International MUON Collider Collaboration

# Target and proton extraction channel studies

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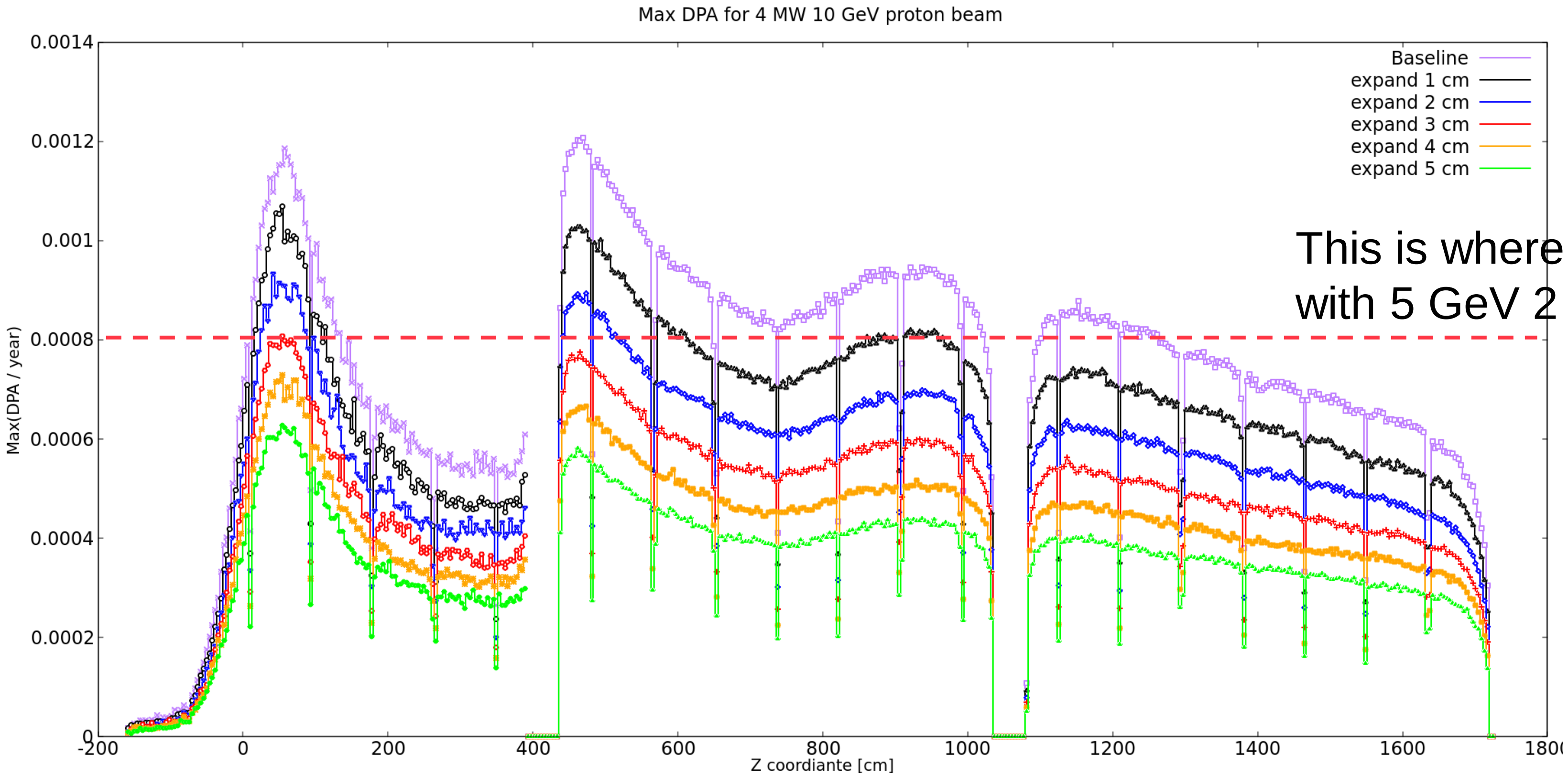
# Outline

