



UNIVERSITY OF
CAMBRIDGE







Initial Interaction Vertex Multiplicity Study for ProtoDUNE-SP

24th November, 2020 – Systematic Effort Meeting

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- Personal Introduction
- Multiplicity analysis on MC true and reconstructed events
- A first approach to high level efficiency metric
- Future work and Q&A

Personal Introduction

- PhD student in High Energy Physics at the University of Cambridge, 
- BSc in Physics (Milan, , ), MSc in Physics (ETH Zurich, )
- Supervisors: Leigh Whitehead and Melissa Uchida (Cambridge), Michael Wang (Fermilab)
- Works in the Pandora team -> Software development for Pandora, data analysis for ProtoDUNE-SP, specialised in Machine Learning
- email: sv408@hep.phy.cam.ac.uk or DUNE Slack

Simulation

- The file I have been using is ProtoDUNE-SP Production 2 1 GeV Monte Carlo Space Charge
- Using https://cdcv.sfnal.gov/redmine/projects/protoduneana/repository/revisions/develop/entry/protoduneana/singlephase/Pion/PionAnalyzer_module.cc I obtain root files containing information about MC truth and reconstruction using Pandora
- All events with <15 hits are cut as well as excited nuclei (PDG code > 5000).
- With MC information, all daughters with PDG code |11| or 22 are called showers, the others tracks.
- Since π_0 mostly decay into a couple of photons, a single π_0 counts as 2 showers.
- With reco information, everything with CNN track score <0.3 is called shower otherwise track. We use only track score from the collection plane.

Beam Particles

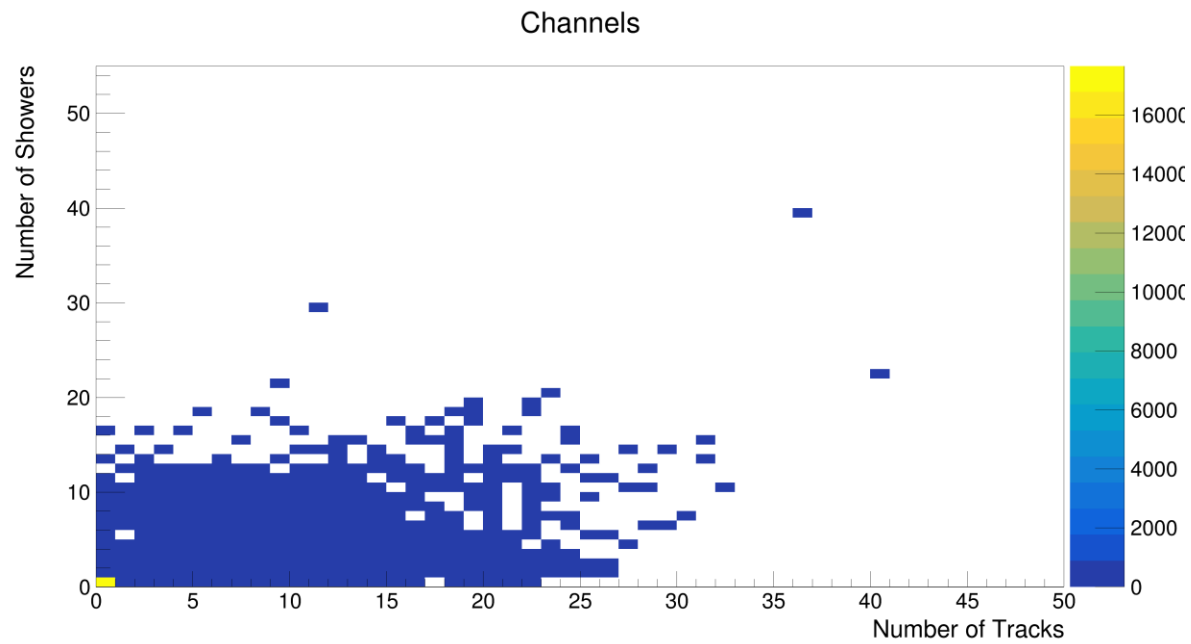
Beam Particle	Count
e^+	19015
p	4424
π^+	3700
μ^+	272
K^+	5
total	27416

A first estimation of high-level efficiency metric : if for a given event the number of reco daughters equals the number of true daughters, histogram is filled.

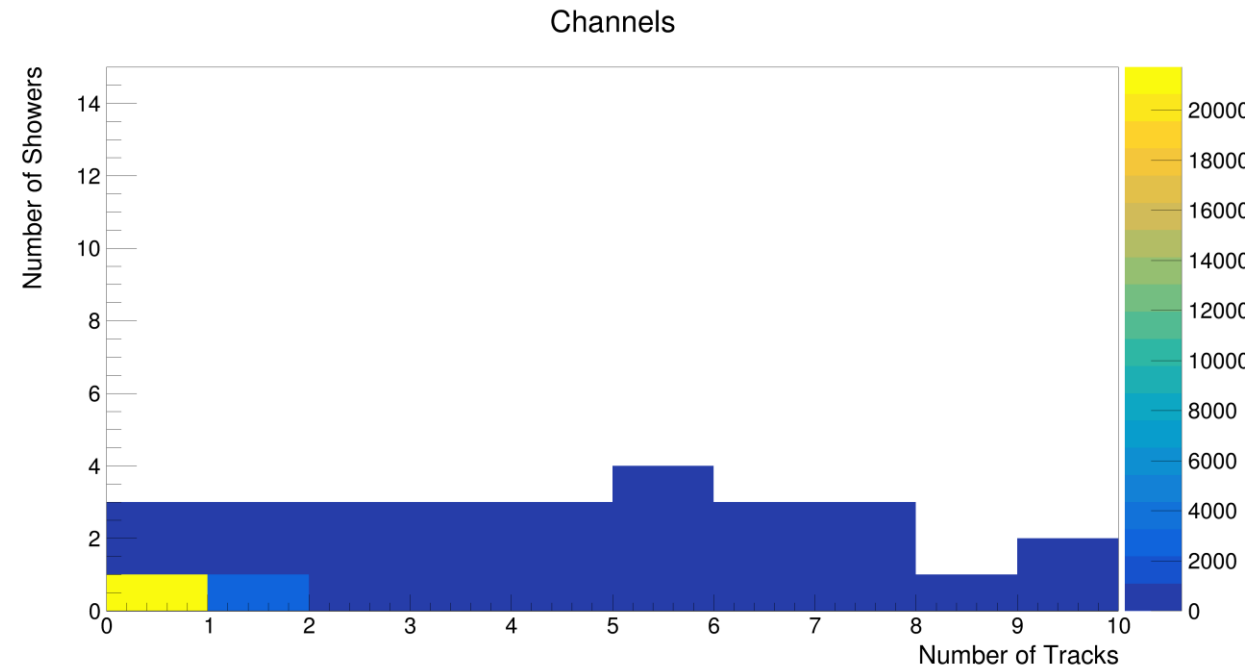
After processing all events, ratio between this histogram and mc true histogram is shown.

