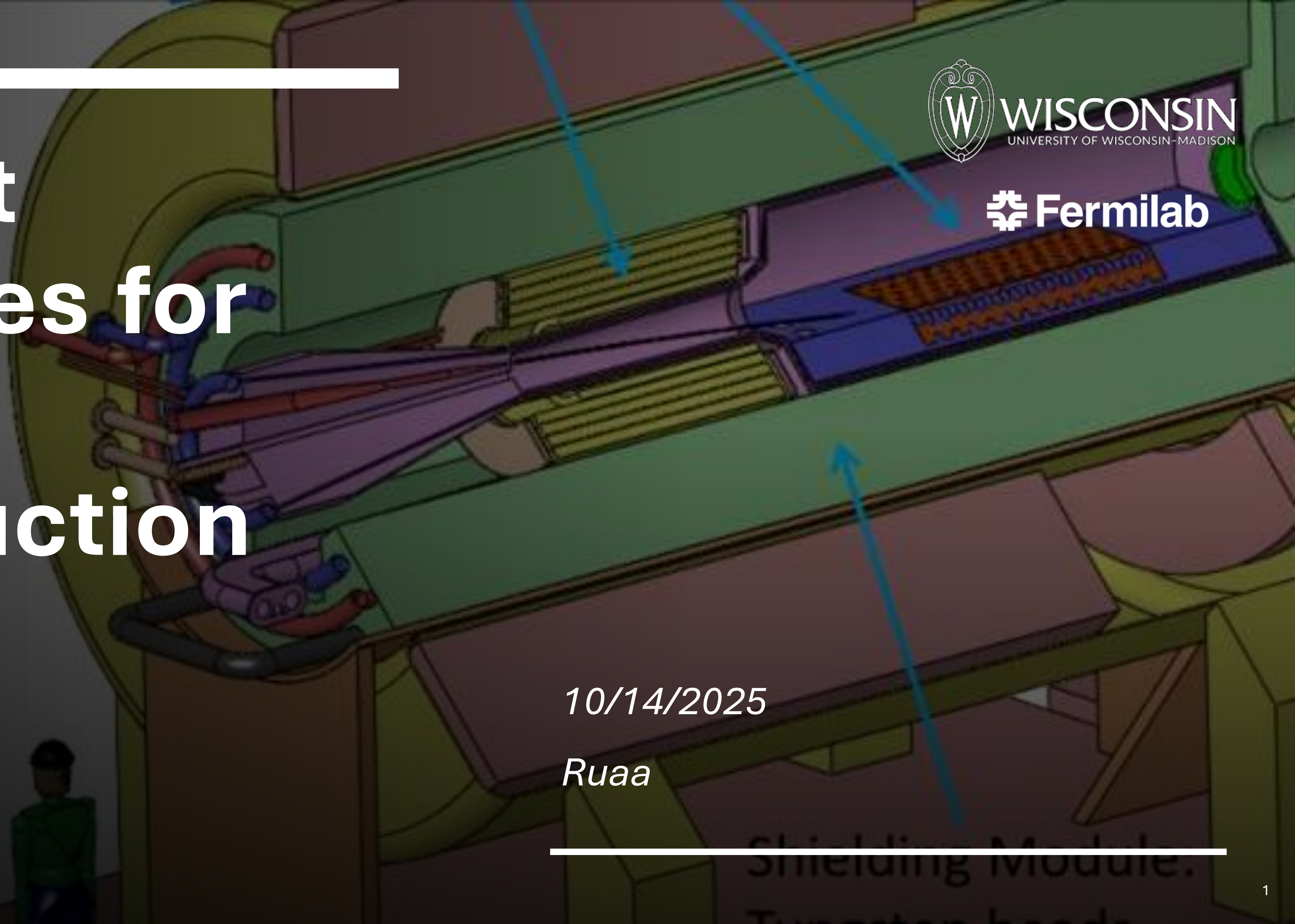
# Target Studies for Muon Production




10/14/2025

Ruaa

WISCONSIN
UNIVERSITY OF WISCONSIN–MADISON

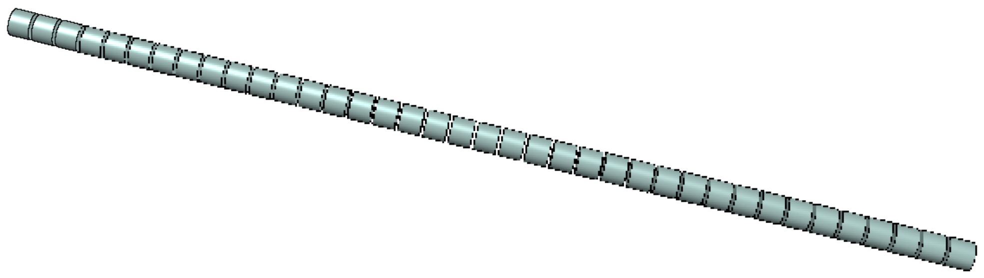
Fermilab

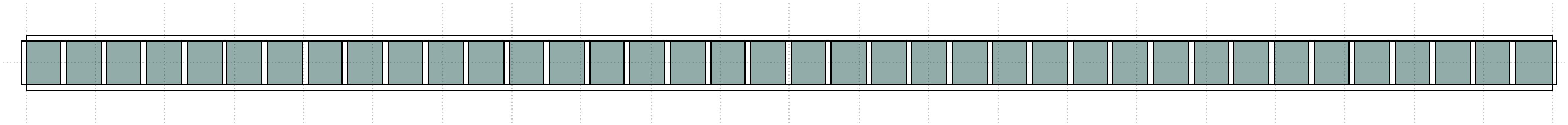
# Mu2e target design

→Material: Tungsten

→The target is 22 cm in length and has radius of 0.315 cm.

→The target is divided into 38 sections, each 0.5 cm wide, separated by 0.08 cm gap.





# MiniBooNE target design

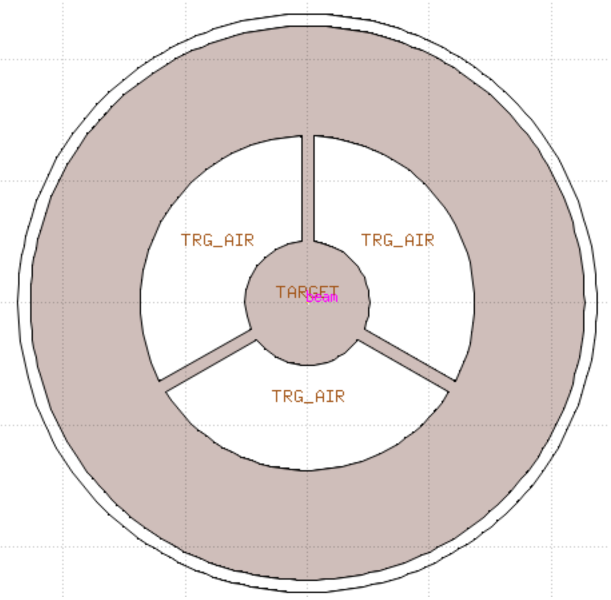
→ Material: Beryllium

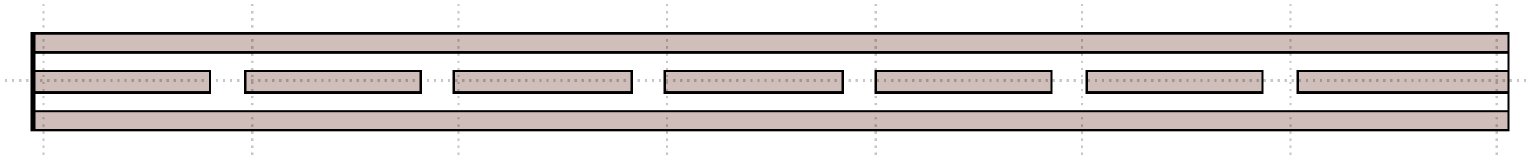
→ The target is 71 cm in length and has radius of 0.51 cm.

