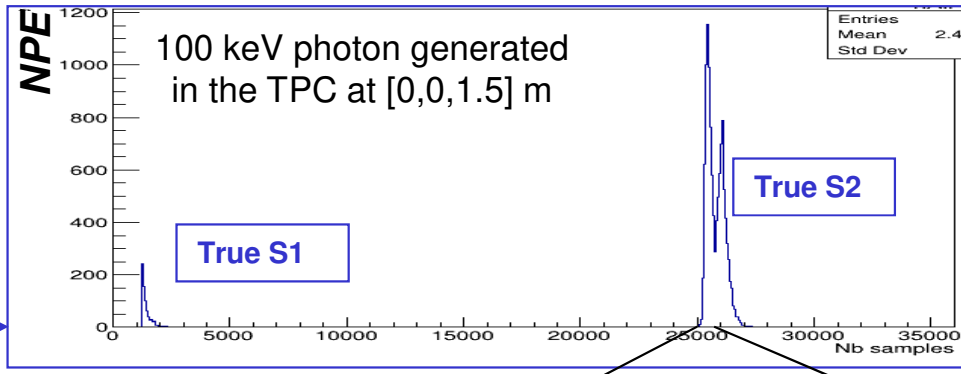
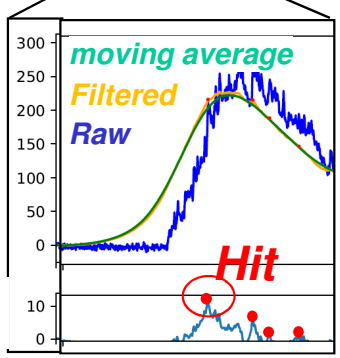
Generalities

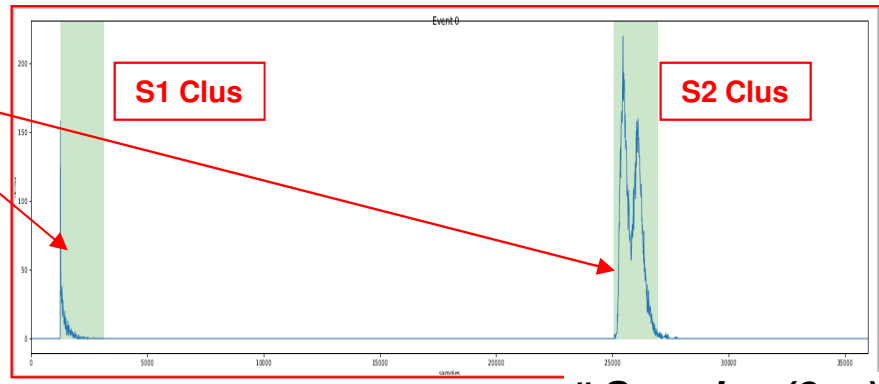
❑ Procedure

- ✓Generate photons in TPC with **g4ds**
- ✓Collect the Number of PhotoElectron (NPE) [PDM nb+ Time (ns)] → Waveform / PDM
- ➔ **Sum all NPE** = input waveform
- ✓Pass it to reconstruction (**pyreco**)
- ✓Add SiPM electronics [tau, sigma]
- ✓Add noise [dcr, spread, …]
- ✓Reconstruct Hits [Time,PDM]
- ➔ **Sum all Hits** = output waveform
- ✓Run **pulse finder algorithm** to find the **clusters**, count nhits/cluster and classify (S1 or S2)





Residuals
(orange – green)



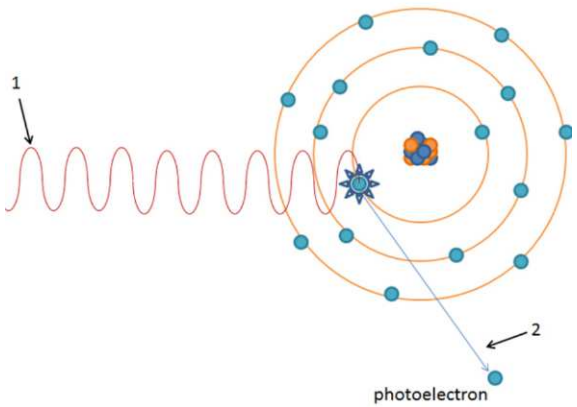
Goal : perform a systematic study of the pulse finder algorithm using MC truth

