Status of Radiation Calculations

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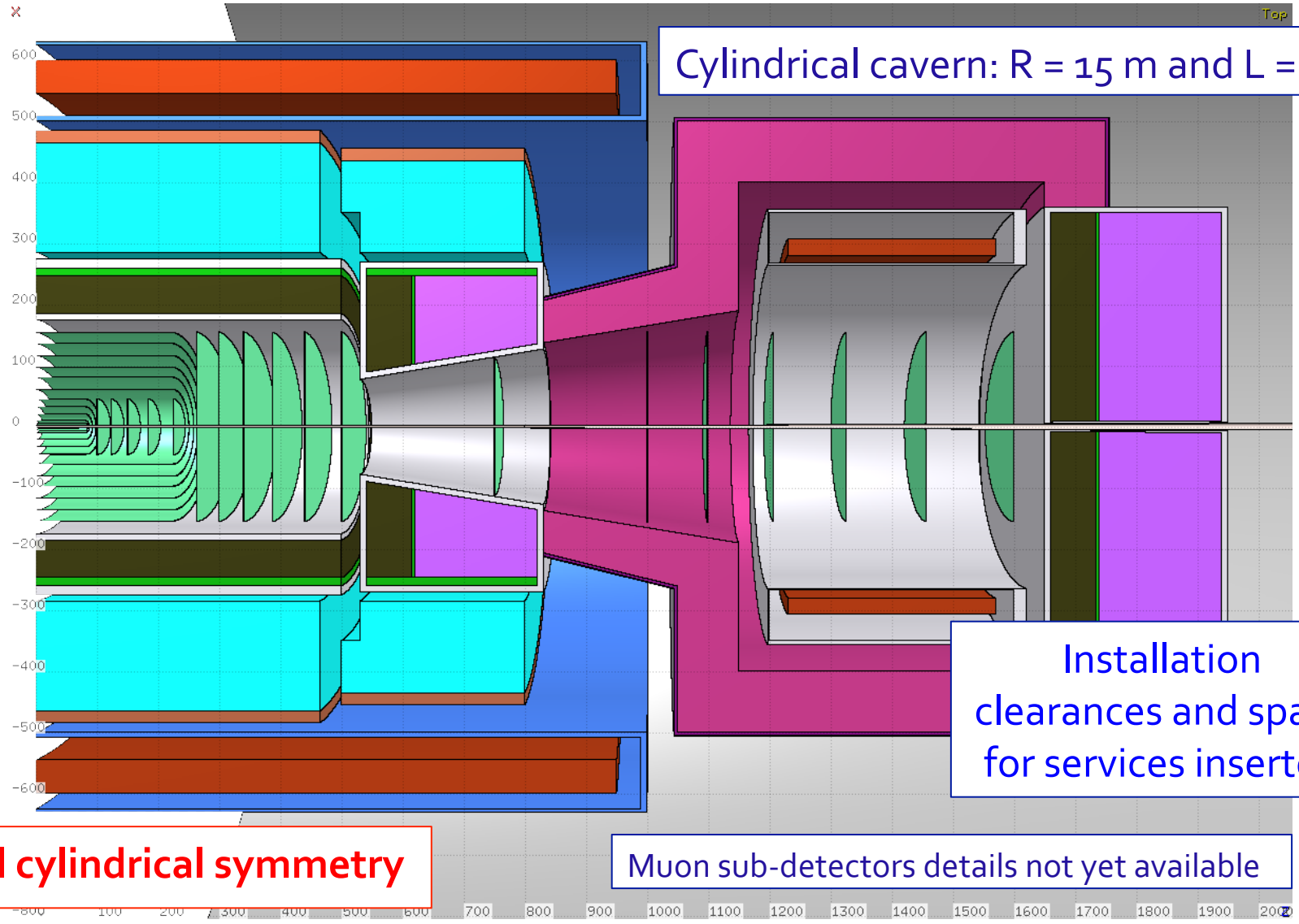
Thanks to the subsystem experts for providing details

Outline

- Geometry as it has been implemented in FLUKA
  - details about the different sub-detectors
  - magnetic field
- Shielding strategy
- Next steps

