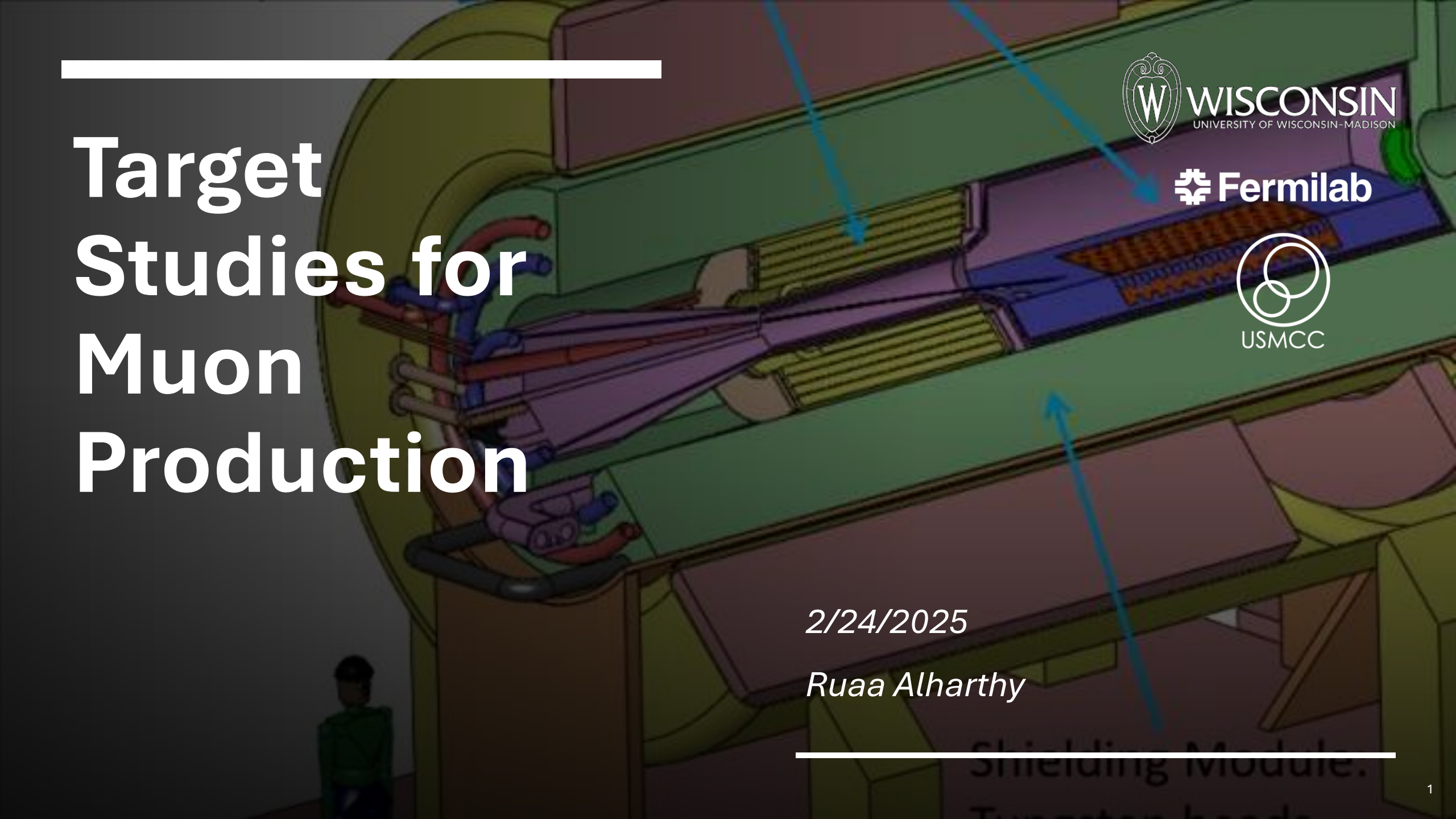
Target Studies for Muon Production



WISCONSIN
UNIVERSITY OF WISCONSIN-MADISON

Fermilab

USMCC

2/24/2025

Ruaa Alharthy

Simulation setup

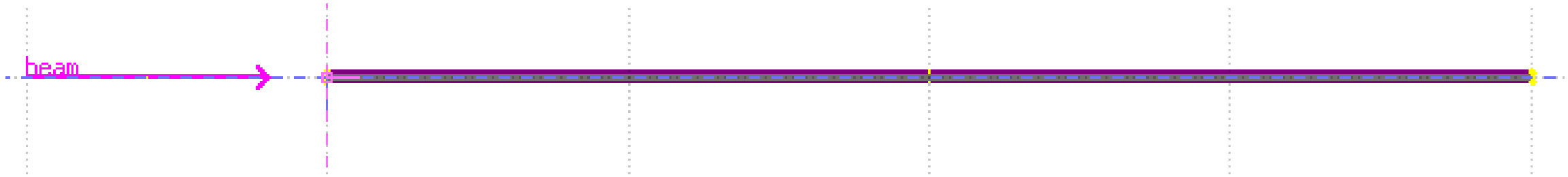
→Material = Graphite

→Length = 40 cm (one interaction length)

→Radius = 0.15 cm

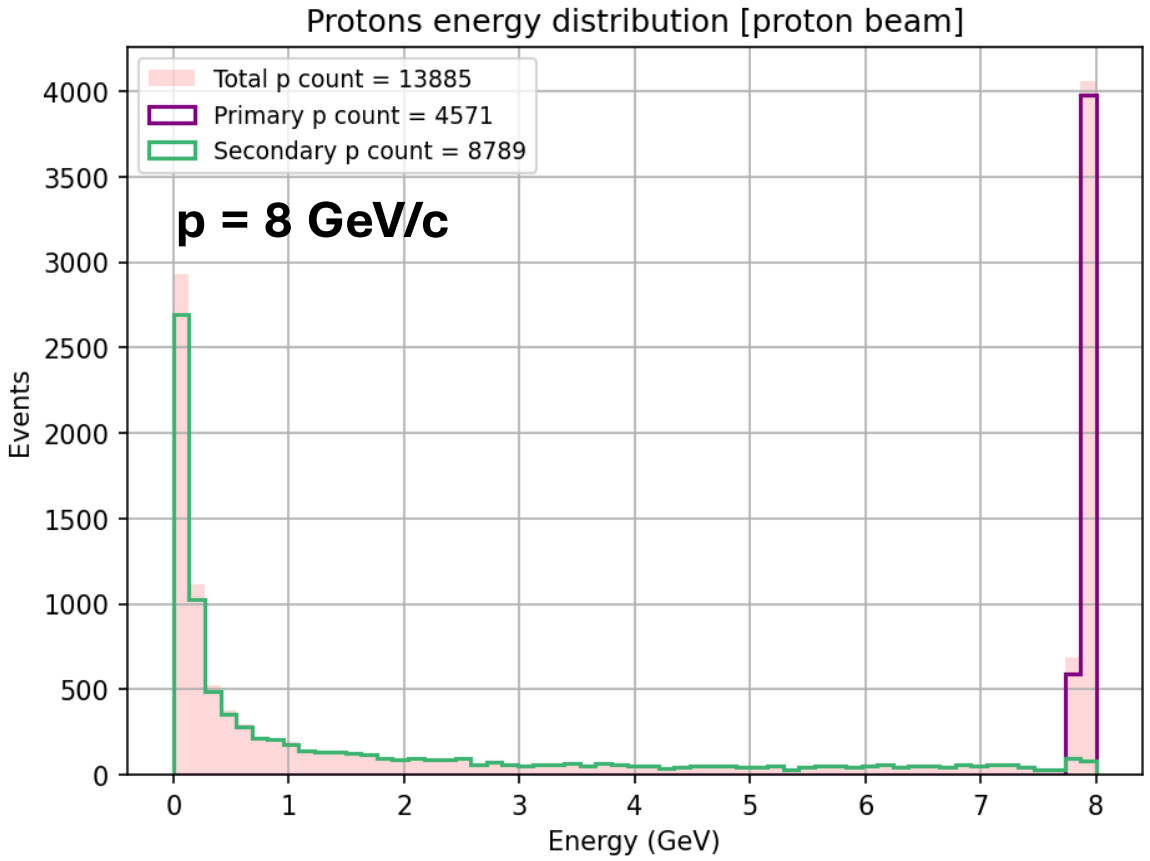
→No magnetic field

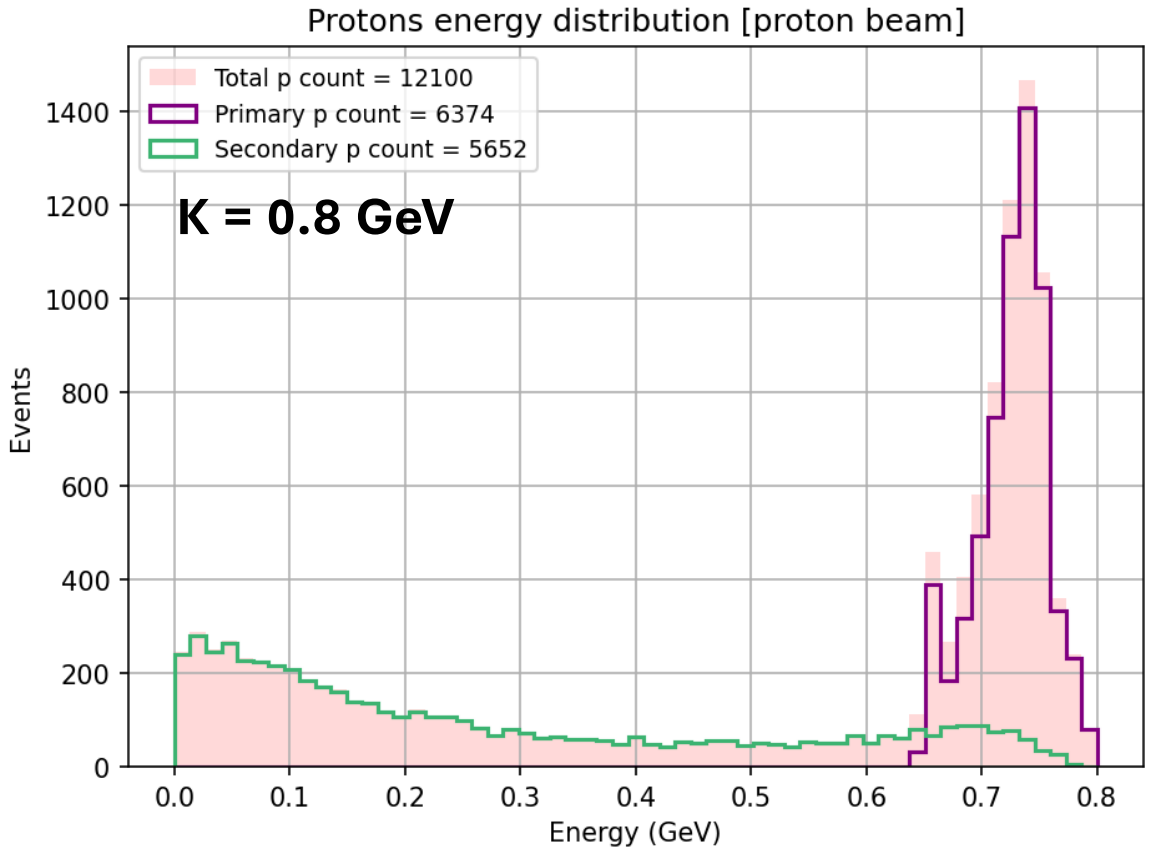
→10,000 primaries



Proton beam [Graphite]

