Astoparticle @Eastern Colombia: updated

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^Instituto Balseiro y Centro Atómico Bariloche, Bariloche Argentina

Escuela de Física Universidad Industrial de Santander

Bucaramanga Colombia

**Departamento de Física, Universidad de los Andes*

Mérida Venezuela

Agenda

- 2016 Colombia Astro-year
- New e-research era
- Latin America Giant Observatory (an update)
  - LAGO High Energy Program
  - LAGO Space Weather Program
  - LAGO Data Program
  - LAGO Universities
- LAGO outside LAGO
  - Colombia @Pierre Auger
  - Astroparticle and health
  - Volcano Muongraphy
  - Citizen Science @Bucaramanga
  - Observatorio Colombiano de Rayos Cósmicos (OCoCo)
  - Polo de Astronomía Social

2016
@Medellín 16-20oct

Universidad Industrial de Santander

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Communicating Astronomy with the Public (CAP2016)

2016

@Cartagena 3-7 Oct

Universidad Industrial de Santander

CONSTRUIMOS FUTURO

XV LARIM

XV Latin American Regional IAU Meeting

Cartagena de Indias
Colombia / 2016

+ info

http://larim.unal.edu.co/

e mail: larim2016@unal.edu.co

2016
@Cartagena 29sep-1oct

Universidad Industrial de Santander

CONSTRUIMOS FUTURO

2DO SIMPOSIO ANDINO DE ASTROFÍSICA RELATIVISTA

desde 29 de septiembre de 2016
para 1 de octubre de 2016
Universidad Tecnológica de Bolivar,
Cartagena Colombia
America/Bogota timezone

- Overview
- Scientific Programme
- Timetable
- Contribution List
- Author List
- My Conference

Información Adicional

lnunez@uis.edu.co

Gracias a los Programas: Es Tiempo de Volver y de Movilidad Internacional para la cooperación con la Comunidad ColCiencias en el mundo y, con el apoyo del Nodo Andino de la *International Astronomical Union*, el Grupo de Investigaciones de Relatividad y Gravitación (GIRG) de la Escuela de Física de la Universidad Industrial de Santander, quiere iniciar un programa de formación en Astrofísica Relativista para los estudiantes de pre y postgrado de la región.

La intención es ofrecer todos los años un curso intensivo sobre un tópico en Astrofísica Relativista y así crear un espacio para la discusión de ideas y generación de proyectos conjuntos entre estudiantes e investigadores de la región.

Este año 2015 se conmemoran los 100 años de las Ecuaciones de Einstein y los 50 de la detección de la radiación cósmica de fondo, queremos unirnos a esta celebración iniciando, en Bucaramanga, el Simposio Andino de Astrofísica Relativista SAAR 2015. Dedicaremos esta primera edición a mostrar algunos avances en la solución numérica de las Ecuaciones de Einstein. Para ello hemos diseñado este curso, el cual solo supone conocimientos de electromagnetismo de pregrado, nociones de programación en algún lenguaje computacional. Tendrá una duración de 20h académicas y estará organizado en 5 módulos temáticos de 3h c/u, un cine foro sobre la película Interstellar y una sesión de carteles para discutir las ideas y proyectos de los participantes.

Starts 29/09/2016 08:00
Ends 01/10/2016 20:00
America/Bogota

Universidad Tecnológica de Bolivar,
Cartagena Colombia

Núñez, Luis
Dr. Montoya, Edison
Dr. Lora-Clavijo, Fabio
Dr. González, Guillermo A.
Ms. Balaguera, Amanda

No material yet

La participación en este evento es sin costo, pero deberá justificar su interés. Adicionalmente, os haciendo esfuerzos por generar ayudas y lementos a todos aquellos participantes que lo iten. Por ello les pedimos que, al registrarse, sten con honestidad que tipo de ayuda requieren y timizar la asignación de los posibles fondos.

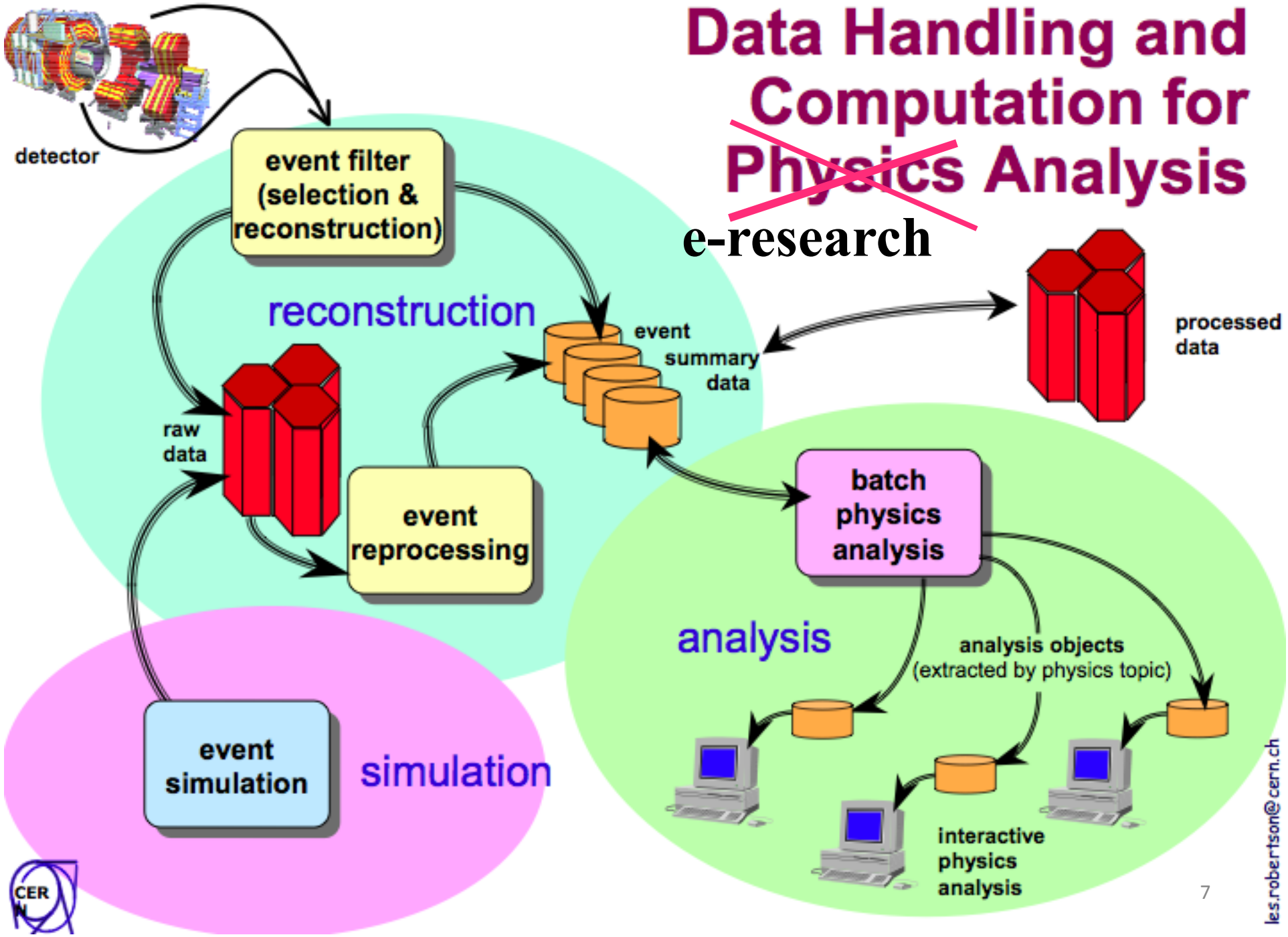
ntrarán también un modelo para la confección del . La impresión del cartel se realizará acá en amanga, por lo que requeriremos que nos lo envíen tardar el lunes 8 de junio.

New Paradigms, New Realities, New era
A Informational Revolution.

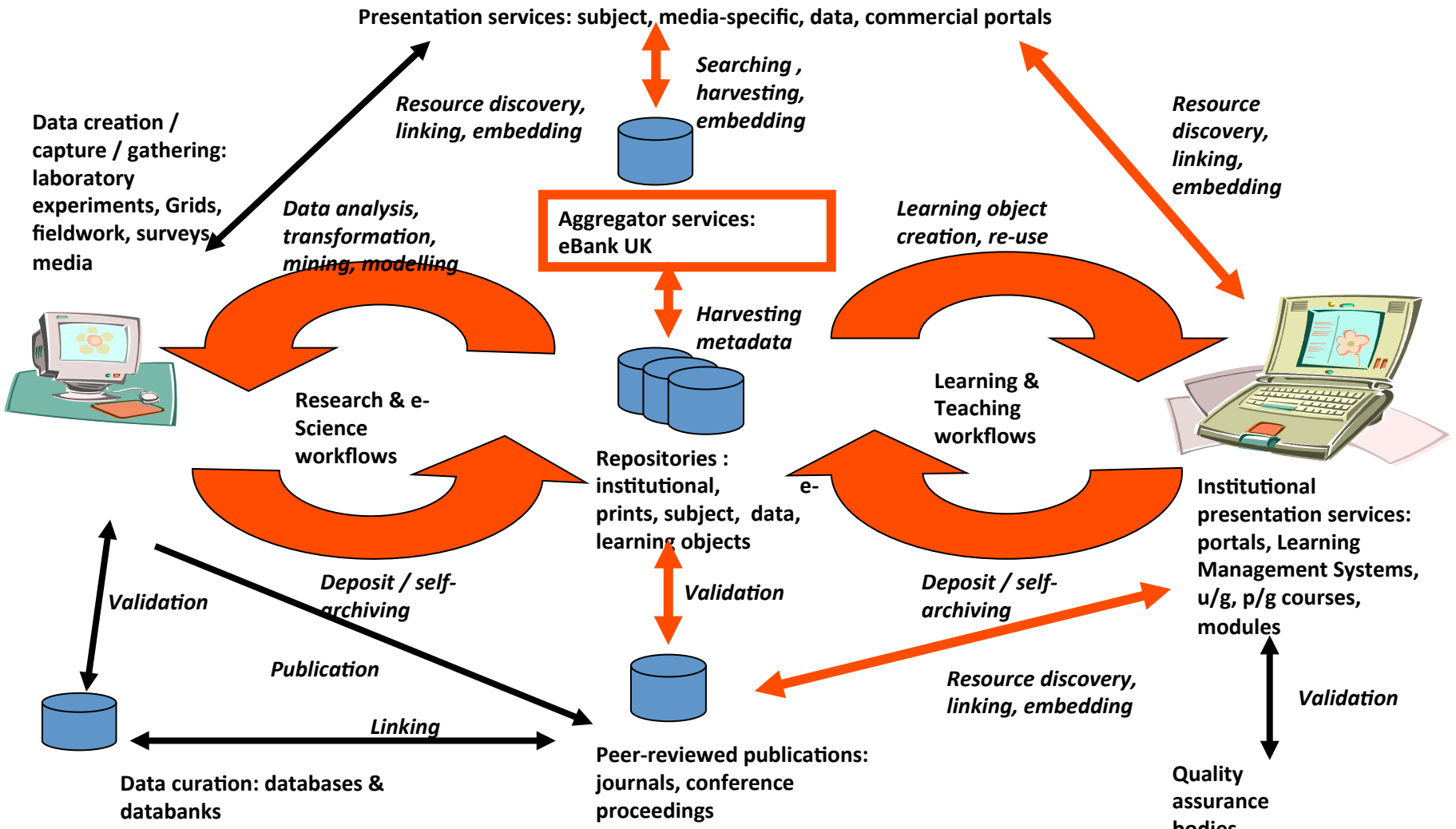
- **New forms of Capitalism production**
  - *Change in process are deeper than only ICT. They are social*
  - *From the industrial economy to the informational economy*
  - *From material products to services*
  - *Knowledge is raw material but also an end product*

- **Informational Economy**
  - *Global and Real time process*
  - *There are no national economies. There are national strategies*
  - *Interdependent networked economy*
  - *Highly qualified, creative and skilful Human resources*

- **New e-research**
  - *Theory - Experiments - Simulation*
  - *Multidisciplinary & Remote Collaborative*
  - *Remote sensing Data mining.*
  - *Science 2.0 a new way to preserve and disseminate knowledge*


Data Handling and Computation for Physics Analysis
e-research
detector
event filter (selection & reconstruction)
reconstruction
raw data
event summary data
processed data
event reprocessing
batch physics analysis
analysis
analysis objects (extracted by physics topic)
event simulation
simulation
interactive physics analysis
les.robertson@cern.ch

E-research means new opportunity to train new researchers



Liz Lyon (2004) *Realising the scholarly knowledge cycle* http:// www.ukoln.ac.uk

The Latin American Giant Observatory (LAGO) Project

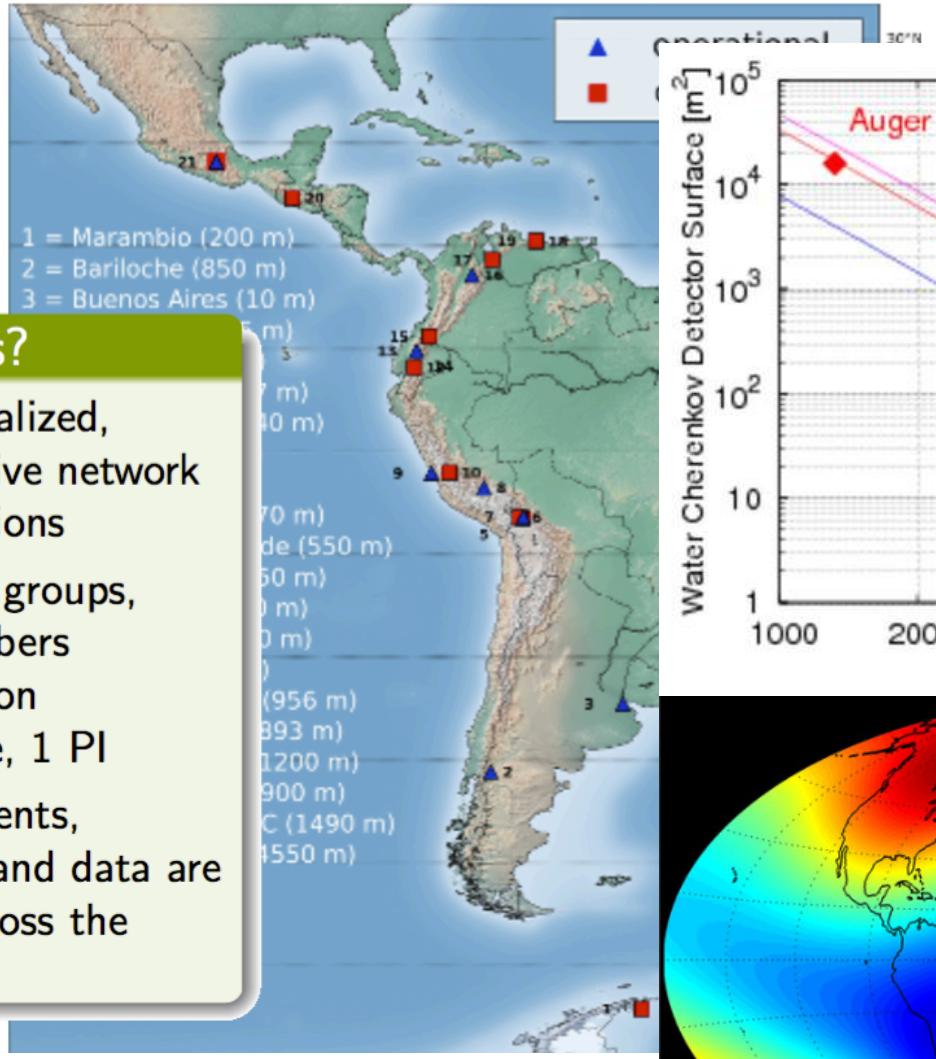
A very long baseline "array" of water Cherenkov detectors (WCD)

