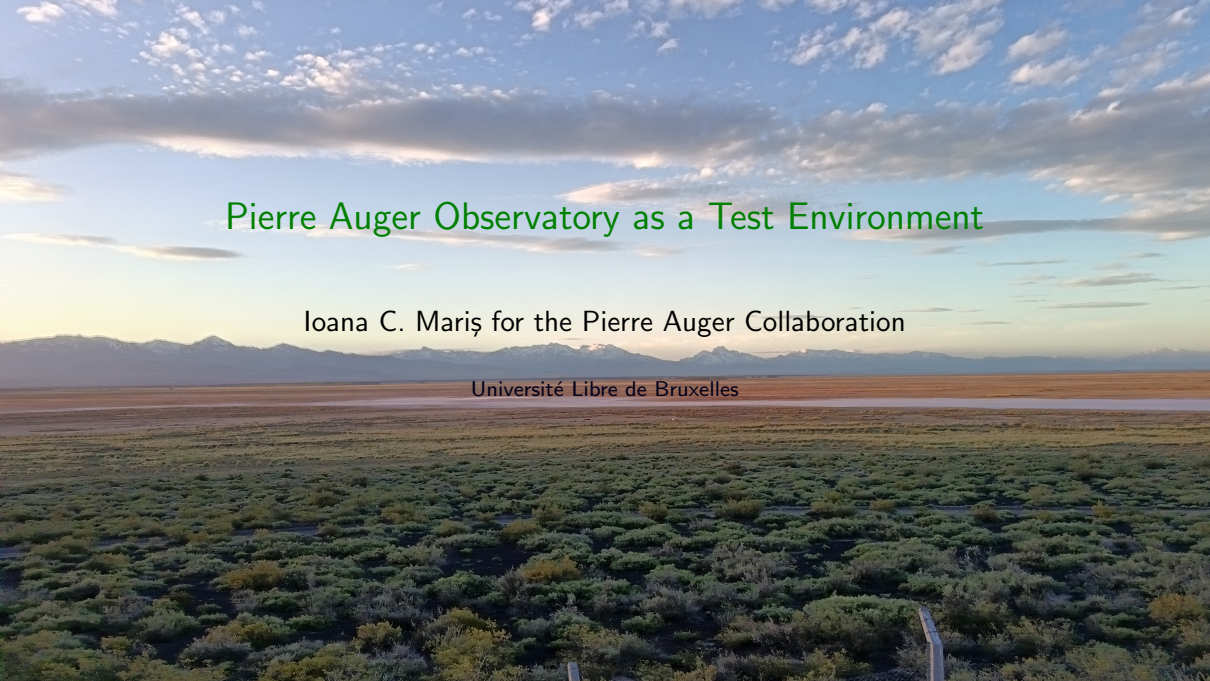


Pierre Auger Observatory as a Test Environment

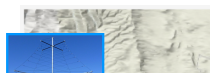
Ioana C. Mariș for the Pierre Auger Collaboration

Université Libre de Bruxelles

Pierre Auger Observatory

Pierre Auger Observatory
Province Mendoza, Argentina

... and AugerPrime



Underground muon detectors (24+)

LIDARs and laser facilities

4 fluorescence detectors
(24 telescopes up to 30°)

High elevation telescopes (3)

1665 surface detectors:
water-Cherenkov tanks
(grid of 1.5 km, 3000 km²)

