Proyecto trasgo Project

The TRASGO Project

Past, Present & Future

Juan A. Garzón (LabCAF / IGFAE - Univ. Santiago de Compostela)

Collaborating members

M. Ajoor[12], H. Alvarez-Pol[10], A.Blanco[4], J.J.Blanco[1], P.Cabanelas[10], F.Clemencio[5,6], J.Collazo[13], J.Cuenca[11], J. Flores[9], P.Fonte[4], Y.Fontenla[11], D.García Castro[11], J.A.Garzón[11], A.Gomis[7], G.Kornakov[14], T.Kurtukian[2], L.Lopes[4], C. Loureiro[5], A.Morozova[3], M.A.Pais[3], A.Pazos[10], V.Pérez Muñuzuri[12], P.Rey[8], I.Riádigos[11,12], M.Seco[10], V. Villasante[6], J. Xuna[11].

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. LIBPhys, Dept. of Physics. U. Coimbra, Portugal / Data Acquisition System
6. E. Superior de Saude, I. Politécnico. Porto, Portugal / Data Acquisition System
7. IGN - Madrid, Spain / Geomagnetic field
8. CESGA Super-computation Center - Santiago de Compostela, Spain / Data storage and distribution
9. CITIUS - Univ. Santiago de Compostela, Spain / Imaging and augmented reality
10. IGFAE - Univ. Santiago de Compostela, Spain / Monitoring and Slow control
11. LabCAF - Univ. Santiago de Compostela, Spain / Cosmic rays physics, software and tracking
12. GFNL - Univ. Santiago de Compostela, Spain / Atmosphere Physics and Climate
13. HIDRONAV. Vigo, Spain / Detector development and Instrumentation
14. Warsaw Univ of Technology. Warsaw, Poland / Software development

Other partners:

Club Desarrollo de las Ciencias, Madrid, Spain

OUTLOOK

- The cosmic rays
- The TRASGO project
- The TRASGO Fleet
- A few activities and preliminary results
- Summary

Outlook:

1. The cosmic rays
2. Cosmic rays in HADES
3. The TRASGO project: TRAGALDABAS
4. Future
5. Summary & comments

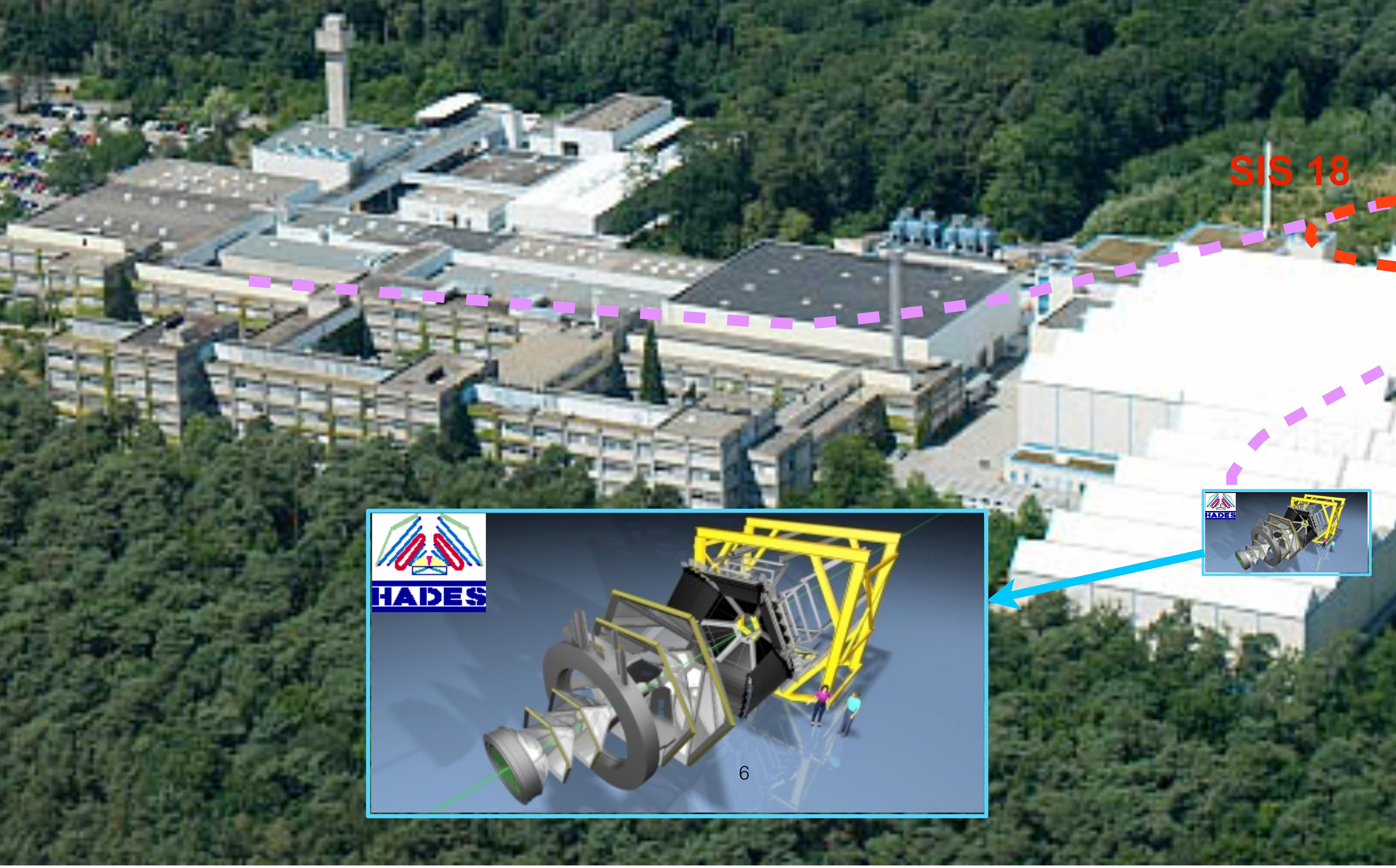
The past:

Cosmic rays at the HADES experiment

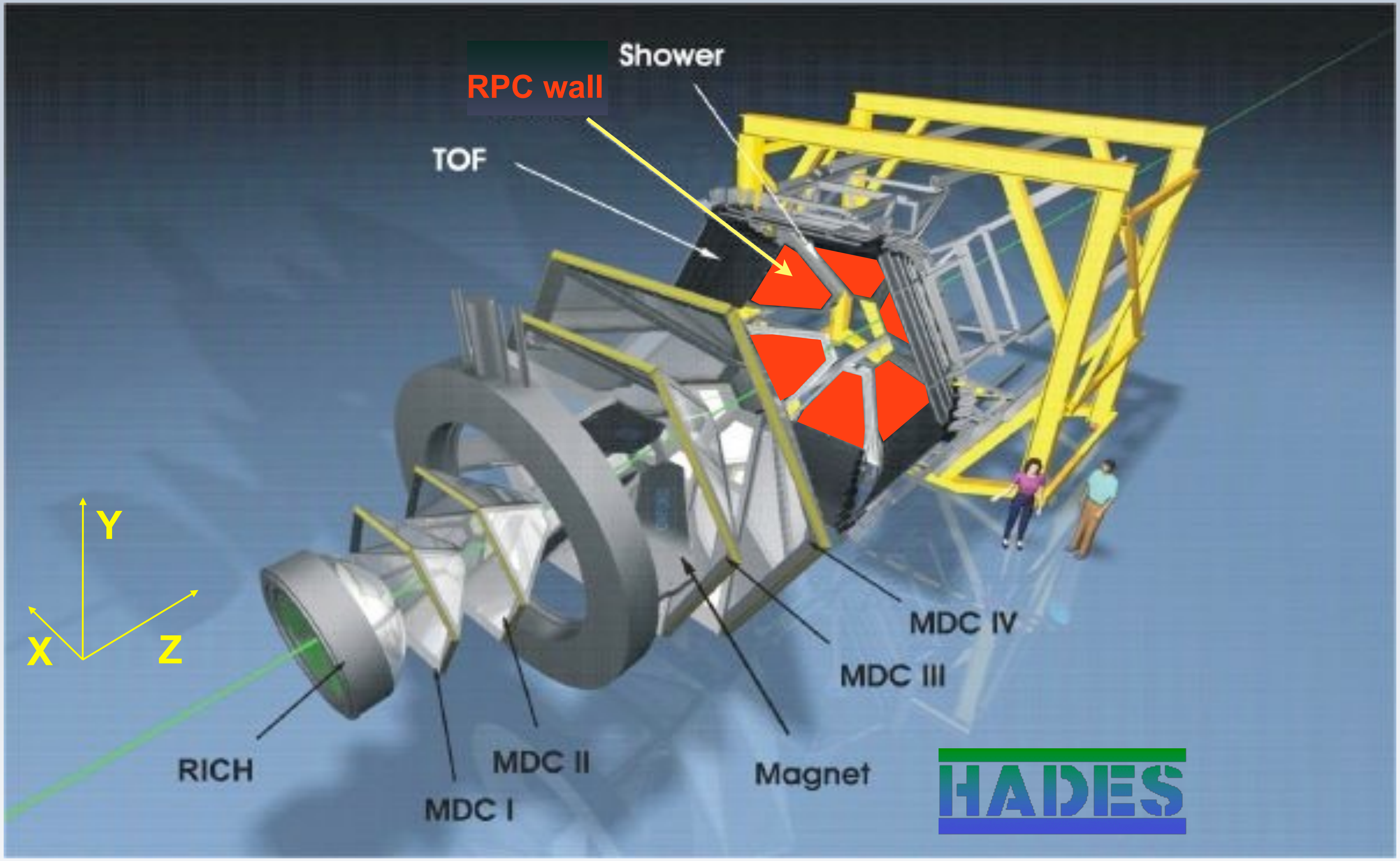
2. Cosmic rays in HADES

Darmstadt (Germany)

Latitude 49.9° N, Longitude 8.7° E; 100 m above **sea level**,

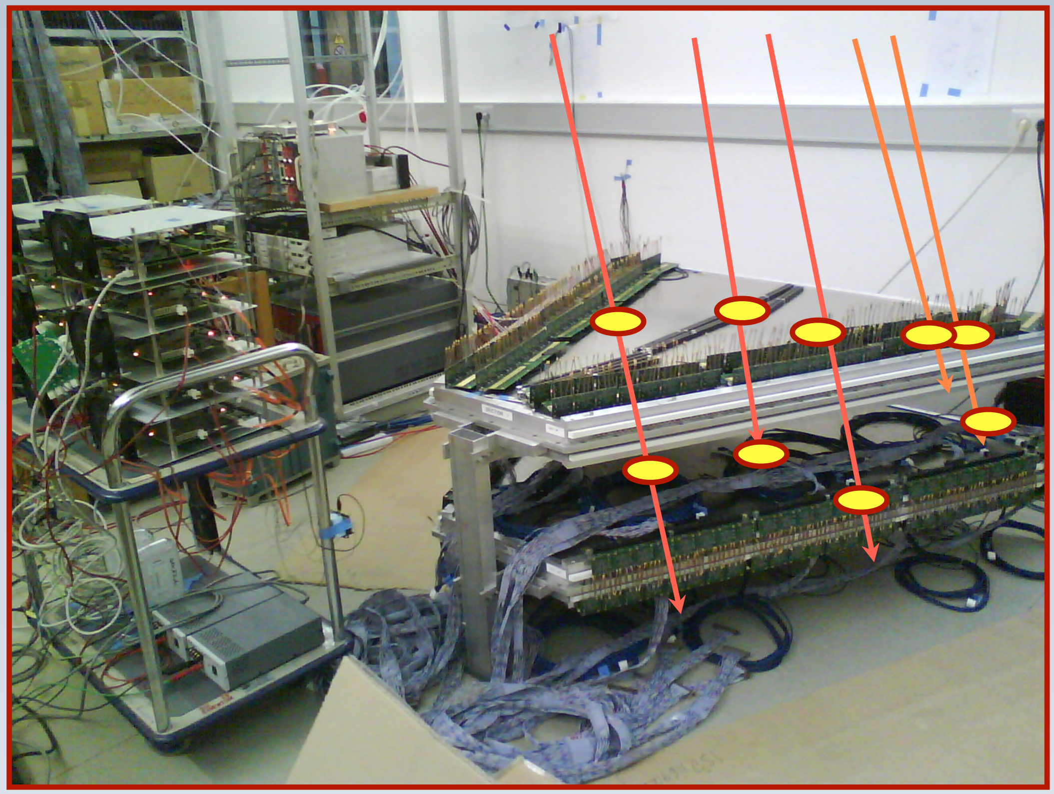


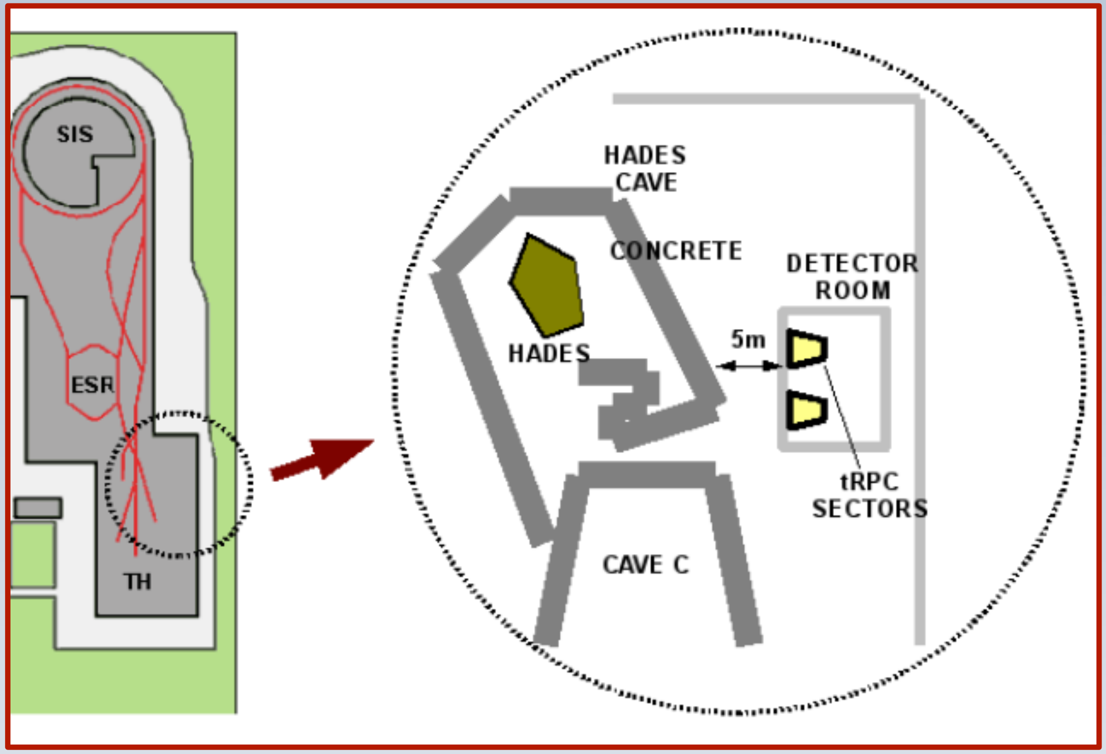
The HADES spectrometer

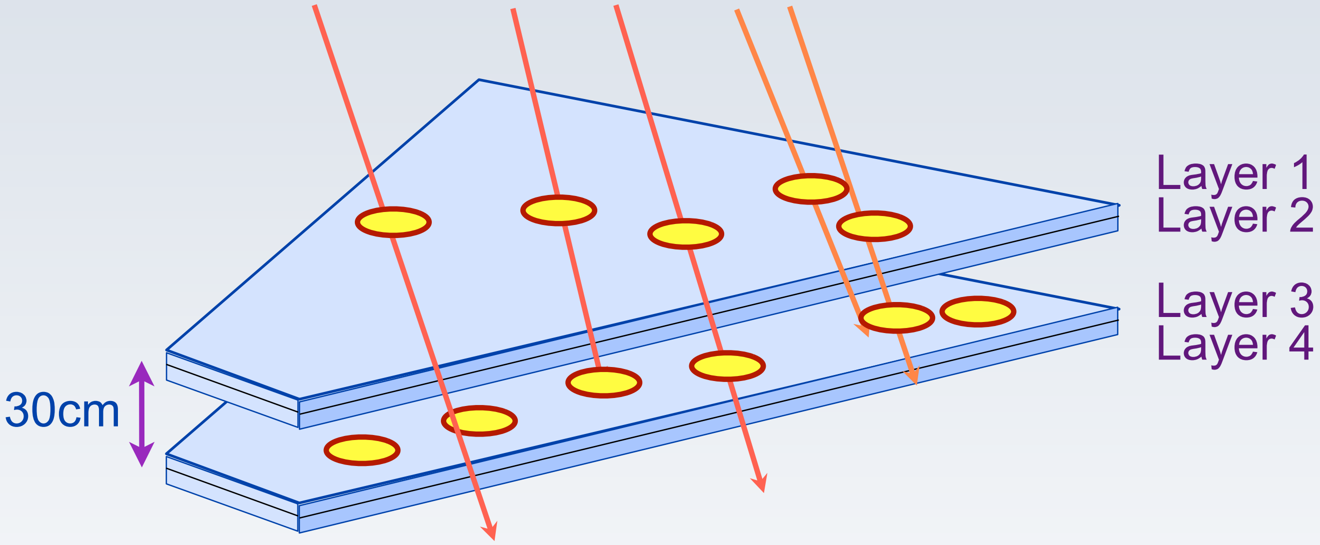


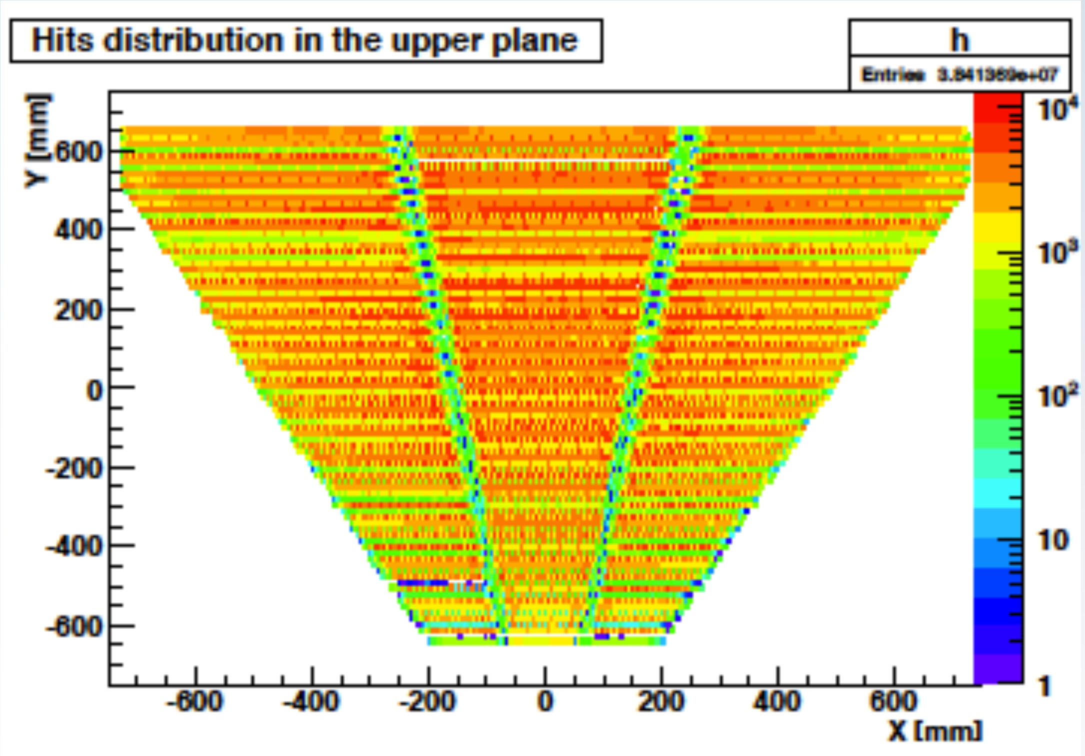
2. Cosmic rays in HADES

The commissioning

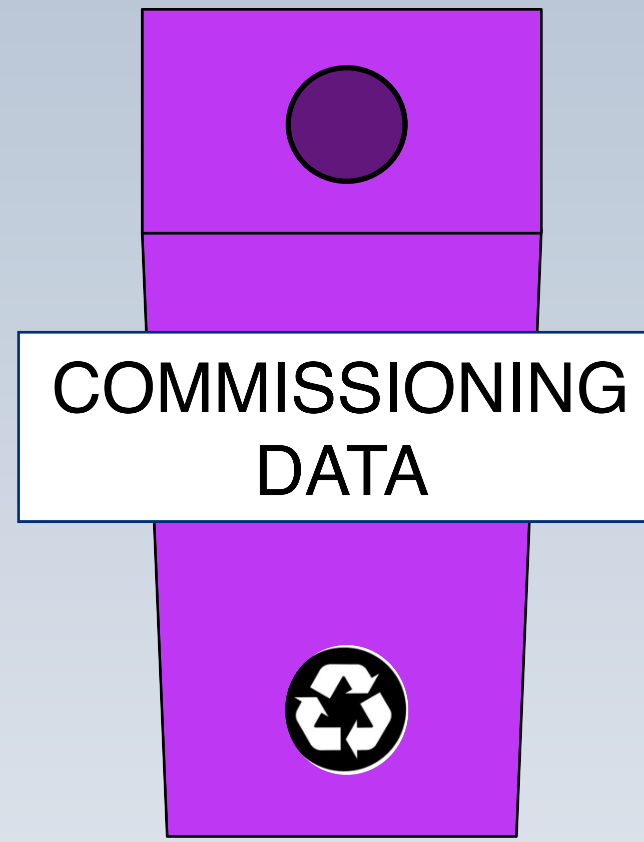








The commissioning



34 millions of events (~5 days) were taken under very stable conditions

- Surface:	~1.2 m^2
- Mean position resolution:	~ 5 cm^2
- Granularity:	up to >100 particles / event
- Time resolution	~ 80ps (hit)

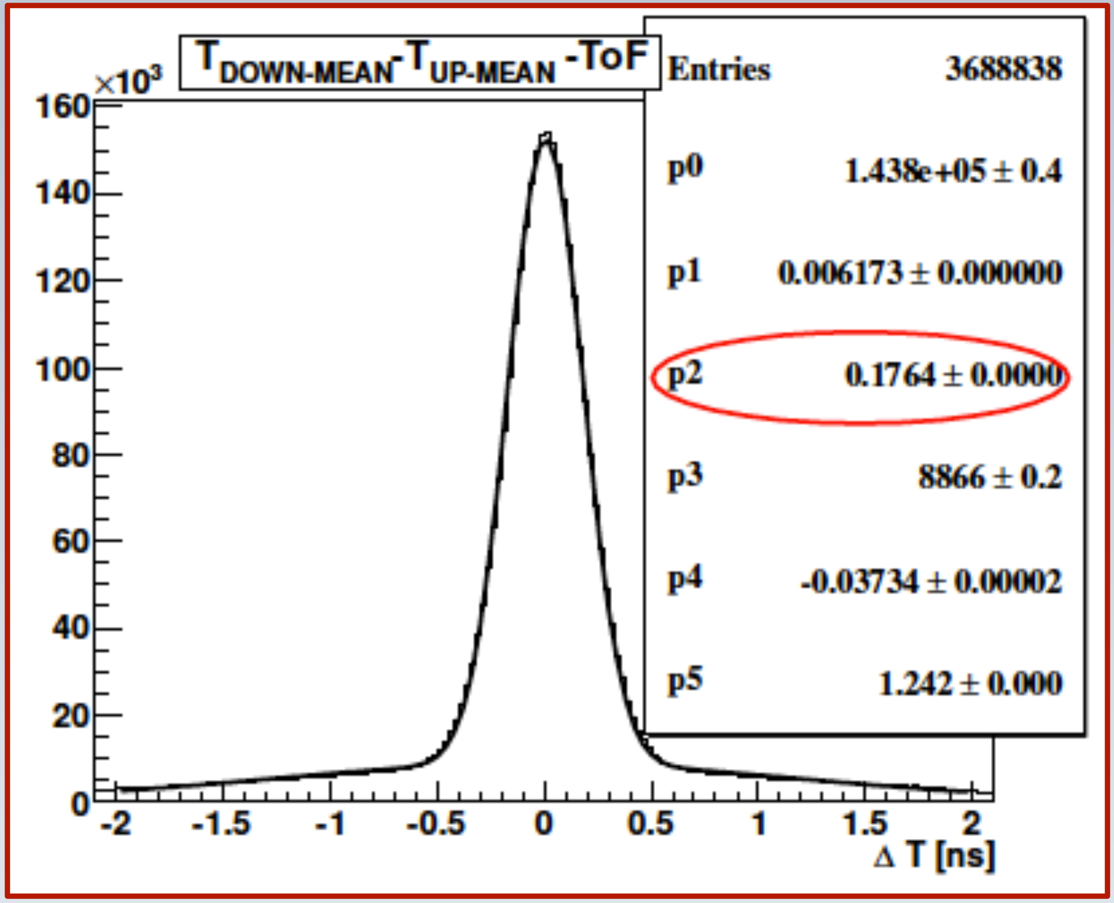
...never cosmic rays were seen at the Earth's surface with such a granularity and position and time resolutions!

