DEEP UNDERGROUND NEUTRINO EXPERIMENT

BROOKHAVEN NATIONAL LABORATORY

CRT studies: upstream CRTs staggered

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Cosmic Ray Tagger (CRT)

Toy model CRTs used in this study covers the active TPC volume in :

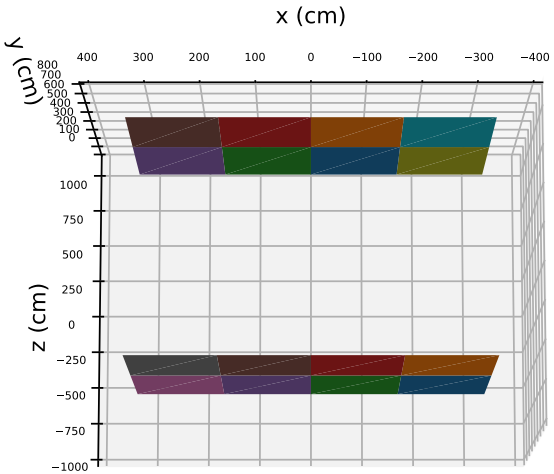
⇒ -340 cm $< x <$ 340 cm and 0 cm $< y <$680 cm

⇒ $z =$ 1000 cm: $\sim$**1 m downstream** from the cryostat

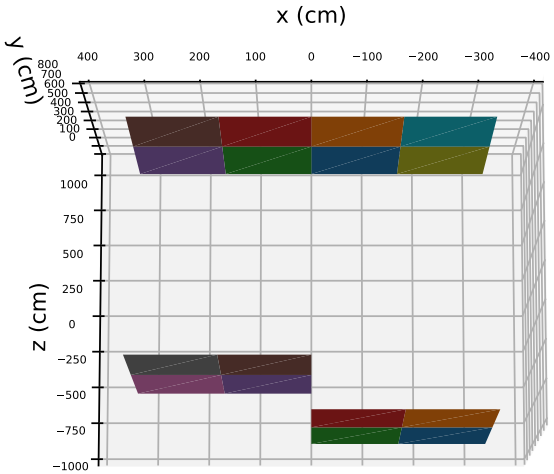
⇒ **Default in-line**: Both Jura side and Saleve side at $\sim$**3.5 m upstream** from the cryostat **or**

⇒ **New staggered**: Jura side at $\sim$**3.5 m** and Saleve side at $\sim$**7 m upstream** from the cryostat

Default in-line



New staggered



⇒ This study is performed with MCC-10: 4 GeV beam (which includes muon halo) + Cosmics

⇒ In this study, we are interested in the rate and coverage of the matched tracks for two different CRT configuration: **Default in-line and new staggered upstream positions**. We will look at these quantities separated for cosmics and muon halo and for matching done with both **Front or Back** and **Front and Back** CRTs.

Matching Efficiency and Purity

Matching Efficiency

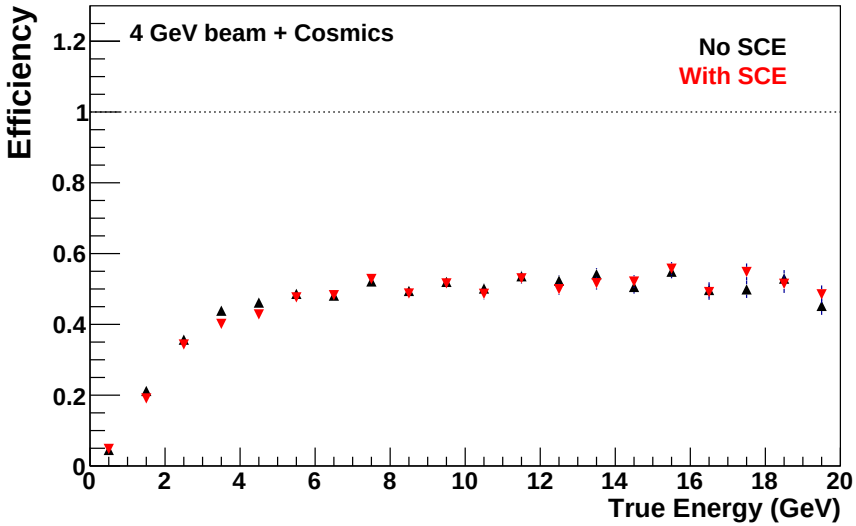
- ⇒ Matching Efficiency = (no. of reco tracks with good match)/(no. of primary muon with one CRT hits (two CRT hits))
- ⇒ Good match means reco track have the same **TrackId** as CRT hit/hits

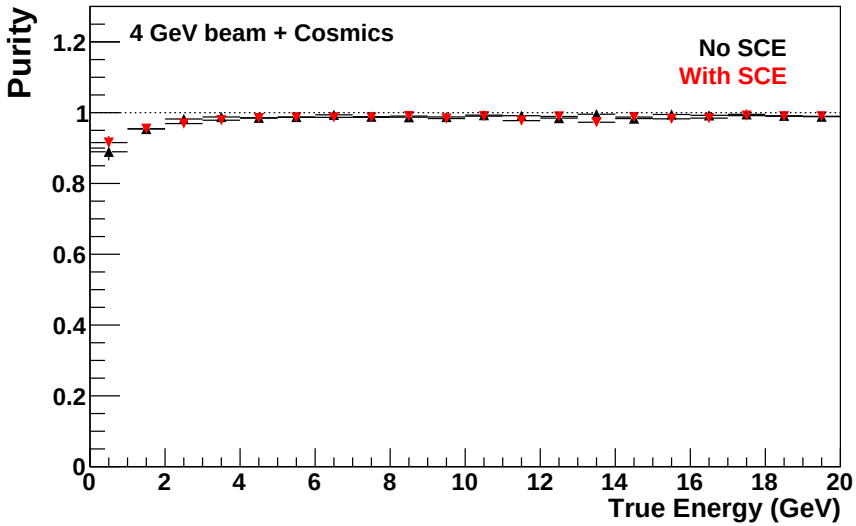
Purity

- ⇒ Purity = (no. of reco tracks with good match)/(no. of reco tracks that match with one CRT hit (two CRT hits))
- ⇒ Good match means reco track have the same **TrackId** as CRT hit/hits