0 means that particular topology was never perfectly reconstructed, 1 means that particular topology was always perfectly reconstructed.

All Beam Particles – MC True before and after cuts

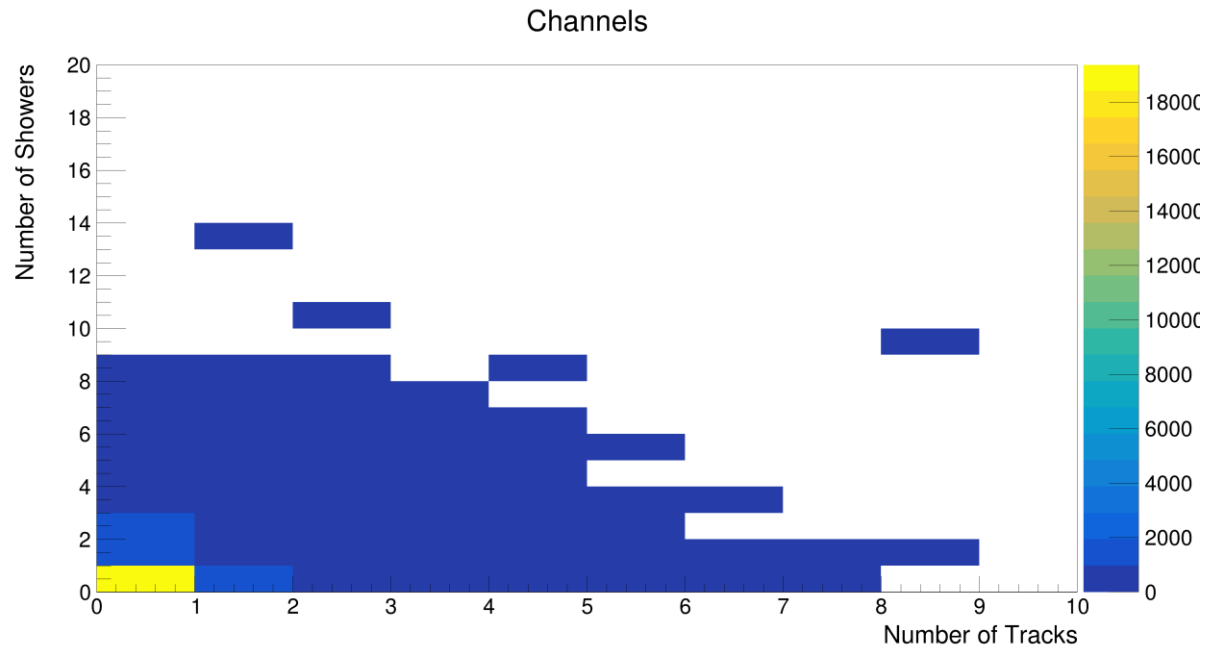


Before cut

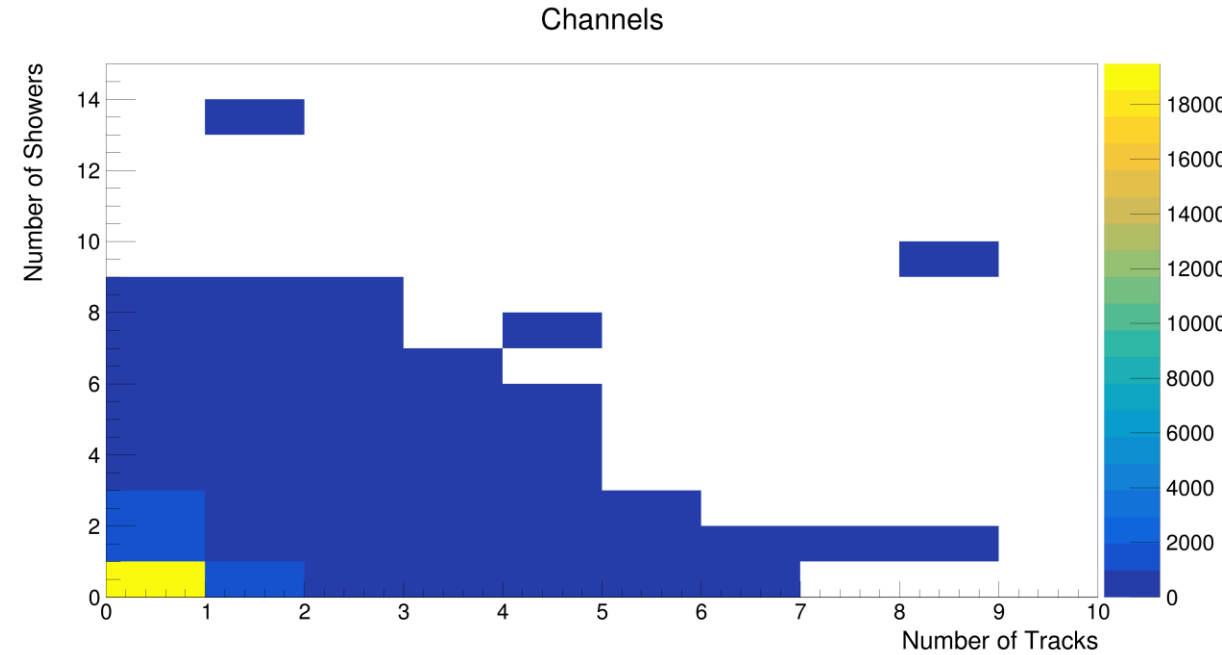


after cut on nHits

All Beam Particles – Reco before and after cuts

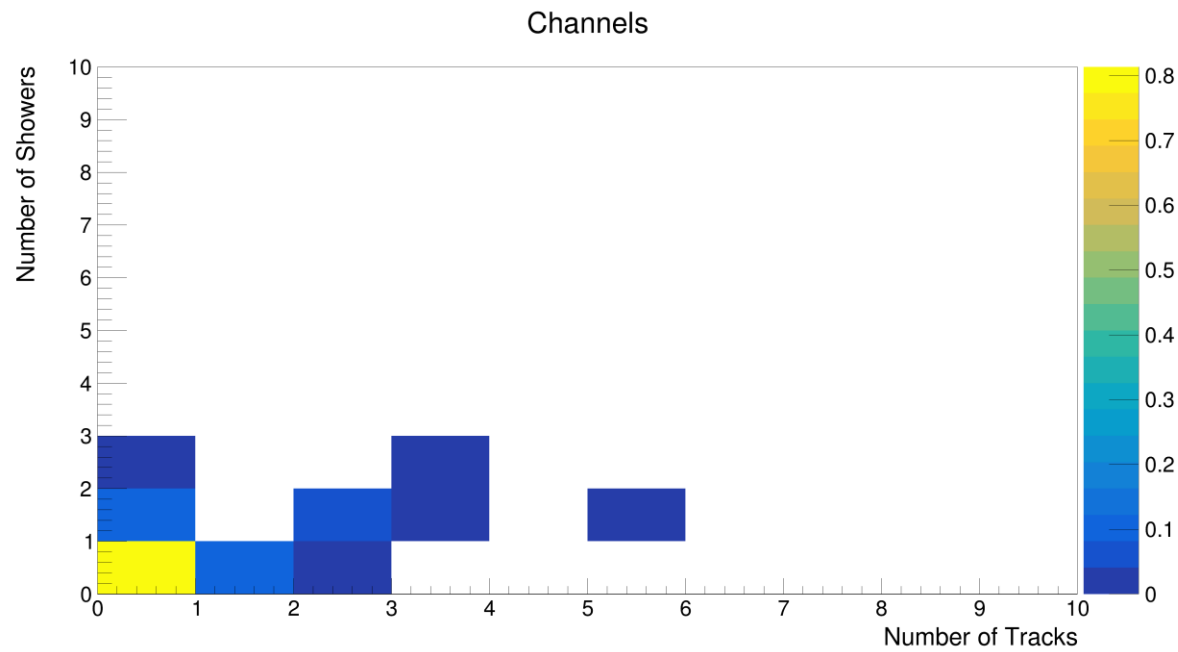


