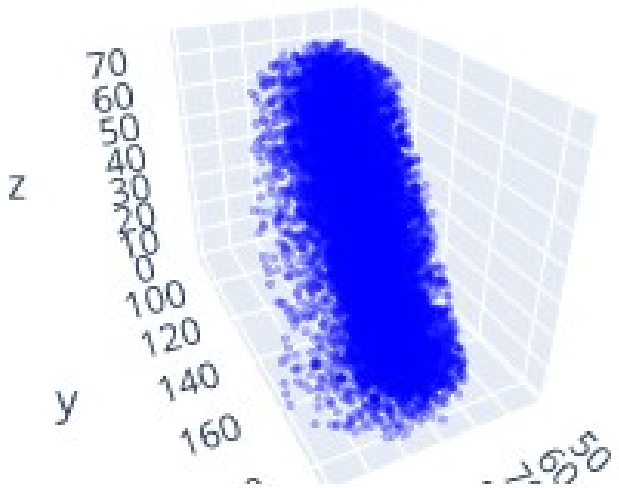
ProtoDune Vertical Drift

- Analysis of PDVD data with SPINE

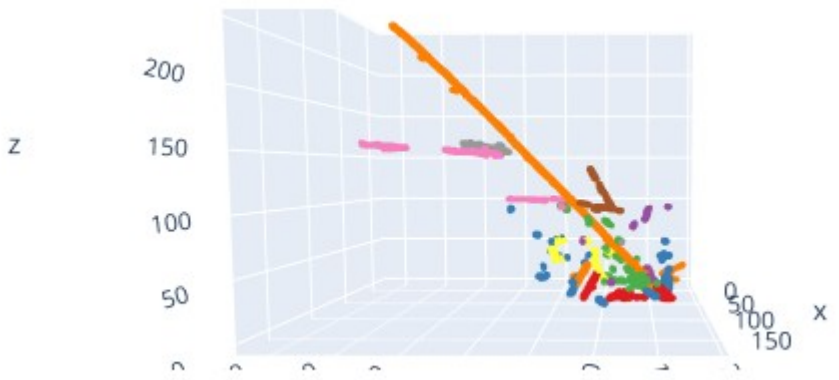
- Beams with momentum 1 GeV/c, 2 GeV/c, 4 GeV/c

Beam particles selection

- Select particles aligned with the beam direction within 25° and with a starting position near the beginning of the beam.



