

# Energy Thresholds in EICRecon

Beatrice Liang-Gilman, Barak Schmookler  
Tracking WG meeting 4/6/2023

# MAPS Energy Threshold

- Decide on an energy threshold in digitization

$$N = \frac{E}{\omega}$$

- $\omega$  = mean energy required to create an electron hole pair in silicon
- $N$  = average number of electron-hole pairs
- $E$  = absorbed energy

- $N=110$  electrons  $\rightarrow$  396 eV

# Code Error

Incorrect:

```
double edep = sim_hit->getEDep();
if (edep * units::keV < m_cfg.threshold) {
    m_log->debug(" edep is below threshold of {:.2f} [keV]", m_cfg.threshold / units::keV);
    continue;
}
```

<https://github.com/eic/ElCrecon/blob/88affbd3e321eeb453d1b2ef75eef0286933f56e/src/algorithms/digi/SiliconTrackerDigi.cc>

- $\text{units::keV} = 10^{-6}$

$$[\text{GeV}] * \frac{10^6 [\text{keV}]}{[\text{GeV}]} = [\text{keV}]$$

- Git issue:

Fix the silicon tracker digitization threshold #527

 Open ShujieL opened this issue 2 weeks ago · 1 comment

# Code Fix

Correct:

```
double edep = sim_hit->getEDep();
if (edep < m_cfg.threshold) {
    m_log->debug(" edep is below threshold of {:.2f} [keV]", m_cfg.threshold / dd4hep::keV);
    continue;
}
```

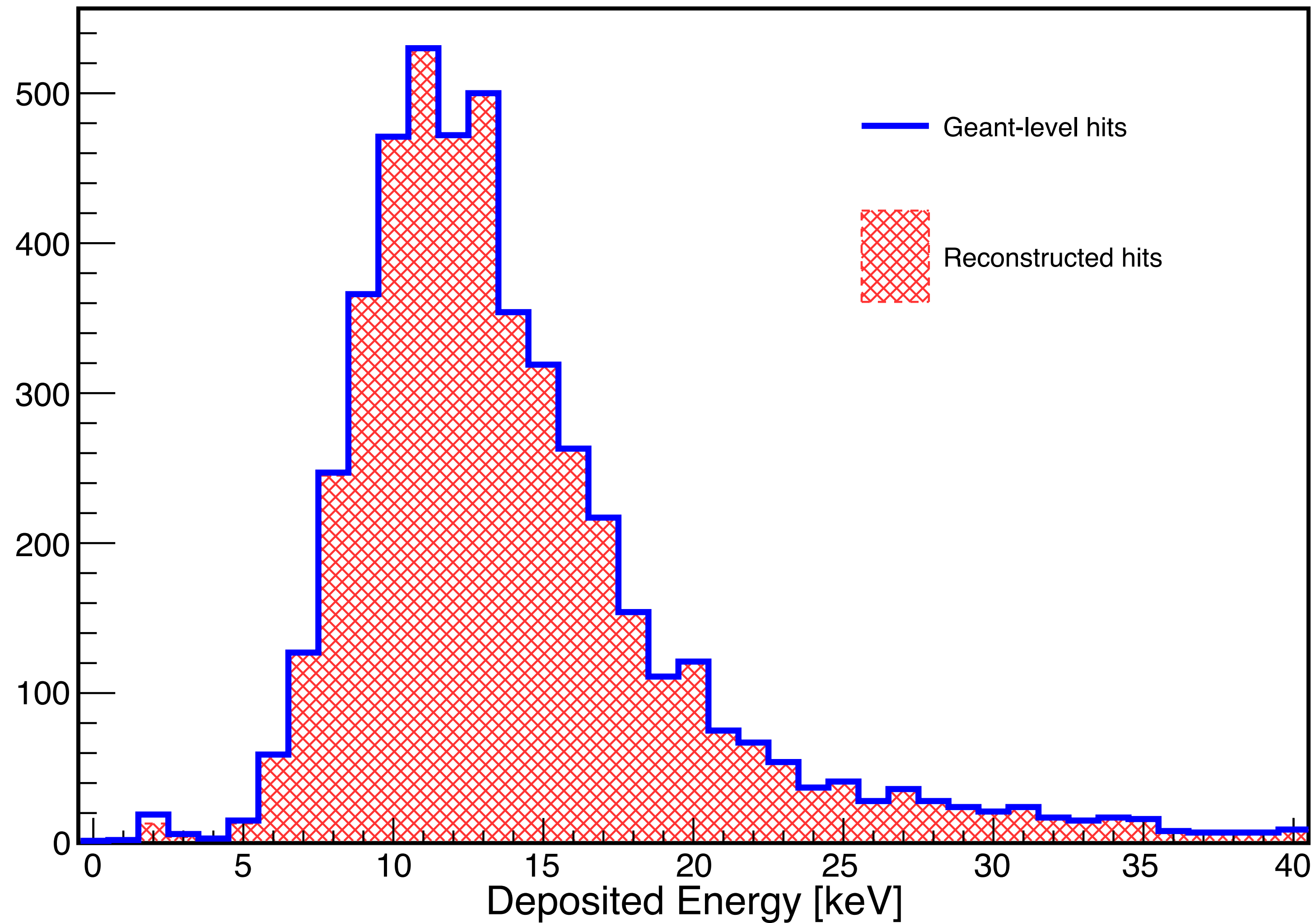
```
struct SiliconTrackerDigiConfig {
    double threshold = 5 * dd4hep::keV;
    double timeResolution = 8;    /// TODO 8 of what units??? Same TODO in juggler. Probably [ns]
};
```

<https://github.com/eic/ElCrecon/blob/88affbd3e321eeb453d1b2ef75eef0286933f56e/src/algorithms/digi/SiliconTrackerDigiConfig.h>

- Detectors that use default threshold: Si barrel tracker, Si barrel vertex, Si endcap tracker
- Detectors that do not: BTOF, ECTOF, barrel MPGD

