The miniTrasgo International Research Network

Juan A. Garzón

(LabCAF - IGFAE. Univ. Santiago de Compostela)

on behalf of the miniTrasgo Collaboration

RPC2024 Conference

9th - 13th September 2024

Santiago de Compostela, Spain

THE COSMIC RAYS

COSMIC RAYS

Galáctic

GCR

Extragalactic

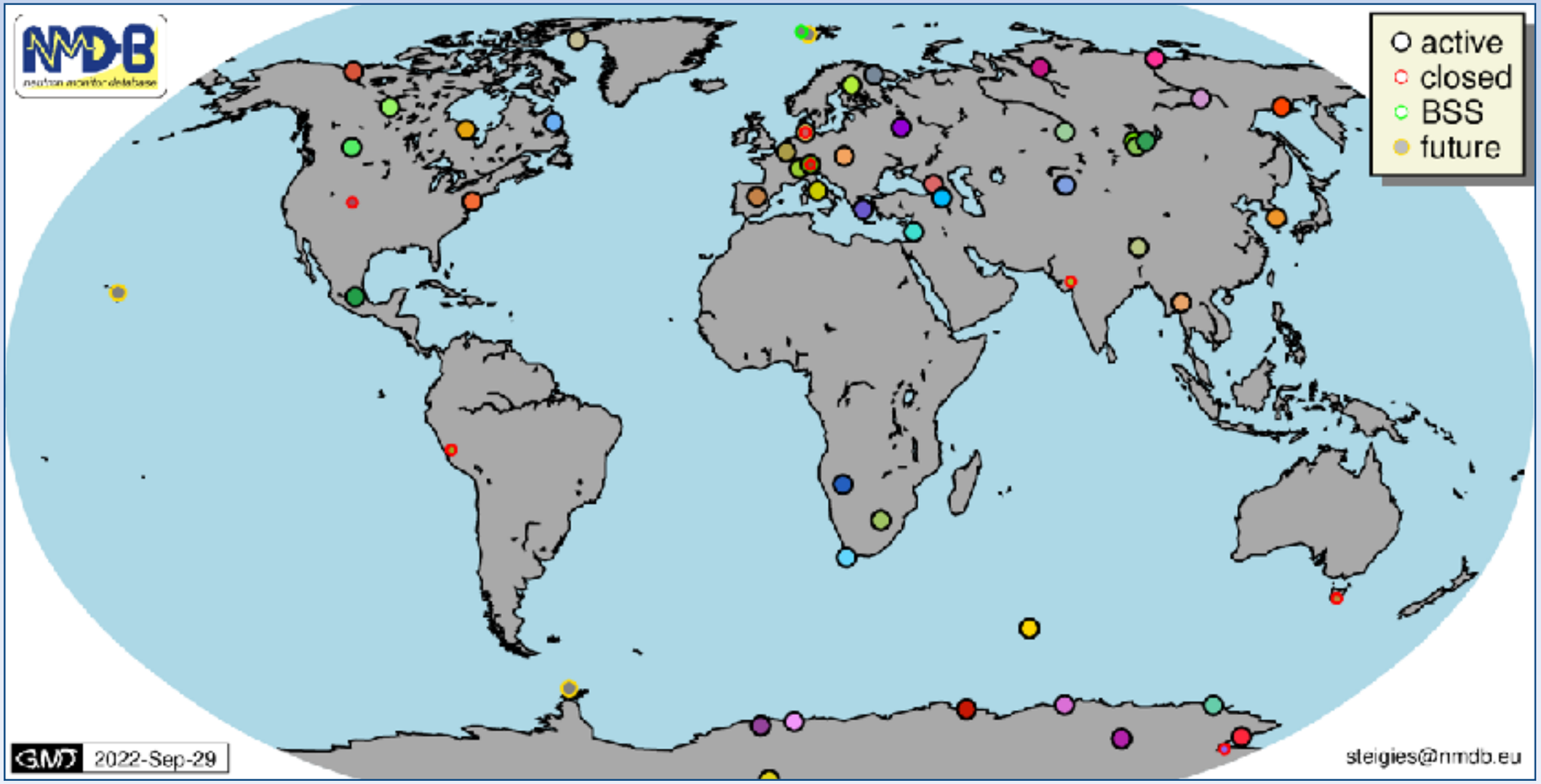
Solar Energetic Particles

SEP

COSMIC RAYS

Regular survey of cosmic ray background

The NMDB network



Pros:

- Low primary cosmic ray energy threshold: ~2GeV
- Robust and reliable standard design (IGY 1957)

Cons:

- They only count integral fluxes inside their acceptance cones

COSMIC RAYS

Regular survey of cosmic ray background

The GMDN network

Pros:

- Directional: sensitive to solar magnetic storms with ~hours in advance

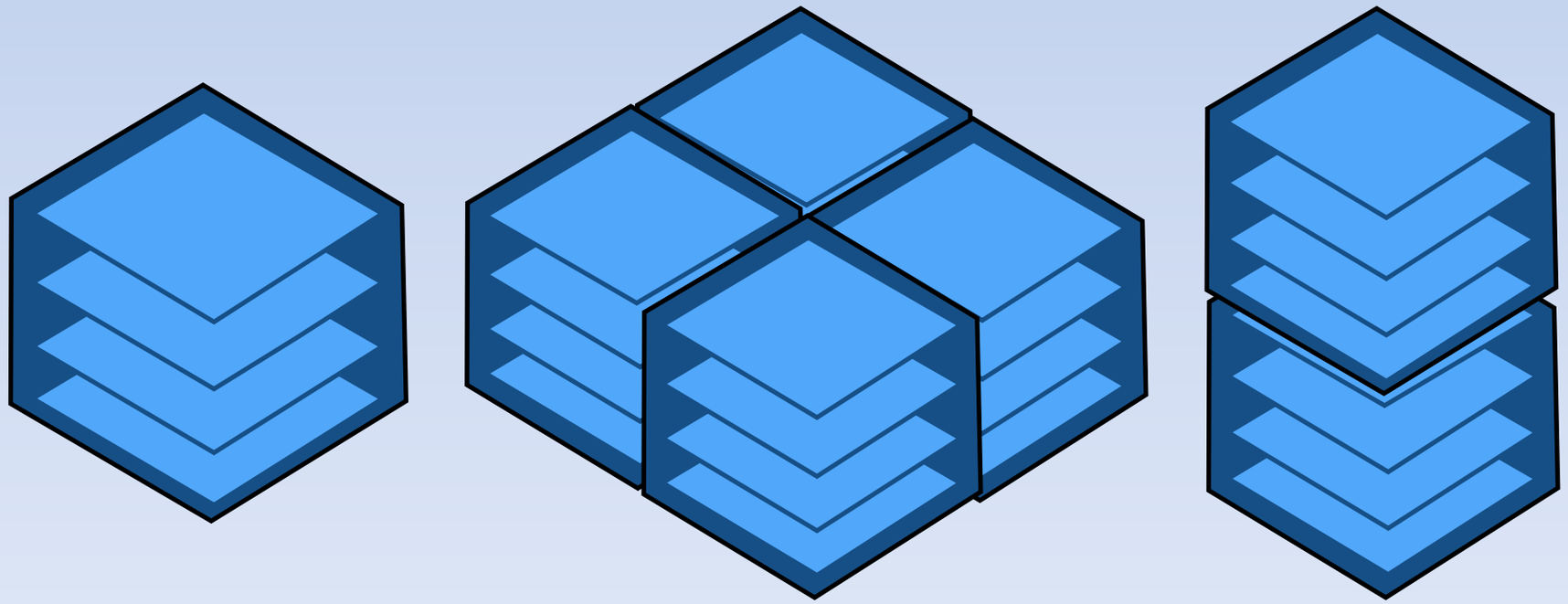
Cons:

- High primary cosmic ray energy threshold: ~6-8GeV
- No standard design
- Atmospheric temperature profile corrections needed (+ days)

THE TRASGO PROJECT

THE TRASGO PROJECT

Affordable high-performance detectors

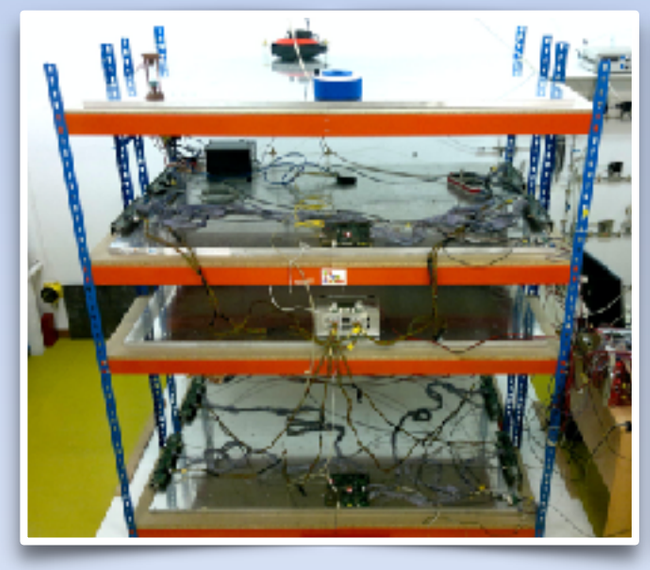


TRASGO (Goblin): TRAck reconStructinG bOx

- RPC-based P&P modular detectors
- Directional (tracking)
- Multiparticle capability
- Sensitive to both muons and electrons
- Rough EM calorimetry

THE TRASGO PROJECT

The TRASGO family

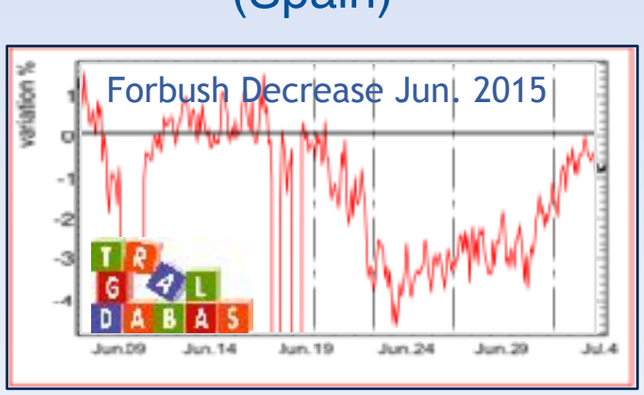


TRAGALDABAS
Univ. S. Compostela
(Spain)

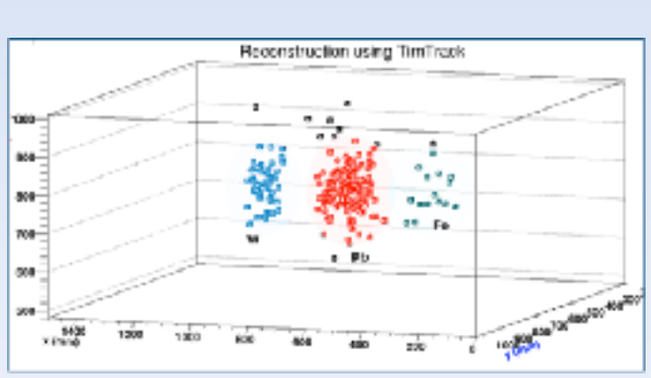
MuTT
Porriño (Spain)

TRISTAN
Livingston Island
(Antarctica)

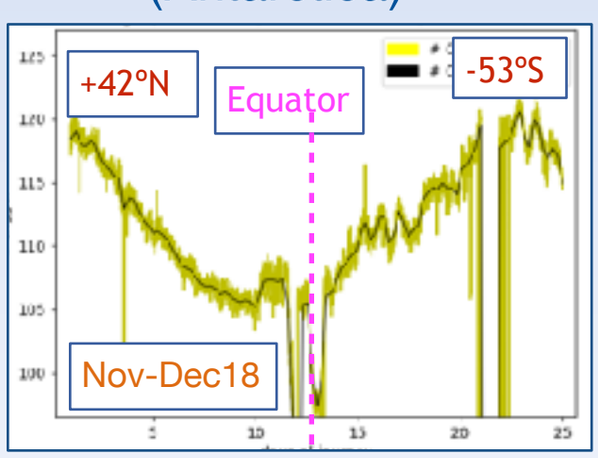
2 x STRATOS
Vigo (Spain)
Coimbra (Portugal)



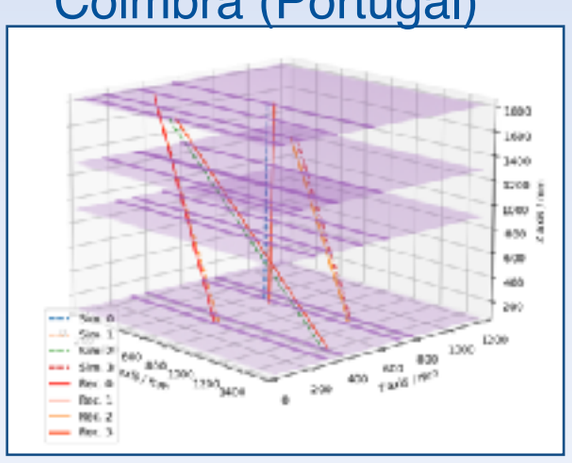
June 2015
Forbush Decrease



Cosmic Ray Muography
(W-Pb-Fe identification)