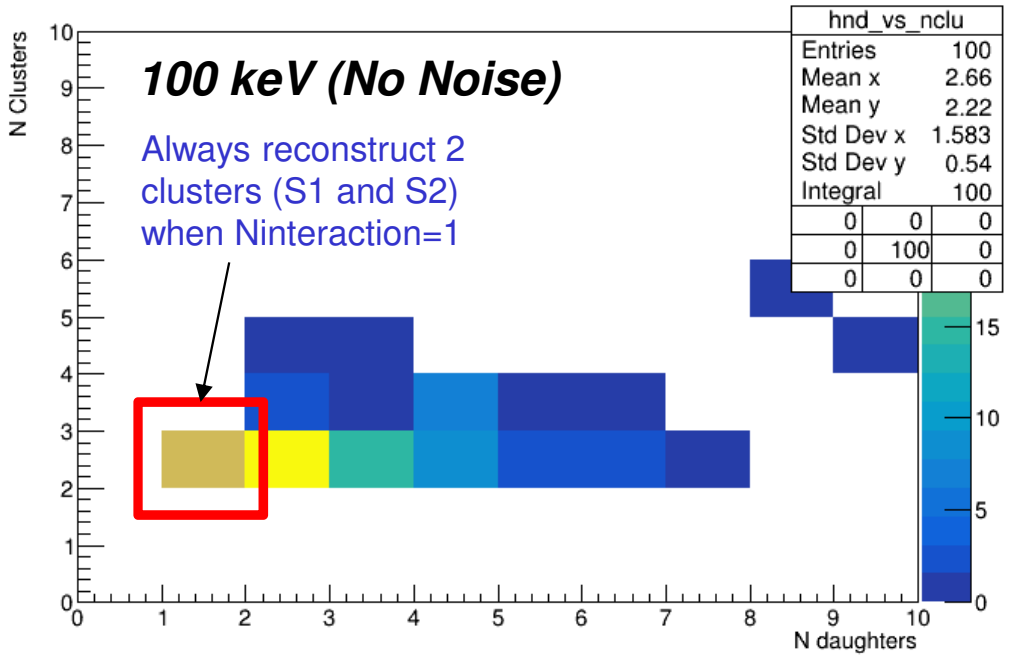
Pulses finder (1/4)

- **DS20k : 100 single γ (0,0,1.5* [m]) shot vertically upwards**
  - Adjust the pulses_finder algorithm :
    - ✓ Perform the search with a binning of one sample
    - ✓ Simplifies the procedure of finding peaks and valleys *(look ahead, delta)*
    - ✓ Find the cluster *(depends on one key parameter 'rolling')*
    - ✓ Merging of nearby clusters if dt < 250 samples
    - ✓ Suppress noise in all bins by removing Nhits==1 in each bin.

[pulse_finding]
width = 8 #(ns)
s1_min = 7
rolling = 800 #(ns)
s1_window = 2500 #(ns)
s2_window = 15000 #(ns)
pre_gate = 8 #(ns)

  - Select only events with one photo-electric effect (~25% for 100 keV)