- Radiation load to the HTS magnets with structural constraints and 4 MW beam
- Energy deposition to the graphite target – forced convection vessel
- Graphite vs Lead – preliminary comparison
- Shortening the tapering region: 5 m and 10 m comparison
- Chicane studies continue

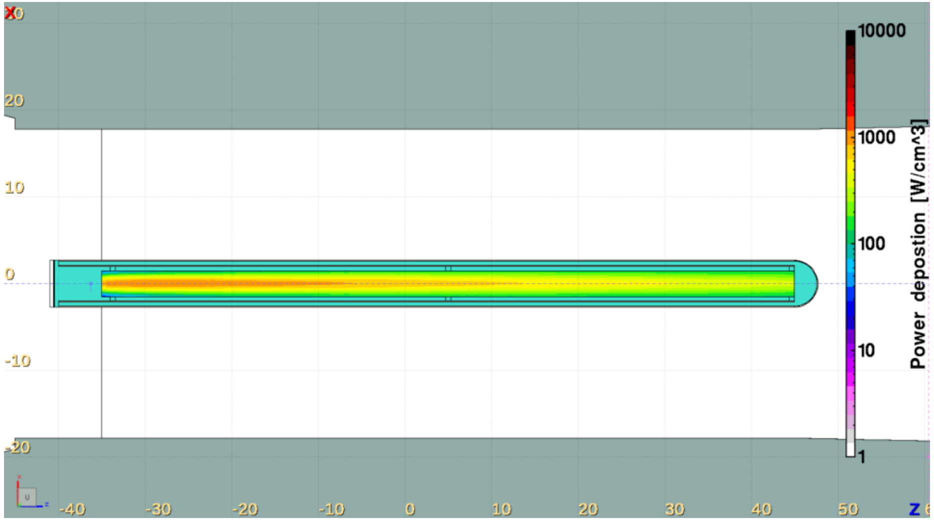
# DPA in HTS, 4 MW 10 GeV

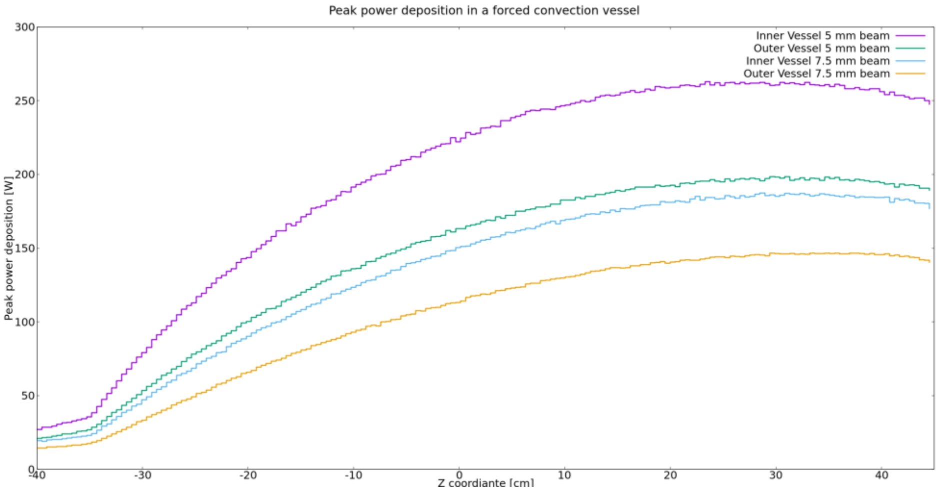



This is where we were with 5 GeV 2 MW

# Target Power deposition – forced convection vessel

Following the instructions from Silvio, the vessel walls are a only few mm from the edge of the target. **The goal of the study is to understand the power load in the new vessel design**




If this works, we could potentially reduce the magnet bore diameter by bringing the shielding closer to the target

