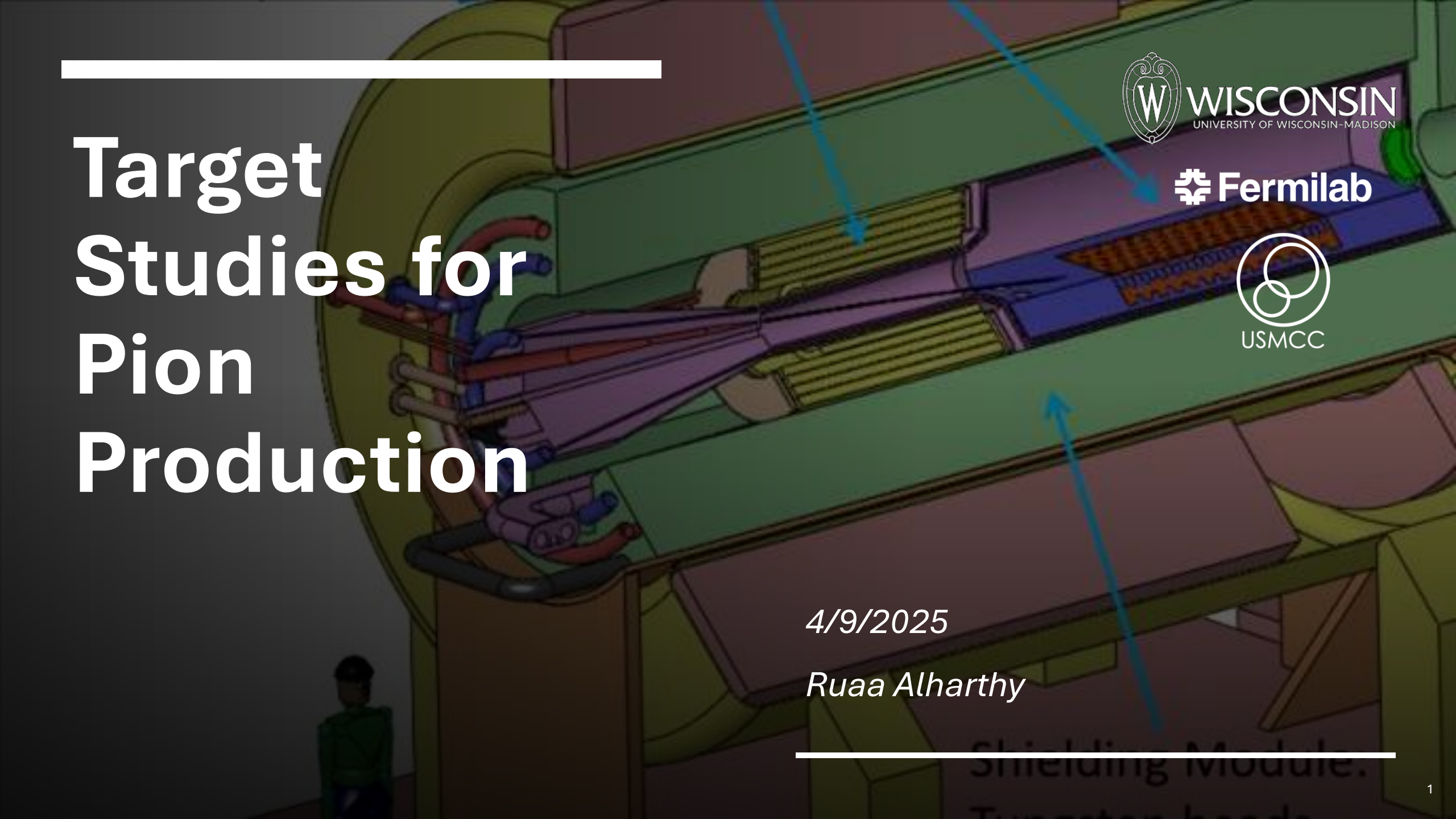
Target Studies for Pion Production



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USMCC

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Simulation setup

→Material = *Graphite*

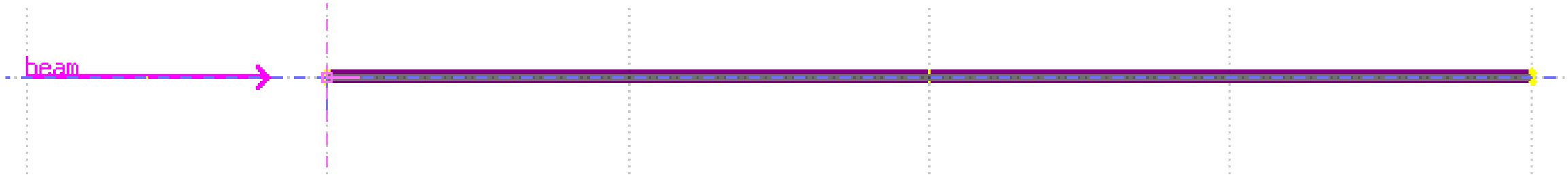
→Length = *Varying length*

→Radius = 0.15 cm

→No magnetic field

→100,000 primaries

→Various energy proton beams



New routine to extract data from simulation

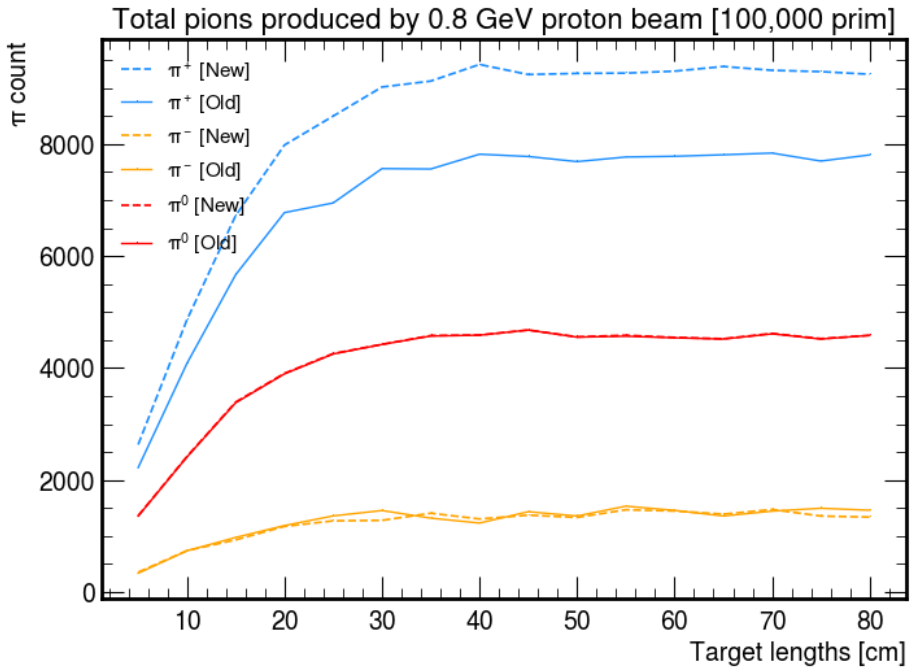
→ My old routine worked well with pions and muons.
→ However, I wanted to work on obtaining the delta resonance from the secondary pions and protons produced from proton-nucleon interactions.
→ Recording protons is tricky with the old routine, because the code included assumptions about the particles to be recorded wich do not fit protons.
→ Therefore, I found a way to completely eliminate assumptions from the routine, which made recording protons much more manageable.
→ However, the new routine counts particles differently from the previous one.
→ I will demonstrate this in the following slide.