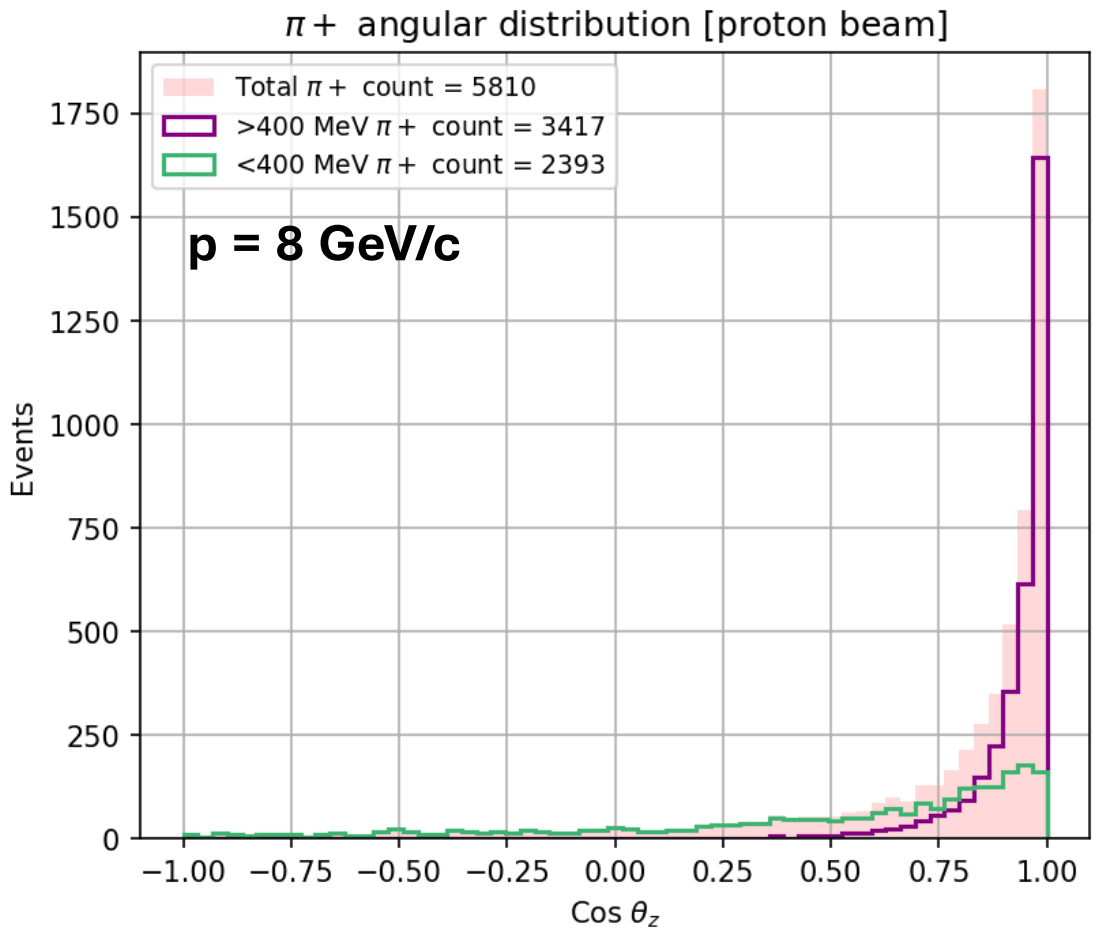
→ Protons

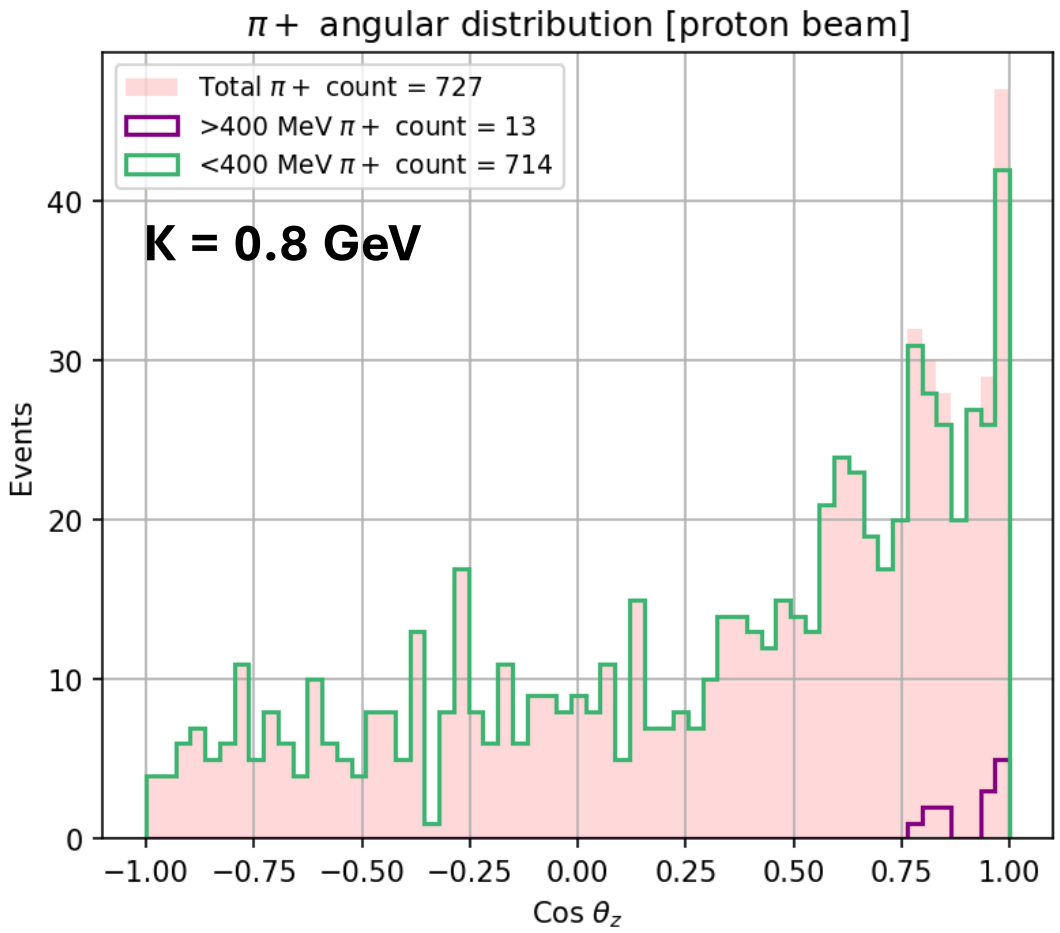




Proton beam [Graphite]

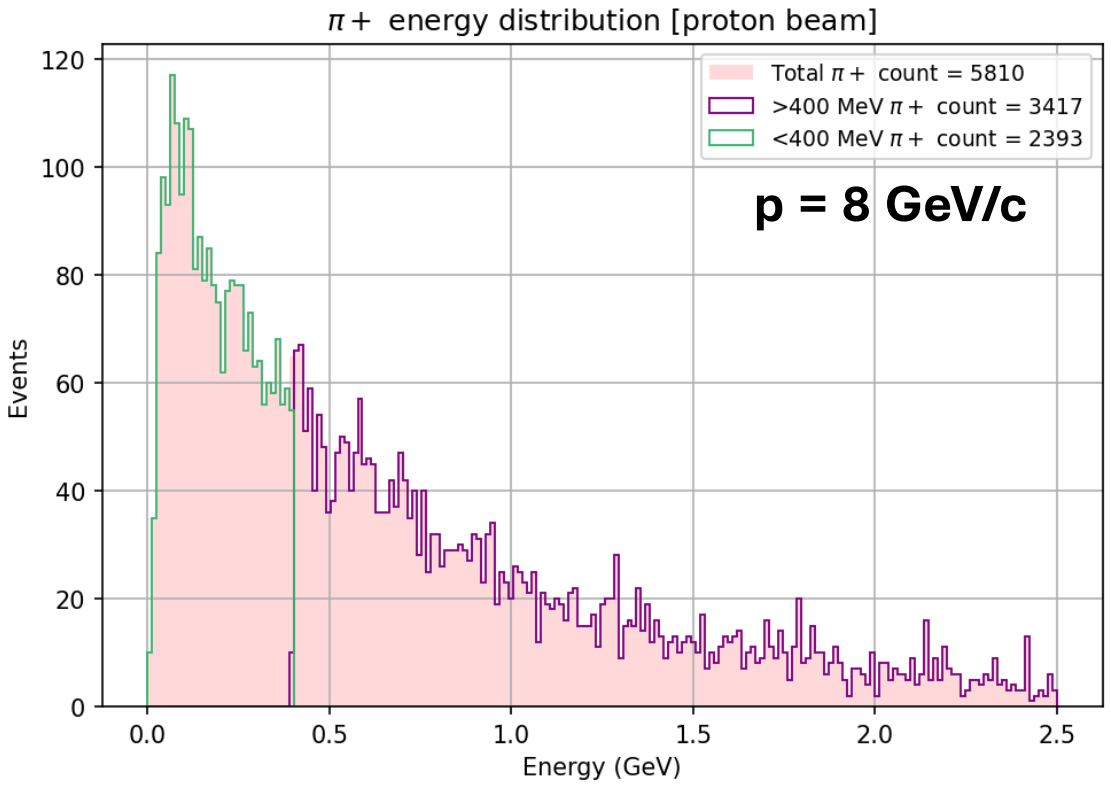
→ Pions

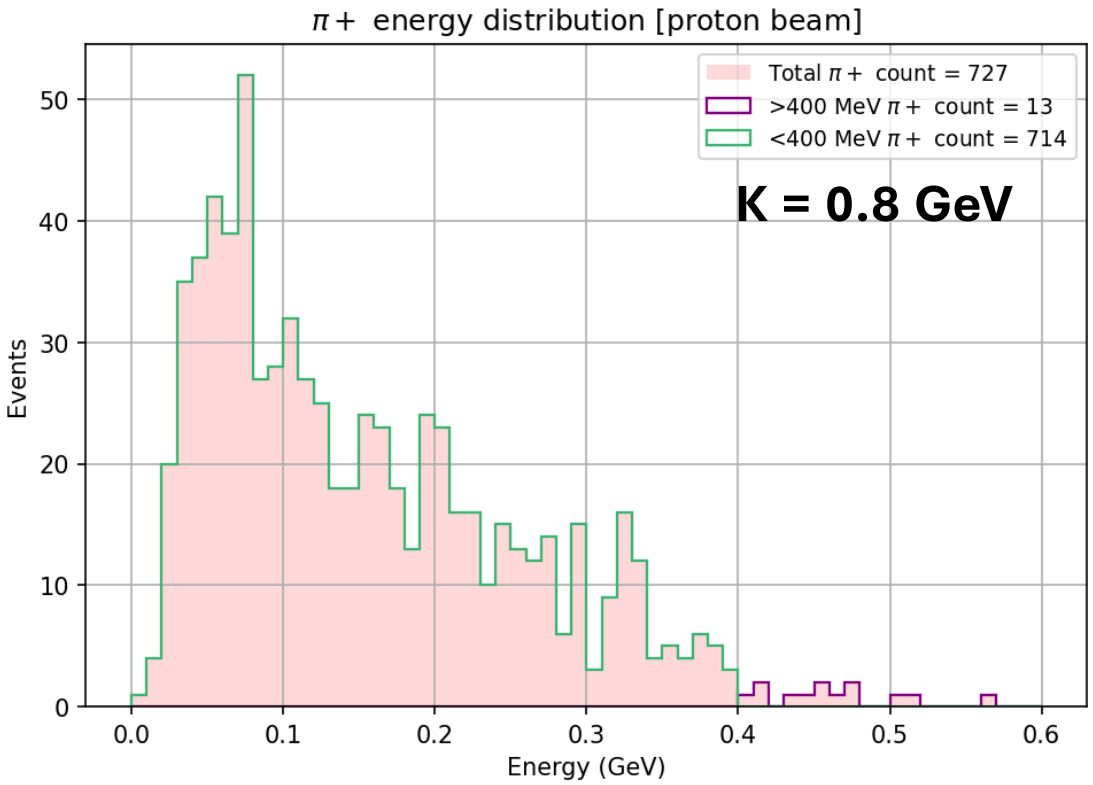




Proton beam [Graphite]

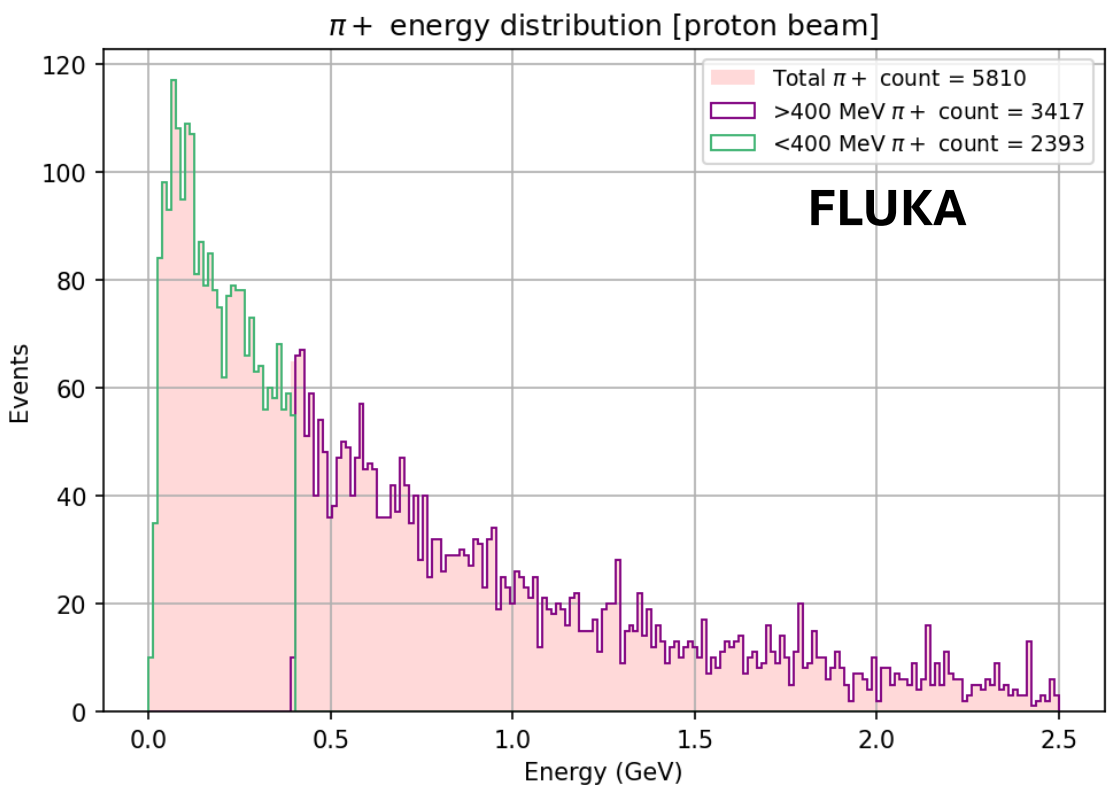
→ Pions

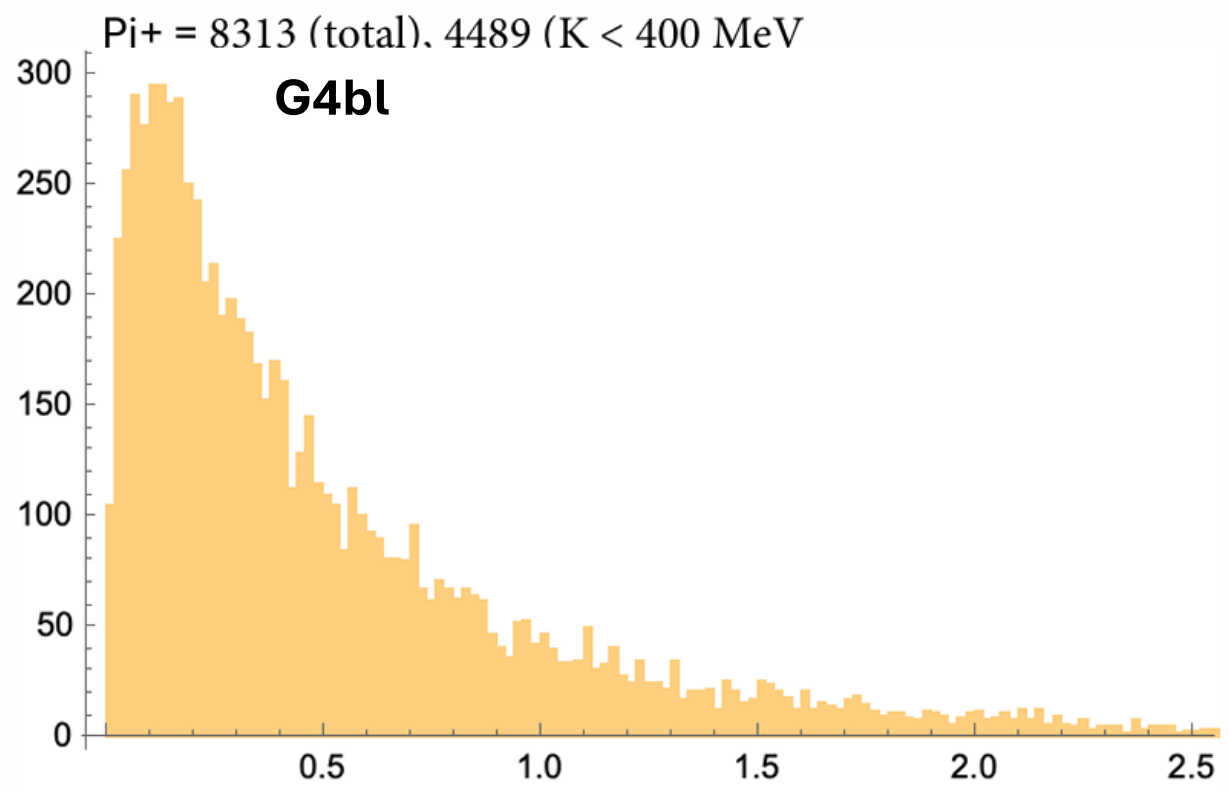




Proton beam (p = 8 GeV/c) [Graphite]

