TEST BEAM 2017 ANALYSIS SUMMARY

COMO - 27/10/2017

INSUBRIA TEAM

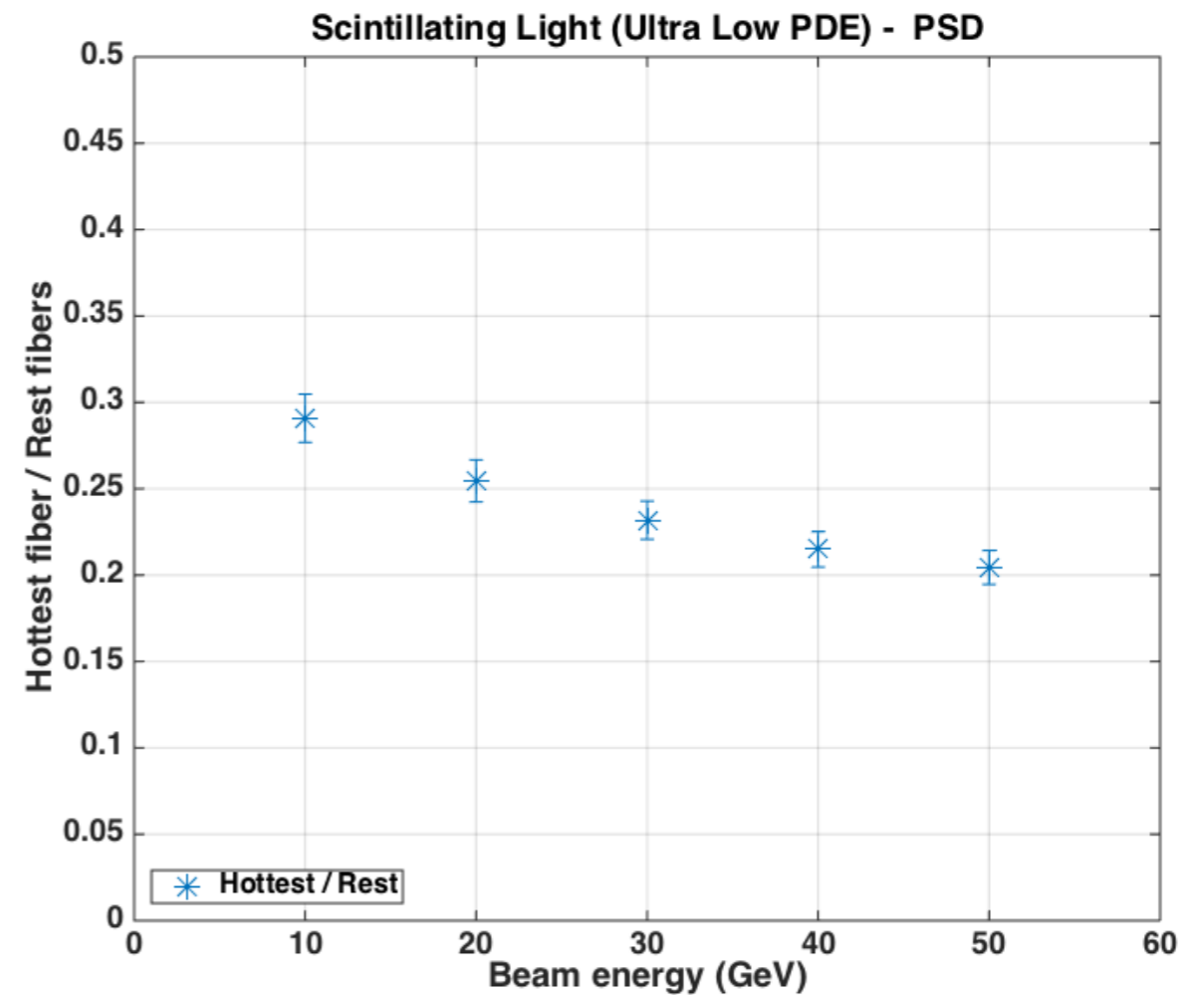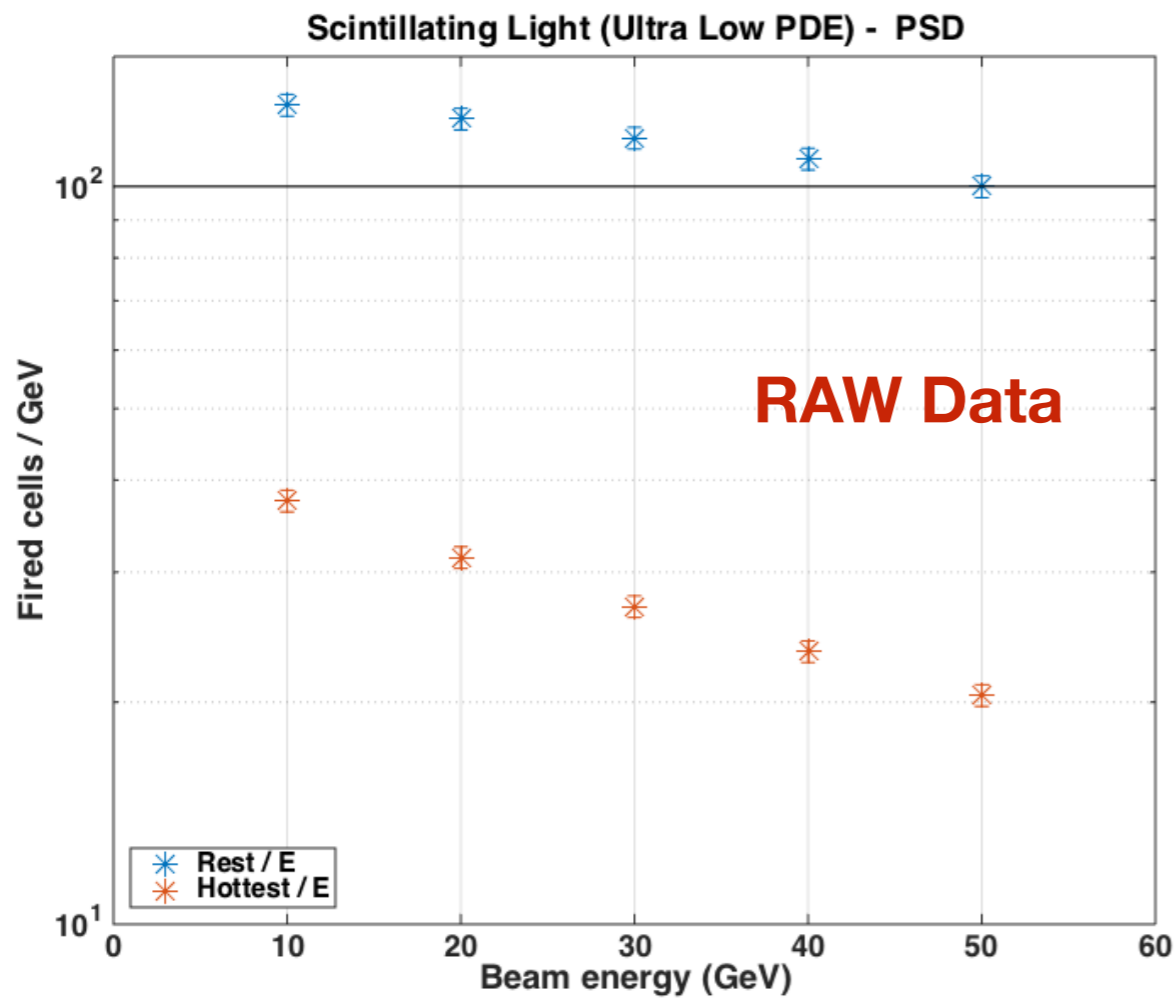FIGURE 11

Fig: 11

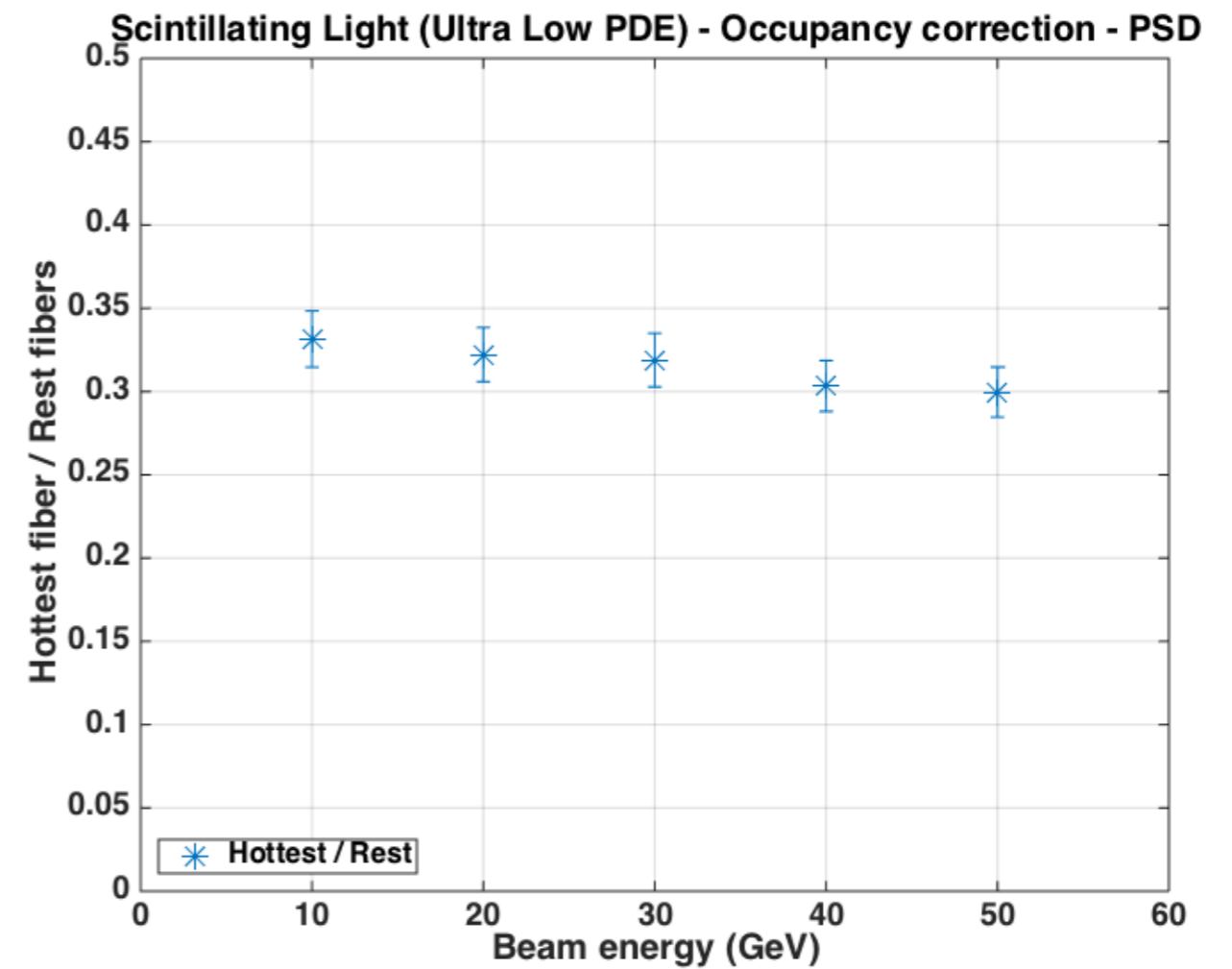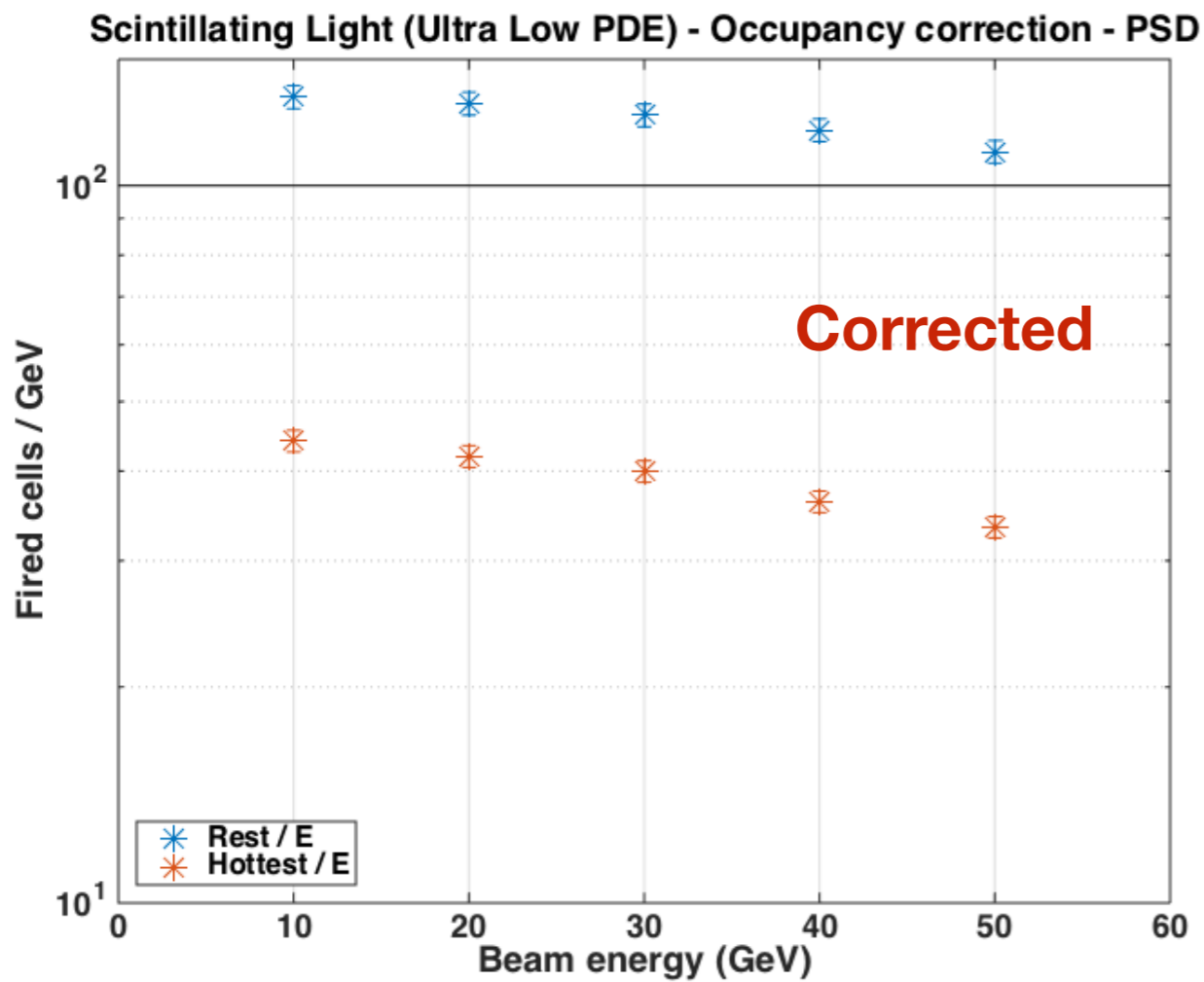▸ Ultra Low PDE configuration —> number of fired cells in the hottest fiber < 1584
▸ But we are in a region of non linearity