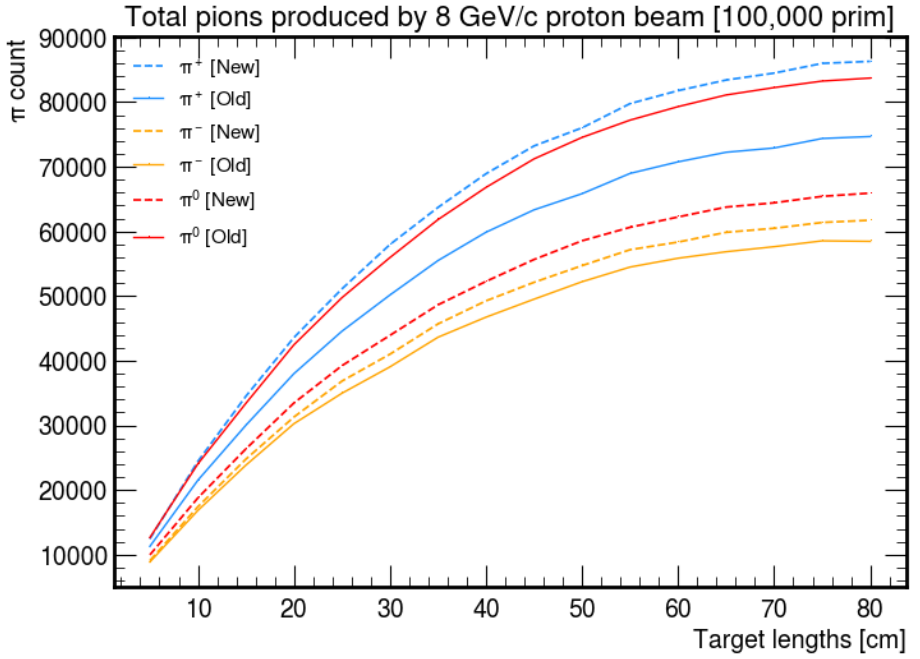
New routine to extract data from simulation

→ Dashed line – New routine
→ Solid line – Old routine

→ For 0.8 GeV beam:
  → π^+ and π^0 production rates seem to be similar between the two routines
  → But there are far more π^+ produced by the new routine

→ For 8 GeV/c beam:
  → We see larger discrepancy in π^0 and π^+ production rates than π^-
  → There were more





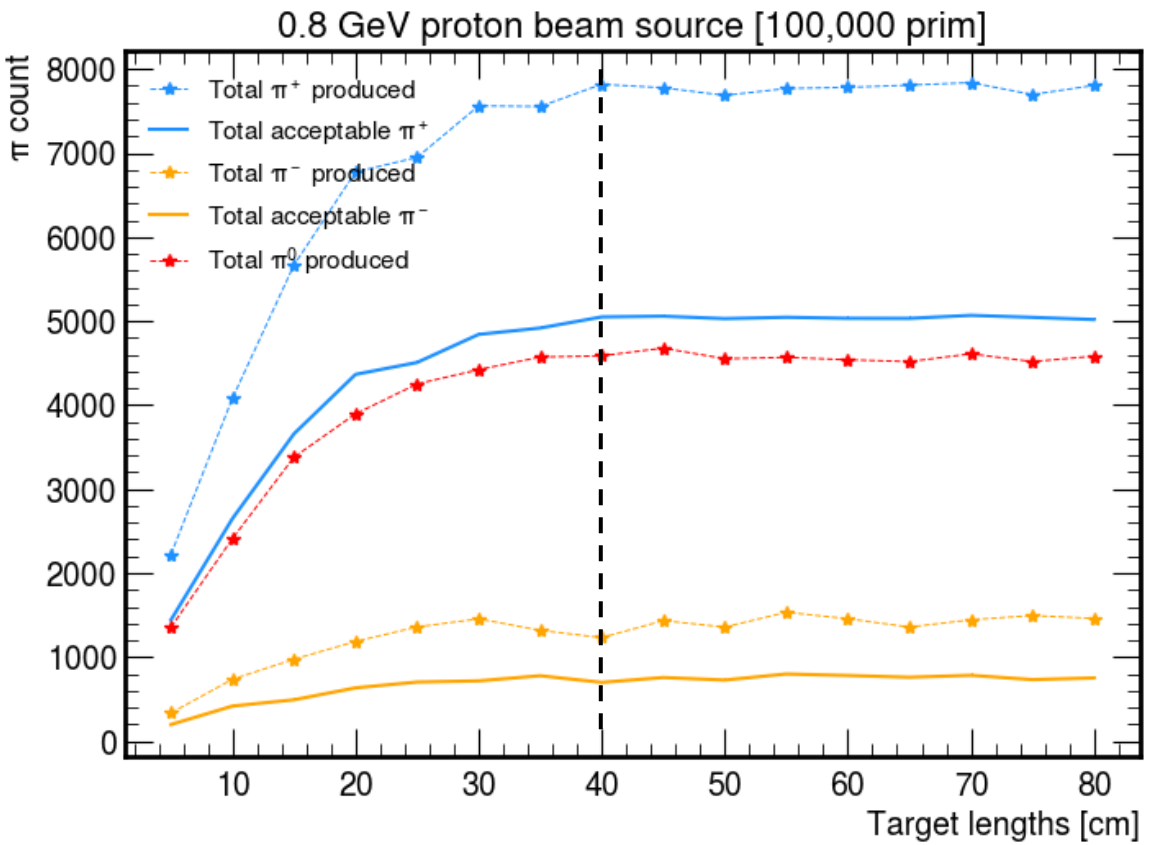
π yields for different target lengths

→ I ran simulations for 0.8 GeV and 8 GeV/c proton beams hitting a target at different lengths.
→ The graphite target lengths range from 5cm – 80cm with 5cm step from one simulation to the other.
→ The tungsten target lengths range from 2cm – 20cm with 2cm step from one simulation to the other.