More than 400 members, 98 institutes, 17 countries

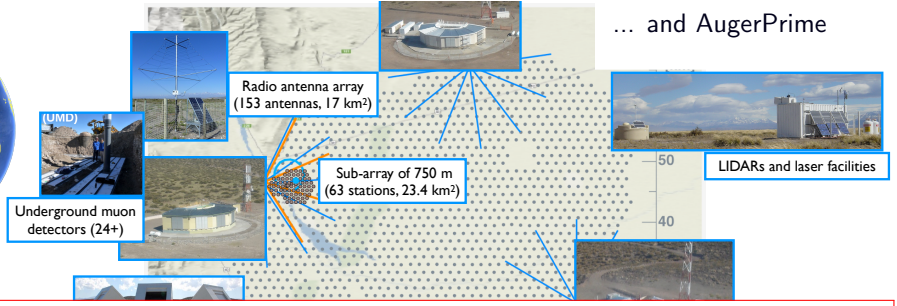
Water-Cherenkov detectors and

Fluorescence telescopes

Southern hemisphere: Malargue, Province Mendoza, Argentina

slide from Ralph Engel

Pierre Auger Observatory



This talk about some of the other detectors

More than 400 members, 98 institutes, 17 countries

Southern hemisphere: Malargue, Province Mendoza, Argentina

Water-Cherenkov detectors and

Fluorescence telescopes

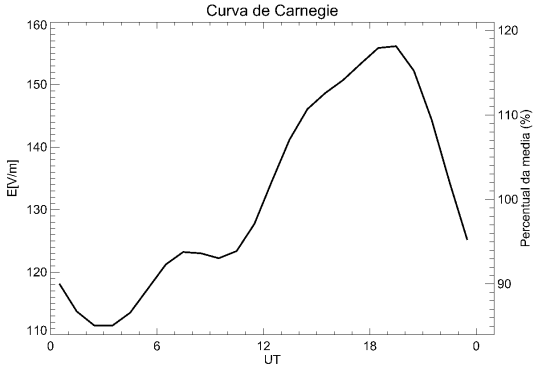
slide from Ralph Engel

AERONET

Sun photometers, CIMEL 318A to measure the sun irradiance and sky radiance for obtaining the aerosol optical depth and extinction

AErosol RObotic NETwork: monitoring around 90% of the Earth's surface (each 15 minutes)

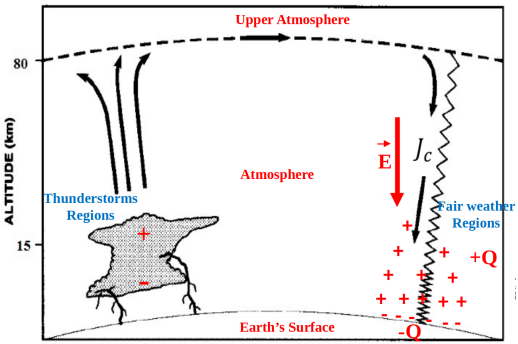
Electric Mills and the Global Electric Circuit



Measurements of atmospheric electric field over the world's oceans in Fair Weather conditions showed a global signal: typical daily variation in Universal Time (UT) independent of the position of the ship

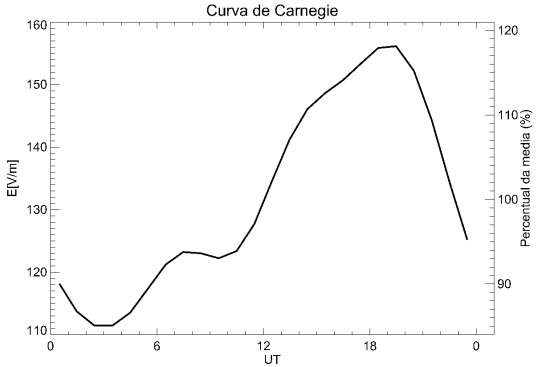
Jose Tacza

Electric Mills and the Global Electric Circuit



The Global Electric Circuit (GEC) relates separation of electric charges in thunderstorms (and electric shower clouds) with electric current in fair weather regions.

Jose Tacza



Measurements of atmospheric electric field over the world's oceans in Fair Weather conditions showed a global signal: typical daily variation in Universal Time (UT) independent of the position of the ship

Do solar effects affect the global electric circuit?

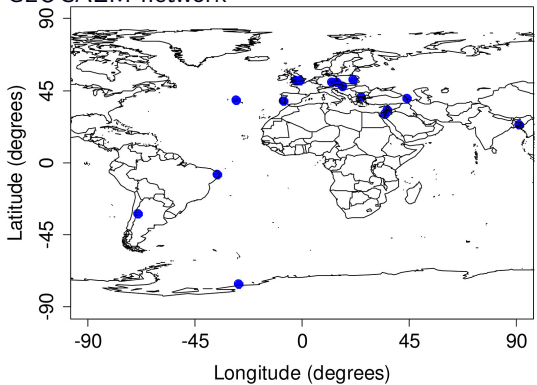
Change of the electric field after the solar events:

- Solar flares
- Forbush decrease
- Solar proton events
- Combination of all

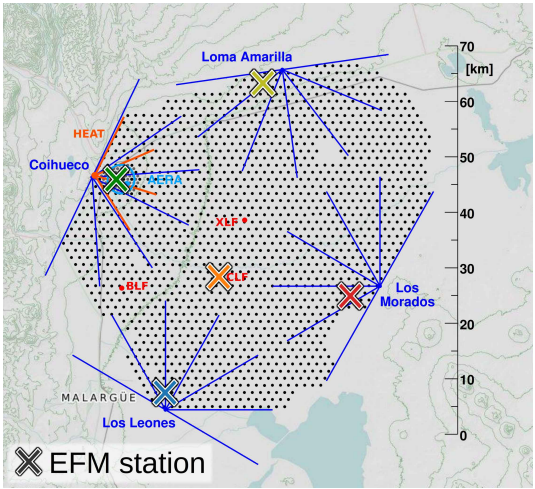
GEC is relevant for global warming, connections to clouds, earthquakes, naturak environment for life on Earth

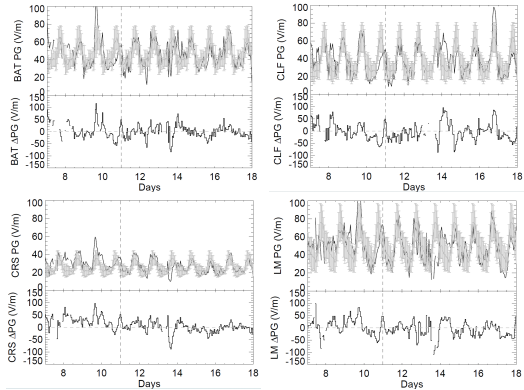
Jose Tacza

GLOCAEM network



Preliminary results during the geomagnetic storm 9-12 May 2024

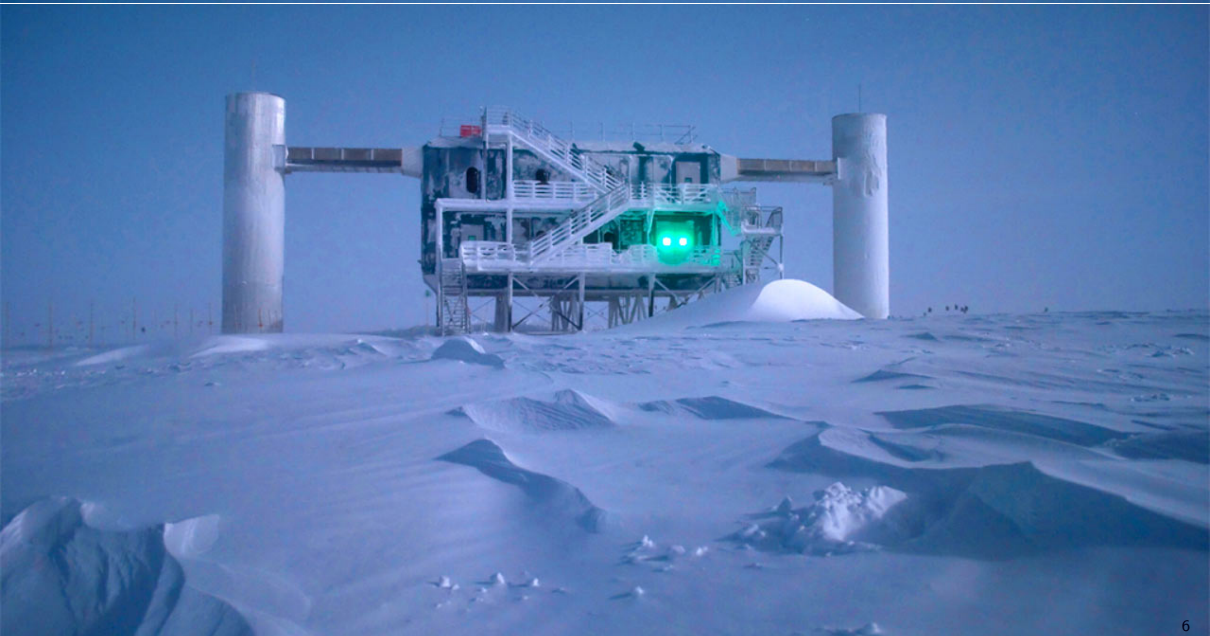




Measure disturbances in the potential gradient

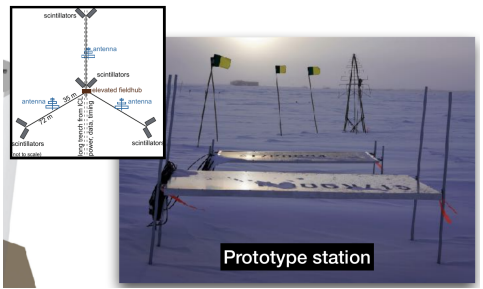
Jose Tacza

IceCube at South Pole



IceCube at Auger

IceCube-Gen2 prototype station



Surface array enhancement: scintillators and radio for snow height measurements and for increased sensitivity

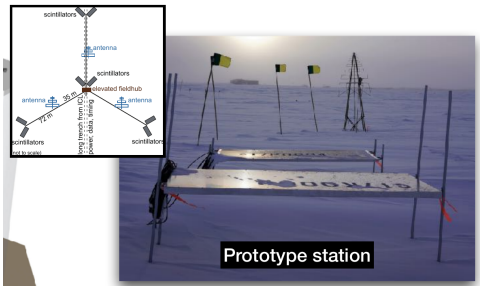
Cross calibration between IceCube and Auger