▸ Correction for non-linearity

$$N_{photons} * PDE = -1584 * \ln\left(1 - \frac{N_{firedcells}}{1584}\right)$$

Corrected

▸ Correction goes in the right direction but it's still not perfect

FIGURE 12

For each event

- Center of gravity used to get $(\bar{x}, \bar{y})$:

- Extracted 32 r_i and the deposited E_i:

$$\bar{x} = \frac{\sum_i x_i E_i}{\sum_i E_i}, \quad \bar{y} = \frac{\sum_i y_i E_i}{\sum_i E_i}$$

$$r = \sqrt{(x_i - \bar{x})^2 + (y_i - \bar{y})^2}$$

Event Display

Sum of all 32 SiPM = 100%

Single event

- Plot for all events
- Scatter plot separated for C and S
  - Cherenkov: 40 GeV RUN **12348** Intermediate PDE with Preshower detector (PSD) cut
  - Scintillating: 10 GeV RUN **12337** Ultra Low PDE (with PSD)
- Using **0.6 mm** pitch
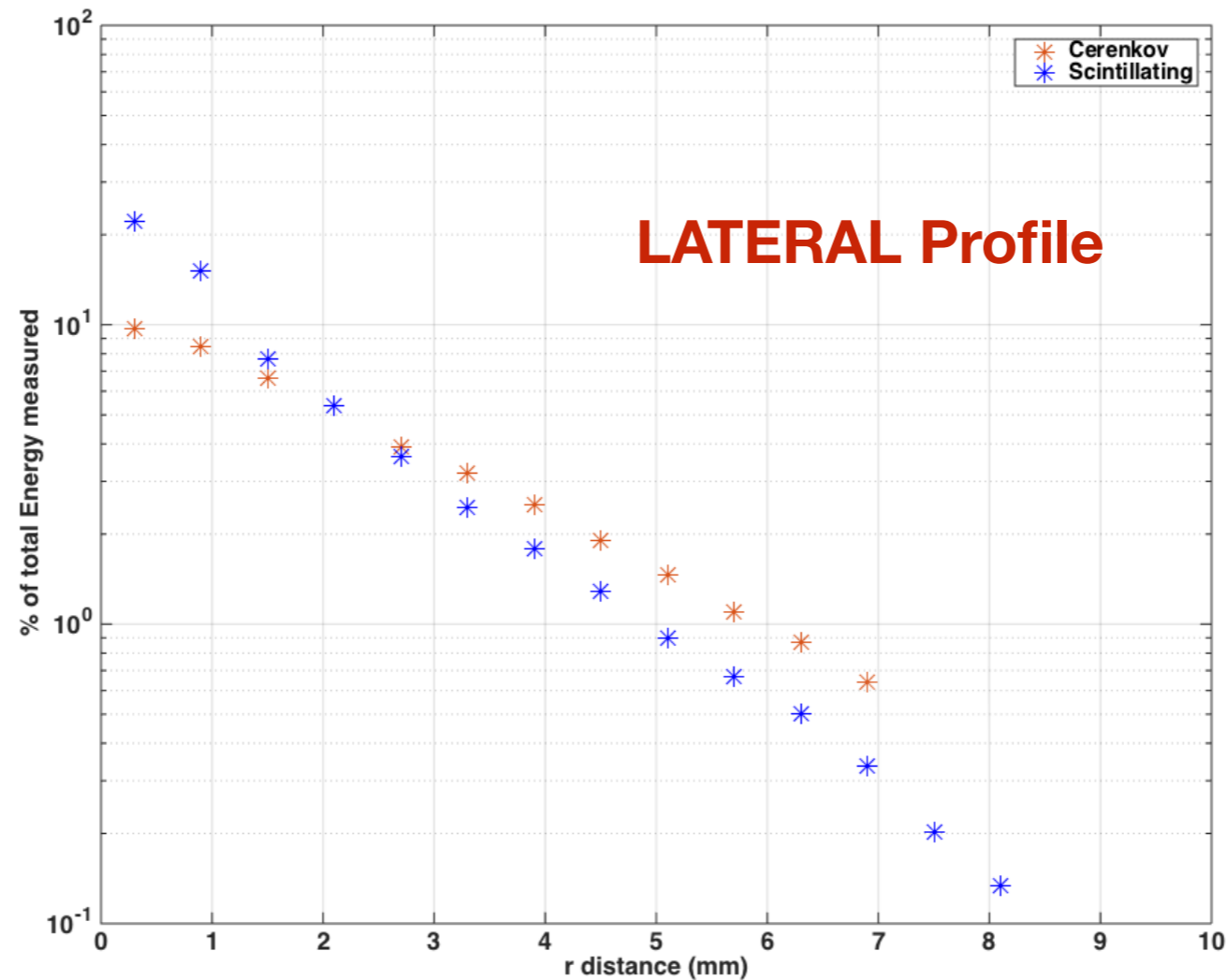
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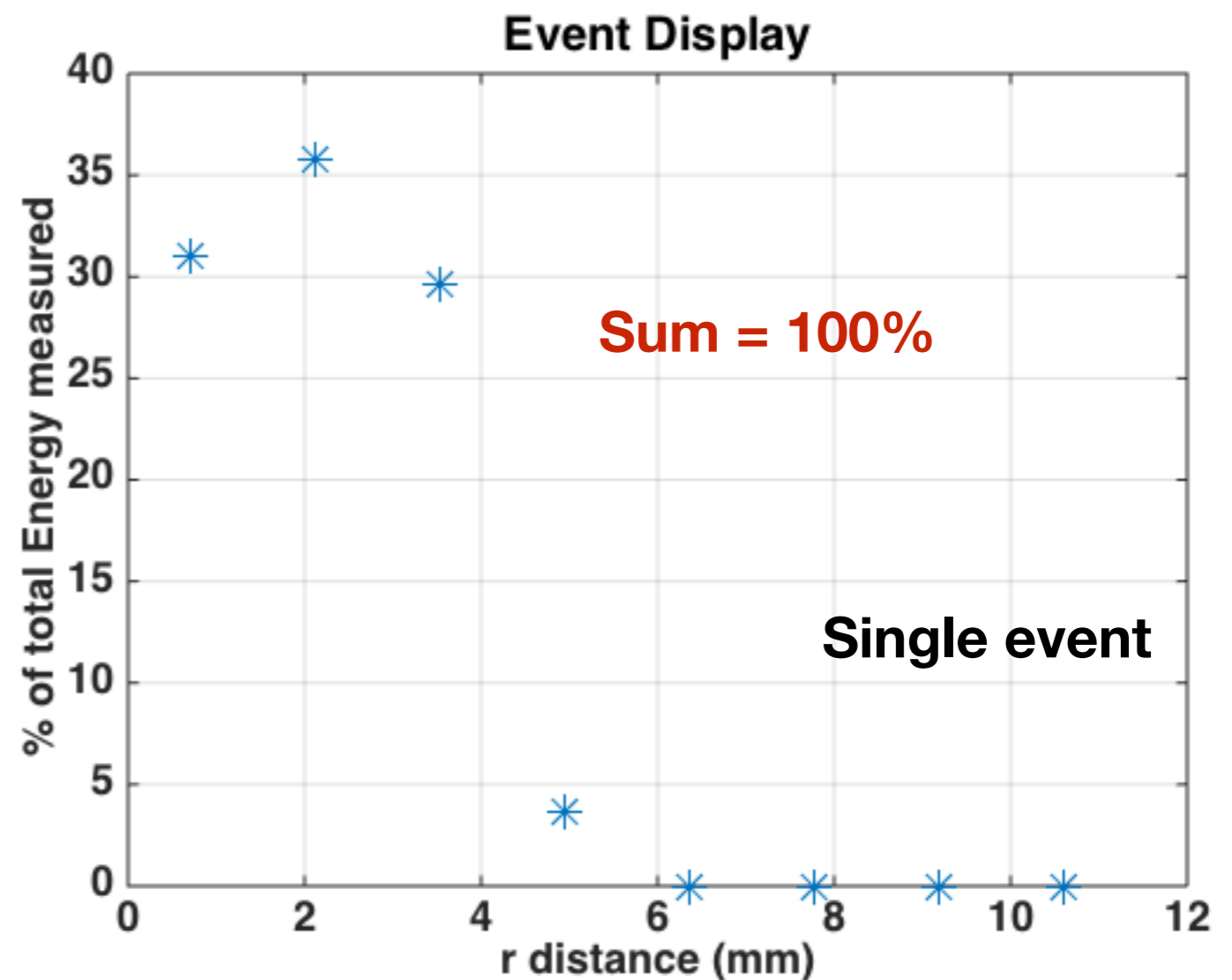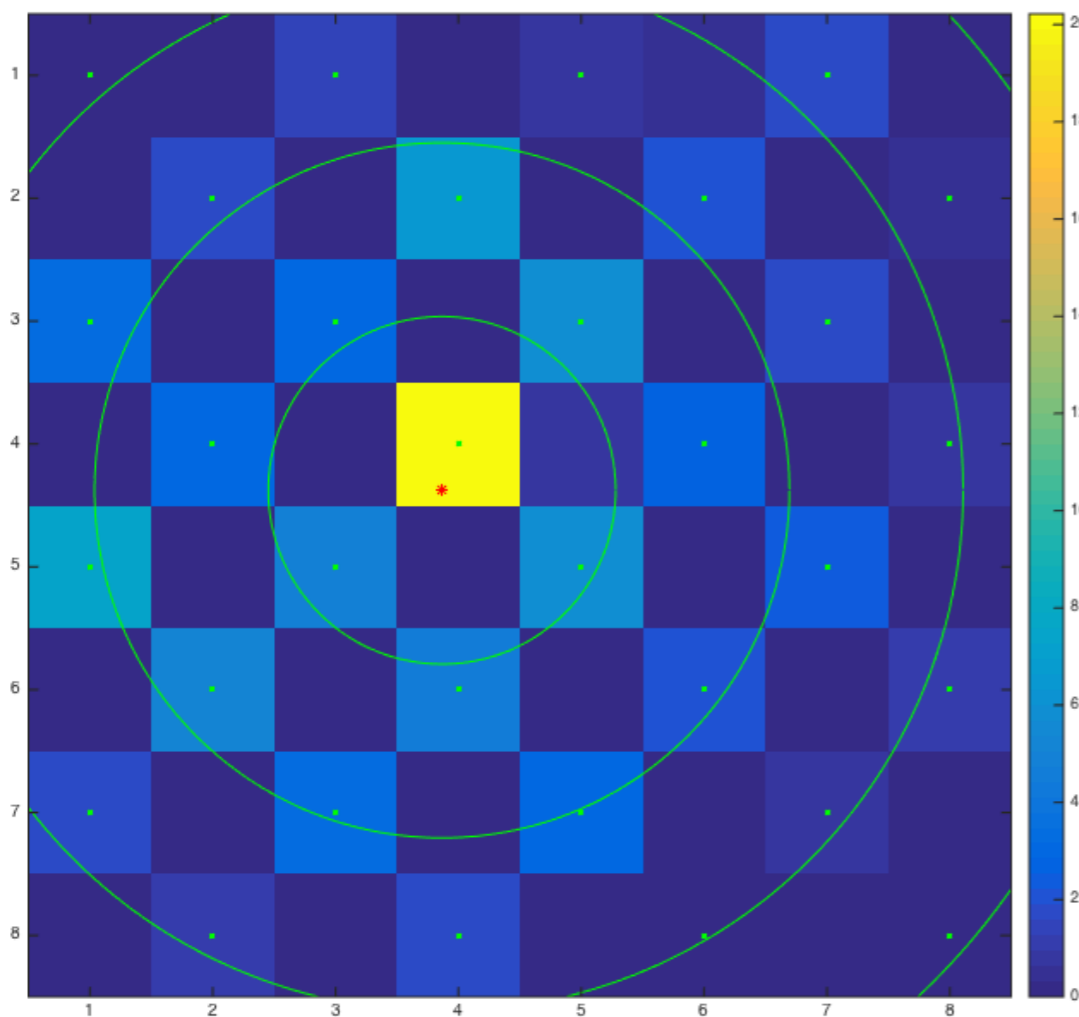- ‣ Using **0.6 mm** pitch