Selected particles starting positions

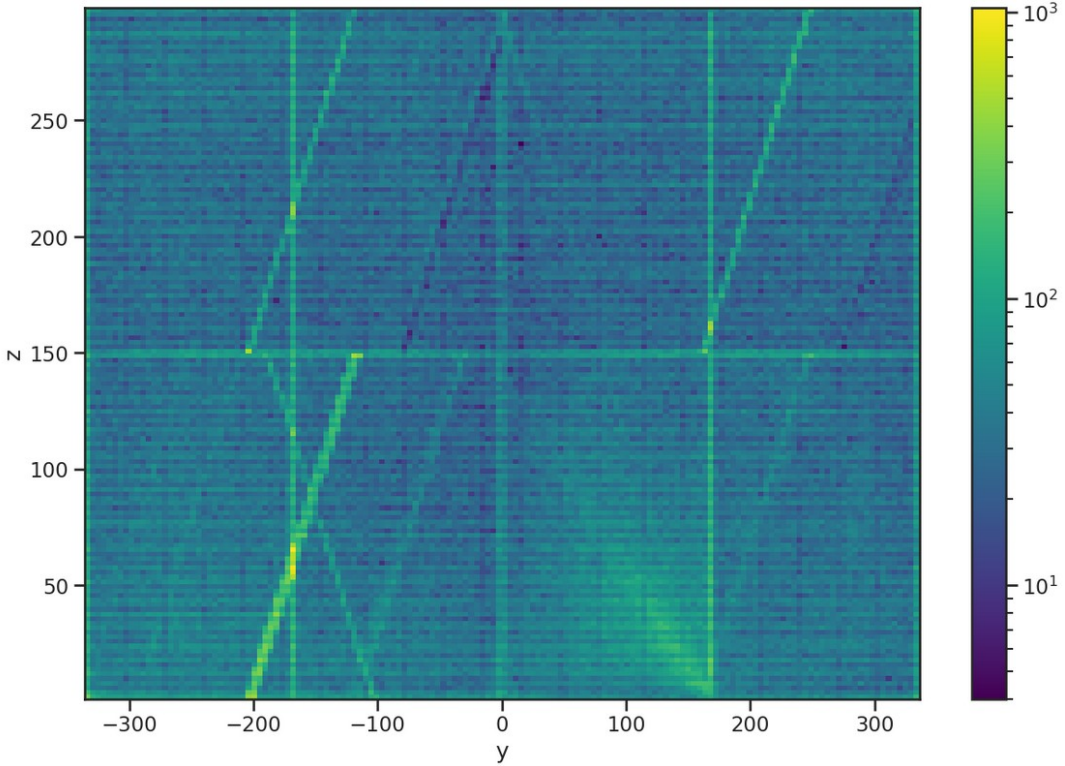


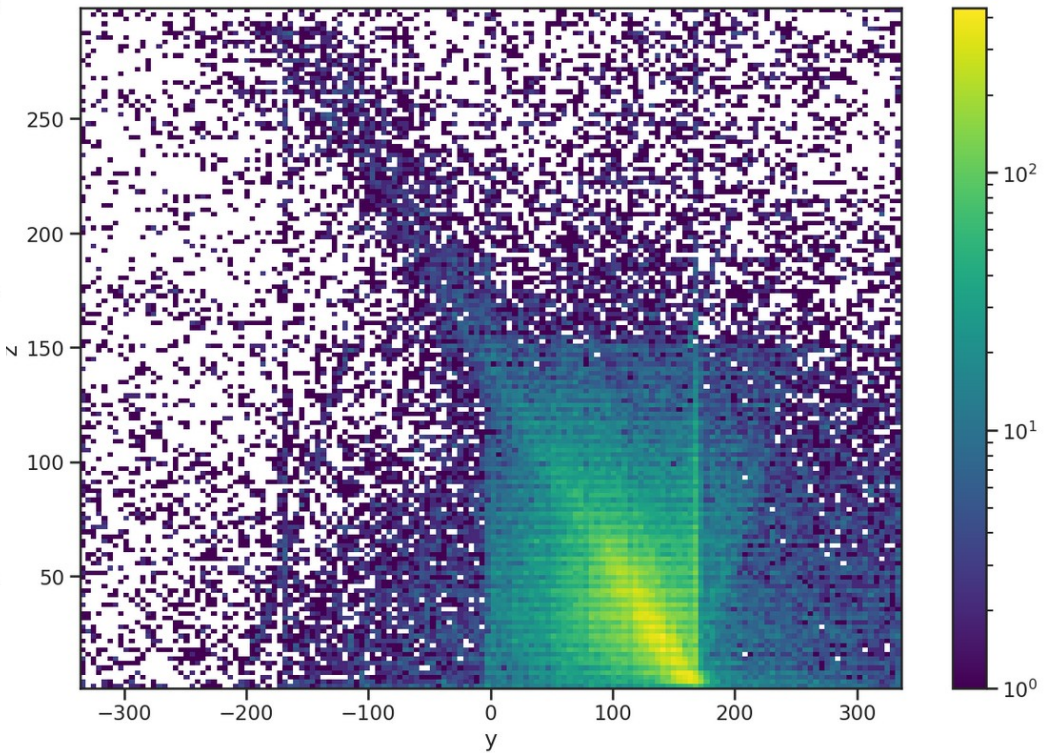
Beam event

Beam particles selection

- Selecting beam primaries and adding the particles in their interactions