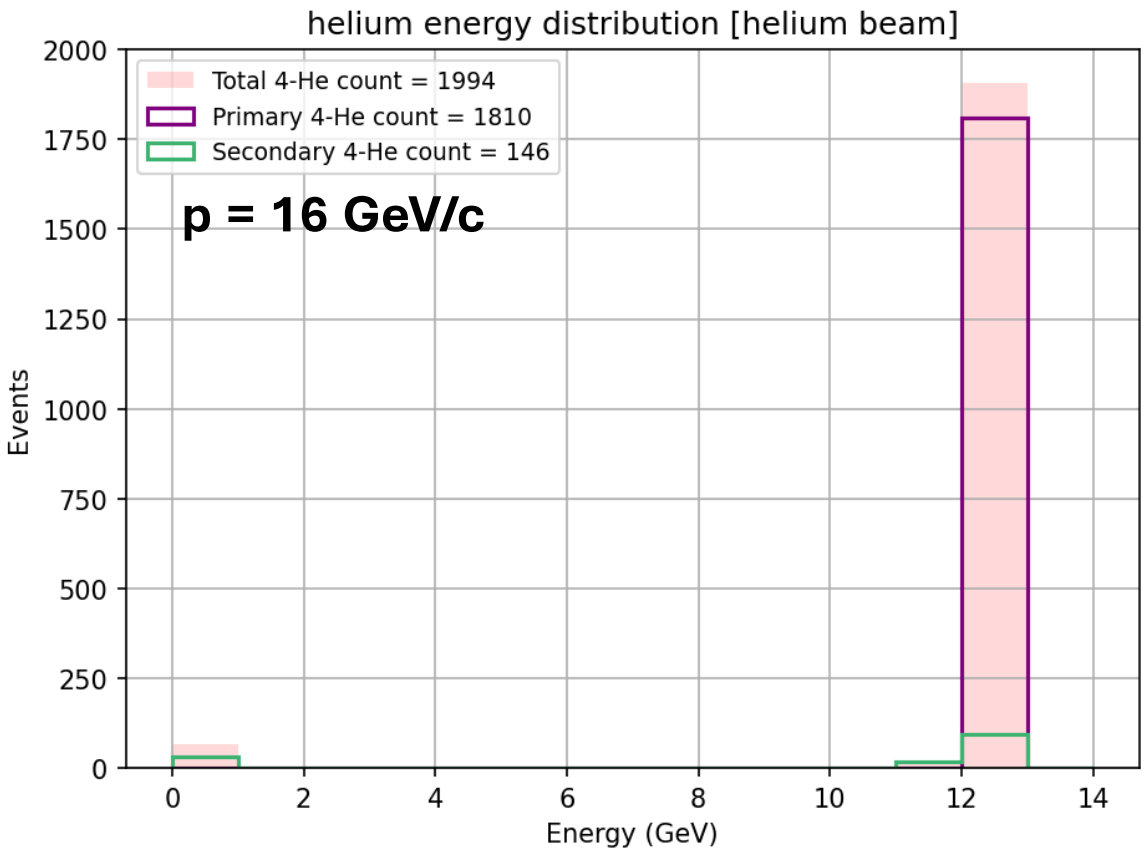
→ Pions

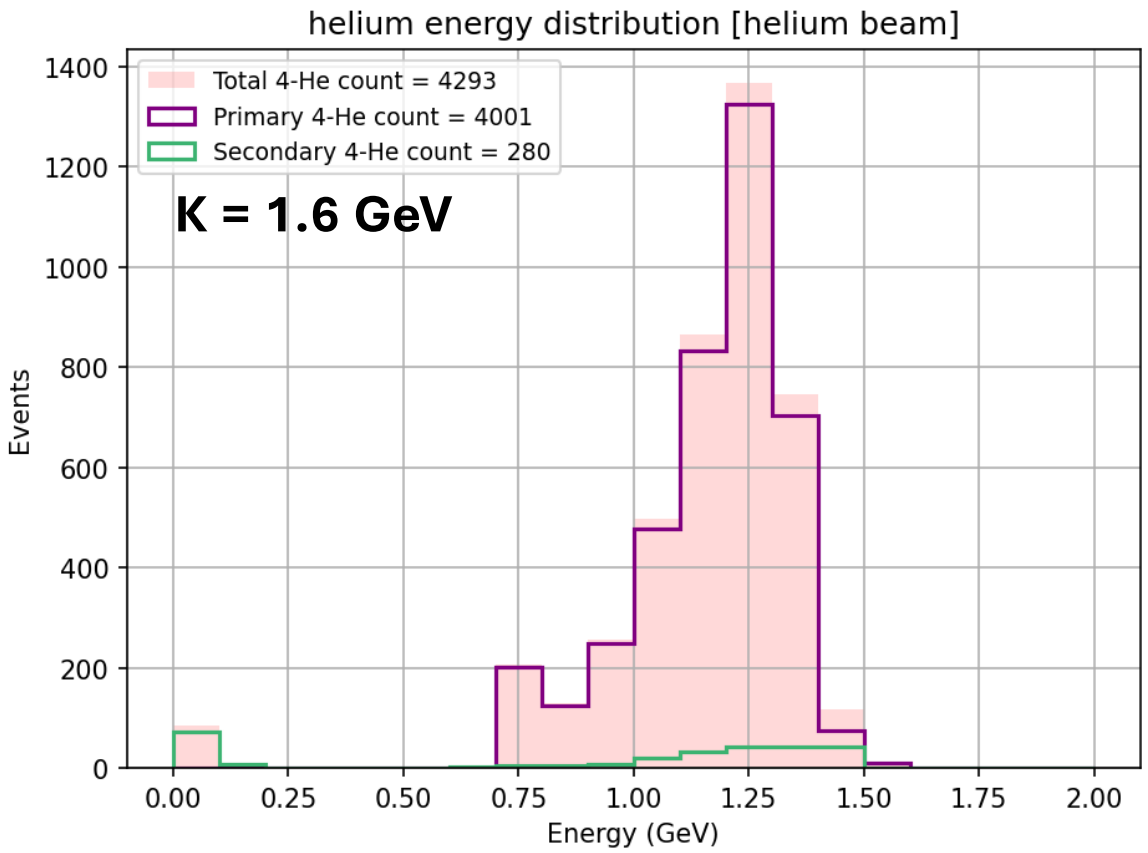




Helium beam [Graphite]

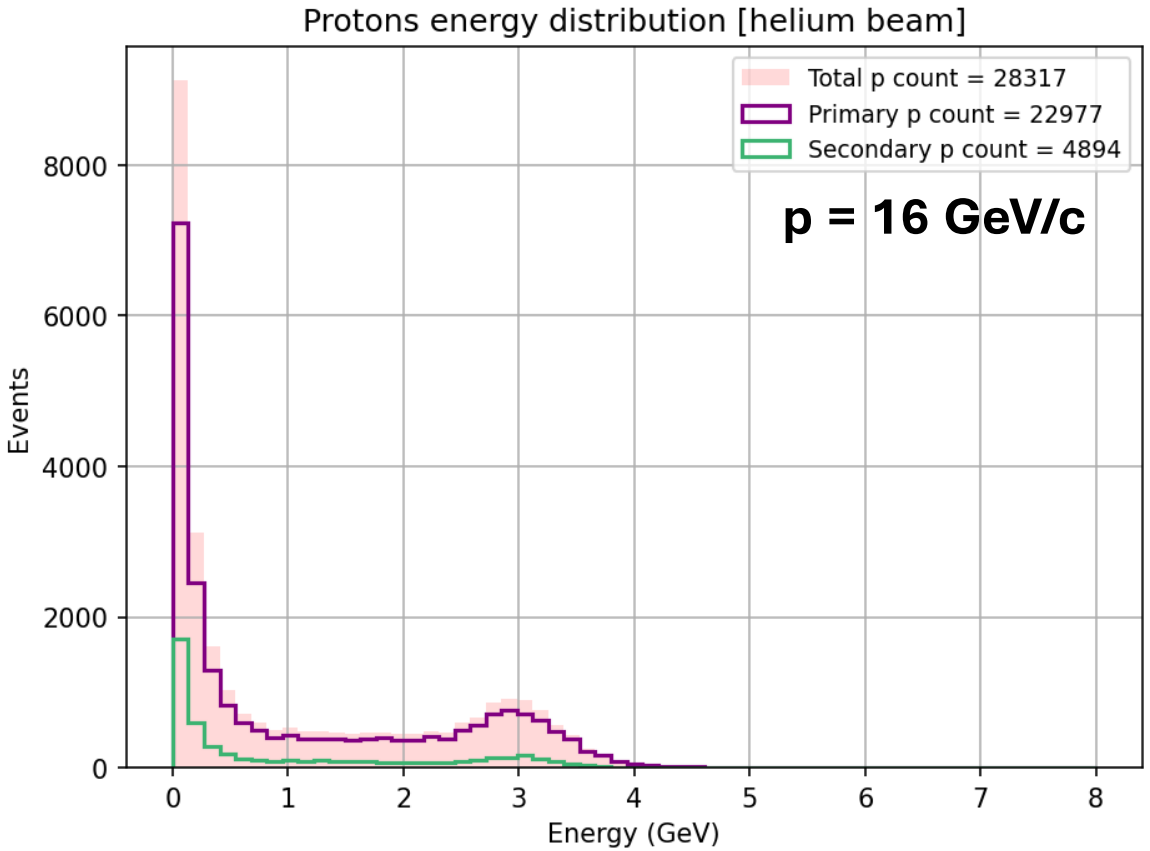
→ Helium

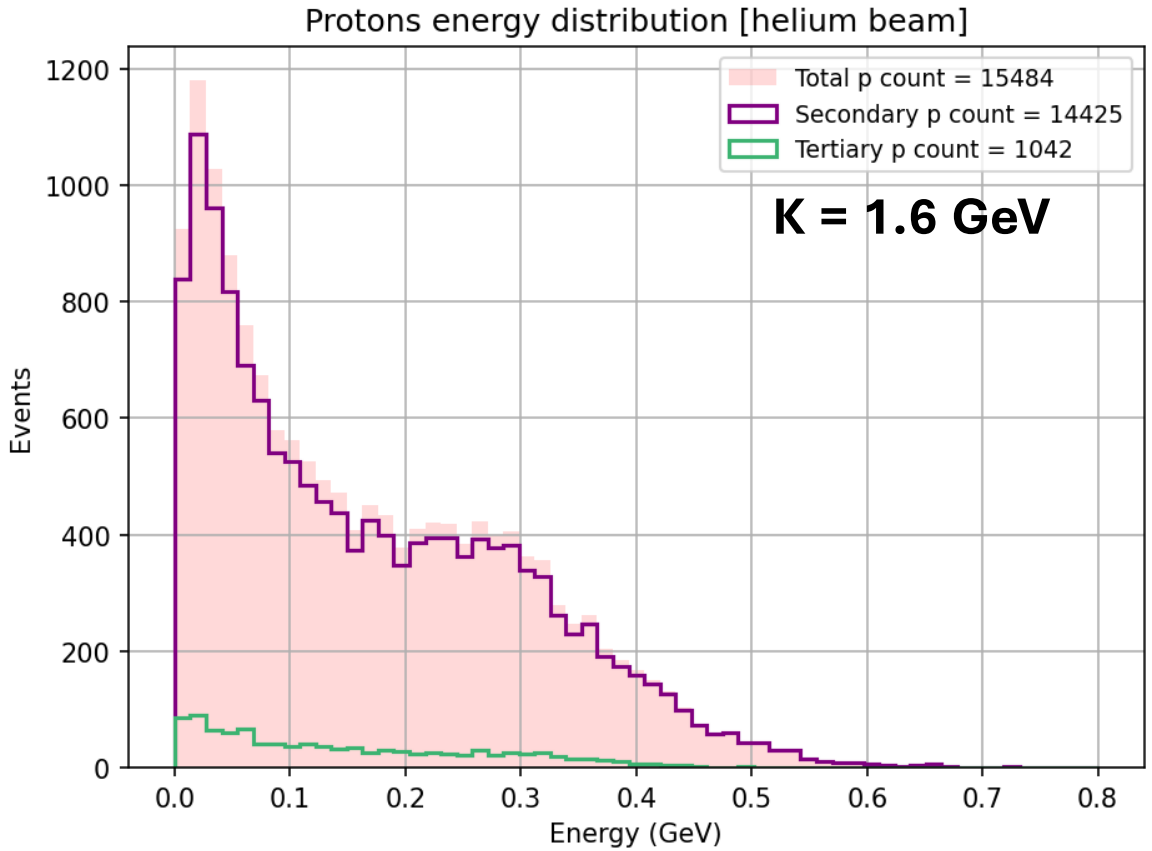




Helium beam [Graphite]

