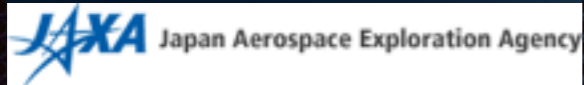


Riproduzione sperimentale delle orbite di JEM-EUSO al TurLab

Roberta Mulas

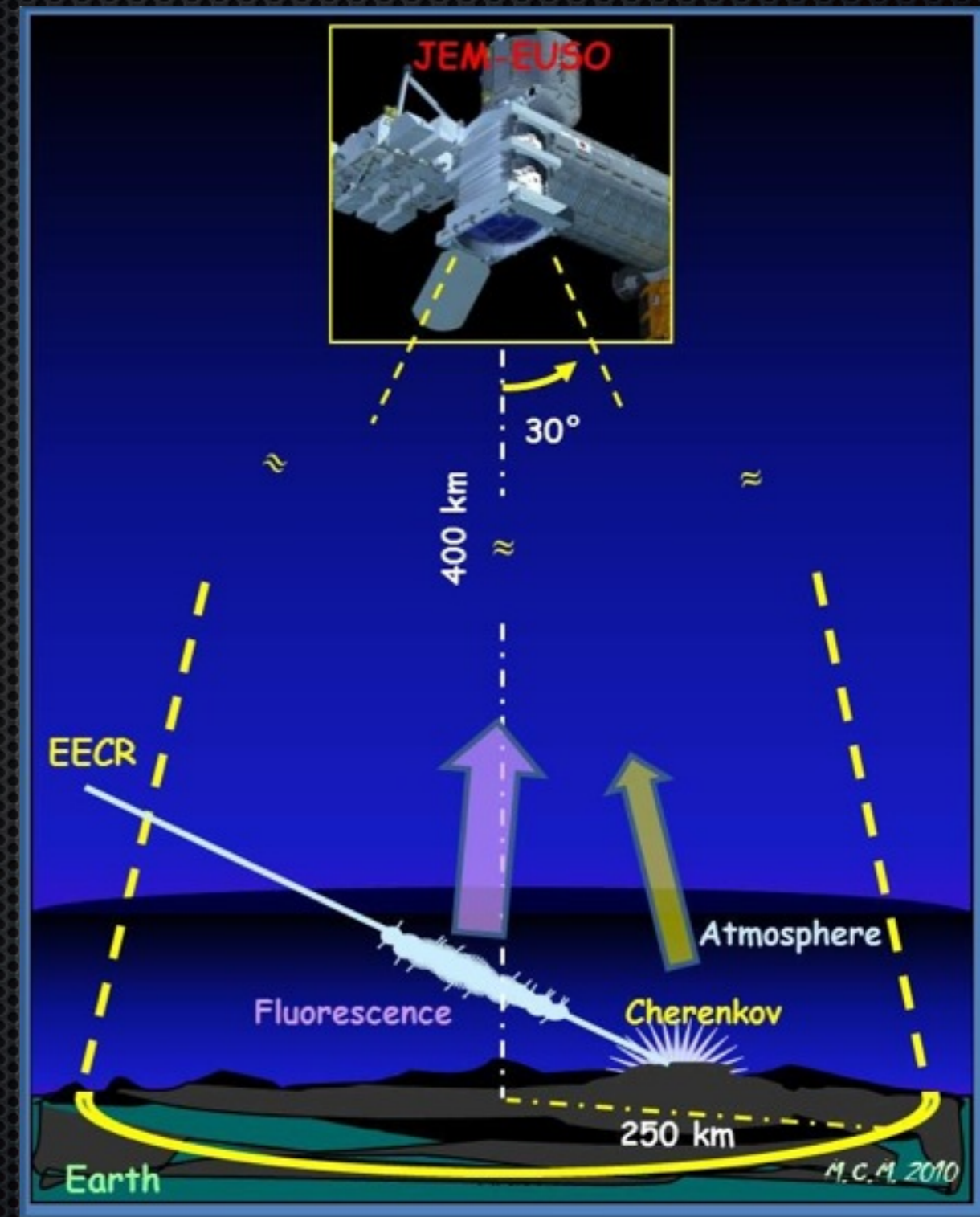
Relatore: Prof. M.E. Bertaina

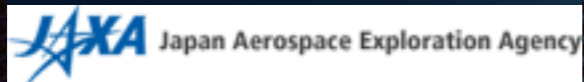


JEM-EUSO

osservare l'atmosfera terrestre dallo spazio per rilevare raggi cosmici di energia estrema