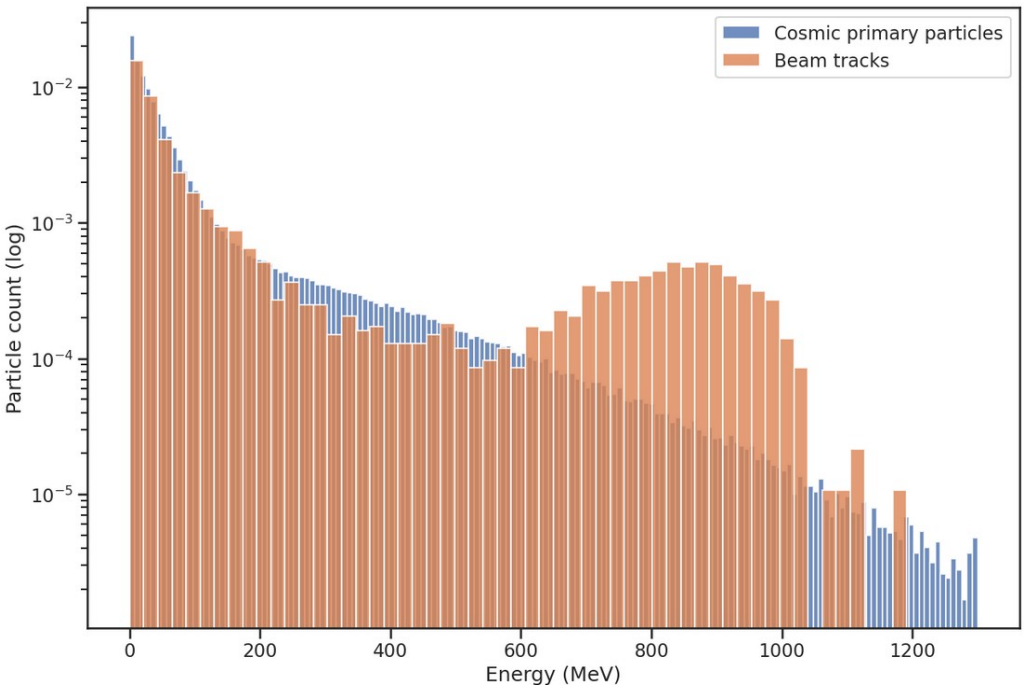
- Particles starting positions before and after beam selection (for 2 GeV/c)

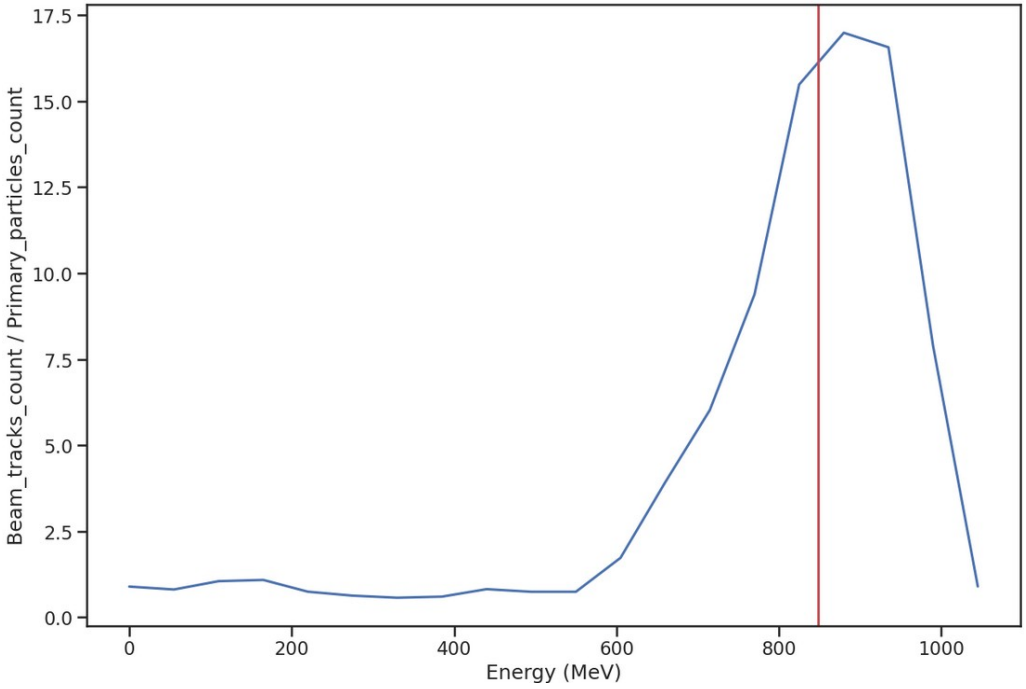




Beam tracks energy

- Beam trajectory inside the detector : 424 cm, beam muons deposit 848 MeV.