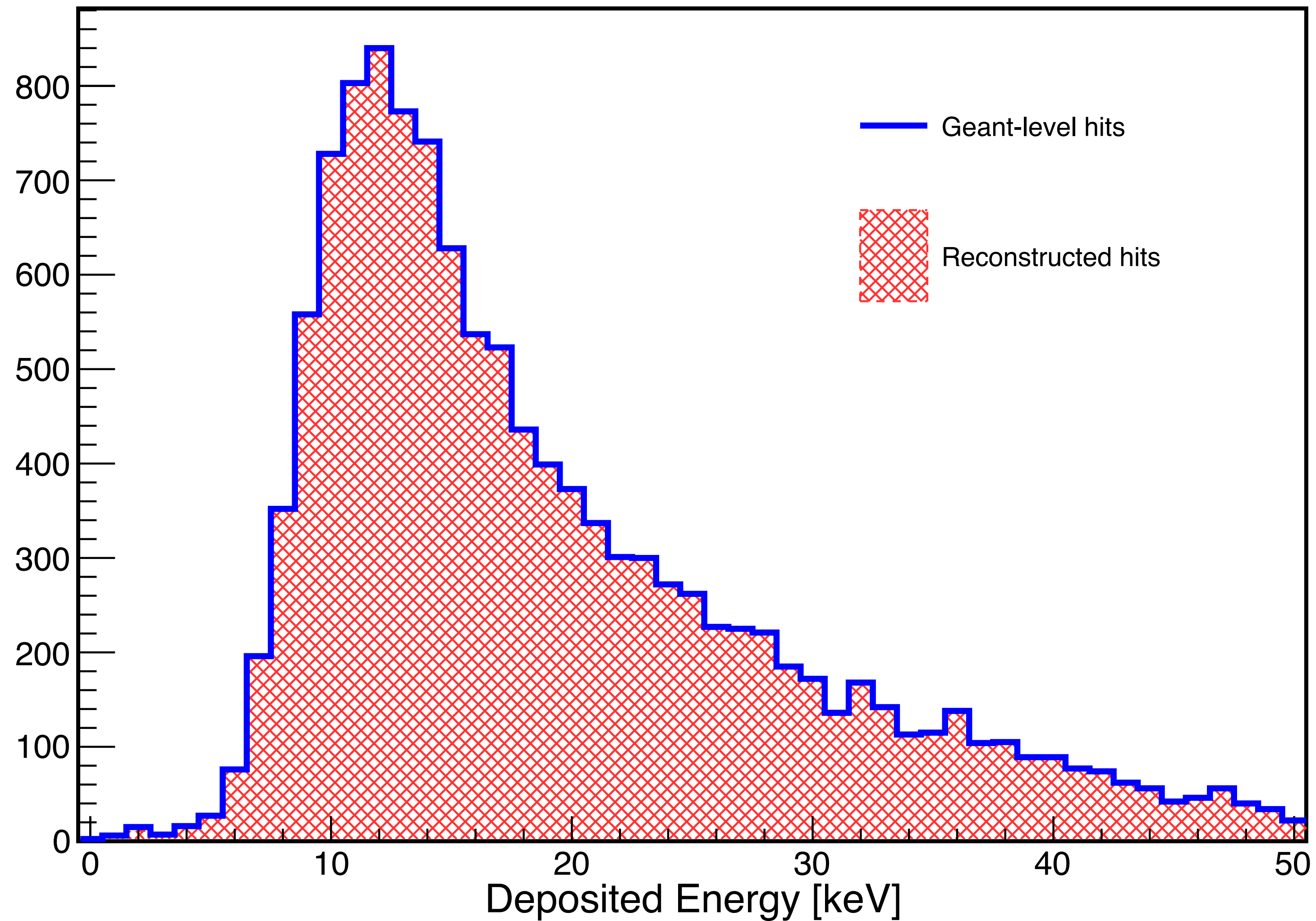
# Energy Distribution (before)

SiBarrelTrackerRecHits.edep



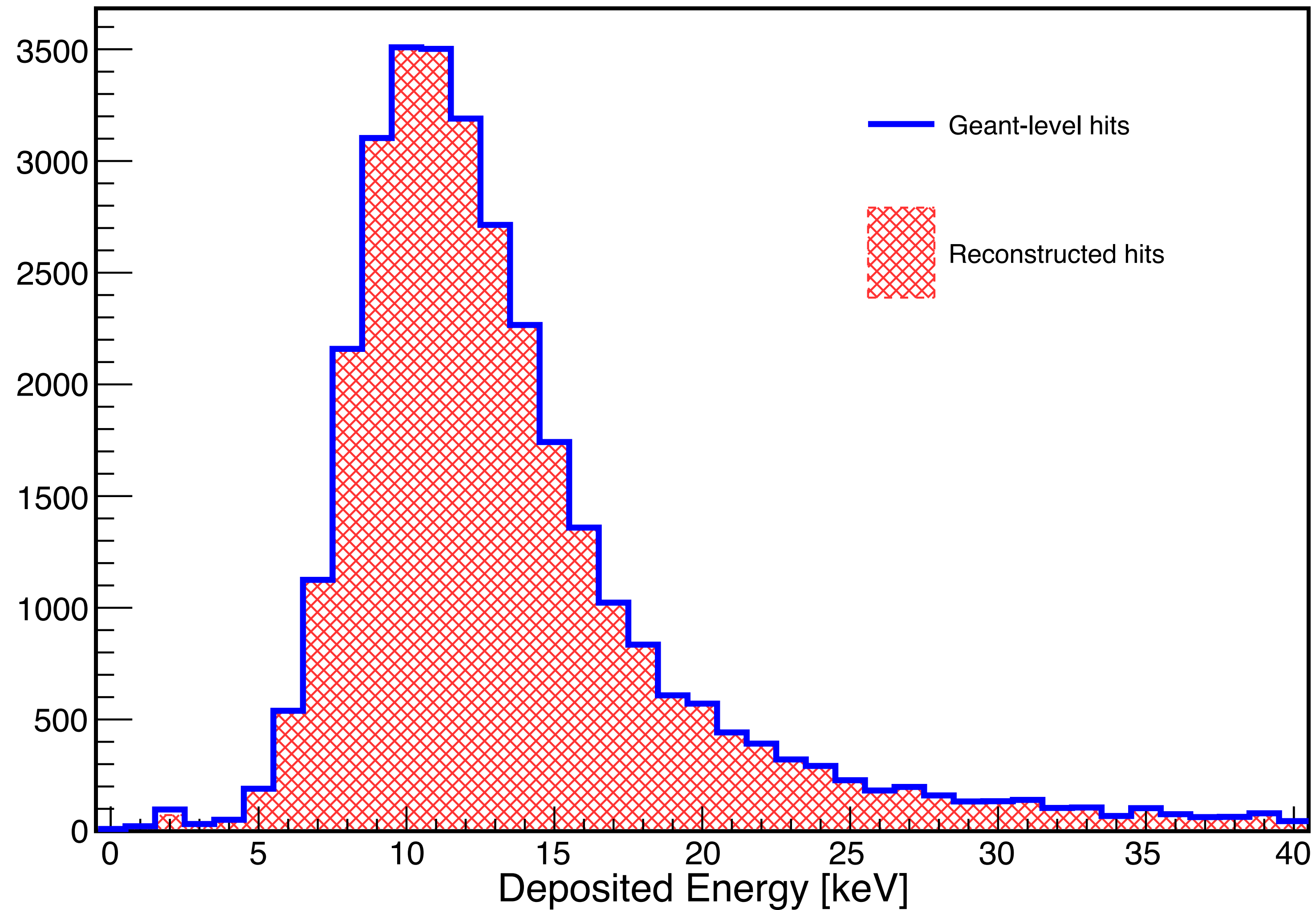
# Energy Distribution (before)

