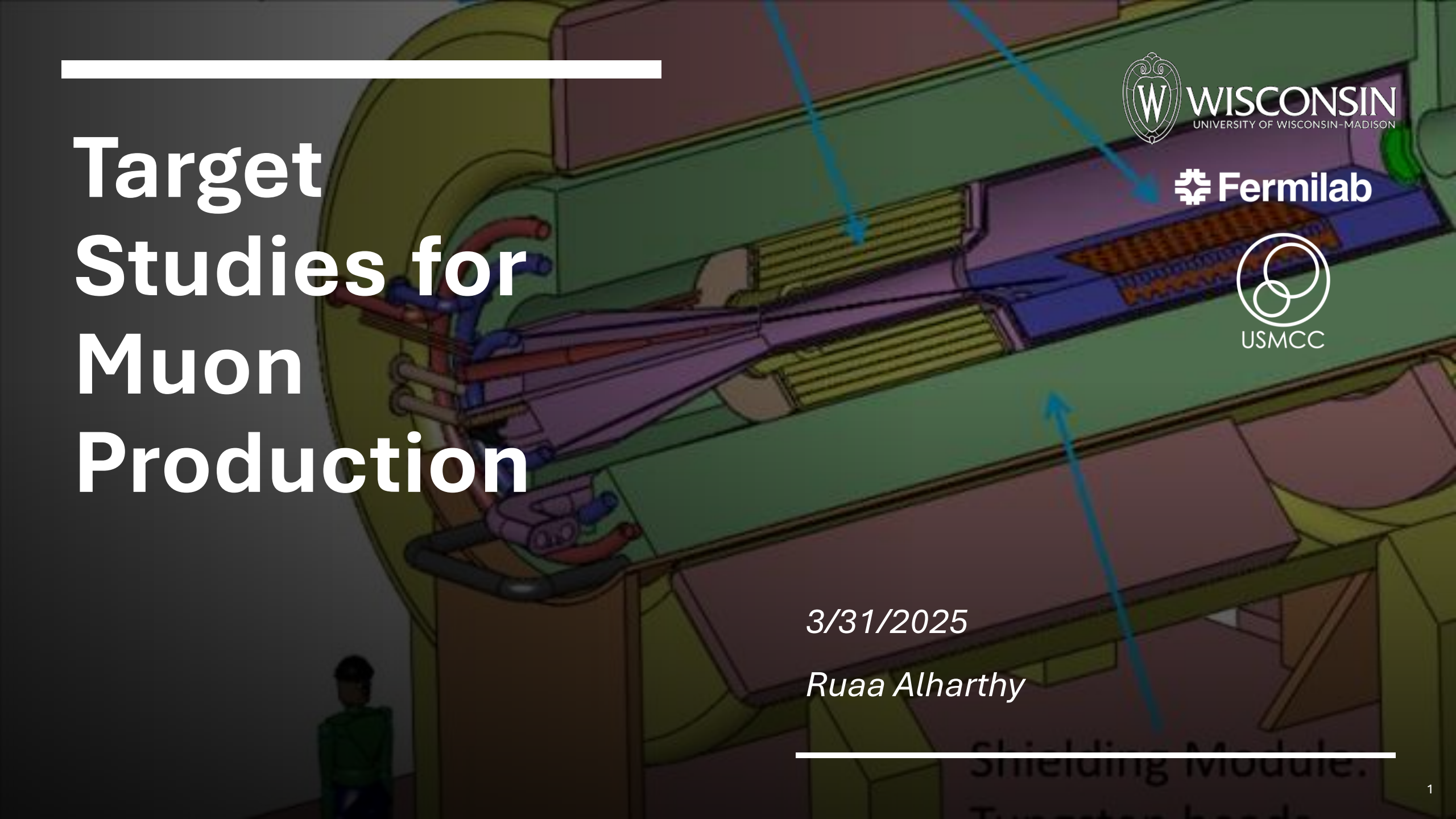
Target Studies for Muon Production



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Simulation setup

→Material = *Graphite*

→Length = *Varying length*

→Radius = 0.15 cm

→No magnetic field

→100,000 primaries

→Various energy proton beams

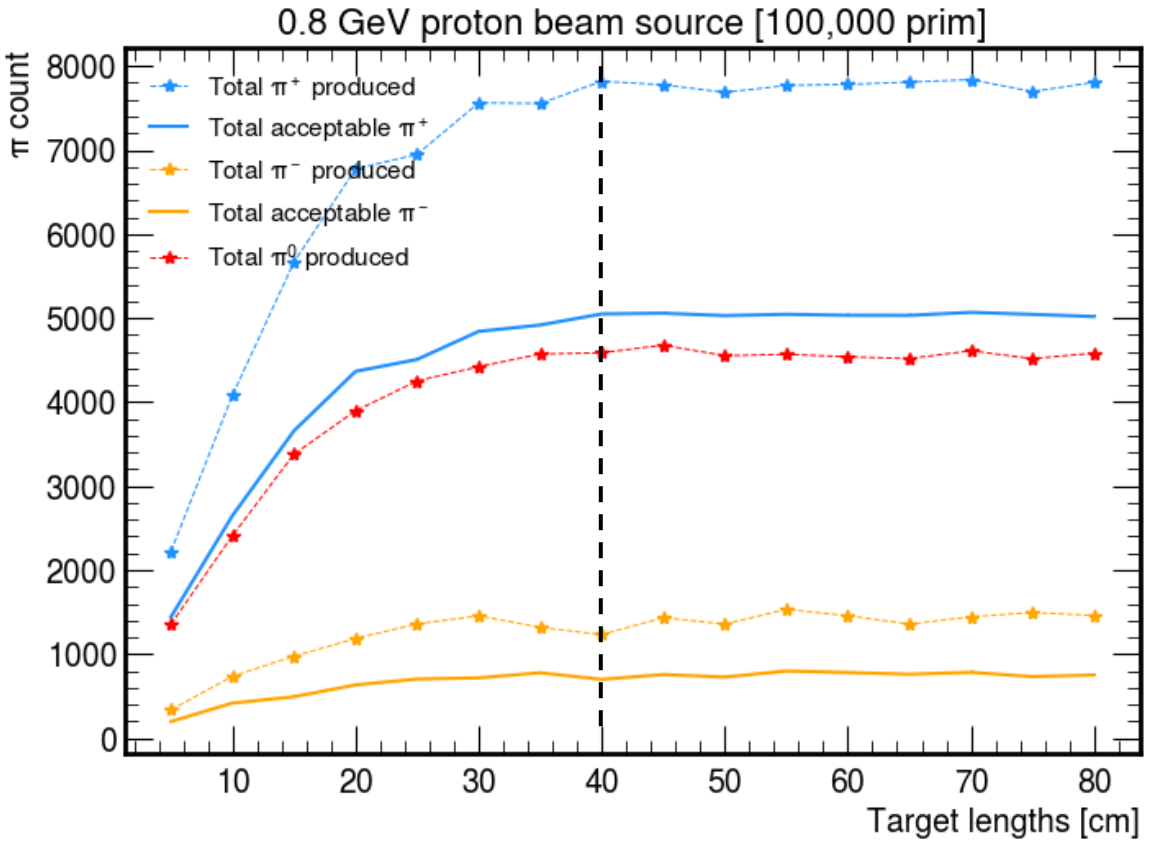
π yields for different target lengths