Detectors calibration & synchronization

A hard work:

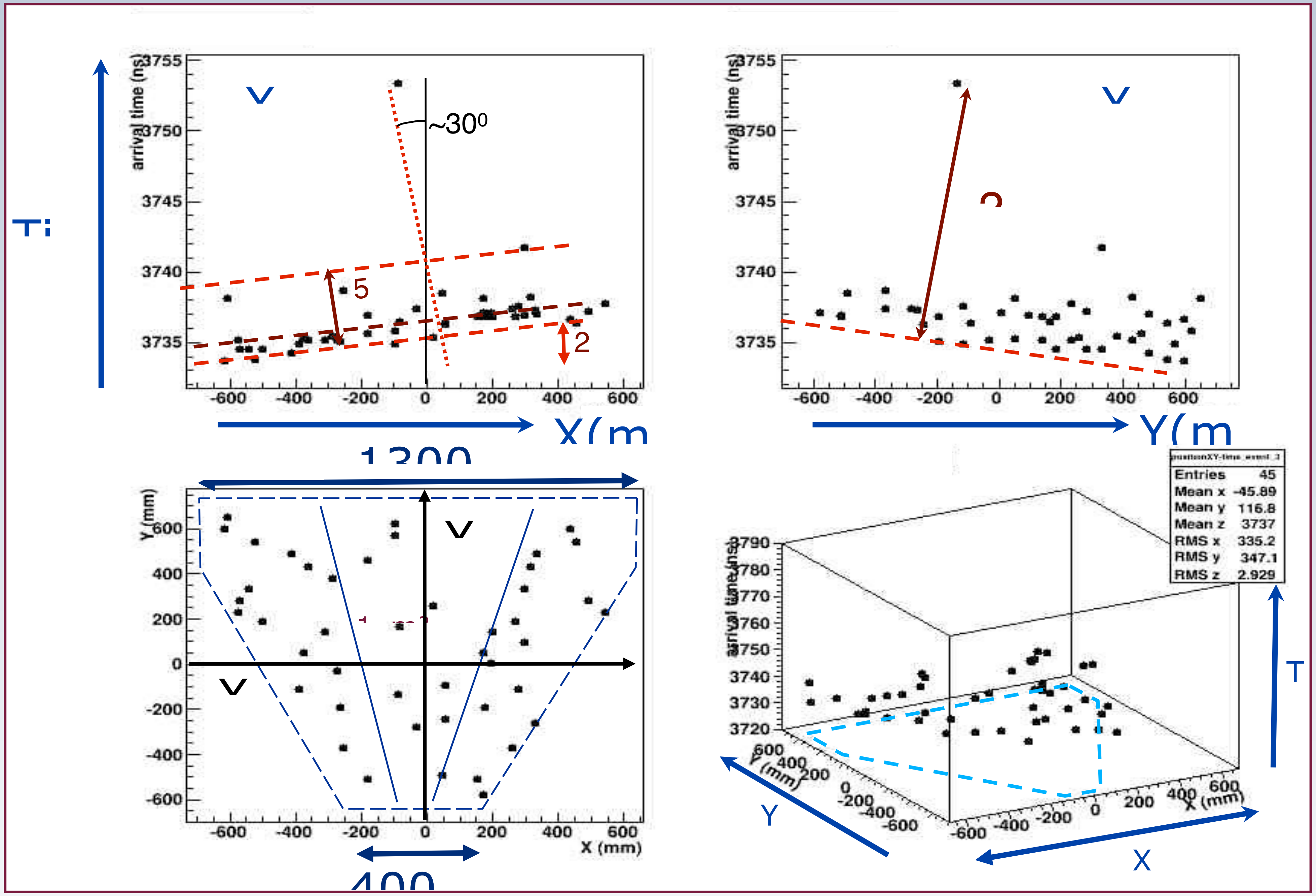
- No target data
- No external T0 signal
- No external tracking
- Cells going to different DAQ cards
- ...

Time resolution: δt = 176 ps



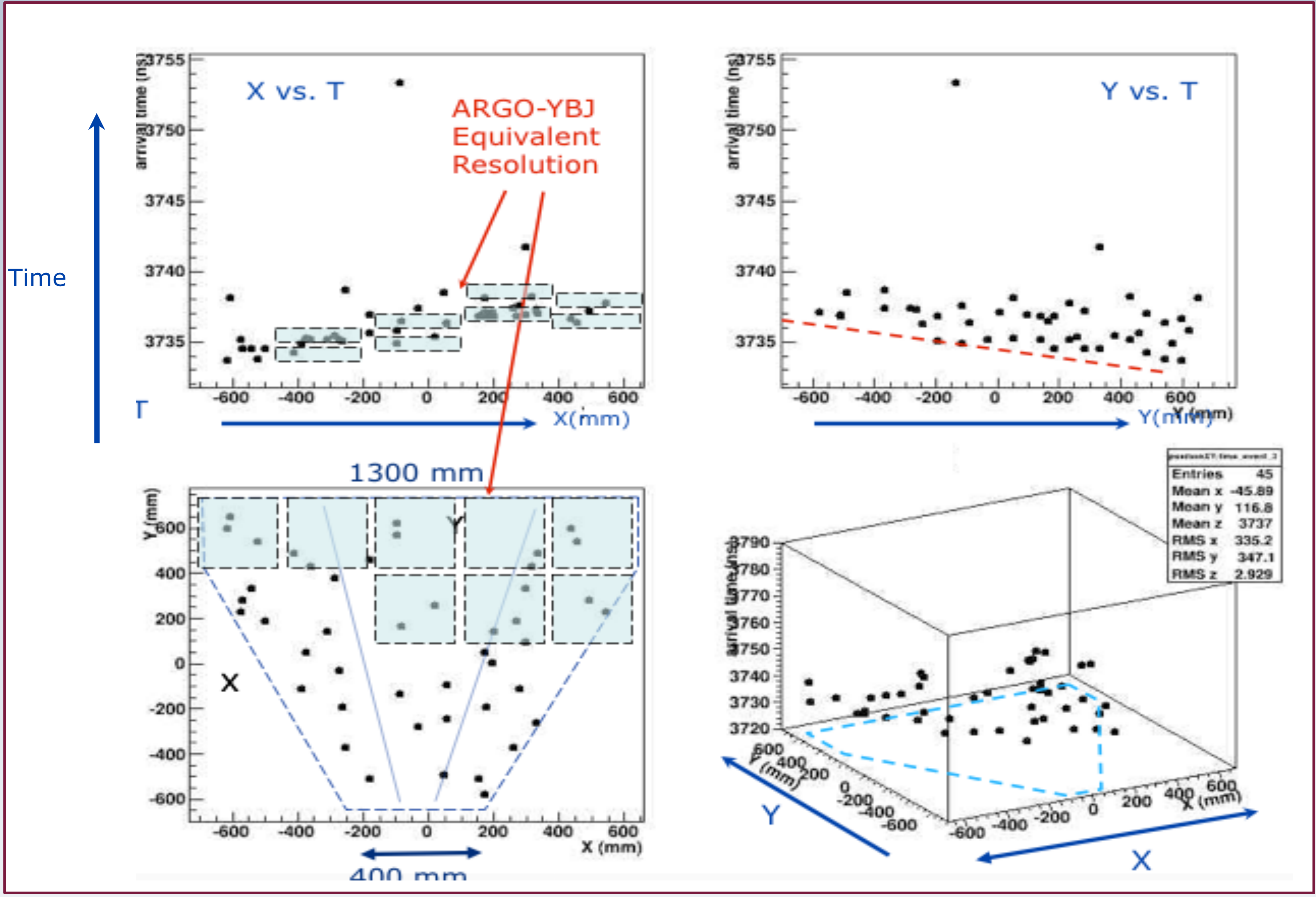
A first glance: a high multiplicity event

A typical high multiplicity event:



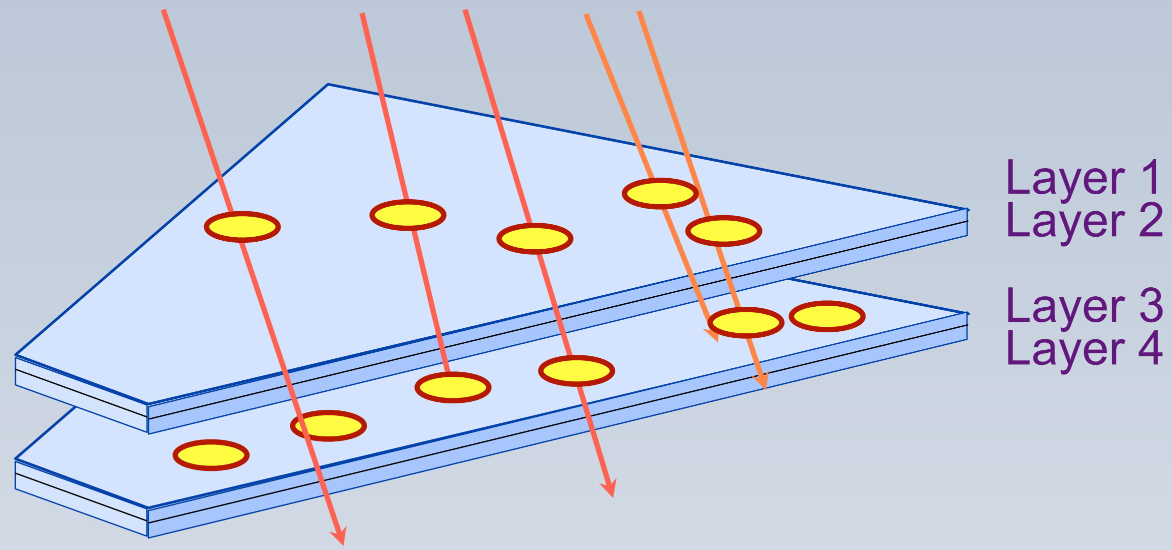
A high-time resolution ~1 m² detector provides a good estimate of the showers profile

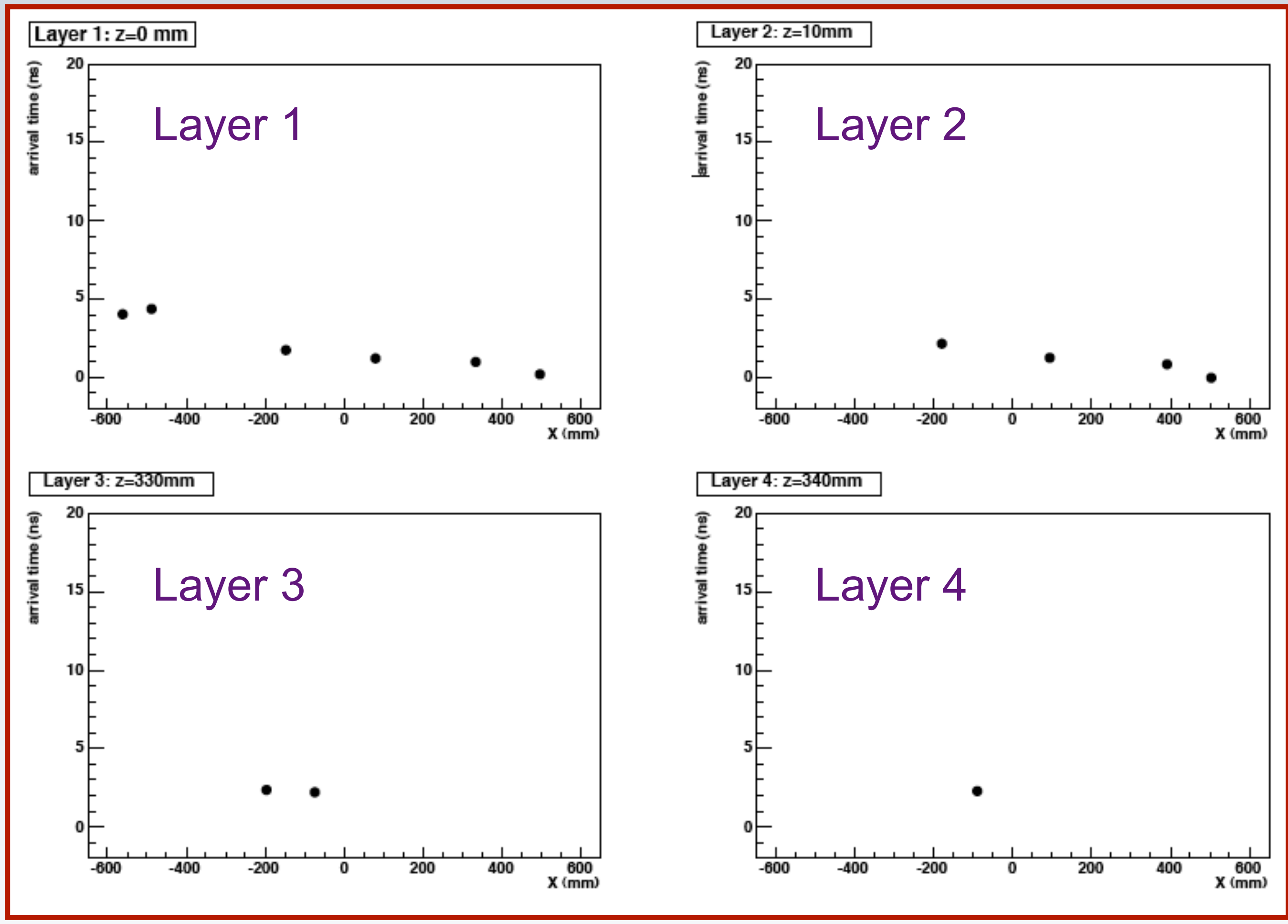
A first glance: a high multiplicity event

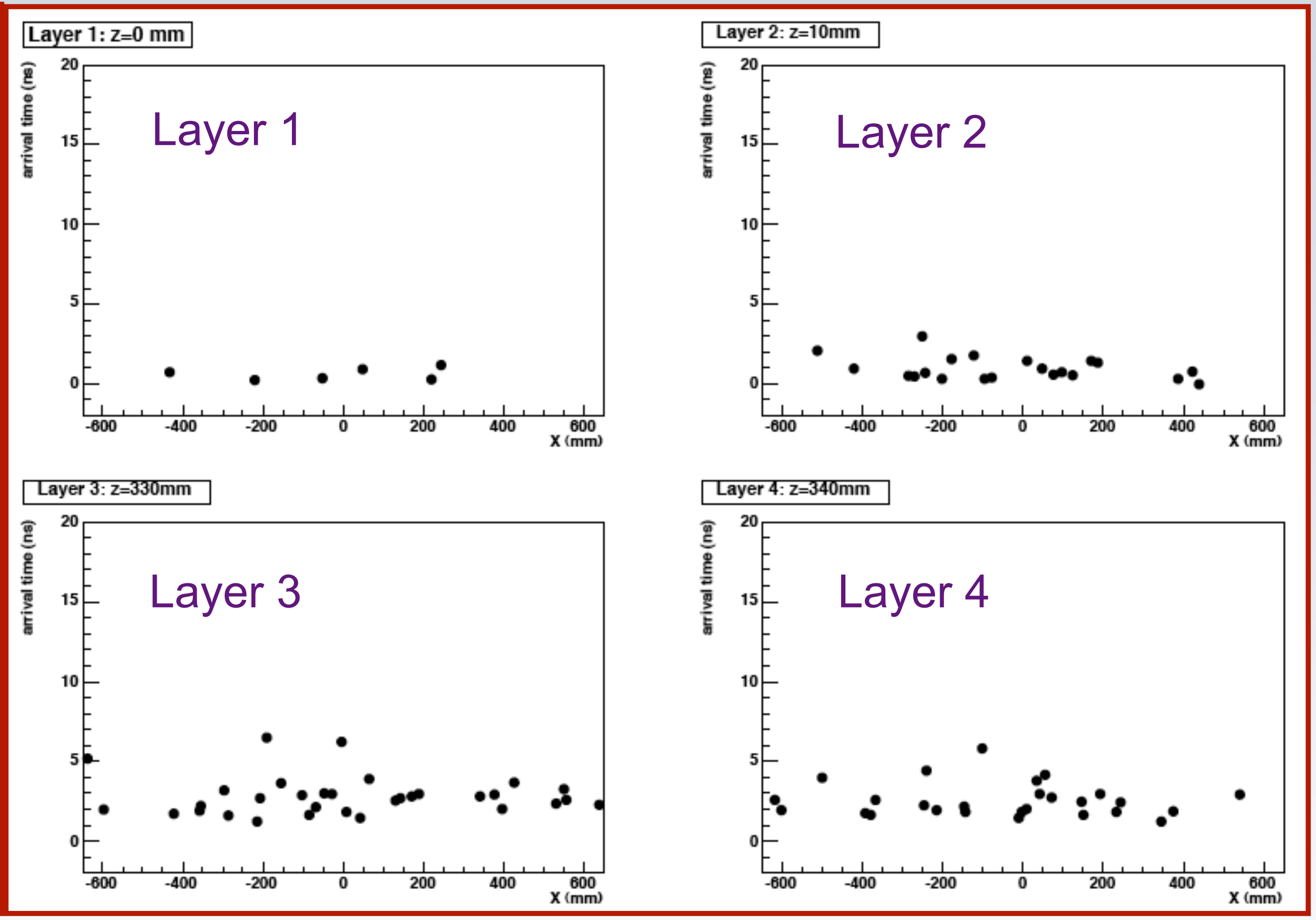


Never cosmic rays had been seen with such a high resolution!