SiBarrelVertexRecHits.edep



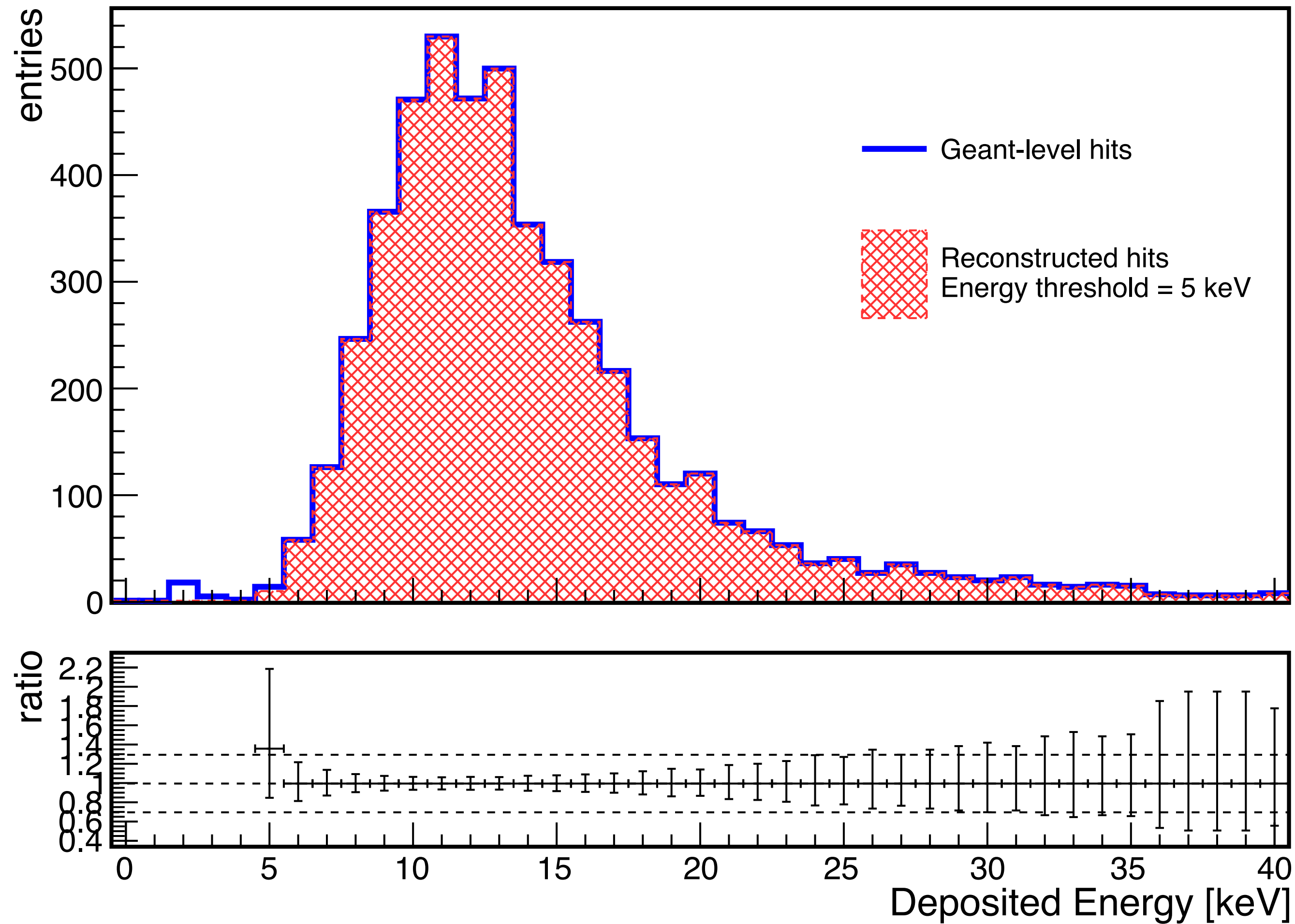
# Energy Distribution (before)