First approximation

‣ We sum the contribution of all SiPMs that have the center sitting inside each circumference

‣ This is just a first approximation. To better estimate the profile, only the ratio of the area of the SiPMs inside the circumference has to be considered
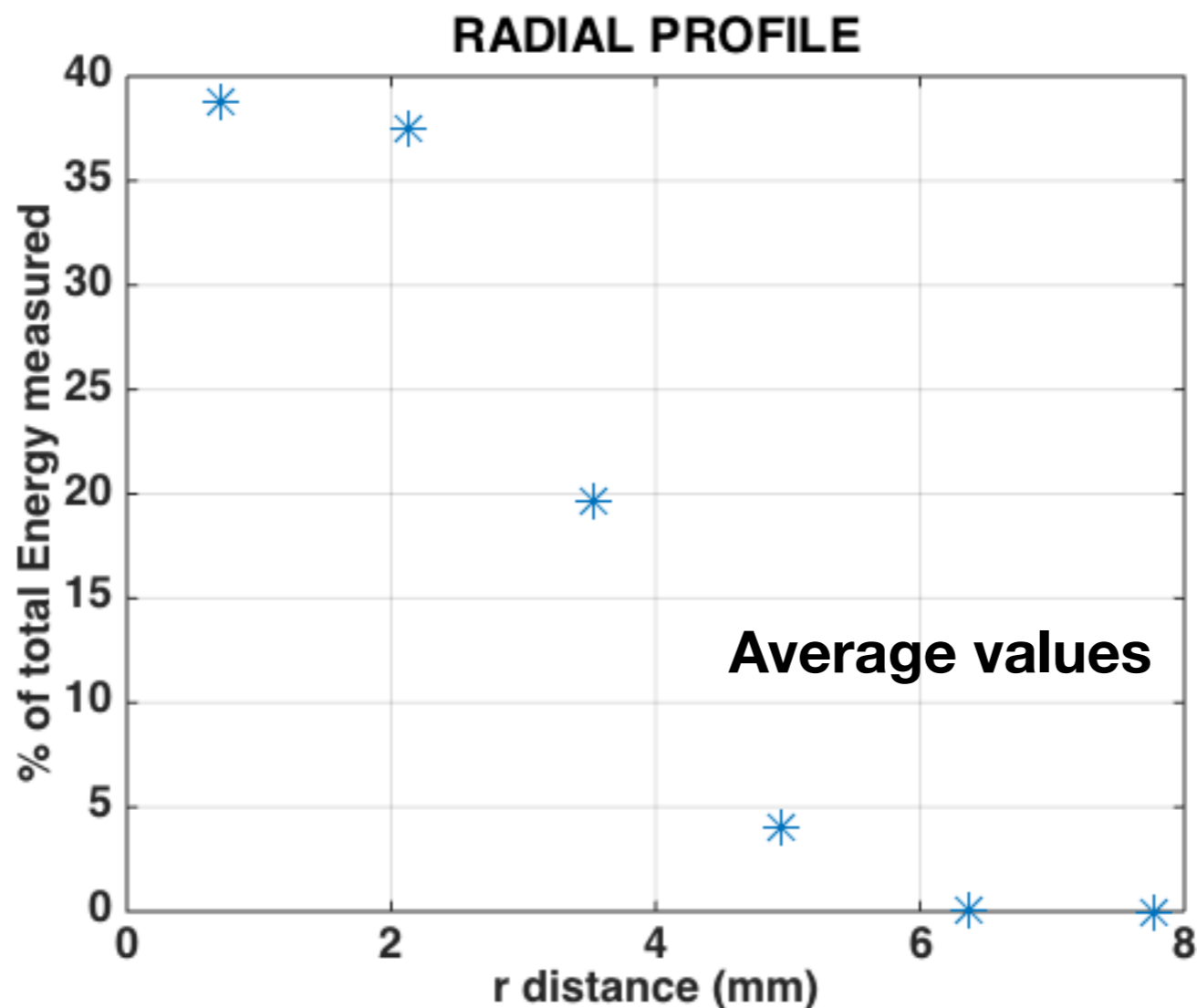

