Containment of secondaries produced in pion interactions

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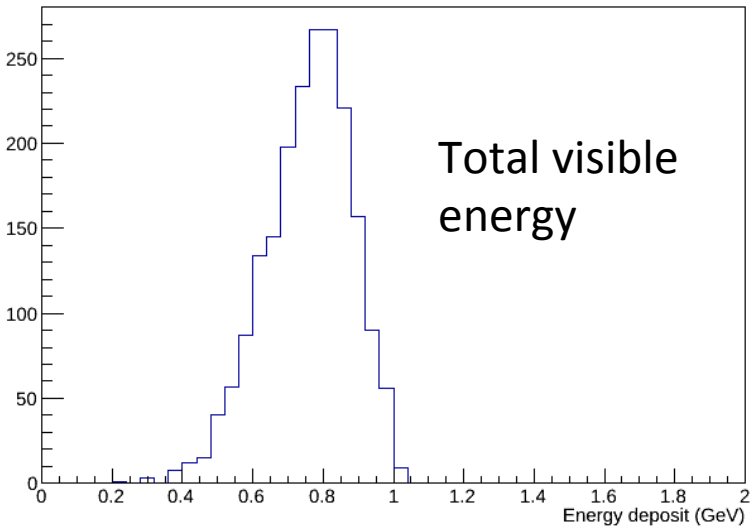
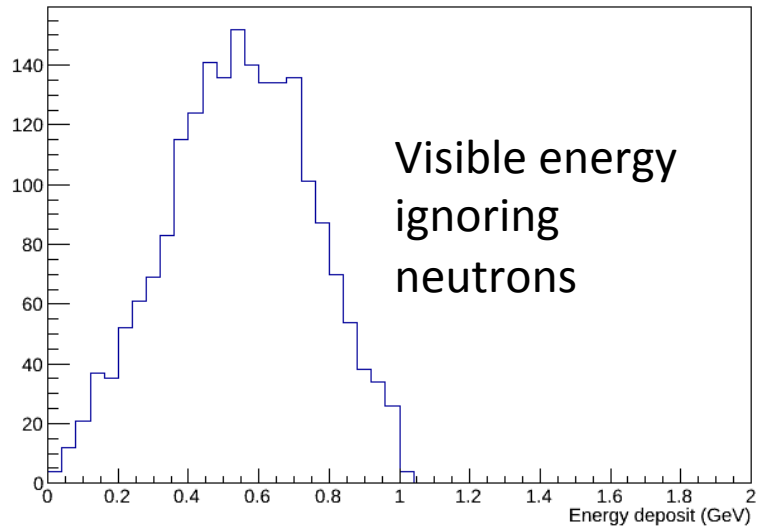
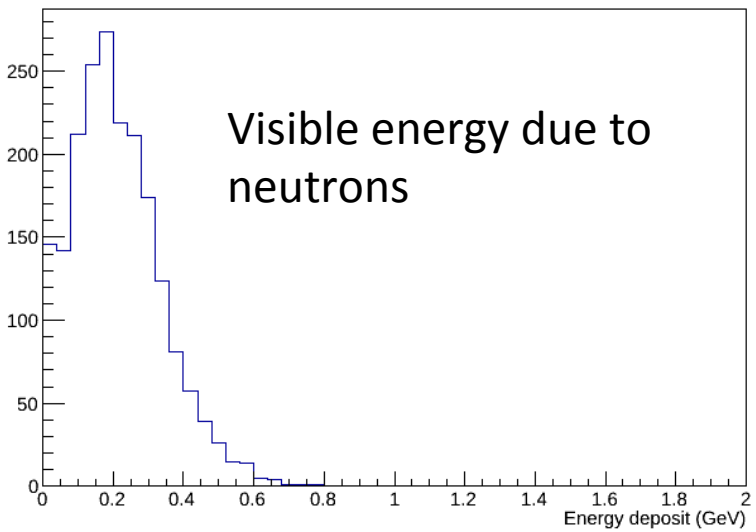
Treatment of neutrons

- Poor apparent containment due to neutrons scattering around the whole detector
  - See my previous presentation
- For now, I am ignoring all neutrons produced in an event
  - This includes any descendant particles of the neutrons

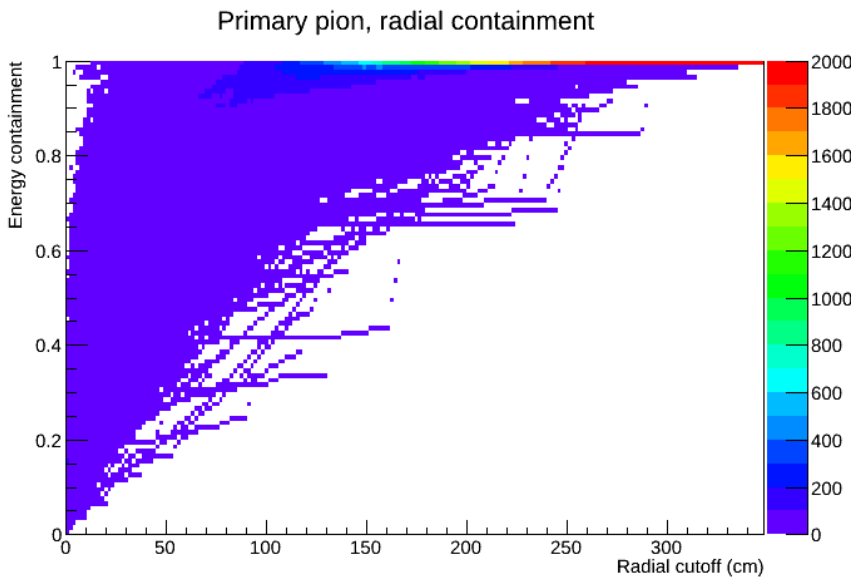
Visible energy (1GeV pion)

