Data Analysis Tasks

MuonMonitor Workshop
09.08.2016, LSC, Canfranc

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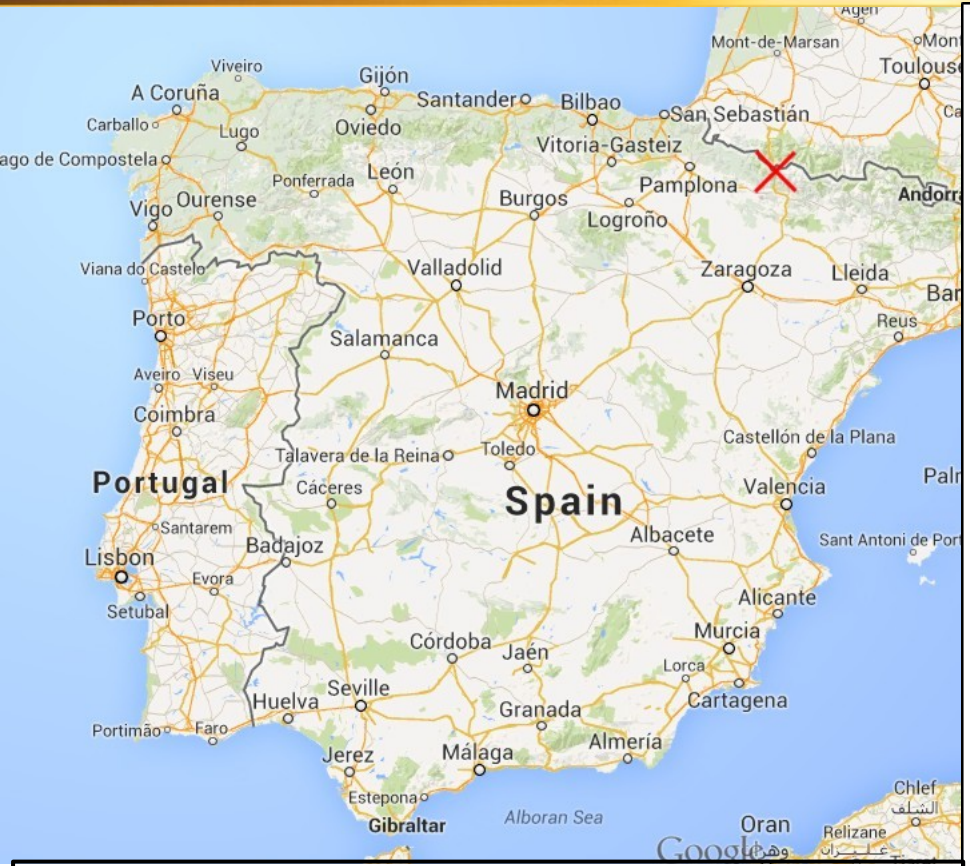