→ The target is divided into 7 slugs, each 8.5 cm wide, separated by 1.6 cm gap.

→ The slugs are housed within a beryllium sleeve that is 0.9 cm thick with an inner radius of 1.37 cm.

→ Each slug is supported inside the sleeve by three beryllium fins



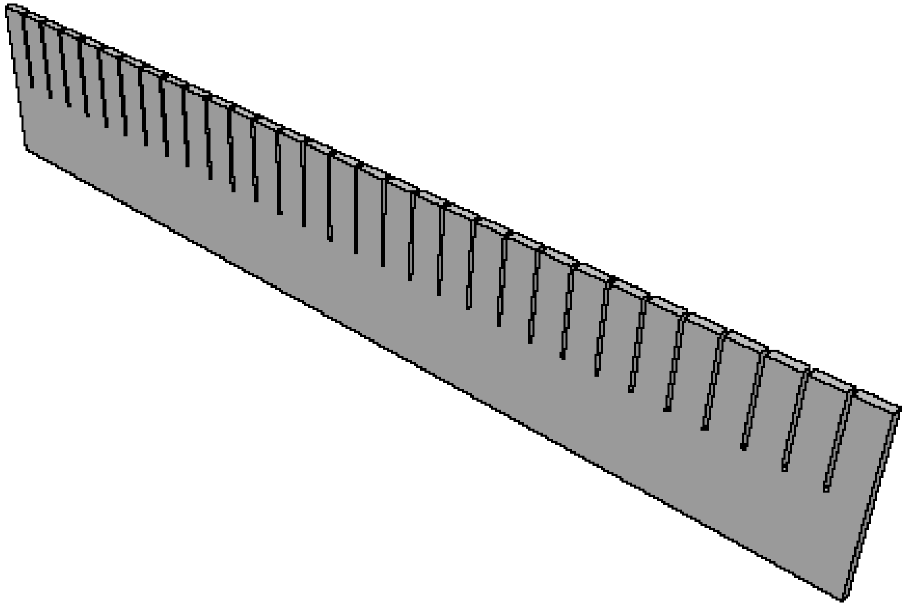



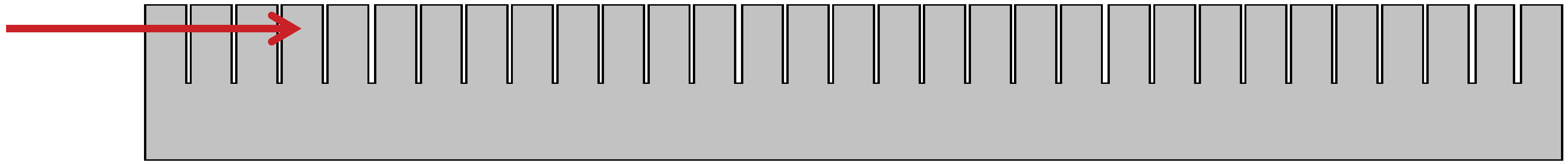
# NOvA target design

→ Material: Graphite

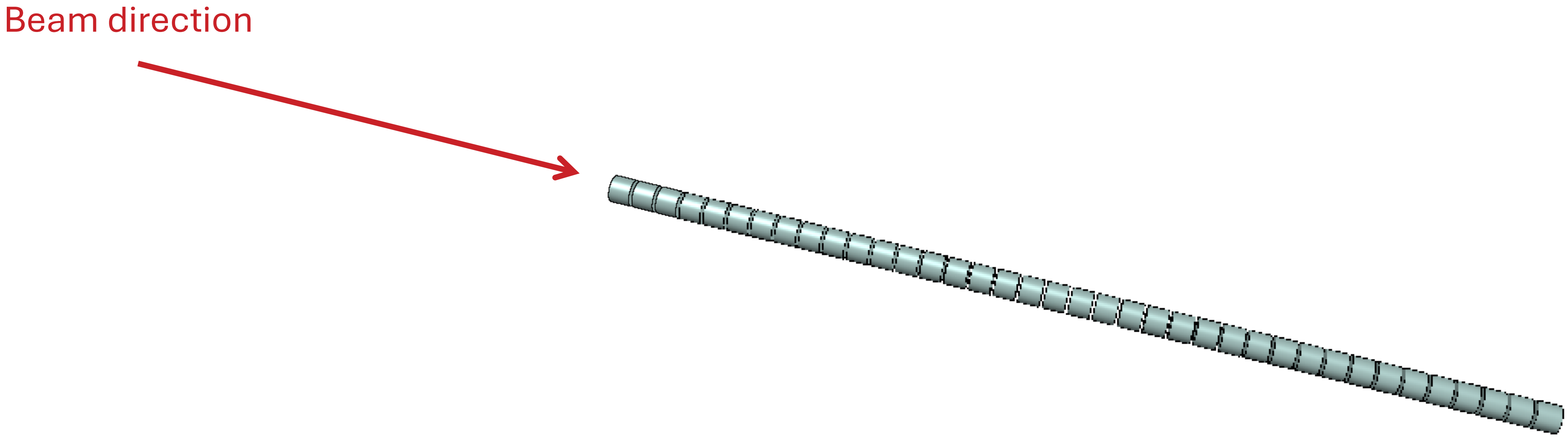
→ The target is 76 cm in length and 0.74 cm wide.

→ The target has 31 fins, each measuring 2.4 cm in length along the beam direction, and 6.3 cm in height, spaced by 0.05 cm gaps.