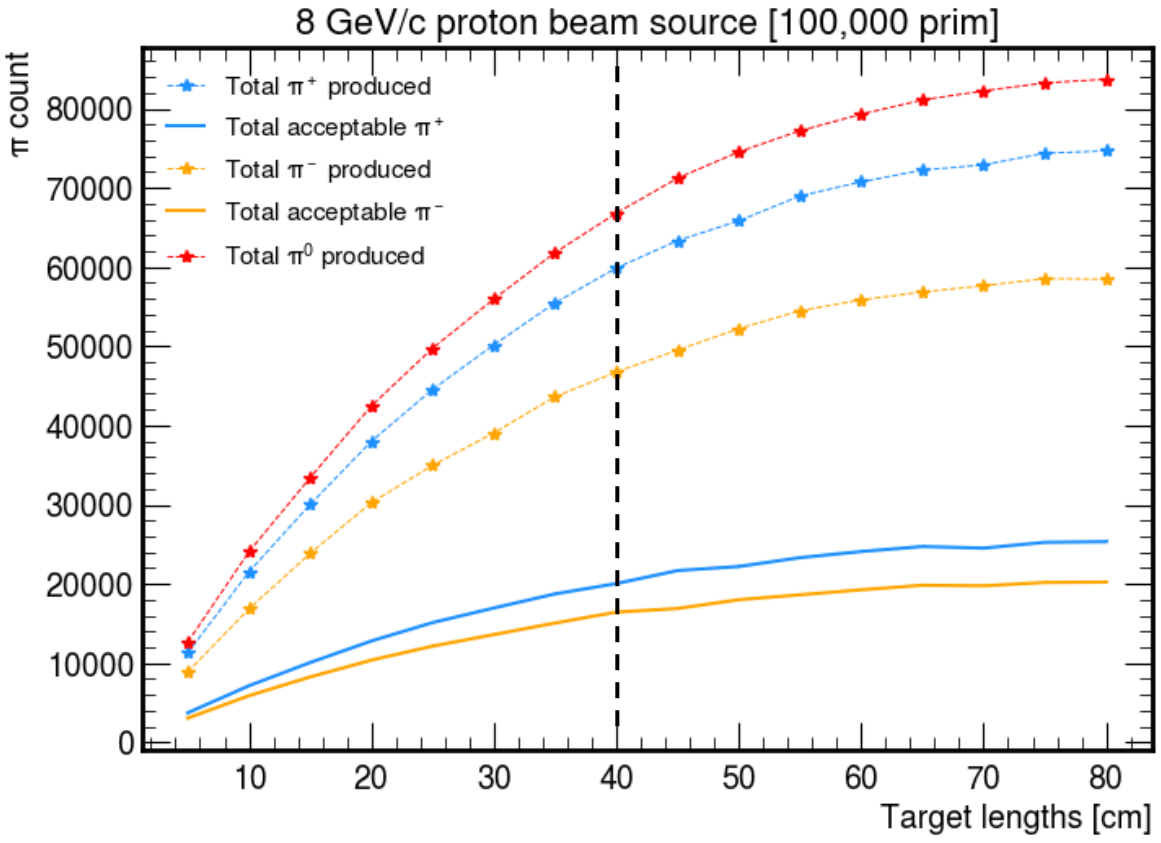
→ I intend to add this as a section in my IPAC conference proceeding.
→ I ran simulations for 0.8 GeV and 8 GeV/c proton beams hitting a graphite target at different lengths.
→ The target lengths range from 5cm – 80cm with 5cm step from one simulation to the other.
→ 80cm is two interaction lengths of the graphite target.