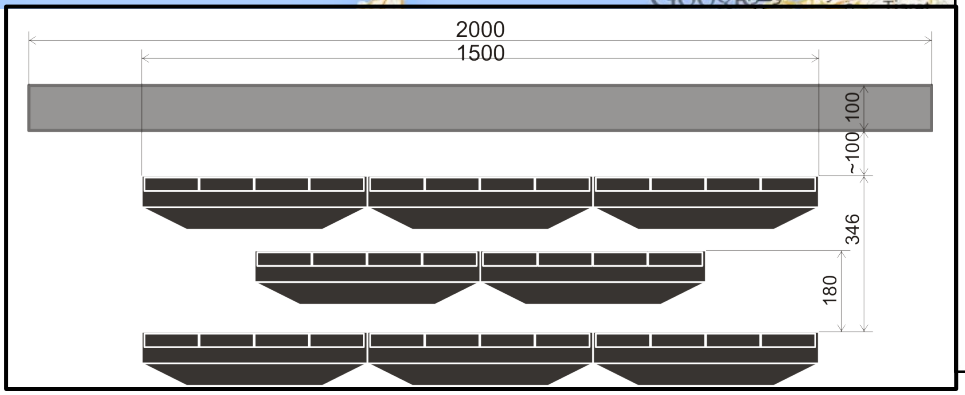
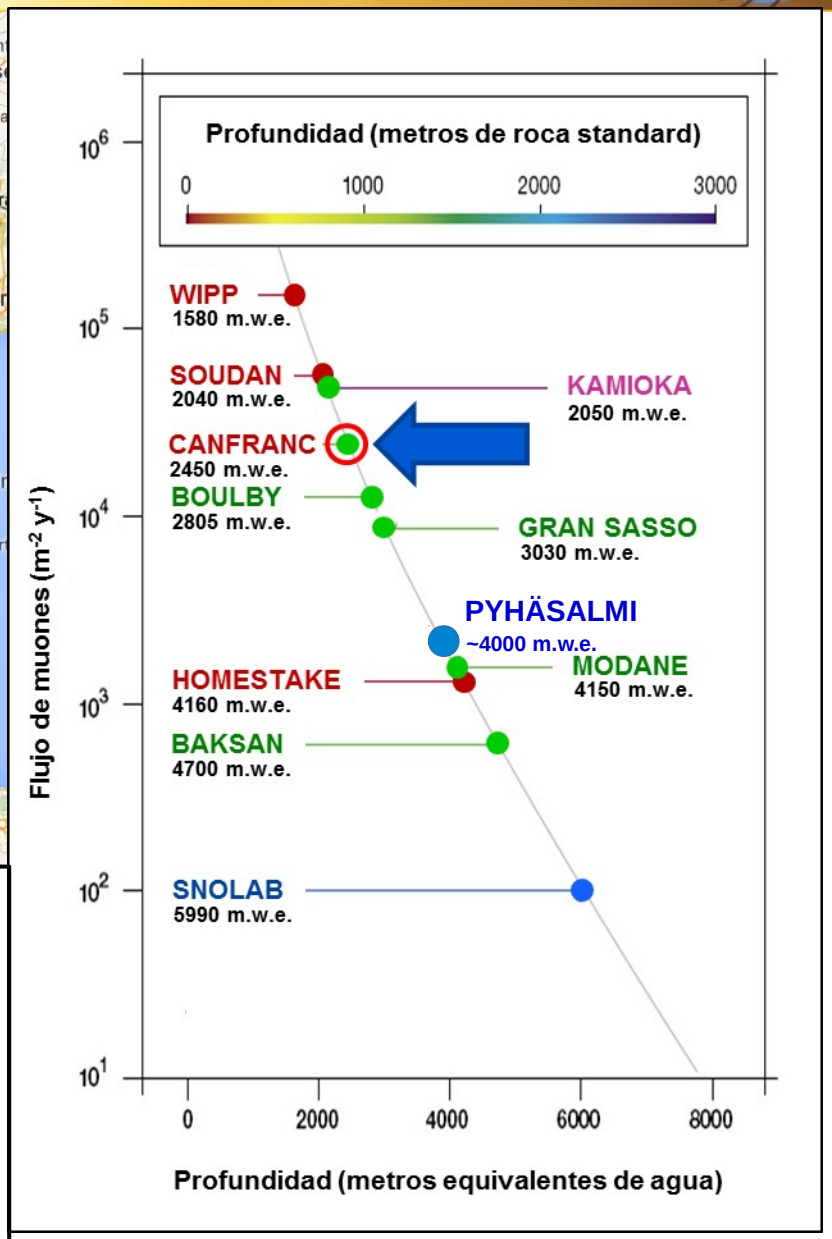
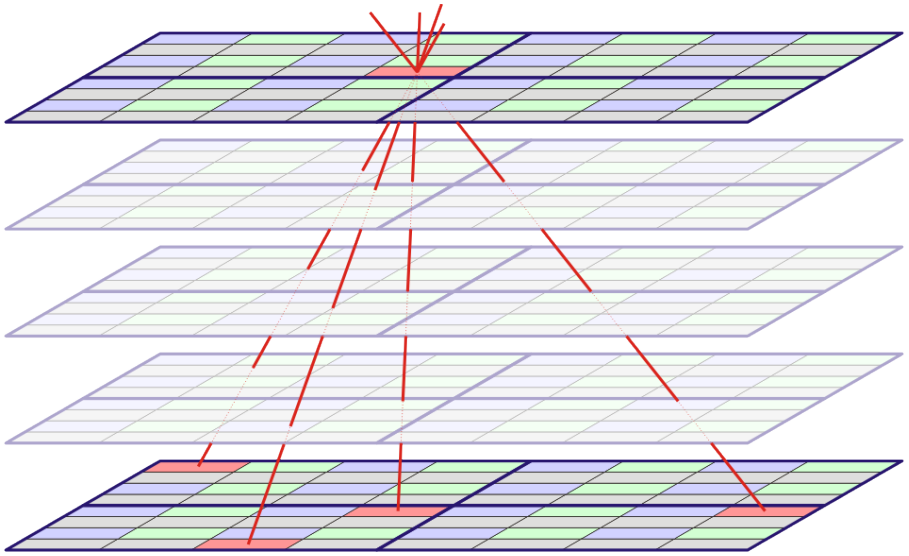