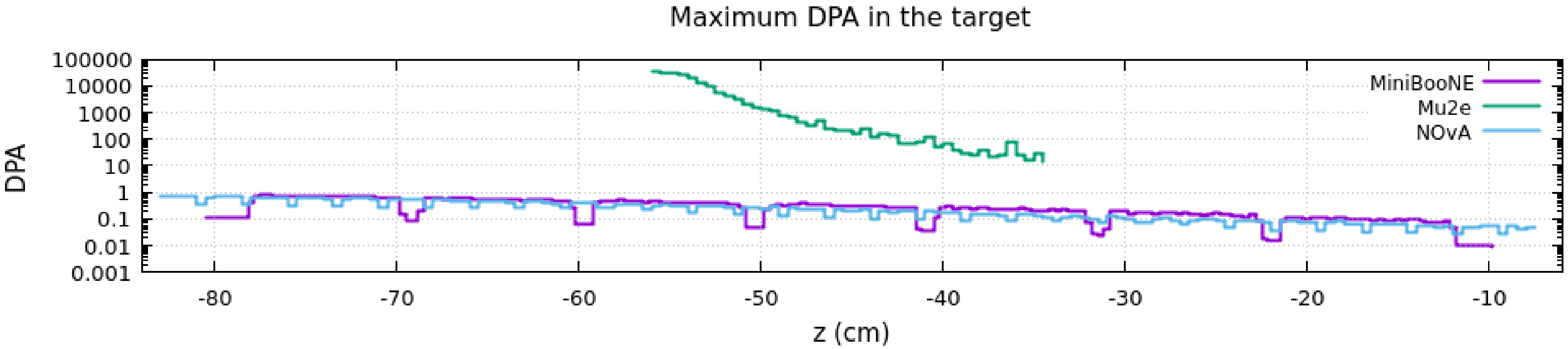


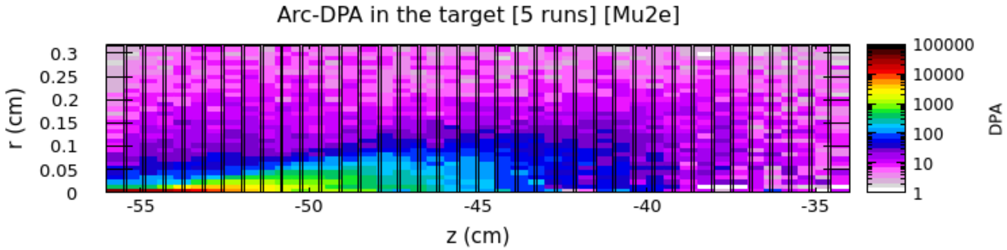


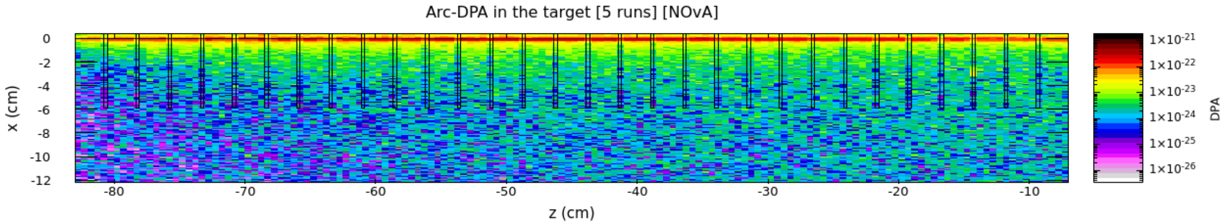
# Target damage study

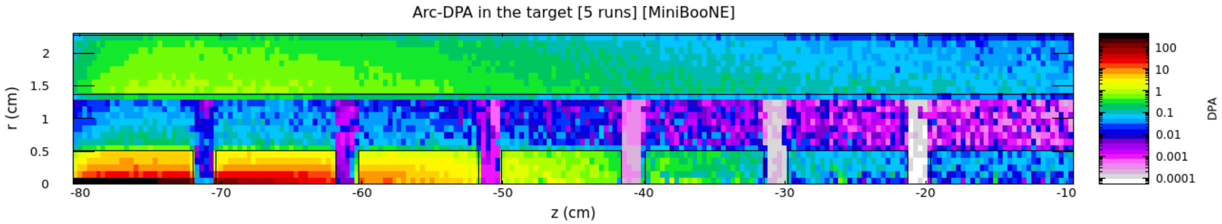


# DPA study for the target

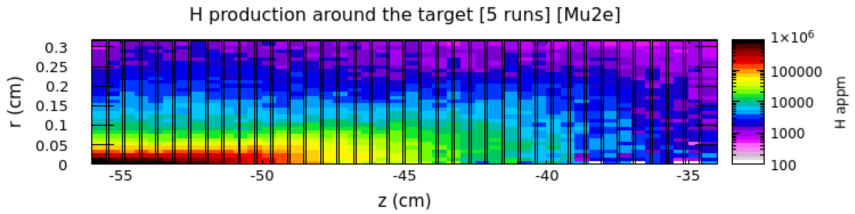


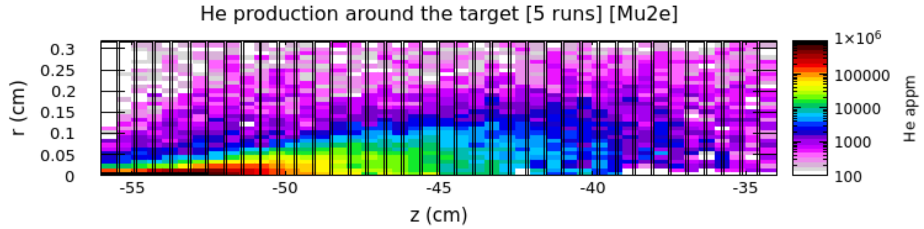



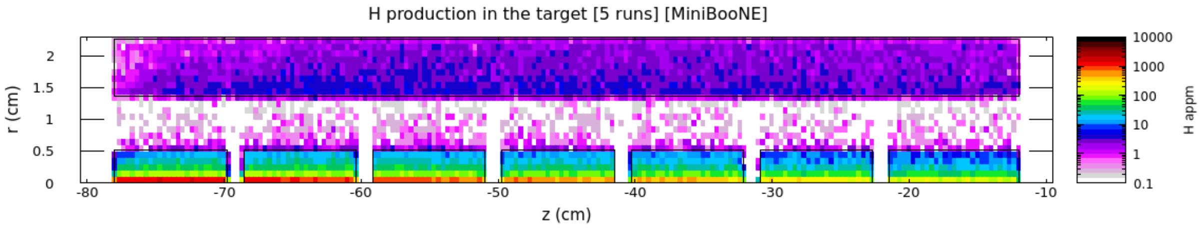



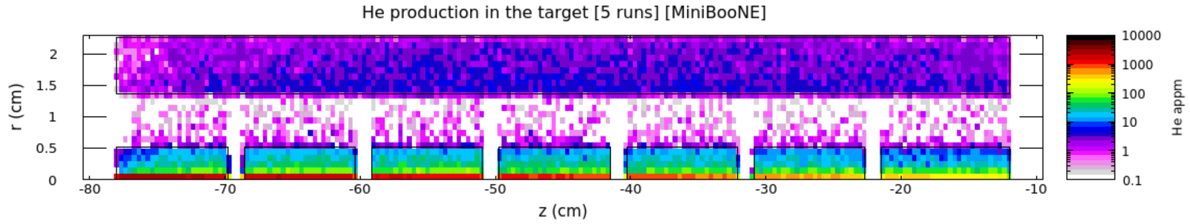



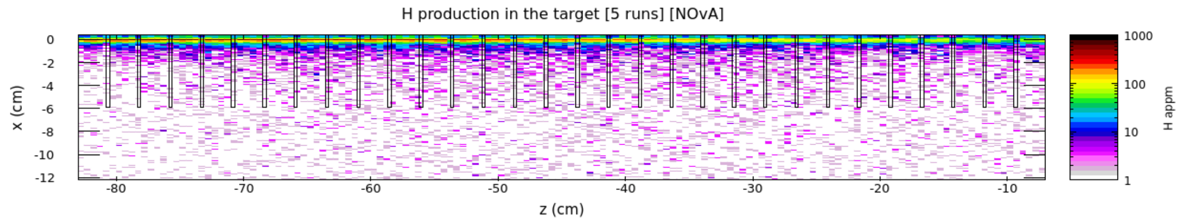
# Nuclei production in the target

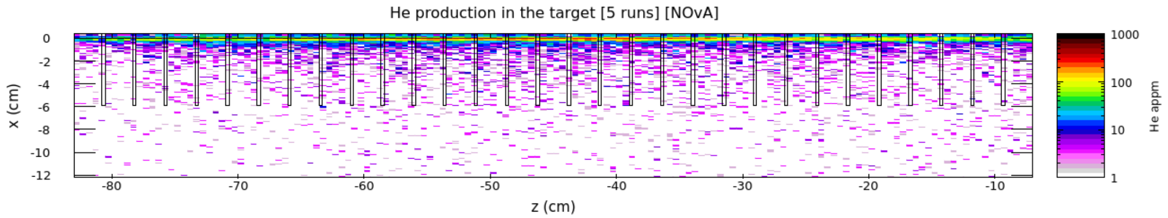


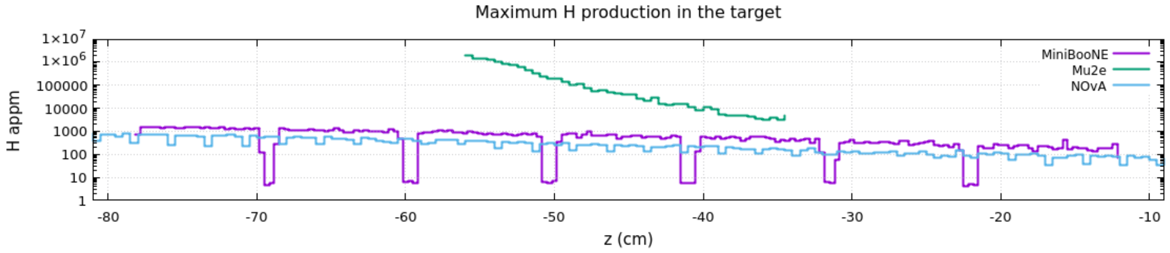



