Trasgo Project & Tragaldabas

Status report

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Outlook:

1. The beginning
2. The TRASGO project
3. Where we are!
4. TRAGALDABAS: preliminary results
   - FD June 2015
   - Atmosphere analysis
5. The TRASGO Project: Next steps
6. Summary & Conclusions

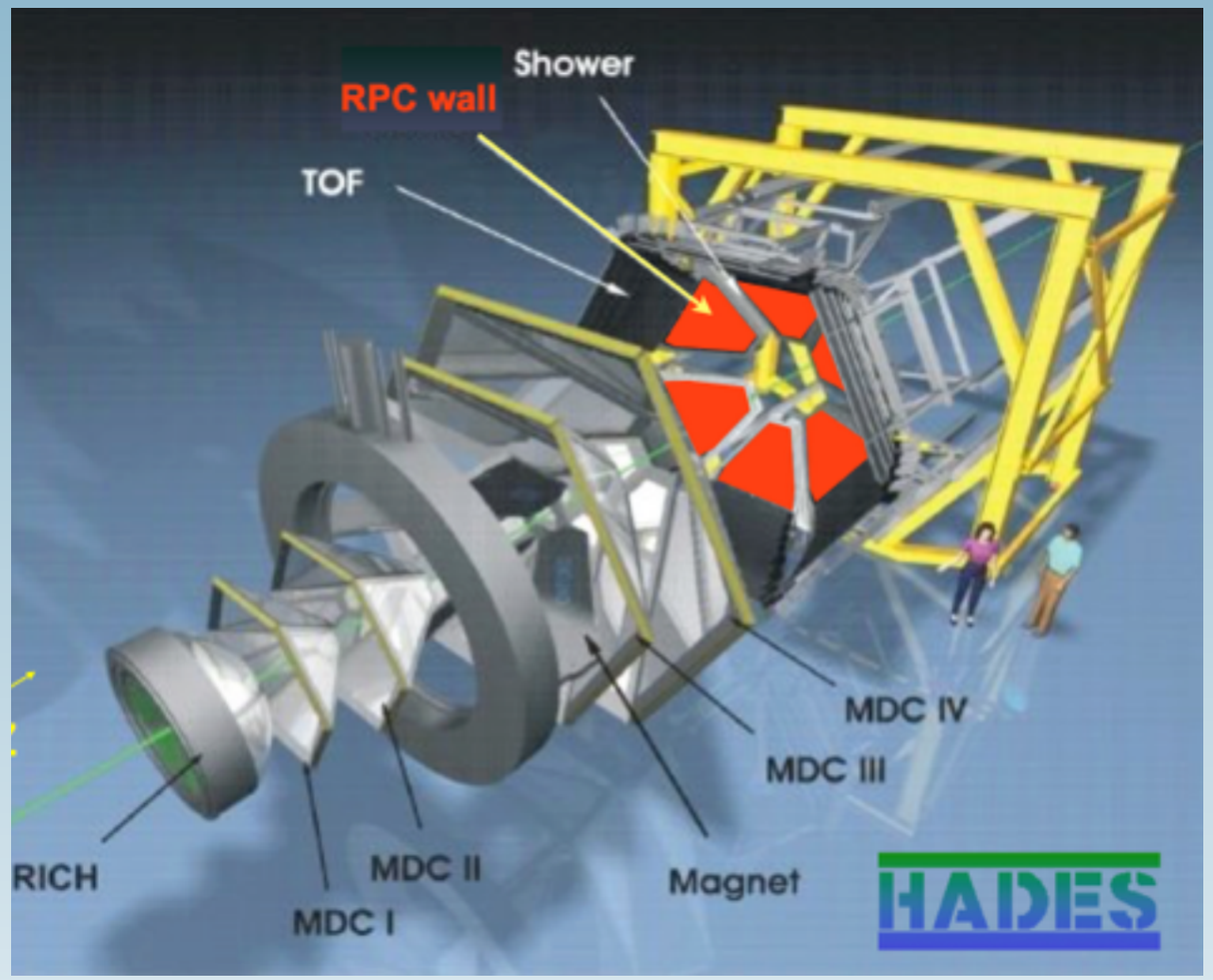
everything began with just a logo…

Proyecto

Project

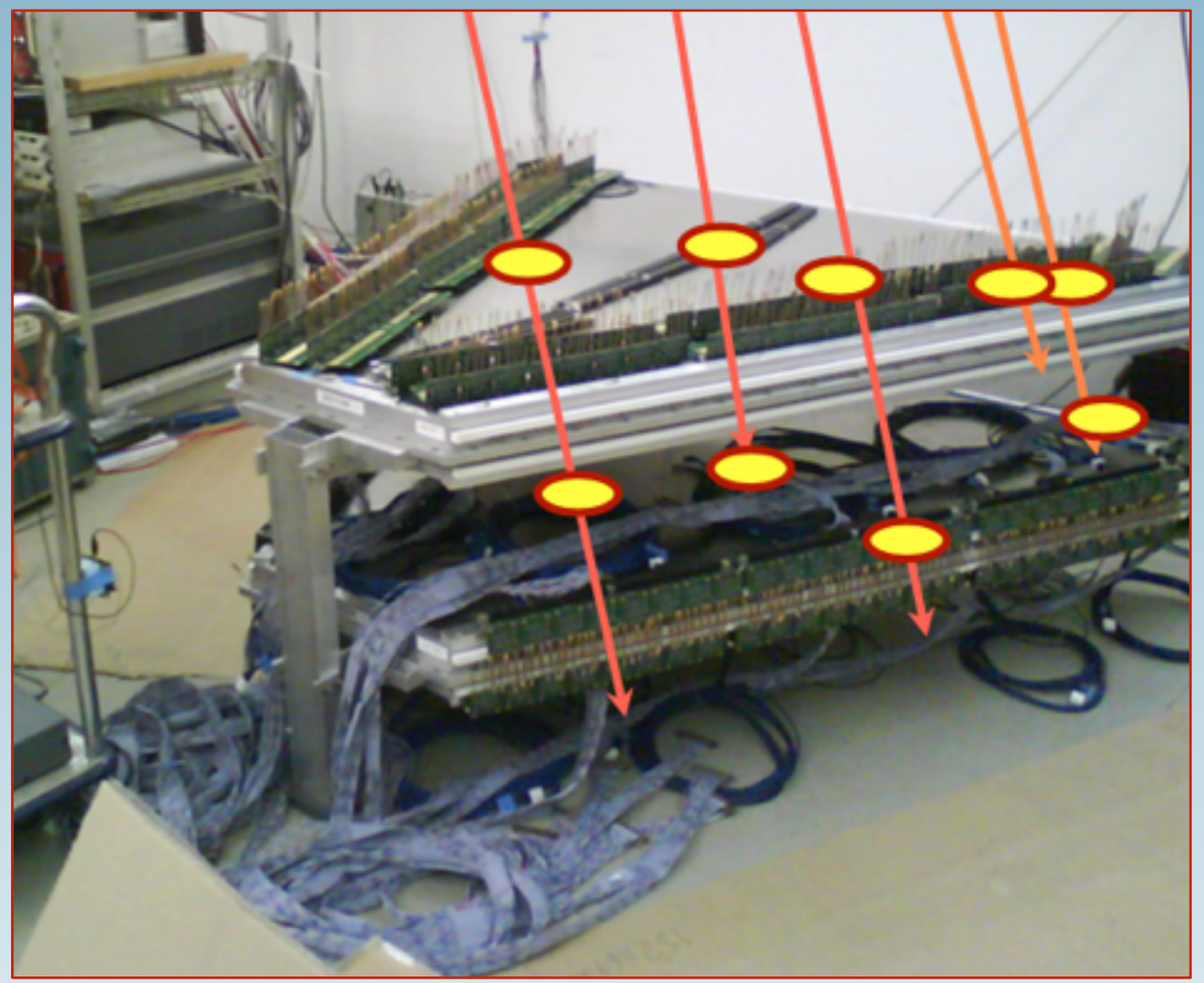
The beginning

The Nuclear Physics HADES experiment



The HADES spectrometer at GSI-Darmstadt

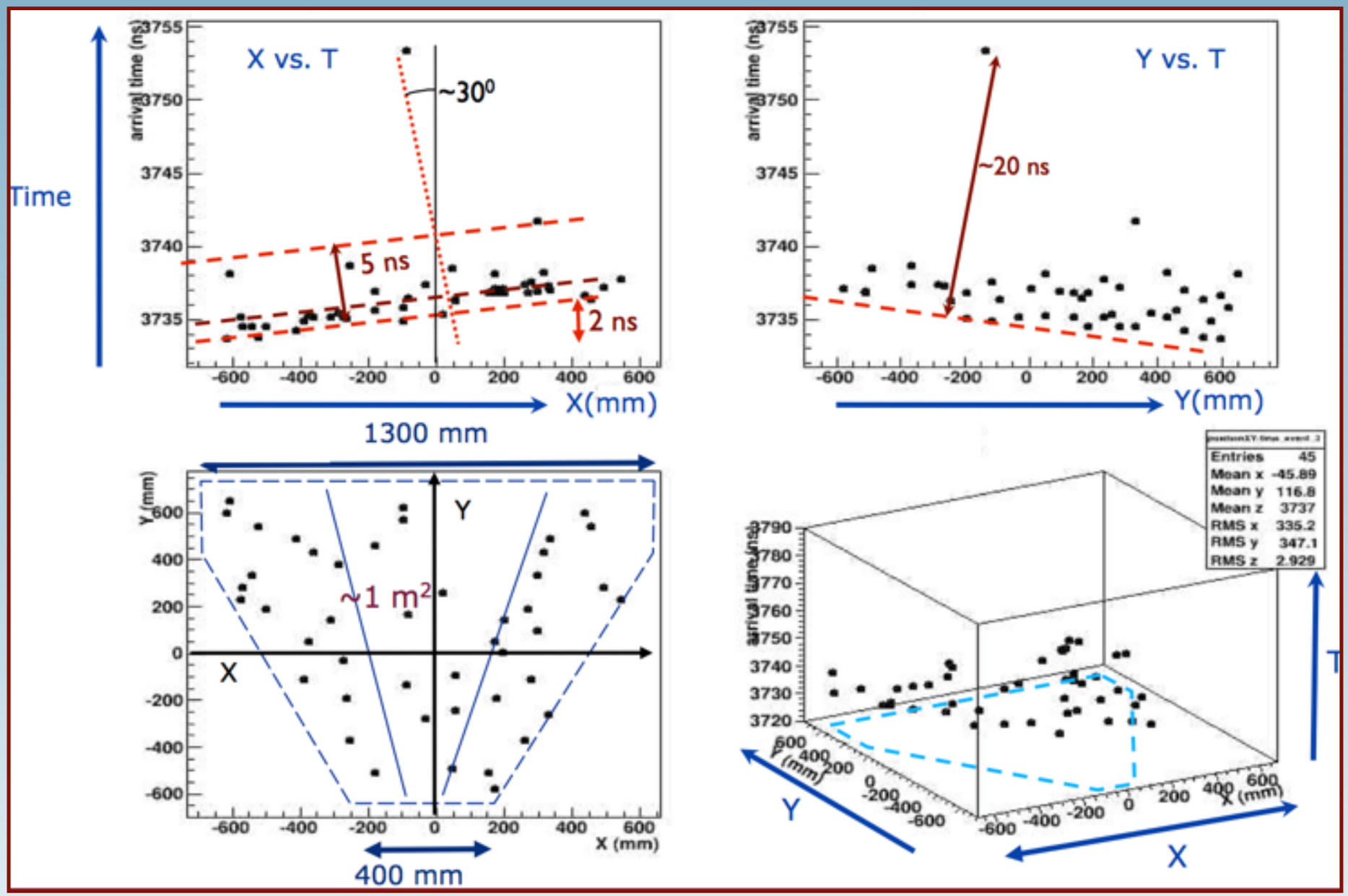
The RPC wall commissioning



RPC commissioning with cosmic rays

The beginning

A cosmic ray shower picture using the HADES RPC detectors

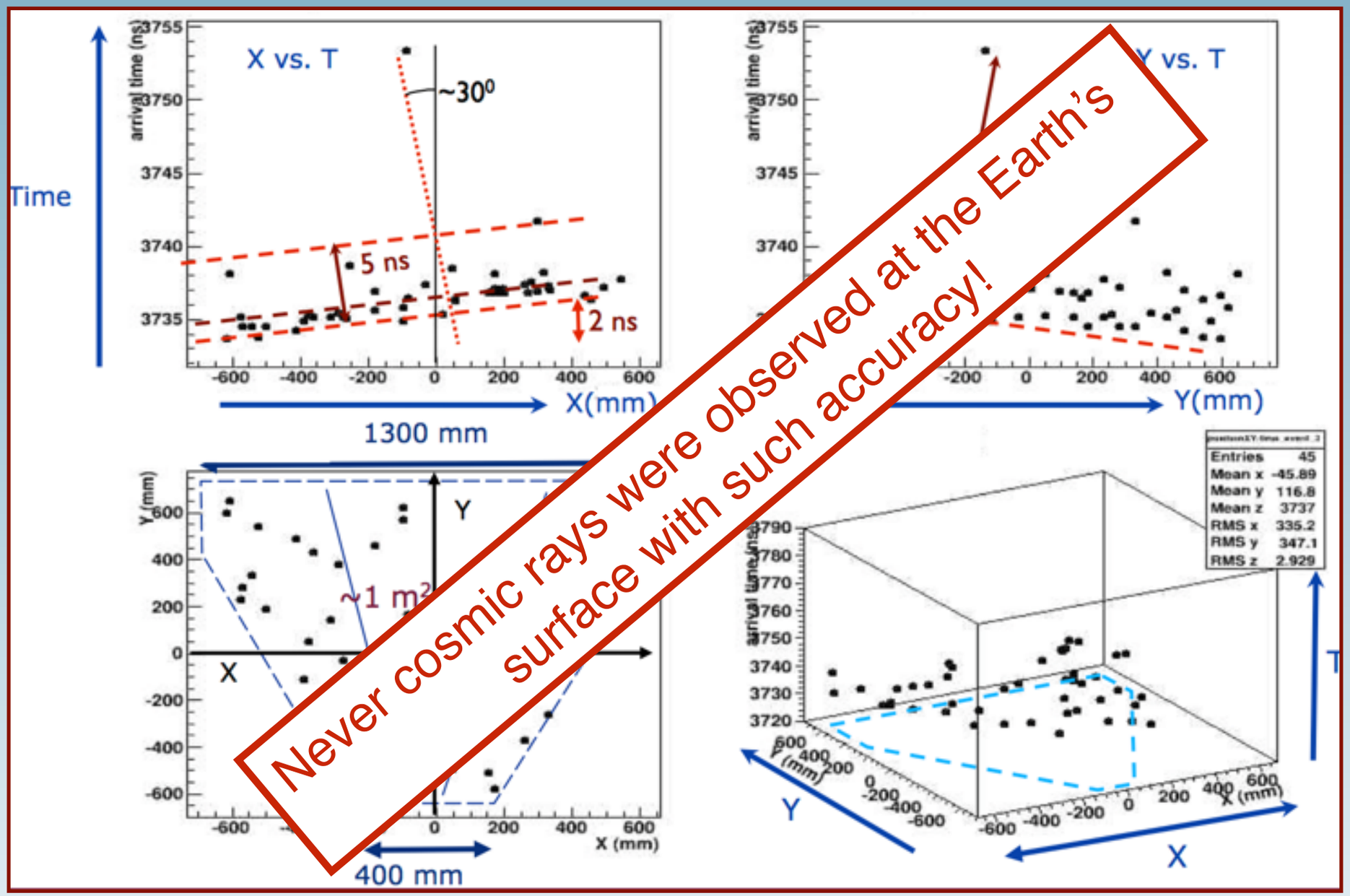


$\delta T \sim 150$ ps, $\delta S \sim 5$ cm^2, $\delta\theta \sim 5^\circ$

Never cosmic rays were observed at the Earth's surface with such accuracy!

The beginning

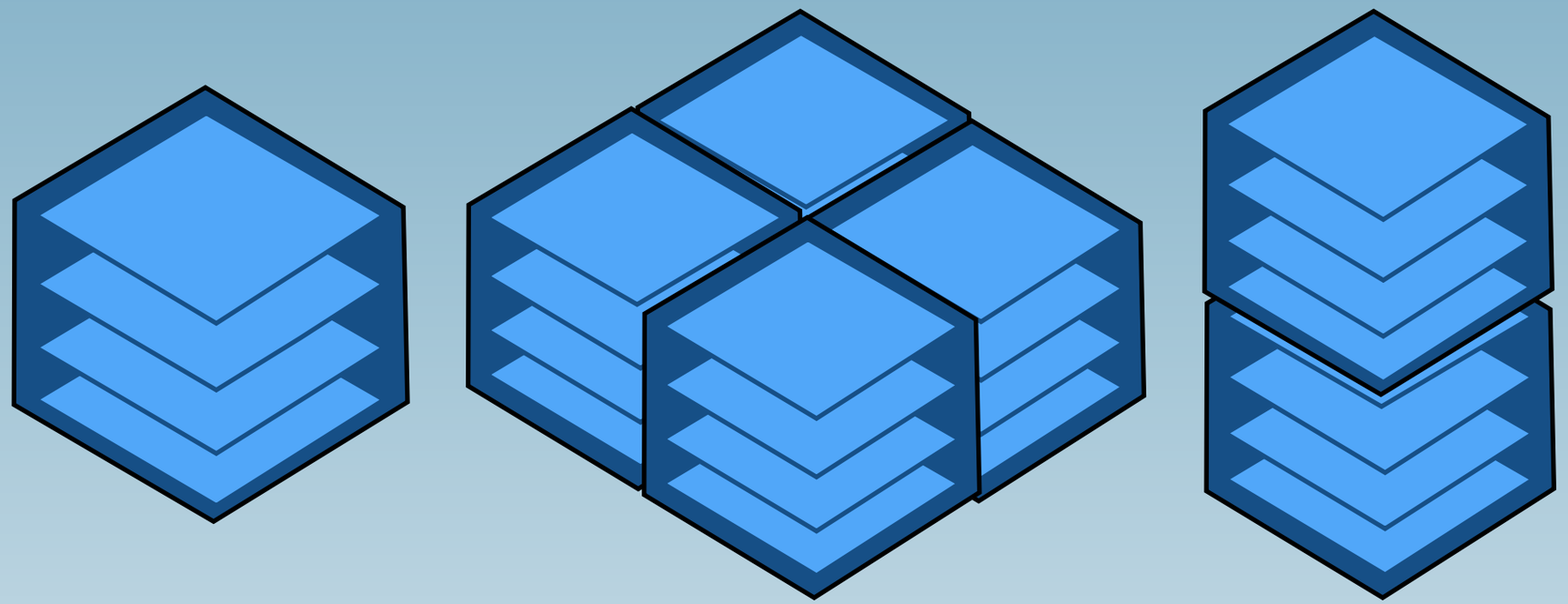
A cosmic ray shower picture using the HADES RPC detectors



Why not building high performance affordable cosmic ray detectors?

The TRASGO project

The answer!

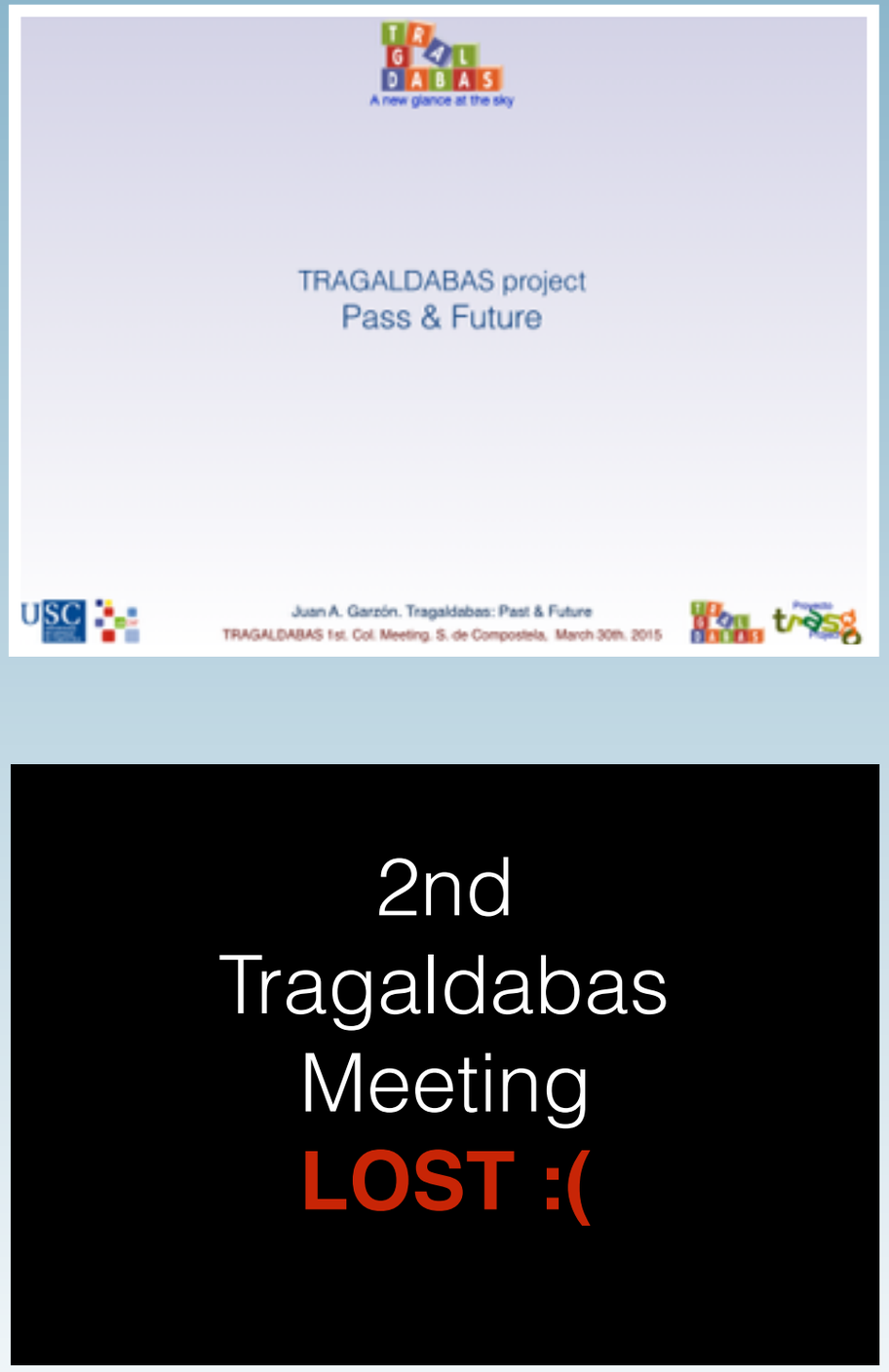


The solution: TRASGO (= pixie, goblin) : TRAck reconStructinG bOx

- Multi-channel Tracking detector
- Modular concept
- Sensitive to both muon and electromagnetic showers (software PID)
- Stand-alone Plug&Play very affordable detector (RPC-based)

The TRASGO project

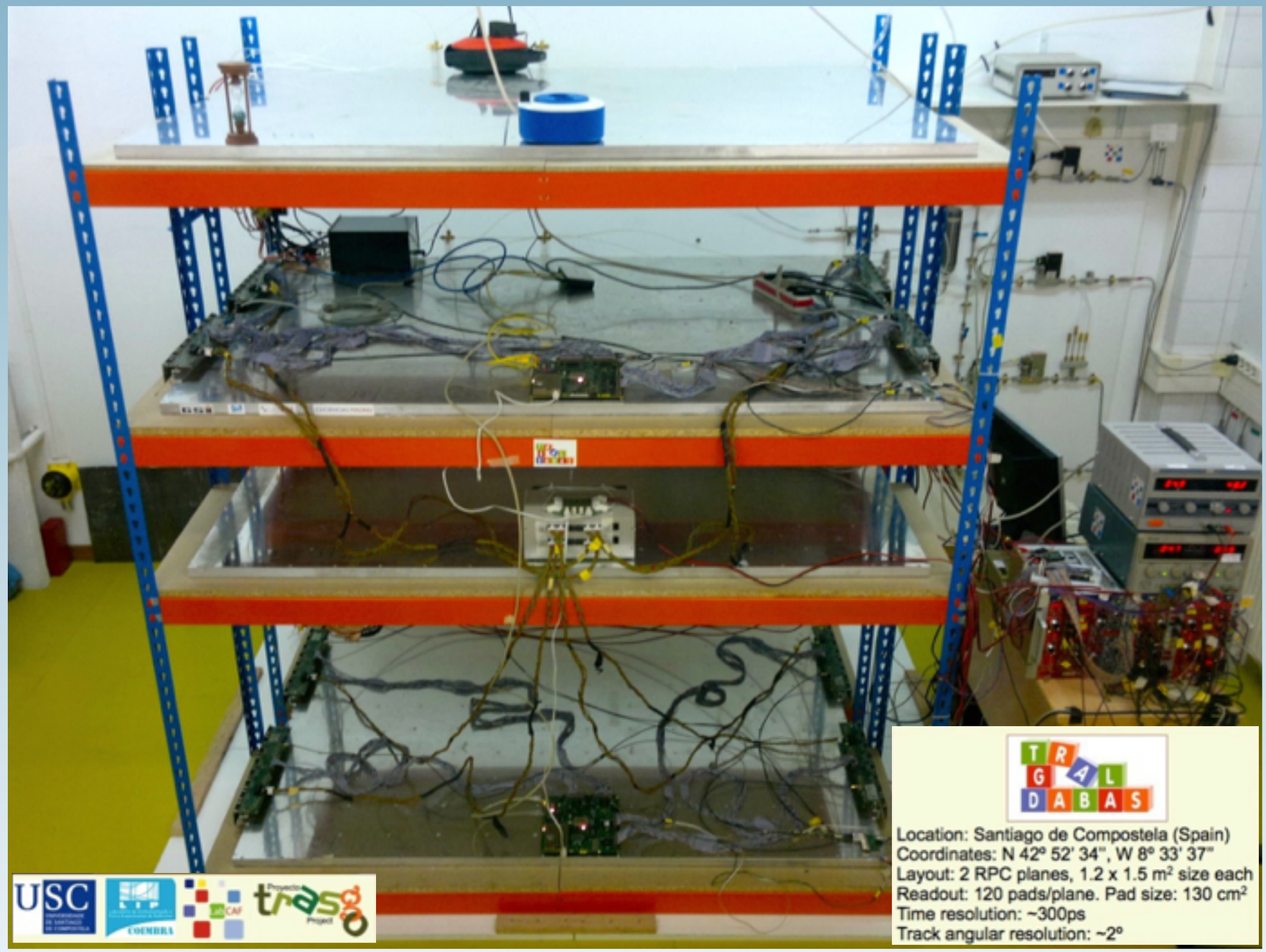
This is the 2 + 2 + 1 meeting!