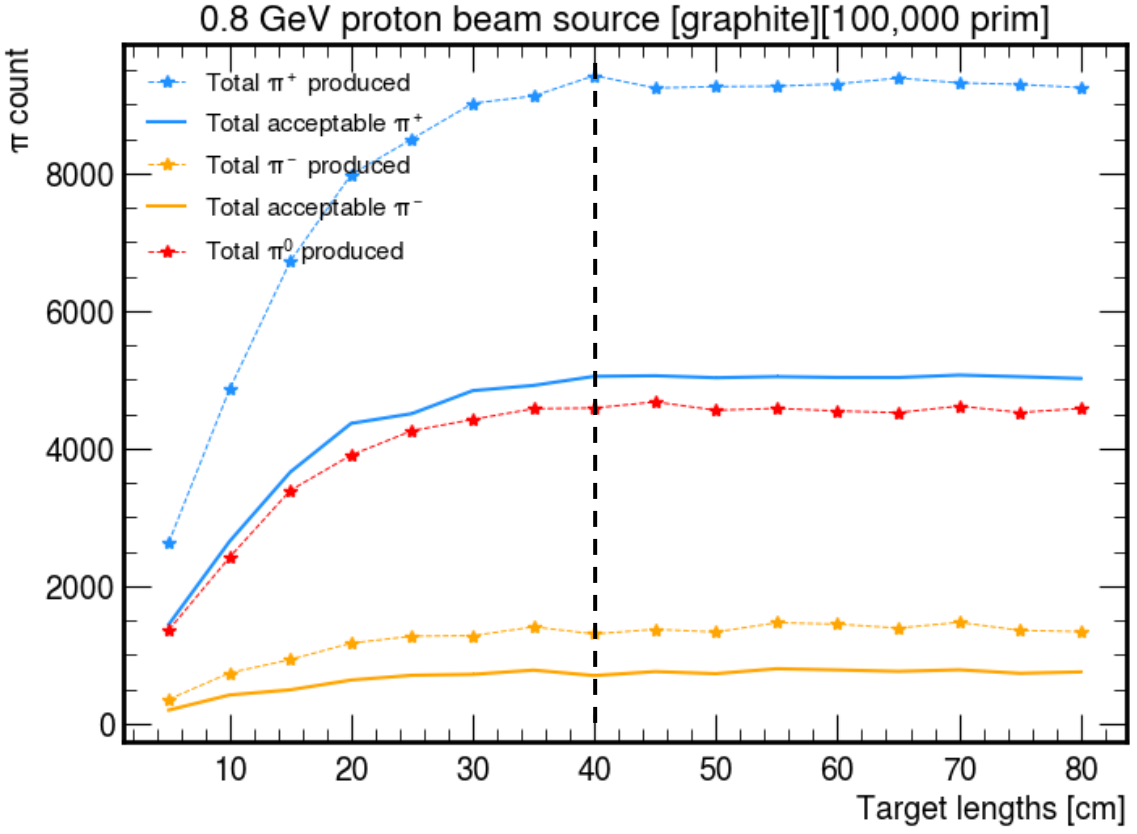
→ For the plots in this section, I am including details about "total pions produced" in the target and "acceptable pions", which are the pions that have passed a selection criteria that is defined as:
  → Pion kinetic energy < 400 MeV
  → Forward moving pions $\cos\theta_z > 0$
  → Pions that have escaped 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 (0.8 GeV)

(old)

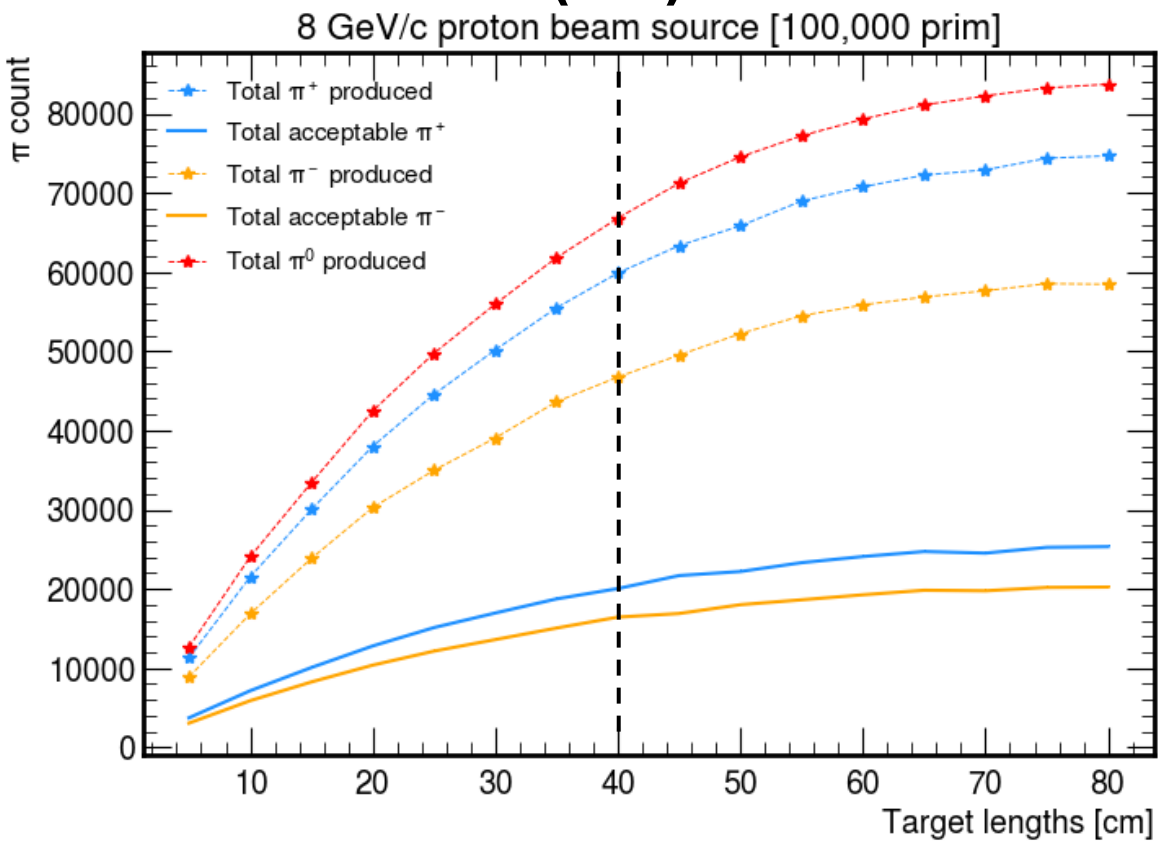


(new)