More accessible location

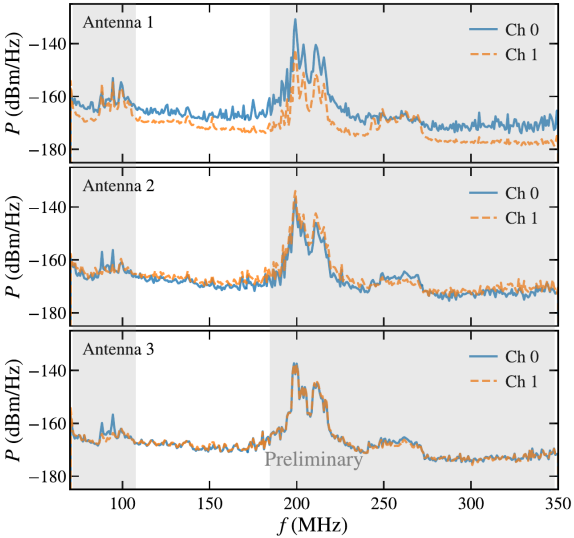
One station functioning at the South Pole and one in the 433 m array

Frank Schroeder, Stef Verpoest, Ben Flaggs

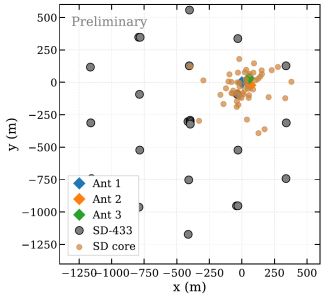
IceCube-Gen2 prototype station

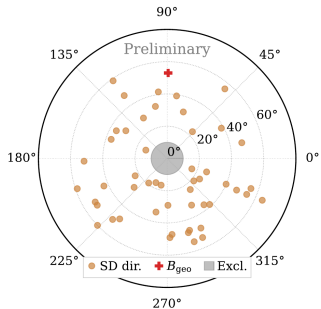


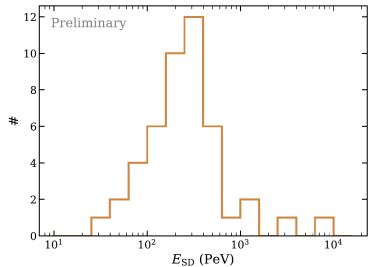
Surface array enhancement: scintillators and radio for snow height measurements and for increased sensitivity



Search for coincidences between the SKALA antennas and Auger events







Identified about 50 coincidence events in 3 months of data taking

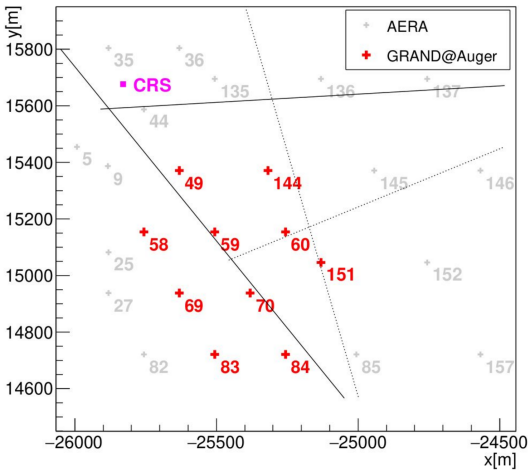
As expected a larger fraction of events from the South

6 more stations to be deployed at Auger in 2025

Frank Schroeder, Stef Verpoest, Ben Flaggs,...