2nd
Tragaldabas
Meeting
LOST :(

Where we are!

The first trasgo: TRAGALDABAS (truguldubus)



TRAsGo for the AnaLysis of the nuclear matter Decay, the Atmosphere, the earth B-field And the Solar activity

Where we are!

The TRAGALDABAS Collaboration

H. Alvarez-Pol[8], A.Blanco[4], J.J.Blanco[1], P.Cabanelas[8], F.Clemencio[4], J.Collazo[10], J.Cuenca[10], P.Fonte[4], Y.Fontenla[10], D.García Castro[10], J.A.Garzón[10], A.Gómez-Tato[7], A.Gomis[6], D.González-Díaz[9], G.Kornakov[5], T.Kurtukian[2], L.Lopes[4], C. Loureiro[4], A.Morozova[3], J.C.Mouriño[7], M.A.Pais[3], A.Pazos[9], V.Pérez Muñuzuri[11], P.Rey[7], I.Riádigos[11], M.Seco[9], V. Villasante[6].

Laboratory / Task

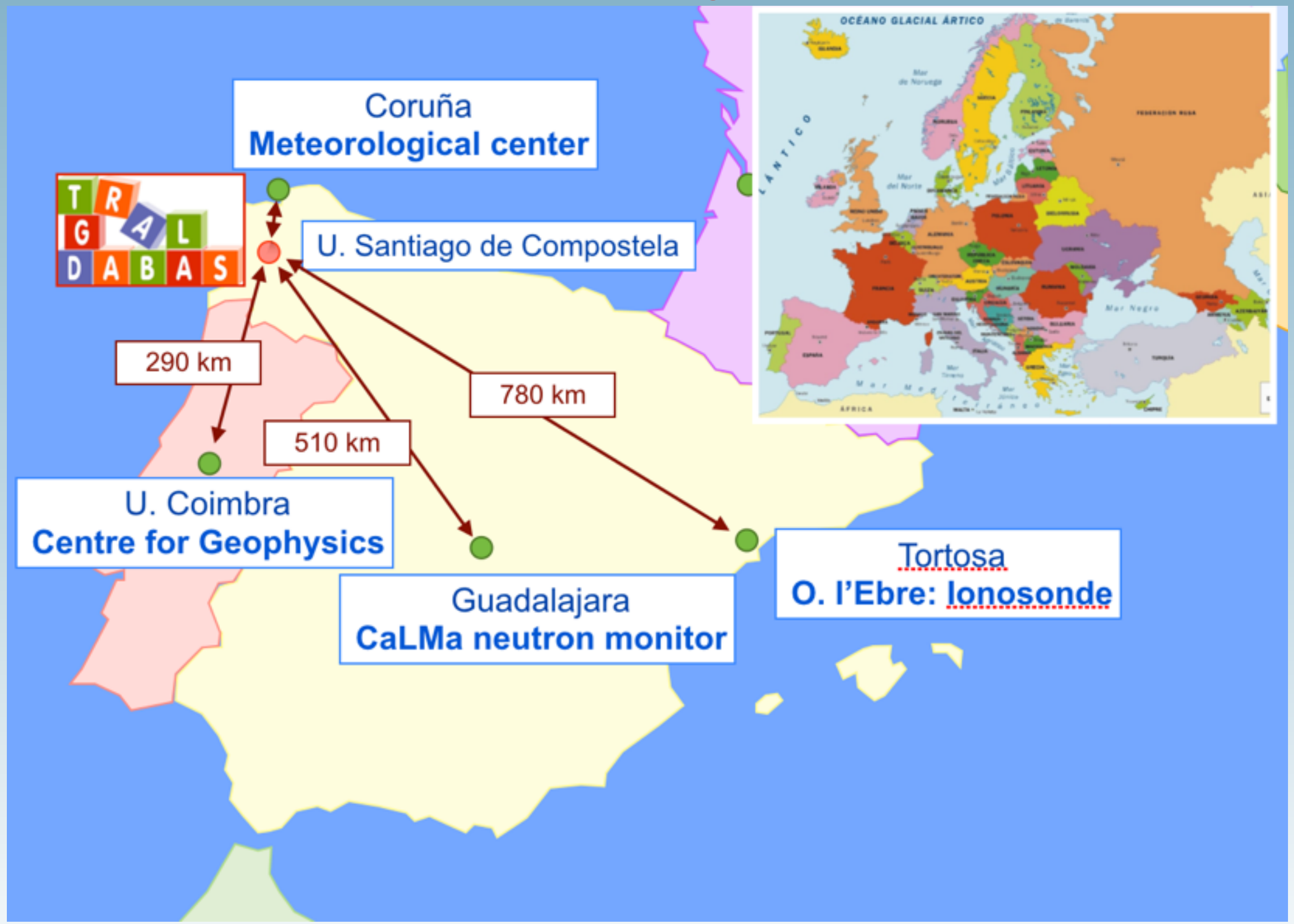
1. Univ. Alcalá de Henares, Spain / Solar Physics
2. CEN - Bordeaux, France / Nuclear and Solar Physics
3. CITEUC - U. Coimbra, Portugal / Geomagnetic field and Space Weather
4. LIP- Coimbra, Portugal / RPC detectors and instrumentation
5. Technische Univ. Darmstadt, Germany / Geomagnetic field
6. IGN - Madrid, Spain / Geomagnetic field
7. CESGA Super-computation Center - Santiago de Compostela, Spain / Data storage and distribution
8. GENP - Univ. Santiago de Compostela, Spain / Software development and simulation
9. IGFAE - Univ. Santiago de Compostela, Spain / Monitoring and Slow control
10. LabCAF - Univ. Santiago de Compostela, Spain / Track reconstruction and data analysis
11. GFNL - Univ. Santiago de Compostela, Spain / Atmosphere Physics and Climate

Other partners:

ATI Sistemas. La Coruña, Spain
Club Desarrollo de las Ciencias, Madrid, Spain
Hydra Technologies Spain S.L. Vigo, Spain

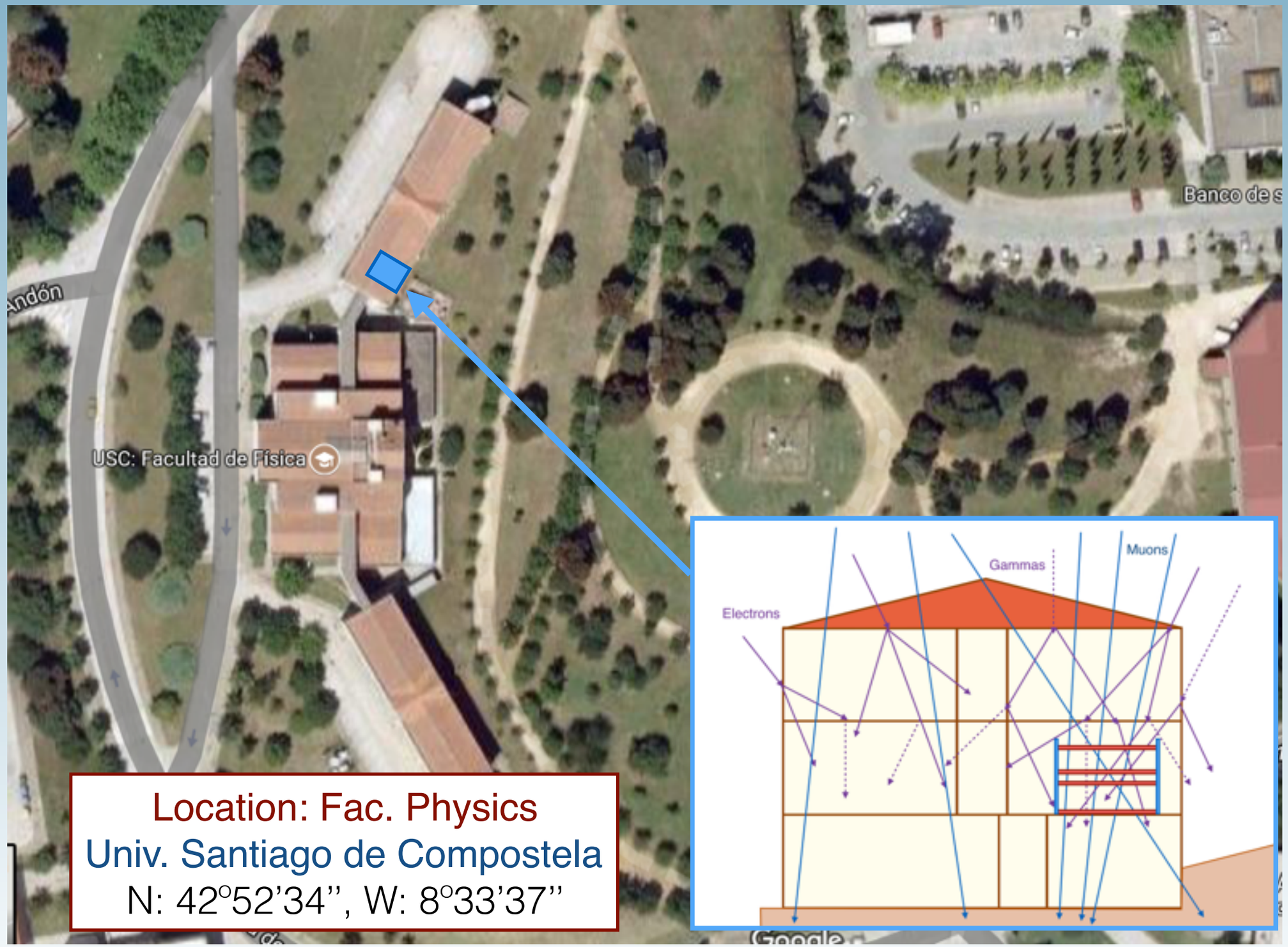
Where we are!

In an outstanding location



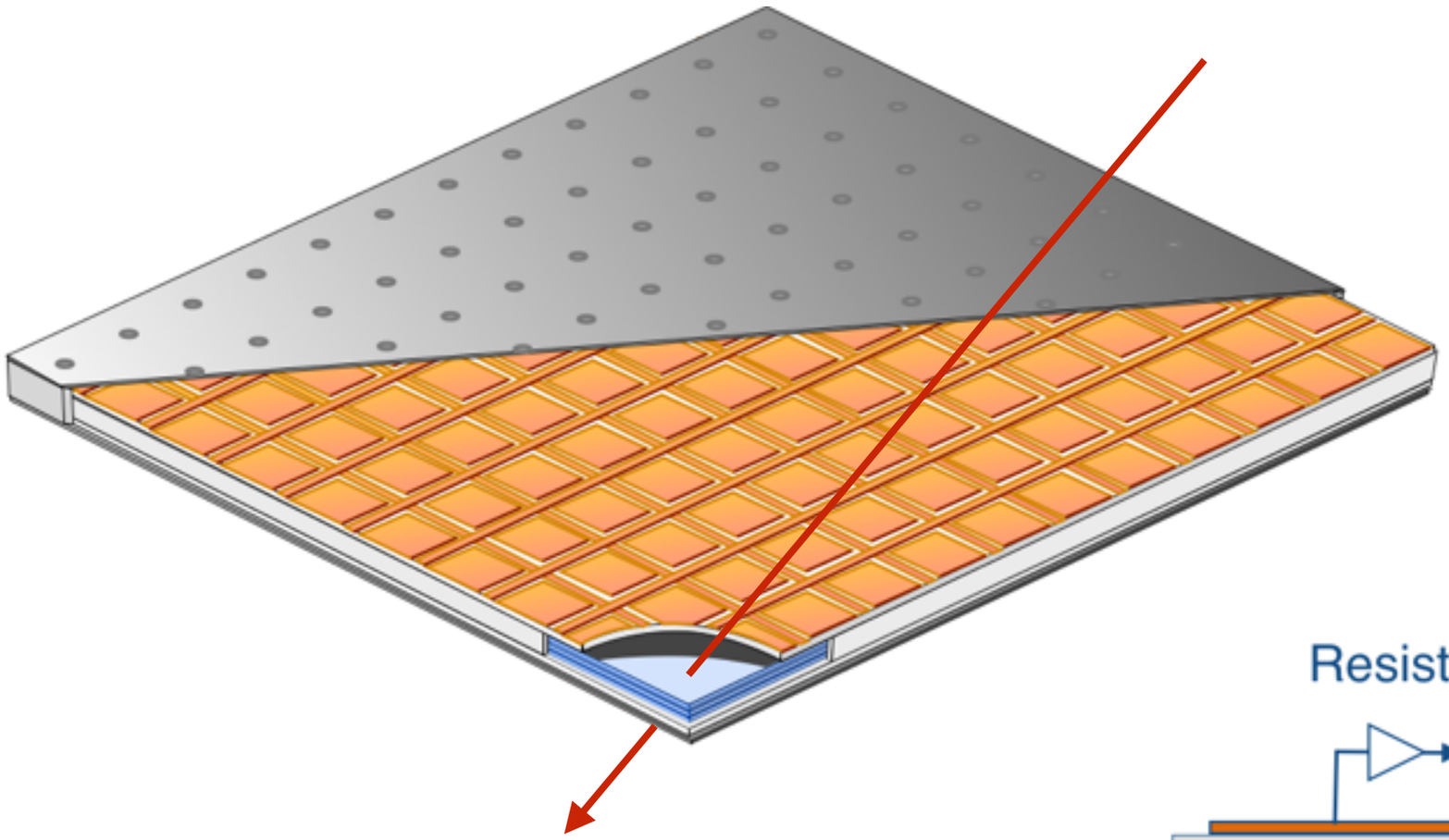
Where we are!

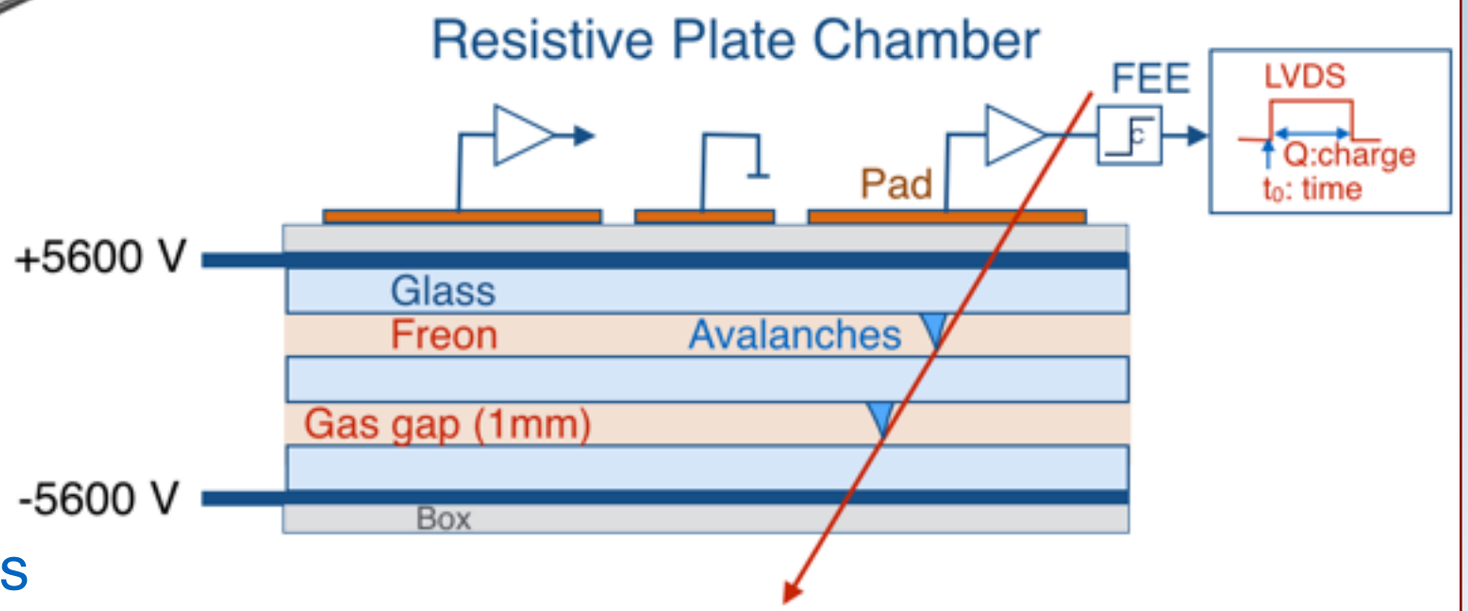
The site



The detector

The timing RPC technology



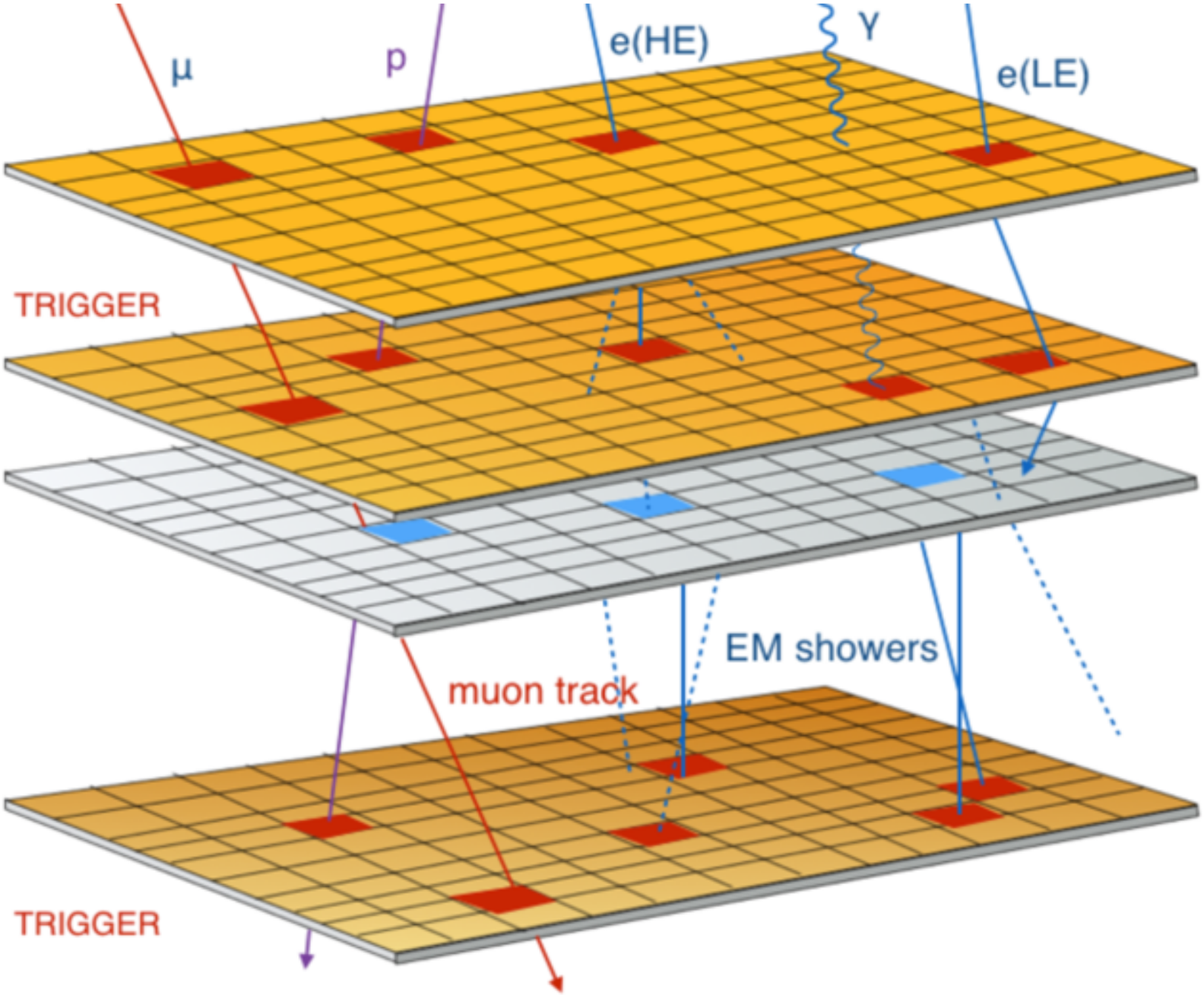


Main features:

- Very affordable technology
- Very good time resolution: ~0.5 ps
- 120 (10x12) channels (~11x11 cm^2)
- 1.8 m^2 (1.2 x 1.5 m^2) planes