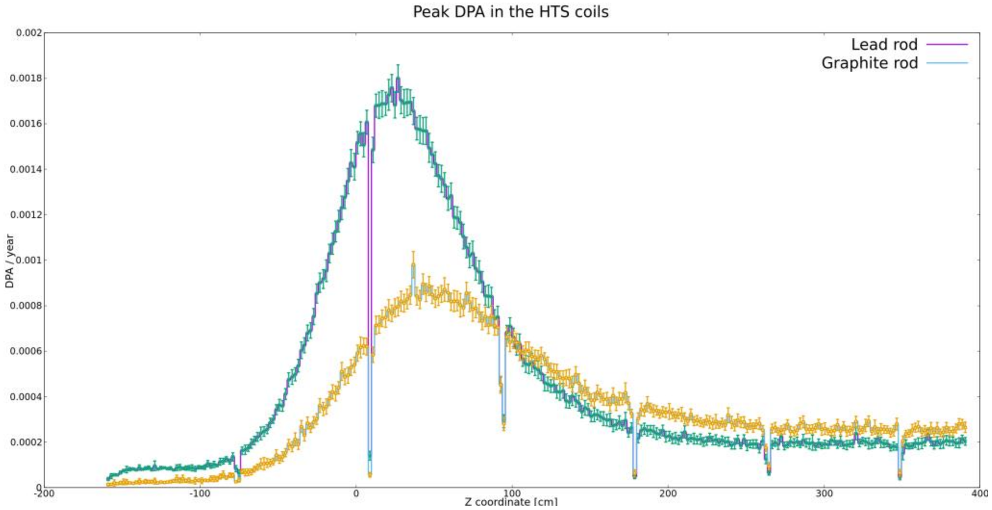
# Lead vs Graphite

| | Graphite | Lead |
|---|---|---|
| Length | 80 cm | 27.95 cm |
| Radius | 15 mm | 5.24 mm |
| Beam size (sigma) | 5 mm | 1.75 mm |

In this comparison, both materials have the rod geometry; the length and the radius is re-scaled according to the ratio of 5 GeV proton inelastic scattering length

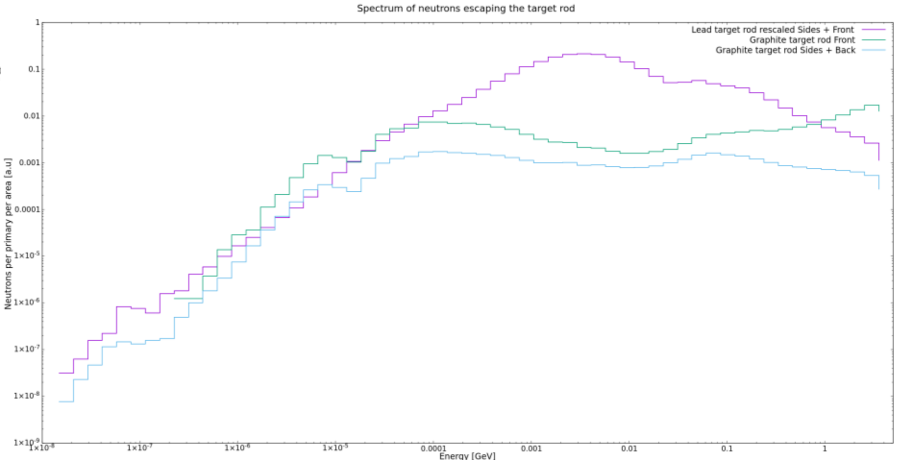
The beam size is also re-scaled accordingly and most likely not feasible for the investigated lead geometry,
The study is meant to understand the pros and cons of different options.

# Lead vs Graphite



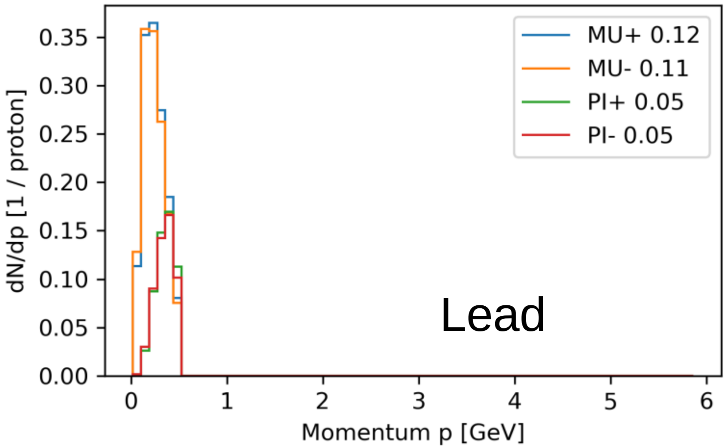

It is expected that the number of proton inelastic collisions is the same in both materials thanks to the re-scaling