→ For the plots in this section, I am including details about "total pions produced" in the target and "acceptable pions", which are the pions that have passed a selection criteria that is defined as:
  → Pion kinetic energy < 400 MeV
  → Forward moving pions $\cos\theta_z > 0$
  → Pions that have escaped the target
→ *These selections ensure that we not only look at total pion production but also look at the subset that could be possible to capture with the accelerator technologies that exist today.*

π yields for different target lengths

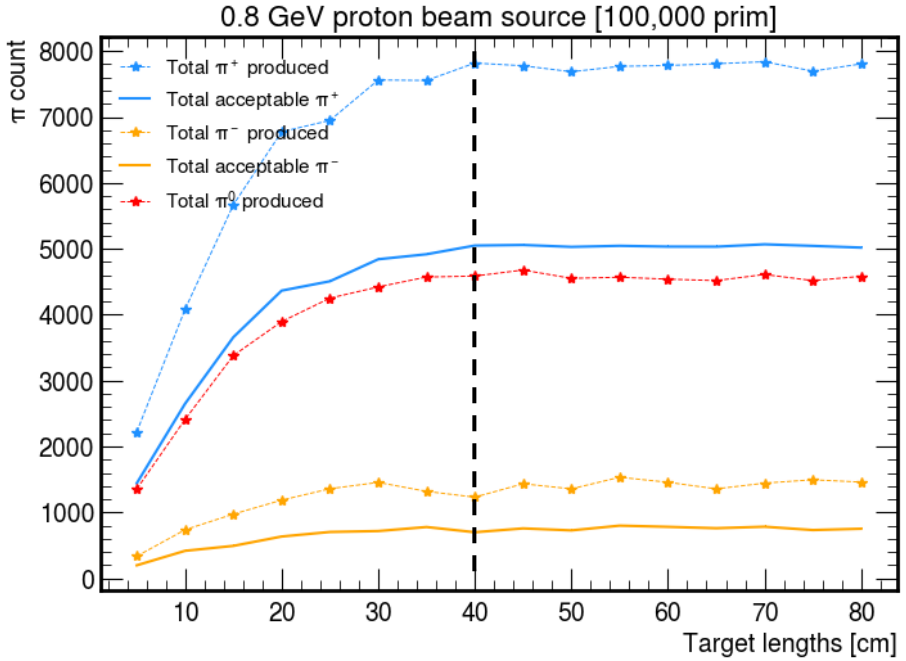
→ *Expectation:* See the production leveling off after one interaction length.

