Efficiency and Purity of ePIC Track Reconstruction

Mito Funatsu
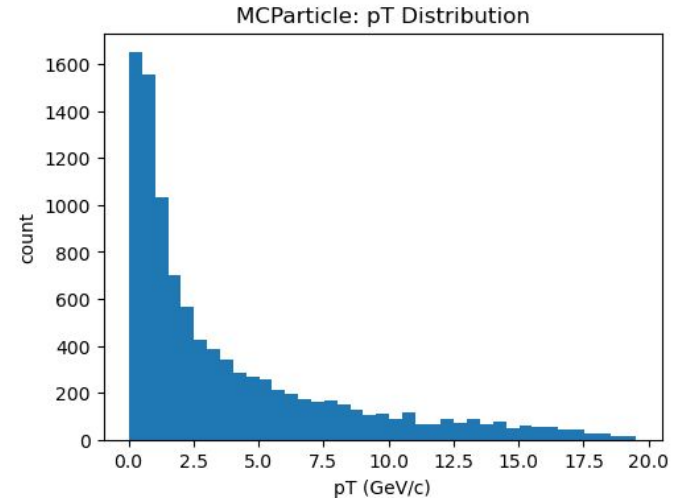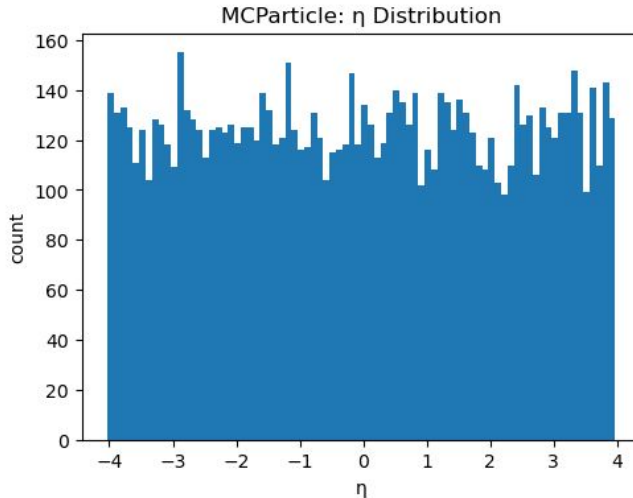
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Outline:

1. Defining efficiency/purity
2. Efficiency/purity of truth-seeded tracks
3. Efficiency/purity of real-seeded tracks
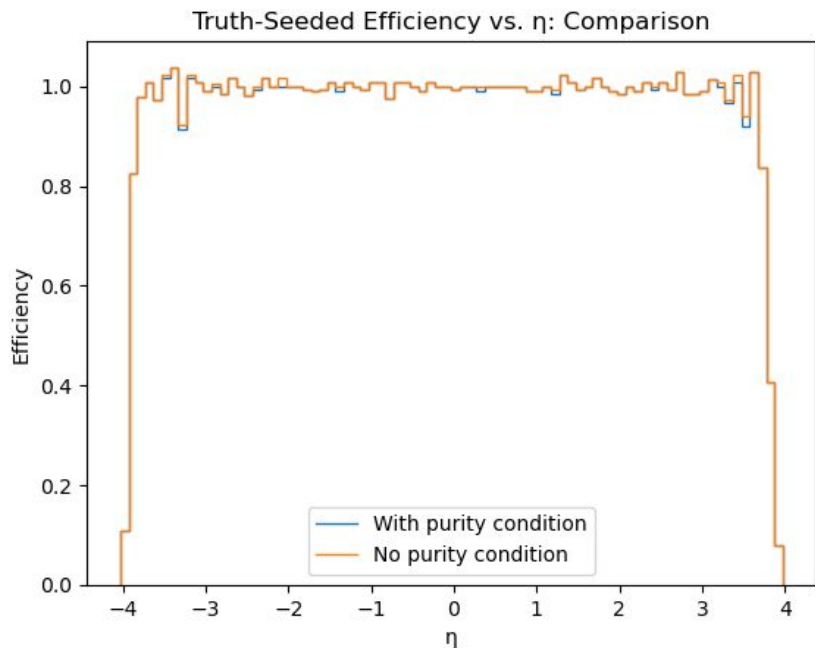4. Next steps