Detector Layout



Cylindrical cavern: R = 15 m and L = 70 m

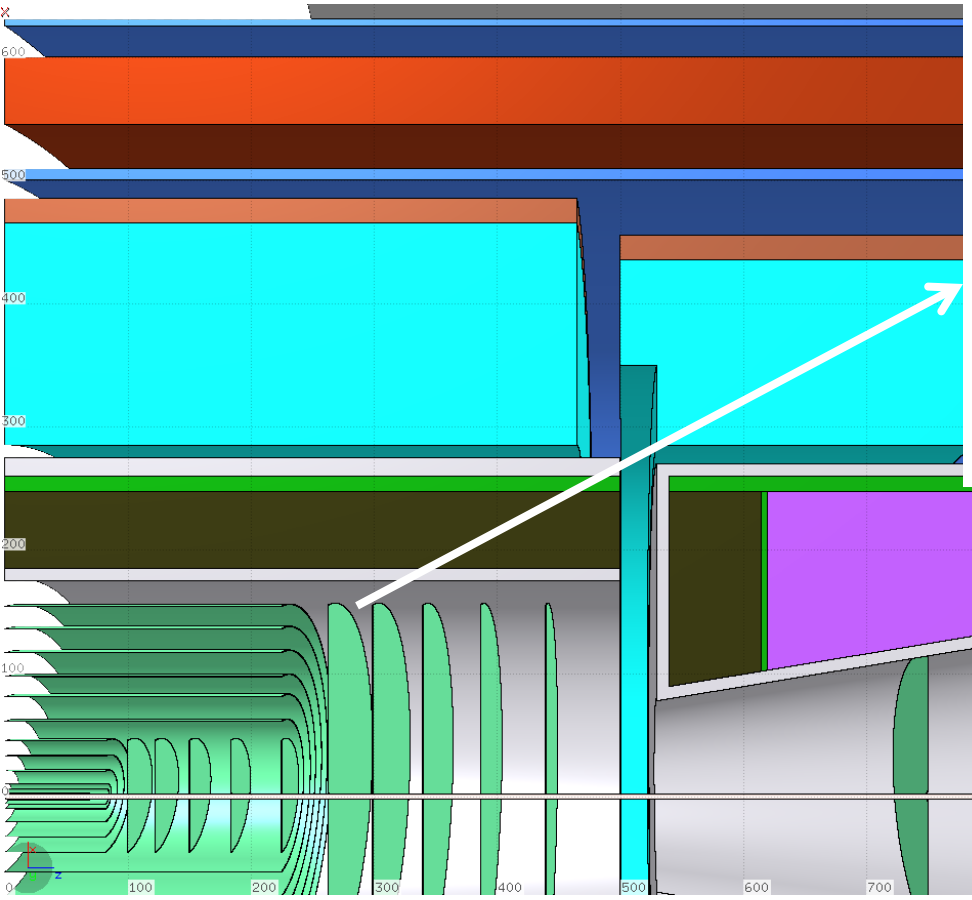
Installation clearances and space for services inserted

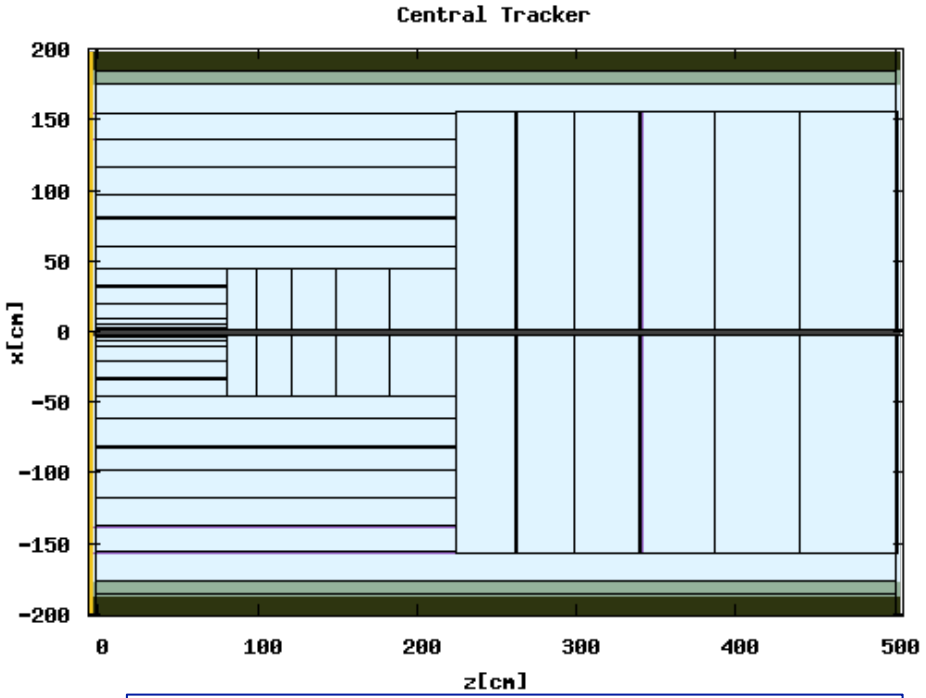
Full cylindrical symmetry

Muon sub-detectors details not yet available

Central Region: Tracker

- Tracker:
  - silicon (20%), copper (2%), aluminum (6%) plastic (30%), carbon (42%)

