Preliminary study of silicon hit efficiencies for cosmic-ray tracks

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Overview

To understand hit efficiencies in the silicon detectors:

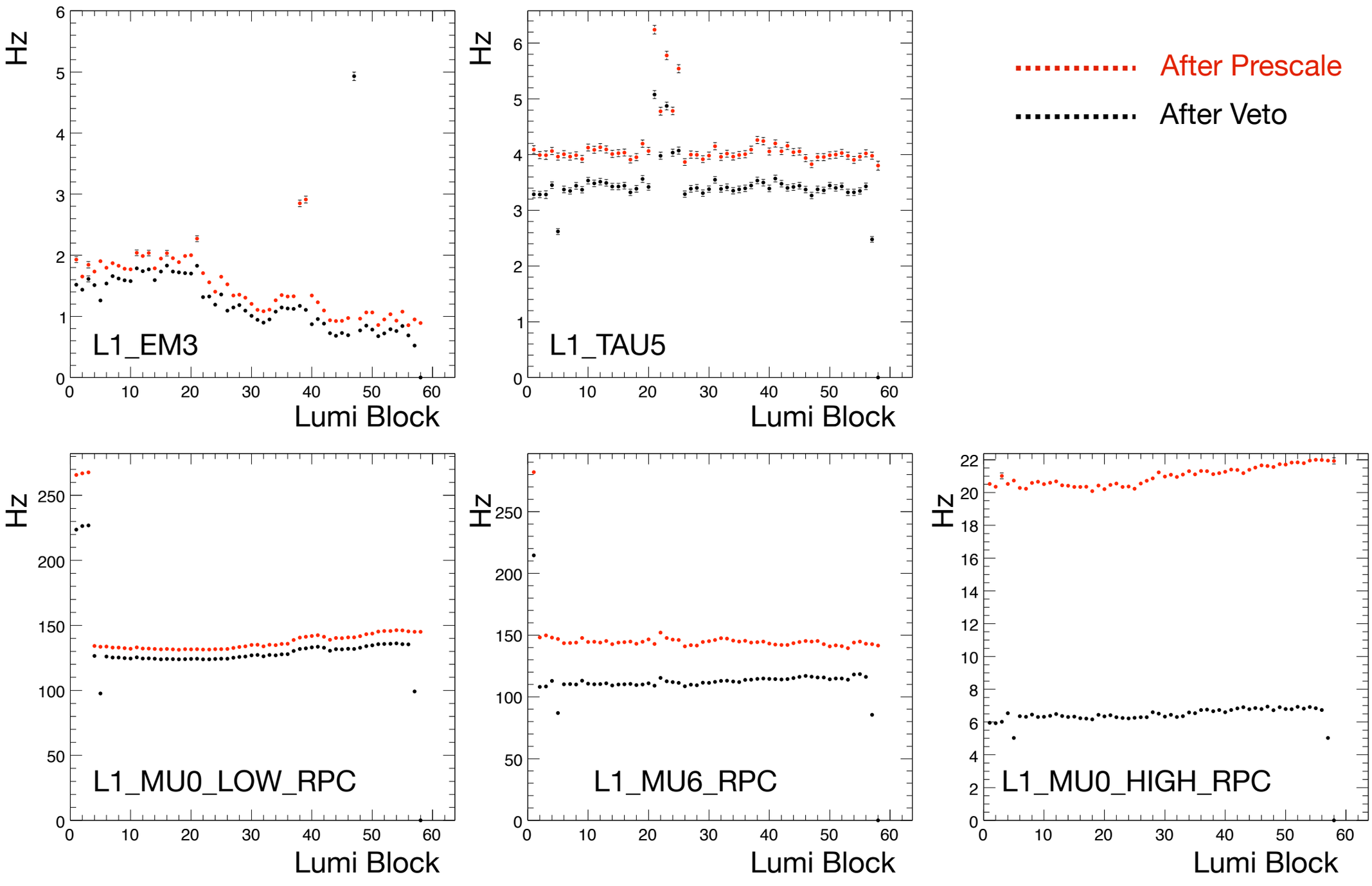
- Use an event trigger that does not bias the results
- Use the TRT to select tracks for further study

Data studied

This study has been preformed on the IDCosmic stream of run 90272:

- Magnetic field was on
- Lasted 16 hours on 28 September 2008
- Events in this stream passed one of two L2 algorithms to enhance the number of ID tracks
  - L2_CosmicsAllTeIDSCAN_AllPhysics_TrkHypo
  - L2_CosmicsAllTeTRTxK_TRTTrkHypo_AllPhysics
- Analyzed ESDs (first processing) using release 14.2.21.8 AtlasTier0

LVL1 Trigger Rates

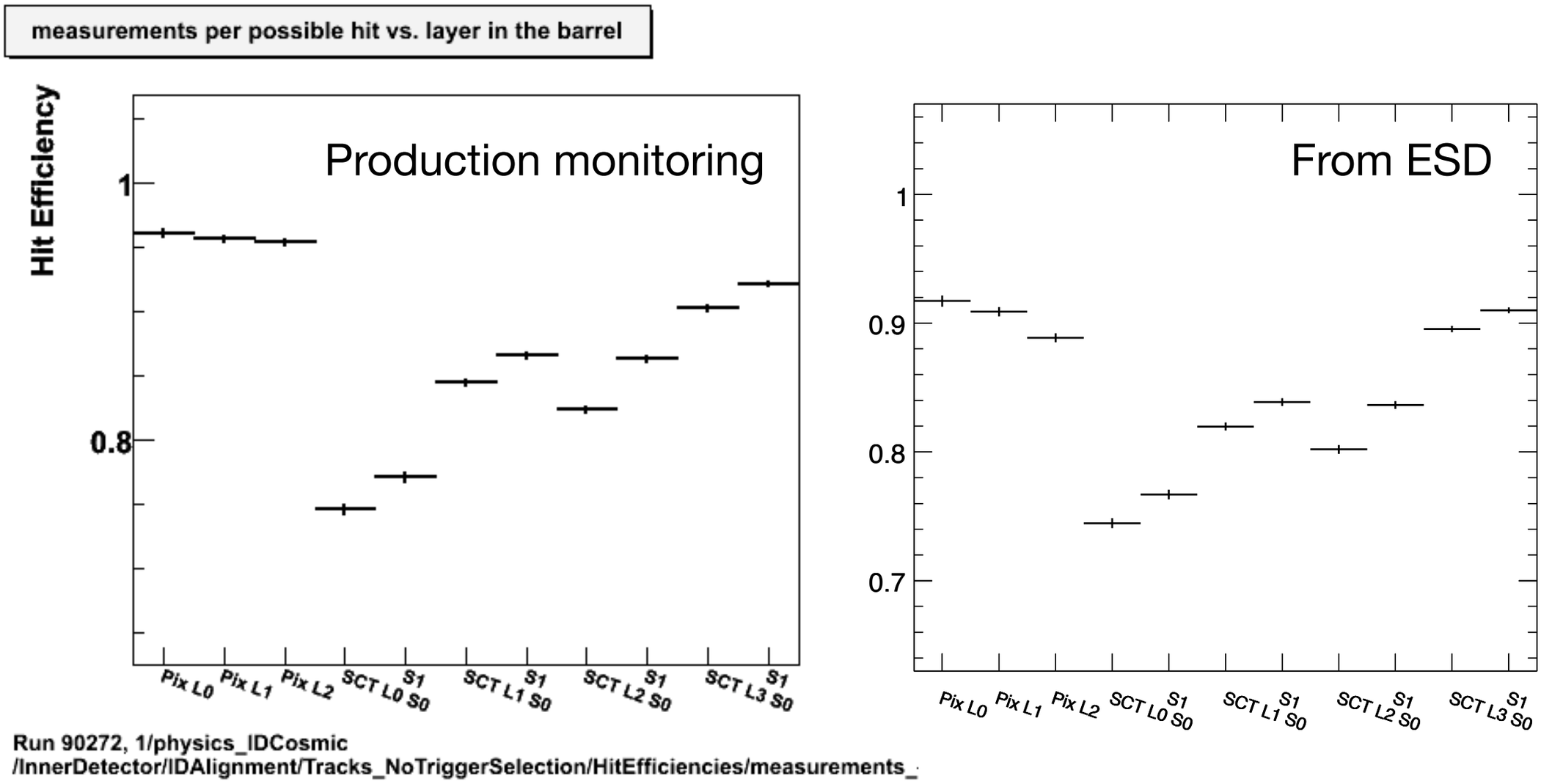


L2 Yields

L2 chains use all L1 as input with no prescales

- Total of 124,691 events in this stream:
  68,274 tracks total, 3,210 tracks with at least 3 pixel hits
  - IDSCAN selected 81,798 events:
    7,780 tracks total
    2,447 tracks with at least 3 pixel hits
  - TRTxK selected 45,285 events:
    64,554 tracks total
    1,817 tracks with at least 3 pixel hits
    Large number of pixel endcap hits
  - Overlap is small

Standard efficiency plot



- Numerator is hits from all tracks in stream
- Denominator is hits, holes, and outliers from all tracks in the stream
- Difference between plots not understood yet

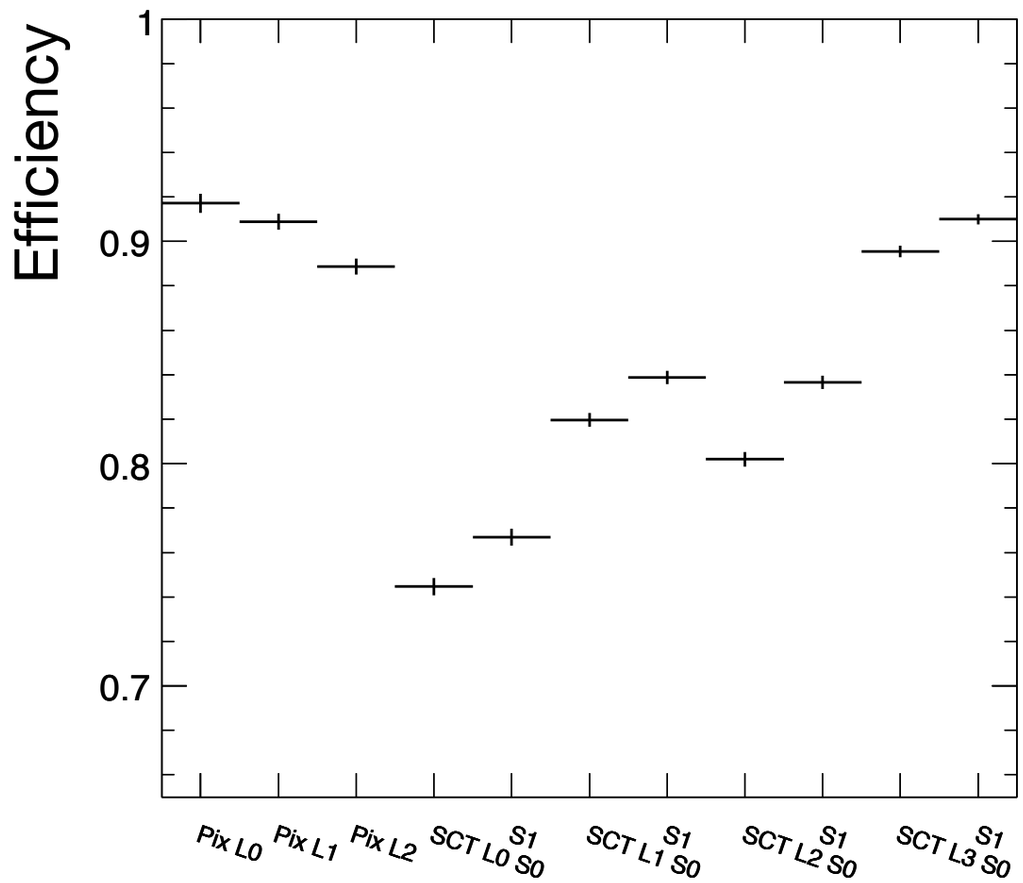
Quality cuts

To remove potential bias and improve quality, the following selections were made:

- Require TRT segment finder L2 algorithm (L2_CosmicsAllTeTRTxK_TRTTrkHypo_AllPhysics)
- At least 30 TRT hits on track
- At least 4 Si hits (required by hole finder)
- $|d_0| < 50$ cm, $|z_0| < 70$ cm