FoV: $1.4 \times 10^5 \text{ km}^2$

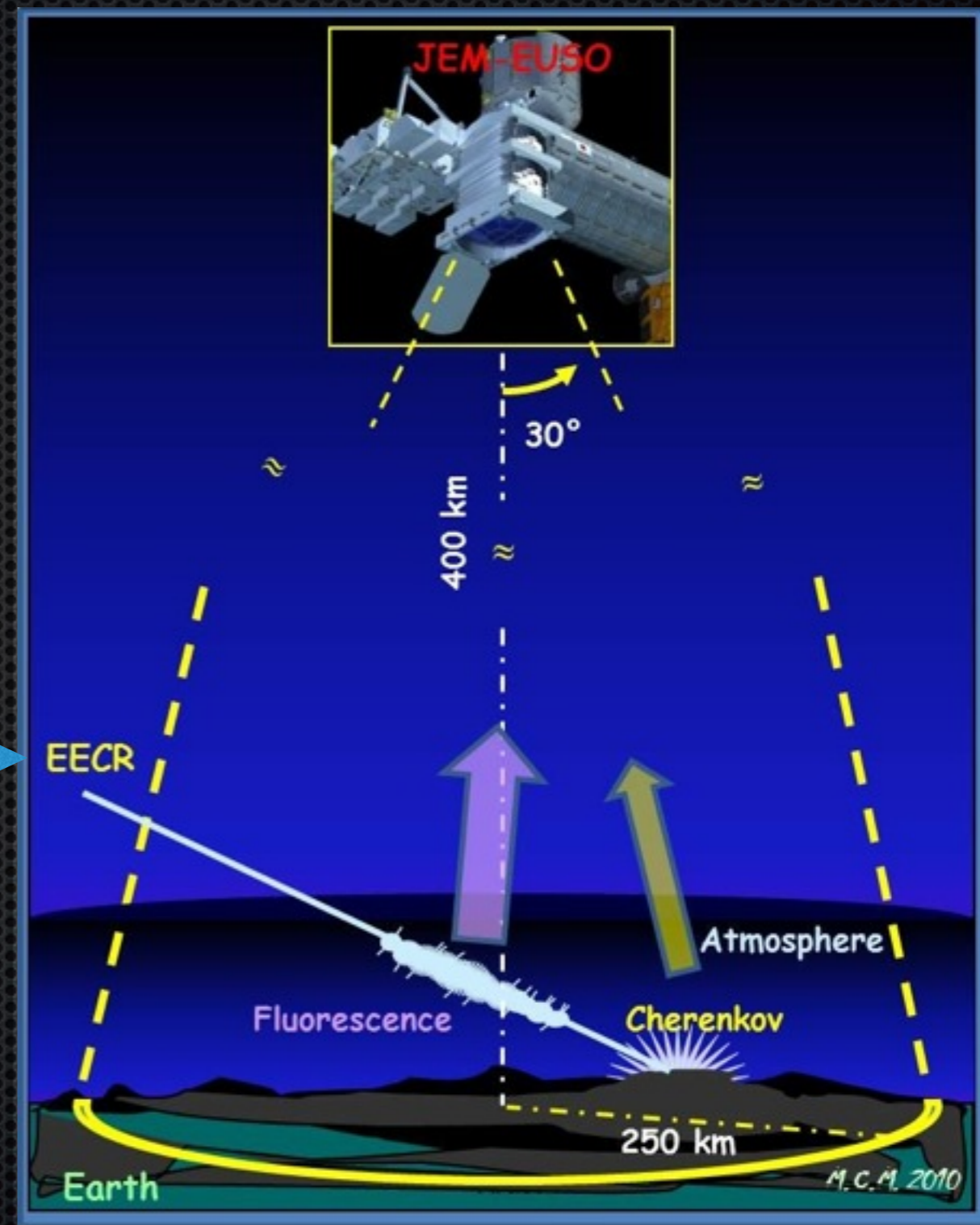


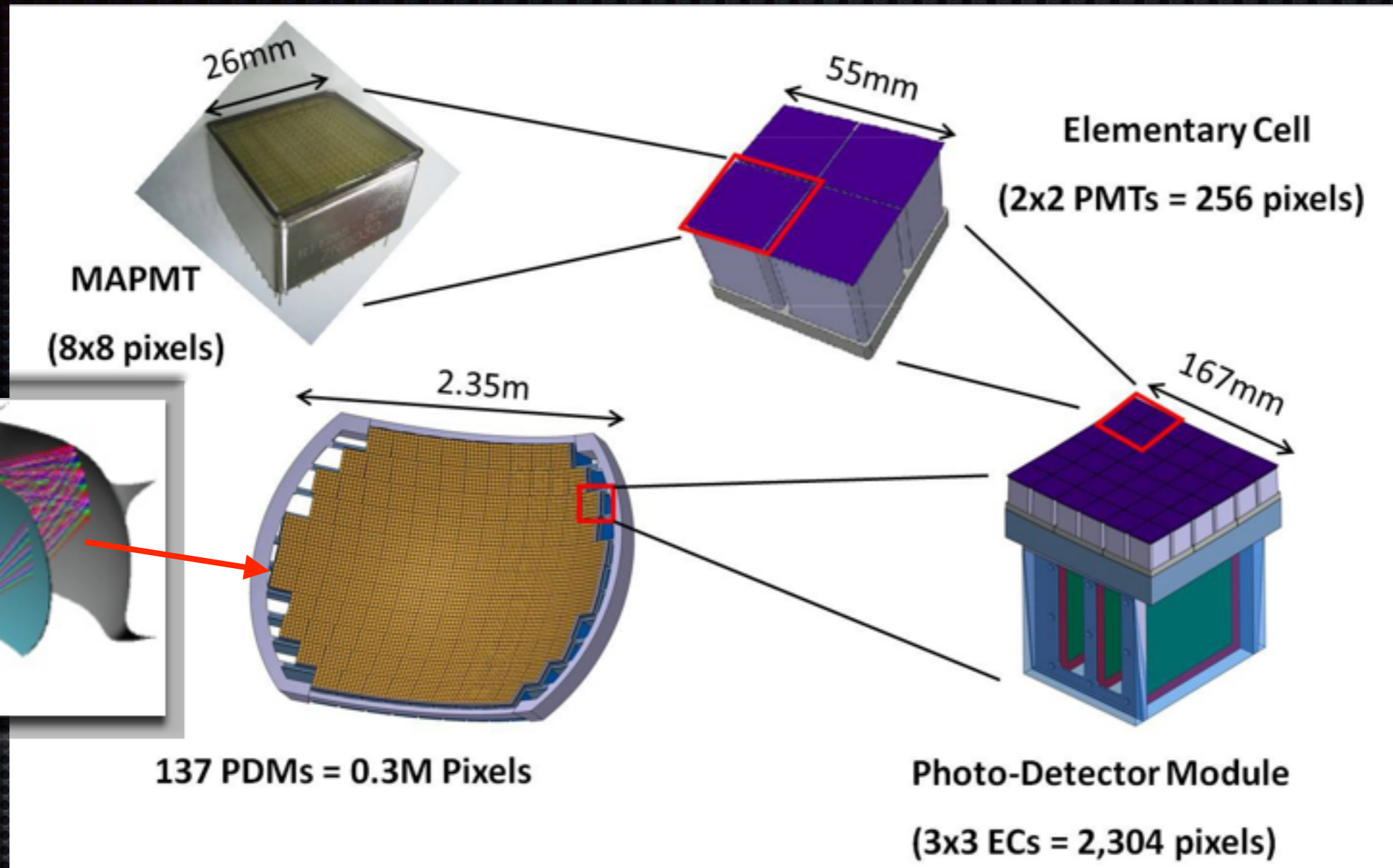


JEM-EUSO

energie: 10^{20} eV
 flusso: 1 part/km²/millennio

FoV: 1.4×10^5 km²





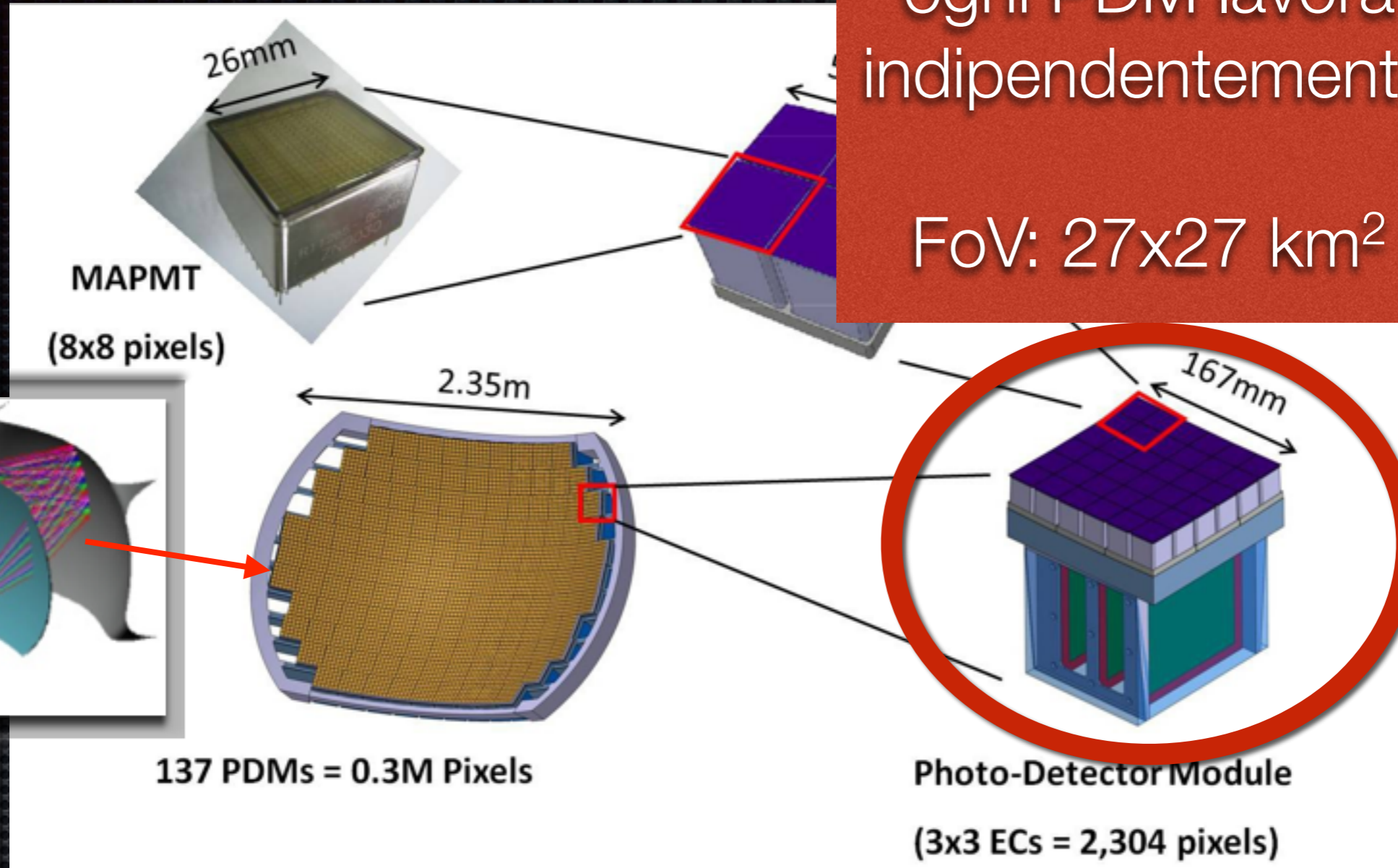
Superficie focale

320 000 pixel

4.5 m²

ogni PDM lavora
indipendentemente

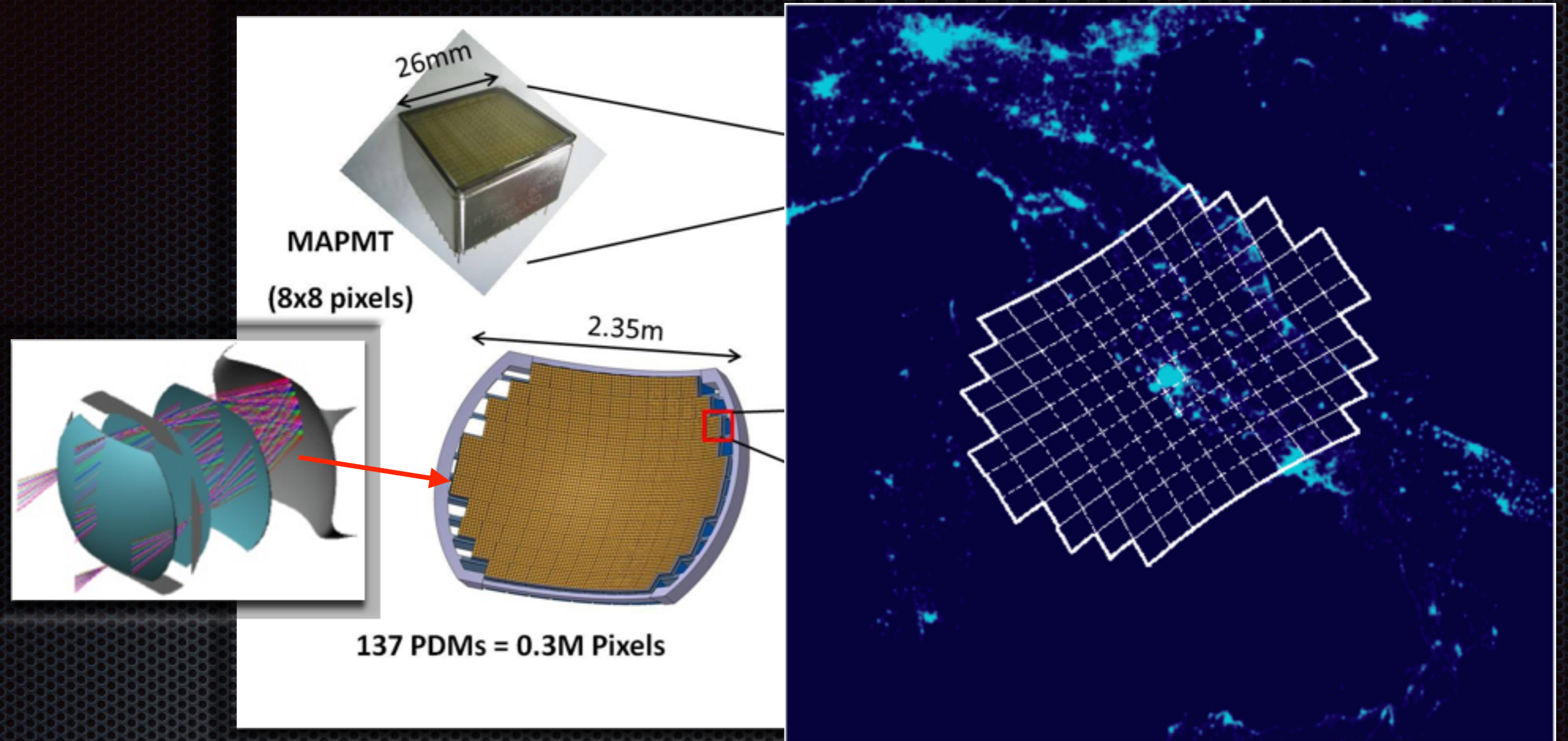
FoV: 27x27 km²



Superficie focale

320 000 pixel

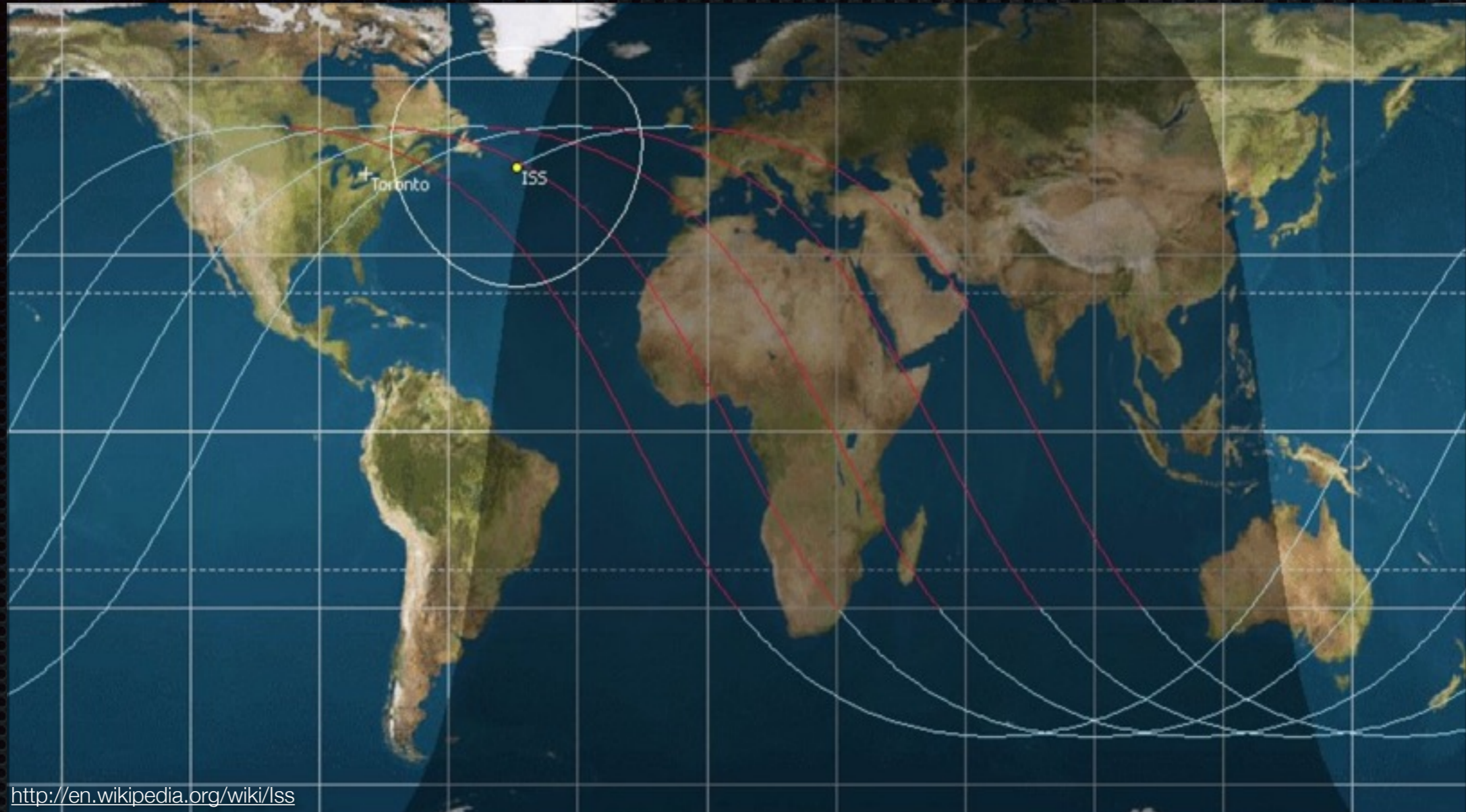
4.5 m²



Superficie focale

320 000 pixel

4.5 m²



<http://en.wikipedia.org/wiki/Iss>

ISS

- 7.5 km/s
- 15.5 orbite al giorno
- 20-40 min di notte

The Pacific Ocean Through the Cupola

Videos produced by the Crew Earth Observations group at
NASA Johnson Space Center

For replication and crediting information, please see our guidelines
on our main video page.

European City Lights

Videos produced by the Crew Earth Observations group at
NASA Johnson Space Center

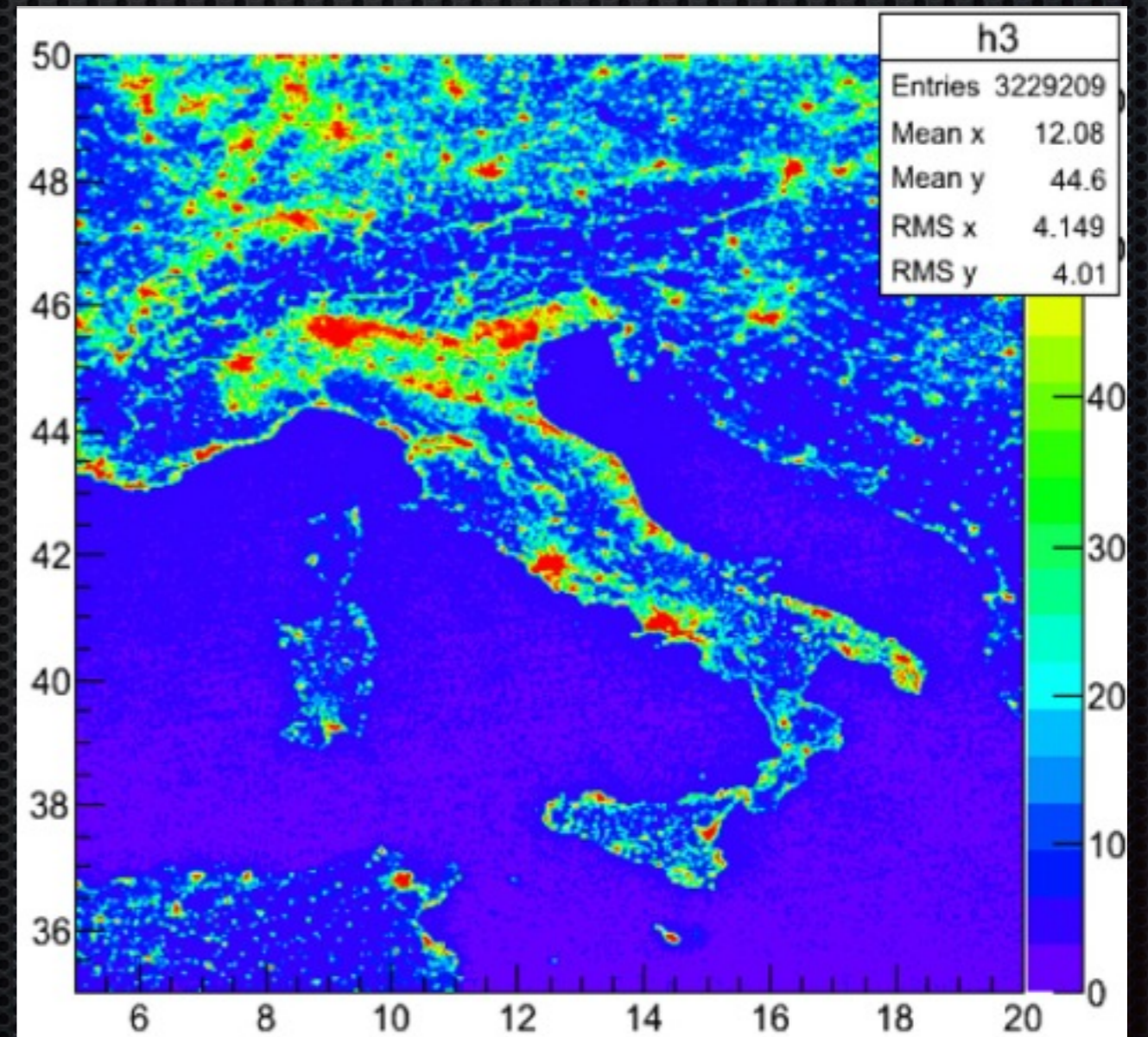
For replication and crediting information, please see our guidelines
on our main video page.

Luminosità UV

500 ph/(m²·ns·sr)



1.4 phe/pix/GTU

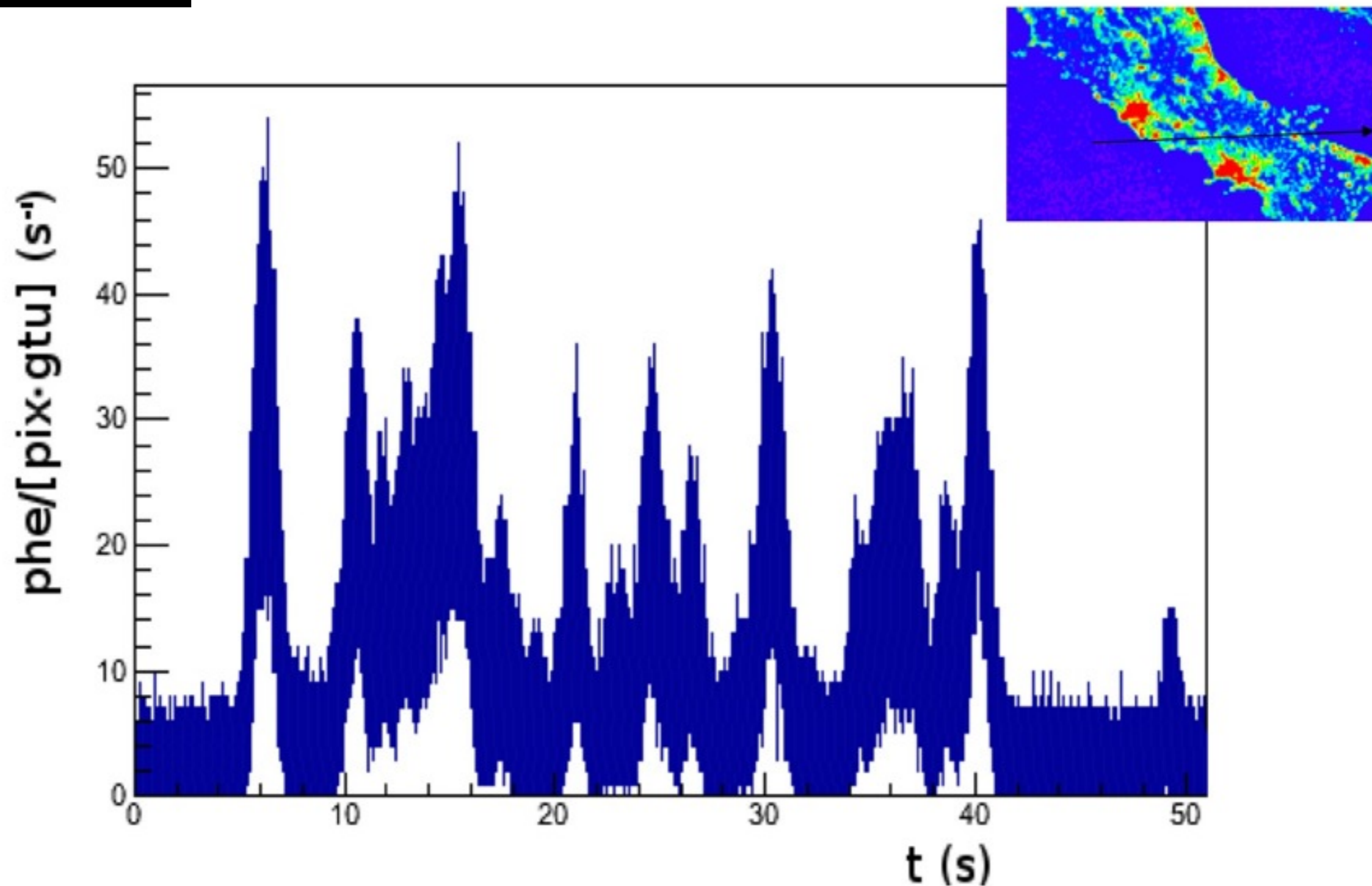


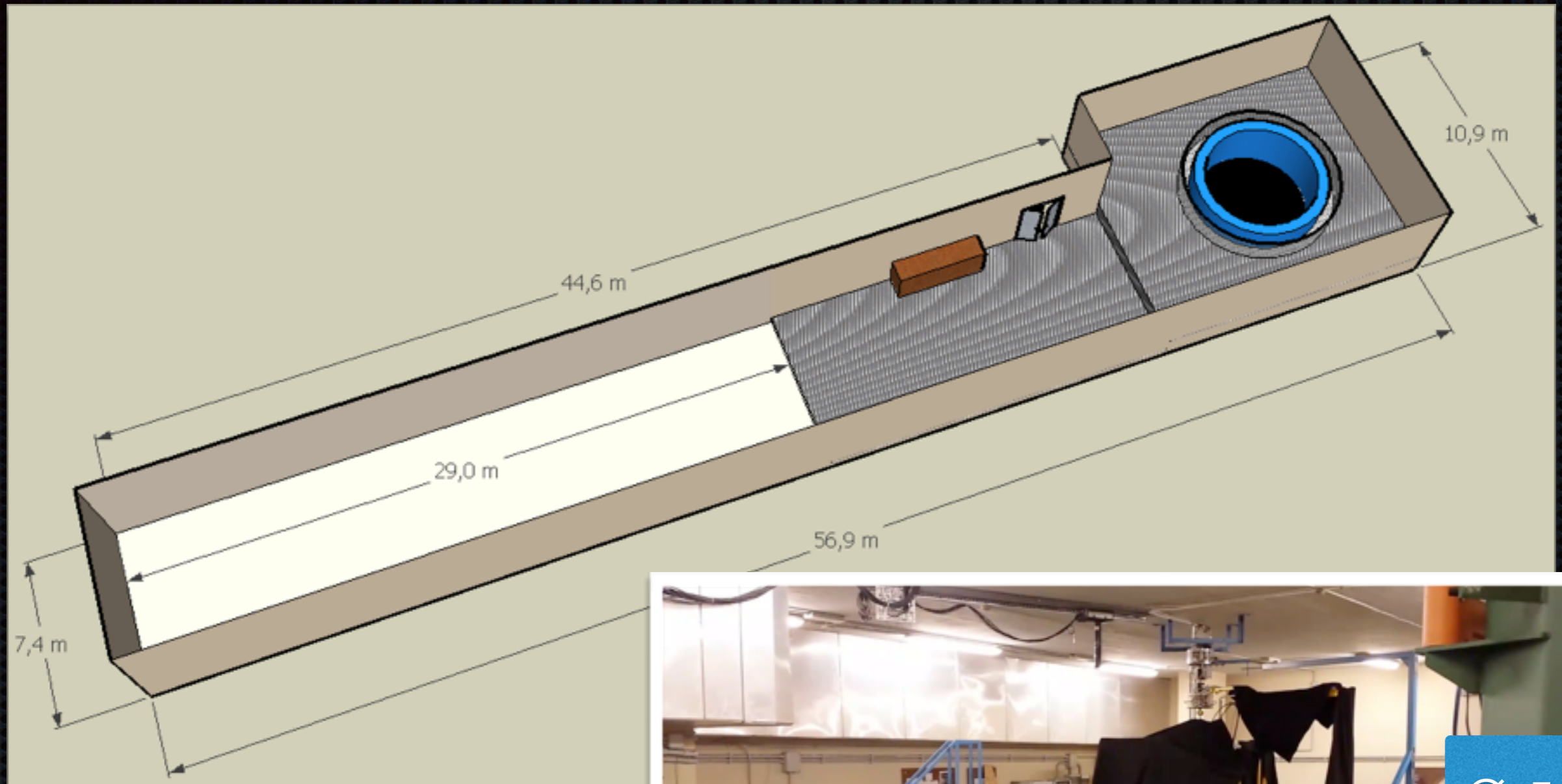
DMSP(Defense Meteorological Satellites Program)