Geomagnetic Survey



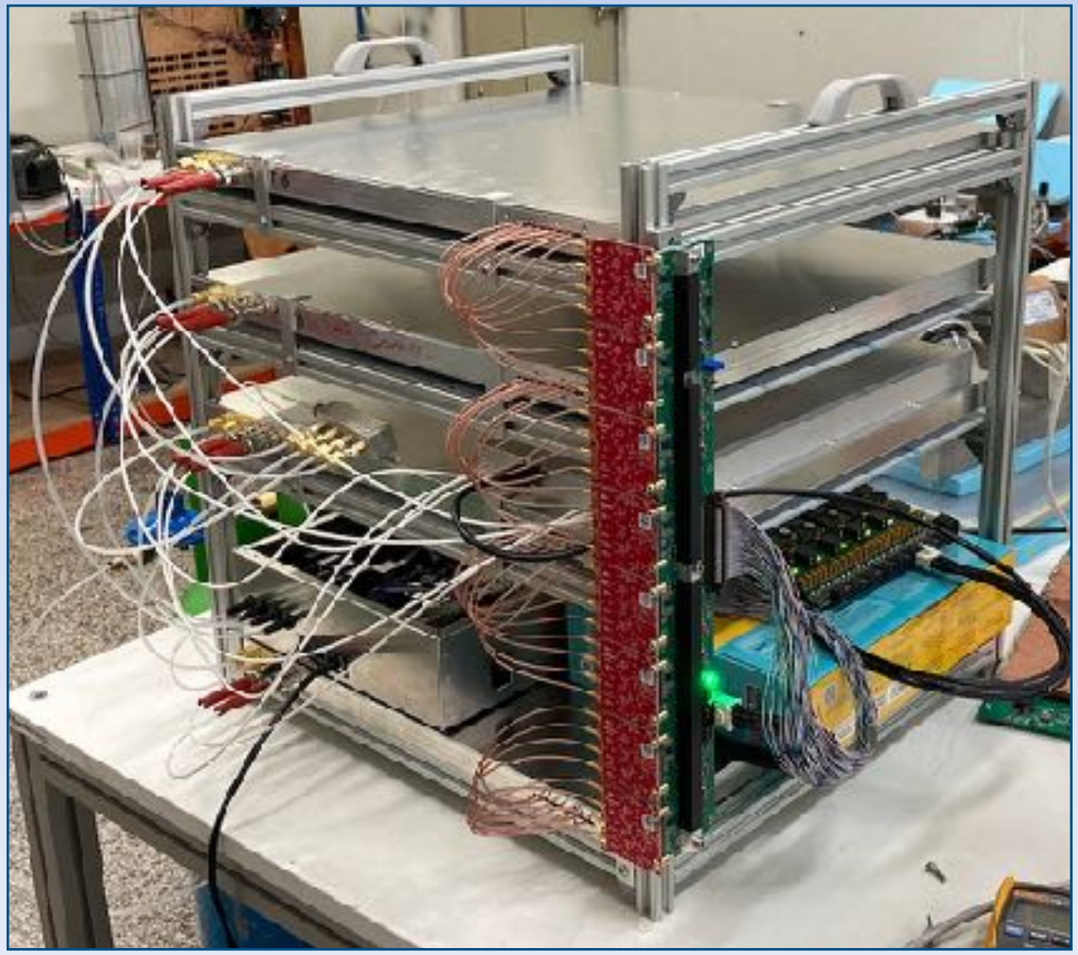
Atmospheric studies

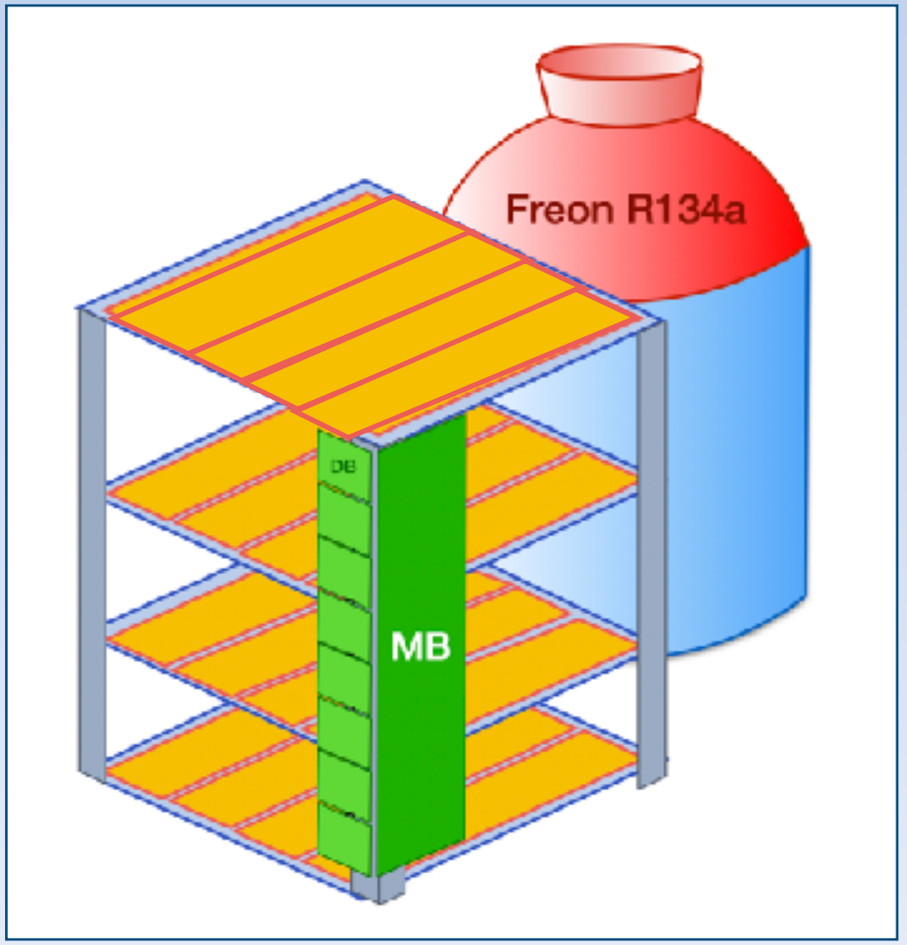
- All detectors showed their virtues in different areas but…
- To slow advances due to their complexity (nb. of channels) and the lack of manpower

THE miniTRASGO PROJECT

THE miniTRASGO PROJECT

The miniTRASGO concept

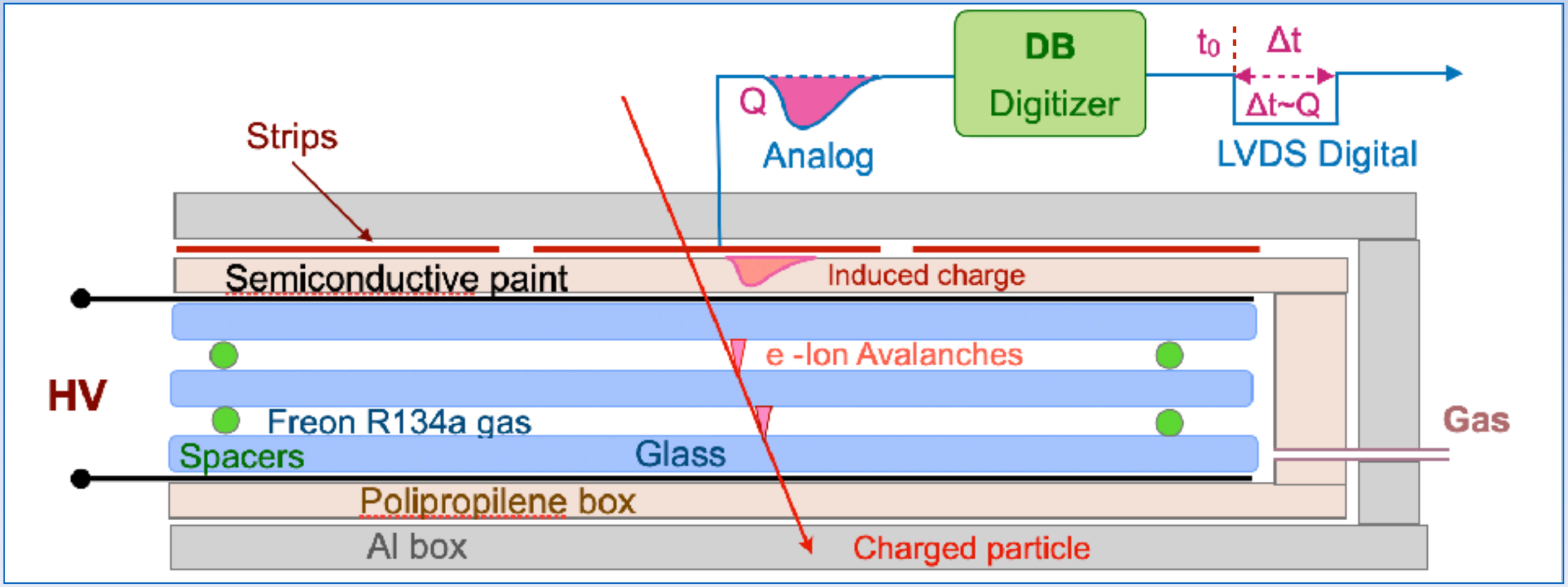




- Same main features as the Trasgos in a more affordable, small and portable detectors, sharing design FEE and DAQ
- Main goals:
  - Development of calibration, reconstruction and analysis tools compatible with the bigger Trasgos
  - Deployment of a World-Wide Network of detectors for the regular survey of the Cosmic Ray background