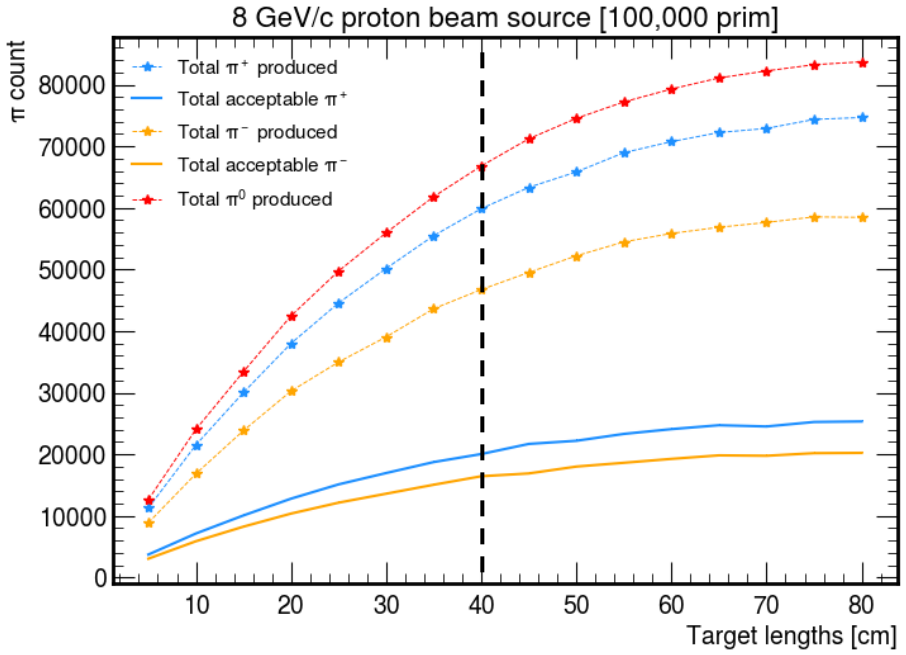




π yields for different target lengths

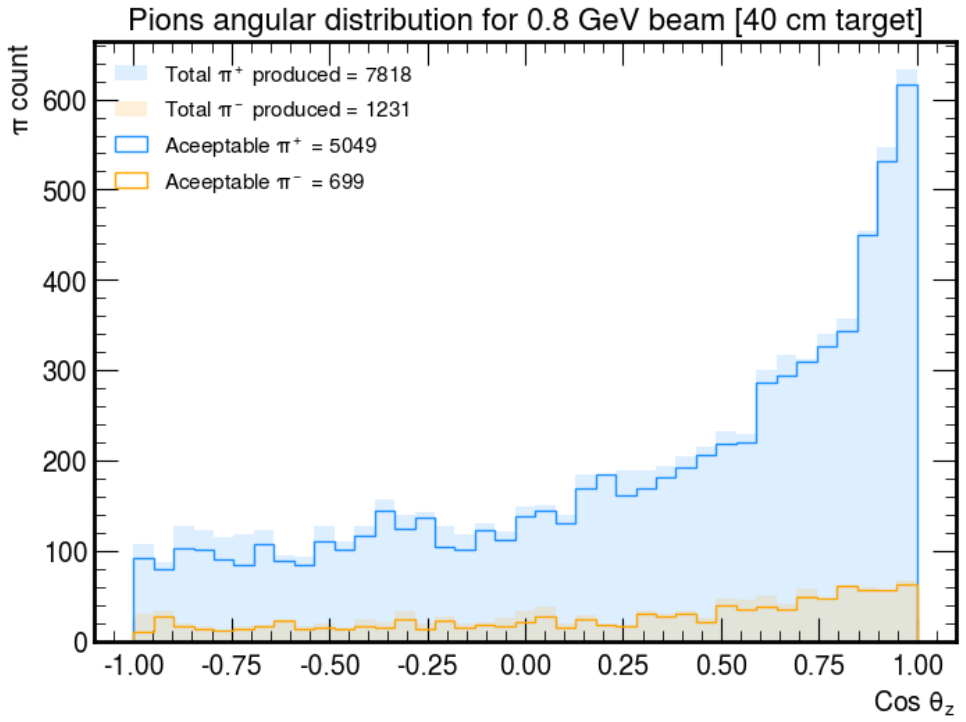
- → *Expectation:* See the production leveling off after one interaction length.
- → While this is true for the low energy proton beam, it isn't the case with the high energy proton beam.
- → In the case of high energy proton beam, the pions are mostly created with more momentum in the forward direction, therefore they end up interacting with carbon nuclei resulting in the production of even more pions. That's why we see that the pion production starts to level out closer to ~80cm
- → In the case of low energy proton beam, most pions are produced with low energies so they can't create more pions.