- Sites at eight countries: Argentina, Bolivia, Colombia, Ecuador, Guatemala, México, Perú & Venezuela
- Two new detectors in Brazil will be incorporated by 2016

The LAGO Collaboration

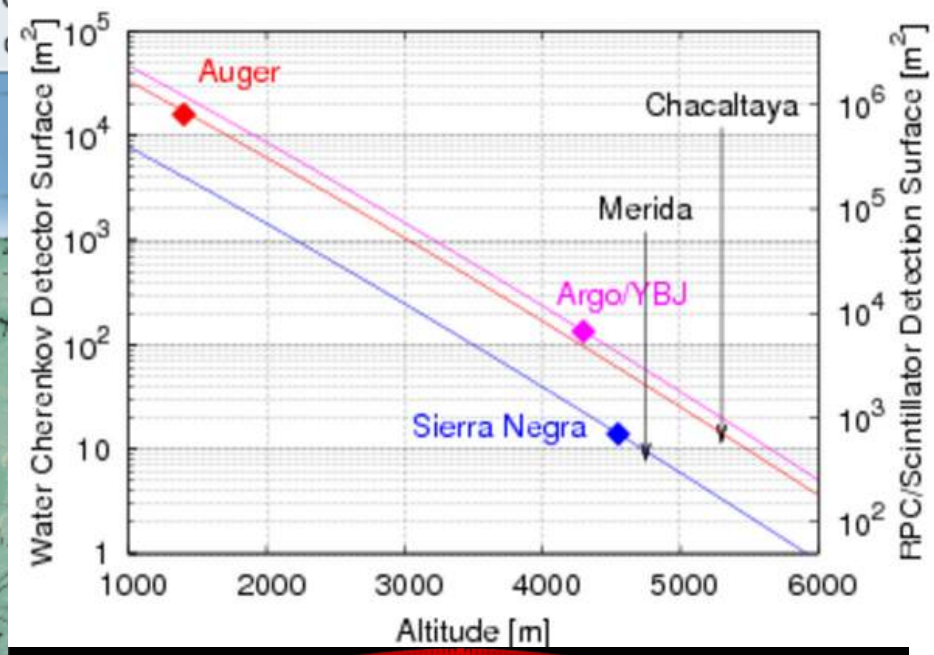
- 80 members from 25 institutions at 10 LA countries
- **Scientific goals**:
  - Astroparticles up to the CR knee
  - Study transient and long term Space Weather phenomena trough Solar modulation (SM) of Cosmic Rays (CR)
  - Measurements of background radiation at ground level
- **Academic goals**:
  - Train latin-american students in HEP and Astroparticle techniques
  - Build a Latin-American network of Astroparticle researchers

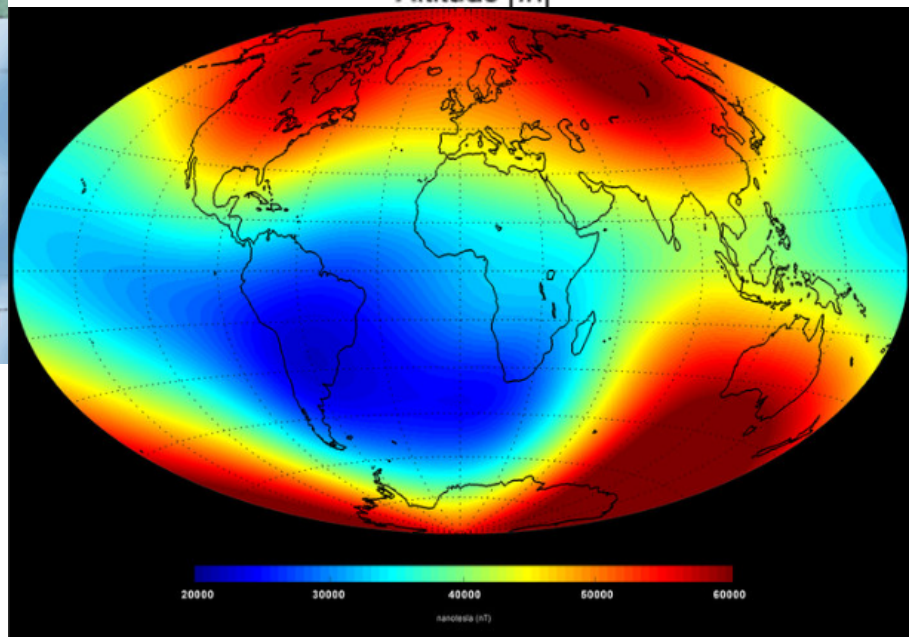
The Latin American astroparticle network



How it works?

- Non-centralized, collaborative network of institutions
- 3 working groups, 9+2 members coordination committee, 1 PI
- Developments, expertize and data are shared across the network

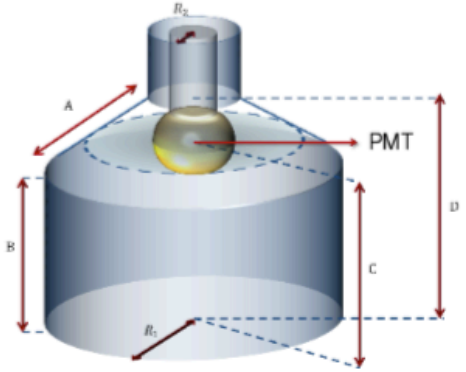




Our detector: sWCD (Water Cherenkov Detector)

s as in *smart*

- Autonomous, reliable, simple and cheap detector
- Commercial tanks with $1{,}5\,\mathrm{m}^2 - 10\,\mathrm{m}^2$ of detection area filled with purified water
- Inner coating of Tyvek (UV diffusive and reflective fabric)
- PMT + Digitizer board (own design)
- FPGA + Raspberry Pi: detector control, telemetry, data acquisition and on board data pre-analysis (including machine learning techniques)



- Digitized signals by a 10-14 bits FADC at 40-100 MHz (10-25 ns)
- Temporal synchronization: GPS in PPS mode
- Station consumption: $\lesssim 8\,\mathrm{W}$

LAGO Programs

LAGO-Extreme Universe

- High energy astroparticles
- Towards CR knees region

LAGO-Space Weather

- Cosmic ray solar modulation
- Possible connections with physics of the atmosphere
- Background radiation at ground (and flight) level

LAGO-Virtual

- Acquire, produce, collect and preserve LAGO data

LAGO-Universities

- Astrophysics and particle physics in undergraduate courses
- Data analysis and statistic
- Muon decay
- Detector physics and interaction of radiation with matter
- Construction and characterization of particles detectors

WG1: Physics

S. Dasso (ARG)

WG2: Detectors

L. Otiniano (PER)

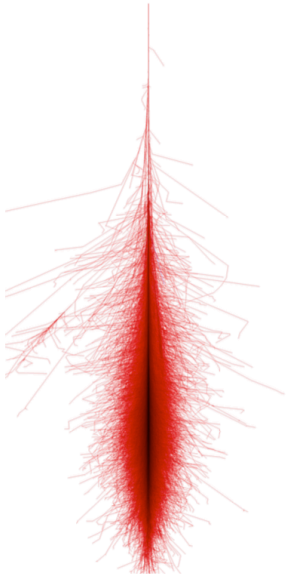
WG3: Data

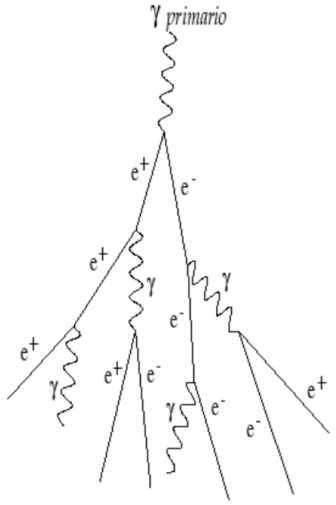
L. A. Núñez (COL)

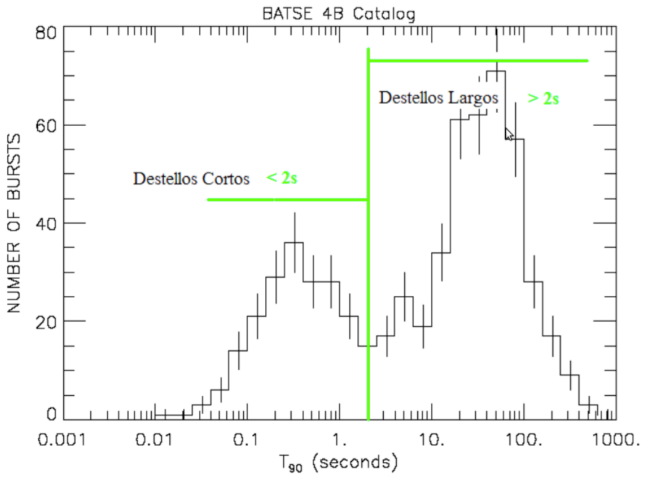
New LAGO High Energy program

Universidad Industrial de Santander

- New detectors at Sierra Negra: 4 segmented 40 m^2 WCD. Full operation in 2015.
- First SN WCD test and calibration (Aug/2014)
- Re-deploy detectors at Chacaltaya (Dec/2014)
- Pico Espejo cable-way will be operative in 2015 (OCAM)
- Re-analysis of the full data set
- Building arrays at medium altitude sites ($h > 3000$ m a.s.l)
- LAGO-GLORIA network: CR+Global warming at high altitude sites
- Signal time superposition analysis at Chacaltaya for Galactic Center studies
- Simulations of high energy showers (knee)
- **The PAS Project**: the first astroparticle







LAGO
High Energy Program

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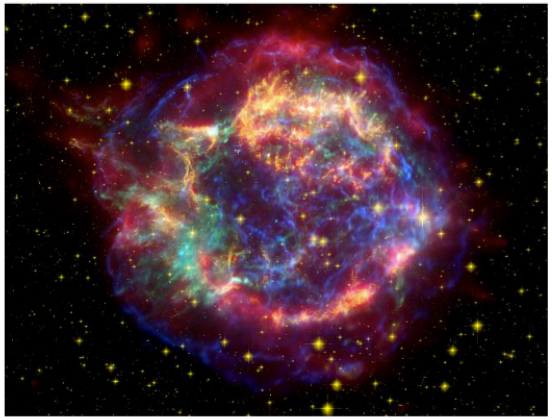
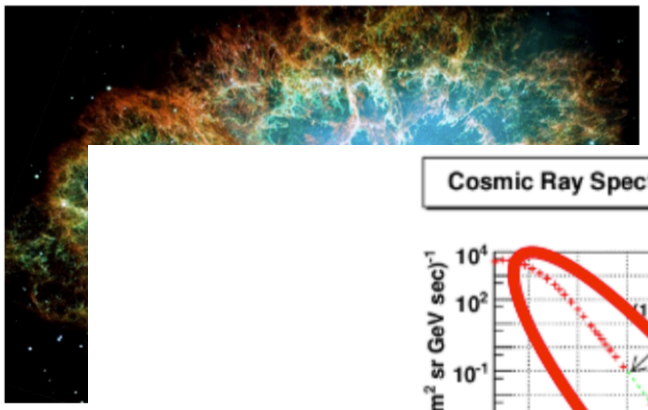
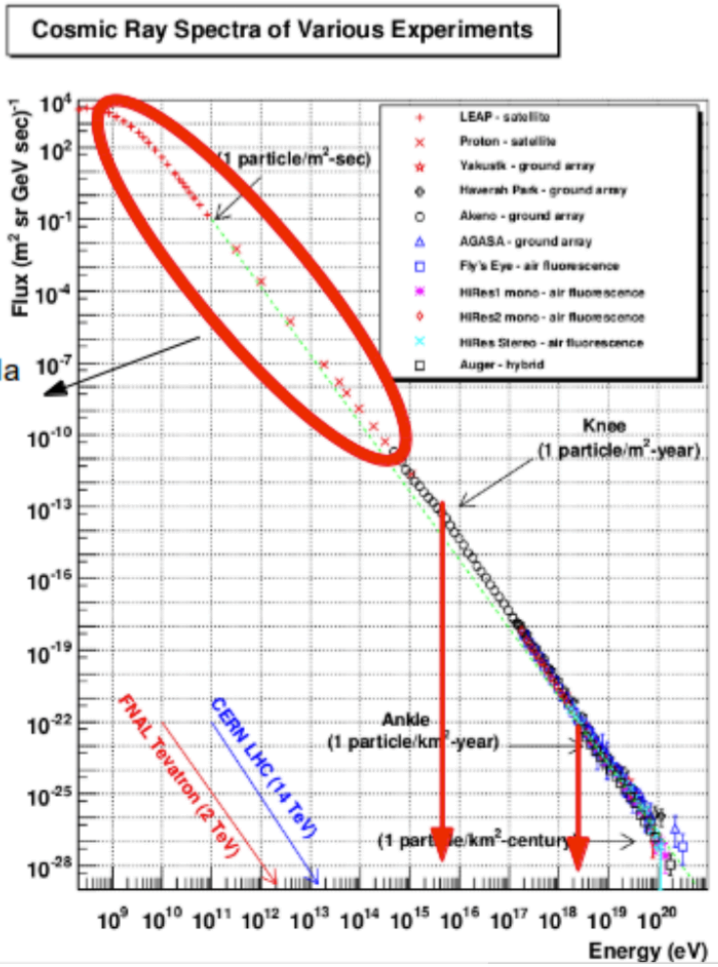
Magnetar