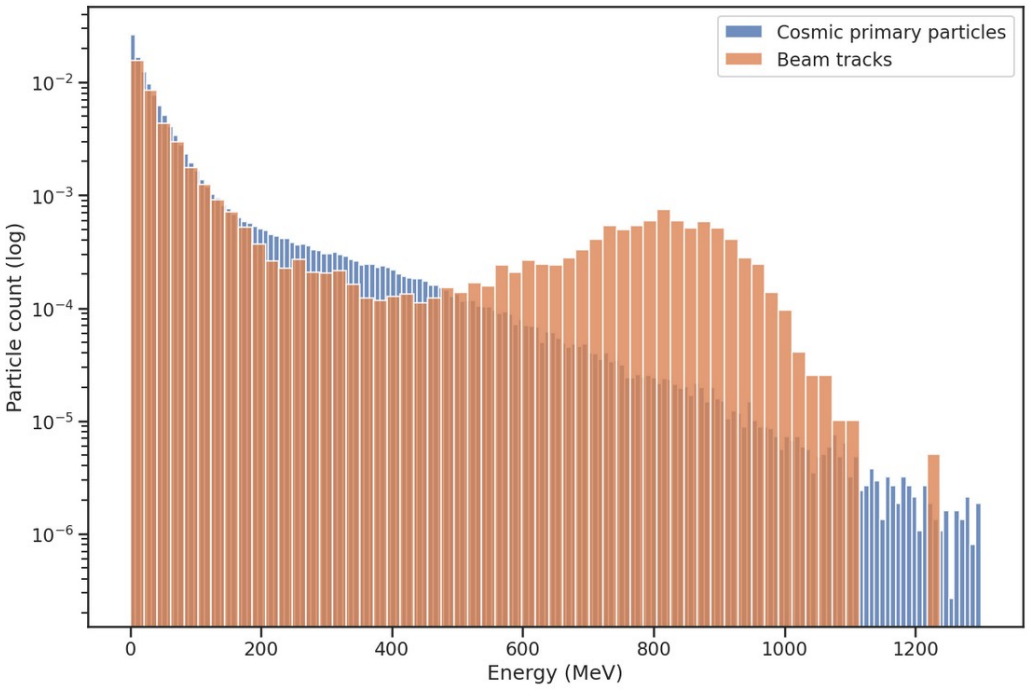


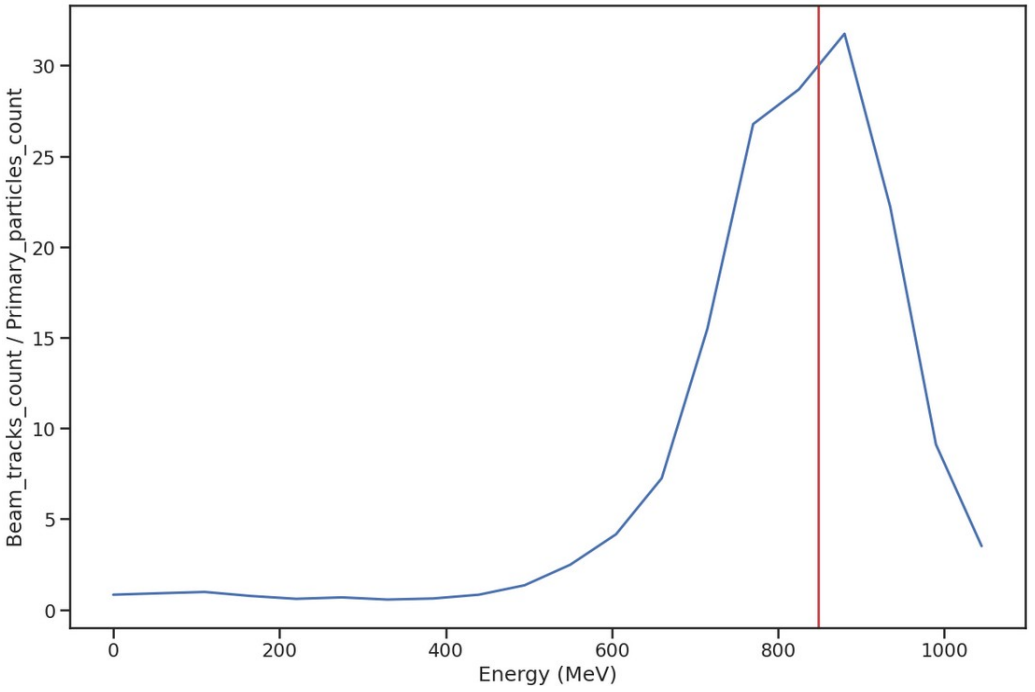


Cosmic and 4GeV/c beam primary tracks energy comparaison

Beam tracks energy

- Beam trajectory inside the detector : 424 cm, beam muons deposit 848 MeV.