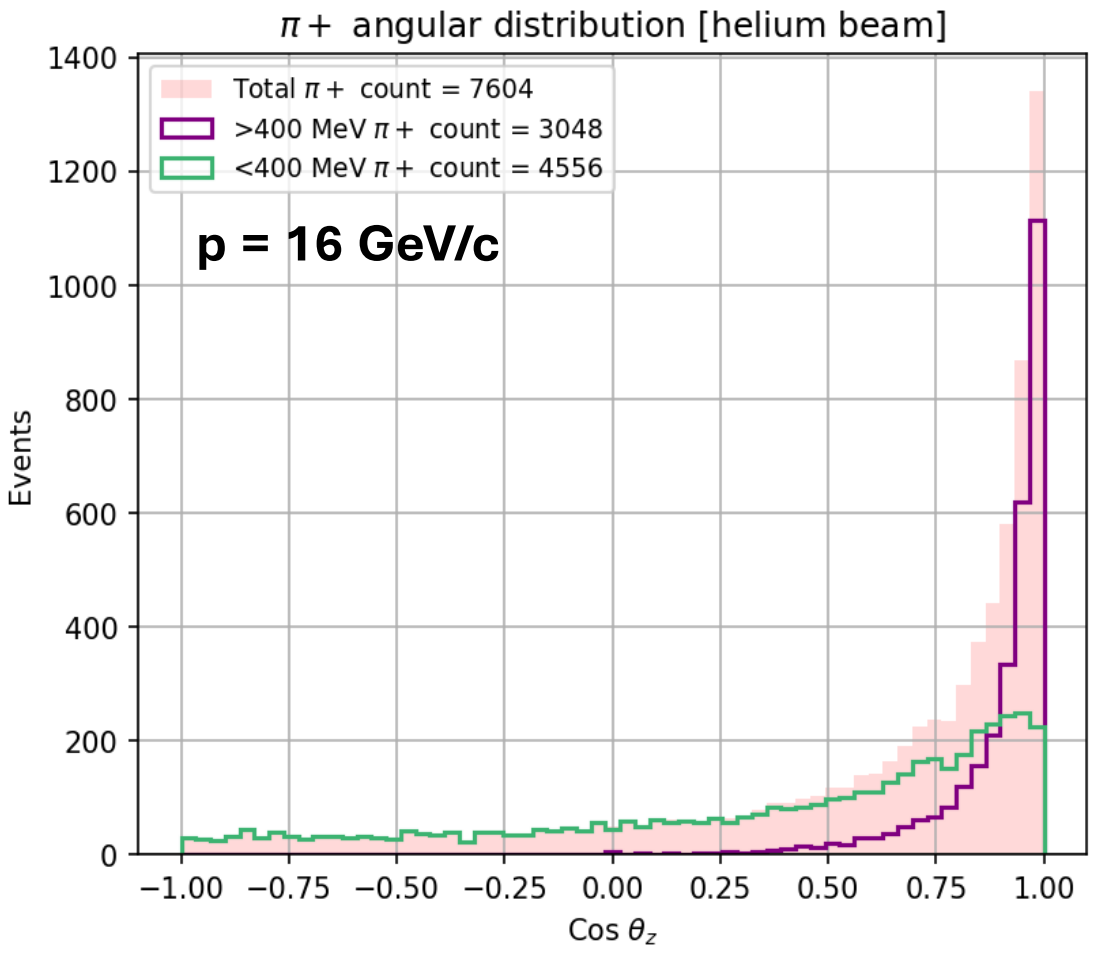
→ Protons

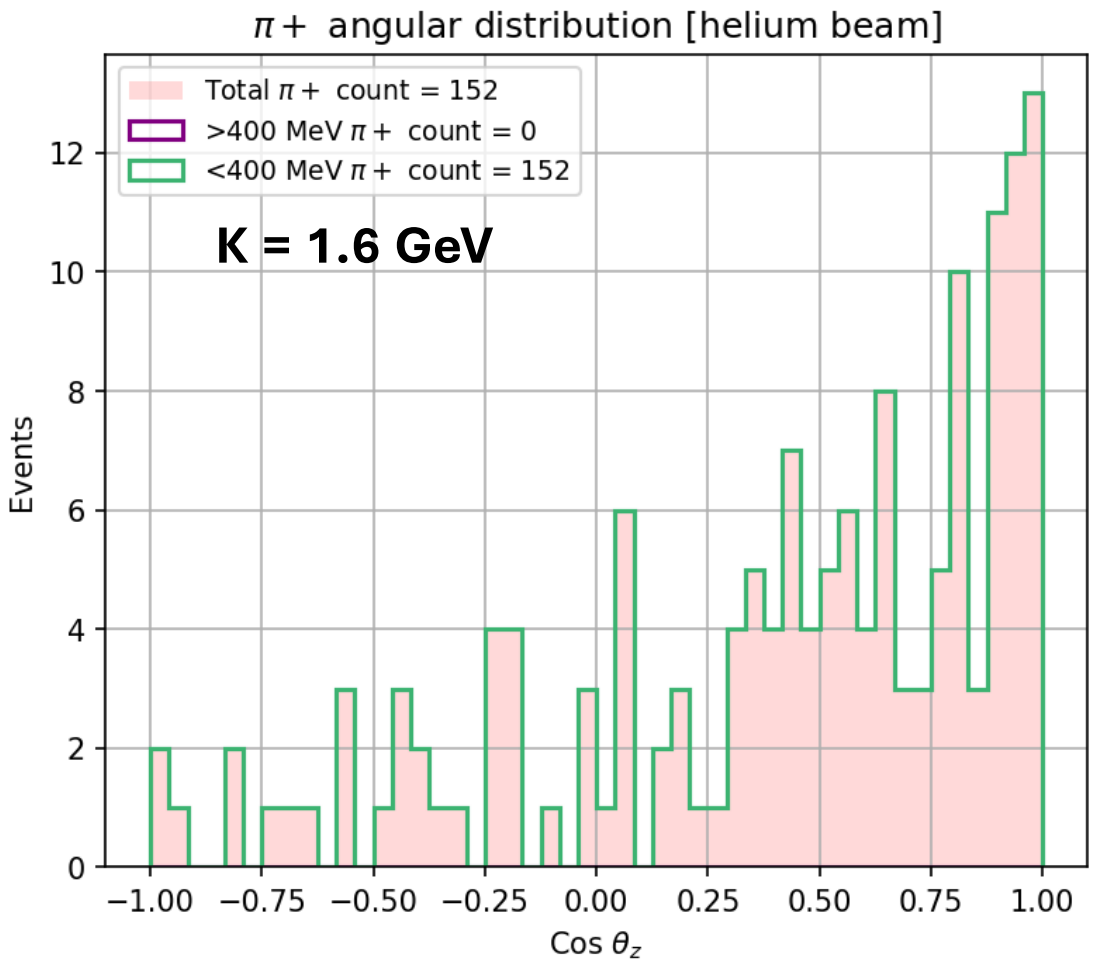




Helium beam [Graphite]

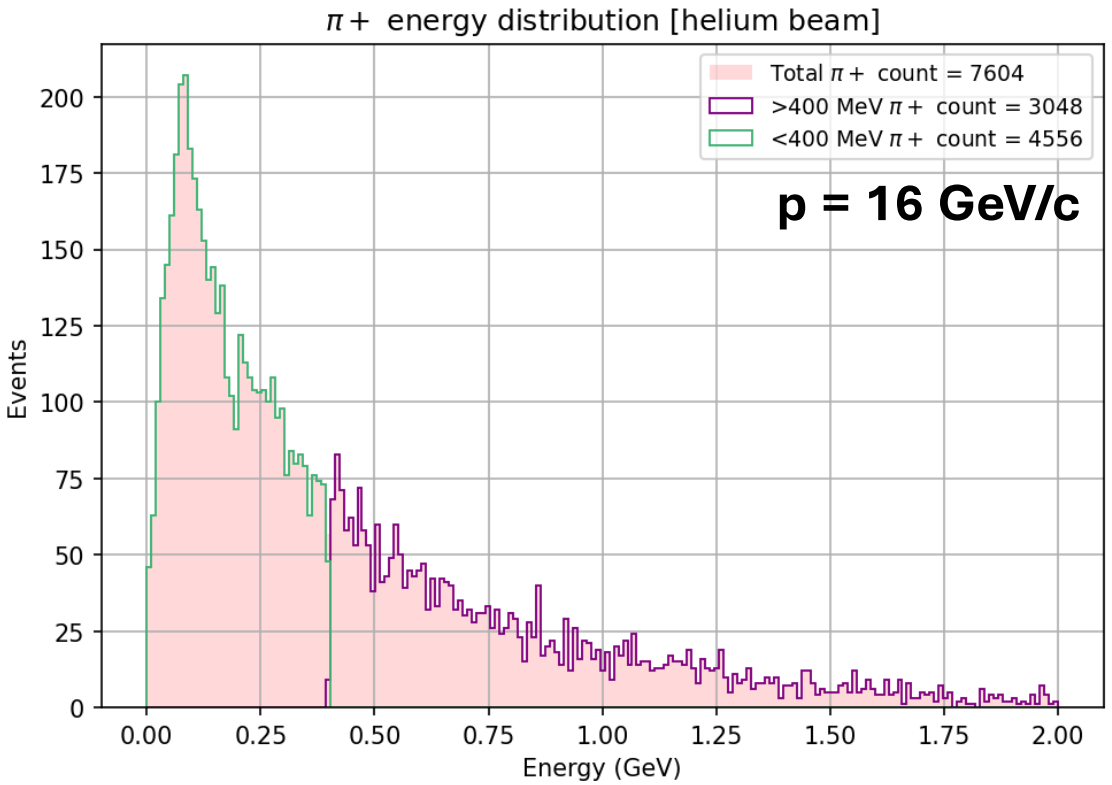
→ Pions

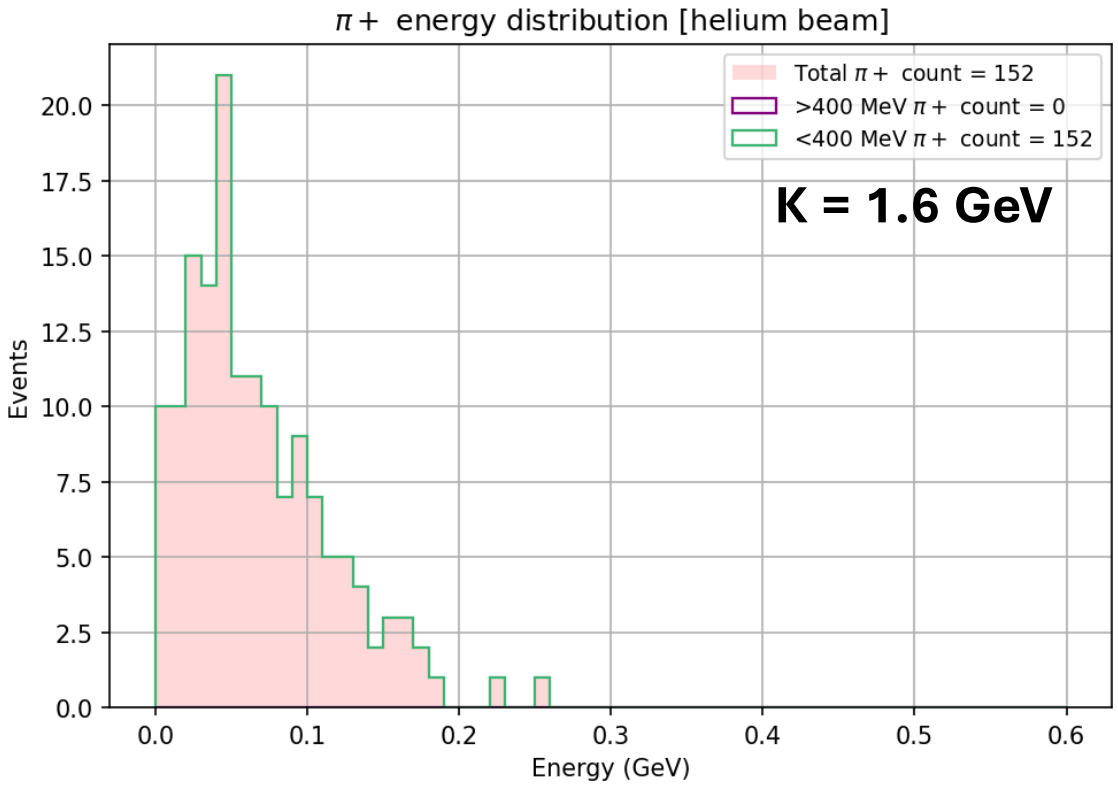




Helium beam [Graphite]

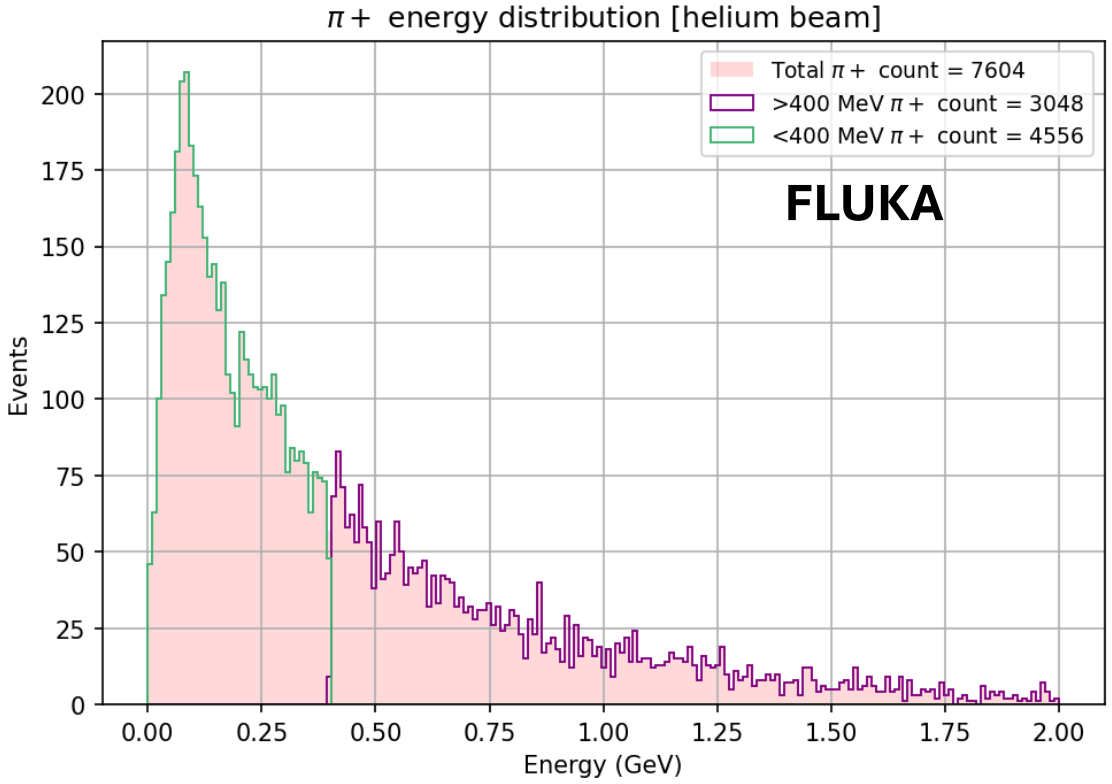
→ Pions

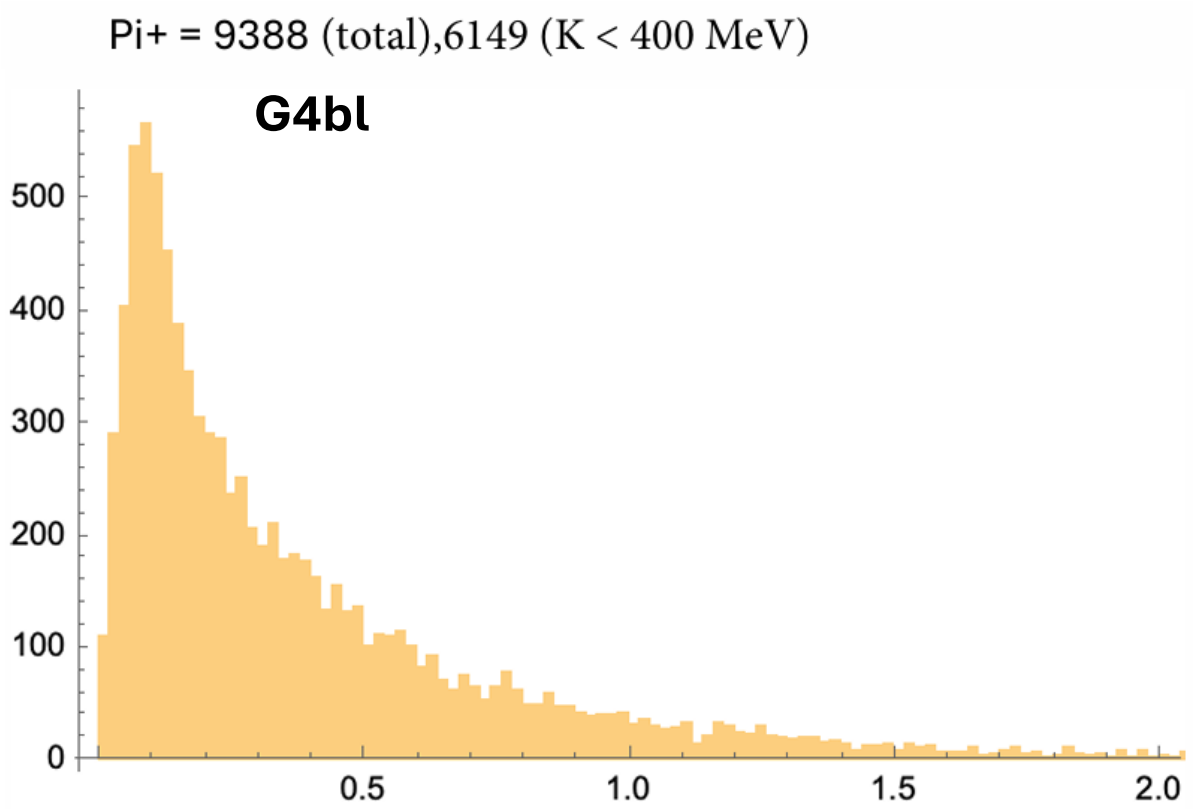




Helium beam (p = 16 GeV/c) [Graphite]

