electron to eV conversion

emma + beatrice

Detected particles ionize the silicon and create electron-hole pairs. This deposited energy can be recorded as an electrical signal due to the pair's motion.

$$N = \frac{E}{w}.$$

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

With ω=3.6 eV (for silicon) and N=110 electrons, we found a total absorbed energy of 396 ± 51 eV, where the **energy threshold is 396 eV**.

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Masters Thesis by Simon Kristian Huiberts

code

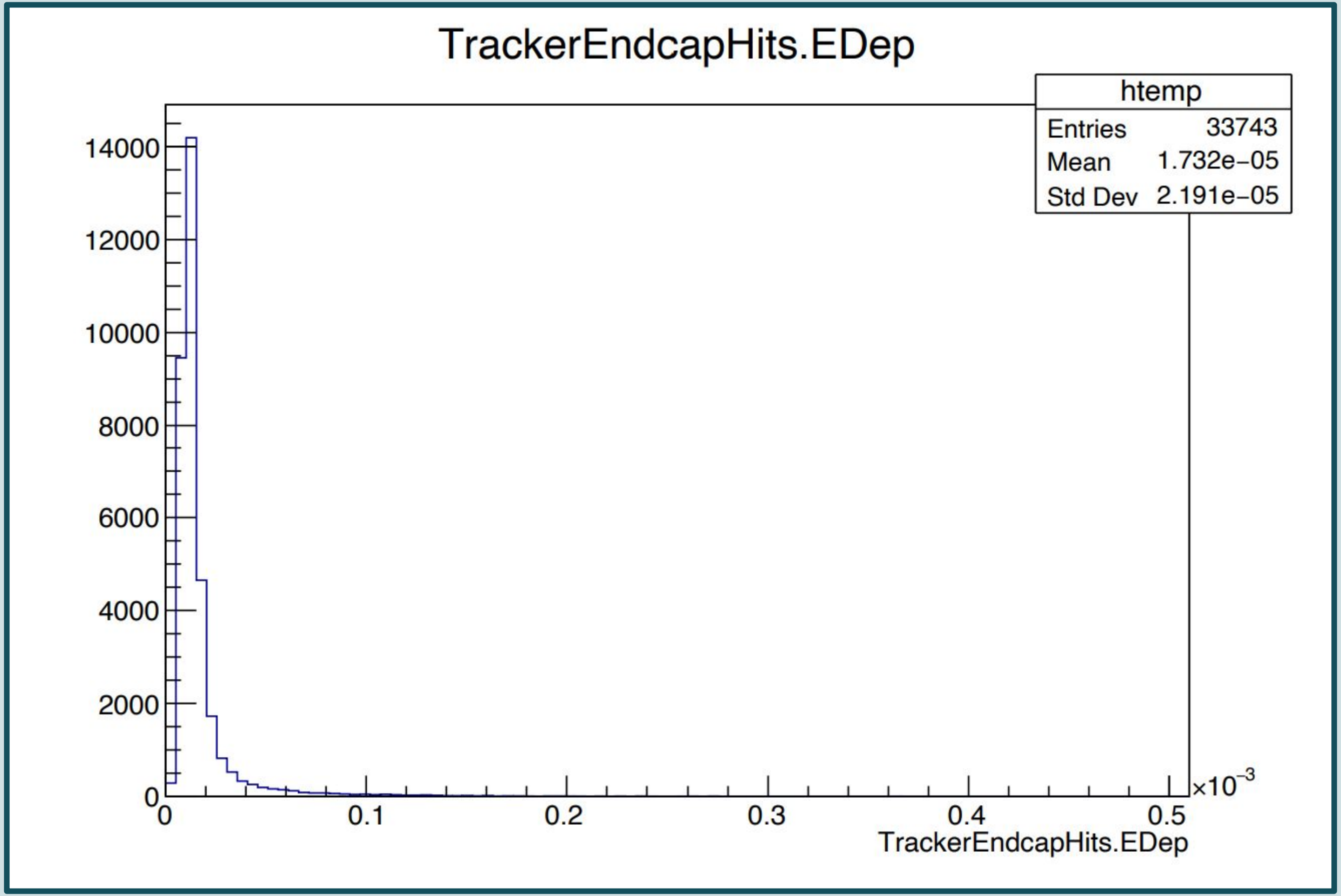
We also wanted to compare the digitized hits before and after implementing this new energy threshold, to check our result.