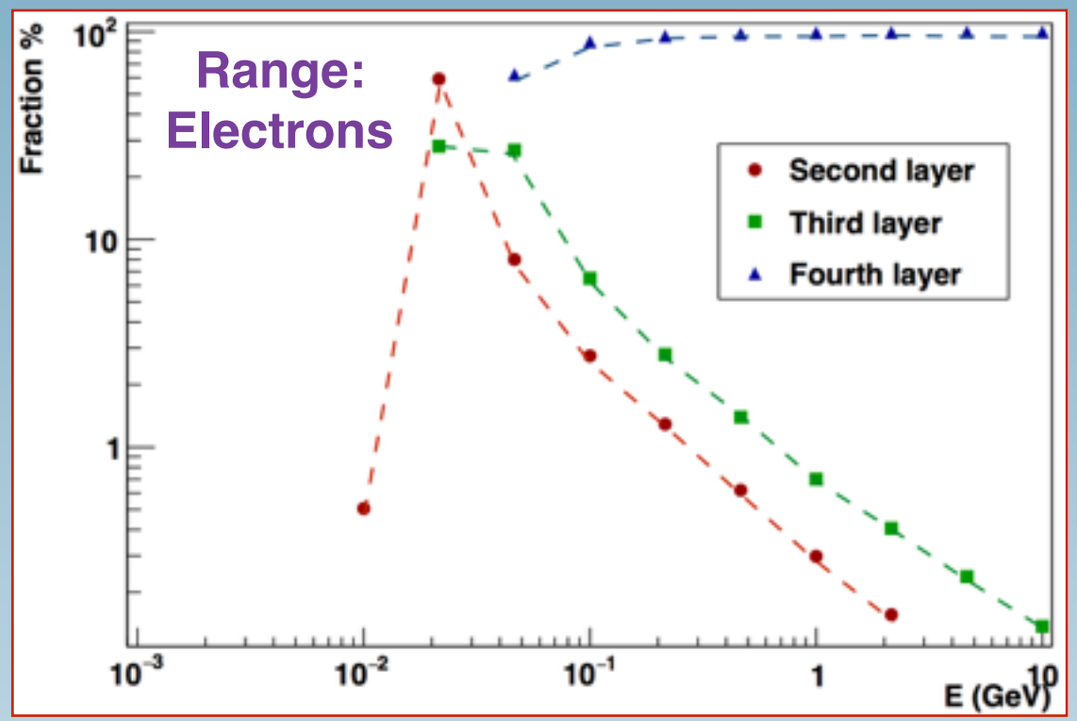
The detector

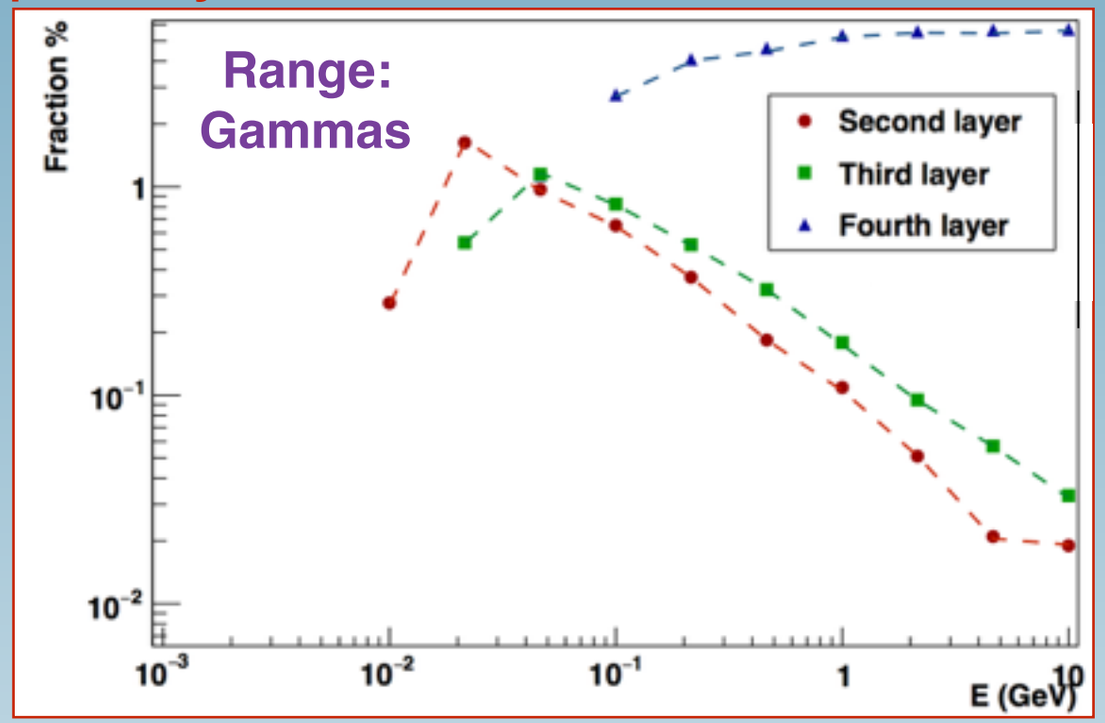
PID capability

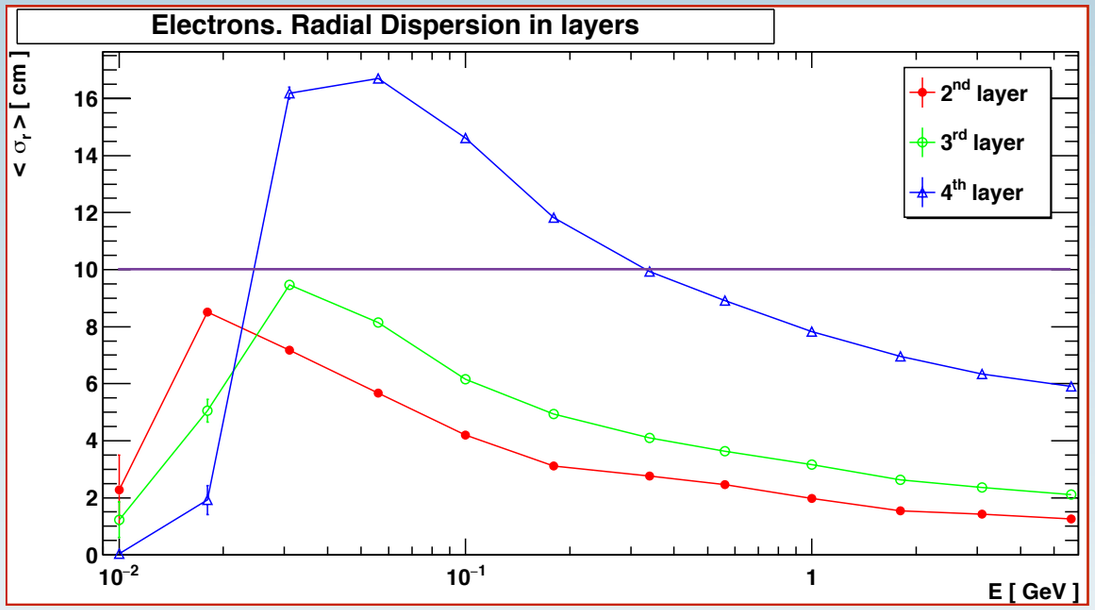


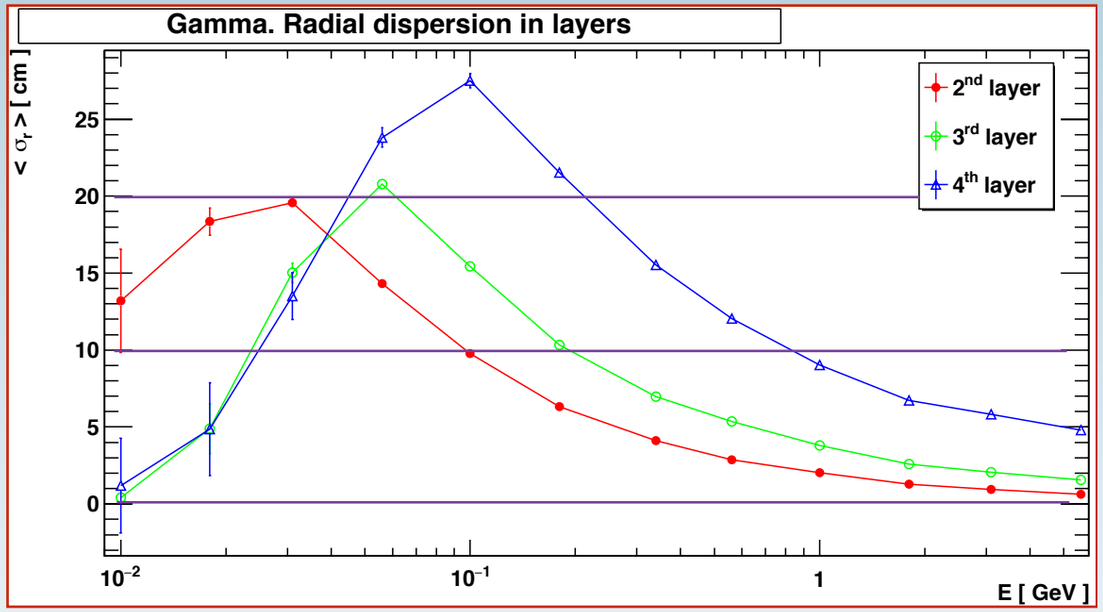
The detector

PID capability





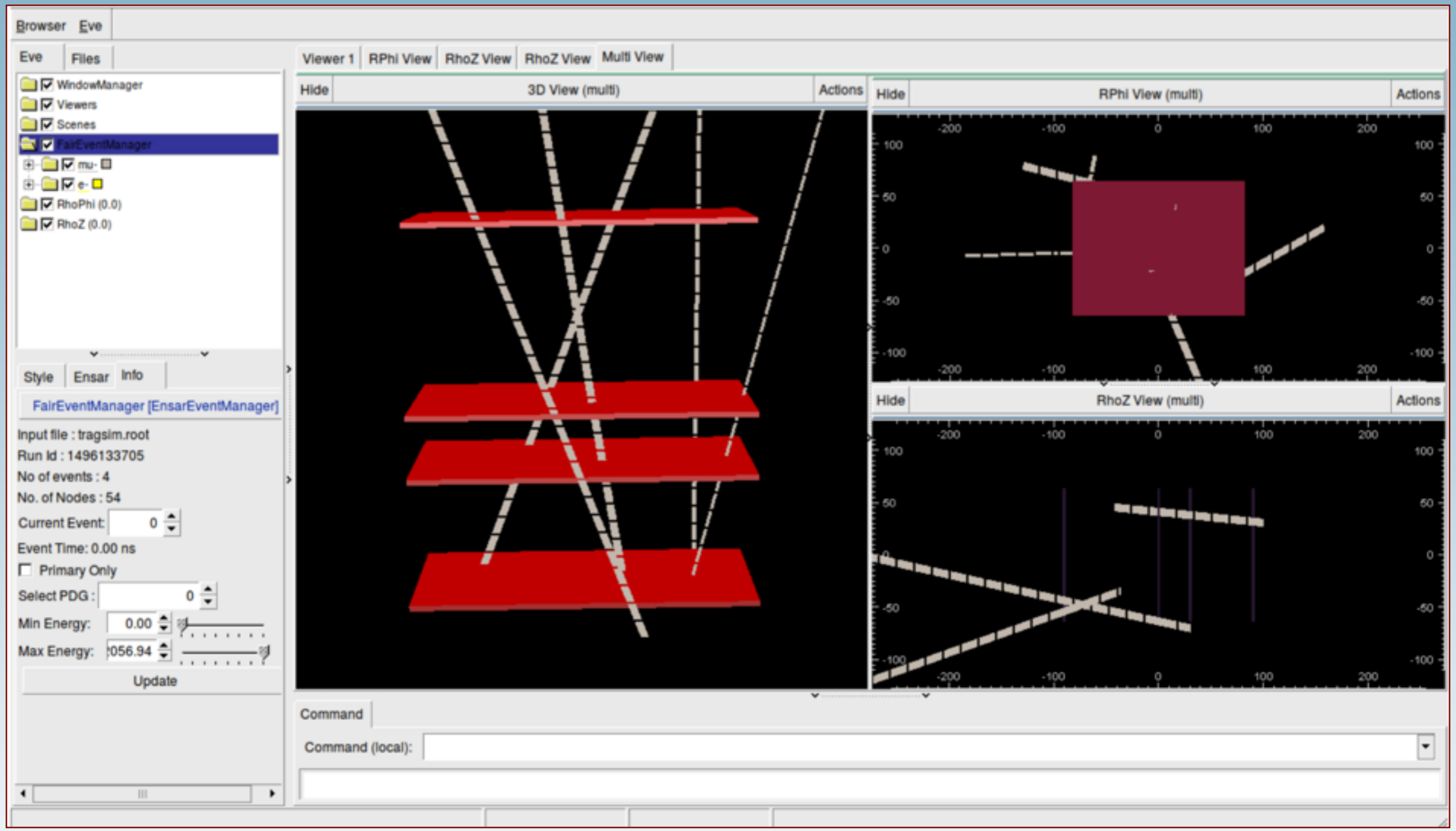




Gamma showers are typically broader than electron showers!

The detector

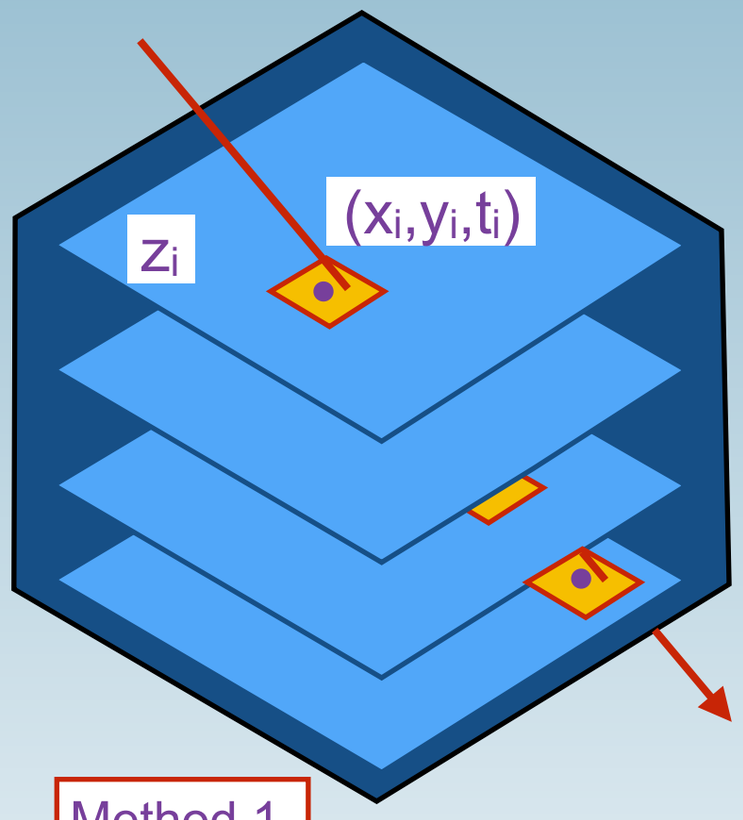
EnsarRoot based detector simulation



The detector

Tracking algorithms based on TimTrack

data, **d** → *timtrack* + fitting models: **m** → (X_0, X', Y_0, Y' T_0, V) parameters



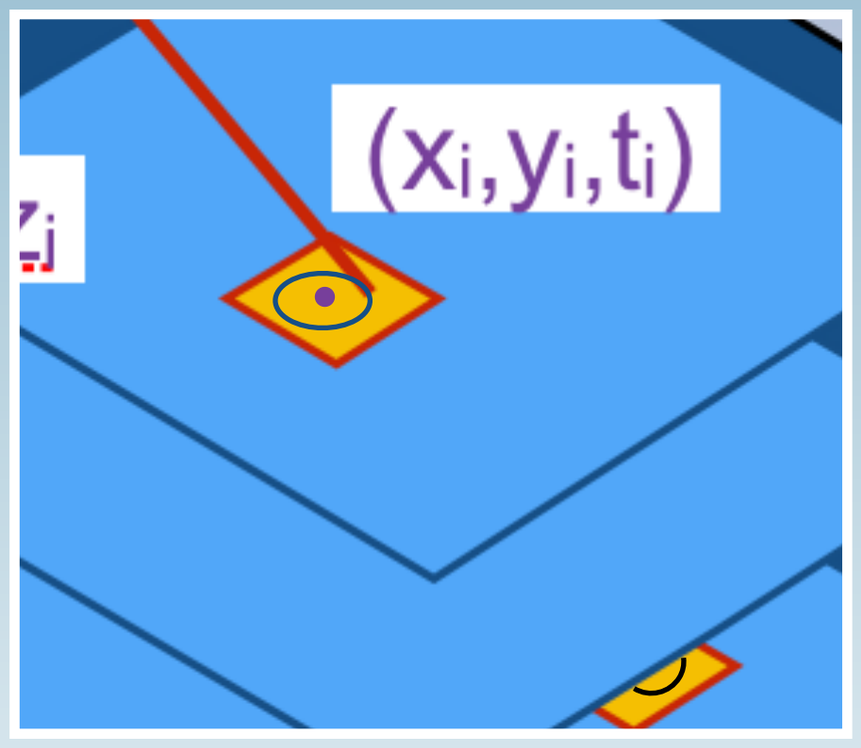
Method 1.

$x_i = X_0 + X' \cdot z_i$

$y_i = Y_0 + Y' \cdot z_i$

$t_i = T_0 + \sqrt{1+X'^2+Y'^2} \cdot z_i / V$

Direct fit to 6 parameters!



Method 2.

We are trying to implement a new method including the drift time of electrons in the electrodes.