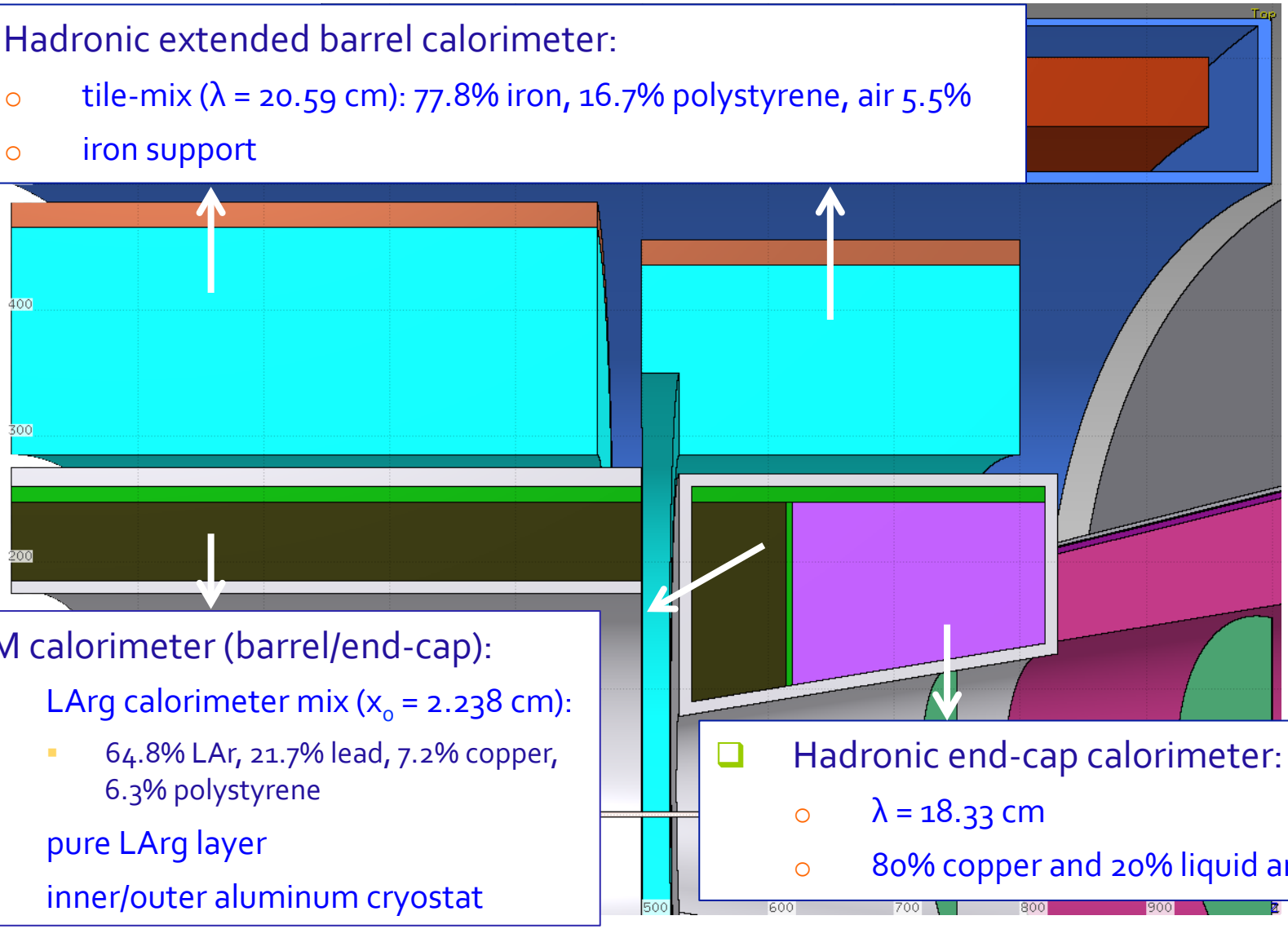




- Inner barrel:
  - 6 barrel layers (1% x_0-1.5% x_0)
  - 5 disks (1.5% x_0)
- Outer barrel:
  - 6 barrel layers (3% x_0)
  - 6 disks (3% x_0)