A first glance: a 4-layer detector



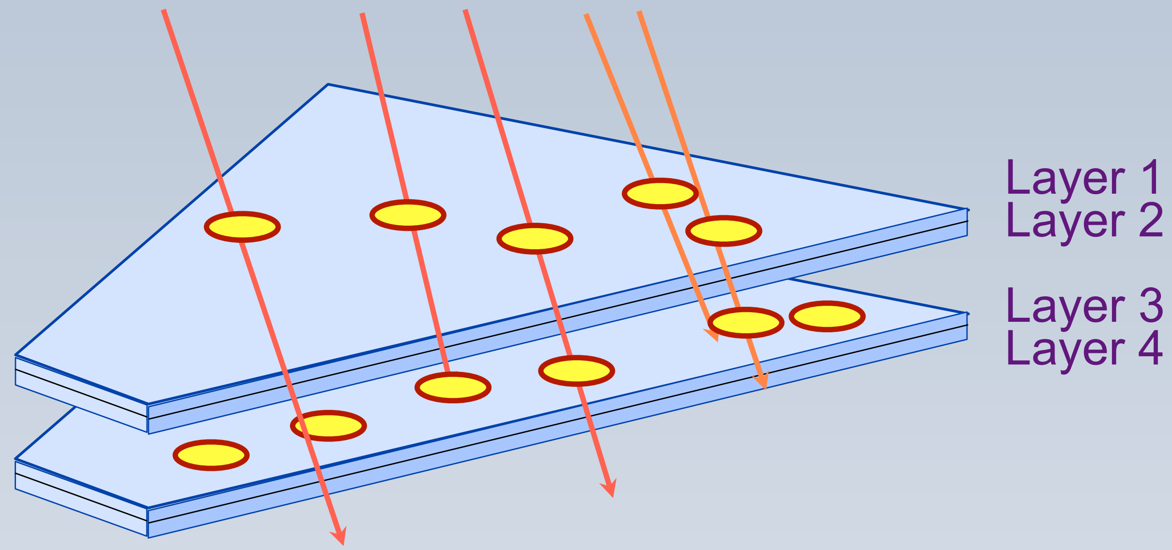


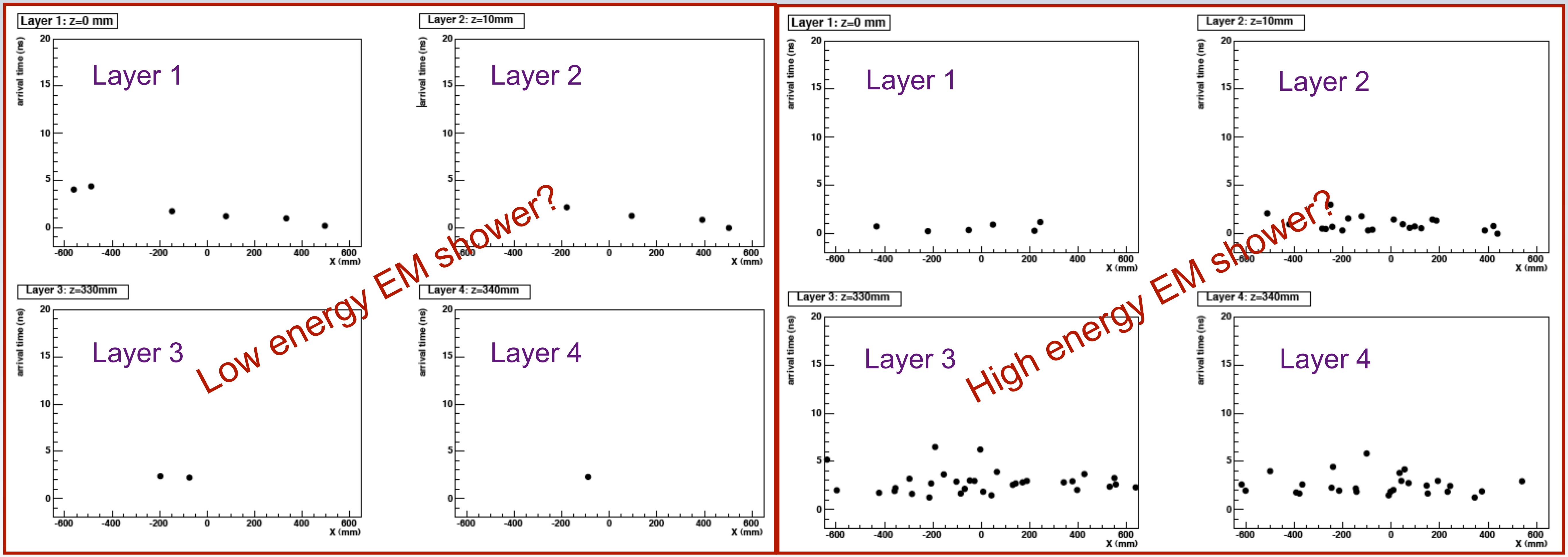


USC UNIVERSIDADE DE SANTIAGO DE COMPOSTELA
IGFAE Instituto Galego de Física de Altas Enerxías
Juan A. Garzon, LabCAF-IGFAE / Univ. Santiago de Compostela
Cosmic Ray Applications Workshop. Atlanta, GSU. Oct.6th. 2019
LabCAF
Proyecto trasgo Project

2. Cosmic rays in HADES

A first glance: a 4-layer detector

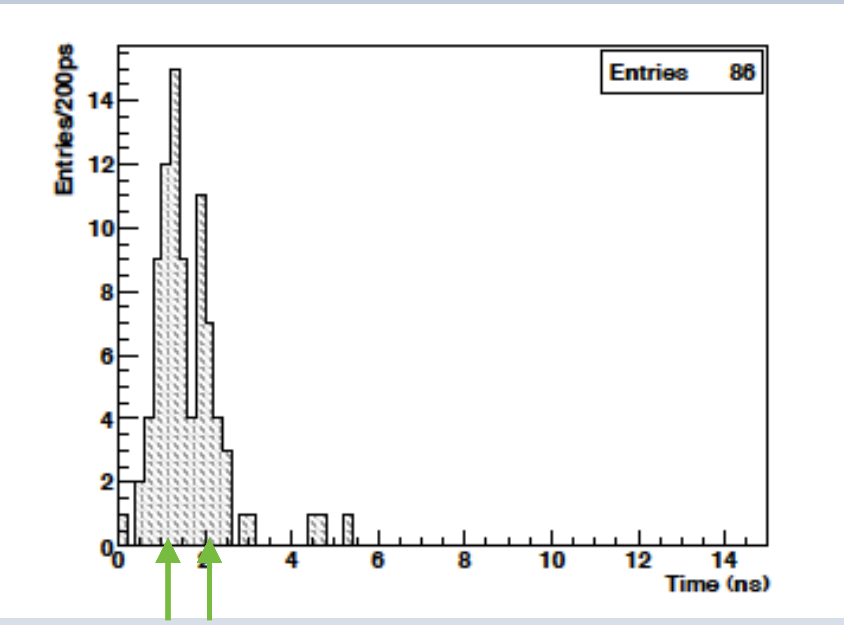




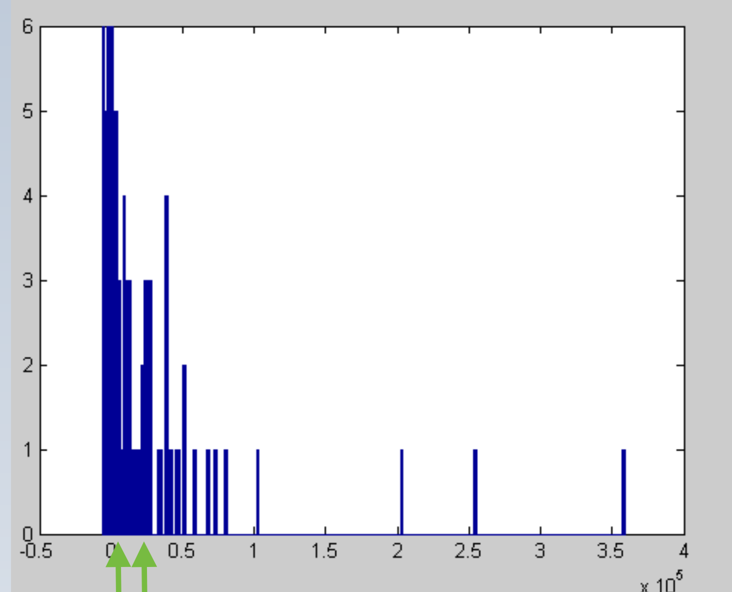
2. Cosmic rays in HADES

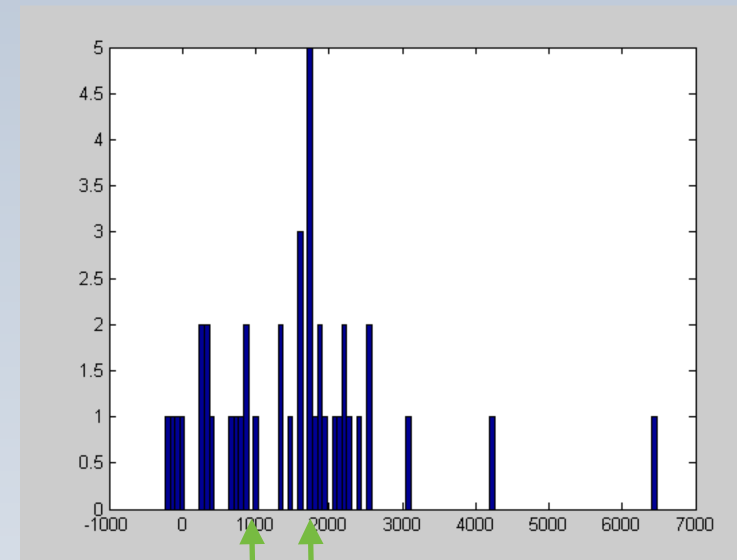
Shower front analysis: a few corrected profiles

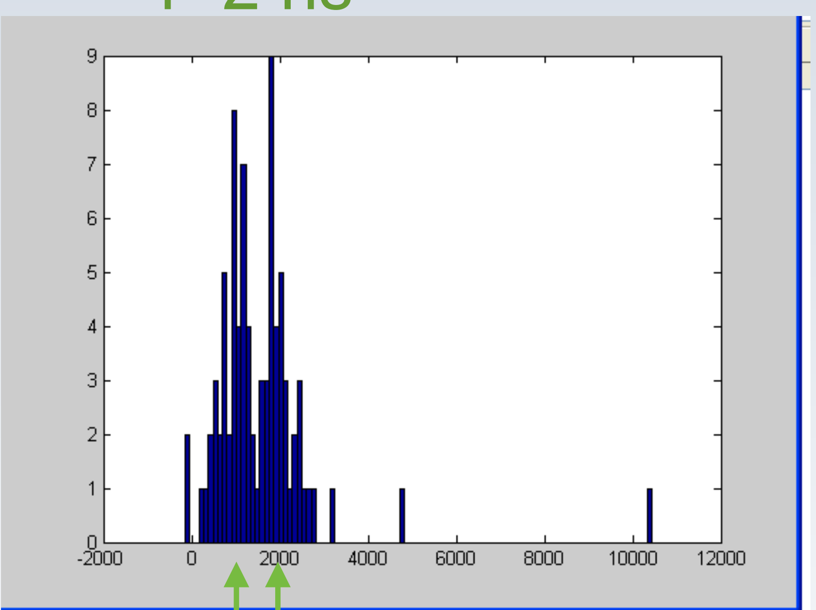
Shower profiles with arrival angle correction: some high multiplicity examples



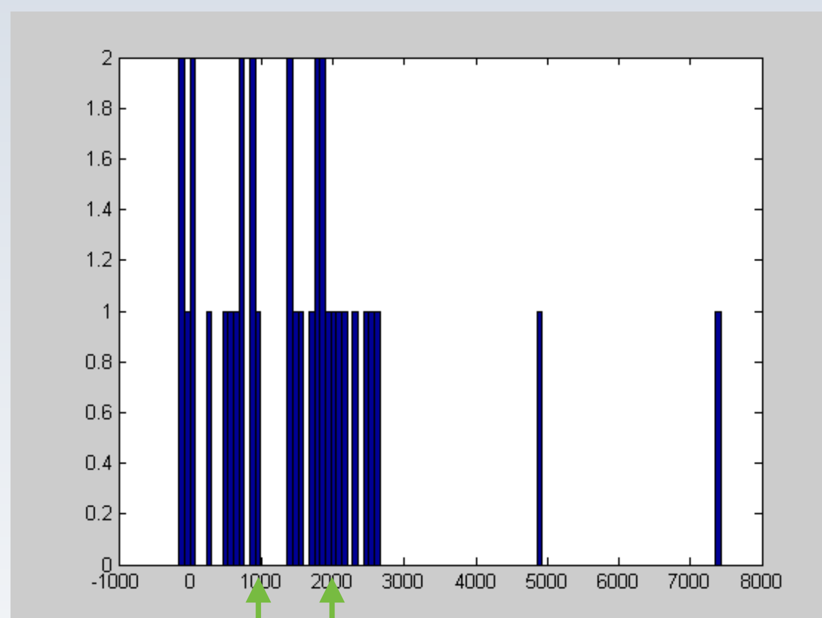
1 2 ns

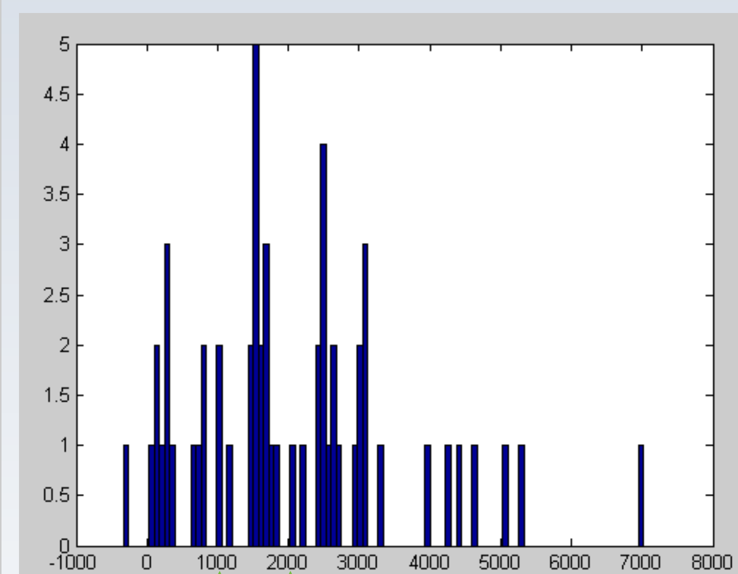






1 2 ns

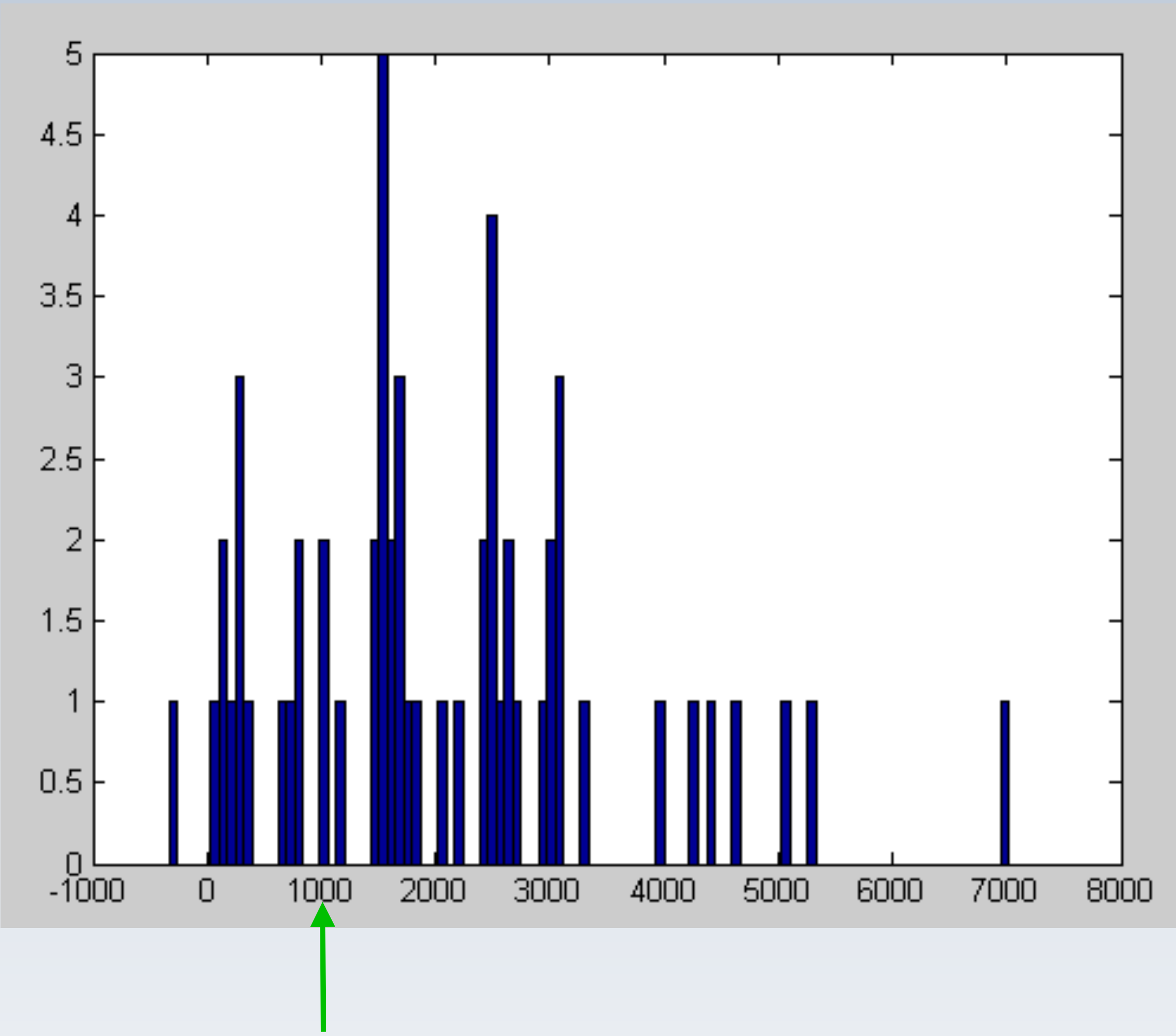




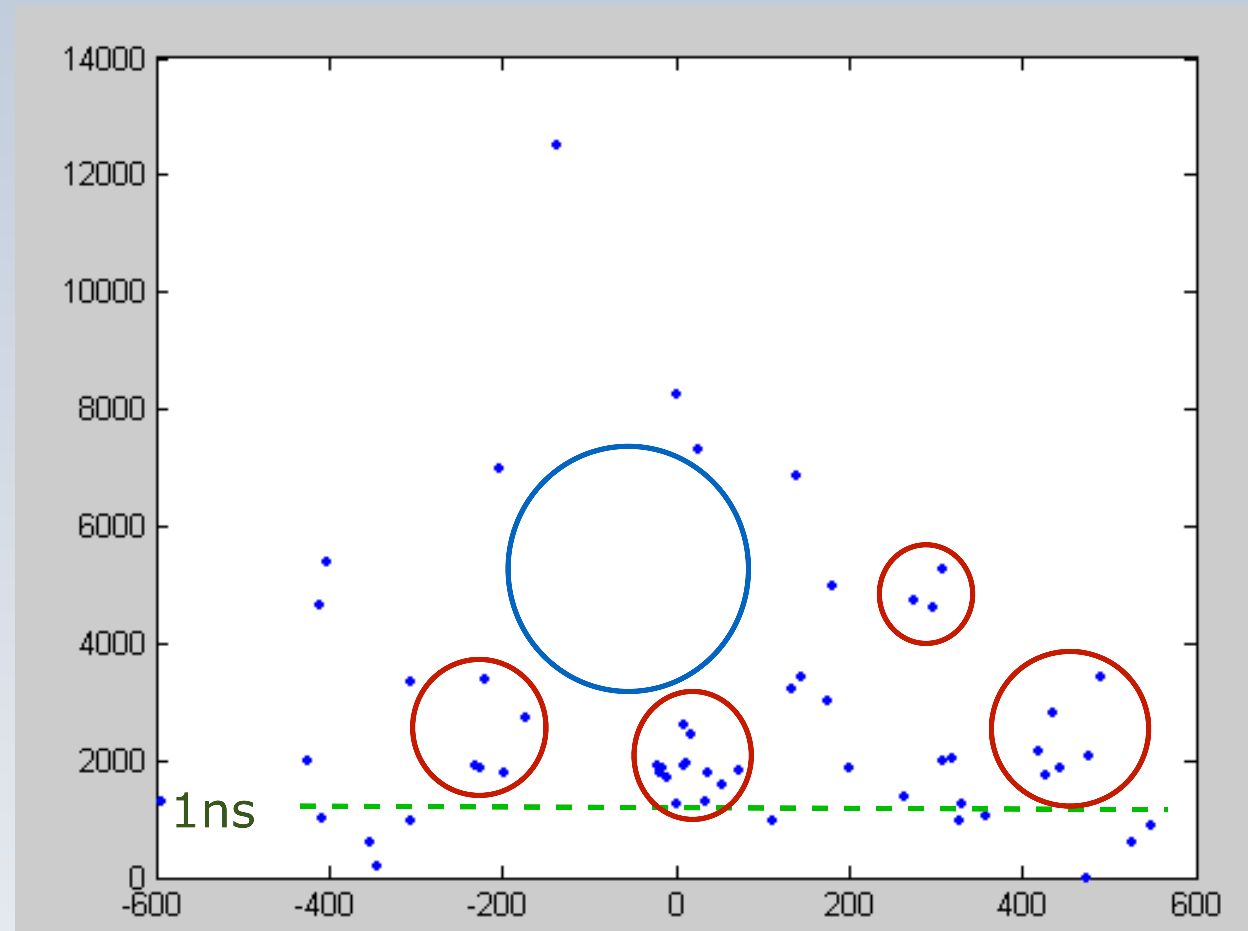
1 2 ns

- Is there a 2-peak structure, in the scale of 1-2 ns?