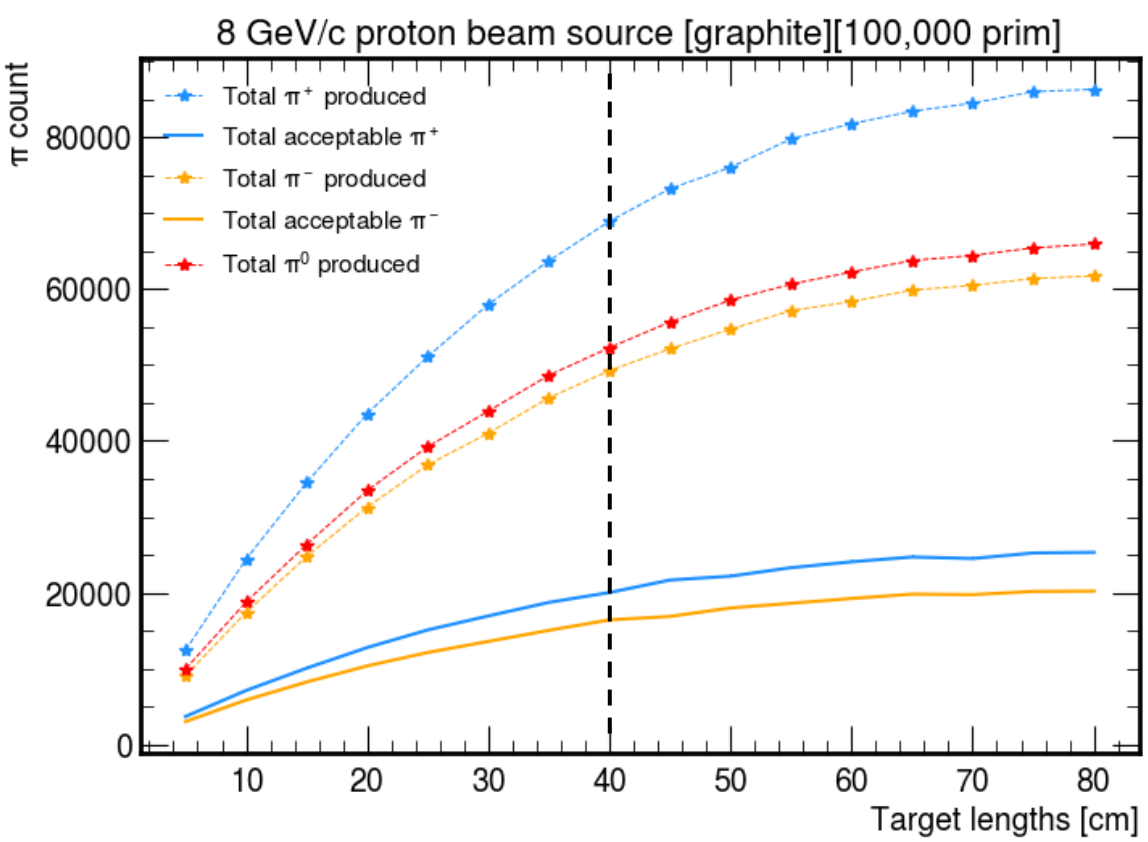


π yields for different target lengths (8 GeV/c)

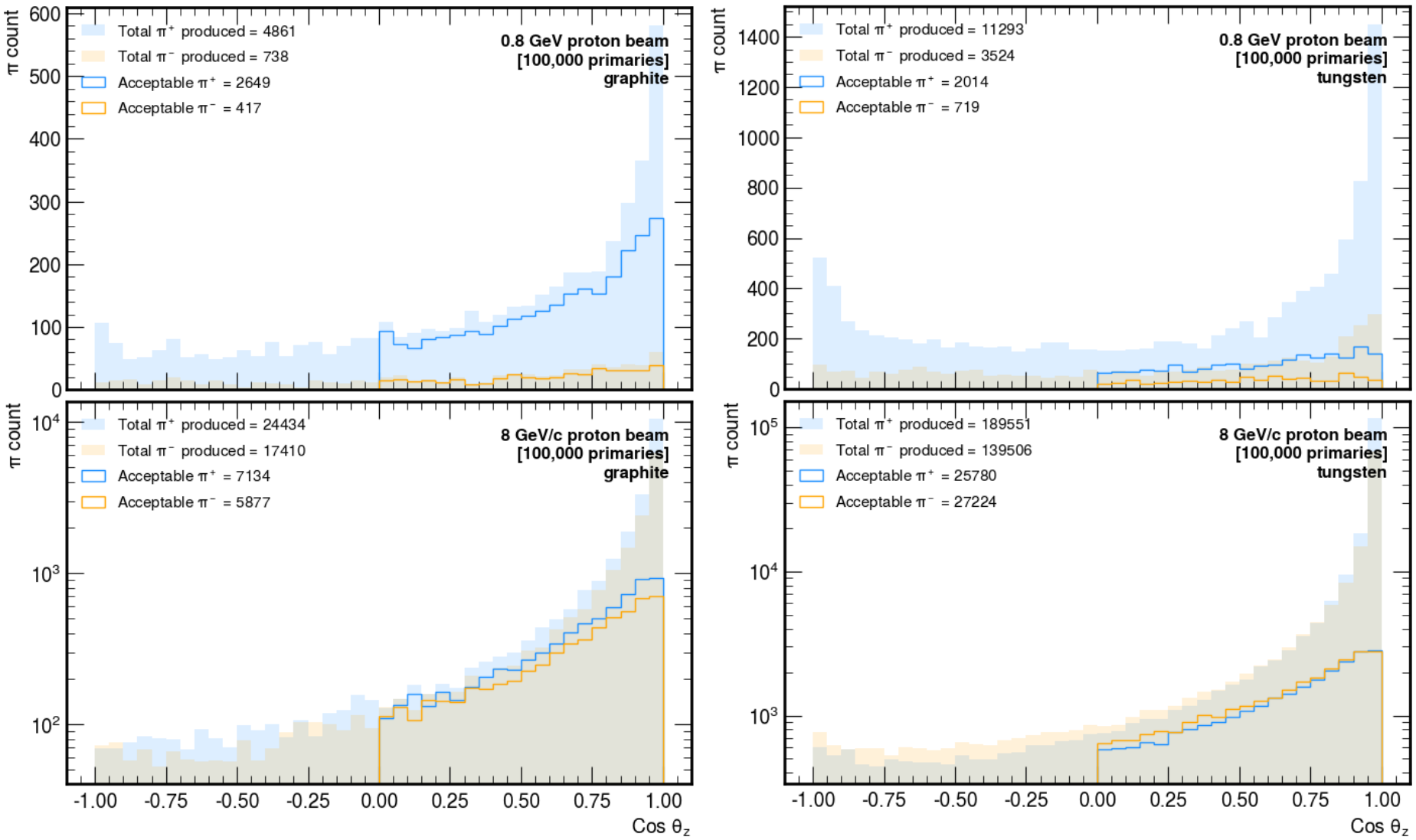
(old)