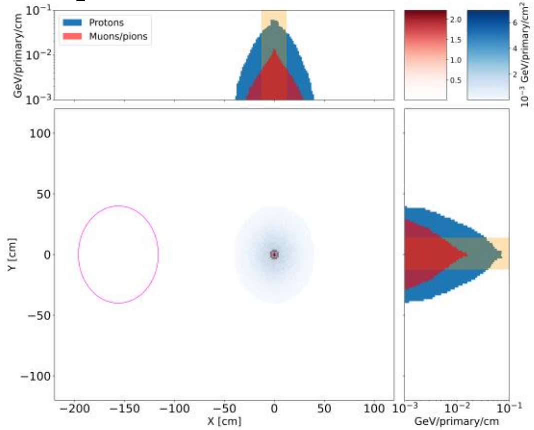
However, the particle spectrum is different and also in the case of lead secondaries are produced on a shorter distance

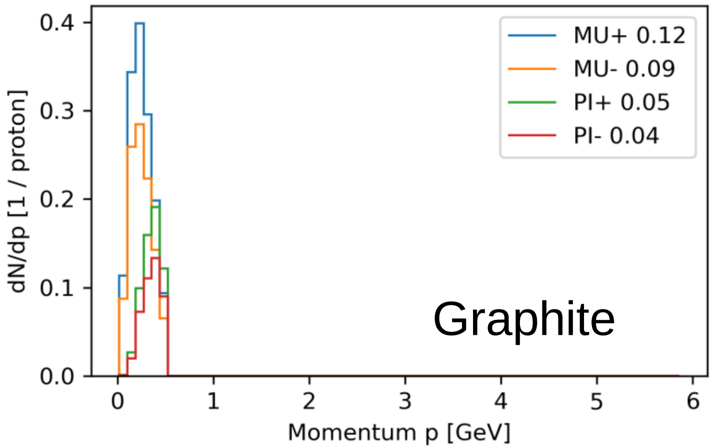


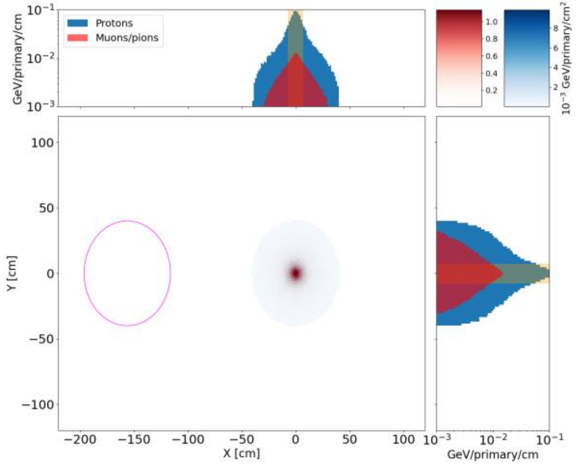
5 GeV 2 MW

# Lead vs Graphite



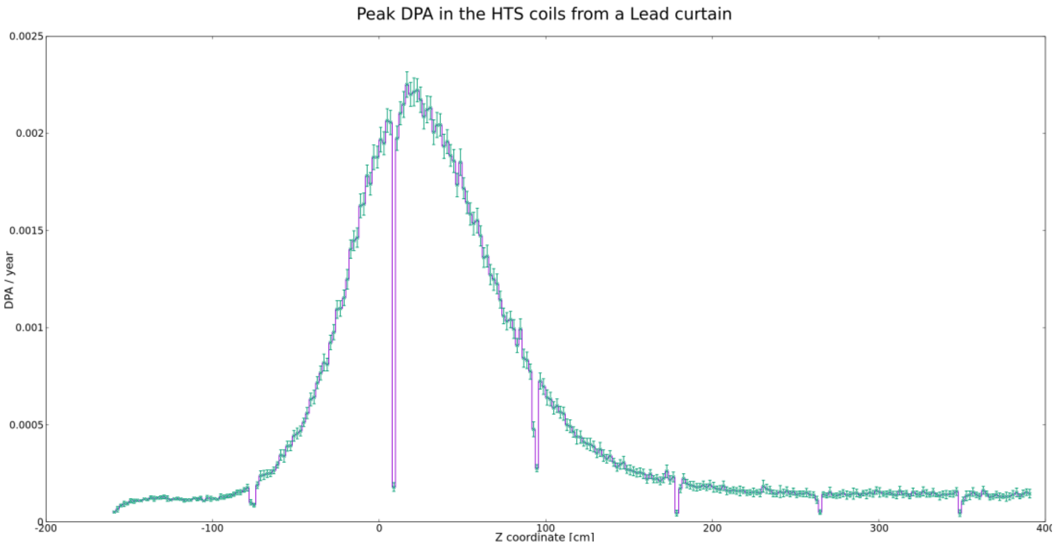