Shower front analysis: a few corrected profiles



1ns



Shower front analysis: a few corrected profiles

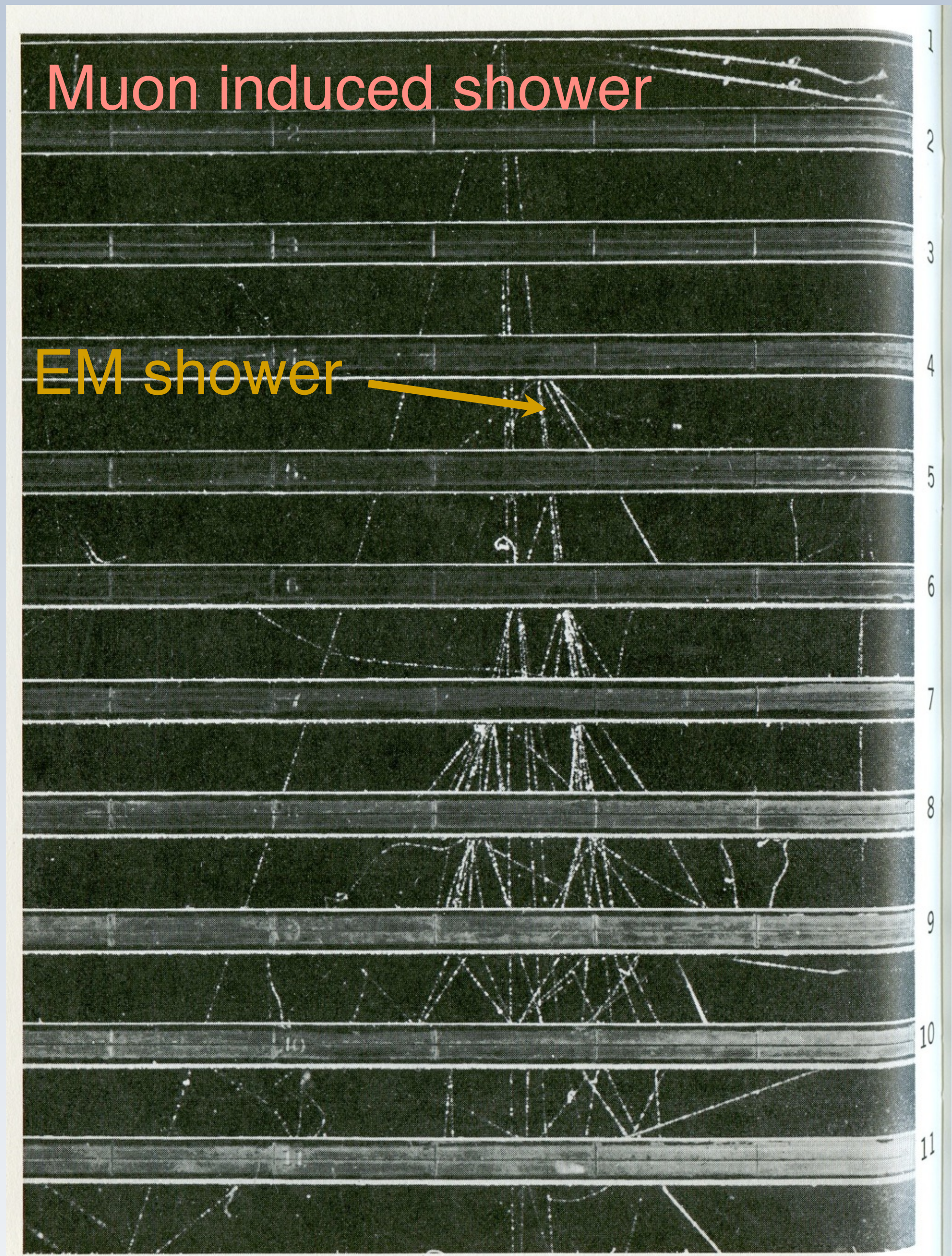
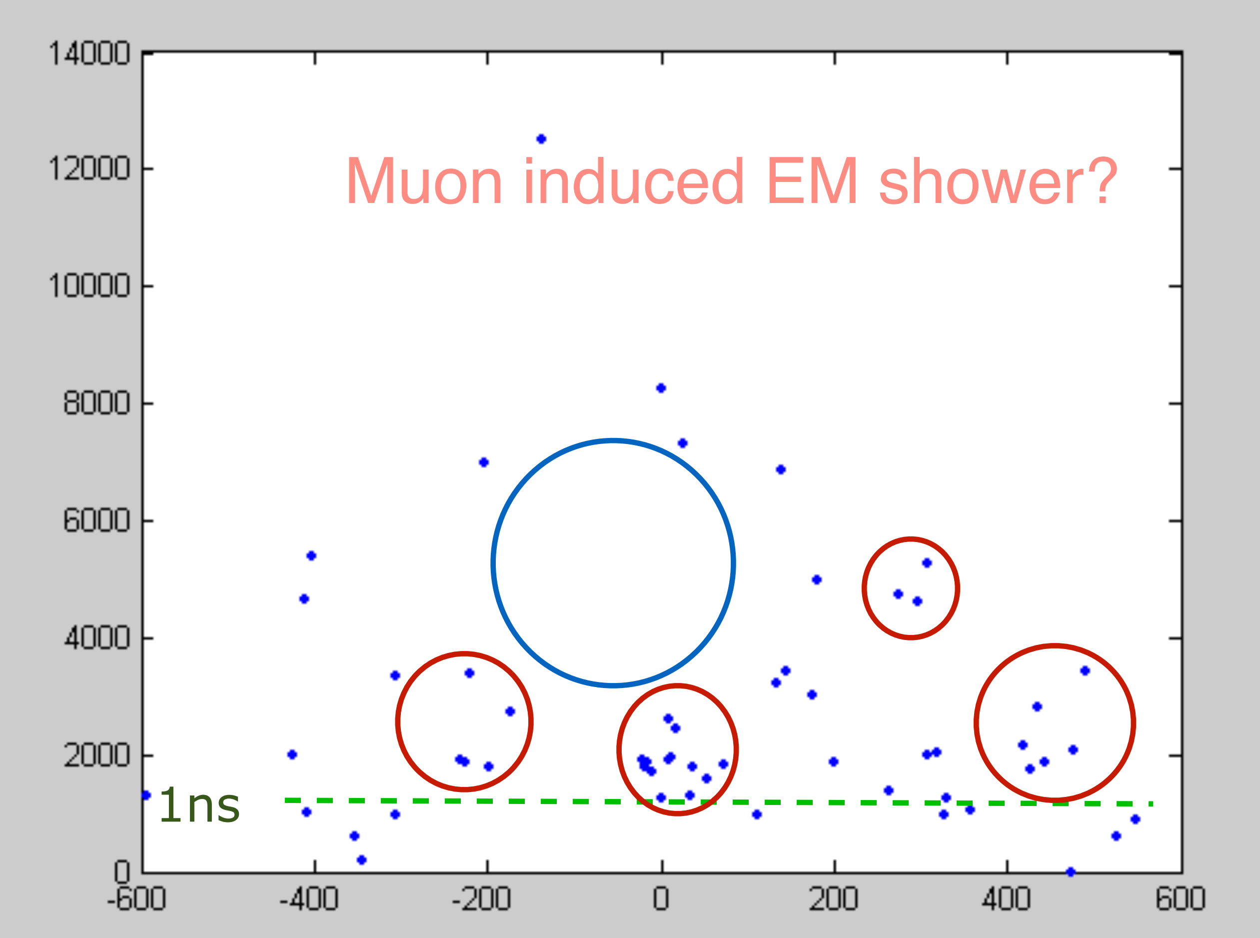


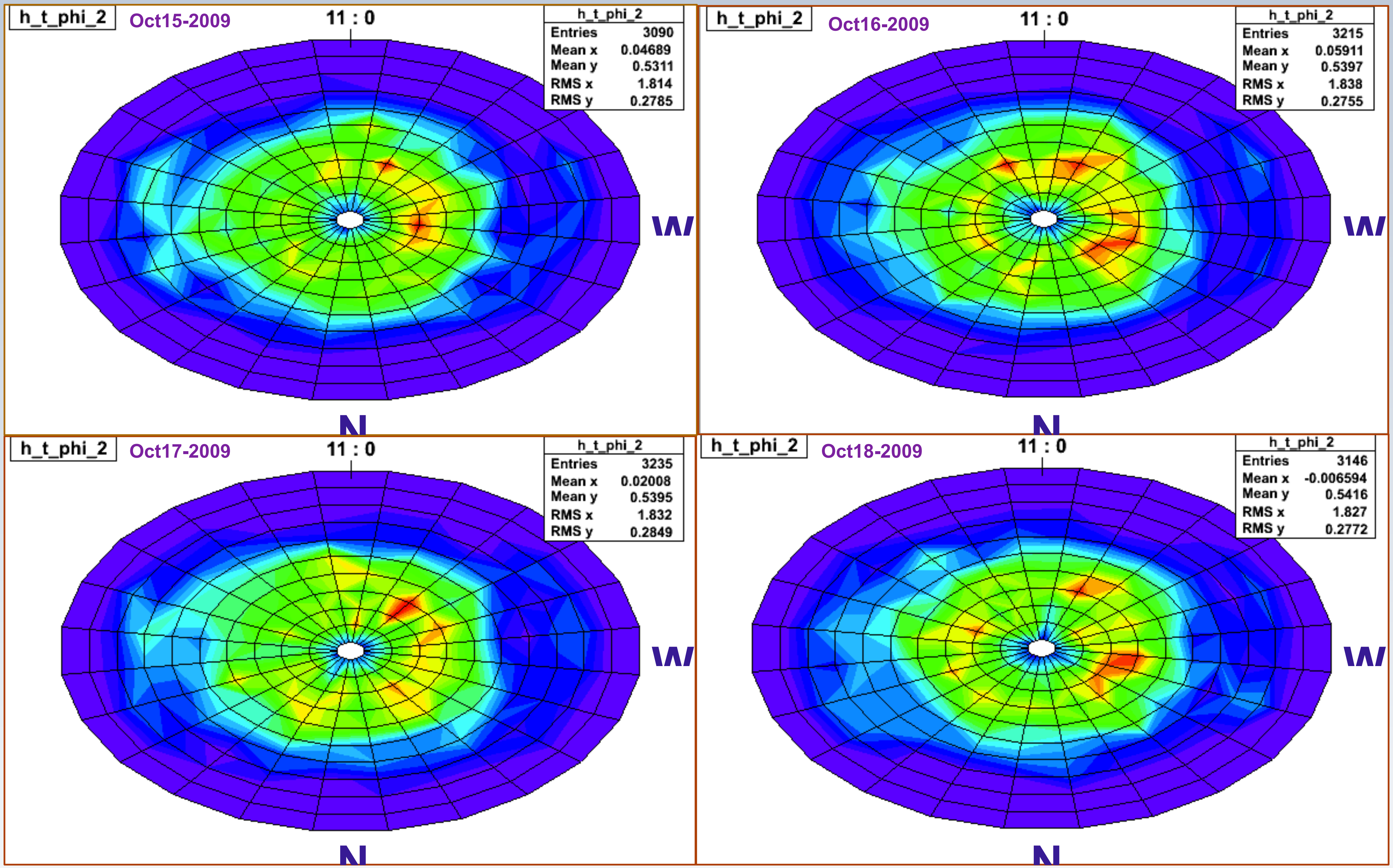
Fig. 10-2 Mesons in a penetrating shower traverse several metal plates of a cloud chamber without producing secondary showers. In plate 4, however, a secondary interaction gives rise to a high-energy photon or electron, which initiates an ordinary shower. The brass plates across the chamber are 1.25 cm thick. The photograph was made by the MIT cosmic-ray group in 1950.

[B.Rossi: Cosmic Rays]



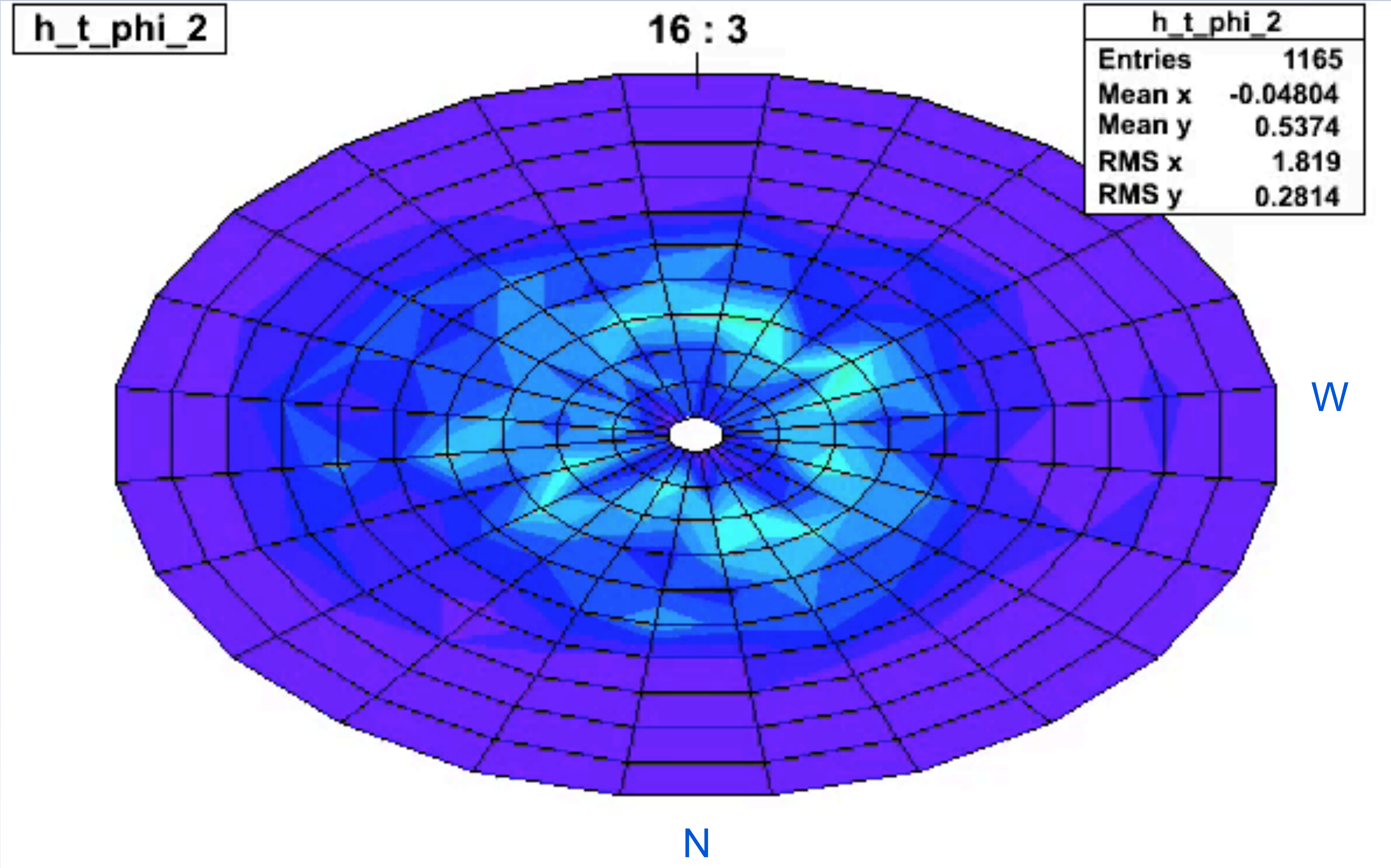
2-particle analysis:

Polar arrival distribution



2-particle analysis:

Polar arrival distribution

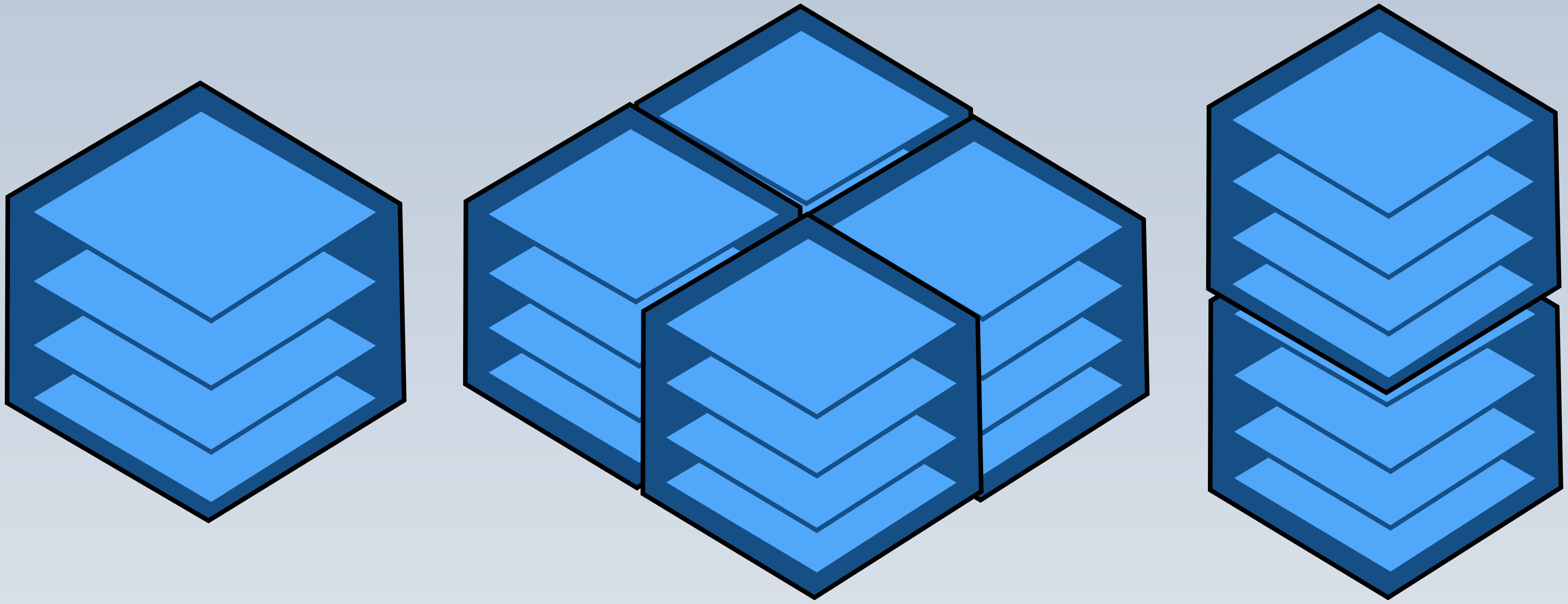


Movie: 1 image/ hour

PRESENT
The TRASGO project

The TRASGO project

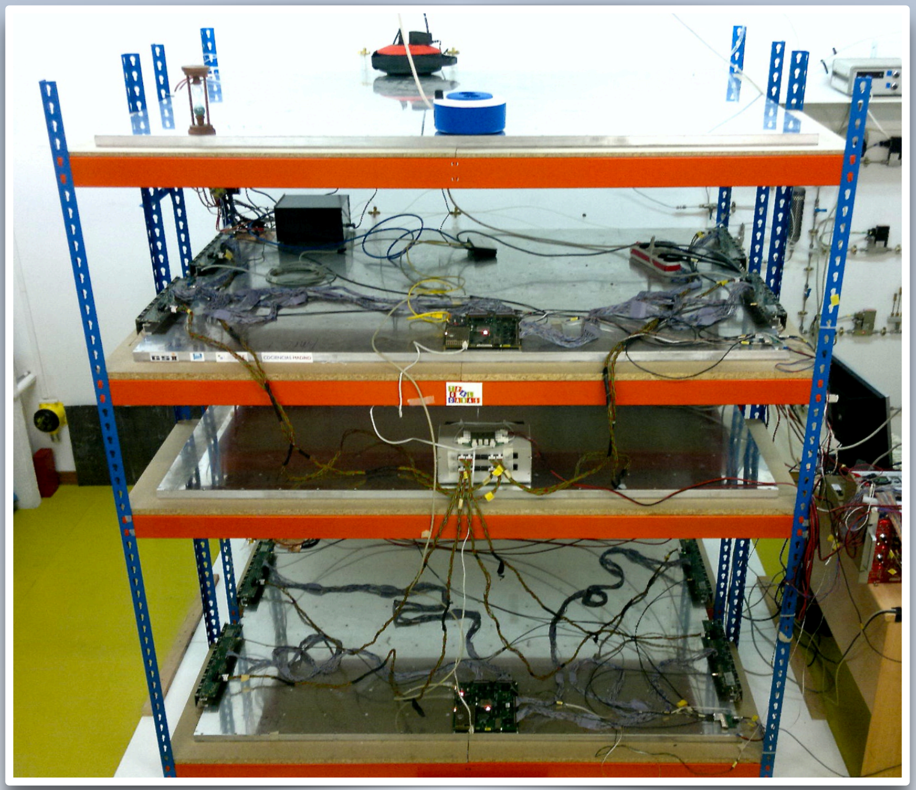
The idea: why not developing modular cosmic ray tracking detectors?