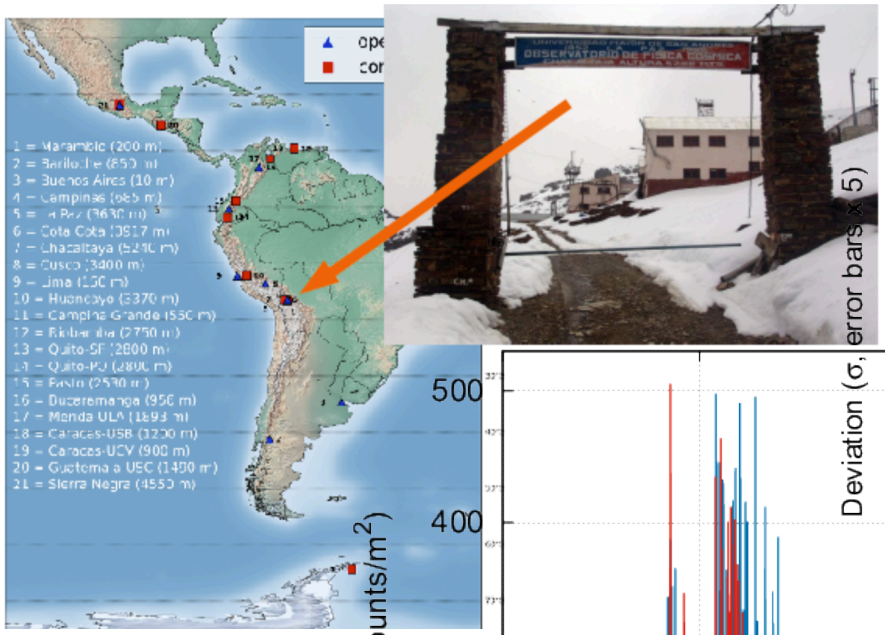
SNR

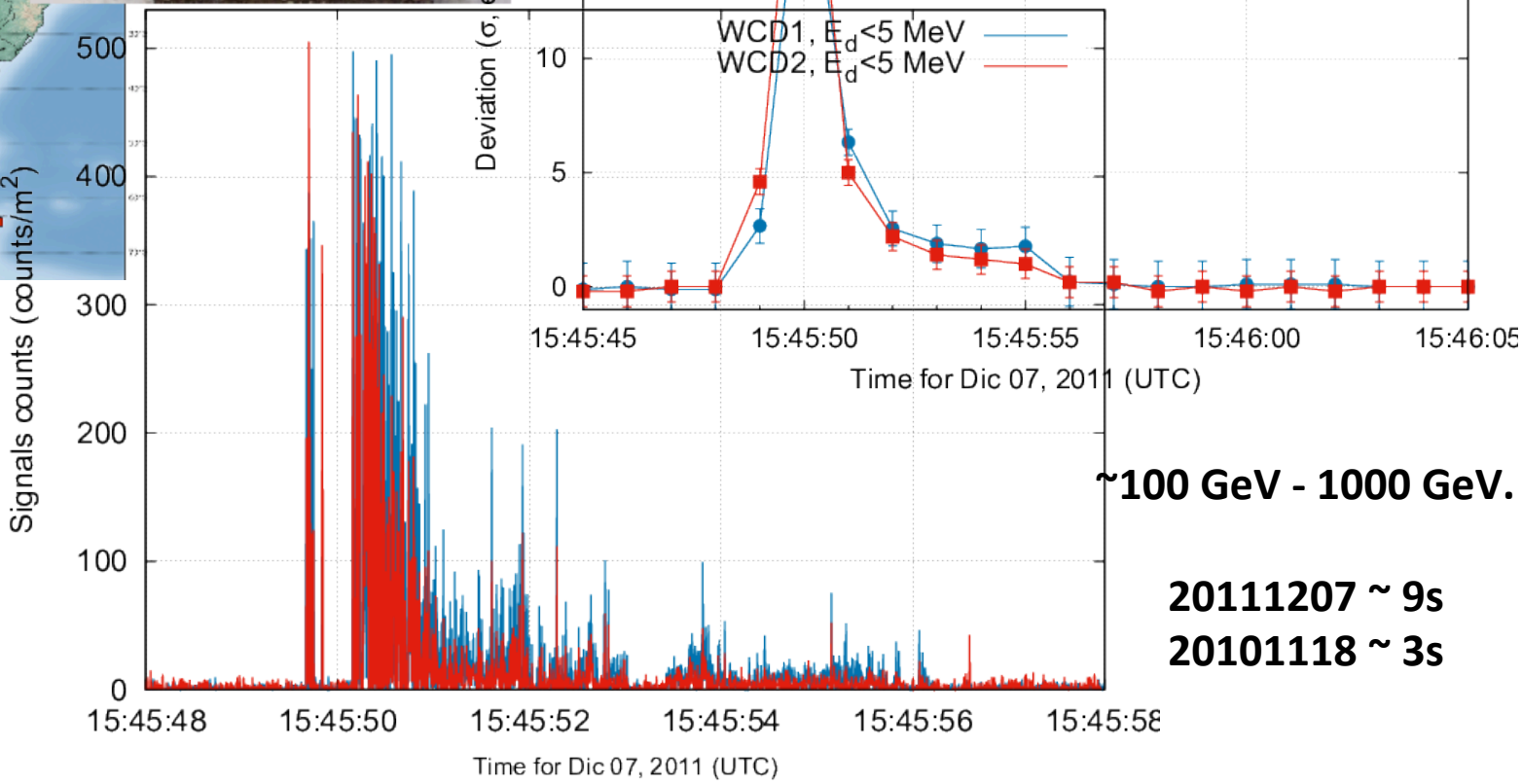


Zona del espectro en la que LAGO actúa



Chacaltaya
2 Gamma Ray Candidates



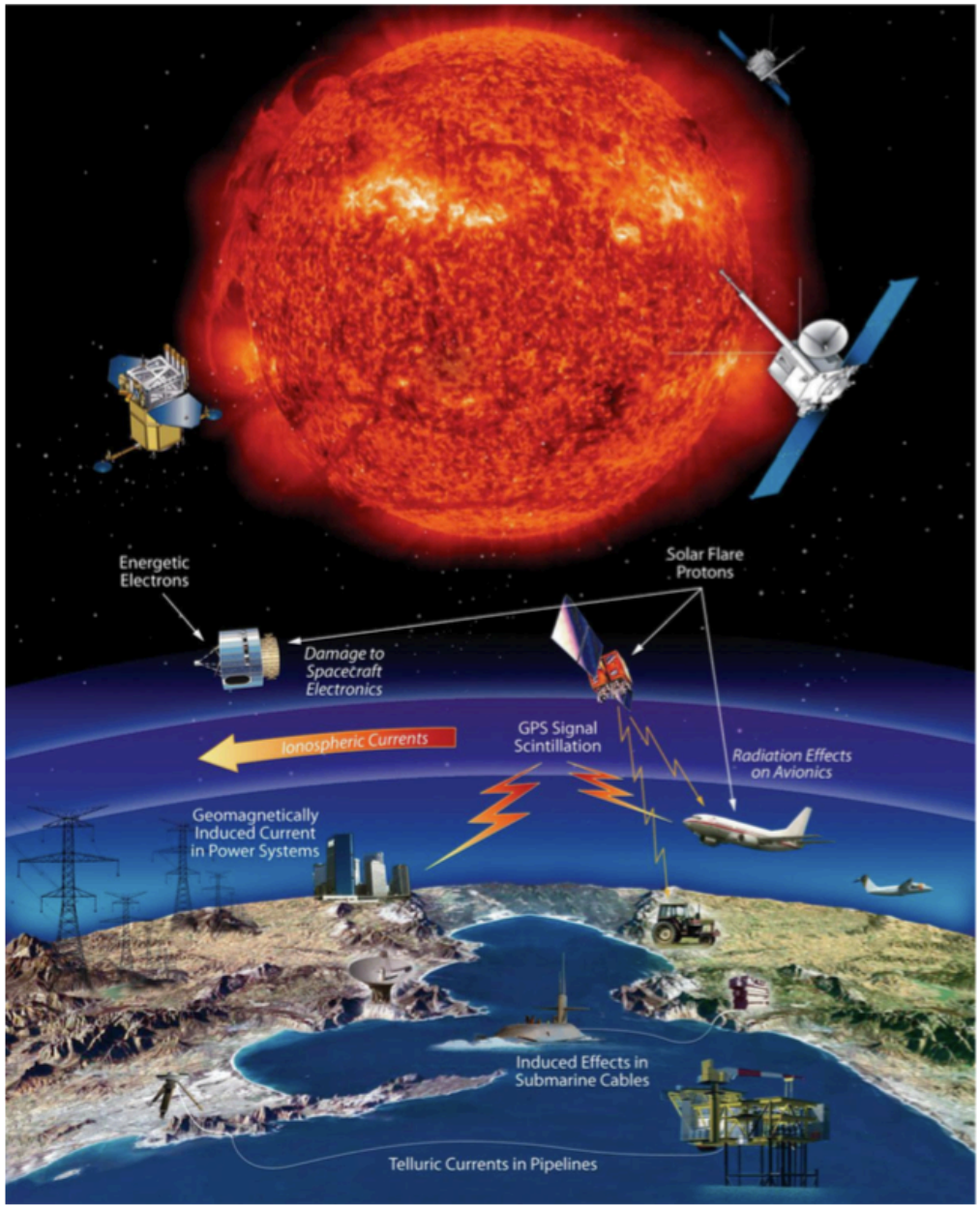


- Sarmiento-Cano, C., (2015) et al ICRC 2015
- Sarmiento-Cano, C. Tesis Maestria UIS (2015)

~100 GeV - 1000 GeV.

20111207 ~ 9s
20101118 ~ 3s

Space Weather



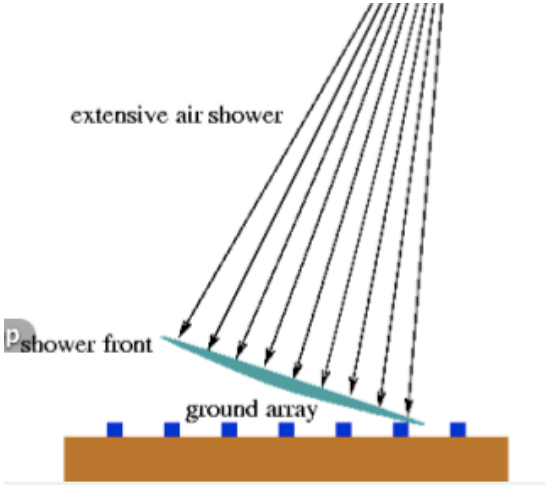
Sun-Earth connection

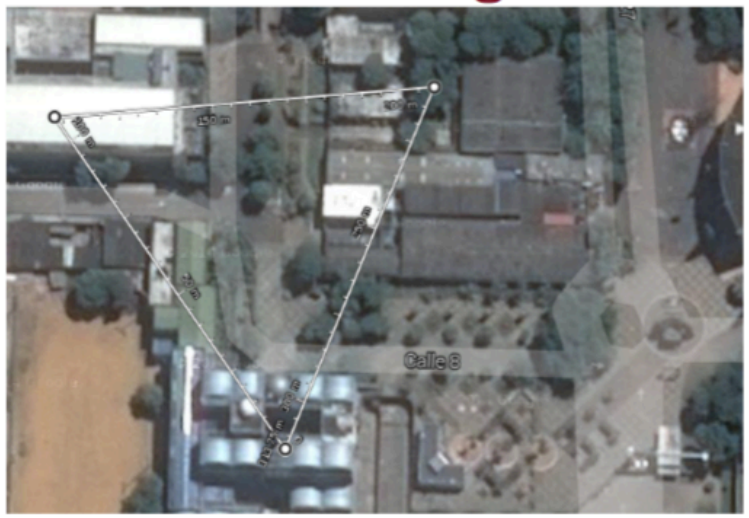
- Dynamic conditions in the Earth outer space environment:
  - Disruption of electrical power grids
  - Contribute to the corrosion of long pipelines
  - HF radio communications and GPS interferences
  - Operational anomalies and damage or degradation of critical electronics on spacecraft, satellites and even on board of commercial airplanes

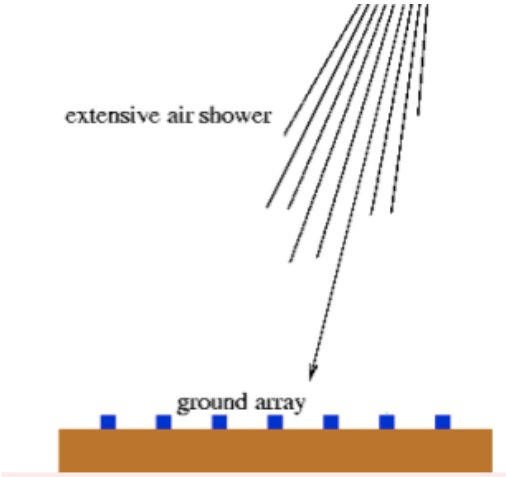
The GUANE Array + The CONIDA Array

Towards Space Weather using small arrays of sWCD

Three 4 m^2 smart LAGO-WCD at the vertices of an equilateral triangle of 105 m side at Bucaramanga and Huancayo



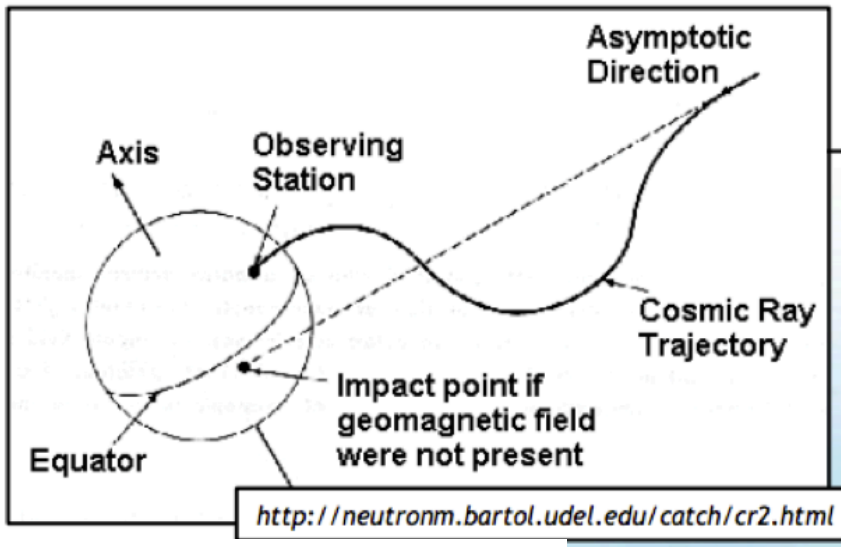




Arrays of WCD: towards detection of mid energy showers

Two detection modes:

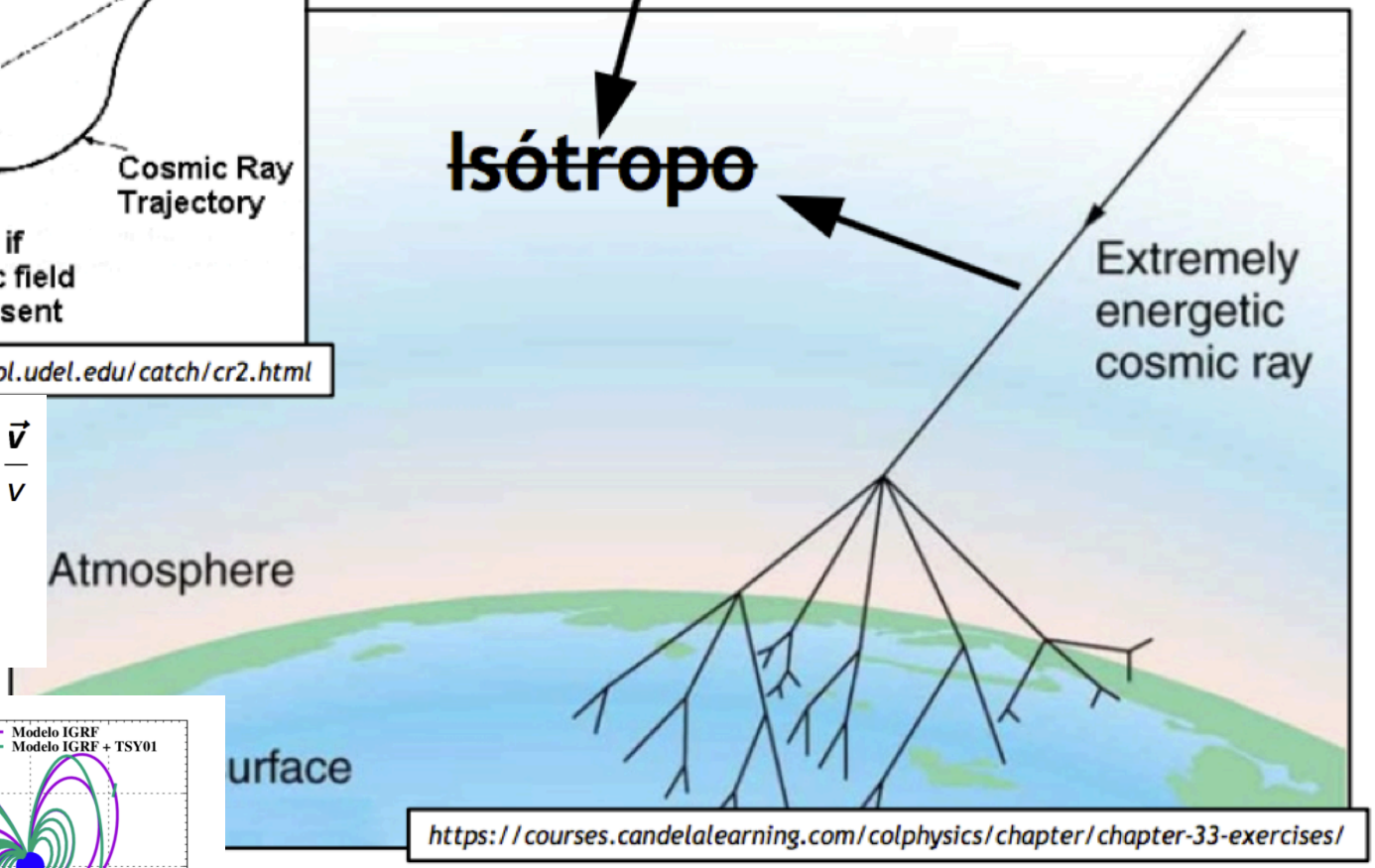
- Counting mode: acquires individual pulses that satisfies trigger condition: amplitude, total charge or pulse shape
- Shower mode: Signal correlation in three detectors $\rightarrow$ extensive air showers: arrival direction and shower energy



http://neutronm.bartol.udel.edu/catch/cr2.html

Energías < GeV

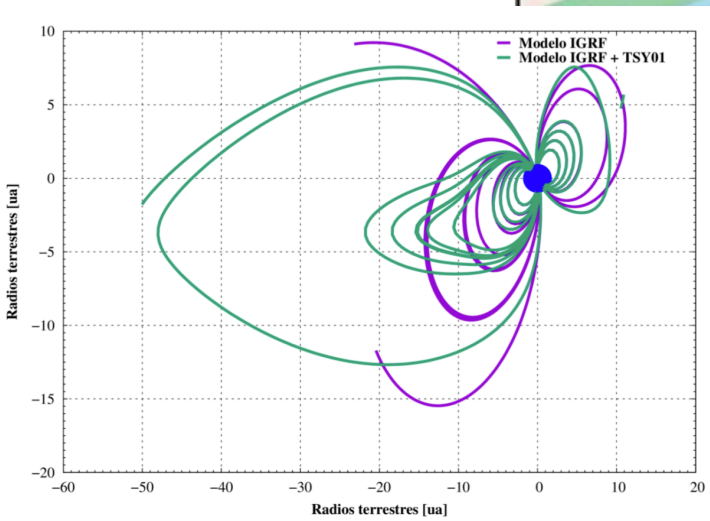
~~Isótropo~~



https://courses.candelalearning.com/colphysics/chapter/chapter-33-exercises/

$$\frac{d\hat{\boldsymbol{l}}_{\boldsymbol{v}}}{ds} = \frac{q}{pc}\hat{\boldsymbol{l}}_{\boldsymbol{v}} \times \vec{\boldsymbol{B}}, \quad \text{con} \quad \hat{\boldsymbol{l}}_{\boldsymbol{v}} = \frac{\vec{\boldsymbol{v}}}{v}$$

$$R = \frac{pc}{q}$$



The LAGO Space Weather Program

via Solar modulation of low energy cosmic rays

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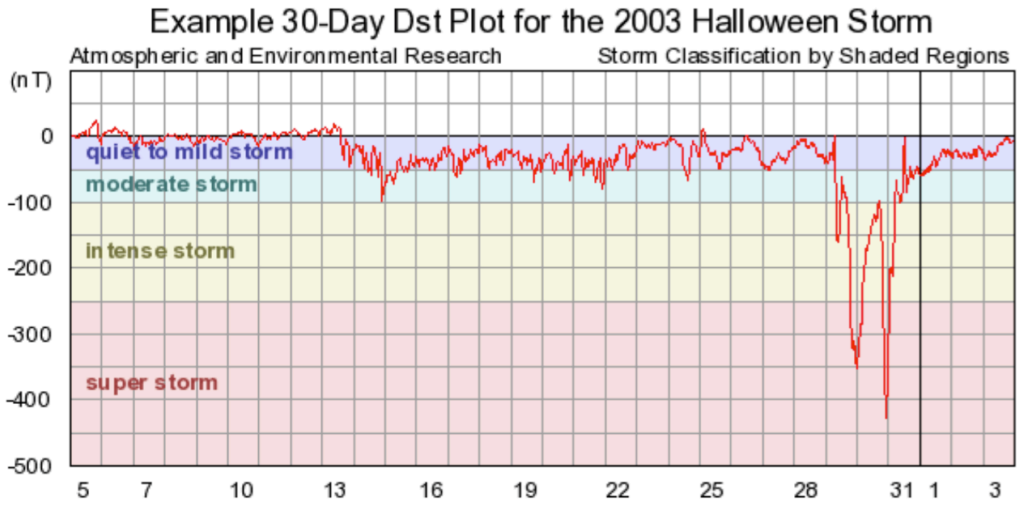
Connections

CR Flux	Solar Activity →	Modulated flux
Modulated flux	Geomagnetic field →	Primaries
Primaries	Atmospheric conditions →	Secondary particles
Secondary particles	Detector response →	**Signals**

Synergy

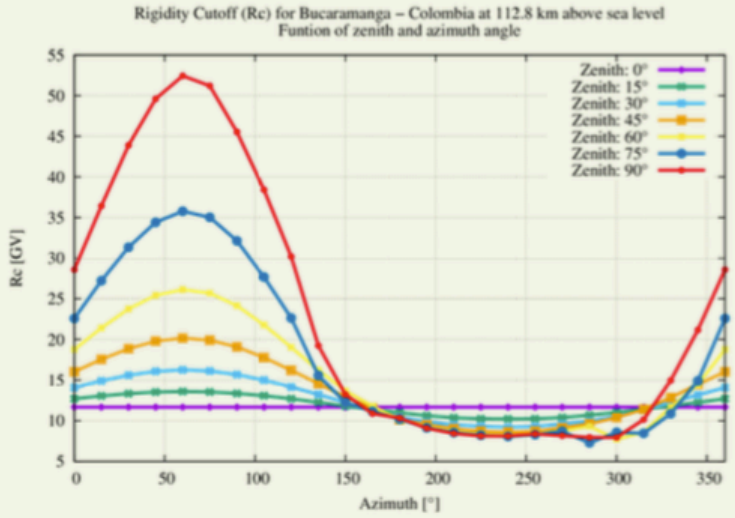
Flux variation of signals at detector level ⇔ Solar Activity

- Asorey, H., Dasso, S., Núñez, L. A., Peréz, Y., Sarmiento-Cano, C., & Suárez-Durán, M. (ICRC2015) (p. 142).
- Suárez-Durán, M Tesis Maestría UIS 2015