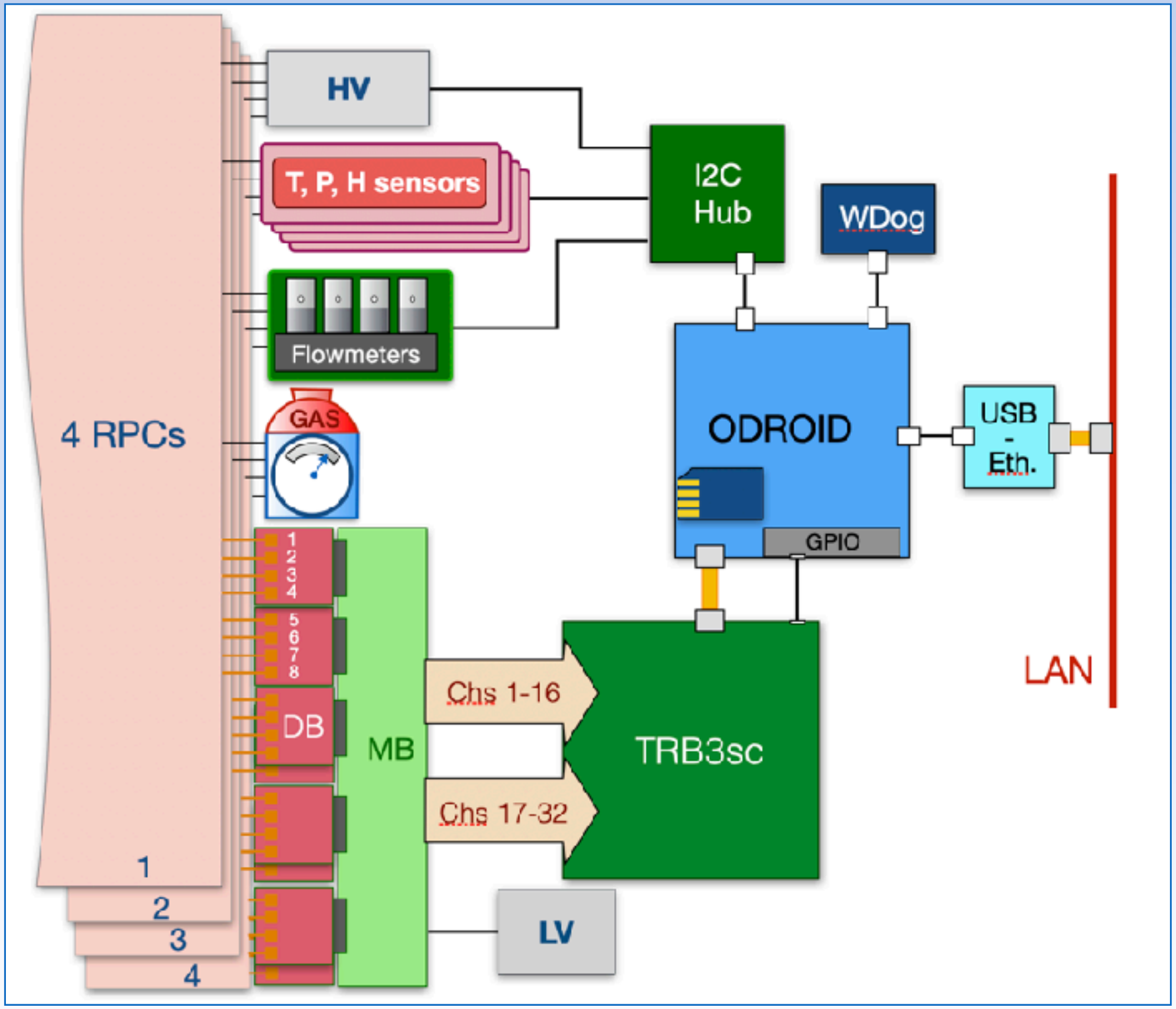
THE miniTRASGO PROJECT

The RPC cell layout



THE miniTRASGO PROJECT

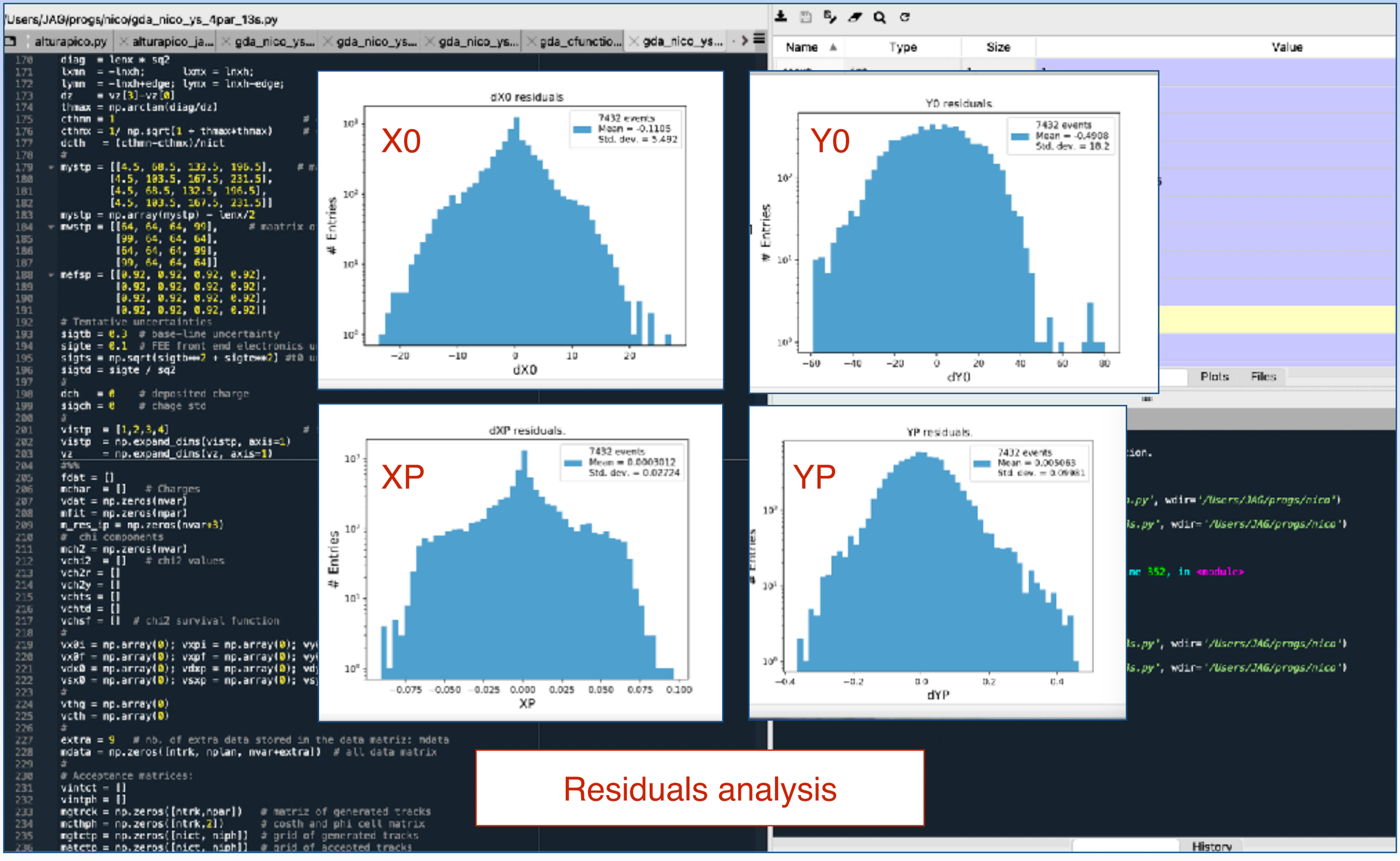
miniTRASGO data flow and logic



miniTRASGO TOOLS

miniTRASGO TOOLS

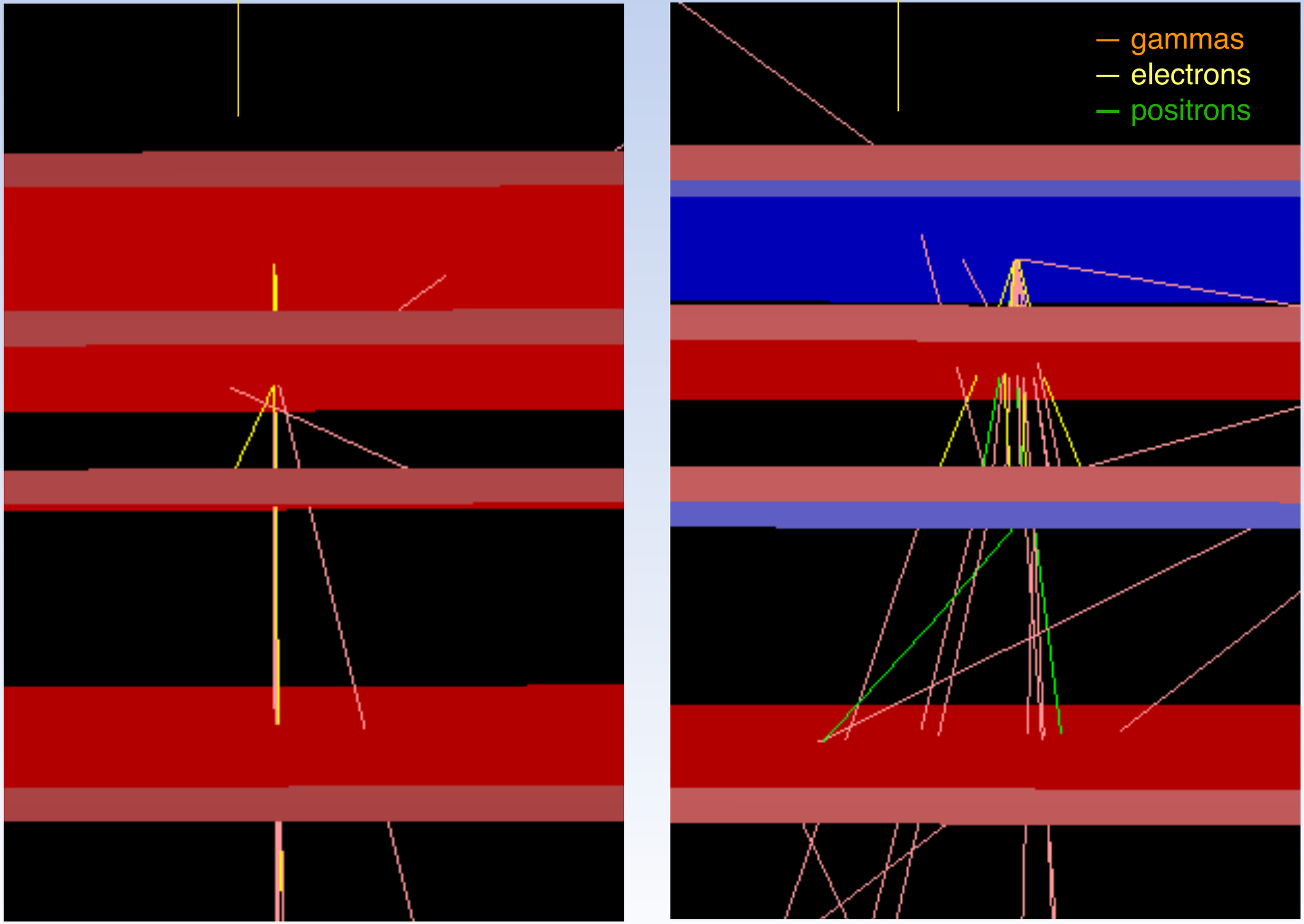
TimTrack as tracking program



Residuals analysis

miniTRASGO TOOLS

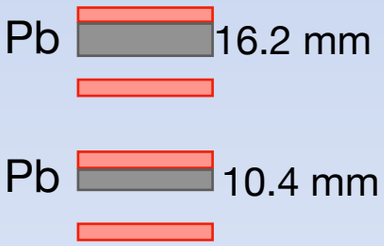
GEANT simulations. Electron interactions