Before cut

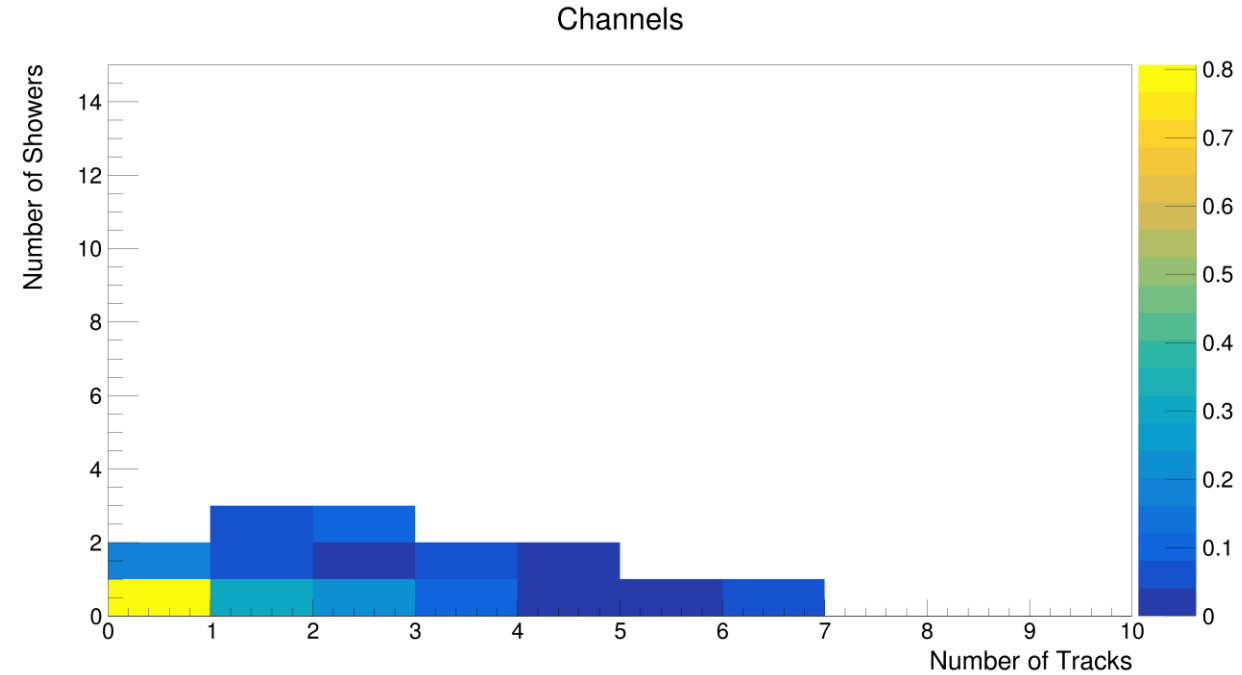


after cut on nHits

All Beam Particles – Ratio before and after cuts

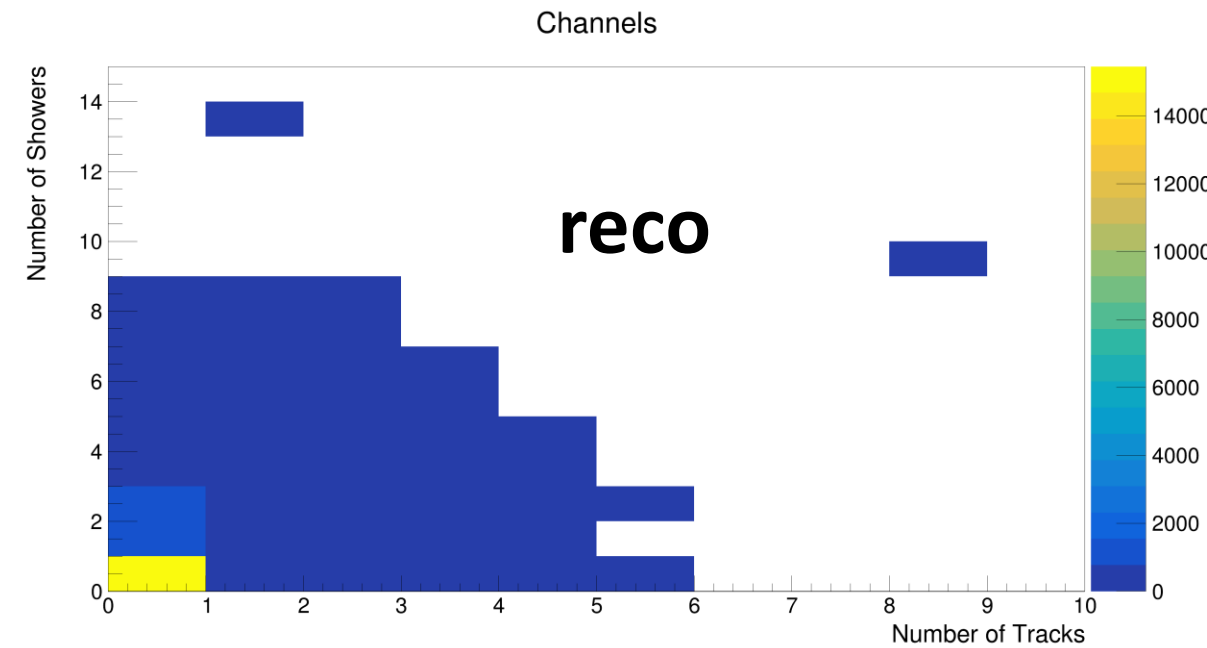
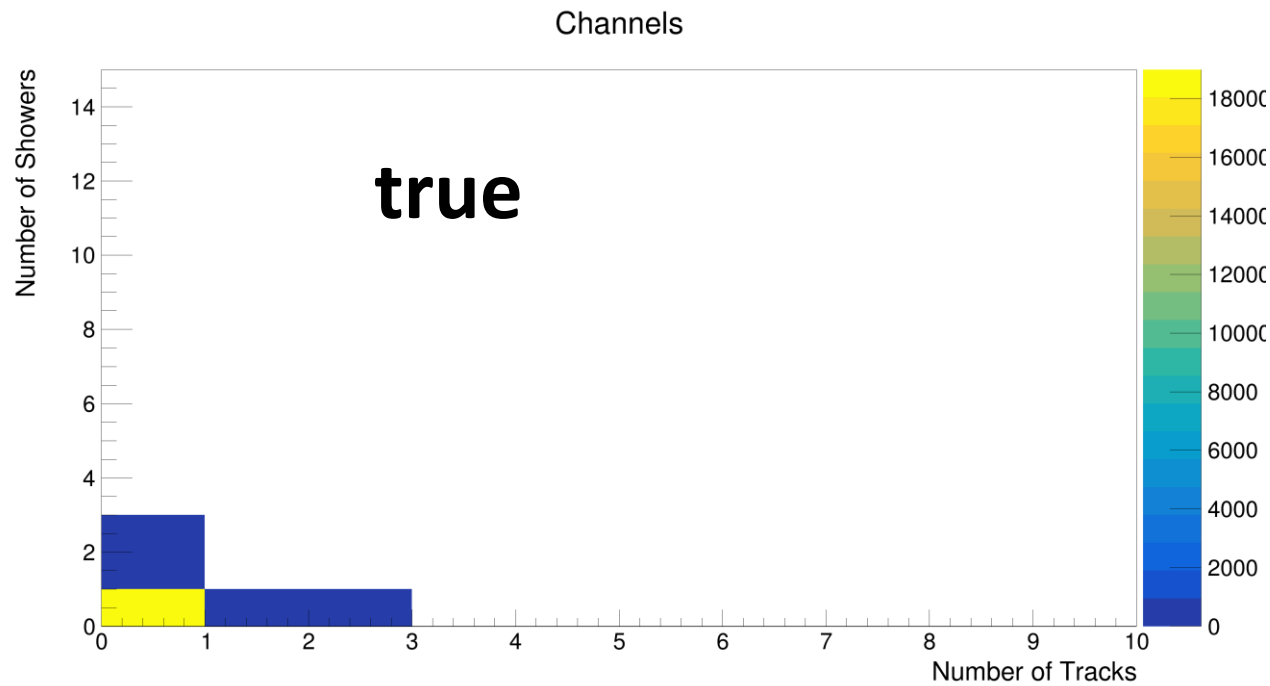