Cambursano

Luminosità UV

Cambursano





TurLab

velocità

max: 1 rot. in 12 s

min: 1 rot. in 20 min



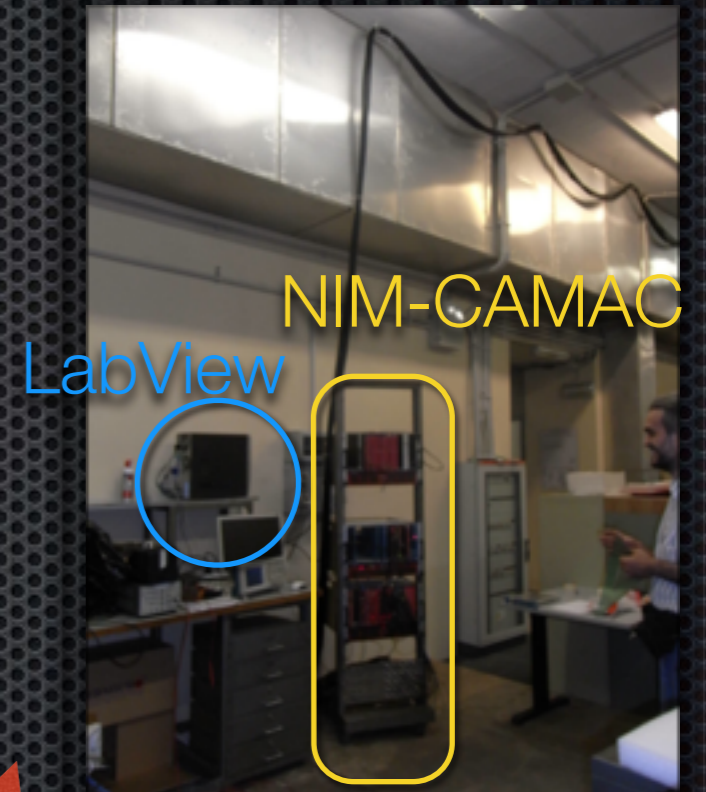
Obiettivi di Euso@TurLab

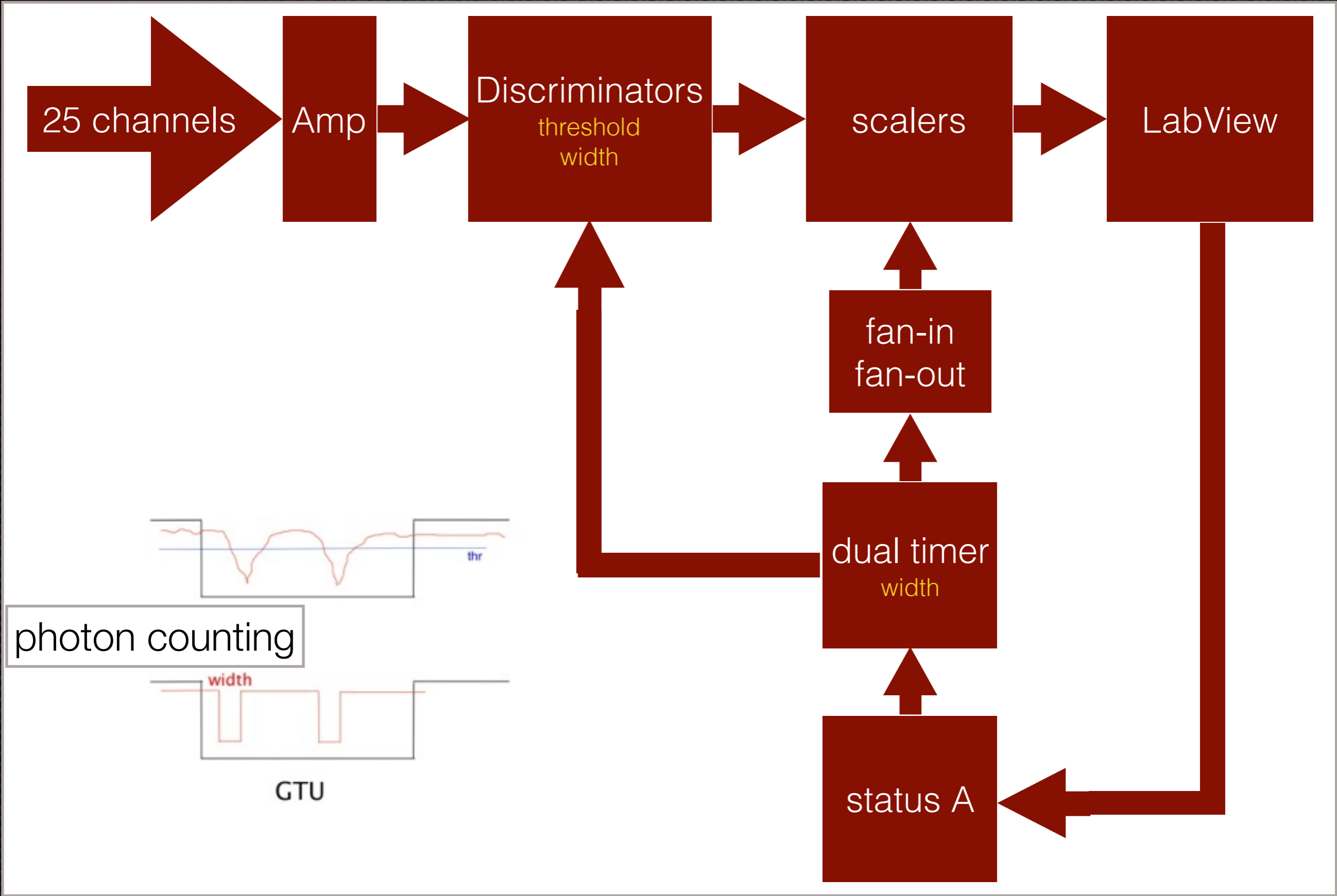
- ✦ Provare le componenti di JEM-EUSO in un ambiente controllato ma riproducendo variazioni di luminosità compatibili con le condizioni di lavoro
- ✦ Verificare il primo livello di trigger con dati di misure reali

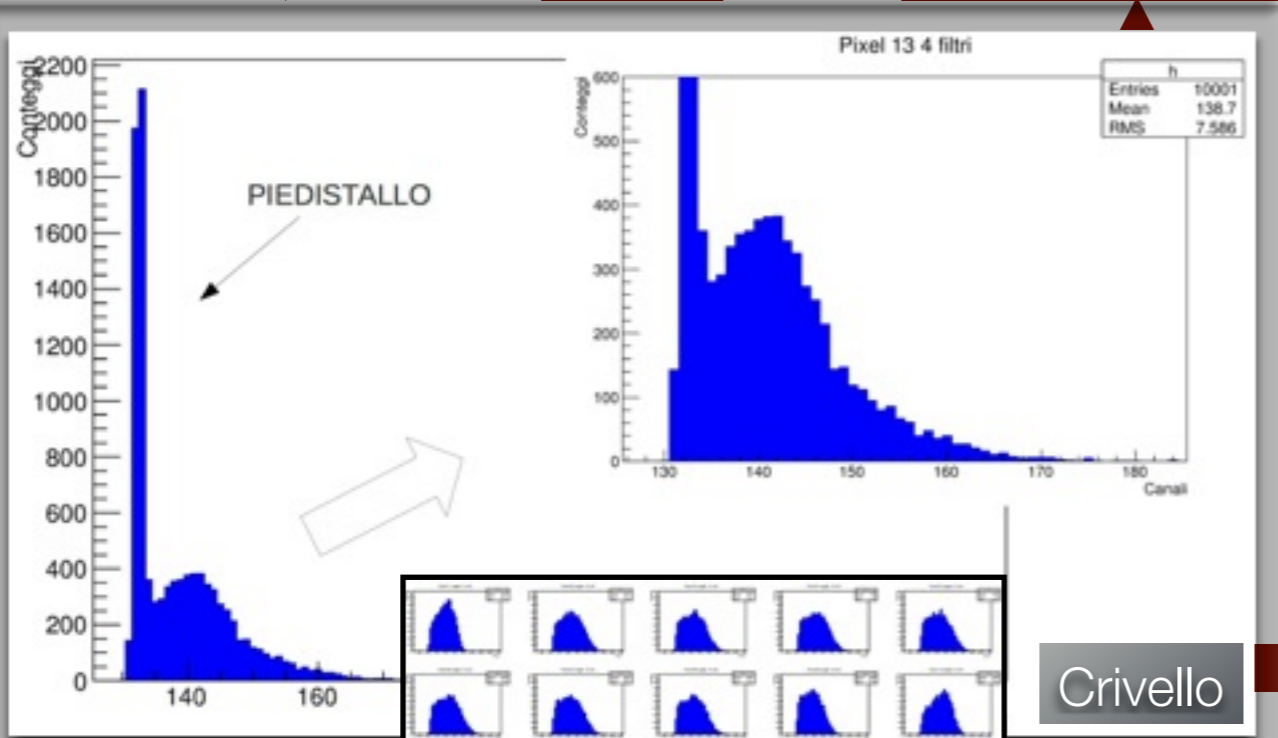
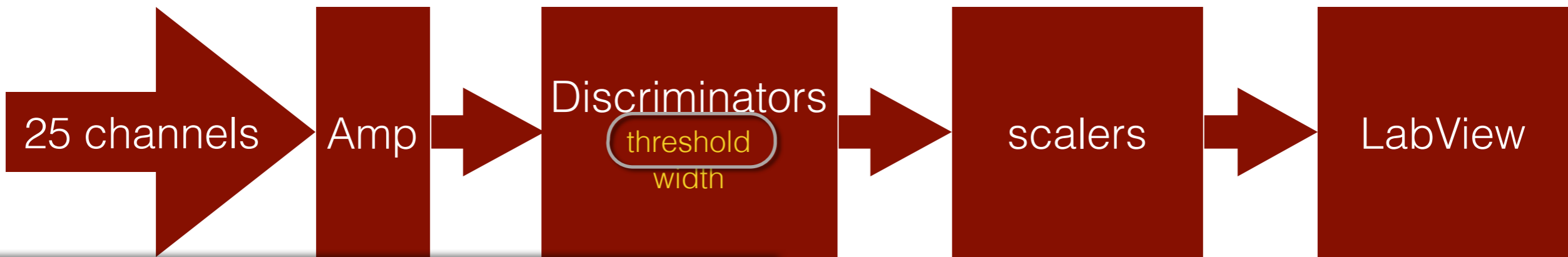
Set-up sperimentale

- ✦ 5x5 pixel MAPMT
- ✦ elettronica
- ✦ la vasca

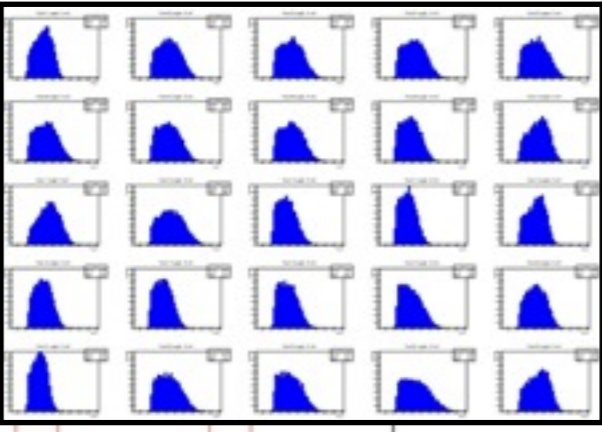
Hamamatsu R8900-M25





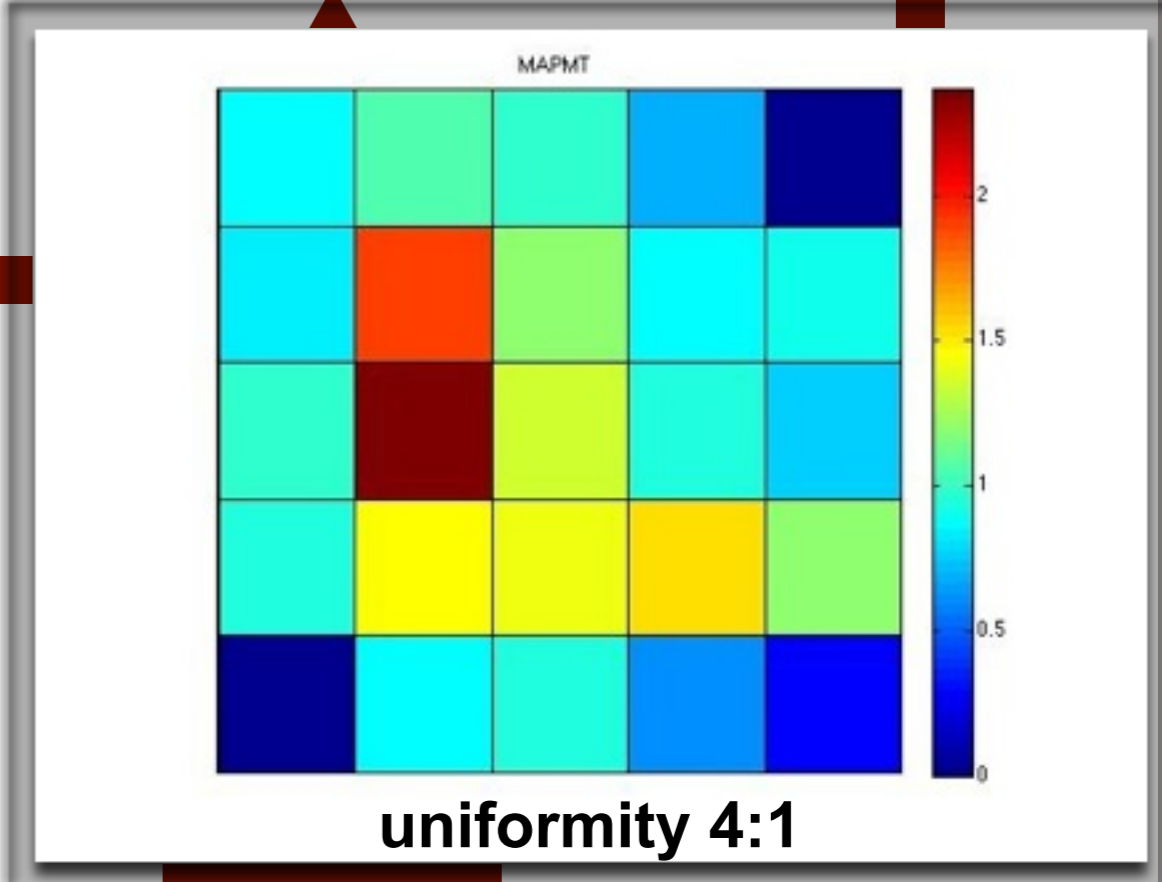


photon cou

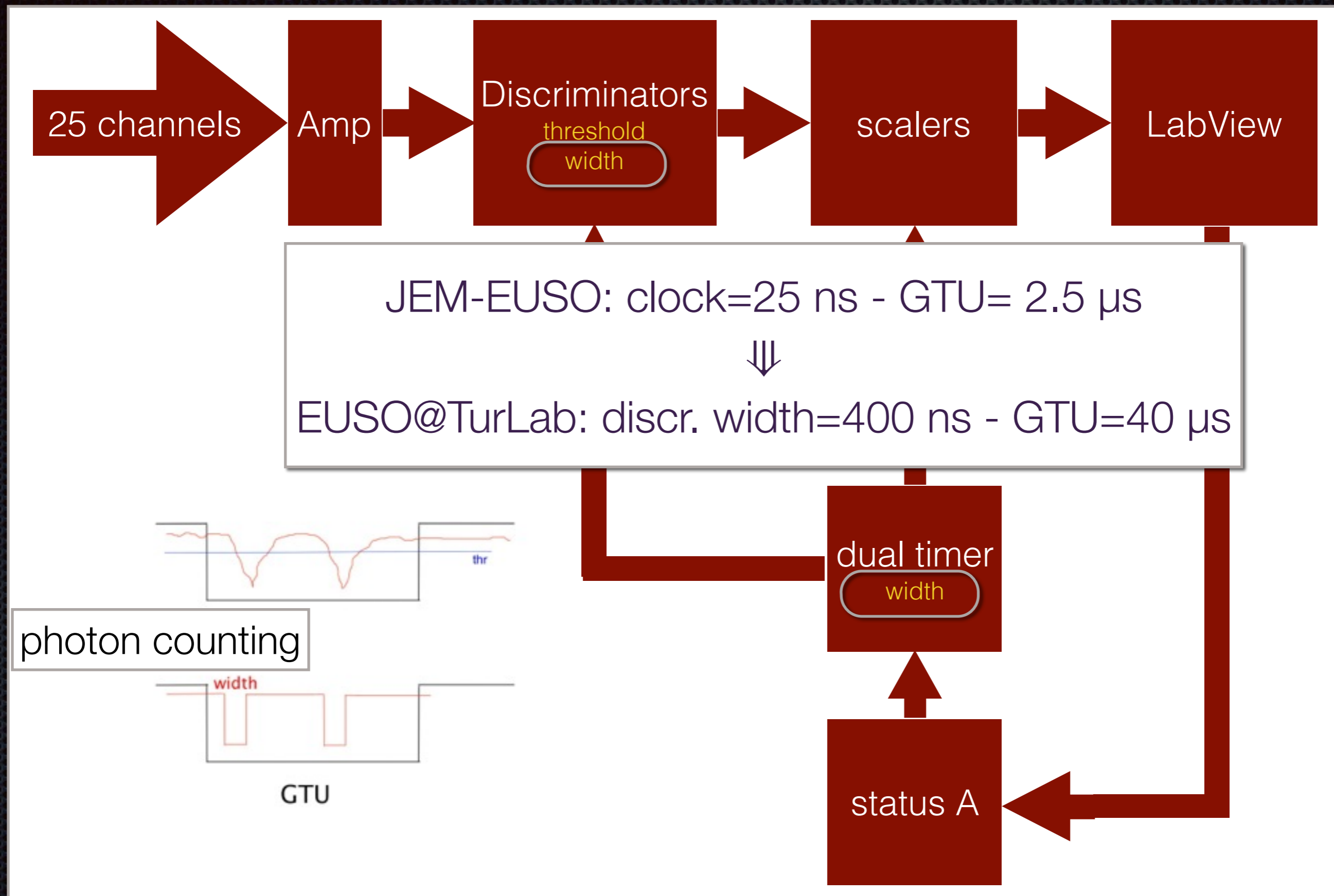


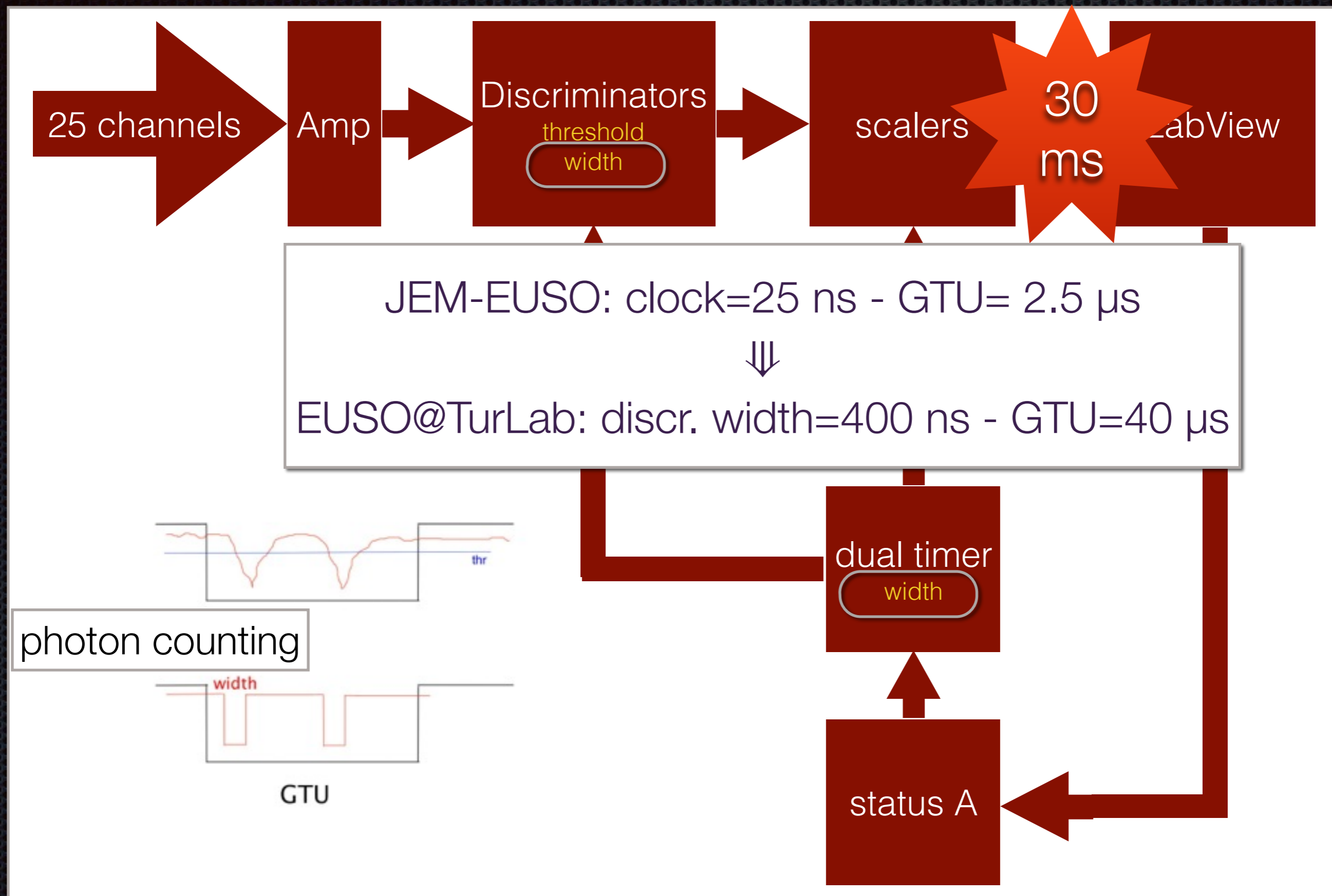
GTU

fan-in
fan-out



uniformity 4:1





risoluzione

tempo

1 GTU = 40 μ s campionati ogni 30 ms

spazio

1 pixel

FoV: 5x5 mm²

TurLab

2 m



5 mm

JEM-EUSO

400 km



500 m

risoluzione

tempo

1 GTU = 40 μ s campionati ogni 30 ms

1 rot/20 min
R = 2 m

spazio

1 pixel

FoV: 5x5 mm²

ISS: 8 km/s — TurLab: 10⁻² m/s

rapporto velocità: TurLab/ISS: 10⁻⁶

5 mm/500 m = 10⁻⁶

cosa ho fatto io

- ✦ partecipato alle prese dati
- ✦ sviluppato programmi elaborazione dati in laboratorio
- ✦ analisi dati
- ✦ verifica trigger