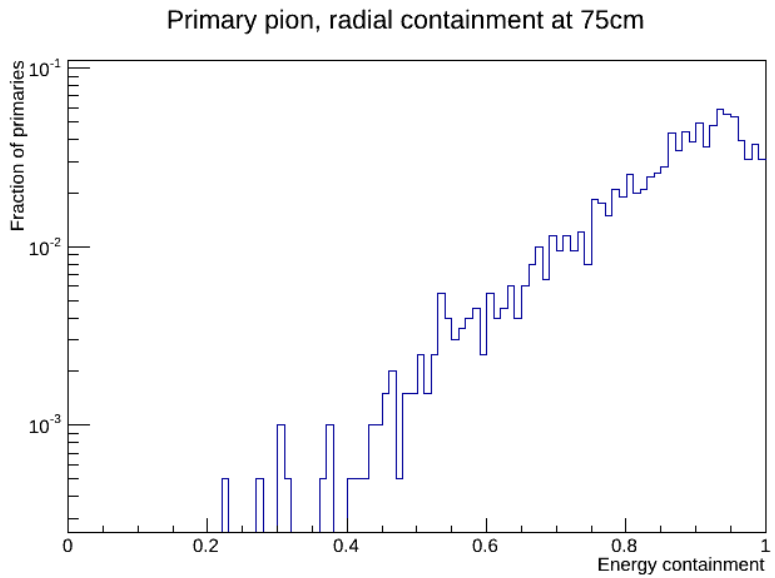


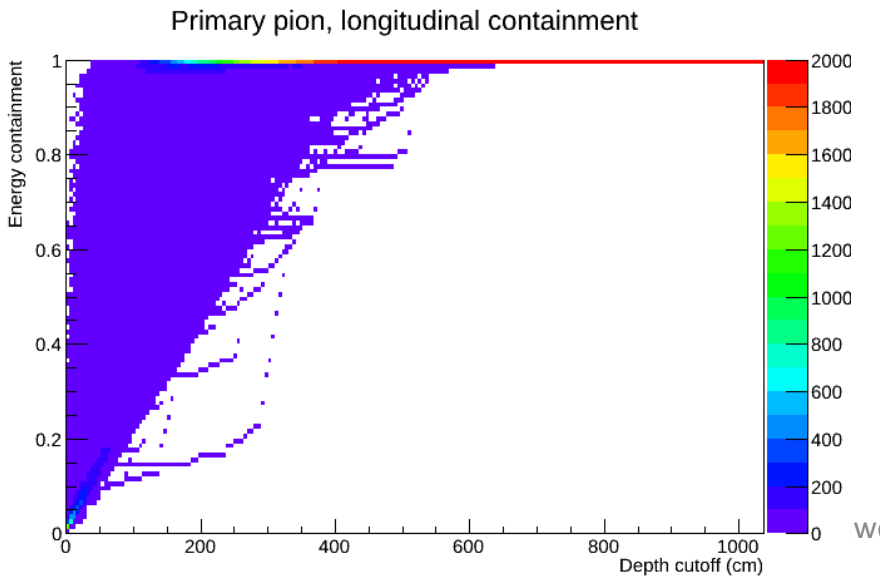


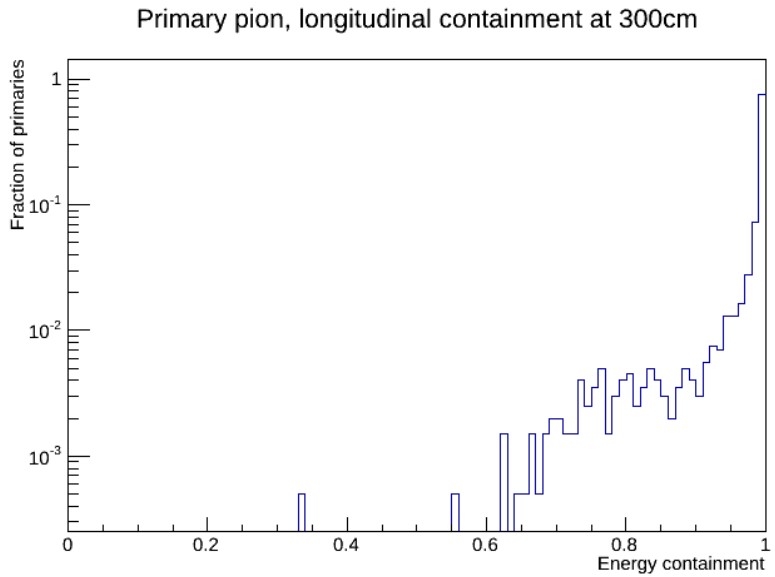


Containment with neutrons









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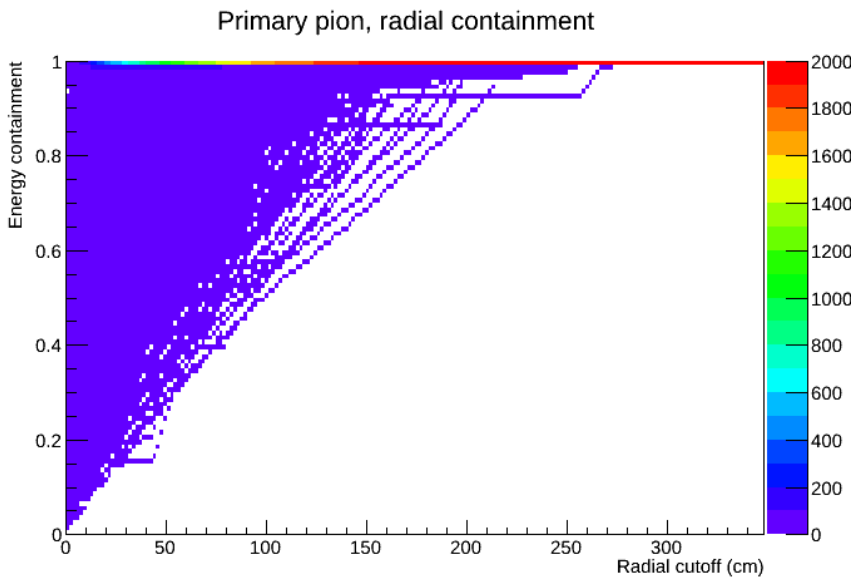
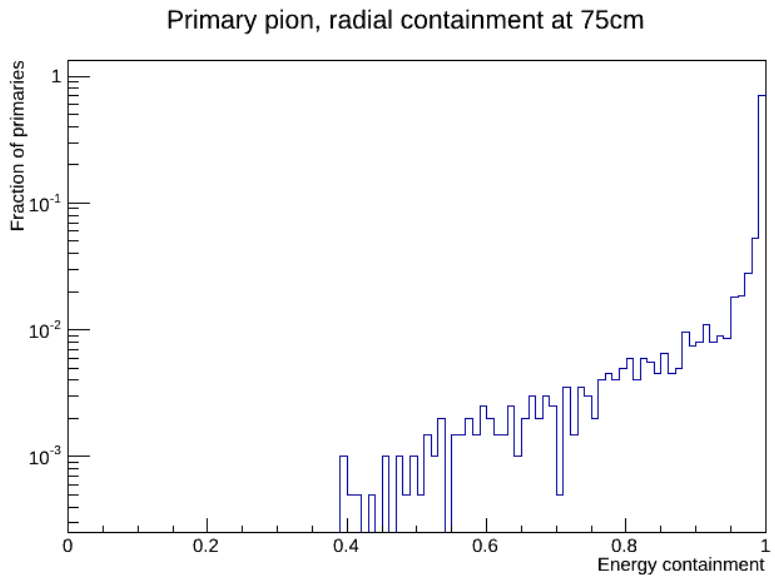
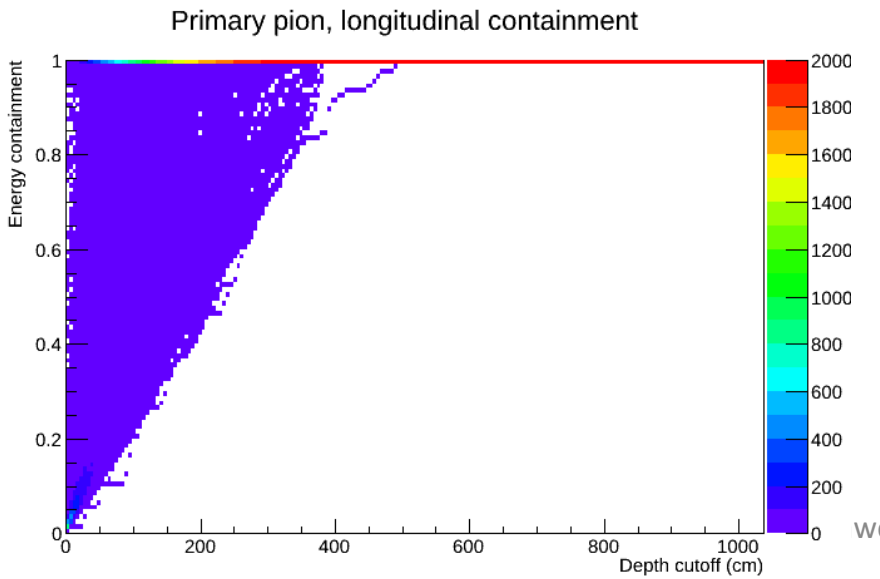
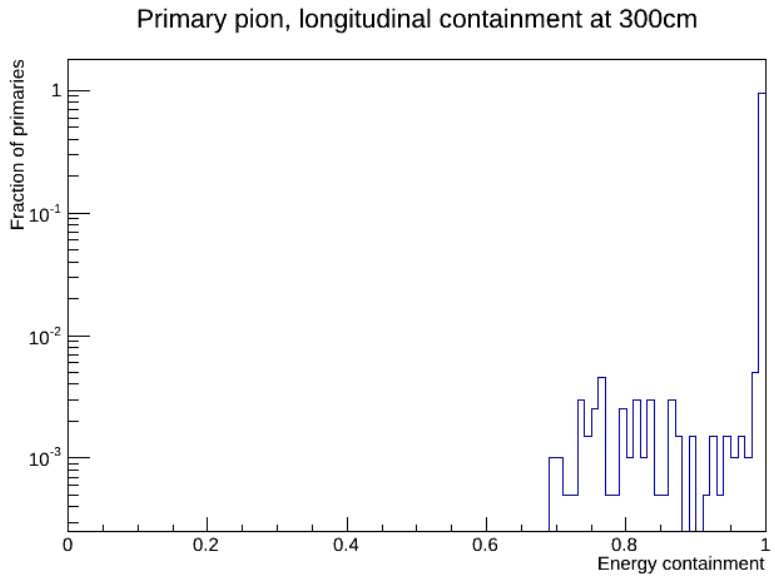
Ignoring neutrons









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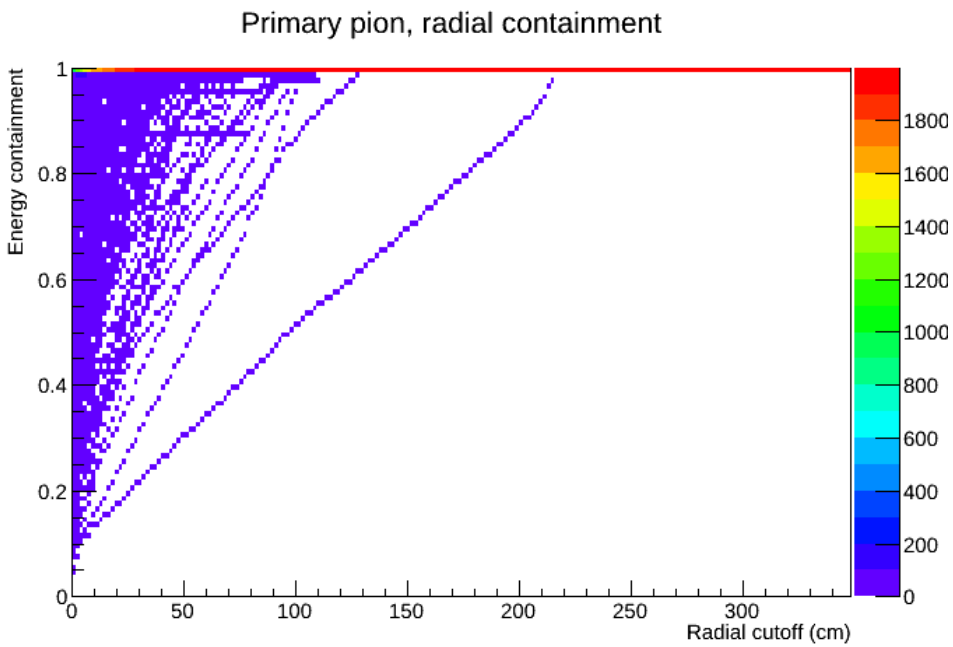
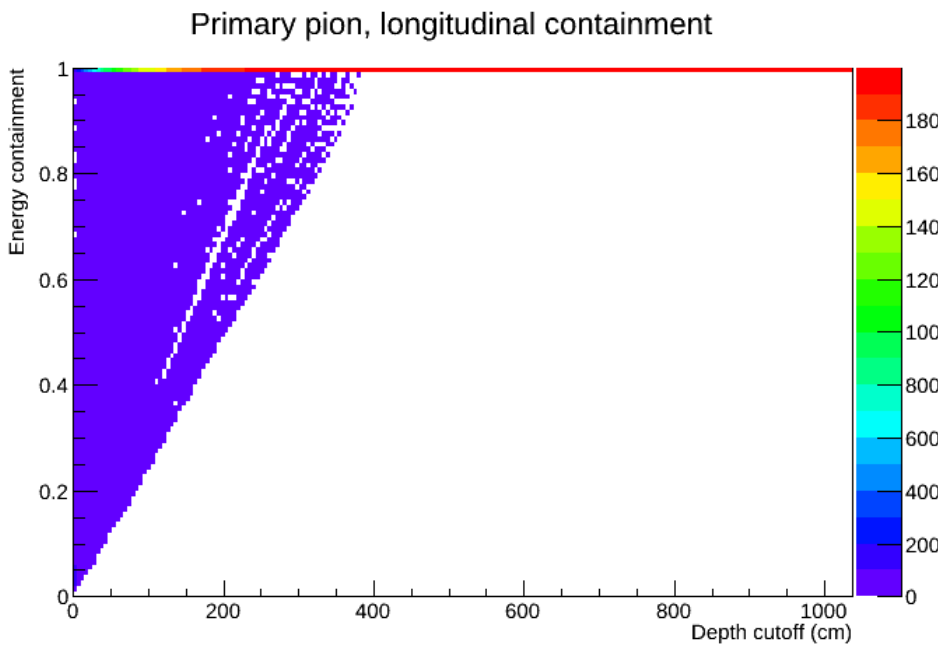
The primary pion

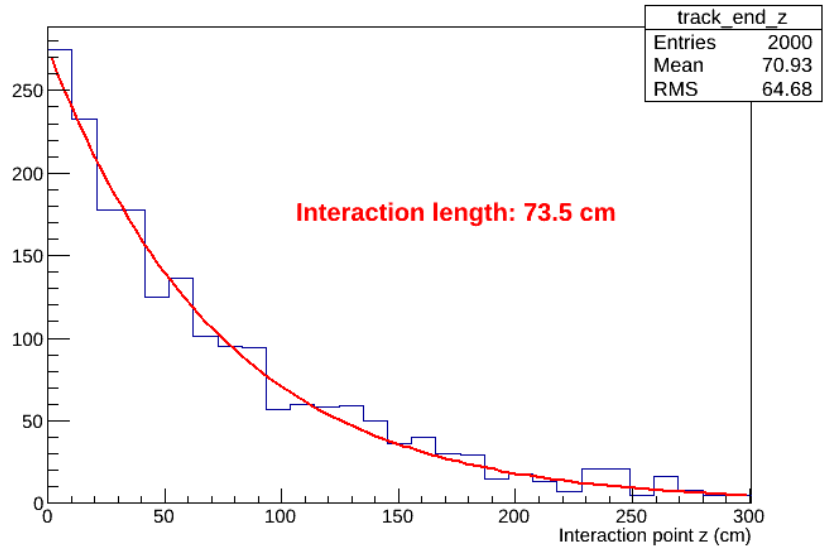
- The 1GeV pion on its own (the ionisation track, before reinteraction) is well contained in (r<75cm, z<300cm)



