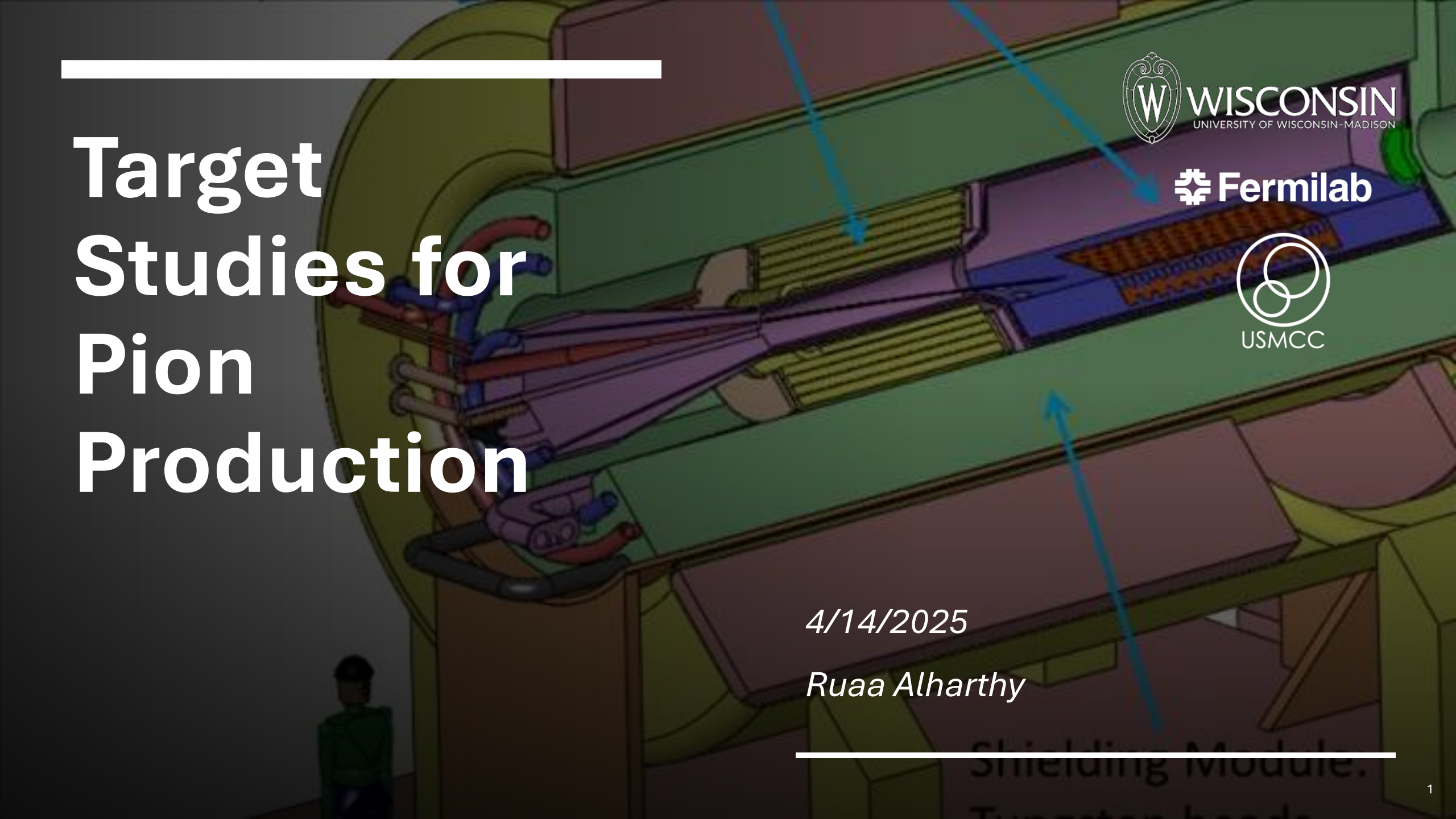
# Target Studies for Pion Production

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Fermilab

USMCC

*4/14/2025*

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# Simulation setup

→Material = *Graphite / Tungsten*

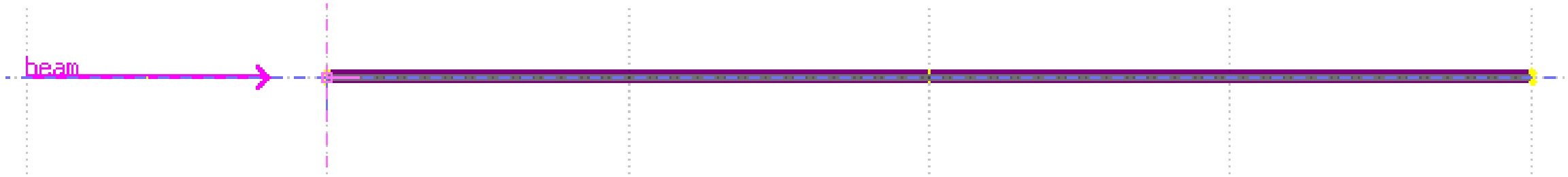
→Length = *Varying length*

→Radius = 0.15 cm

→No magnetic field

→100,000 primaries

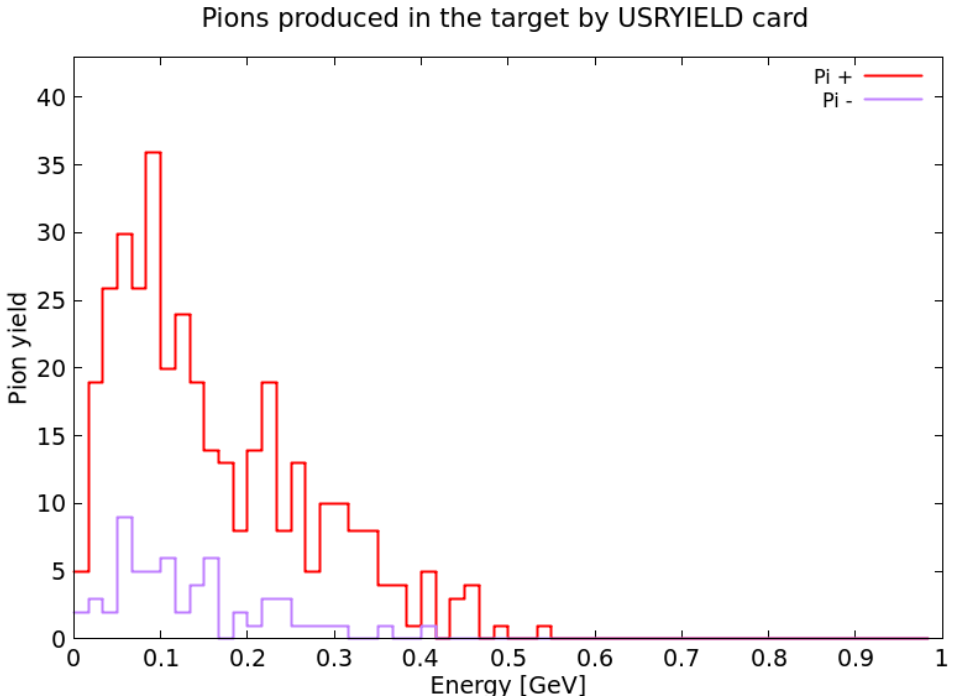