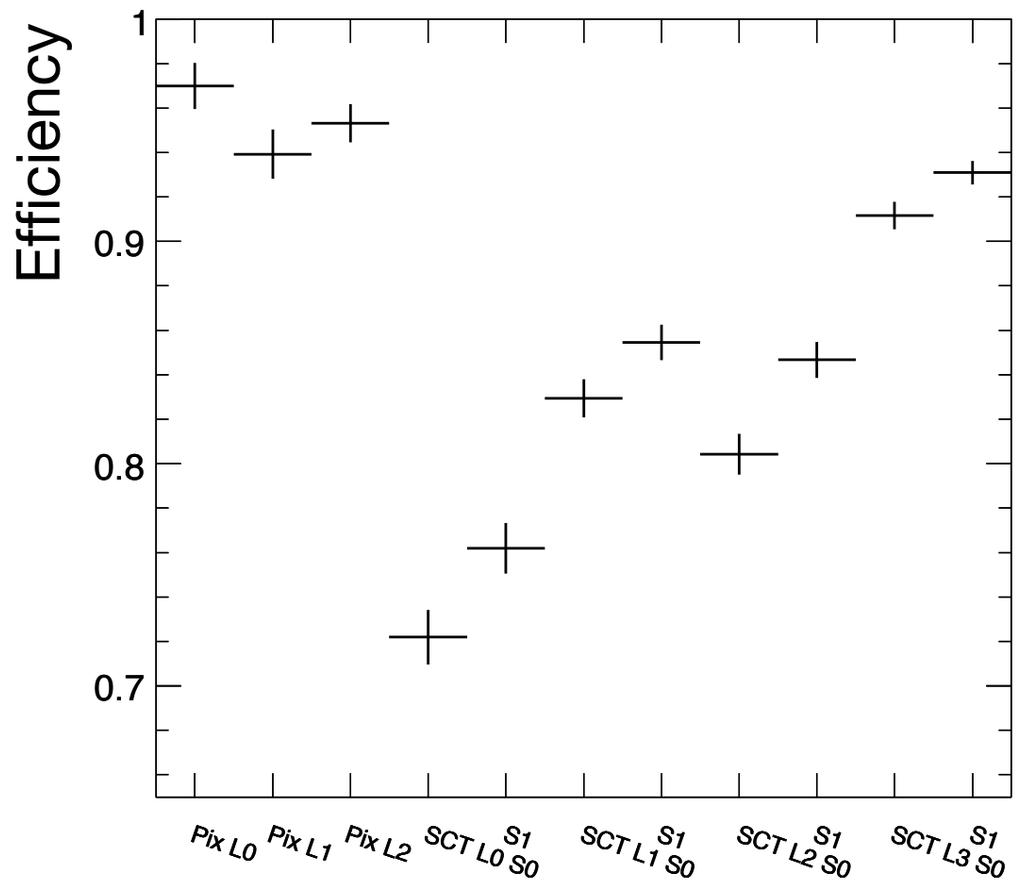
Efficiency plot after cuts

All tracks



134,570 hits or holes
in denominator

Quality cuts applied



16,165 hits or holes
in denominator

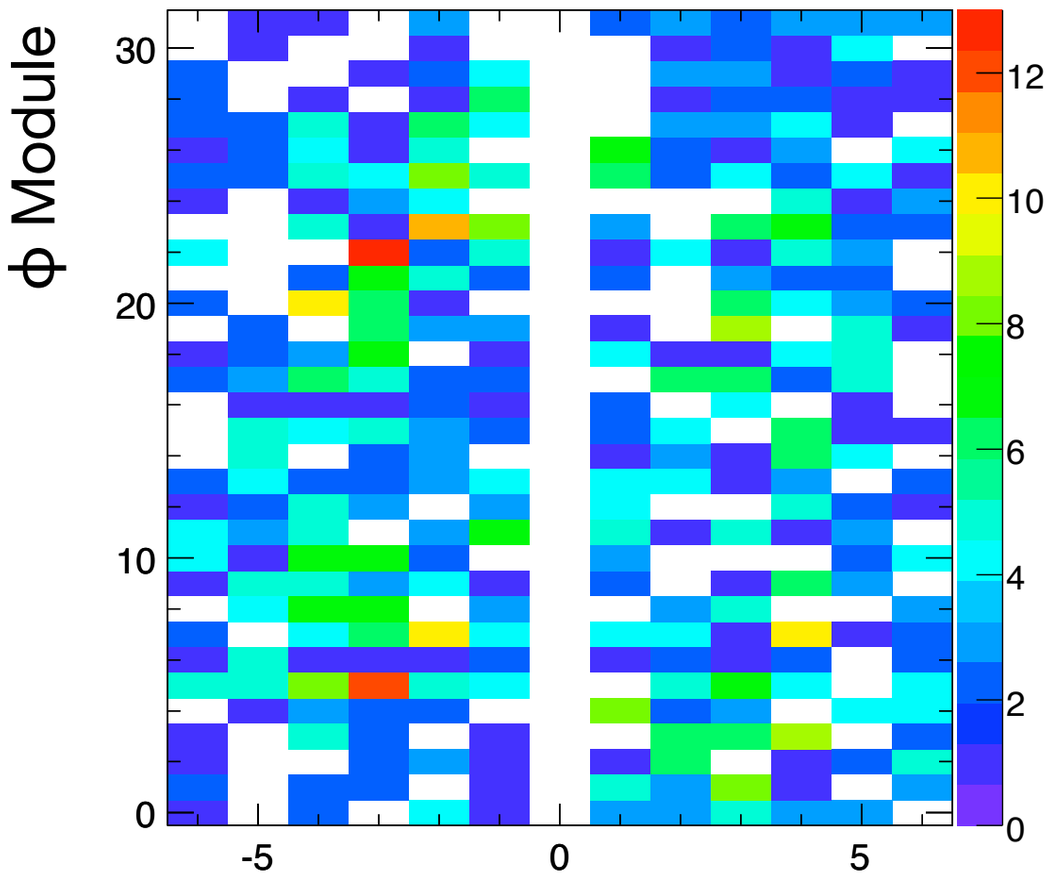
The hole-search tool

The hole-search tool assumes that tracks originate from the center of the detector