Sum = 100%

Single event

First approximation

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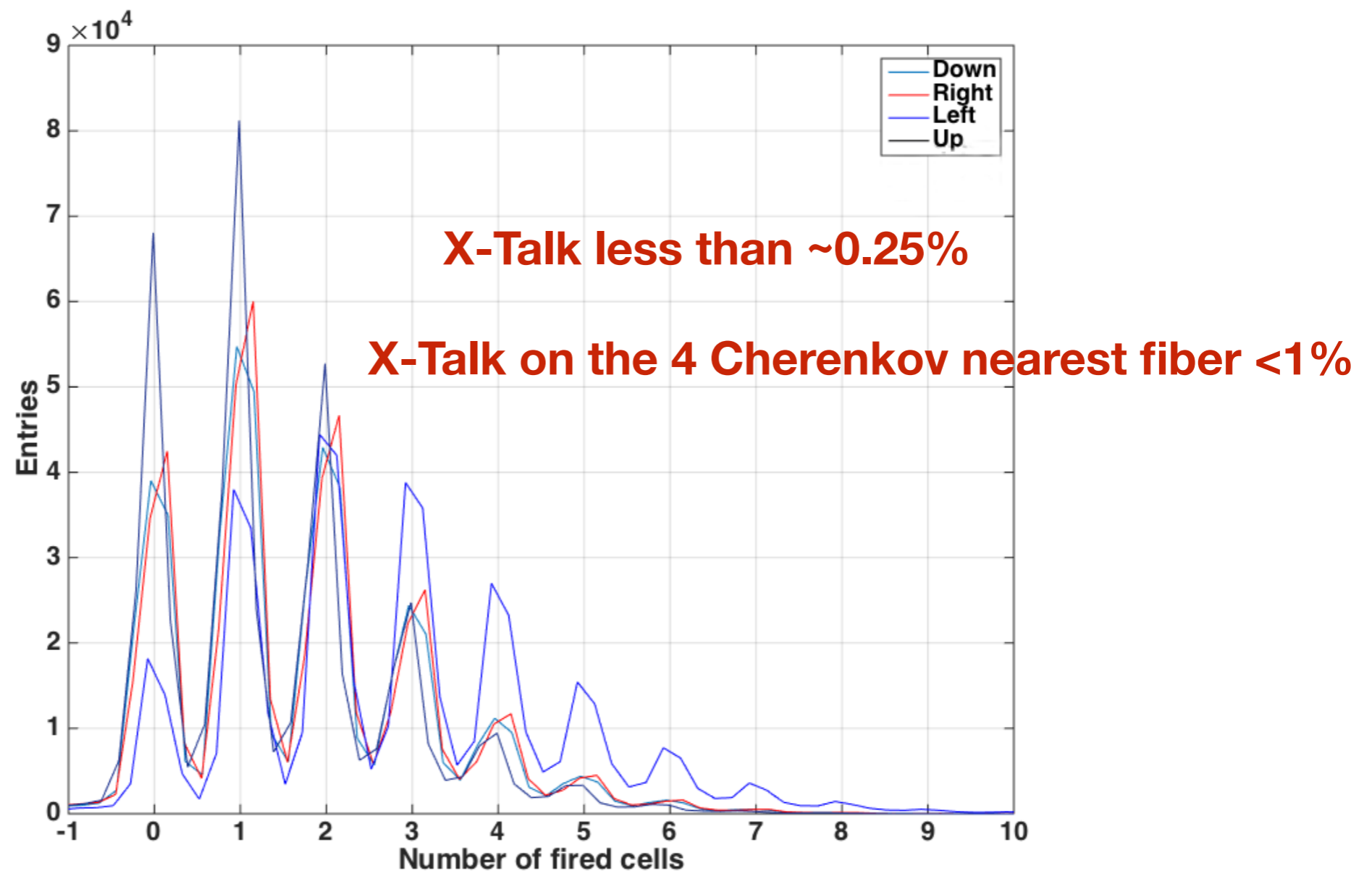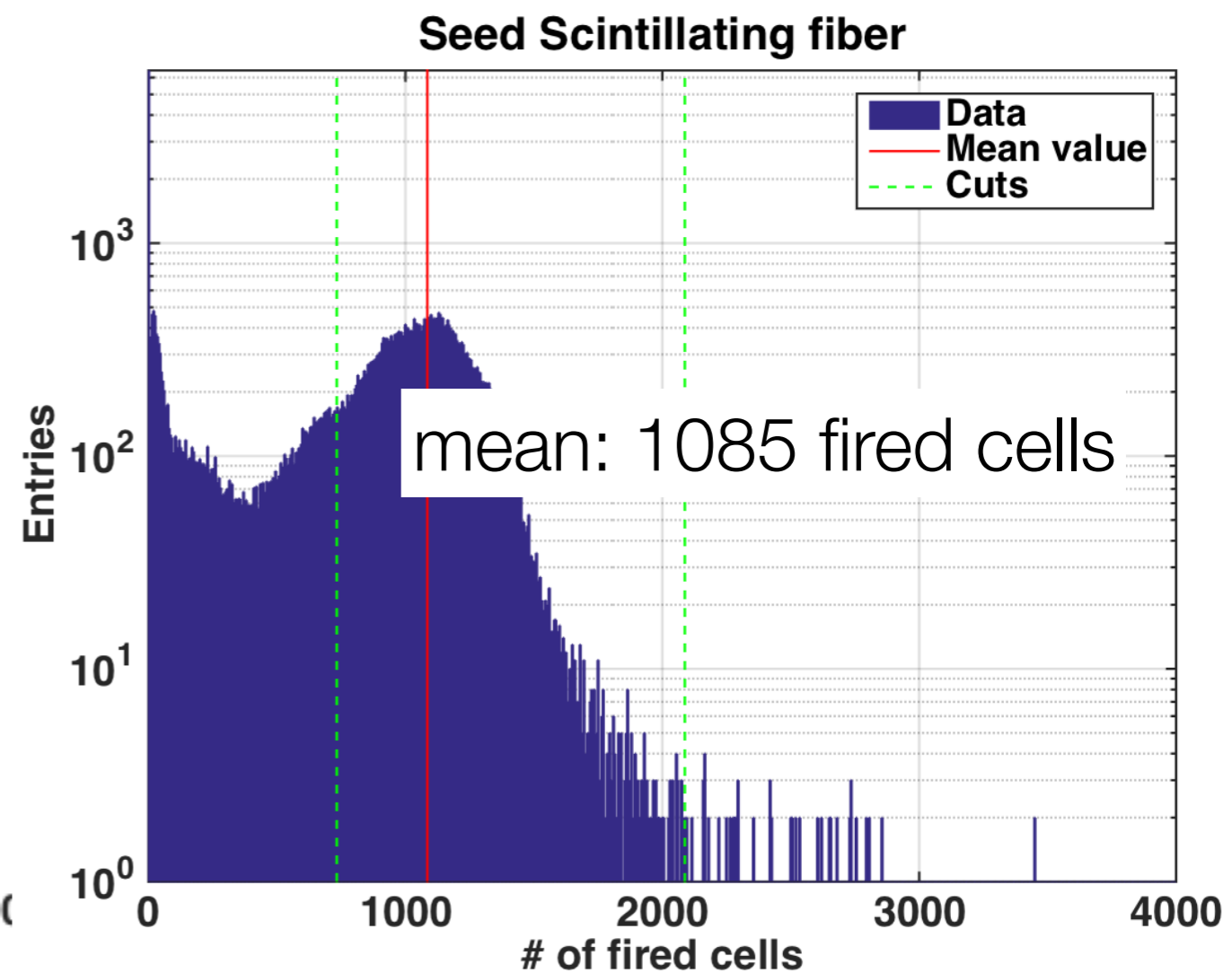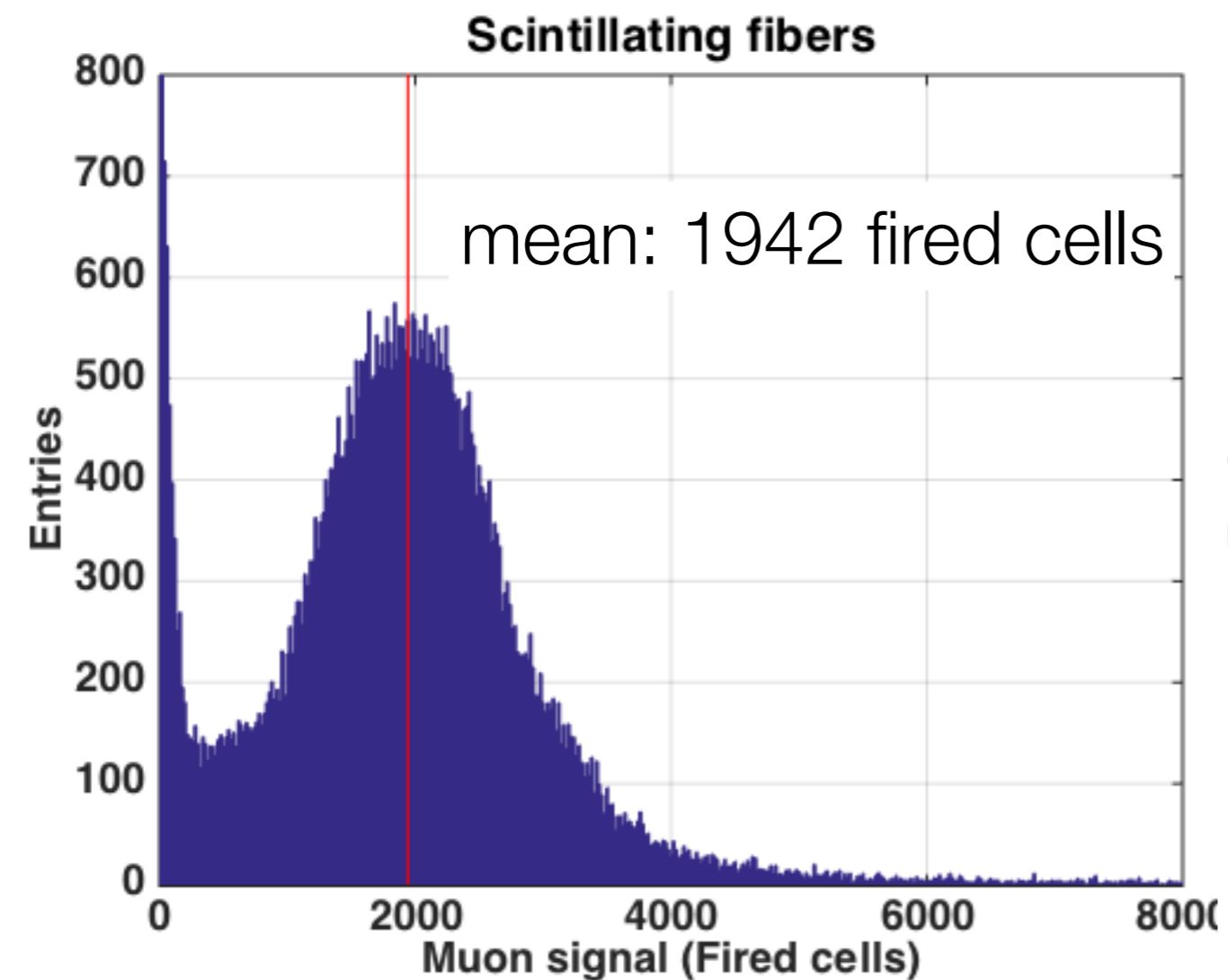

Average values

X-TALK

X-Talk Measured

- ▸ Only one scintillating fiber illuminated
- ▸ Light produced (mean value) ~ **1089 fired cells** on scintillating fiber
- ▸ Maximum light produced in the near cherenkov fibers (mean value) ~ **2.8 fired cells**
- ▸ Signal in the near cherenkov fibers with no light (mean value) **< 1.0 fired cells**

Up: 1.41 ± 0.03
Down: 1.67 ± 0.03
Left: 2.78 ± 0.04
Right: 1.70 ± 0.03

X-Talk less than ~0.25%

X-Talk on the 4 Cherenkov nearest fiber <1%

X-Talk - Scintillating fibers

▸ **125 GeV muons** (12351-12352): select muons with 1 MIP deposited in PSD
▸ The noise leftover is ~14 Fired cells
▸ The average value for the seed is **1085.33 Fired cells** —> we should **correct for non linearity**
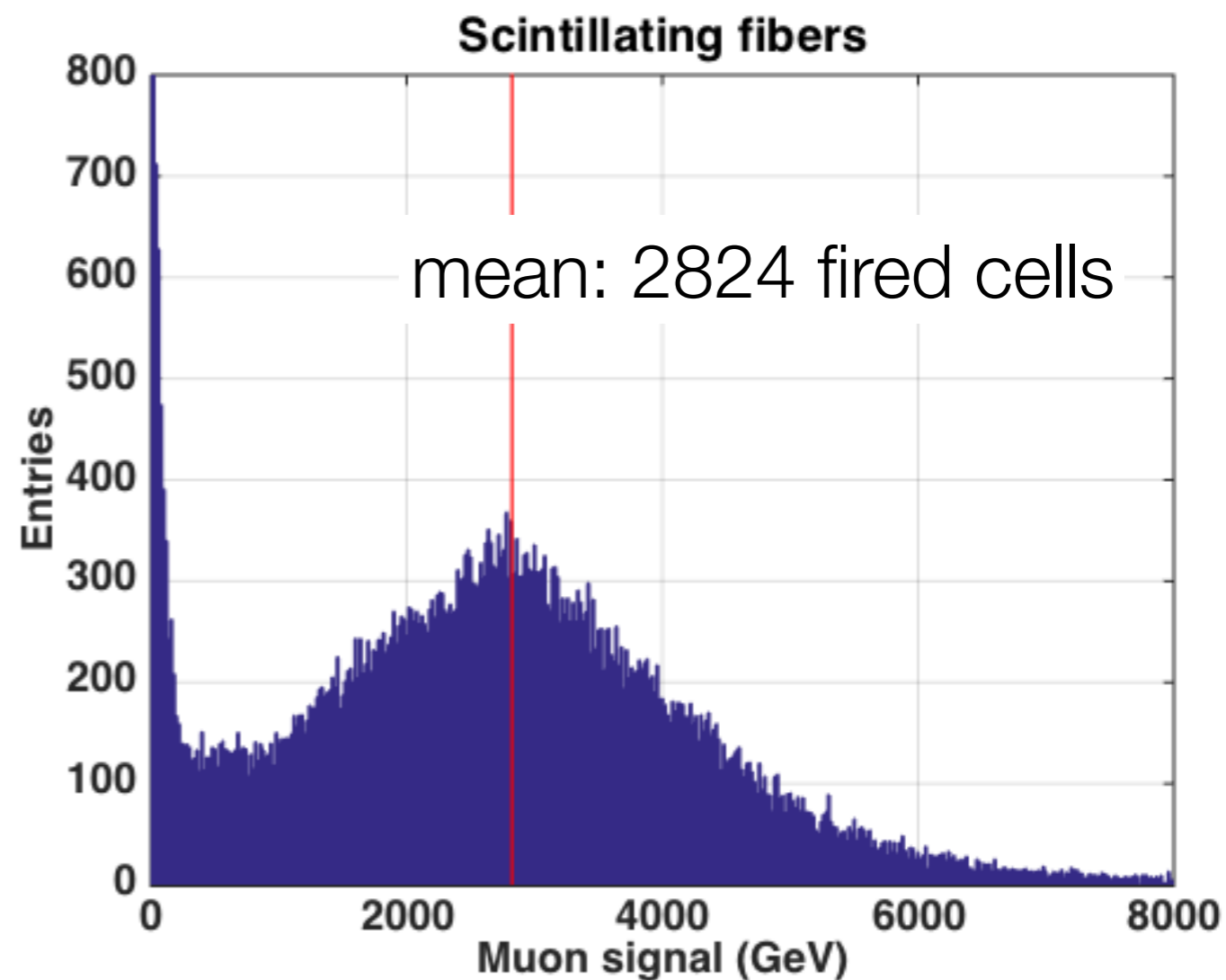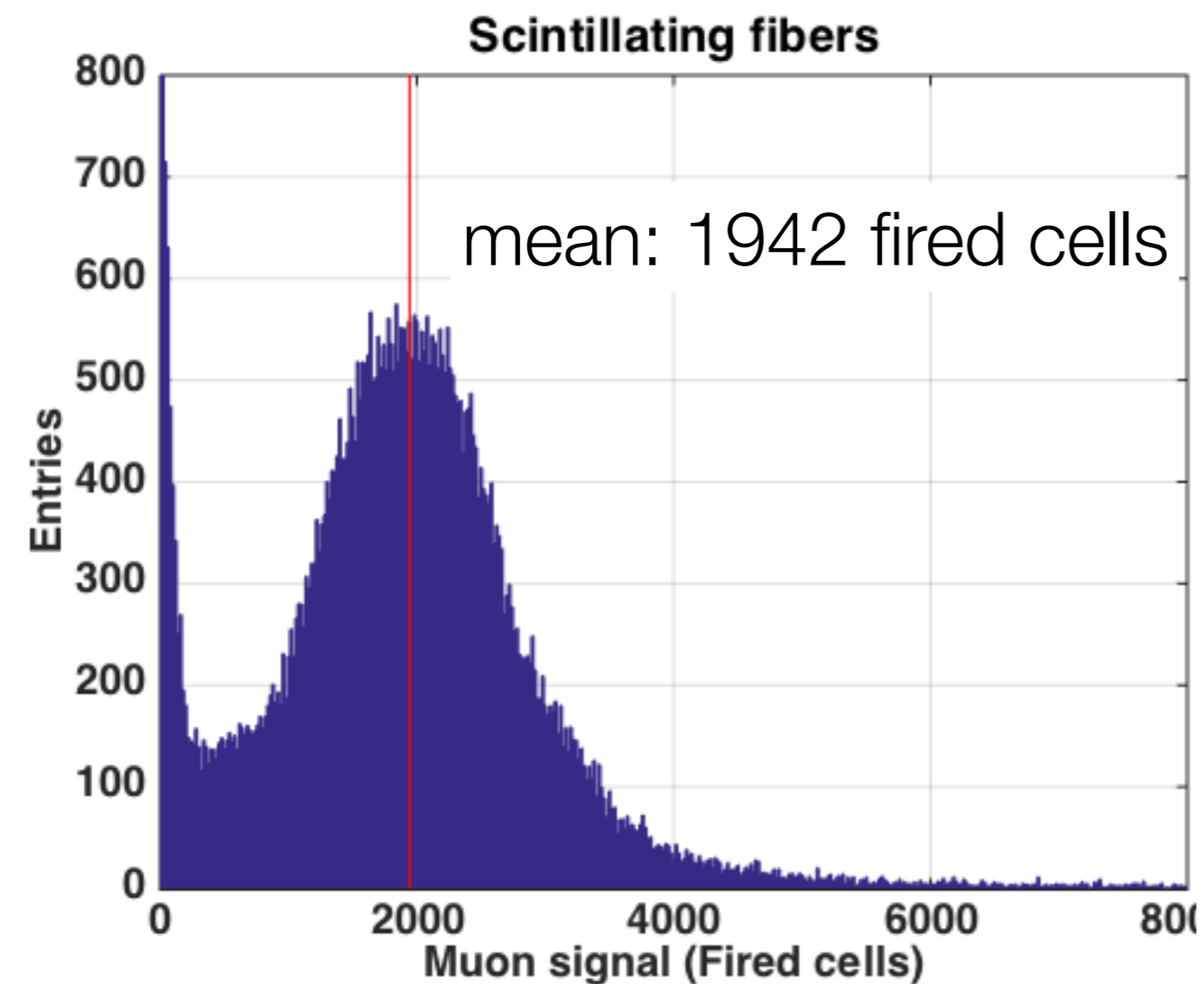
X-Talk - Scintillating fibers