The solution: TRASGO (~ elf, 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 PRESENT FLEET OF TRASGOS

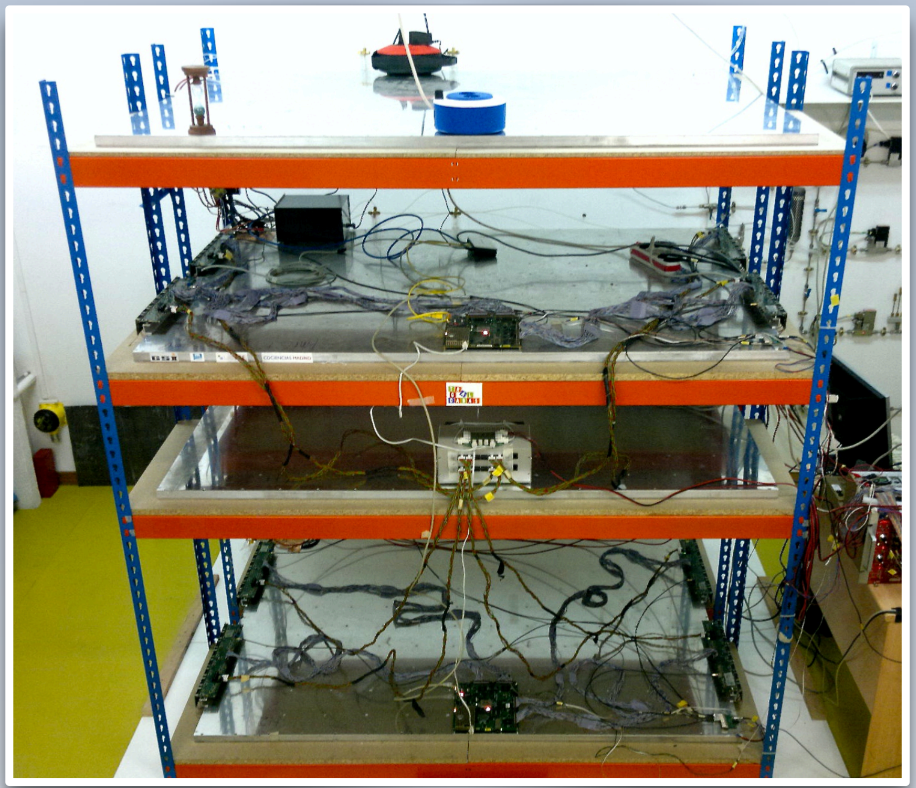


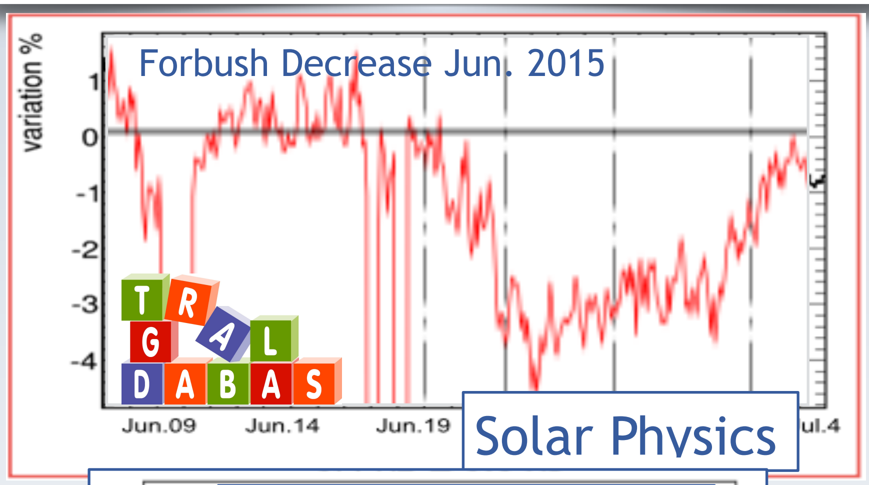
TRAGALDABAS
(Univ. S. Compostela)
Multipurpose detector

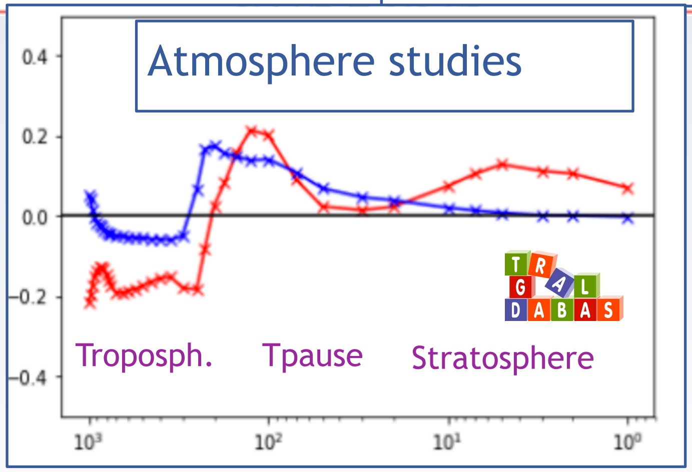
MuTT
(Porriño, Vigo)
Tomography studies
HIDRONAV Initiative

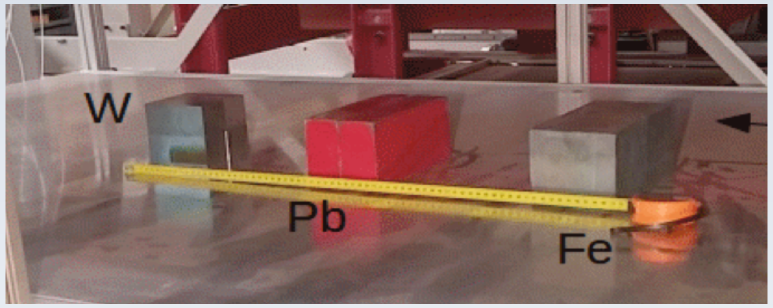
TRISTAN
(Antarctica, End 2019)
Multipurpose detector

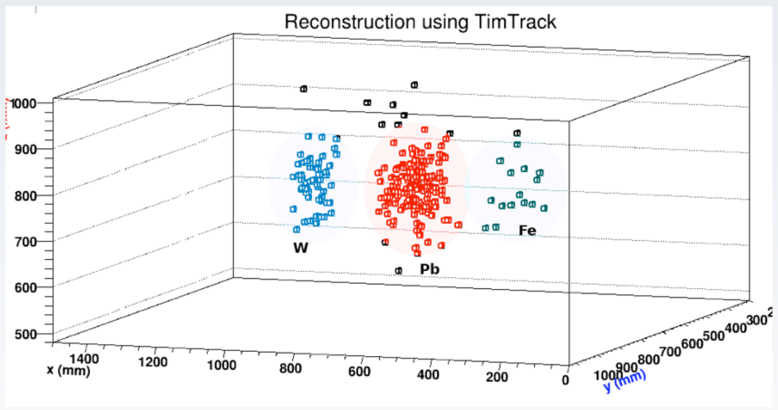
THE PRESENT FLEET OF TRASGOS

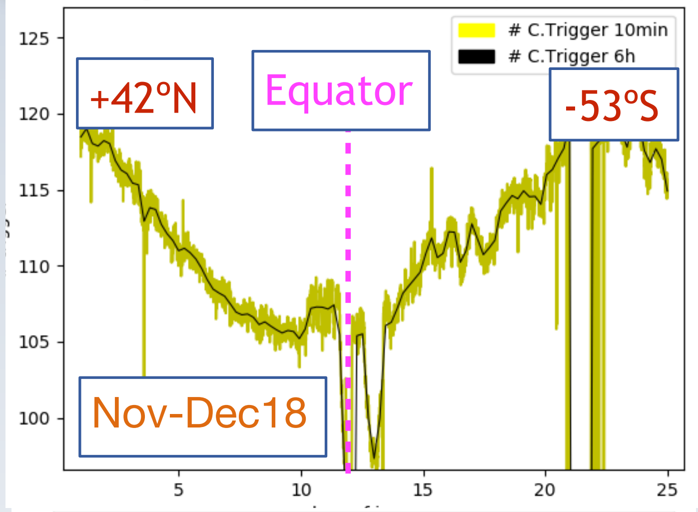


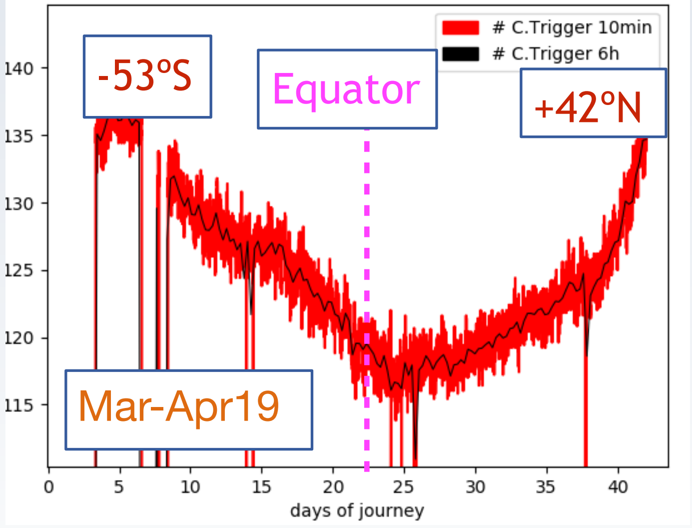










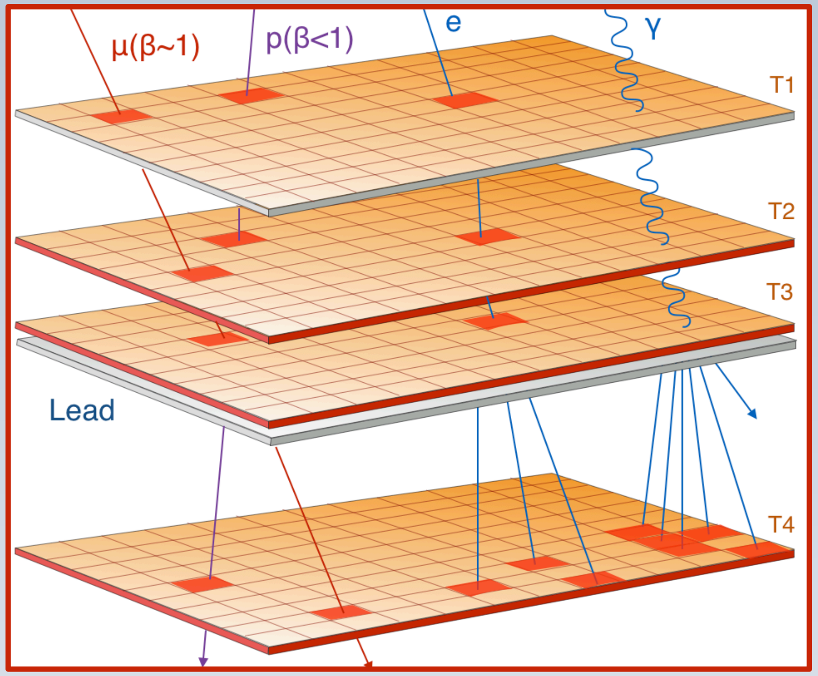


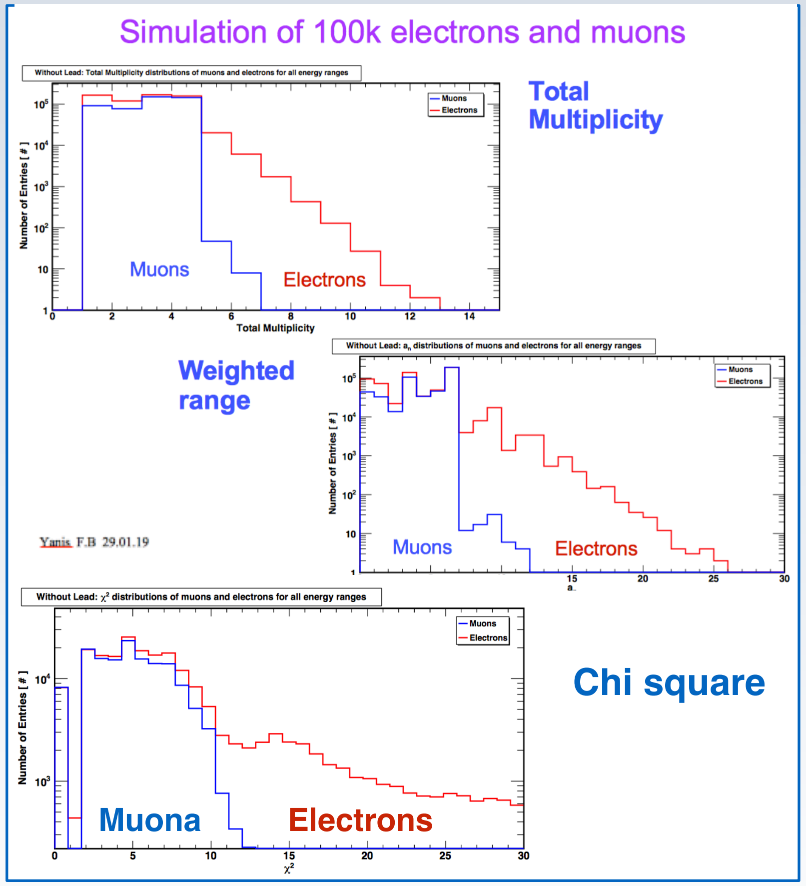
THE PRESENT FLEET OF TRASGOS

THE PRESENT FLEET OF TRASGOS

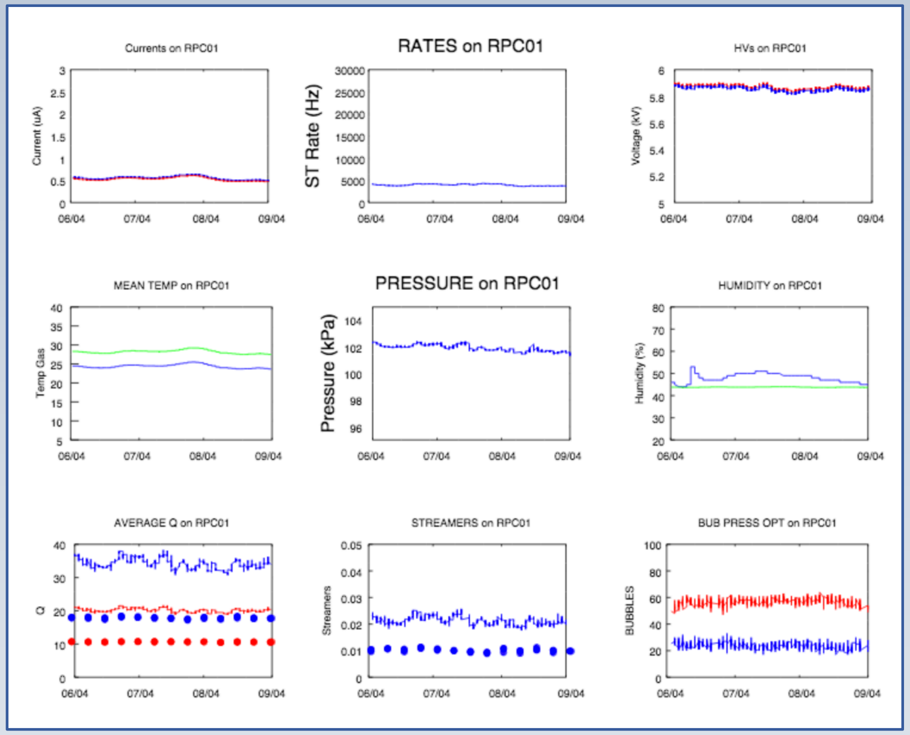
Some tools

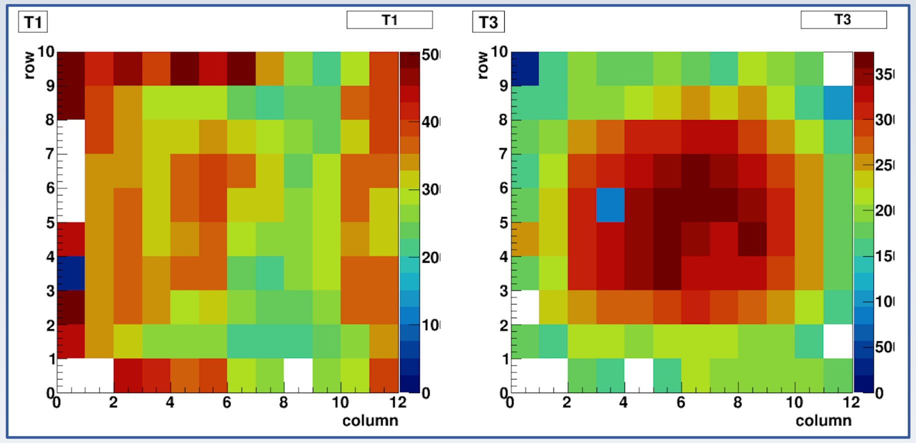
Particle identification



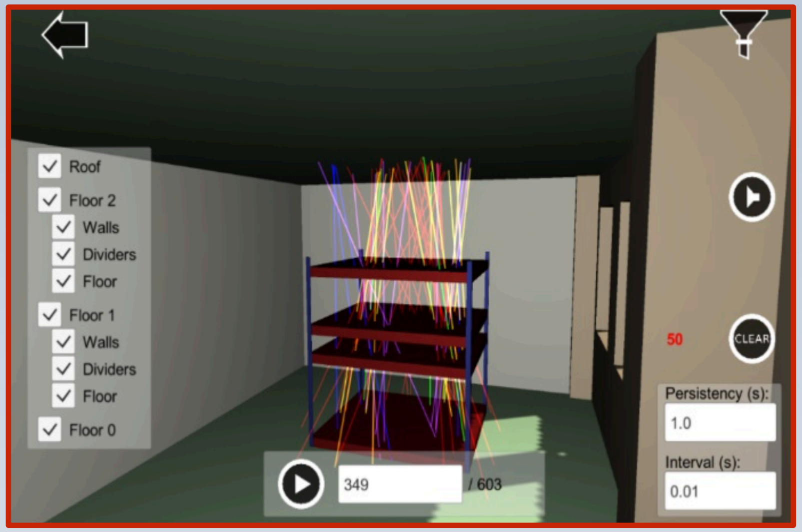


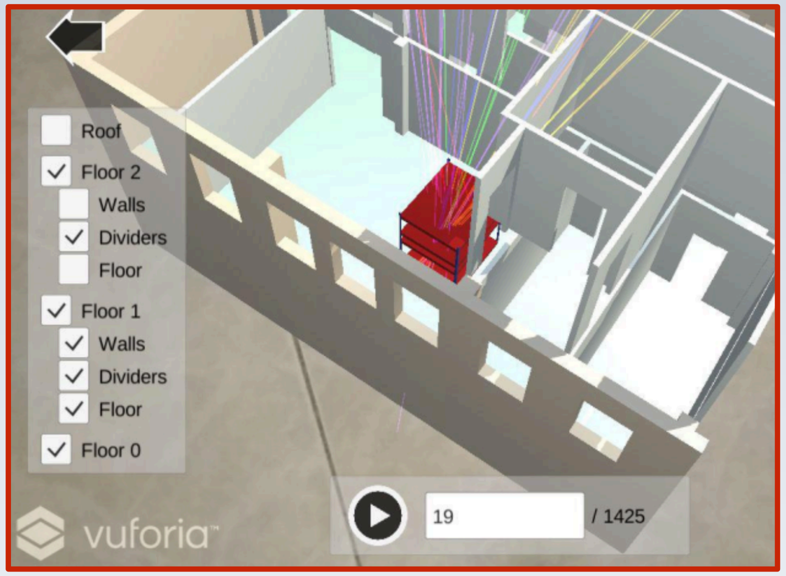
Monitoring





3D-Visualization

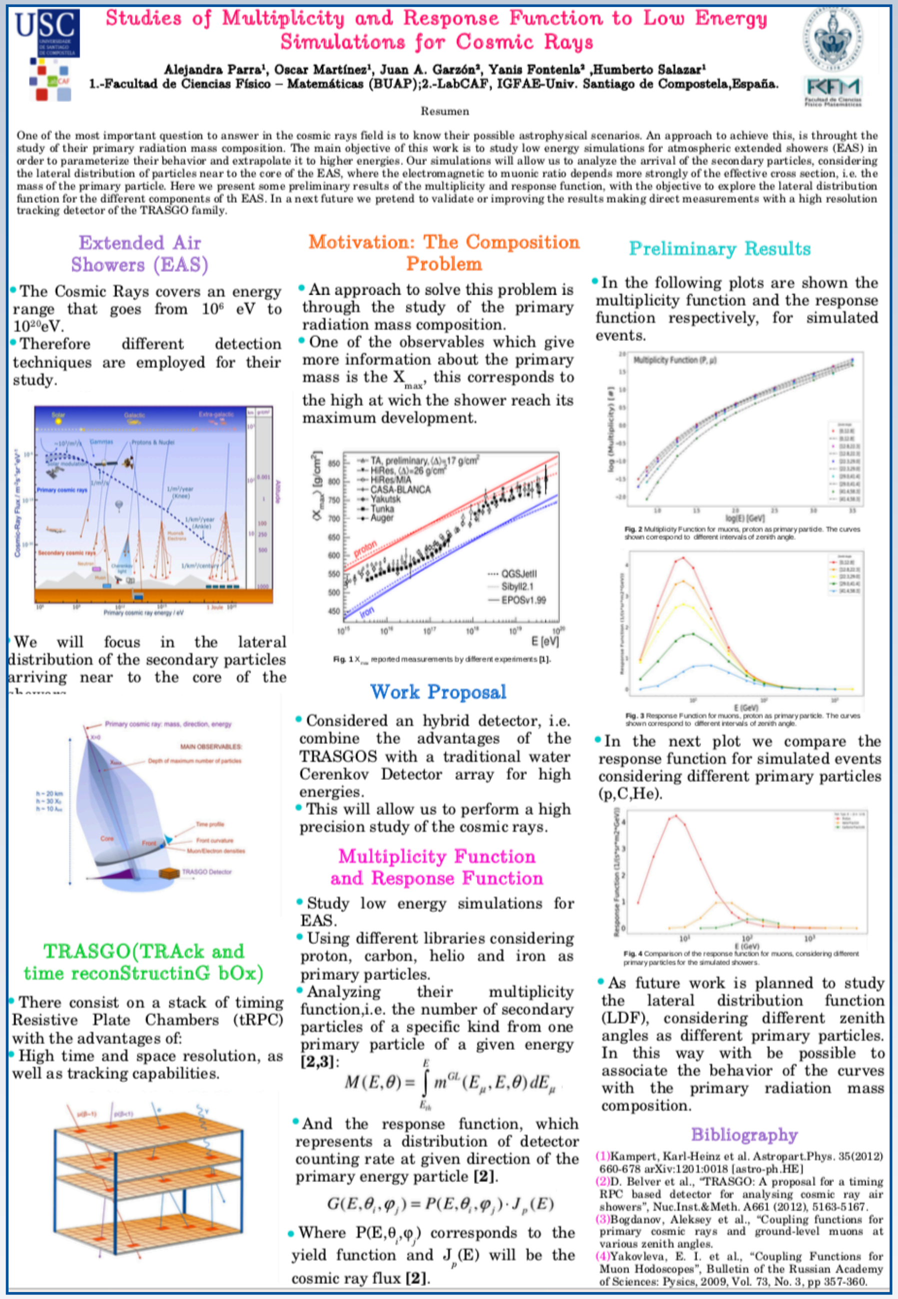




THE TRASGO PROJECT: Other initiatives

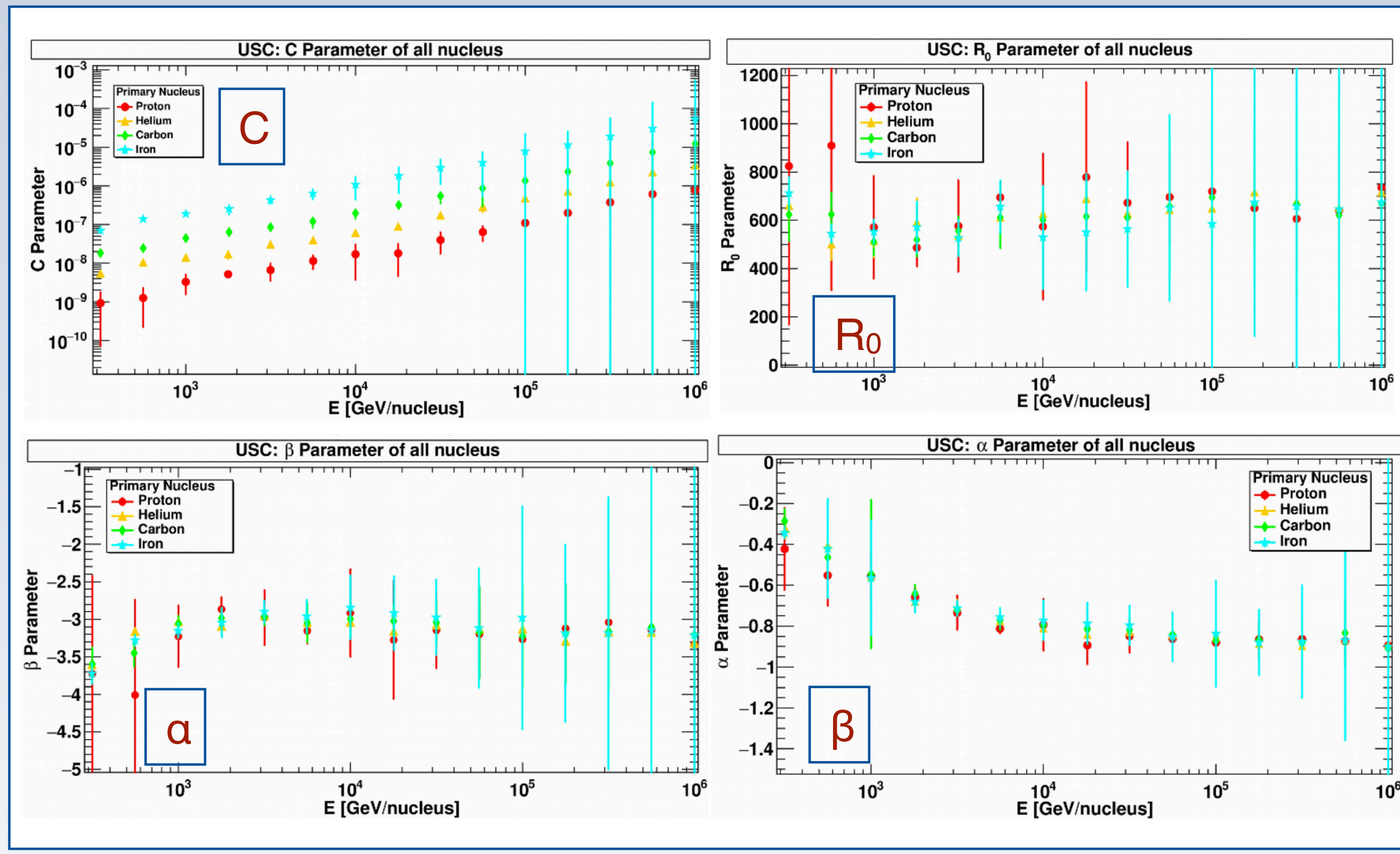
2. Systematic analysis of the properties of low energy cosmic ray extensive air showers
(in S. Compostela- Spain, Sierra Negra- Mexico, Tunja- Colombia, Livingston I.-Antarctica)