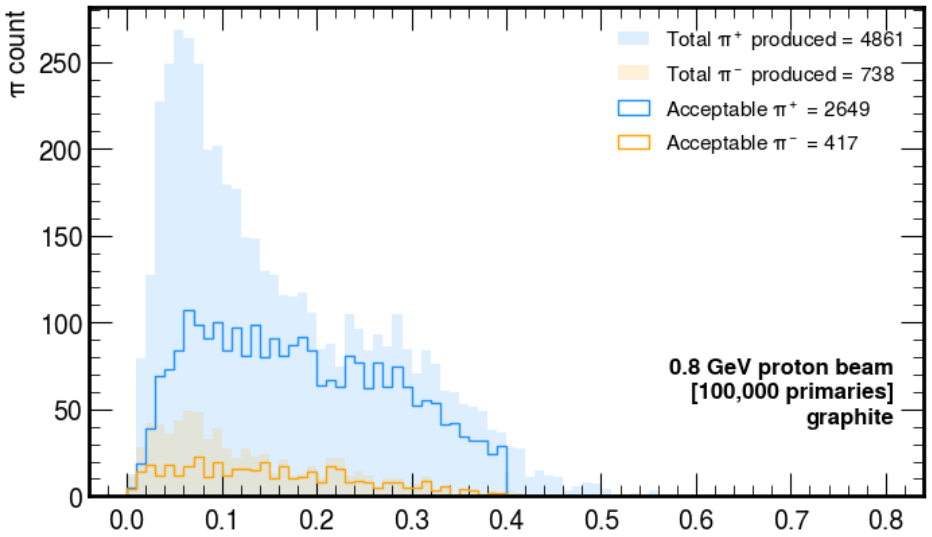
(new)