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mean: 1942 fired cells

mean: 2824 fired cells

X-Talk - Scintillating fibers

Extrapolate Energy Values:

▸ Considering the number of fired cells/GeV ~**166.2 ± 5.6 fired cells** (number taken from the **10 GeV e⁻ with Ultra Low PDE)**

▸ Extrapolating at **Intermediate PDE** (considering the different PDE):

$$166*0.2218/0.01733 = \textbf{2129.5 ± 94.5 fired cells/GeV}$$

▸ We get that the released energy is 2823.6/2129.5 = **1.33 ± 0.06 GeV**

mean: 1321 fired cells
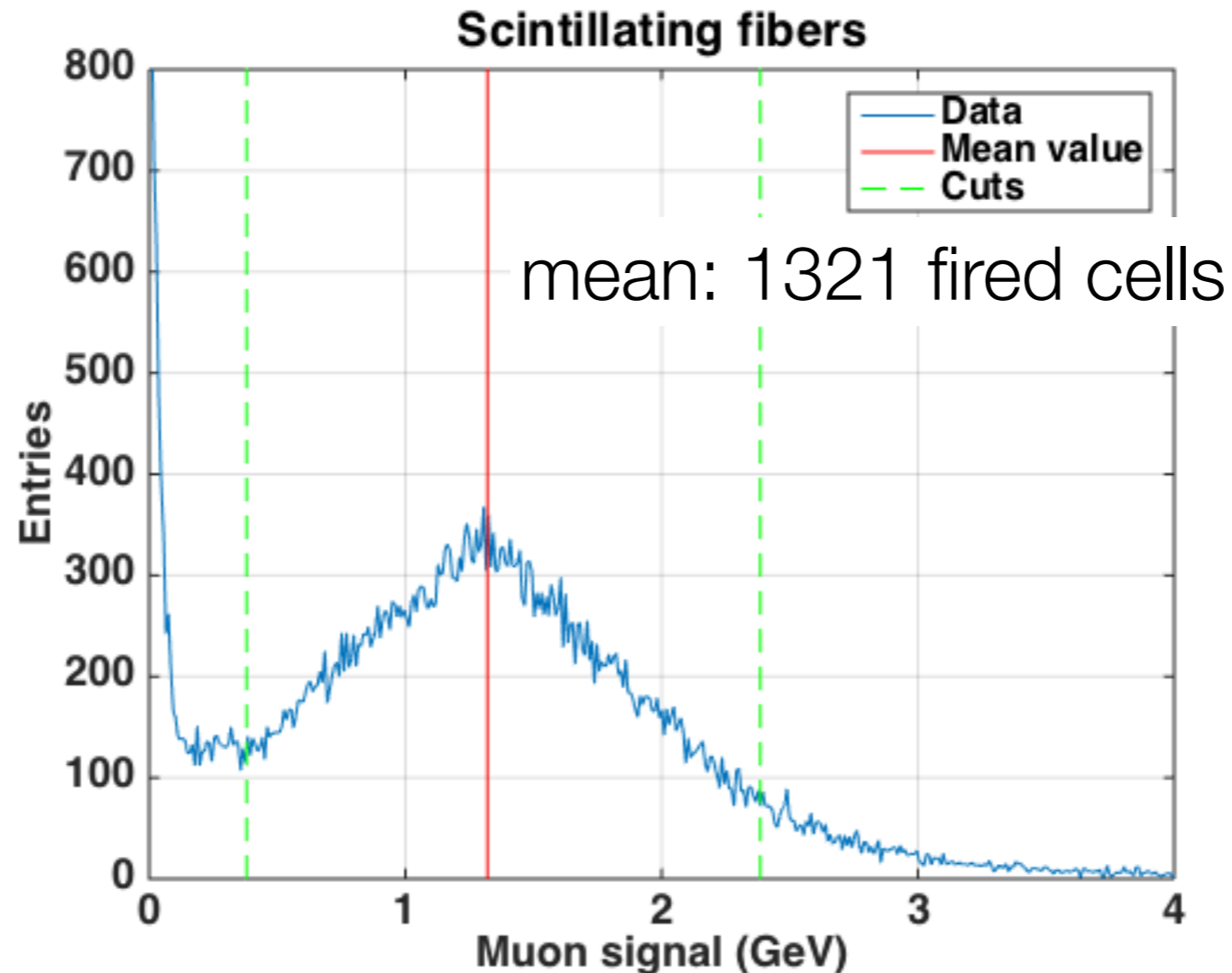
X-Talk - Cherenkov fibers