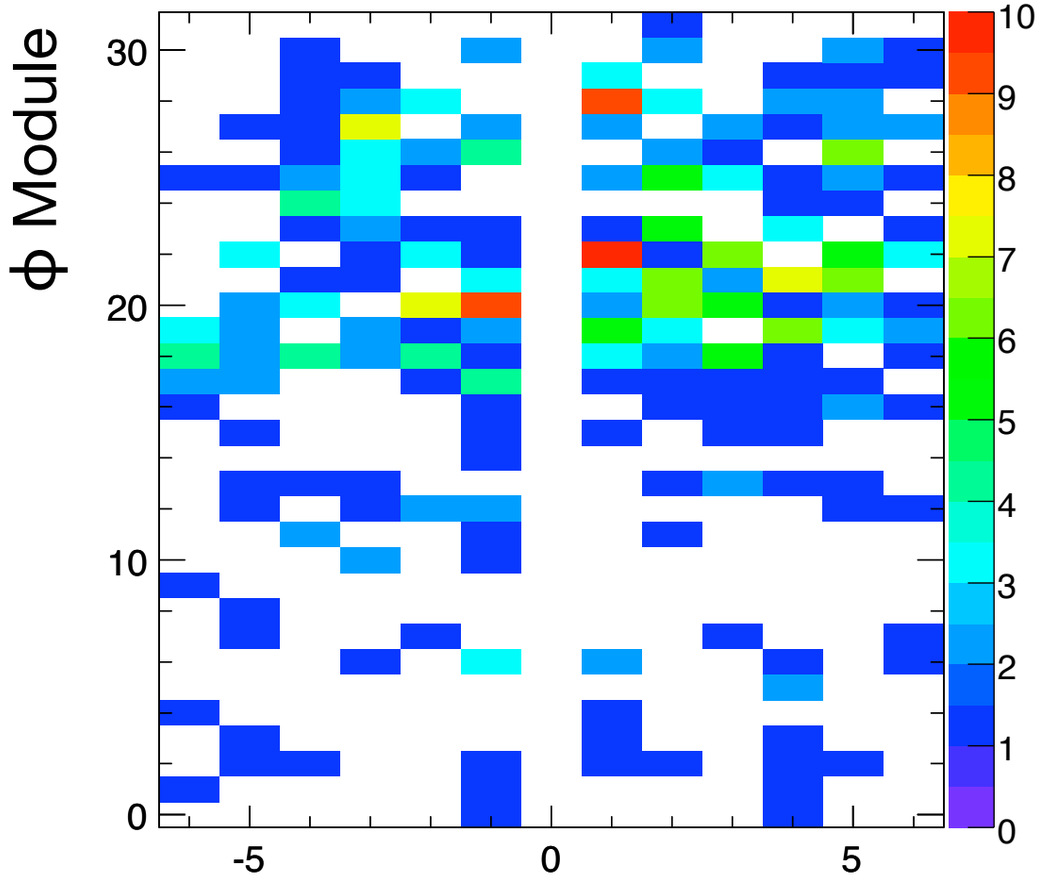
- It seems that it does not correctly find holes when a cosmic-ray track traverses both the top and bottom of the detector.
- Efficiencies reported here are not correct for the lower halves of the detectors.