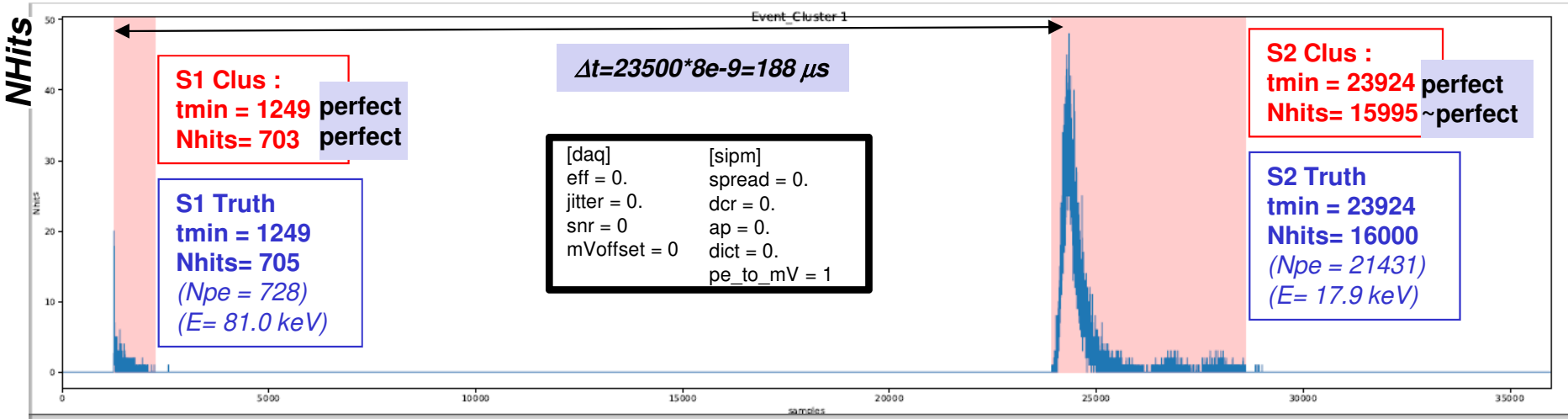
*20 cm below the top SiPMs

Pulses finder (2/4)

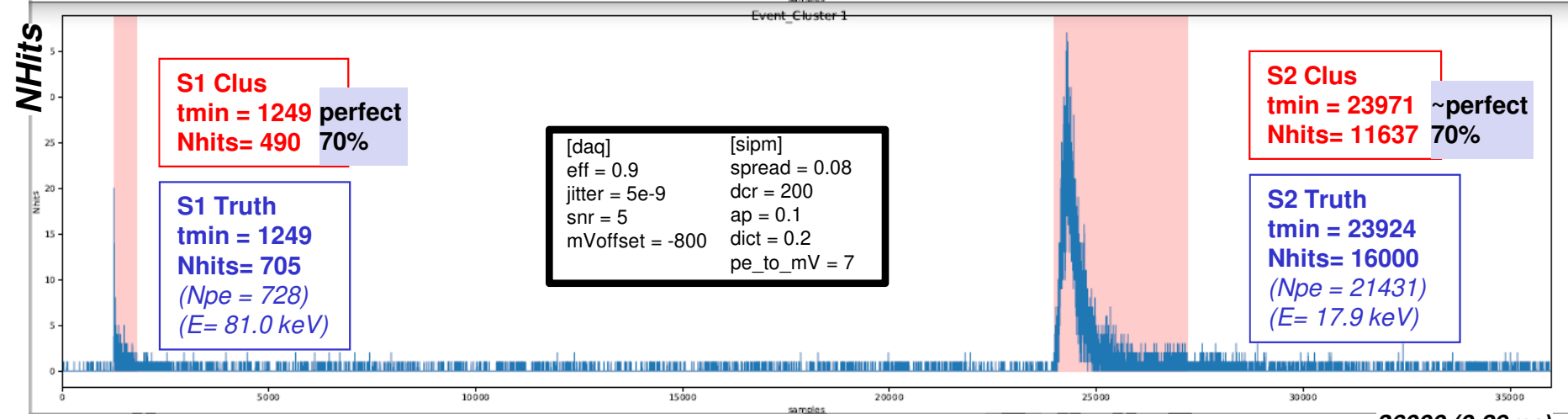
Electron velocity in DS:
E = 0.2kV/cm (Ar)
v(Ar) = 1mm/µs = 10^{-5}c