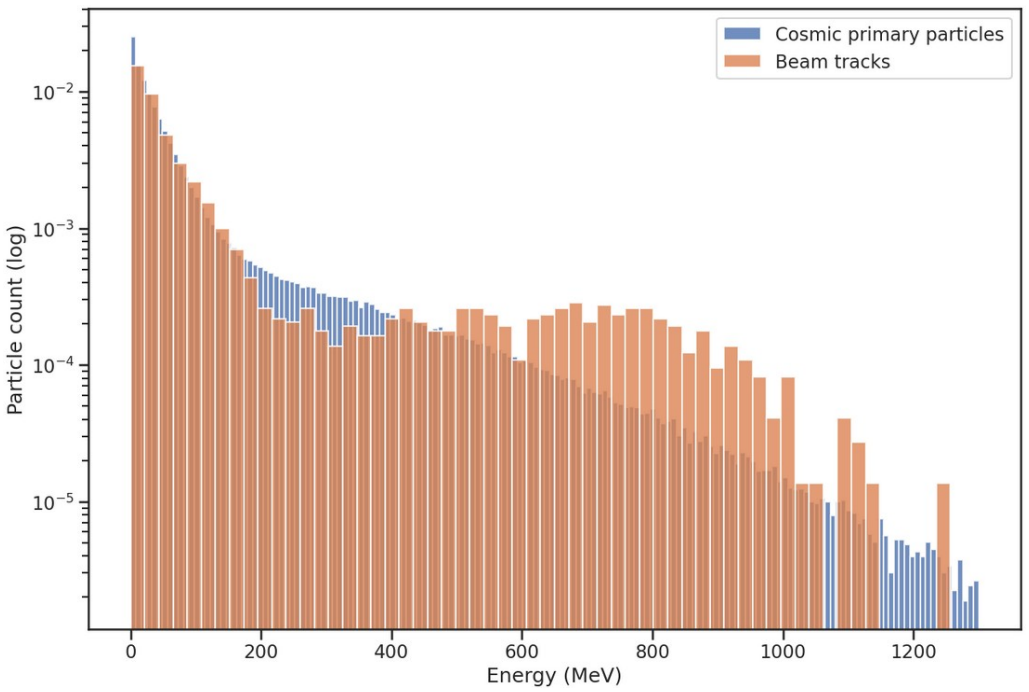


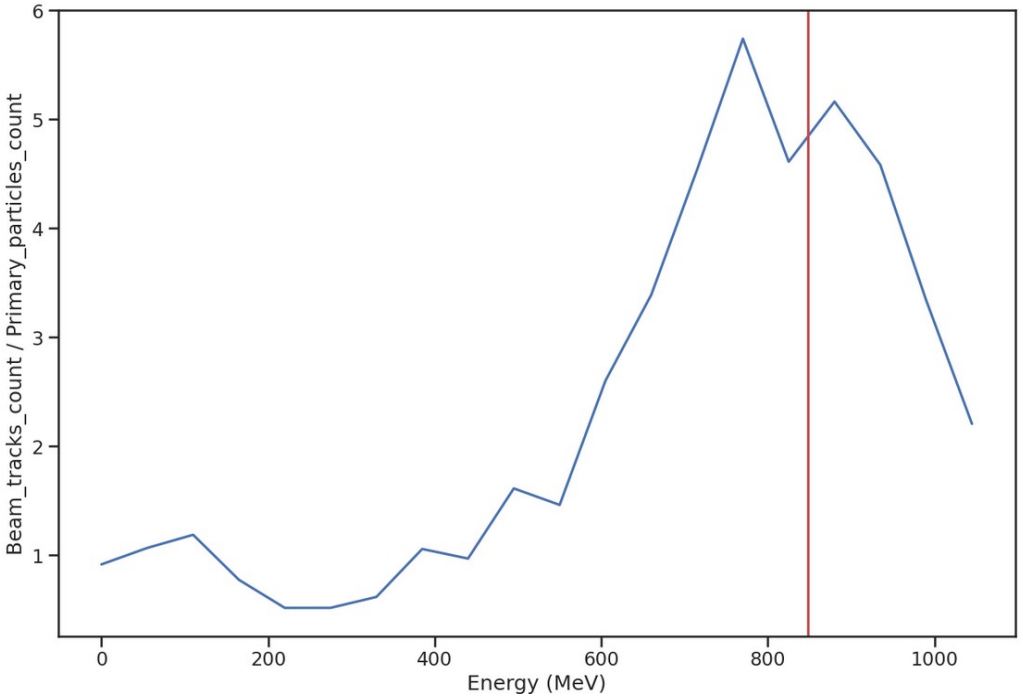


Cosmic and 2GeV/c beam primary tracks energy comparaison

Beam tracks energy

- Beam trajectory inside the detector : 424 cm, beam muons deposit 848 MeV.