Viveiro
Gijón
A Coruña
Santander
Bilbao
San Sebastián
Carballo
Lugo
Oviedo
Vitoria-Gasteiz
Ponferrada
León
Pamplona
Vigo
Ourense
Burgos
Logroño
Viana do Castelo
Valladolid
Zaragoza
Lleida
Porto
Salamanca
Reus
Aveiro
Viseu
Madrid
Coimbra
Castellón de la Plana
Talavera de la Reina
Toledo
Portugal
Cáceres
Spain
Valencia
Santarem
Badajoz
Albacete
Lisbon
Evora
Alicante
Setubal
Murcia
Córdoba
Jaén
Lorca
Seville
Huelva
Granada
Cartagena
Portimão
Faro
Almería
Jerez
Málaga
Estepona
Gibraltar
Alboran Sea
Oran
Relizane
Google


2000
1500
100
~100
346
180


Profundidad (metros de roca standard)
0
1000
2000
3000
WIPP
1580 m.w.e.
SOUDAN
2040 m.w.e.
KAMIOKA
2050 m.w.e.
CANFRANC
2450 m.w.e.
BOULBY
2805 m.w.e.
GRAN SASSO
3030 m.w.e.
PYHÄSALMI
~4000 m.w.e.
MODANE
4150 m.w.e.
HOMESTAKE
4160 m.w.e.
BAKSAN
4700 m.w.e.
SNOLAB
5990 m.w.e.
Flujo de muones (m-2 y-1)
Profundidad (metros equivalentes de agua)

Time calibration.

Done by Pasi @ CUPP



An example of calibration of different geometry (slightly different method used)

Procedure:

1) Find all **single pixel coincs**. such that there is one pixel firing in Mid and Bot.

2) Find peaks in timing for each pixel in **Bot**
   → Take TOF into account
   → Use as time reference the time difference between all Mid pixels and a given Bot pixel
   → This way each pixel in Bot uses **average timing of pixels in Mid as reference**

3) Use Bot pixels to calibrate all pixels in **Mid**.

4) Use Mid to calibrate the rest (**Bot & Top**).

5) In the final analysis use prompt peak
   → but leave the timing gate relatively broad as the timing depends on the arrival angles

Time calibration.

Done by Pasi @ CUPP

Summary:

→ All pixels are working
(no rates just totals, no efficiency estimation)

→ Statistics very low (25-50 counts) in 1 pixel

→ Statistics low (<100 counts) in 16 pixels (11%)

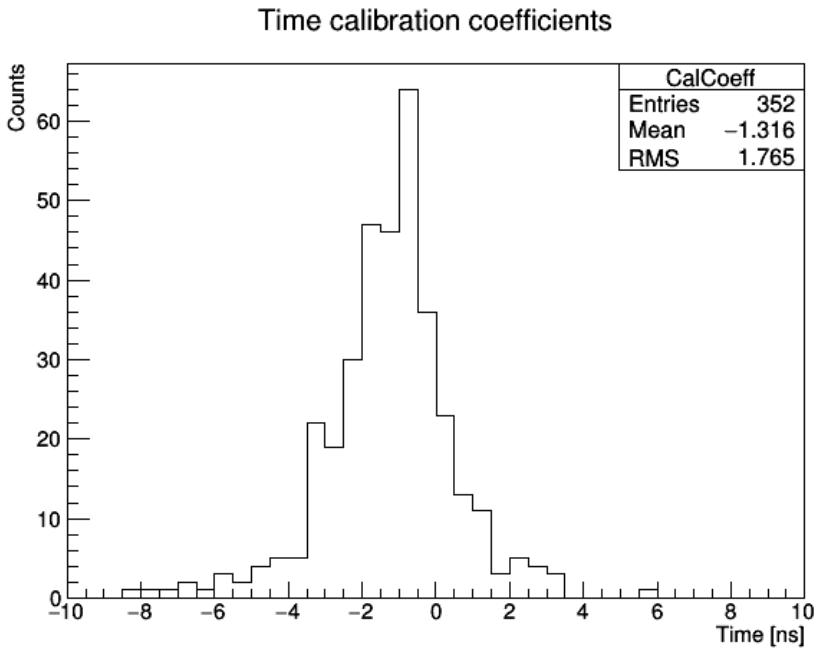
Before calibration:

→ Time spread: average **2-3 ns** (max 14 ns) → right

After calibration (test involves 'verticals' only):

→ Centroid within **0.4 ns**

→ Sigma: ~3 ns (max 8 ns)



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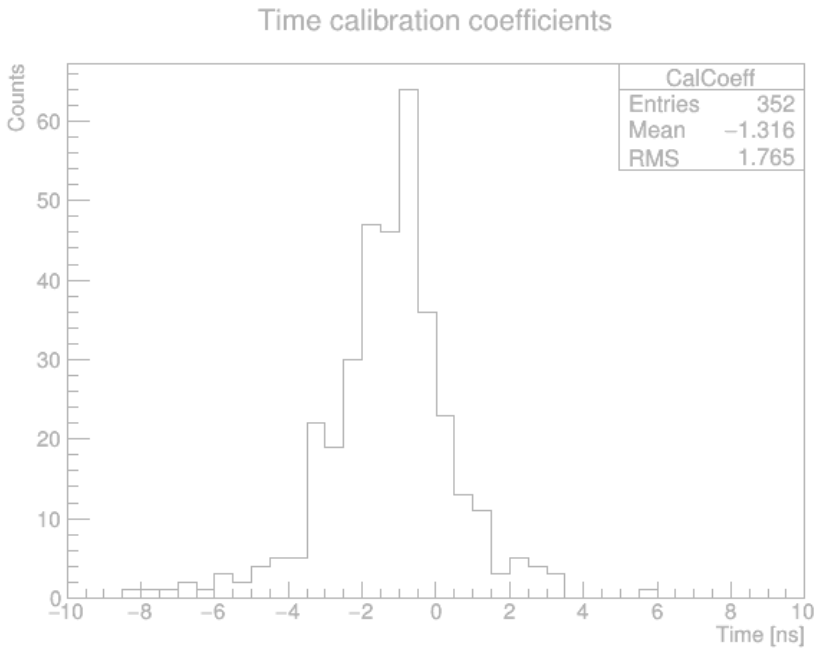
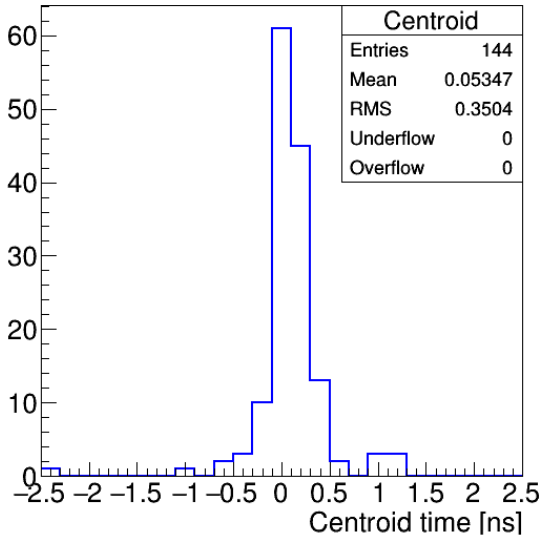
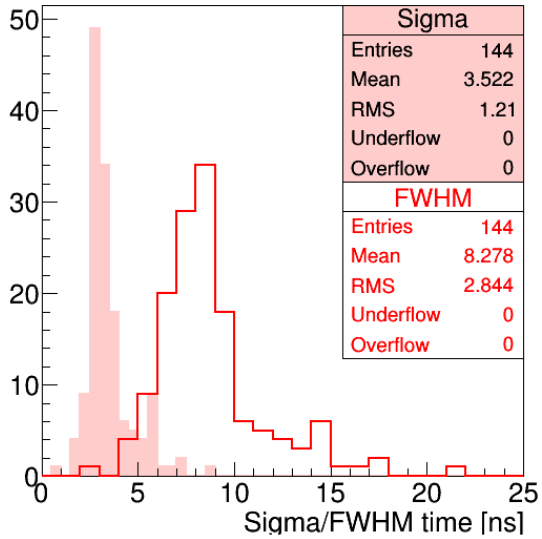
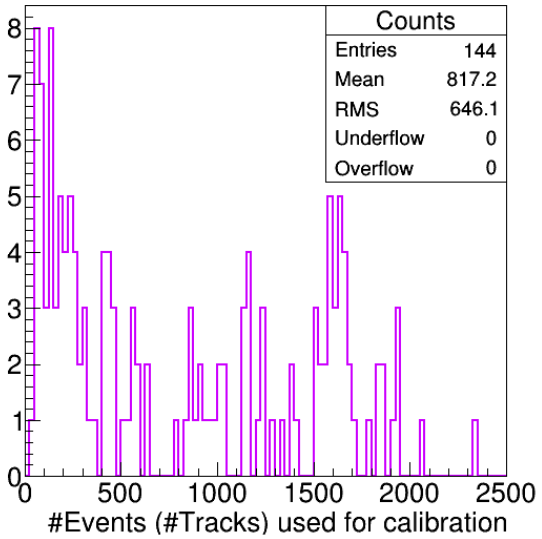