GRAND at Auger

GRAND: designed to measure UHECRs neutrinos, with radio antennas on extremely large areas



Validate GRAND detector concept

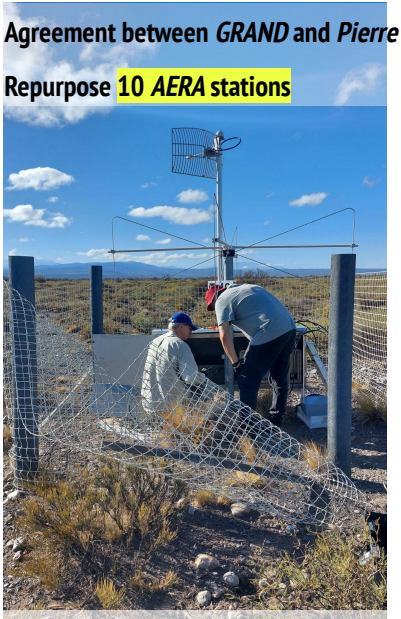
Time coincidence with Auger SD

Test the GRAND recontruction algorithms
GRAND@Auger: refurbish 10 AERA stations

Beatriz de Errico and Charles Timmermans (GRAND coll.)

Agreement between *GRAND* and *Pierre Auger Observatory*

Repurpose 10 *AERA* stations

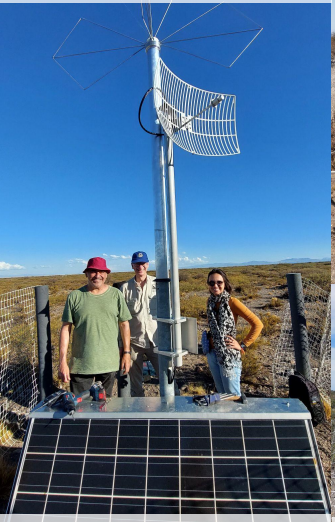


AERA's Butterfly antenna

Dismantled antenna

GRAND's Horizon antenna

5 trips to site since March/2023:



March/2023

August/2023

Olivier M., Marion G., Frederic M., Charles T. and Beatriz E.

November/2023

March/2024

Charles T. and Beatriz E.