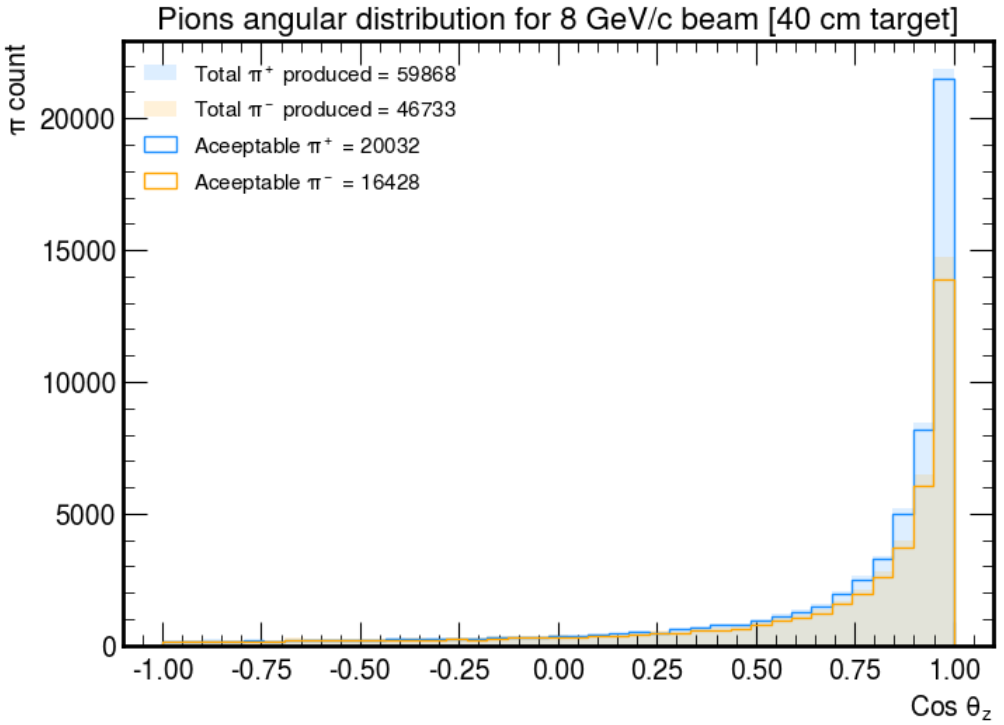




π yields for different target lengths
→ Angular distributions

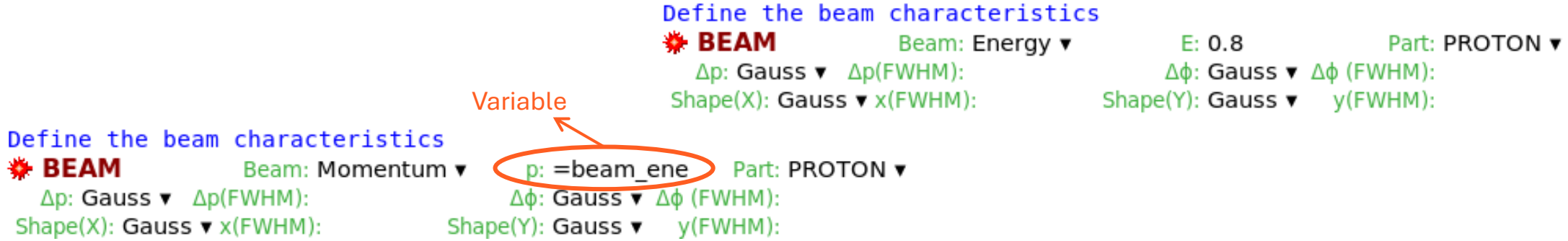
→ The following shows the angular distribution of pions for a 40cm target that is hit by two different proton beams