- https://github.com/eic/EICrecon/blob/88affbd3e321eeb453d1b2ef75eef0286933f56e/src/algorithms/digi/SiliconTrackerDigiConfig.h

```
struct SiliconTrackerDigiConfig {
    double threshold  = 0.396;
    double timeResolution = 8;   /// TODO 8 of what units??? Same TODO in juggler. Probably [ns]
};
```

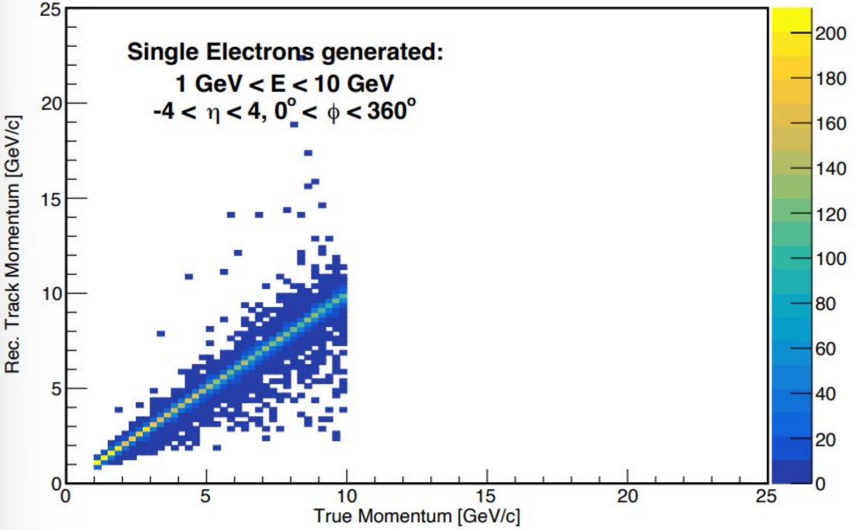
- https://github.com/eic/EICrecon/blob/88affbd3e321eeb453d1b2ef75eef0286933f56e/src/algorithms/digi/SiliconTrackerDigi.cc

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

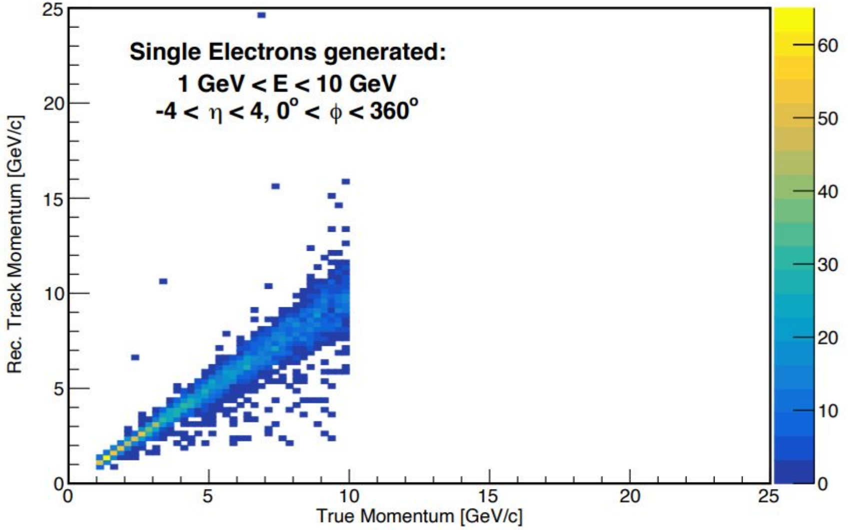

TrackerEndcapHits.EDep
htemp
Entries 33743
Mean 1.732e−05
Std Dev 2.191e−05
14000
12000
10000
8000
6000
4000
2000
0
0
0.1
0.2
0.3
0.4
0.5
×10⁻³
TrackerEndcapHits.EDep