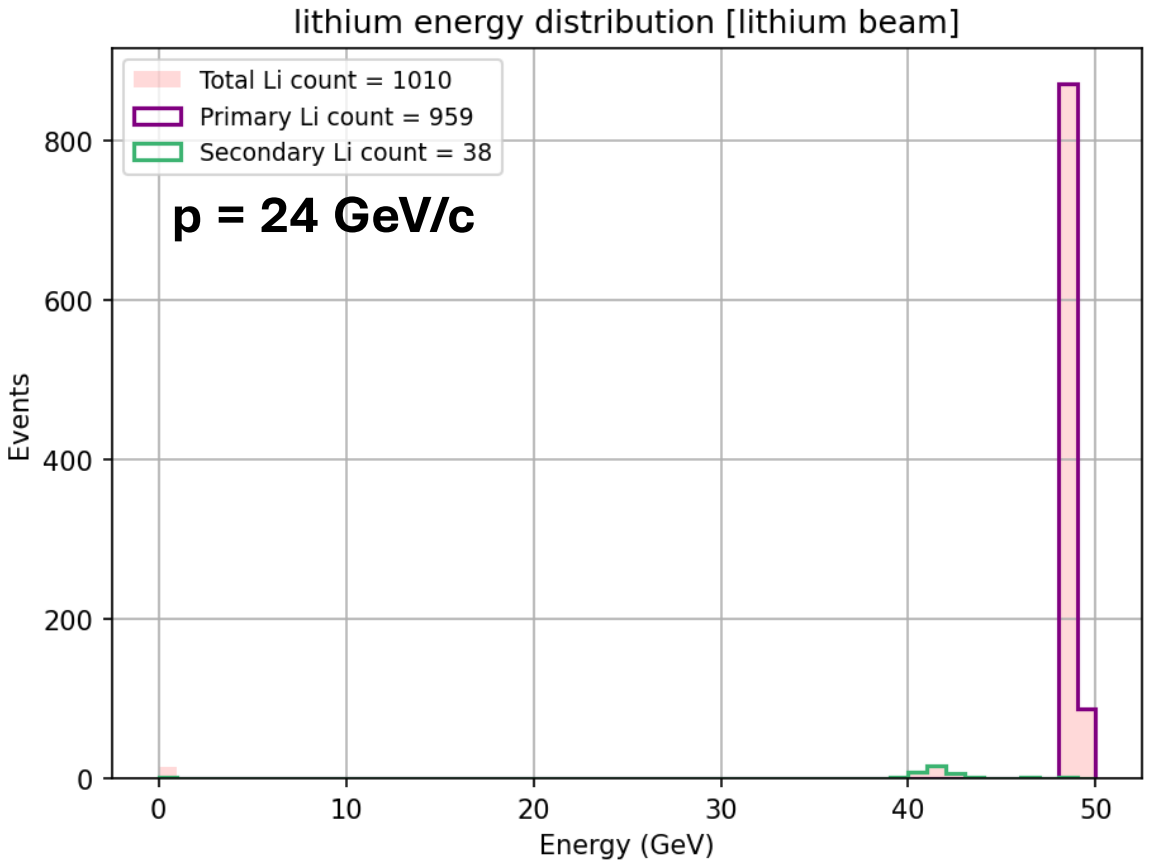
→ Pions

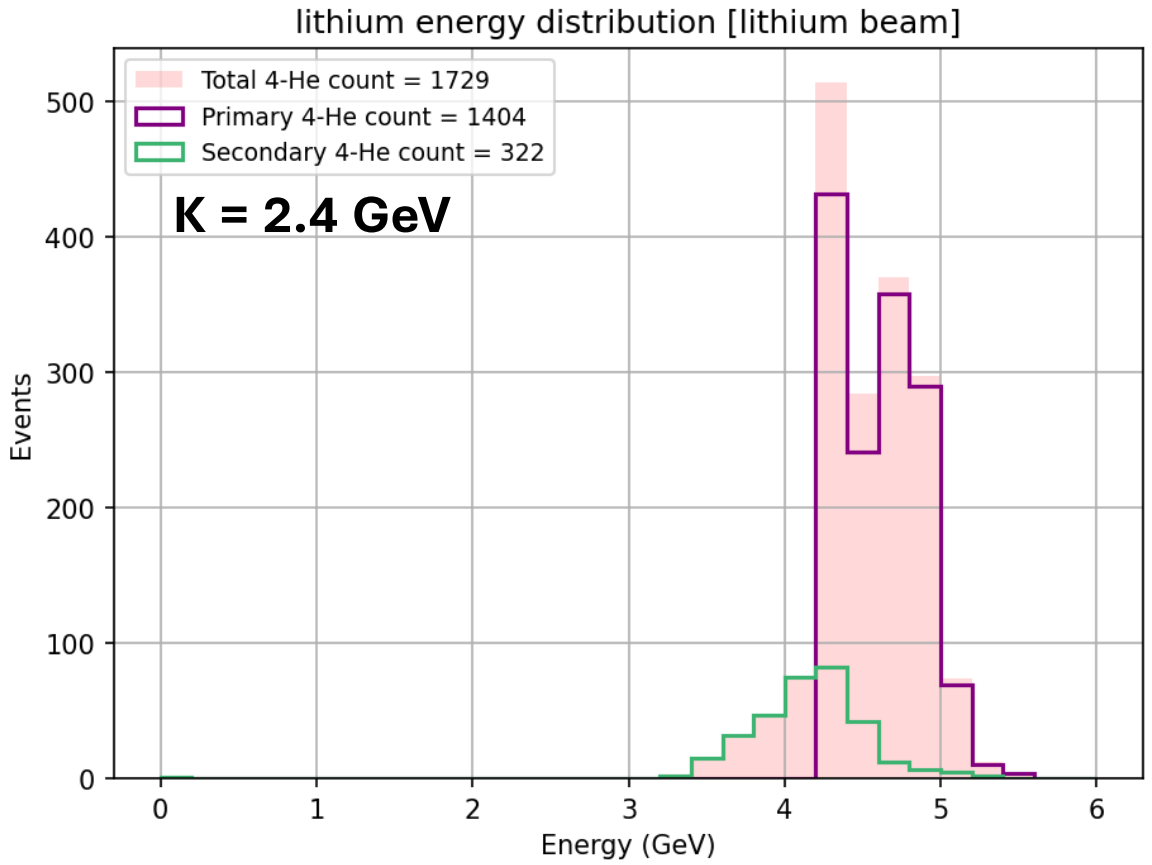




Lithium beam [Graphite]

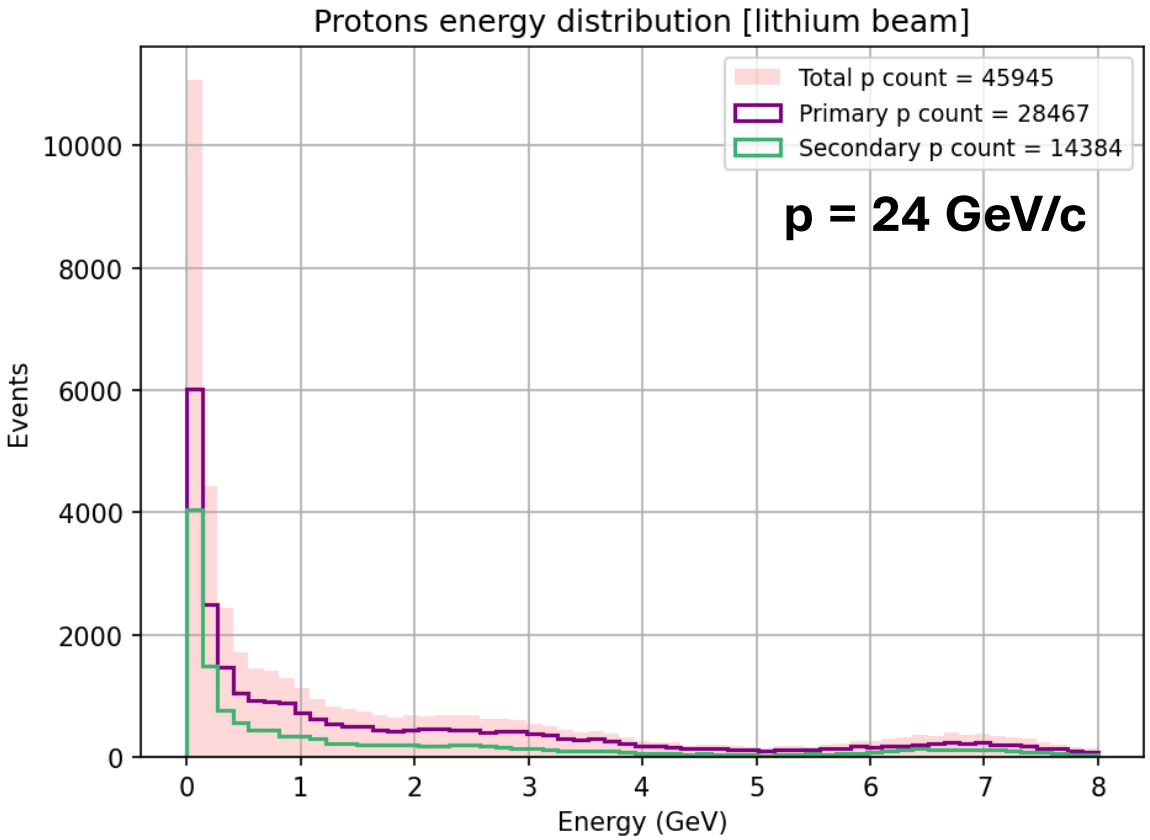
→ Lithium ions

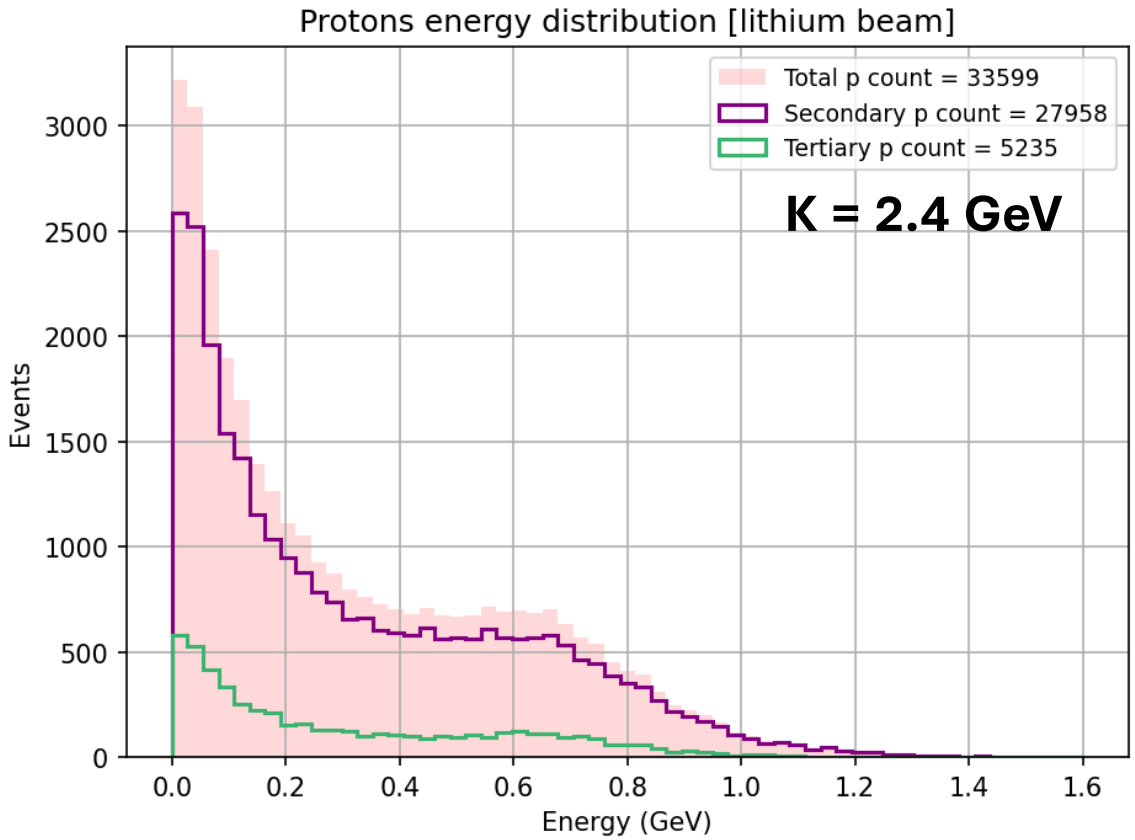




Lithium beam [Graphite]