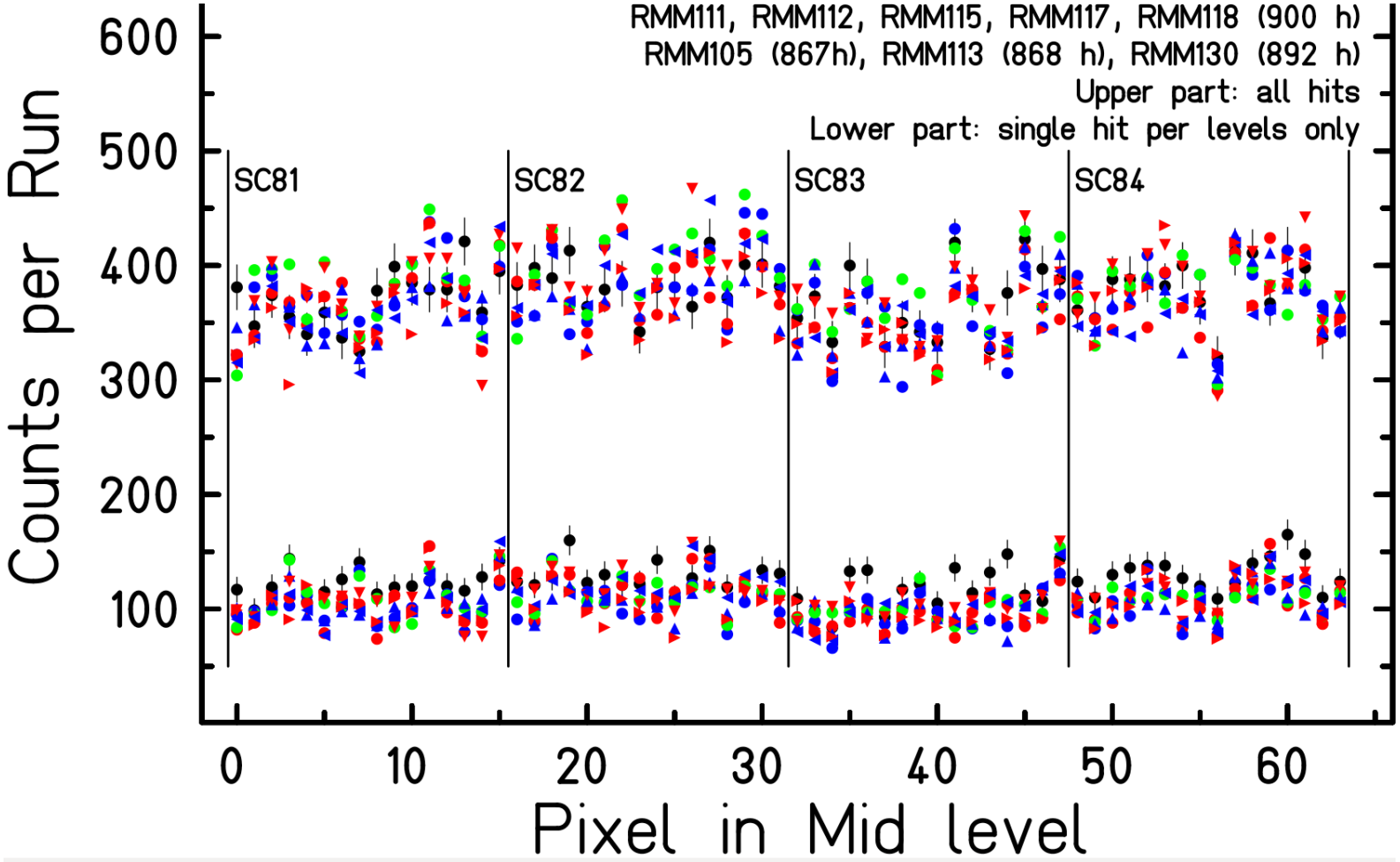




Muon-like rates

Done by Timo @ CUPP

Aim: determine any **pixel deterioration** during 2-years of data taking (3-fold