Events used:
- Crater Lake geometry
- Single muon
- 10,000 events
- 0.5<p<20 GeV/c
- -4≤η≤4

MCParticle: η Distribution
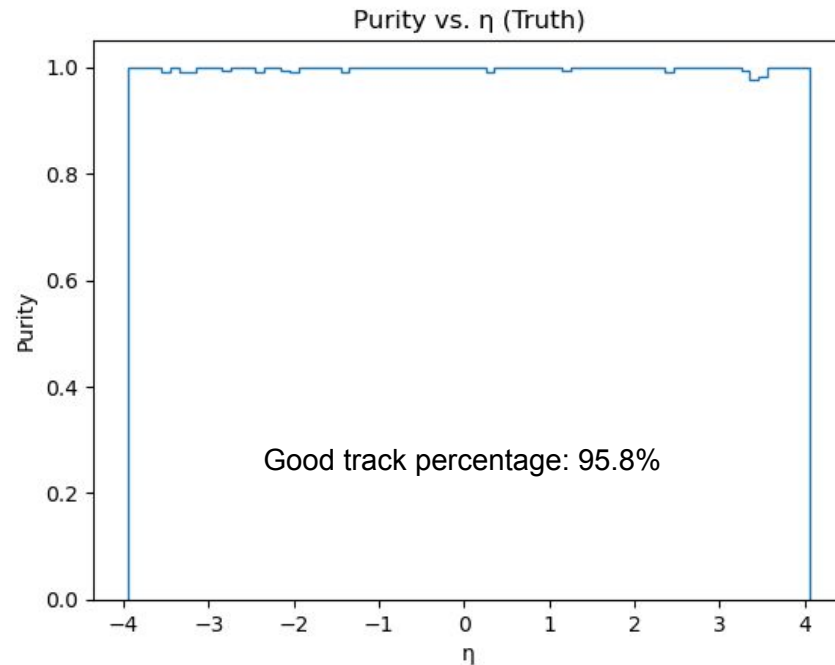

MCParticle: pT Distribution

Definitions: Efficiency and Purity

Efficiency	Purity
Efficiency is the ratio: $$\frac{\text{\# of reconstructed tracks}}{\text{\# of MCParticles}}$$	**Purity** is the ratio: $$\frac{\text{\# of "good" tracks}}{\text{\# of reconstructed tracks}}$$ A reconstructed track is "**good**" if it can be matched with an MCParticle within: • $\Delta\Theta$ **(theta) : 0.005 rad** • $\Delta\Phi$ **(phi) : 0.03 rad** *** dpp: 5%, DCA: 3mm**

Truth-Seeded: Efficiency and Purity (η)

Truth-Seeded Efficiency vs. η: Comparison

Legend:
- With purity condition
- No purity condition

Purity vs. η (Truth)

Good track percentage: 95.8%

Efficiency = $\dfrac{\text{\# of reconstructed tracks}}{\text{\# of muon MCParticles}}$

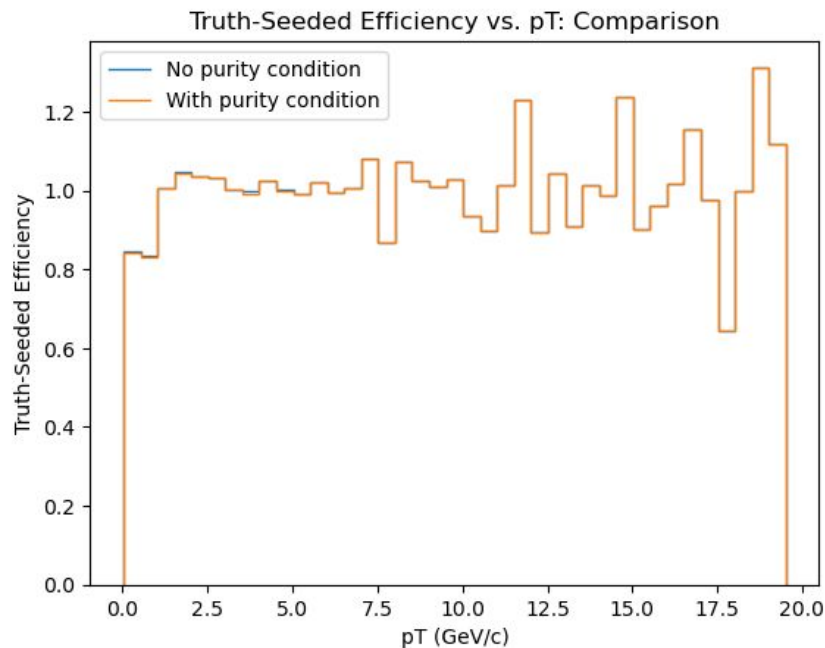**Purity =** $\dfrac{\text{\# of good tracks}}{\text{\# of reconstructed tracks}}$