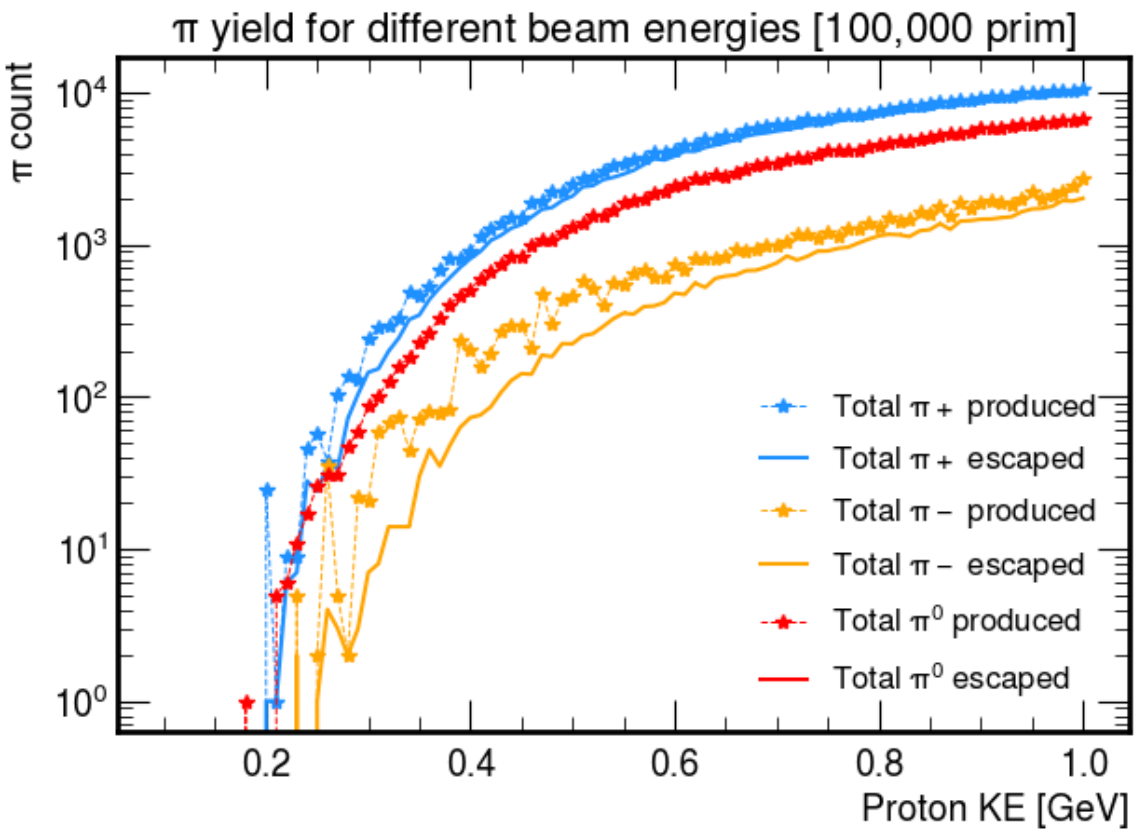
π yields for different beam energies

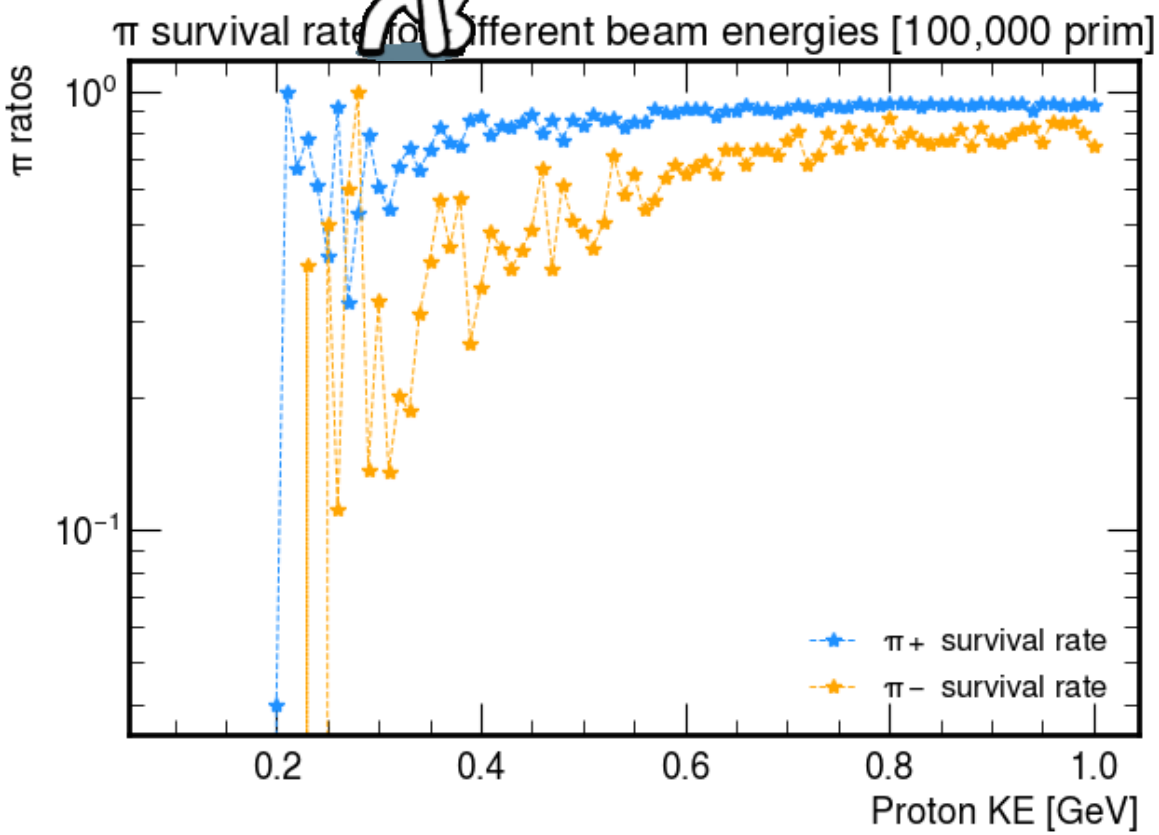
→ I ran simulations for proton beams with different energies hitting a graphite target.
→ The beam energies range from 0.1 GeV – 1 GeV with 0.01 GeV step from one simulation to the other.
→ *The problem with the previous round of simulations:*
  → Fluka re-interpreted my "beam energy" inputs as momenta (for some reason) even though I chose to define energy in my beam card.
→ *Solution:*
  → I realized that fluka doesn't accept to take a variable for energy input in the beam card. Therefore, I calculated proton momenta from given energy values and inserted that as an argument in the beam card.
→ To demonstrate:



π yields for different beam energies

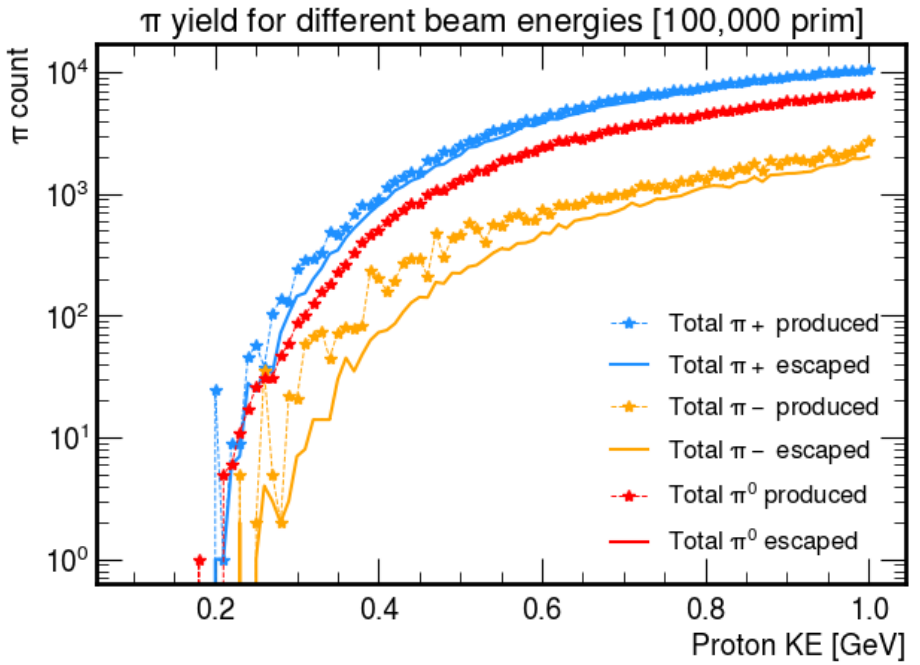
→ This time, pion production starts at ~0.2 GeV proton beam energy