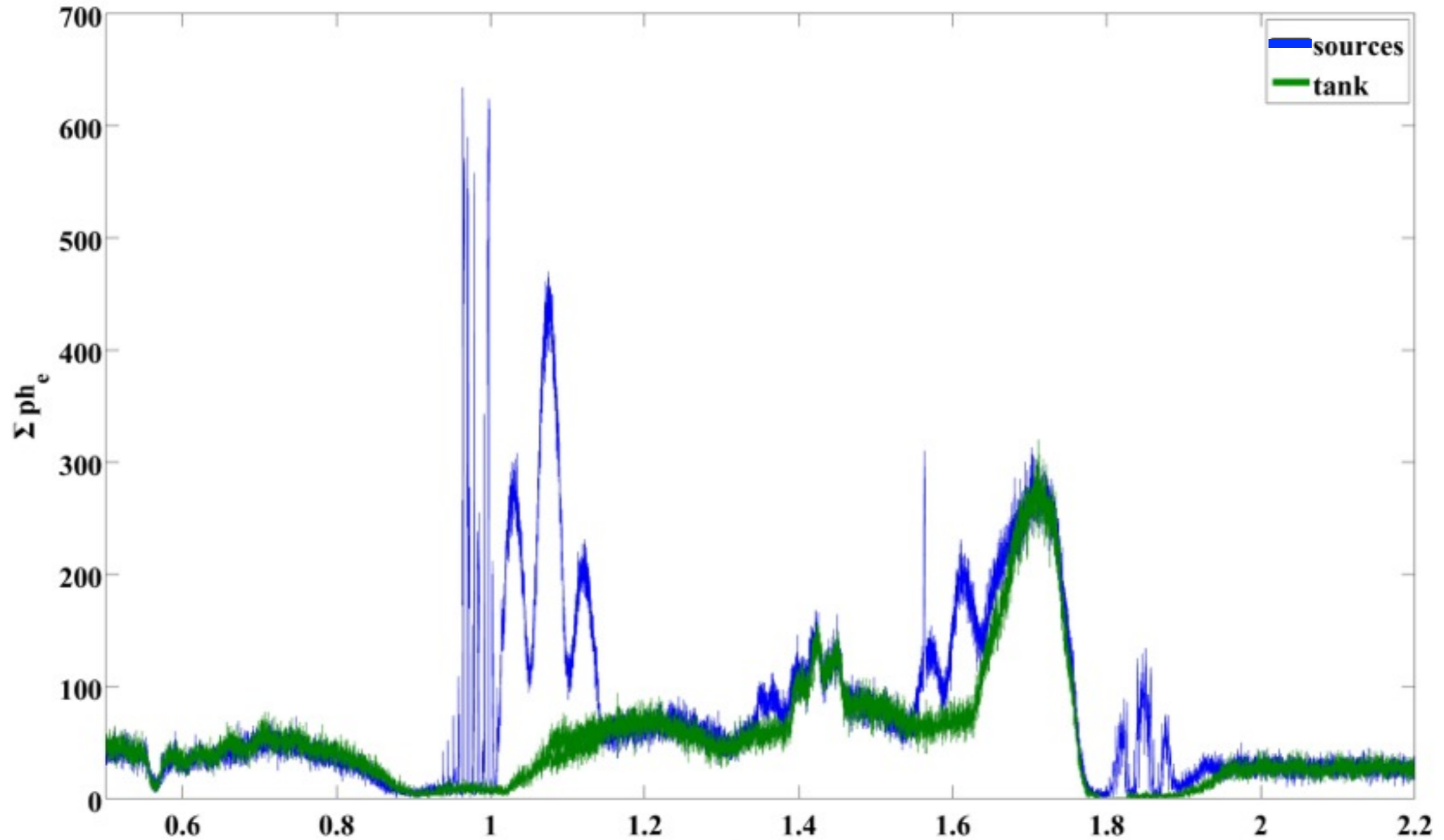
condizioni di lavoro



cosa si ottiene dalle misure

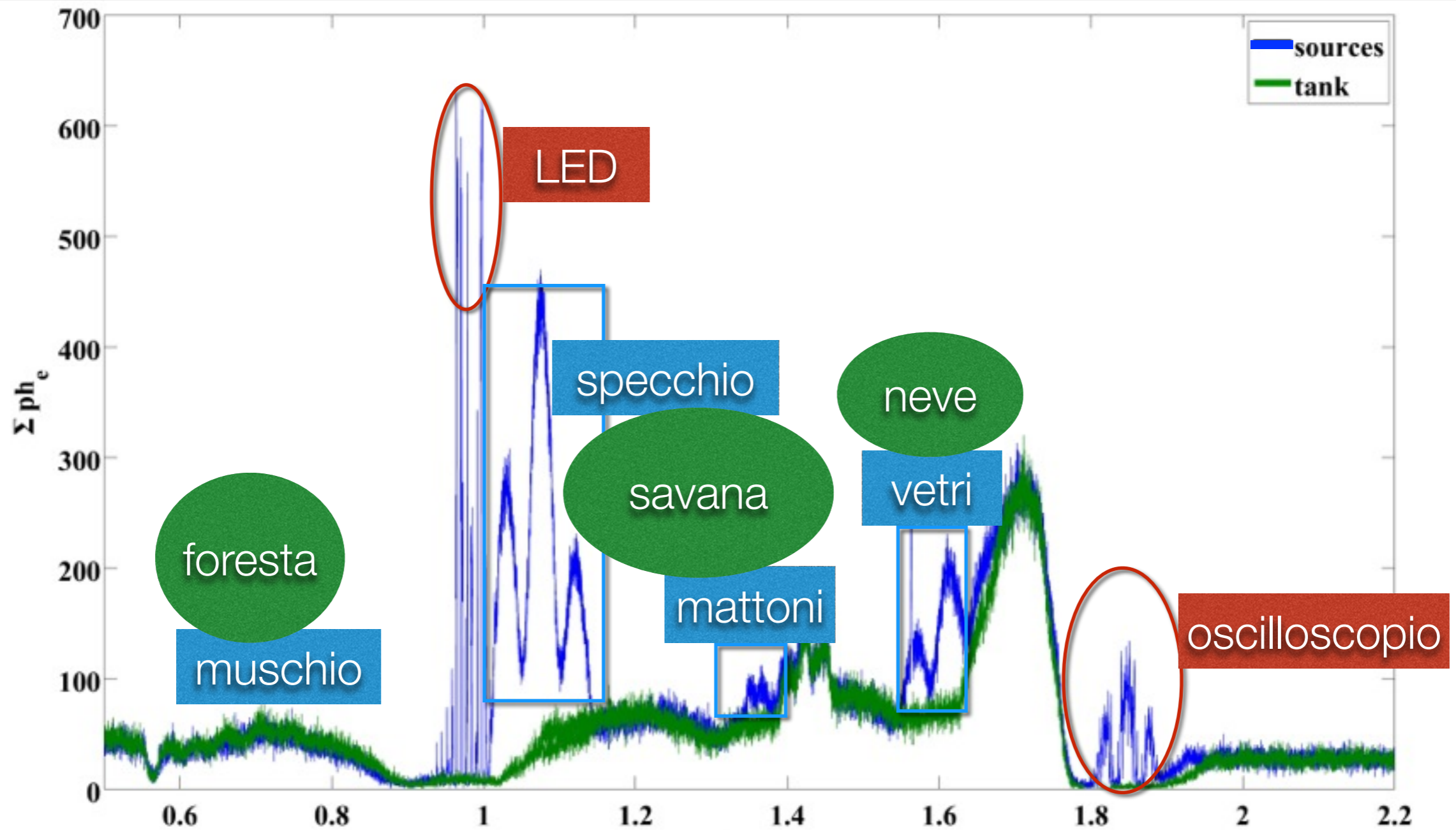
2 approcci:

- 'tempo reale'
 - ↳ s (per PDM - EUSO)
- 'tempo equivalente'
 - ↳ GTU (per testare il trigger)



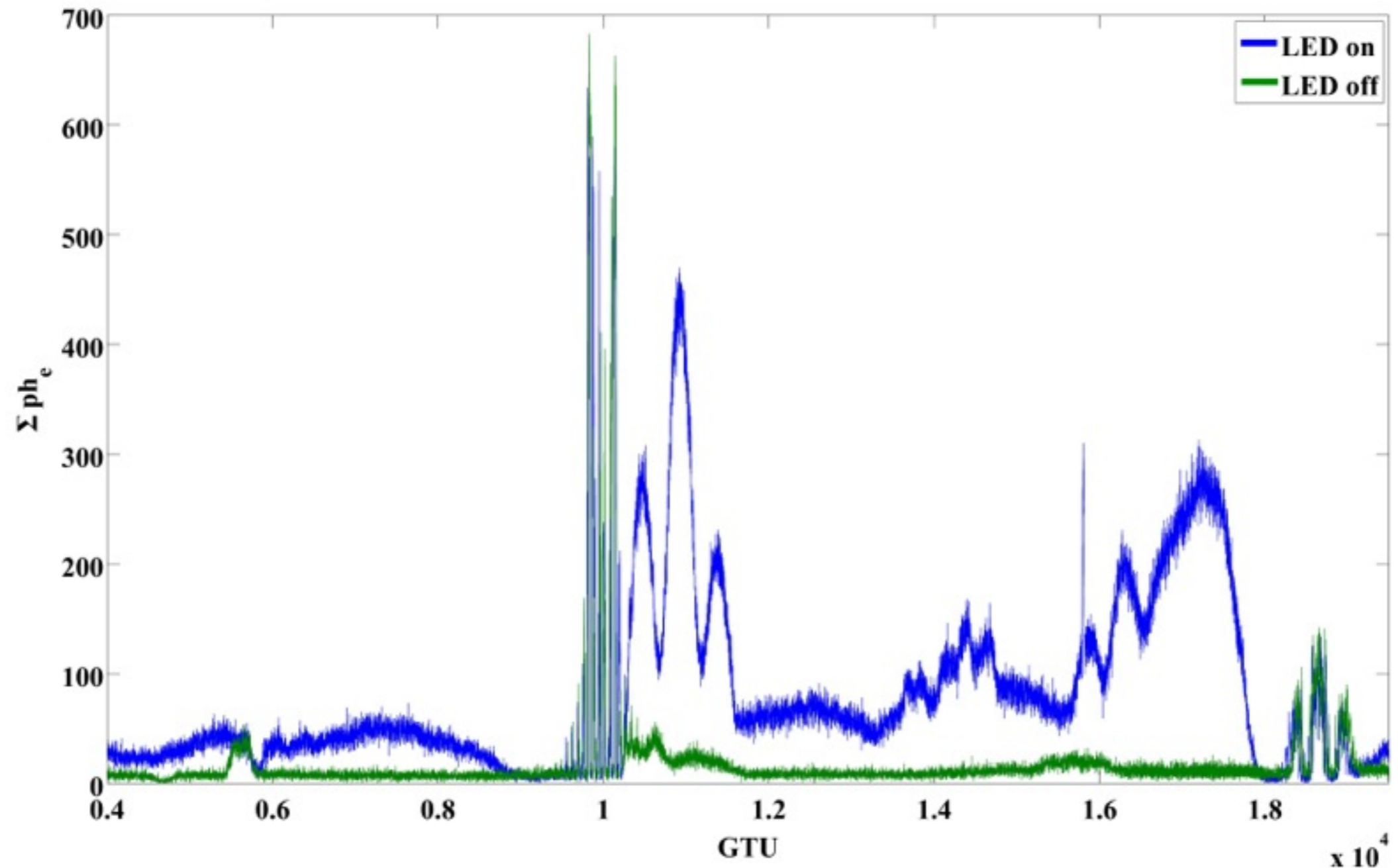
sorgenti di luce

- * luce diretta
- * luce riflessa



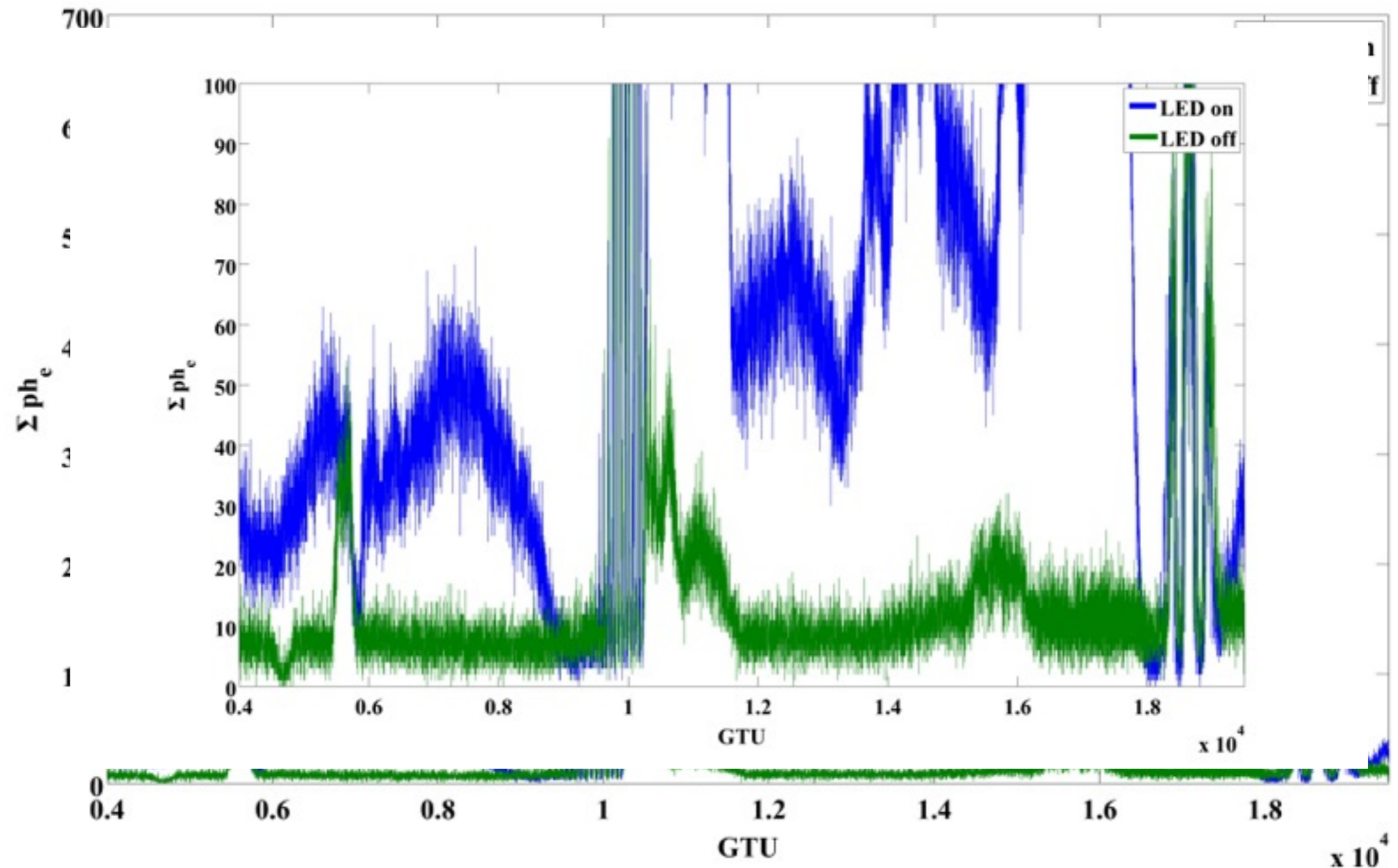
sorgenti di luce

- * luce diretta
- * luce riflessa



luce di background

cambiando l'illuminazione della stanza possiamo ottenere diverse condizioni di luminosità dai diversi materiali sulla vasca