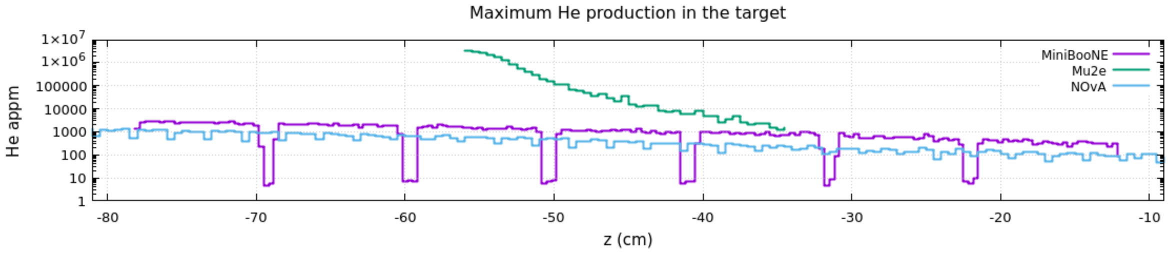



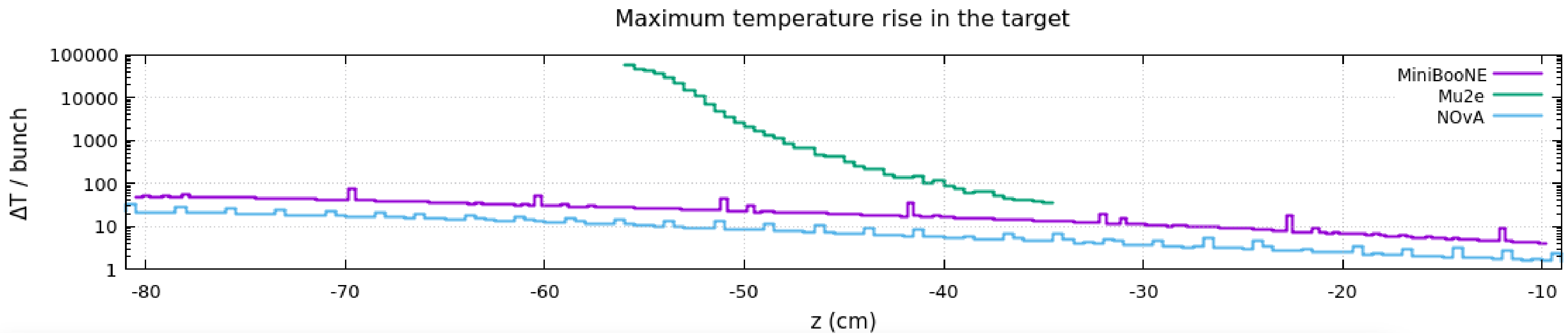



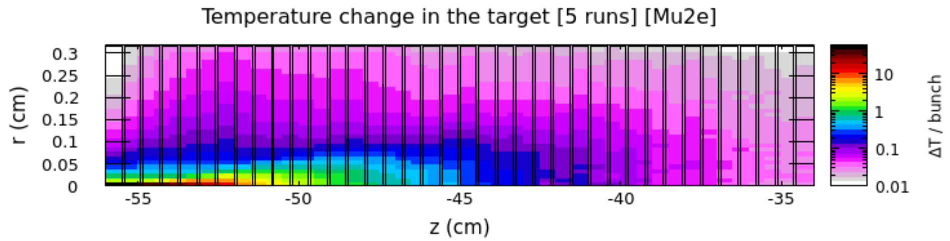



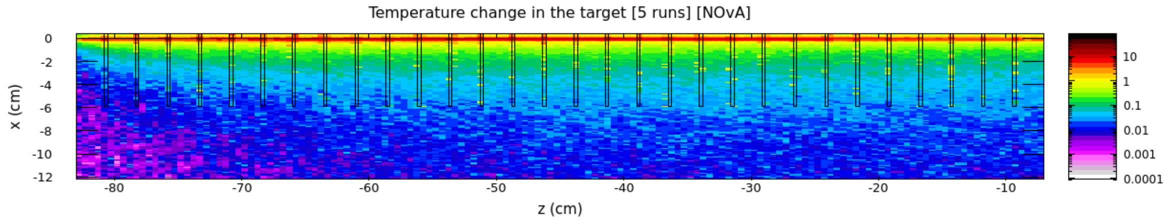



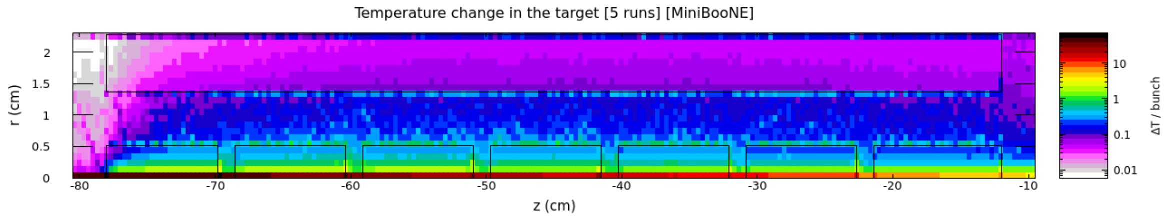



# Temperature rise in the target



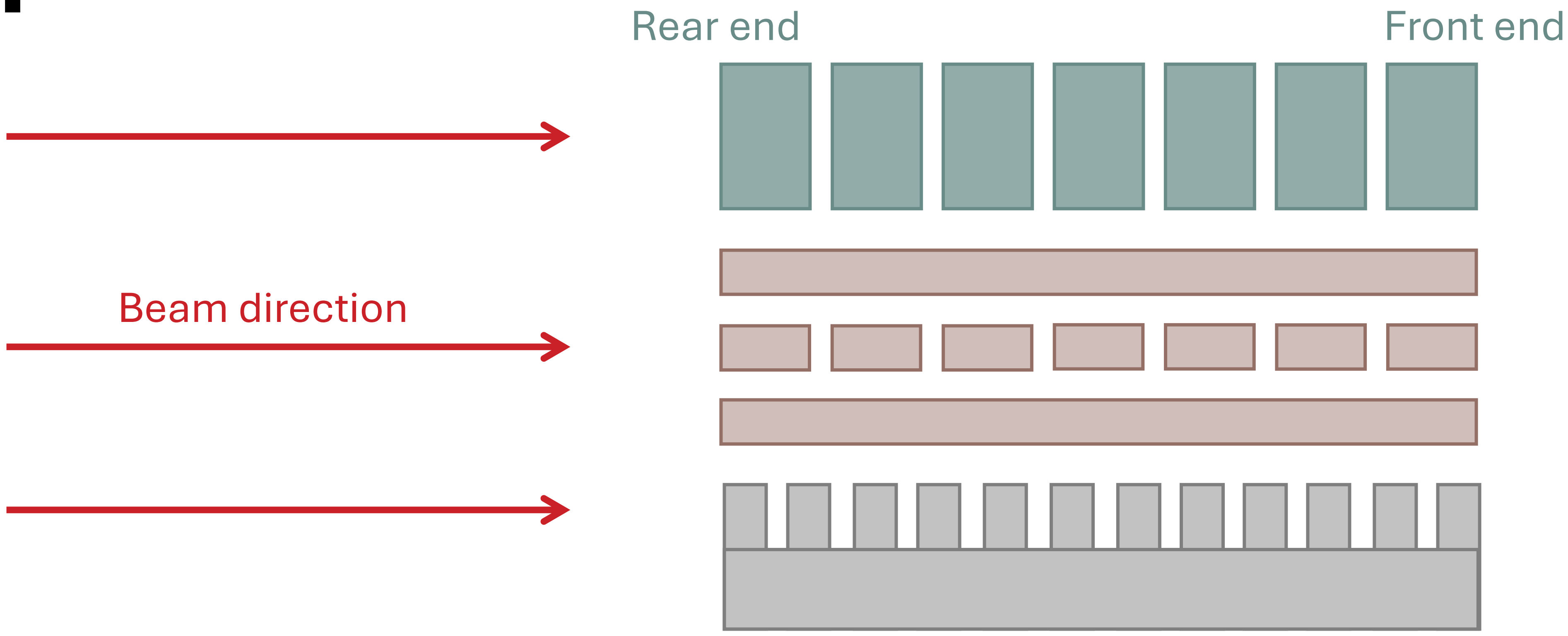
# Summary

→Unfortunately, I still don’t have a clear idea of what the material thresholds for DPA and gas production within the target.

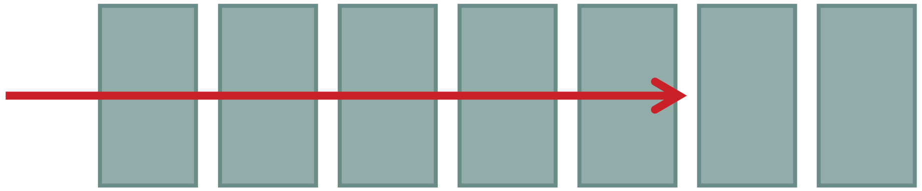
- → Despite this, tungsten’s results seem to be expected yet unrealistic.