Still, convergence problems! :(

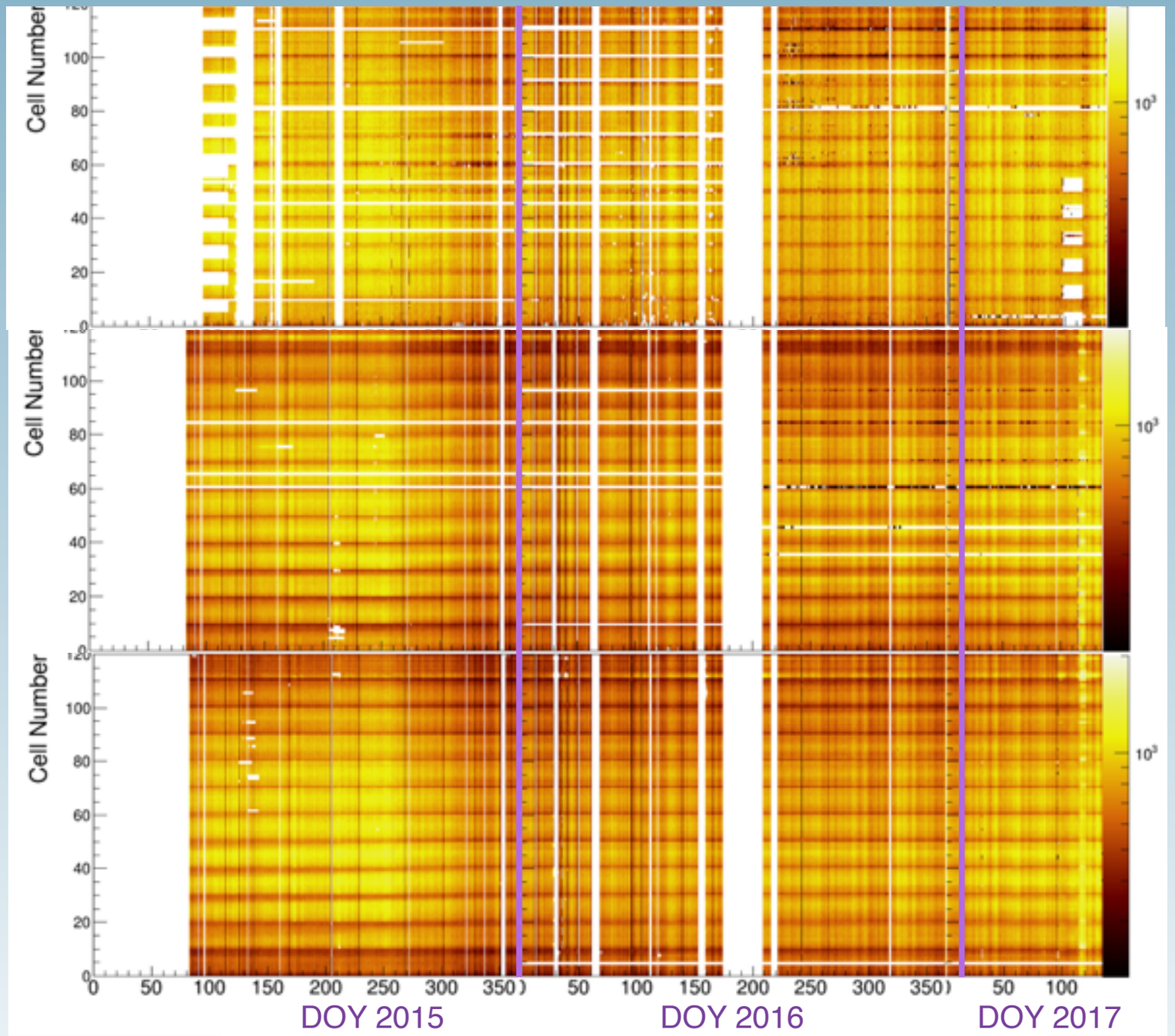
TRAGALDABAS: preliminary results

Data sample: fired cells map

Plane T1

Plane T2

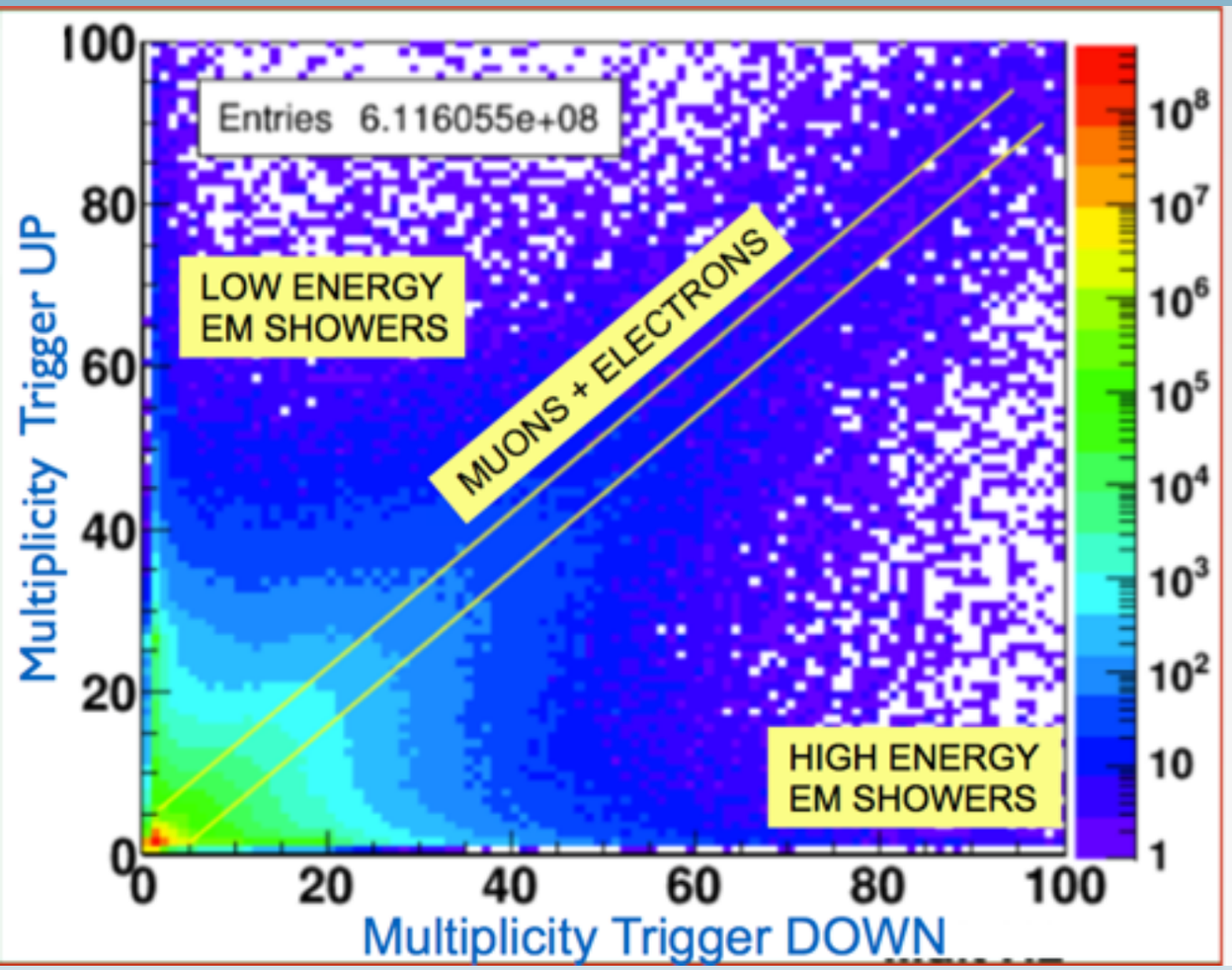
Plane T4

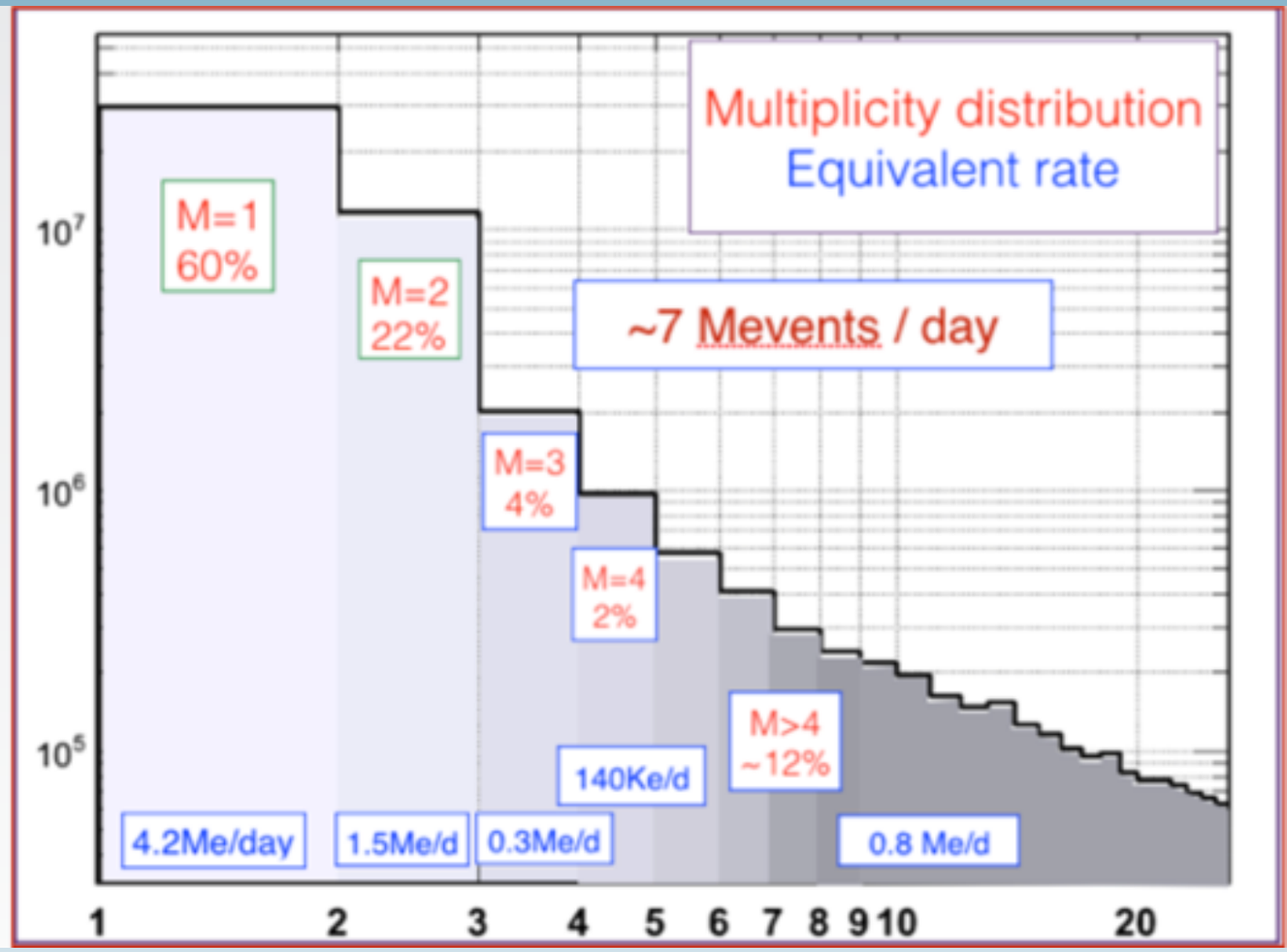


2 years of data collected: ~ 5· 10^9 events!

TRAGALDABAS: preliminary results

Trigger summary

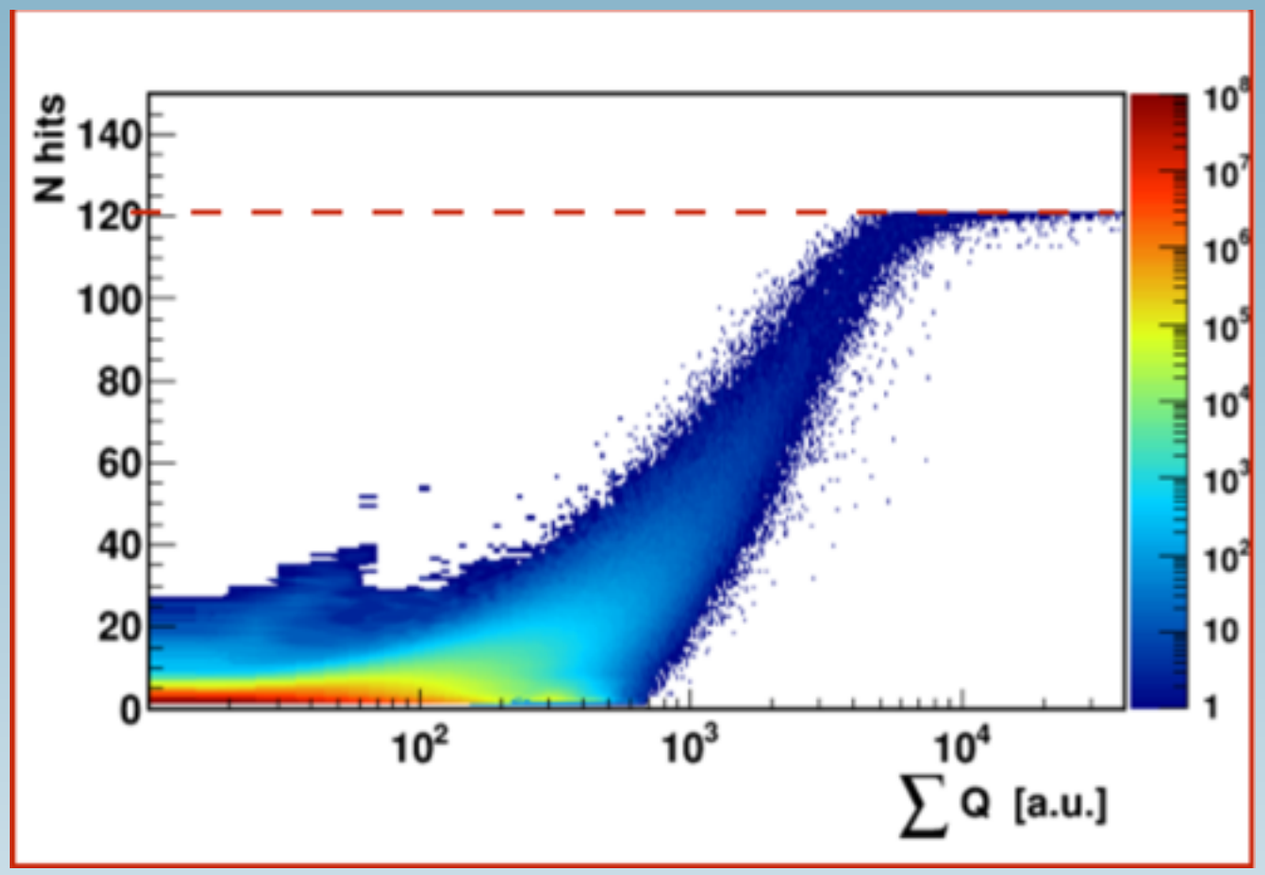




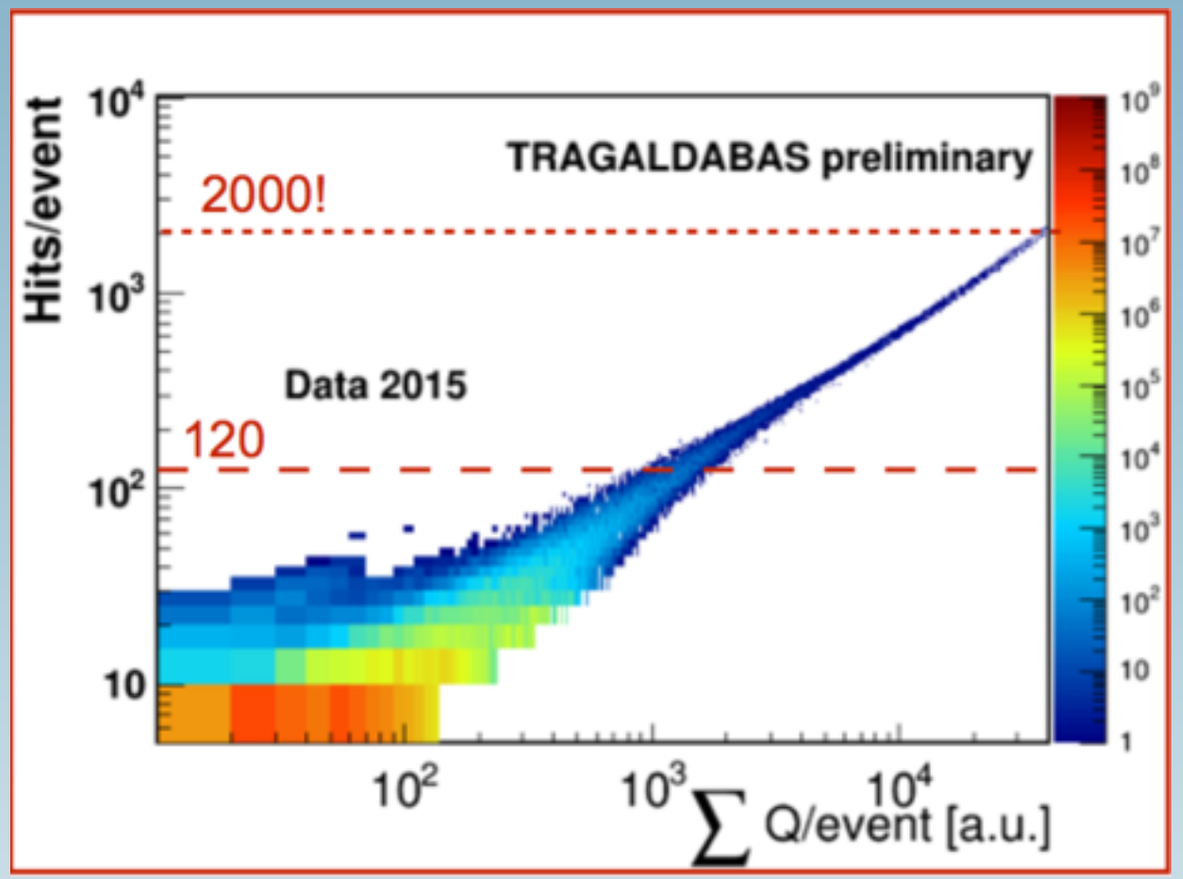
Trigger rate: ~ 70 Hz.
Event rate: ~ 7Mevents /day
Storage rate: ~ 0.7 Tb / year (1.9 Gb /day)
Mean duty time: > 90%

TRAGALDABAS: preliminary results

Preliminary charge analysis



No. hits vs. total charge Q



Corrected No. hits vs. total charge Q

As the FEE is sensitive to charge, having only 120 cells/plane it is possible to estimate multiplicities of up to ~1000/m^2.

The detector will be able to analyze the space-time microstructure of cosmic ray showers near the core!!!

TRAGALDABAS: preliminary results

2 year rate behaviour (pressure corrected)

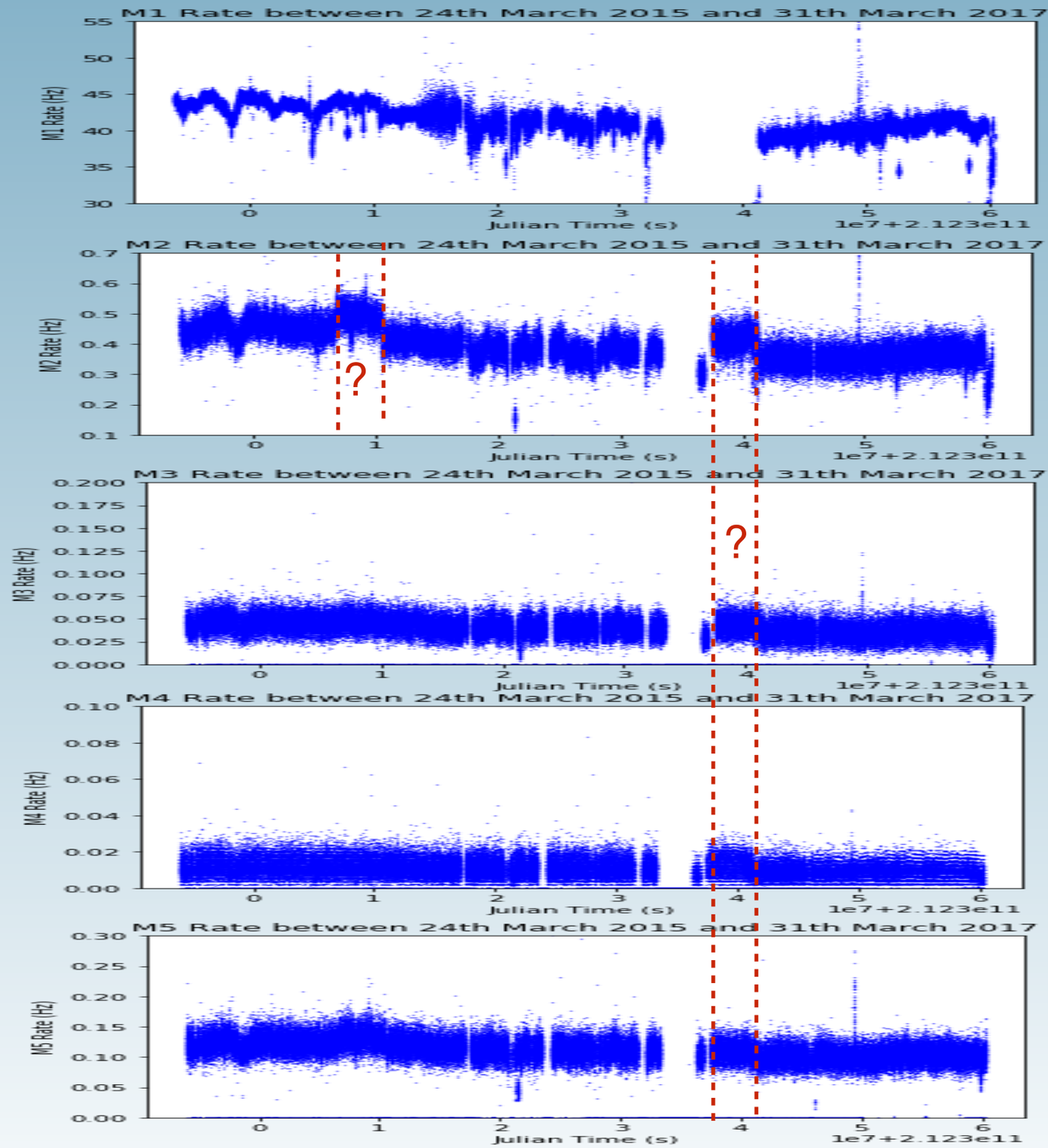
Multiplicity M=1

Multiplicity M=2

Multiplicity M=3

Multiplicity M=4

Multiplicity M>4



TRAGALDABAS: preliminary results

2 year rate behaviour (pressure corrected)

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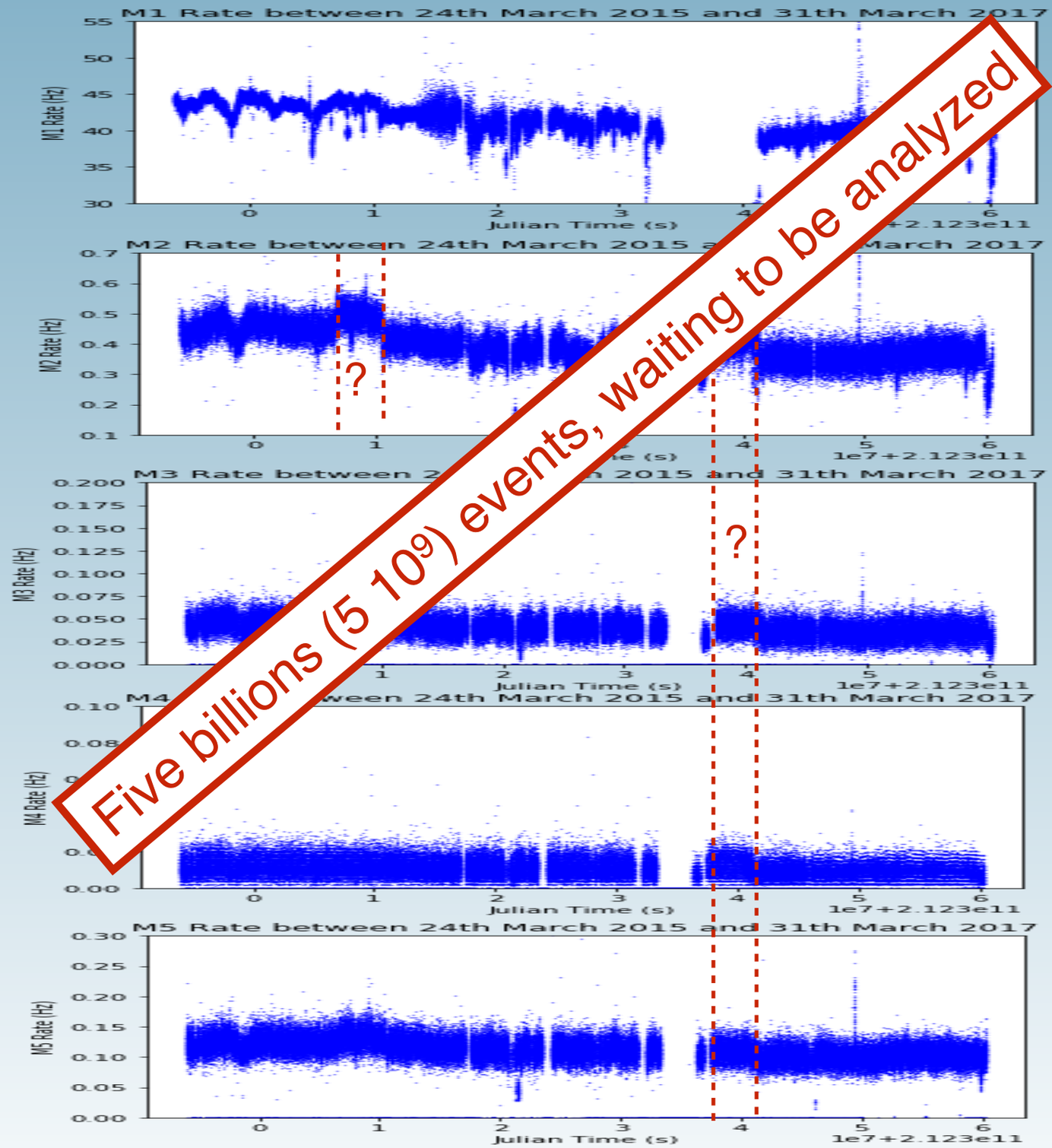
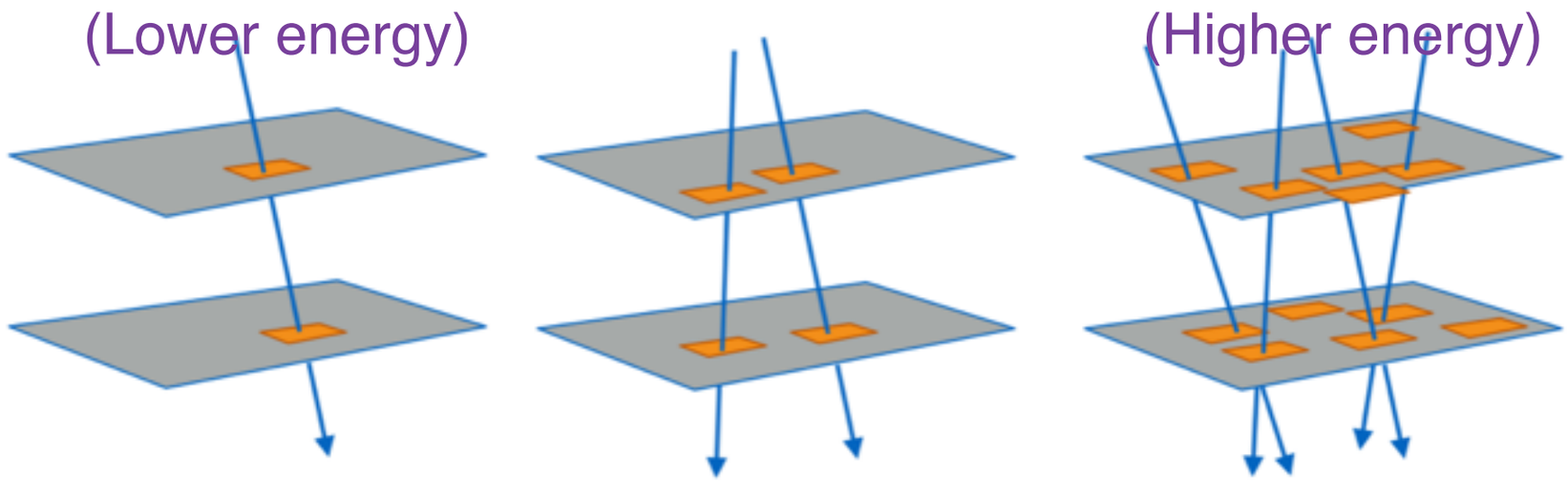
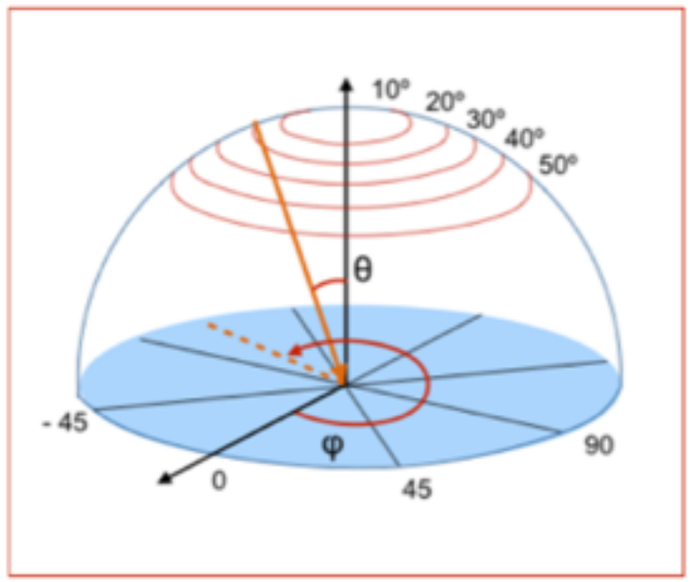