→0.8 GeV and 8 GeV/c proton beams



# New routine to extract data from simulation

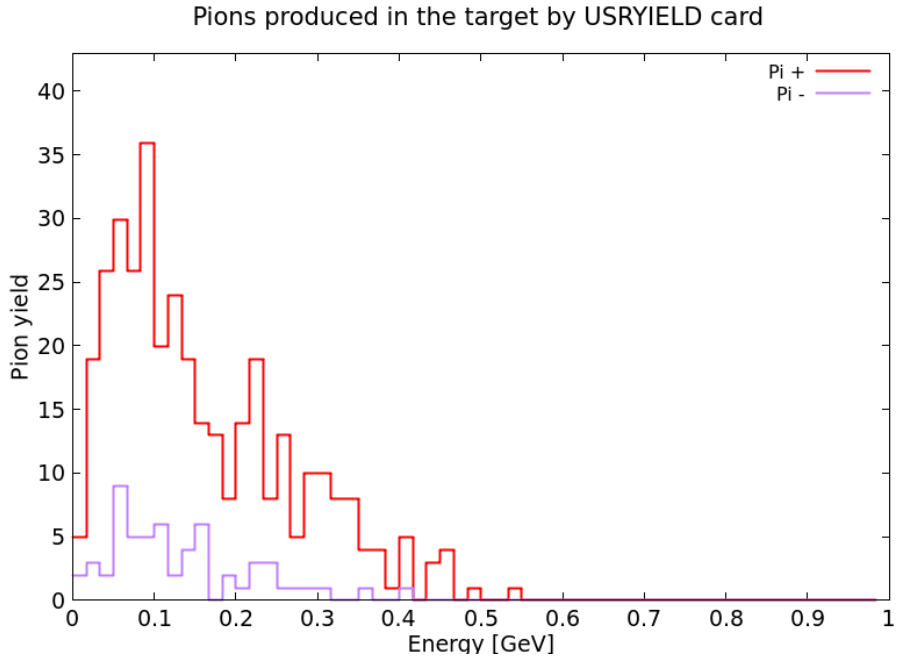
→ Last week, I shared how the newest version of my custom routine performed in extracting particle data in comparison to my older version.
→ With Michael's help, I discovered that the USRYIELD card in flair does the job.
→ *So basically, my 8-month worth of work didn't amount to much…*