Before cut

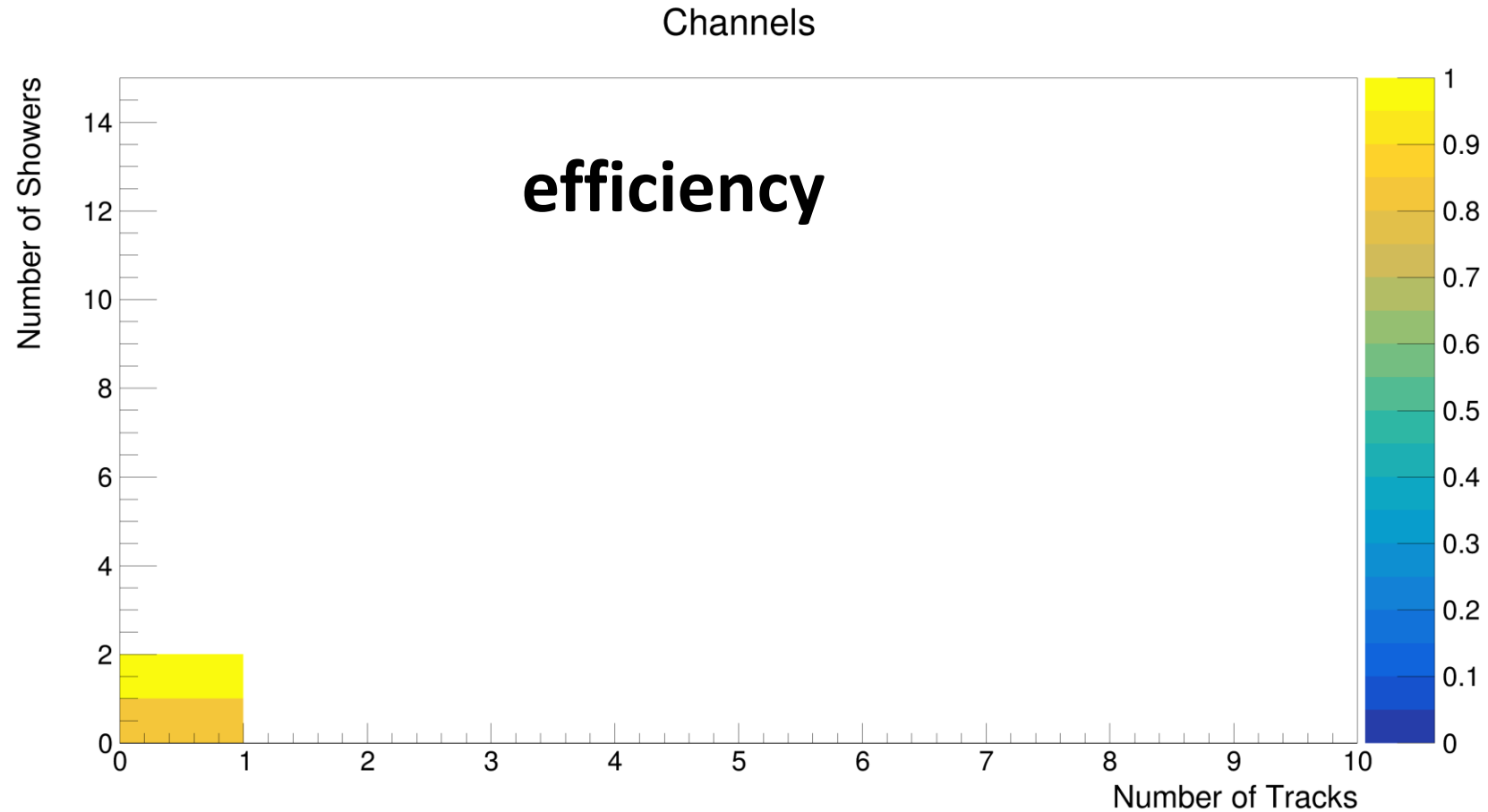


after cut on nHits

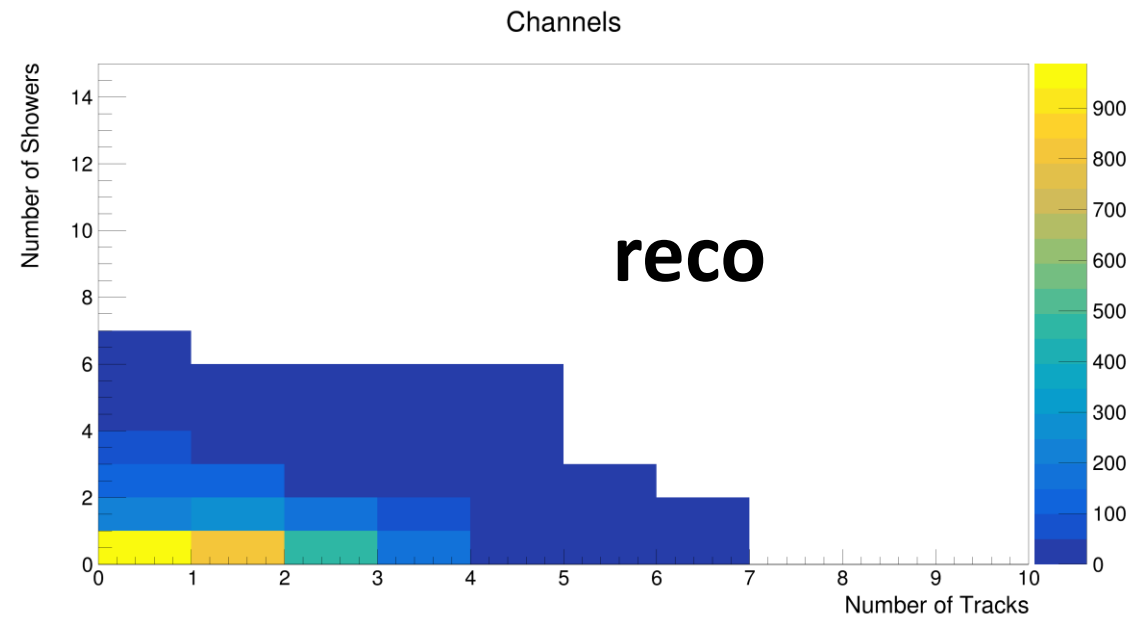
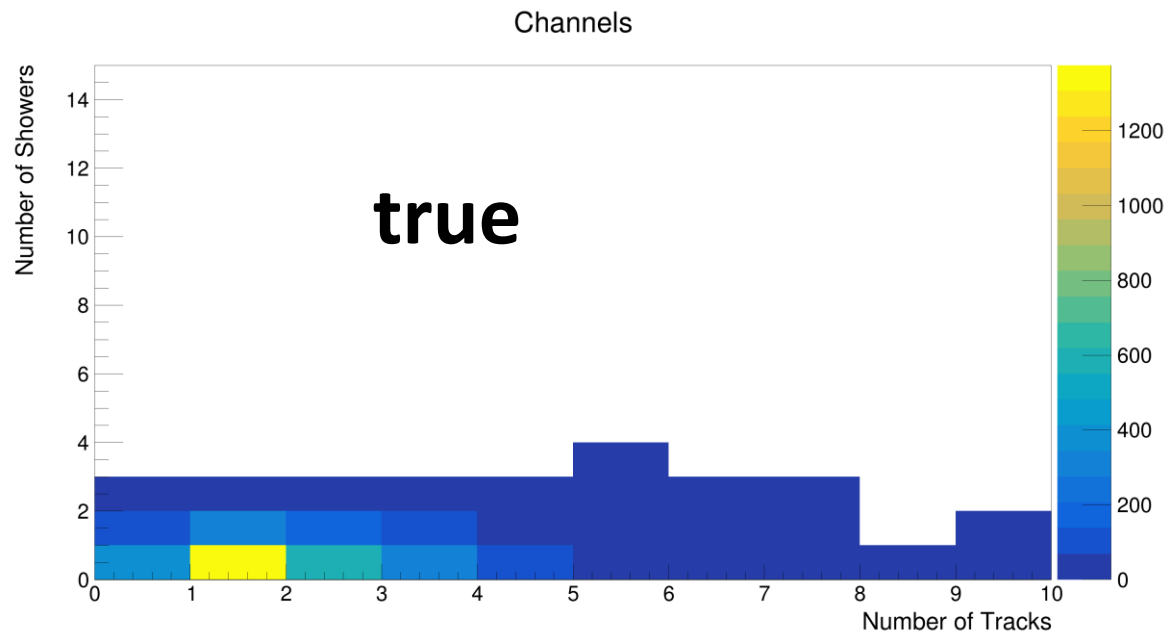
Positron Beam Particle – cut on nHits