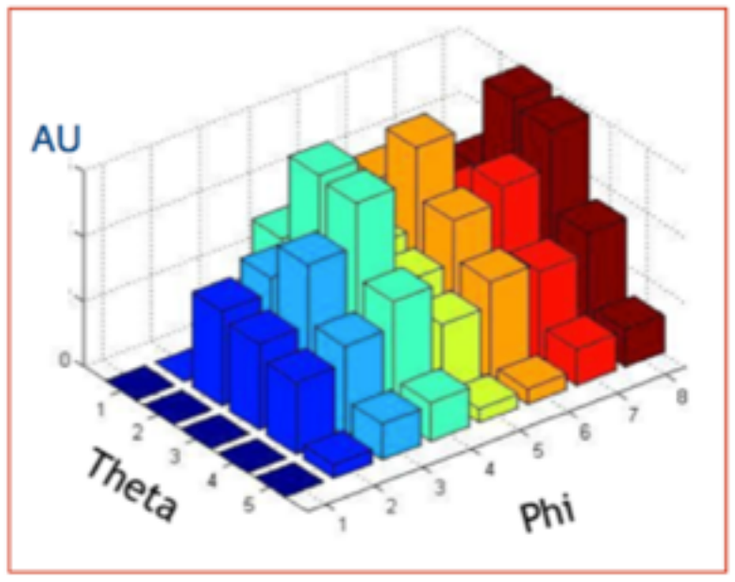
TRAGALDABAS: preliminary results

Preliminary reconstructed data sample



3 sets of multiplicity: m

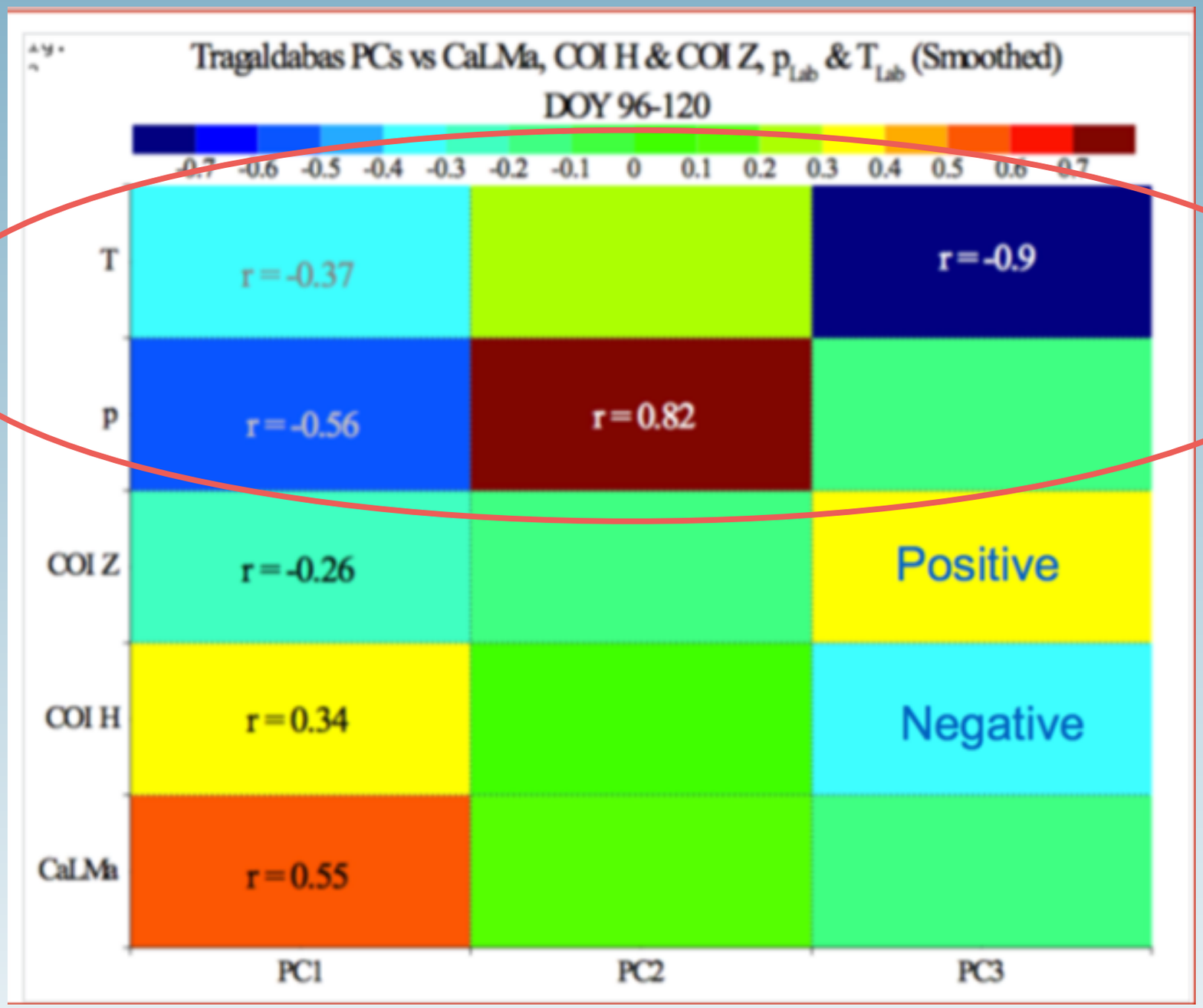




Data stored in 5x8 (theta x phi) matrices in 10-min time intervals

TRAGALDABAS: preliminary results

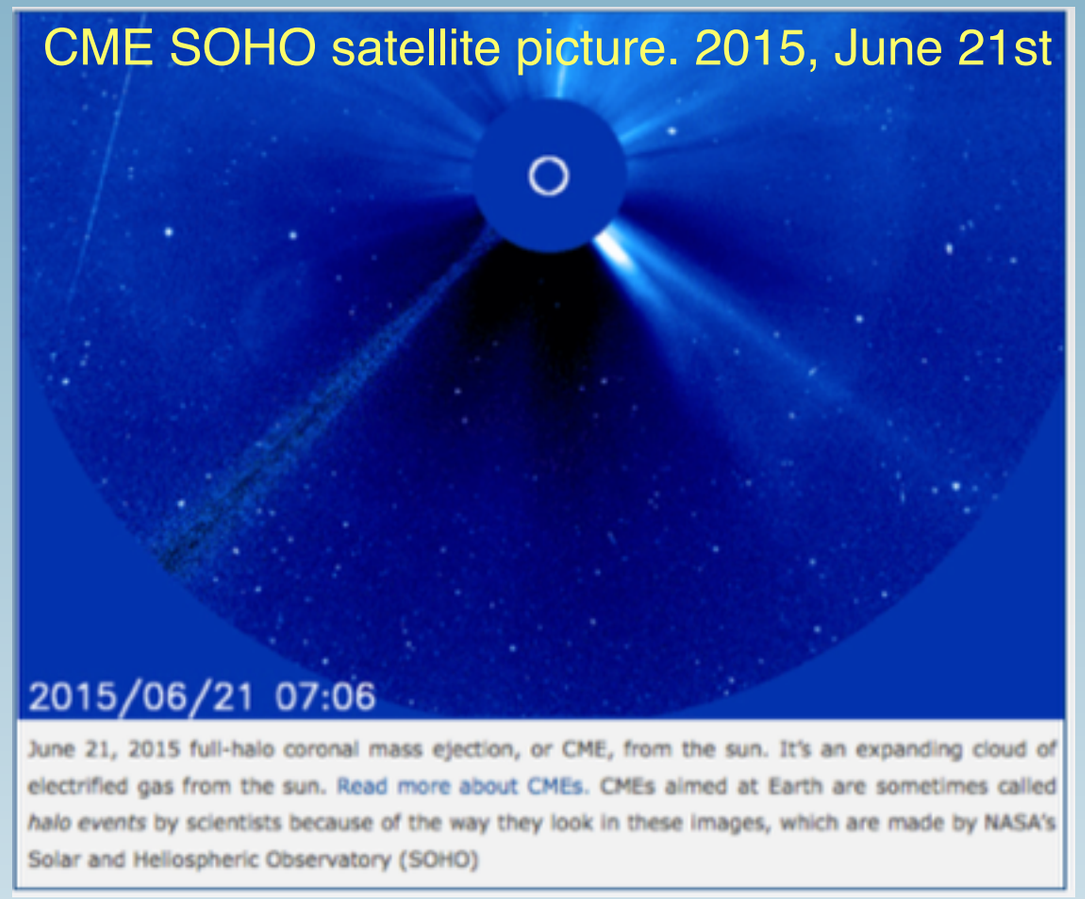
PCA analysis

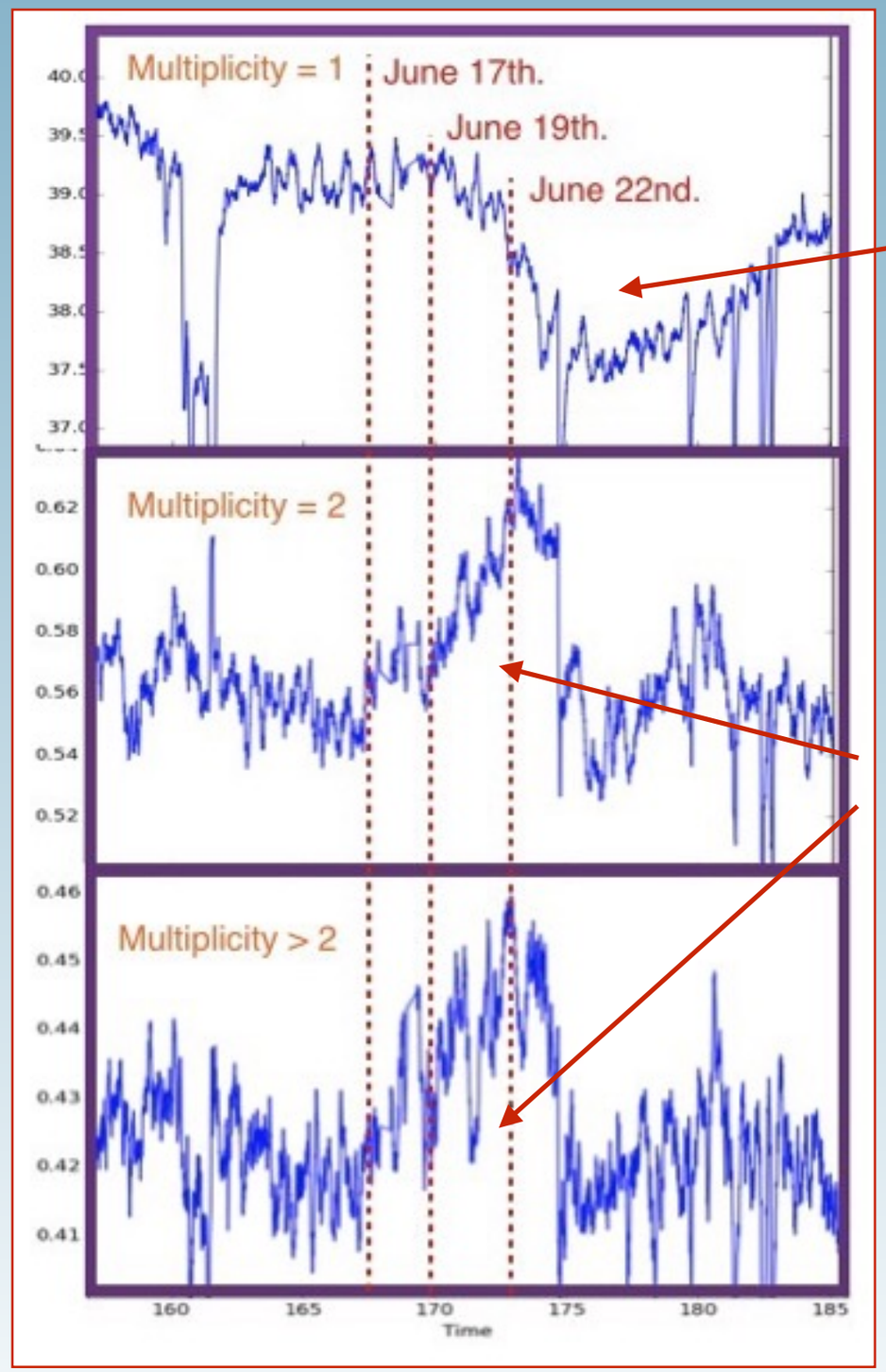


Pressure and temperature insufficiently corrected!

TRAGALDABAS: preliminary results

Analysis of the FD of June 2015





TRAGALDABAS: preliminary results

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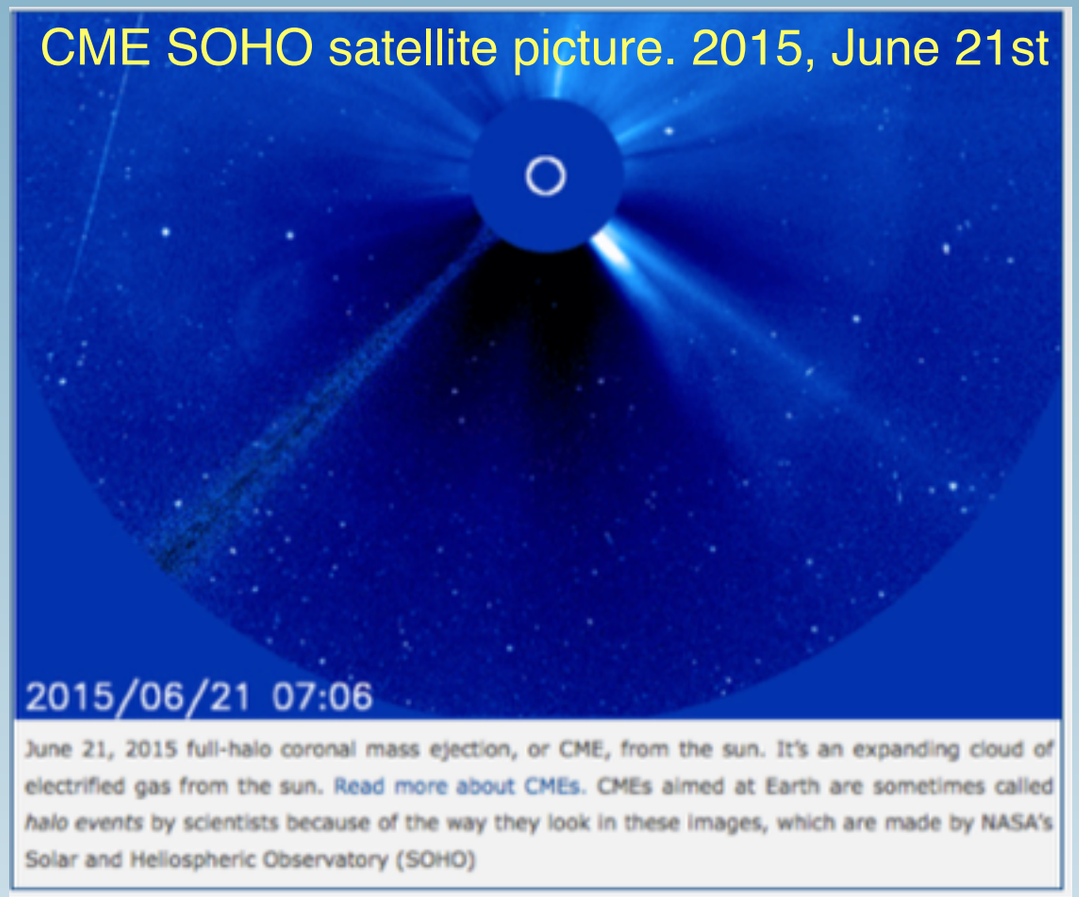
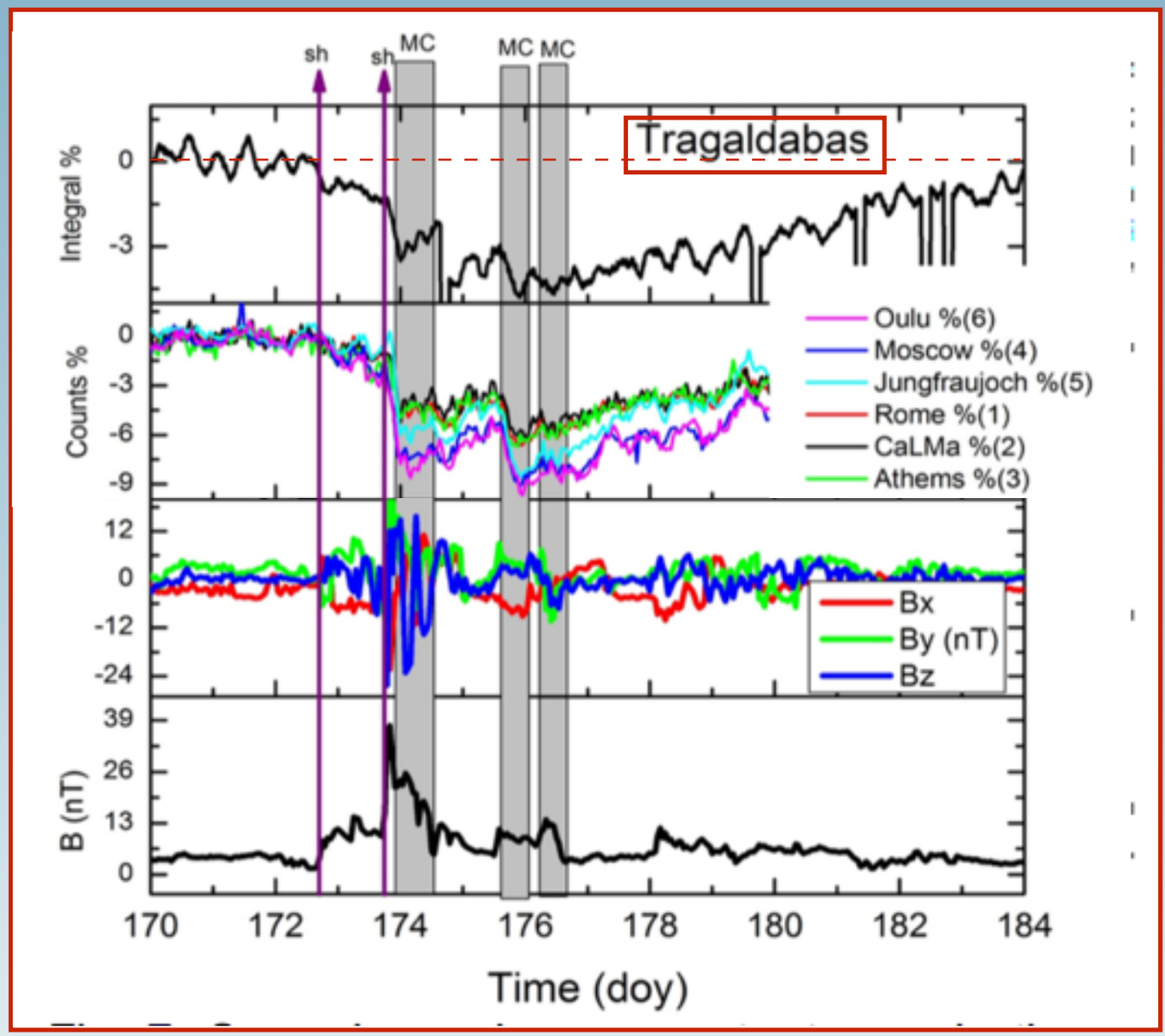
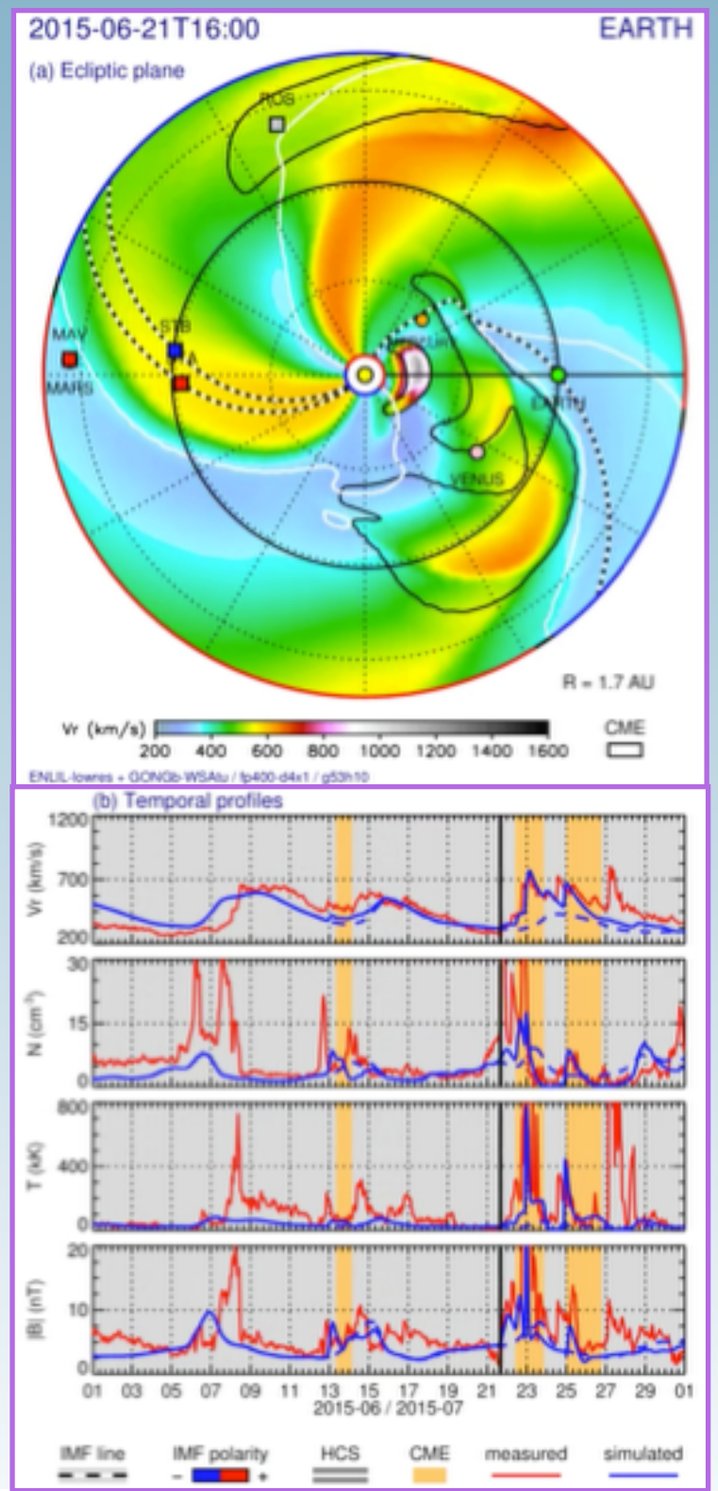