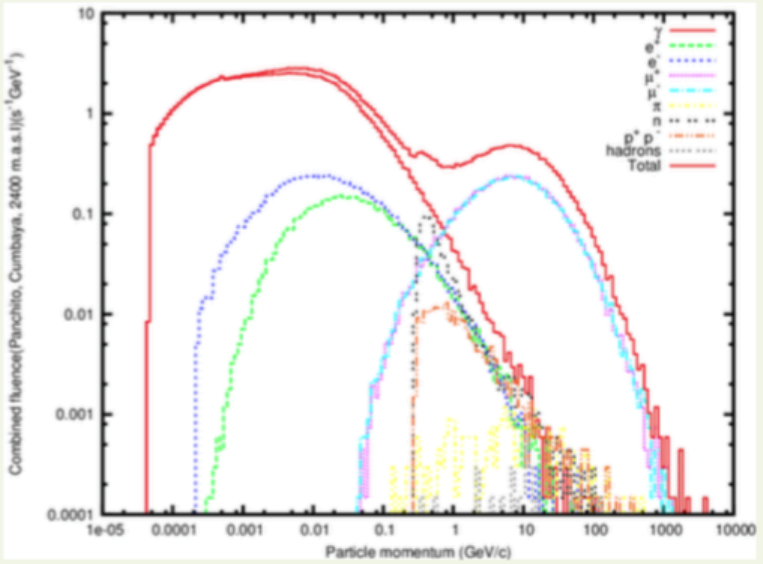


Simulations

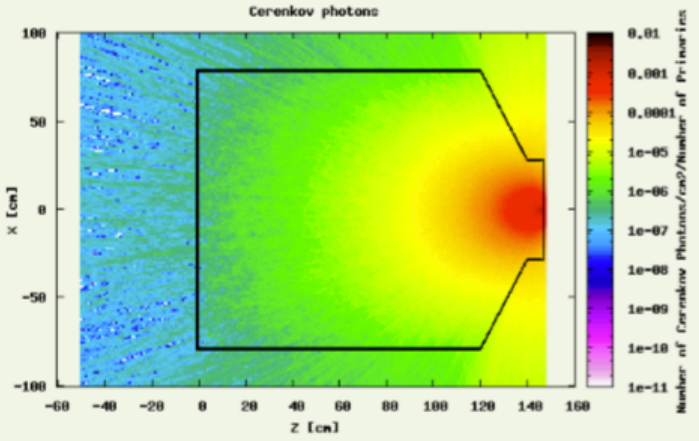
Geomagnetic effects



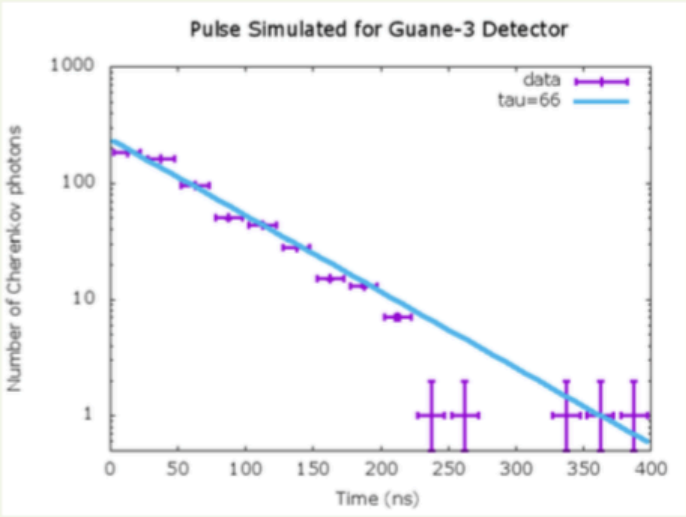
Site characterization



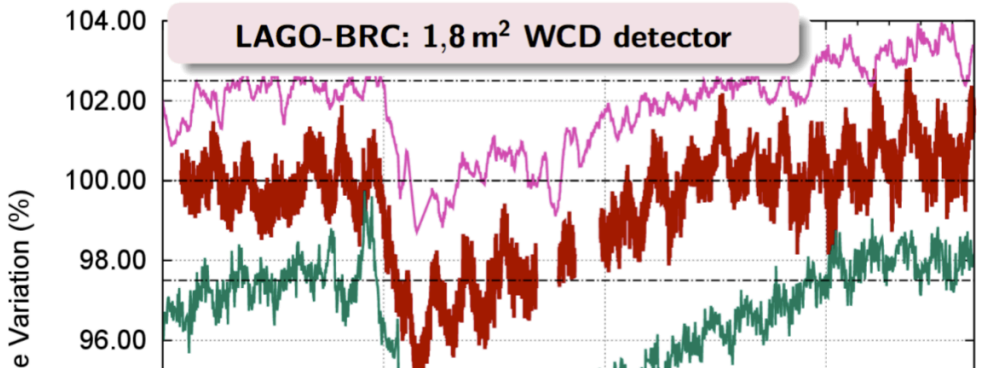
FLUKA WCD response

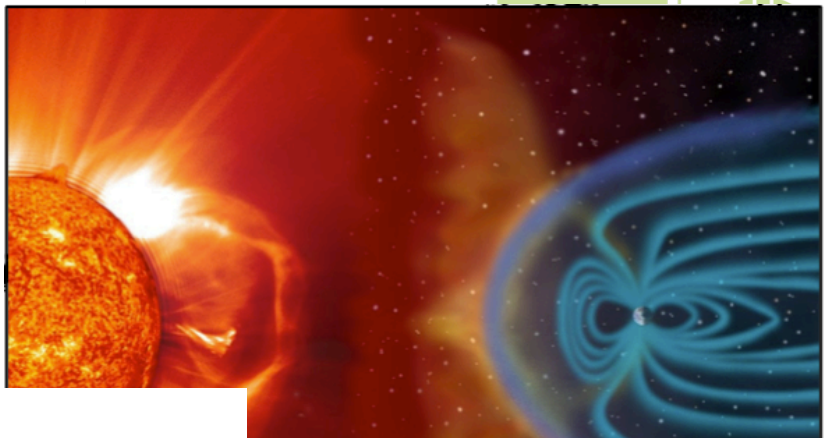


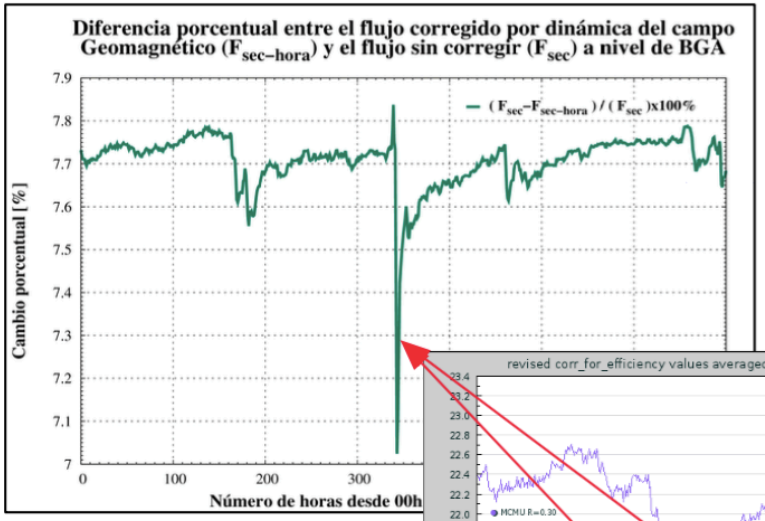
G4 full detector simulation

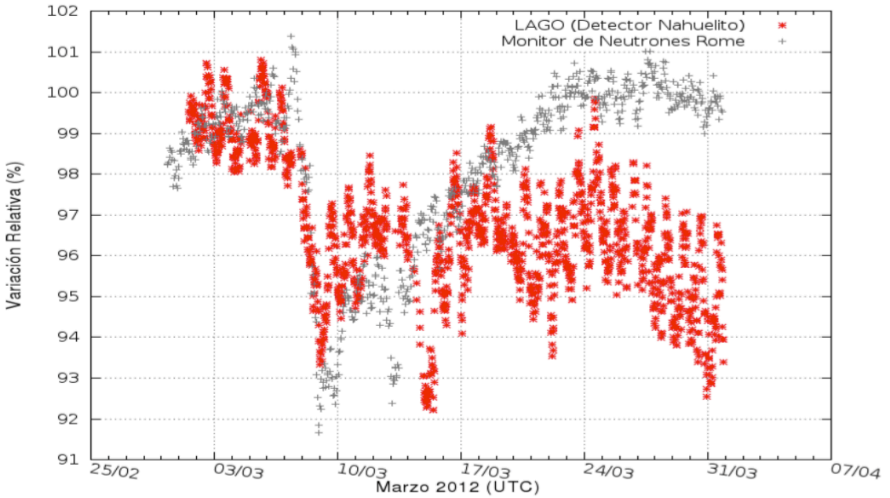


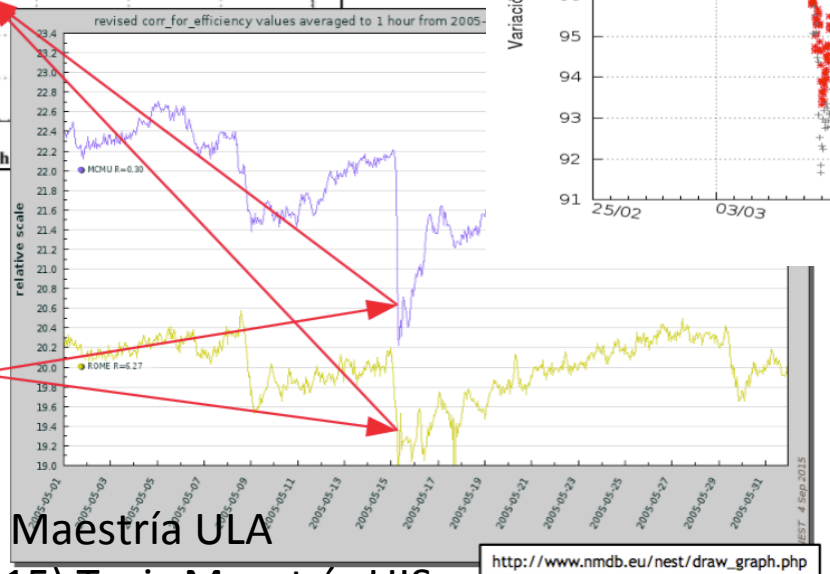
08/March/2012: Forbush event ← single LAGO detector











Monitores
de Neutrones
(Roma y McMurdo)

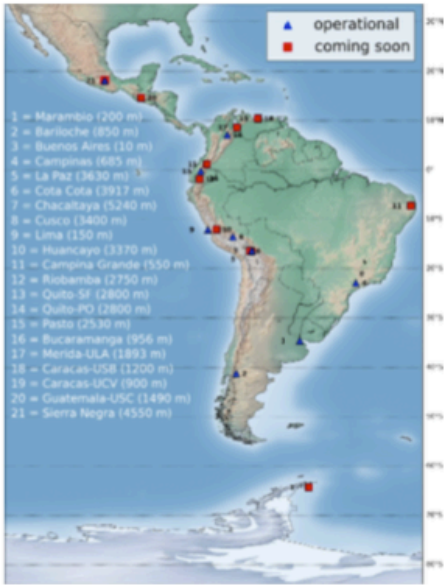
Pérez Y. (2015) Tesis Maestría ULA

Suarez-Duran M. (2015) Tesis Maestría UIS

LAGO-Virtual: the Latin American astroparticle **network**

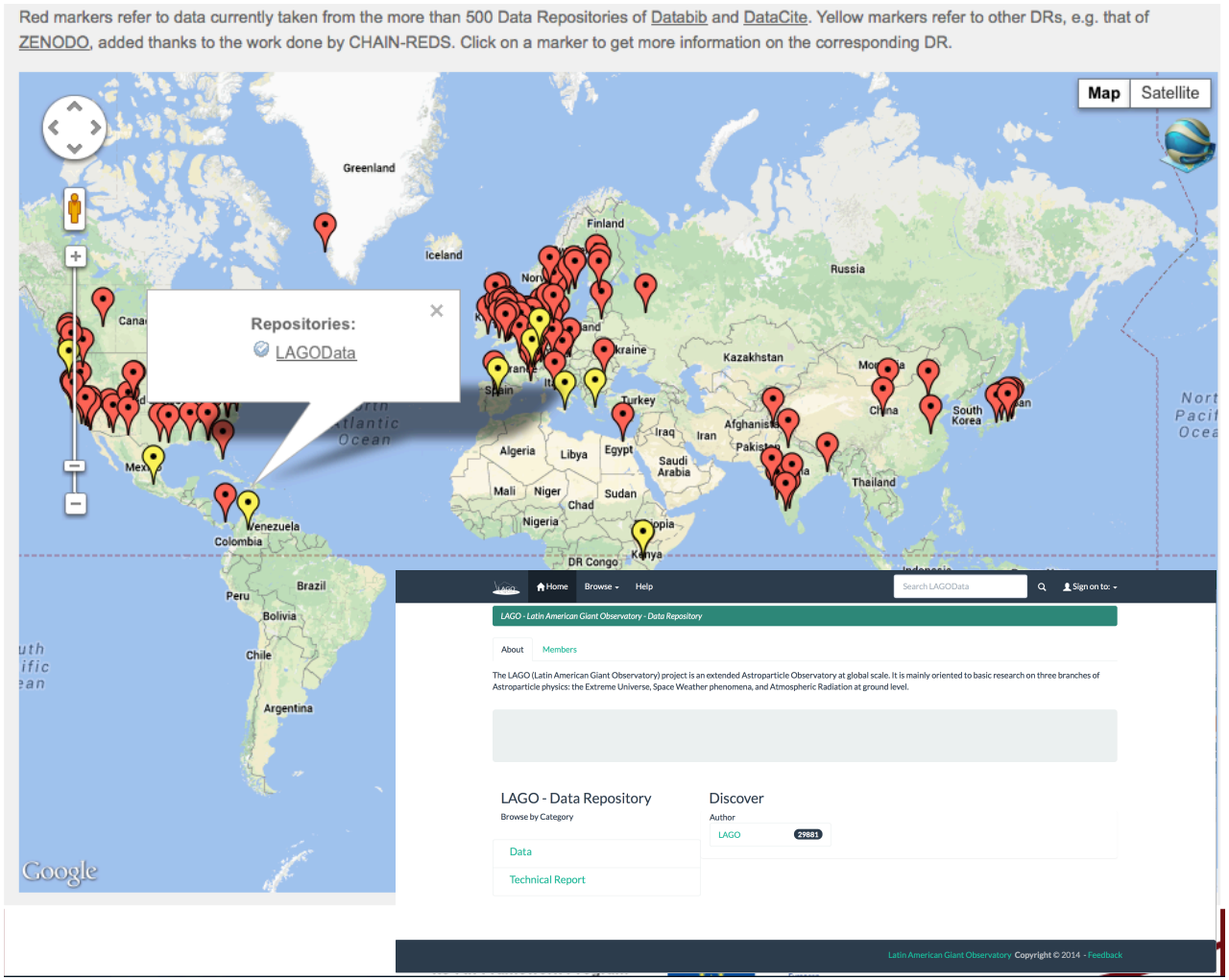
LAGO Data

- Two types of data: measured and simulated
- Measured data: 4 quality levels: raw data, preliminary, Data Quality & High Quality
- Massive data production: raw ($\sim 1\,\mathrm{TiB\,year^{-1}\,det^{-1}}$); sims ($\sim 3\,\mathrm{TiB\,year^{-1}\,site^{-1}}$)
- LAGO is an EU FP7 CHAIN-REDS case study: first data repository in LA
- LAGO data challenge: DART (Data Accessibility, Reproducibility and Trustworthiness) initiative
- Deploying LAGO-CORSIKA implementation on GRID



LAGO & RedCLARA

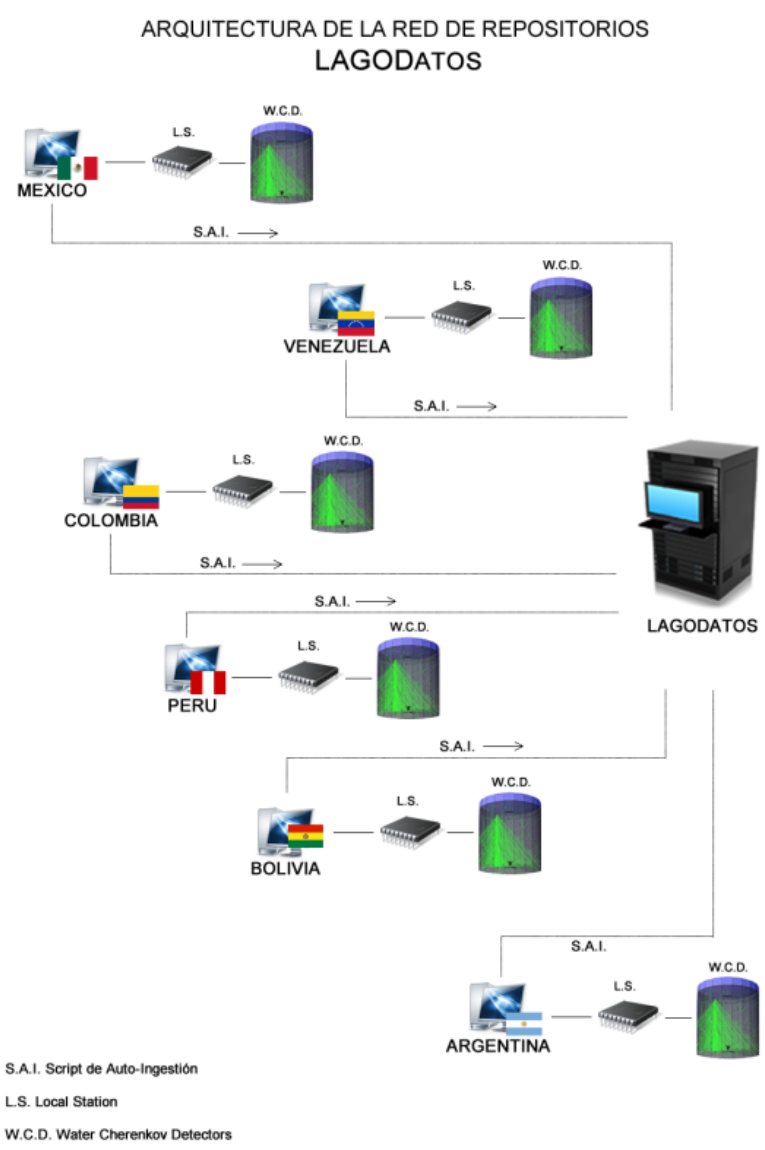
- Data repository located at UIS (BGA, Colombia)
- Data transfer from Sites to Repository using RedCLARA (where available)

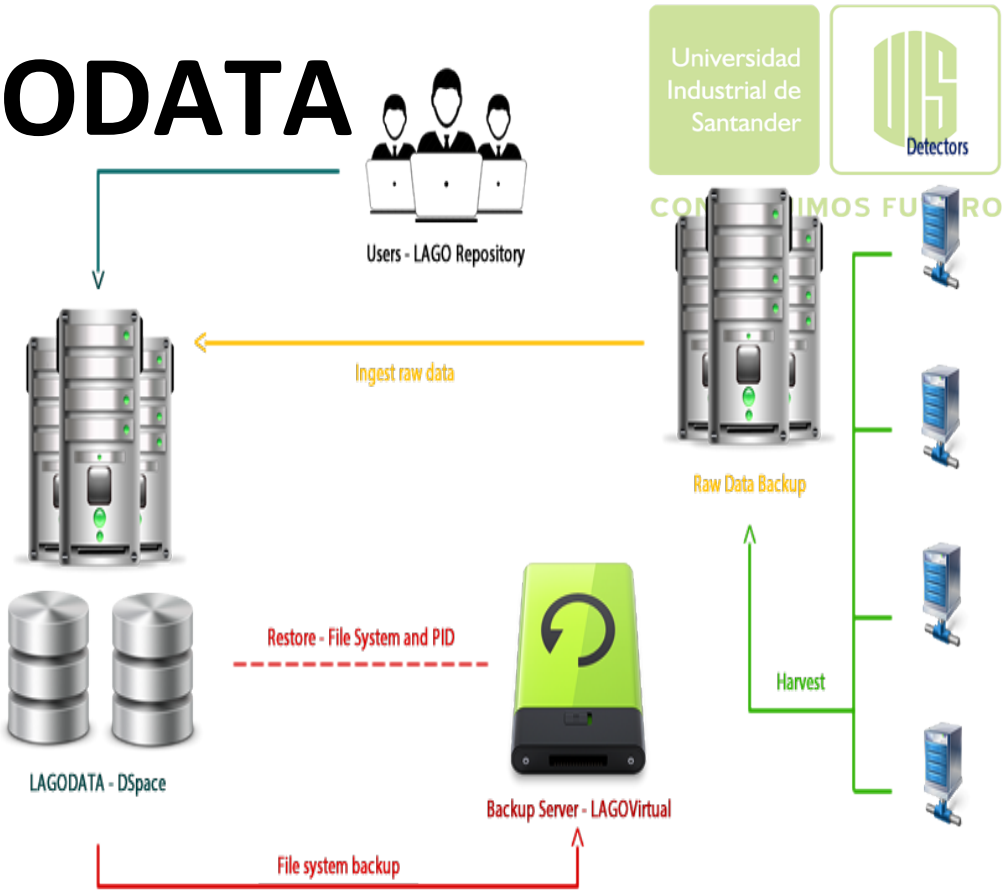


Awareness on Standards:
CHAIN-REDS helped LAGO on the adoption of standards for data infrastructures, including metadata

Data Accessibility:
CHAIN-REDS has helped LAGO to configure and tune-up the OAI-PMH of LAGOData Repository
Now integrated in the CHAIN REDS KB and SSE

LAGODATA


ARQUITECTURA DE LA RED DE REPOSITORIOS
LAGODATOS
MEXICO
L.S.
W.C.D.
S.A.I.
VENEZUELA
COLOMBIA
PERU
BOLIVIA
ARGENTINA
LAGODATOS
S.A.I. Script de Auto-Ingestión
L.S. Local Station
W.C.D. Water Cherenkov Detectors


Universidad Industrial de Santander
Detectors
Users - LAGO Repository
Ingest raw data
Raw Data Backup
Restore - File System and PID
Harvest
LAGODATA - DSpace
Backup Server - LAGOVirtual
File system backup