❑ DS20k : 100 single γ 100 keV (0,0,1.5 [m]) shot vertically upwards

- No Noise



- Noise

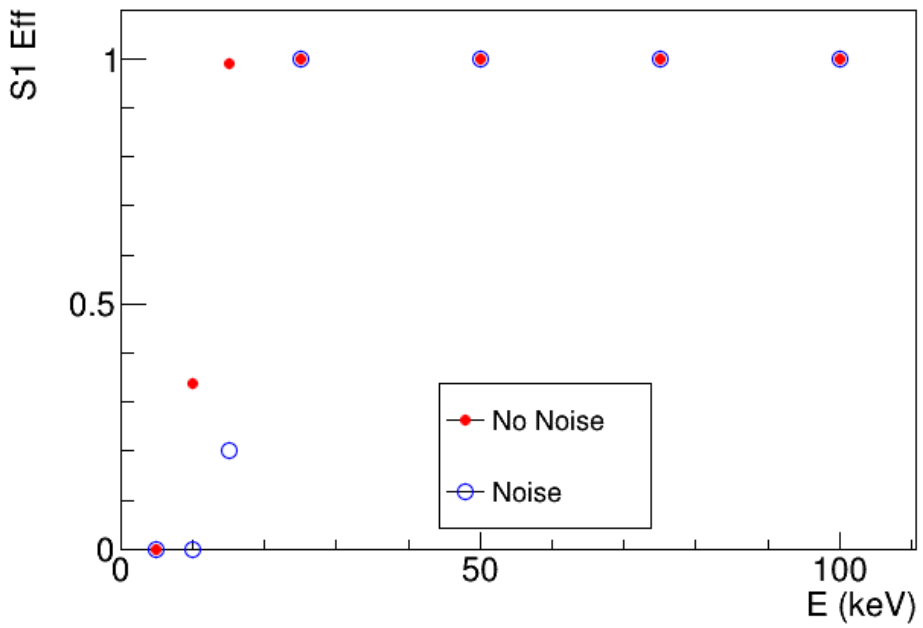


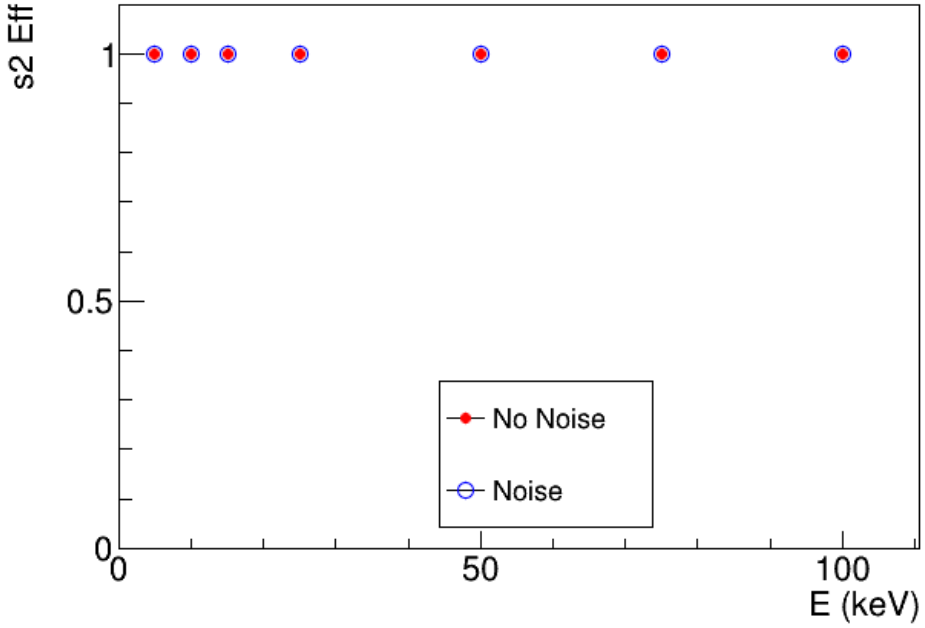
36000 (0.29ms)