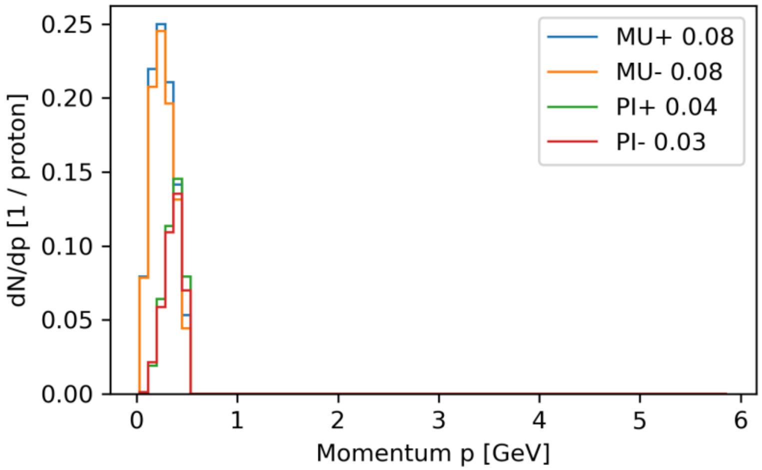



# Lead curtain

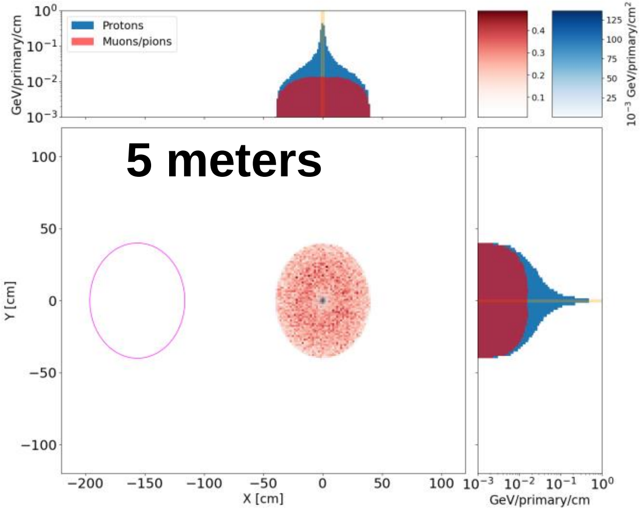
- The more feasible proposed lead target geometry is a curtain, but it was found that it reduces the muon/pion yield while increasing the radiation load to the HTS coils.