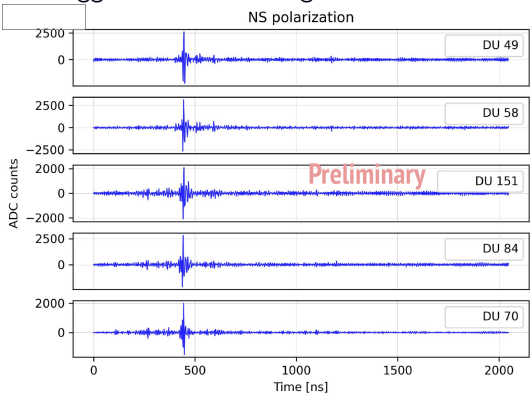
August/2024

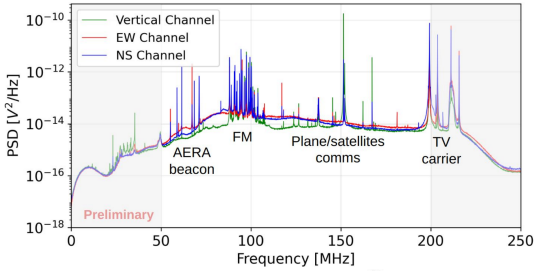
Great support from the local staff

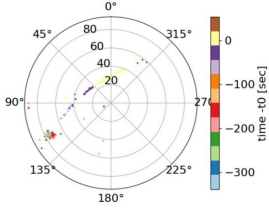
Beatriz de Errico

GRAND at Auger: first look at the data

Self-triggered event with signal in 5 stations







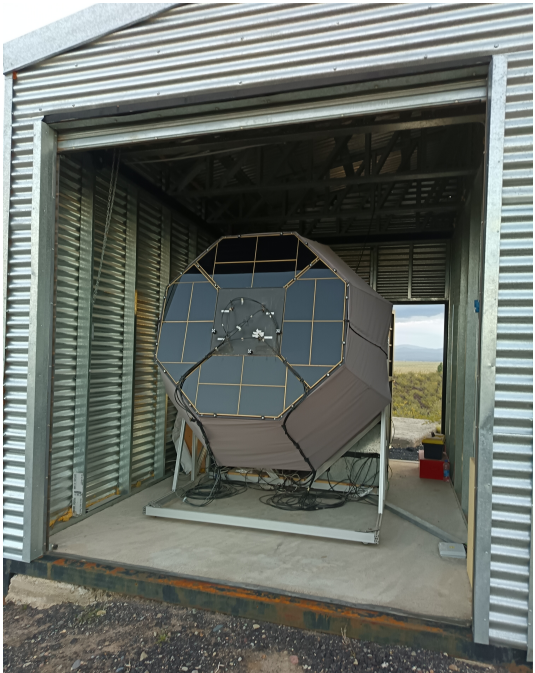
Background characterisation and external source identifications

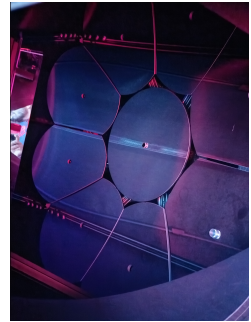
Underway: search for coincidence events and the measurement of the galactic radio background

Beatriz de Errico

FAST at Auger

FAST at Auger





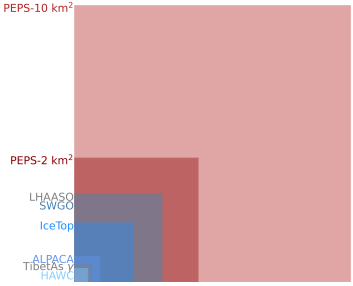
– Small single pixel fluorescence detectors to cover large areas

– Deployed at Telescope Array and Auger for energy cross-calibration

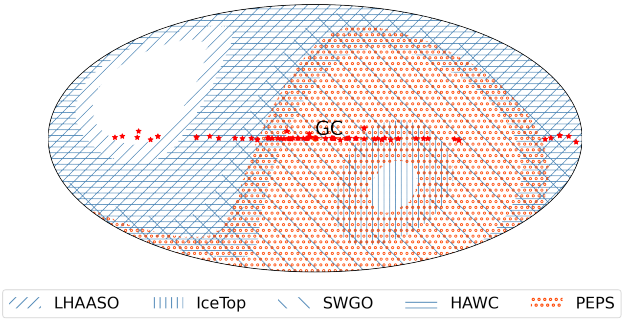
– Prototype for a FD solution for GCOS

– FAST mini-array: 4 detectors of second generation to be installed at Auger, spaced by 11 km to fully test the concept

Probing Extreme PeVatron Sources (PEPS)



The worldwide largest gamma-ray Observatory: a 10 km^2 array of double liner water-Cherenkov detectors (Phase I of 2 km^2 in the next years), cost effective

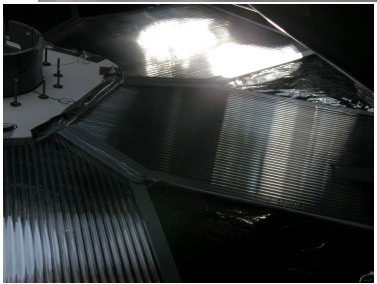


Complementary in sky coverage and energy to the other experiments

Energy range 1-30 PeV, 55 detectors/km^2, 145 m spacing

I.M.

PEPS at Auger



B. Flaggs, I.M., ...

5 prototypes deployed in 2014
3 were unmounted
Guapa Guerrera and Clairon Jr are taking data for 10 years
3 new prototypes to be deployed in 2025

Conclusions and outlook

Pierre Auger Observatory: unique infrastructure providing deployment expertise from the local staff, good communication systems, a multitude of detectors for comparison of all techniques, a perfect playground!

A very welcoming environment for cross-calibration and testing detectors

Excellent opportunities to learn from each other and test new ideas