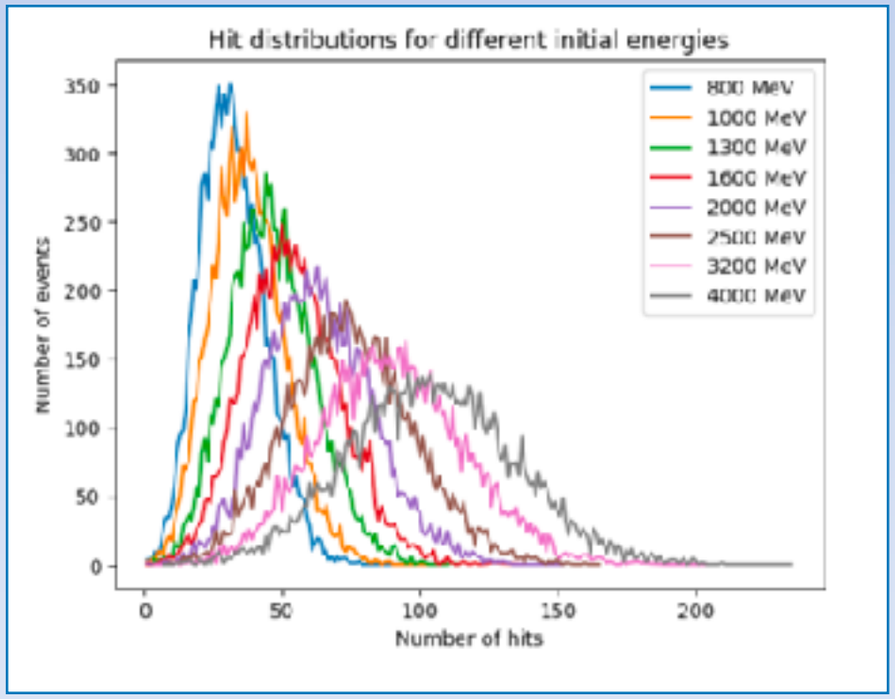


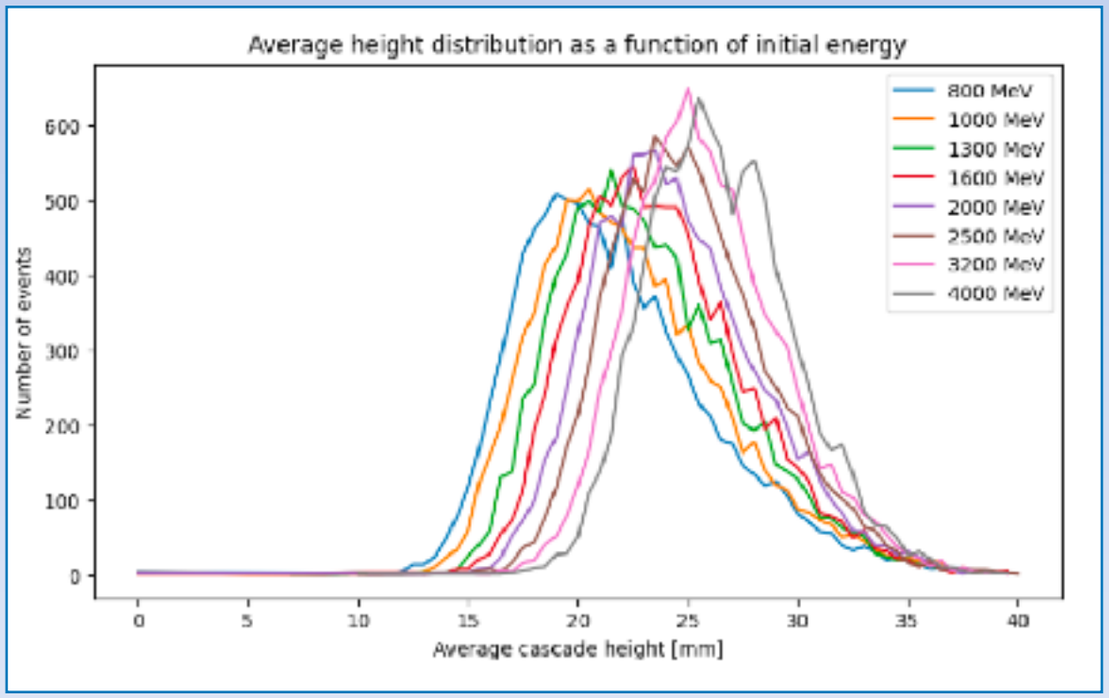
miniTRASGO TOOLS

GEANT simulations. Electron interactions

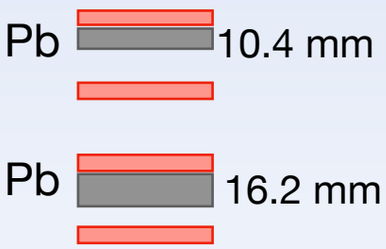
Conf1

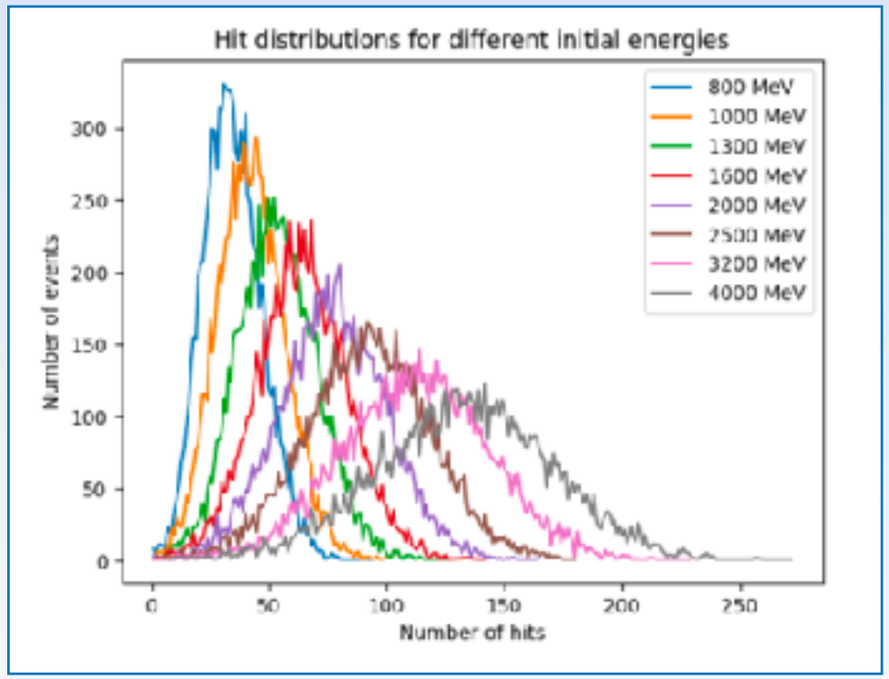


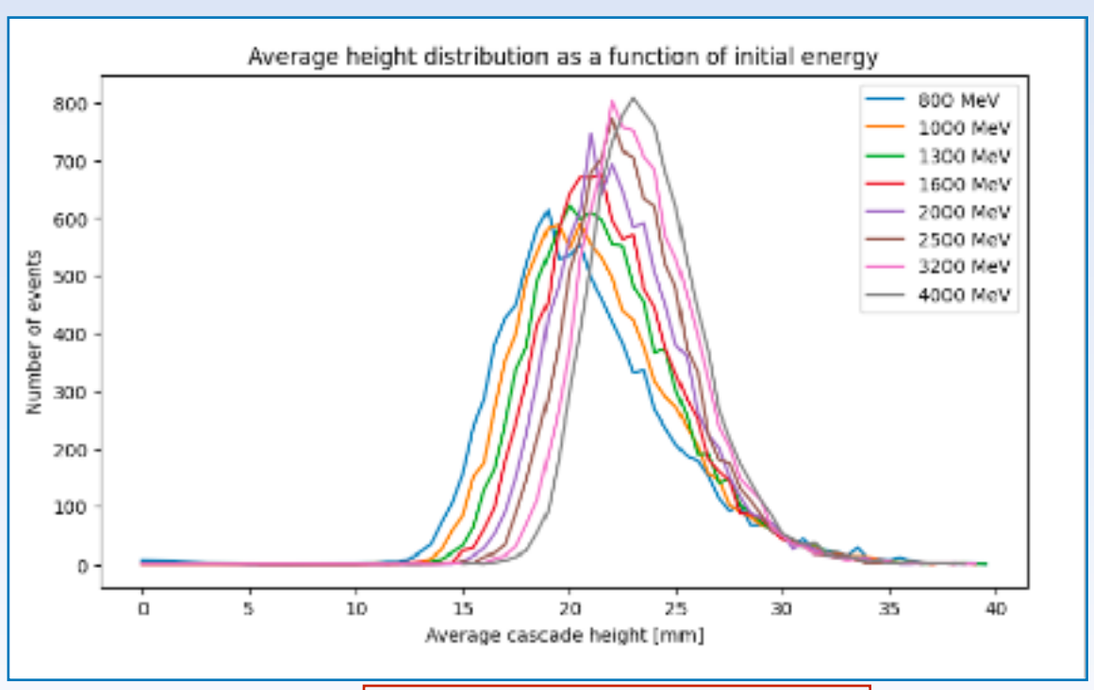




Conf2





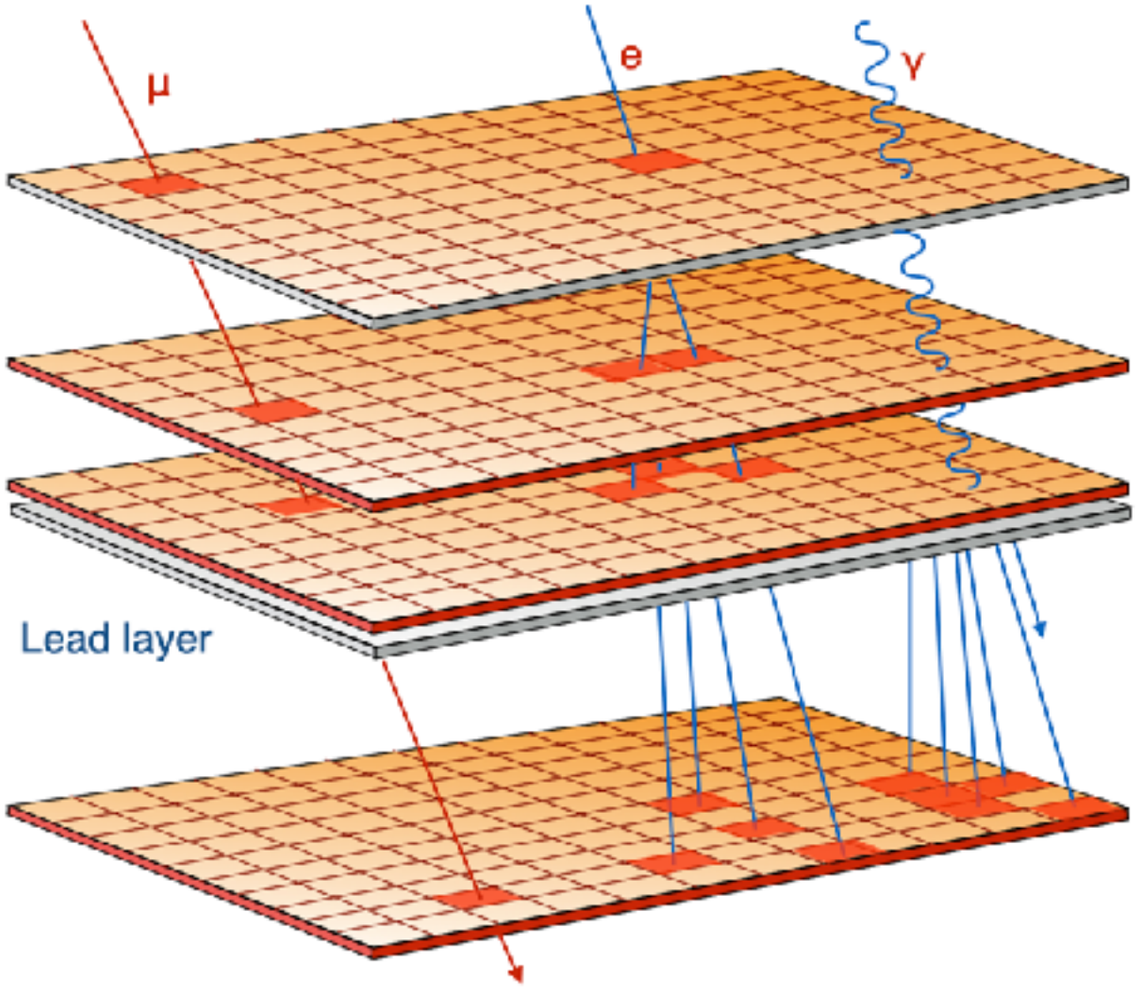


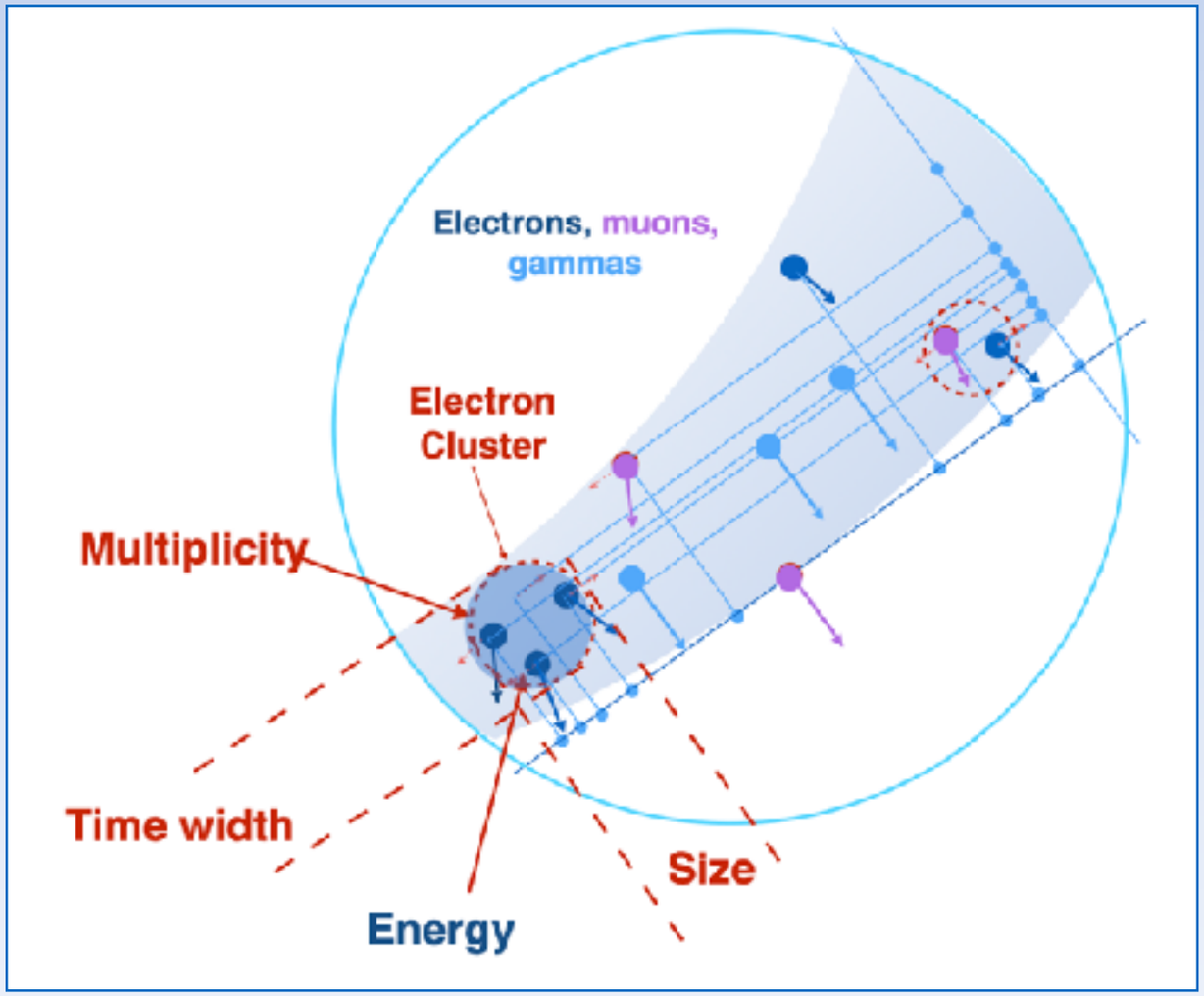
Hit Number

Mean depth / mm

miniTRASGO TOOLS

Shower simulation and reconstruction of particles and clusters or particles





miniTRASGO TOOLS

Shower simulation and reconstruction of particles and clusters or particles

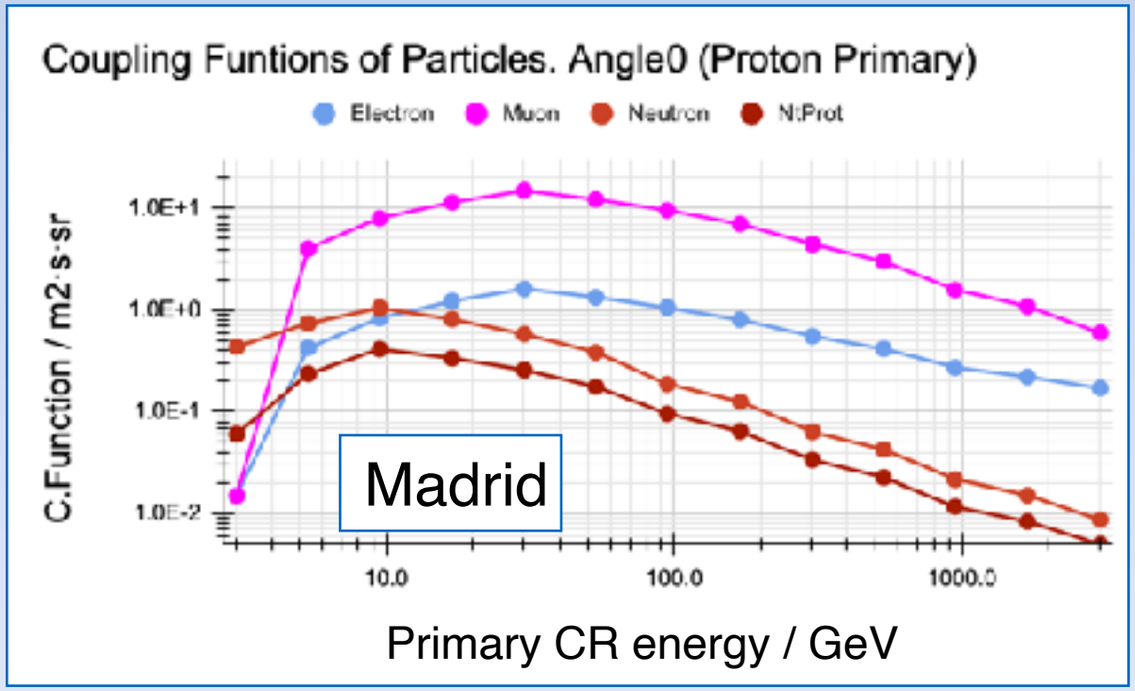
Original author: Camilo J. Torres
created: march of 2024 personal email: camilcjtorresc@gmail.com email: camilo.torres@cern.ch

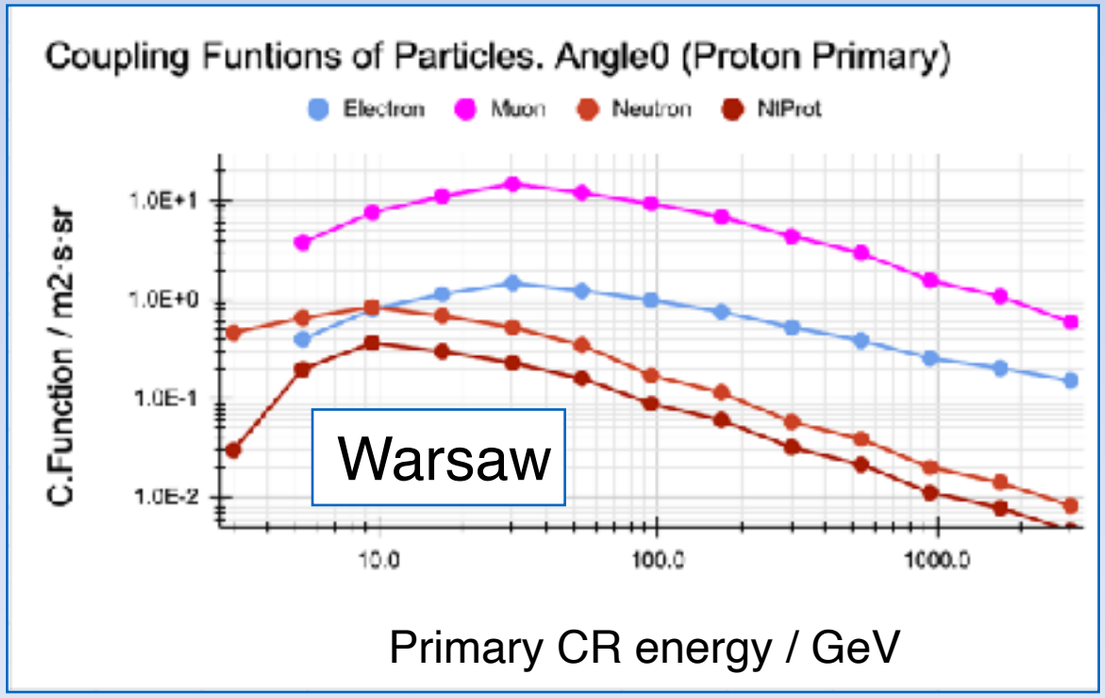