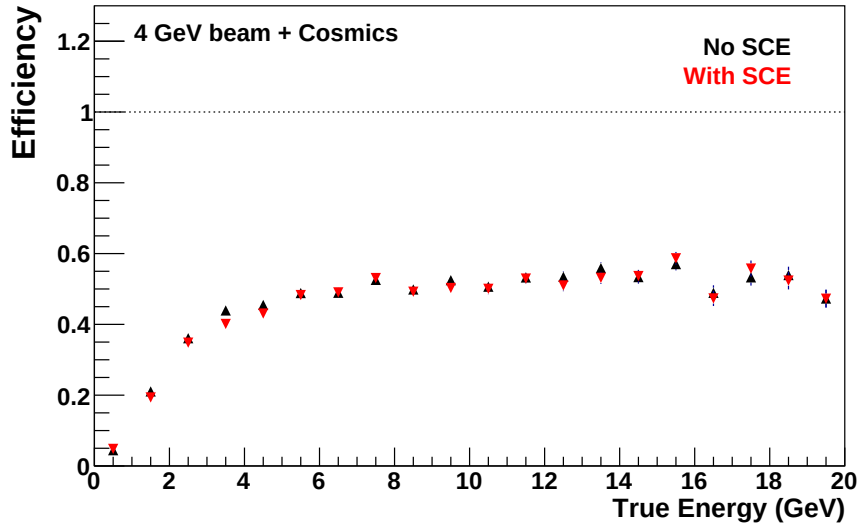
All: Front or Back

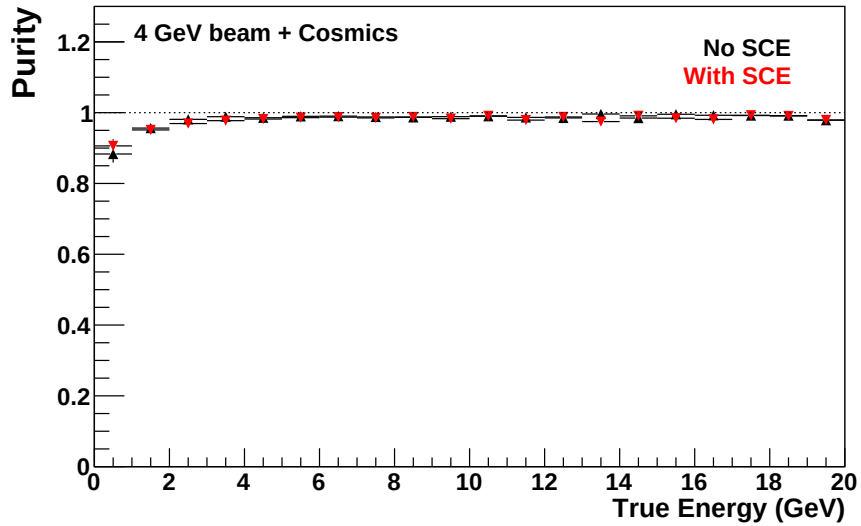
Upstream z = default in-line





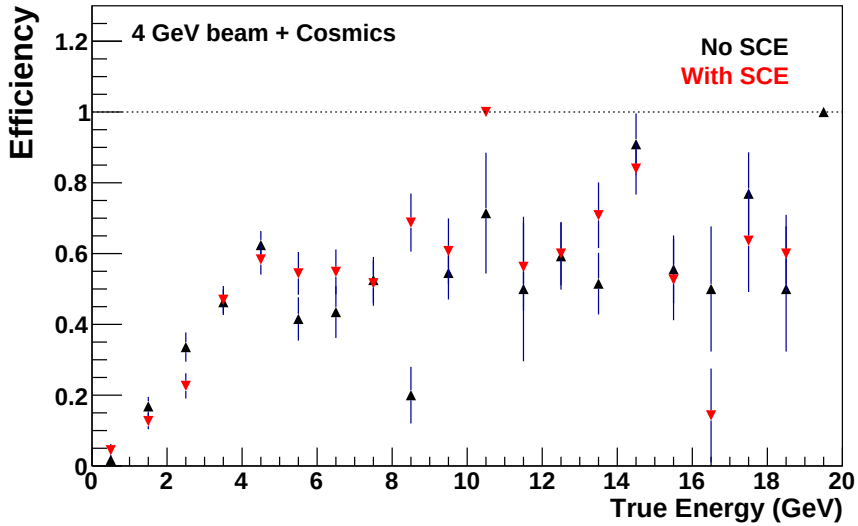
Upstream z = new staggered

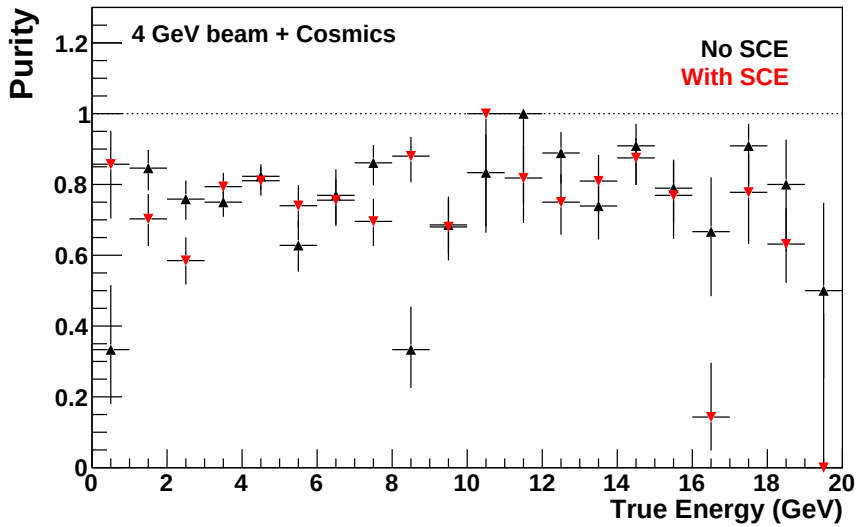




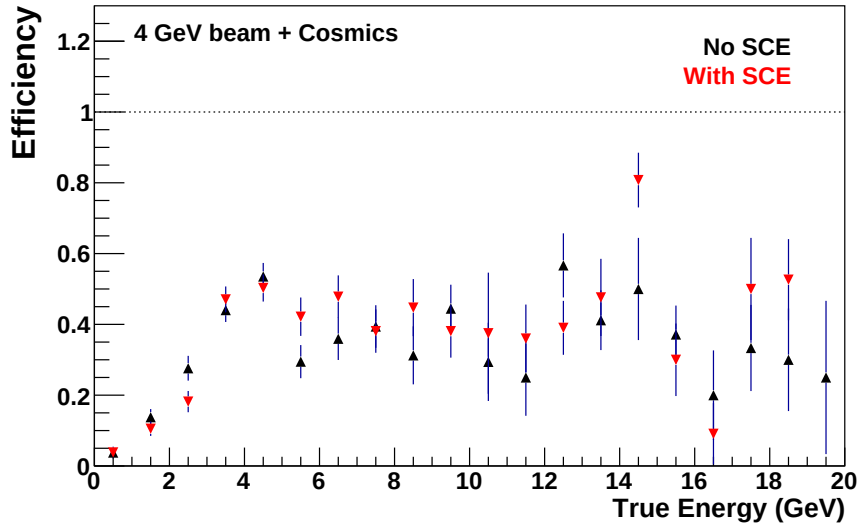
All: Front and Back

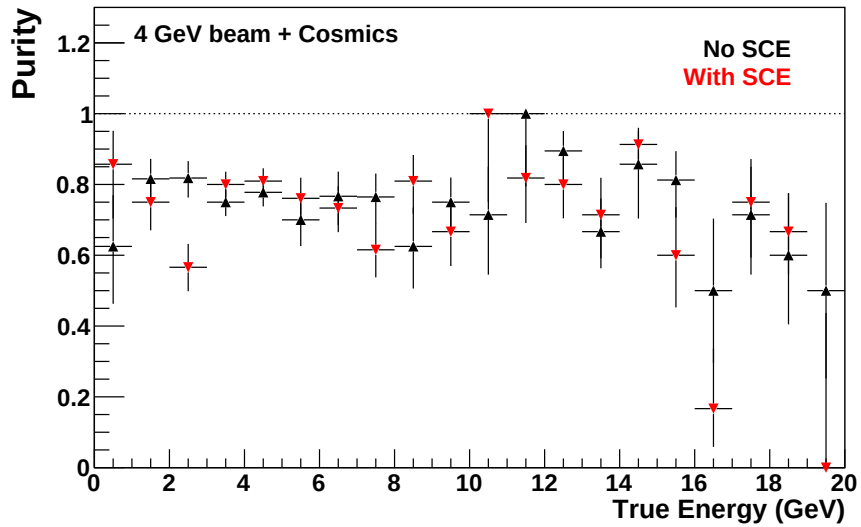
Upstream z = default in-line





Upstream z = new staggered





Front or Back

	No. of matched tracks per event (with SCE)	
	Upstream z = default in-line	**Upstream z = new staggered**
All	2.03	1.85
Cosmics	2.01	1.83 (9% decrease)
Halo	0.015	0.014 (7% decrease)
Beam	negligible	negligible

Front and Back

	No. of matched tracks per event (with SCE)	
	Upstream z = default in-line	**Upstream z = new staggered**
All	0.080	0.065
Cosmics	0.048	0.034 (29% decrease)
Halo	0.031	0.030 (3% decrease)
Beam	negligible	negligible

Front or Back

	No. of matched tracks per event (with SCE)	
	Upstream z = default in-line	**Upstream z = new in-line**
All	2.03	1.68
Cosmics	2.01	1.66 (17% decrease)
Halo	0.015	0.014 (7% decrease)
Beam	negligible	negligible

Front and Back

	No. of matched tracks per event (with SCE)	
	Upstream z = default in-line	**Upstream z = new in-line**
All	0.080	0.046
Cosmics	0.048	0.020 ($\sim$58% decrease)
Halo	0.031	0.026 ($\sim$16% decrease)
Beam	negligible	negligible

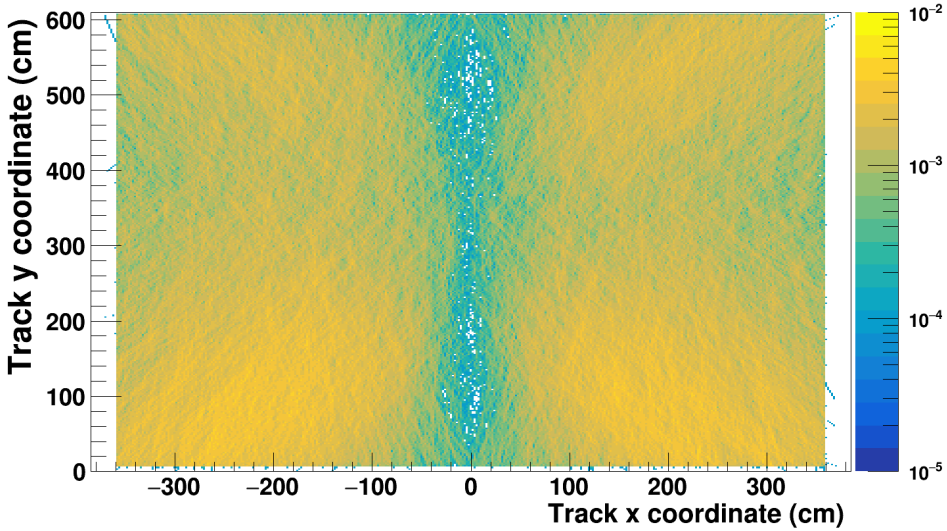
Coverage

Coverage

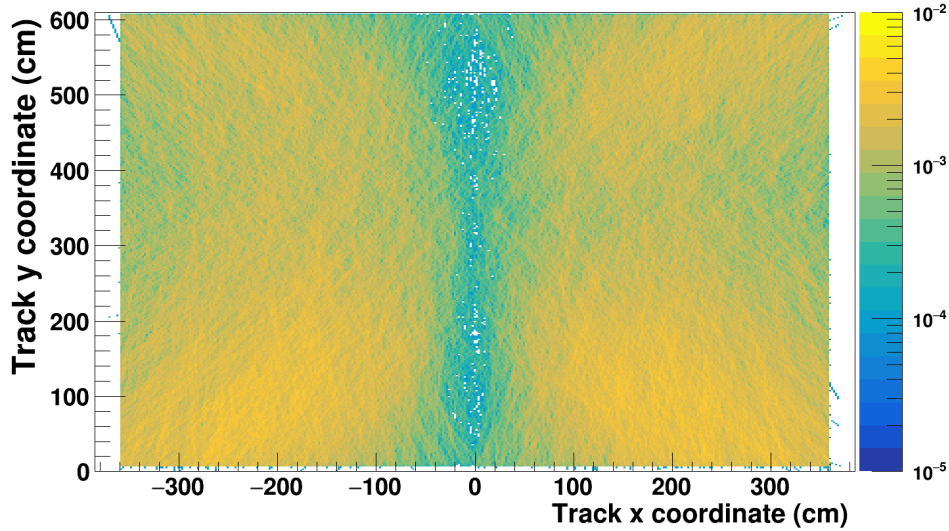
- ⇒ Coverage maps include SCE
- ⇒ Coverage maps show which area of the TPC have the highest concentration of tagged tracks
- ⇒ Plots are normalized by the total number of events
- ⇒ x is the corrected x-coordinate