SiEndcapTrackerRecHits.edep

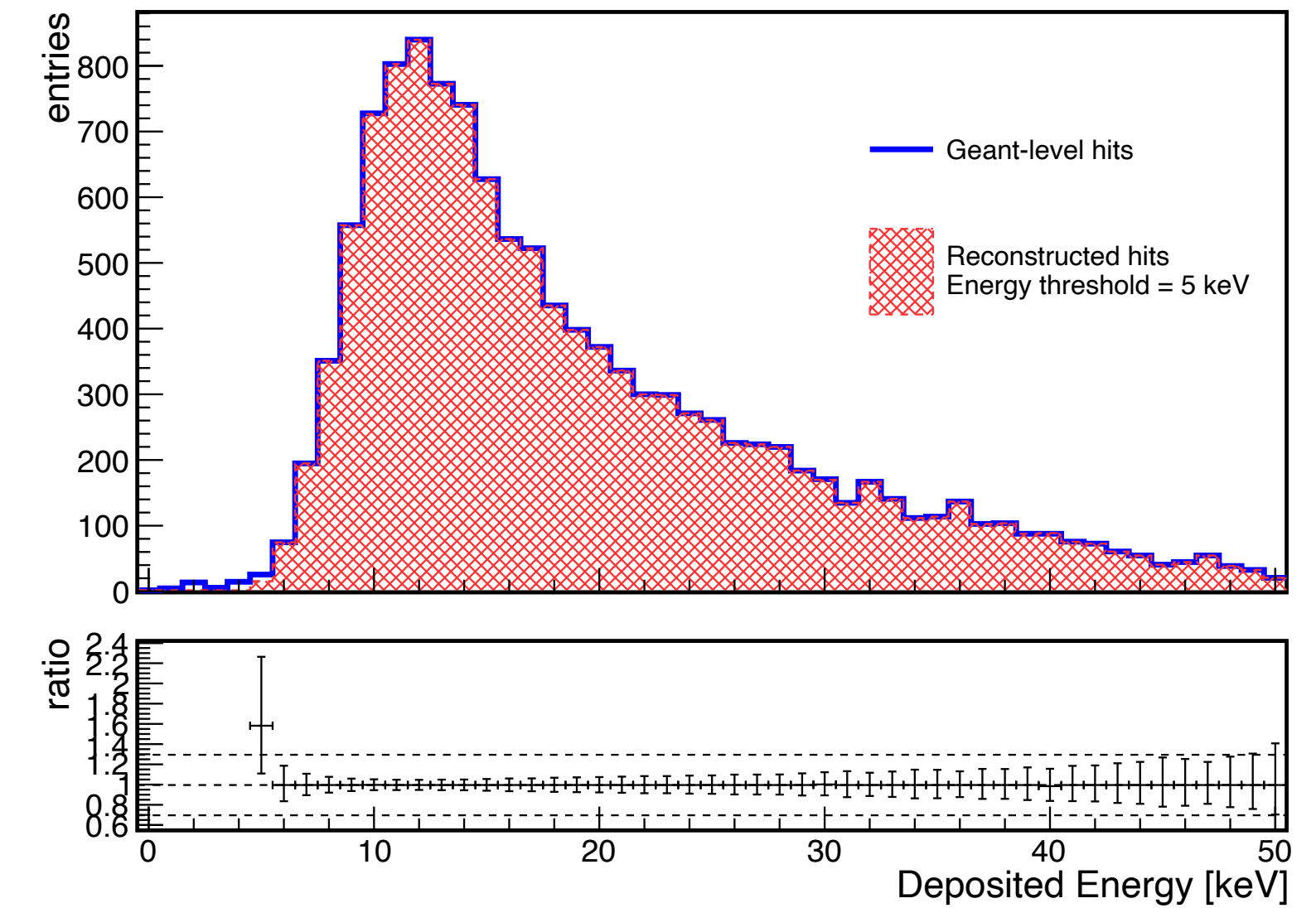


# Energy Distribution (after)

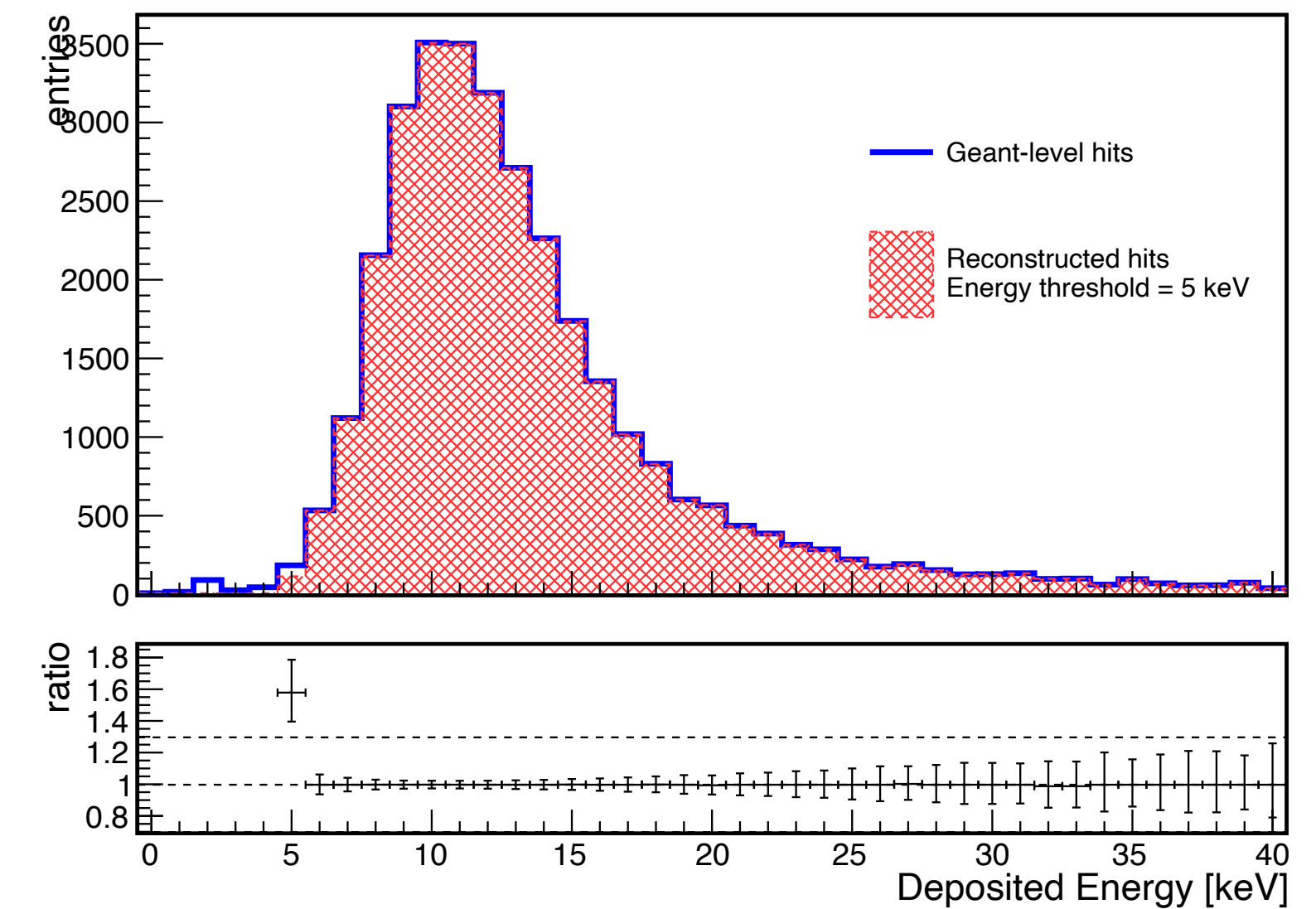
SiBarrelHits.EDep



VertexBarrelHits.EDep



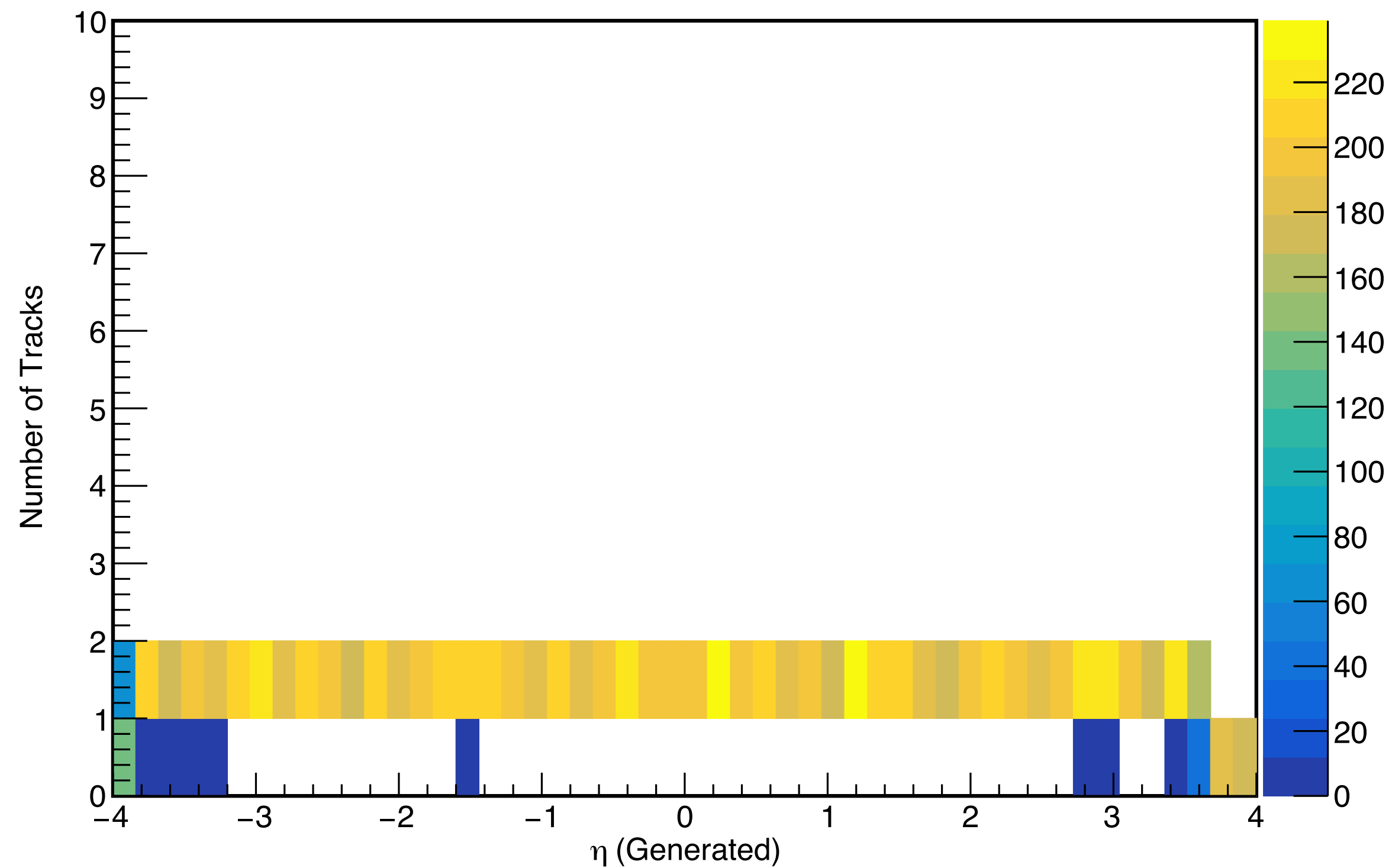