Reco p vs true p

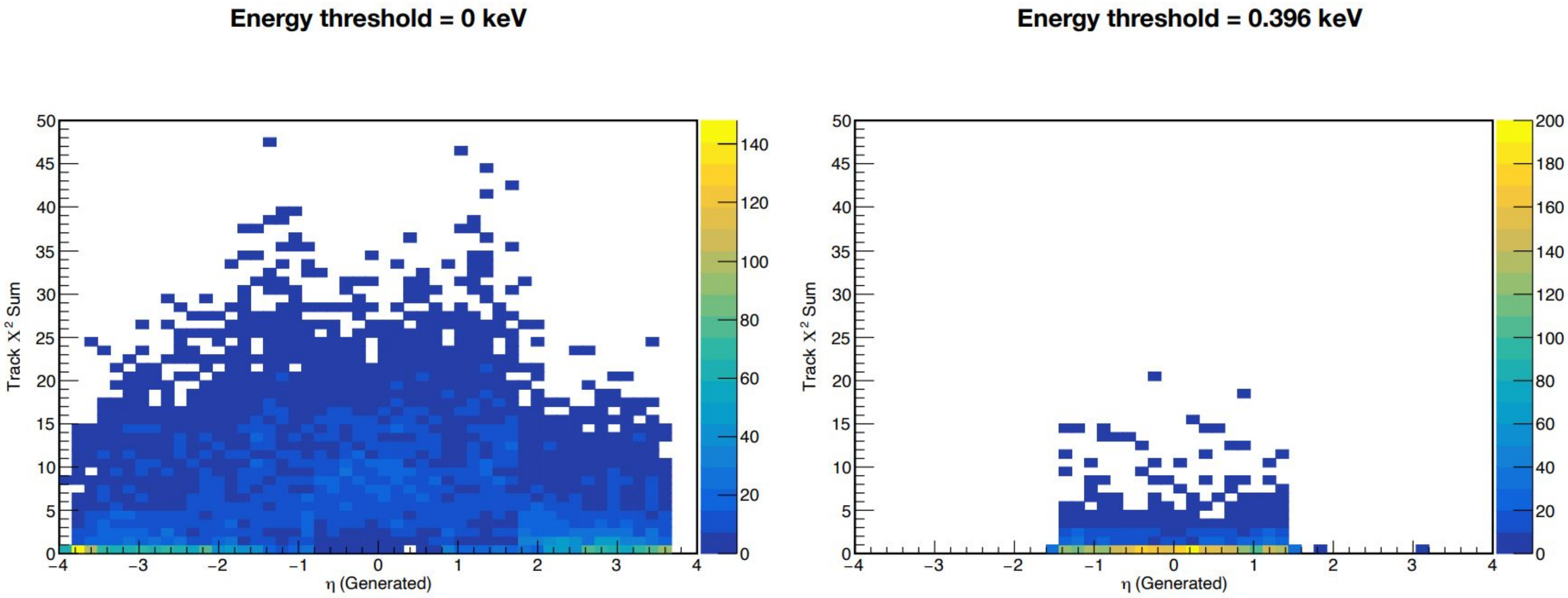
Energy threshold = 0 keV



Energy threshold = 0.396 keV

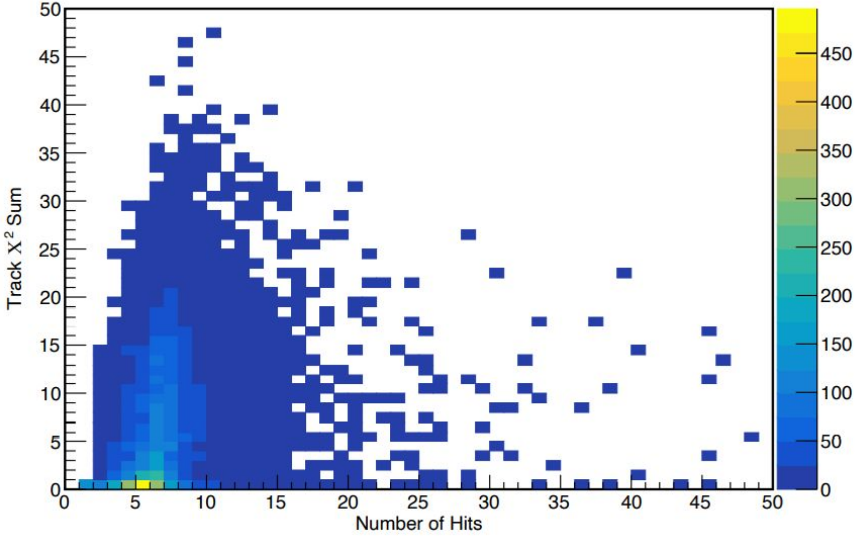


Track χ^2 Sum vs η

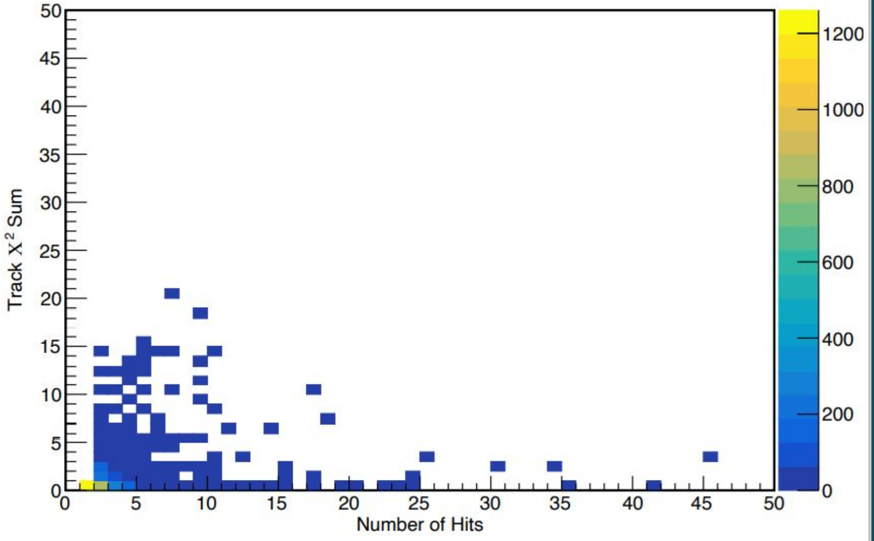


