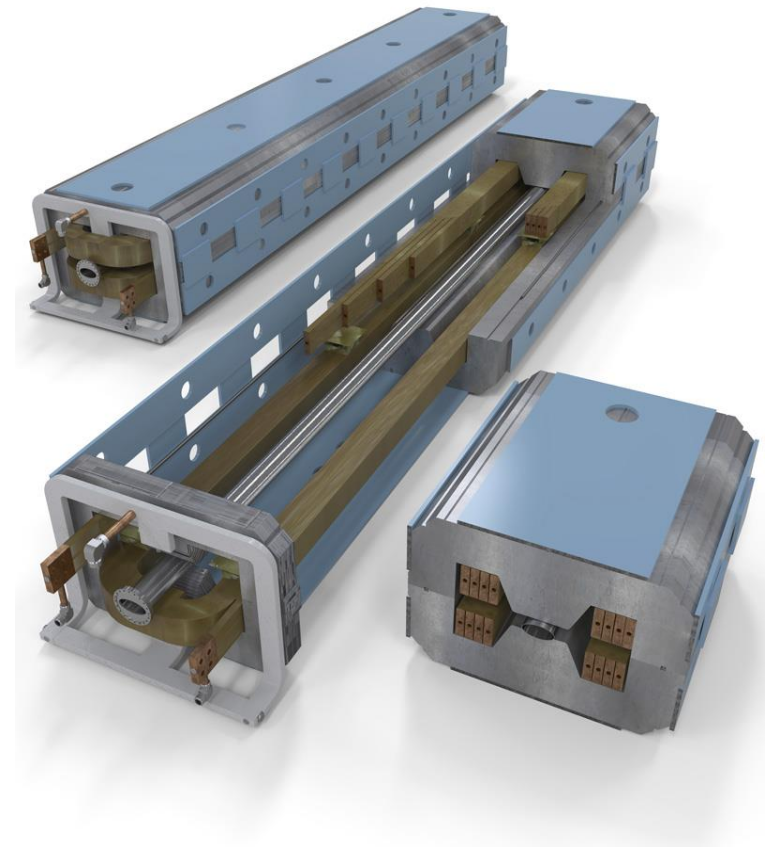


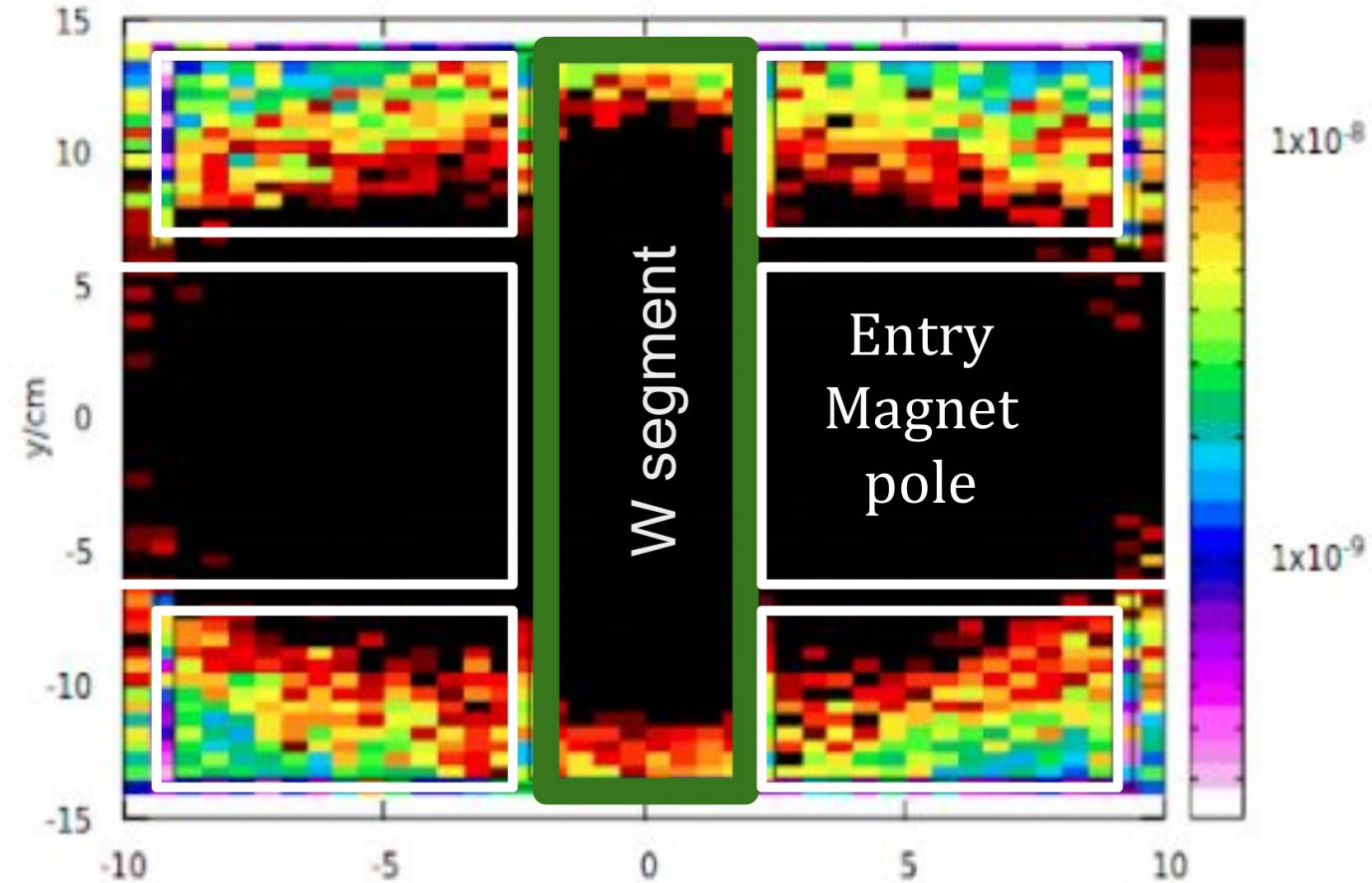
Magnet Studies in OPERA

Hovanes Egiyan

Motivation



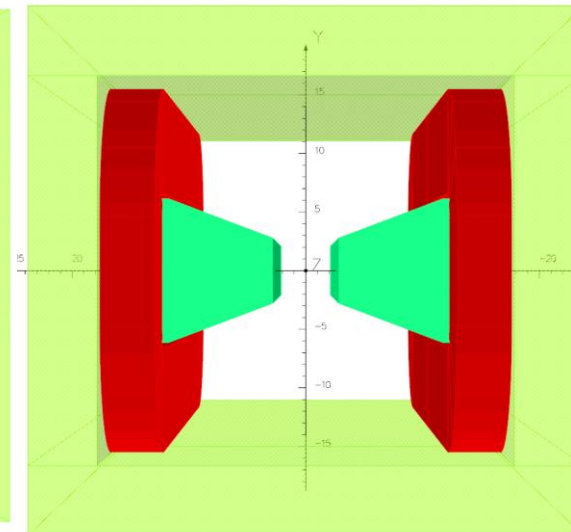
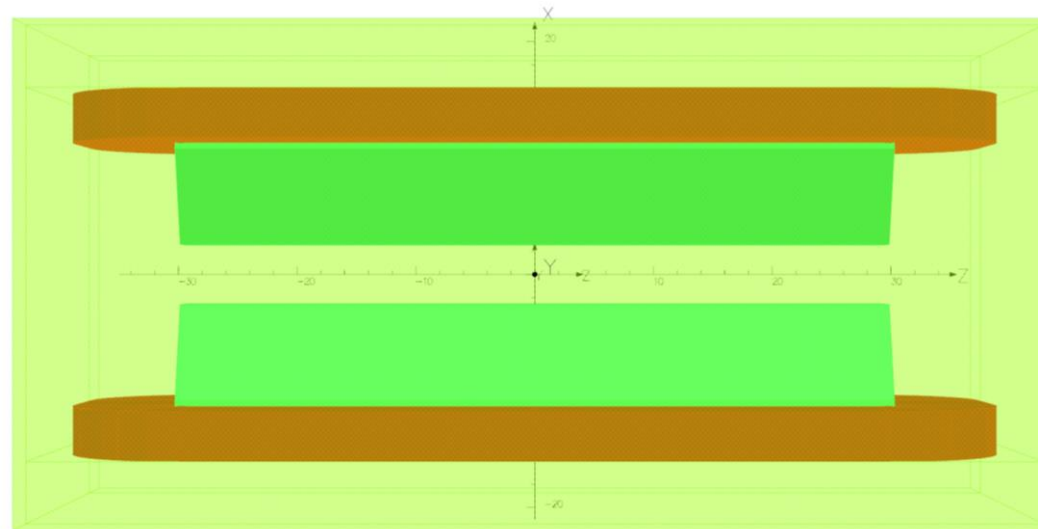
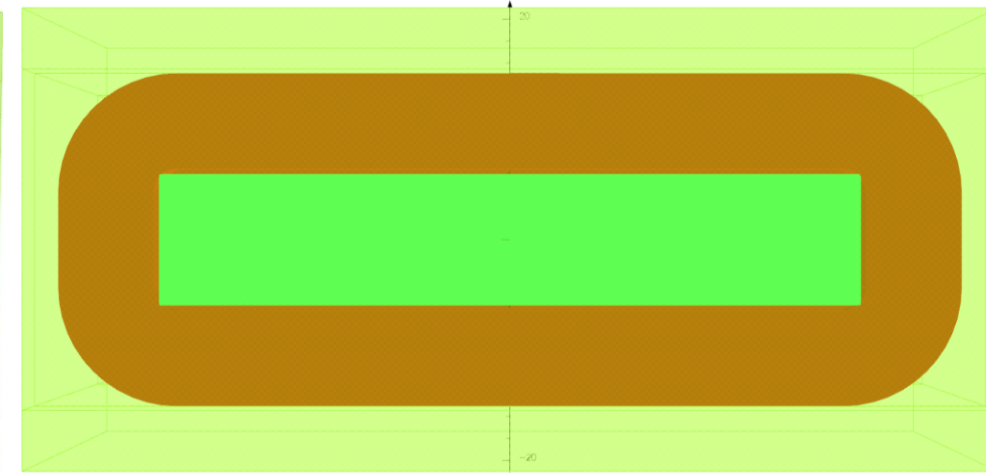
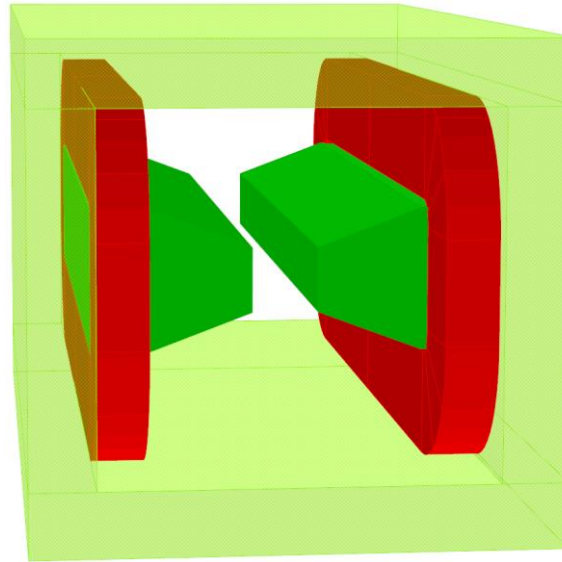
COIL 22 <z/cm>25 DOSE [GeV/g/e] Black=2.E-8 [] CPSKPTTELL080822TRA 28



- Vitaly's studies show that there is a large radiation dose rate near the beamline where the magnet coils are.
- Some parts of the coils in the conceptual design seem to be in a high radiation area.
- It is better to move coils some distance (10cm) away from the beamline.
- May or may not be able to do it with Fermilab magnet.
- Do a generic study with OPERA to have more convincing arguments for the Readiness review.
 - Criteria is to have 2x magnetic field ($2 \times B = 0.5T$) to fit the existing conceptual model.

