Cross talk & light yield issues

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The Como lab measurements

Light injected in a scintillating fiber, all other fibers masked.
Result:
1000 p.e. signal in S fiber produces < 3 p.e. in C neighbors
Conclusion: Crosstalk < 0.3%

However:
Showers produce 30 times more S light than C light in module
Therefore, this result means that C signals contain at maximum 10% S light.

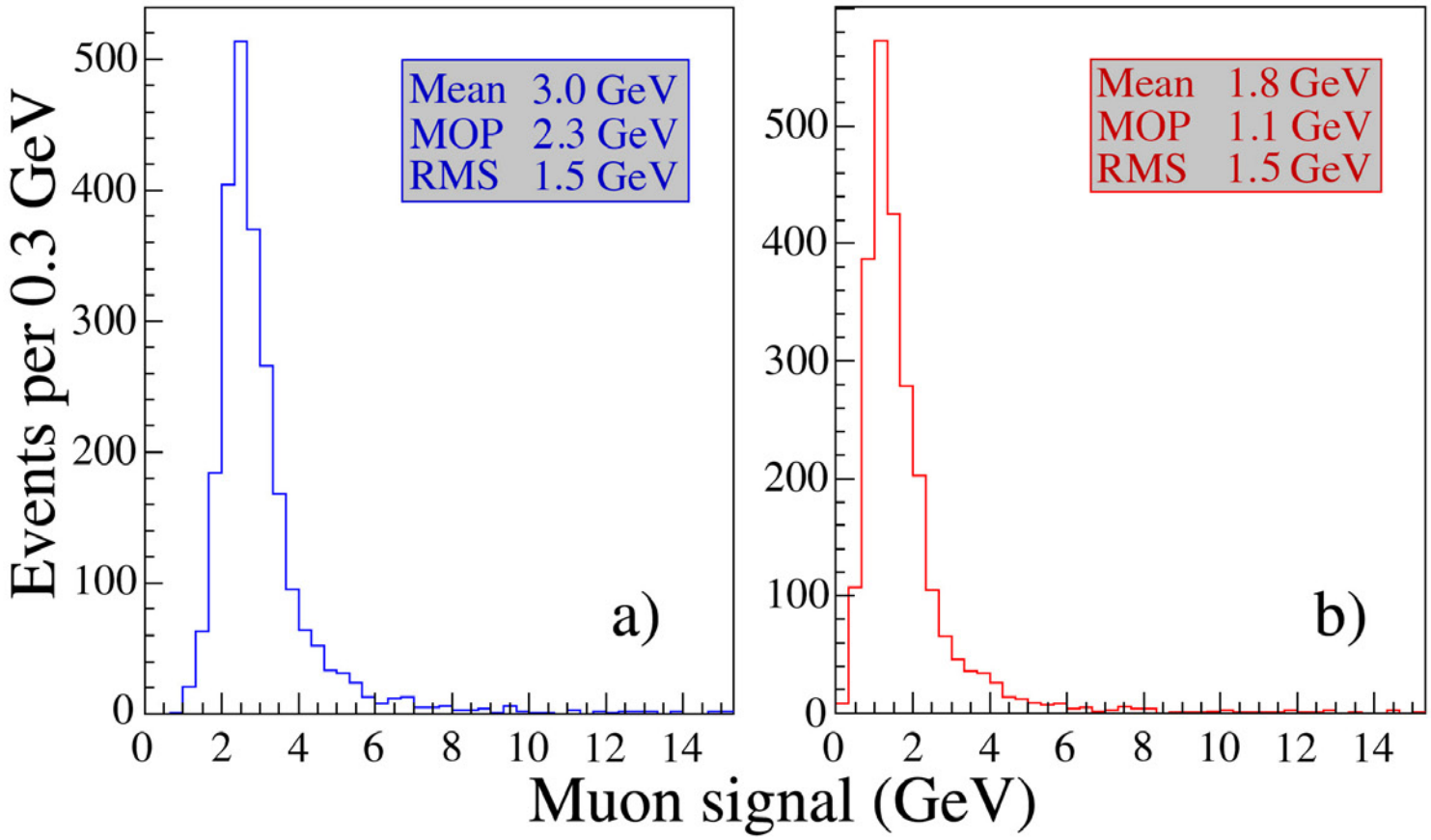
Also, lab result obtained for only one fiber. How representative?