Central Region: Calorimeters

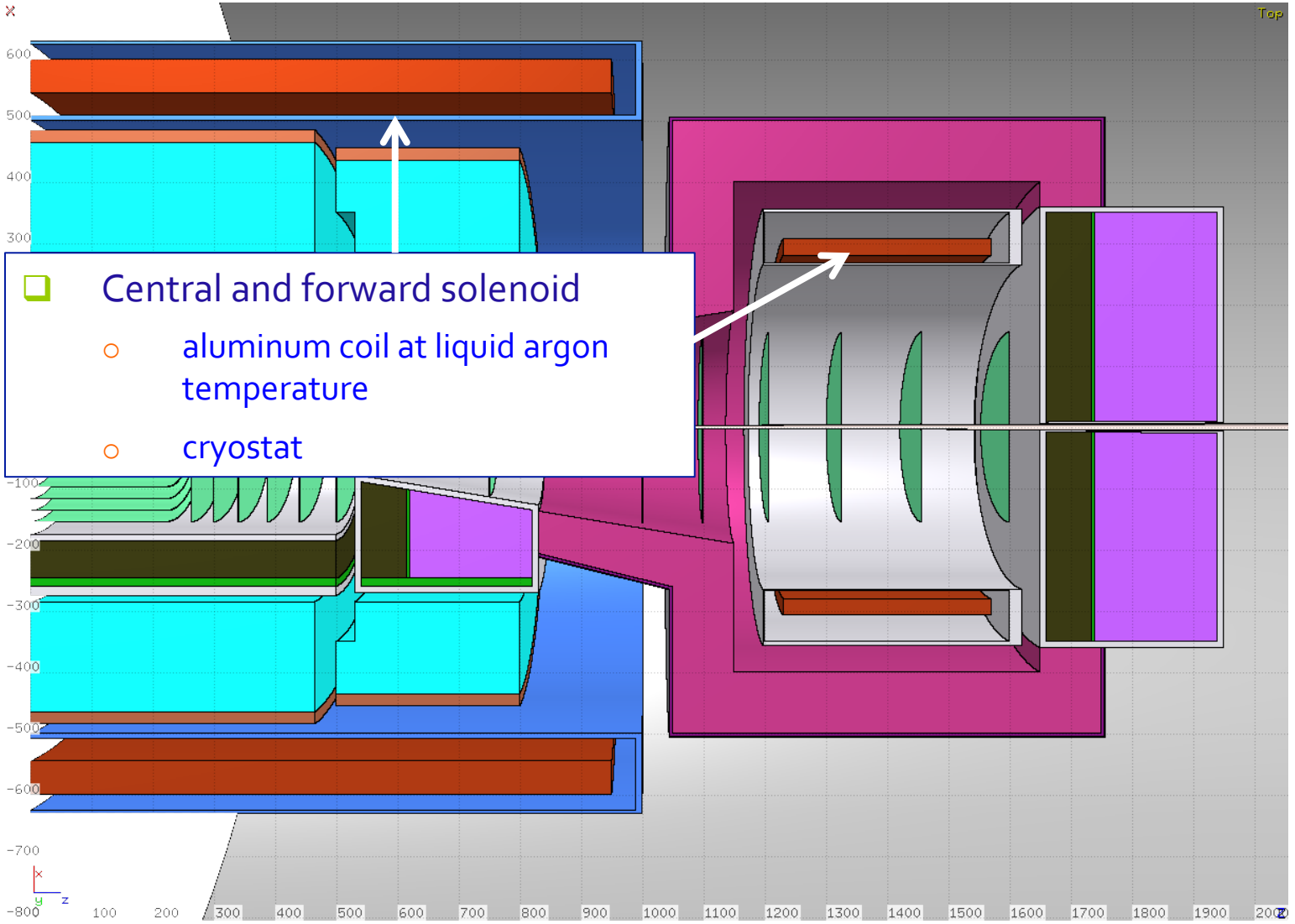
- Hadronic extended barrel calorimeter:
  - tile-mix (λ = 20.59 cm): 77.8% iron, 16.7% polystyrene, air 5.5%
  - iron support



- EM calorimeter (barrel/end-cap):
  - LArg calorimeter mix (x_0 = 2.238 cm):
    - 64.8% LAr, 21.7% lead, 7.2% copper, 6.3% polystyrene
  - pure LArg layer
  - inner/outer aluminum cryostat

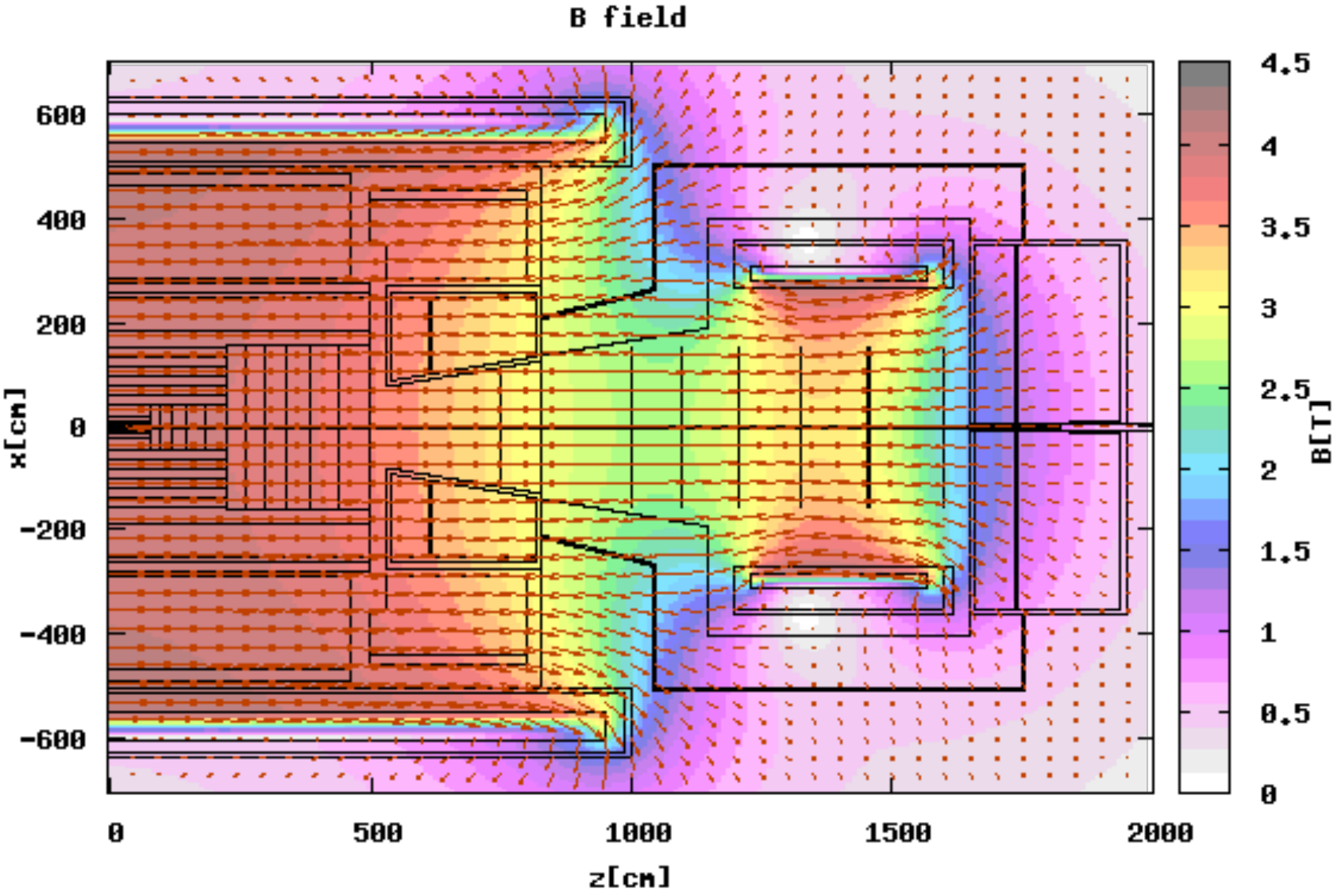
- Hadronic end-cap calorimeter:
  - λ = 18.33 cm
  - 80% copper and 20% liquid argon

