Istituto Nazionale di Fisica Nucleare

GRAN SASSO SCIENCE INSTITUTE

RUN4: data selection towards a NR selection

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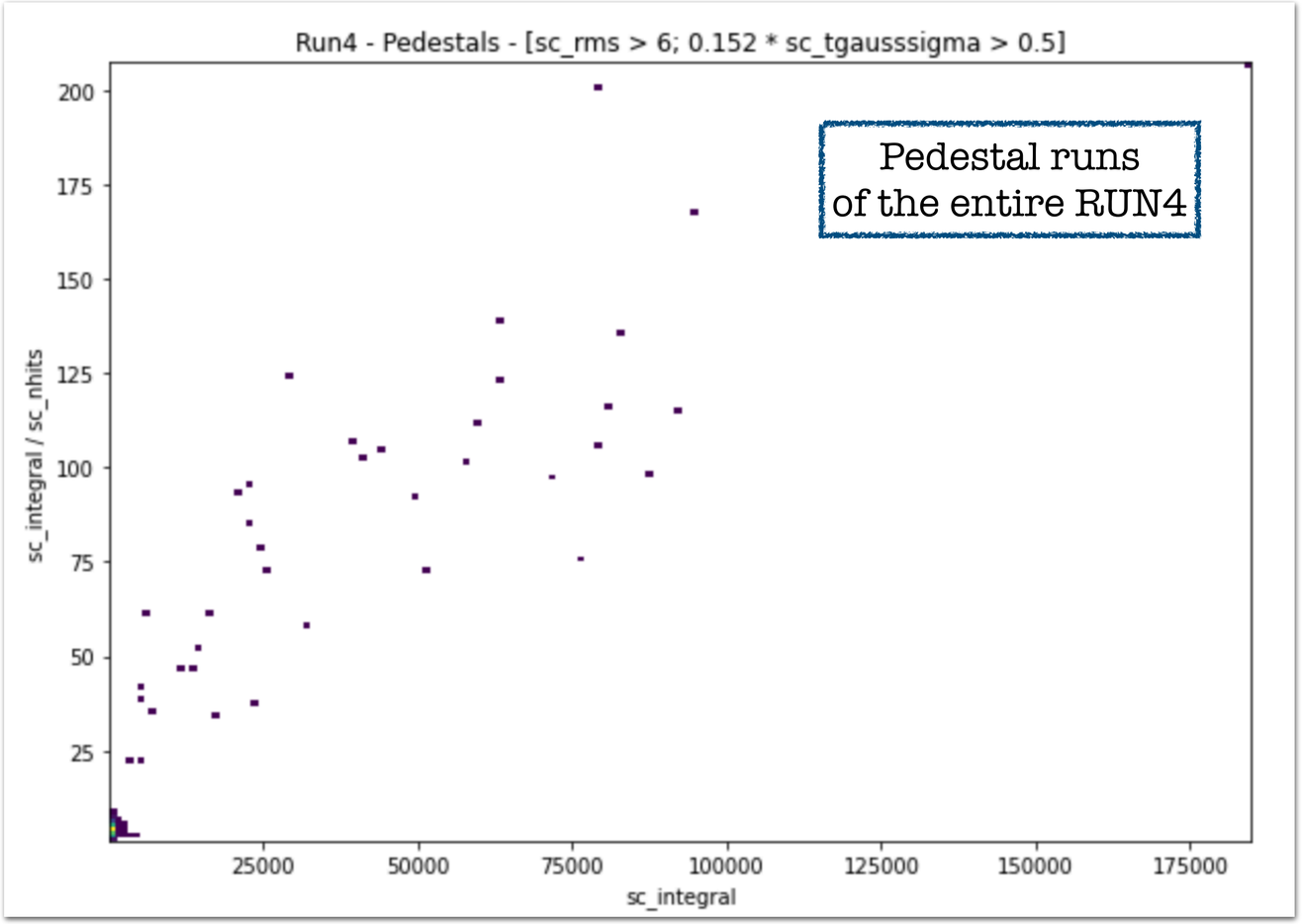
Analysis Meeting - 19/09/2024

Starting from the pedestals

- Usual **quality** cuts:

  sc_rms > 6 ← to remove fake cluster

  sc_tgausssigma > 0.5 ← to cut out events on the sensor

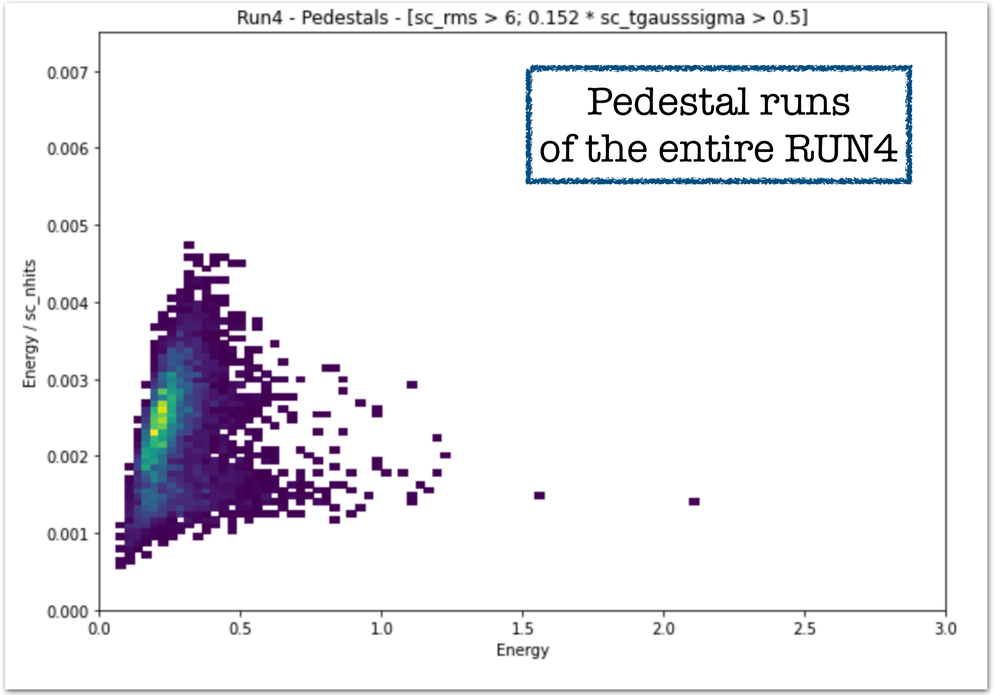


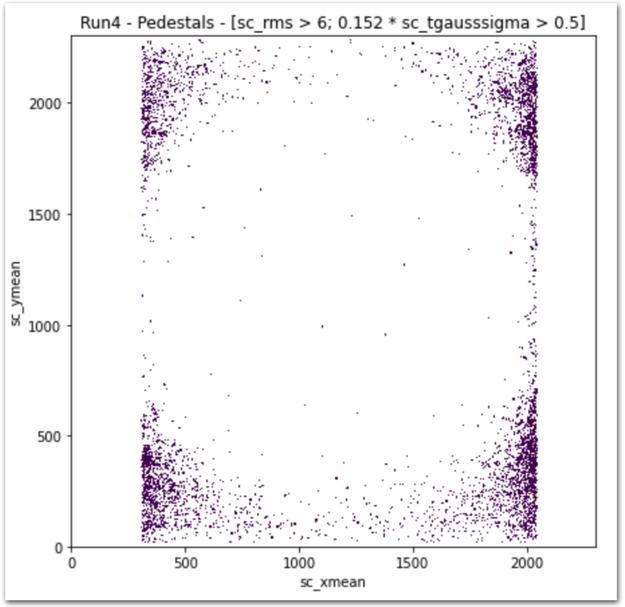
1. There are **leftover events** of both categories of events
2. Strengthening the cuts would decrease the efficiency on the data

Cut also on other variables

Example: the fake clusters

- sc_integral converted to energy using the **average** Step 3 daily calibration ^{55}Fe Light Yield (LY)
- Zoom in the low energy region:
- Position distribution:

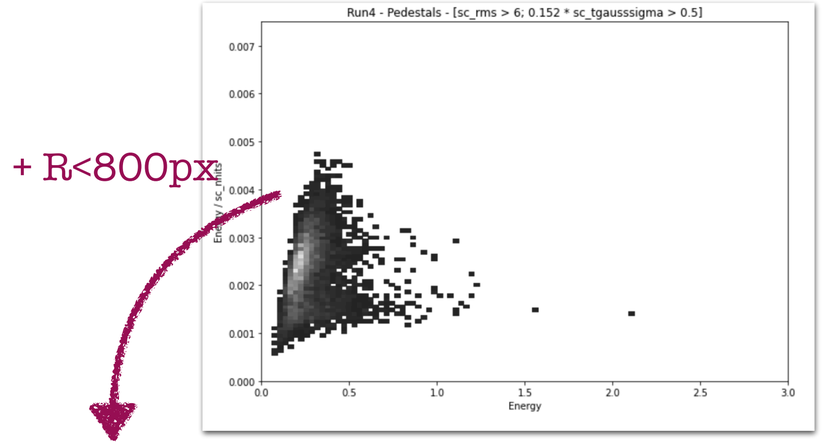




These fake clusters are due to:

1. Noise of the camera
2. Vignetting correction

Example: the fake clusters

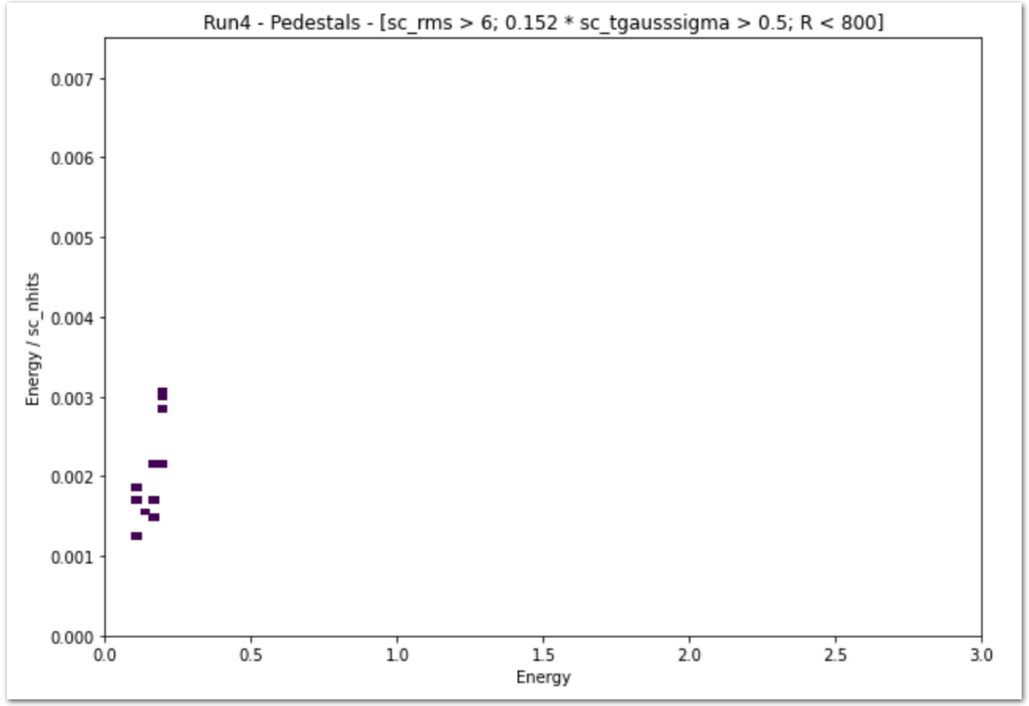


- Two options:
  1. Accept an energy threshold of ~1.5 keVee
  2. Fiducialization:

sc_rms > 6
R < 800 px
} ← to remove fake cluster

sc_tgausssigma > 0.5 ← to cut out events on the sensor

Low energy threshold is $\lesssim$ 500 eVee *



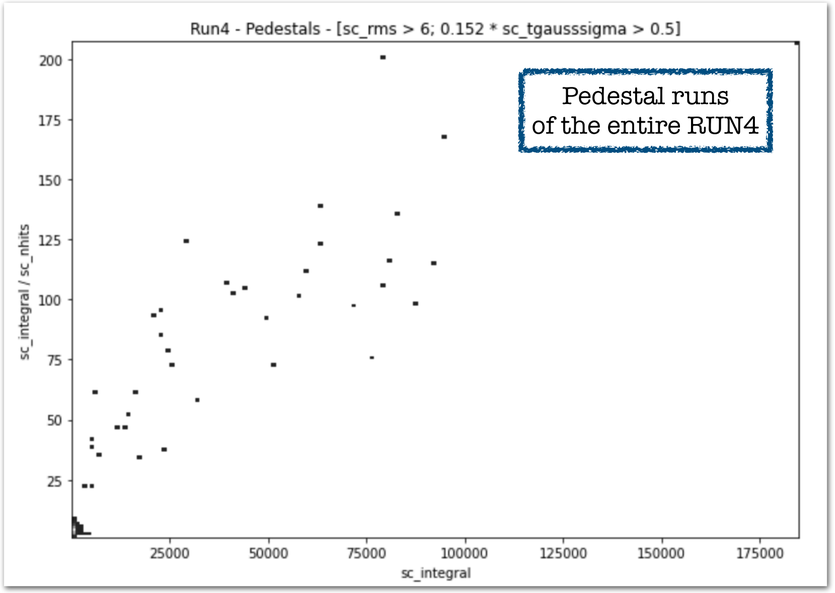
* No event in the [300, 500] eVee window, but pedestals have very low statistics

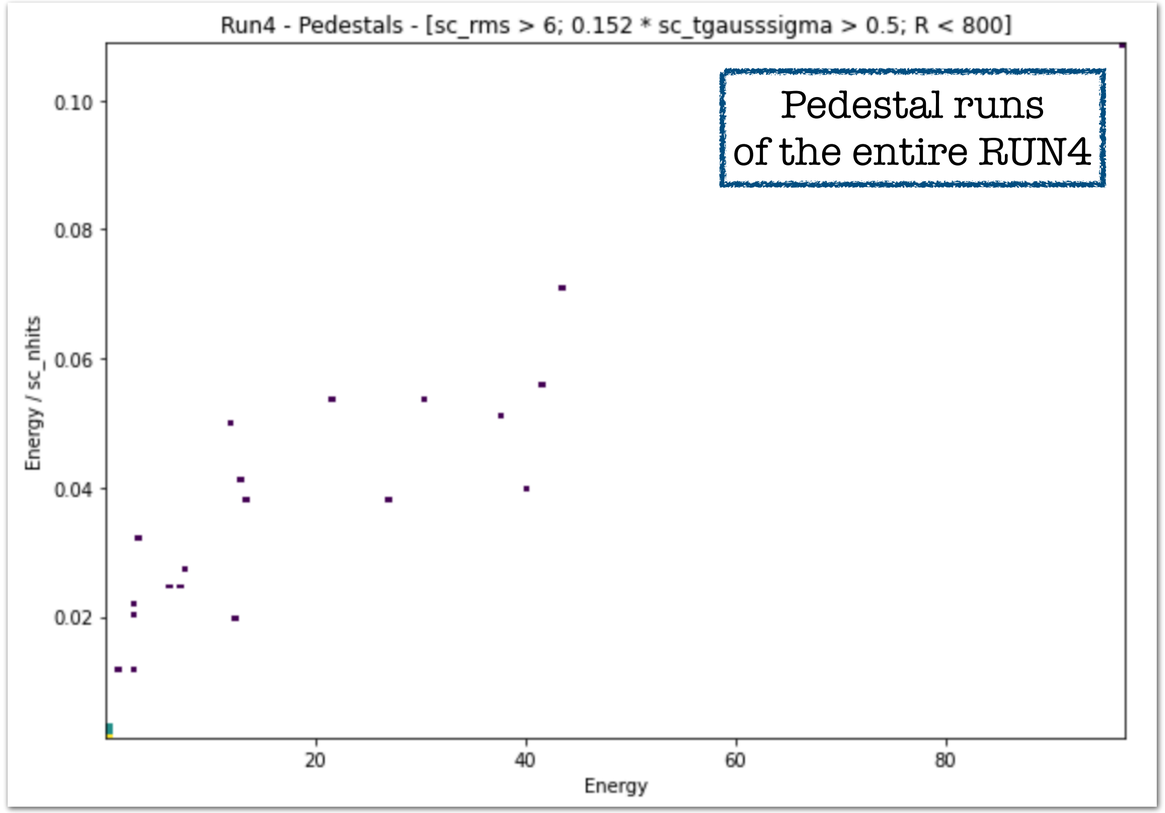
Example: the fake clusters

- **Quality** cuts:

sc_rms > 6
R < 800 px
} ← to remove fake cluster

sc_tgausssigma > 0.5 ← to cut out events on the sensor

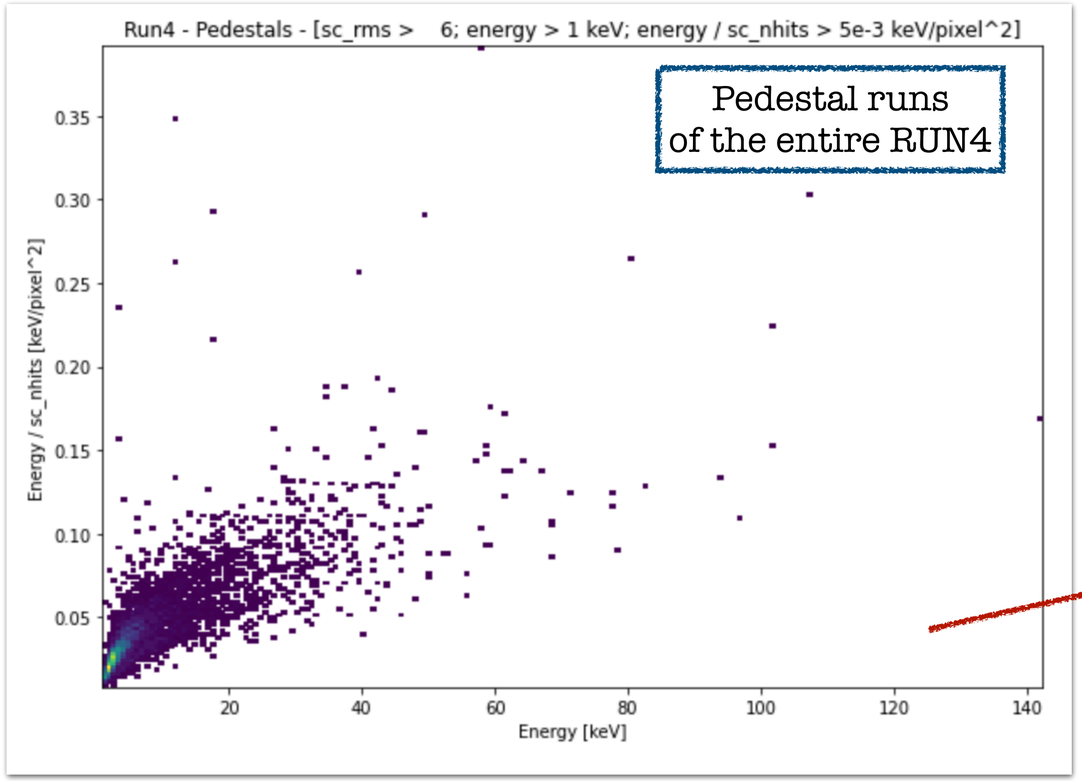




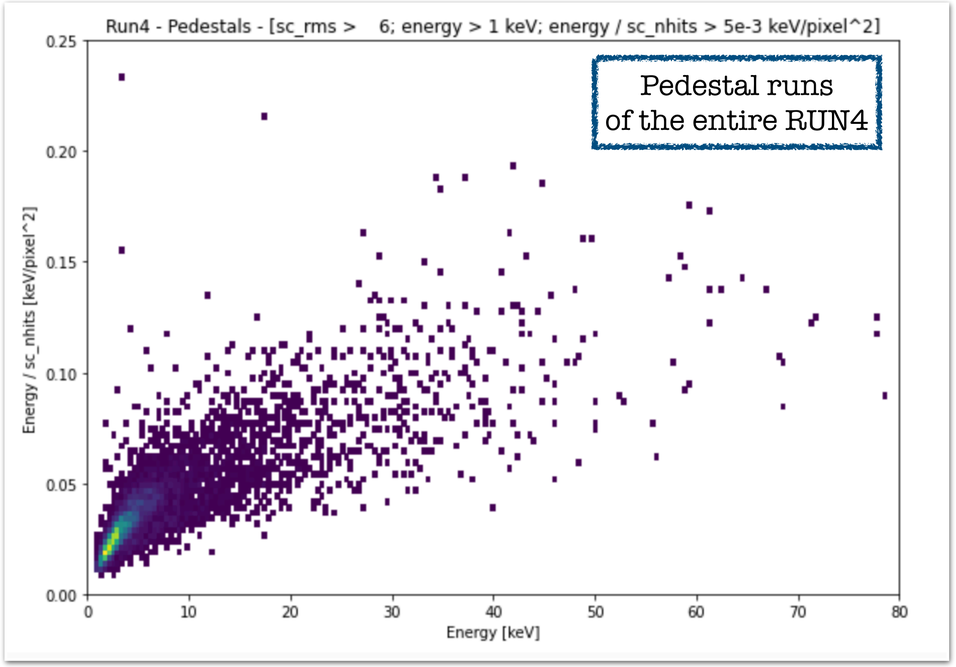
+ R<800px

The events on the CMOS

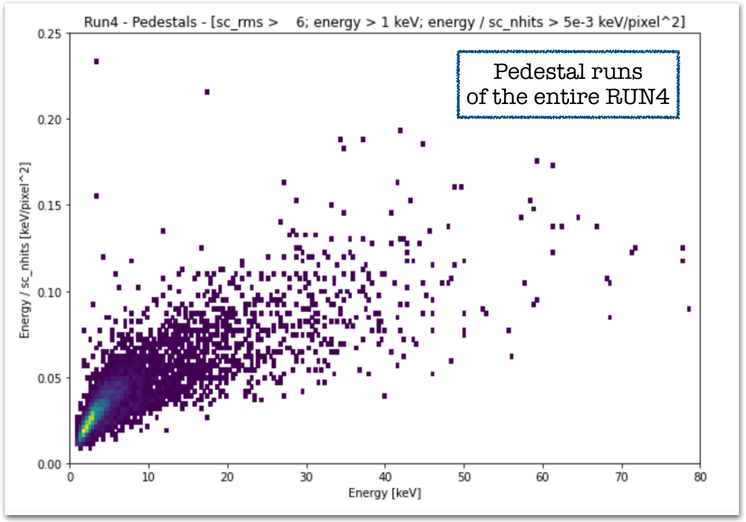
- Let's focus on the **"high" energy** and **"high" density** regions and **remove the sc_tgausssigma cut:**