It would therefore be good to have an independent alternative measurement. Use muon signals for this purpose

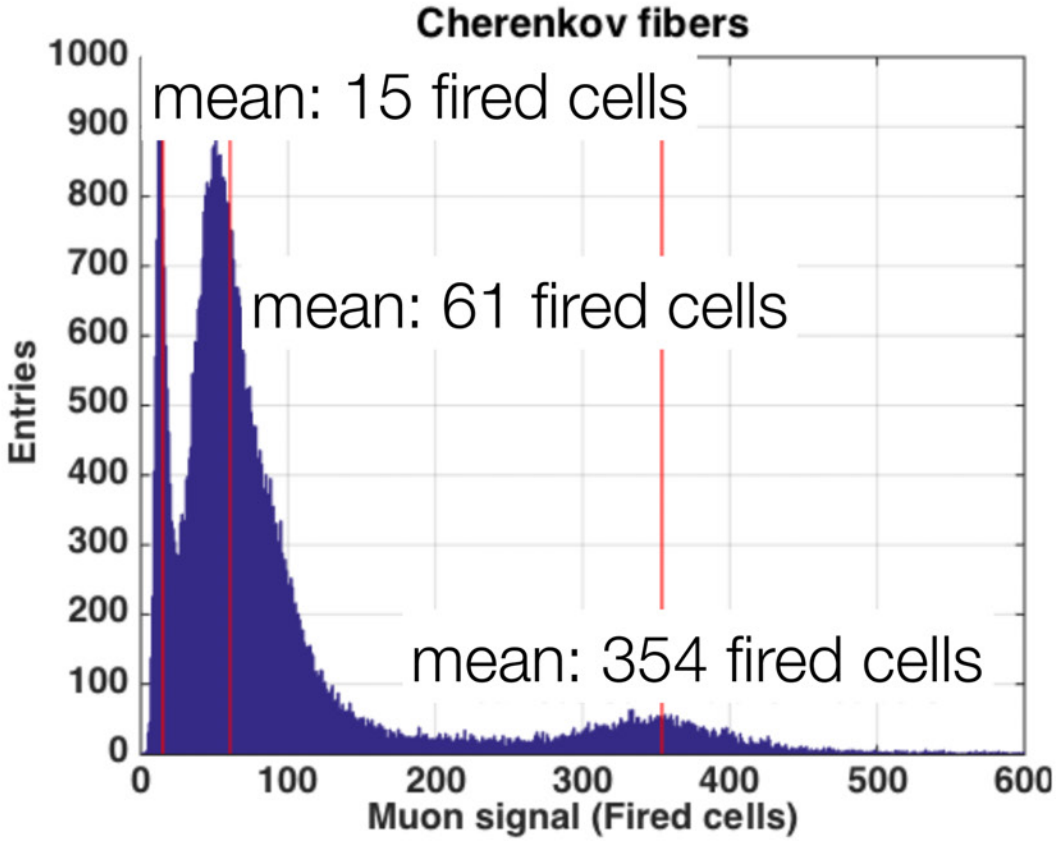
Why muons?

When the energy scale for S and C signals is set with electrons
muons give different energy deposites in the S and C channels
(S ~ 2C, see measurements with DREAM/PMTs)

If crosstalk between S and C signals in SiPM module,
then difference between S and C response to muons becomes smaller



The SiPM Cherenkov signal for 125 GeV muons



15 cts = pedestal, 61 cts = μ signal, 354 = instrumental effect, ignore

Average μ signal = 61 - 15 = 46 ADC counts

Electron data: 1 GeV = 65 ADC cts (after containment correction, 28.4/0.44 = 65)