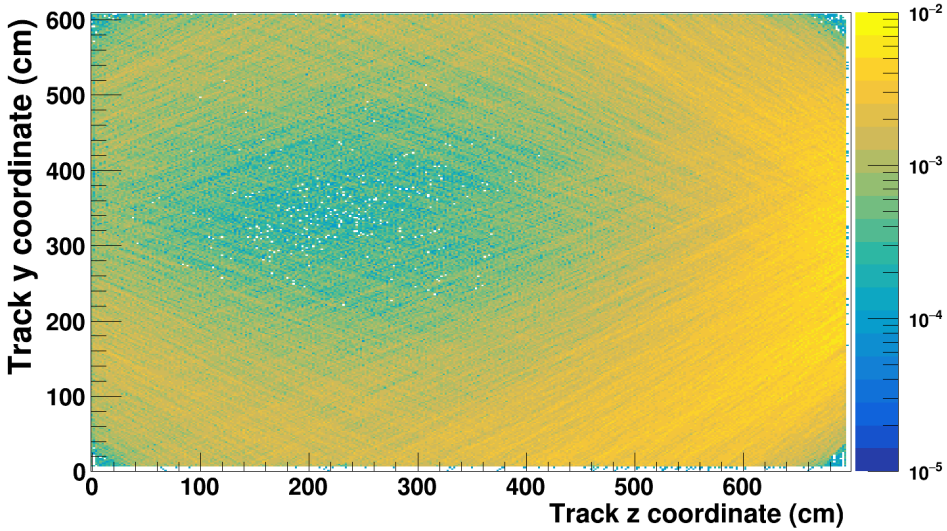
All: Front or Back

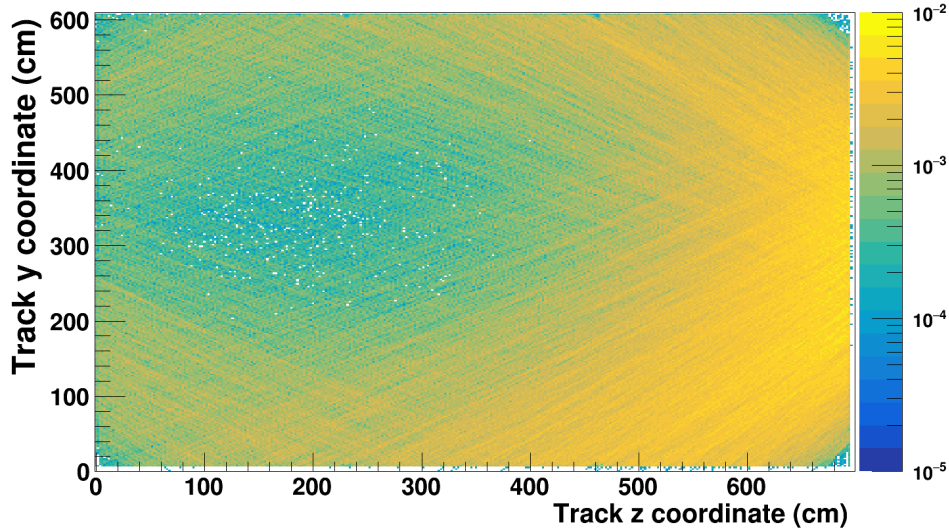
Upstream z = default in-line



Upstream z = new staggered

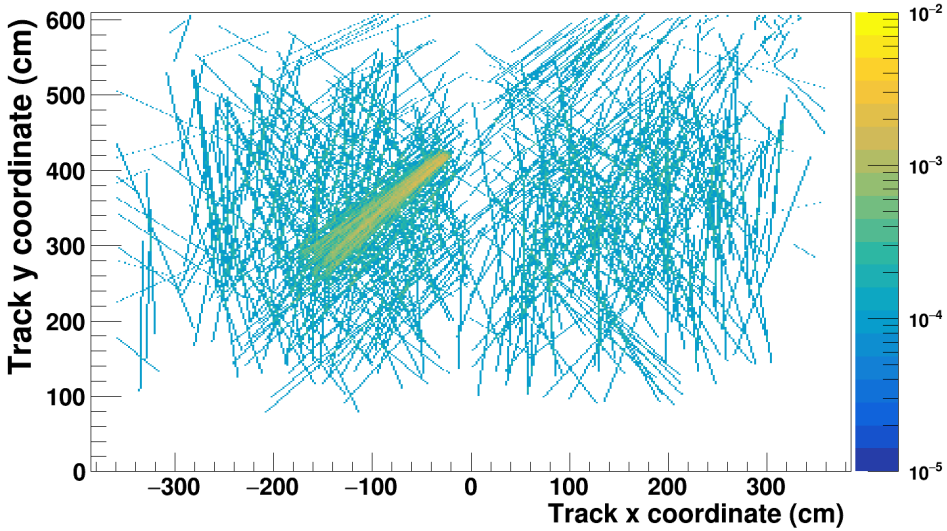




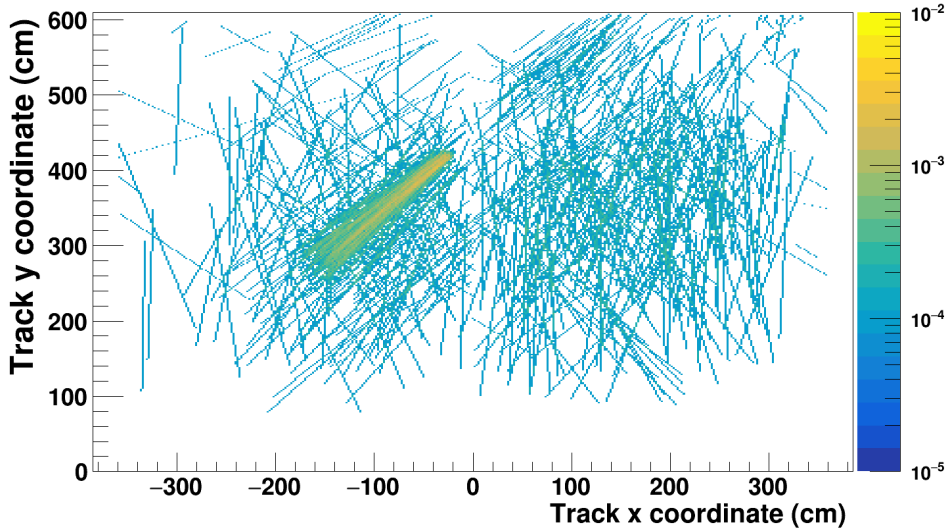


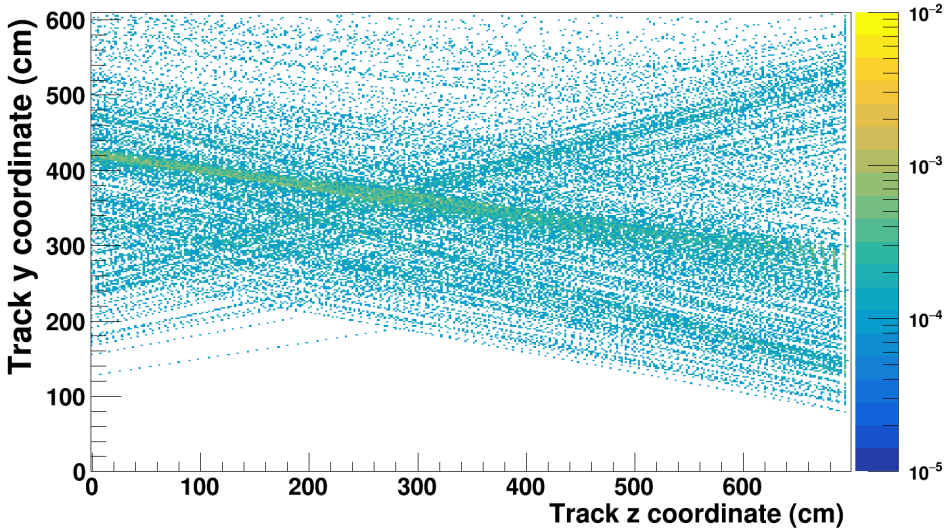
All: Front and Back

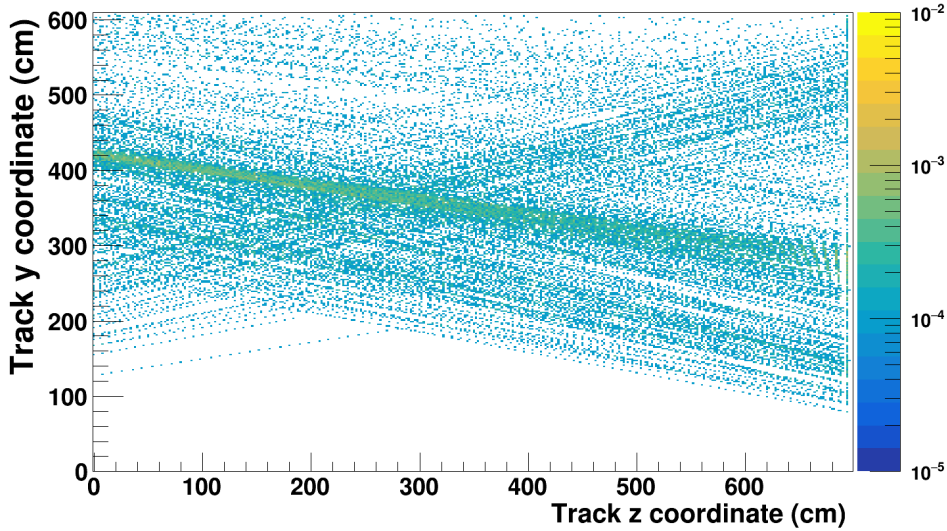
Upstream z = default in-line