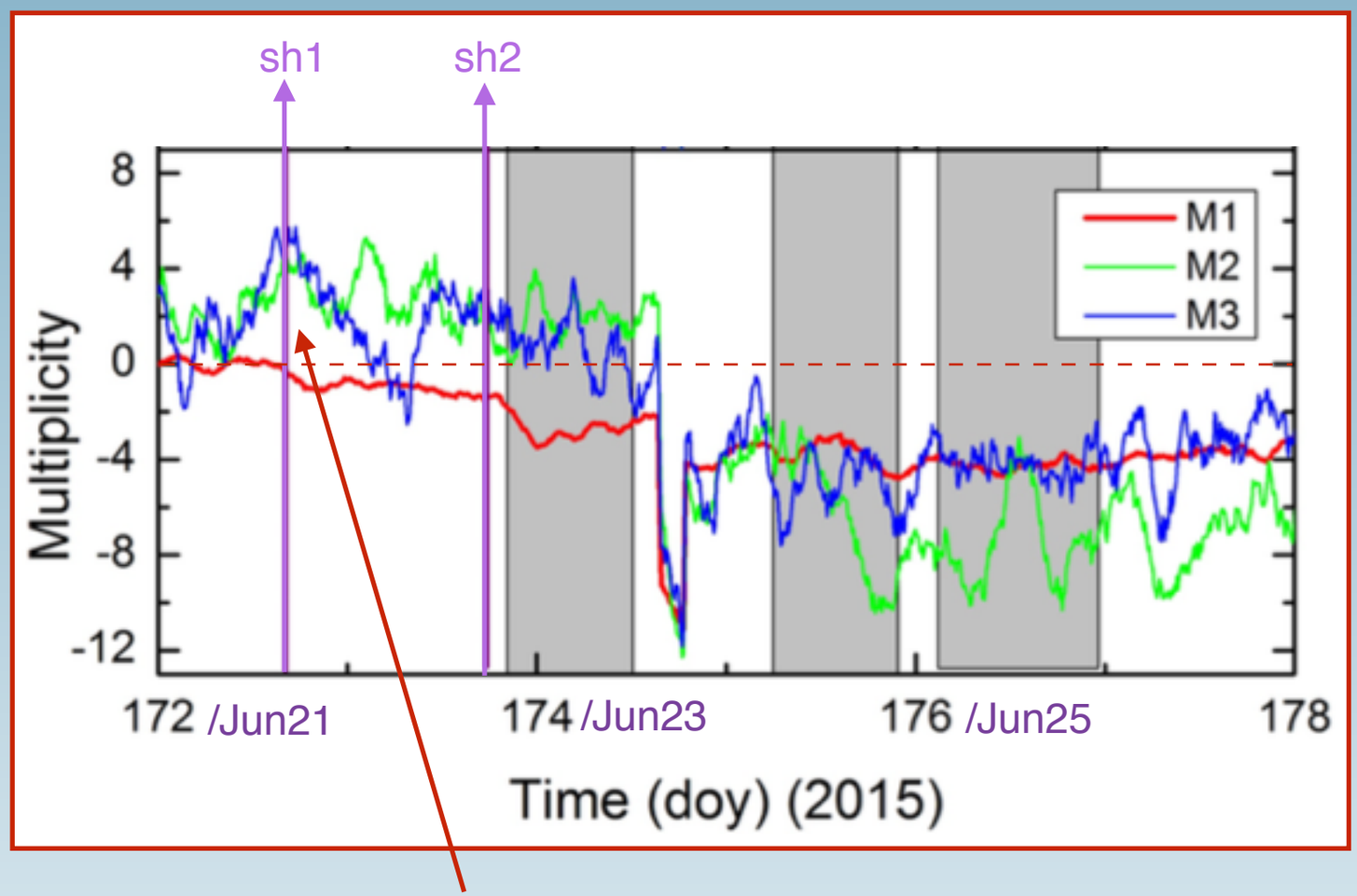


FD is observed very well with a roughly 2 m^2 detector !

TRAGALDABAS: preliminary results

Analysis of the FD of June 2015

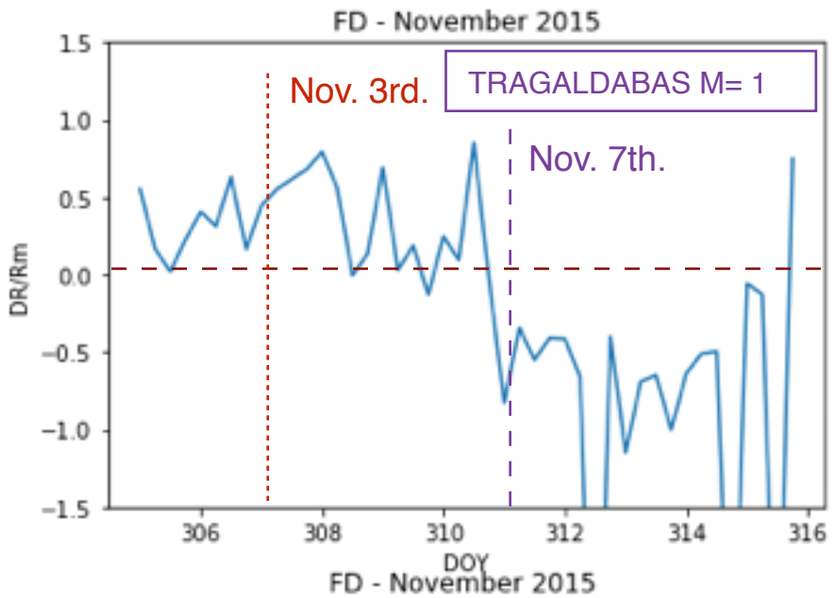


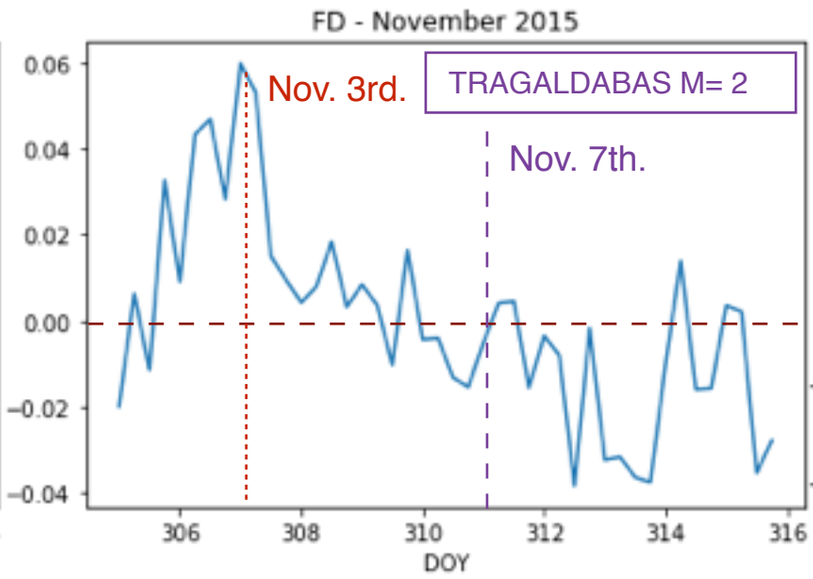


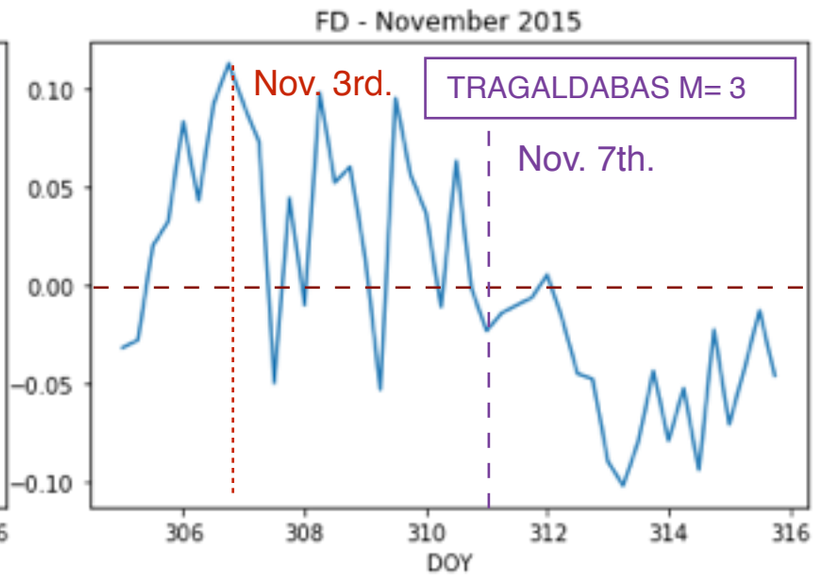
Interesting feature: high multiplicity excesses seem to be associated with the first magnetic shock!