Just a zoom

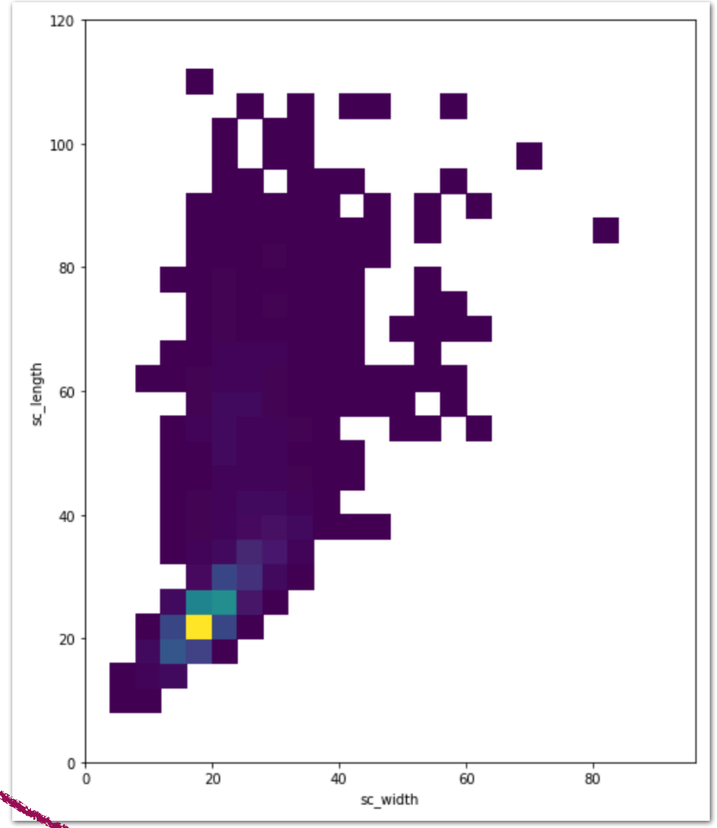


The events on the CMOS: some variables

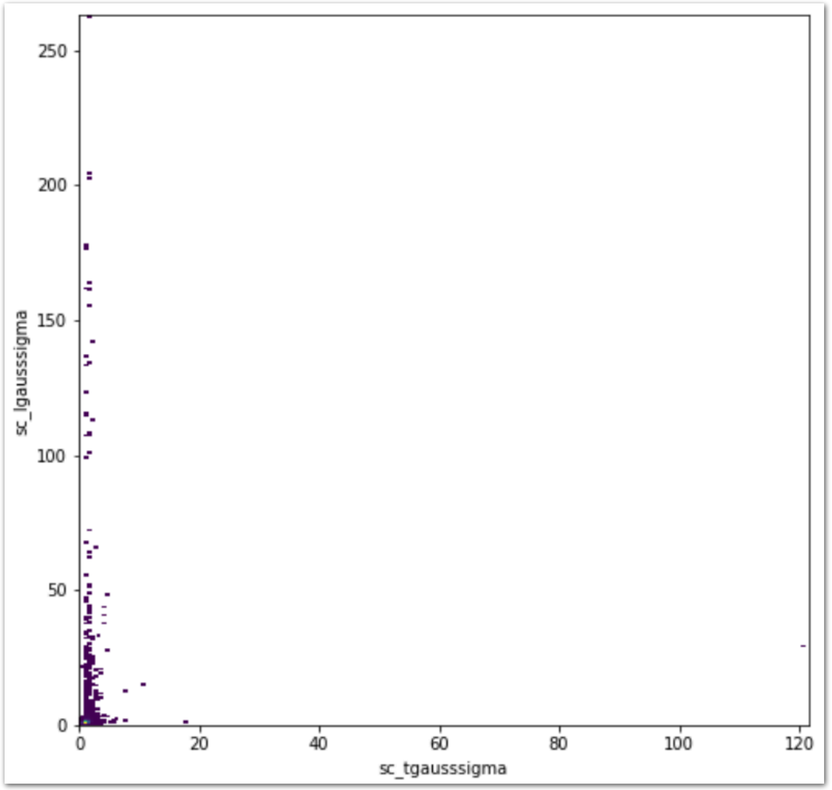


- Mostly spotlike with 20x20 pixel width
- There are also few longer events

length vs width

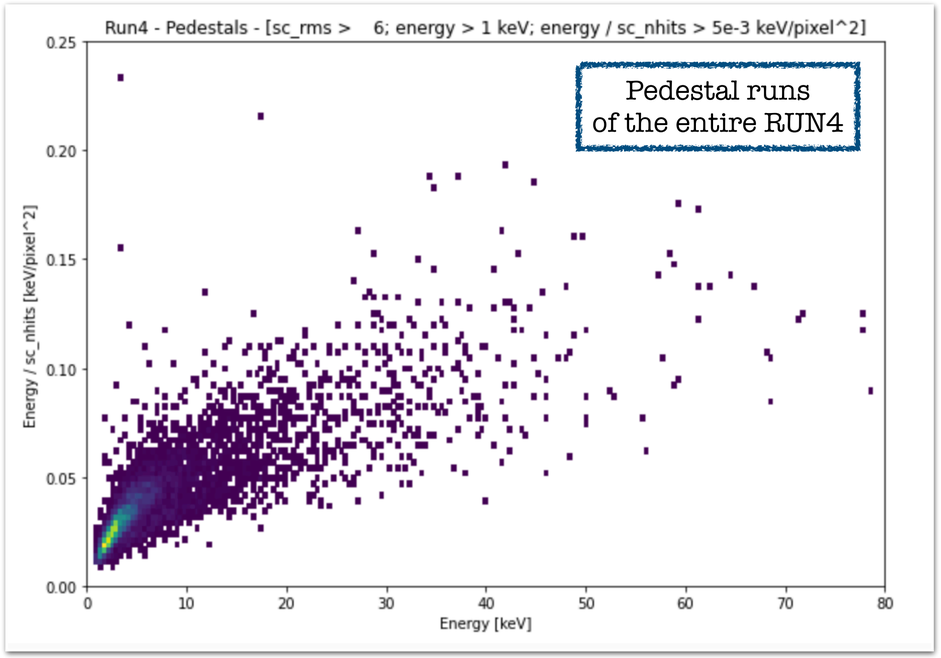


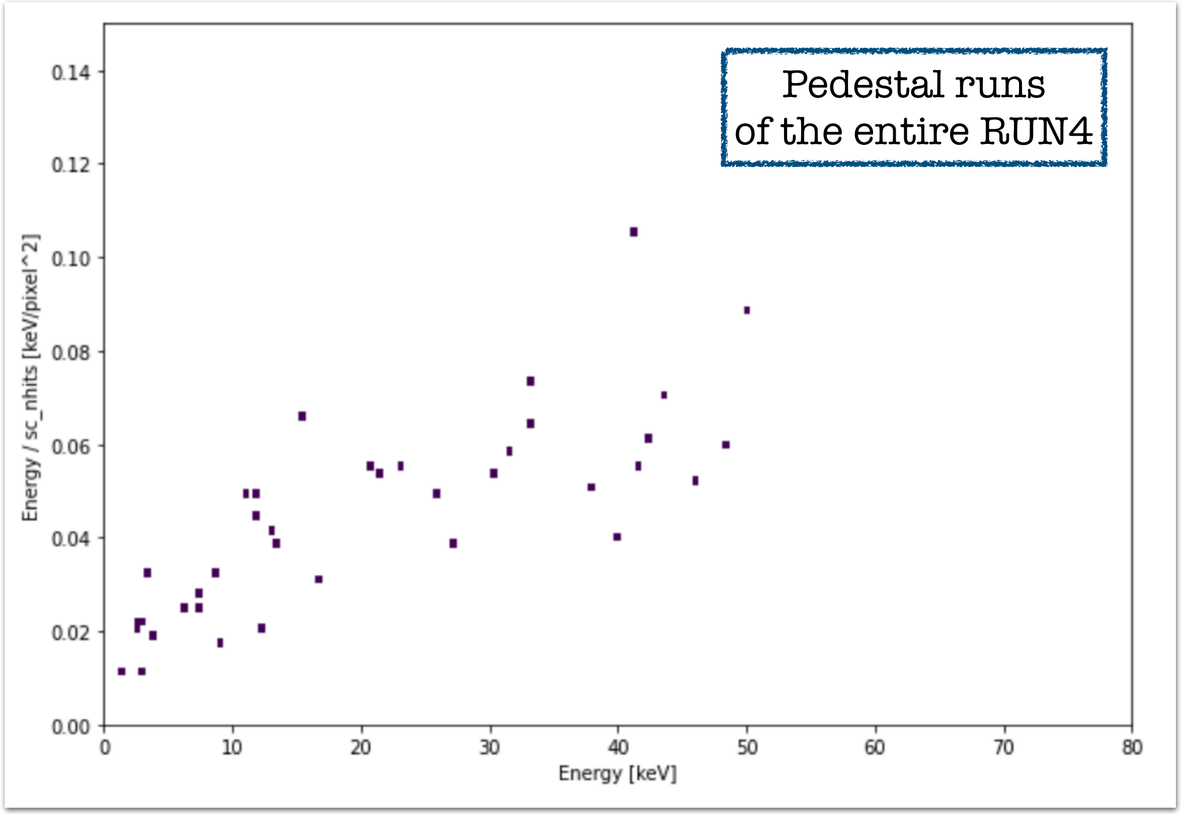
lgausssigma vs tgausssigma



The events on the CMOS: after the tgausssigma cut

+ sc_tgausssigma * 0.152 > 0.5





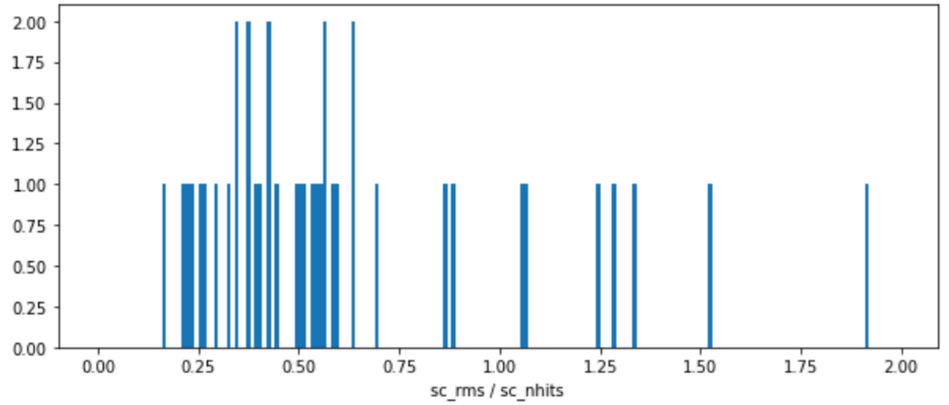
The tgausssigma cut removes only 99.4% of the events on the sensor, not great on the long run

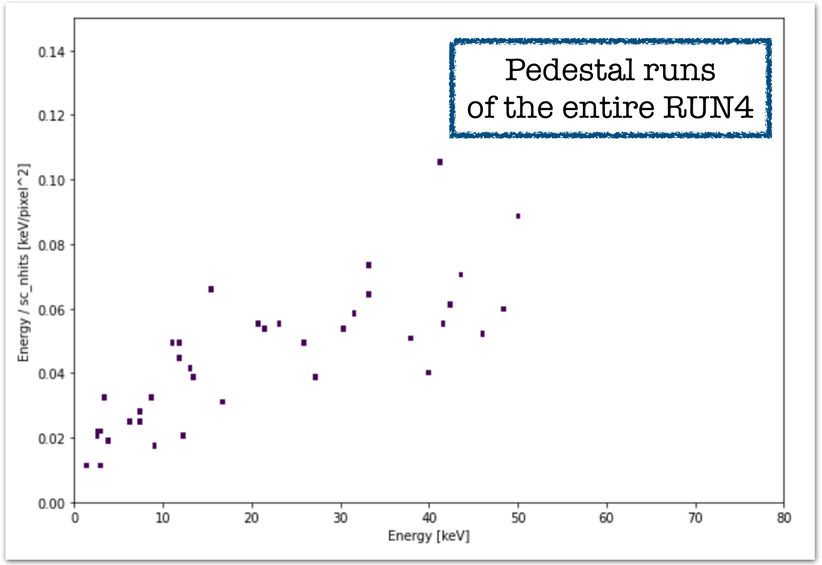
The events on the CMOS: a new variable ρ

- What is "big" for the tracks on the sensor?
  1. sc_rms
  2. 1/sc_nhits

$$\rho \equiv \frac{\text{sc\_rms}}{\text{sc\_nhits}}$$

Distribution of ρ





A possible cut that remove **all** the residual tracks is:

$$\rho < 0.15$$

- Question: will this cut out also data?