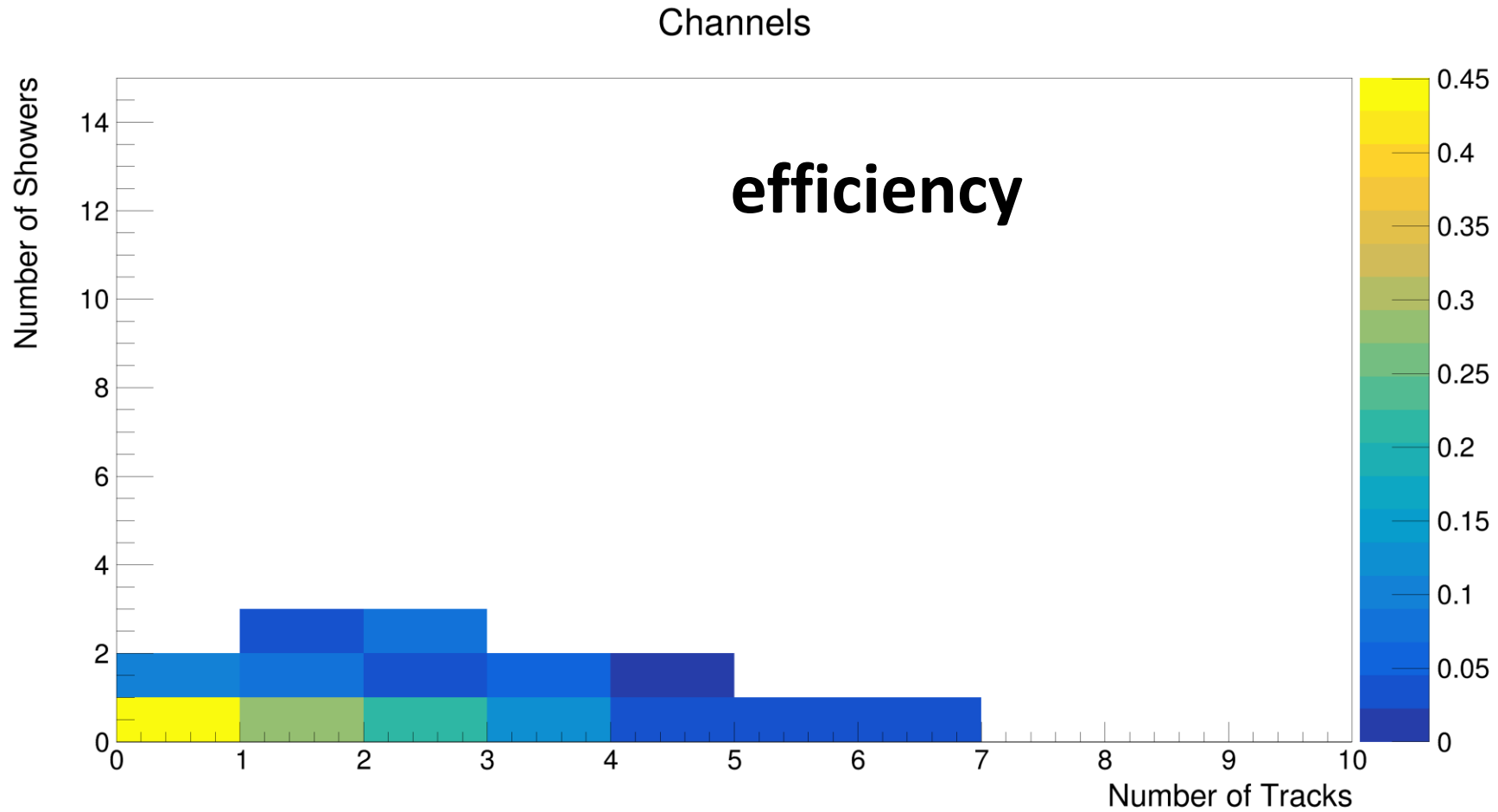
Positron Beam Particle – cut on nHits



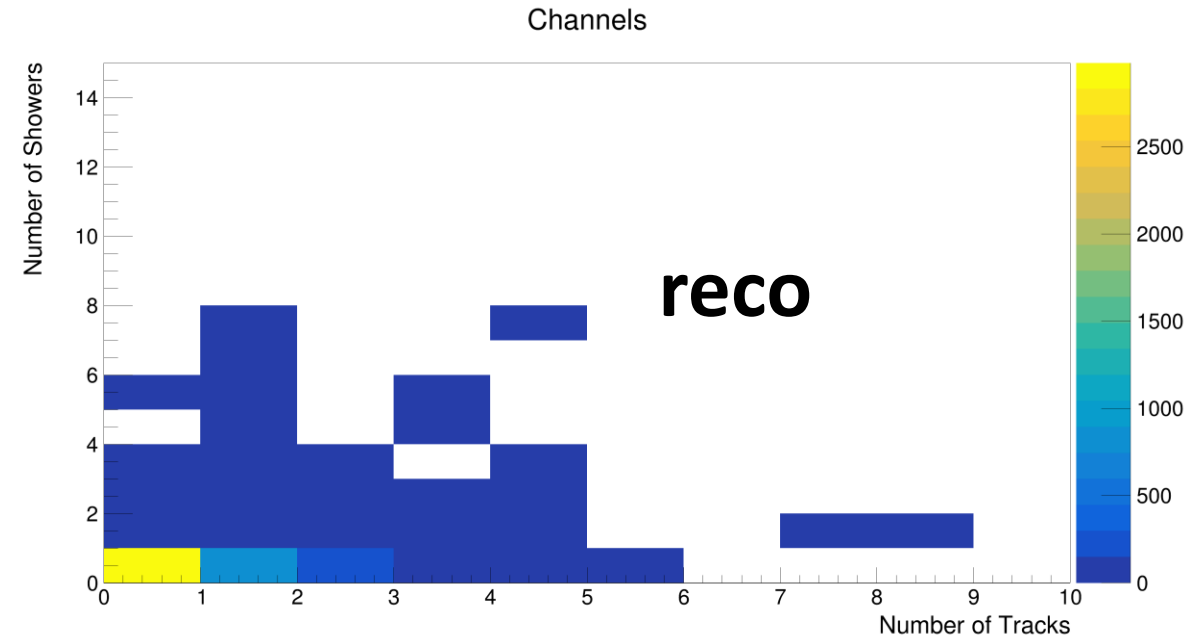