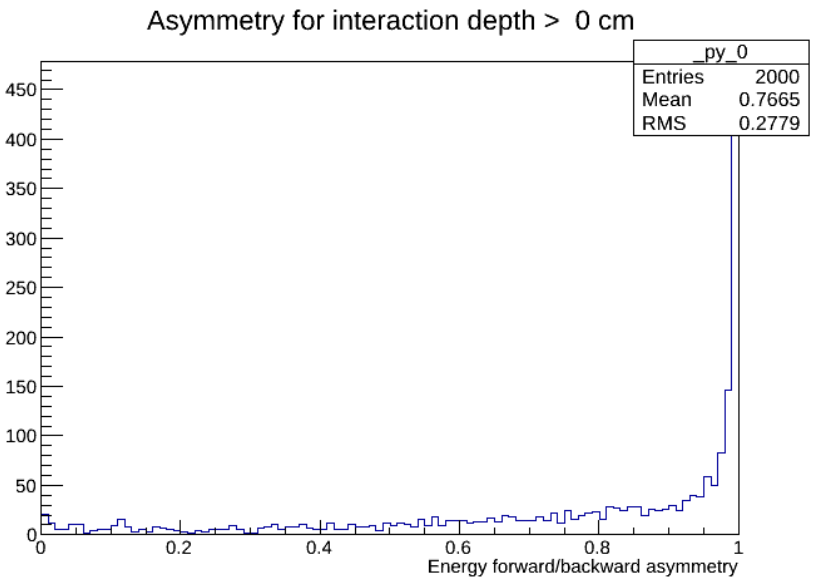


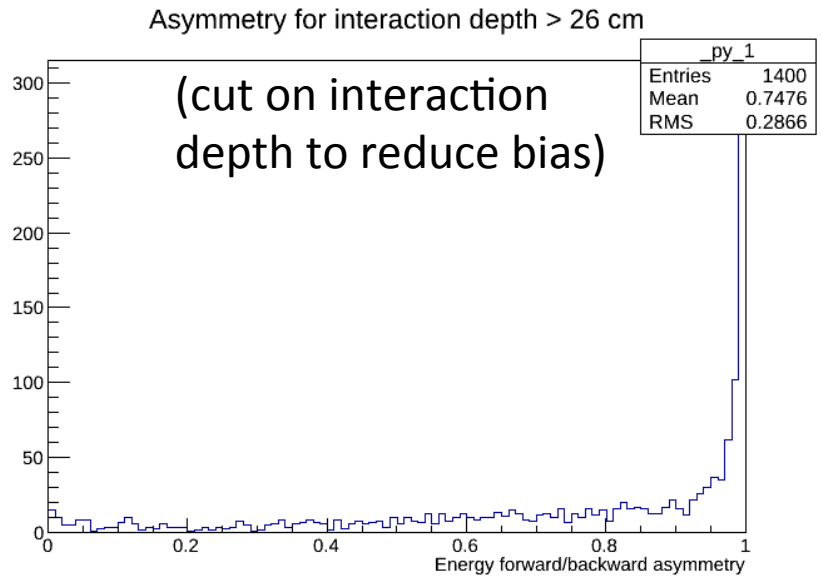
Pion interaction point

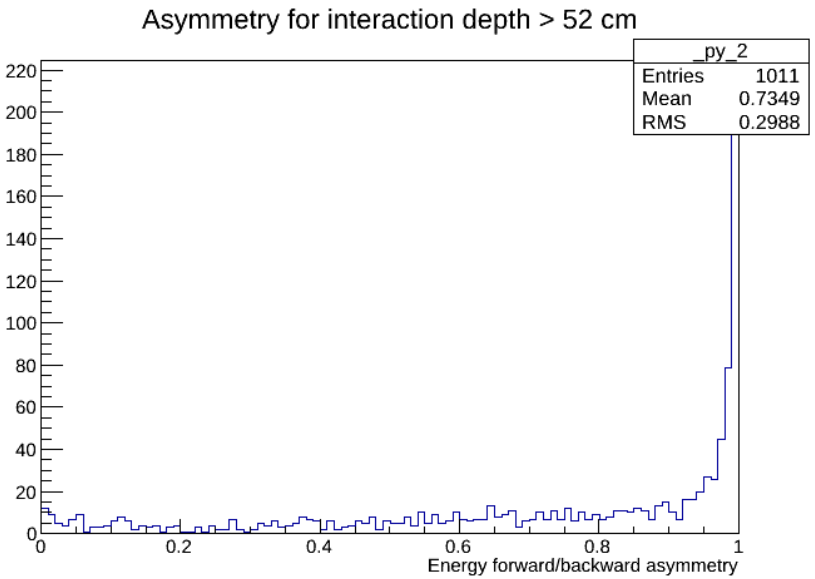
- Most pions interact close to the front of the detector
- Most of the energy of the secondaries is forward going (next slide)
  - Even when accounting for bias when interaction point is near the front

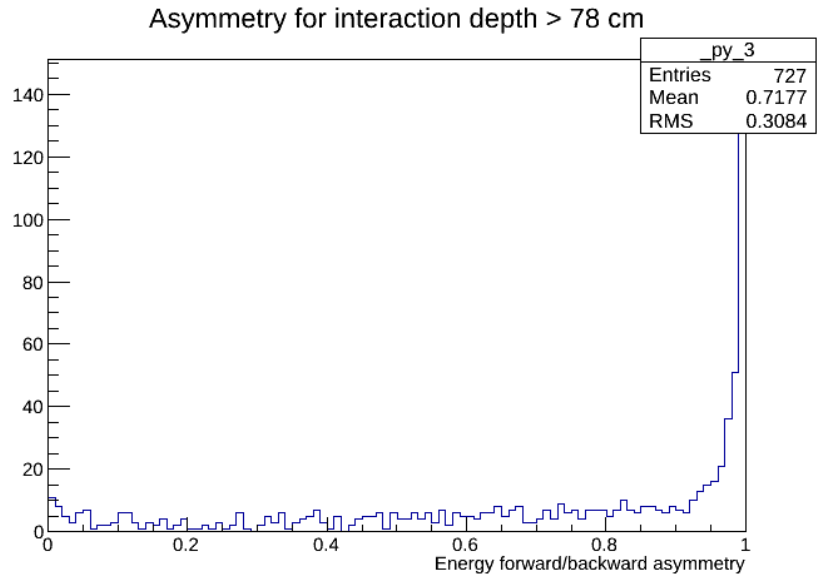


Secondary energy forward/backward asymmetry (1 = all forward, 0 = all backward)









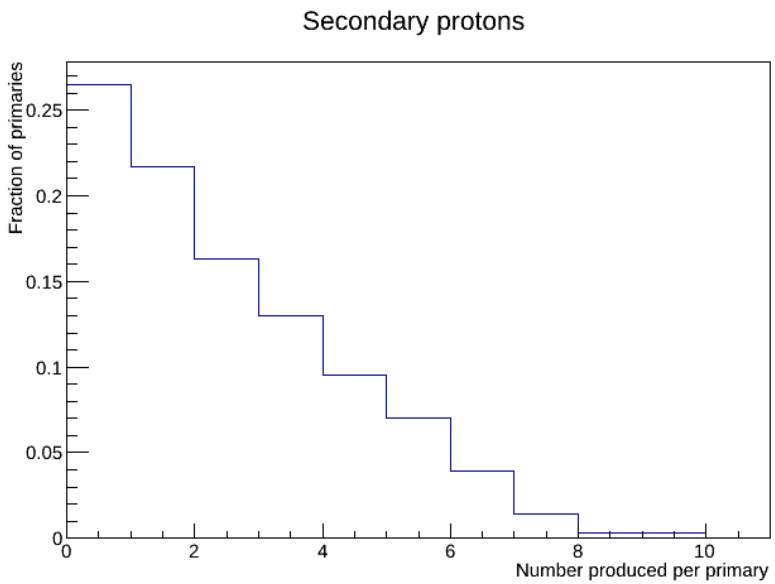
Secondaries

- After reinteraction, the secondaries are mainly protons, neutrons, other pions*, π^0s, and muons
- There are also nuclear deexcitation photons (E < 10 MeV), recoil nuclei (very short tracks), and in rare cases strange particles (K^0, Λ^0)
  - These I have not studied further

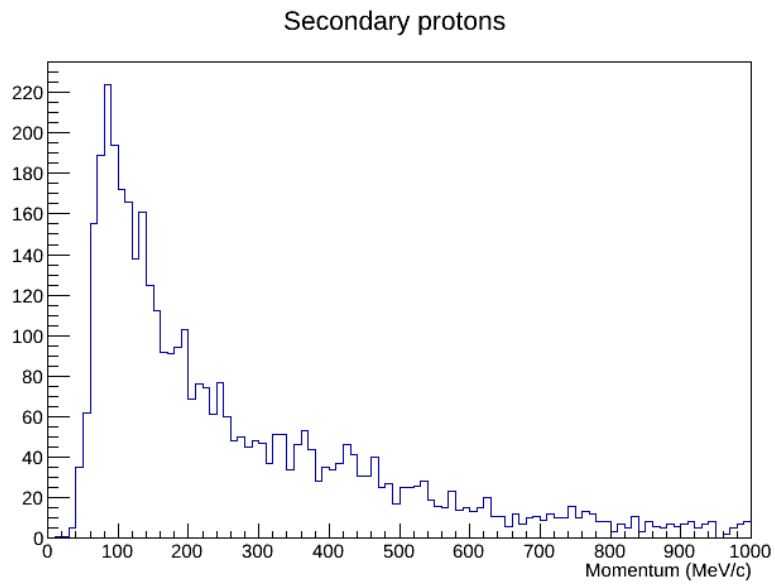
*nomenclature: 'pion' = charged pion

Protons

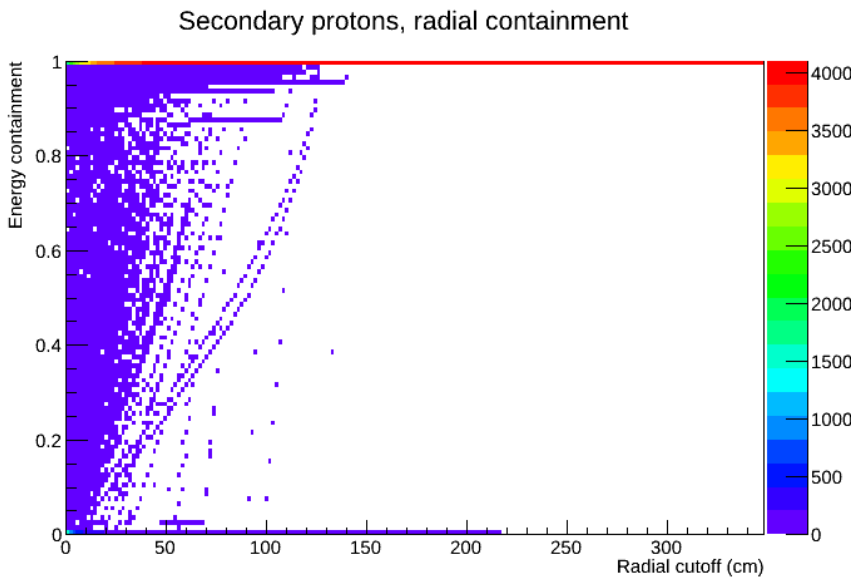
Number of protons produced per incoming pion