Purity condition:
- ΔΘ (theta) : 0.005 rad
- ΔΦ (phi) : 0.03 rad

Truth-Seeded: Efficiency and Purity (p_T)

Truth-Seeded Efficiency vs. pT: Comparison

No purity condition
With purity condition

Truth-Seeded Efficiency

pT (GeV/c)

Purity vs. pT (Truth)

Purity

Good track percentage: 95.8%

pT (GeV/c)

$$\text{Efficiency} = \frac{\text{\# of reconstructed tracks}}{\text{\# of muon MCParticles}}$$

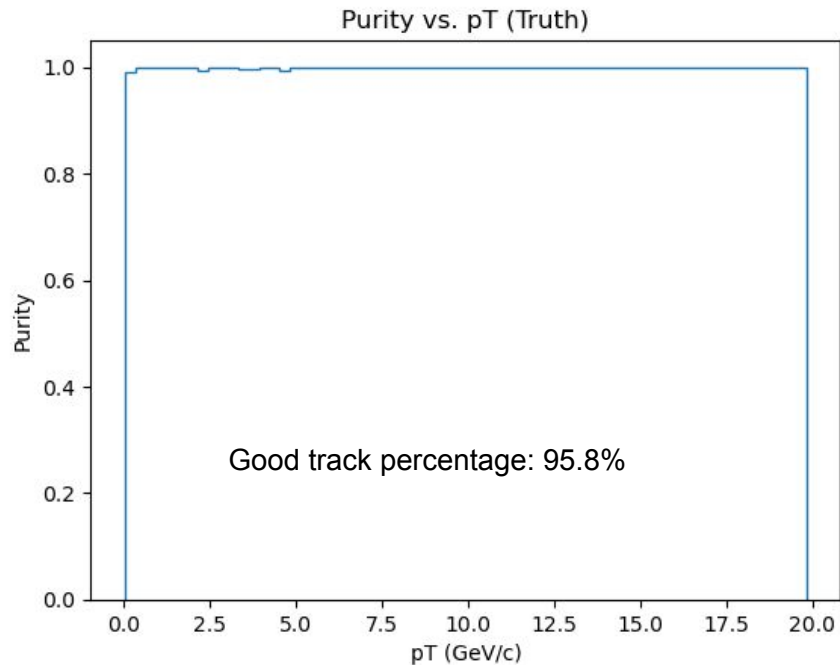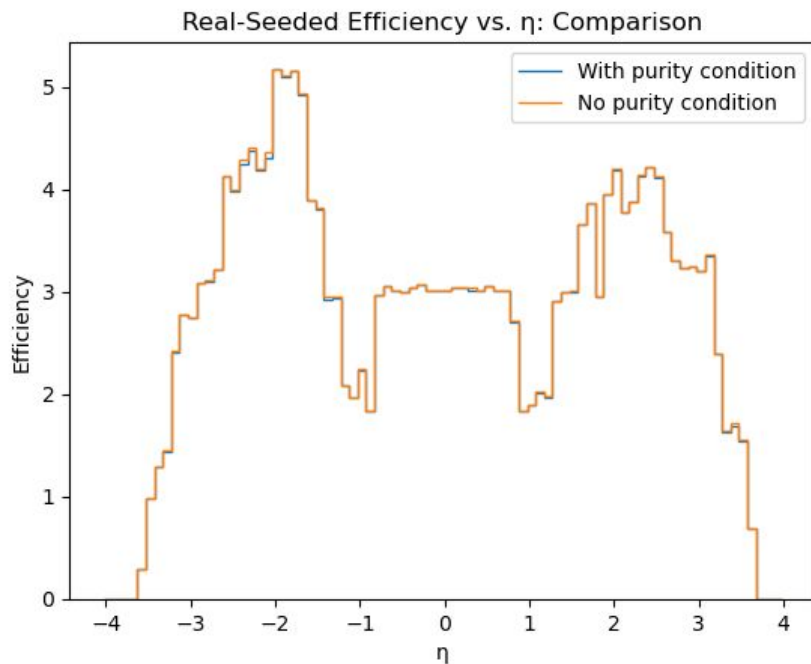$$\text{Purity} = \frac{\text{\# of good tracks}}{\text{\# of reconstructed tracks}}$$