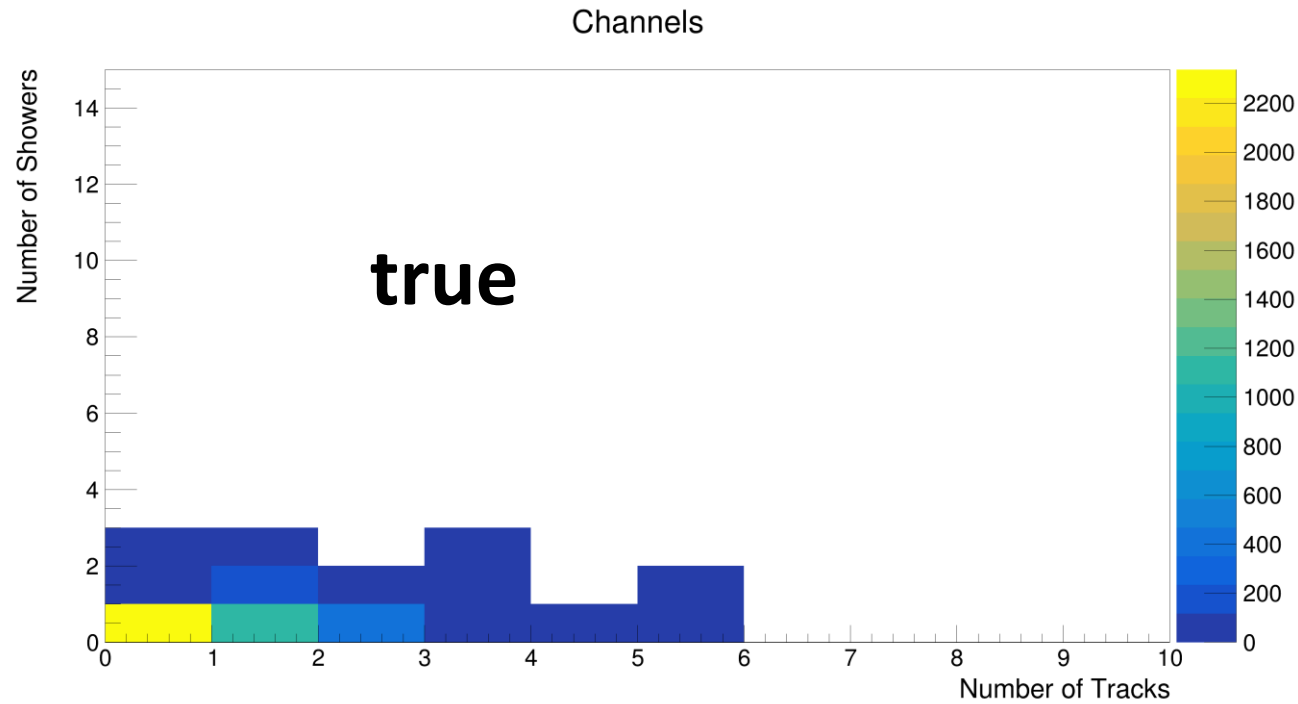
Pion Plus Beam Particle – cut on Nhits