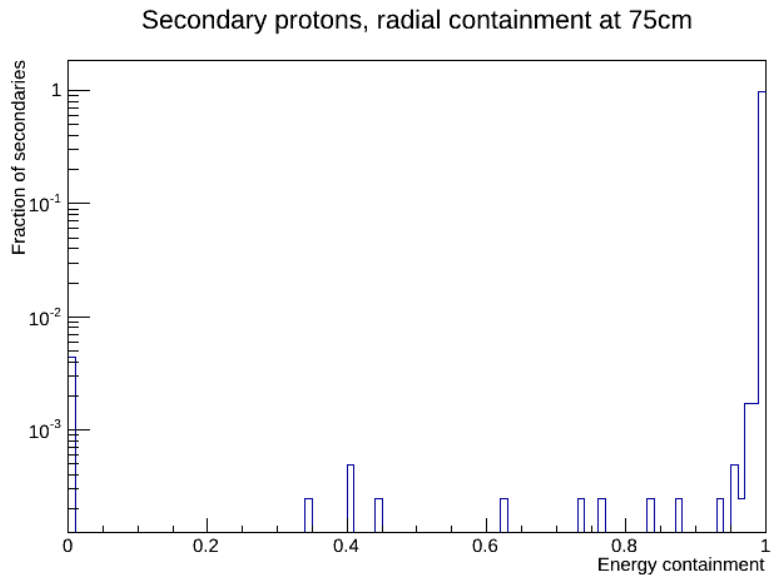


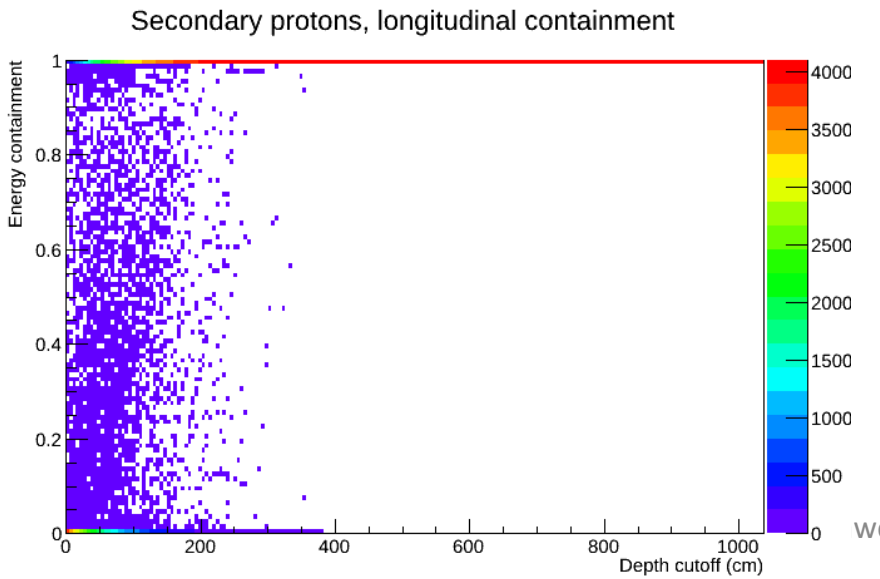
Momentum of these protons

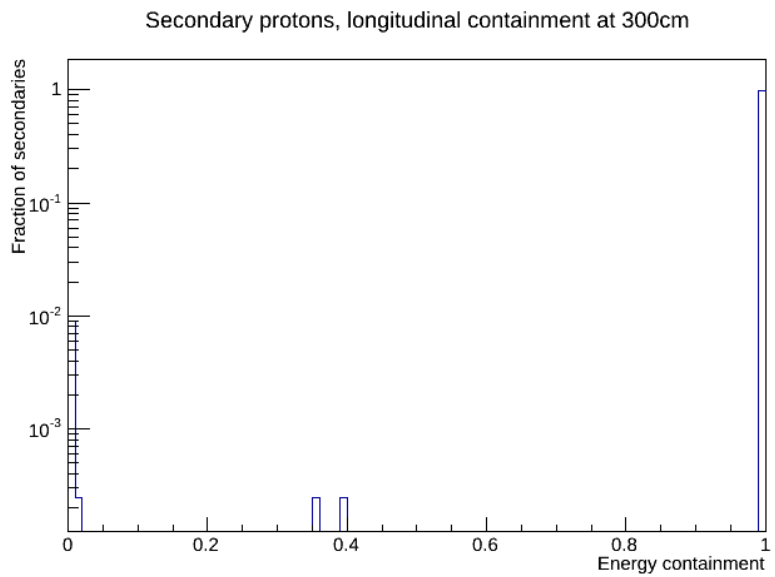


Protons









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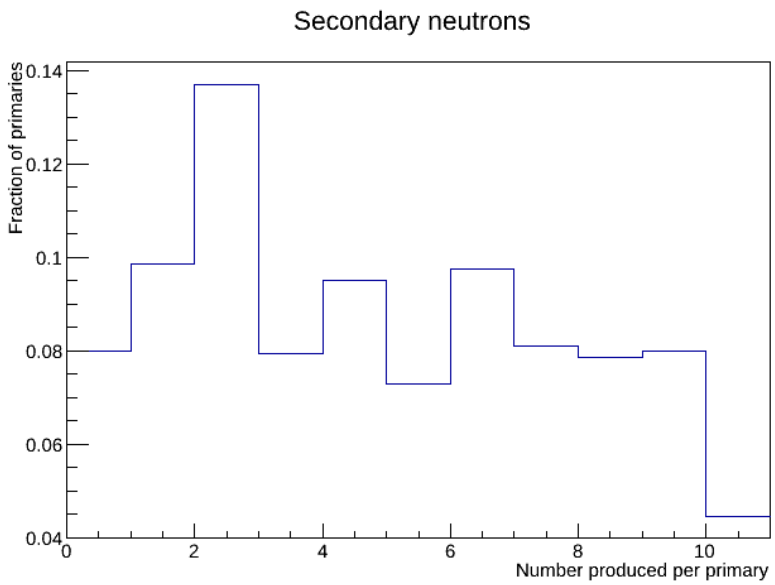
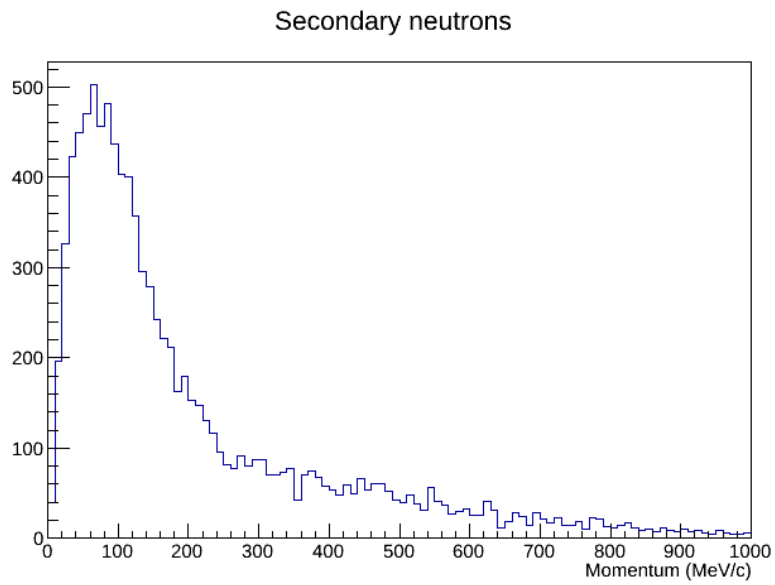
Neutrons

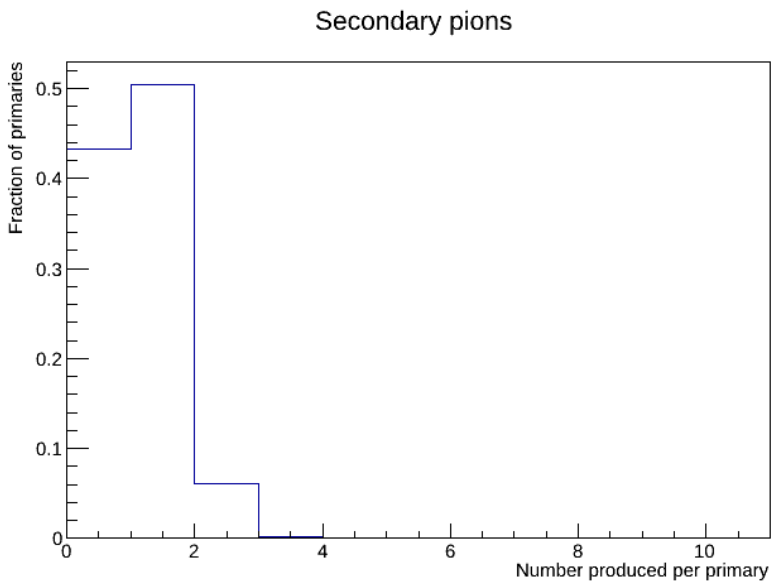
As I am ignoring their deposits, I have no containment plots for these

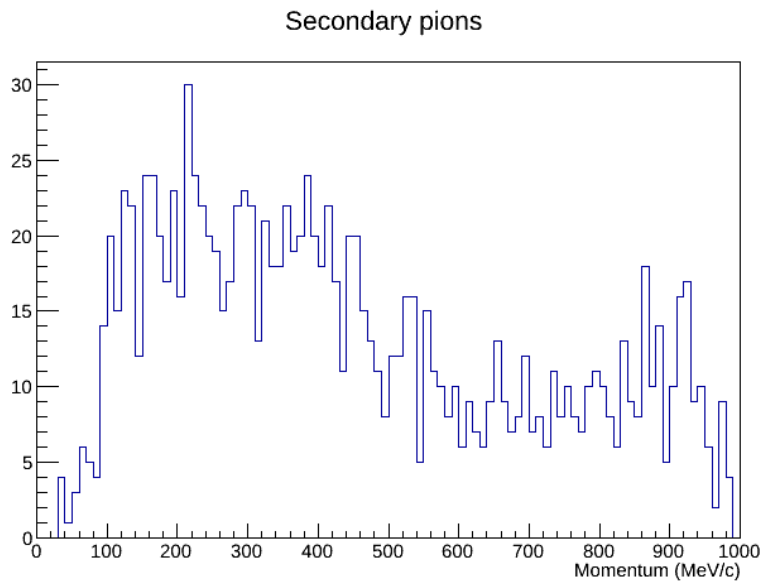




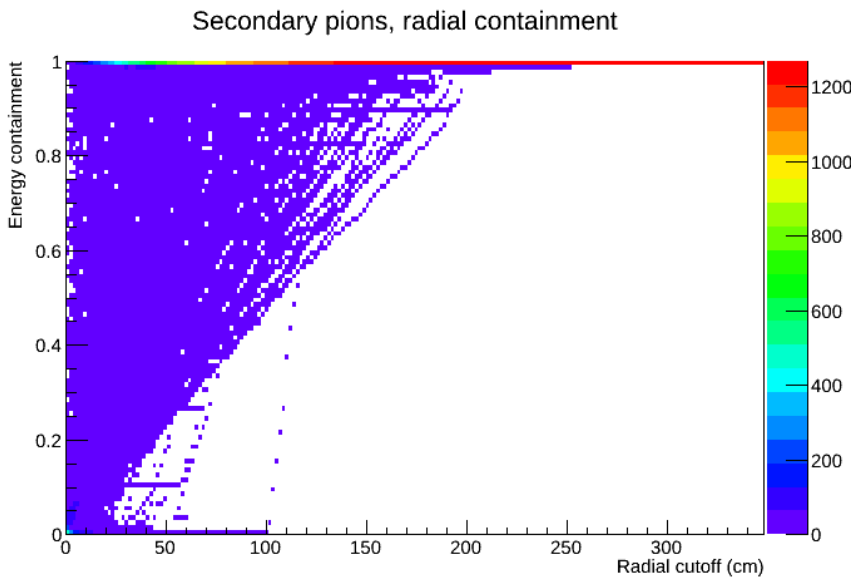
Pions

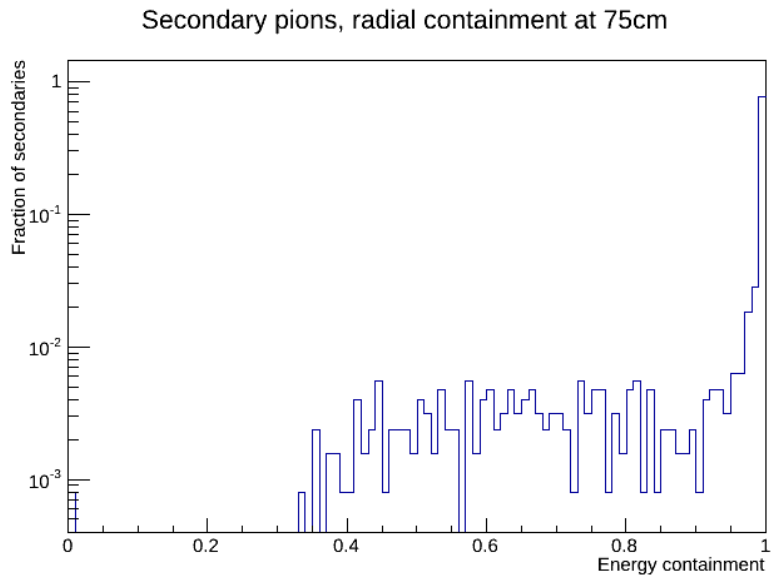
(Containment plots include any tertiaries produced by these pions)