- → They are expected, since with higher density more particle interactions occur.
- → But they are unrealistic because there are many other factors that contribute to the result that have not been considered.
- → These “other factors” seem to play a more significant role with tungsten.

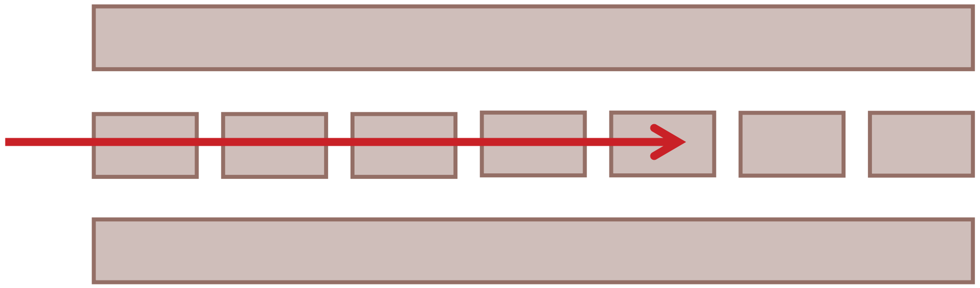
→In the temperature plot, we see that tungsten’s maximum temperature rise is higher than 10,000 K. This cannot happen since tungsten is going to experience melting and the material’s integrity may change.