▸ Here the spectrum is quite more complicated
▸ **2 peaks** + noise leftover (15 Fired cells)
▸ No Correction for linearity is required
▸ Considering **28.4 fired cells/GeV**
▸ We should expect the 0.6 GeV peak at ~ **17 fired cells** **which is quite close to the noise leftover**
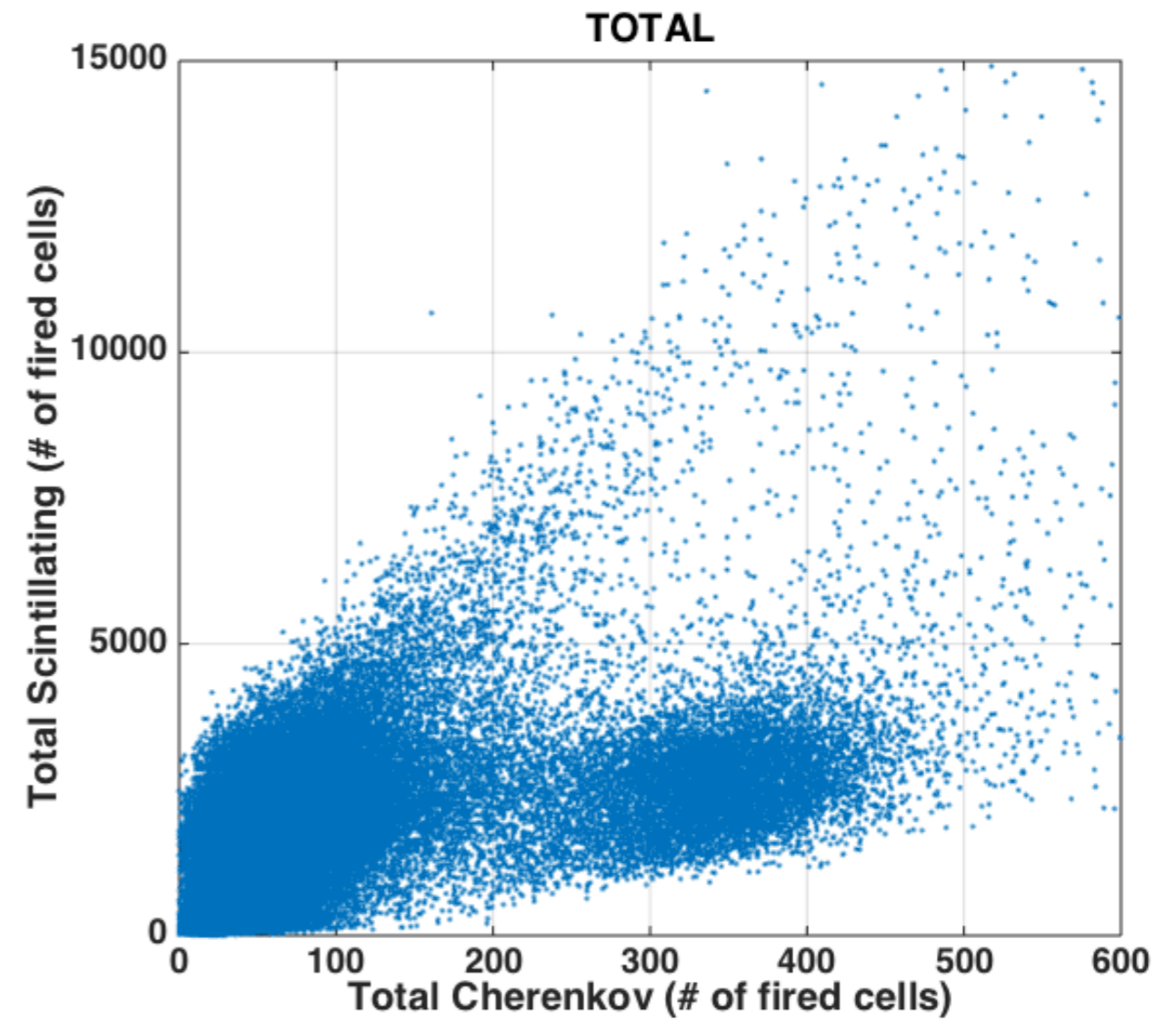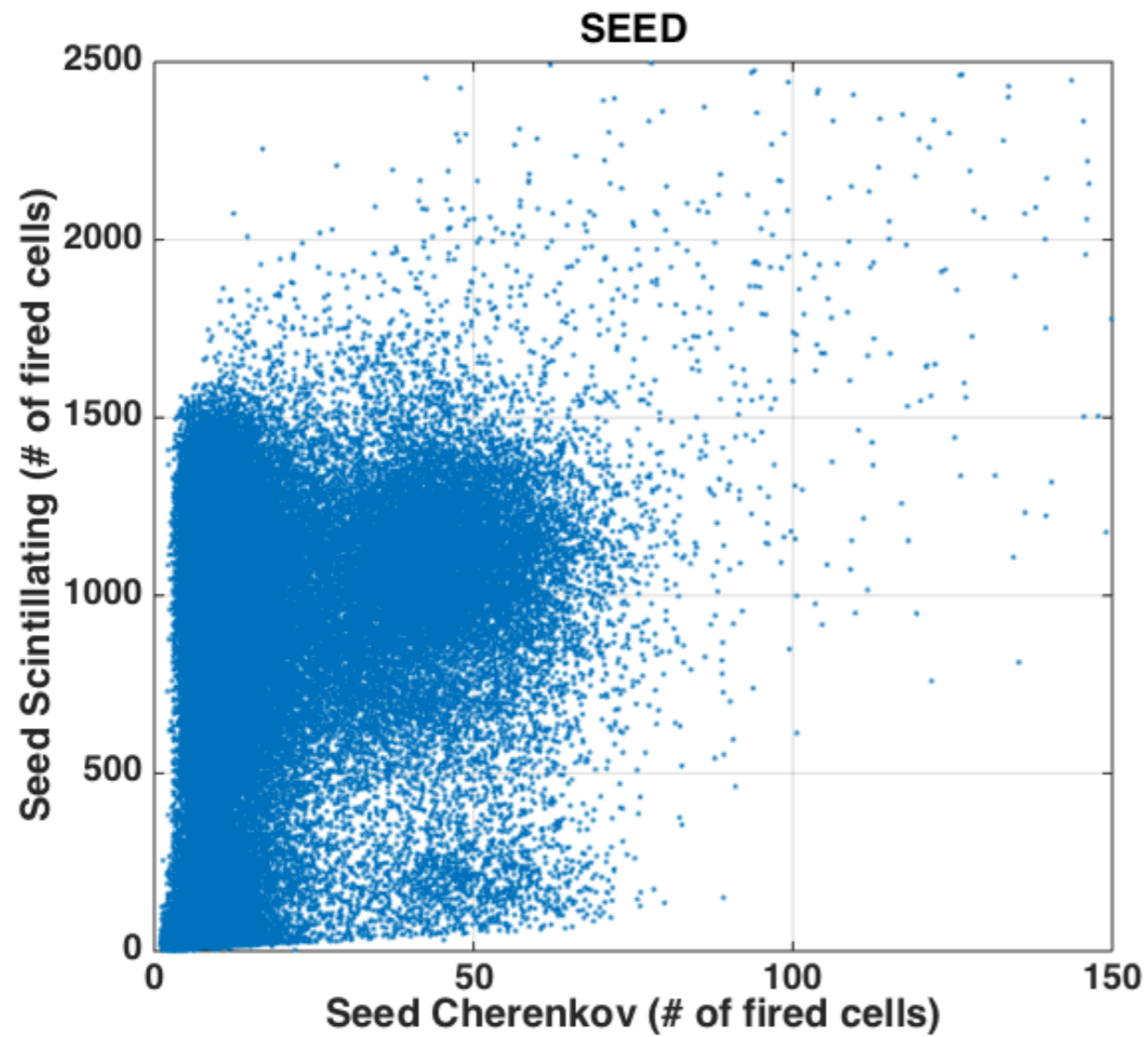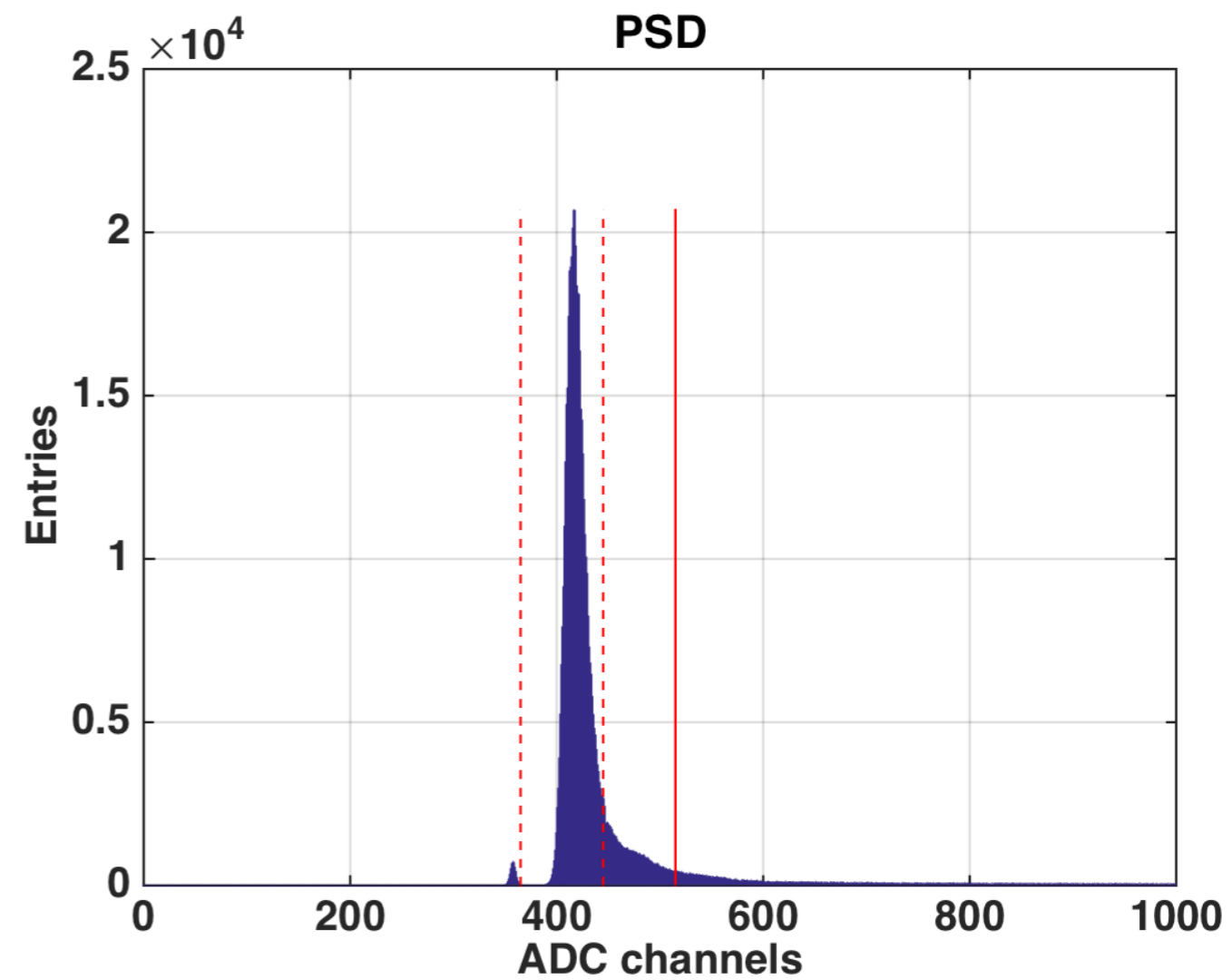▸ In addition what can we say about the other peaks?
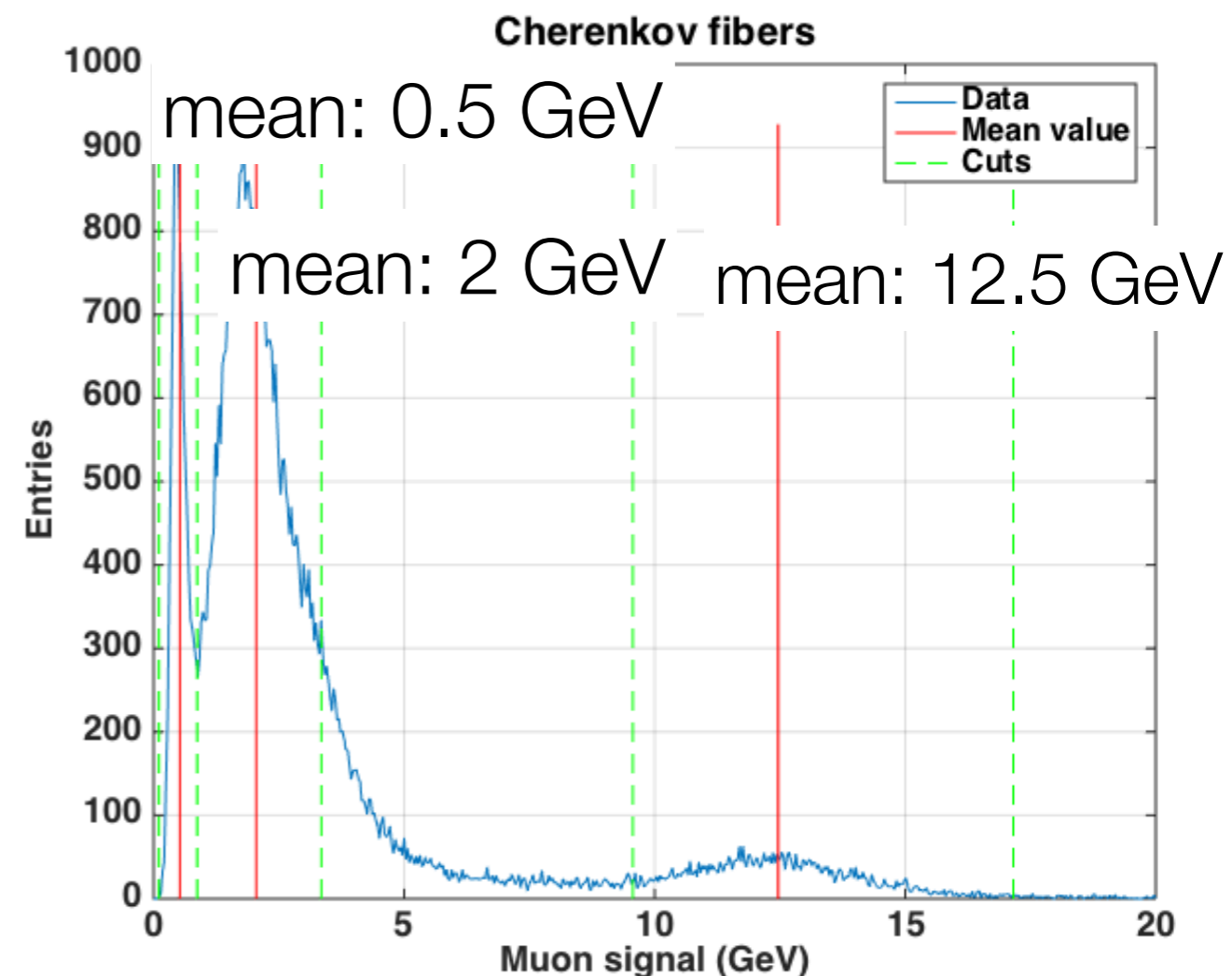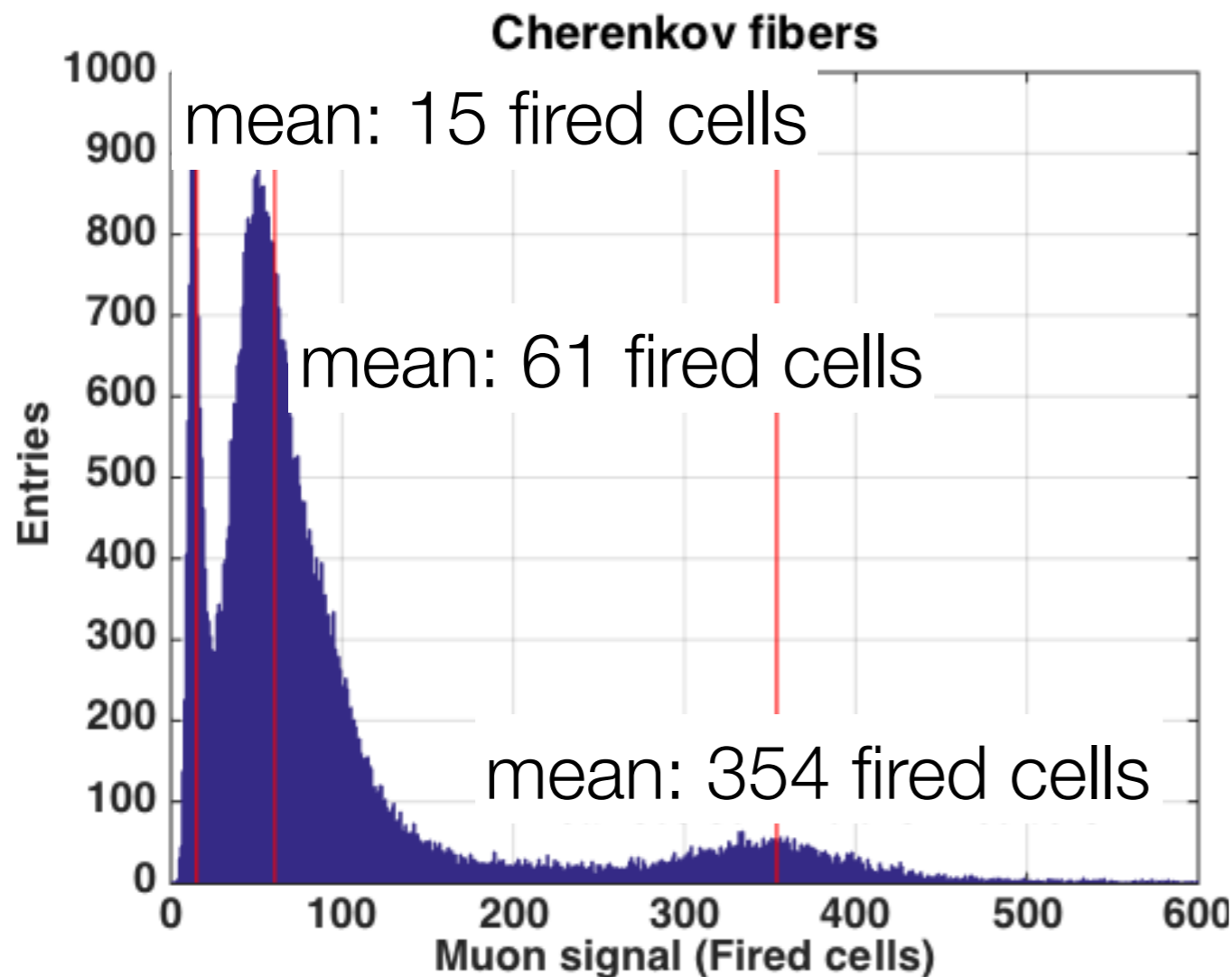
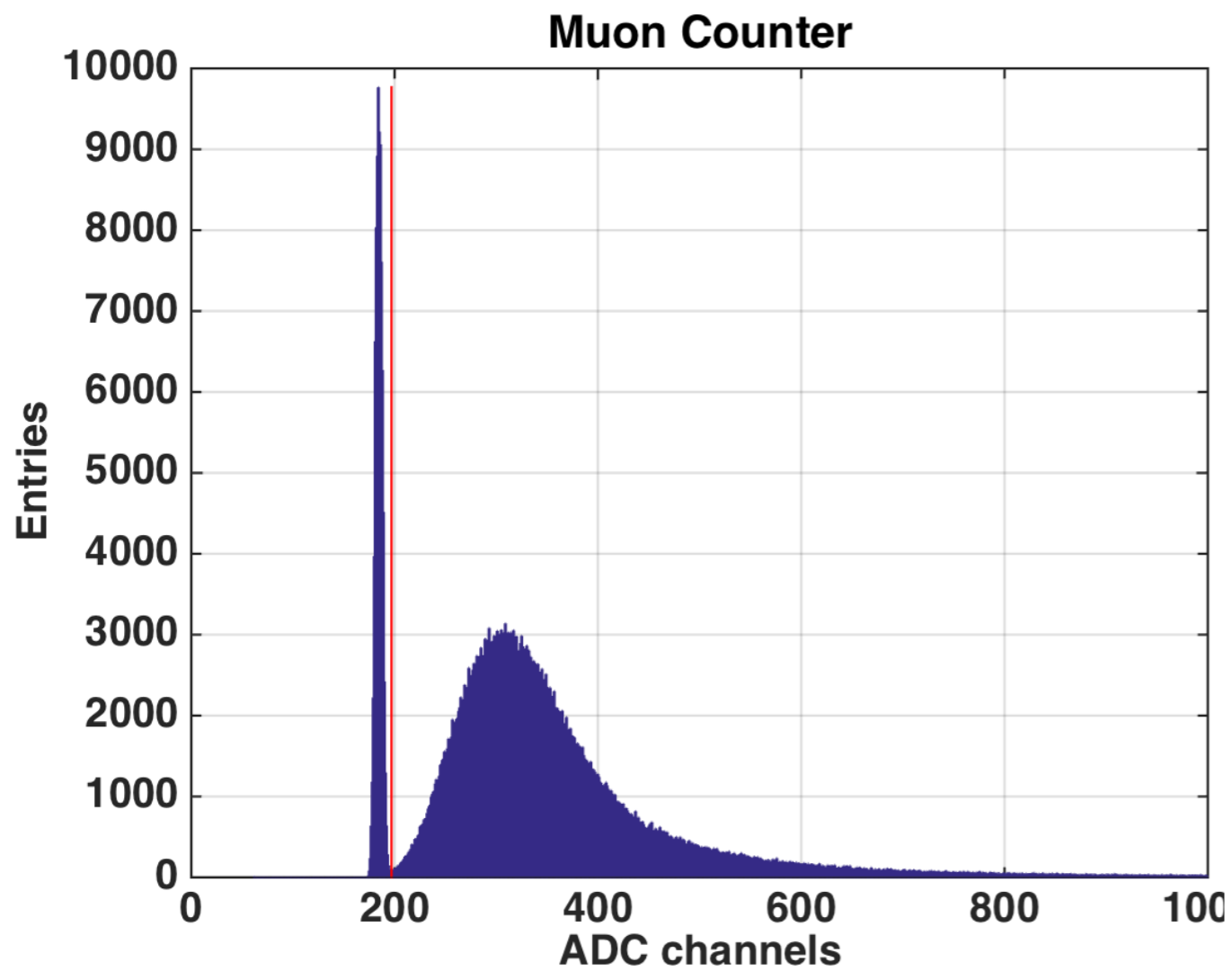# BACKUP