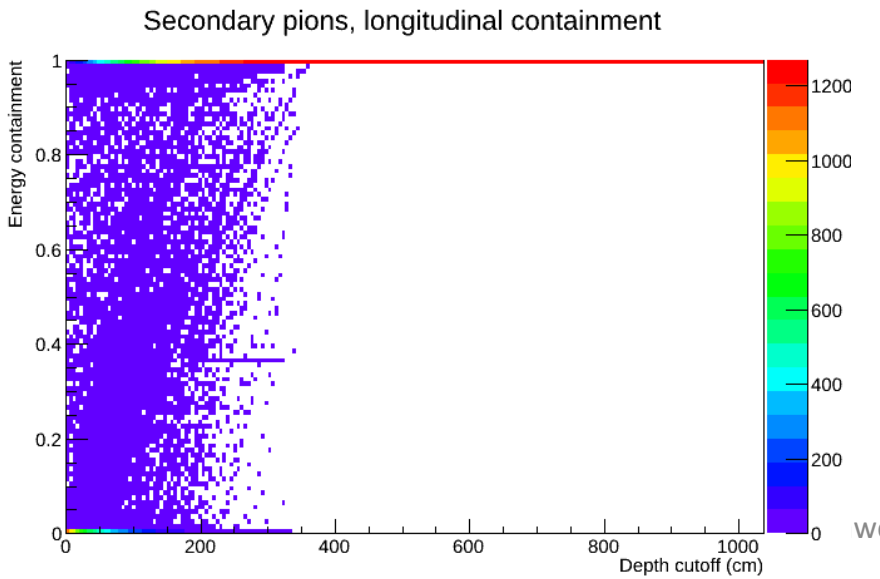


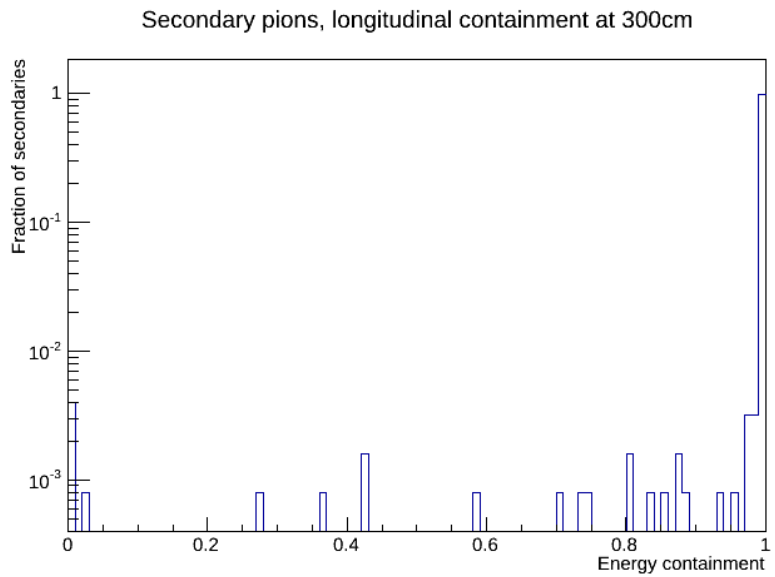


Pions









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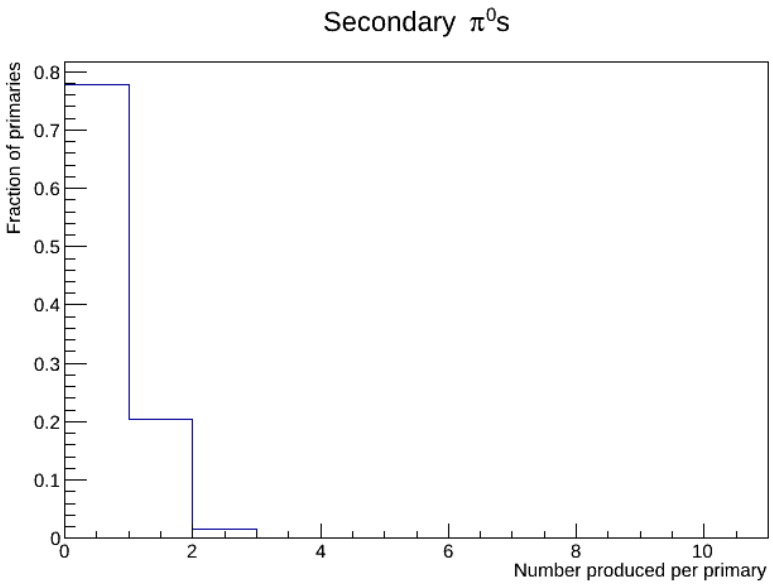
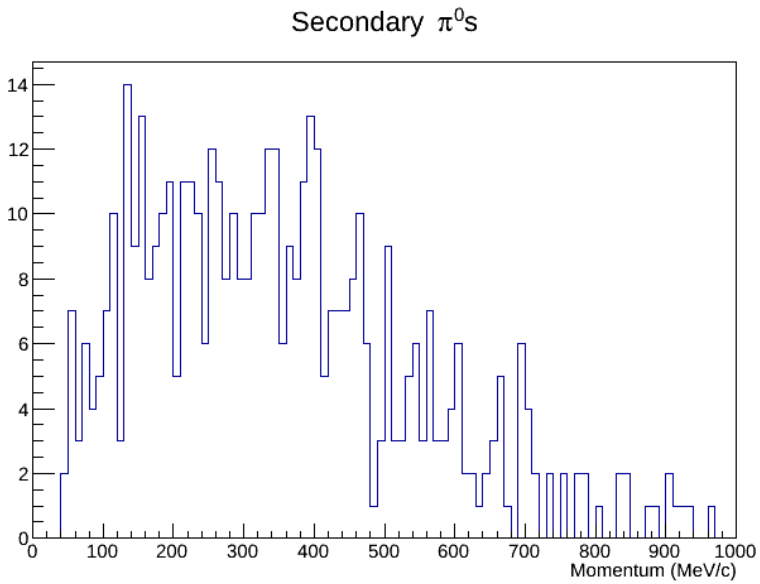
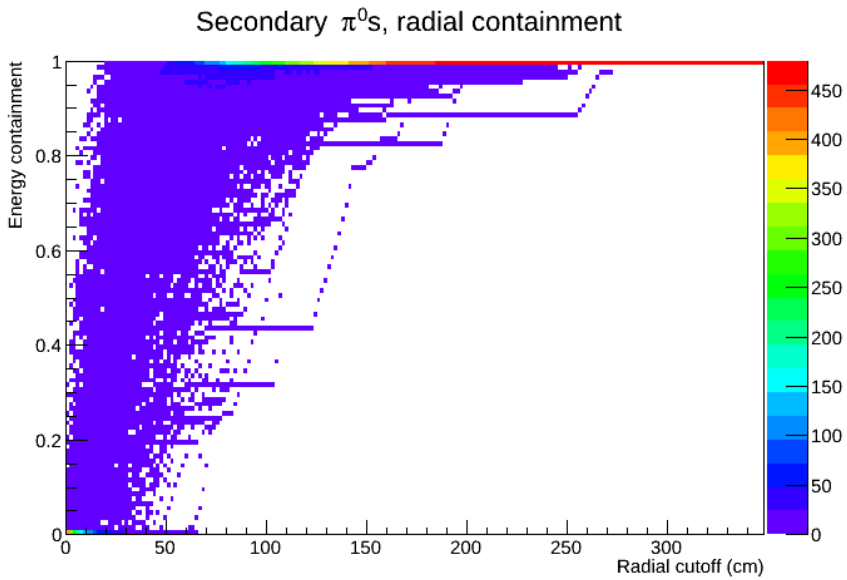
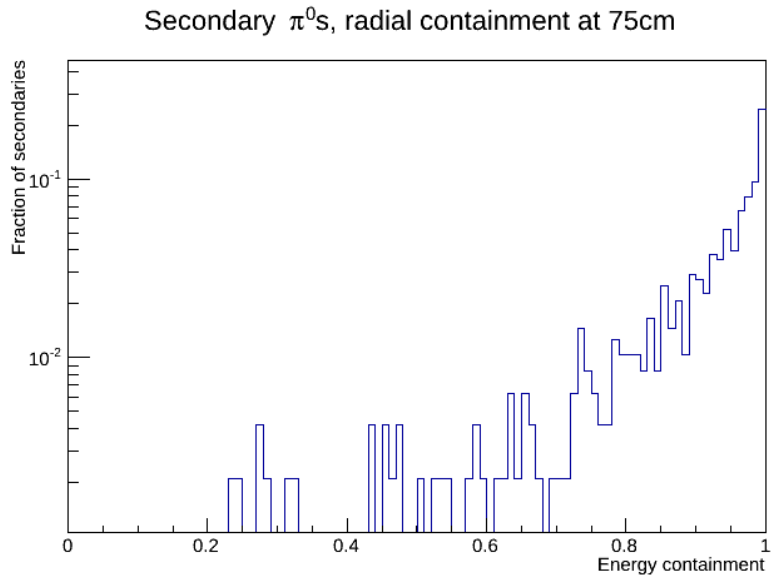
π^0s

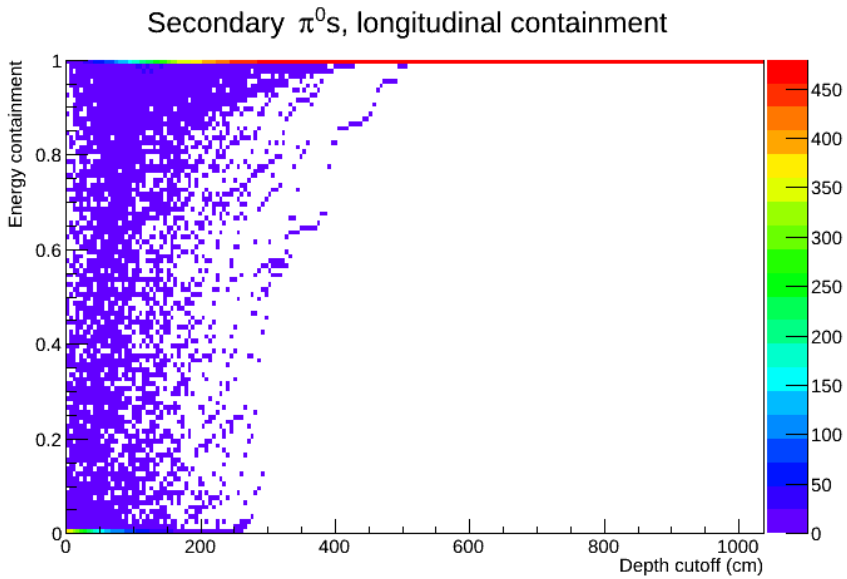

Secondary π^0s
Fraction of primaries
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
2
4
6
8
10
Number produced per primary

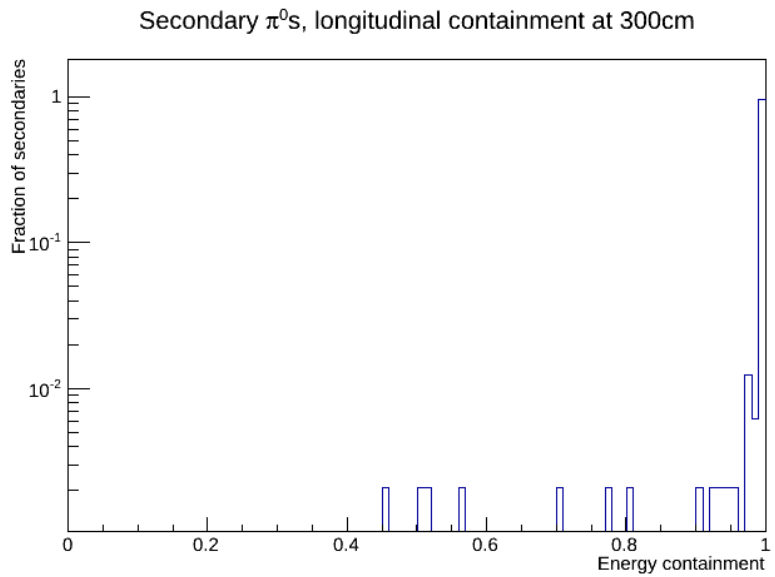

Secondary π^0s
14
12
10
8
6
4
2
0
0
100
200
300
400
500
600
700
800
900
1000
Momentum (MeV/c)