	iClst	nShow	NPart	CCode	sCCode	ftP_ID	ltP_ID	dXm_mm	dYm_mm	dRm_mm
42	43.0	1.0	2.0	1001.0	2.0	1.0	1.0	160.443194	94.996607	186.457432
45	46.0	1.0	2.0	1001.0	2.0	3.0	1.0	-382.466691	436.994111	580.727667
91	92.0	1.0	2.0	1001.0	2.0	1.0	3.0	-145.989187	9.844103	146.320707
161	162.0	1.0	2.0	2000.0	3.0	2.0	3.0	-172.940473	51.883327	180.555495
171	172.0	1.0	2.0	1001.0	2.0	1.0	3.0	-172.753884	130.088839	216.256816
189	190.0	1.0	2.0	2.0	1.0	1.0	1.0	-282.198611	72.604368	291.388830
196	197.0	1.0	2.0	1001.0	2.0	2.0	1.0	-418.524023	-166.251800	450.335451
261	32.0	2.0	2.0	1001.0	2.0	3.0	1.0	-413.587052	140.235318	436.715232

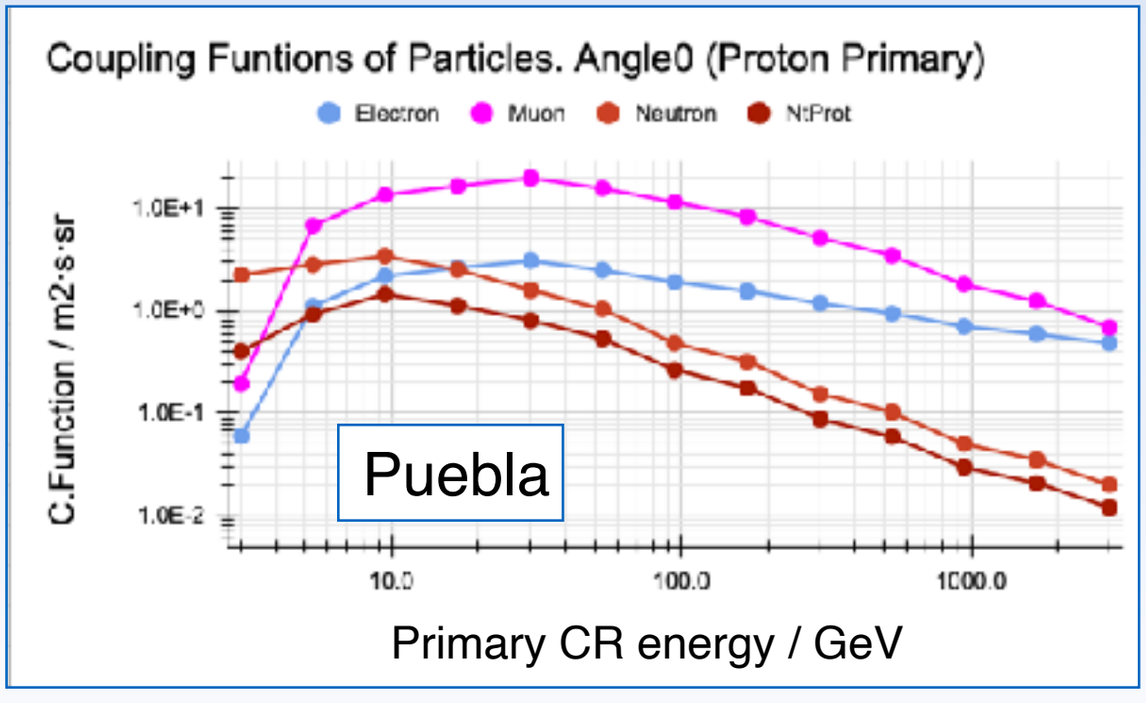
THE miniTRASGO TOOLS

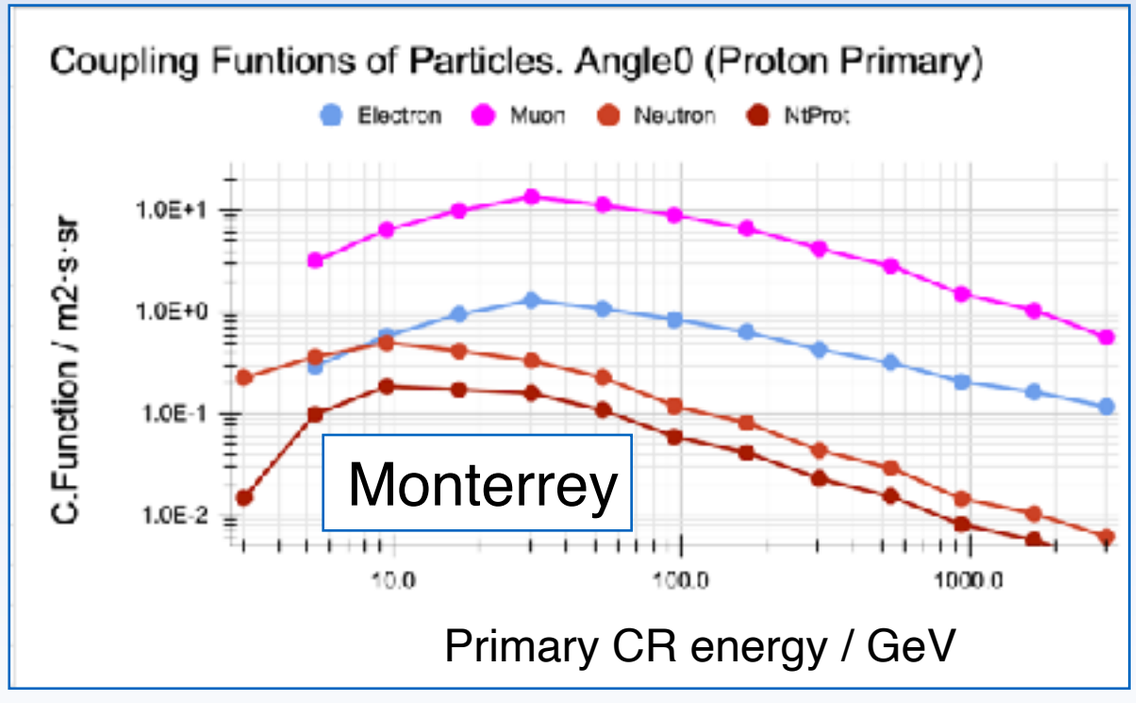
Shower simulation and reconstruction of particles and clusters or particles