μ signal corresponds thus to 46/65 = 0.7 GeV energy deposit

mop value ~ 0.6 GeV

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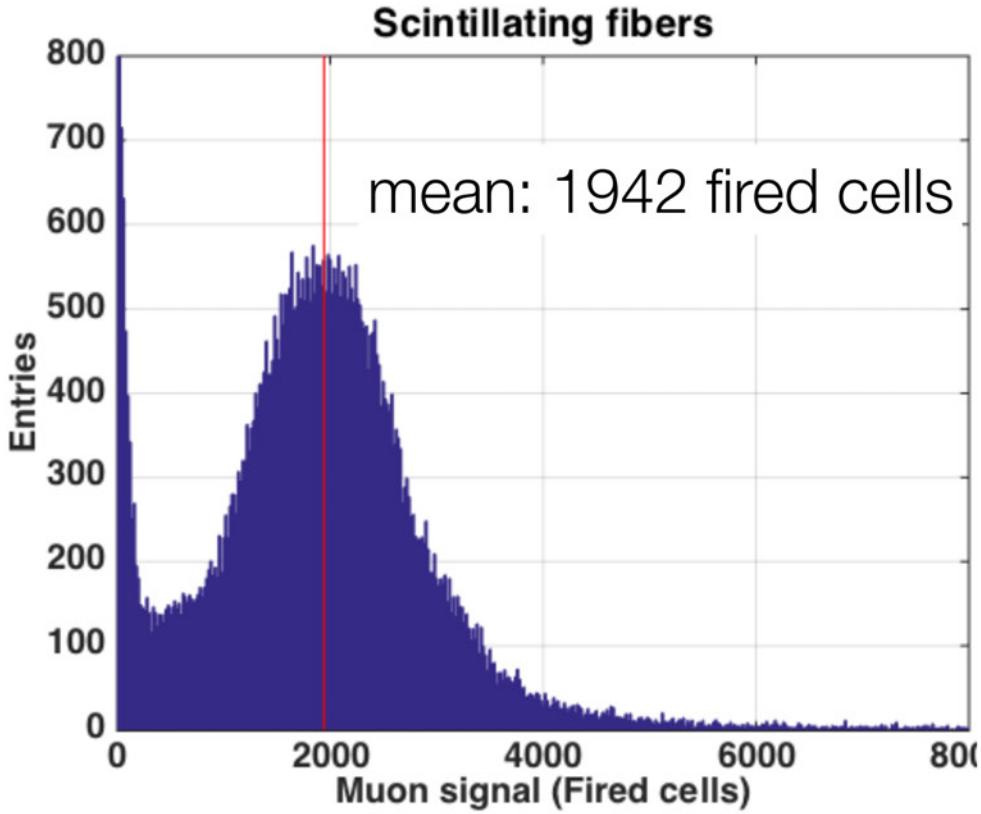
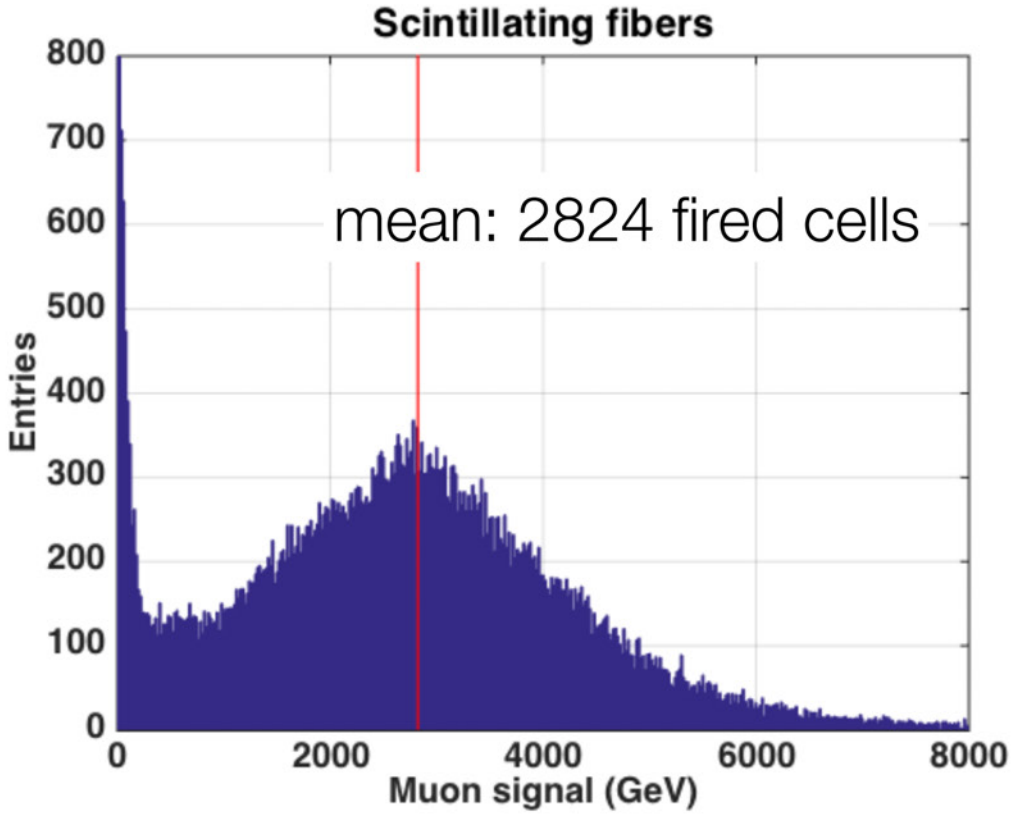
- **125 GeV muons** (12351-12352): select muons with 1 MIP deposited in PSD
- The noise leftover is ~14 Fired cells
- The average value for the seed is **1085.33 Fired cells** —> we should **correct for non linearity**





Question: Non-linearity should only affect the seed (some of ALL other fibers = 857)

Does non-linearity really increase seed signal from 1085 to 1967 (80% increase)?