π^0s









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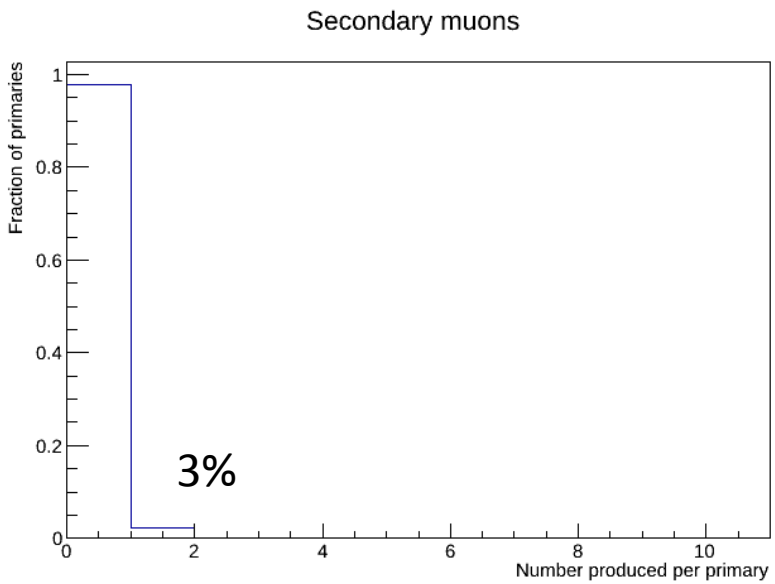
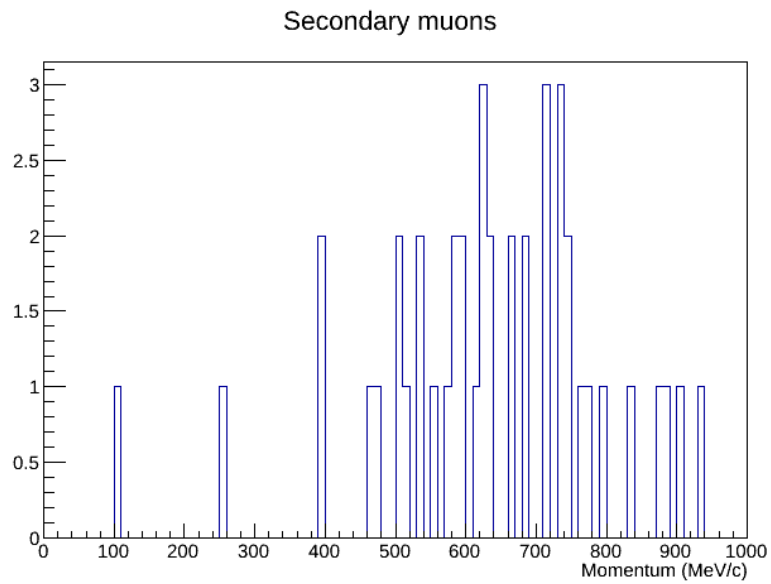
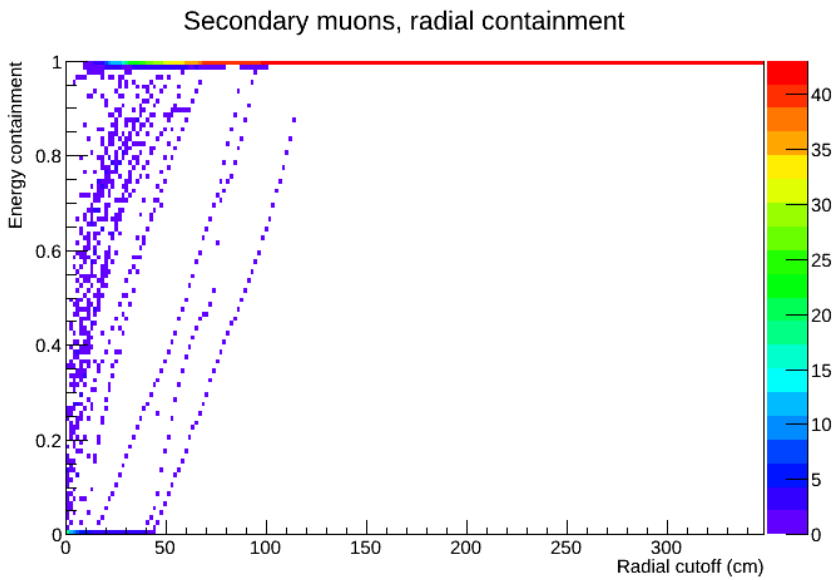
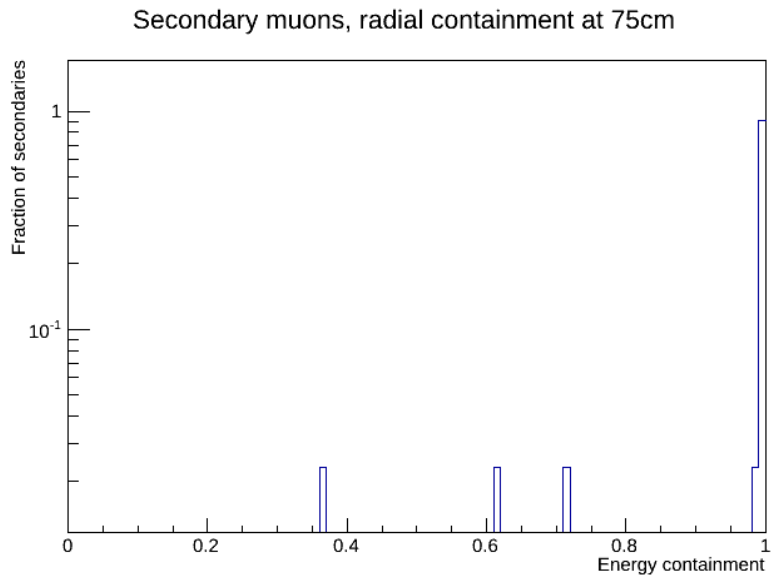
Muons

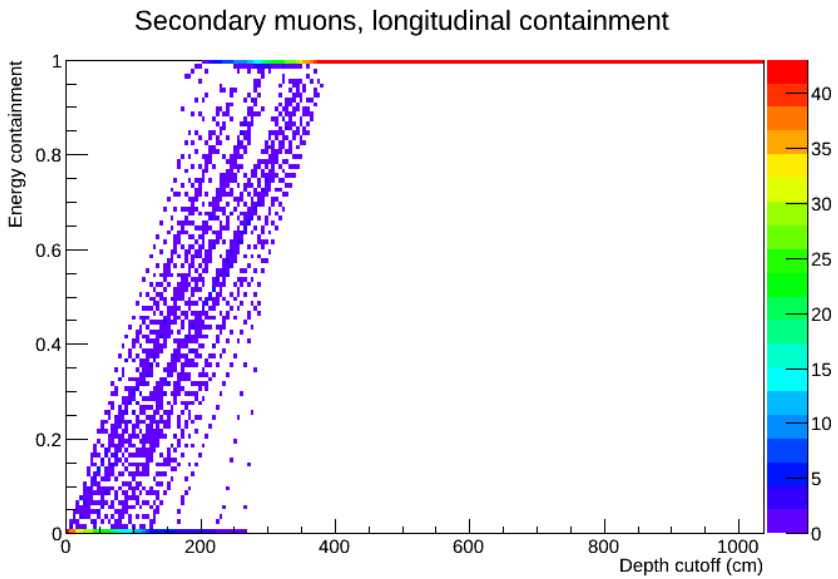

Secondary muons
Fraction of primaries
Number produced per primary
3%

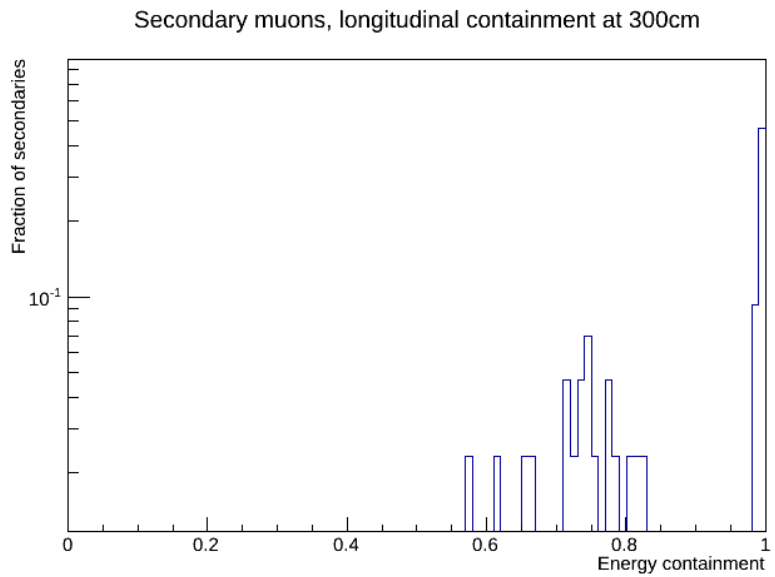

Secondary muons
Momentum (MeV/c)

Muons









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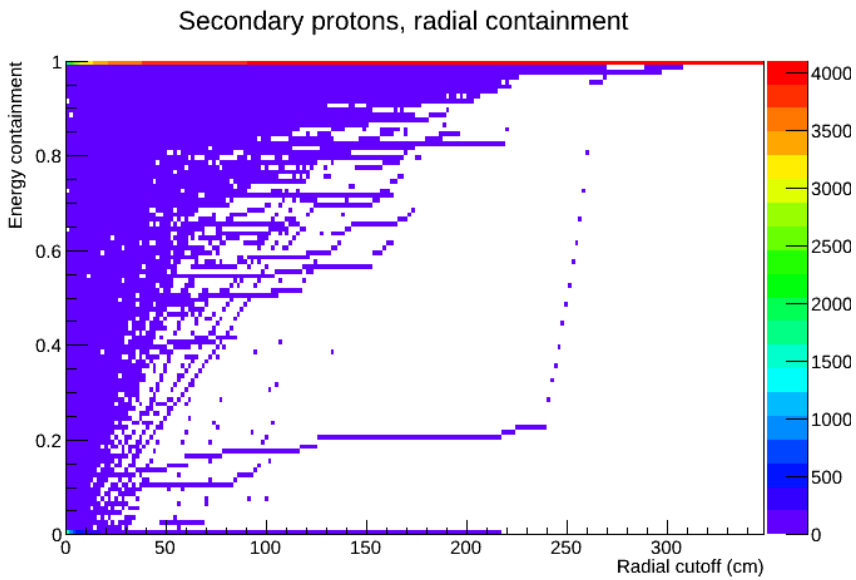
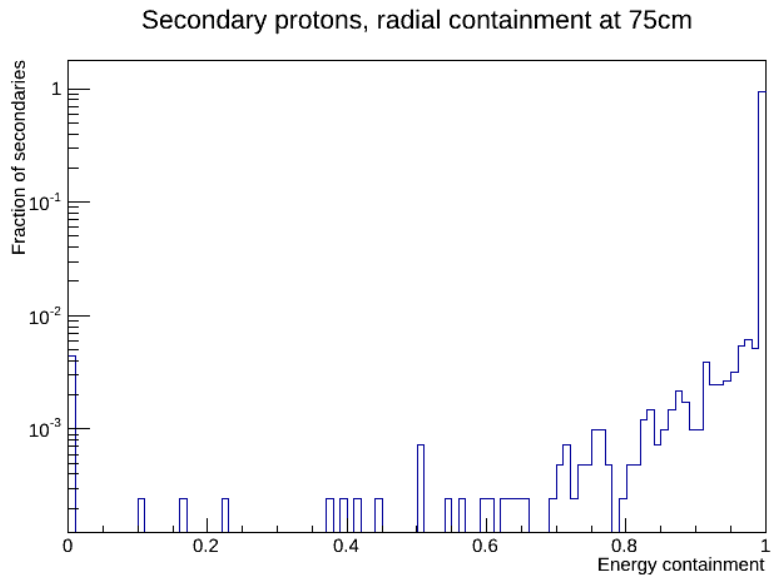
Conclusions

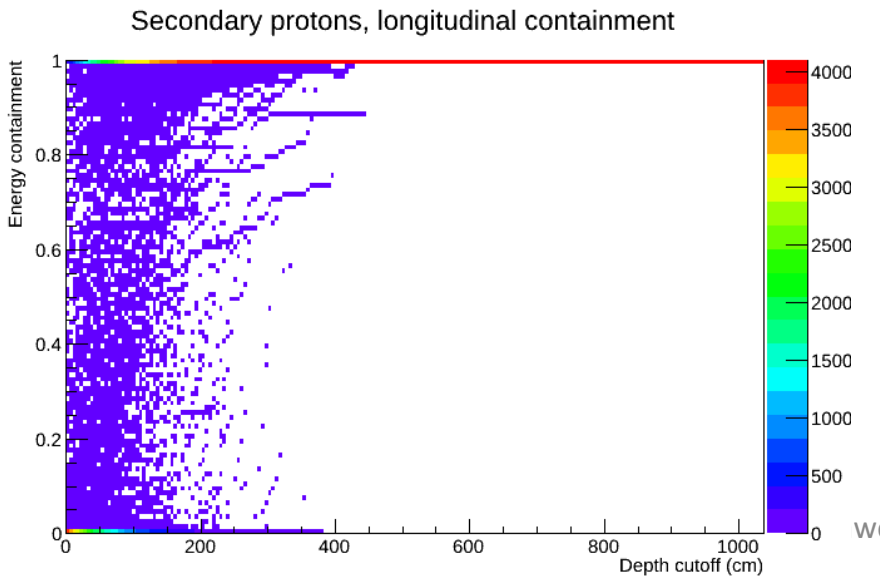
- Most of the poor radial containment of a 1GeV pion (after removing all neutrons) is due to any π^0s produced
  - Only around 20% of the decay showers fully contained within a radius of 75cm
- Secondary protons, pions, muons are relatively well contained in (r<75cm, z<300cm)
  - Around 50% of muons not contained longitudinally