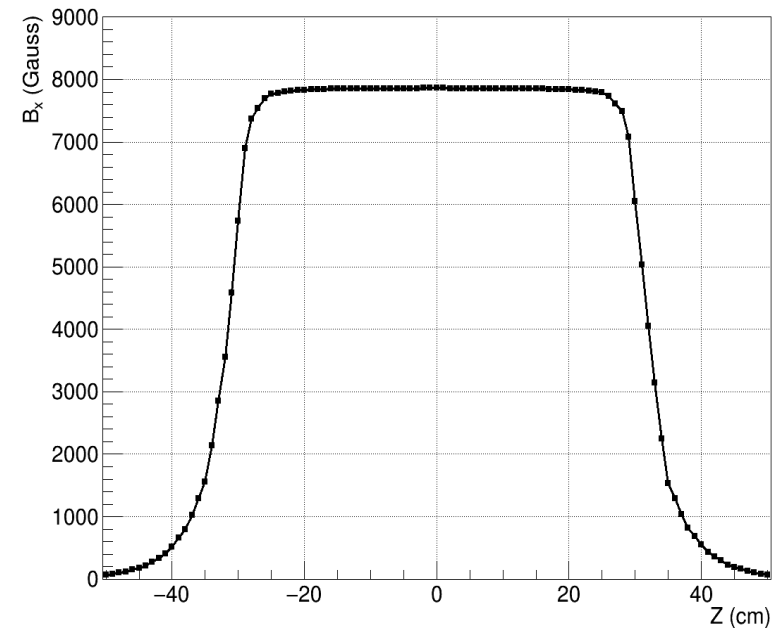
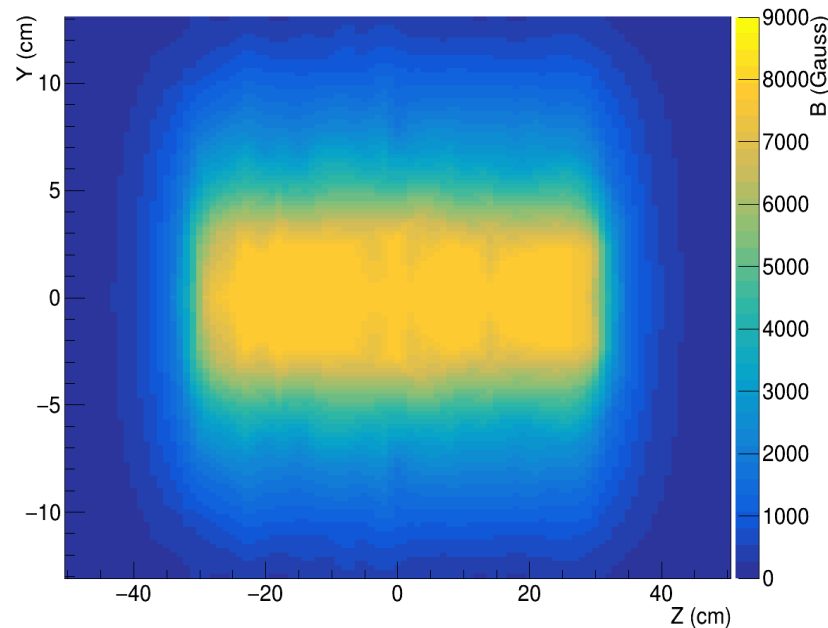
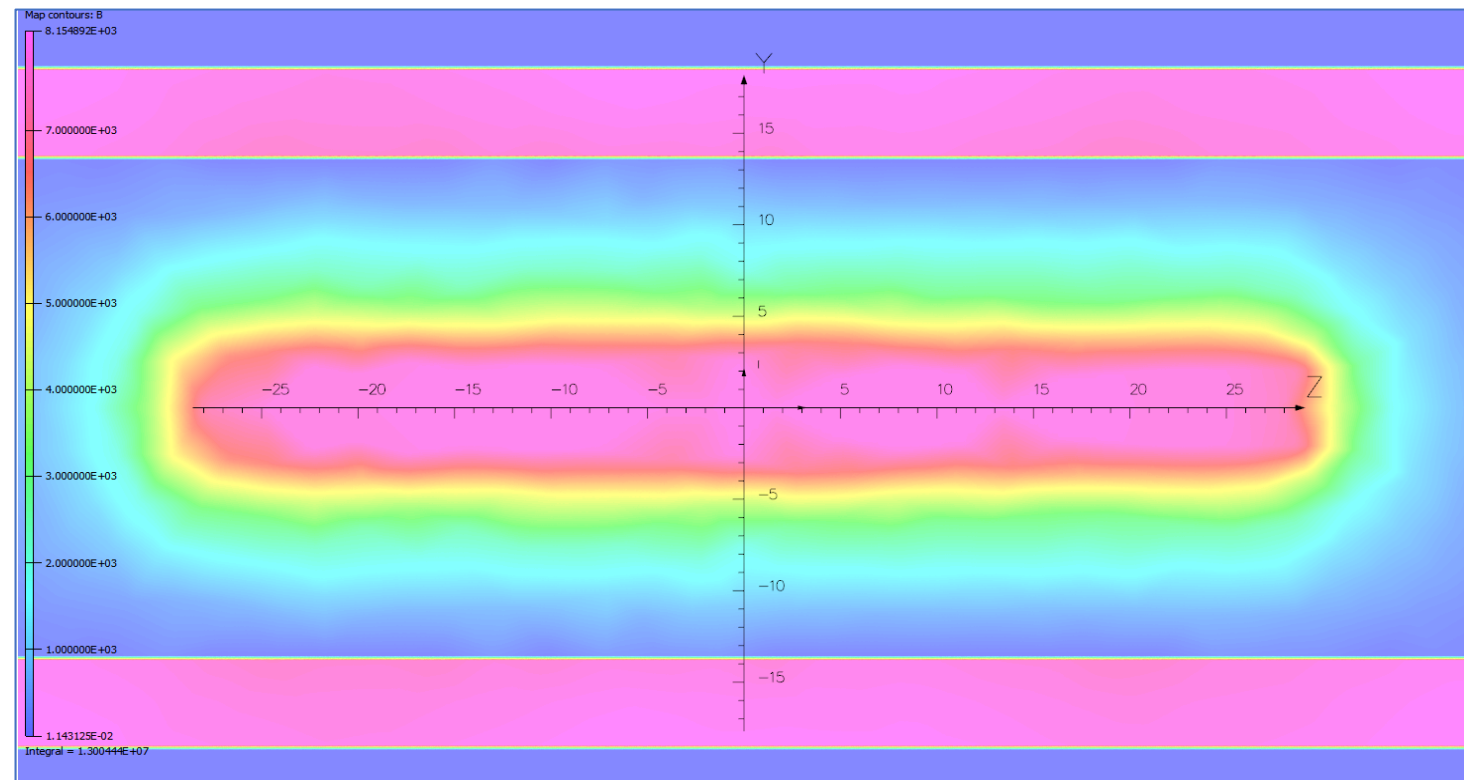
OPERA Model