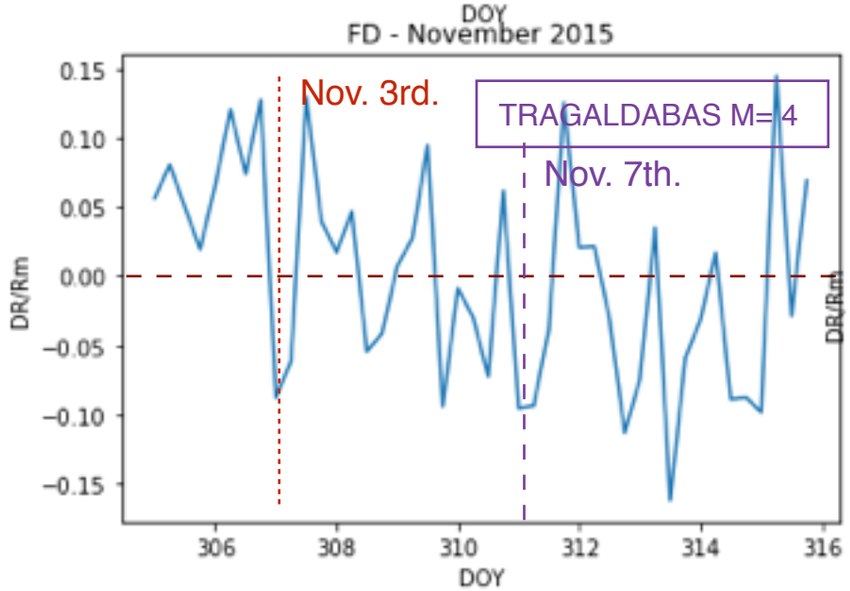
TRAGALDABAS: preliminary results

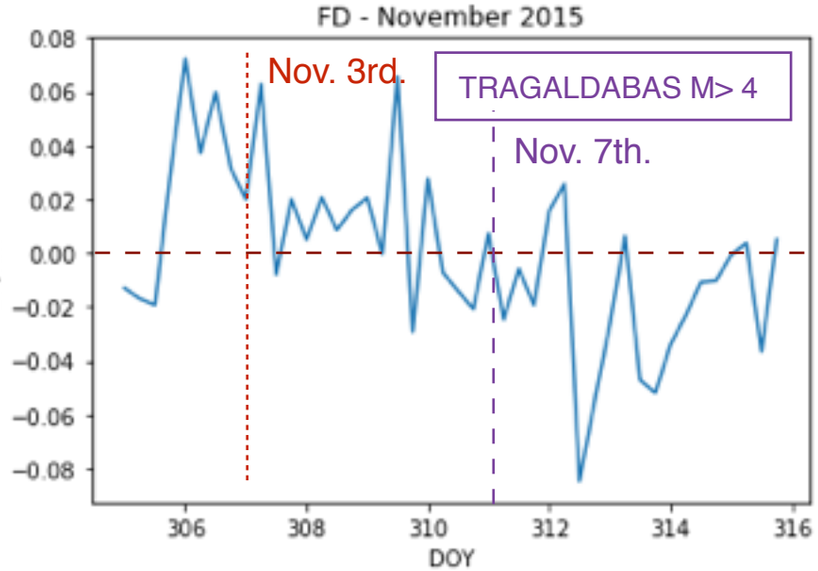
Analysis of the FD of November 2015

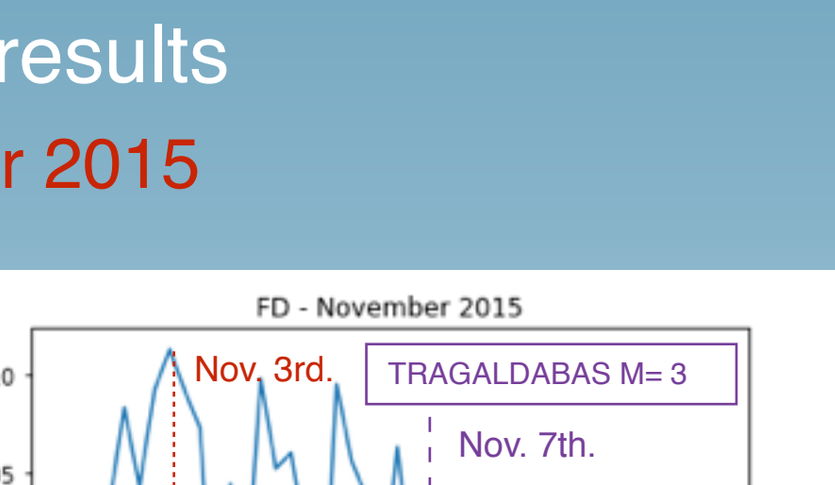






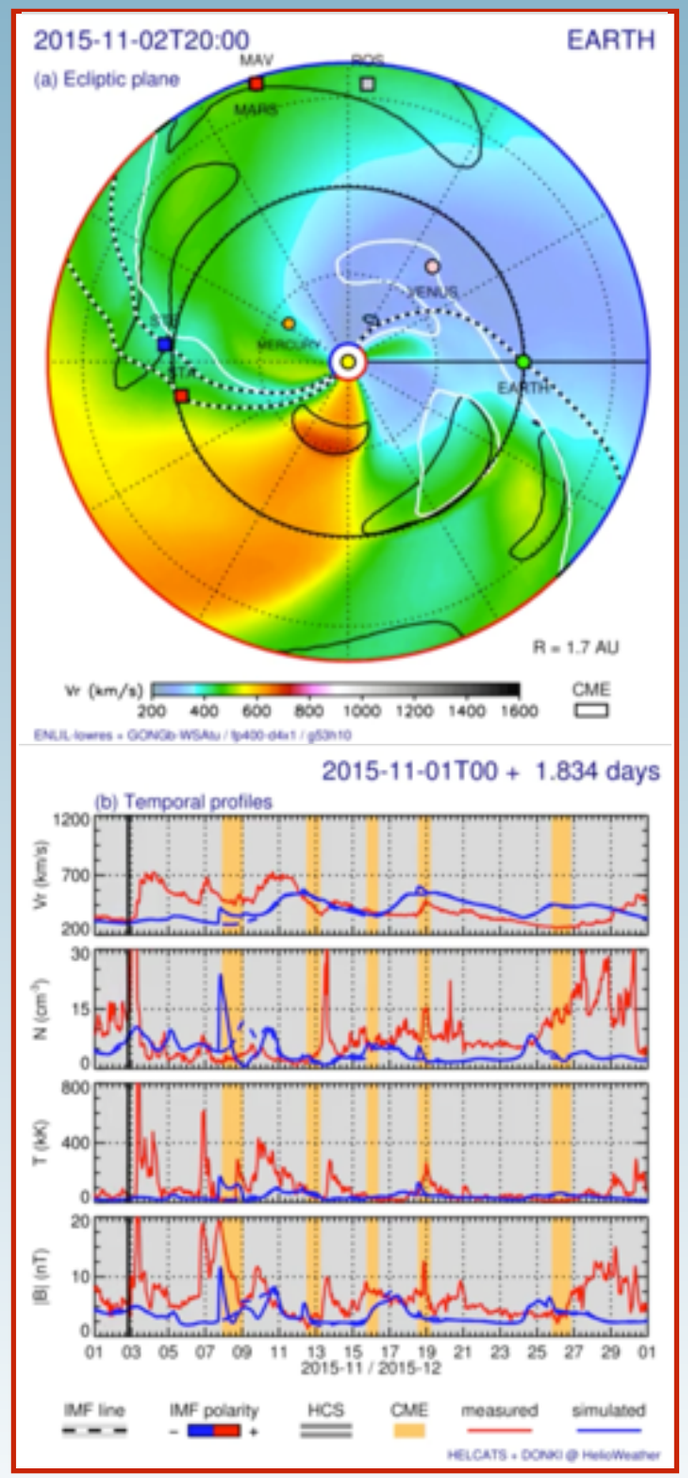


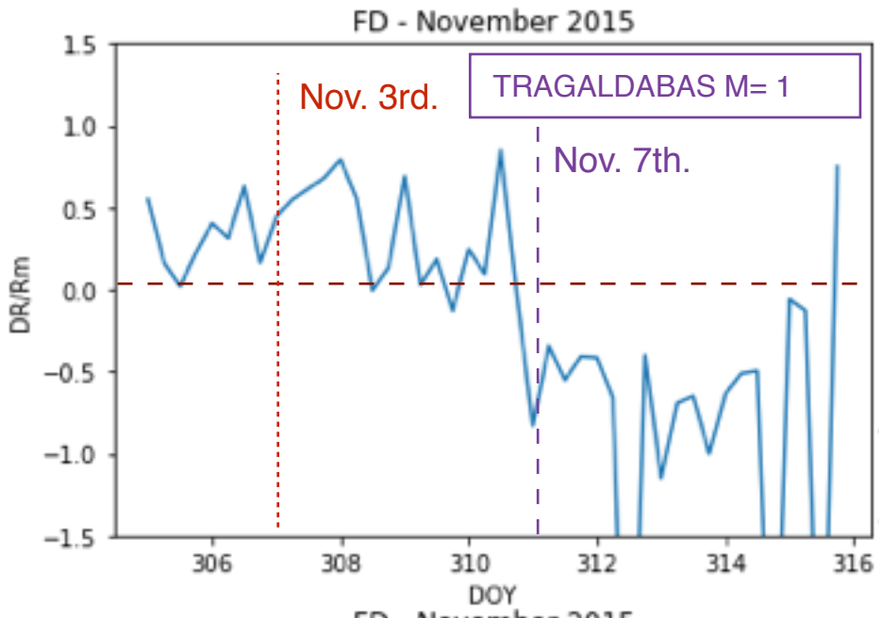


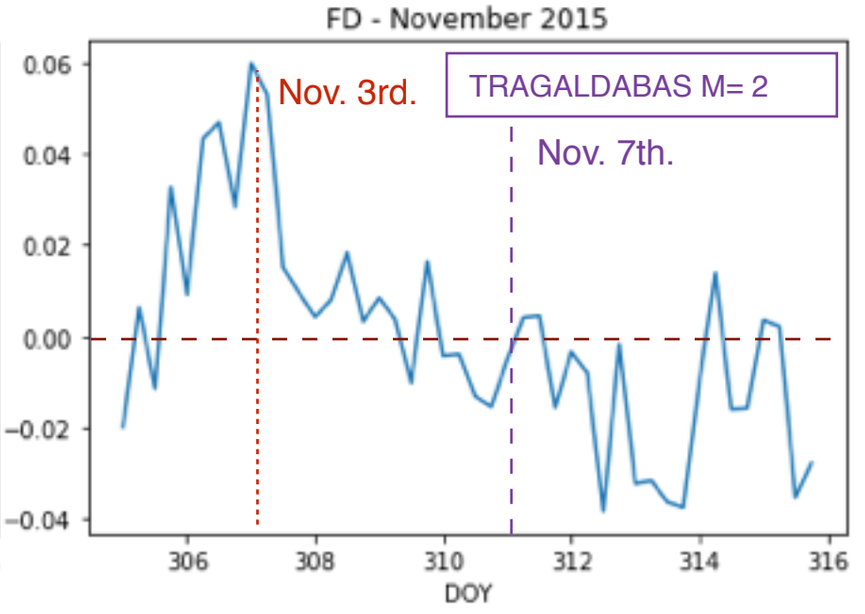


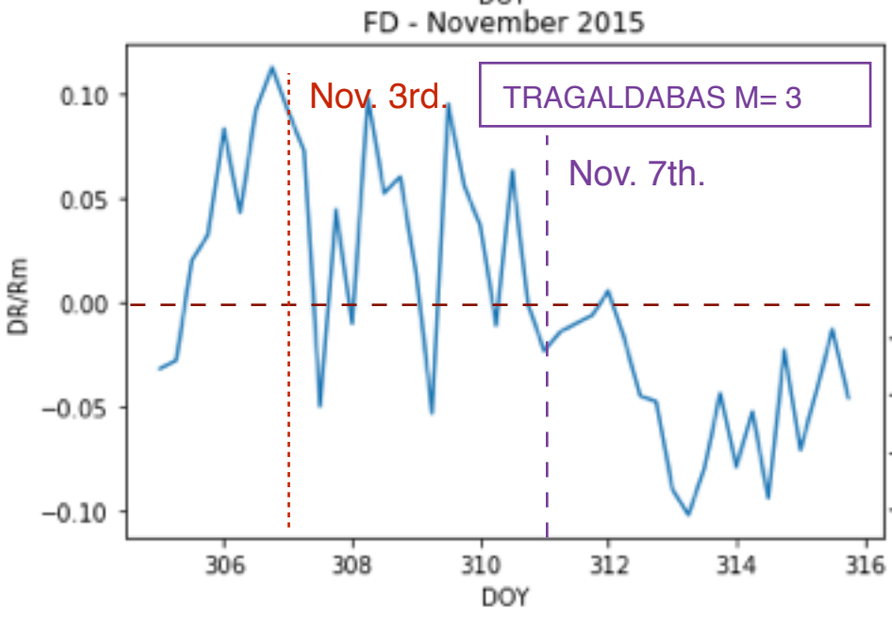
TRAGALDABAS: preliminary results

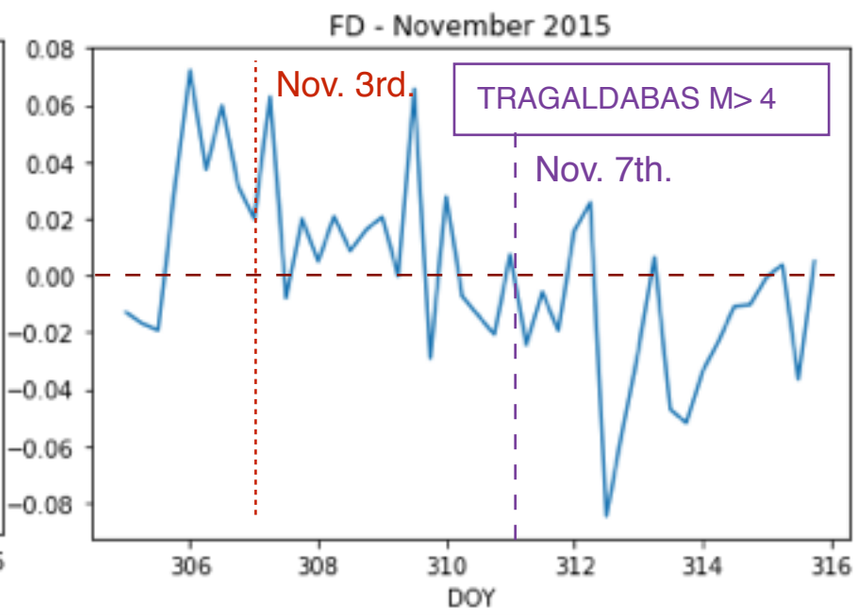
Analysis of the FD of November 2015





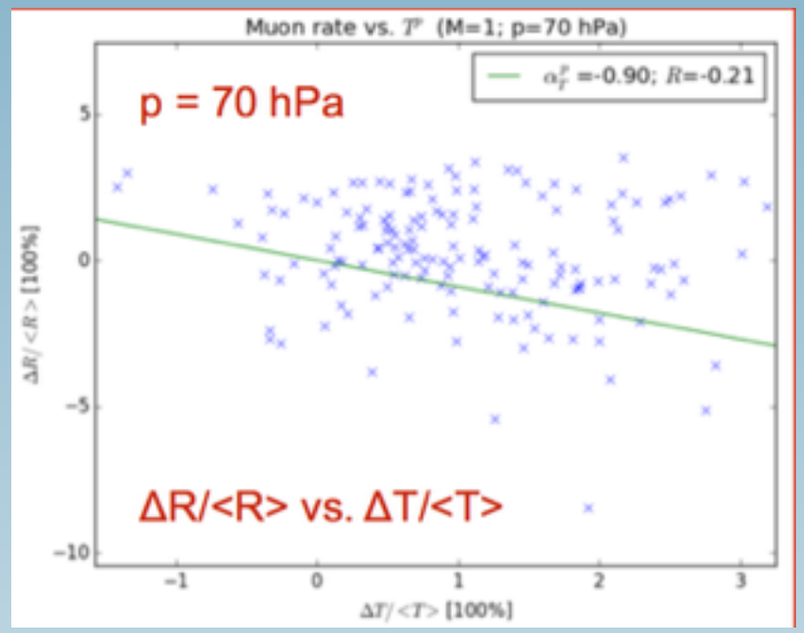


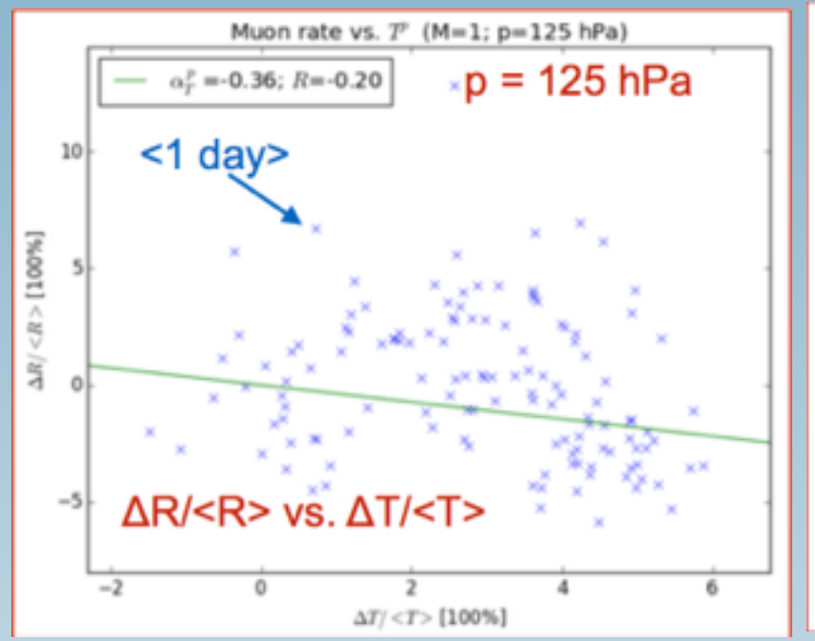


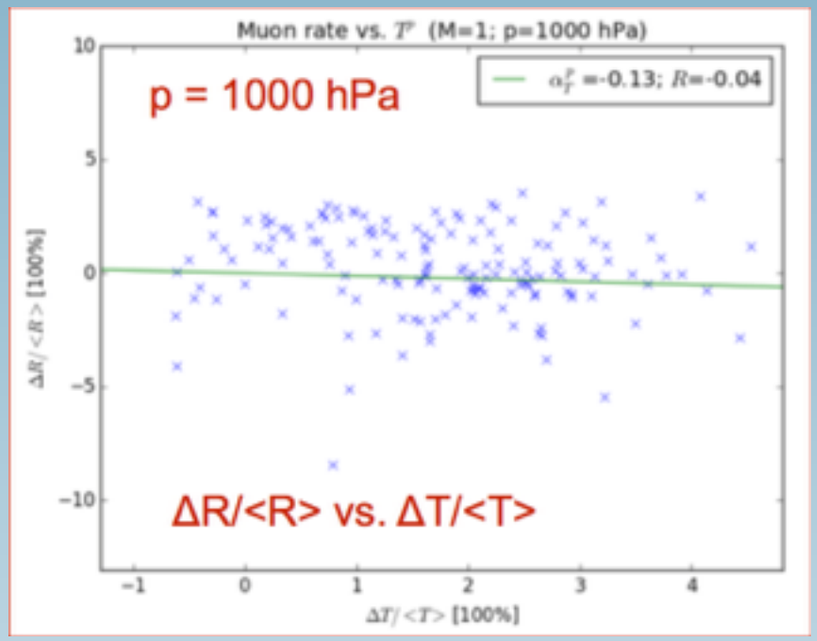


TRAGALDABAS: preliminary results

Atmosphere slope analysis



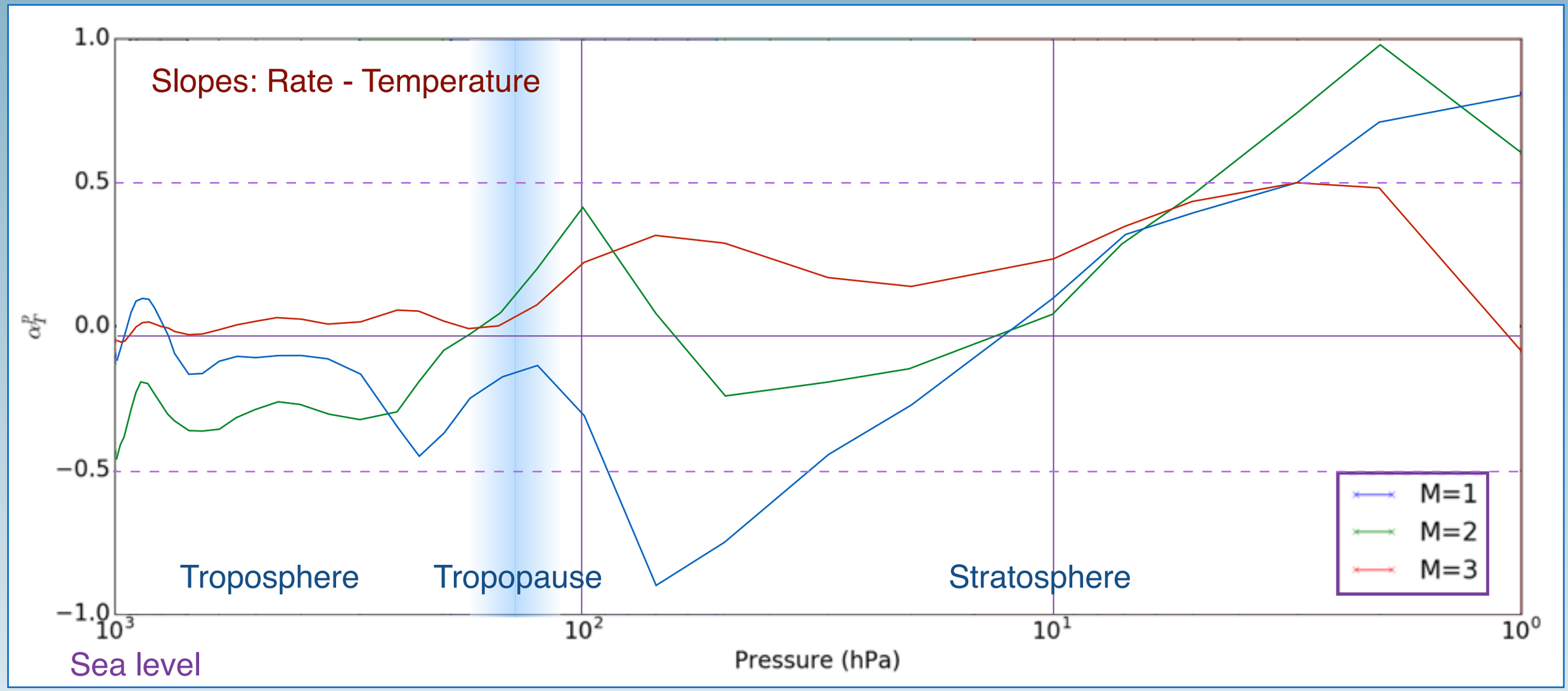




Linear fits of the relative rate changes (dR/R) respect the relative temperature changes (dT/T) at different pressure levels

TRAGALDABAS: preliminary results

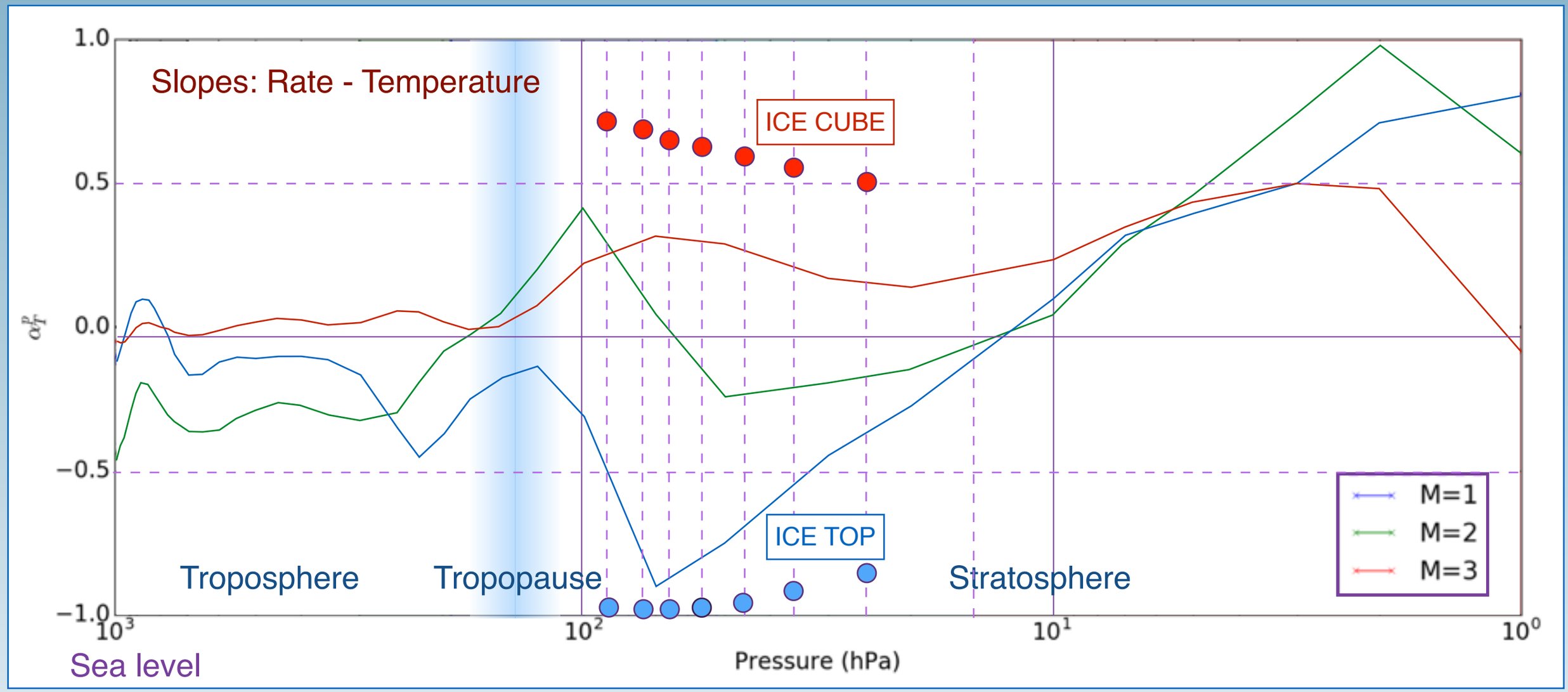
Atmosphere slope analysis



Different multiplicity (energy) events show a different behaviour respect temperatures at the different heights of the atmosphere

TRAGALDABAS: preliminary results

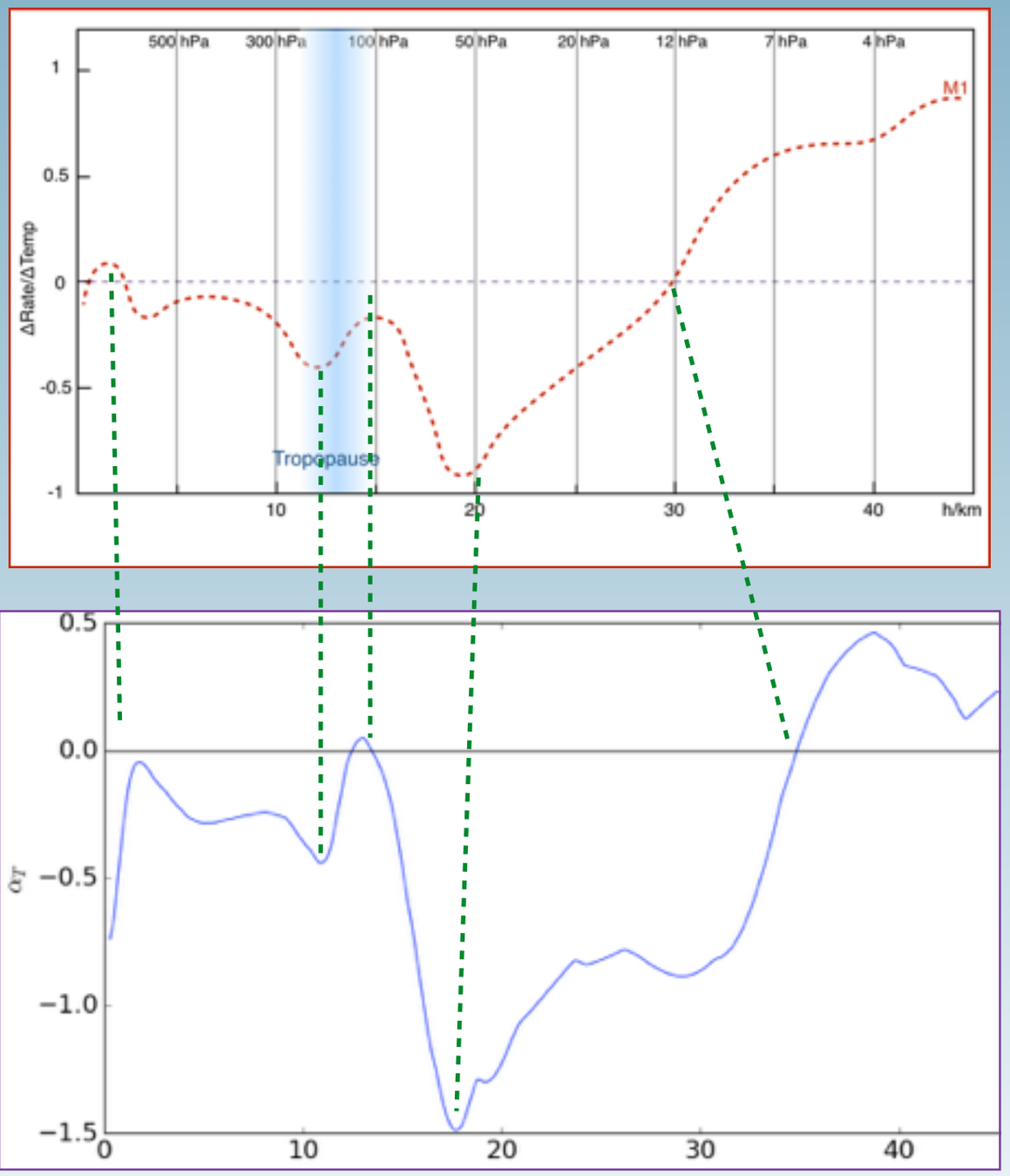
Atmosphere slope analysis



We observe similar trends that the ones observed in the IceTop - IceCube observatory for low and high energy muons