Co-ordination & Harmonisation of Advanced e-Infrastructures
Go to
Hernán Asorey (Sign Out)
Science Gateway
Welcome Help Applications Job Status My Workspace Project Home
My Workspace
Jobs
JobsMap
Data
Help
MyJobs
Active Jobs List
Done Jobs List
The table below shows the status of your jobs.
Statuses are automatically updated every 15 minutes so there is no need to reload this page more frequently. However, if you don't see your jobs in the table within a reasonable amount of time (a couple of hours at most), click on Help in the the MyWorkspace portlet and notify us the problem.
Once your jobs have finished, you have 96 hours to retrieve their output. Beyond that time, the output of your jobs will automatically be deleted from the Science Gateway in order not to fill its storage with undesired stuff.
Copy Print Save Download Job output
Search:
Show 10 entries
Application Name
User Description
Started on (UTC)
Status
CORSIKA-LAGO
DAT130900-0013-0050000-BER.input
2015-03-03 18:02:36.0
CORSIKA-LAGO
DAT130500-0013-0050000-BER.input
2015-03-19 12:32:10.0
SUBMITTED
Showing 1 to 2 of 2 entries
Grant Agreement no. 306819
e-infrastructure
Contacts: account | project | support
Privacy Policy | Terms of Use | Instructions to Register and Sign in
Powered By Liferay
Implemented with Catania SG Framework
This is a Service Provider of:
eduGAIN

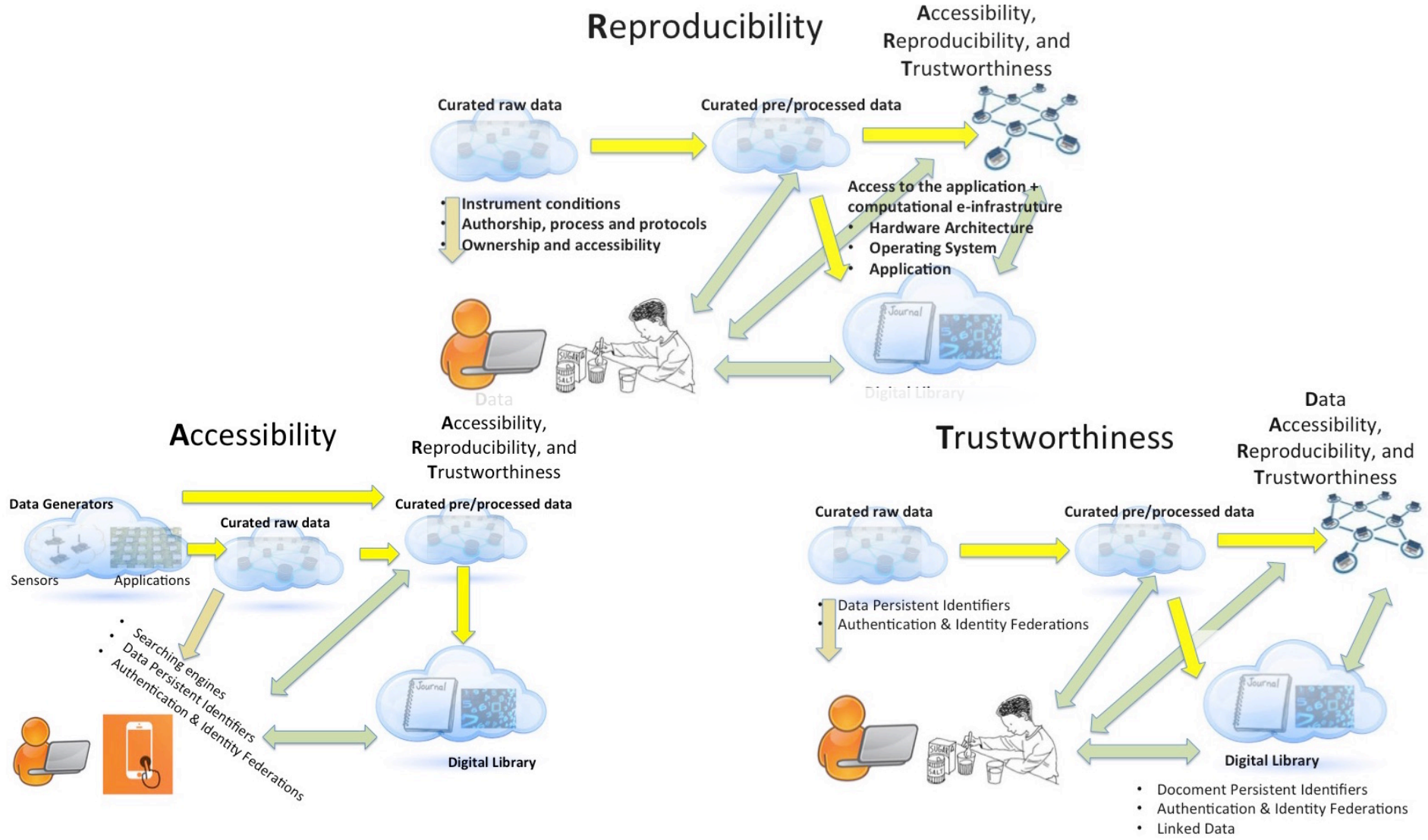

Go to
Hernán Asorey (Sign Out)
Co-ordination & Harmonisation of Advanced e-Infrastructures for Research and Education Data Sharing
Science Gateway
Welcome Help Applications Job Status My Workspace Project Home
My Workspace
Jobs
JobsMap
Data
Help
CORSIKA-LAGO
Your job has been successfully submitted; you may get reference to it with identifier:
DAT130500-0013-0050000-BER.input
Have a look on MyJobs area to get more information about all your submitted jobs.
Run a new application
Press the Run a new application button to start another job submission
High Energy Physics
ALEPH Analysis
CORSIKA-LAGO
Browse
NUCLEMD
Grant Agreement no. 306819
e-infrastructure
Contacts: account | project | support
Privacy Policy | Terms of Use | Instructions to Register and Sign in
Powered By Liferay
Implemented with Catania SG Framework
This is a Service Provider of:
eduGAIN

Nov2015

Encuentro Anual LAG

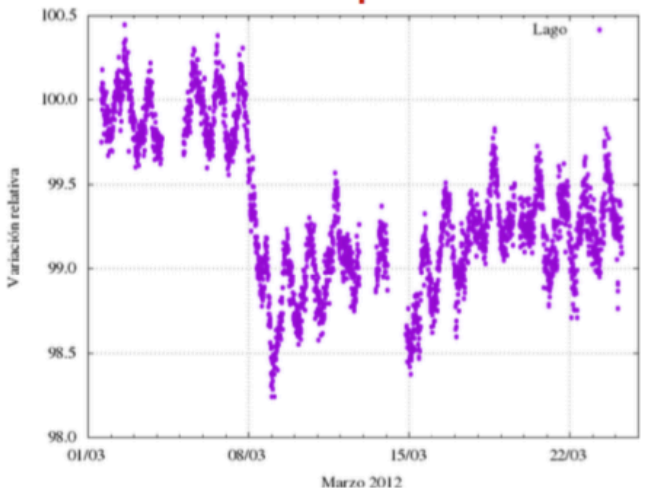
DART Challenge

Data Accessibility, Reproducibility and Trustworthiness

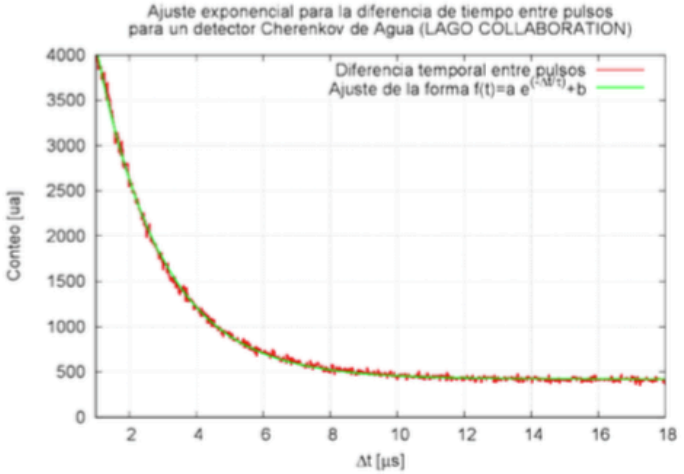


LAGO-Universities

Introductory Physics Course 2014 at Universidad Industrial de Santander:
python + gnuplot + data analysis techniques



Particle Physics or Experimental Physics courses at UIS (COL), Balseiro (ARG) and UCV (VEN):
Electroweak theory + python + data analysis techniques



$$\tau_\mu = (2020 \pm 0{,}1)\ \text{ns}$$

$$\rightarrow g_w = \frac{m_W}{m_\mu \tau_\mu^{1/4}} \left(\frac{12\hbar(8\pi)^3}{m_\mu c^2} \right)^{1/4}$$

$$g_w = 0{,}7 \pm 0{,}1$$

Colombia @Auger

Thanks to Brazil

OBSERVATORIO
PIERRE AUGER
PIERRE AUGER OBSERVATORY

Datos Técnicos

Objetivo: determinar la naturaleza, energ
los 10^{18} eV, para comprender mejor el un

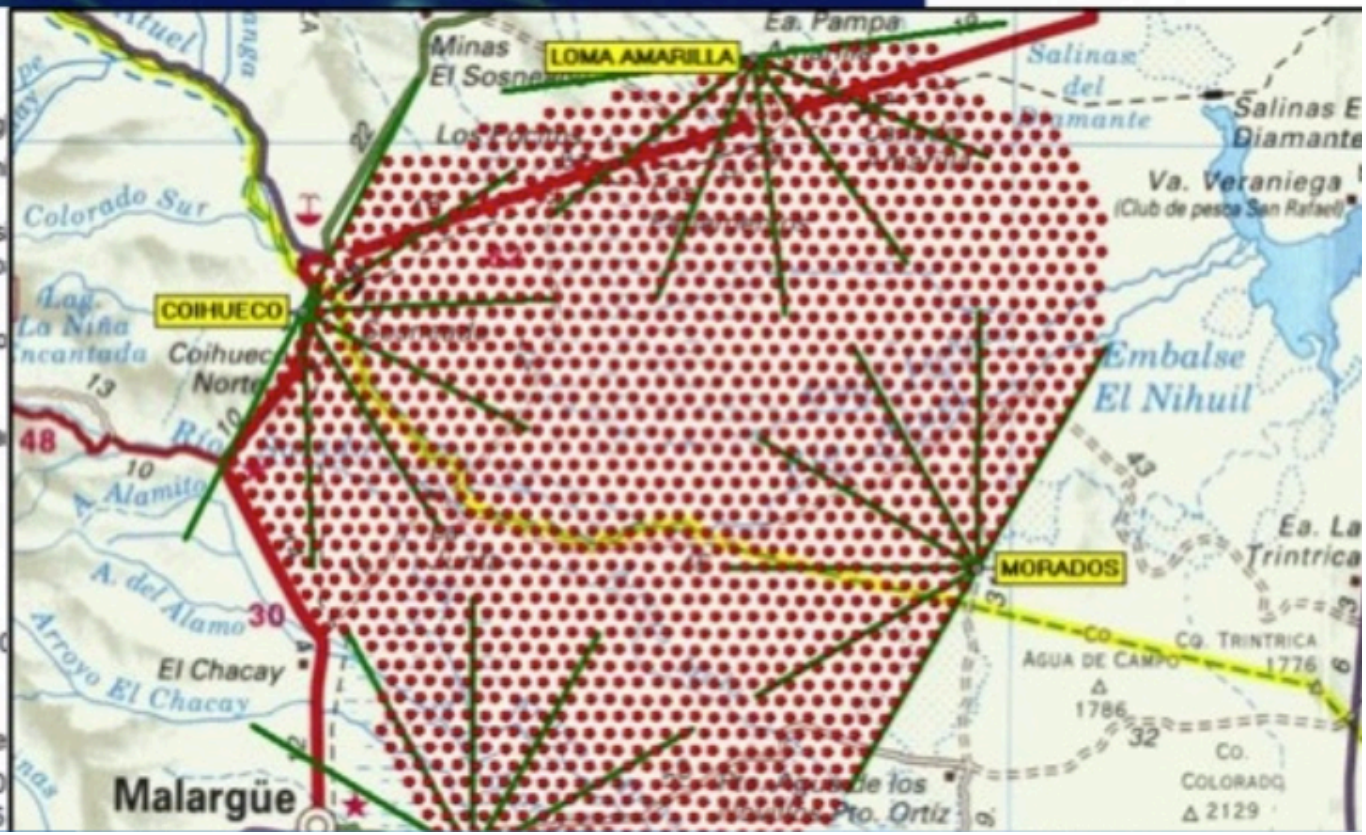
Tipo de observatorio: "híbrido", cons
telescopios de fluorescencia atmosférica p

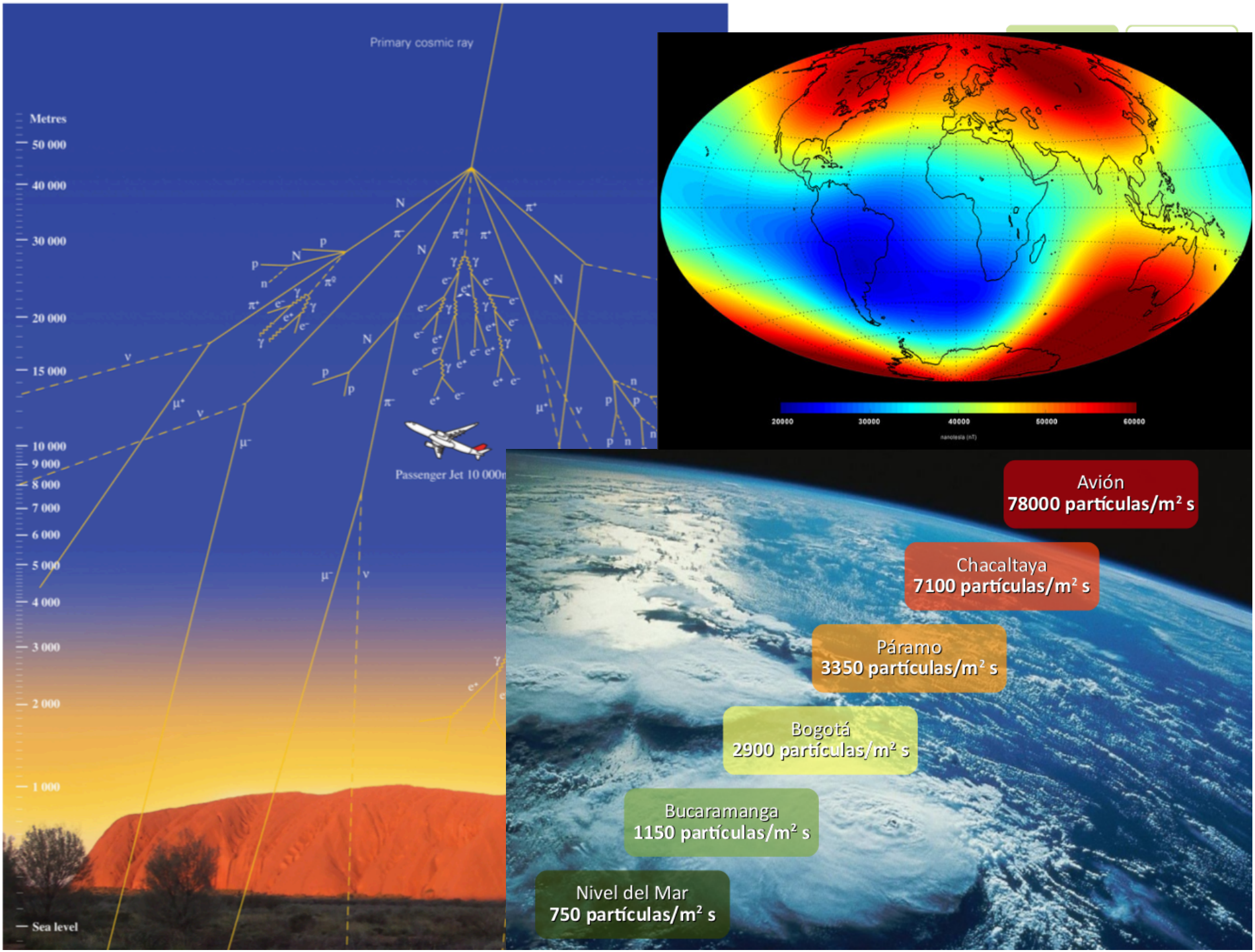
Estadística: Unos 30 eventos por año co
objetivos de este observatorio.