Upstream z = new staggered

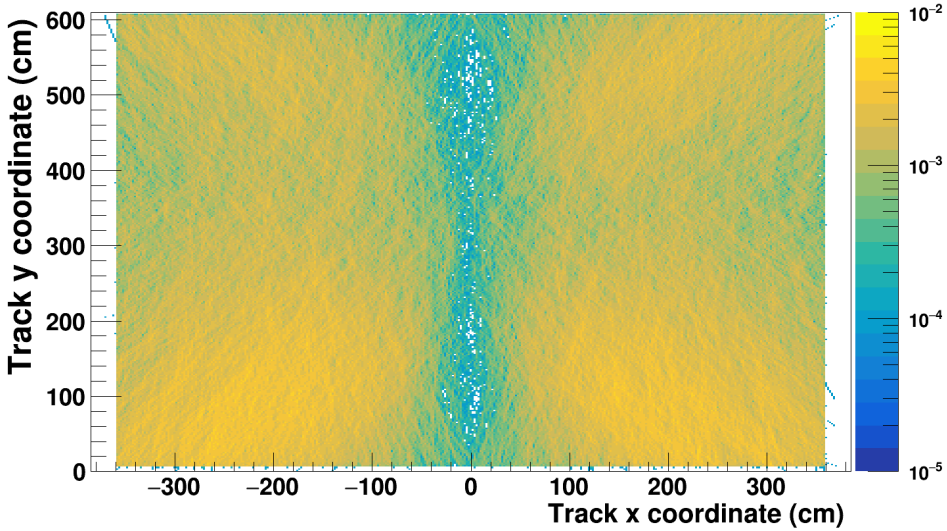




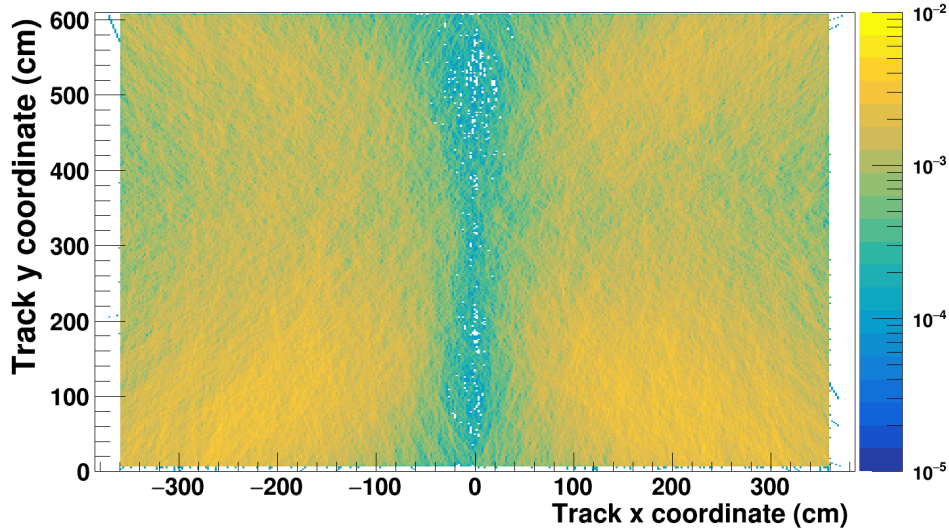


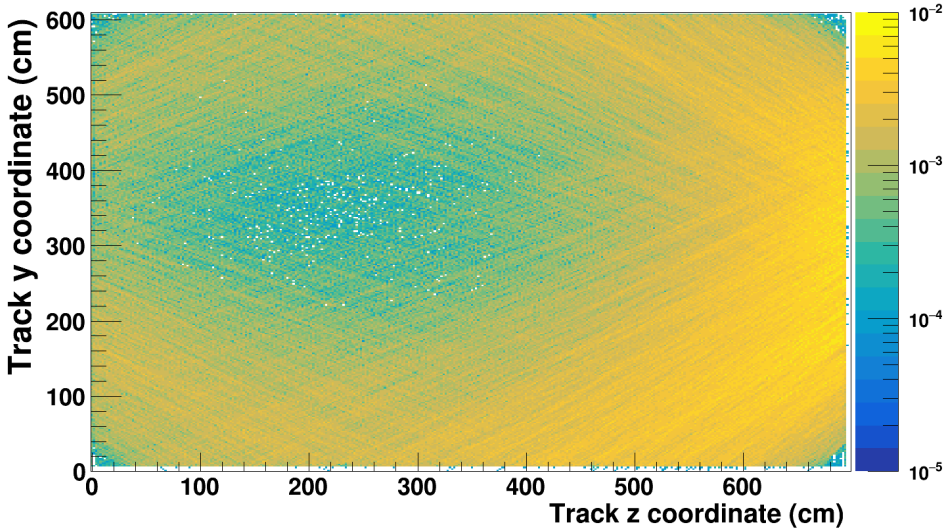
Cosmics: Front or Back

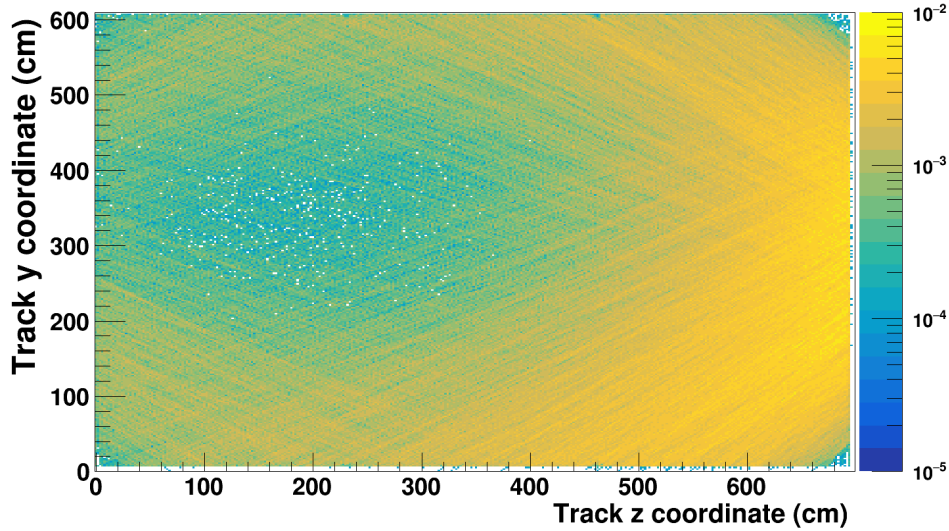
Upstream z = default in-line



Upstream z = new staggered

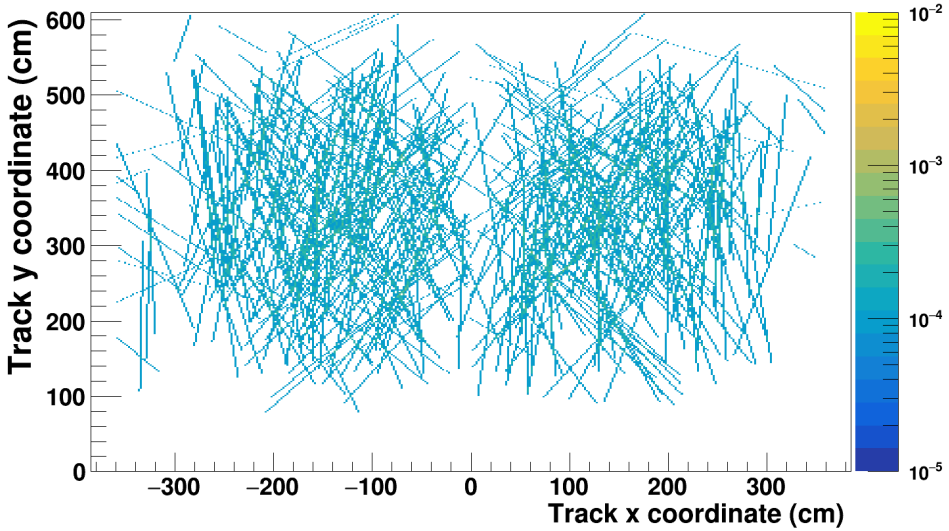




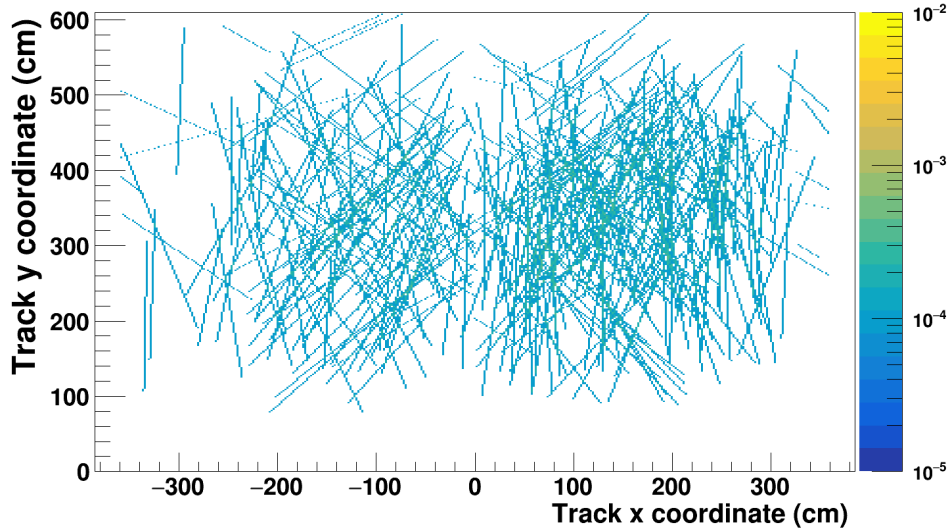


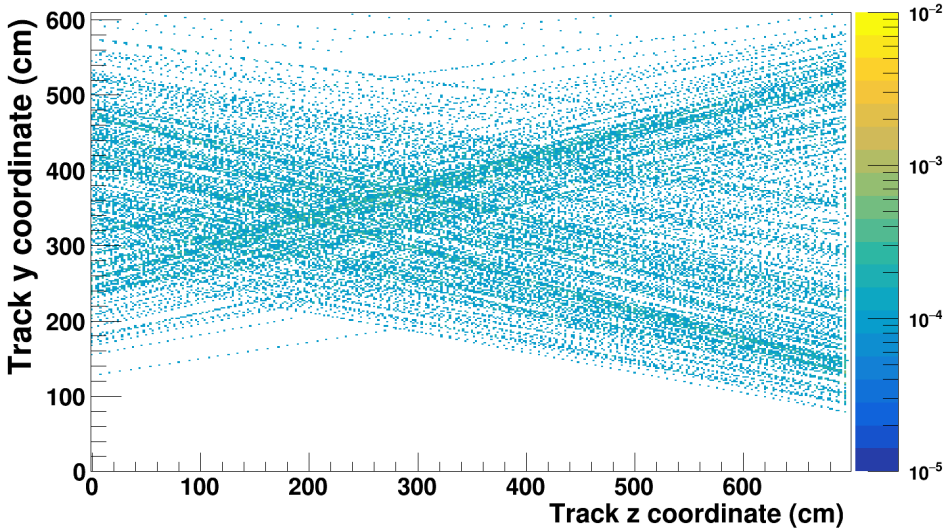