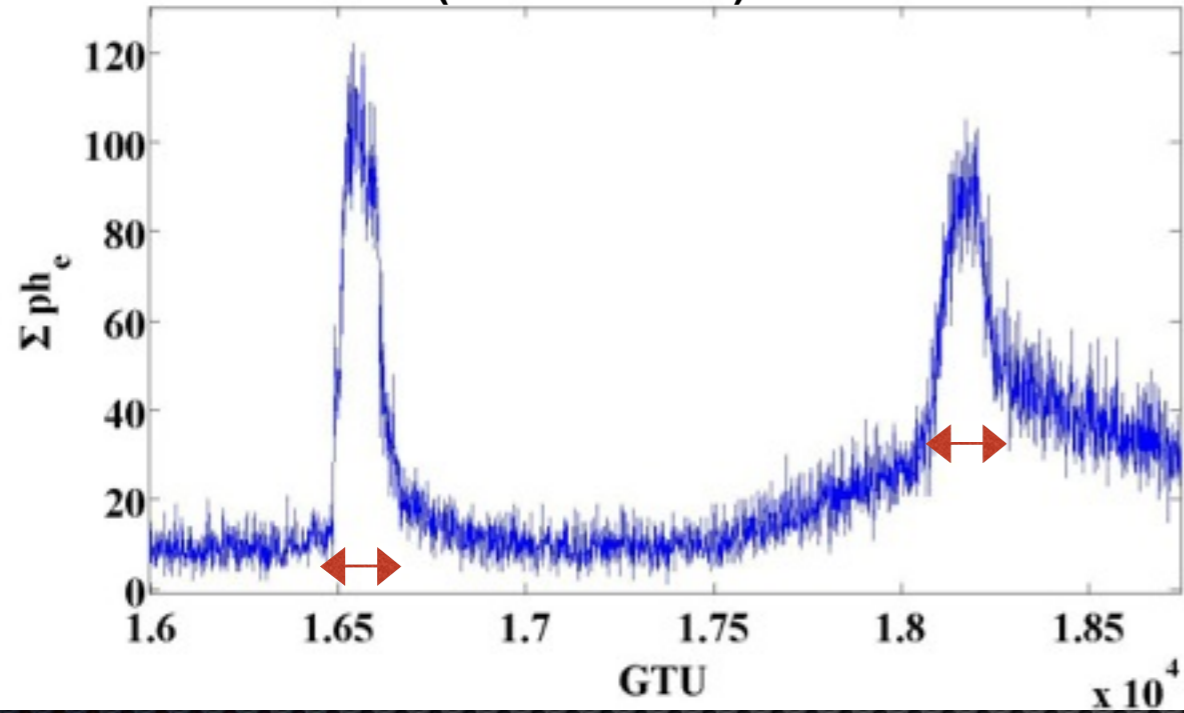


luce di background

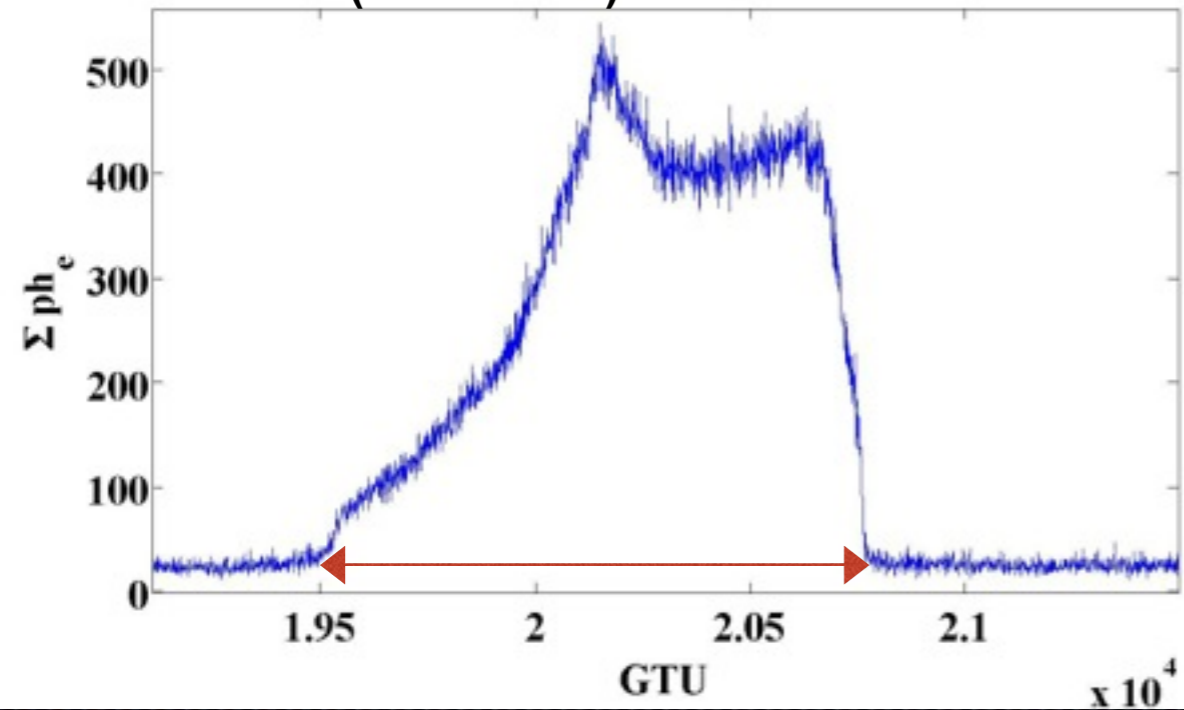
cambiando l'illuminazione della stanza possiamo ottenere diverse condizioni di luminosità dai diversi materiali sulla vasca

Riproduzione di diversi scenari

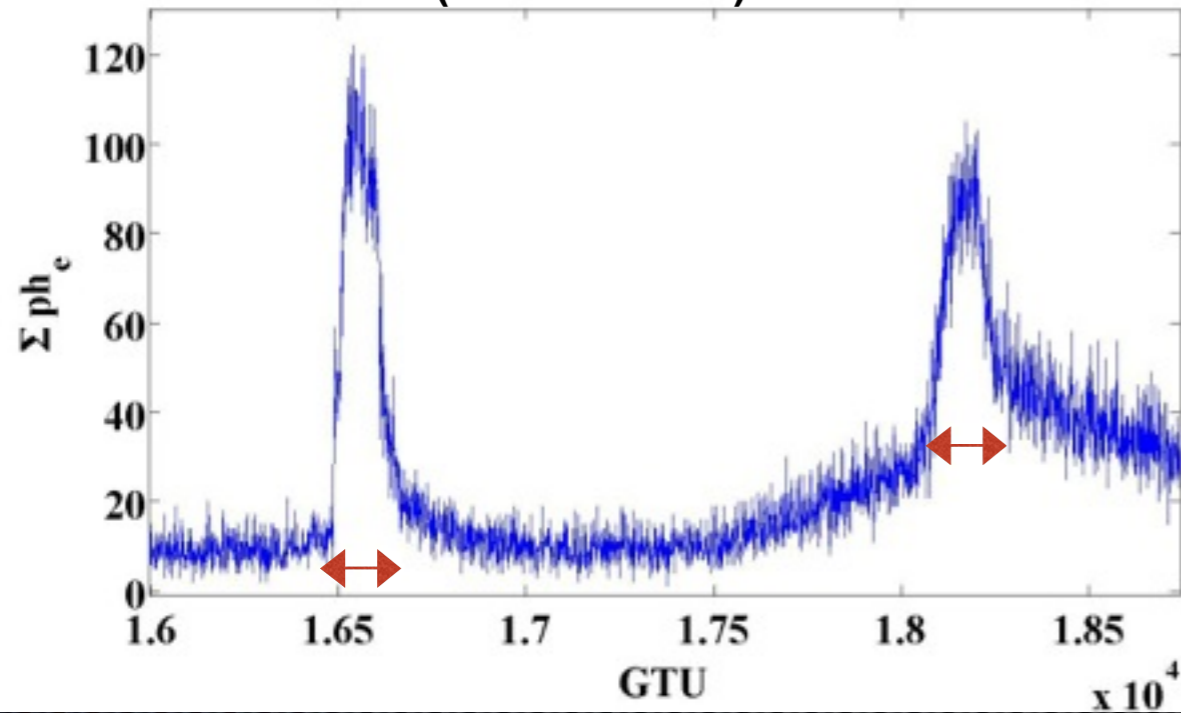
150-200 GTU: 4-5 s (ISS 30-40km)



1800 GTU: 54 s (ISS 380km)



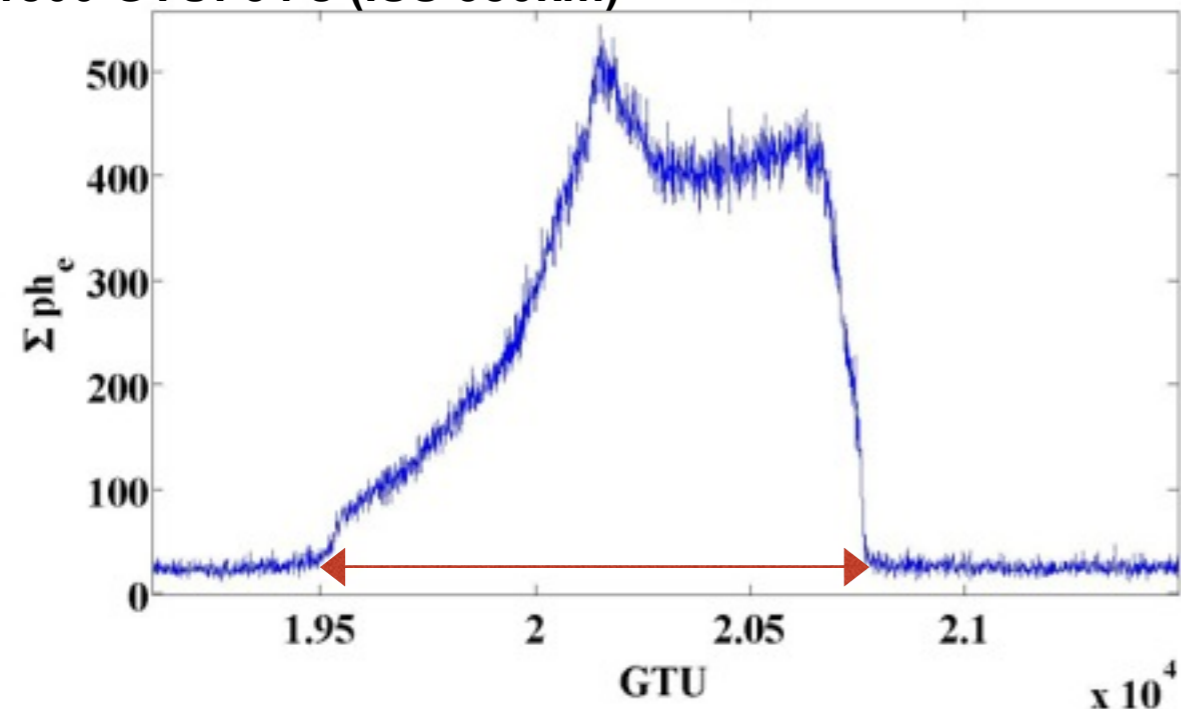
150-200 GTU: 4-5 s (ISS 30-40km)

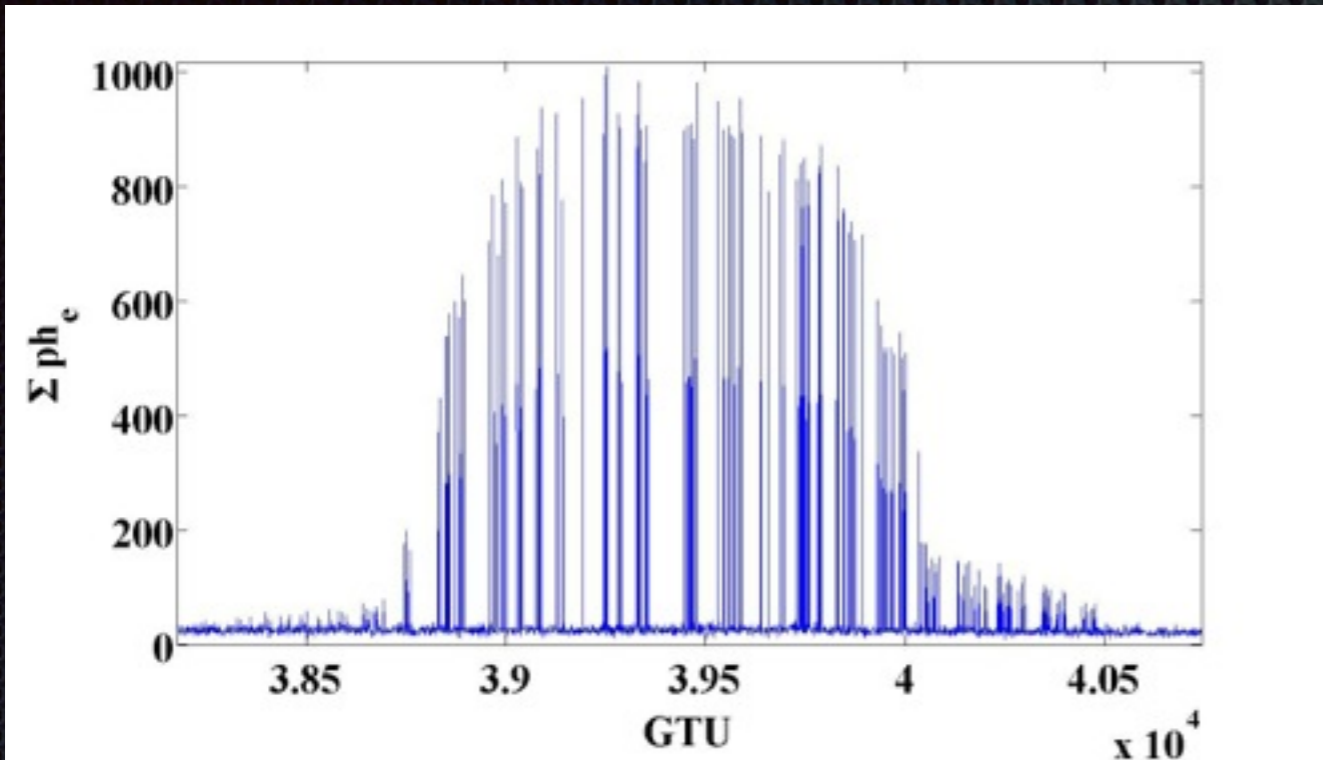


cambiando velocità vasca

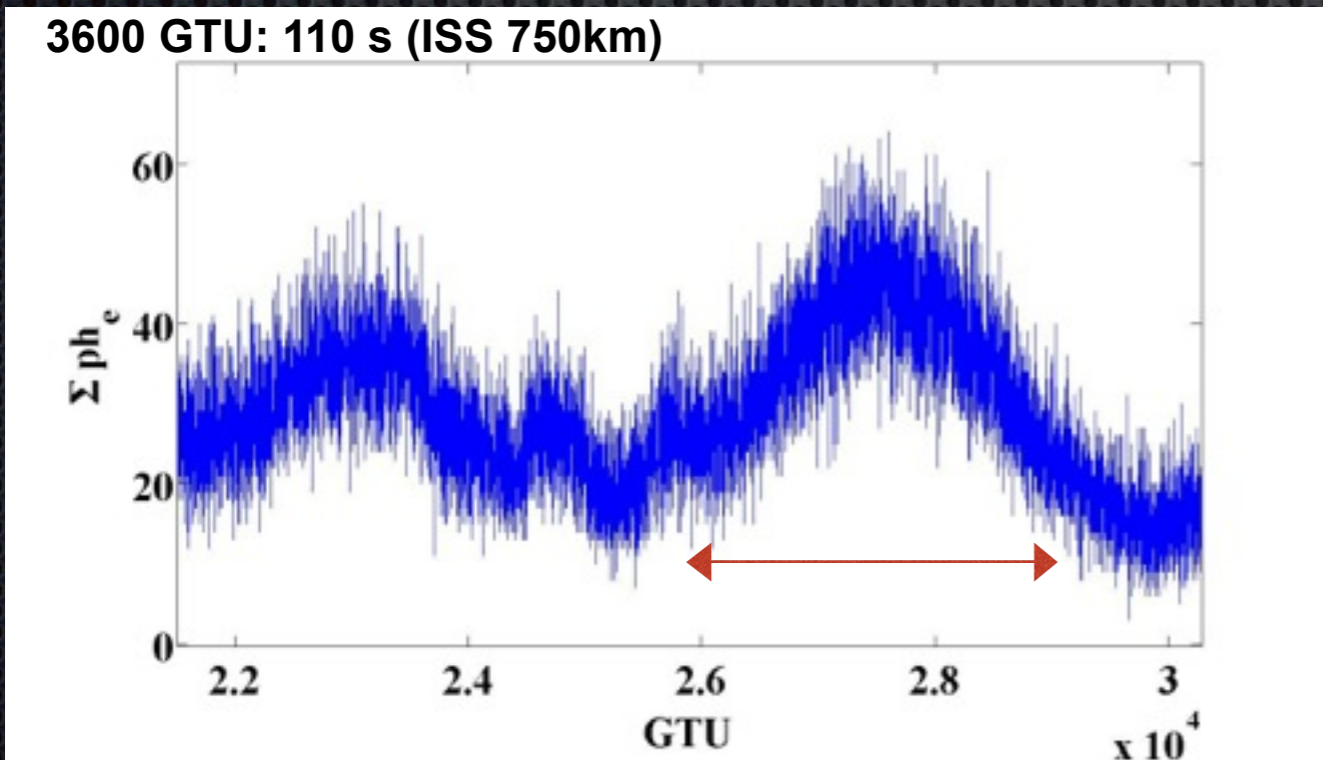
0.7 - 70 s
ISS: 5 - 500 km

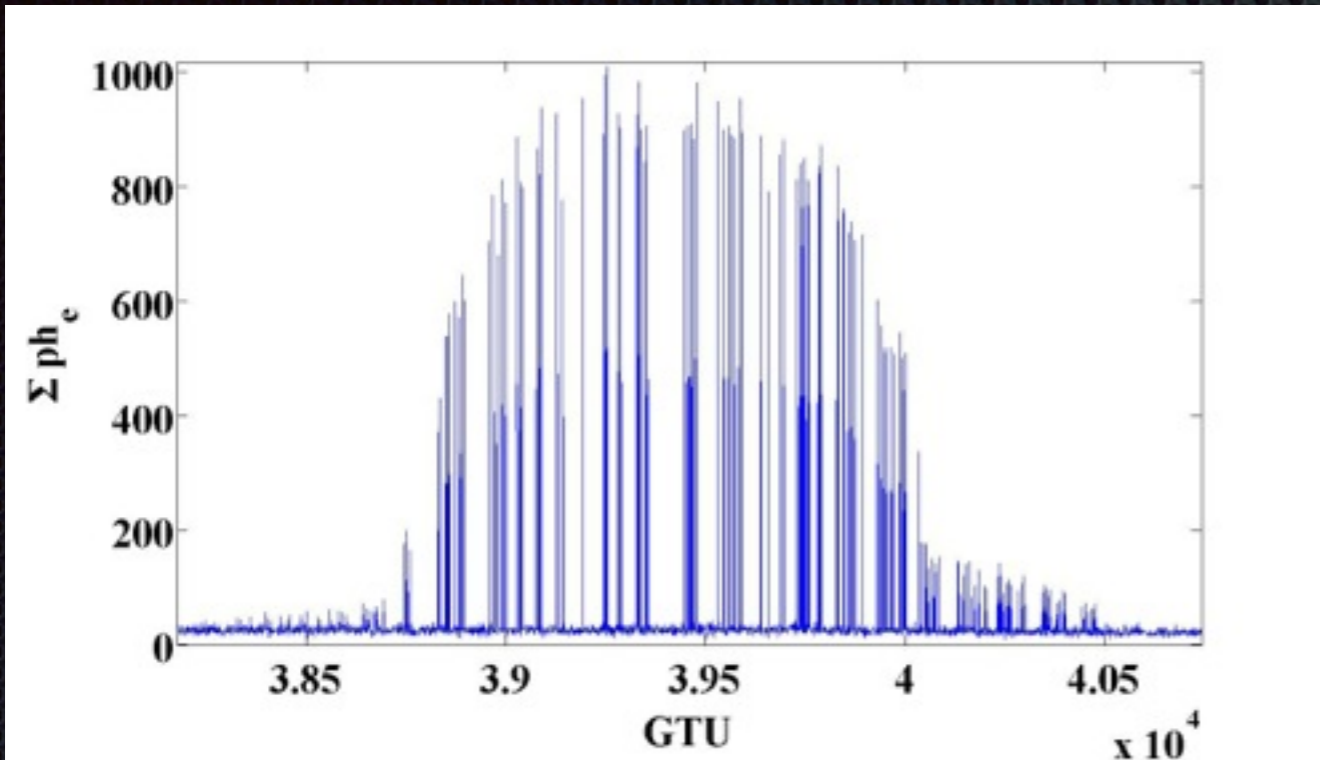
1800 GTU: 54 s (ISS 380km)