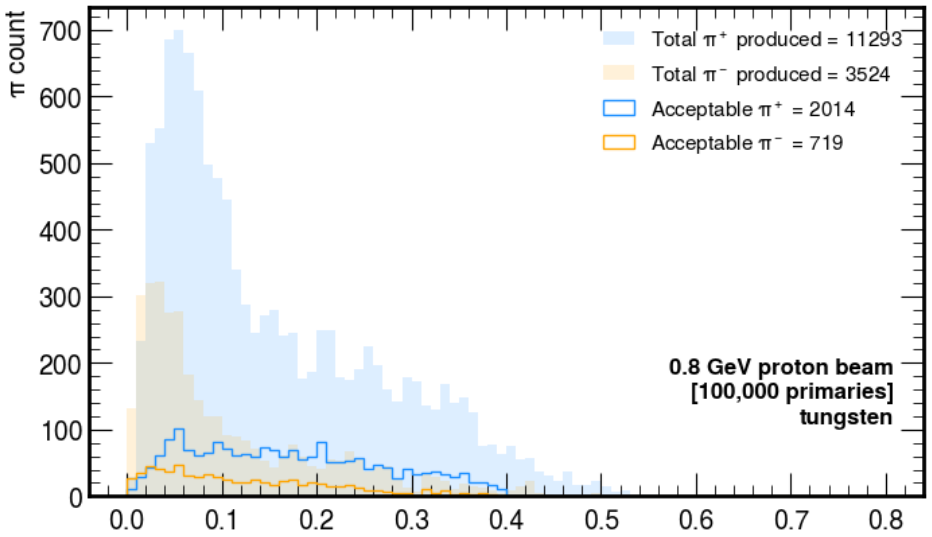


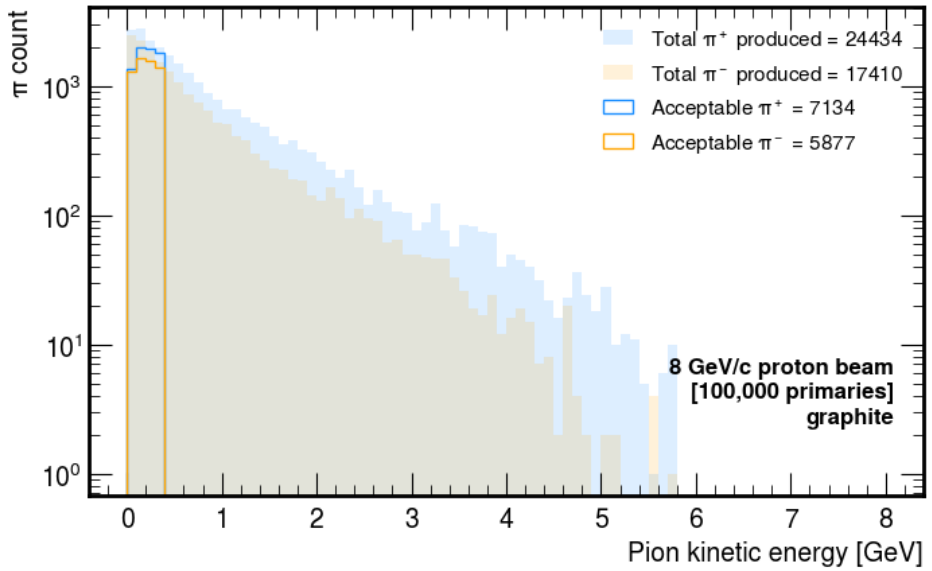
→ Angular distributions

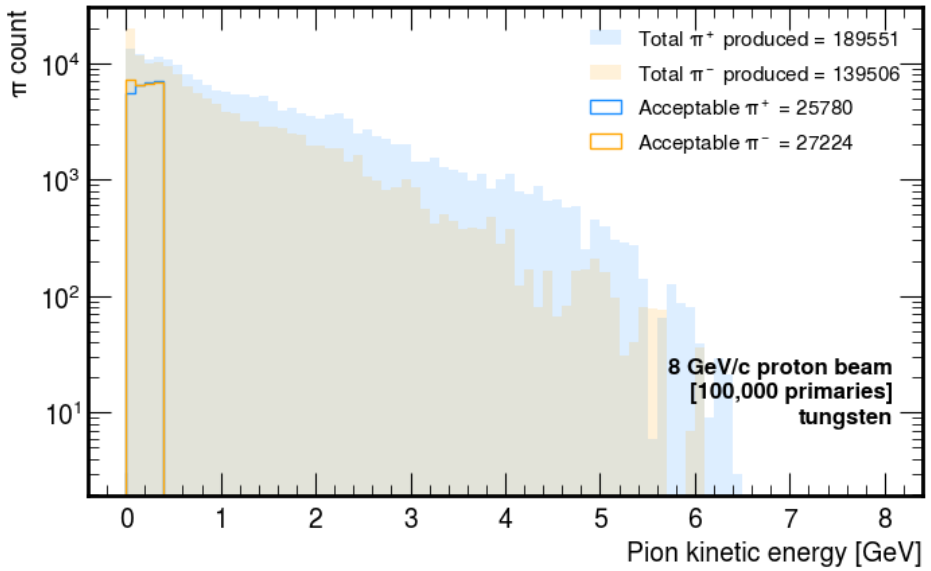


→ Energy distributions