Magnets



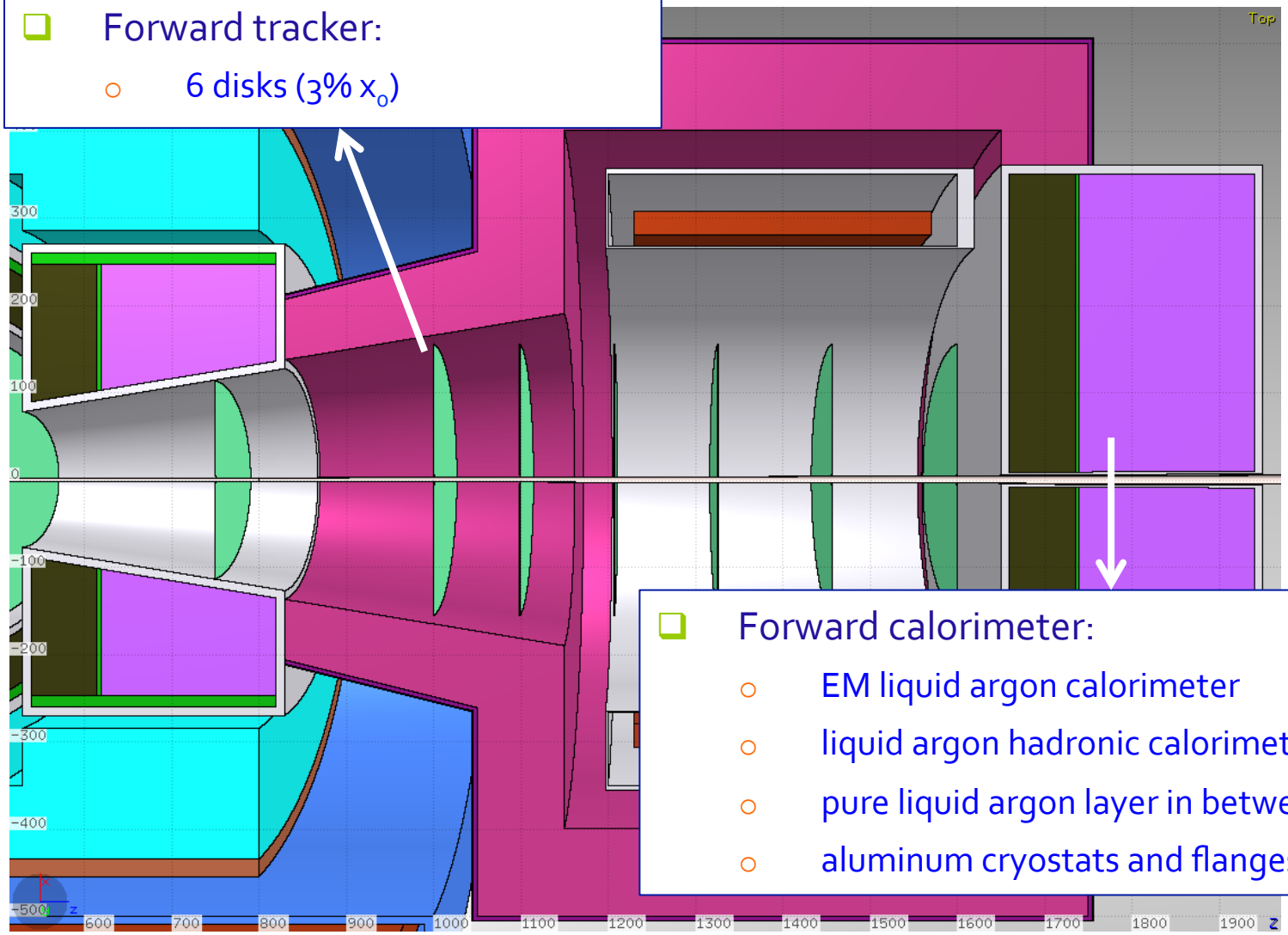
- Central and forward solenoid
  - aluminum coil at liquid argon temperature
  - cryostat