X-Talk - Cherenkov fibers

X-Talk

▸ 125 GeV muons cut (12351-12352): select muons with 1 MIP deposited in PSD

Error propagation

▸ For each event we sum all the 32 scintillating signals and we convert the ADC number into a number of fired cells:

$$N_{evt} = \sum N_{i(fired\_cells)} = \frac{\sum ADC_i}{\Delta_{pp}}$$

▸ Where:

$$\Delta_{pp} \pm \sigma_{\Delta_{pp}} = 1.427 \pm 0.048$$

▸ is the value extrapolated for the Ultra Low PDE settings

▸ The most important source of error in the final result is due to that conversion:

$$\sigma_{N_{evt}} = \sqrt{\left(\frac{\sum(ADC_i)^2}{\Delta^4_{pp}}\right) * \sigma^2_{\Delta_{pp}}}$$

▸ The error from FIT is also considered in the calculation

▸ The error for the values corrected for the linearity is:

$$\sigma_{Ncorrected} = \sqrt{\left(\frac{-1584}{\Delta_{pp} - 1584}\right)^2 * \sigma^2_{N_{evt}}}$$

▸ For each event extracted 32 r_i and the deposited $\%E_i$ was calculated

▸ Chess board geometry problems: we have 2 different centers of gravity: one for Scintillating fibers and one for Cherenkov one, but not the REAL center of the shower