1. Lateral distribution analysis [+ O. Martinez, A. Parra (Puebla, Mexico)]



2018: Mexican meeting on particles&fields

$$\rho(R)=C(R/R_0)^{\alpha}(1+R/R_0)^{\beta}$$



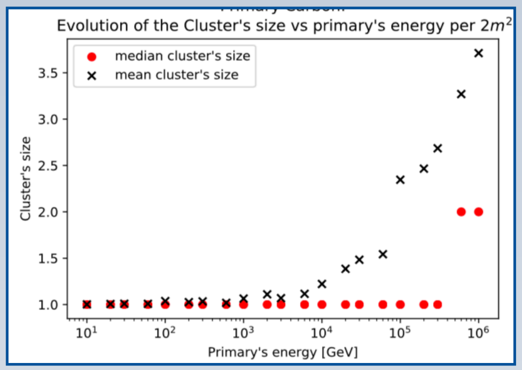
Lateral distribution analysis for P, He, C & Fe, under the knee at SCQ

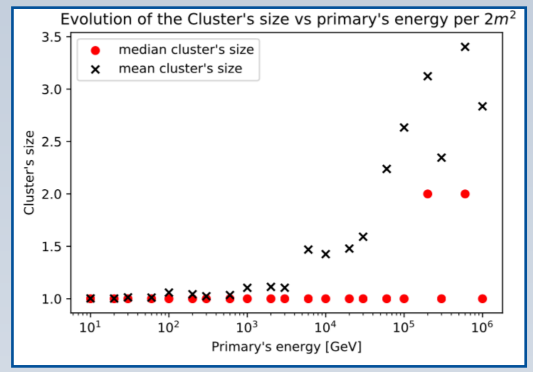
THE TRASGO PROJECT: Other initiatives

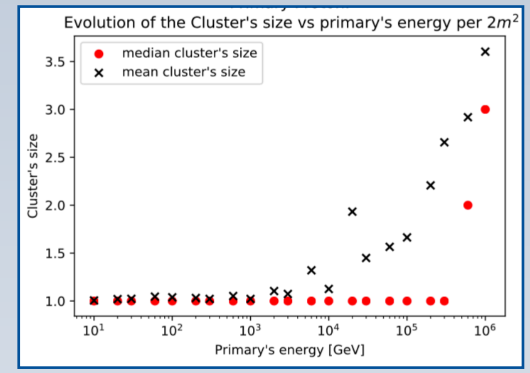
2. Systematic analysis of the properties of low energy cosmic ray extensive air showers
(in S. Compostela- Spain, Sierra Negra- Mexico, Tunja- Colombia, Livingston I.-Antarctica)

P | He | C | Fe

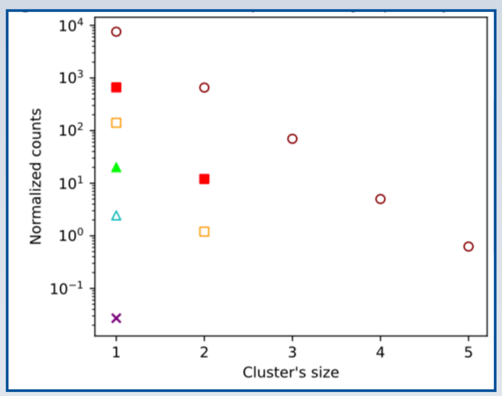
cluster size vs. energy

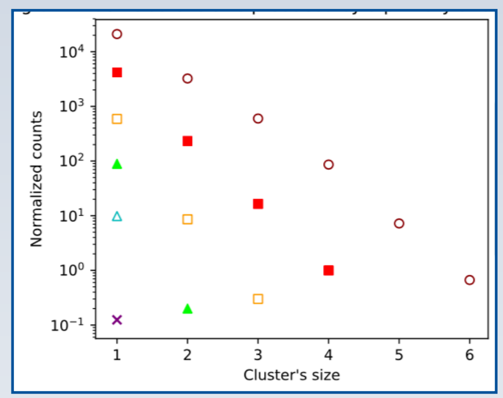


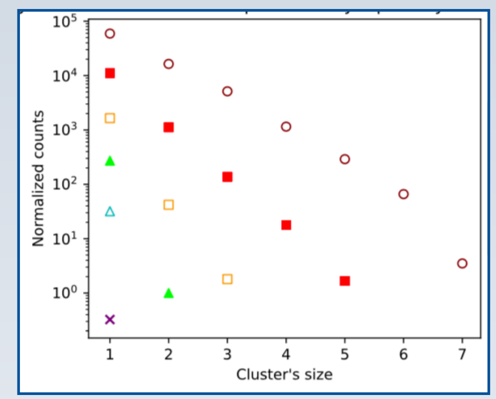




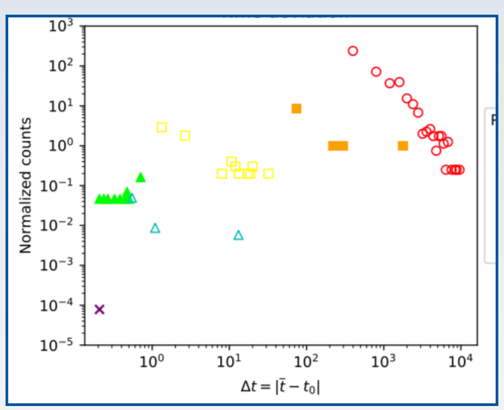
μ clusters

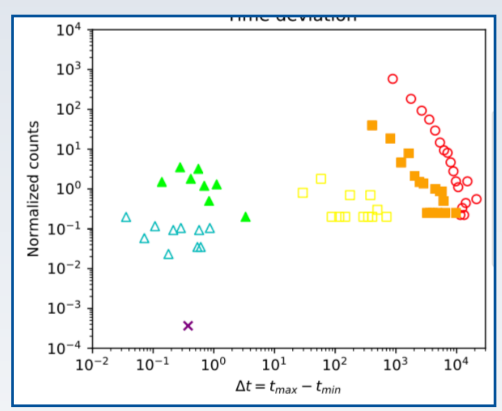


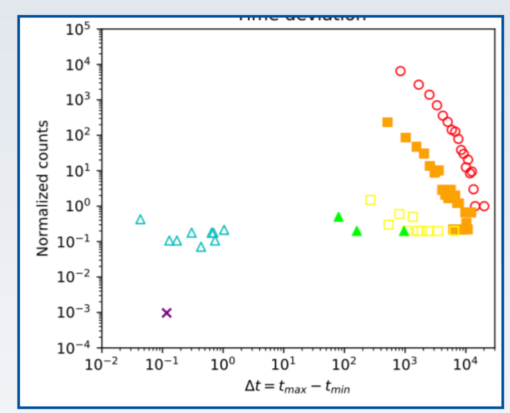


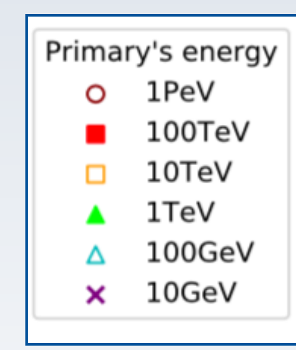


cluster time width



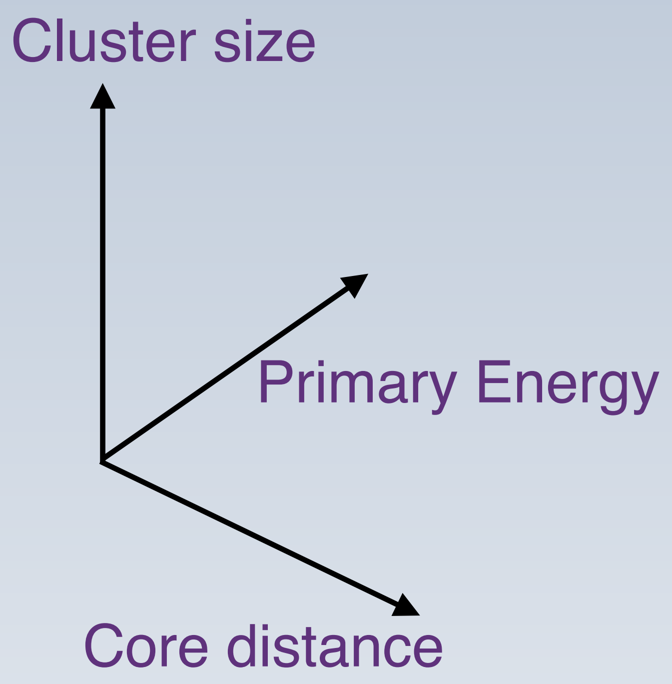


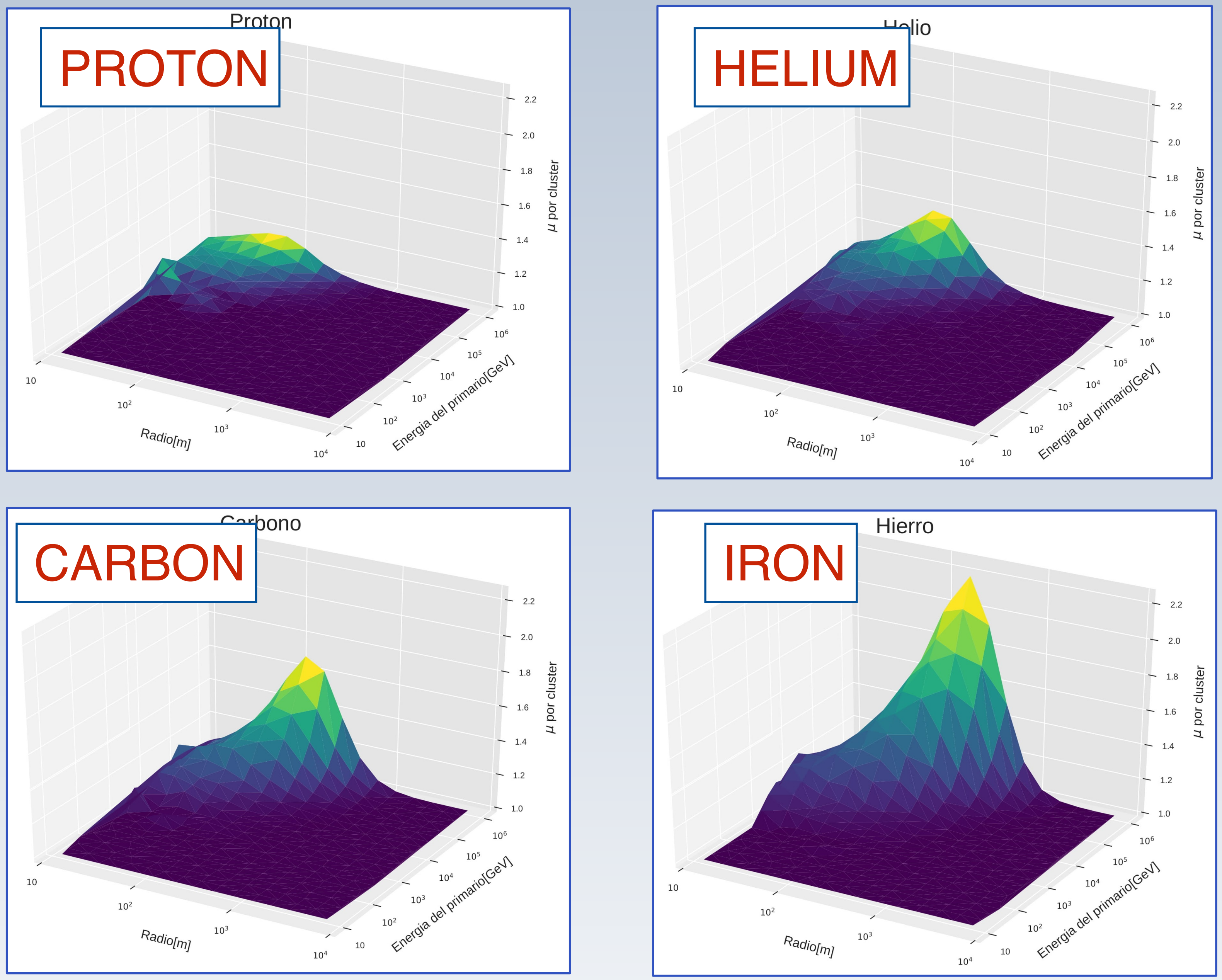




Correlations between primary cosmic ray parameters and cluster of particles properties

2. Systematic analysis of the cluster size measured by a 10m² detector





Correlations between primary cosmic ray parameters and cluster of particles properties

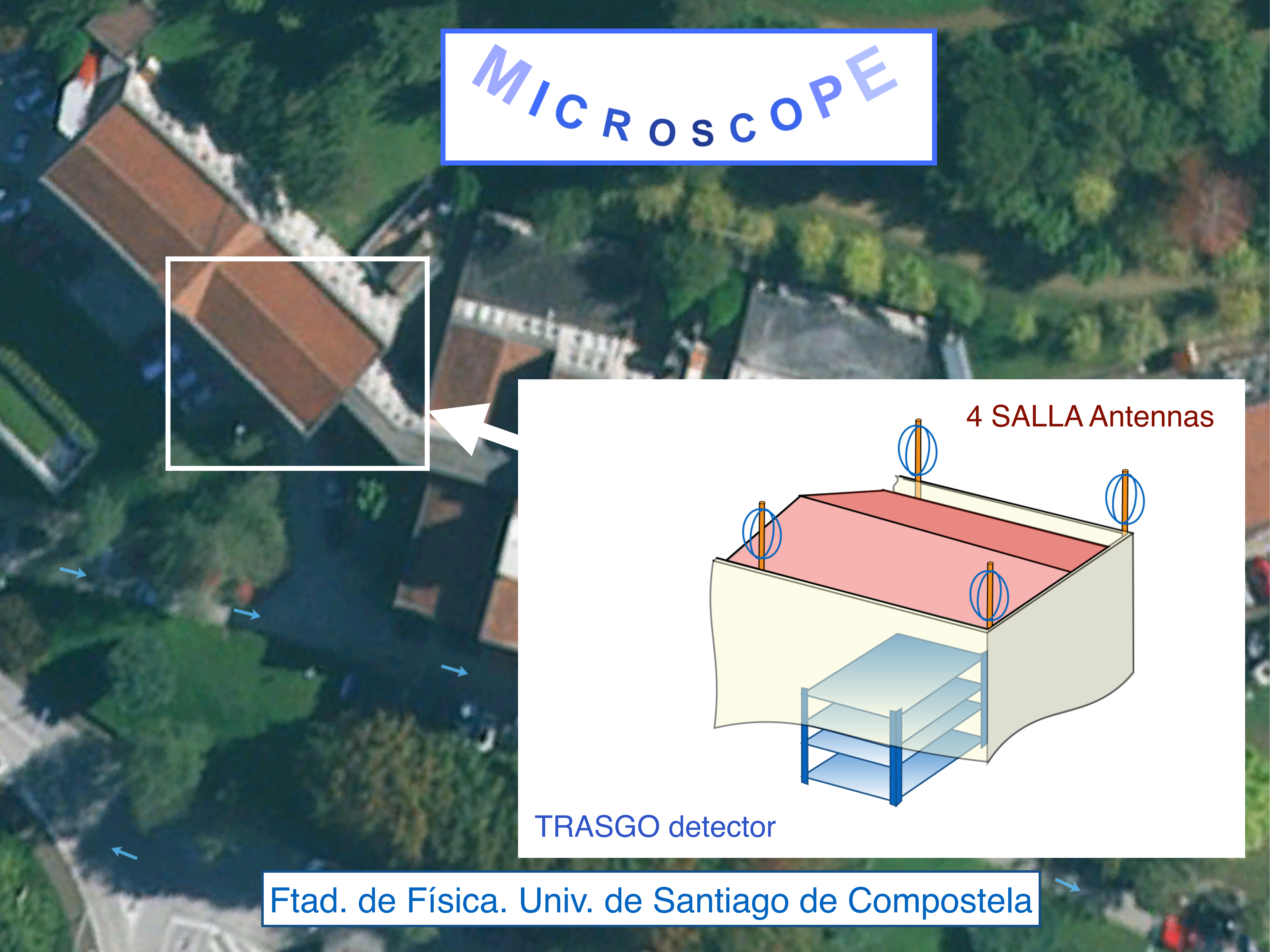
FUTURE

Microscope

The Antarctic Observatory

Stratos Project

DS DRACO relational data base


MICROSCOPE
4 SALLA Antennas
TRASGO detector
Ftad. de Física. Univ. de Santiago de Compostela

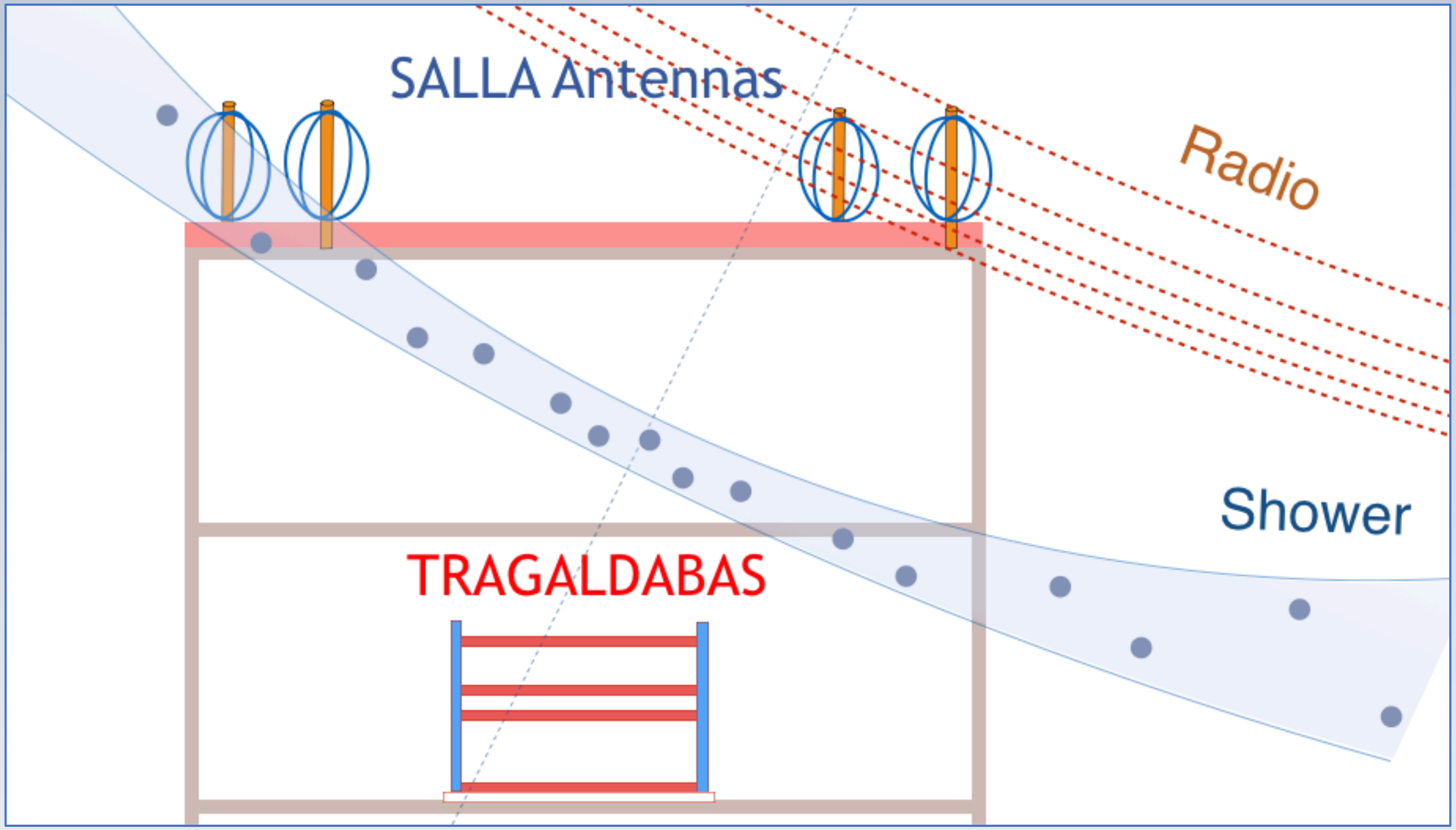
MICROSCOPE

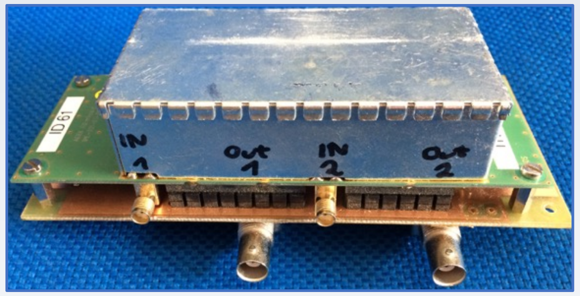
MIni Cosmic Ray Observatory of Santiago de COmPostEla