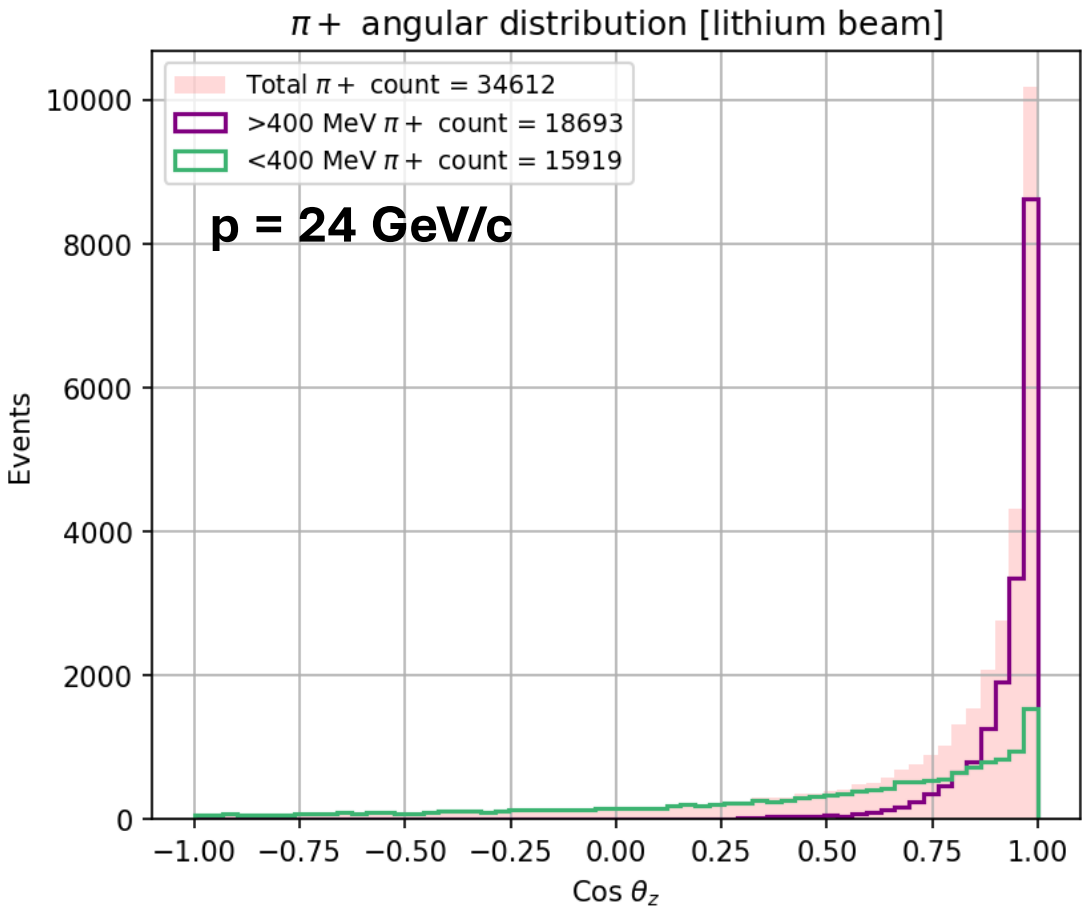
→ Protons

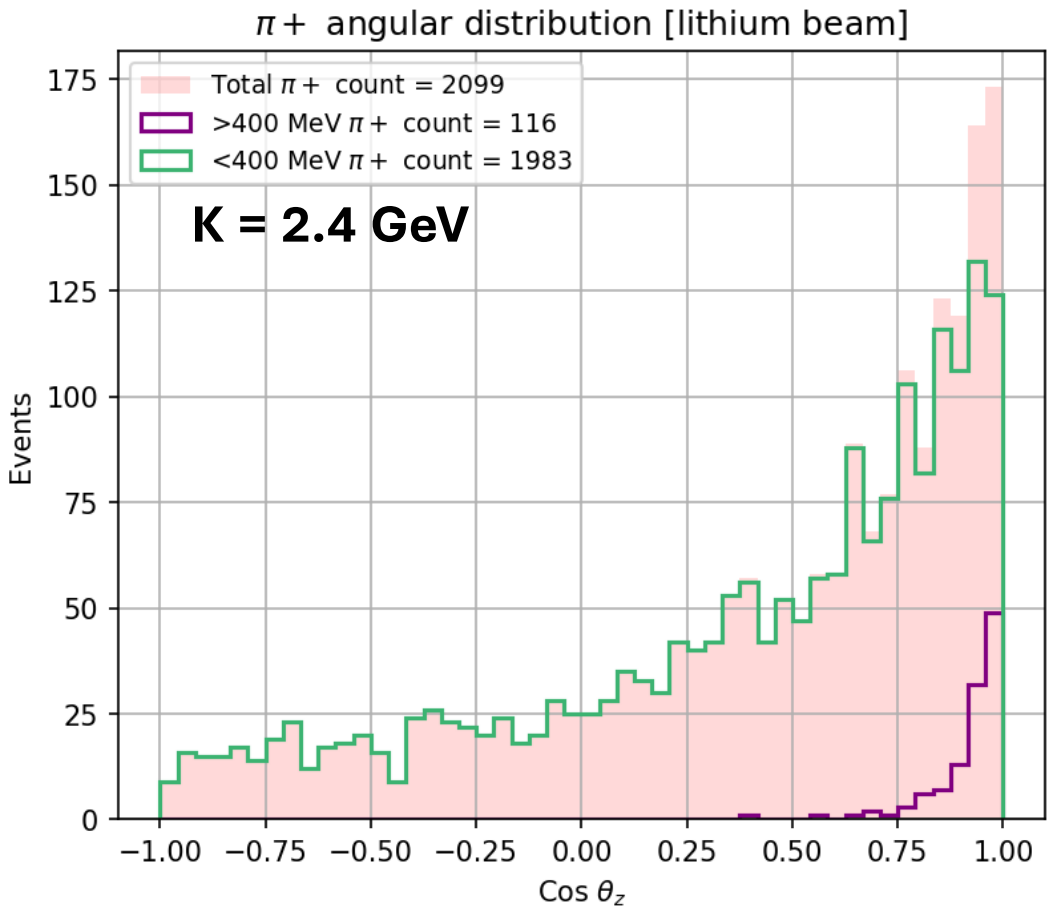




Lithium beam [Graphite]

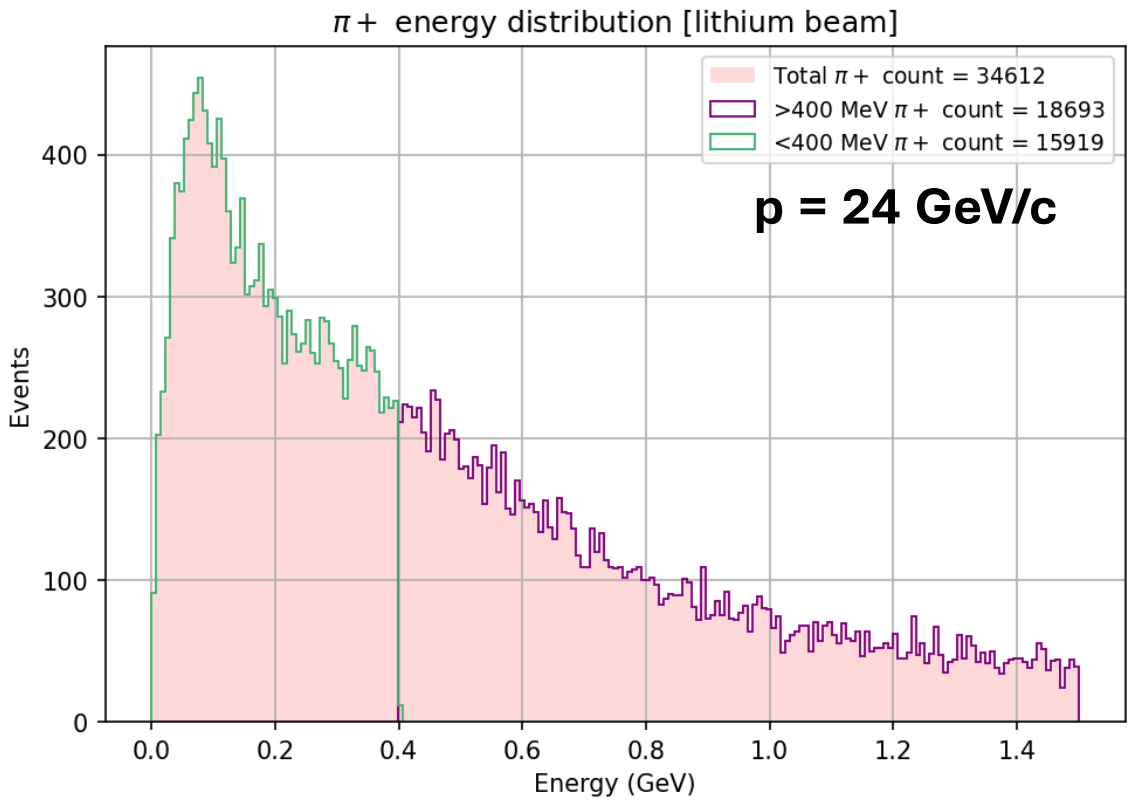
→ Pions

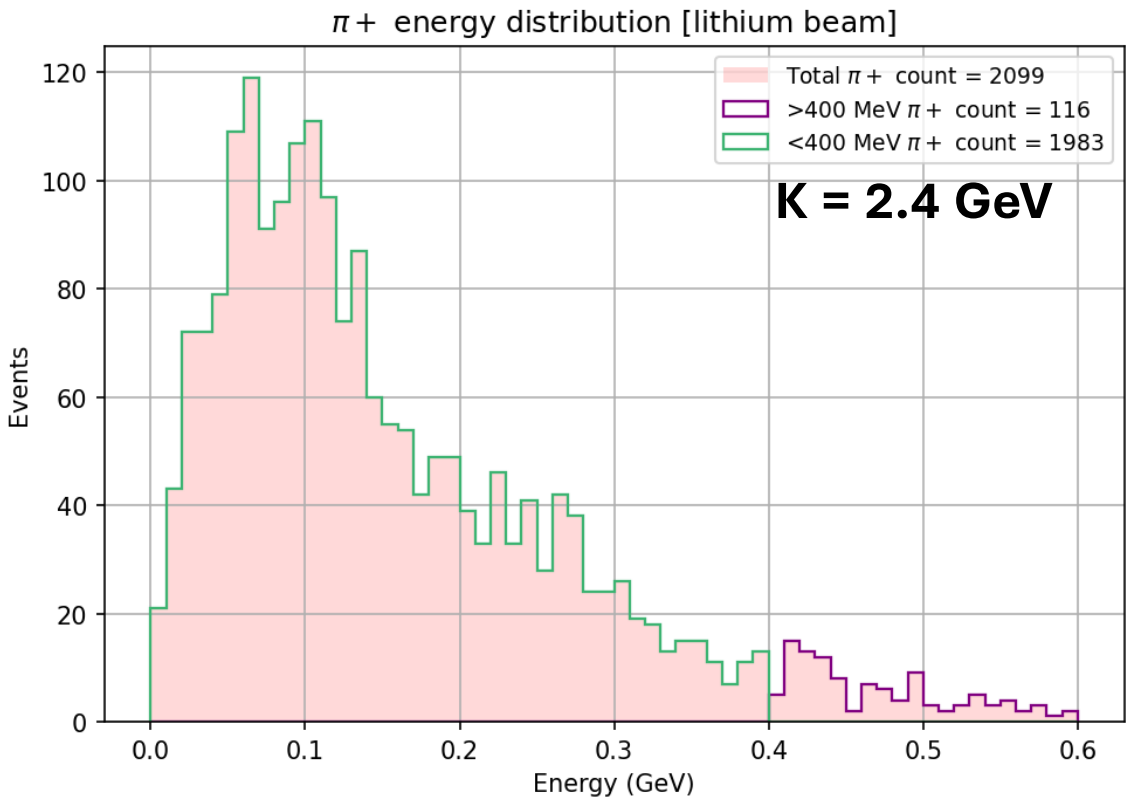




Lithium beam [Graphite]

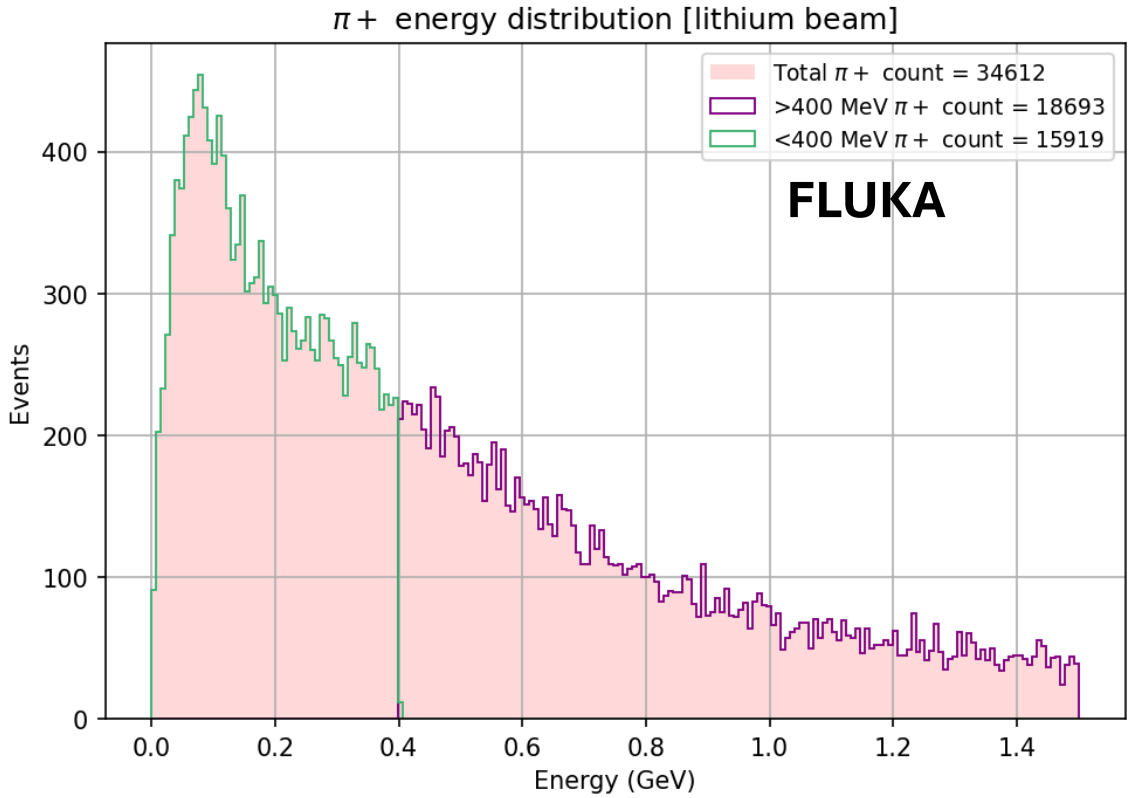
→ Pions

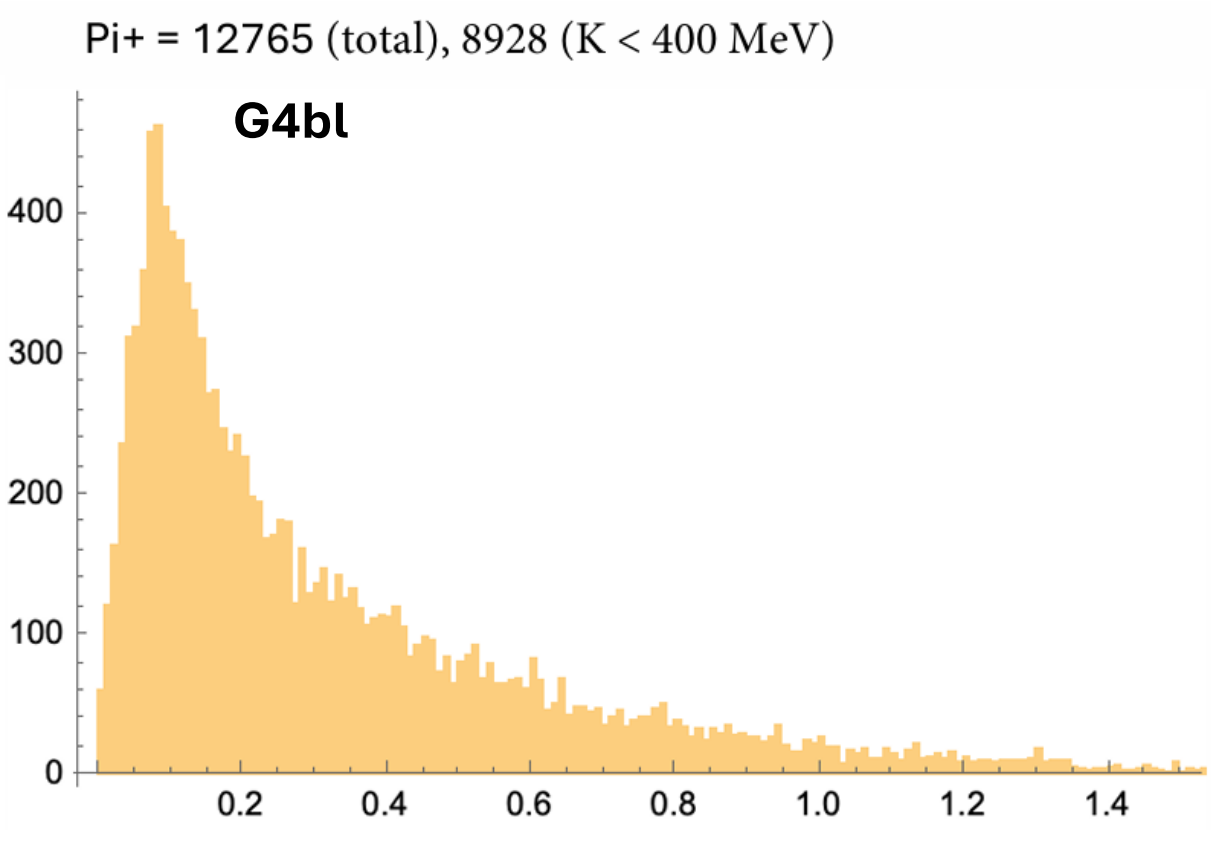




Lithium beam (p = 24 GeV/c) [Graphite]

→ Pions





Summary

Beam	Energy (GeV or GeV/c)	Simulation	<400 MeV pions	Total pions
Proton	0.8	FLUKA	714	727
	8	FLUKA	2393	5810
	8	G4bl	4489 (new)	8313 (new) 5030 (old)
Helium	0.8	FLUKA	152	152
	8	FLUKA	4556	7604
	8	G4bl	6149	9388
Lithium	0.8	FLUKA	1983	2099
	8	FLUKA	15919	34612
	8	G4bl	8928	12765