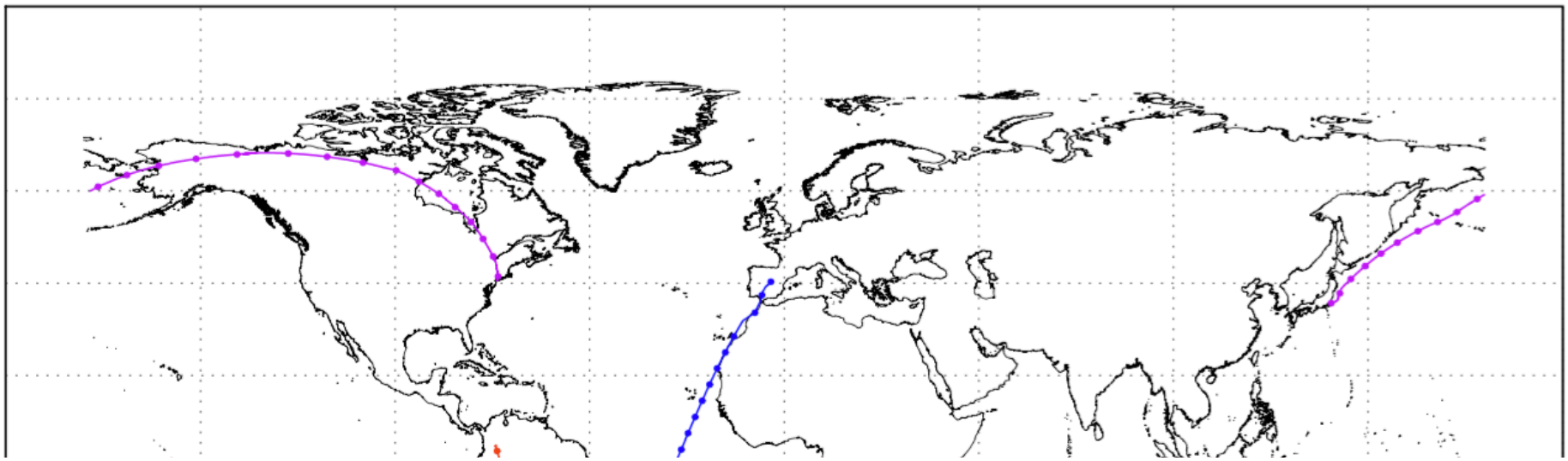
Sitio de emplazamiento: Malargüe y Sa

Detectores de superficie:
Área cubierta: 3000 km^2.
Cantidad de detectores: 1600.
Distancia entre detectores: 1,5 km.
Tipo de detectores: Cherenkov, con 1200

Telescopios de fluorescencia:
Cantidad de telescopios: 24, distribuidos e
Alcance: mayor a 30 km para lluvias de 10
Espejos: superficie esférica de 3,6 m x 3,6




Primary cosmic ray
Metres
50 000
40 000
30 000
20 000
15 000
10 000
9 000
8 000
7 000
6 000
5 000
4 000
3 000
2 000
1 000
Sea level
Passenger Jet 10 000m
20000
30000
40000
50000
60000
nanotesla (nT)
Avión
78000 partículas/m² s
Chacaltaya
7100 partículas/m² s
Páramo
3350 partículas/m² s
Bogotá
2900 partículas/m² s
Bucaramanga
1150 partículas/m² s
Nivel del Mar
750 partículas/m² s



$$d_N = \frac{N_{\text{ruta}} - N_{\text{BGA}}}{N_{\text{BGA}}} \tag{10}$$

S. Pinilla-Velandia (2015) Tesis Fisica

Ruta	γ	e^+	e^-	μ^+	μ^-	n^0	p^+	Otros	Total
BOG-BUE	55.5	56.0	56.2	3.5	3.9	84.6	165.8	122.6	46.1
BUE-MAD	56.6	57.0	57.3	3.6	4.0	90.7	175.9	124.6	47.1
JNB-SYD	93.3	89.3	90.3	6.2	6.5	388.7	638.0	195.6	82.2
NYC-TYO	91.0	87.2	88.1	6.1	6.3	380.6	621.9	190.4	80.2
SAO-JNB	71.3	70.5	70.8	4.9	5.3	162.7	296.6	151.7	60.3

Cuadro: *Incremento relativo d_N en condiciones seculares (DST=0 nT).*

Muongraphy primer

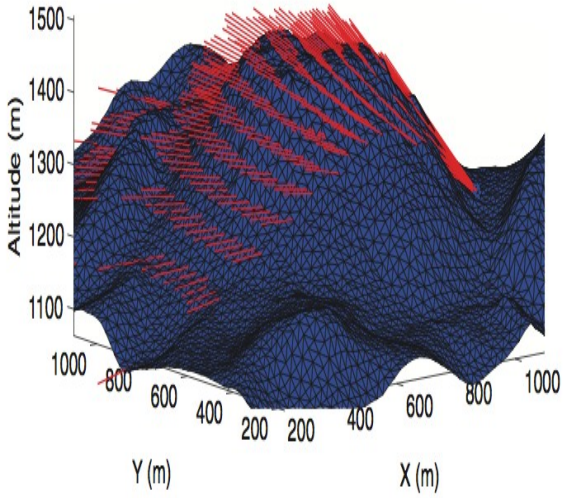
Universidad Industrial de Santander

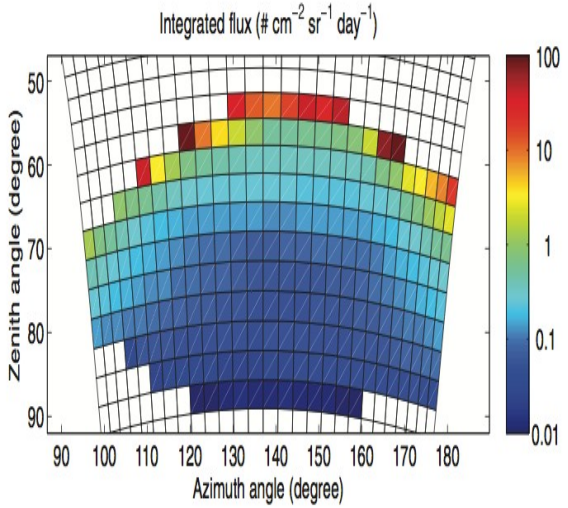
CONSTRUIMOS FUTURO

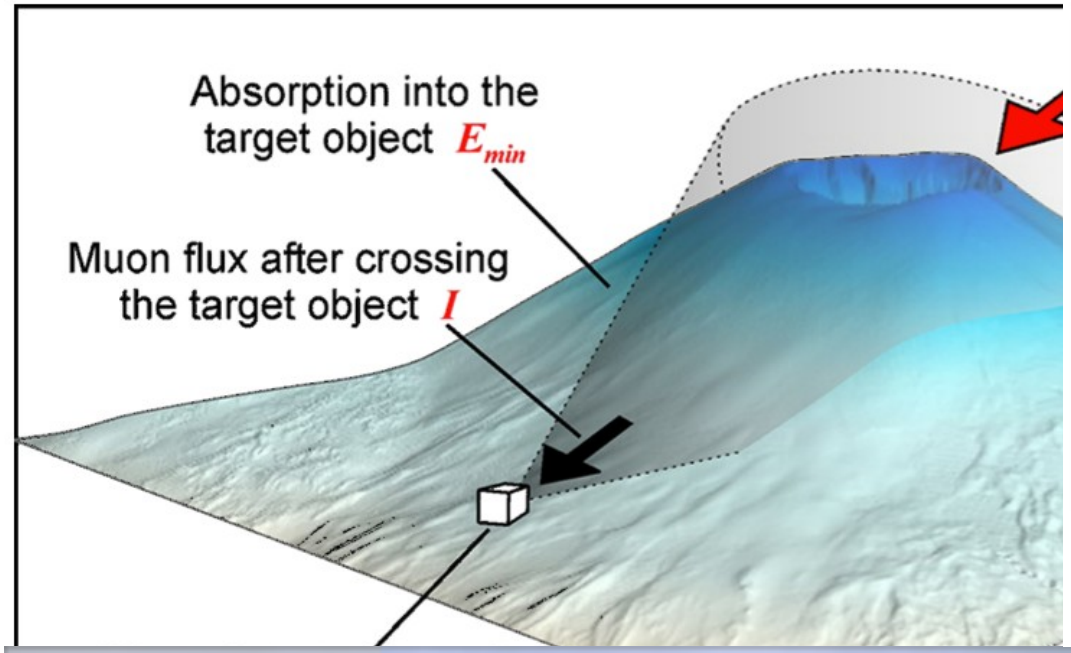
- Muons: Very low stopping power:

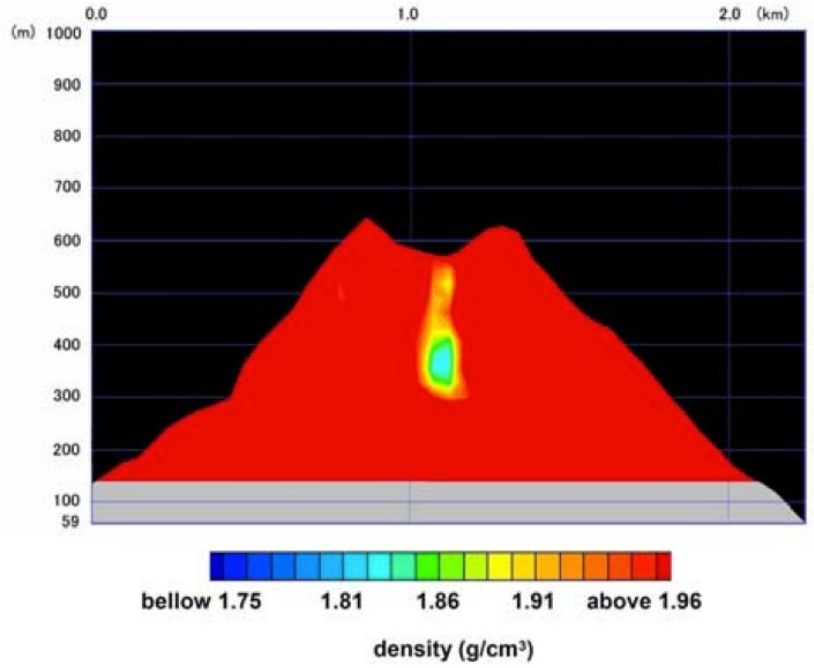
$$\left(\frac{dE_\mu}{dX_{\text{std rock}}}\right) \simeq 6\text{MeV cm}^{-1}$$

- High energy atmospheric muons can penetrate hundreds of meters of rock
- From the known atmospheric muon flux and measured directional flux across the volcano $\rightarrow$ rock opacity
- From rock opacity and volcano and detector geometry $\rightarrow$ internal density profile
- Internal density profile $\rightarrow$ deep volcanic structures