Cosmics: Front and Back

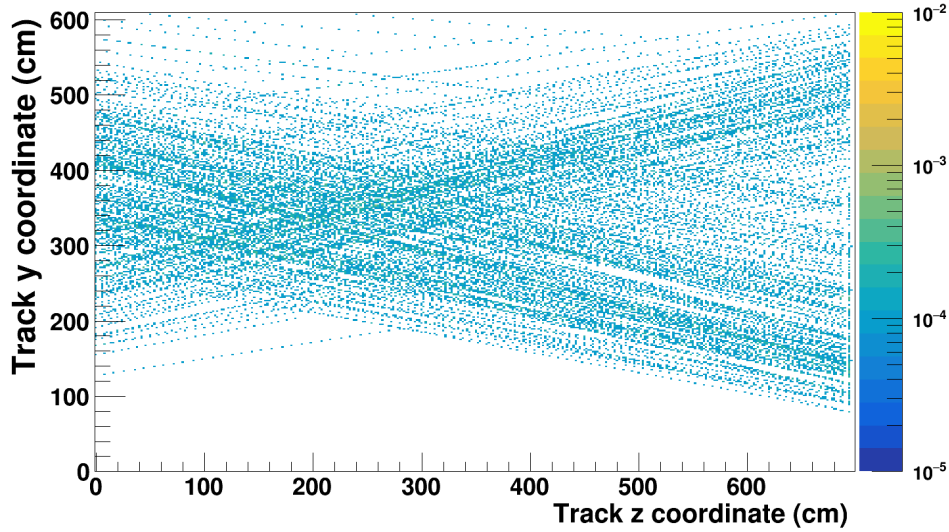
Upstream z = default in-line



Upstream z = new staggered

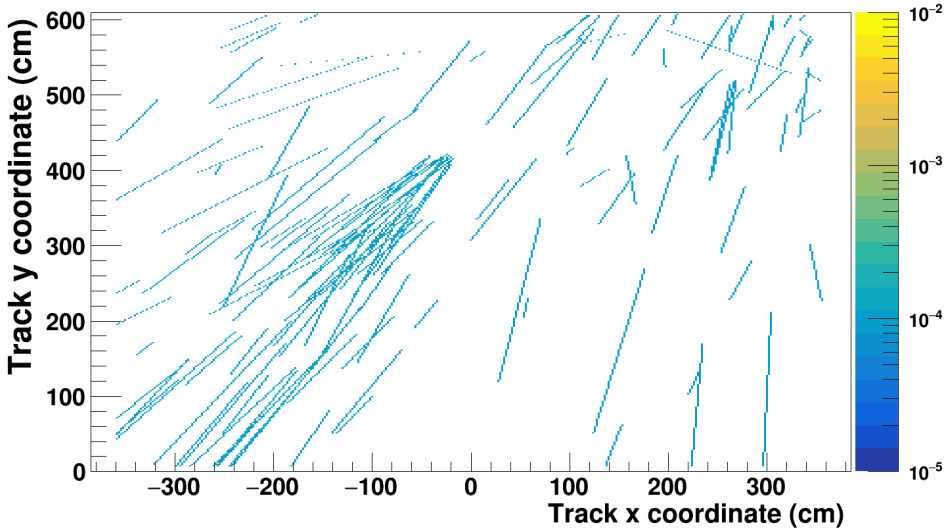




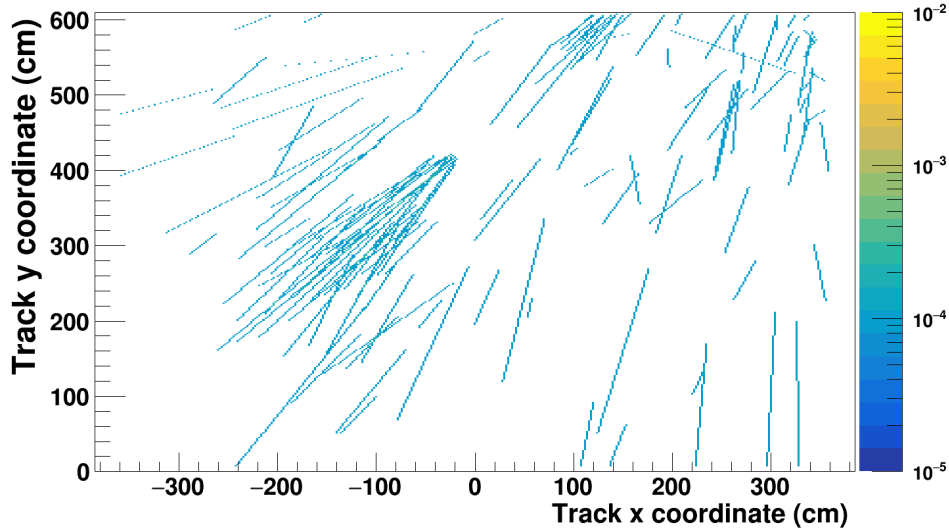


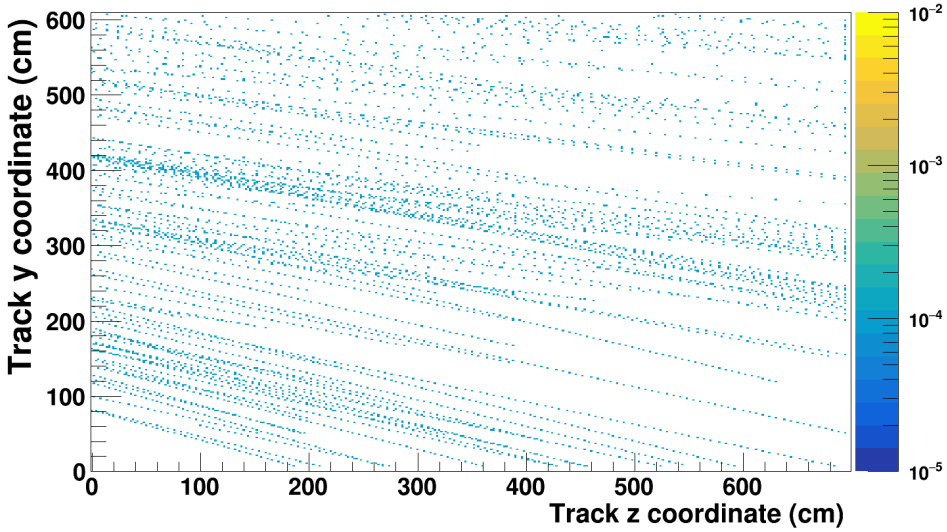
Halo: Front or Back

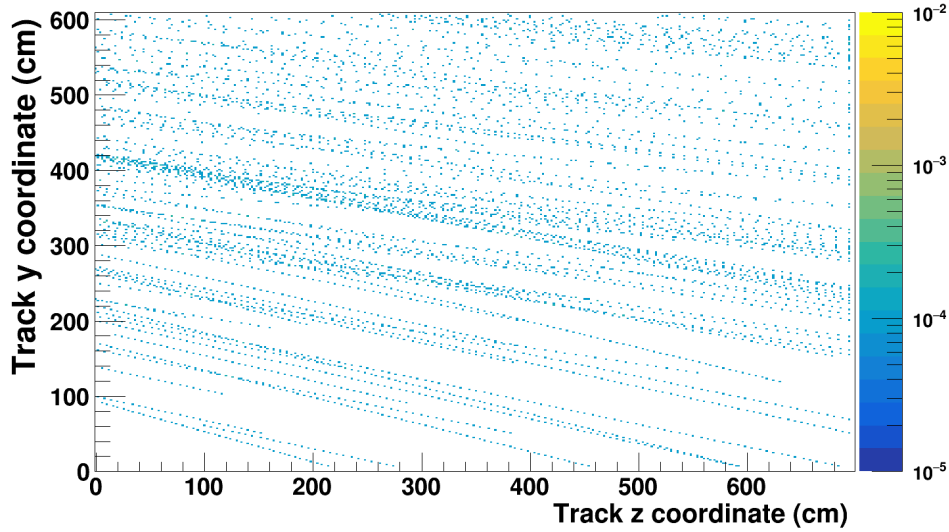
Upstream z = default in-line



Upstream z = new staggered