Purity condition:
- $\Delta\Theta$ (theta) : 0.005 rad
- $\Delta\Phi$ (phi) : 0.03 rad

Real-Seeded: Efficiency and Purity (η)

Purity vs. η (Realistic)

Real-Seeded Efficiency vs. η: Comparison

- With purity condition
- No purity condition

Good track percentage: 88.1%

$$\text{Purity} = \frac{\text{\# of good tracks}}{\text{\# of reconstructed tracks}}$$

Purity condition:
- $\Delta\Theta$ (theta) : 0.005 rad
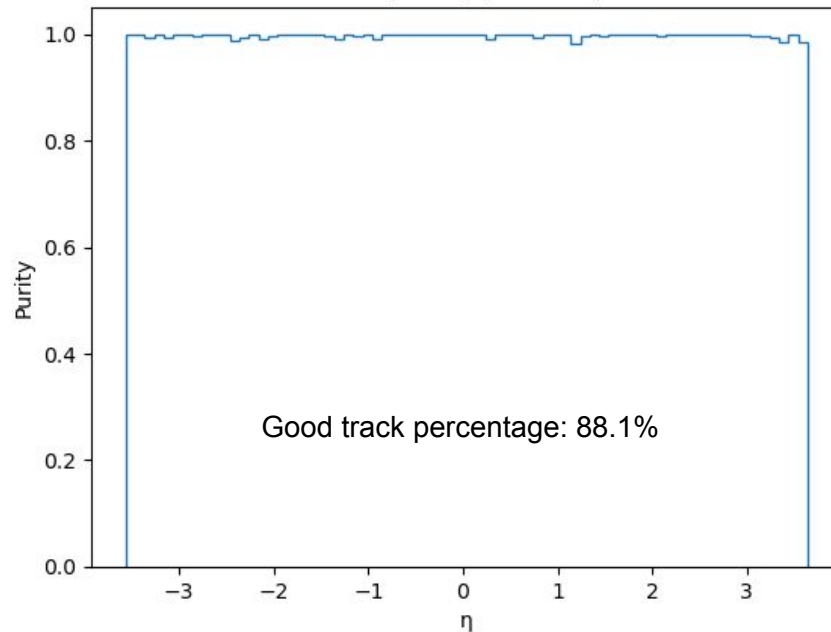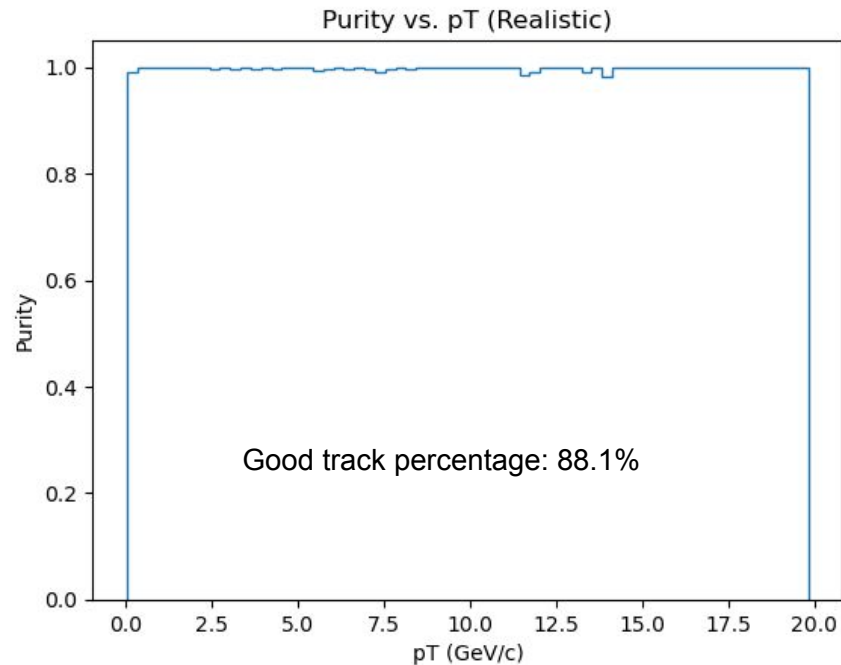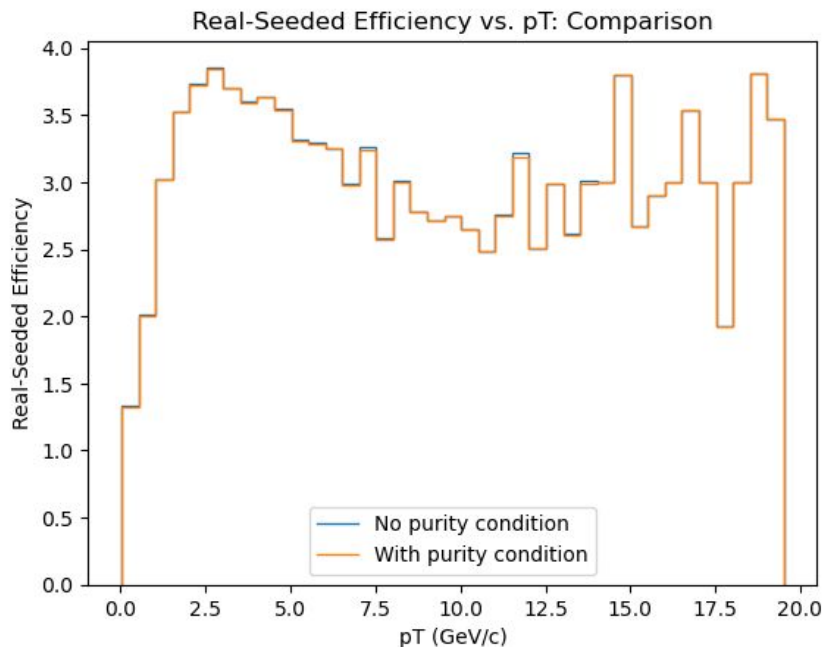- $\Delta\Phi$ (phi) : 0.03 rad

$$\text{Efficiency} = \frac{\text{\# of reconstructed tracks}}{\text{\# of muon MCParticles}}$$

Real-Seeded: Efficiency and Purity (p_T)

Purity vs. pT (Realistic)

Real-Seeded Efficiency vs. pT: Comparison

- No purity condition
- With purity condition

Good track percentage: 88.1%

Efficiency =
$$\frac{\text{# of reconstructed tracks}}{\text{# of muon MCParticles}}$$

Purity =
$$\frac{\text{# of good tracks}}{\text{# of reconstructed tracks}}$$

Purity condition:
- $\Delta\Theta$ (theta) : 0.005 rad
- $\Delta\Phi$ (phi) : 0.03 rad

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*Work in progress: with ambiguity solver

Real-Seeded: Efficiency and Purity (η)