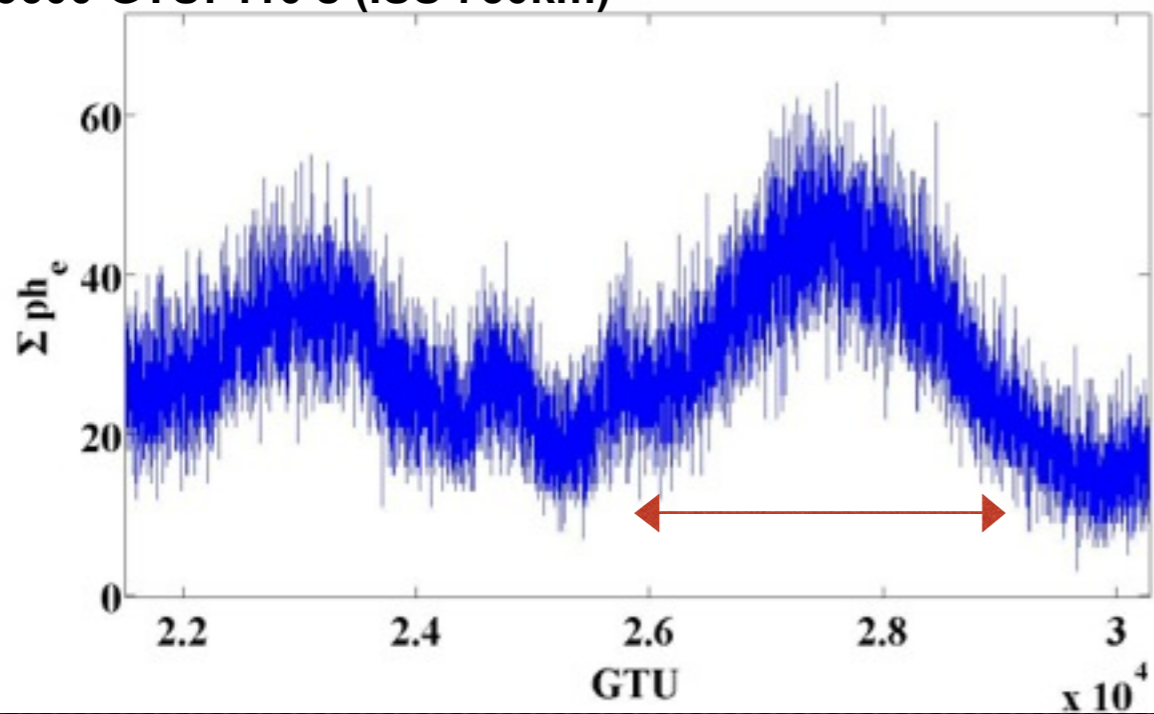


<http://www.nasa.gov>





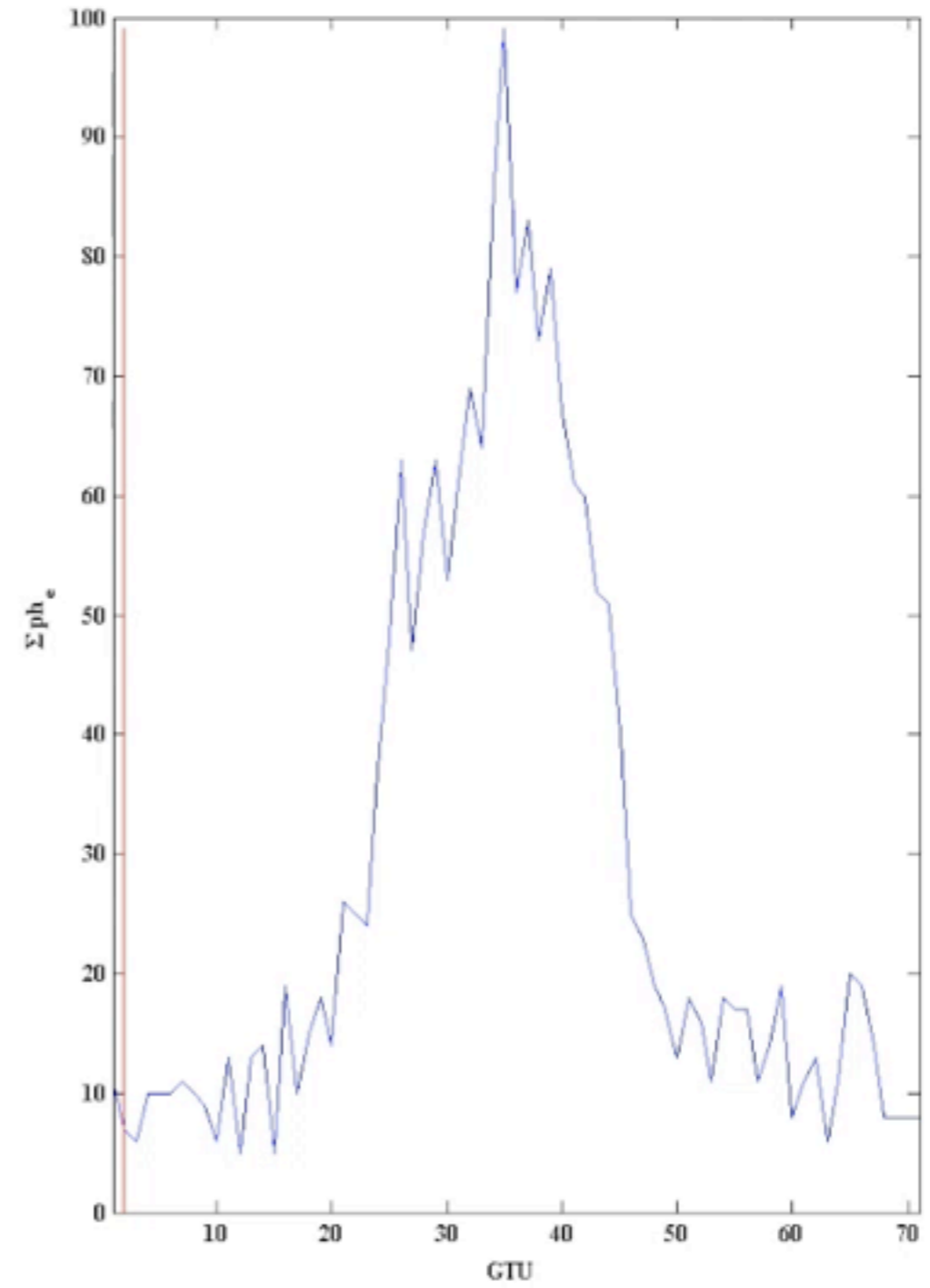
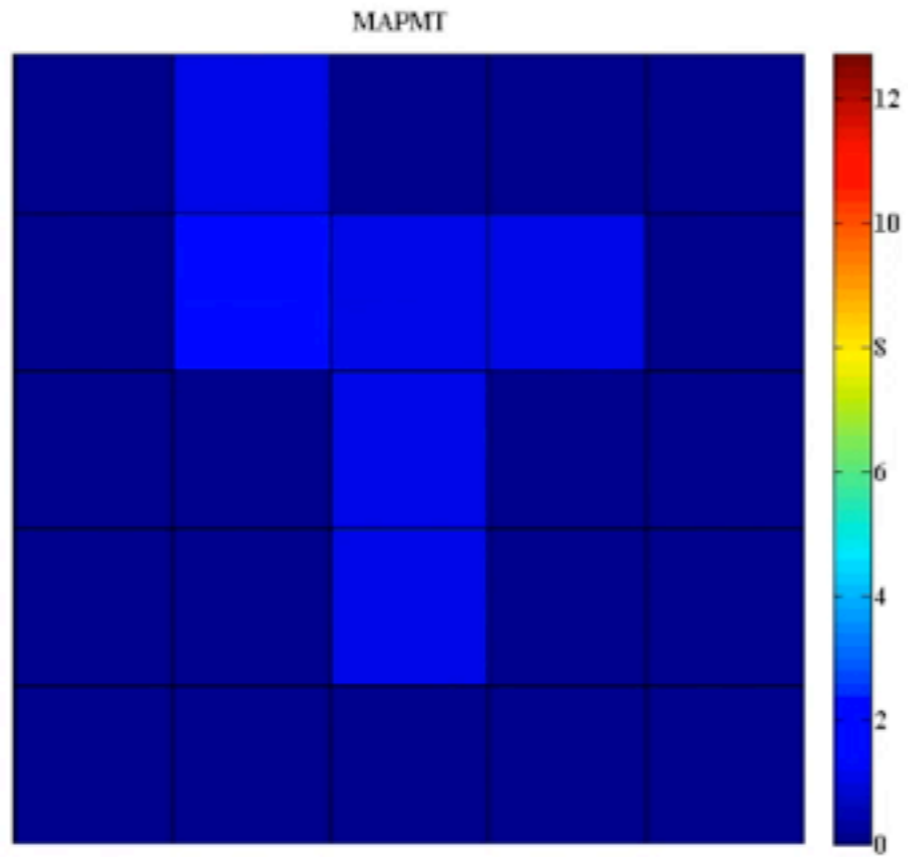
3600 GTU: 110 s (ISS 750km)



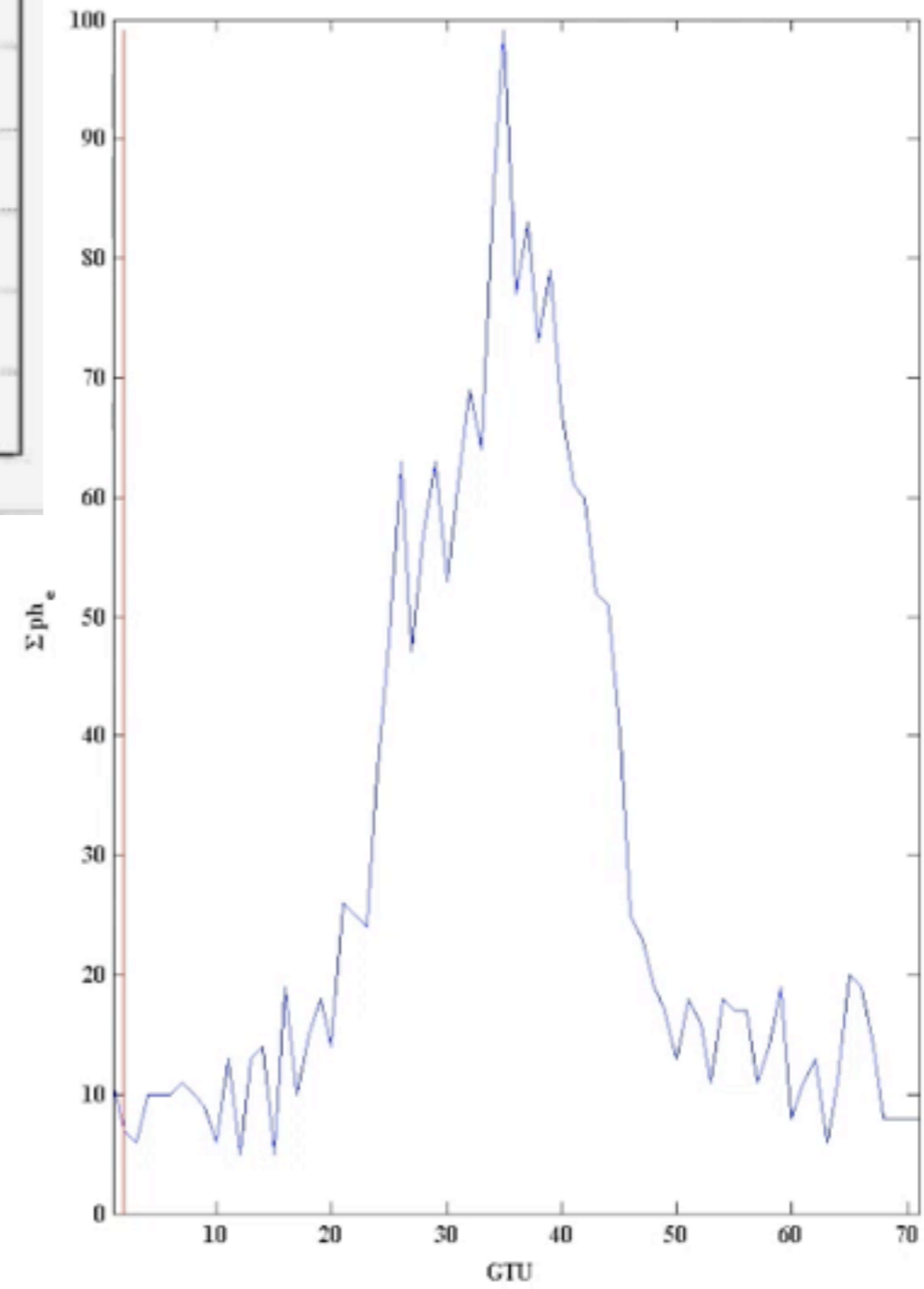
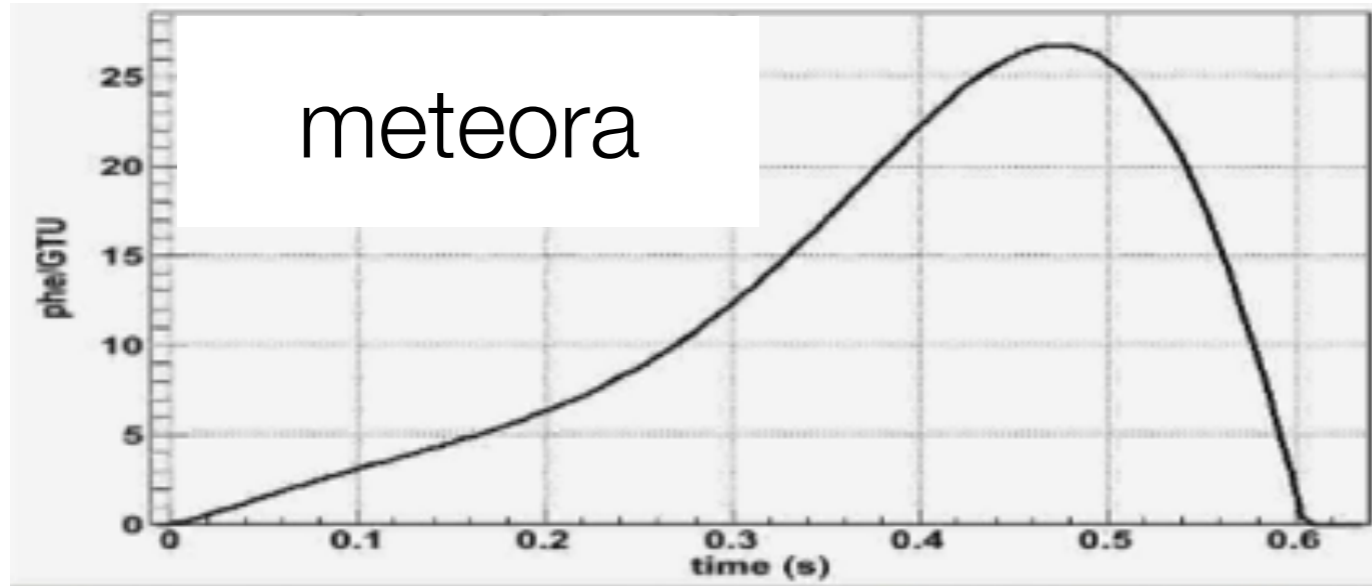
1.4 - 140 s
ISS: 10-1000 km