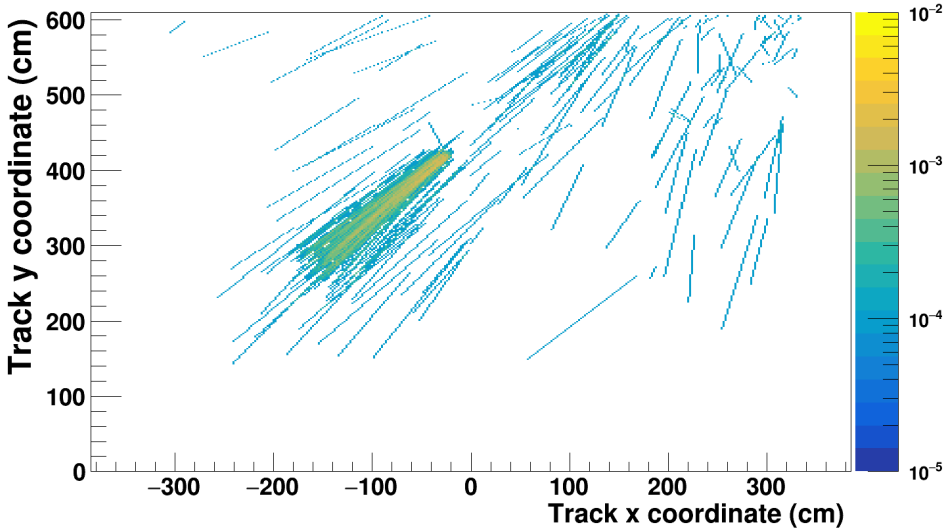




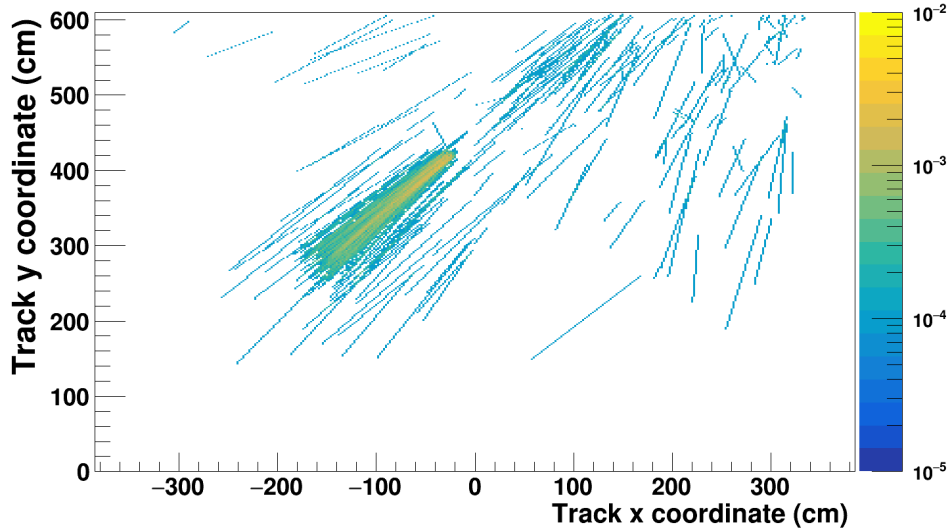


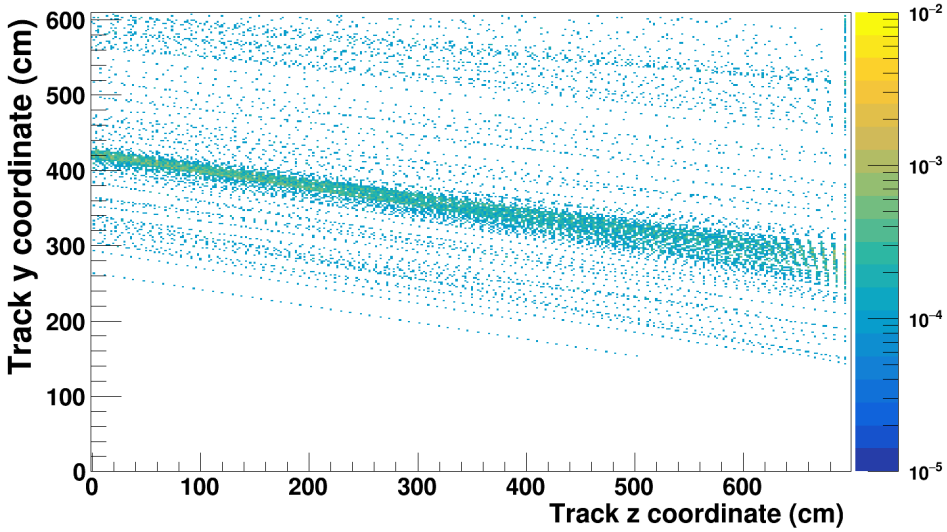
Halo: Front and Back

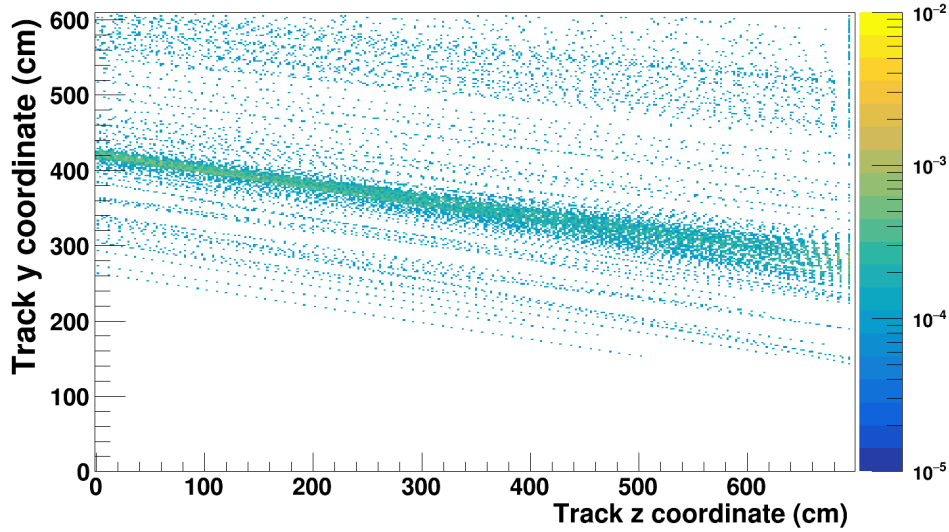
Upstream z = default in-line



Upstream z = new staggered



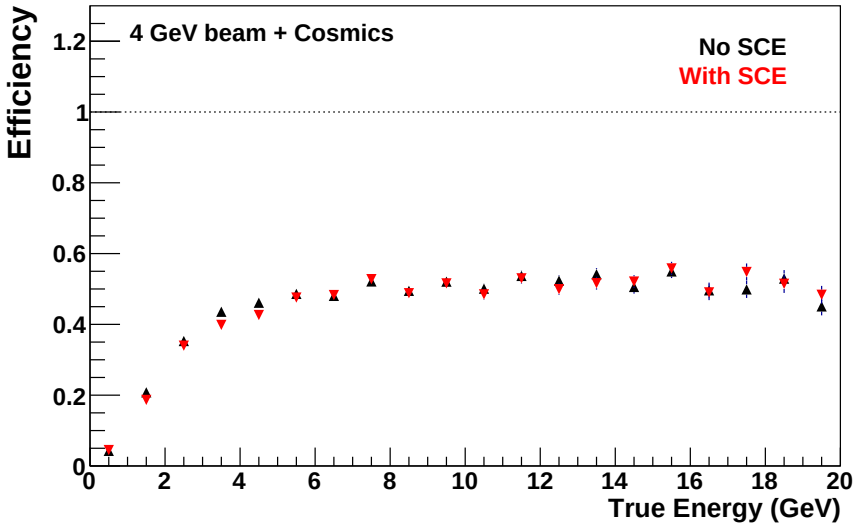


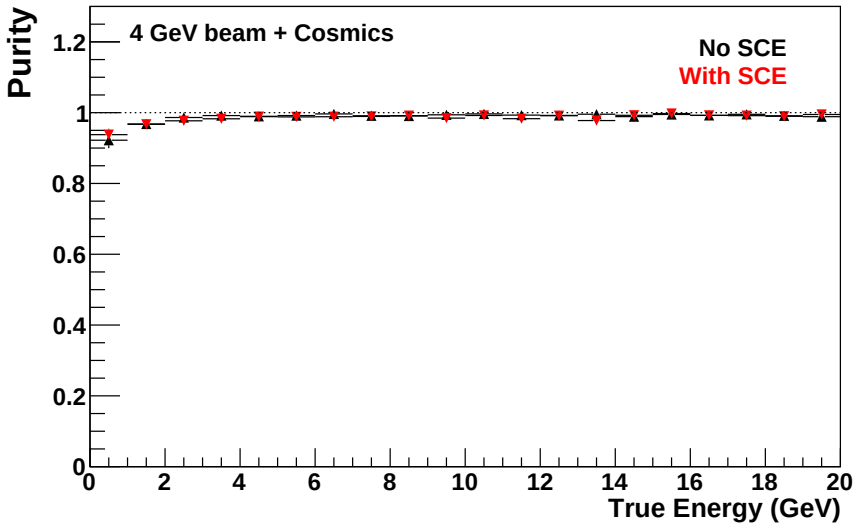


Backup

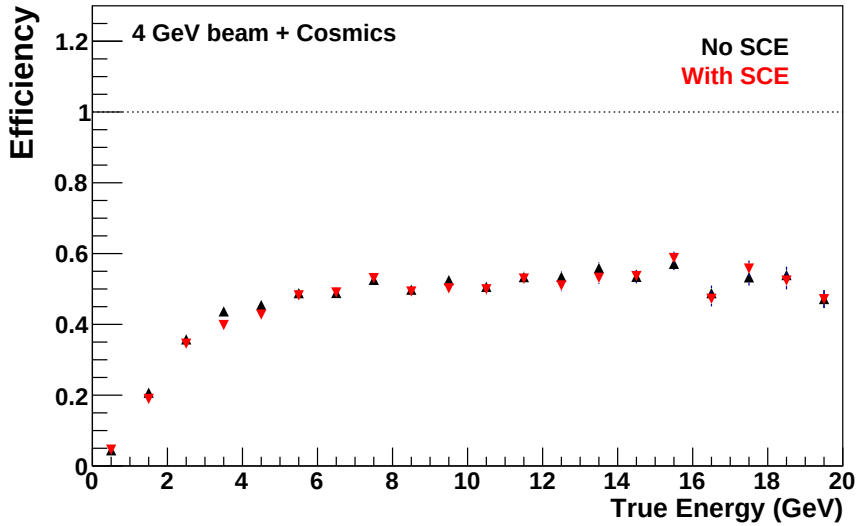
Cosmics: Front or Back