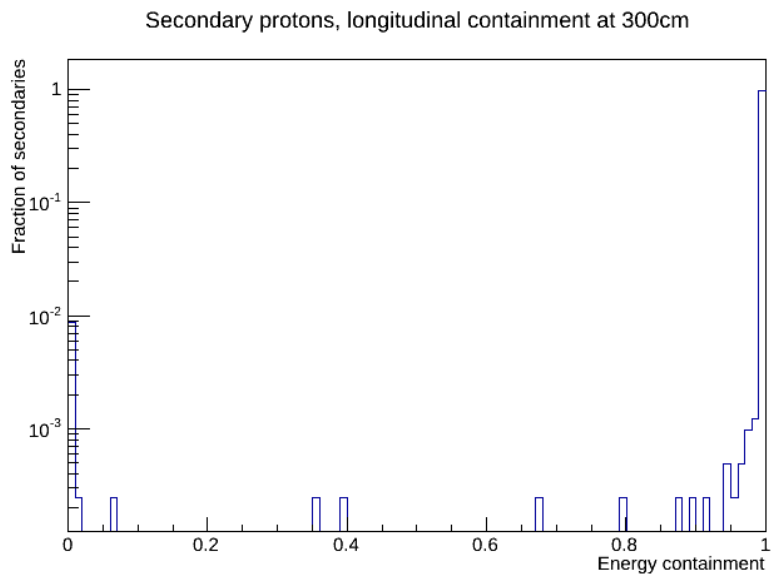
BACKUP:
INCLUDING ALL NEUTRONS

Protons









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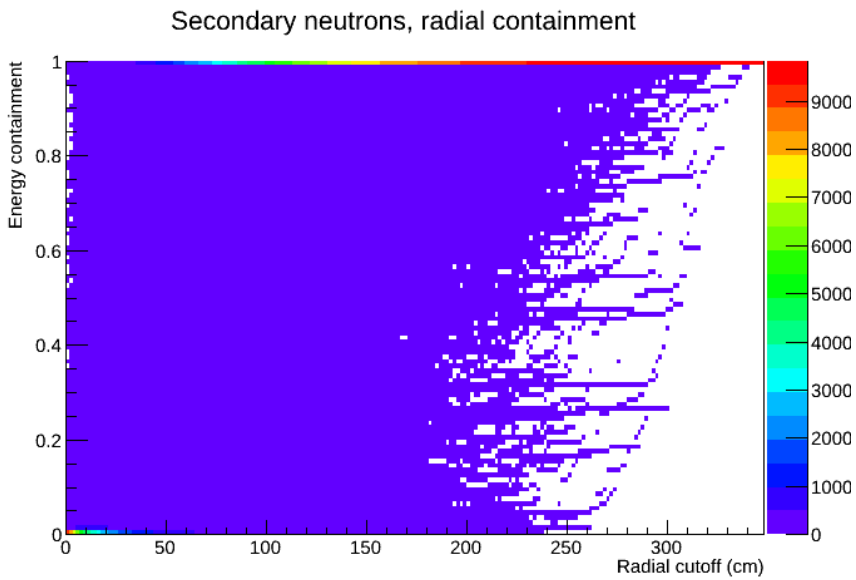
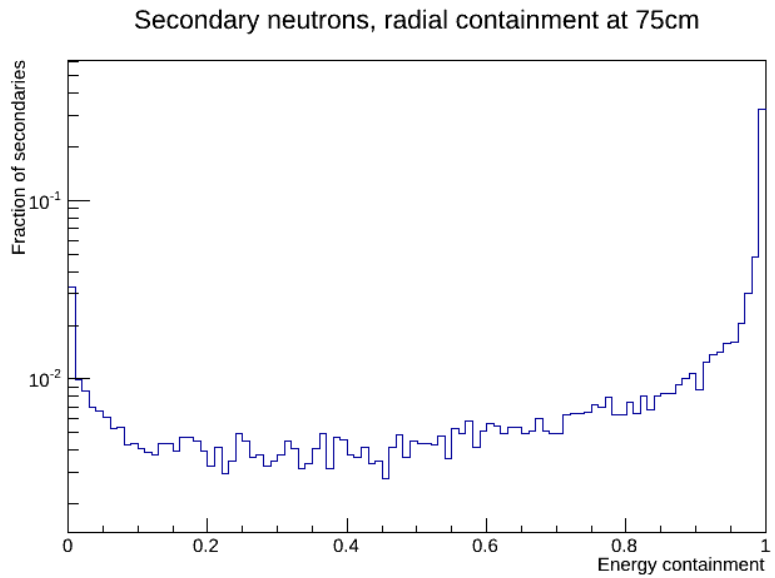
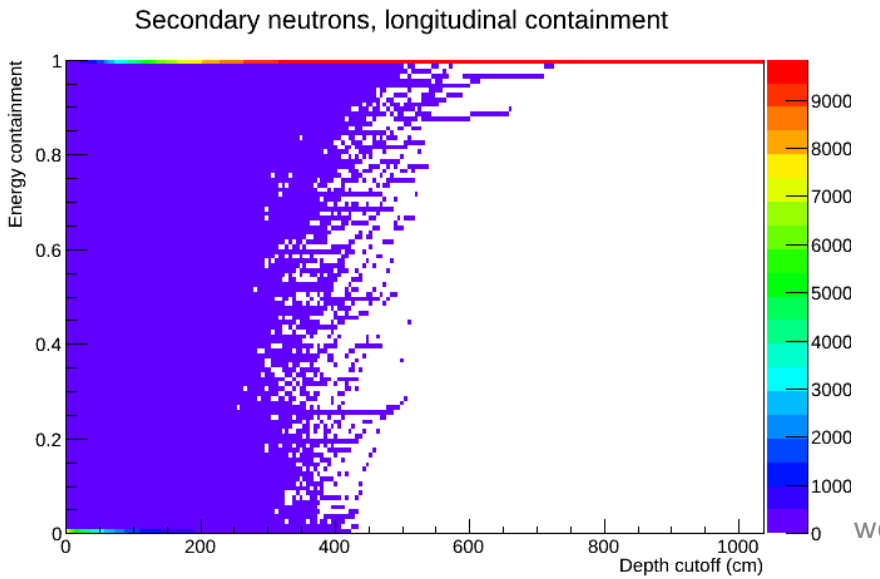
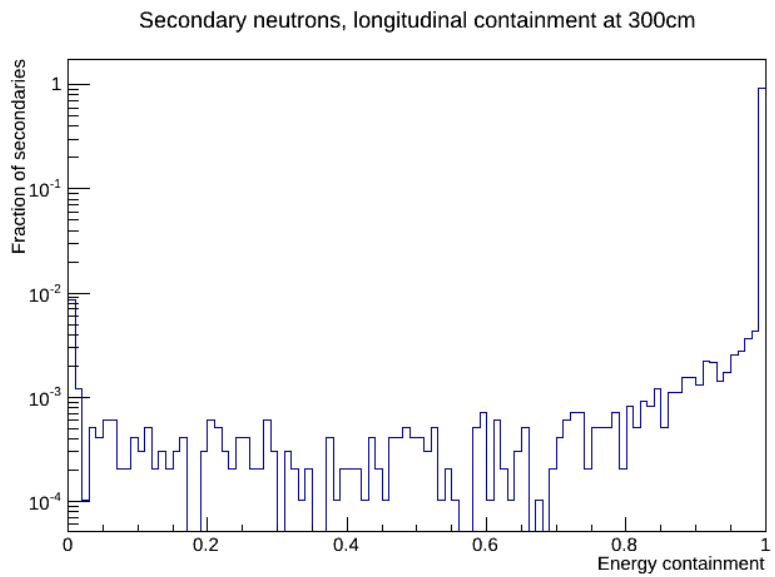
Neutrons









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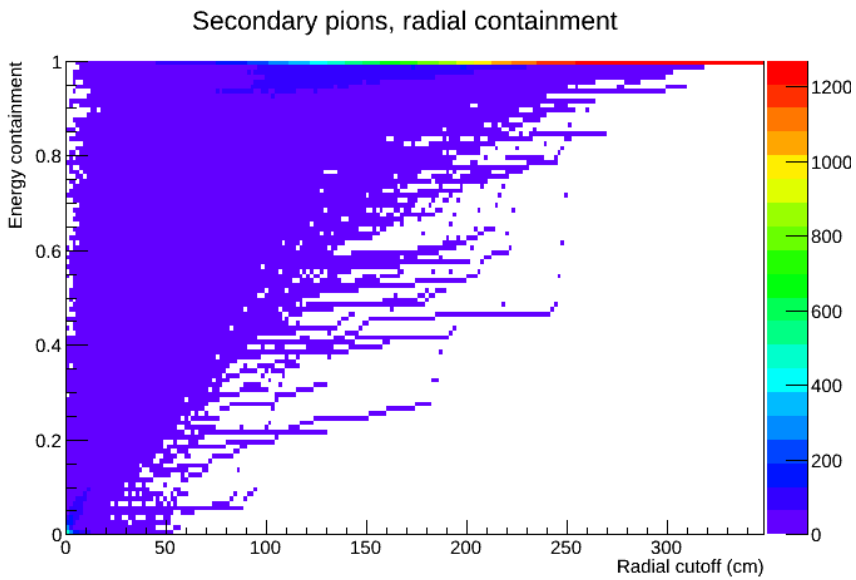
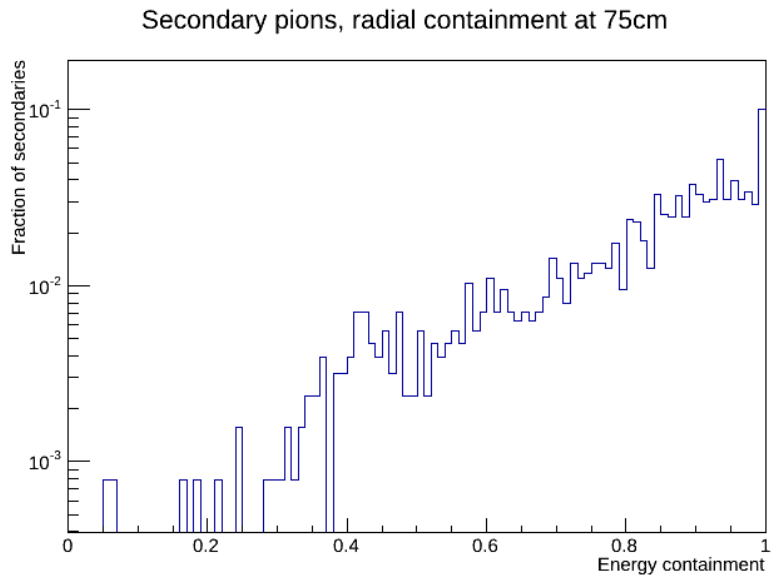
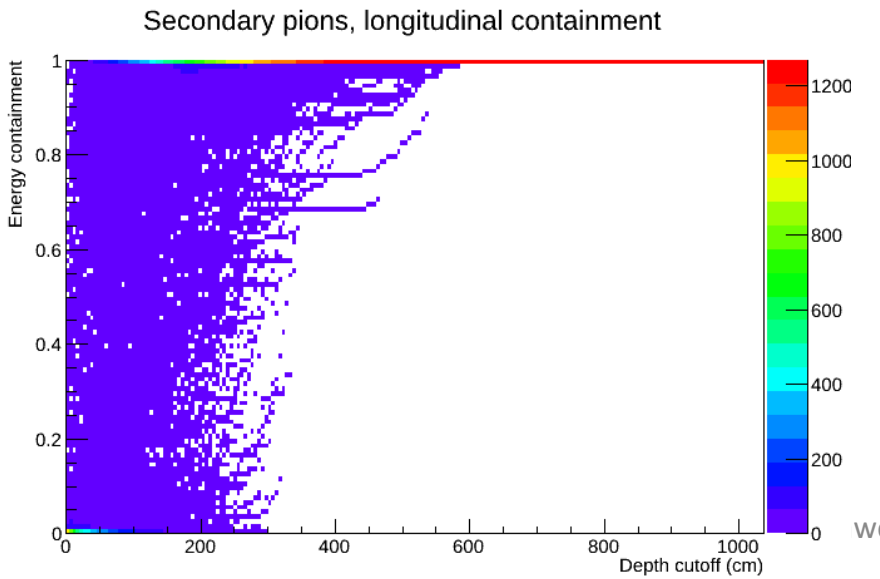
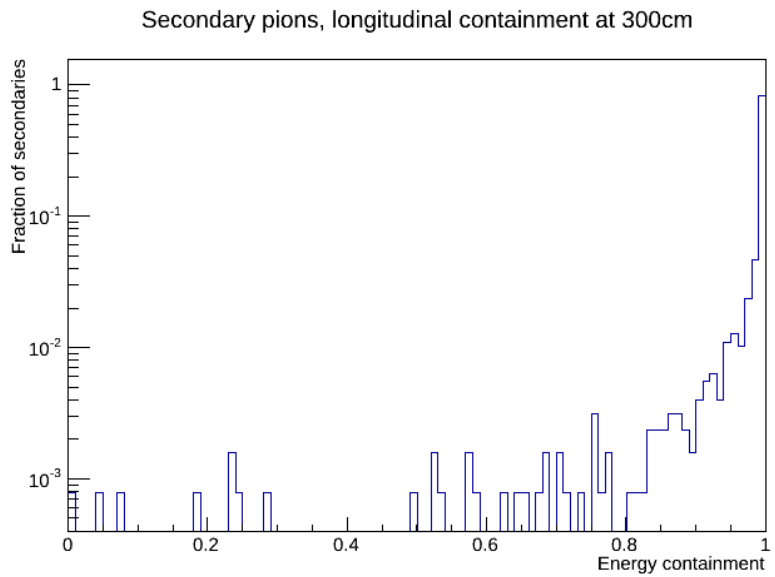
Pions