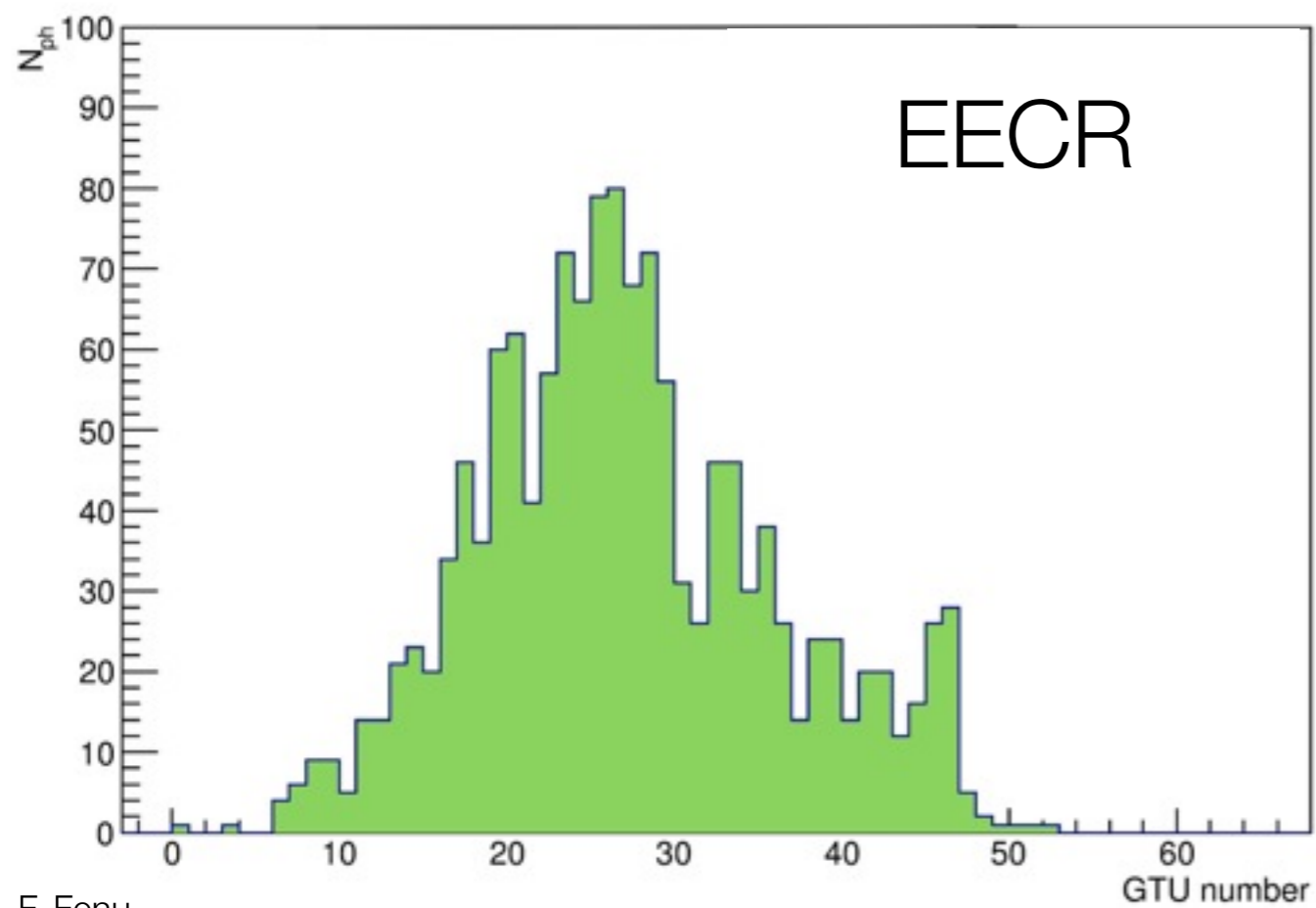
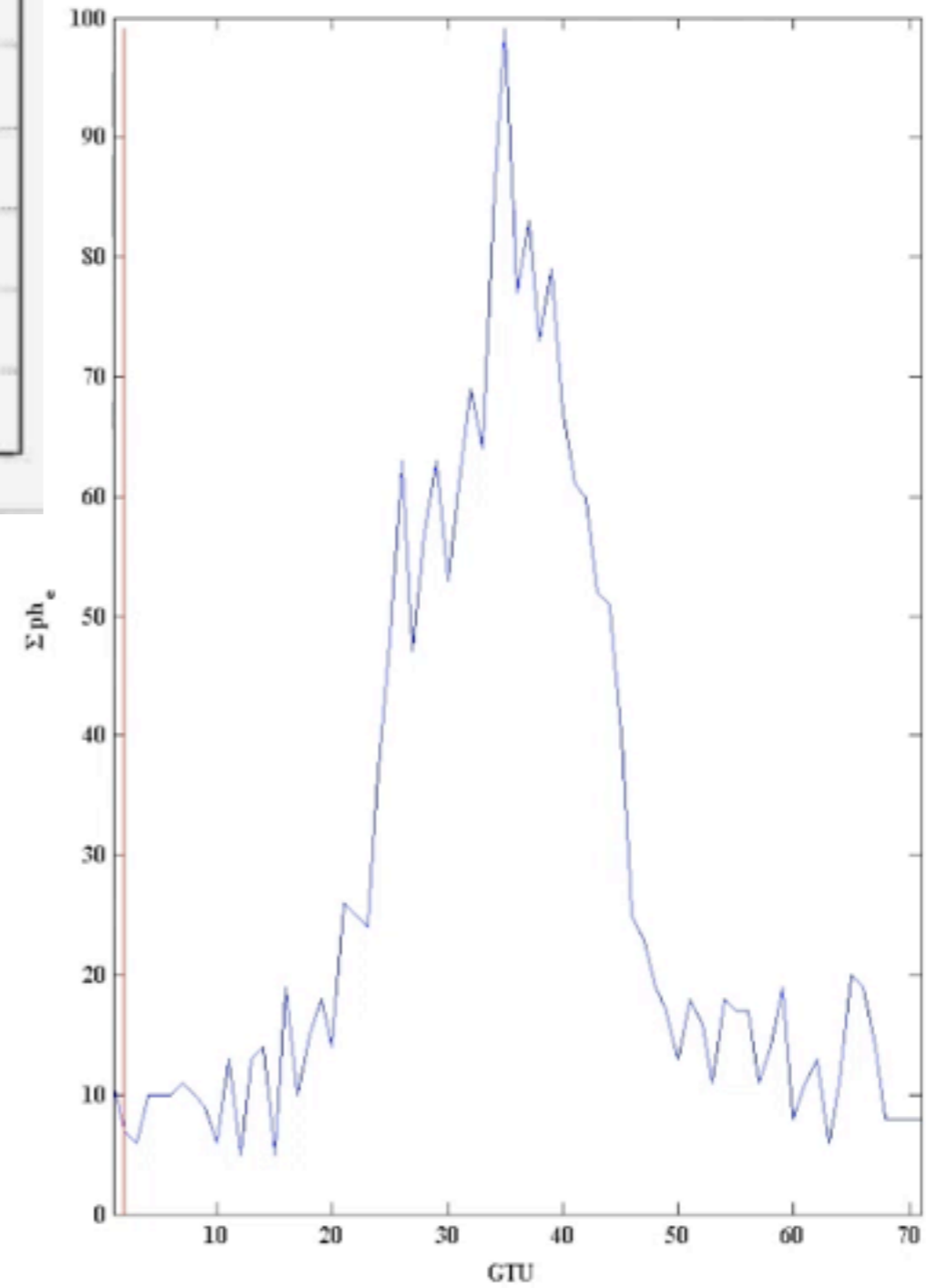
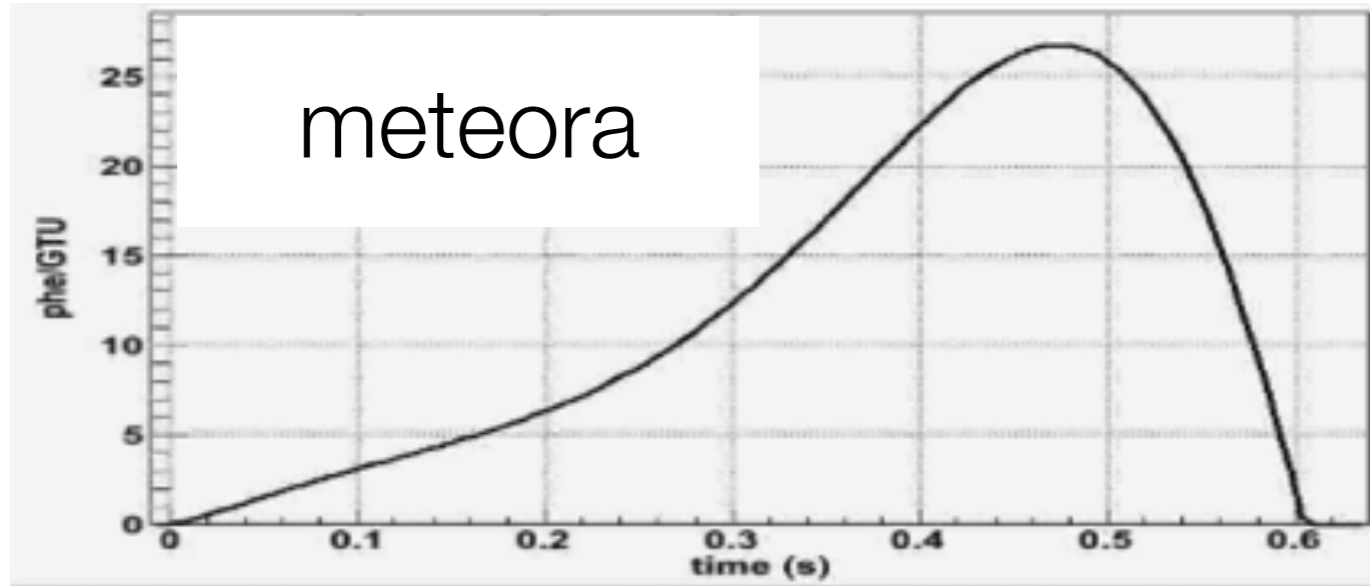
20-30 GTU: 0.6-0.9 s



20-30 GTU: 0.6-0.9 s



20-30 GTU: 0.6-0.9 s



Trigger

320000 pixel ogni 2.5 μ s

VS

ISS data transferring 300 kbit/s

è necessario selezionare i dati da salvare

Trigger

10^{11} data/s

320000 pixel ogni 2.5 μ s

VS

ISS data transferring 300 kbit/s

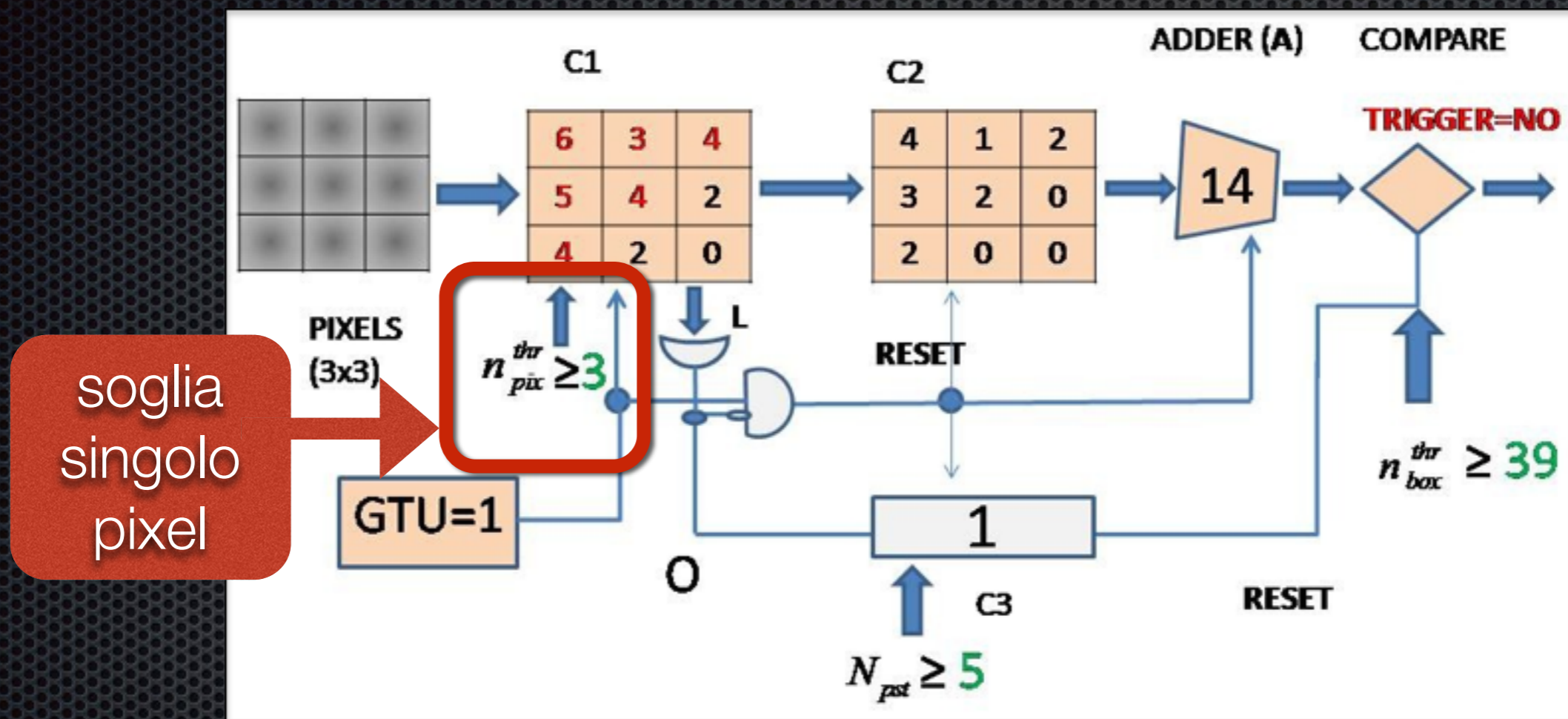
è necessario selezionare i dati da salvare

rate di acquisizione ammesso:
qualche Hz/PDM

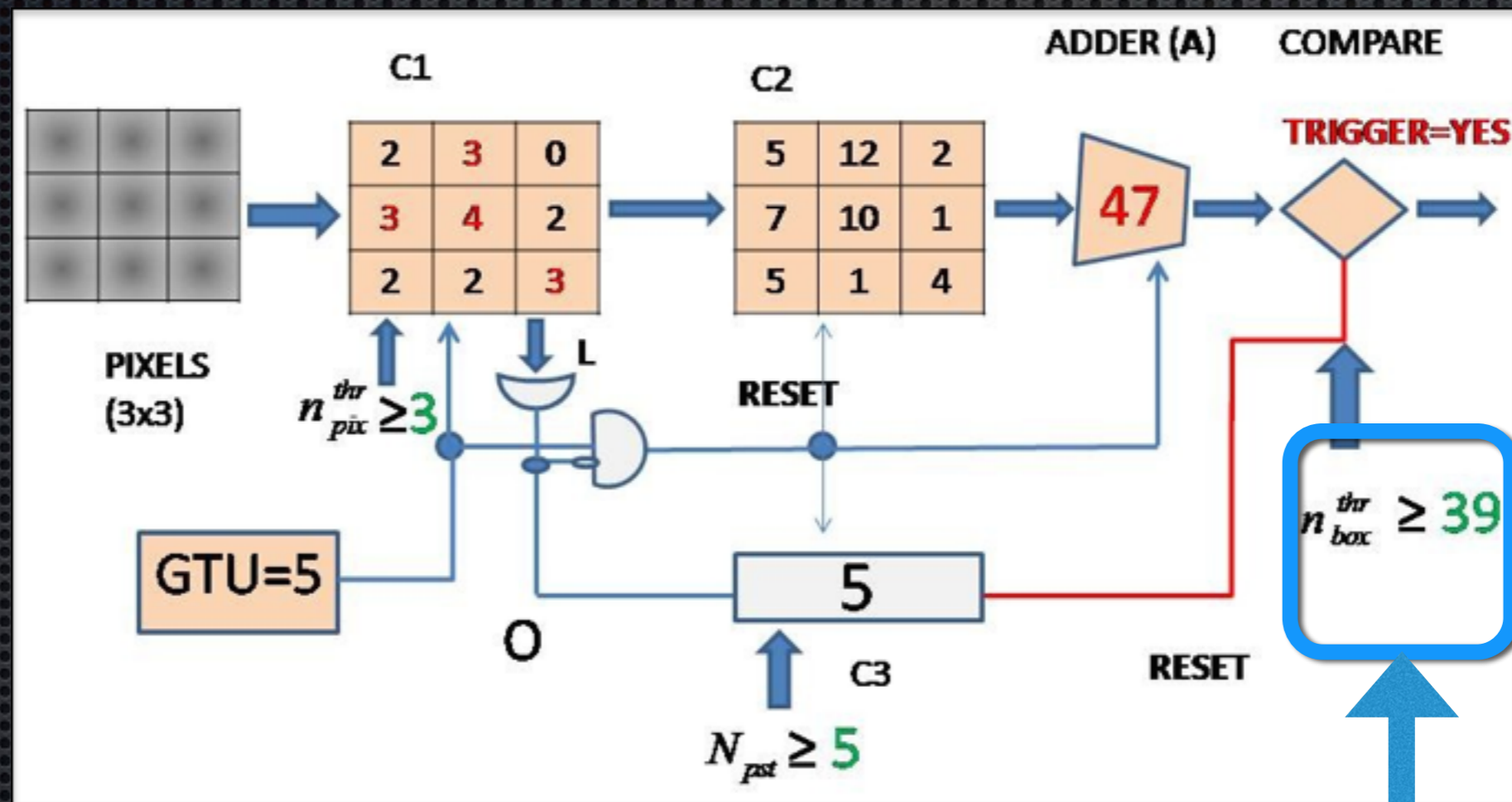
Trigger di primo livello

- ✦ Rilevare la luminosità in eccesso rispetto al background
- ✦ Verificare che la durata del segnale luminoso sia compatibile con un raggio cosmico