coincidences only)



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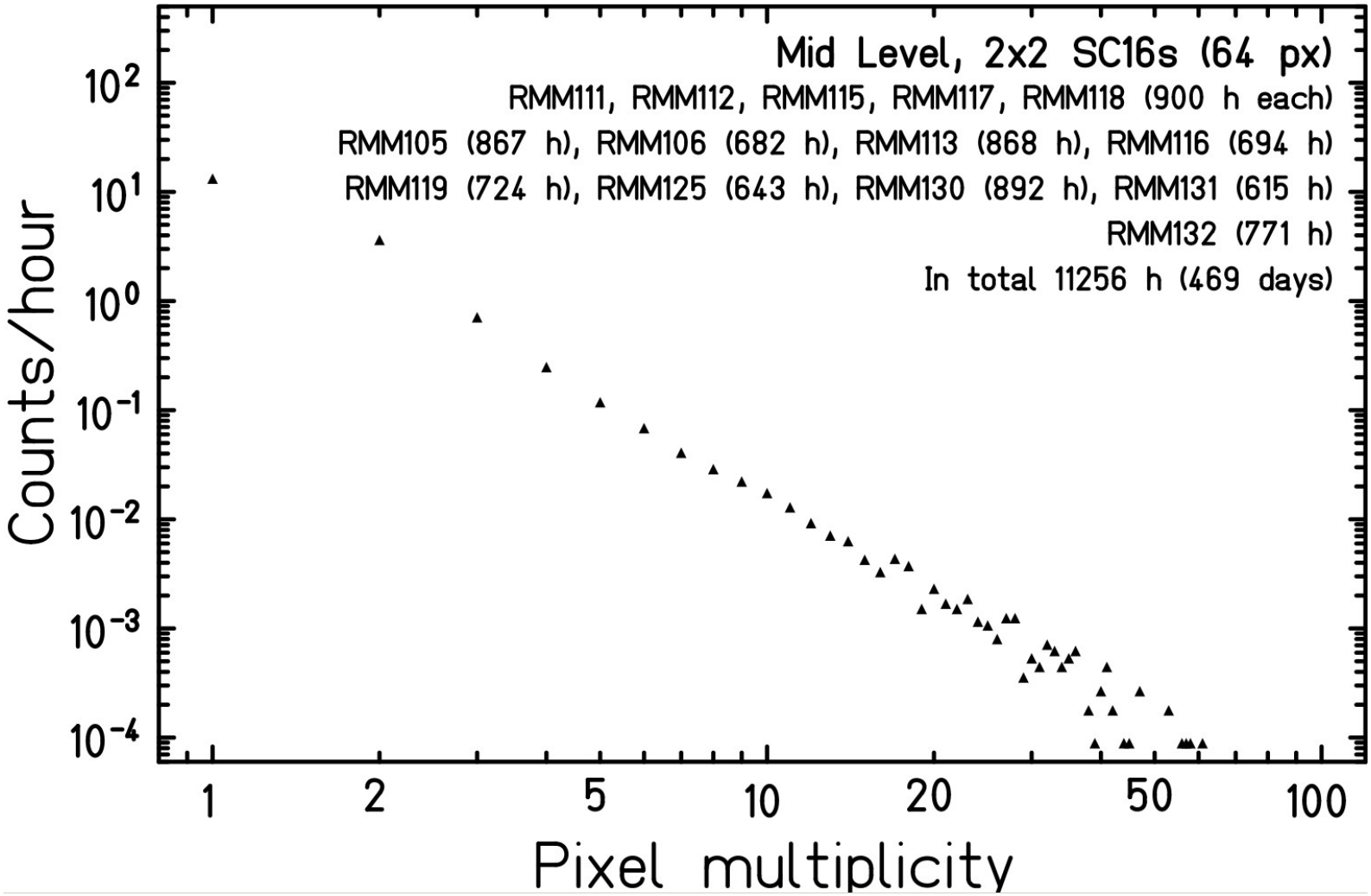
Extra outcome – **pixel multiplicity**.