Magnetic Field



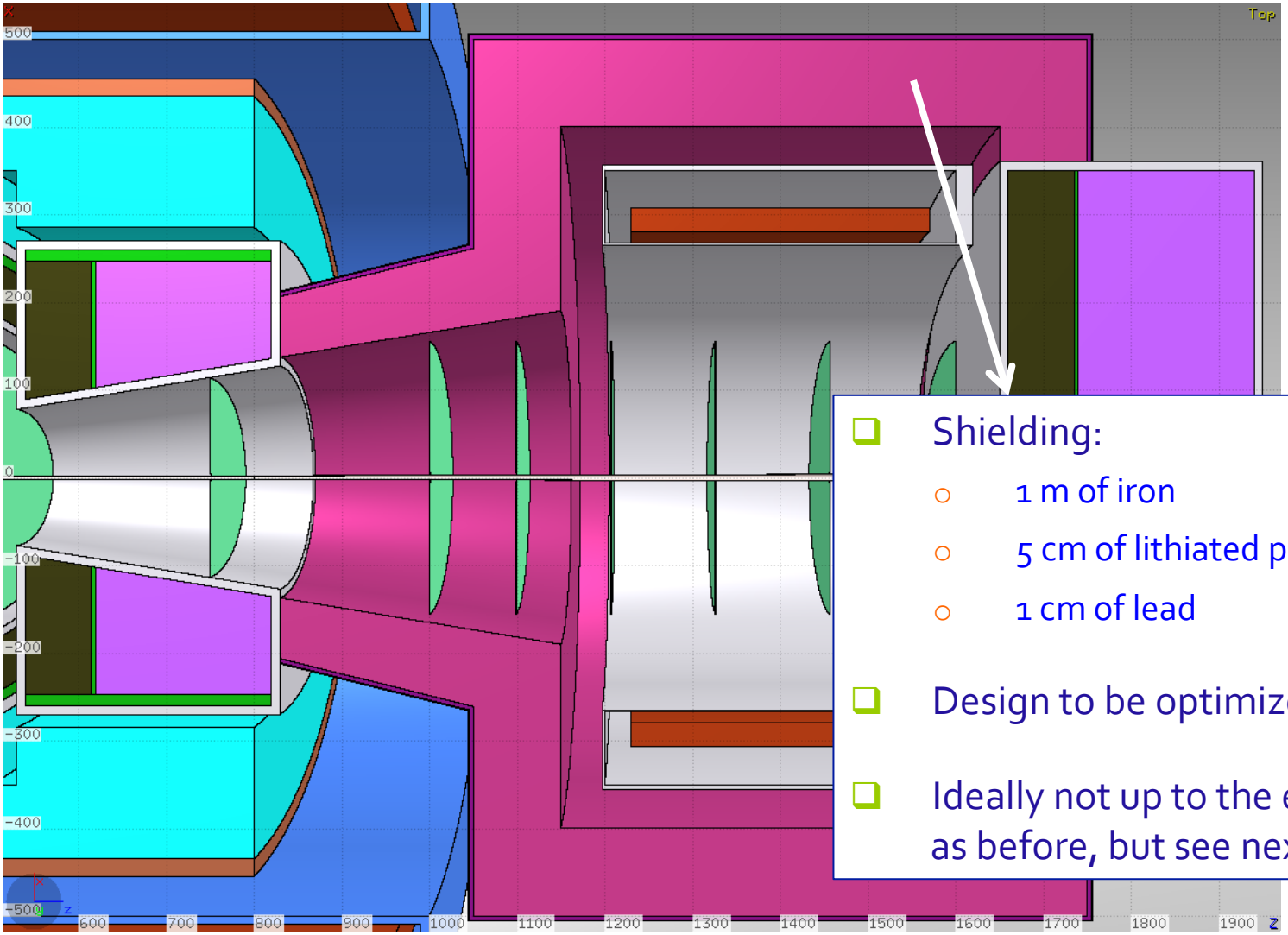
Forward Region

- Forward tracker:
  - 6 disks (3% x_0)