Hits and Holes for SCT L0

Hits

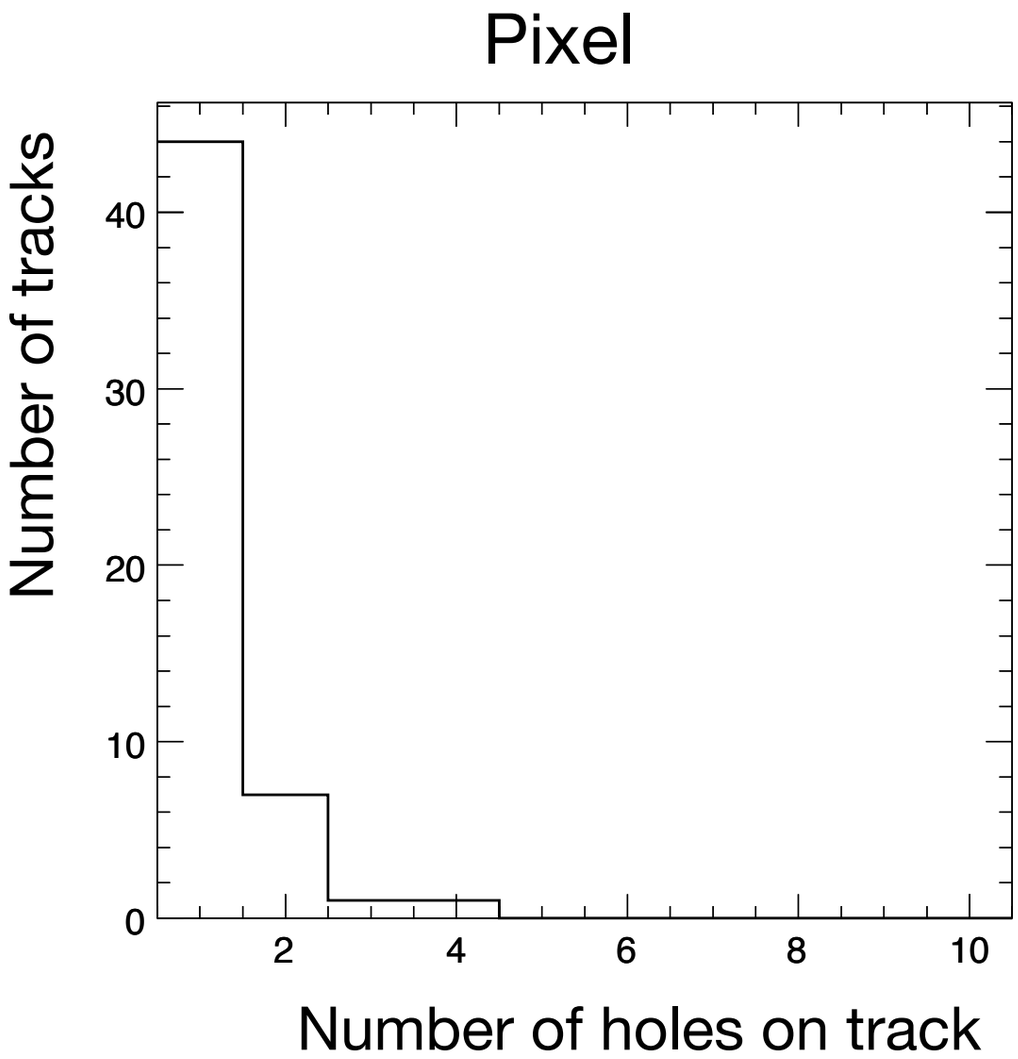


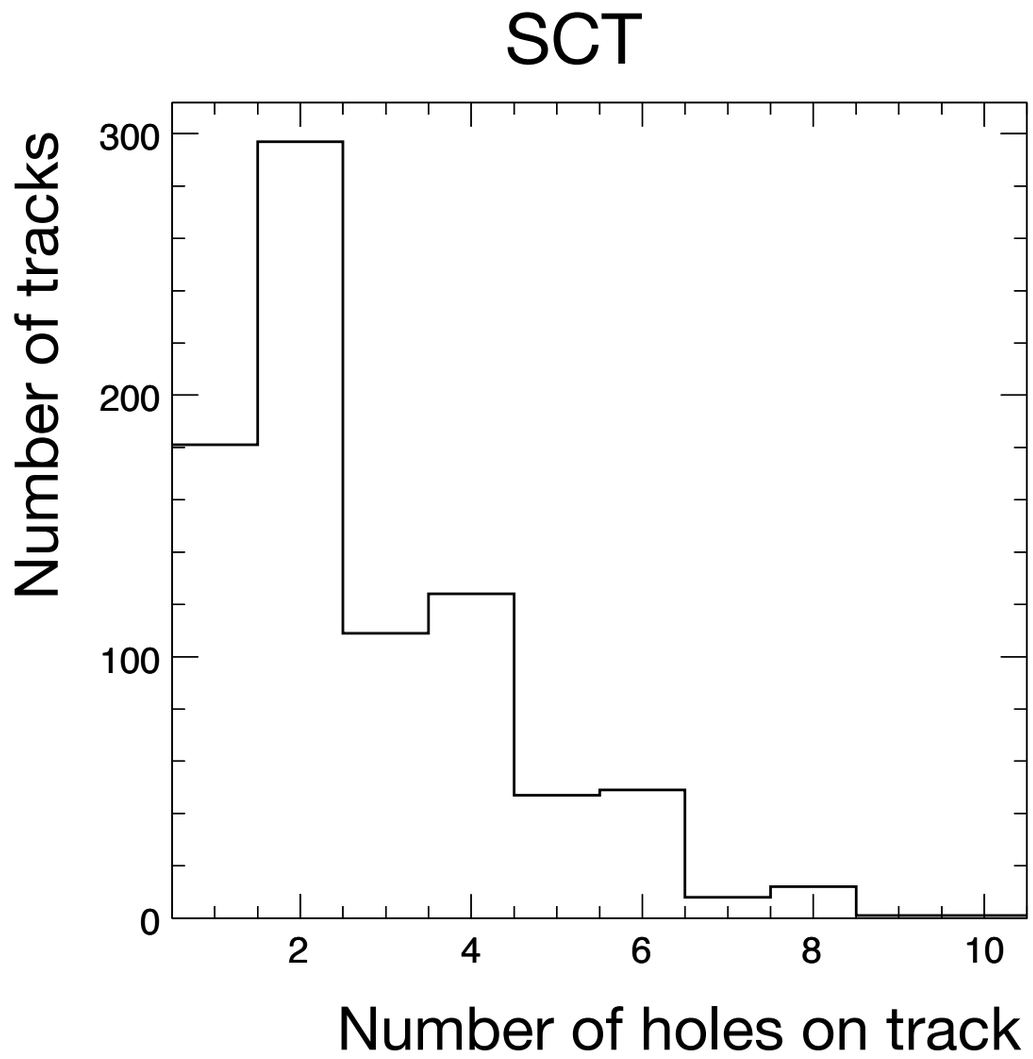
Holes



Holes are preferentially found in half the detector

Holes per track





Looking forward

The efficiencies are not yet understood, but most tools exist to study them

- Need a hole-search tool that works reliably on cosmics to make more progress
- More data can be used
- Need to get in touch with SCT community to understand SCT hit efficiencies