TrackerEndcapHits.EDep



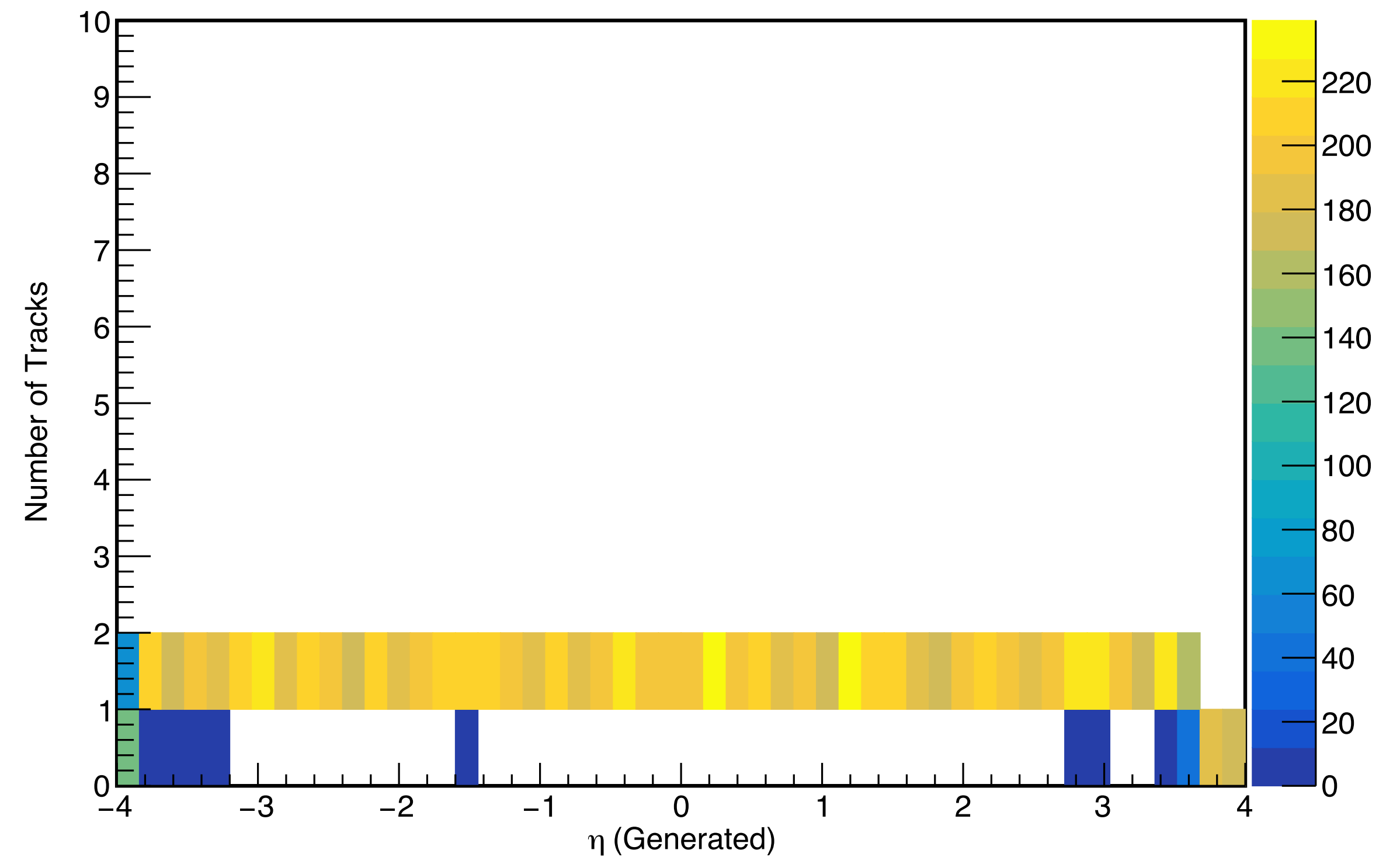


# Number of Tracks (before & after)

From rec file, Energy threshold = 0 keV



From rec file, Energy threshold = 5 keV



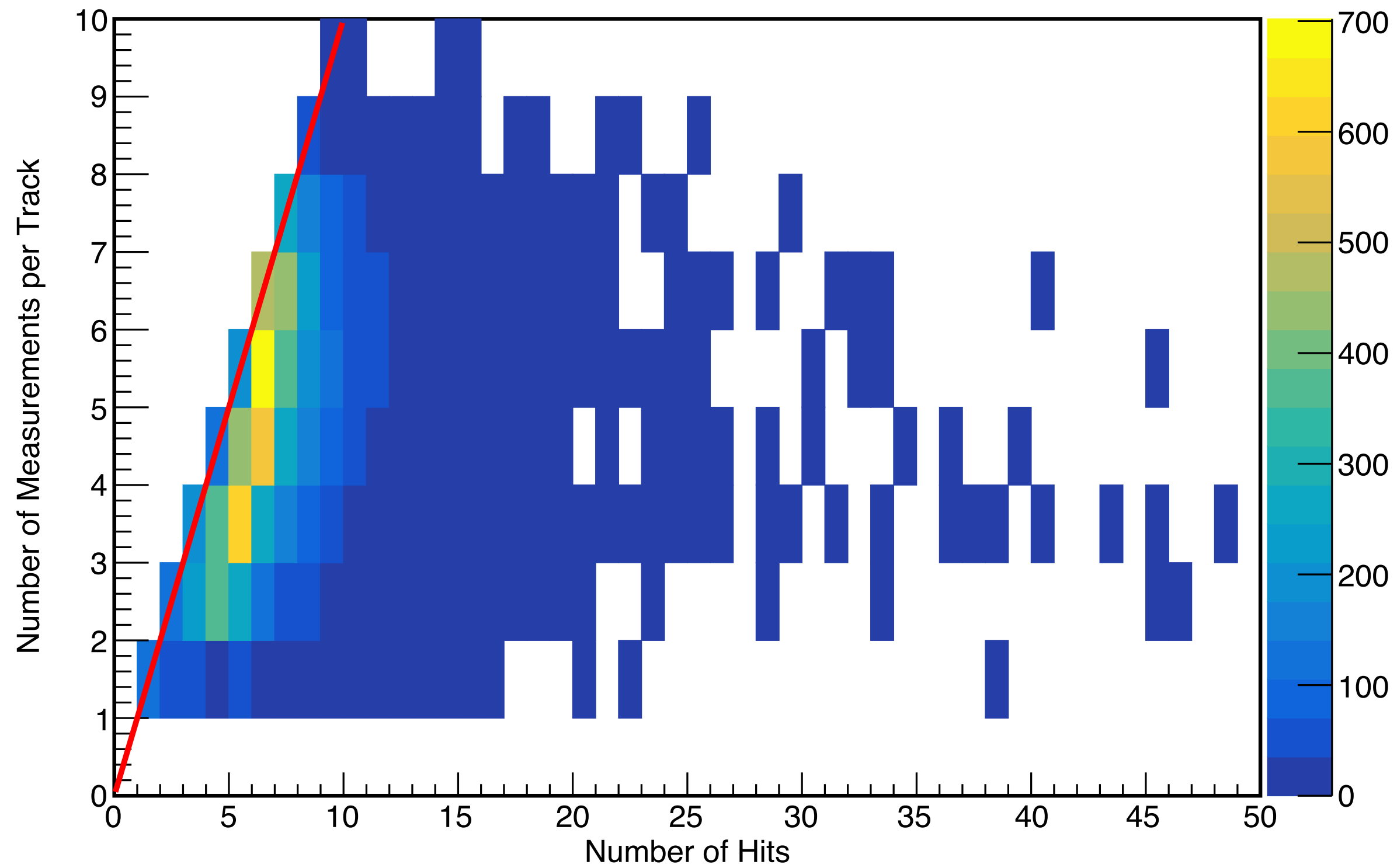
# Summary and Next Steps

- Silicon energy threshold can be set to 5 keV
  - No significant changes
- Other detectors are using different threshold values
- The github issue has been resolved and pushed!
- I will show plots of the residuals next week