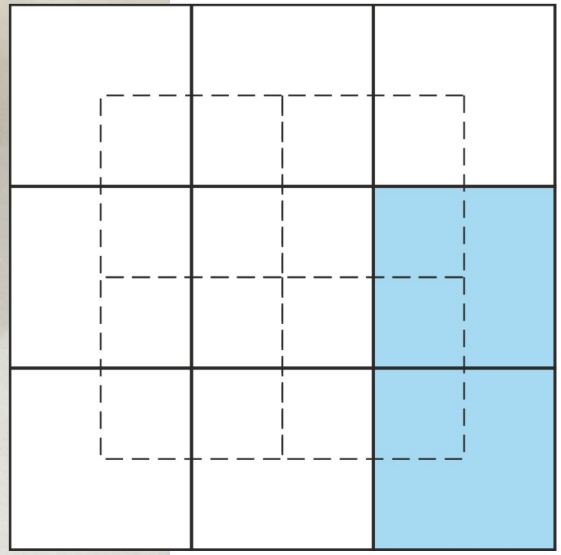


Pixel efficiencies

Not started

→ Use of data collected with **additional two scintillators** on top.
→ How to analyse this data?
→ Any other ideas?

The data has been collected (Sep. 2015), but not analysed yet.



Main tasks – Angular distr.

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1. Angular distribution of muon flux.
2. Absolute muon flux

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1a. First order approximation

(**done** by Almaz and Maciej, some adjustments still required)

- Determine usable data **quality cuts**
- Use **only data** (no simulation)
- **Randomize** hit position within a pixel

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1d. Fourth order (TODO)
- Look in **2b**

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- The result is quite **underestimated** muon flux (by how much?)

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  = Using **geant simulation** to study how often a local muon-associated EM shower activates more than 2 pixels per level (or 2 not neighbouring pixels)

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Note: The data, which is cut, should always be checked in the same way as 'good' data to make sure it is really random (doesn't contain an angular structure, excluding detector geometry influence).

Summary

News:

- Google drive designated to store and share preliminary results (ask Maciej for a link)
- **Alexander Nozik** @ MIPT joined our efforts → thanks for your **active participation**!

Progress:

- Time calibration: **done**
- Pixel counting rates: **checked**
- **Angular distribution: preliminary figures available**
- Pixel efficiencies: to be done
- Absolute muon flux: stuck

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Thank you for attention

Topics for discussion:
- Various coding projects are stored in different places
  - Alexander uses **BitBucket** mainly
  - Maciej uses **GitLab** (sortti @ CUPP) for code and **Google Drive** for plots
  - Almaz uses **Google Drive** for his scripts and plots
  - Others → ?
    → Should we **unify** at least some of them (especially **results**)?
- Efficiency calibration → Who and how? Ideas?
- Time calibration → How to apply?