Track χ^2 Sum vs # of Hits

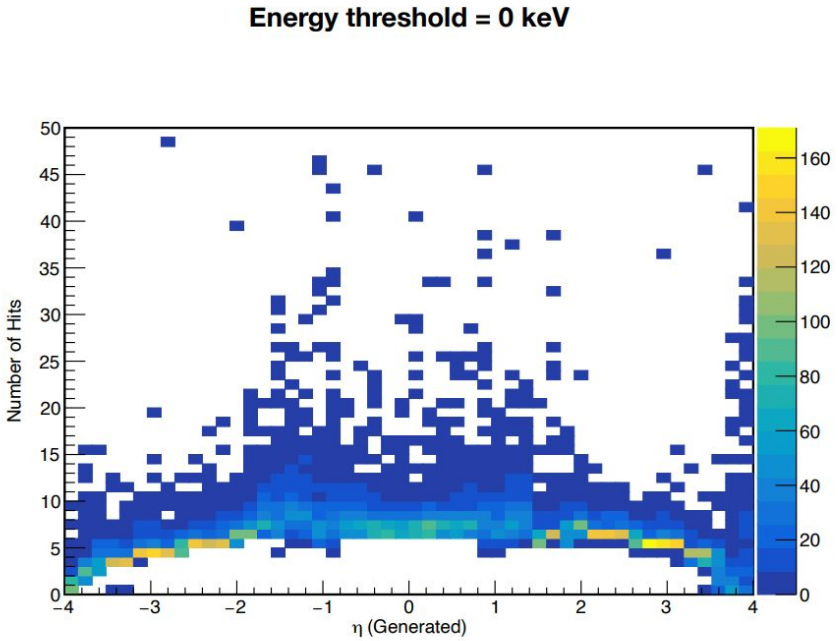
Energy threshold = 0 keV

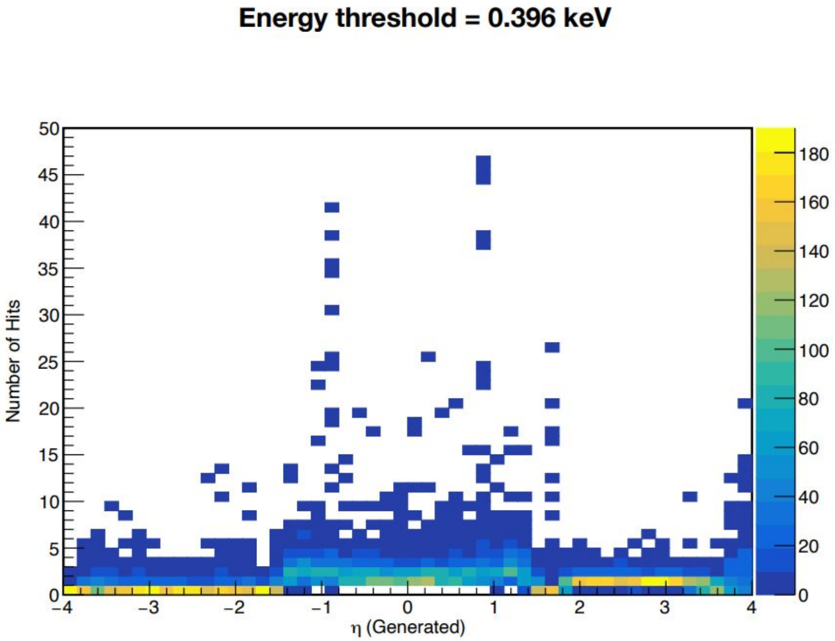


Energy threshold = 0.396 keV