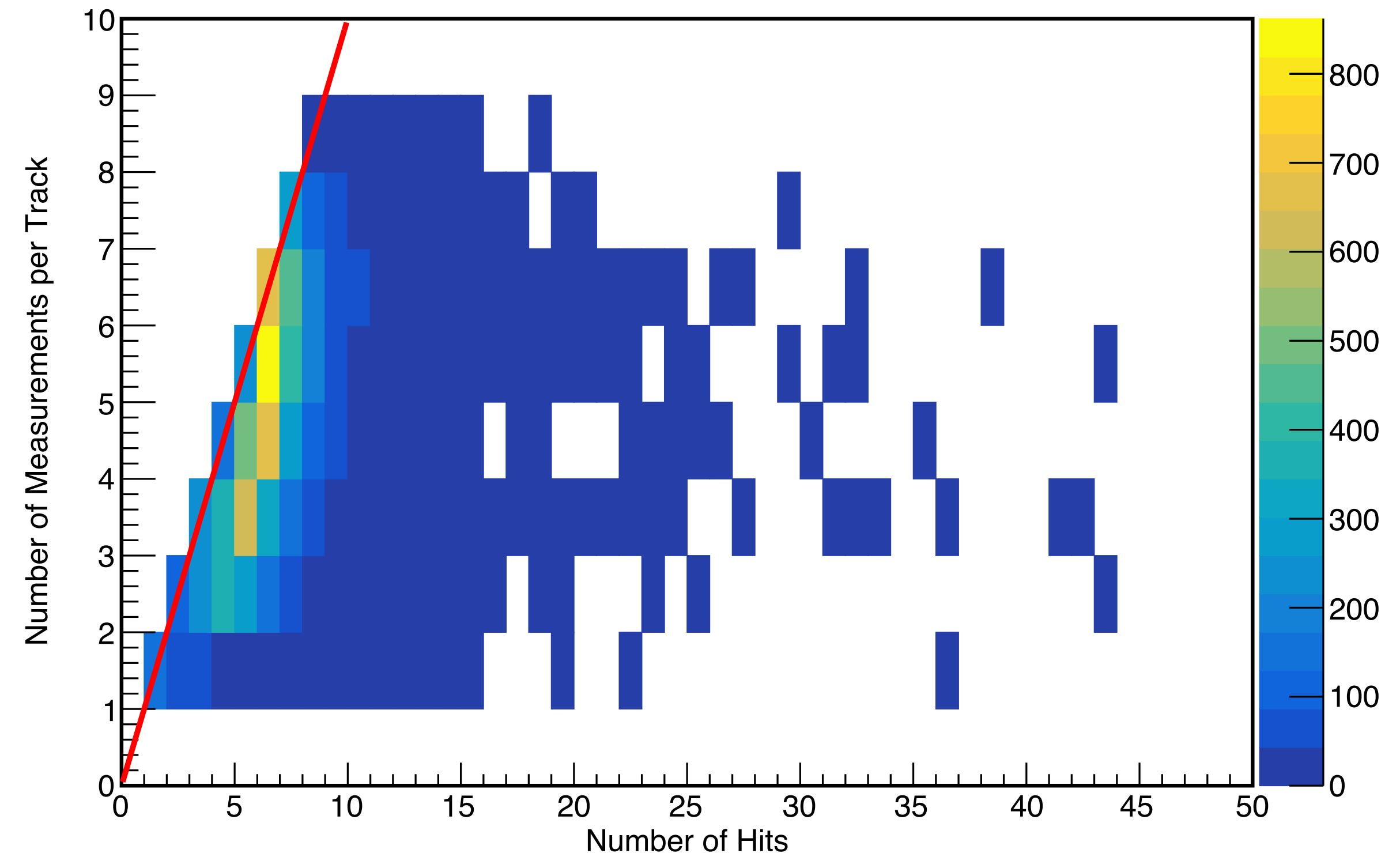
# Backup

# # of Measurements per Track vs # of Hits

From rec file, Energy threshold = 0 keV

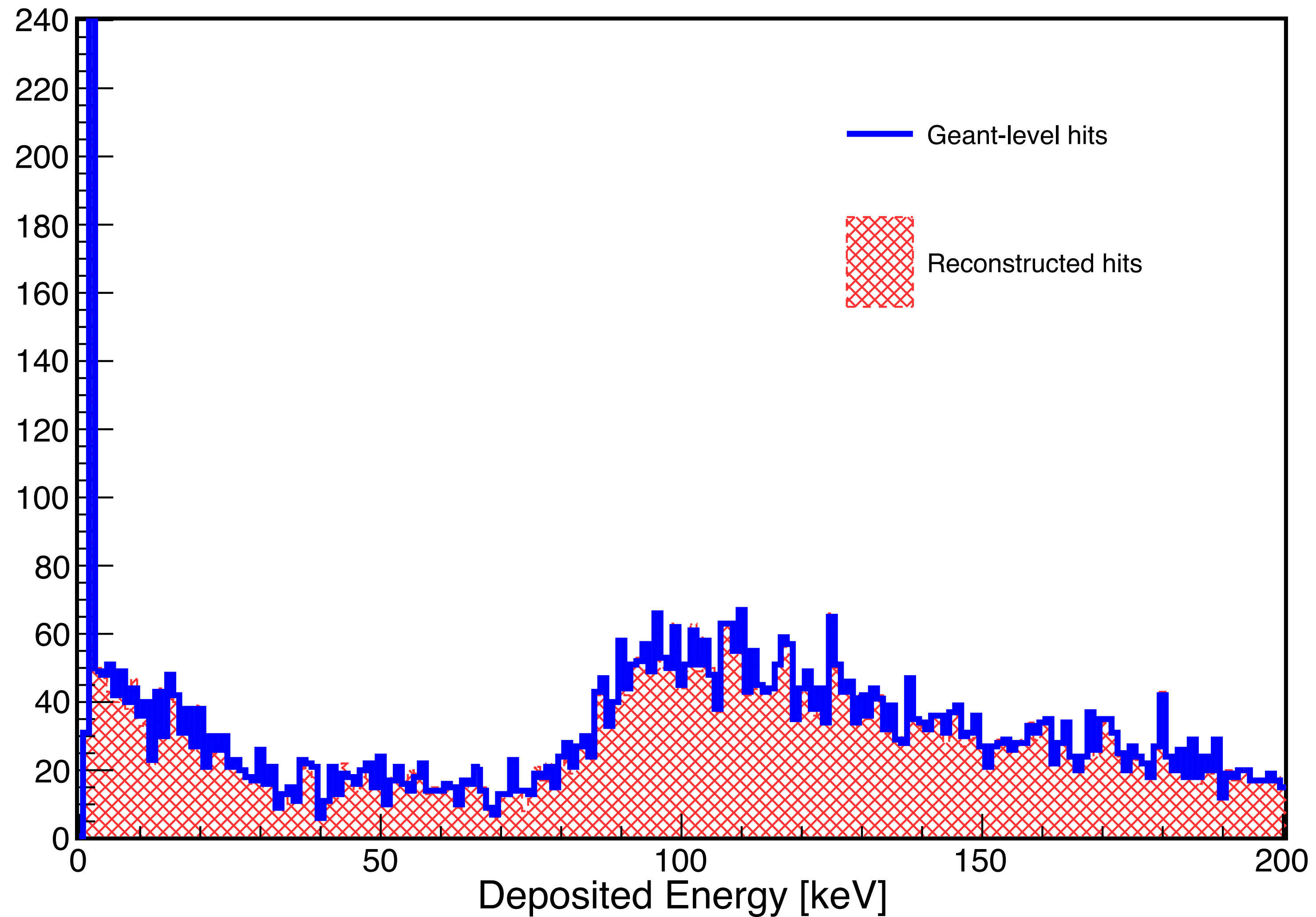


From rec file, Energy threshold = 5 keV