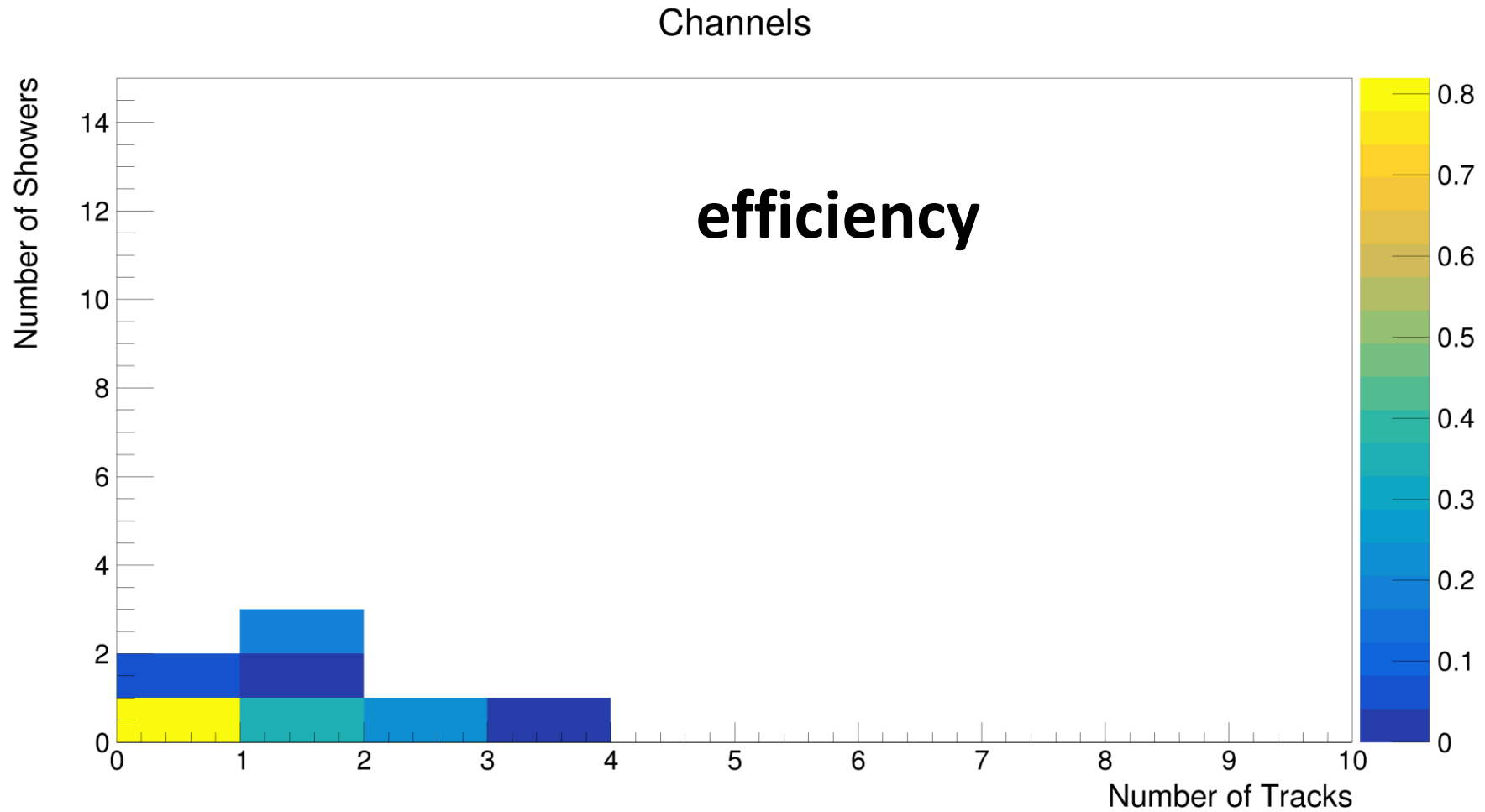
Pion Plus Beam Particle – cut on Nhits



Proton Beam Particle – cut on Nhits



Proton Beam Particle – cut on Nhits



- Check performance explicitly for the analysis channels (using the same truth definition)
- Look in more detail at the events that aren't correctly reconstructed - which particles are missed?