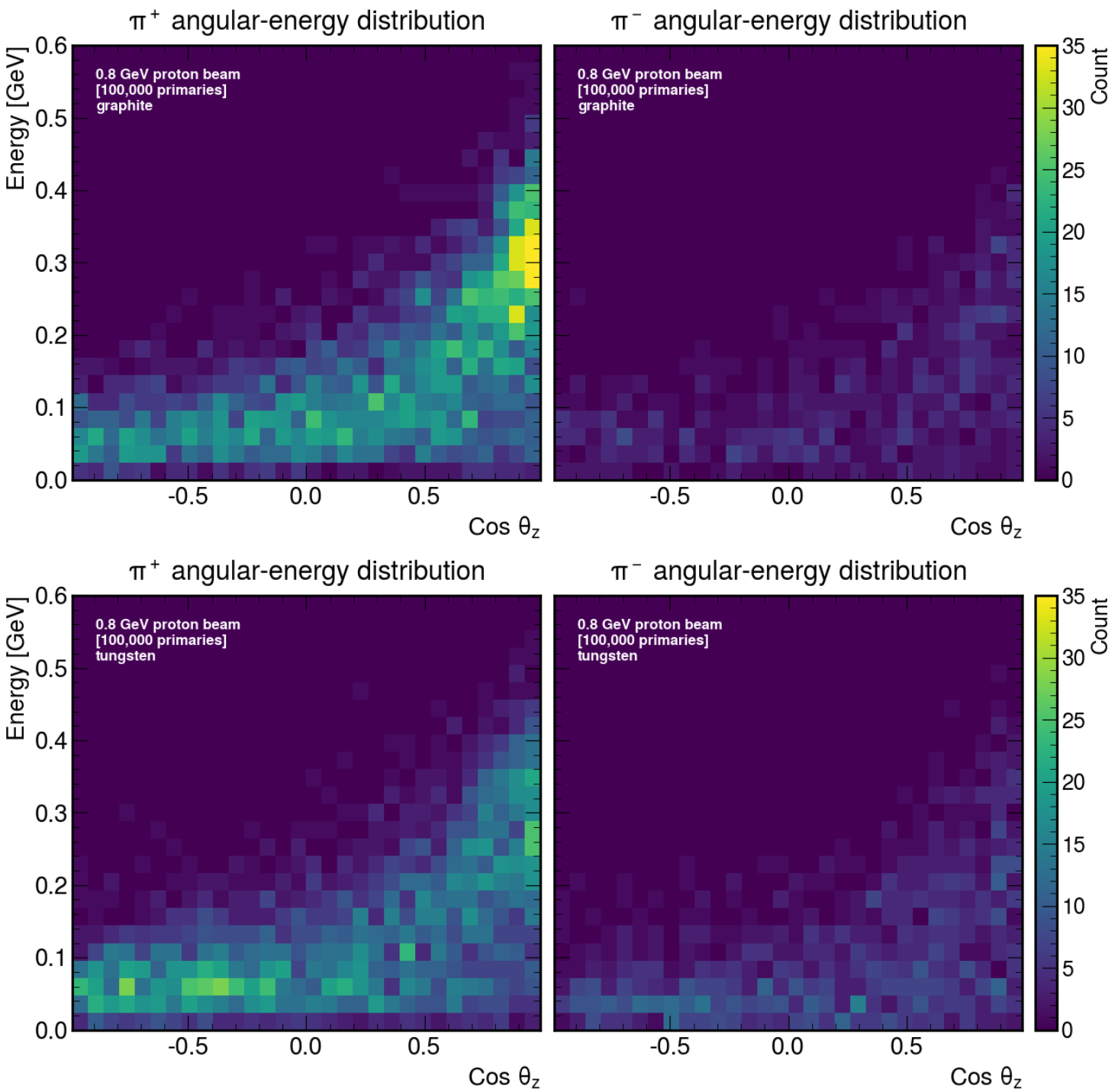




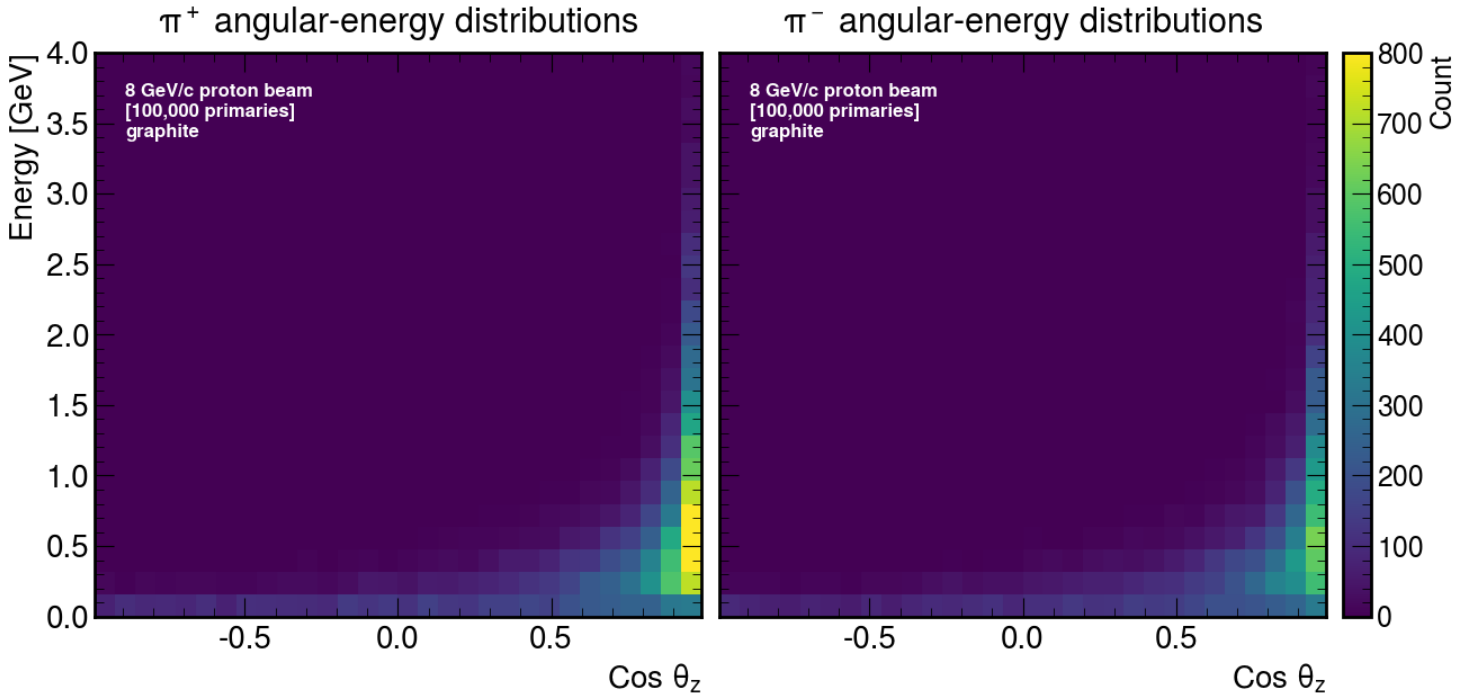


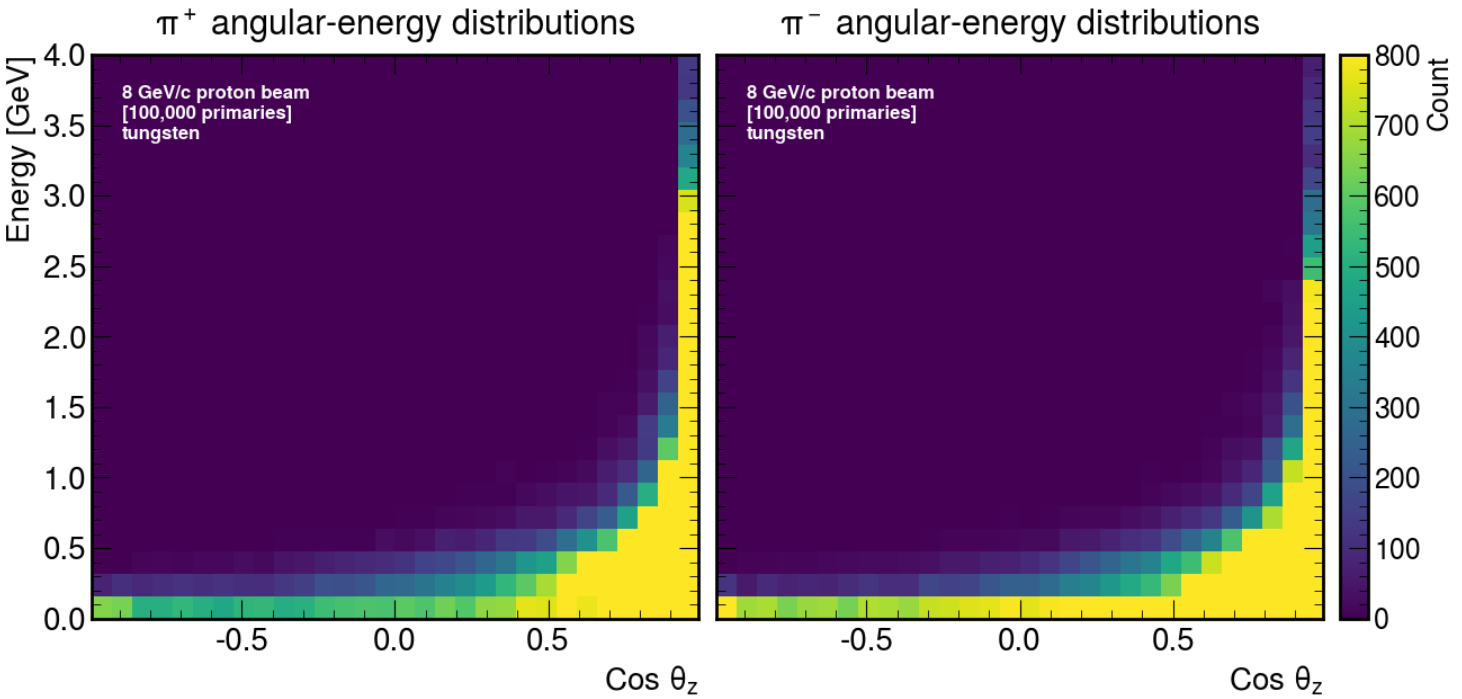


→ Angular-energy distributions for 0.8 GeV beam