Pre - trigger: rileva luminosità in eccesso

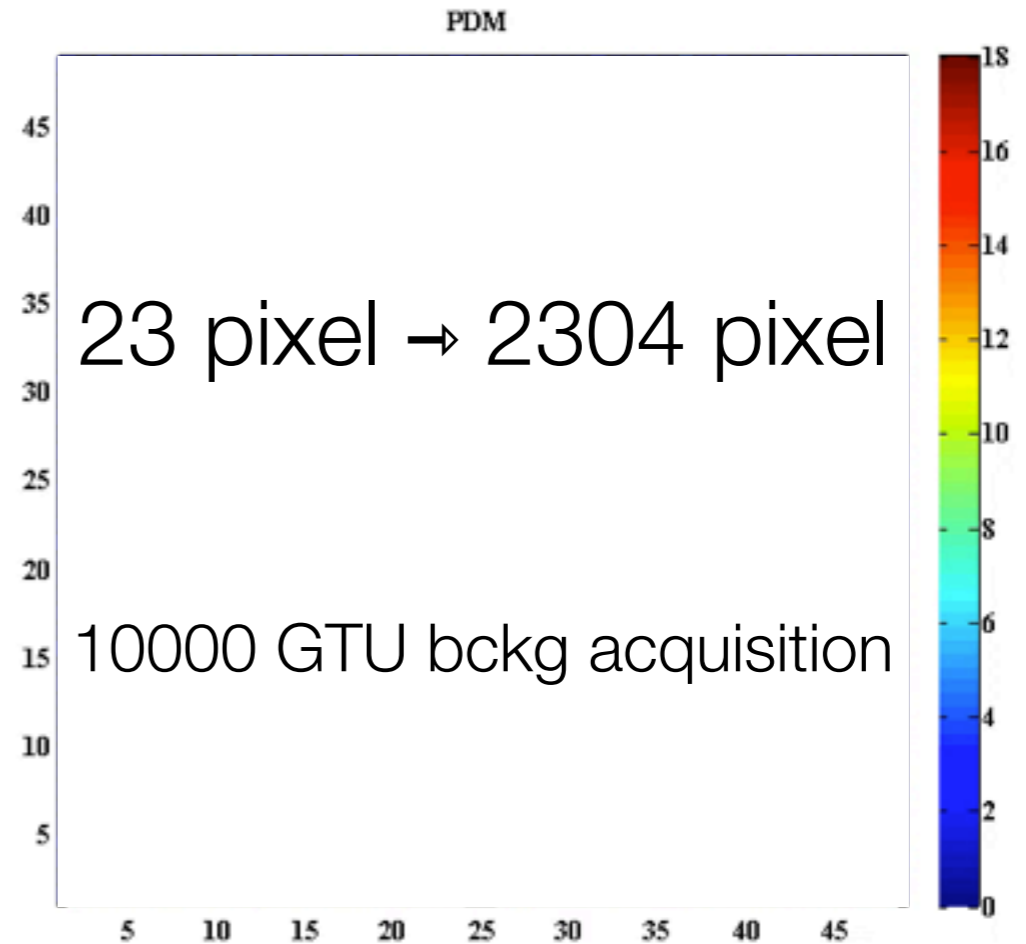


Pre - trigger

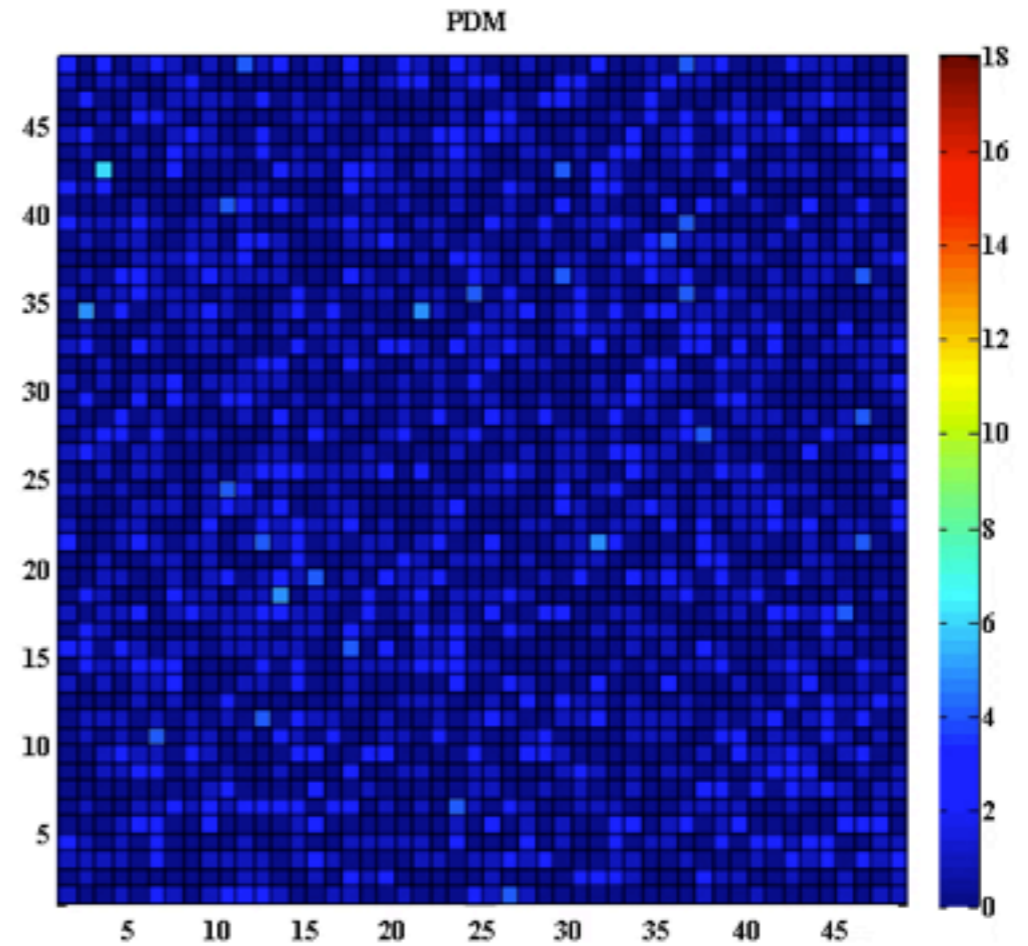


soglia
3x3 pixel

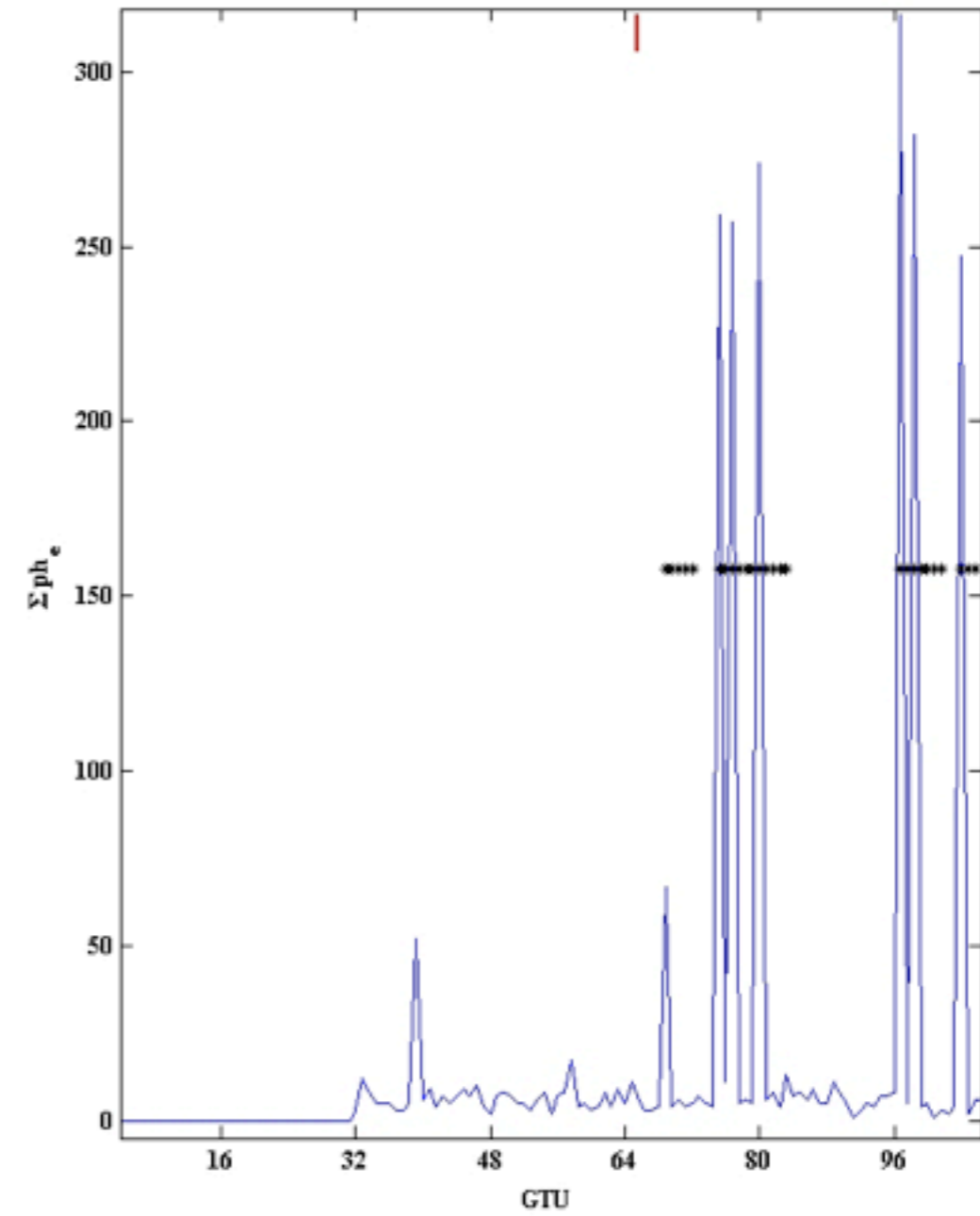
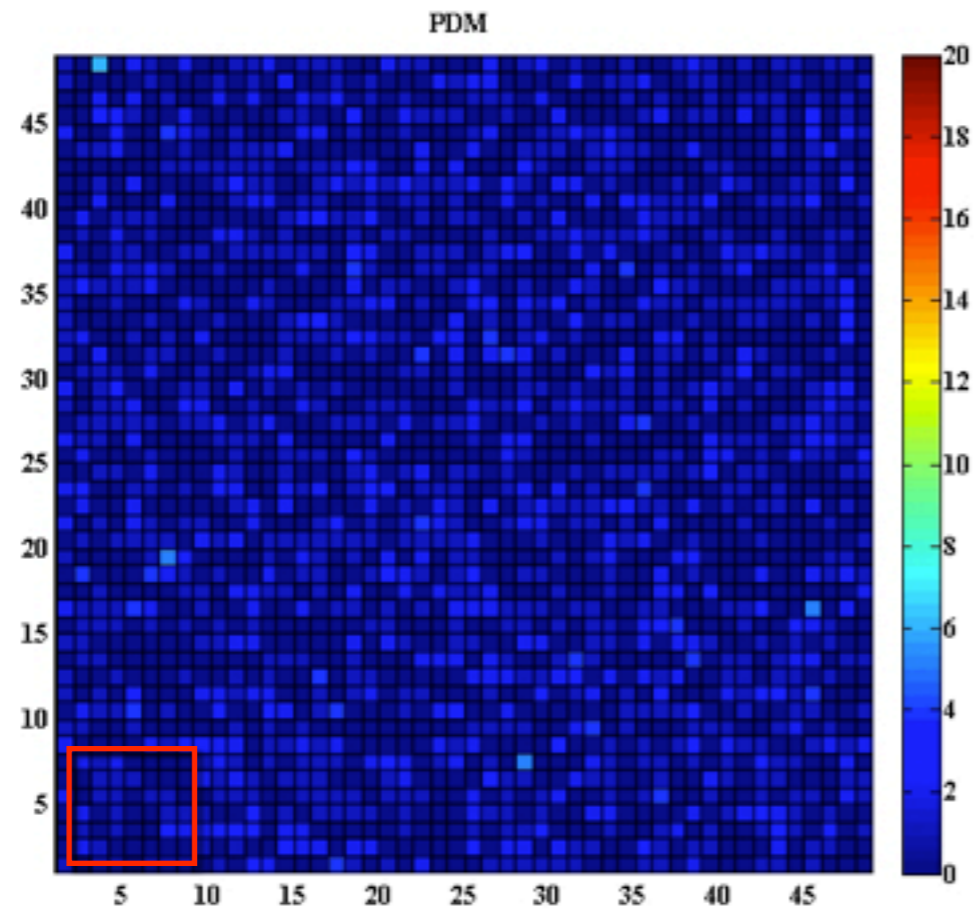
L'arte di
arrangiarsi
ricreare una PDM con
un MAPMT 5x5



L'arte di
arrangiarsi
ricreare una PDM con
un MAPMT 5x5

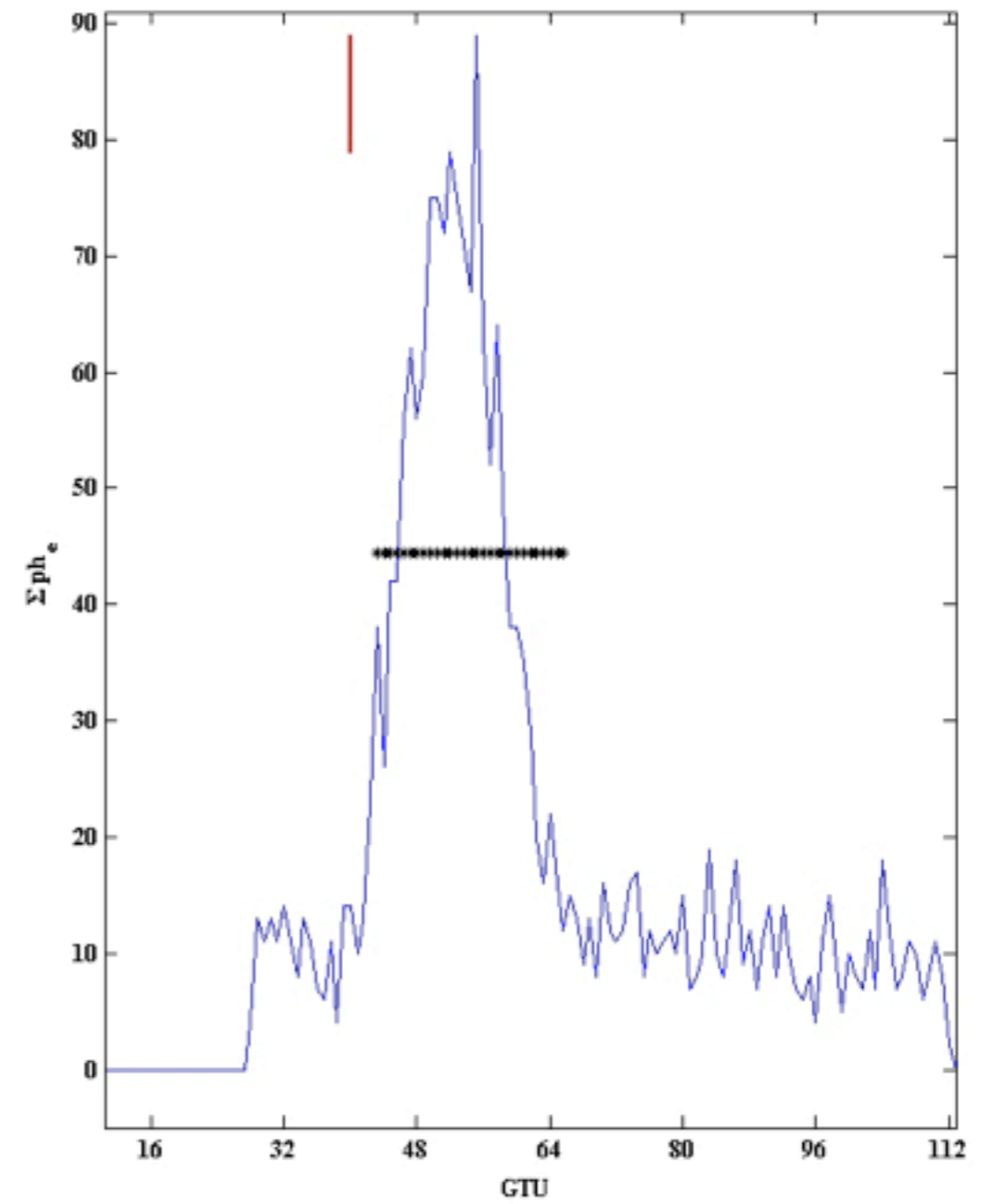
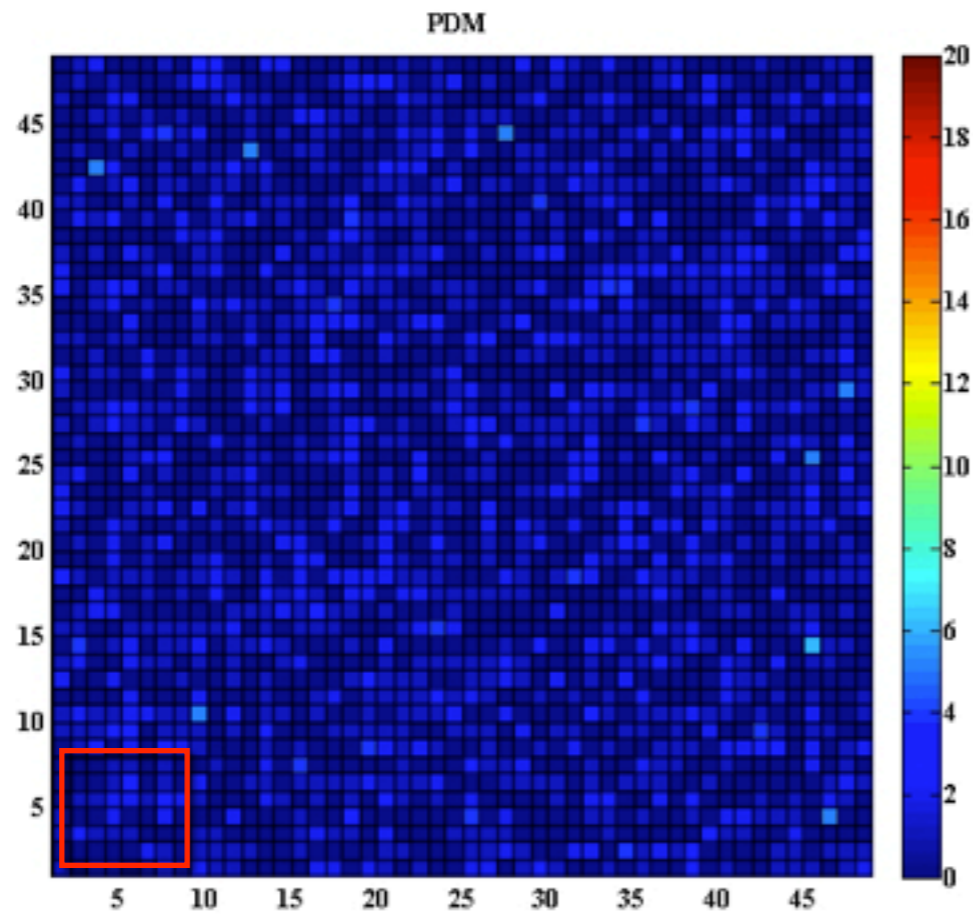


pre-trigger



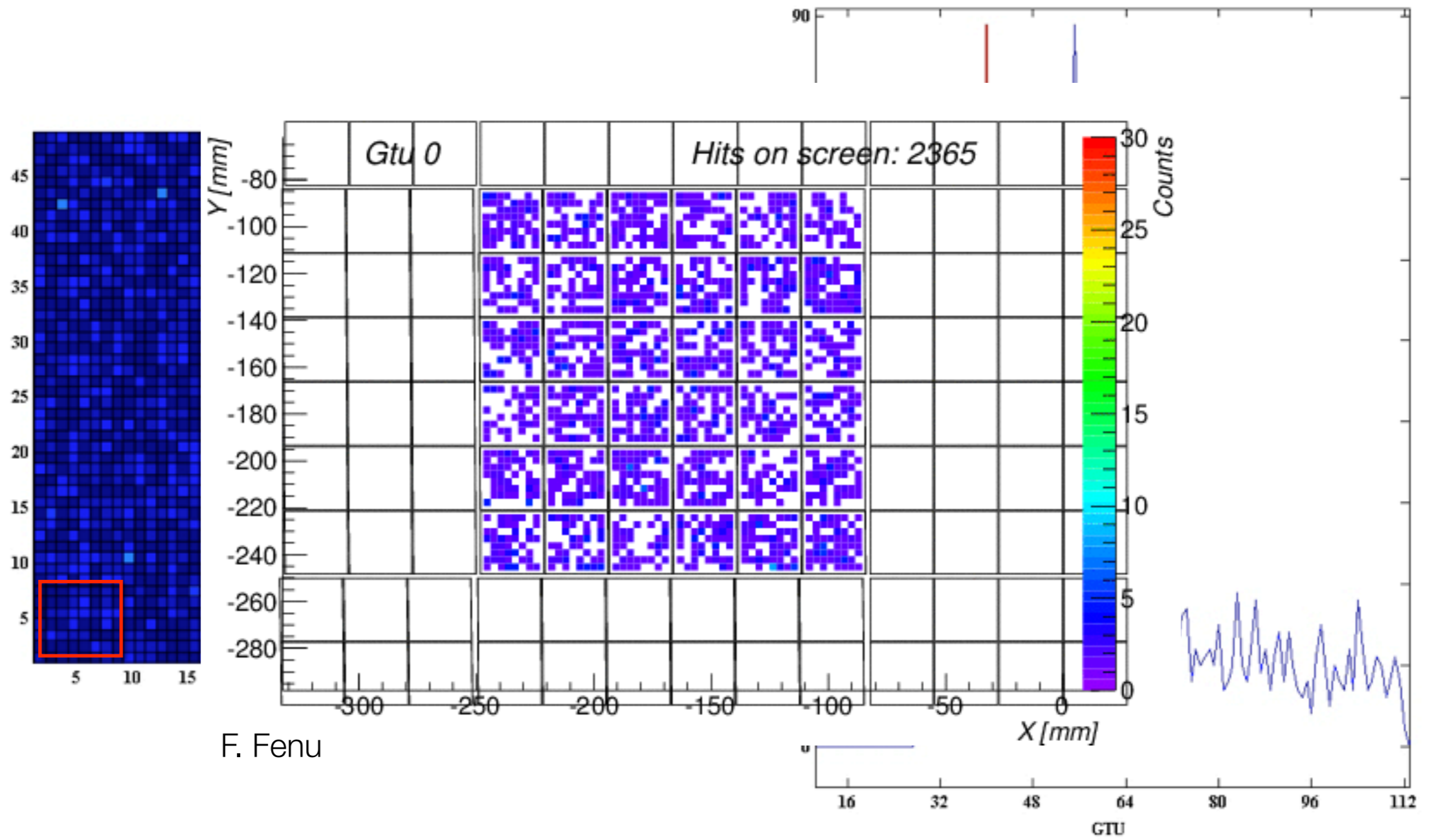
fulmini

pre-trigger



EECR

pre-trigger



F. Fenu

EECR

Conclusioni

- ✦ Il primo livello di trigger di JEM-EUSO è stato testato utilizzando misure reali ottenute da un MAPMT 25 pixel
- ✦ Si è dimostrata la possibilità di ricreare al TurLab una larga varietà di situazioni compatibili con le condizioni di lavoro di JEM-EUSO
- ✦ Grazie ai risultati ottenuti il TurLab è oggi considerato con interesse nello sviluppo del progetto JEM-EUSO

fine