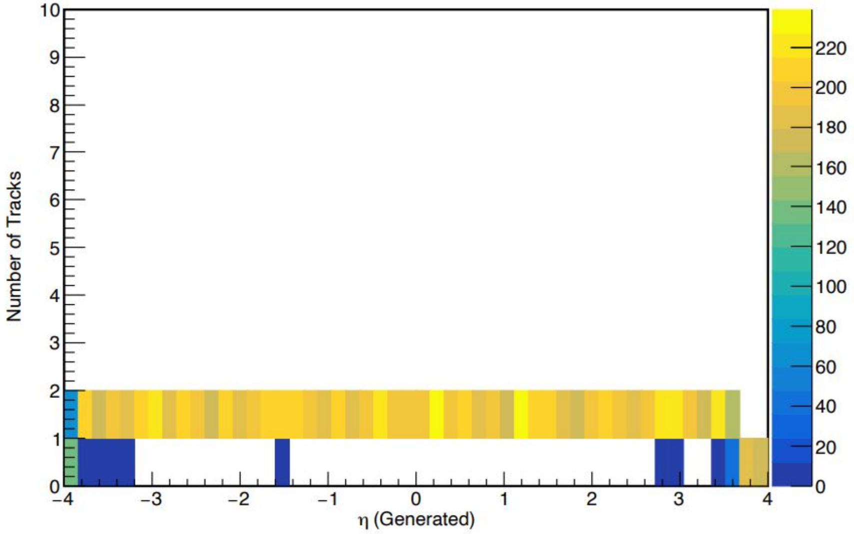
of Hits vs η


Energy threshold = 0 keV
Number of Hits
η (Generated)

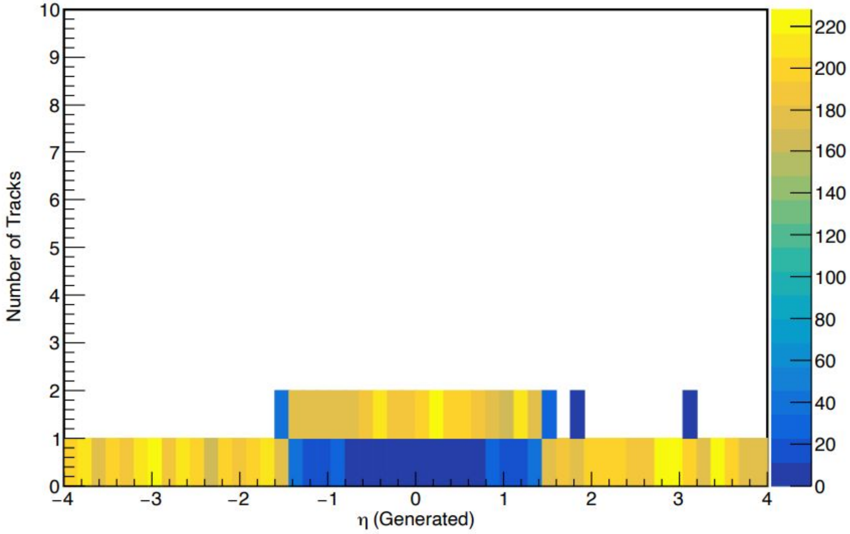

Energy threshold = 0.396 keV
Number of Hits
η (Generated)