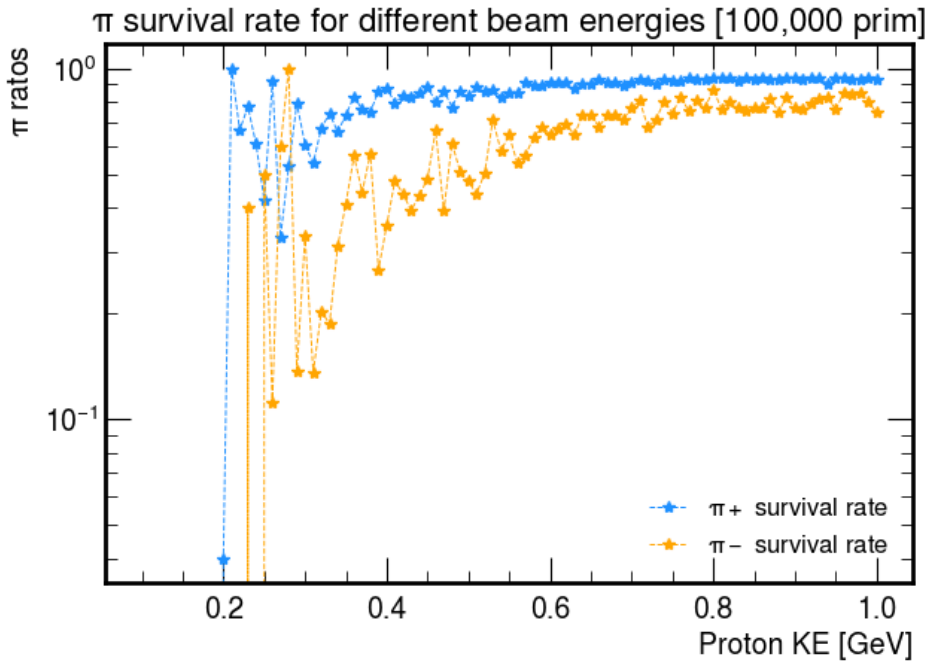




π yields for different beam energies

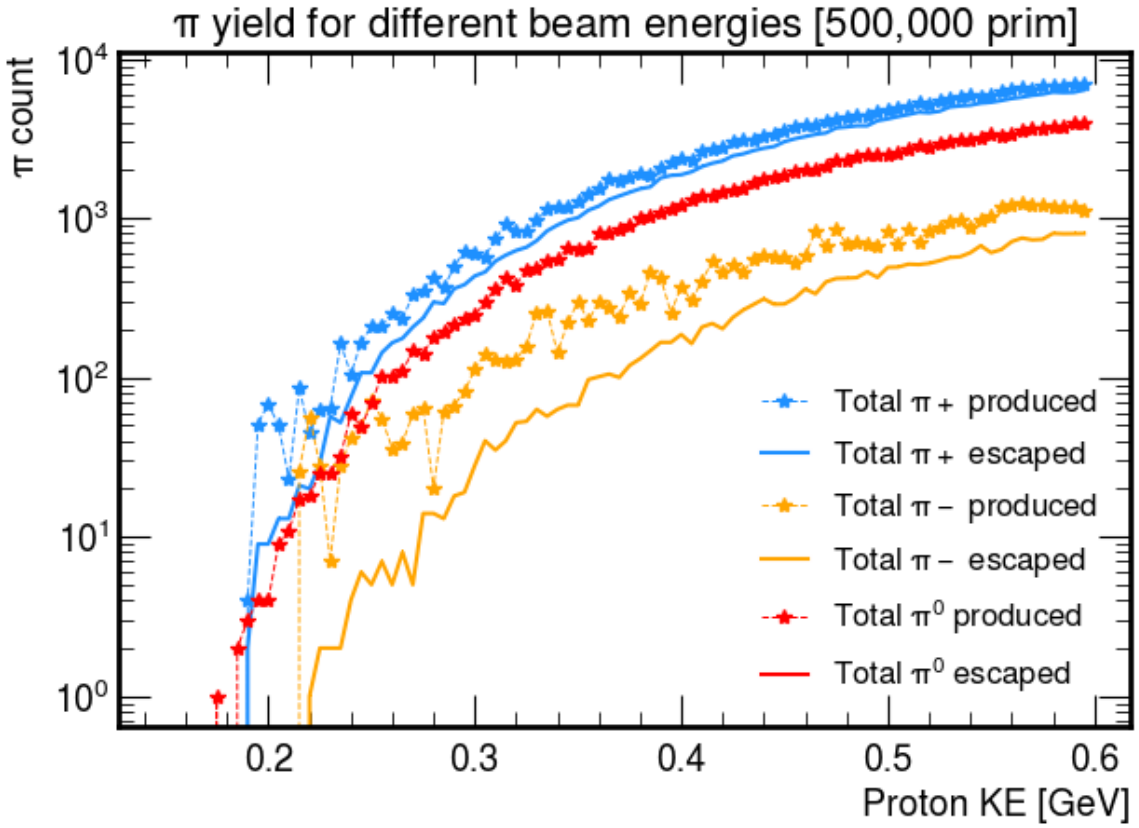
→ This time, pion production starts at ~0.2 GeV proton beam energy
→ We still don't see the delta resonance at lower energies
  → Delta resonance shows up in single pion processes
  → Shorten the target → 5 cm
  → Focus on lower energy range: 0.15-0.6 GeV
  → Increase source beam to 500,000