- Forward calorimeter:
  - EM liquid argon calorimeter
  - liquid argon hadronic calorimeter (end-cap mix)
  - pure liquid argon layer in between
  - aluminum cryostats and flanges

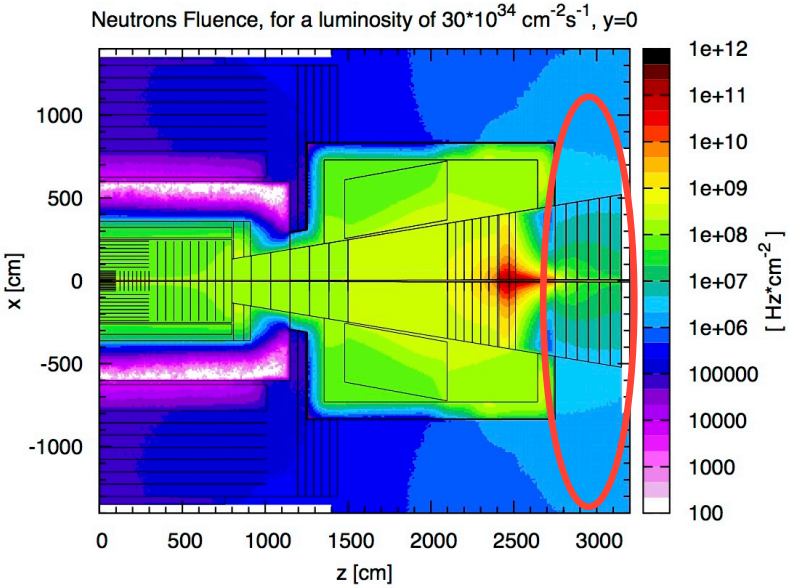
Shielding Strategy I



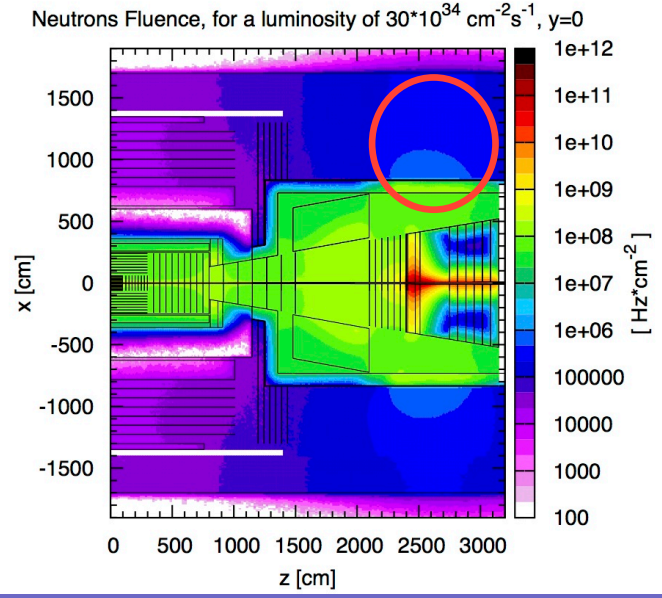
- Shielding:
  - 1 m of iron
  - 5 cm of lithiated polyethylene
  - 1 cm of lead
- Design to be optimized
- Ideally not up to the end of the cavern as before, but see next slide

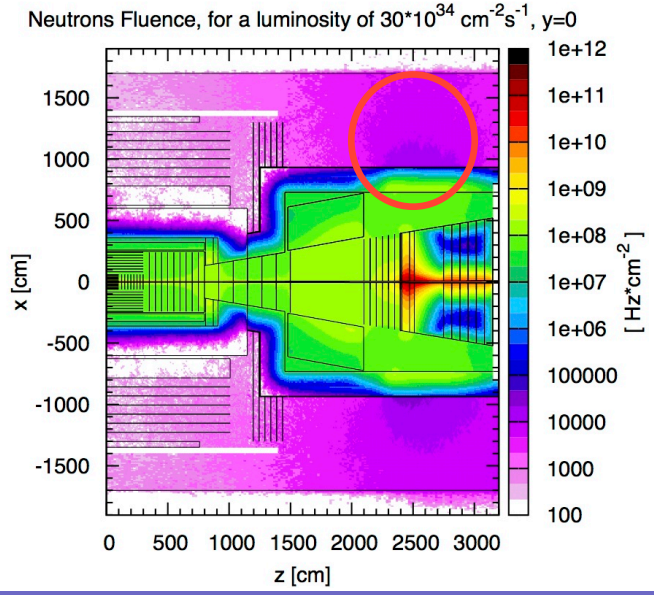
Neutron Fluence

- First option:
  - 1 m thick shielding up to the end of the hadronic calorimeter and air between forward muon chambers
    - ➢ important re-population in the barrel and end-cap muon chambers from the detector forward part