MICROSCOPE

MIni Cosmic Ray Observatory of Santiago de COmPostEla

Four SALLA antennas have been installed at the roof on top of the TRAGALDABAS detector



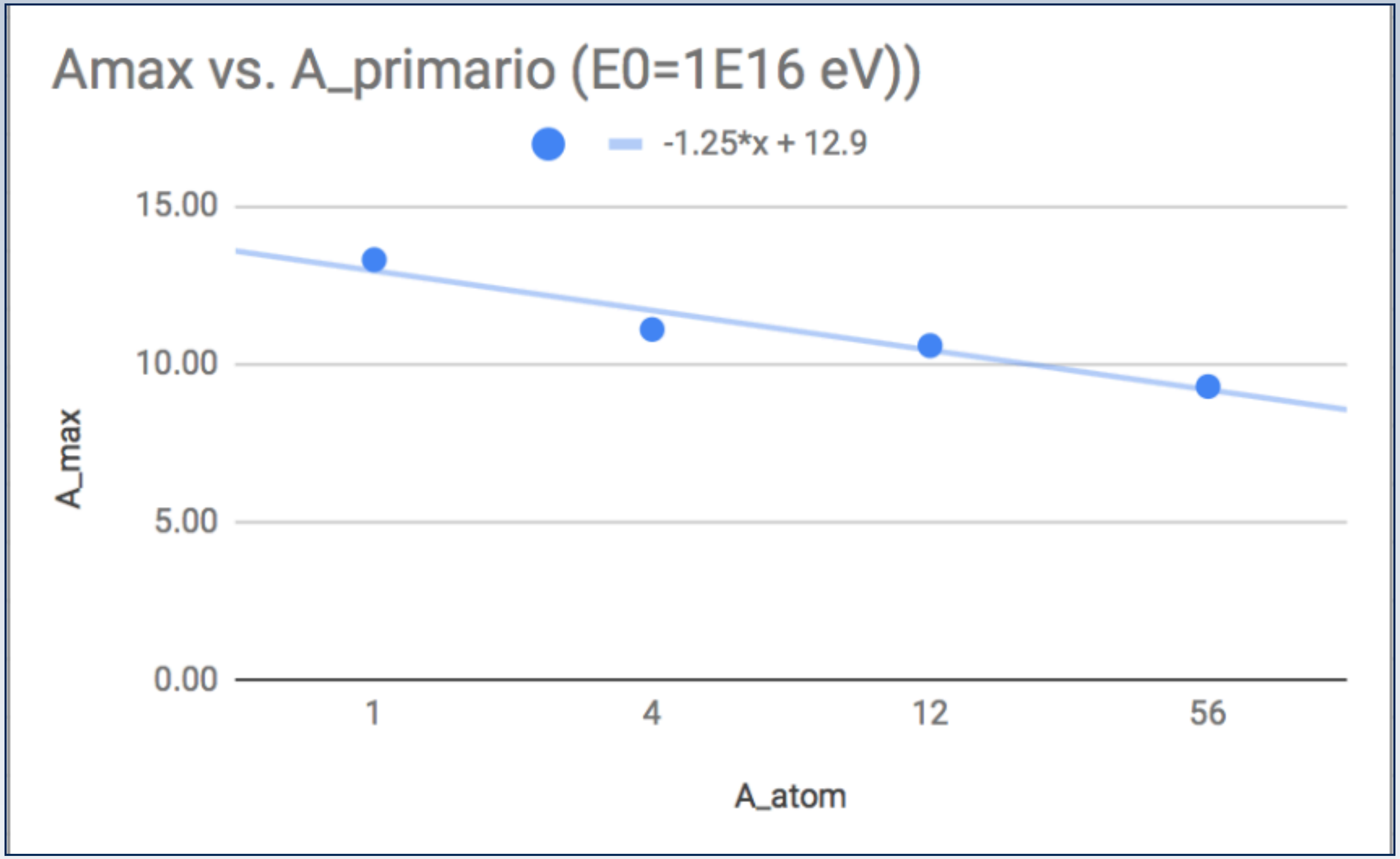


Correlation between Tragaldabas measurements with an external energy estimation

MICROSCOPE

MIni Cosmic Ray Observatory of Santiago de COmPostEla

Four SALLA antennas have been installed at the roof on top of the TRAGALDABAS detector



- An extensive simulation program (energy, angle, position, etc.) is going on

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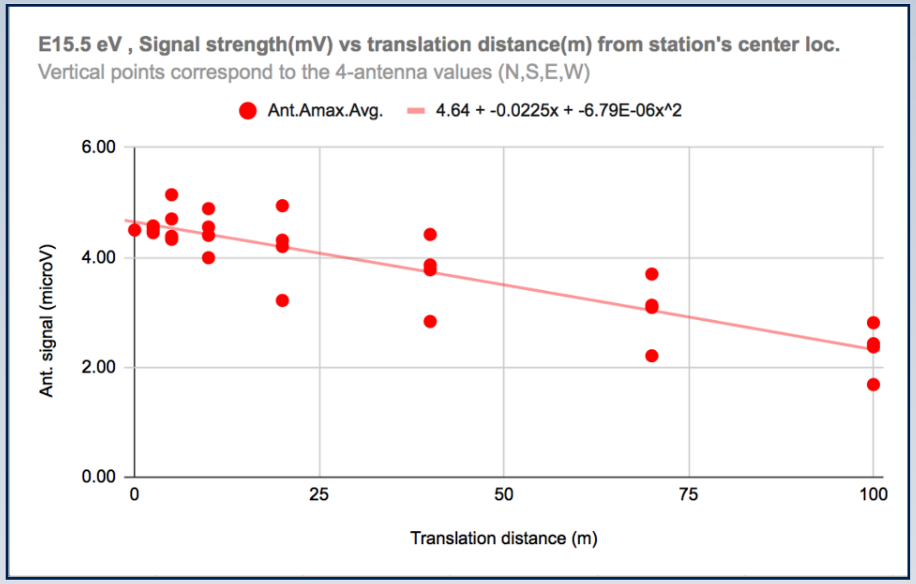

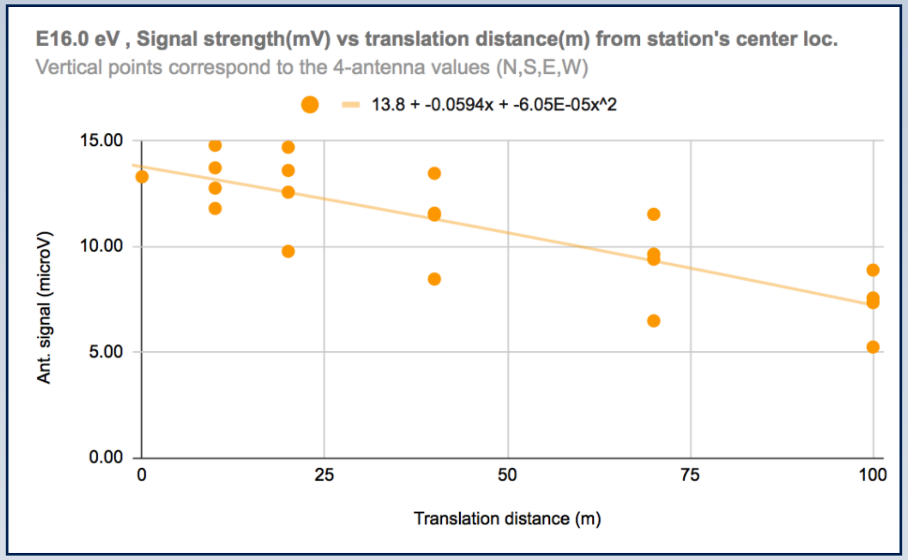

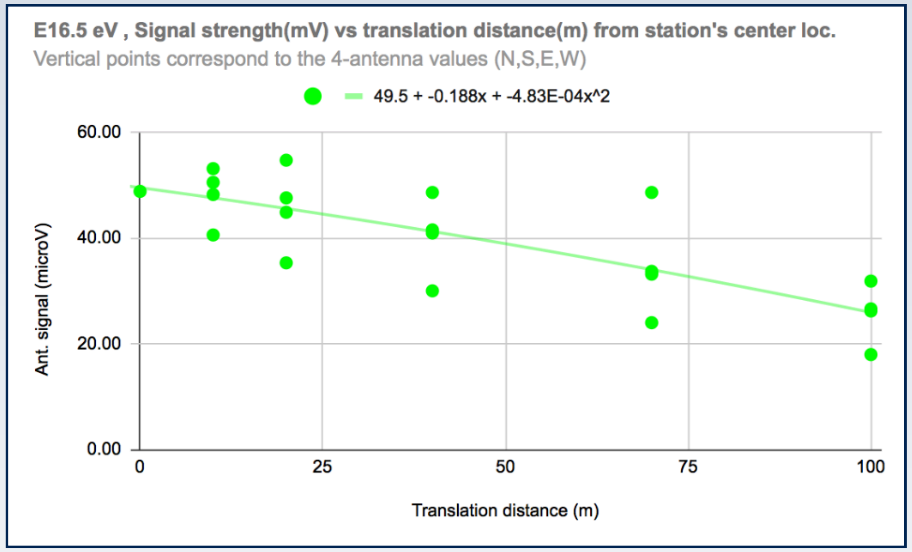

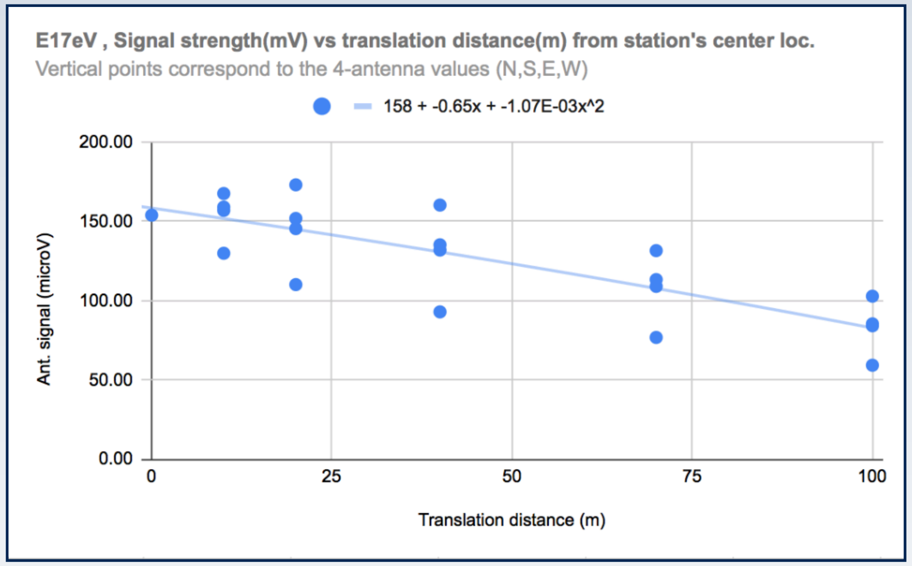

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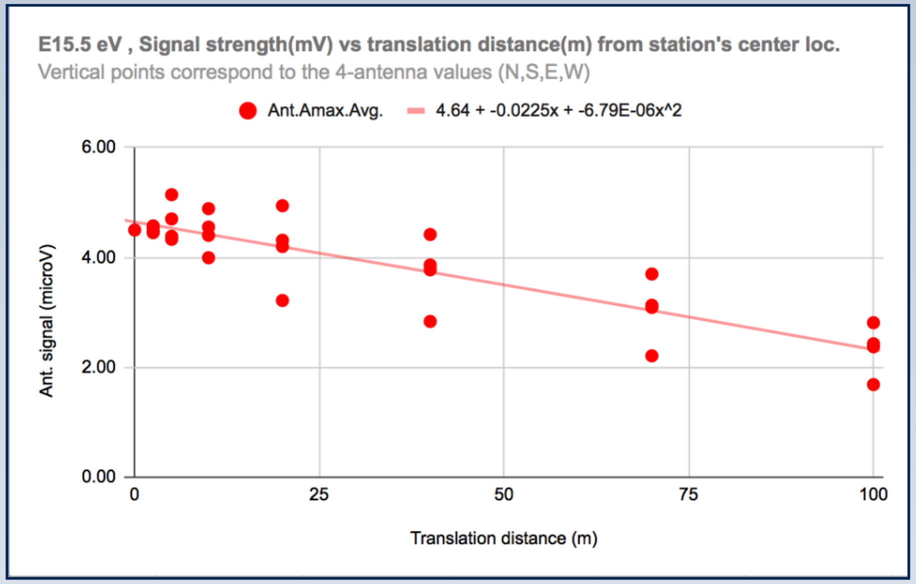
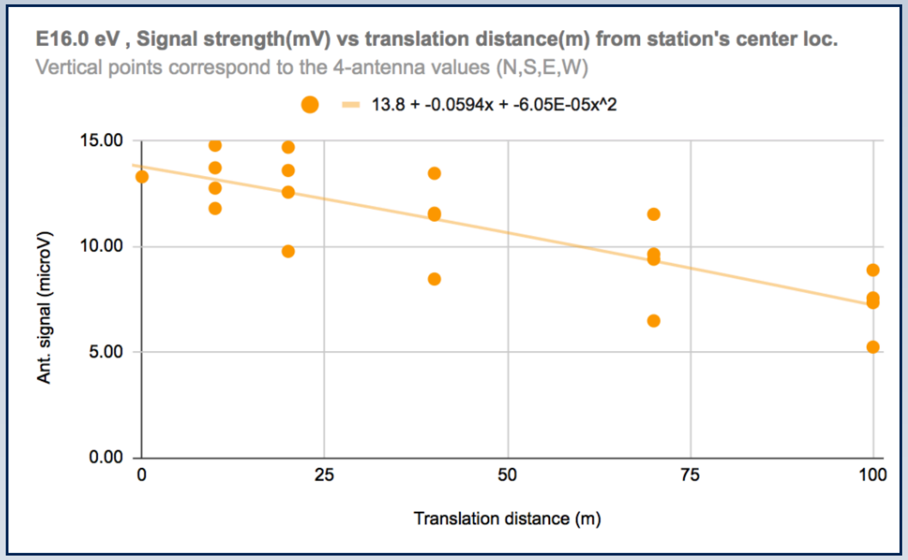
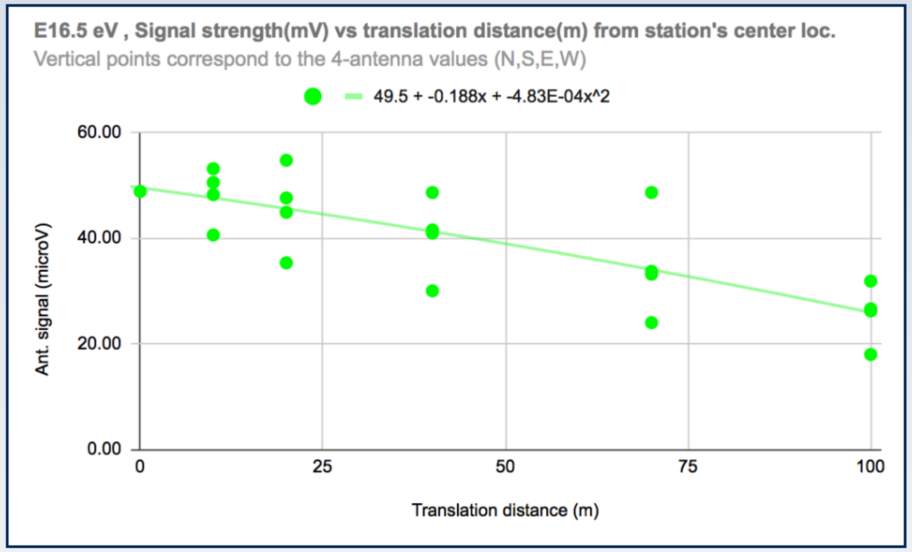
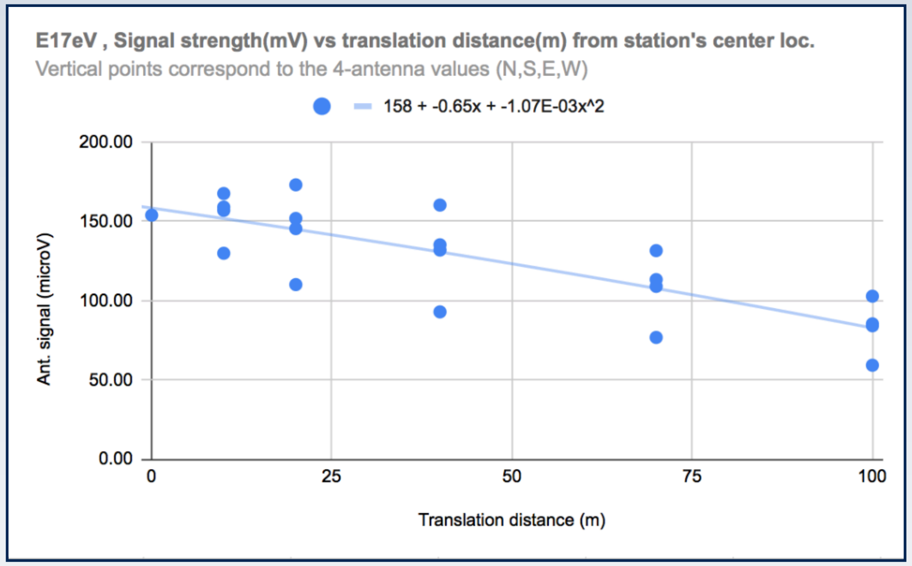








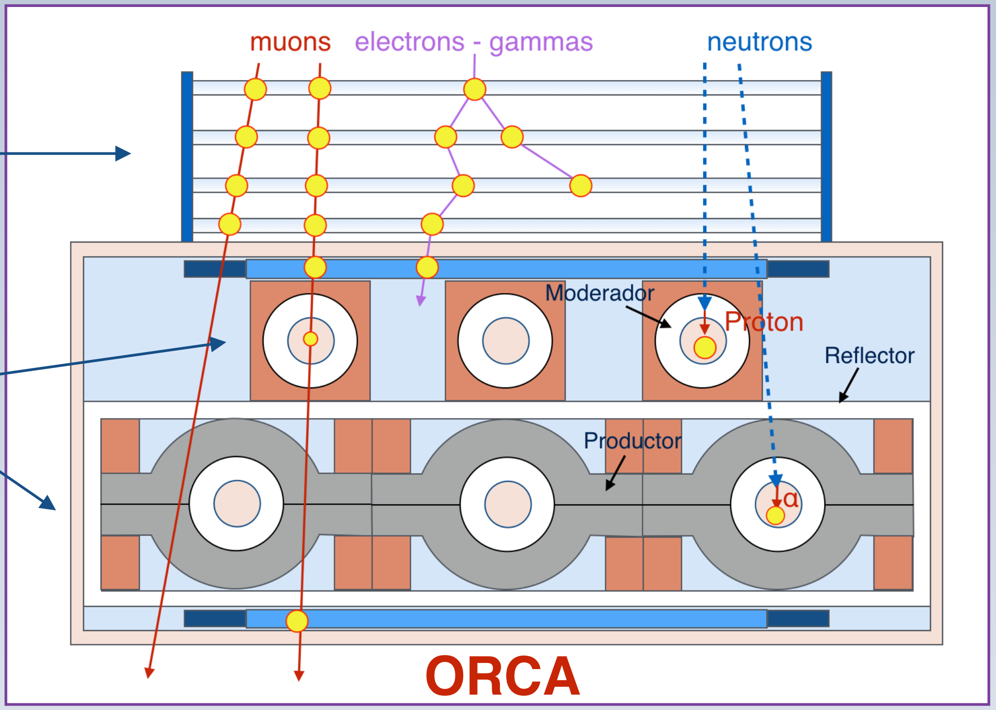
- An extensive simulation program (energy, angle, position, etc.) is going on