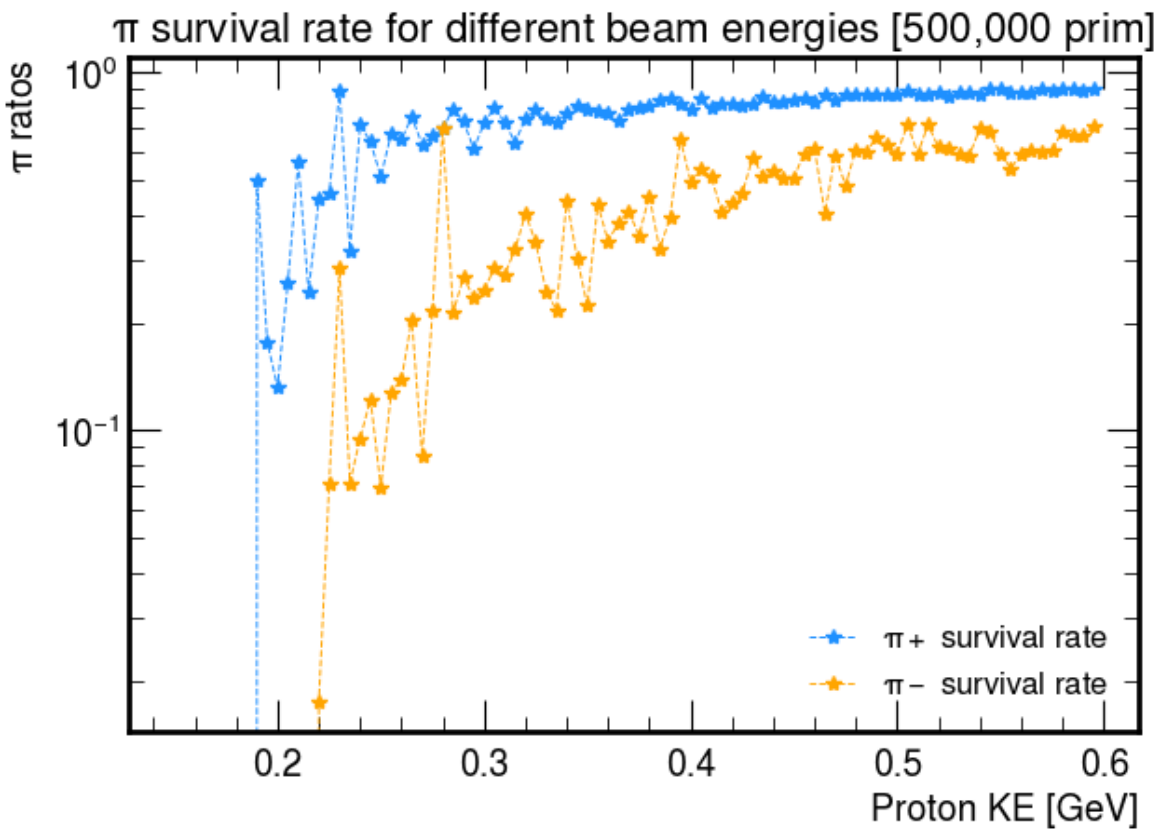




π yields for different beam energies

→ Still… no delta-resonance… but why? Should I use a shorter target?





Conference proceeding update

→ I am done with the introduction, simulation setup and selection criteria sections.

→ I am planning to finish the analysis section today.

→ Hopefully finish the rest of the paper tomorrow.

→ I want to submit my paper tomorrow, is it okay if I share my progress later today to get feedback?

→ My paper is short ~3 pages