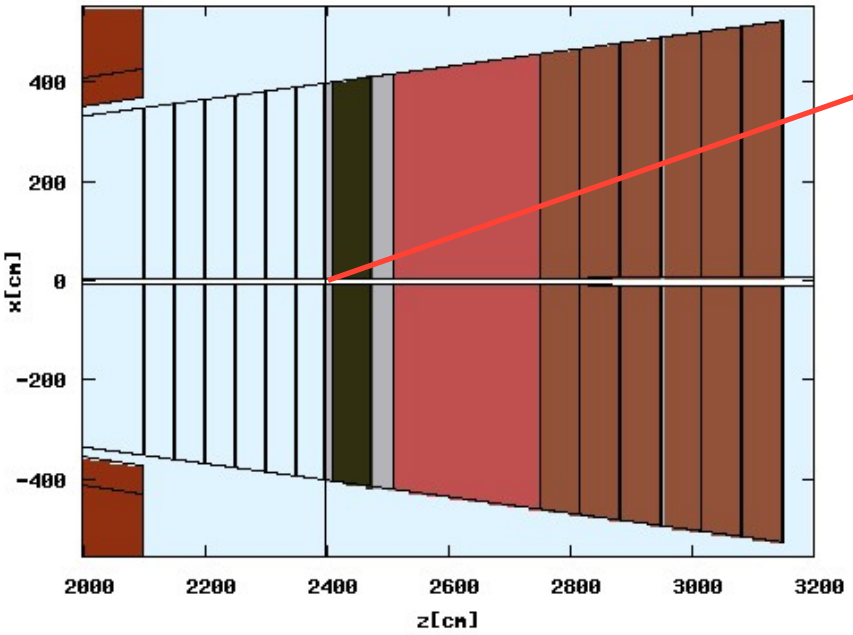
- Second option:
  - shielding up to the cavern wall and iron between forward muon chambers
    - ➢ still some leakage, significantly reduced with a 2 m thick iron shielding

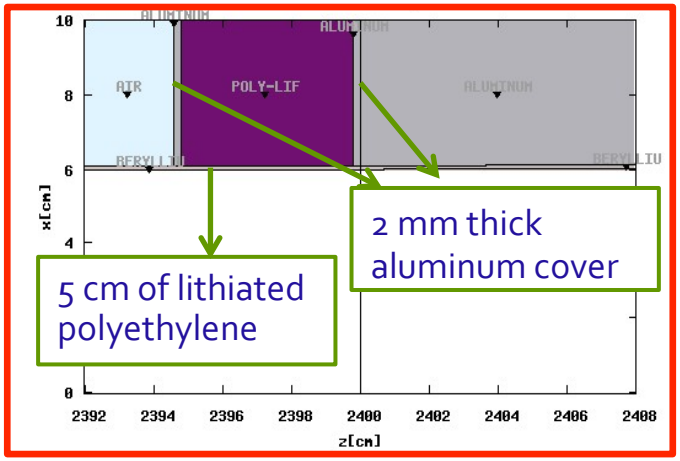


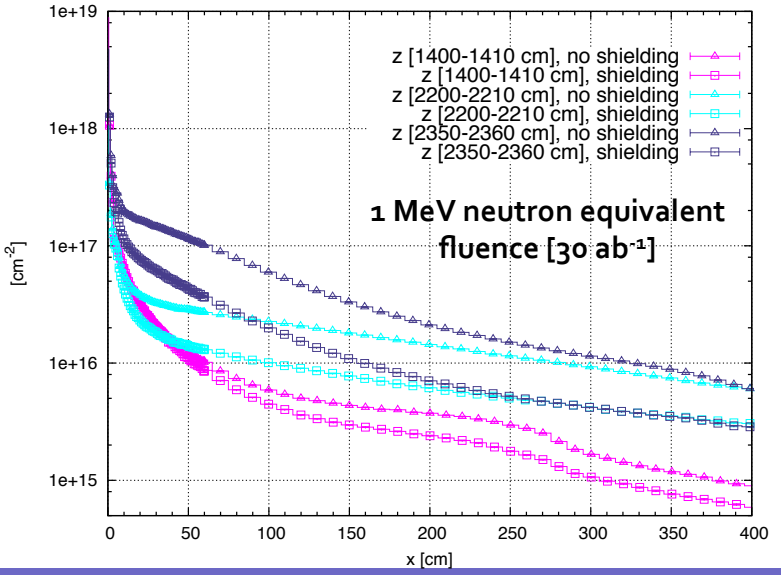


Shielding Strategy II

Shielding in front of the forward calorimeter to protect tracking stations from particles from the forward calorimeter







In the tracking station close to the forward calorimeter the gain is about a factor of 3.

Next Steps

- The implementation of the new detector geometry in FLUKA is in a quite advanced stage

- Next steps:
  - implement the shielding **in front of** the forward calorimeters
  - optimize the shielding **around** the forward calorimeter
    - increase its longitudinal length
    - increase the thickness at the hot spot
  - set-up the relevant scorings
  - implement the muon chambers in the geometry as soon as they are available
  - possible optimization of forward calorimeter aperture to reduce the back-scattering into the forward tracking stations:
    - reach η=6 coverage deep inside the calorimeter only = at larger distance from the forward tracking stations