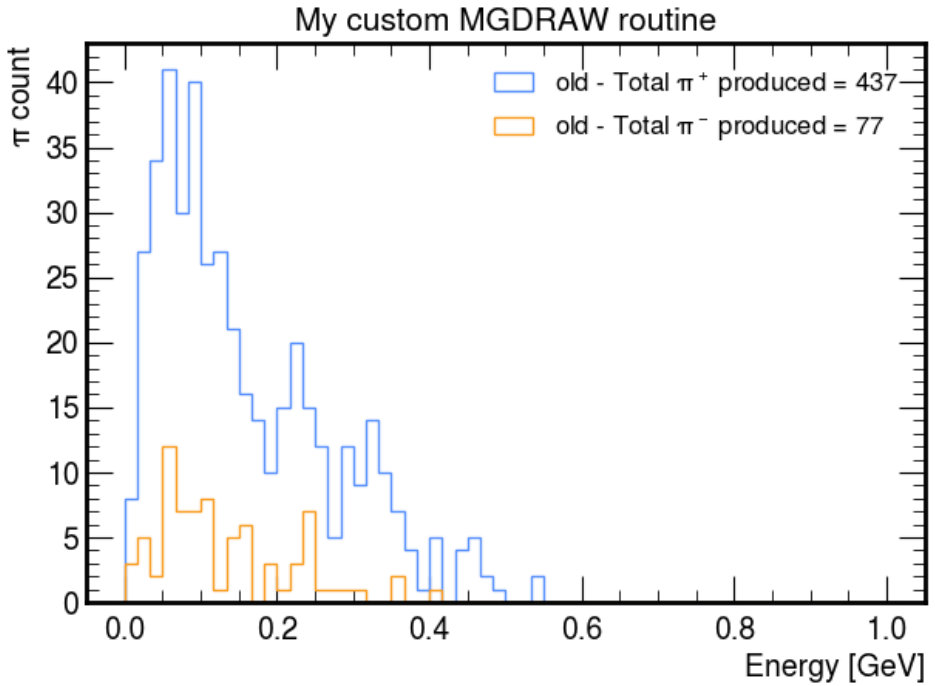
→ I set-up the ***useryield*** card, the ***fluscw*** routine and the ***mgdraw*** routine (which contains my custom code) to run everything in the same simulation.
→ I produced the following plot of pions produced in the target using *flair*.
→ Now, I compare flair results with ***fluscw*** and ***mgdraw***
→ I produced ***mgdraw*** and ***fluscw*** results in python