[spoiler: it doesn't]

The ρ variable on RUN4 data

- **Quality** cuts:

  sc_rms > 6
  R < 800 px

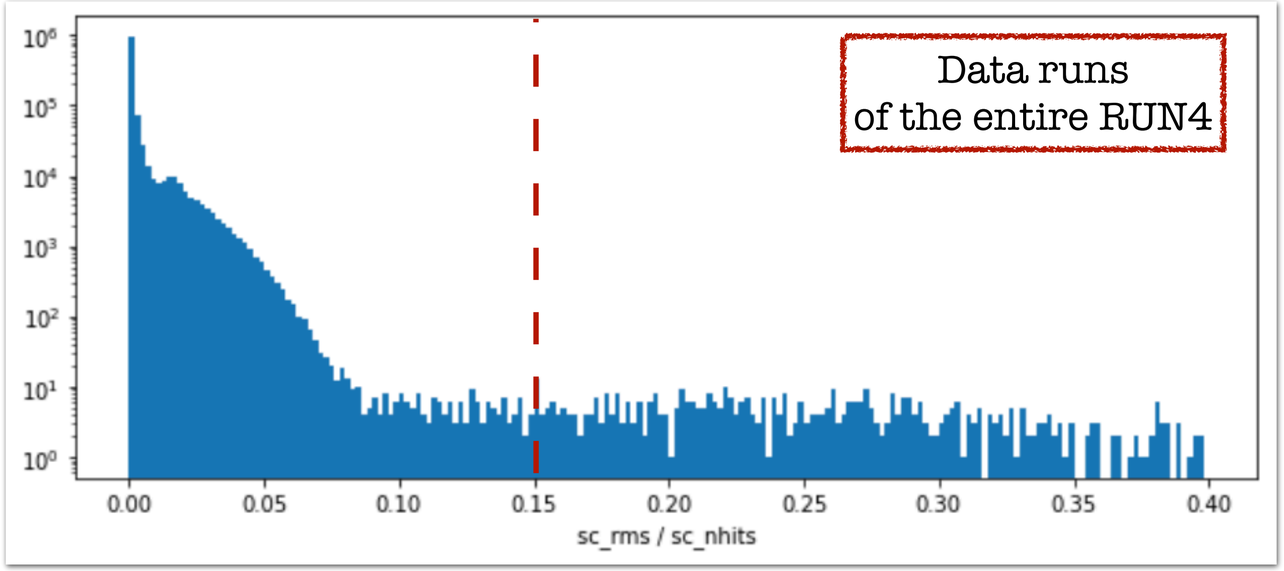
  sc_tgausssigma > 0.5

  “energy” > 500 eV

- Just for this plot I used as energy calibration the average LY of the ^{55}Fe Step 3 daily calibration

- **Please note:** the data contains much more pics than pedestals → much more events on the sensor

Histogram of ρ in RUN4 data



- Question: are NRs in the region which is cut out?

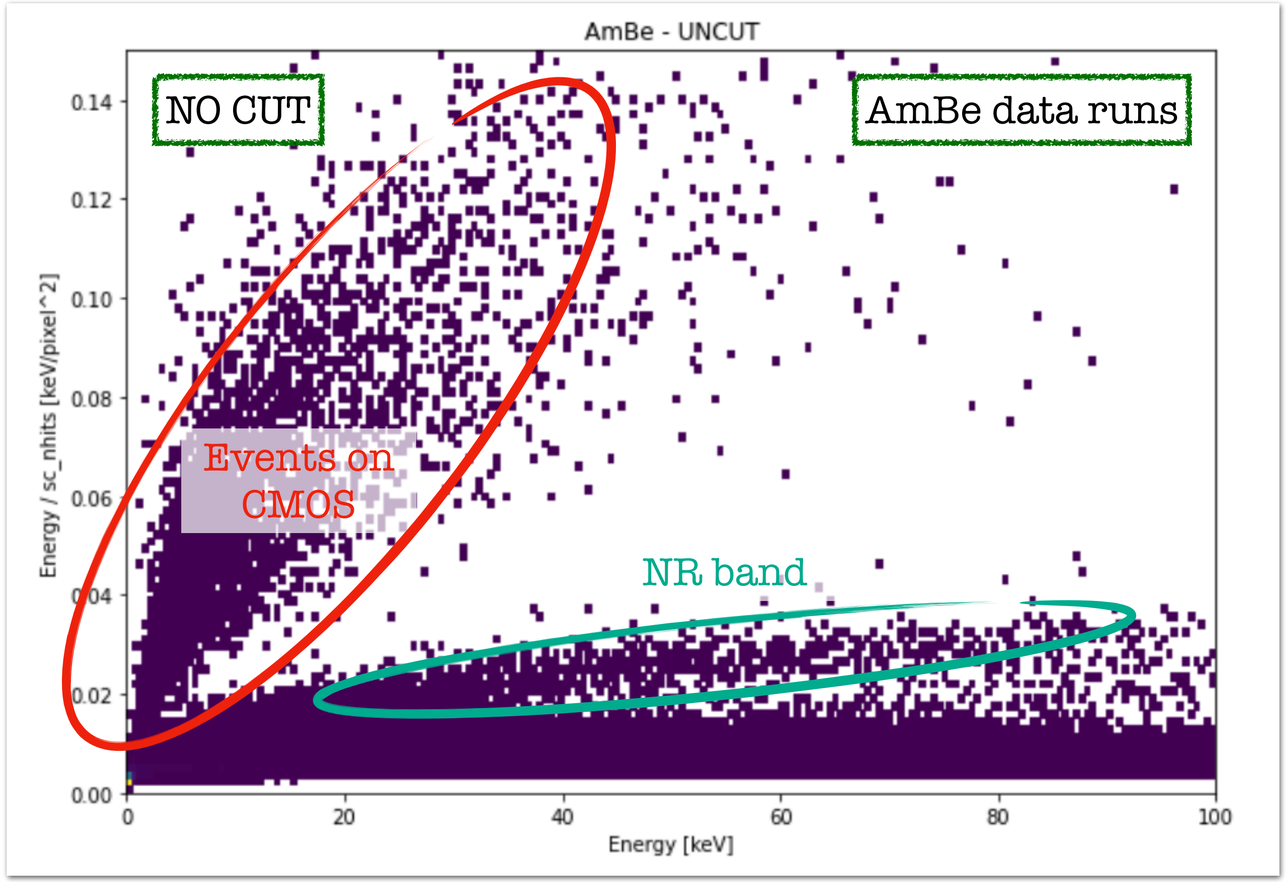
  [spoiler: they are not]