 # Samples (8ns)

Pulses finder (3/4)

- **DS20k : 100 single γ (0,0,1.5 [m]) shot vertically upwards**
  - Variation as a function of energy : reconstruction efficiency



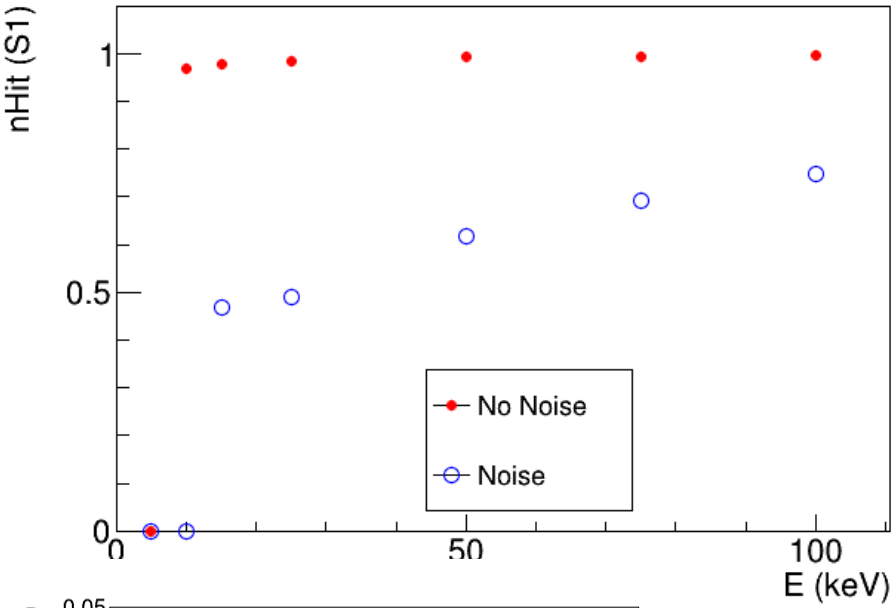


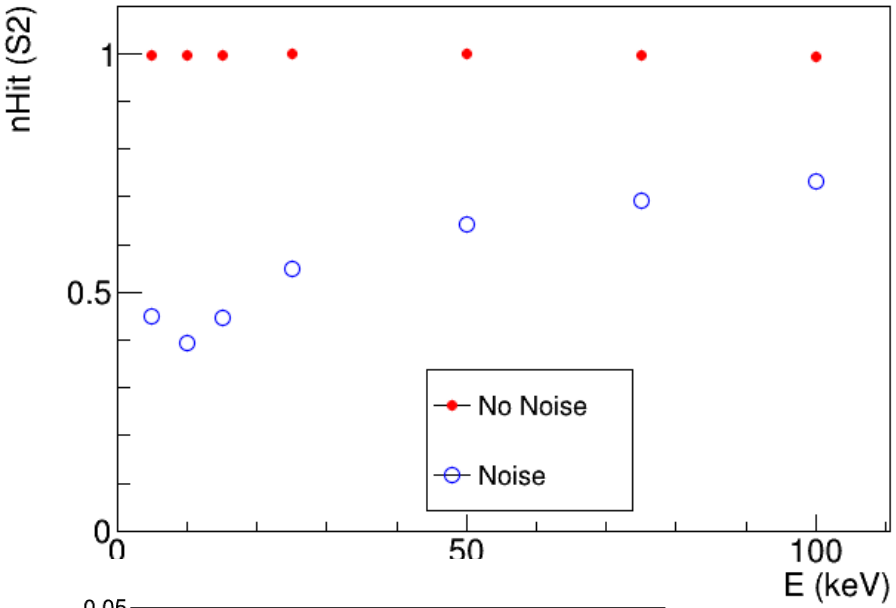
S1: Large drop of efficiency below 20 keV (Expected as too NPE)

