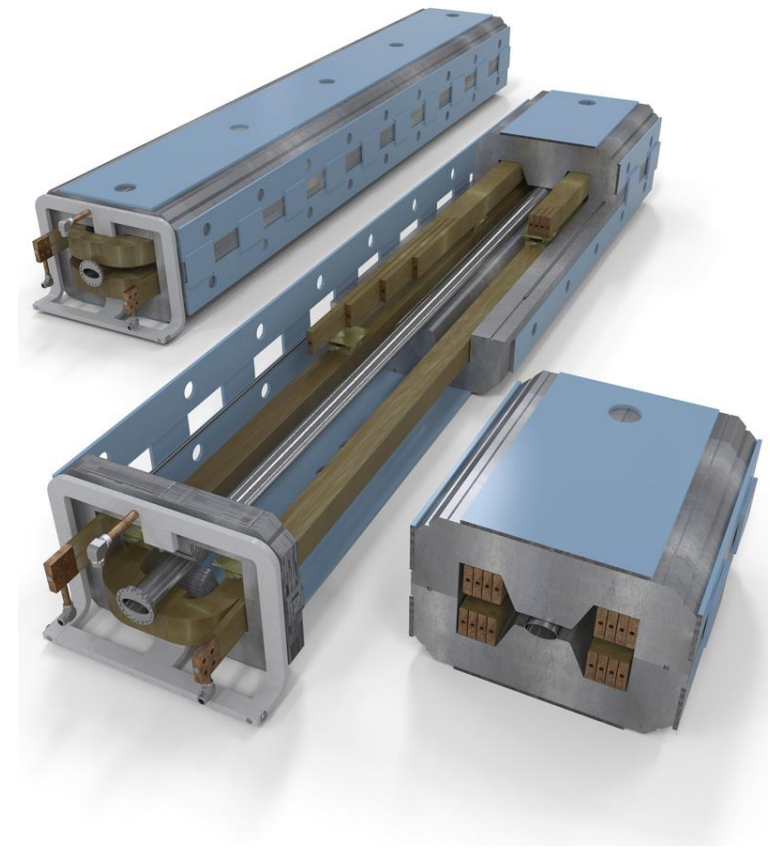