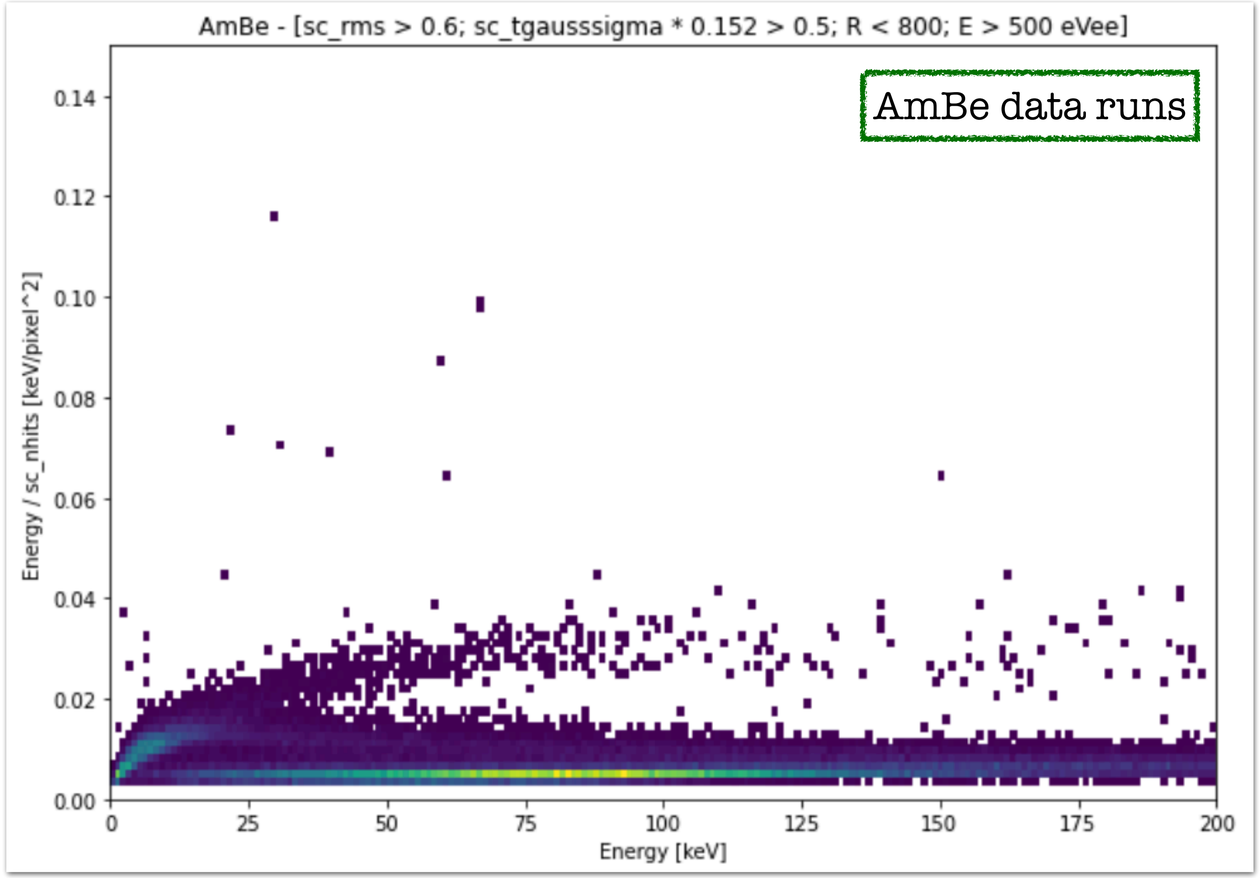
Let's take the AmBe data

sc_rms > 6
R < 800 px

sc_tgausssigma > 0.5

"energy" > 500 eV



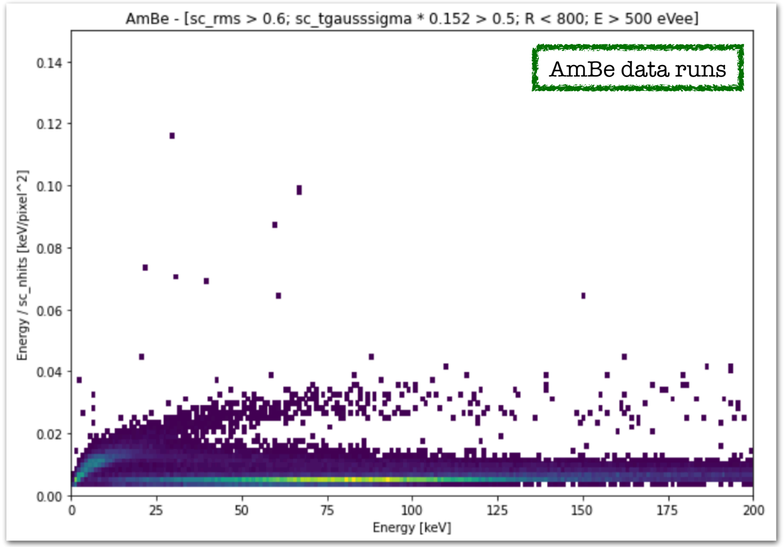


Let's take the AmBe data

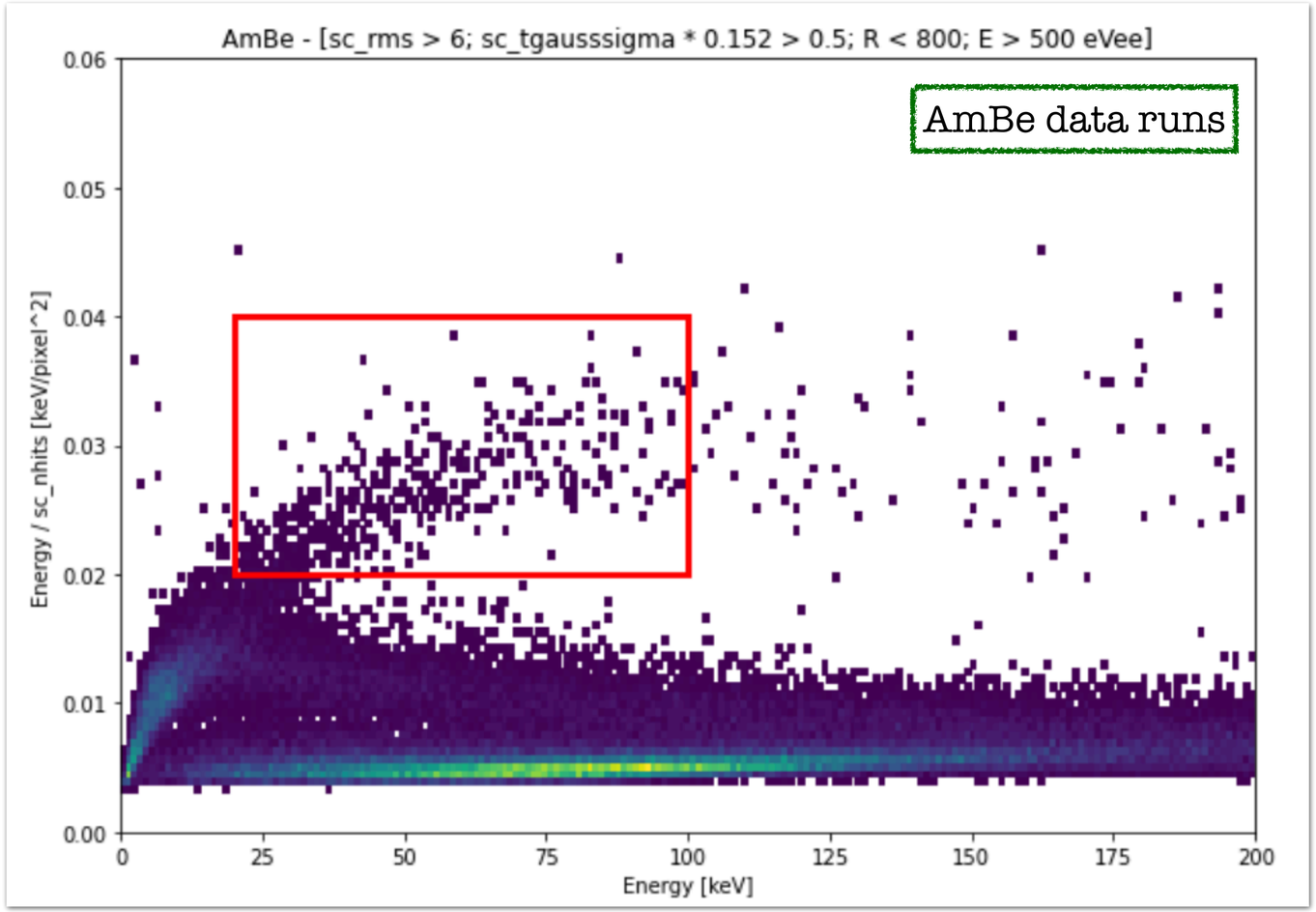
sc_rms > 6
R < 800 px

sc_tgausssigma > 0.5

"energy" > 500 eV



Just a zoom



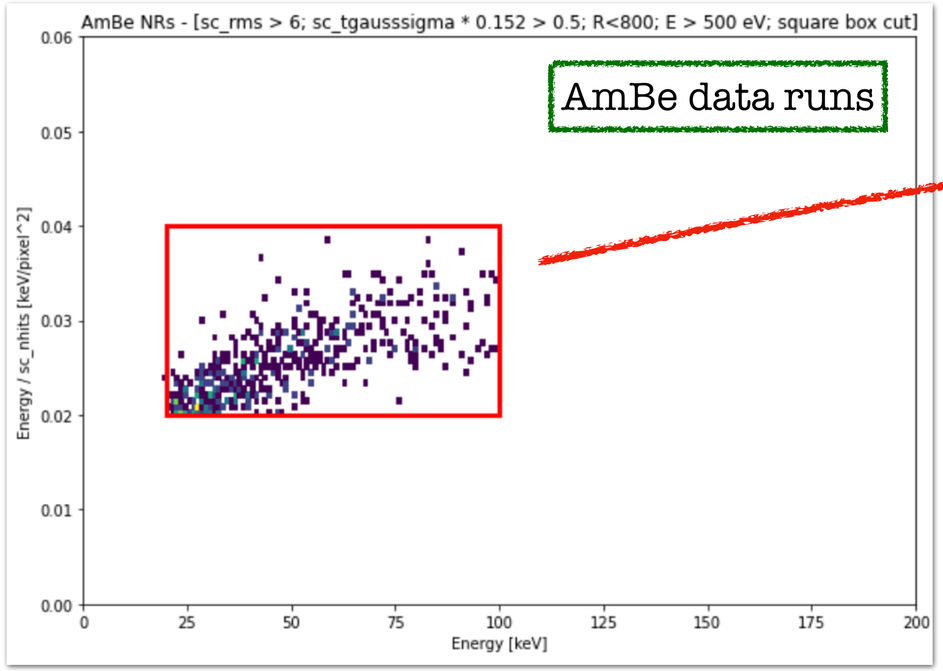
- Let's focus on the most certain NR tracks (red box)