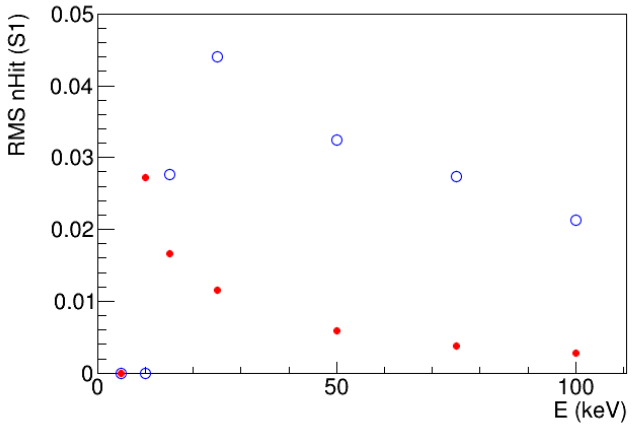
S2: Reconstruction eff is stable at 100% vs E

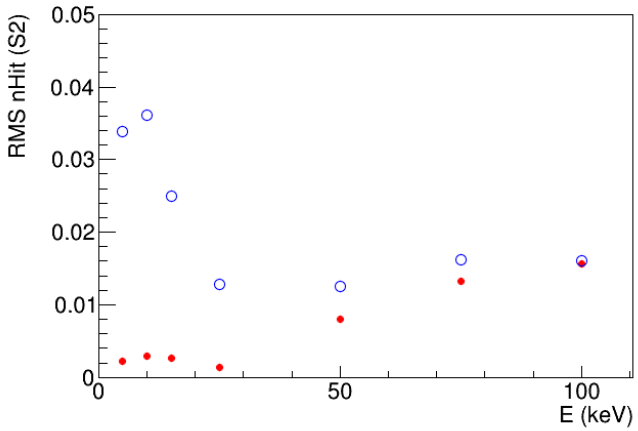
Pulses finder (4/4)

- **DS20k : 100 single γ (0,0,1.5 [m]) shot vertically upwards**
  - Variation as a function of energy : nHits reconstruction wrt Truth