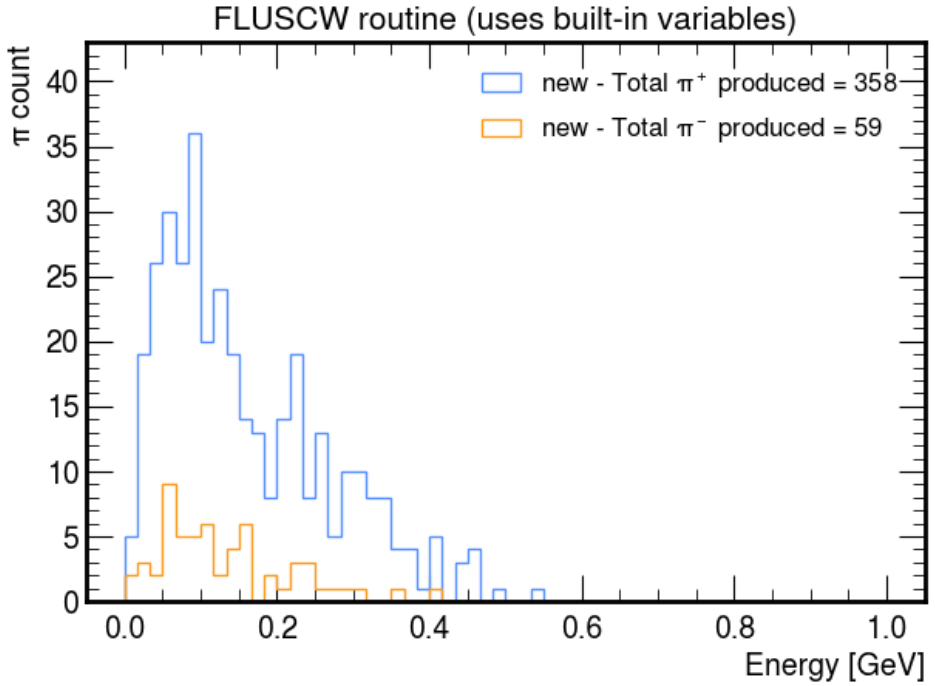


# New routine to extract data from simulation

→ It seems that ***fluscw's*** result is identical to that of the ***usryield*** card… which makes sense since ***fluscw*** literally uses the card to record data