Coupling functions









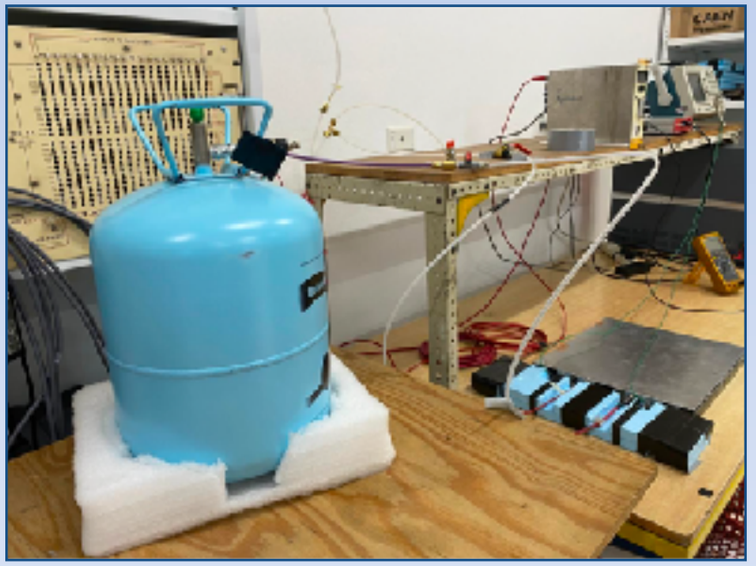
THE miniTRASGO NETWORK

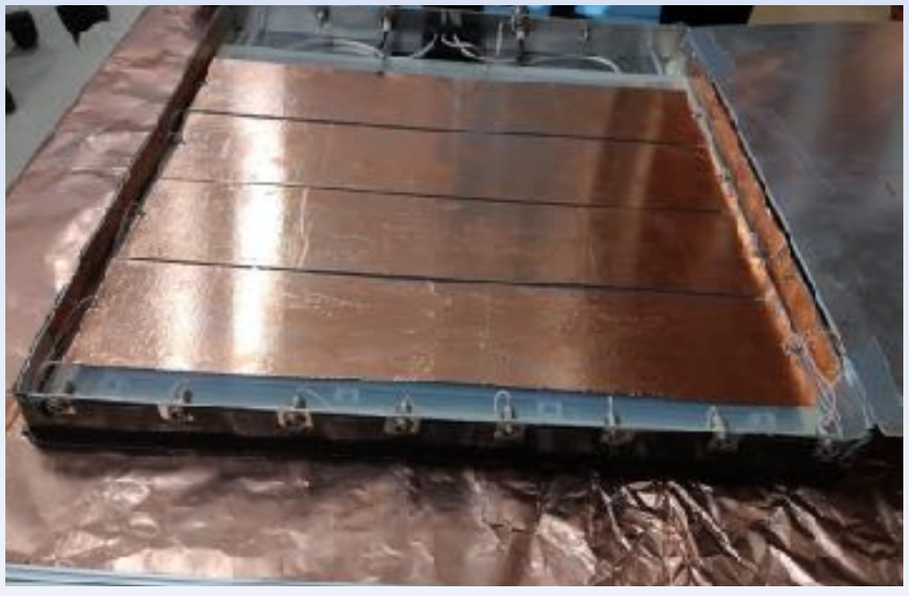
THE miniTRASGO NETWORK

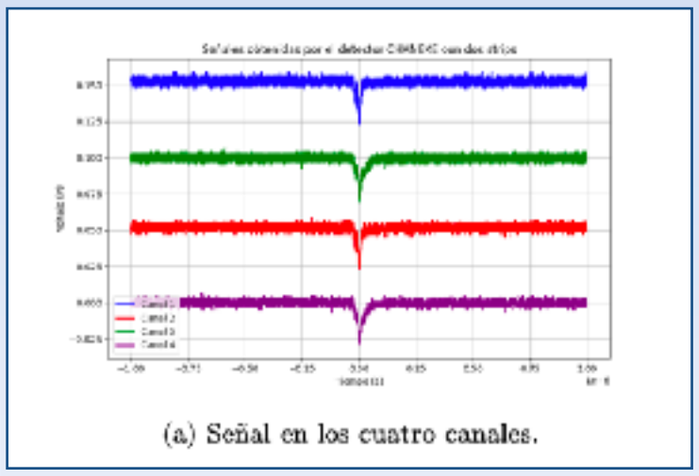
The first miniTRASGOs

THE miniTRASGO NETWORK

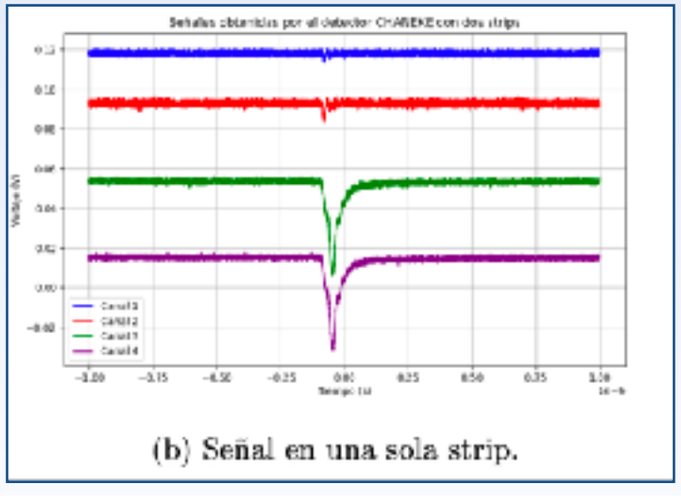
Chaneque: The Mexican cousin of Puebla







(a) Señal en los cuatro canales.



(b) Señal en una sola strip.

THE miniTRASGO NETWORK

The miniTRASGO network

Name	Location	Latitude	Longitude	Altitude/ m	MRigidity/ GeV	Status
mTrasgo01	Madrid	40.45	-3.72	600	~7	Working
mTrasgo02	Warsaw	52.22	21.00	100	~2.5	Comissionning at WTU-Warsaw
mTrasgo03	Puebla	18.93	-98.16	2200	~7.5	Comissionning at LIP-Coimbra
mTrasgo04	Monterrey	25.66	-100.42	664	~6	Still unassembled (LIP - Coimbra)

miniTRASGO PRELIMINARY RESULTS

miniTRASGO PRELIMINARY RESULTS

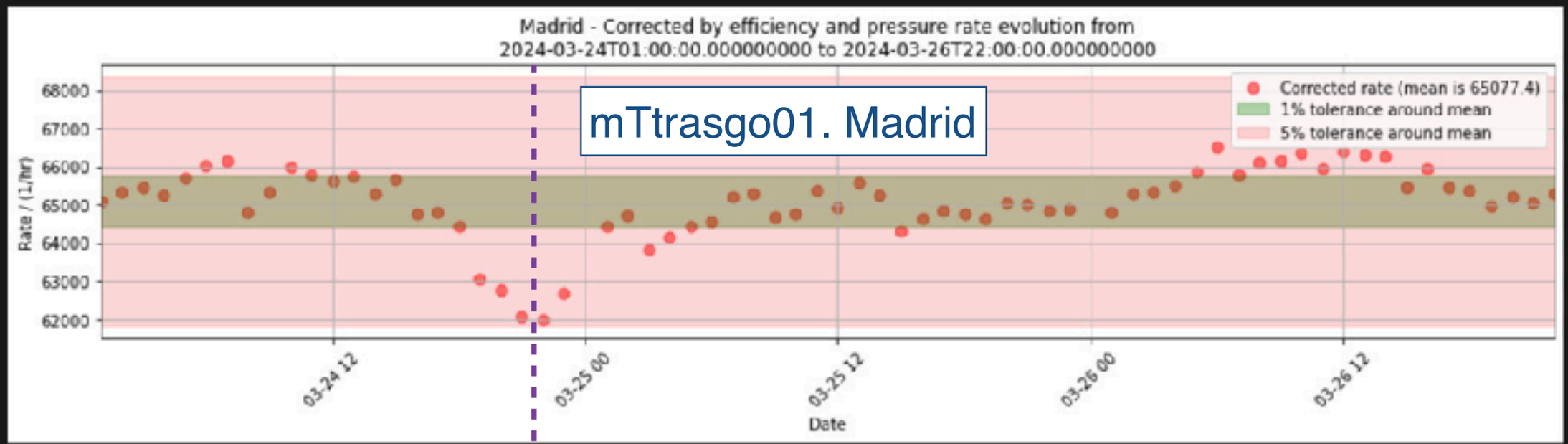
A miniTRASGO expected resolutions (for a trigger rate: 5 Hz)

Expected uncertainties for different effects: 100/sqrt(N)								
Time	Total rate		5 %		2 %		1 %	
	N. counts	100/sqrt(N)	N. counts	100/sqrt(N)	N. counts	100/sqrt(N)	N. counts	100/sqrt(N)
10 min	**3000**	2	**150**	8	**60**	1.3	-	-
1 h	**18000**	0.7	**900**	3.3	**360**	5	**180**	7.5
1 day	**430 000**	0.2	**2200**	0.7	**8600**	1	**4300**	1.5

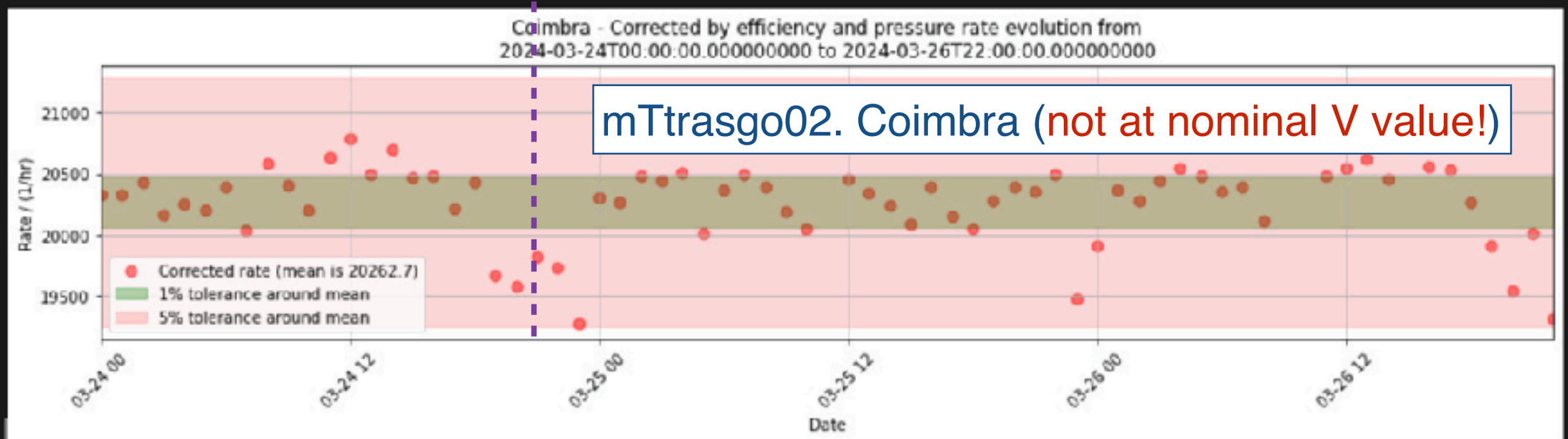
miniTRASGO PRELIMINARY RESULTS

Forbush decrease March 2024

Madrid:

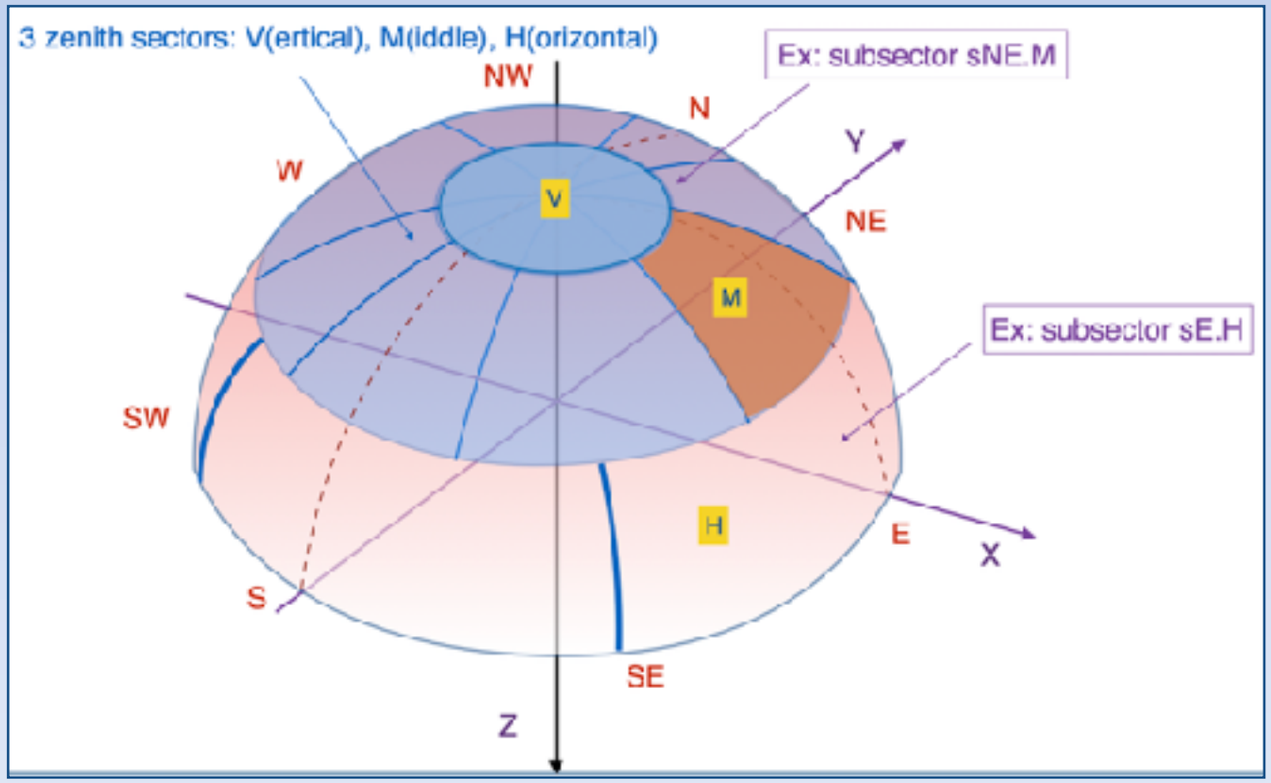


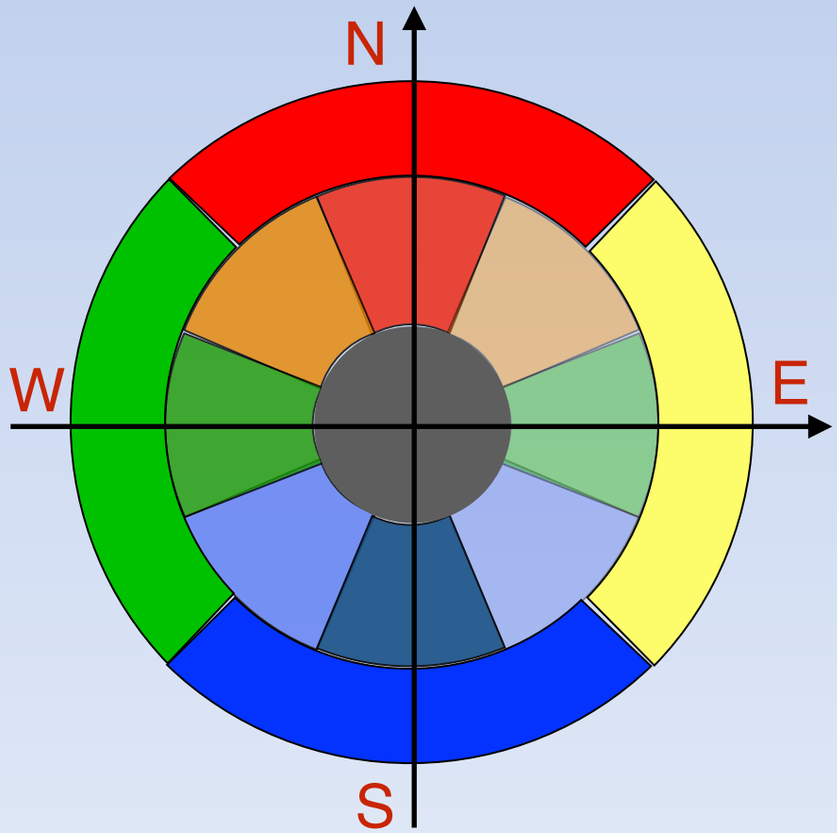
Coimbra:

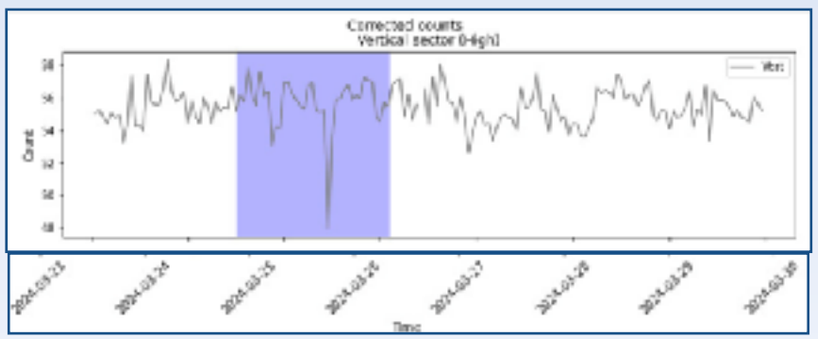


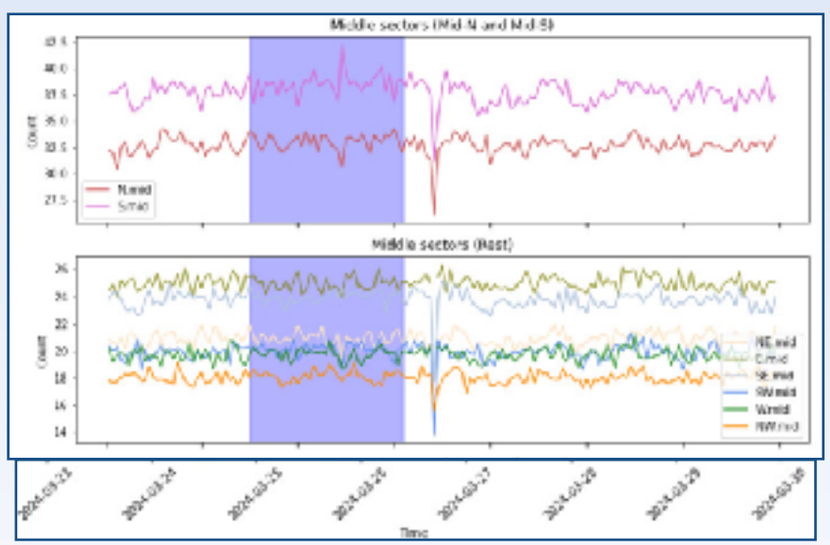
miniTRASGO PRELIMINARY RESULTS

13 directional sectors









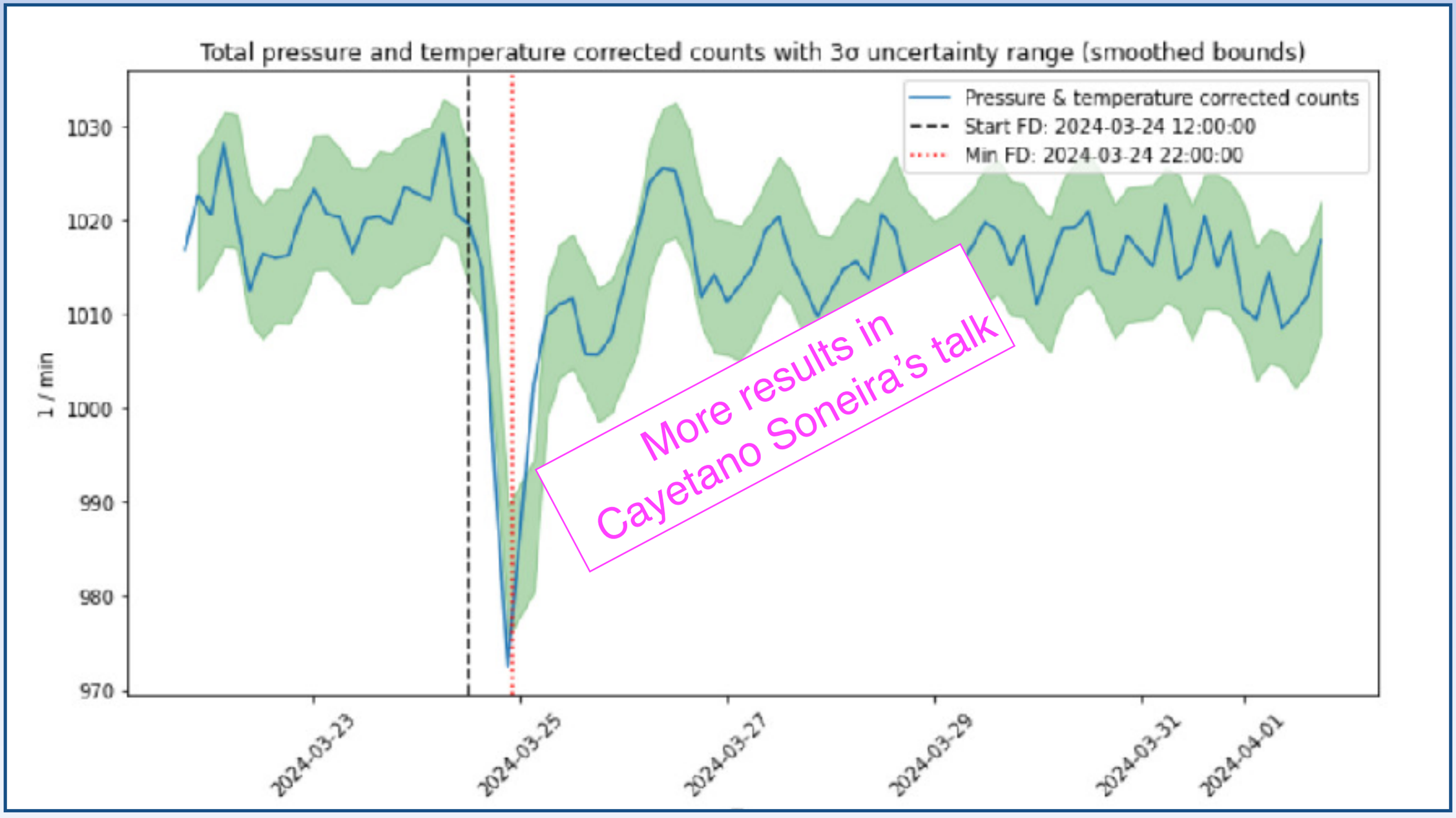
Sector rates during the FD at March 24th. 2024

Juan A. Garzón. The mTrasgo International Network

RPC 2024 Conference. S. Compostela, Sept. 9th.-13th. 2024

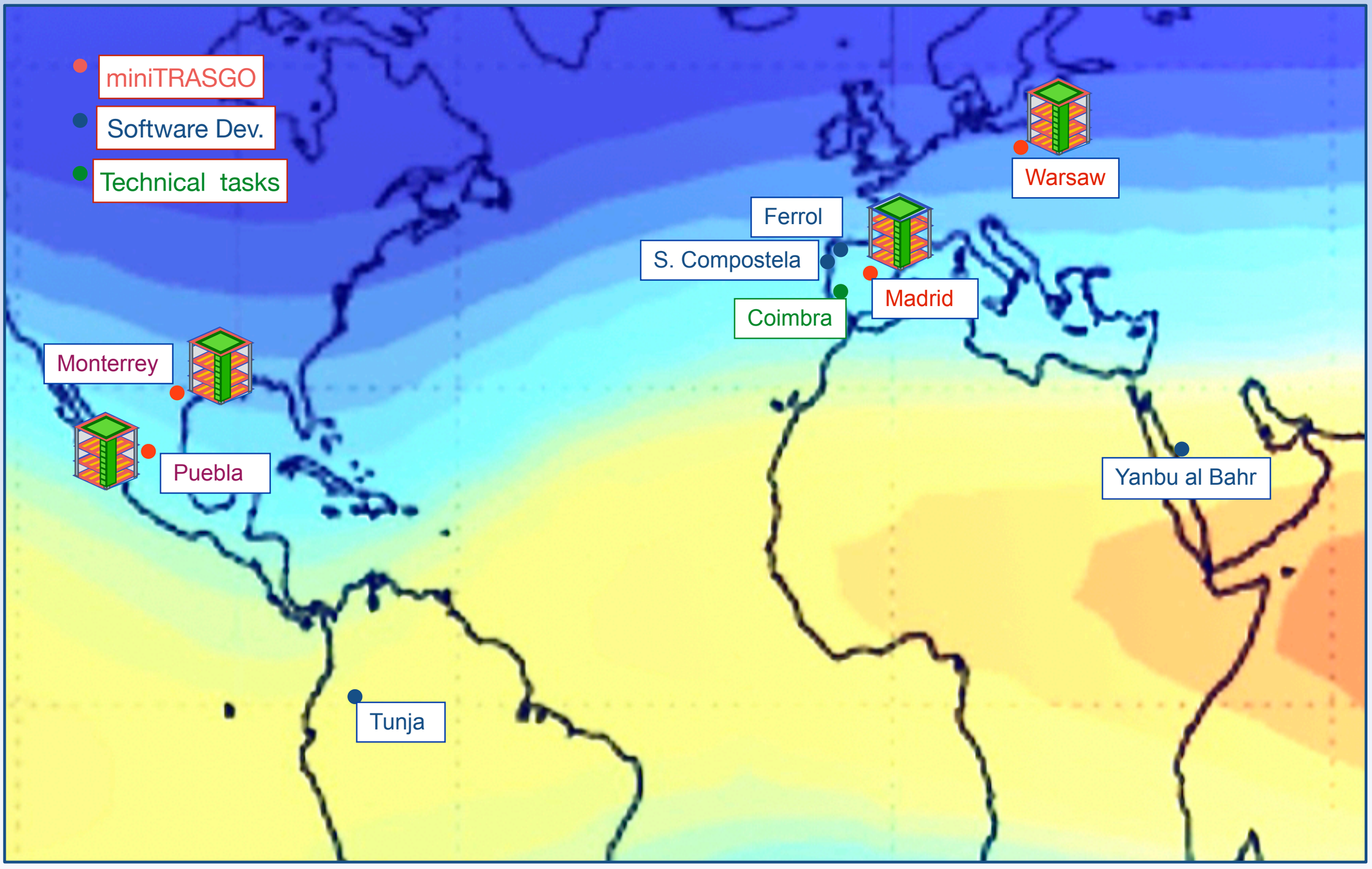
miniTRASGO PRELIMINARY RESULTS

Forbush decrease March 2024



The miniTRASGO COLLABORATION

THE miniTRASGO COLLABORATION



THE miniTRASGO COLLABORATION

Members:

C. Aguilar[6], M. Ajoor[10], I. Bautista[5,6], A. Blanco[2], R. del Bosque[4], Cid[6], P. Fonte[2], M. Fraile[3], J.A. Garzón[7], L. Lópes[2], G. Kornakov[9], A. Labrador[11], L. Lappo[9], M. Kostera[9], O. Martínez[6], H. Martínez-Huerta[4], A. Parra[4], E. Ponce[5,6], A.Plachta[9], M. Plaszek[9], J.L. Rodríguez[1], O. Ruiz[6], W. Rzesa[9], H. Salazar[5,6], J. Saraiva[2], M. Seco[7], C. Soneira[3], C. Torrres[6], J.M. Udías[3], E. Varela[6], J. Vargas[8], L. Villaseñor[5]

Institutions:

1. CITENI-UDC. **A Coruña**, Spain
2. LIP. **Coimbra**, Portugal
3. UCM. **Madrid**, Spain
4. DFM - UM. **Monterrey**, Mexico
5. CIIEC-BUAP. **Puebla**, Mexico
6. FCFM-BUAP. **Puebla**, Mexico
7. IGFAE - USC. **Santiago de Compostela**, Spain
8. UPTC. **Tunja**, Colombia
9. TUV. **Warsaw**, Poland
10. TU. **Yanbu City**, Saudi Arabia
11. **IGDORE**: Institute for Globally Distributed Open Research and Education

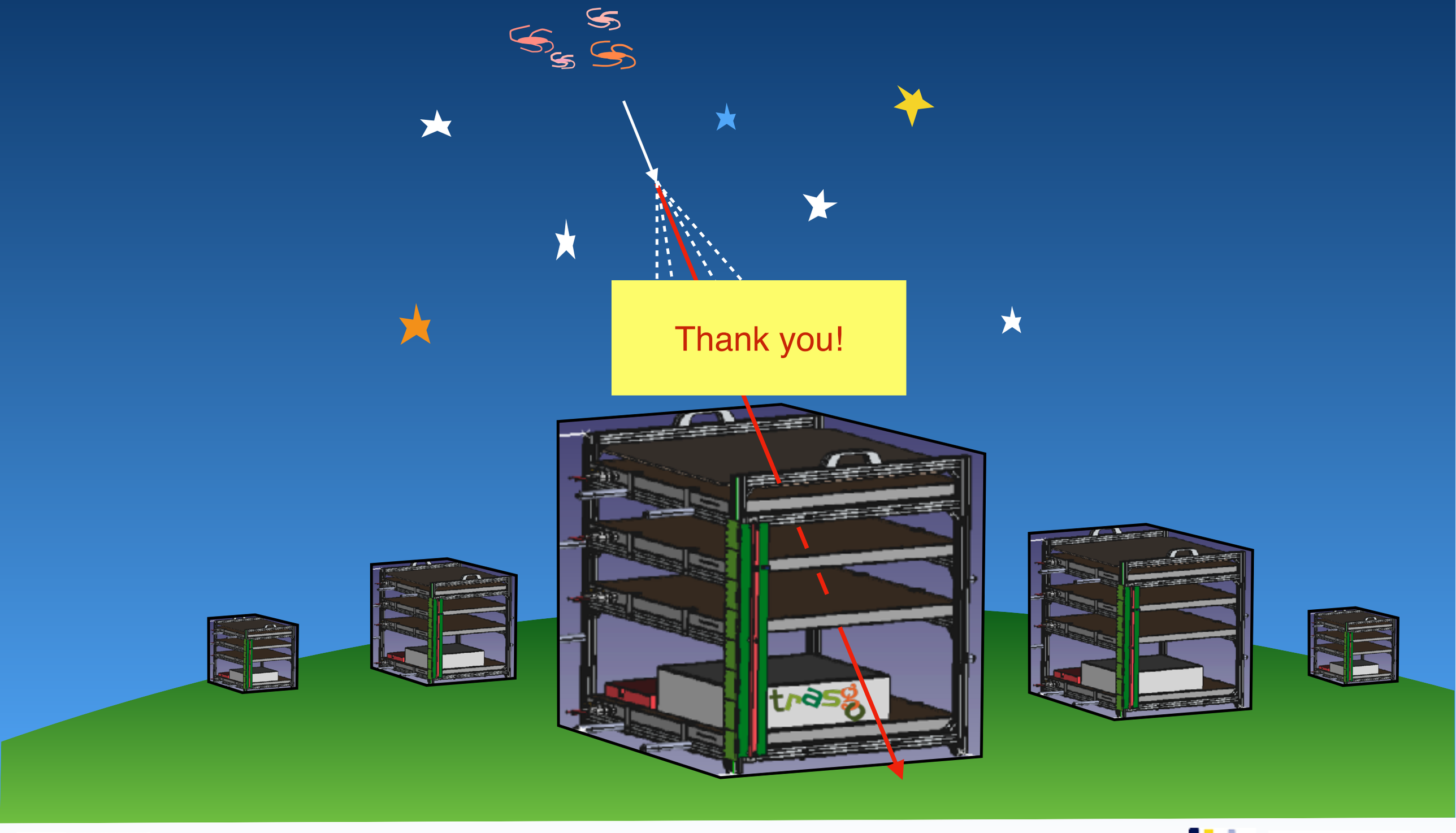
SUMMARY AND CONCLUSIONS

SUMMARY AND CONCLUSIONS

- New miniTrasgo detectors are being developed as an entry into the Trasgo concept
- They are smaller and more affordable devices than Trasgos, sharing with them software and analysis tools
- We are deploying an international network of miniTrasgos as an alternative/ complement to existing networks for the regular survey of the cosmic ray background
- Four miniTrasgo detectors are already built or under construction for their installation at four universities on two continents covering ~1/8 of the celestial hemisphere
- A collaboration of about 30 people from about 10 institutions in 6 countries is being organized for ongoing data collection and their analysis

First physical results are coming soon

Towards a World-Wide network of miniTrasgos?



THE miniTRASGO COLLABORATION

USC UNIVERSIDADE DE SANTIAGO DE COMPOSTELA

IGFAE Instituto Galego de Física de Altas Enerxías

LIP LABORATÓRIO DE INSTRUMENTAÇÃO E FÍSICA EXPERIMENTAL DE PARTÍCULAS

CENTRO INTERDISCIPLINARIO DE INVESTIGACIÓN Y ENSEÑANZA DE LA CIENCIA

BENEMÉRITA UNIVERSIDAD AUTÓNOMA DE PUEBLA · 1578 ·

POLITECHNIKA WARSZAWSKA WARSAW UNIVERSITY OF TECHNOLOGY

UDEM

Uptc Universidad Pedagógica y Tecnológica de Colombia

IGDORE Institute for Globally Distributed Open Research and Education

CITENI

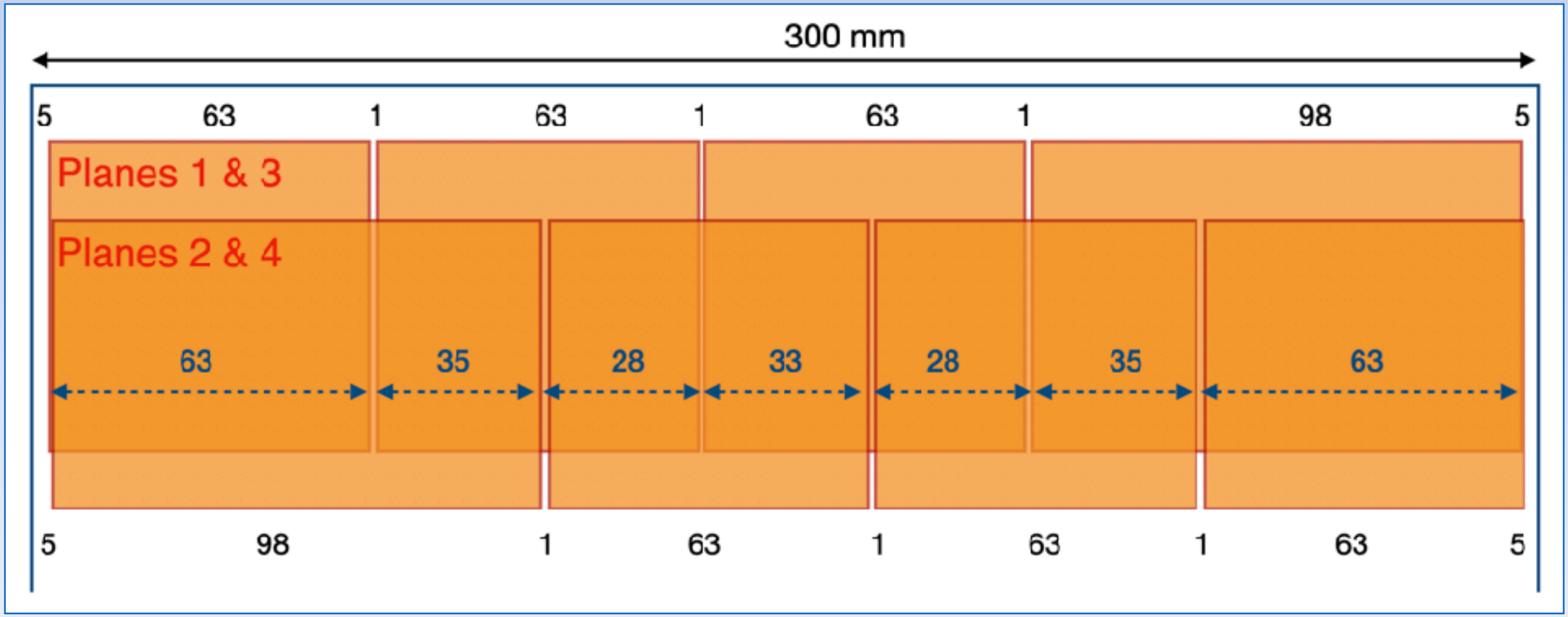
UNIVERSIDADE DA CORUÑA

HIDRONAV TECHNOLOGIES

madrid

THE miniTRASGO PROJECT

Strip layout



THE miniTRASGO PROJECT

Cell and detector attenuation parameters

RPC cell layout	Width/mm	Density/(gr/cm^3)	Mass width/(gr/cm^2)	X_0/cm	ΔX_0
Al	2	2.70	0.54	8.9	0.022
Foam	10	0.3	0.30	142	0.007
Cu	0.03	8.96	0.03	1.43	0.002
PCB (FR4)	1.57	2.6	0.40	31.8	0.005
Polipropilene	1	0.9	0.09	~40	0.003
Glass	1.9	2.5	0.47	3.2	0.059
R134a	1	0.0045	0	26.5	0.004
Glass	1.9	2.5	0.47	3.2	0.059
R134a	1	0.0045	0	26.5	0.004
Glass	1.9	2.5	0.47	3.2	0.059
Polipropilene	1	0.9	0.09	~40	0.003
Al	2	2.70	0.54	8.9	0.022
Total	25.7	-	3.40	-	0.249

mTrasgo layout	Width/mm	Density/(gr/cm^3)	Mass width/(gr/cm^2)	X_0/cm	ΔX_0
T1	25.7	-	3.40	-	0.25
Air	65.0	0.001	0.0065	30420	0
T2	25.7	-	3.40	-	0.25
Air	65.0	0.001	0.0065	30420	0
T3	25.7	-	3.40	-	0.25
Pb	10.4	11.35	11.80	0.56	1.86
Air	180	0.001	0.0065	30420	0
T4	25.7	-	3.40	-	0.25
Total	423.2		25.4		2.86