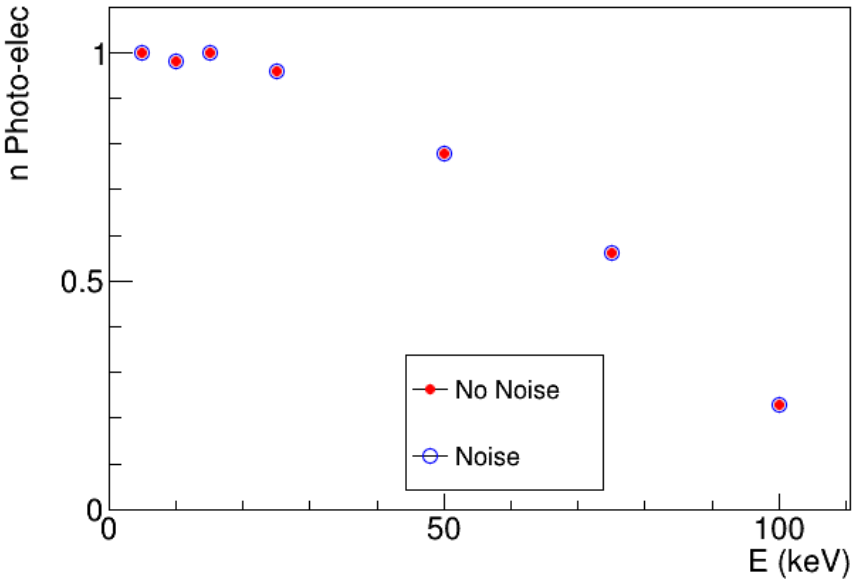




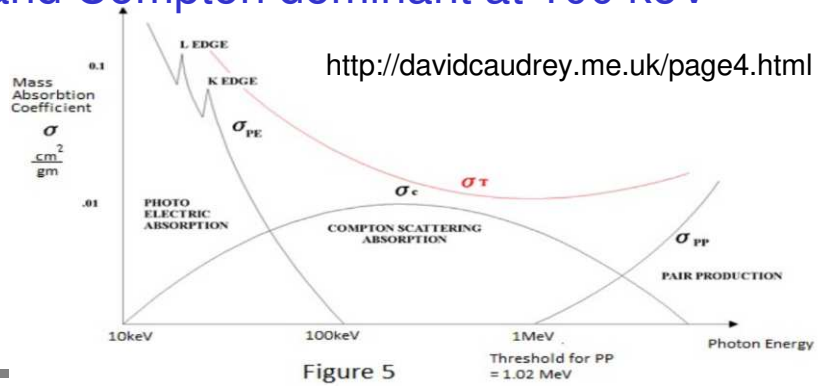
Nhits reconstructed with noise is energy dependent

Plus (1/2)

- **DS20k : 100 single γ (0,0,1.5 [m]) shot vertically upwards**
  - Variation as a function of energy : Physics