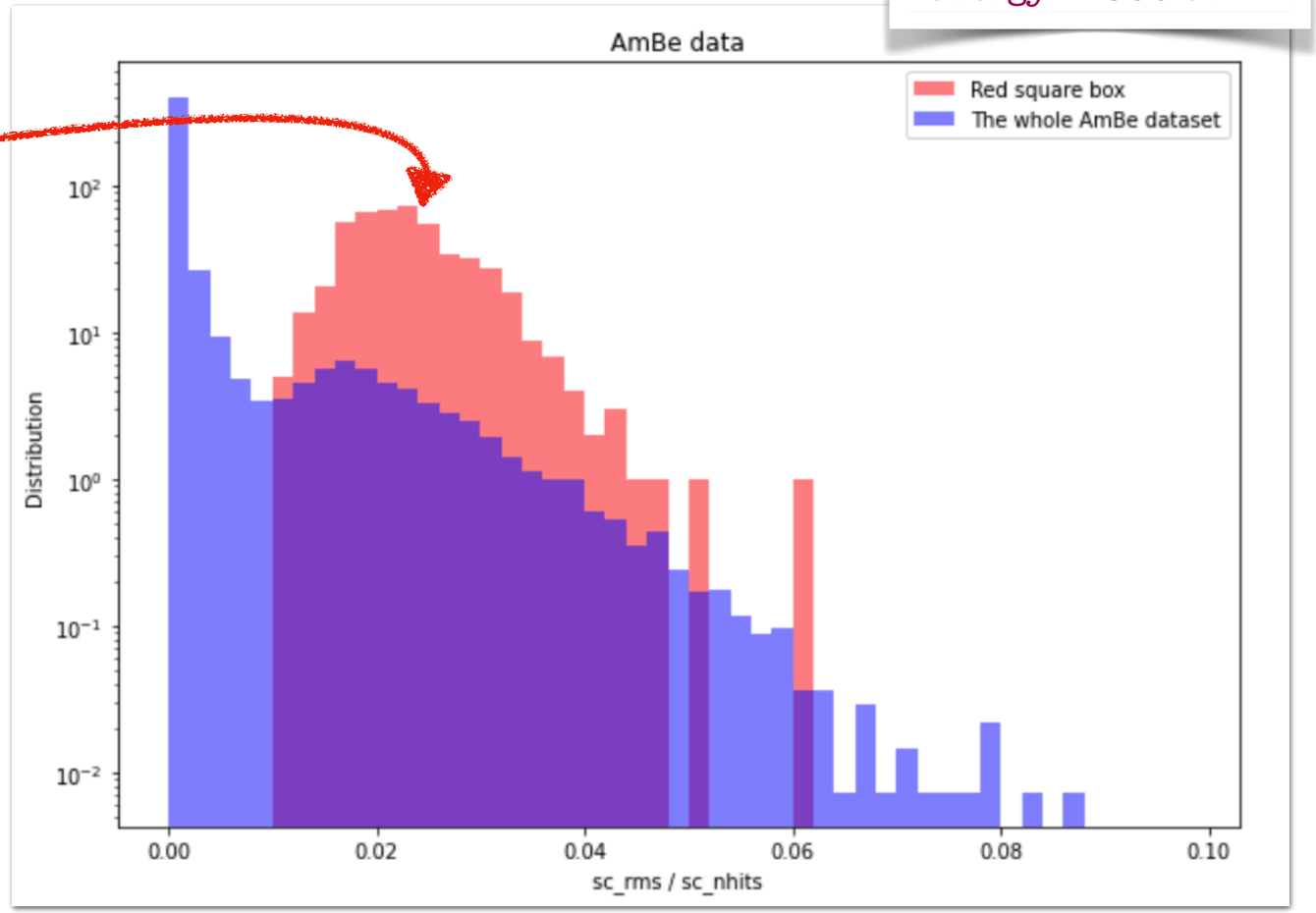
The ρ variable on AmBe data

sc_rms > 6
R < 800 px

sc_tgausssigma > 0.5

“energy” > 500 eV

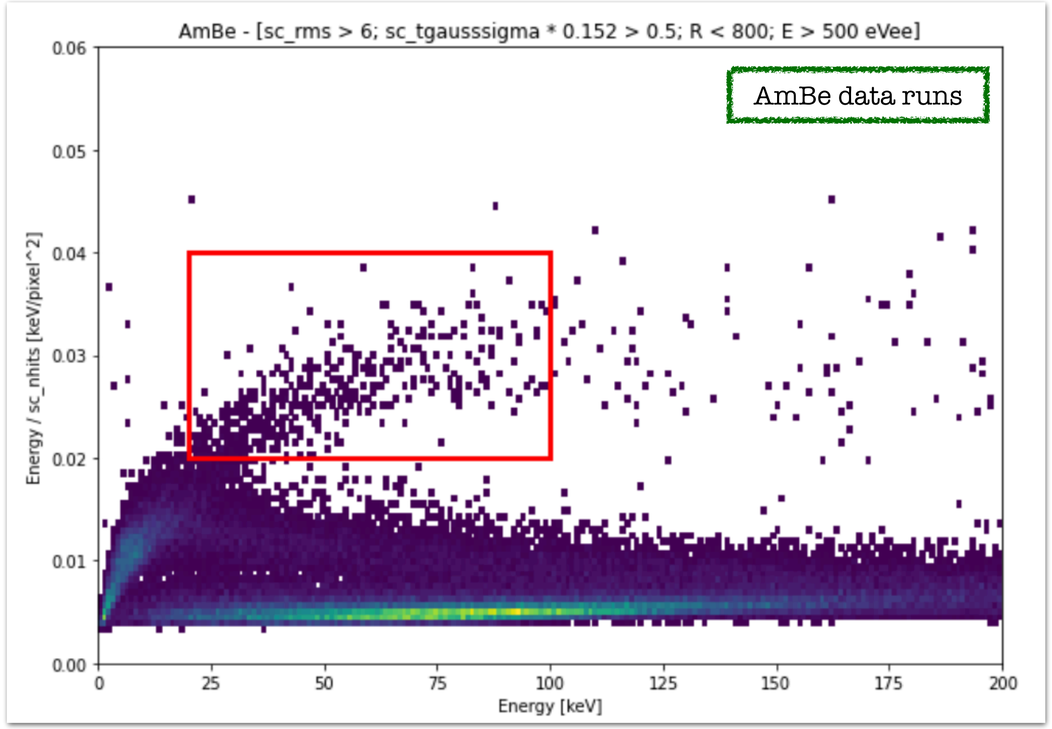




1. The **NR tracks** have a **peak in** ρ
2. The **peak is well below** $\rho = 0.15$

Conclusion: not only ρ is good to remove events on the sensor, but also **to select for NR tracks**