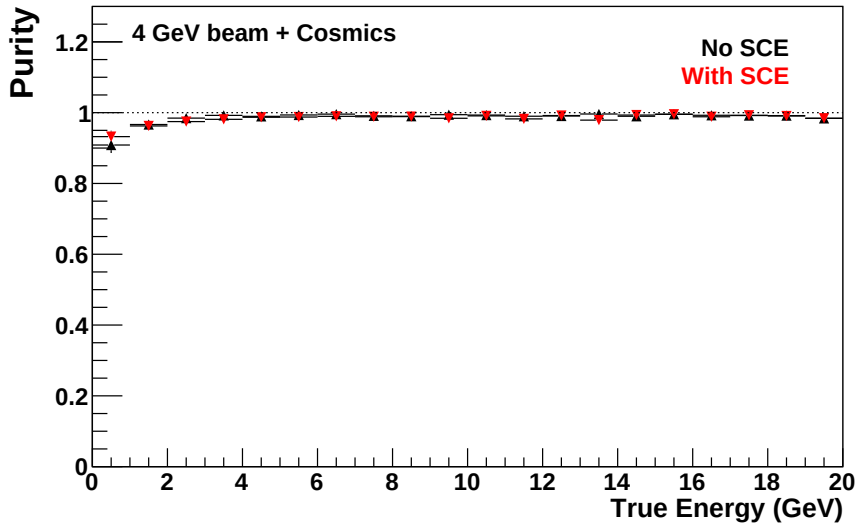
Upstream z = default in-line





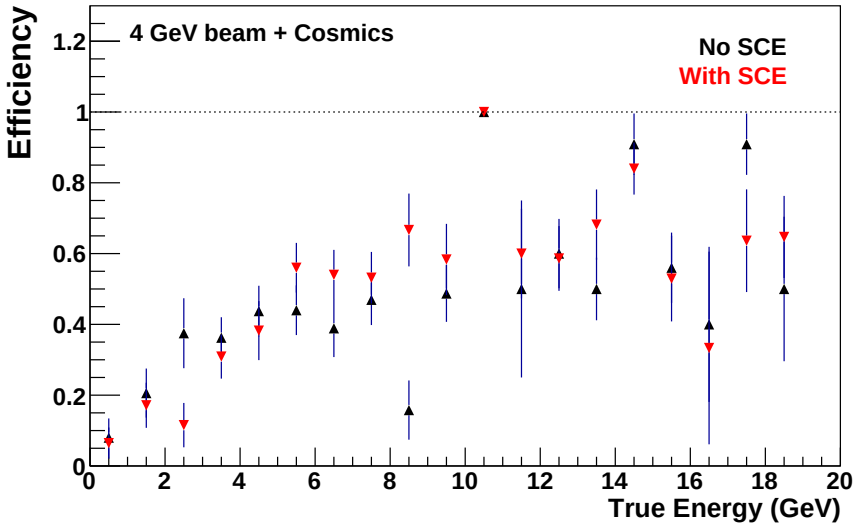
Upstream z = new staggered

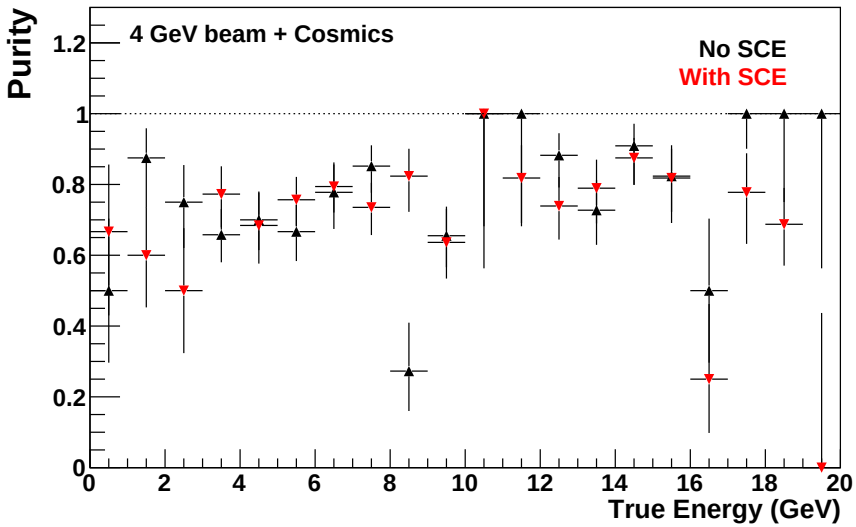




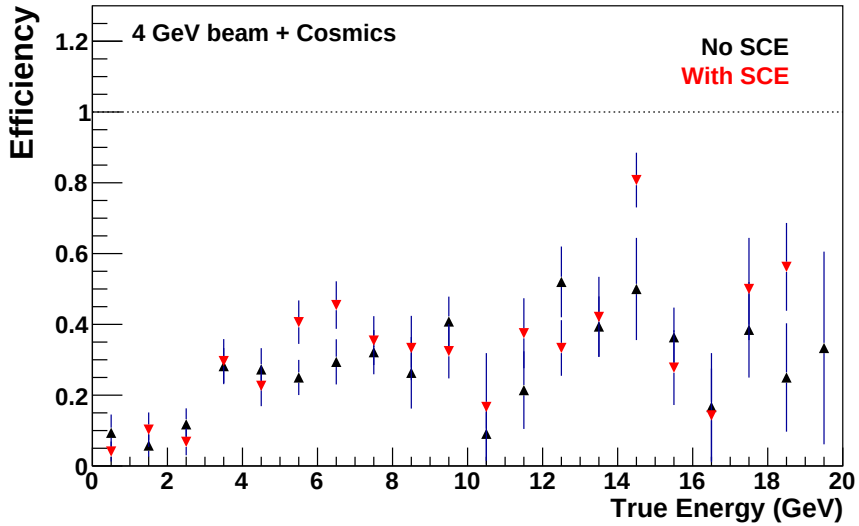
Cosmics: Front and Back

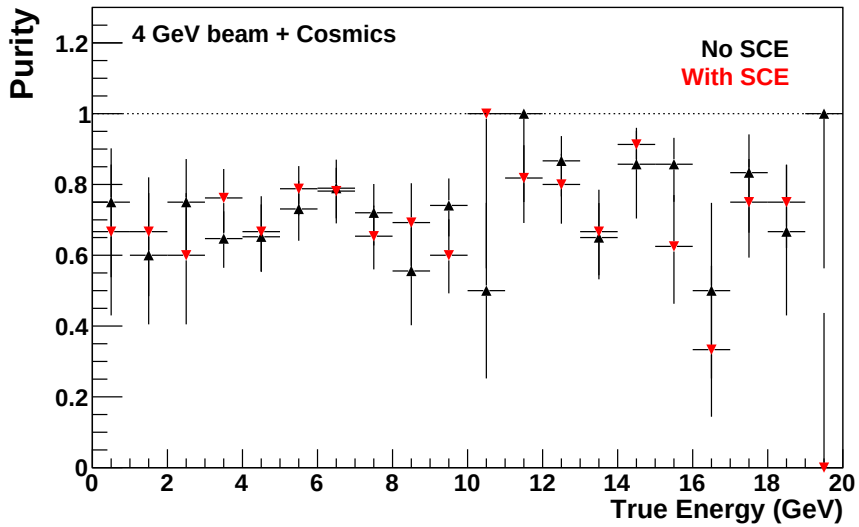
Upstream z = default in-line





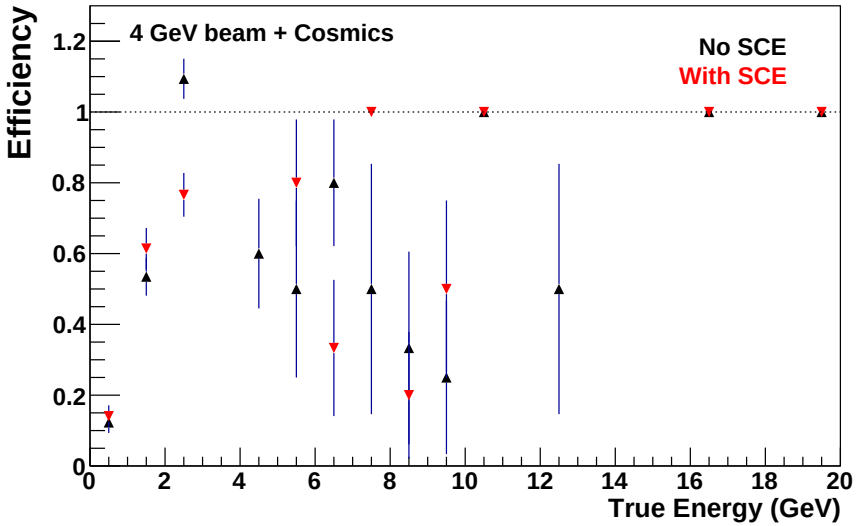