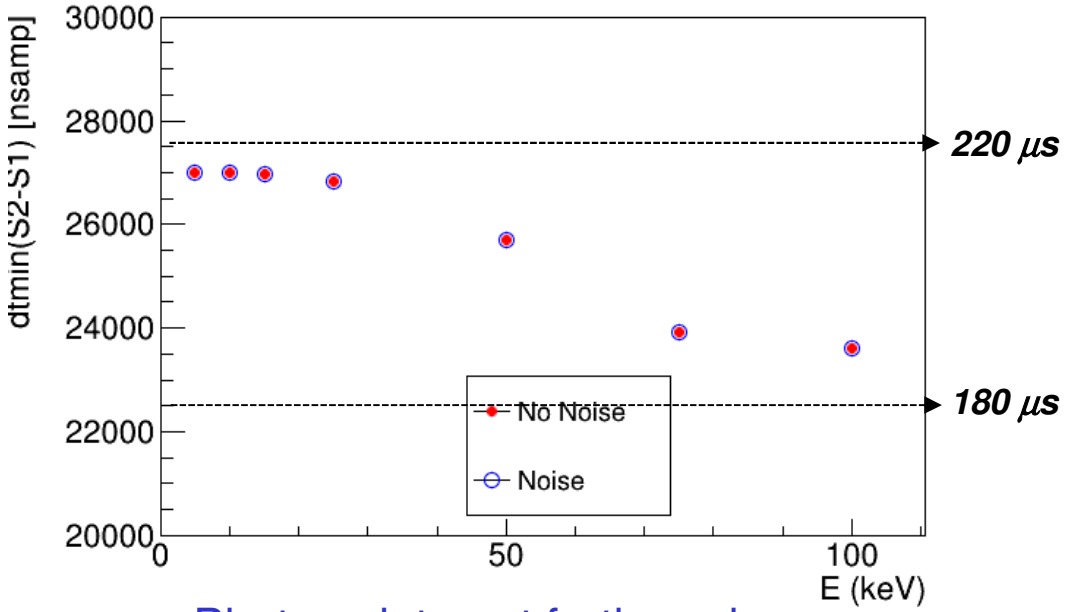


PhotoElectric effect dominant at 10 keV and Compton dominant at 100 keV



http://davidcaudrey.me.uk/page4.html

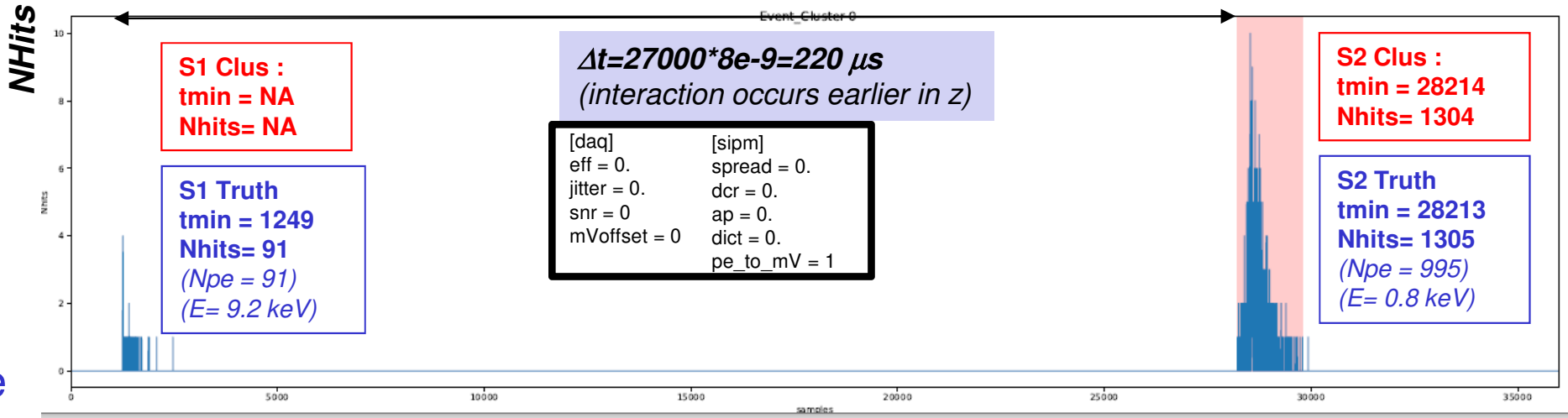
Figure 5

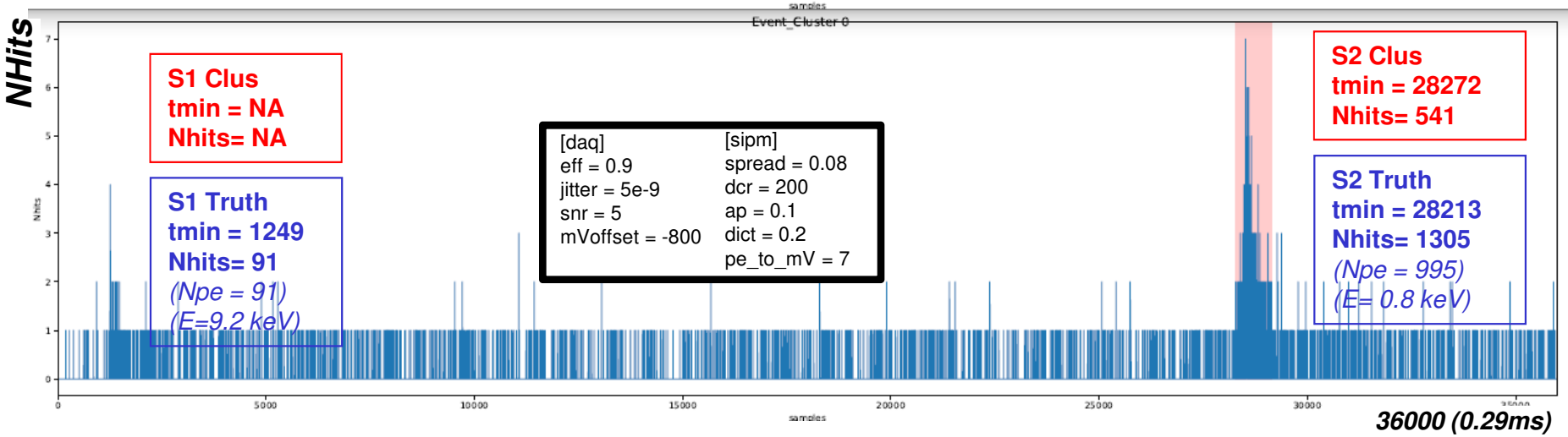


Photons interact farther when energy increases → dt(s1-s2) decreases

Plus (2/2)

- **DS20k : 100 single γ 10 keV (0,0,1.5 [m]) shot vertically upwards**
  - No Noise
  - Noise





36000 (0.29ms)

 # Samples (8ns)