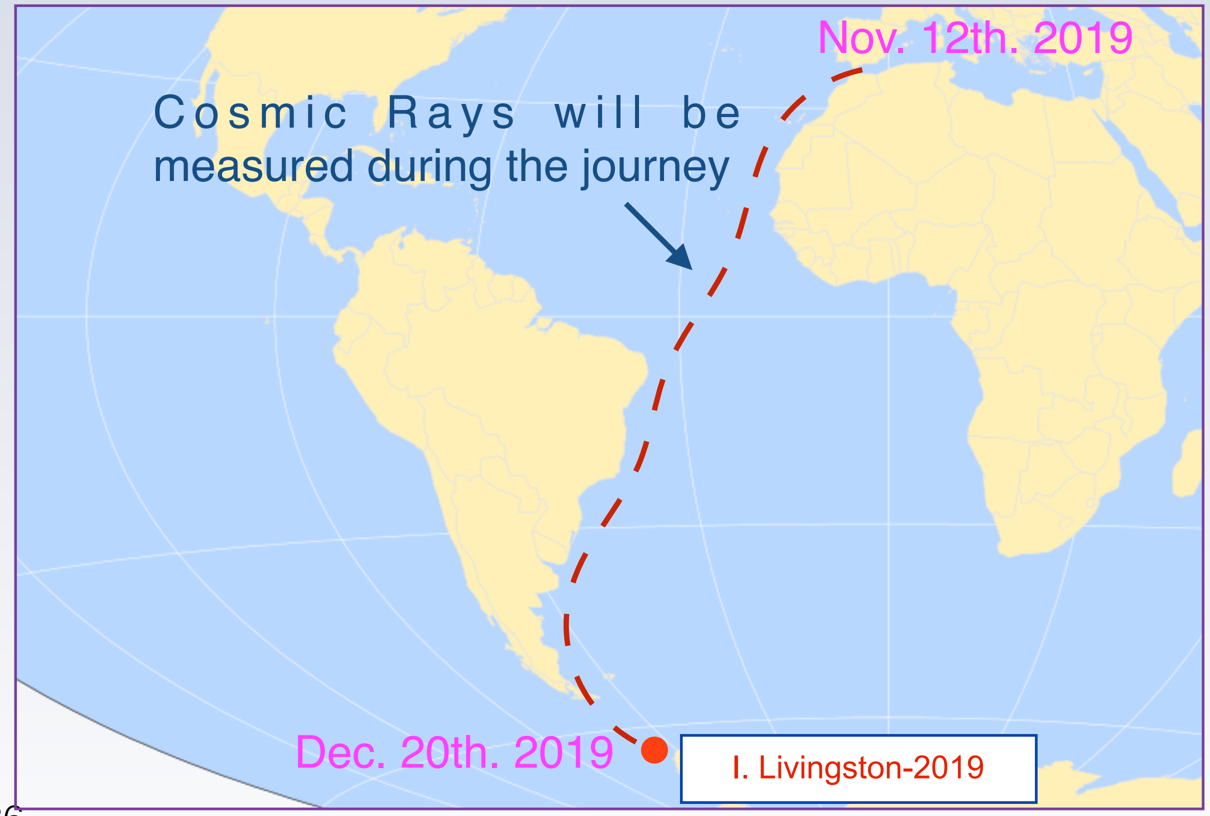
The ORCA (Antarctic Cosmic Ray Observatory) project

An hybrid cosmic ray detector will be installed at the end of 2019 in the Spanish Antarctic base at the Livingston island (1500 km South Ushuaia)

TRISTAN
(RPC based
tracking detector)

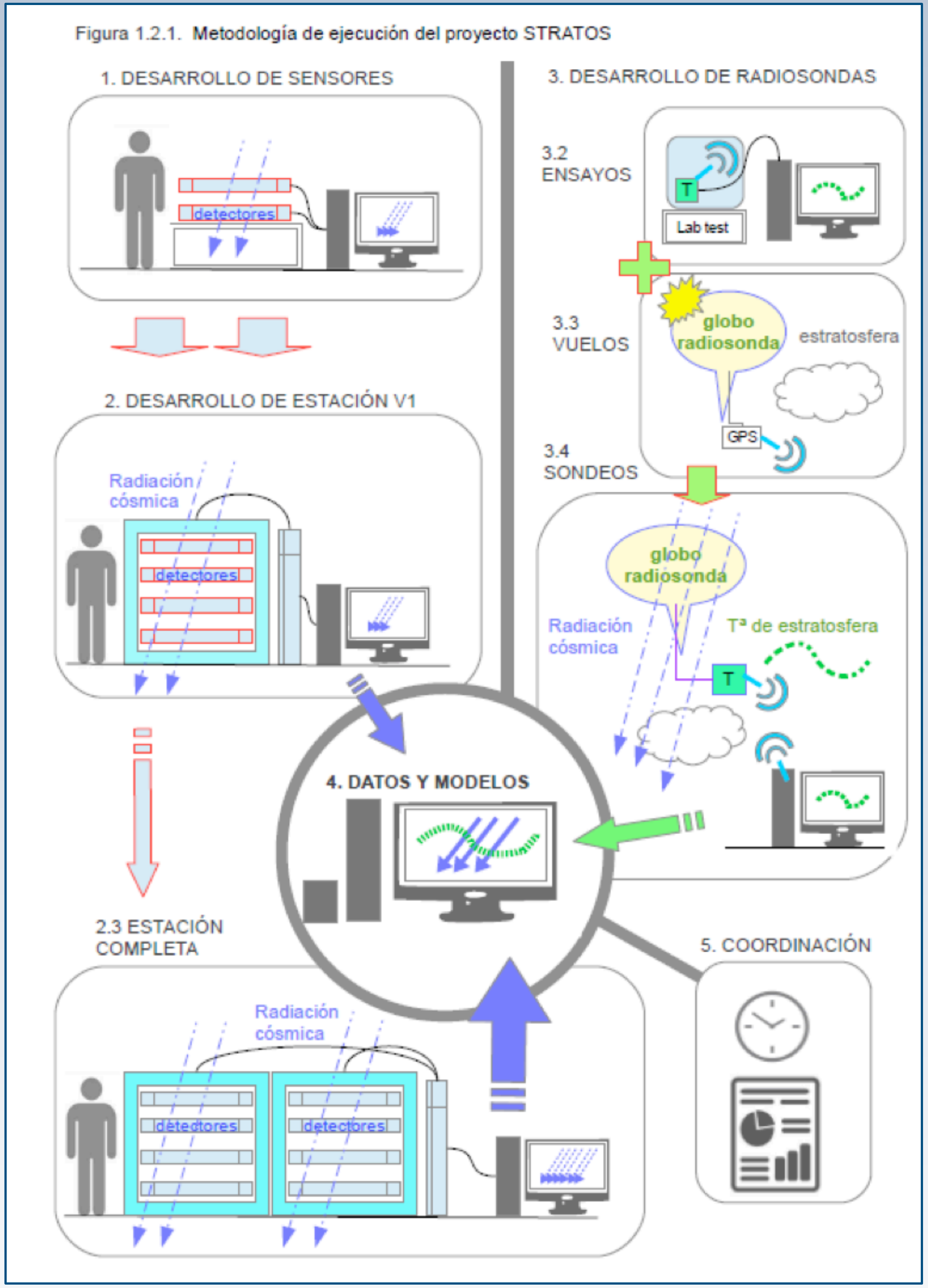
Neutron
monitors





STRATOS Project

STRATOS: a Trasgo tandem for atmospheric studies



STRATOS: a Trasgo tandem for atmospheric studies

DS DRACO relational database

DRACO (Distributed Real time Atmospheric and Cosmic ray Observatory)

EOSC-hub

DS-DRACO

Space Weather Data Infrastructure

eosc-hub.eu

@EOSC_eu

Dissemination level: Public

By: HIDRONAV
HIDRONAV TECHNOLOGIES SL

Alfredo Iglesias Lago (Hidronav) and **Manuel Valladares Hermelo** (RLIT)

EOSC-hub receives funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 777536.

EOSC: European Open Science Cloud

DS DRACO relational database

EOSC-hub

HIDRONAV
HIDRONAV TECHNOLOGIES SL
DS-DRACO

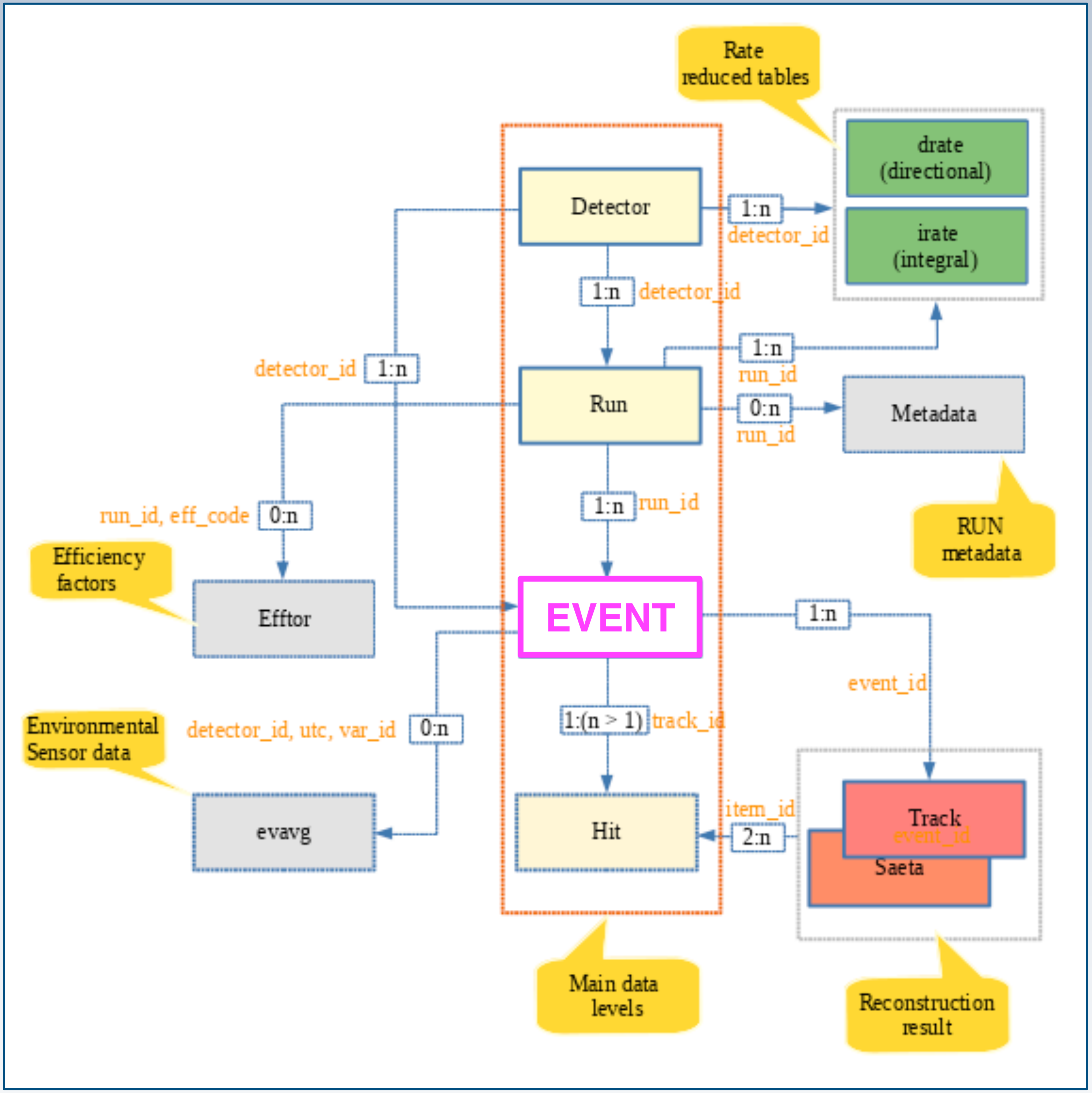
1. DS-DRACO in summary

- 1.1 – What´s it about
  - **DS-DRACO** is conceived as a **web portal** that will integrate, in its first stage, a terrestrial network of **Cosmic Ray detectors**,
    - providing facilities to query, filter and grouping data as well as convenient results presentation as tables, plots and datasets download services.
  - **DS-DRACO** will offer valuable and **real-time data** to scientific, public and private organizations and individuals interested in research fields related to Space Weather.
  - **DS-DRACO** is integrated in **EOSC-Hub** by means of the supercomputing cloud platform of CESGA (Galicia Supercomputing Centre).

2018 www.hidronav.com HIDRONAV HIDRONAV TECHNOLOGIES SL 7

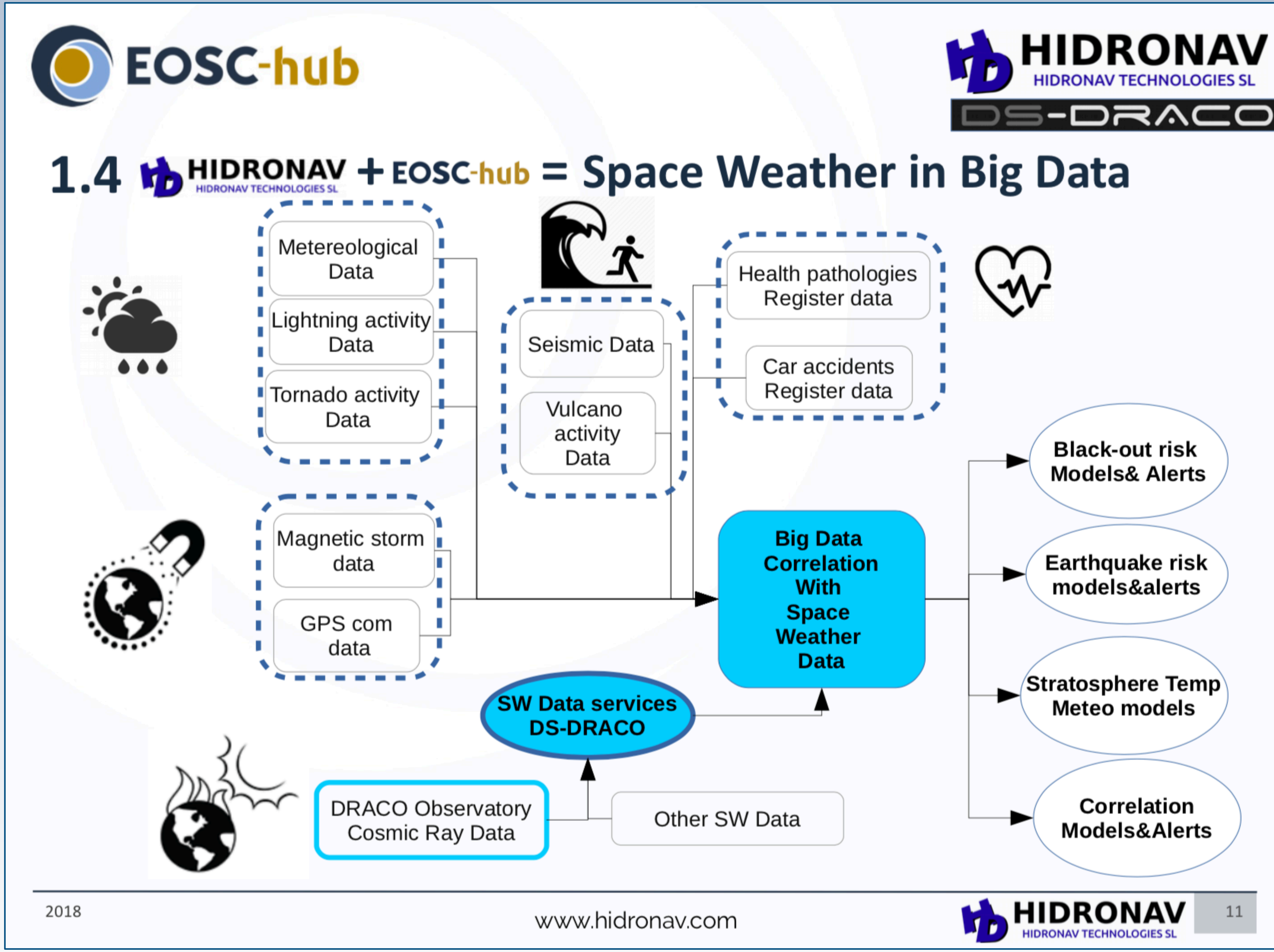
DS DRACO relational database

Data level structure (facing future implementation of Big Data techniques)



ERD data level diagram

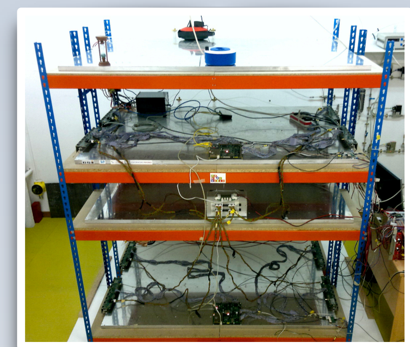
DS DRACO relational database



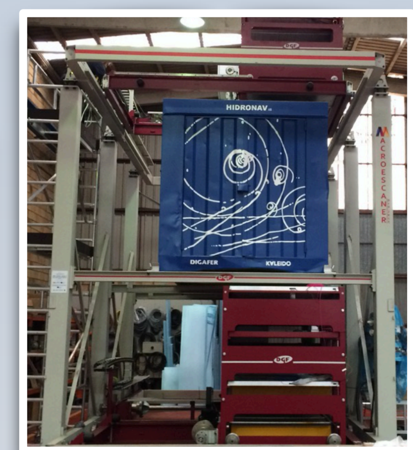
DS DRACO relational database

DRACO (Distributed Real time Atmospheric and Cosmic ray Observatory)

TRAGALDABAS



MUTT Macroscanner



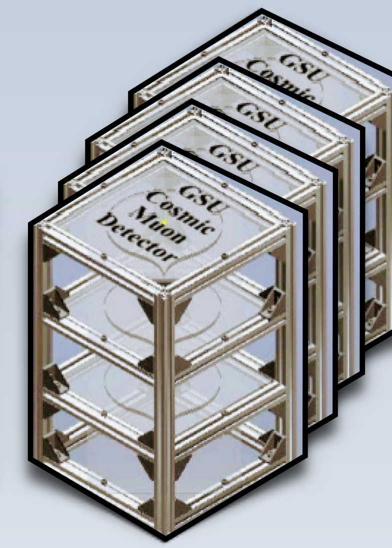
TRISTAN

DATA BASES

Atmospheric
Geomagnetic
Heliospheric
Seismic.
…
DATA BASES

New TRASGOS

Portable Cosmic Ray Detectors



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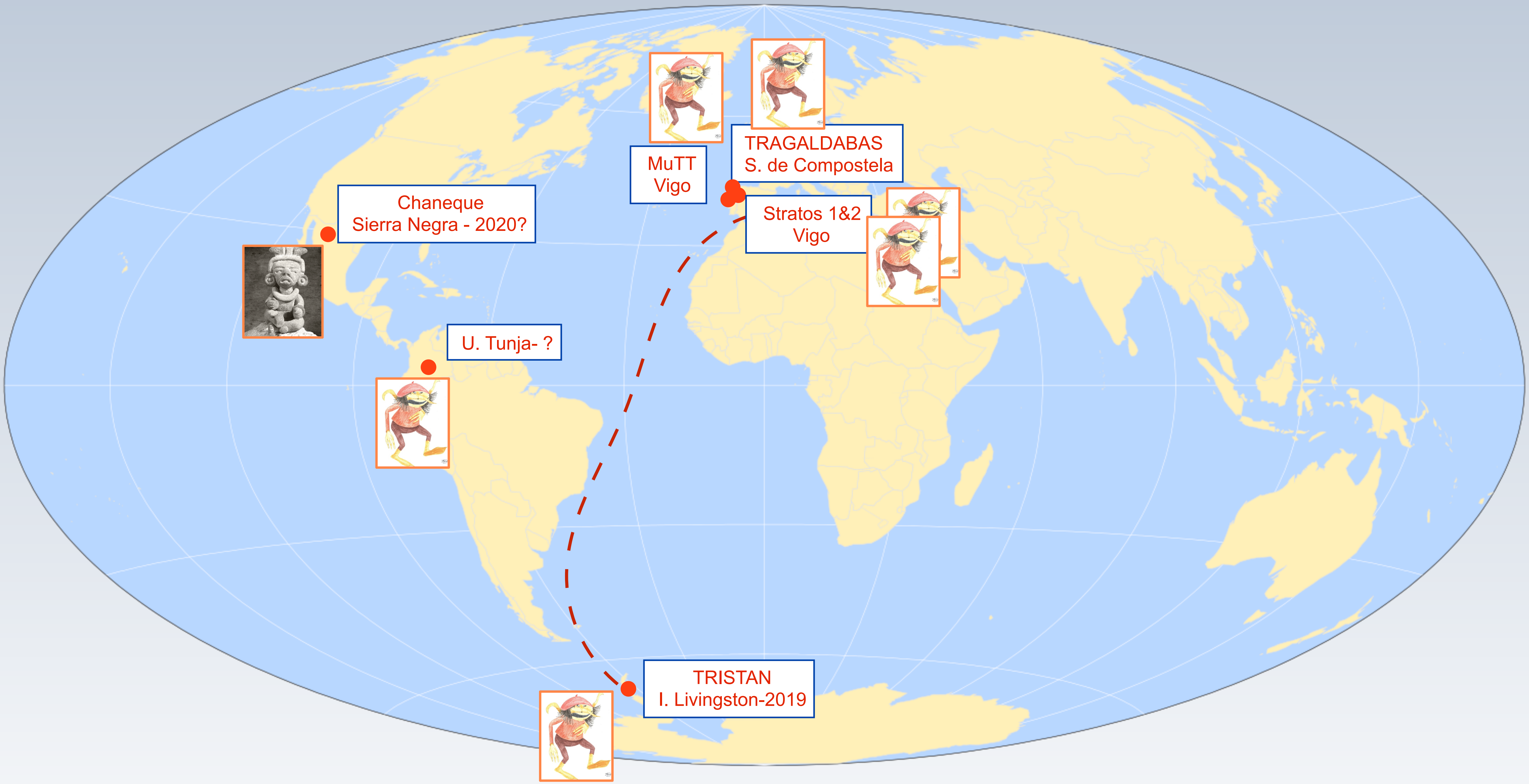
DSDRACO

Summary & Conclusions

SUMMARY and CONCLUSIONS

Towards a world wide TRASGO network?



SUMMARY and CONCLUSIONS

- The TRASGO Project is a very an initiative aiming to offer a new family of cosmic ray detectors, with very high position and time resolution and multi-particle capability. A few detectors have been already built and we are doing a big effort for developing all the reconstruction, calibration and analysis tools.
- Our goal is the Trasgos complement the existing techniques for the regular measurement of cosmic rays, as the Neutron Monitors and the Directional Muon Telescopes
- Trasgos do also complement very well the Portable Cosmic Ray Telescopes initiative of the GSU
- The DS-DRACO data base developed by our partner Hidronav Technologies could offer a nice framework for giving access to the PCRT data

The End

Thanks!