Upstream z = new staggered

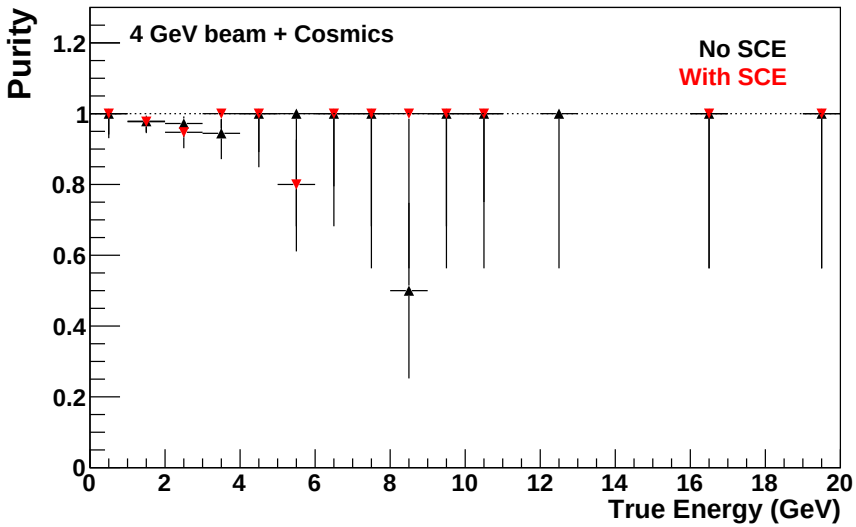




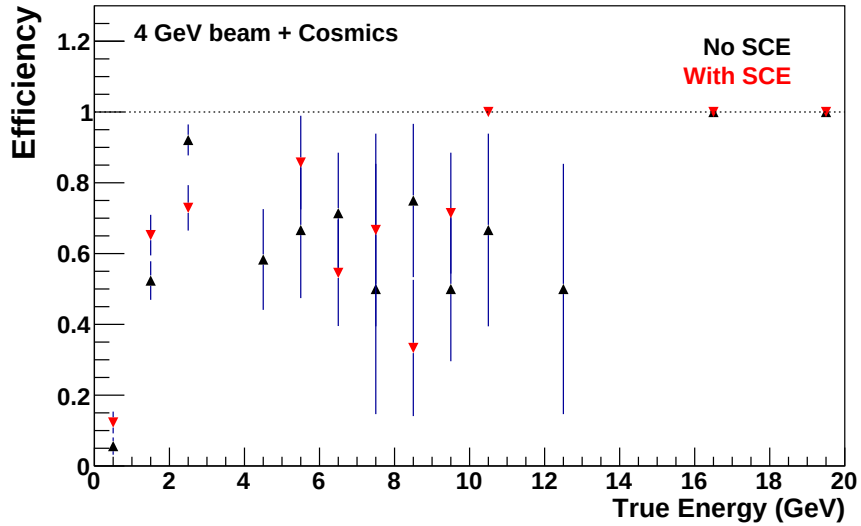
Halo: Front or Back

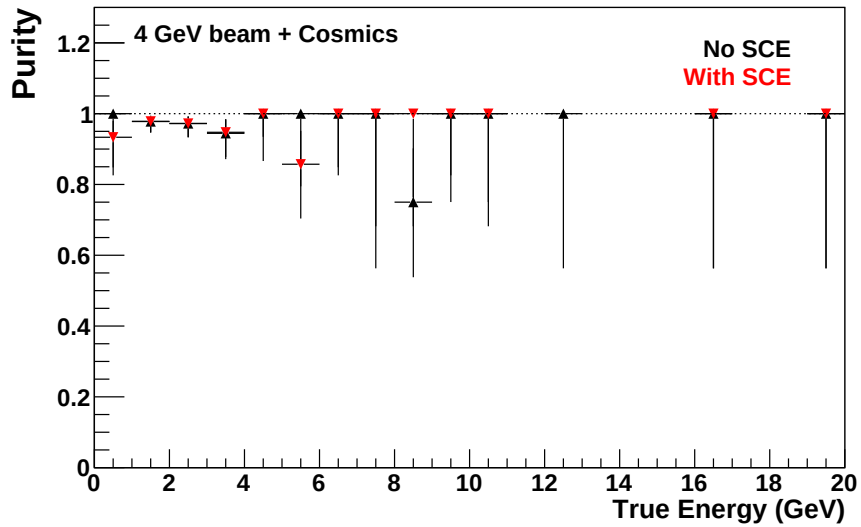
Upstream z = default in-line





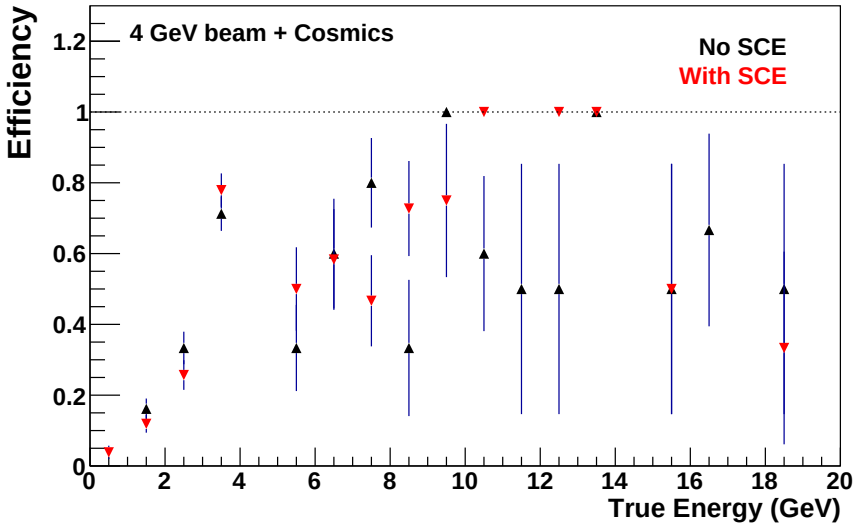
Upstream z = new staggered

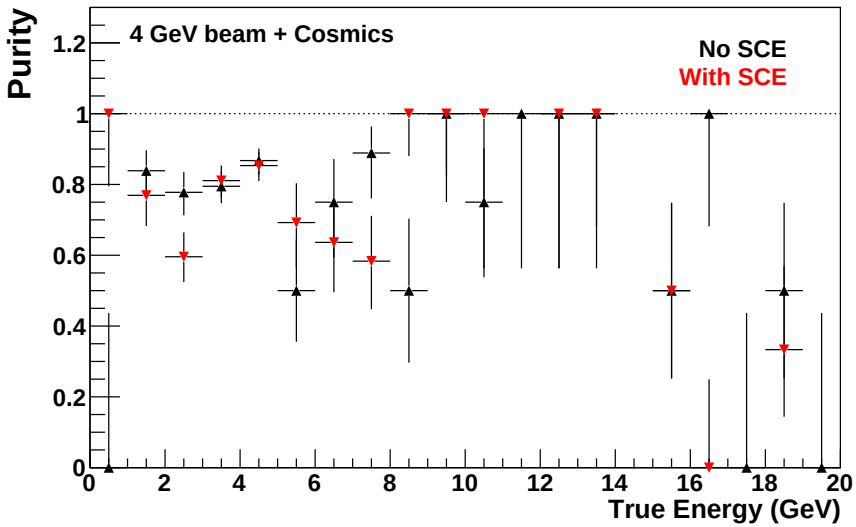




Halo: Front and Back

Upstream z = default in-line





Upstream z = new staggered