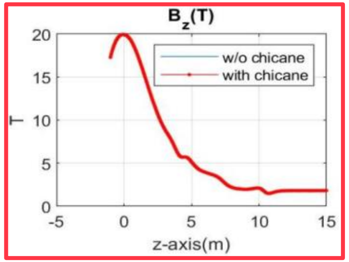



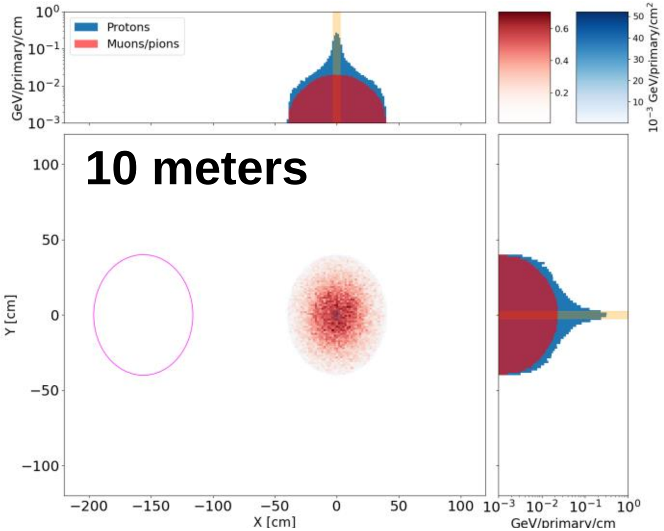
10 GeV 4 MW

# Shorter tapering – spent protons and yield

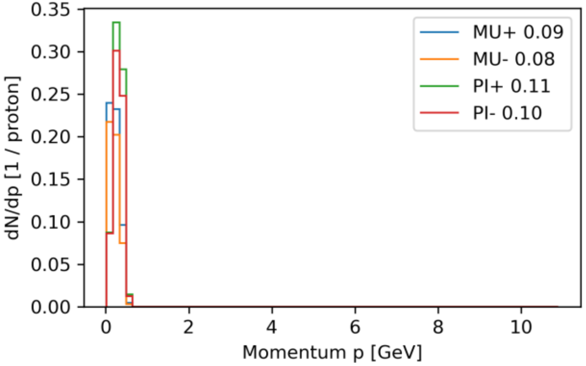


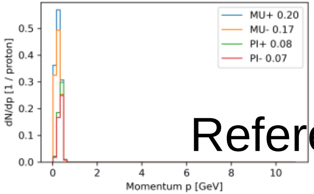

All the plots are at the end of the tapering



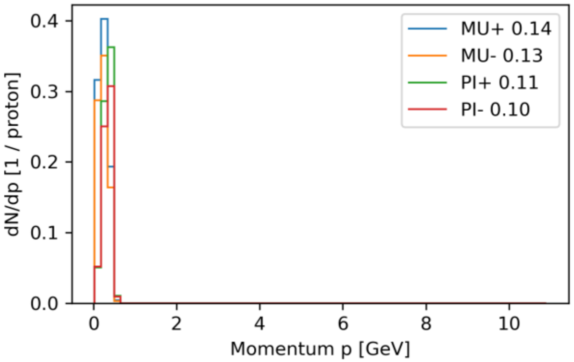




Magnetic field profile in the tapering is compressed in Z, not re-calculated!




Reference yield

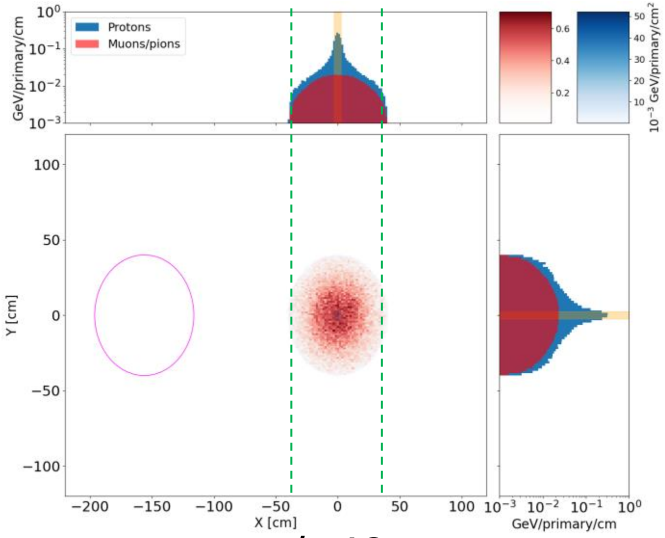


# Short tapering

- Shortening the tapering does not reduce the radiation load to the chicane magnets – the proton halo is still present
- If we want to keep the solenoid chicane, we may have to search for viable solutions to expand the extraction window size.
- The spent beam size is mostly driven by the