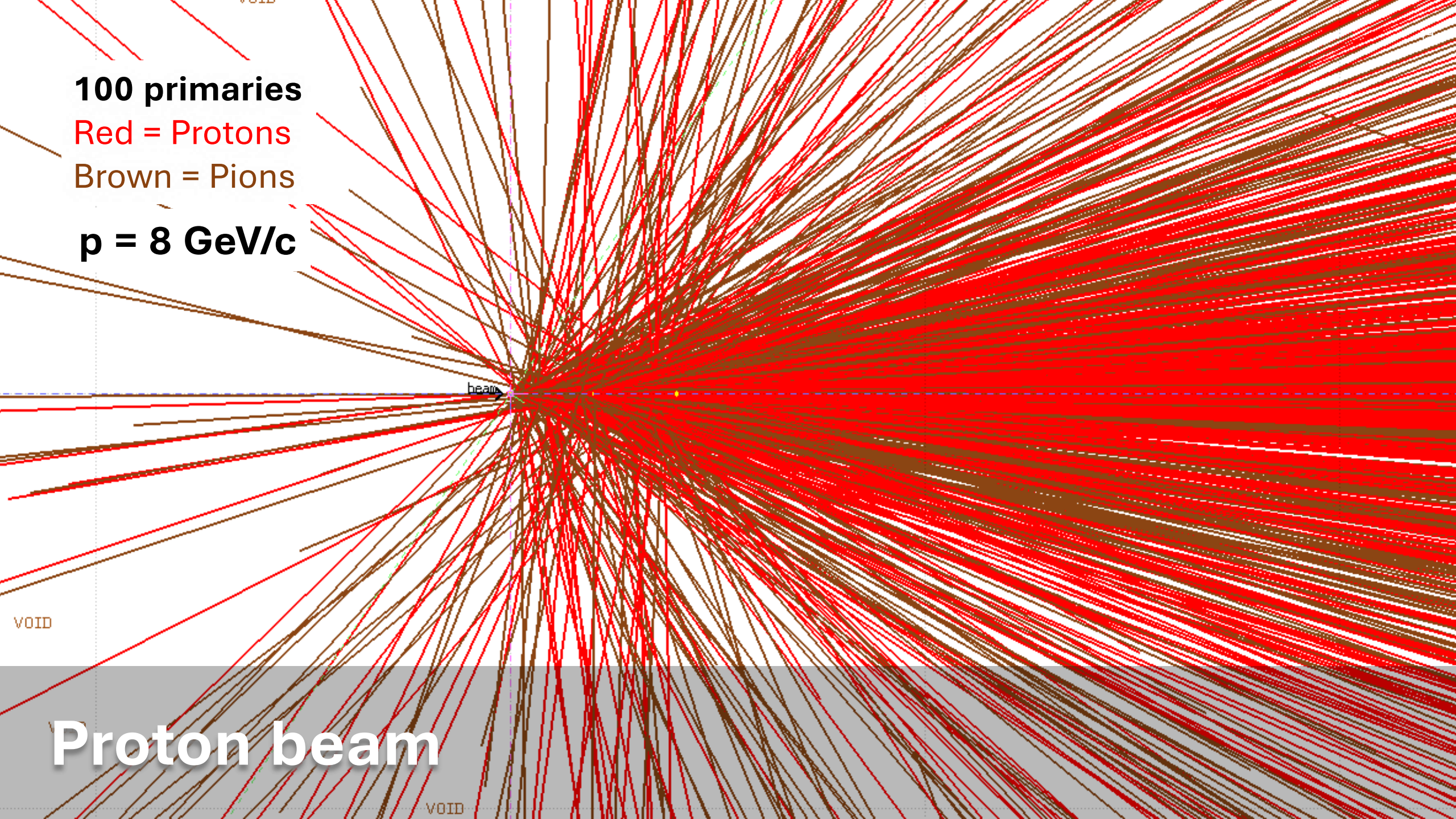
Notes☺

→This week I simulated pion production for 0.8 GeV/u (KE) beams

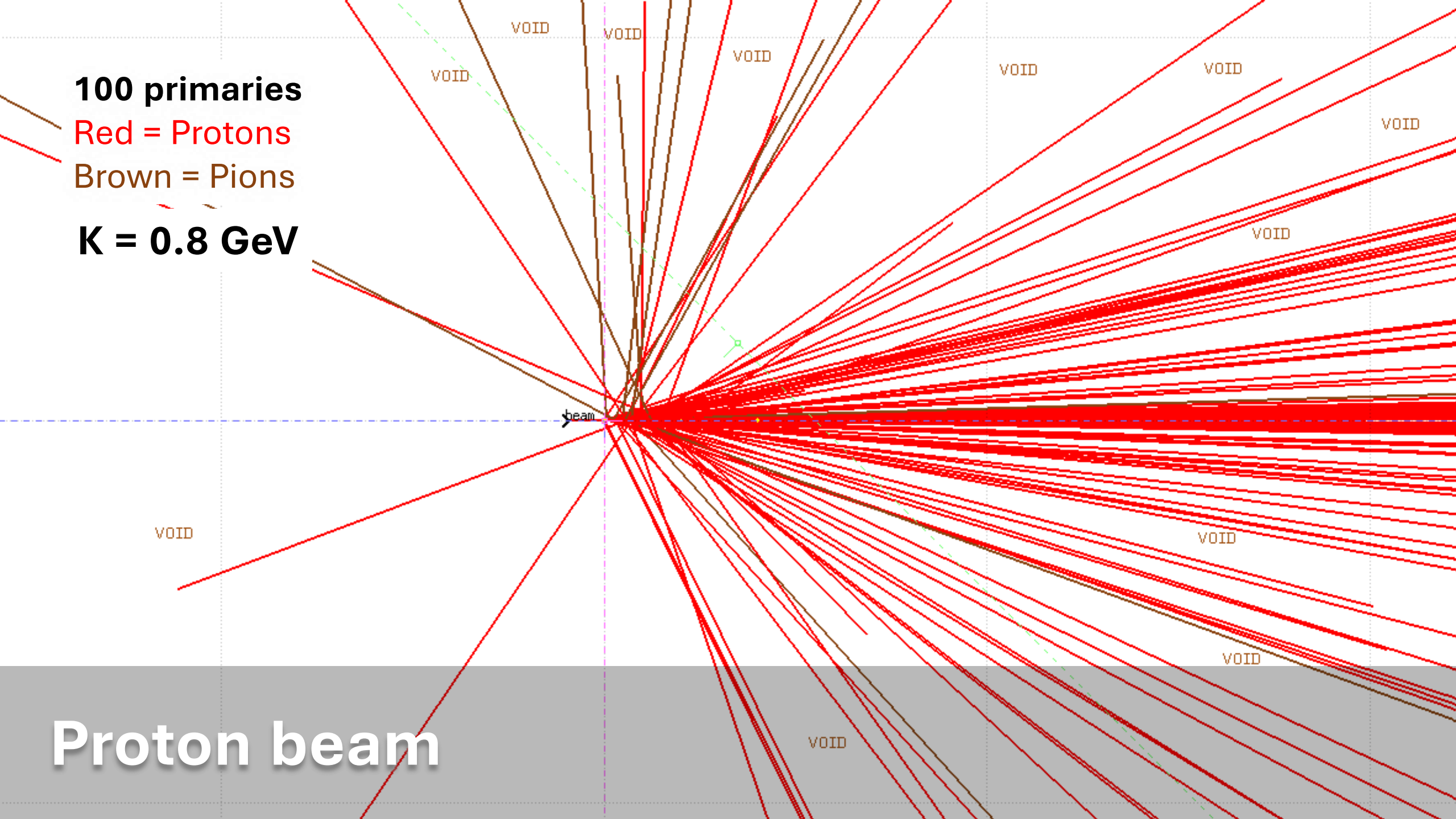
→We see that more beam particles go straight through the target without interaction

→Less interaction causes pion yield to decrease

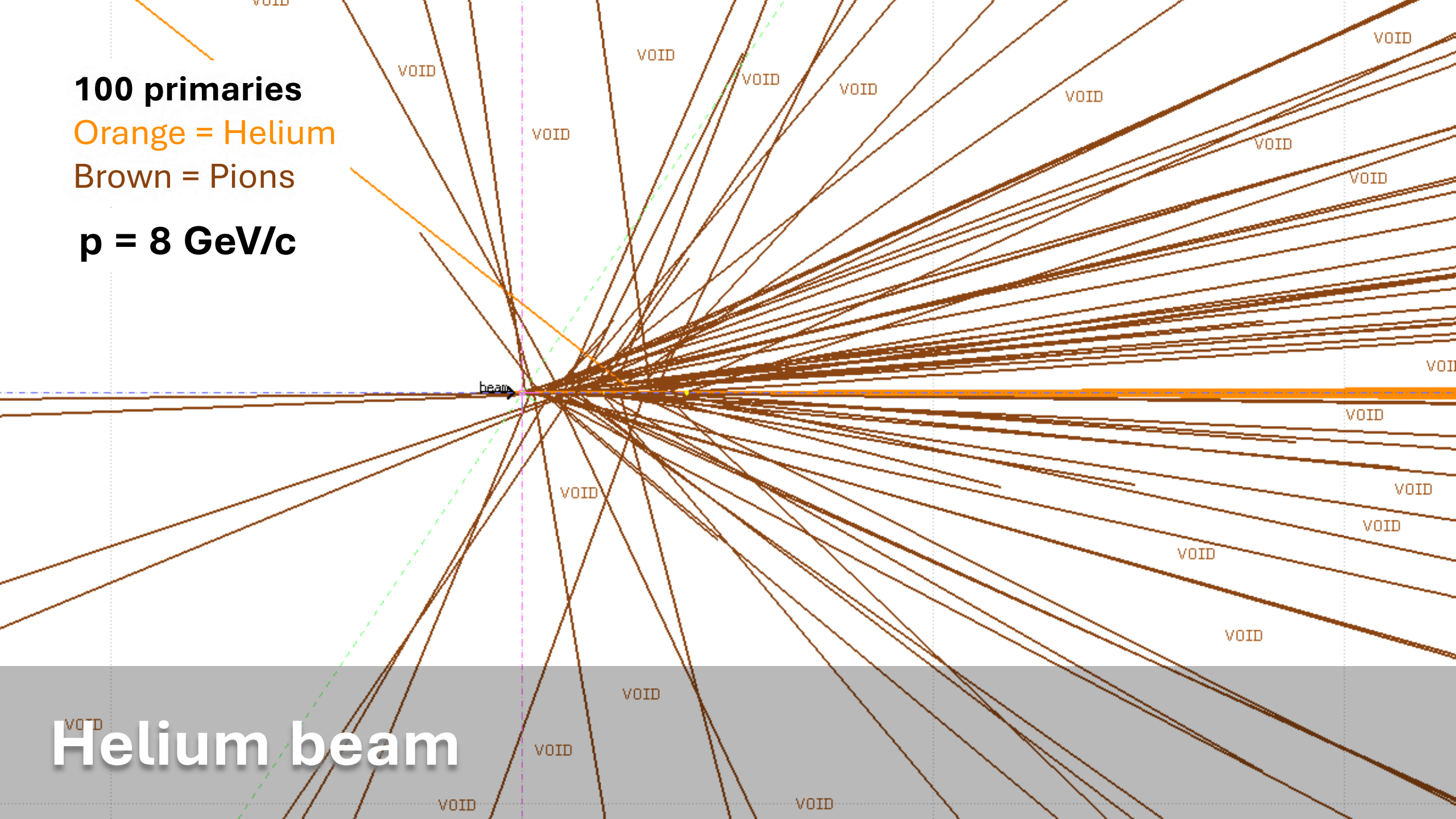
→The pion yield from FLUKA and G4bl simulations look quite different