Real-Seeded Efficiency vs. η: Comparison

Purity vs. η (Realistic)
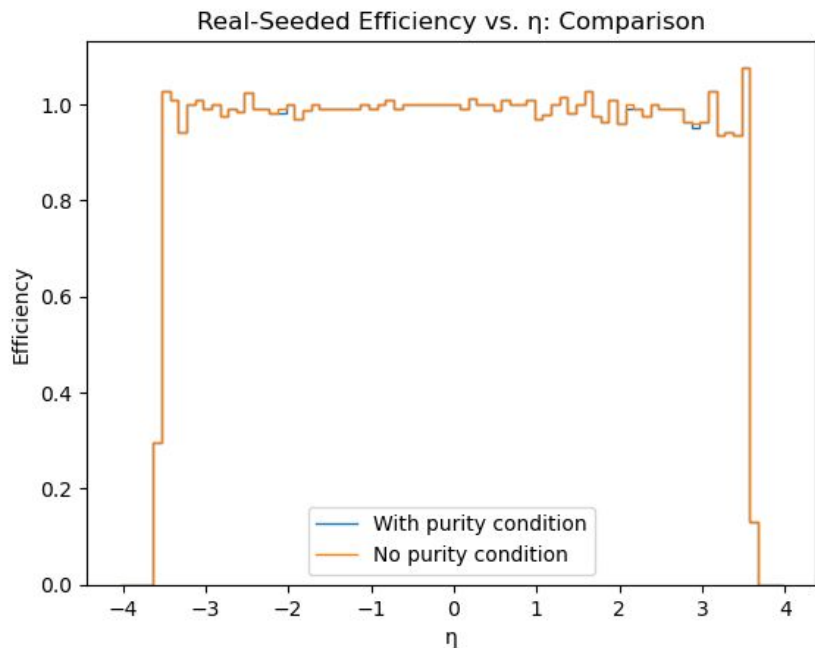
Good Track Percentage: 99.9%

$$\text{Efficiency} = \frac{\text{\# of reconstructed tracks}}{\text{\# of muon MCParticles}}$$

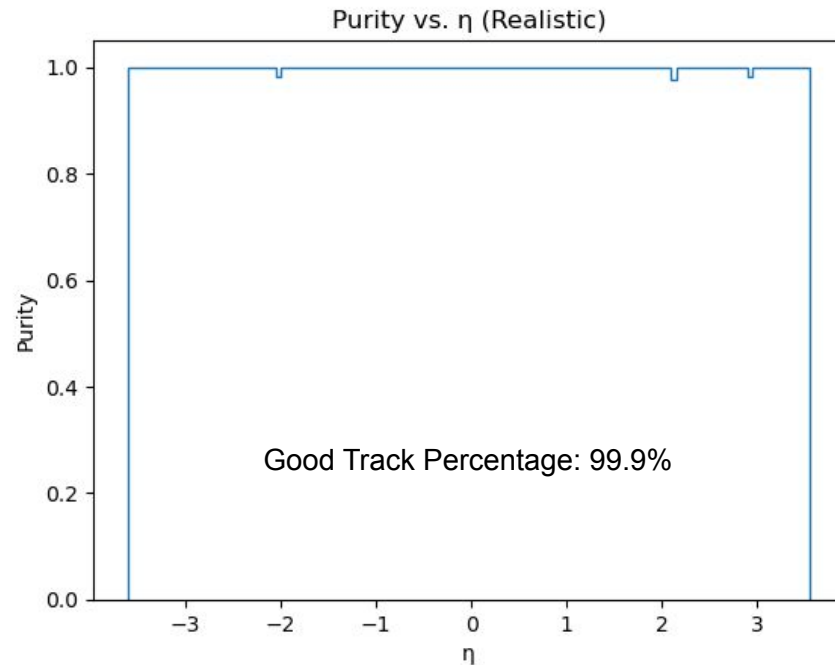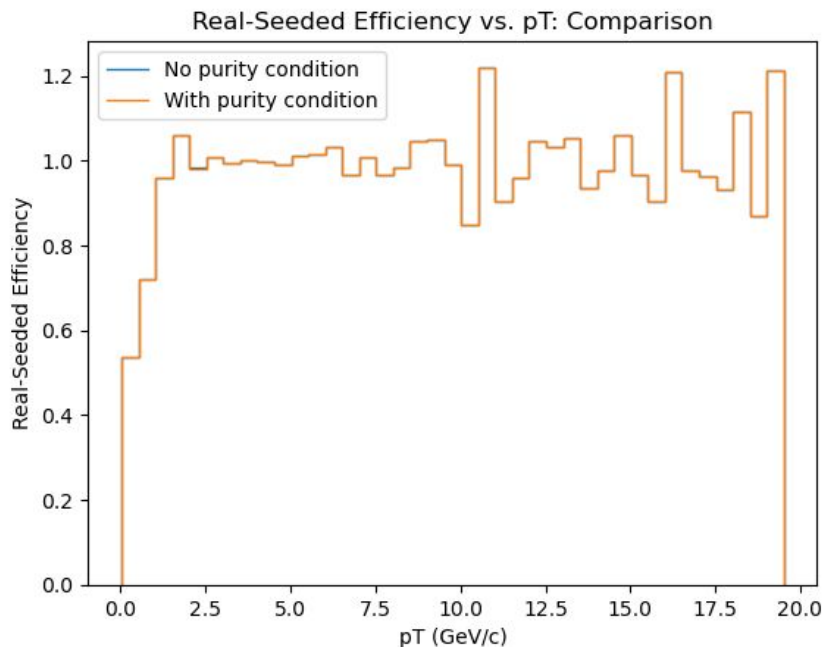$$\text{Purity} = \frac{\text{\# of good tracks}}{\text{\# of reconstructed tracks}}$$