▸ Only few events has their center corresponding to the center of one SiPM and relies the most of their energy in it
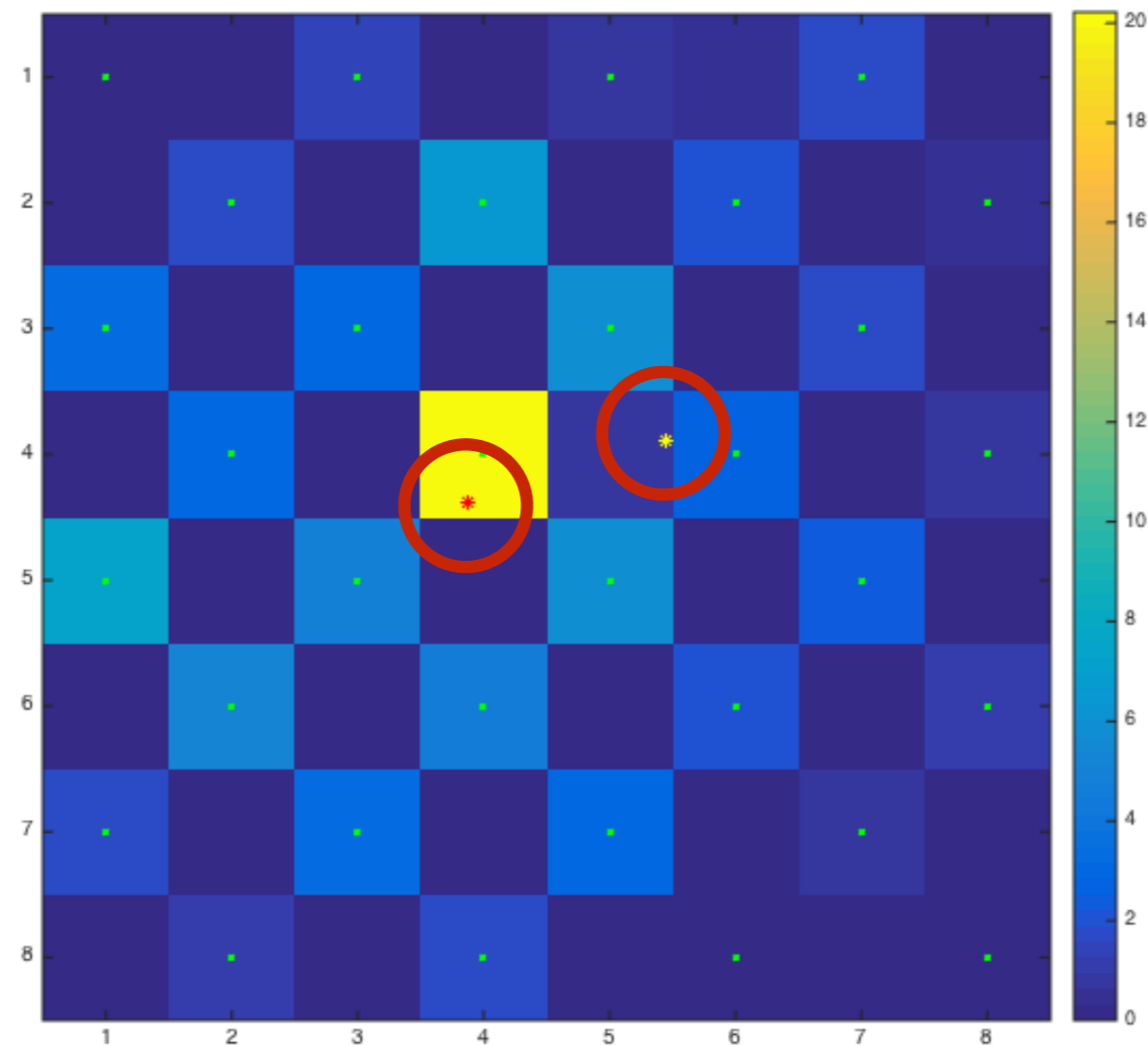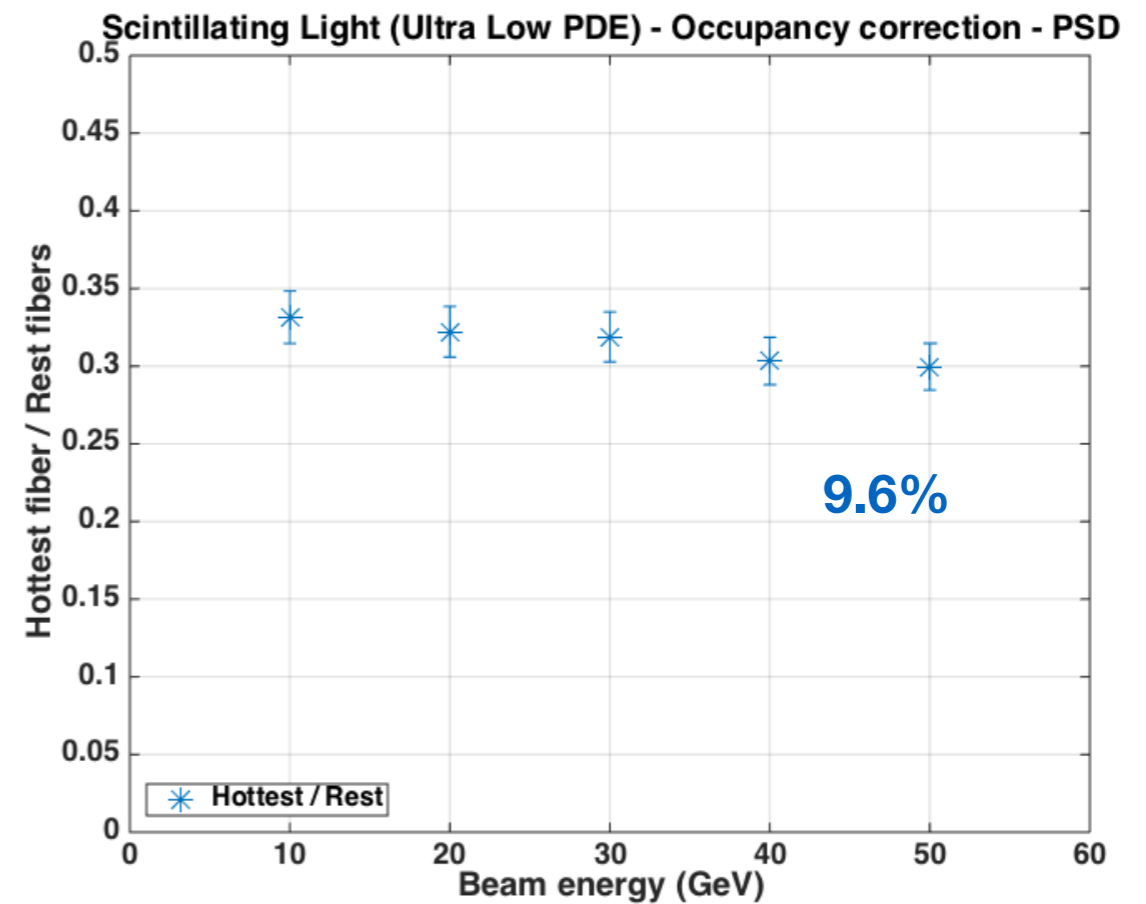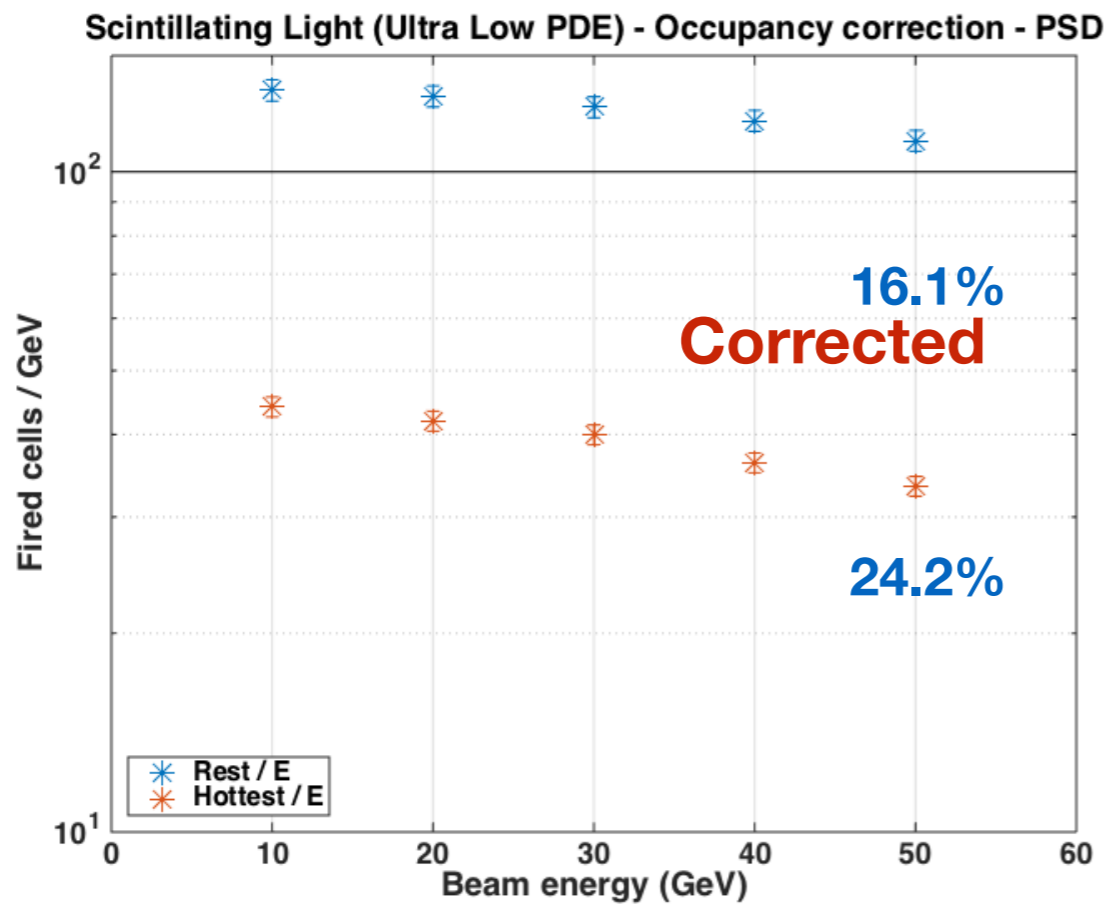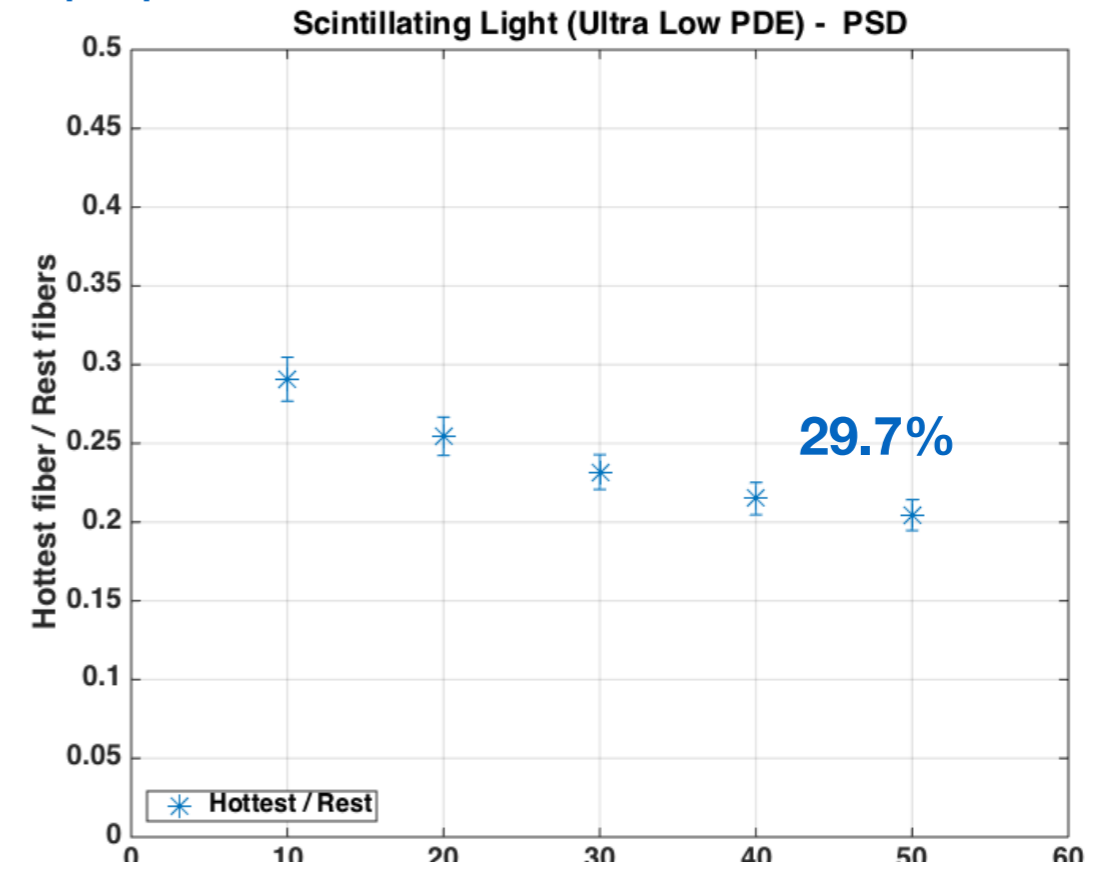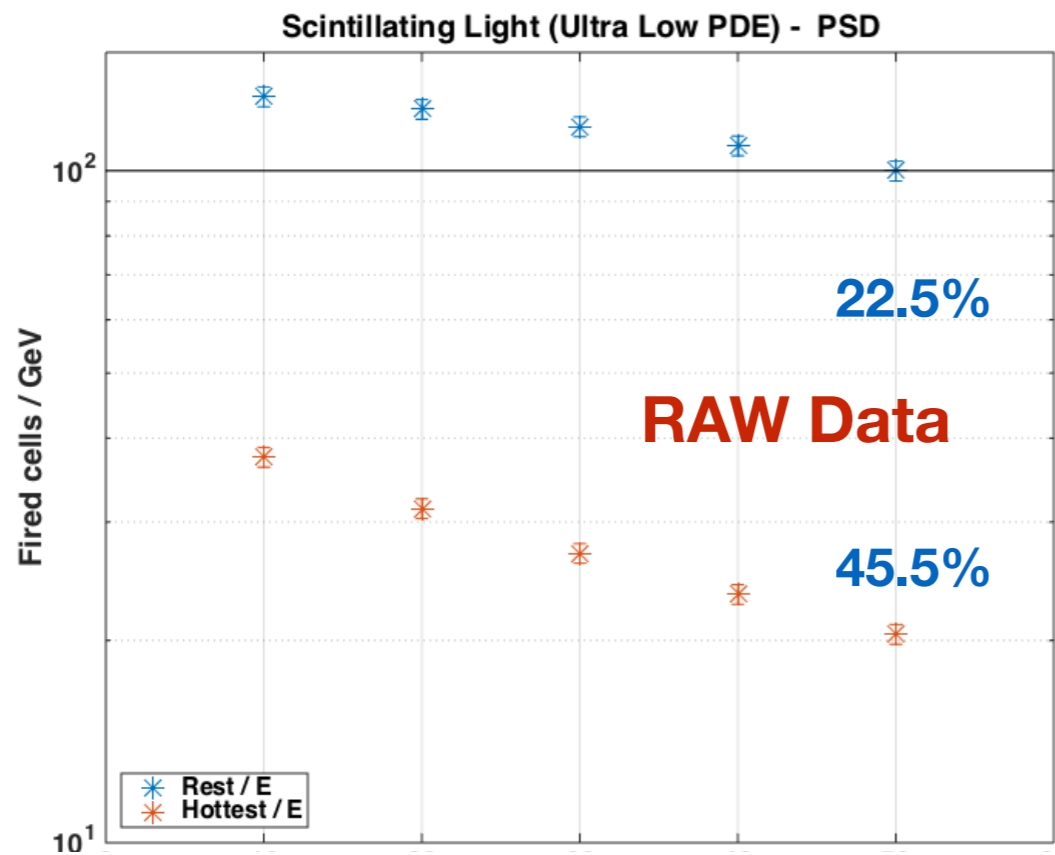
Fig: 11

▸ Correction applied:

$$N_{photons} * PDE = -1584 * \ln\left(1 - \frac{N_{firedcells}}{1584}\right)$$

▸ If the beam energy increase —> the difference between linearity and correction also increase

▸ There is something else to be understand and considered