TRAGALDABAS: preliminary results

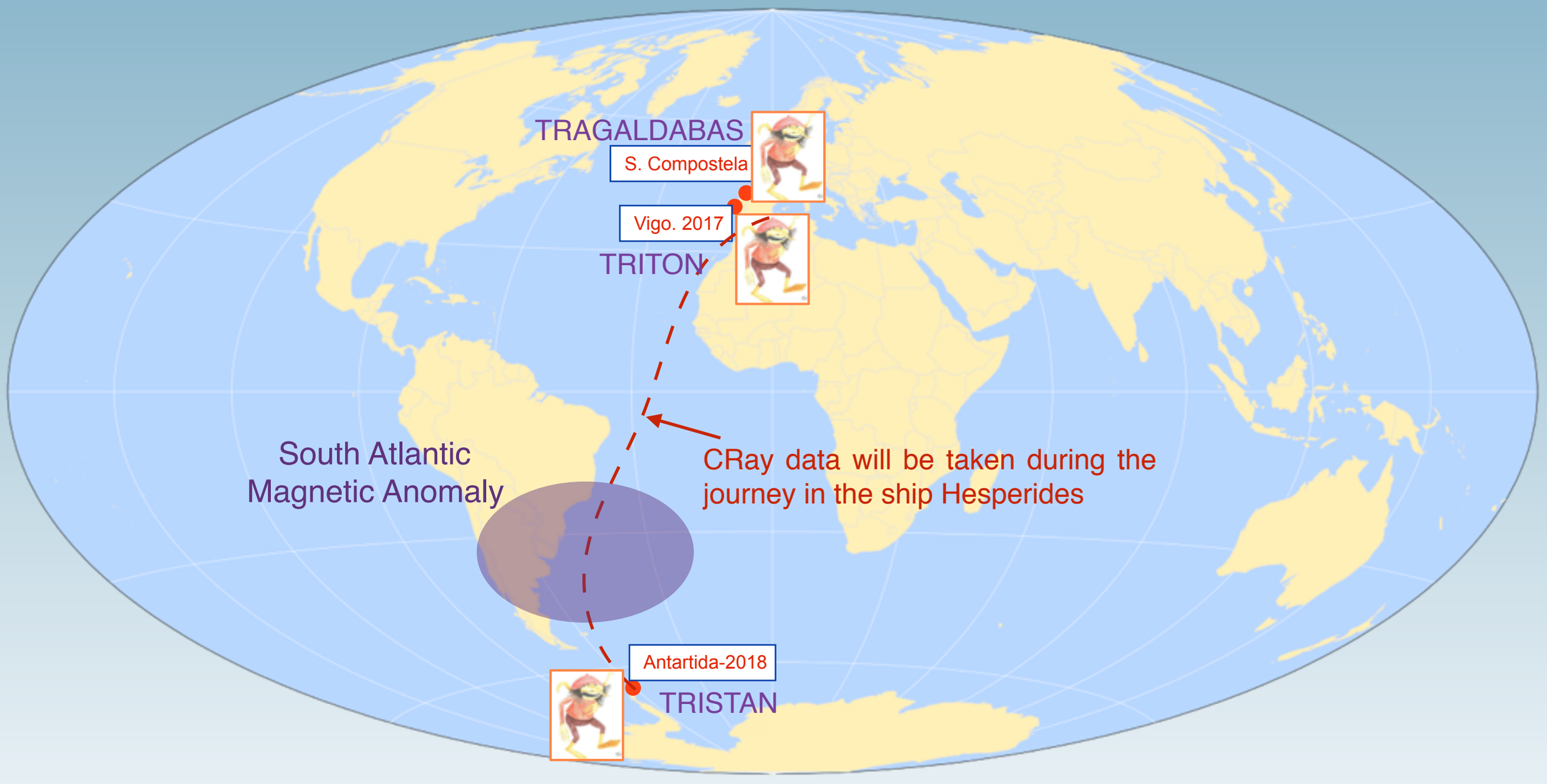
Atmosphere slope analysis



Most of the observed effect in the slopes are reprouced by a naive MCarlos

The TRASGO project: next steps

- Install new Trasgos in other places: Vigo & Spanish Antarctic Base



The TRASGO project: next steps

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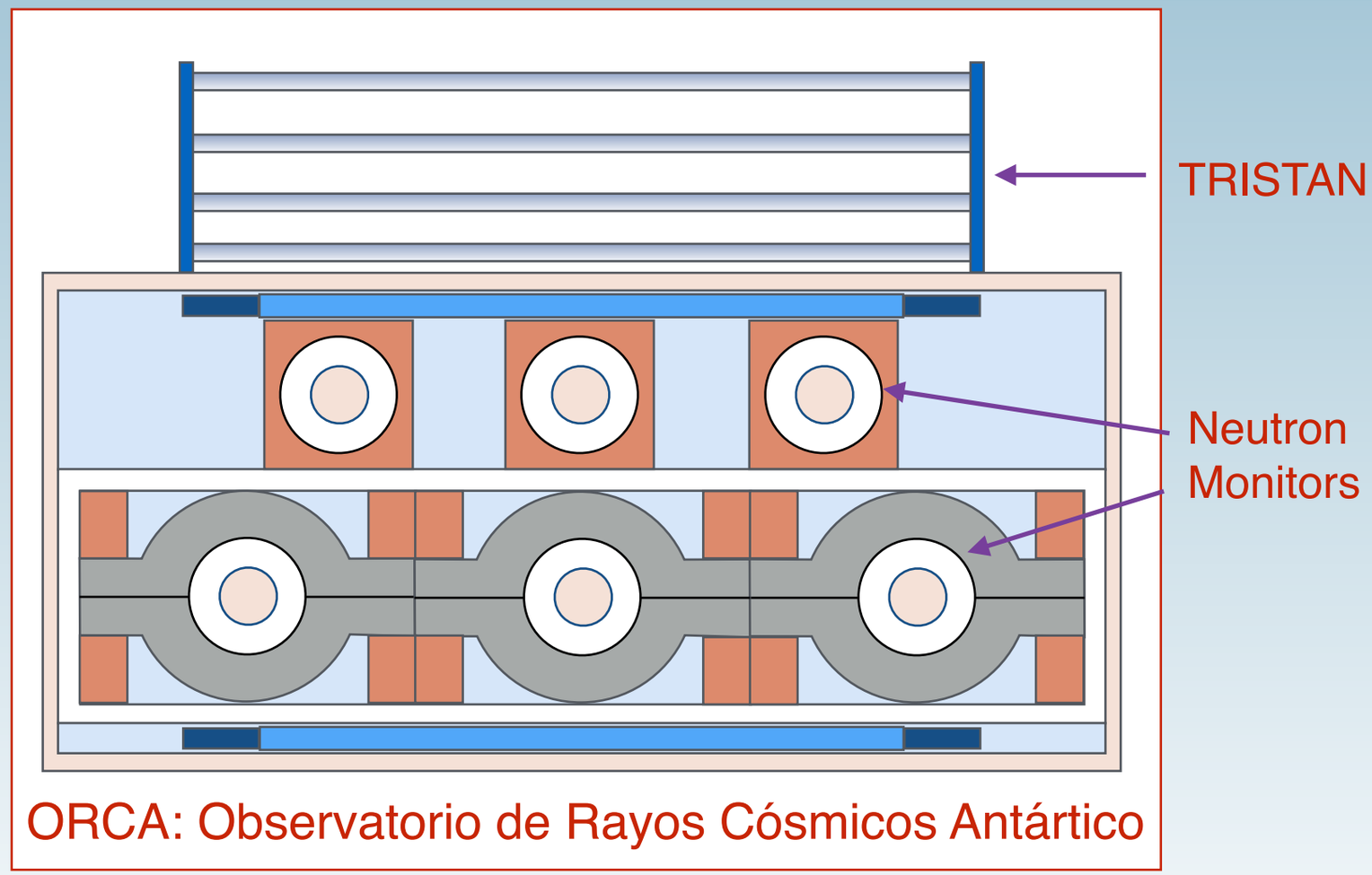
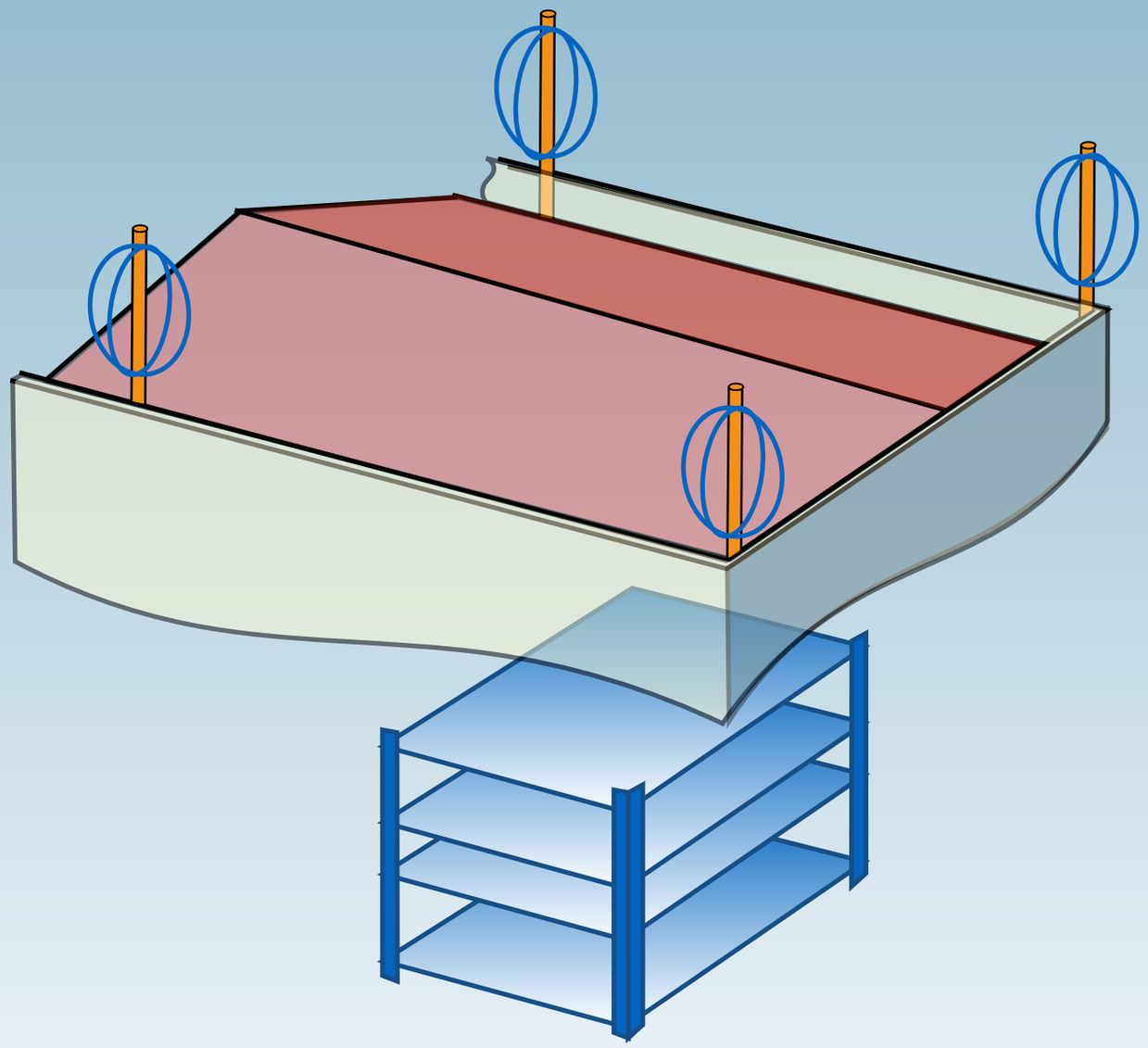


ORCA: Observatorio de Rayos Cósmicos Antártico

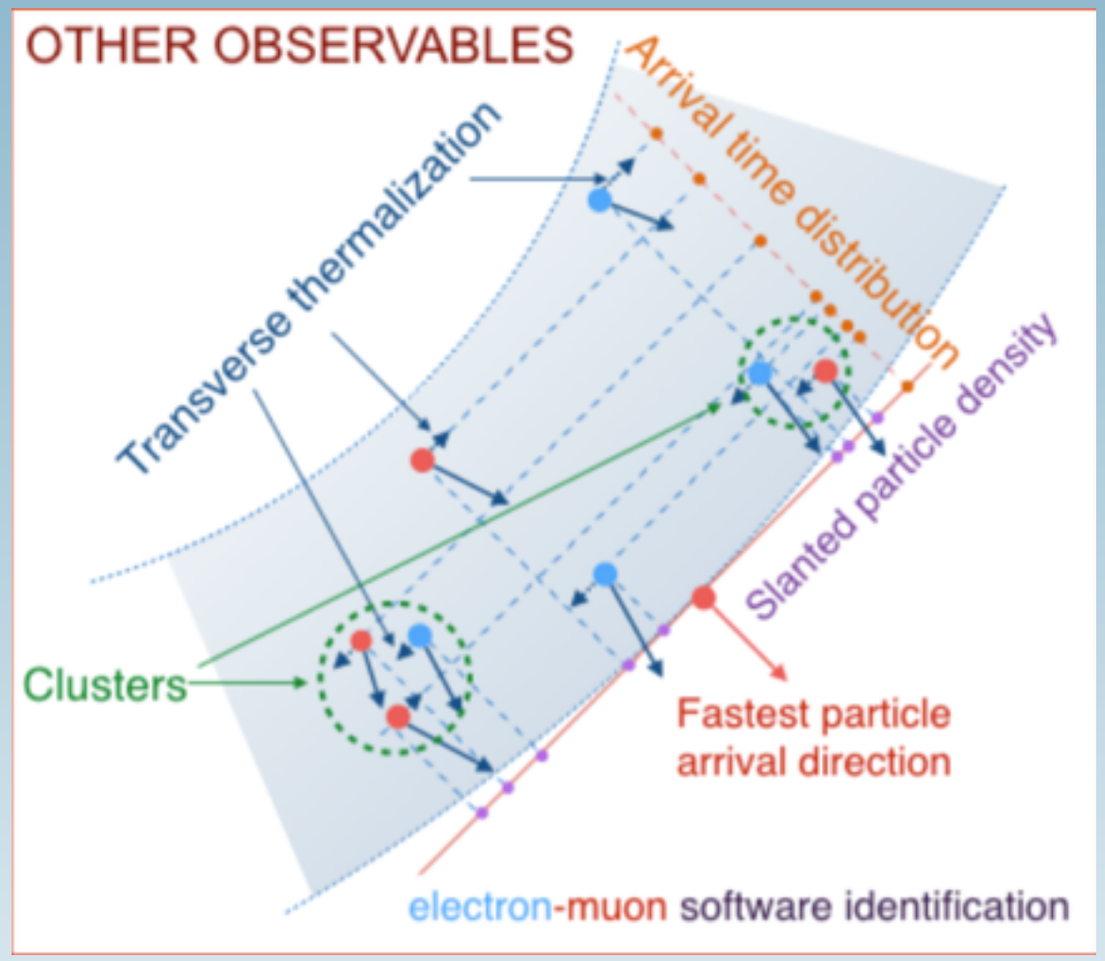
The TRASGO project: next steps

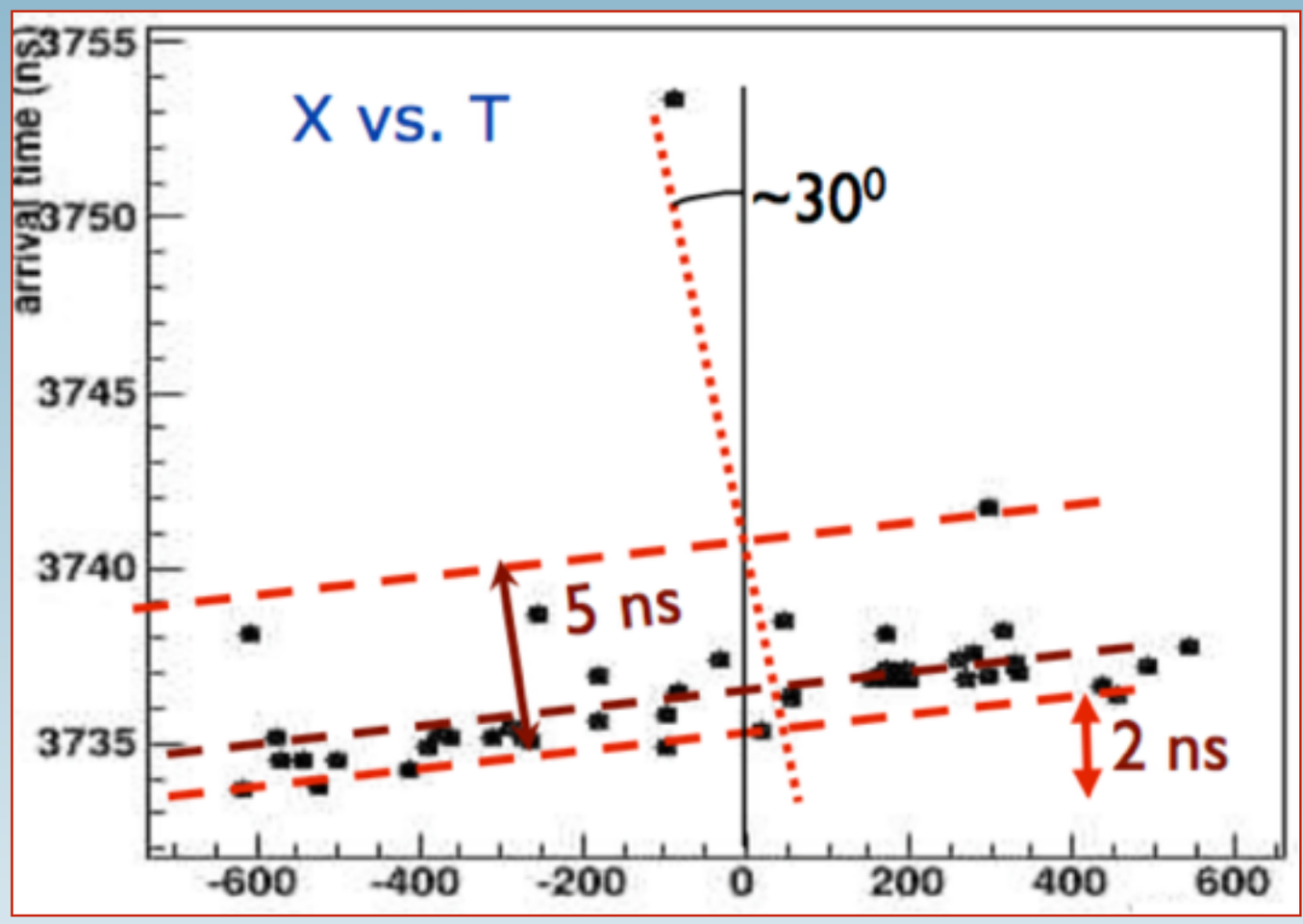
- Install 4 SALLA radio-antennas provided by KIT (Karlsruhe), on the roof for identifying high energy air showers.



The TRASGO project: next steps

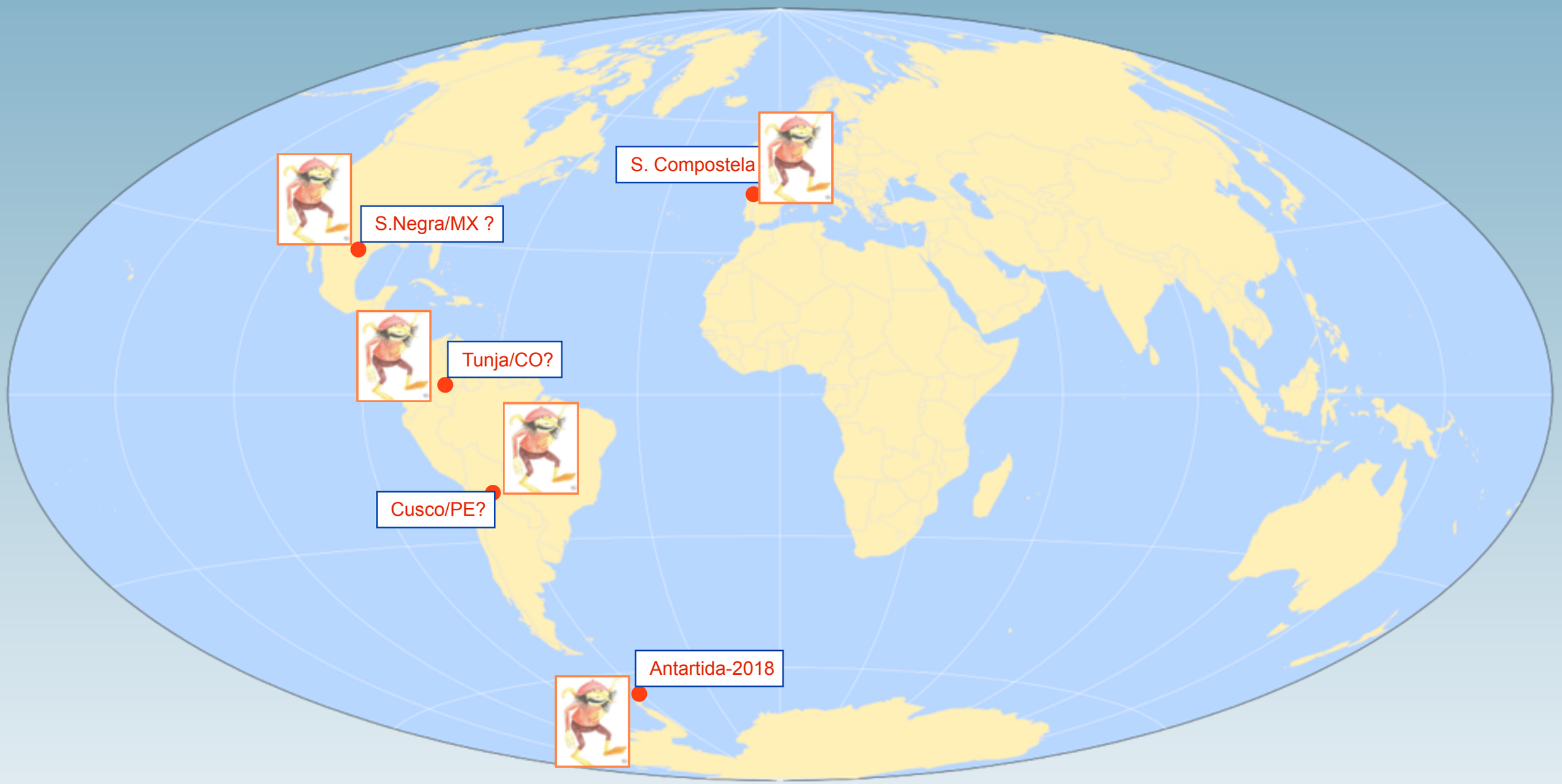
- Look for new signatures allowing a better measurement of primary cosmic rays





The TRASGO proyect: next steps

- CORSAIR (Cosmic Ray Simulation Research Network)



Goal: To simulate Cosmic Rays air showers, at different locations in order to look for new trends that could be measured with high accurate TRASGO detectors.

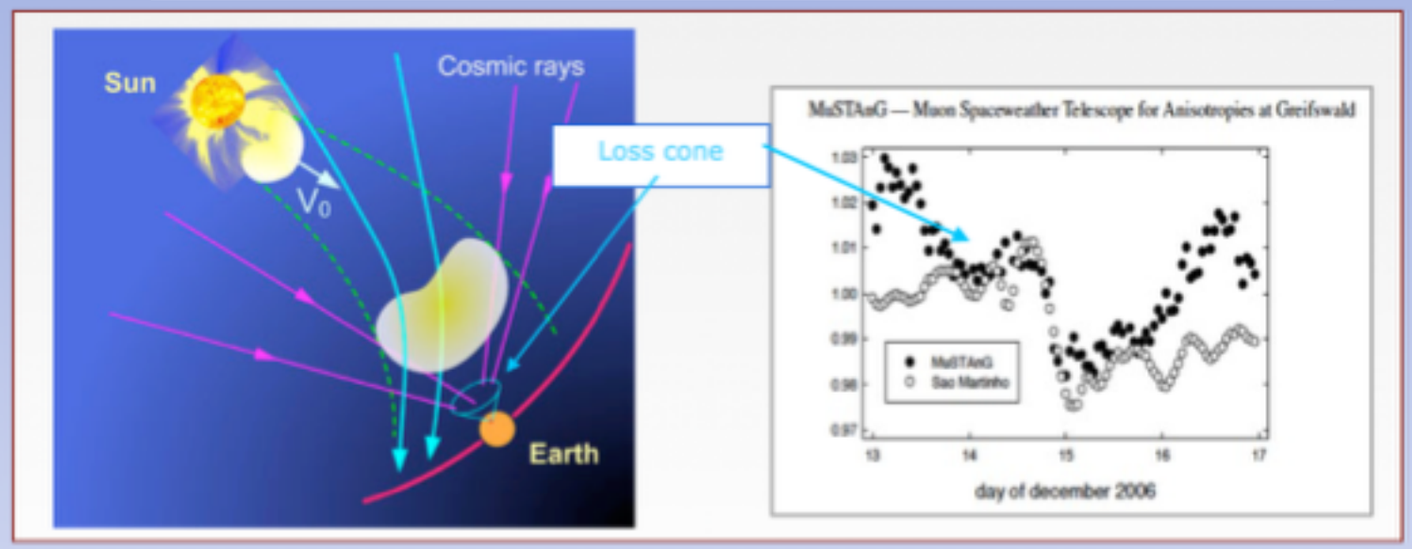
The TRASGO proyect: next steps

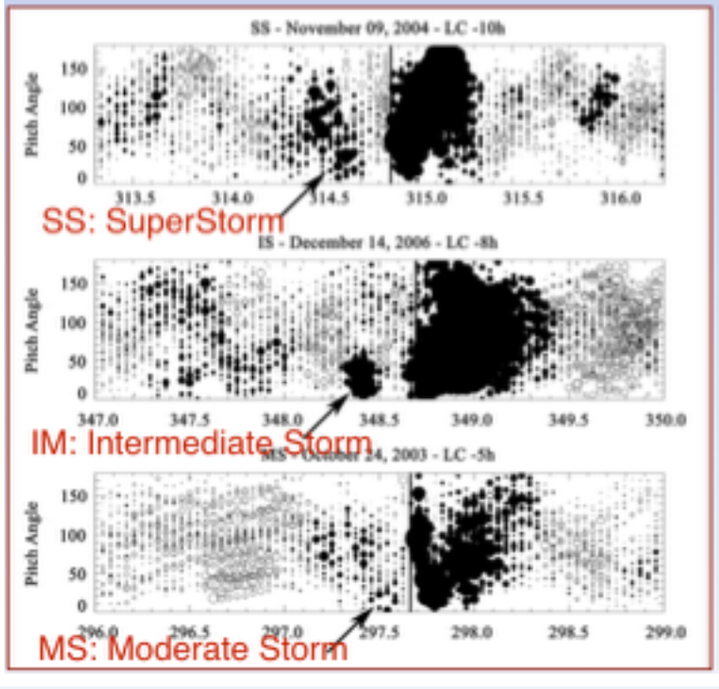
- KARMA Interreg-Sudoe project: network for the early detection of magnetic storms installing many Trasgos in Southwest Europa

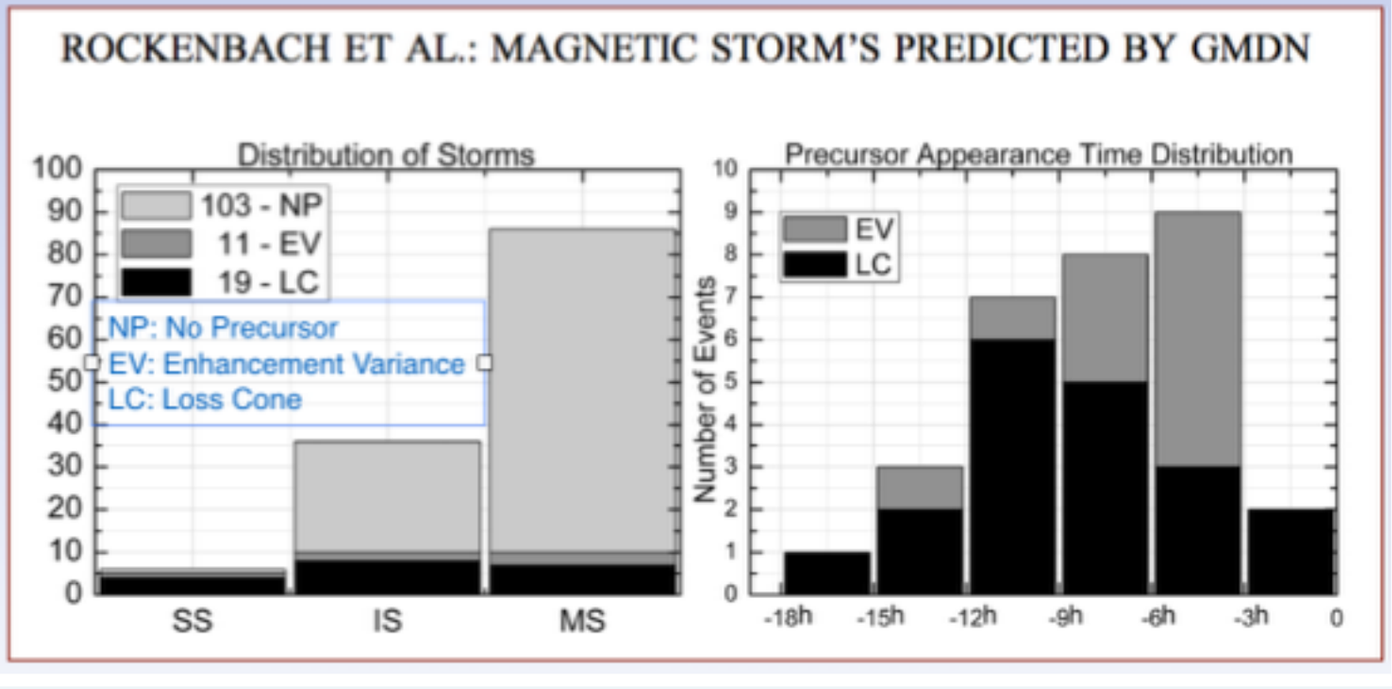
The TRASGO proyect: next steps

- Interreg-Sudoe project: network for the early detection of magnetic storms

Cosmic rays and the solar activity







Summary

- TRASGOS are very interesting devices that may allow us to improve significantly our knowledge on many cosmic rays aspects.
- Preliminary results are very encouraging
- TRASGOS are complicated devices and still several problems should be fixed
- There is still a lot of work to be done in front of us
- A first detector is operative and taking data regularly at the Univ. of Santiago de Compostela. Soon other TRASGOS will be operative in other places providing new data

- TRASGOS are complicated devices and still several problems should be fixed

Summary

Taking

good quality data

and having

a better understanding

of both

the detector

and

the atmospheric
pressure and
temperature effects

are

our main priorities!

Proyecto trasgo Project

The adventure goes on…

TRAGALDABAS

MACROESCANER project

the end

Thanks!