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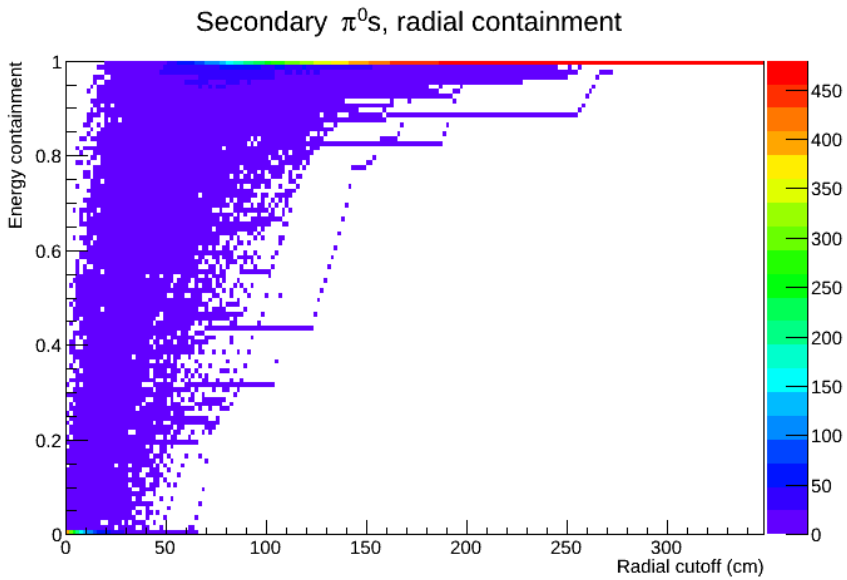
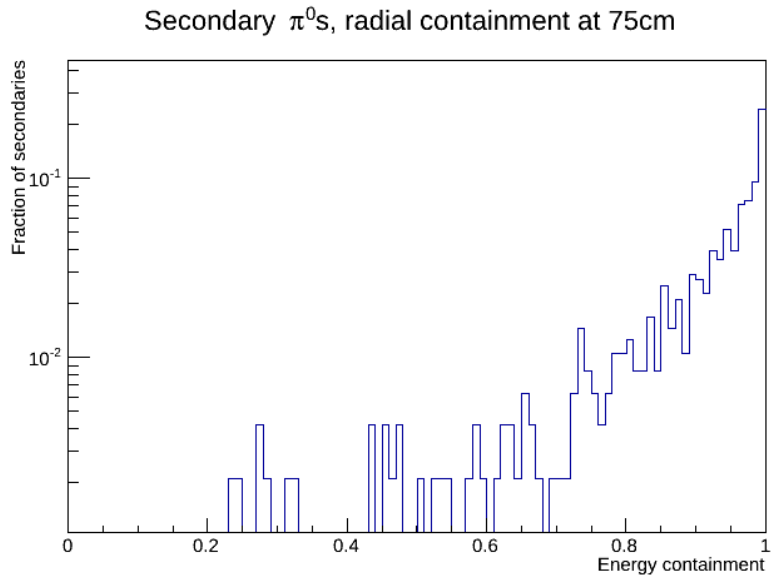
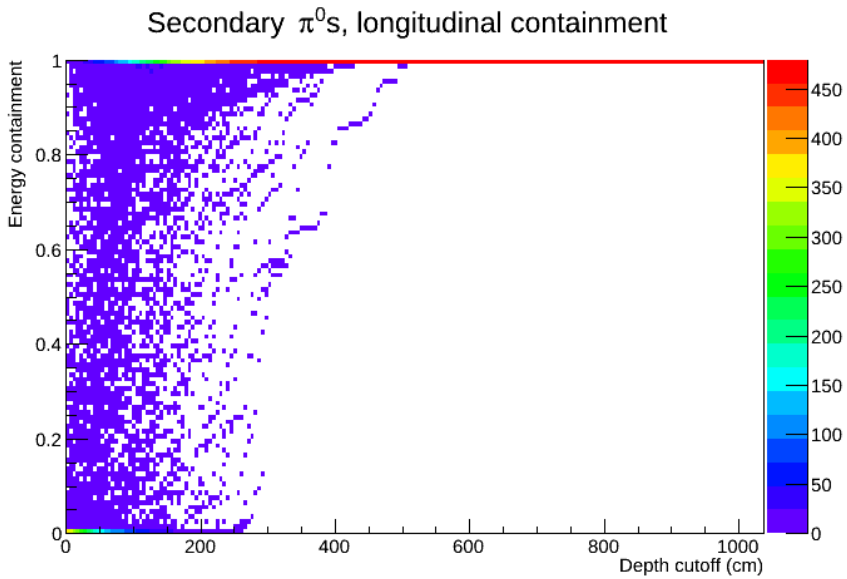
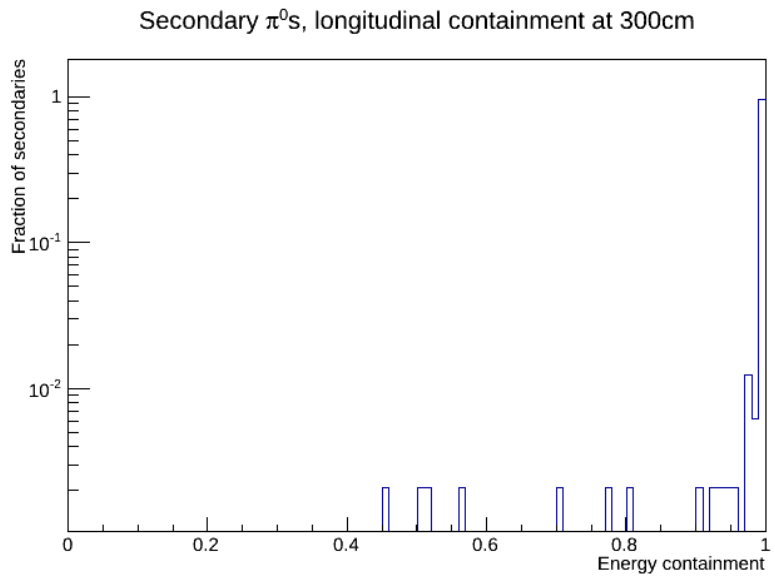
π^0s

(Pretty much unchanged as these in general don't produce neutrons)









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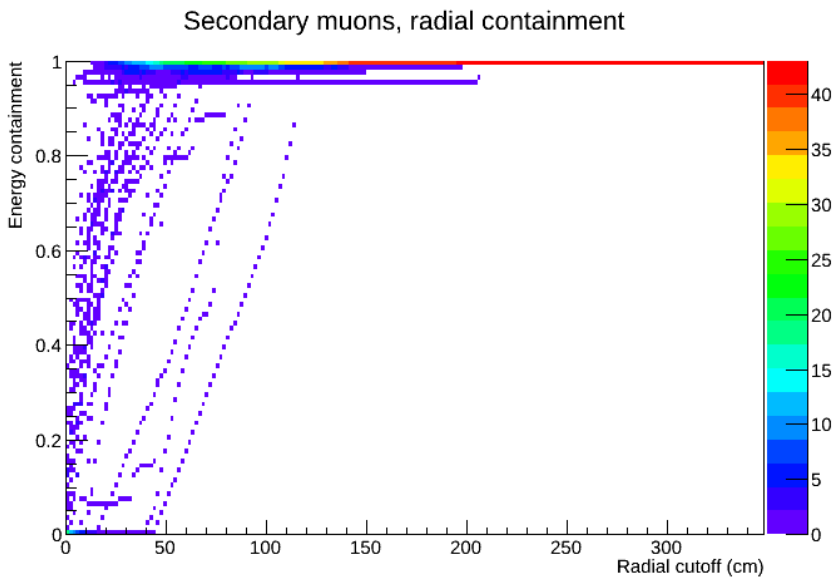
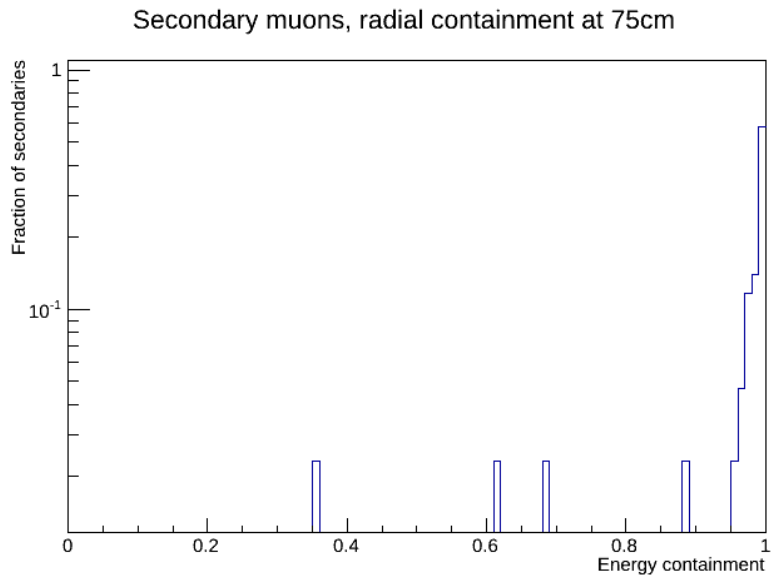
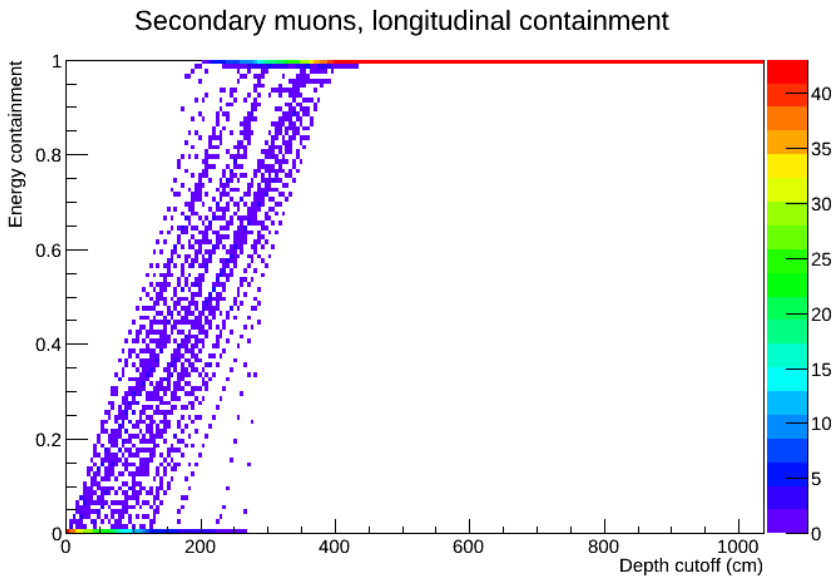
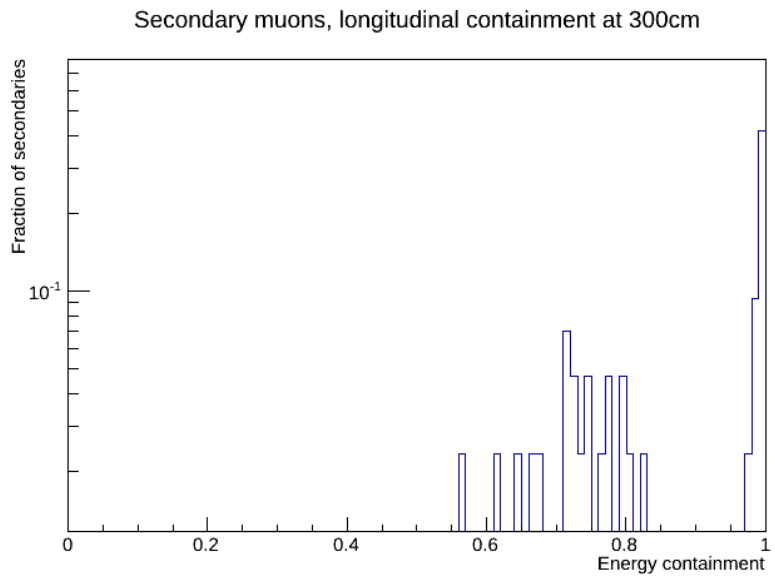
Muons

(Pretty much unchanged as these in general don't produce neutrons)









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