Cosmic and 1GeV/c beam primary tracks energy comparaison

Beams compositions

	Photons	Electrons	Muons	Pions	Protons
1 GeV/c primaries	1032	938	1043	2073	266
	19.28 %	17.53 %	19.49 %	38.73 %	4.97 %

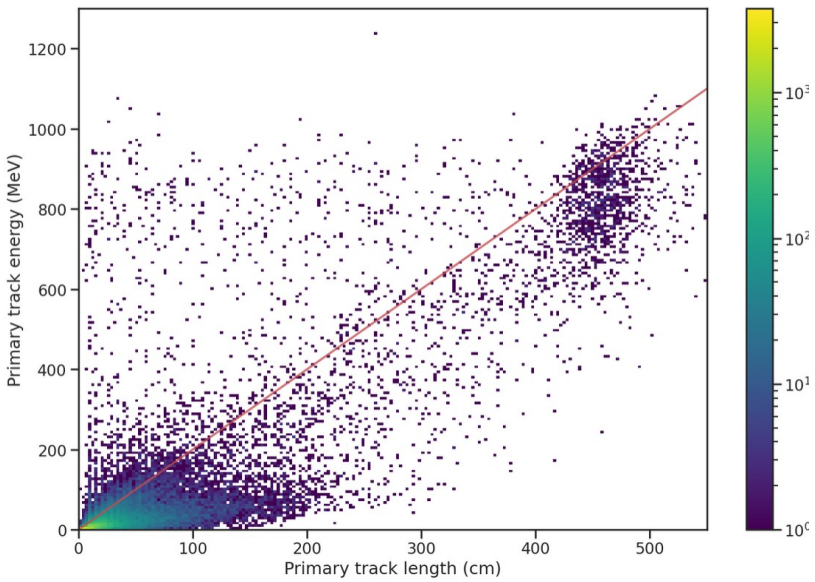
	Photons	Electrons	Muons	Pions	Protons
2 GeV/c primaries	1979	3055	3218	5979	311
	13.61 %	21.01 %	22.13 %	41.12 %	2.14 %

	Photons	Electrons	Muons	Pions	Protons
4 GeV/c primaries	350	902	1785	2470	37
	6.31 %	16.27 %	32.2 %	44.55 %	0.67 %

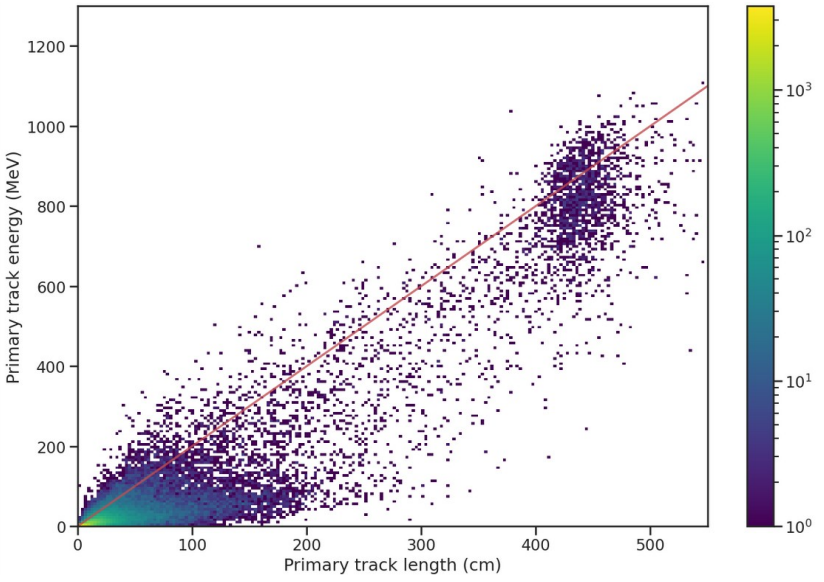
Primary beam particles compositions

Beam tracks dQ/dx

- Expect a line with 2 MeV/cm slope
- SPINE attribute p.length is sometimes wrong. Using the norm of p.end_point – p.start_point gives more accurate results