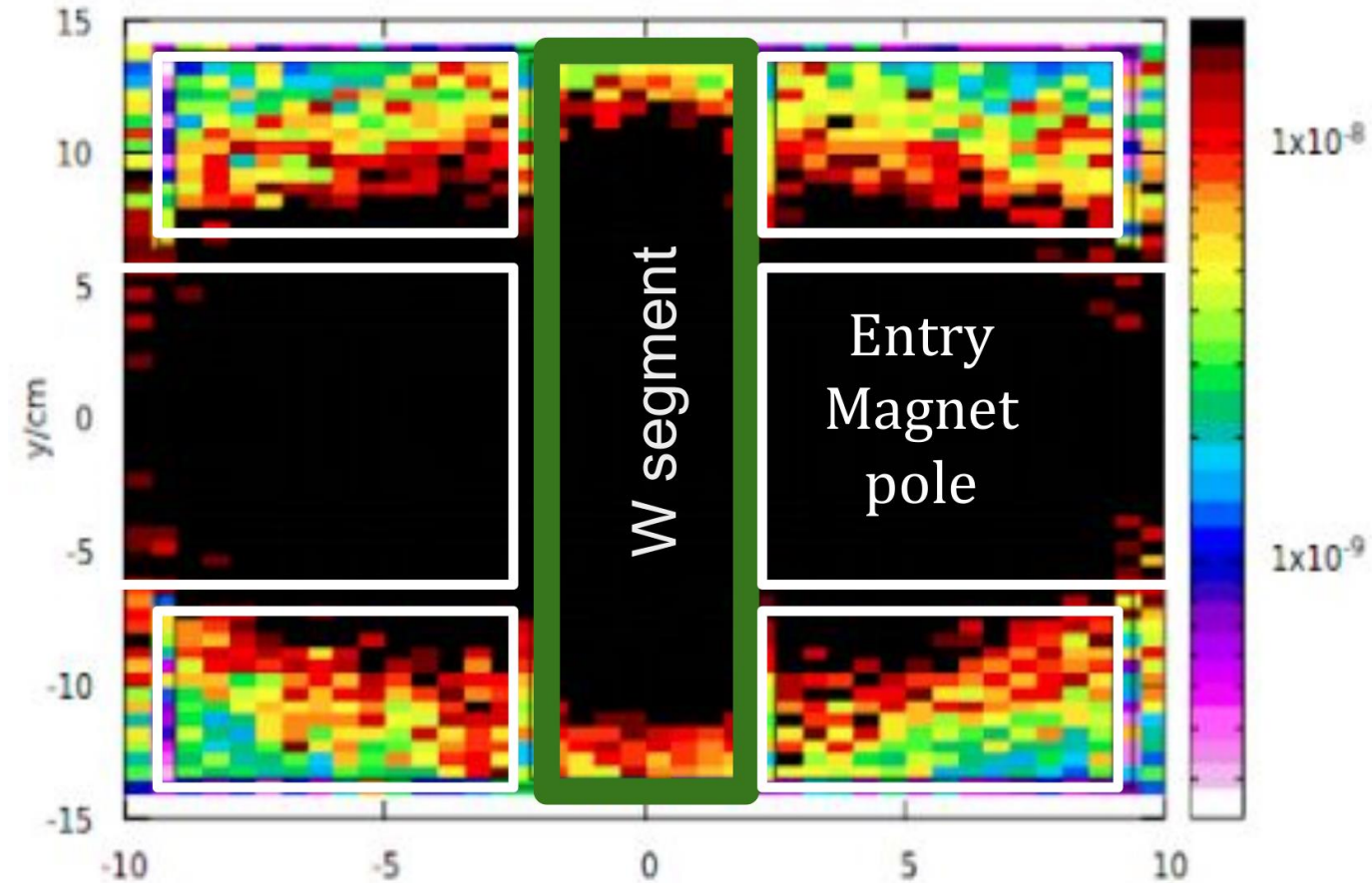