100 primaries
Red = Protons
Brown = Pions
p = 8 GeV/c
beam
VOID
VOID

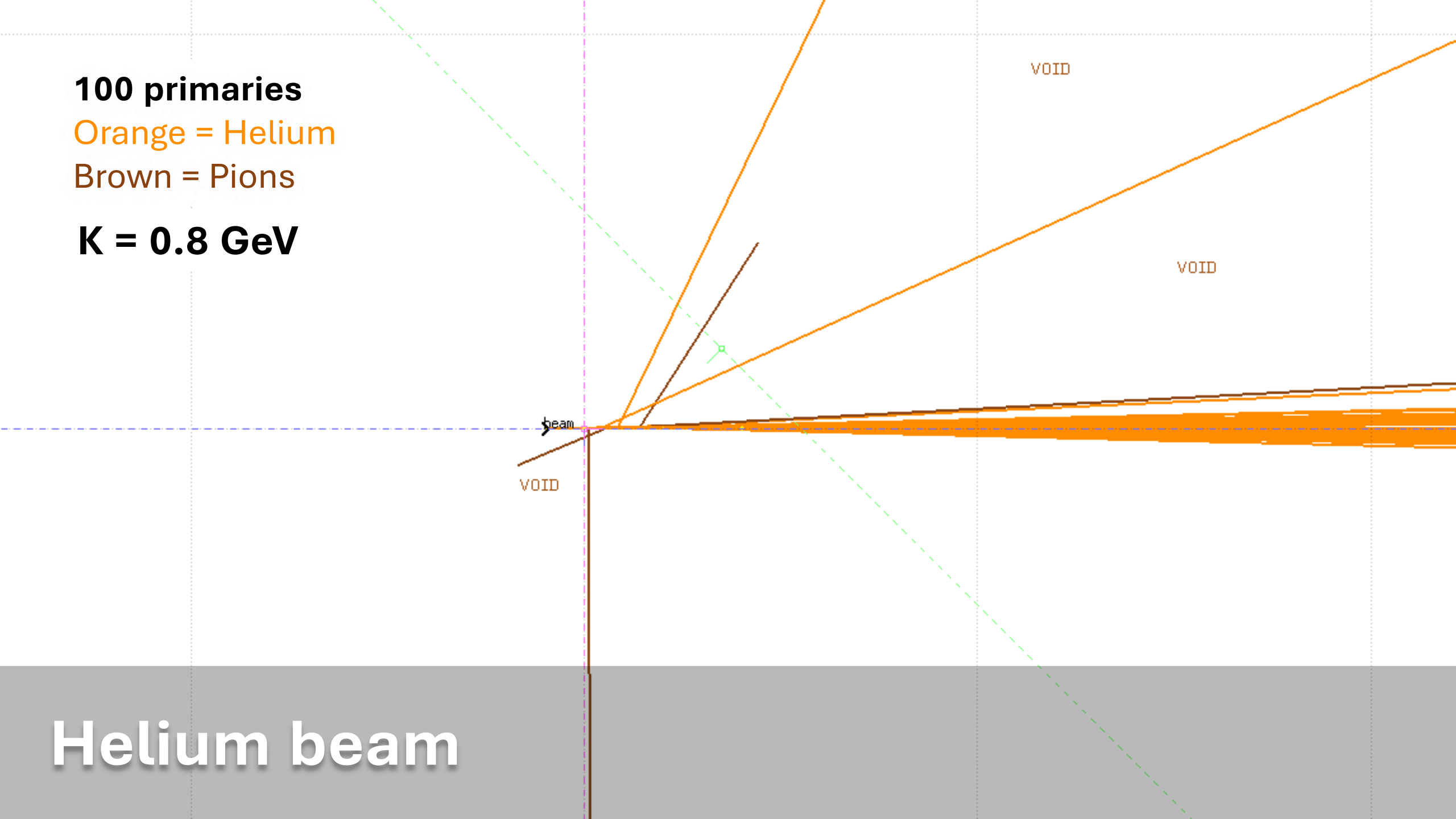
Proton beam



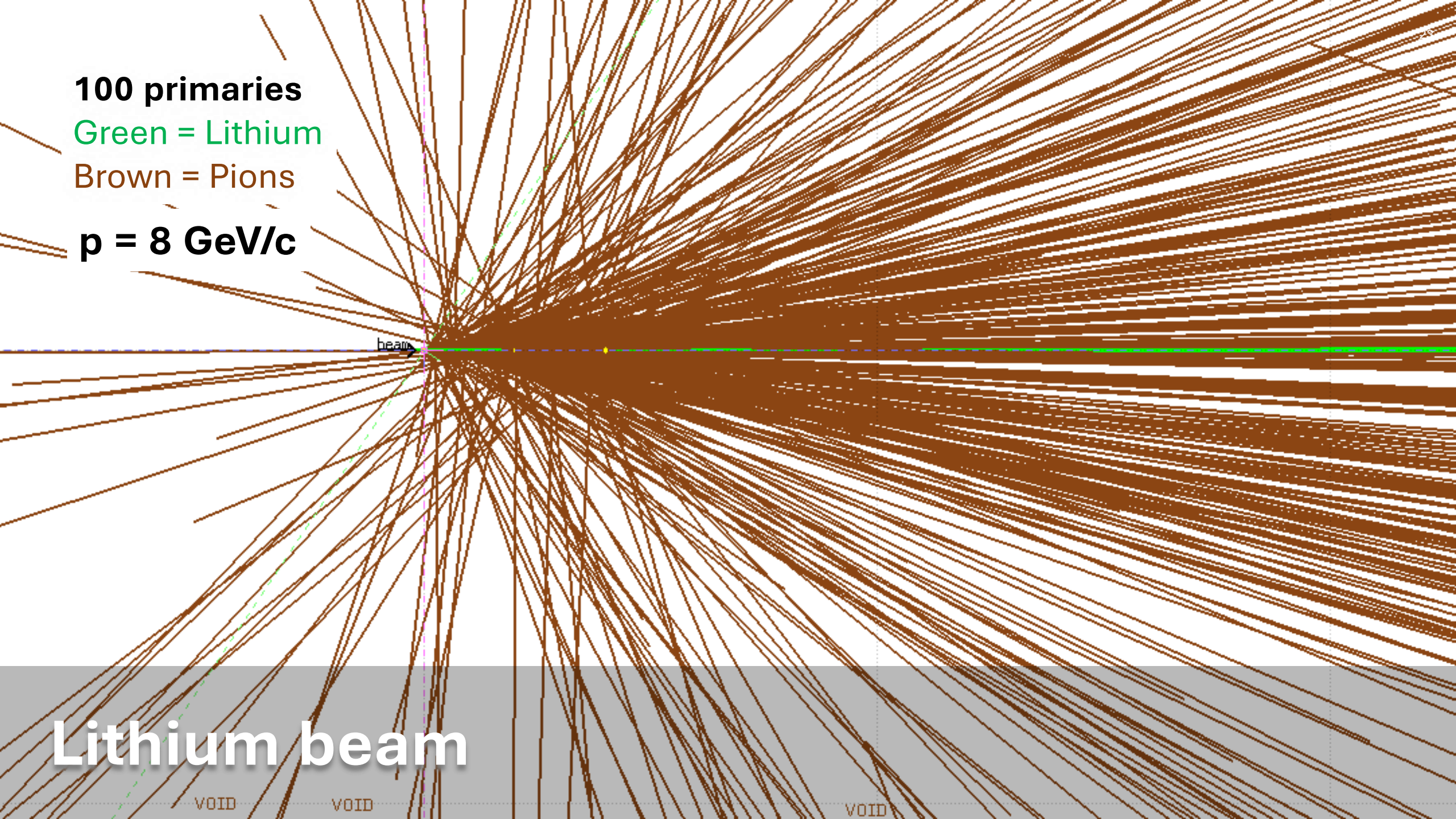
Proton beam



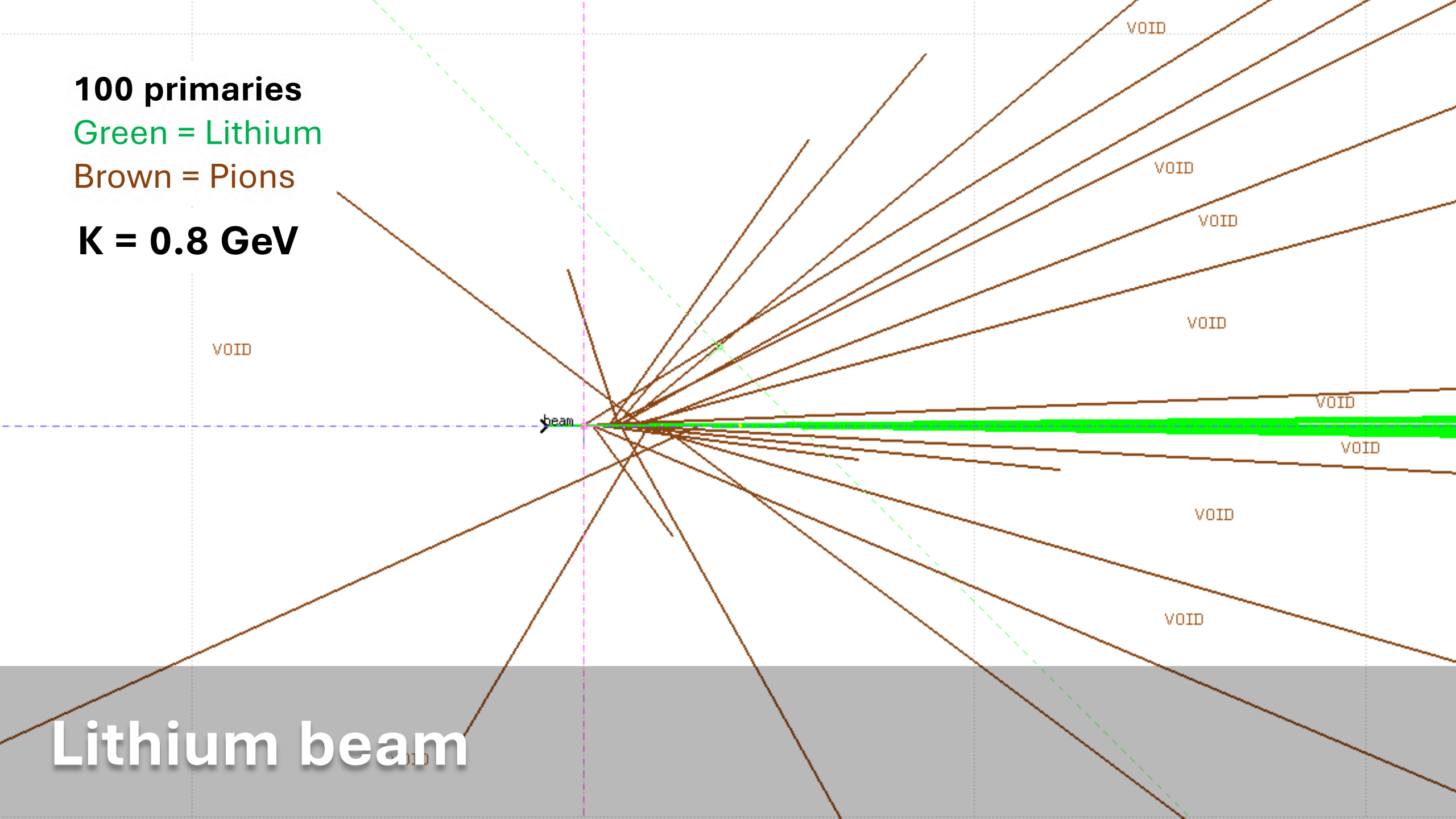
Helium beam

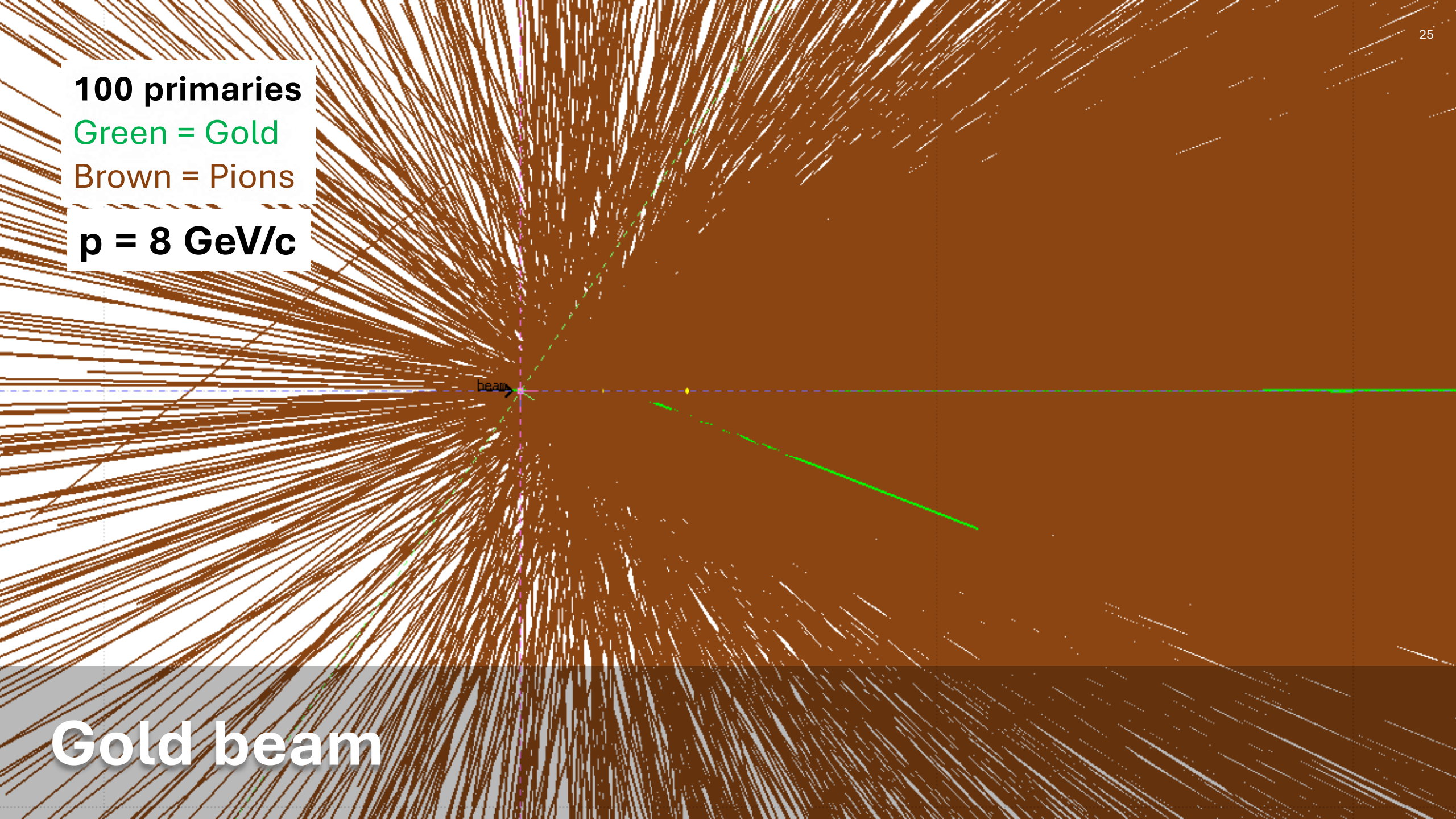

100 primaries
Orange = Helium
Brown = Pions
K = 0.8 GeV
VOID
VOID
VOID
beam

Helium beam

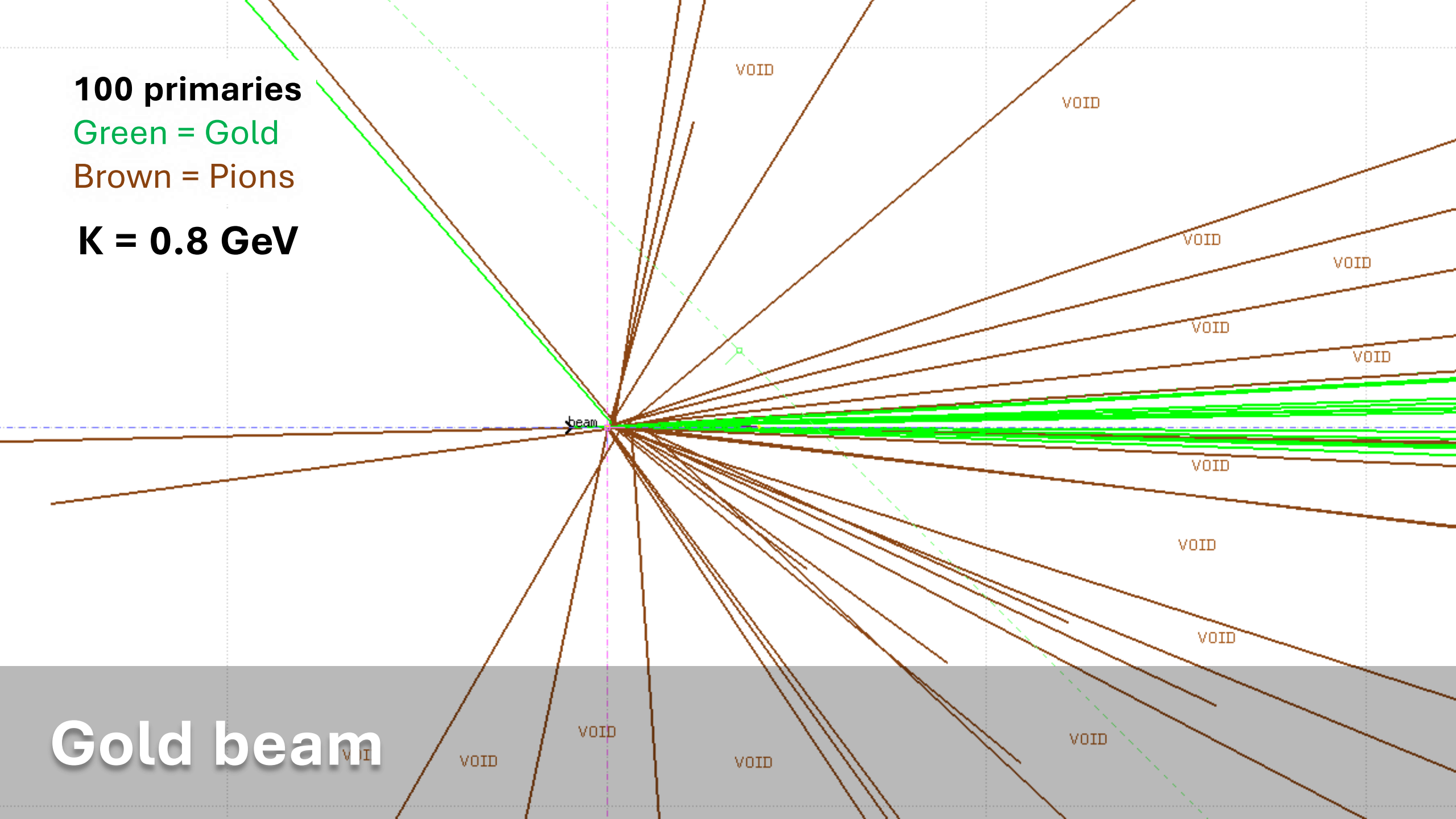


Lithium beam


100 primaries
Green = Lithium
Brown = Pions
K = 0.8 GeV
VOID
VOID
VOID
VOID
VOID
VOID
VOID
VOID
VOID
VOID
beam
Lithium beam



Gold beam


100 primaries
Green = Gold
Brown = Pions
K = 0.8 GeV
VOID
beam
Gold beam