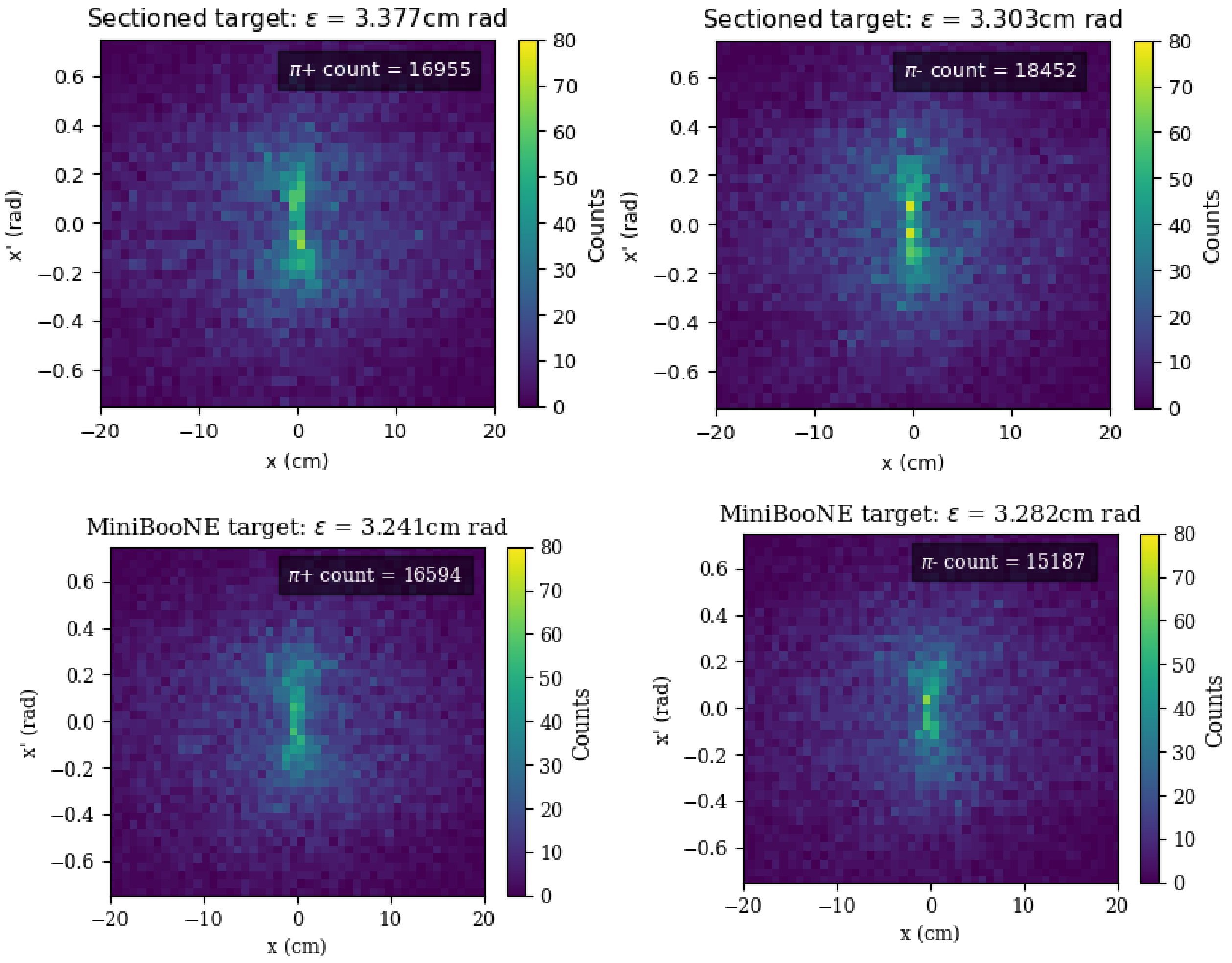
# Beam properties



# The resultant beam at the end of the solenoid







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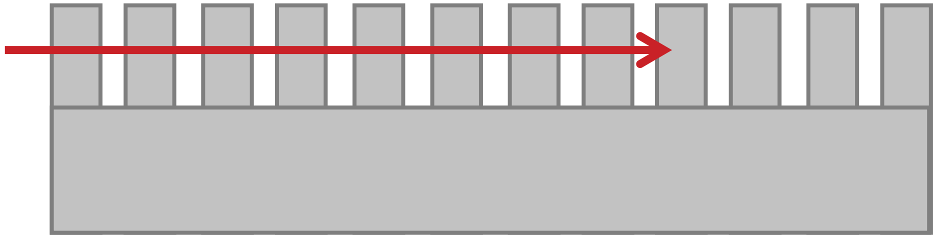

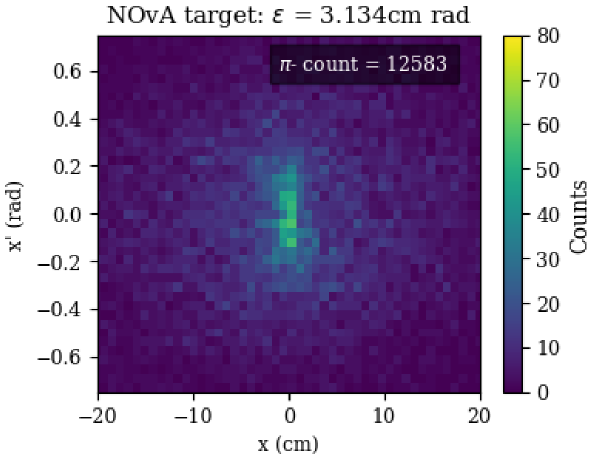


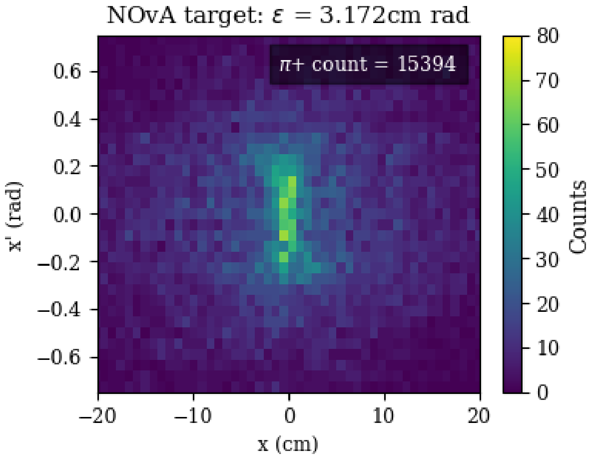

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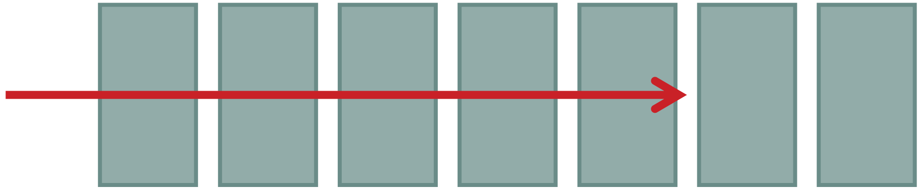