# Magnet Studies in OPERA

Hovanes Egiyan

# Motivation

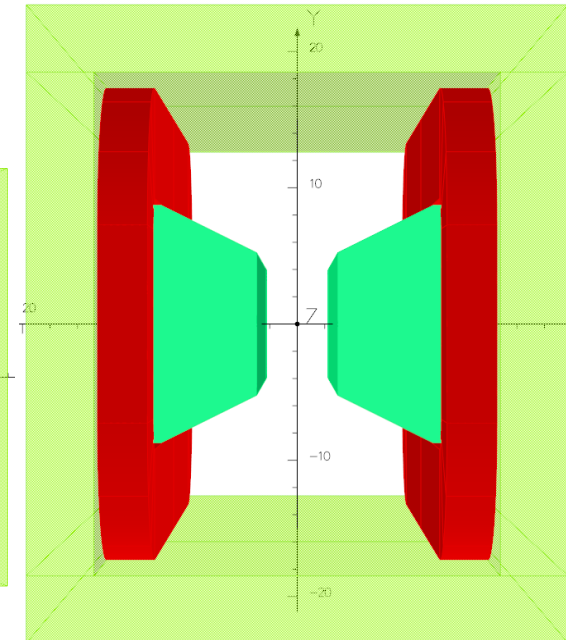
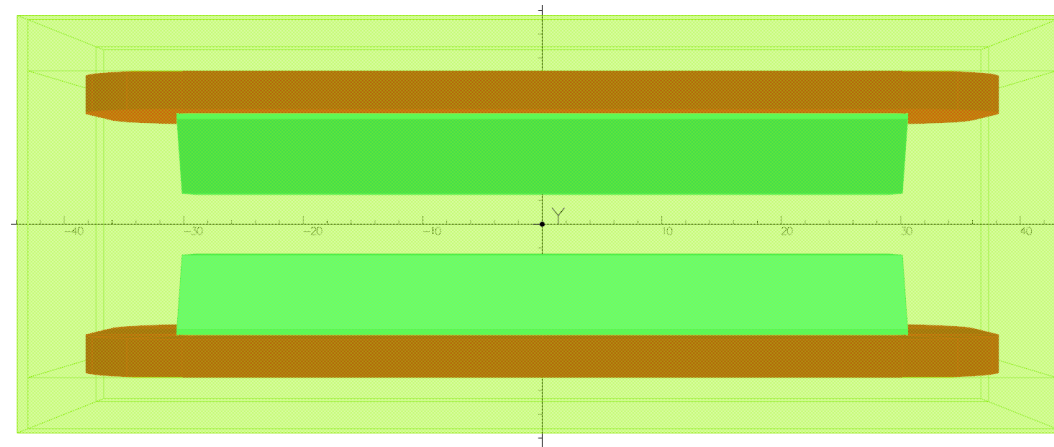
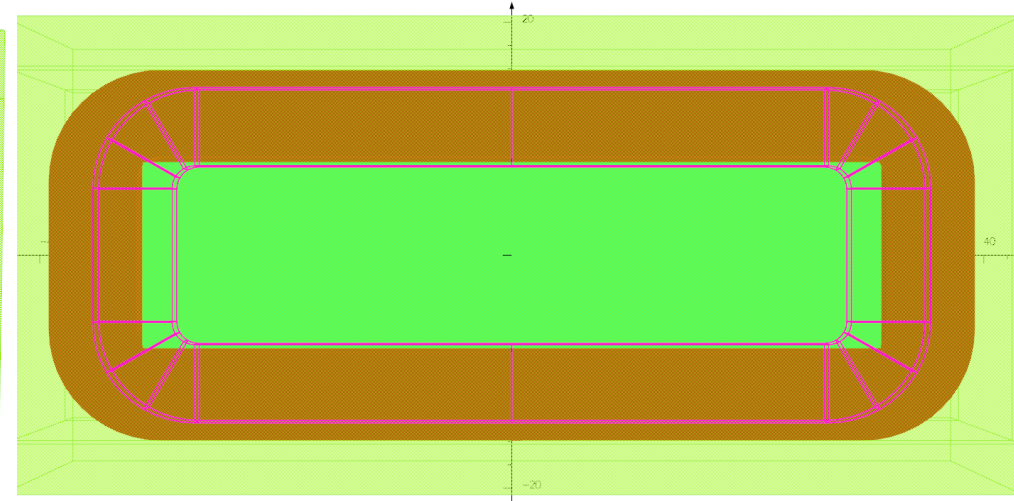
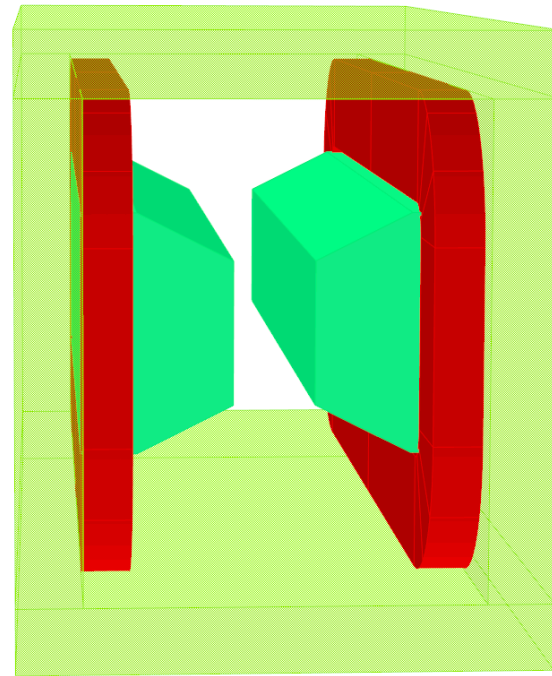
COIL 22 <z/cm<25 DOSE [GeV/g/e] Black=2.E-8 [] CPSKPTTELL080822TRA 28



- 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 ( $2 \times B = 0.5\text{T}$ ) to fit the existing conceptual model.