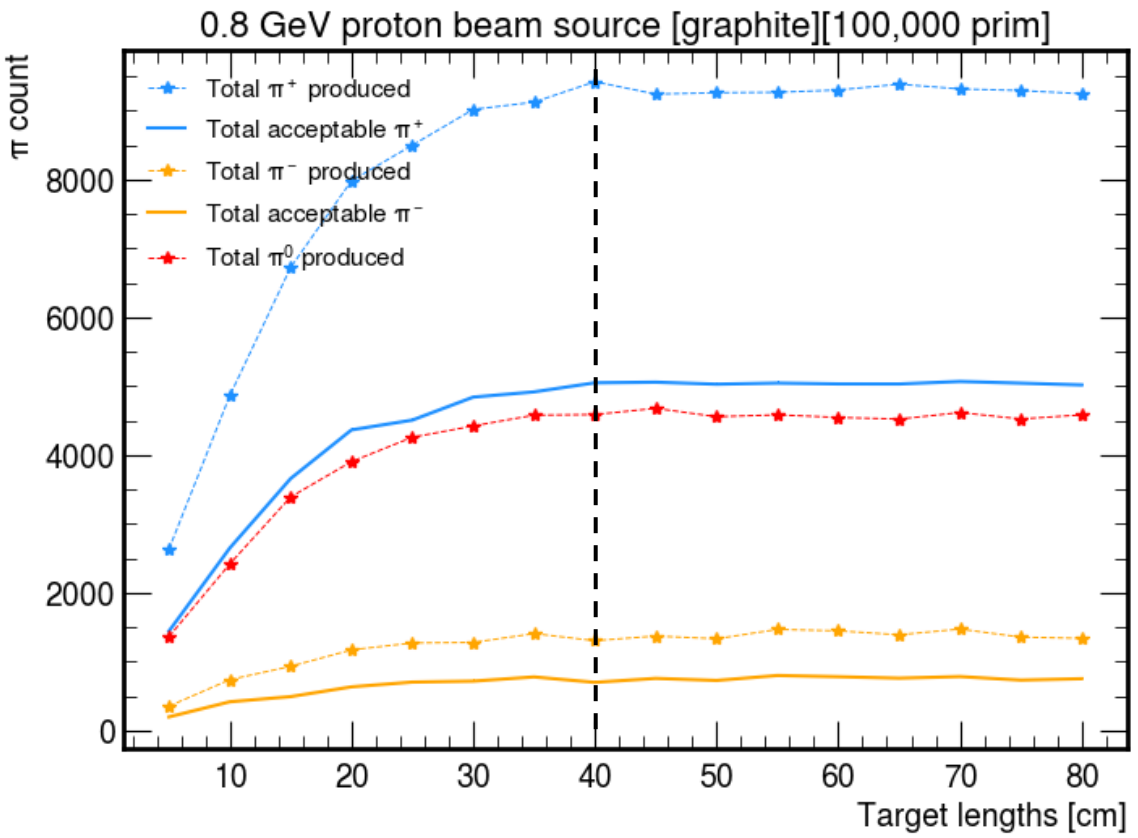


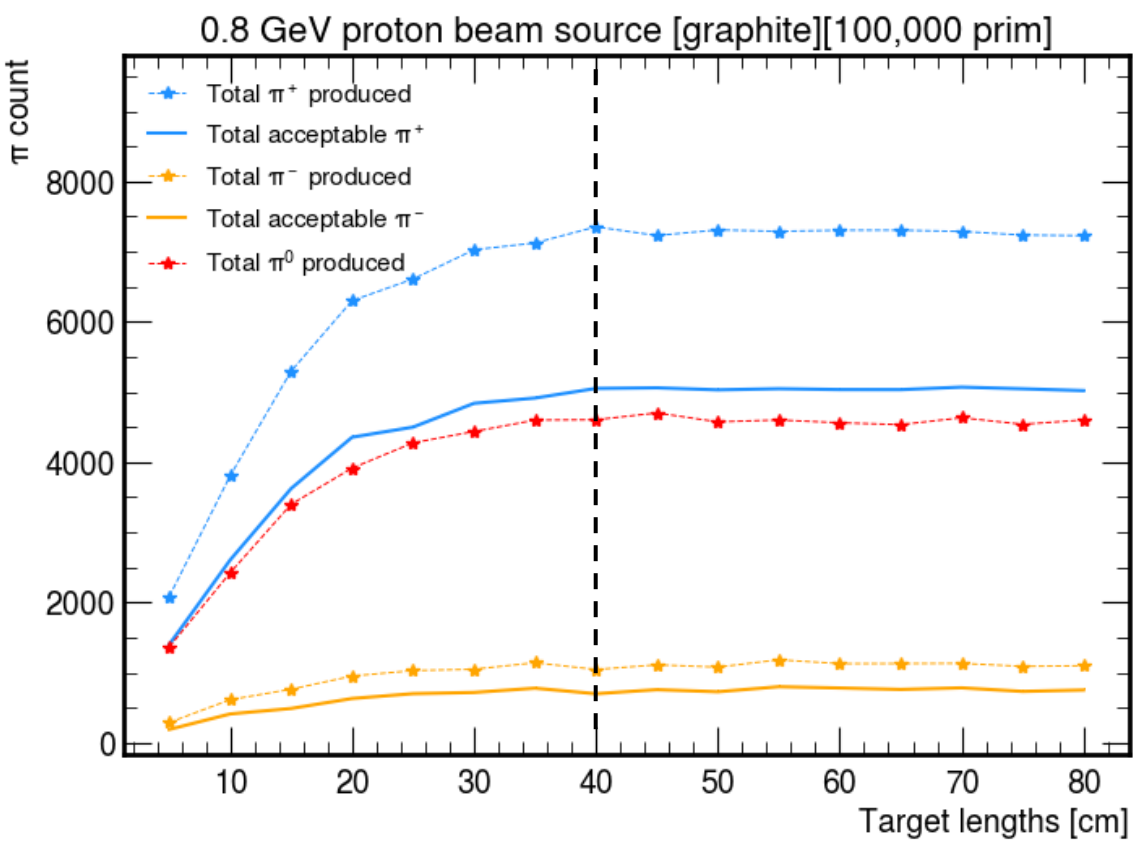



# π yields for different target lengths (0.8 GeV)

**(mgdraw)**

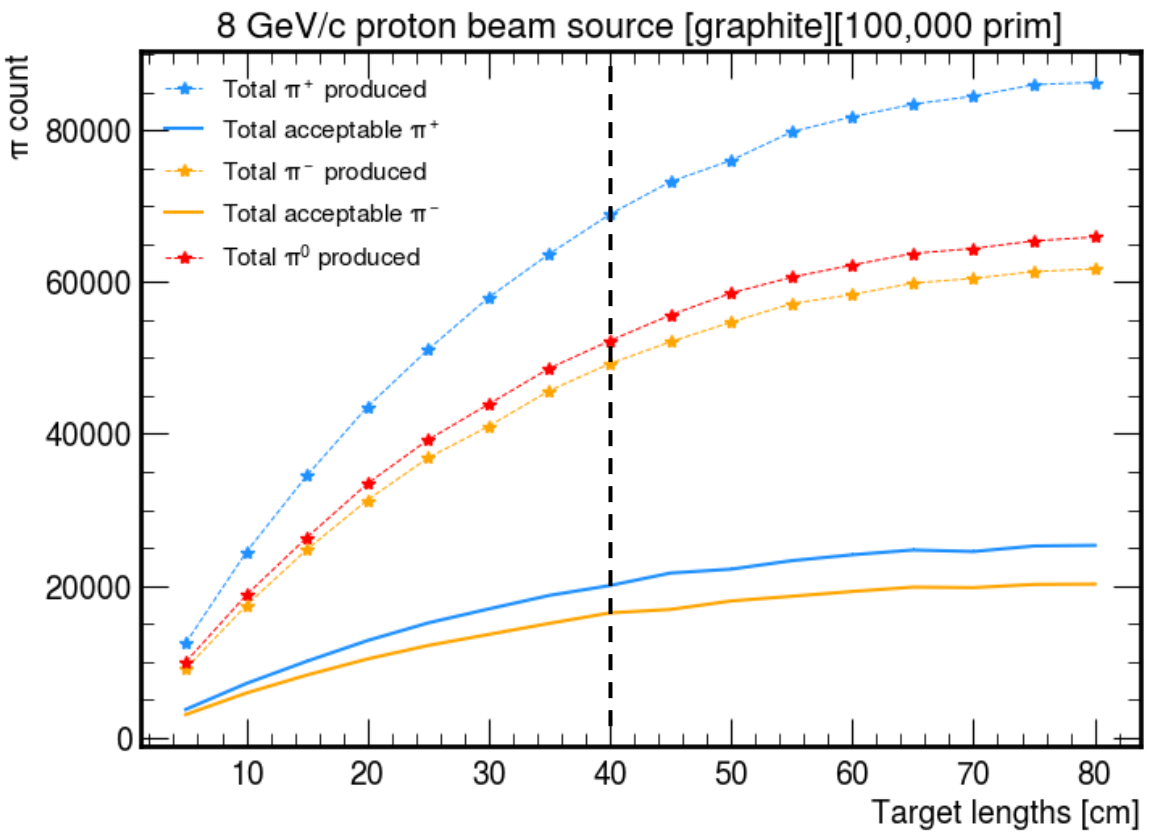