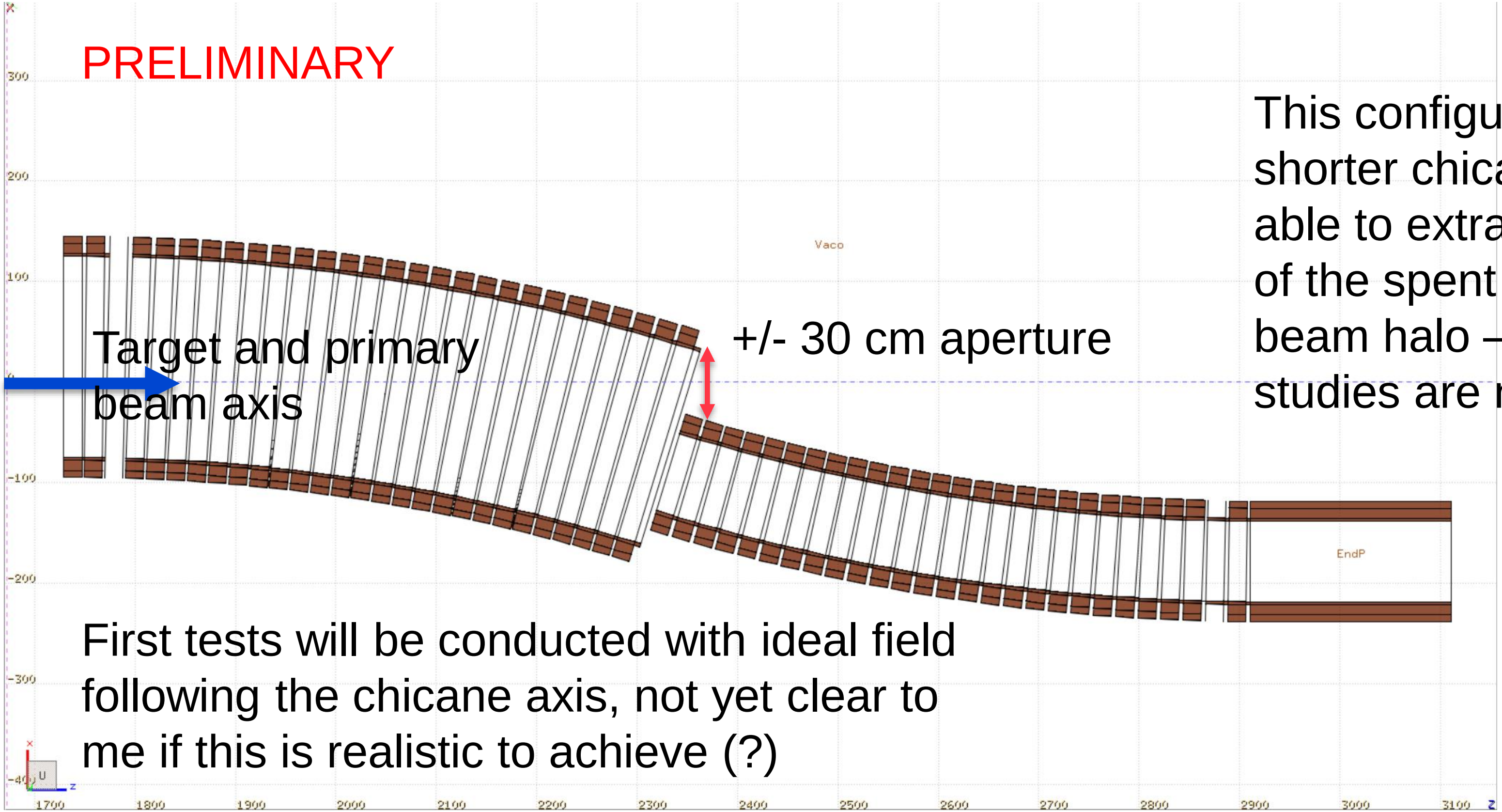
size of the tapering

- Current window size is ~+/- 20 cm
- Doubling this size would be ideal.




~+/- 40 cm

# Chicane with shifted axis




PRELIMINARY

Target and primary beam axis

+/- 30 cm aperture

This configuration with a shorter chicane could be able to extract a big part of the spent proton beam halo – more studies are needed

First tests will be conducted with ideal field following the chicane axis, not yet clear to me if this is realistic to achieve (?)