Purity condition:
- $\Delta\Theta$ **(theta) : 0.005 rad**
- $\Delta\Phi$ **(phi) : 0.03 rad**

Real-Seeded: Efficiency and Purity (p_T)

Real-Seeded Efficiency vs. pT: Comparison

- No purity condition
- With purity condition

Purity vs. pT (Realistic)

Good Track Percentage: 99.9%

$$\text{Efficiency} = \frac{\text{\# of reconstructed tracks}}{\text{\# of muon MCParticles}}$$

$$\text{Purity} = \frac{\text{\# of good tracks}}{\text{\# of reconstructed tracks}}$$
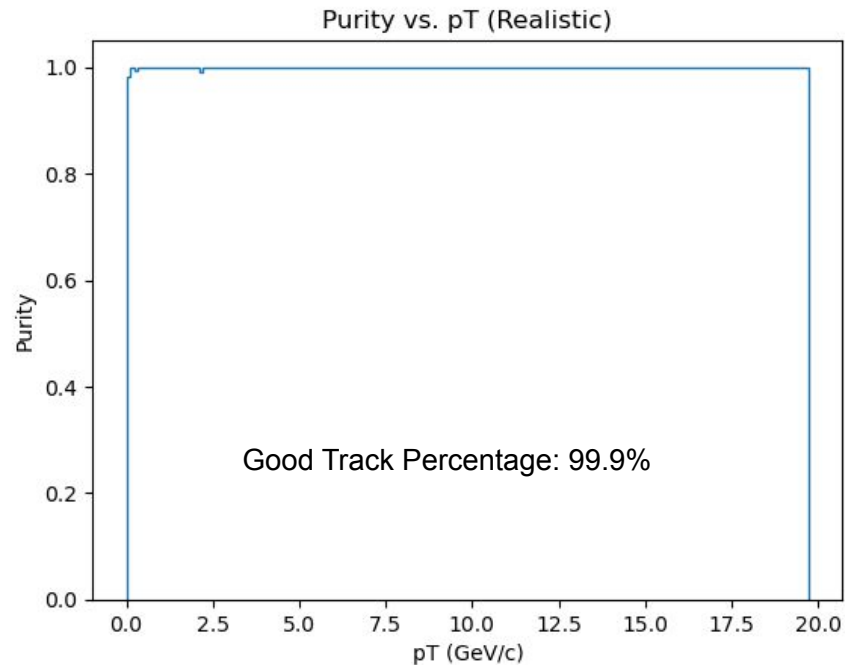
Purity condition:
- $\Delta\Theta$ (theta) : 0.005 rad
- $\Delta\Phi$ (phi) : 0.03 rad

Summary:

Purity measurement is conducive to assessing the reliability of efficiency plots. These plots will give us a baseline for when we add noise.

Next Steps:

1. Update purity conditions to include: **dpp: 5%, DCA: 3mm**
2. Look at the efficiency and purity values with **noise**
3. Analyze DIS events