**(fluscw)**

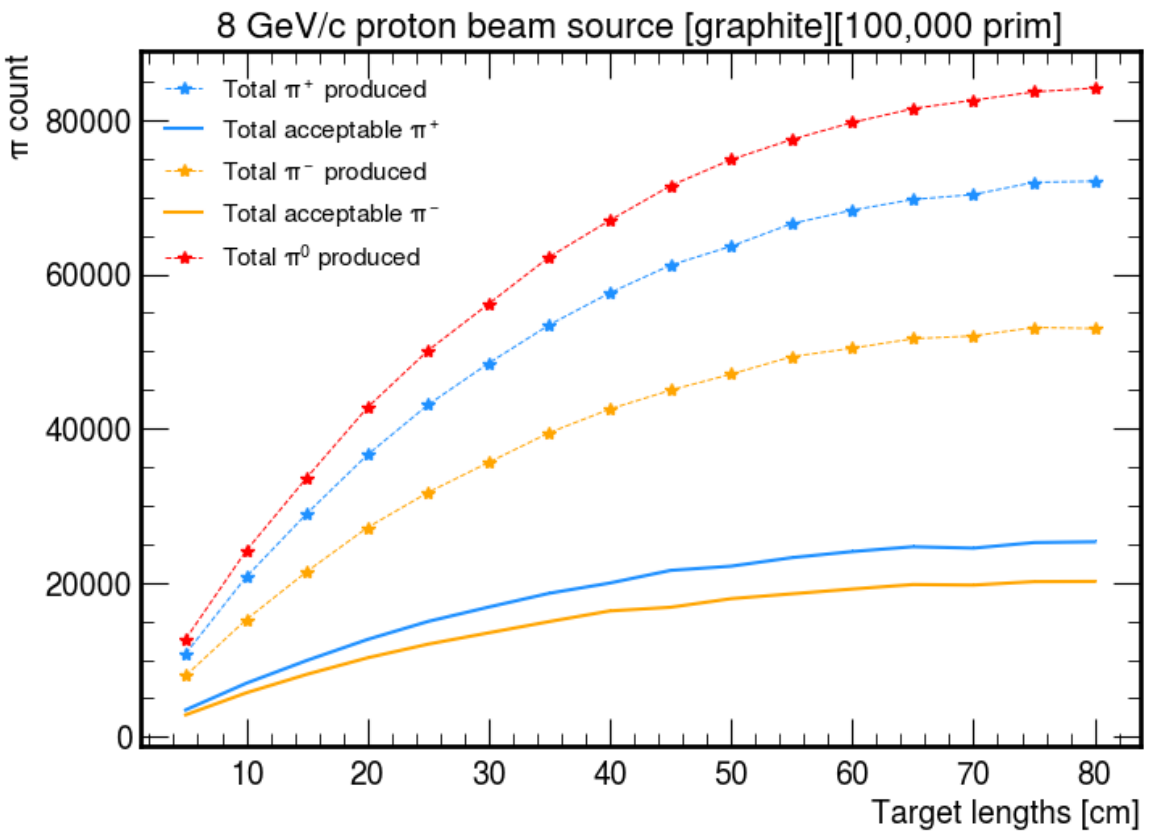


# π yields for different target lengths (8 GeV/c)

**(mgdraw)**




**(Fluscw)**



# Delta resonance

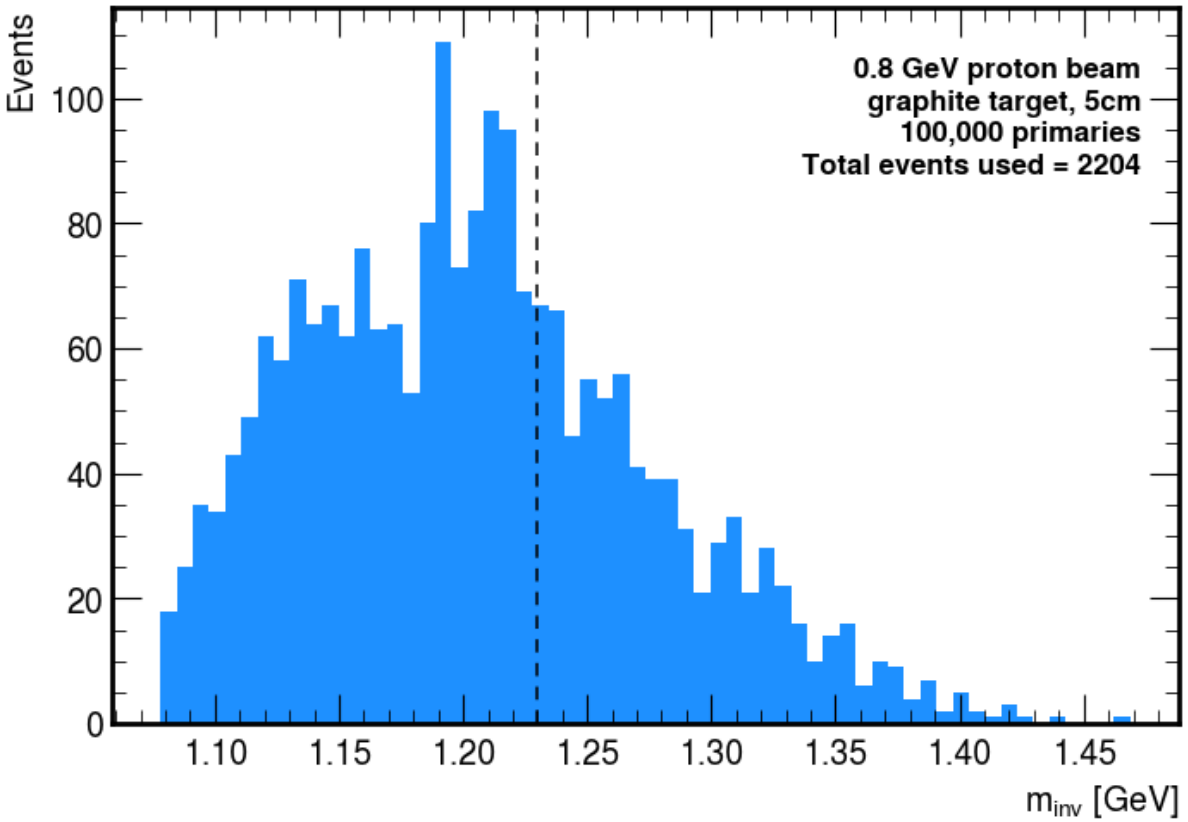