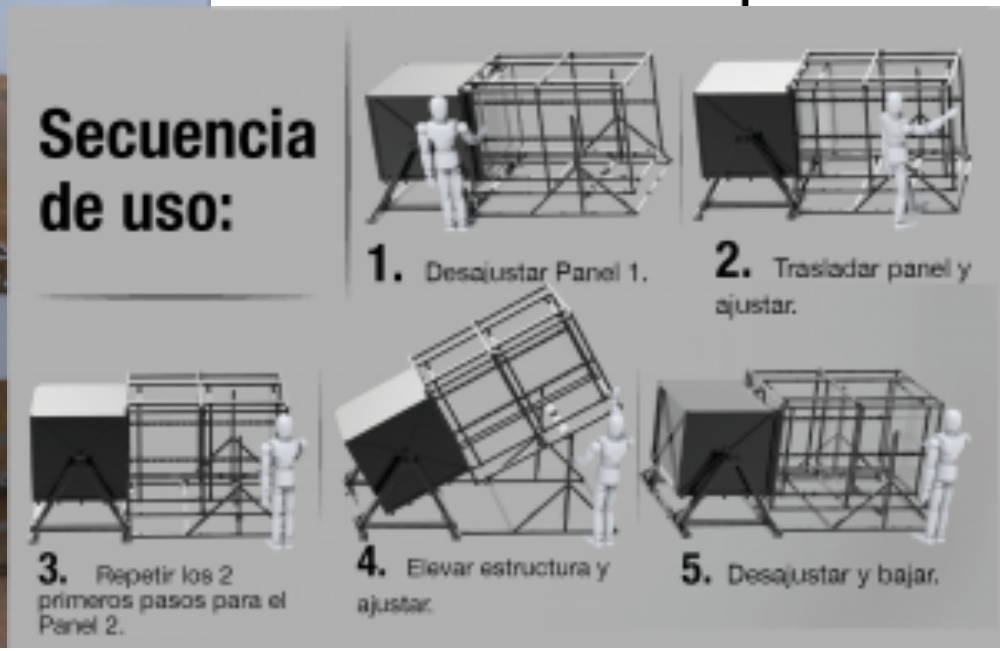






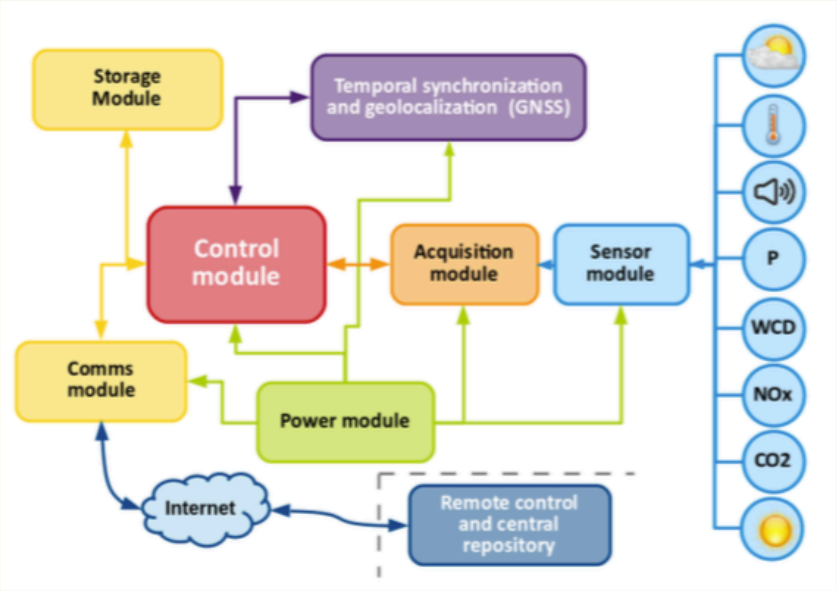


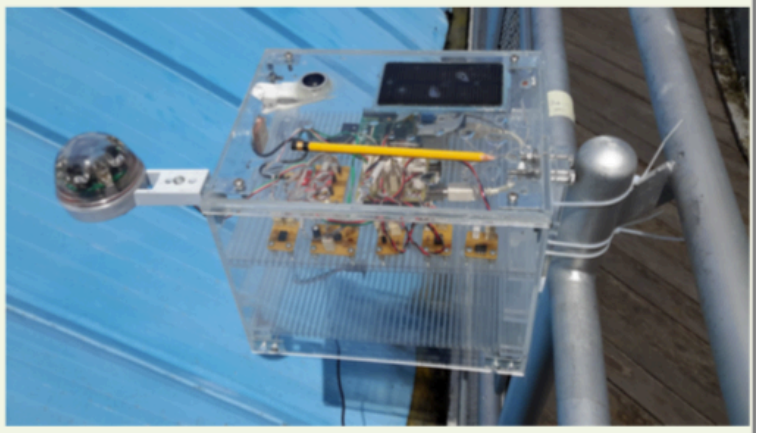
http://halley.uis.edu.co/fuego



Our new station: the smart LAGO-WCD

RACIMO: Red Ambiental Ciudadana de MOnitoreo

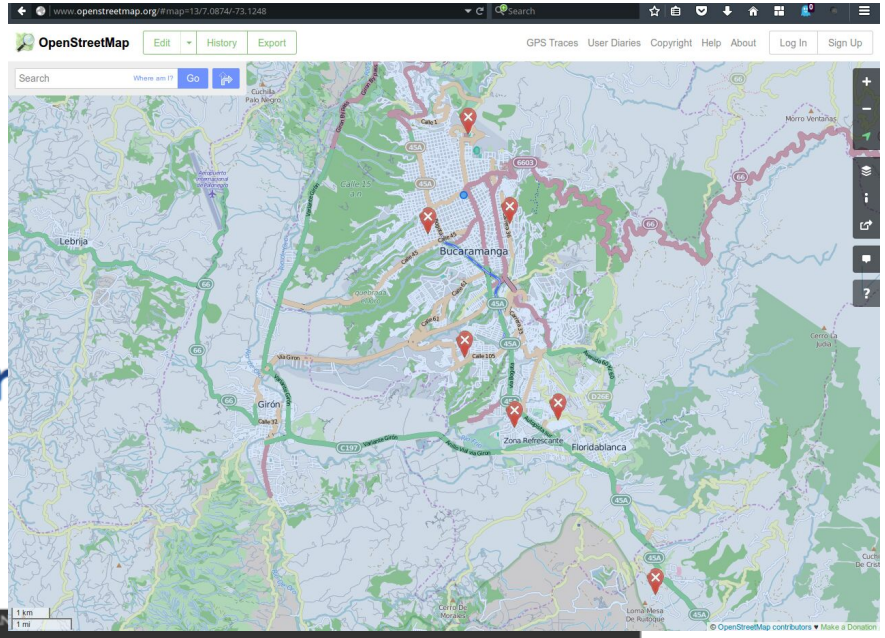


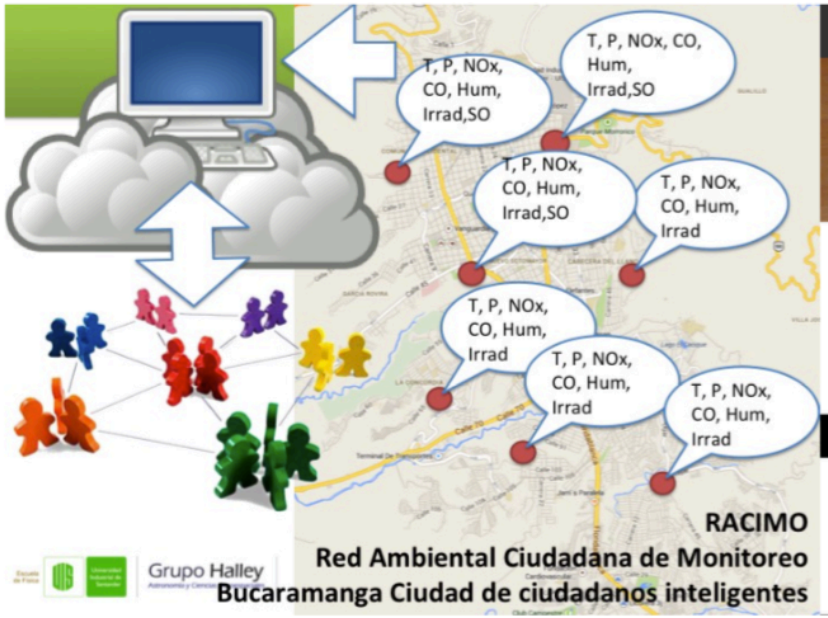


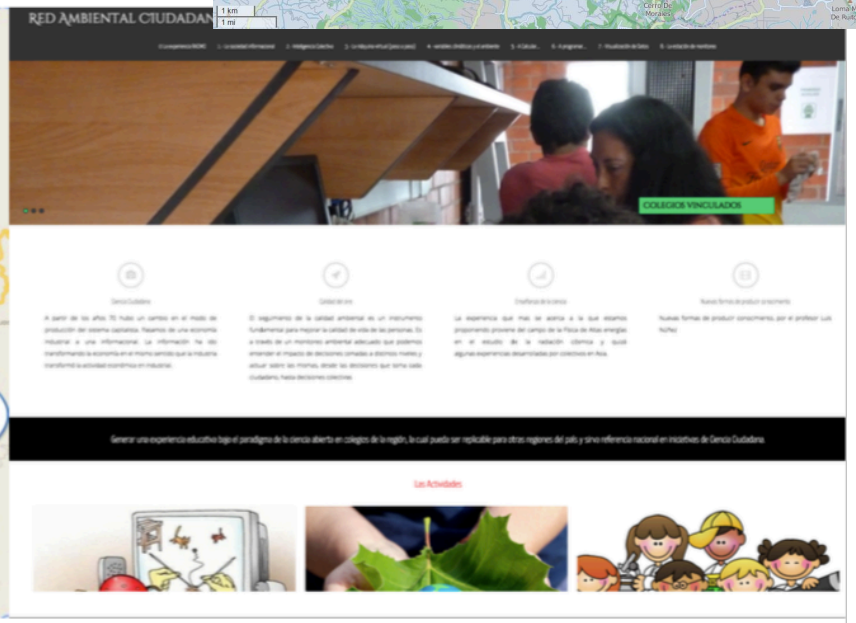
Control and Acquistion Station → Environment (including WCD)

- Sensors: Arduino-One&shield + environmental sensors (P, T, CO_2, NO_x, radiance, illuminance, noise)
- Control (SBC Raspberry Pi): data conformation, pre-processing and station control
- Power: 15 W solar panel and batteries
- GNSS: geo-localization and time synchronization
- Comms: support standard protocols: WiFi, GPRS (2.5G-3G-3.5G), 4G-LTE

Citizen Science Environmental Pr

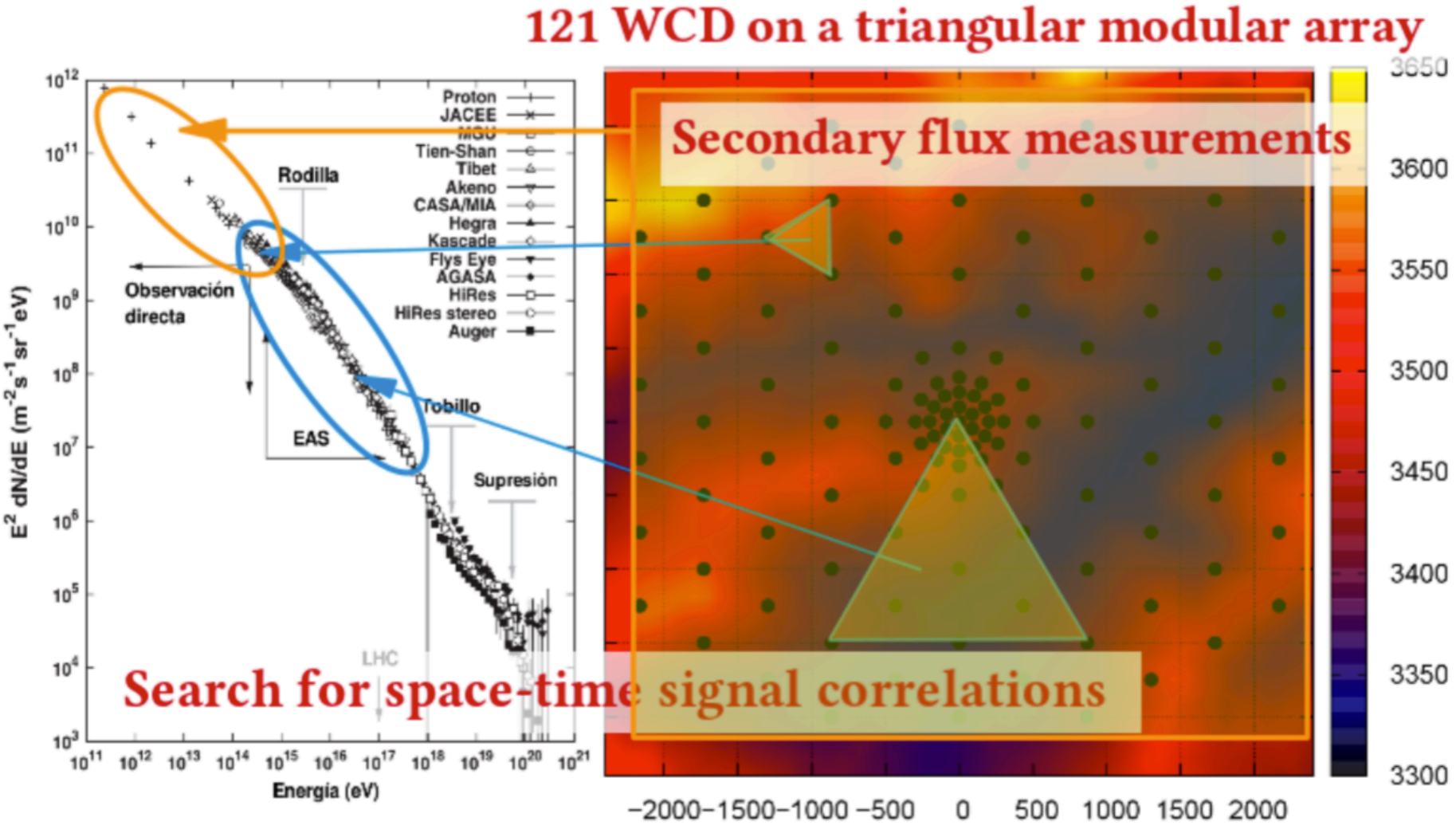






http://halley.uis.edu.co/tierra/

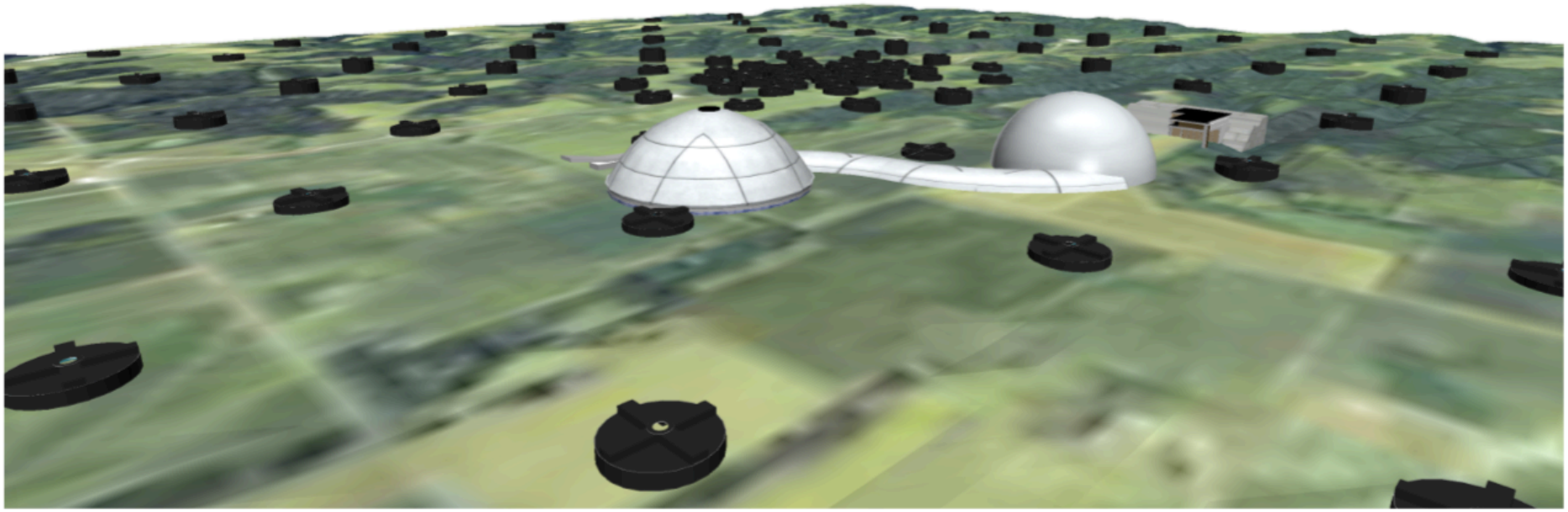
OCoCo: Observatorio Colombiano de Rayos Cósmicos



PAS: Polo de Astronomía Social

Main objectives

- **To become a permanent link between Science and Society**
- **To build a world class centre in astrophysics and related sciences**



Universidad Industrial de Santander

CONSTRUIMOS FUTURO

"Society" Dome

- Planetary
- Convention center
- Data visualization

."

"Science" Dome

- 20" fully automated optical telescope
- control and data acquisition of the array
- labs and offices

"Science" Tunnel

- "A unique bridge between science and society"
- Outreach activities
- Interactive visualization wall and ceiling

Conclusions

LAGO

- Ultra long baseline "array" of sWCD from Mexico to Antarctica
- High and low altitude sites across the Andean range: Background radiation, Space Weather and HE
- New smart WCD and environmental stations: data for other communities
- Full simulation chain: from primary flux to detector signals
- Local to regional integration of Universities and Citizen Science initiatives
- **Very active LA community: several projects funded in many LA countries**

The LAGO Project: A Latin American network of astroparticle students and researchers

Stay tuned with us at @lagoproject

Thanks