Number of Tracks vs η

Energy threshold = 0 keV



Energy threshold = 0.396 keV



Backup

electron to eV conversion

emma + beatrice

The energy deposited to the silicon can go to produce thermal energy, which can fluctuate the amount of electron-hole pairs. Therefore we can find the variance:

$$\langle \Delta N^2 \rangle = FN = \frac{FE}{w}.$$

- ➔ F = Fano factor, 0.1293 +/- 0.0012 for Silicon
- ➔ N = average number of electron-hole pairs

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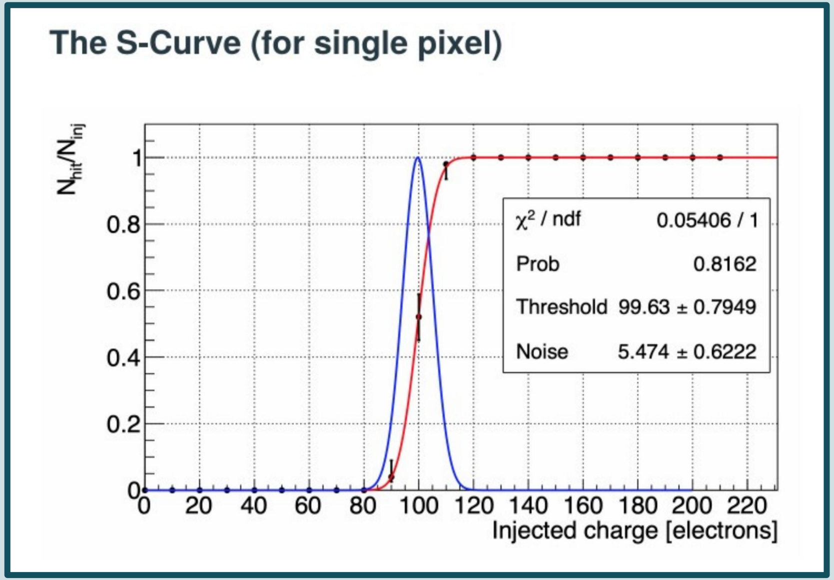
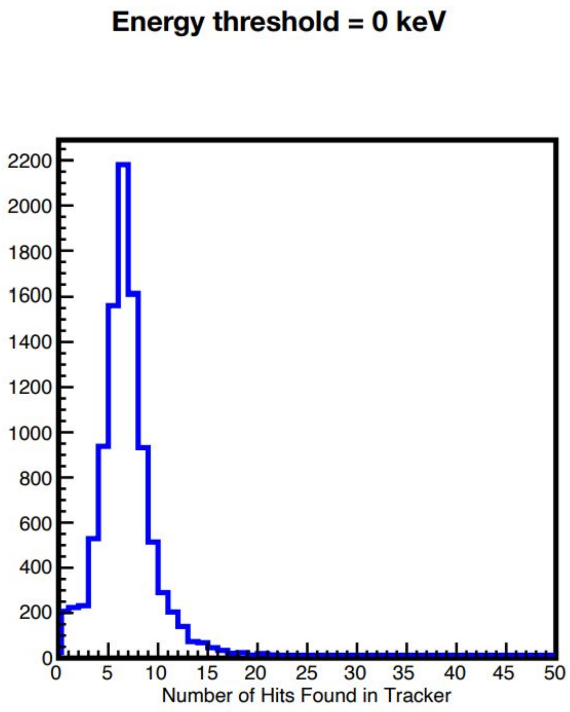
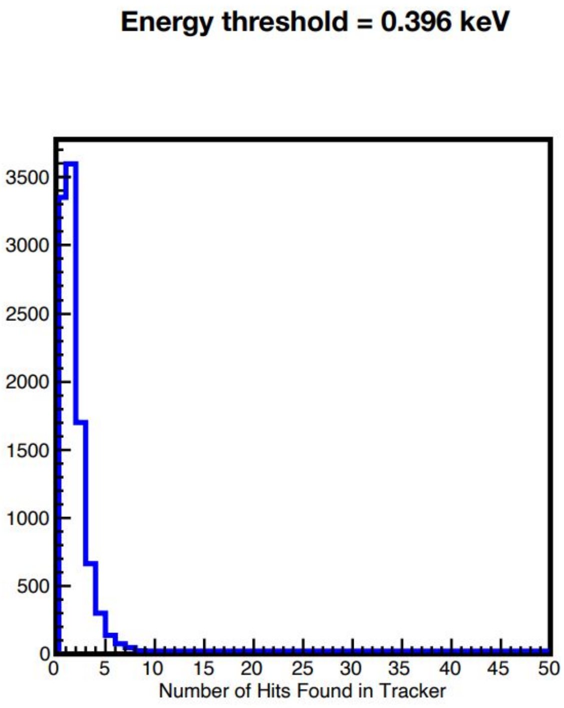
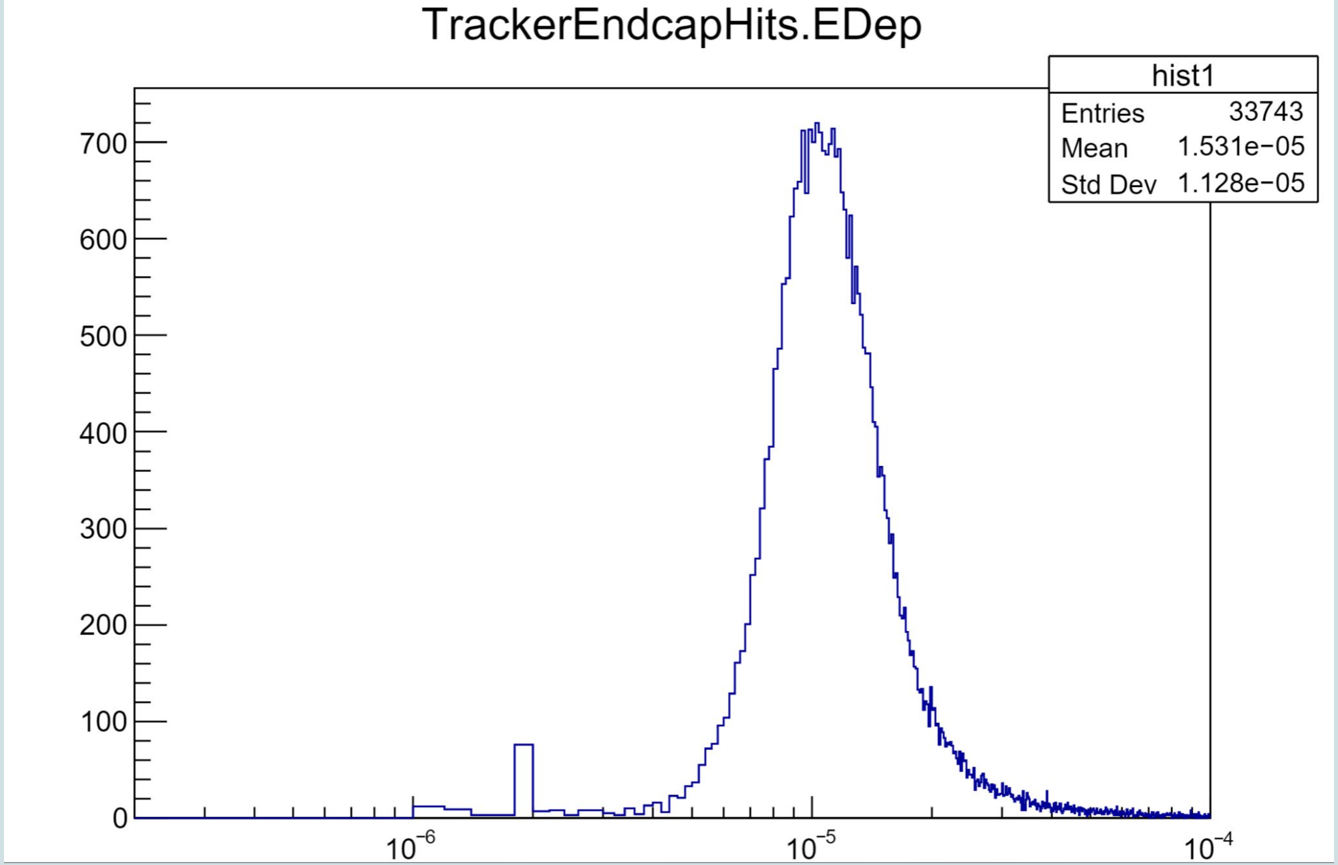
Our mean variance is **14.2 electrons**, or **51 eV**