→ Delta++ Baryon: $\Delta^{++} = uuu$

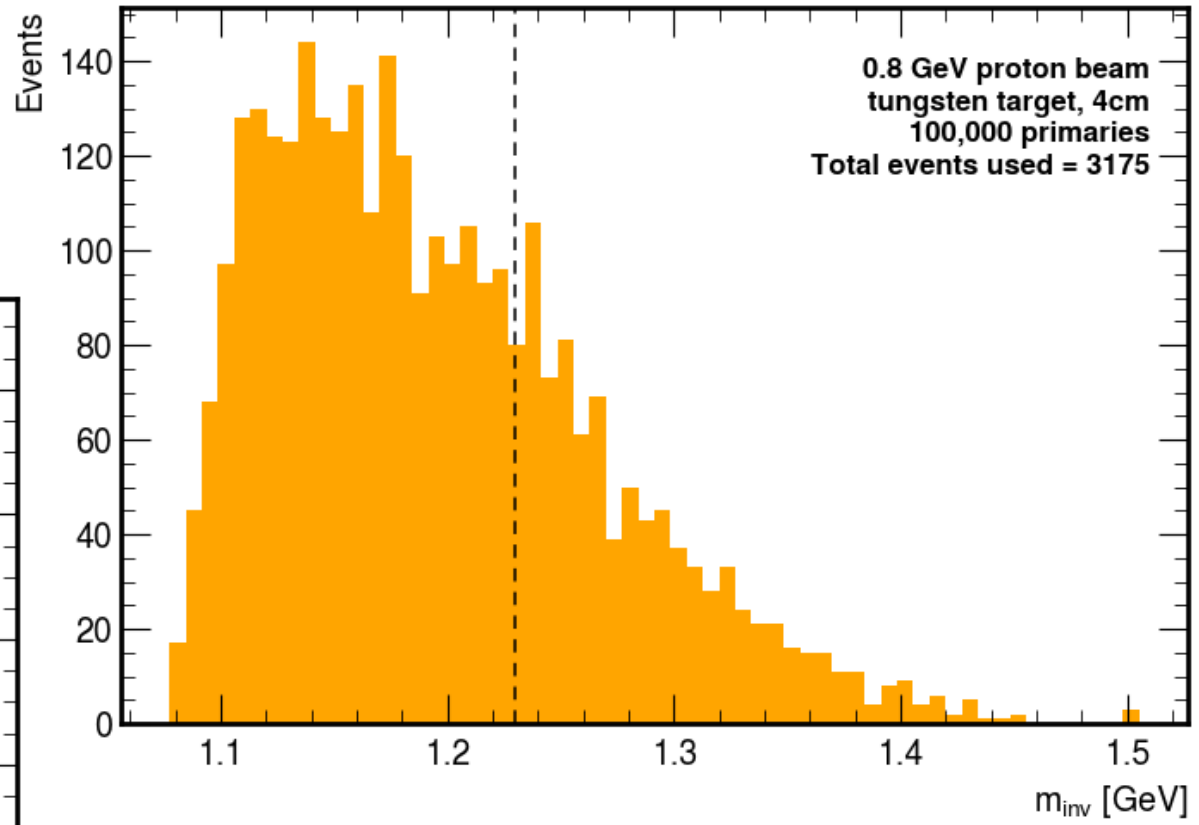
→ Delta++ baryon production: $p + p \rightarrow \Delta^{++} + X \rightarrow p + \pi^{+} + X$

→ What to detect from the simulation: $\Delta^{++} \rightarrow p + \pi^{+}$

→ Build the invariant mass: $m^2 = (E_p + E_\pi)^2 - |\vec{p}_p + \vec{p}_\pi|^2$

# Delta resonance
# → 0.8 GeV beam



# Delta resonance
# → 8 GeV/c beam