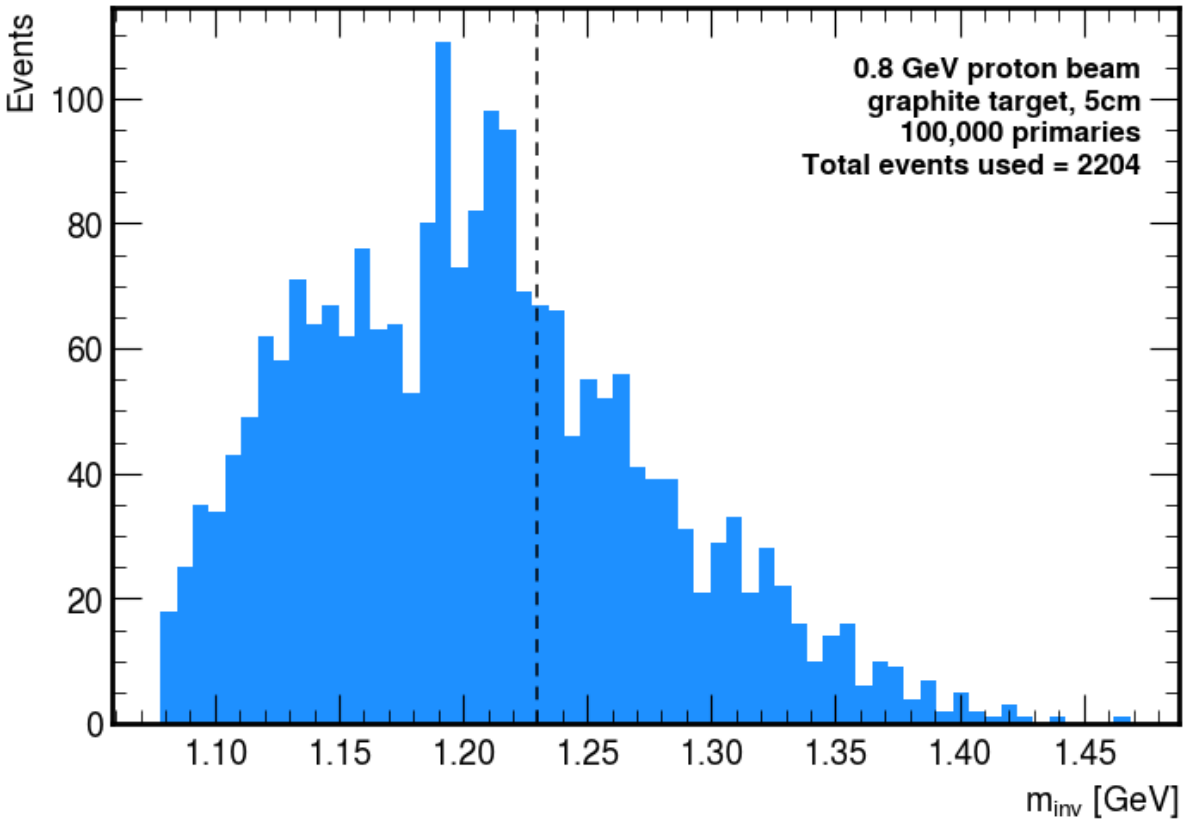


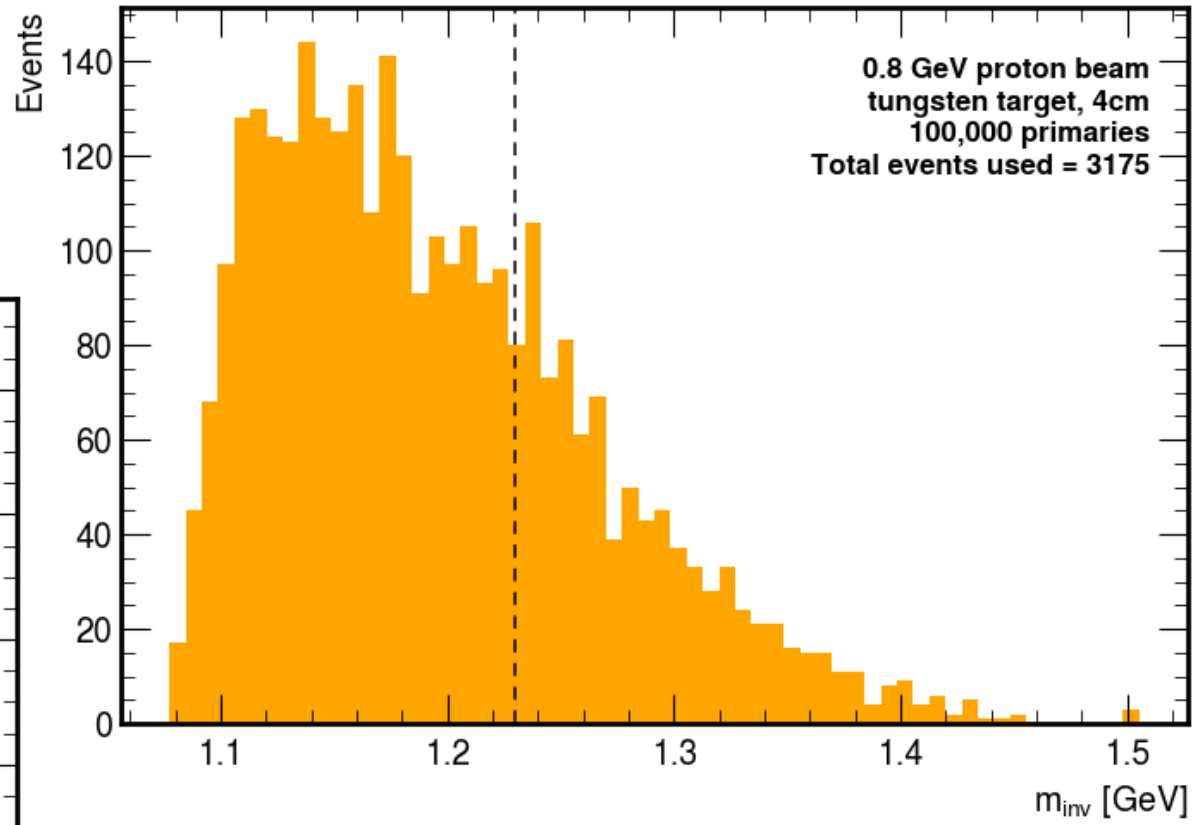
→ Angular-energy distributions for 8 GeV/c beam





Delta resonance
→ 0.8 GeV beam





Delta resonance
→ 8 GeV/c beam