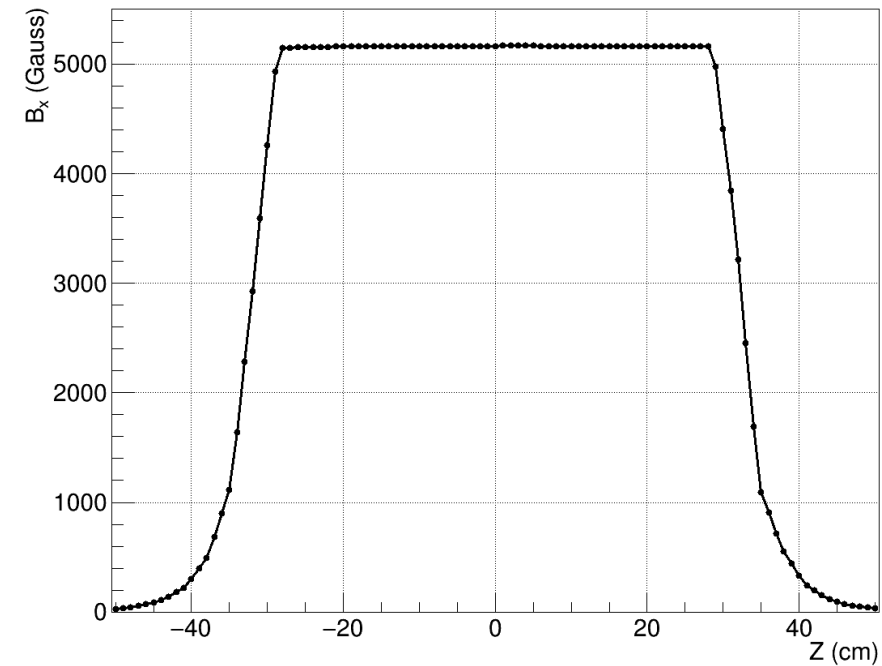
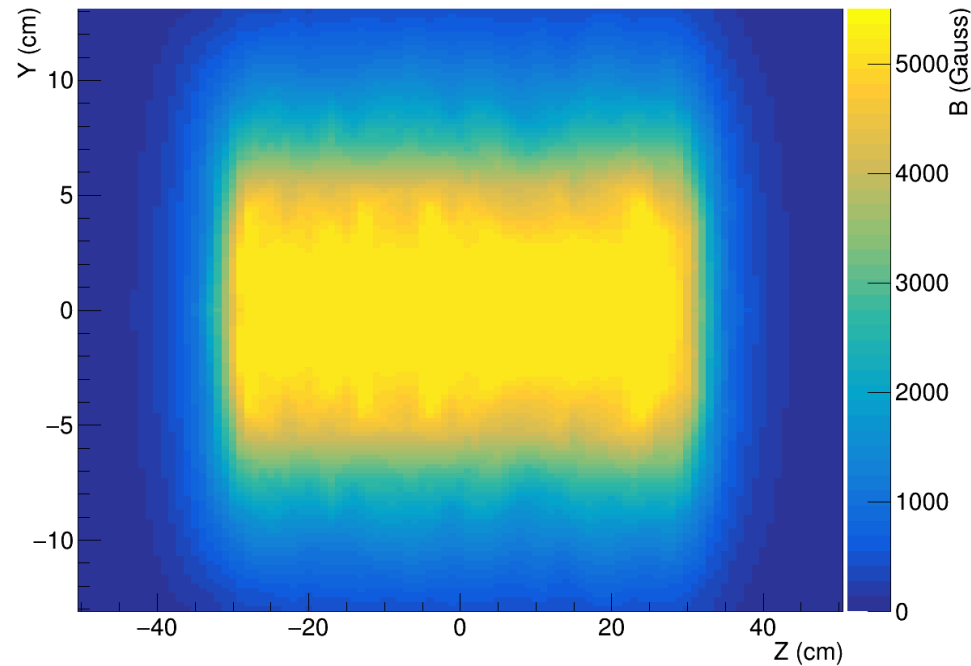
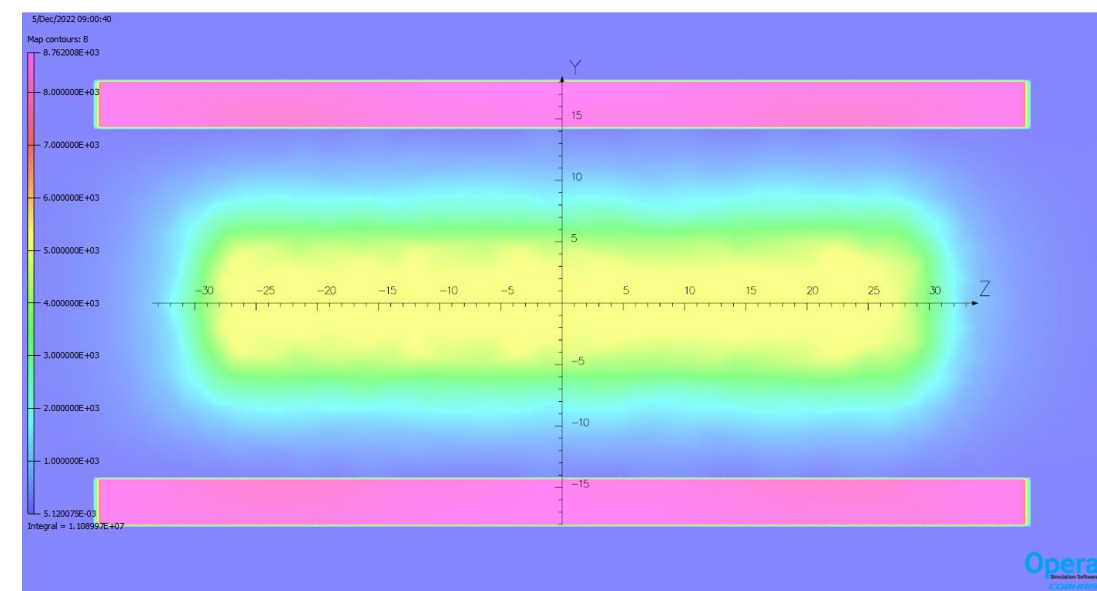
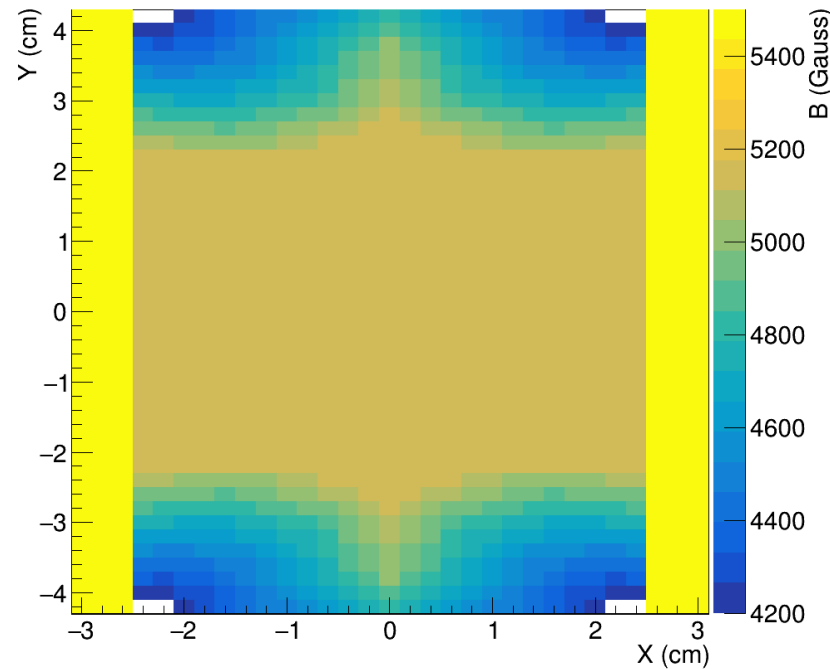
# OPERA Model

- The outer dimensions of the magnet are such that it fits in  $30 \times 40 \text{ cm}^2$  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 9 cm away from the center plane  $x=0$ .
- In y-direction the inner part is  $\sim 8 \text{ cm}$  away from  $y=0$  plane.
- The yoke and poles are iron.
- Iron yoke of 4cm 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  $7 \times 3 \text{ cm}^2$  in cross section
  - Current density in the coils is  $500 \text{ A/cm}^2$
  - Assuming coils with 8 turns this would correspond to 1312A 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.



# Field

- The maximum field between the poles is about 0.566 T.
  - $> 2x$  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, but need to watch the current density.



# Conclusions

- With this configuration we can get at least 2x times the field in the model.
  - Should fit Vitaly's design
- An optimized magnet design by a professional would probably provide 20% larger field than what a rookie gets.
  - Maybe increase the current density.
- If we do not need ~10cm distance from the beam center, we need to define the distance looking at the Vitaly's simulation for dose rates near the coils
  - 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.