- The outer dimensions of the magnet are such that it fits in $40 \times 40 \text{cm}^2$ tungsten block.
 - Important to minimize tungsten costs.
 - May still be too large in the x-direction.
- The inner part between the coils allows to put a copper insert $27 \times 4.4 \text{cm}^2$.
 - Use 2" gap as it is in the Fermilab magnet.
- The innermost part of the coil package is 10 cm away from the center plane $x=0$.
 - In y-direction the inner part is still $\sim 6 \text{cm}$ away from $y=0$ plane.
- The yoke and poles are iron.
- Iron yoke of 5cm for sufficient shielding and for 2x field required by Vitaly's design.
 - Fermilab magnet seems to have $\sim 6 \text{cm}$ of iron.
- Coils of $8 \times 4 \text{cm}^2$ in cross section
 - Current density in the coils is 500 A/cm^2
 - For coils with 16 turns this would correspond to 1000 A current from the power supply.
- Not much effort spent to optimize the field strength.
 - Professionals from the NPD magnet group should be able to improve the magnetic field strength by optimizing the coil and the yoke shape.



Resulting Fields

- The maximum field between the poles is about 0.786 T.
 - $> 3x$ required B-field
- The field is quite uniform in Z.
 - It is easy to make the magnetic field longer.
- The iron yoke is still not saturated.
 - Can increase the total current.
 - Need to watch the current density.



Conclusions

- With this configuration we can get at least 3x times the field in the model.
 - I suspect this magnet model is a little big in the x-direction.
 - Shift the coils in y-direction and reduce the x-shift.
- Can try reducing the cross section of the coil package to make the size smaller and reduce the field strength.
 - An optimized magnet design by a professional would probably provide 20% larger field than what a rookie gets.
- If we do not 10cm distance from the beam center, we need to define the distance looking at the Vitaly's simulation
 - I need Vitaly's FLUKA ".bnn"-file for the radiation dose of coils.
 - I would like to remake the figures in the note using ROOT, probably adding some projection plots .
 - We probably need to fix the lifetime safety statement to just the fiberglass coil insulation.
 - Define the criteria for coil lifetime : 5x PAC days or 10x PAC days.