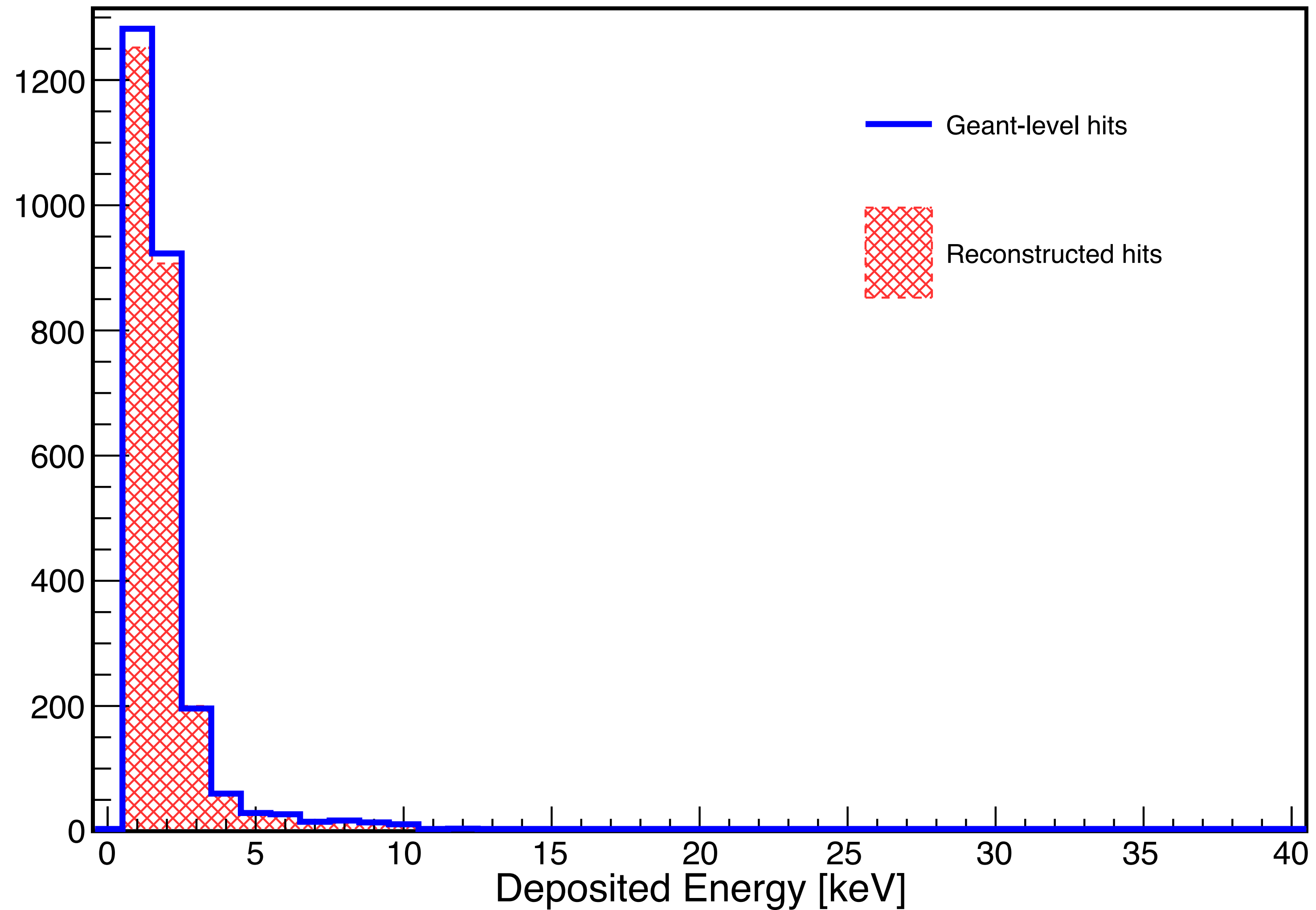
# Energy Distribution (before)

TOFBarrelRecHit.edep



# Energy Distribution (before)

MPGDBarrelRecHits.edep



# Energy Distribution (before)

TOFEndcapRecHits.edep