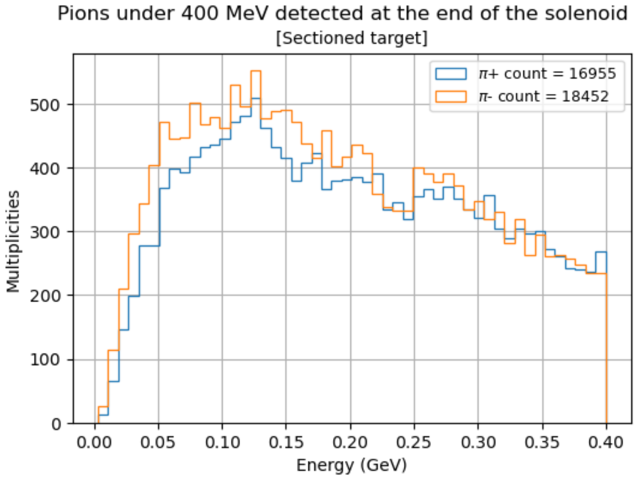


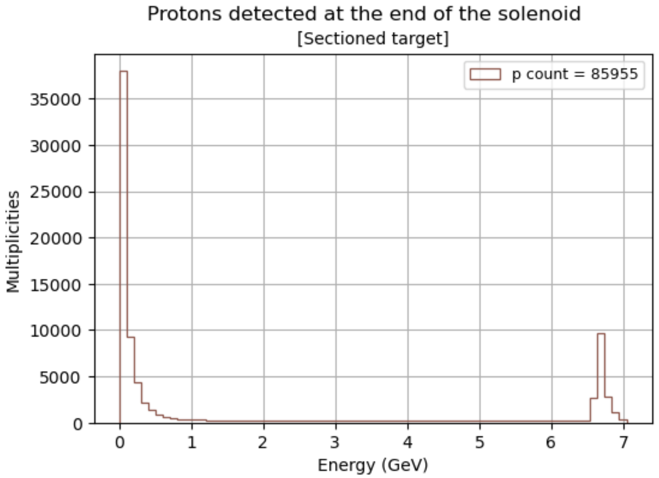


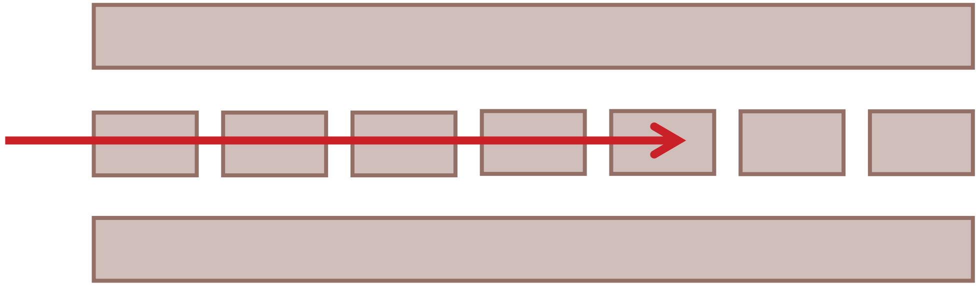

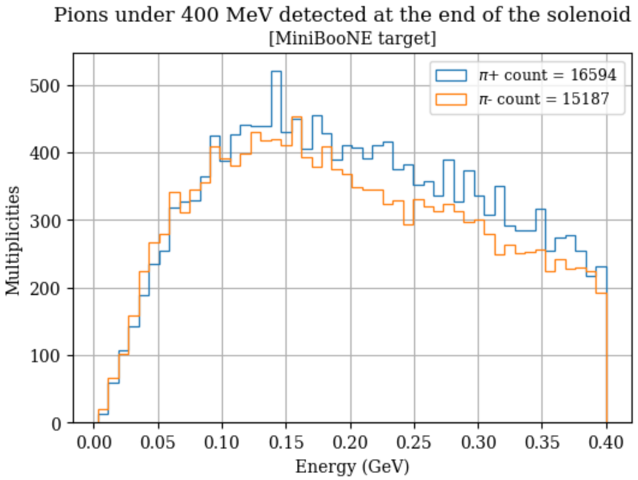


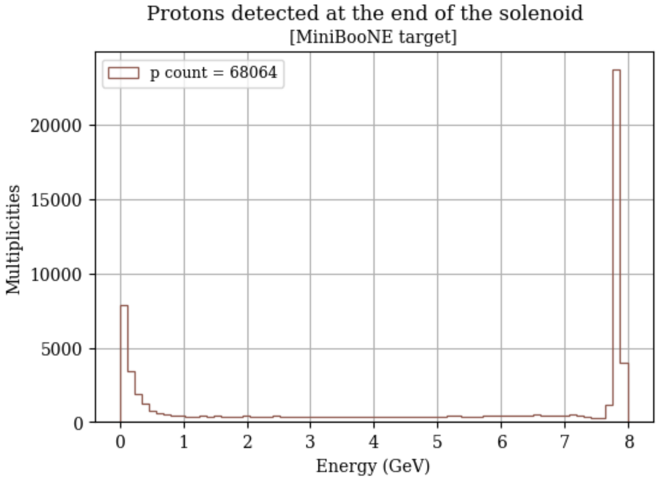

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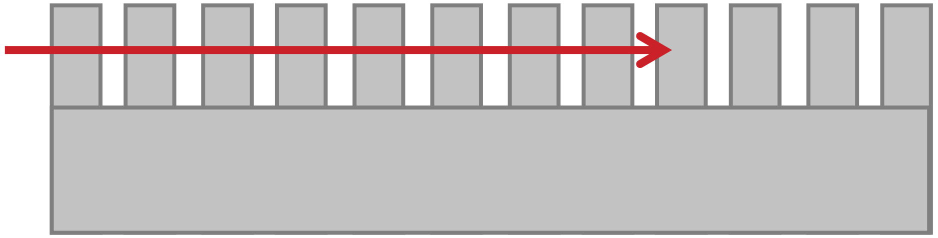
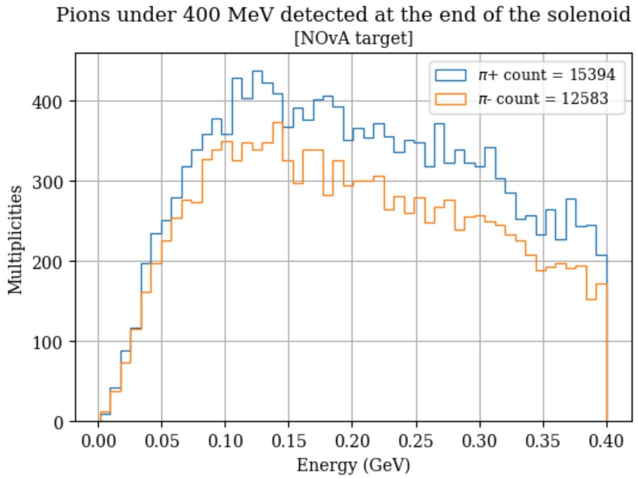
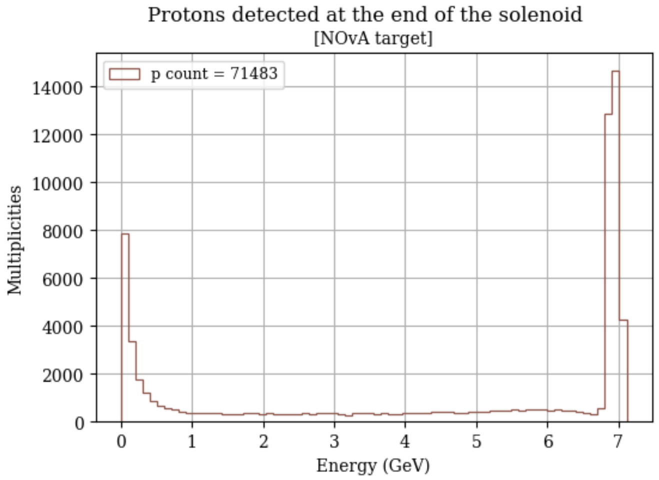
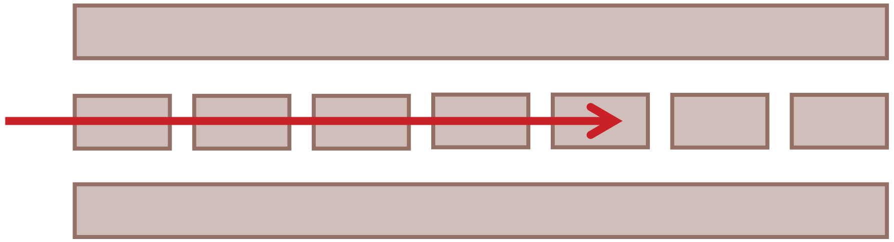
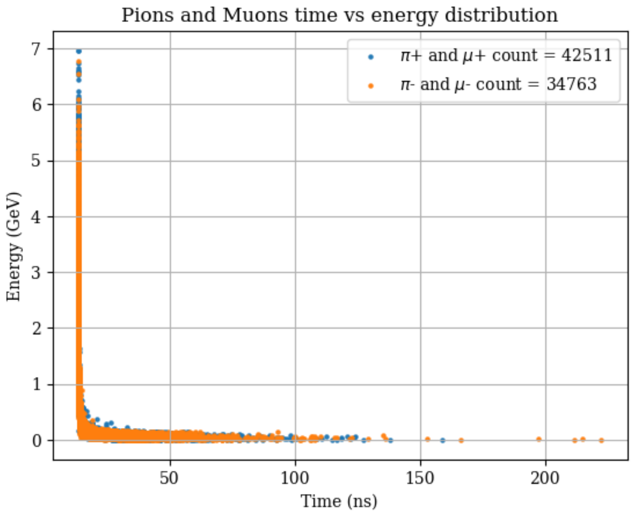