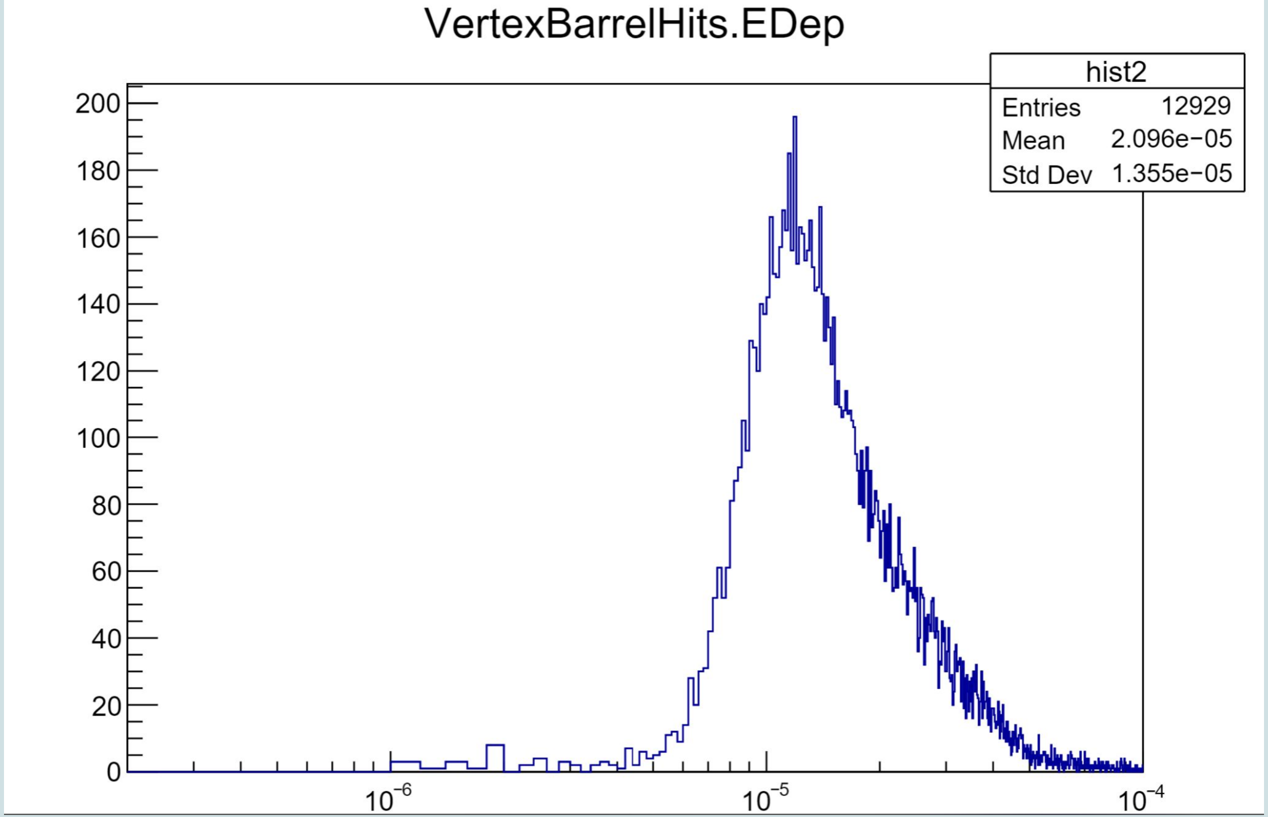
Histogram of # of hits







TrackerEndcapHits.EDep
hist1
Entries 33743
Mean 1.531e−05
Std Dev 1.128e−05
700
600
500
400
300
200
100
0
10^−6
10^−5
10^−4


VertexBarrelHits.EDep
hist2
Entries 12929
Mean 2.096e−05
Std Dev 1.355e−05
200
180
160
140
120
100
80
60
40
20
0
10^−6
10^−5
10^−4