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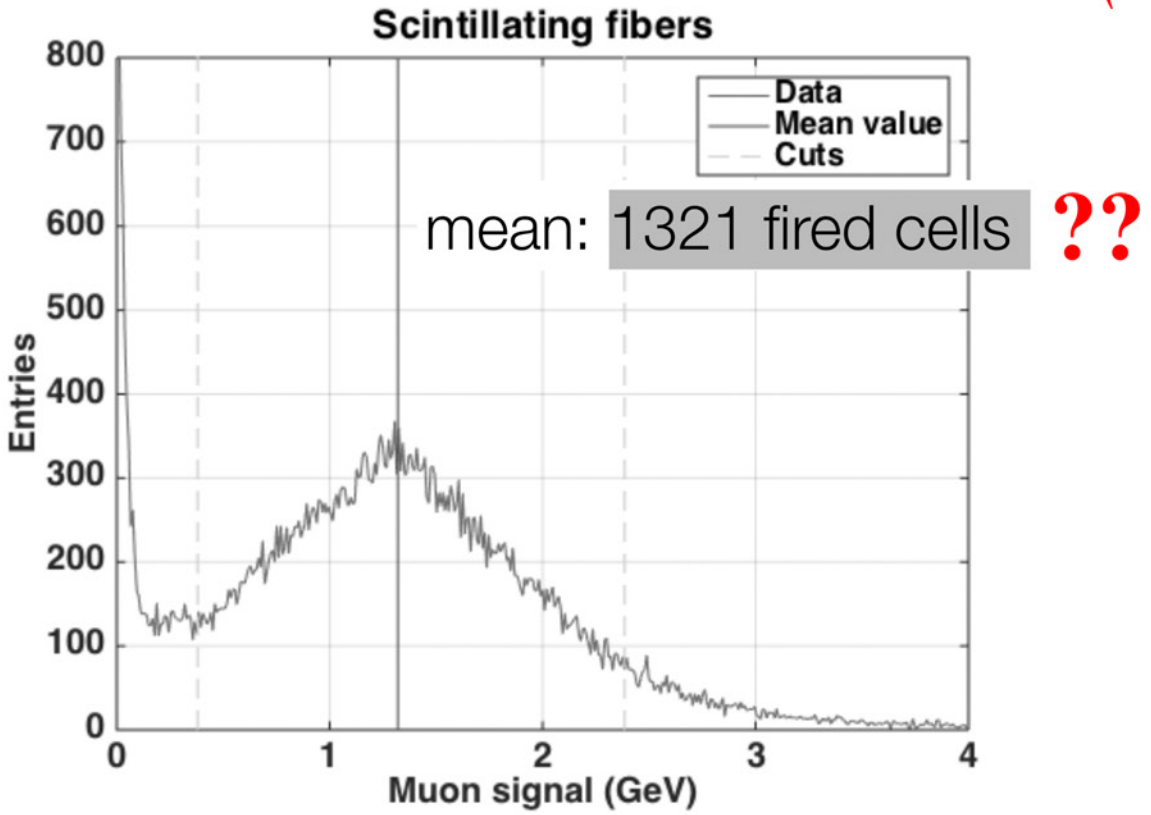
Extrapolate Energy Values:

- 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 = **2129.5 ± 94.5 fired cells/GeV**

- We get that the released energy is 2823.6/2129.5 = **1.33 ± 0.06 GeV** *(mop)*



Need to address PDE issues in paper!

S light yield: current text of draft paper

When the same bias voltage was used as for the Čerenkov signals, the saturation effects and the resulting signal non-linearities were even much stronger. At an electron beam energy of 10 GeV, the average number of photoelectrons measured in the hottest fiber was 1,560, close to the theoretical maximum of 1,600. The sum of the scintillation signals in the other 31 fibers increased from 1,190 to 8,790. According to the mentioned Monte Carlo simulations, the total energy deposit in these 31 fibers amounted to 3.3 GeV. Assuming that saturation effects did not play a role, this leads to the conclusion that the scintillation light yield amounted to 2,700 Spe/GeV, or a factor of 35 larger than the Čerenkov light yield.

PDE comparison: 2129.5 Spe/GeV, i.e. >20% less

This discrepancy has to be solved!!!

Summary & Conclusions

DREAM/PMT: mop S = 2.3 GeV mop C = 1.1 GeV

RD52/SiPM: mop S = 1.3 GeV mop C = 0.6 GeV

The DREAM calorimeter was 2 m deep, SiPM module 1 m

This seems to confirm the absence of significant crosstalk

CHECK S LIGHT YIELD CALCULATION

CHECK NON-LINEARITY CORRECTION

Write paragraph on determination different PDE values