Example: NR selection in AmBe



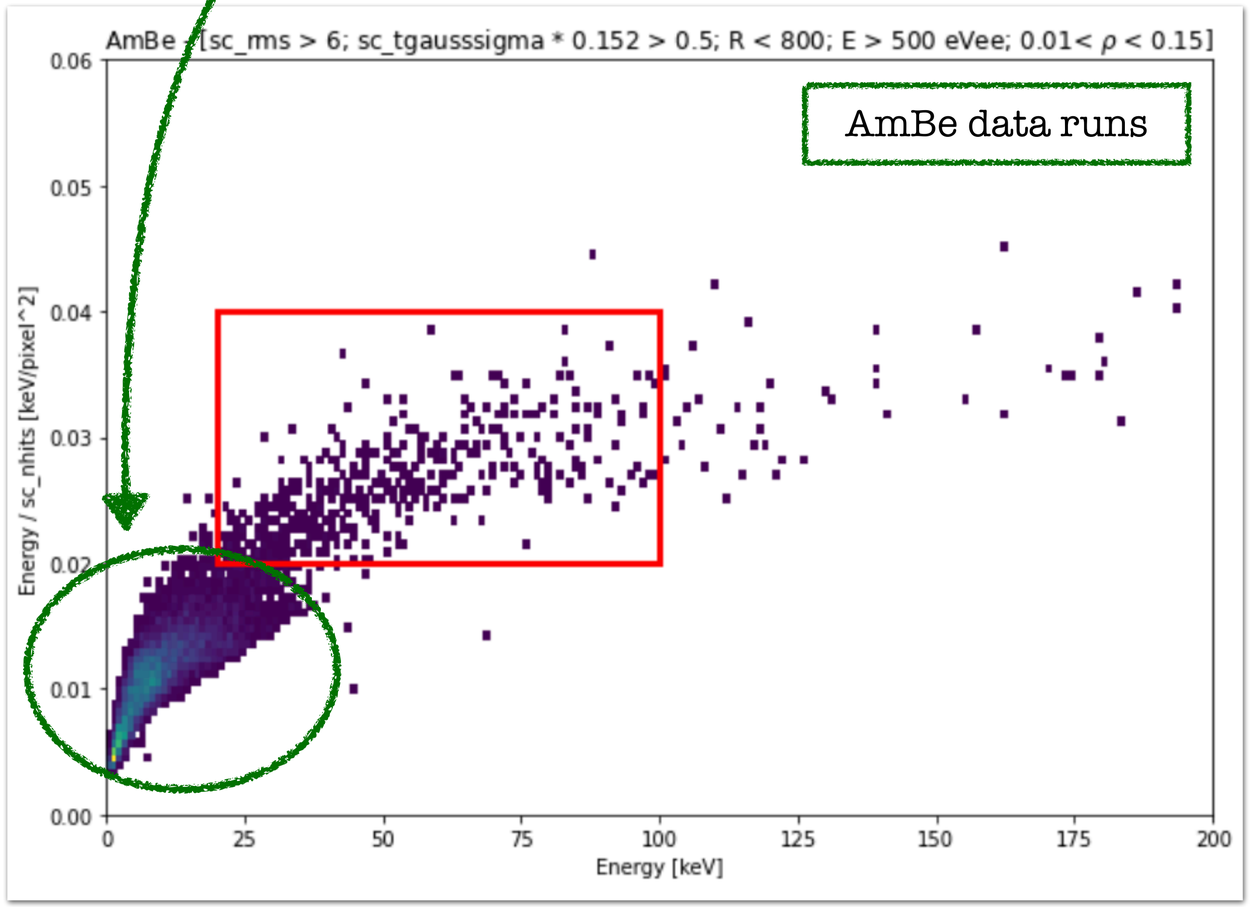
sc_rms > 6
R < 800 px

sc_tgausssigma > 0.5

“energy” > 500 eV

0.01 < ρ < 0.15

Clear contamination of ERs



PRELIMINARY

ample: NR selection in AmBe

sc_rms > 6
R < 800 px

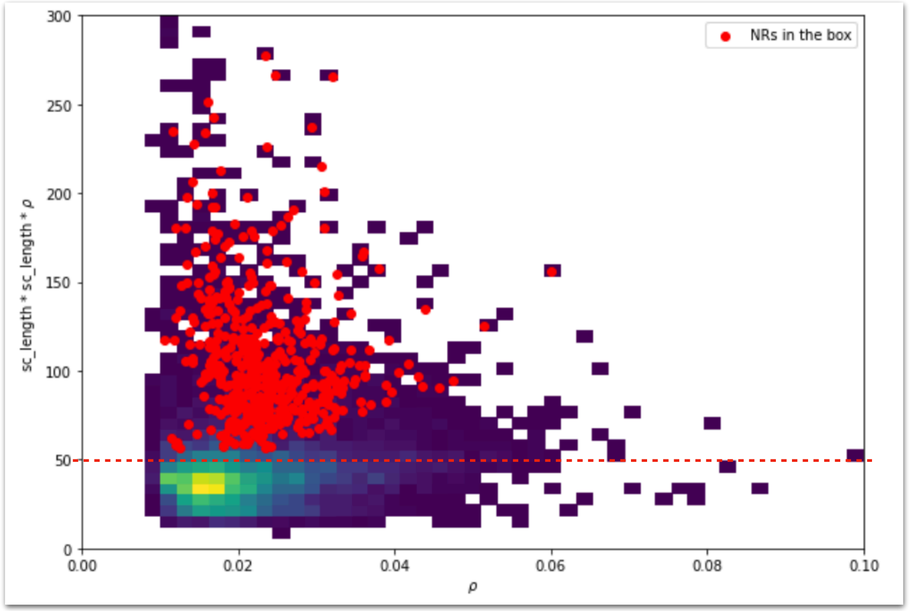
sc_tgausssigma > 0.5

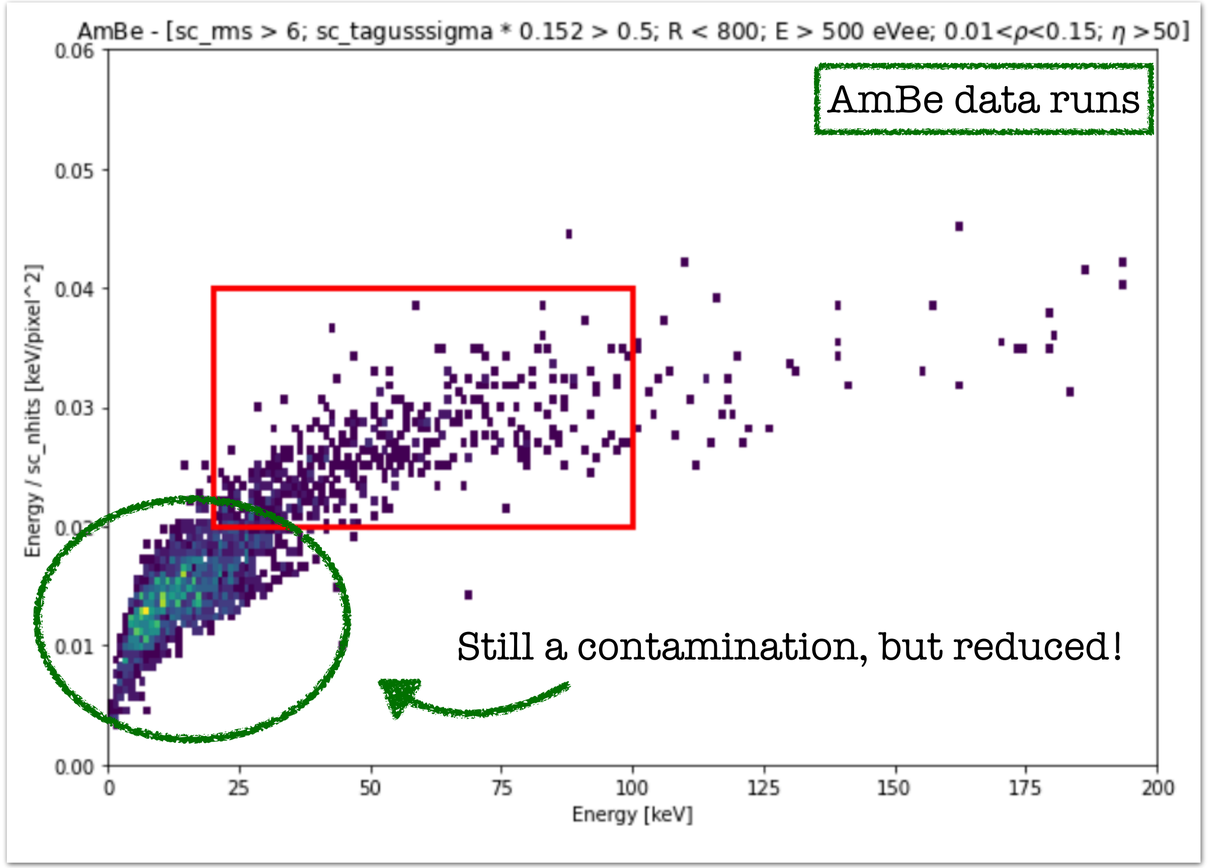
“energy” > 500 eV

$0.01 < \rho < 0.15$
$\eta > 50$

- Looking deeper in AmBe data, it seems there is another interesting variable:

$$\eta \equiv \text{sc\_width} * \text{sc\_length} * \rho$$





PRELIMINARY

ample: NR selection in AmBe

sc_rms > 6
R < 800 px

sc_tgausssigma > 0.5

“energy” > 500 eV

$0.01 < \rho < 0.15$
$\eta > 50$

- Apply this to RUN 4 Step 3 ^{55}Fe data

$$\eta \equiv \text{sc\_width} * \text{sc\_length} * \rho$$