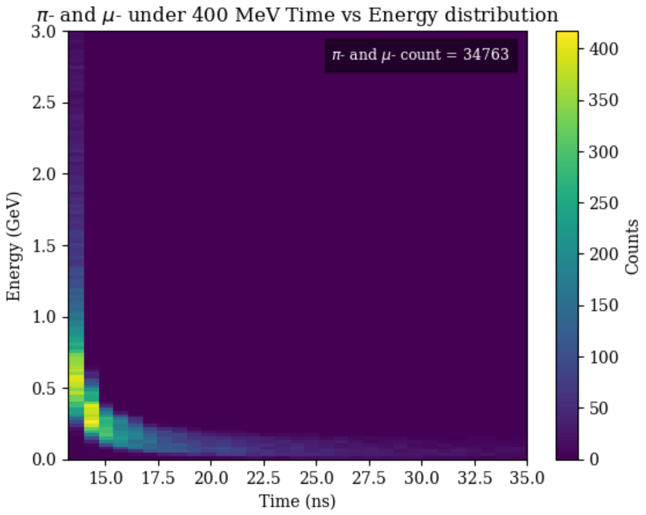


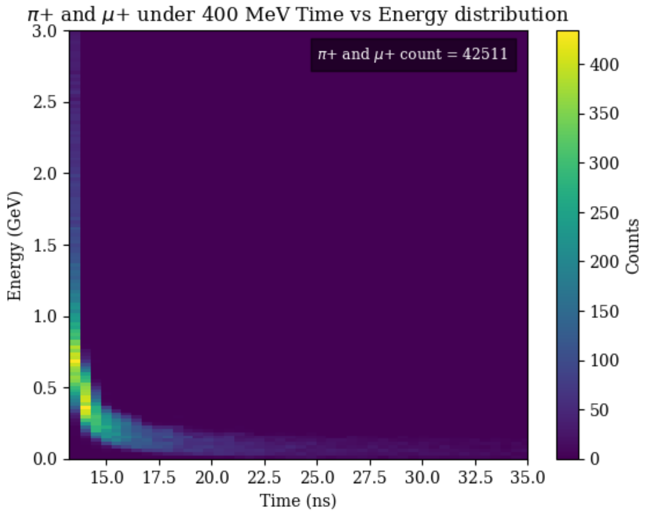



# Beam time structure





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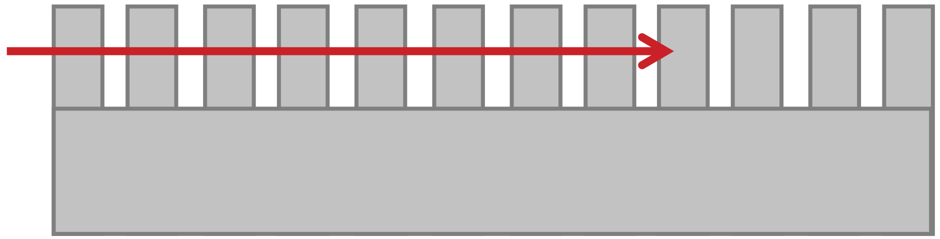

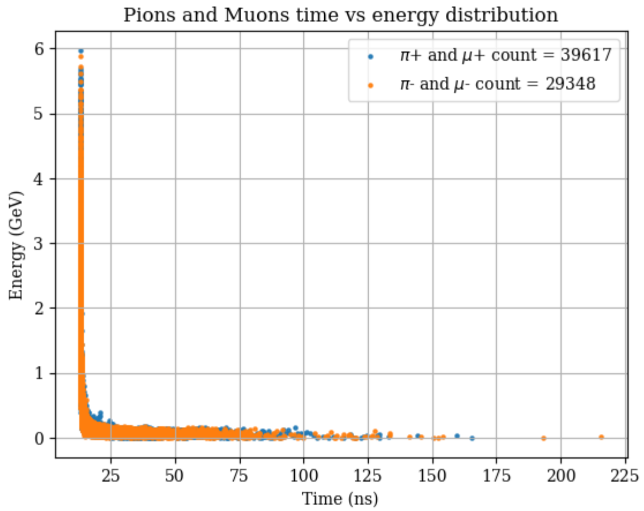


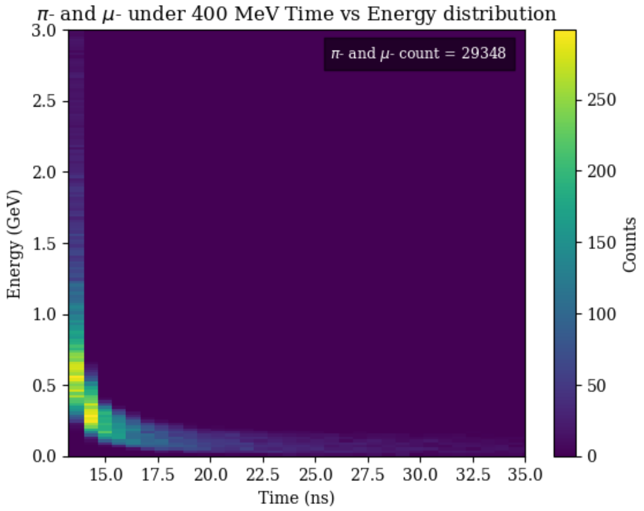


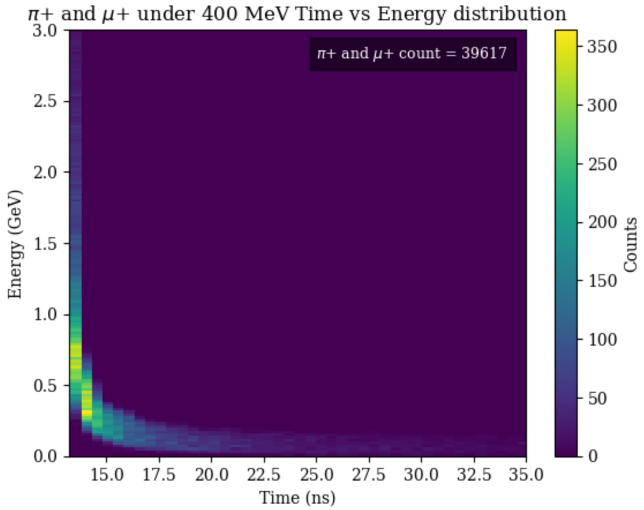

# For next week…

→**Focus on the target damage studies.**

- → Play with different parameters of each target.
- → I will try to find better methods to simulate damage. The results that I've shown today aren't very realistic especially with tungsten.
  - → The temperature increase in tungsten cannot go that high since the material will undergo melting and experience other factors that could contribute to cooling.

→**Learn more about the time structure of the beam.**

→**Simulate the progression of phase space of the beam at different stages of the setup.**

- → The purpose of this analysis is to understand what part/s of the target geometry affect the produced pion beam.
- → Moreover, it will be good to know how the density of the material actually affects the pion beam (other than the fact that pion production increases).