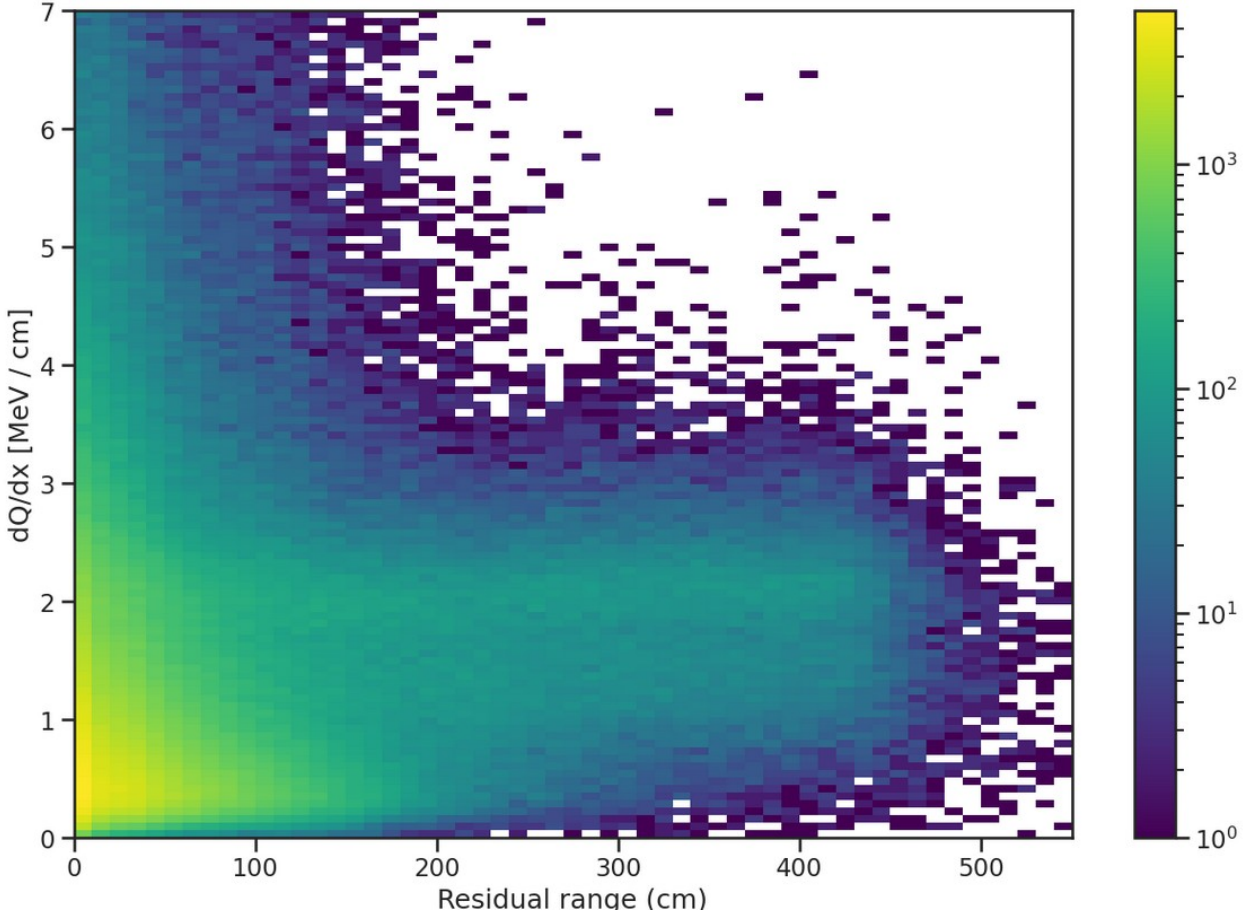
Primary beam tracks length vs energy
using p.length
(2GeV/c beam)



Primary beam tracks length vs energy
using the norm of end_point-p.start_point
(2GeV/c beam)

Beam tracks dQ/dx

- Expect to see a horizontal line at 2 MeV/cm
- Surprising peak at 0.5 MeV/c on shorter tracks



dQdx for all beam related tracks
(2 GeV/c beam)

Misreconstructed tracks

- Tracks with length > 90 and E < 110 seem to be part of dense events. The average number of particles in interactions containing these particles is 31.
- The average number of particles for all beam interactions is 16