The Pierre Auger Observatory staring science:Open Data and Outreach activities

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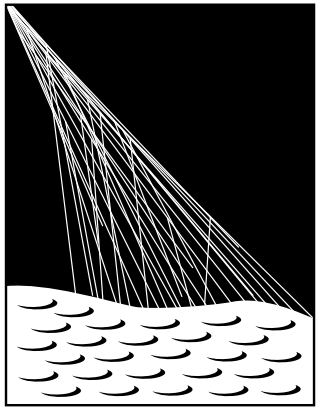
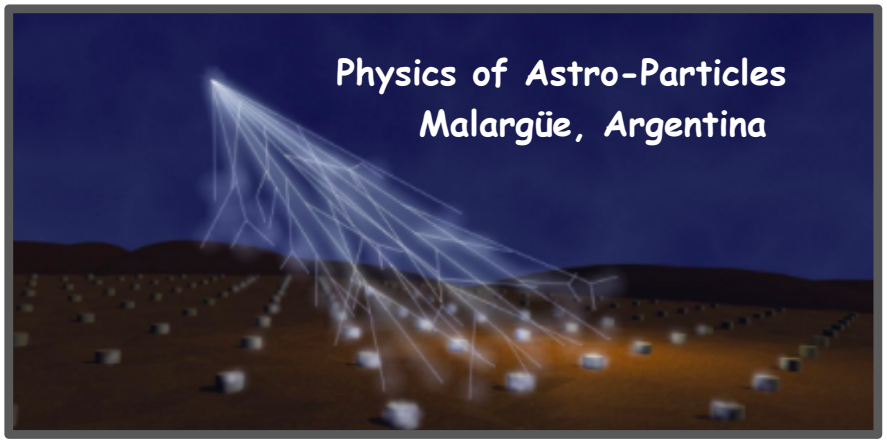
Overview

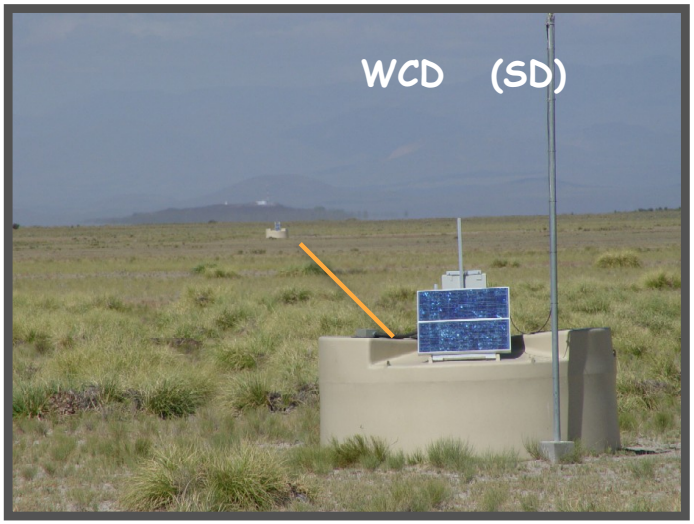
- Pierre Auger Observatory, Visitor Center
- Web page
- VR3D
- Women in Science
- Talks and Science fairs
- Data release and Software approach
- Masterclasses (IPPOG)
- Auger goes to School
- International Cosmic Day and other events
- QR, Wikipedia, videos, brochure and Auger in Focus

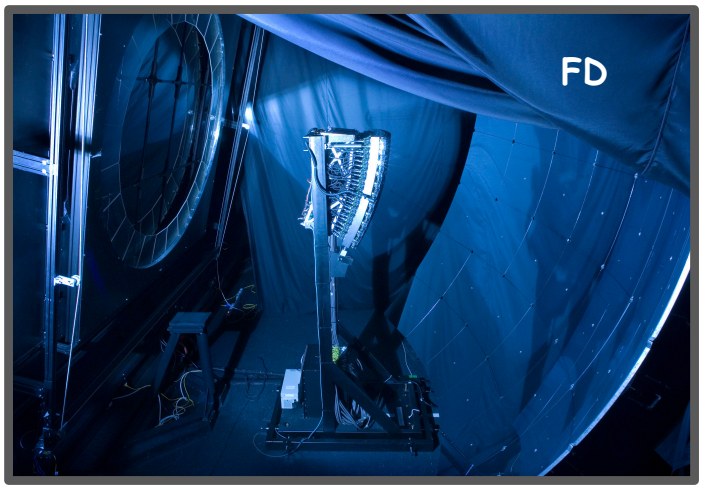


PIERRE AUGER OBSERVATORY

The Pierre Auger Observatory







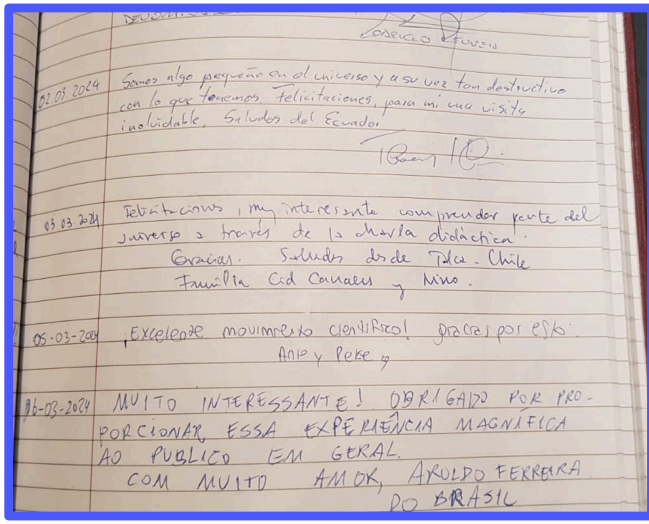
The Pierre Auger Collaboration

- Planned in 1992 -> 1999 Agreement
- Inaugurated in 2008
- Finished in 2009 (First part)
- Continued to Auger Prime 2015
- ~ 400 collaborators, ~17 countries

70 institutions

- https://auger.org/
- https://visitantes.auger.org.ar/

Visitor Center

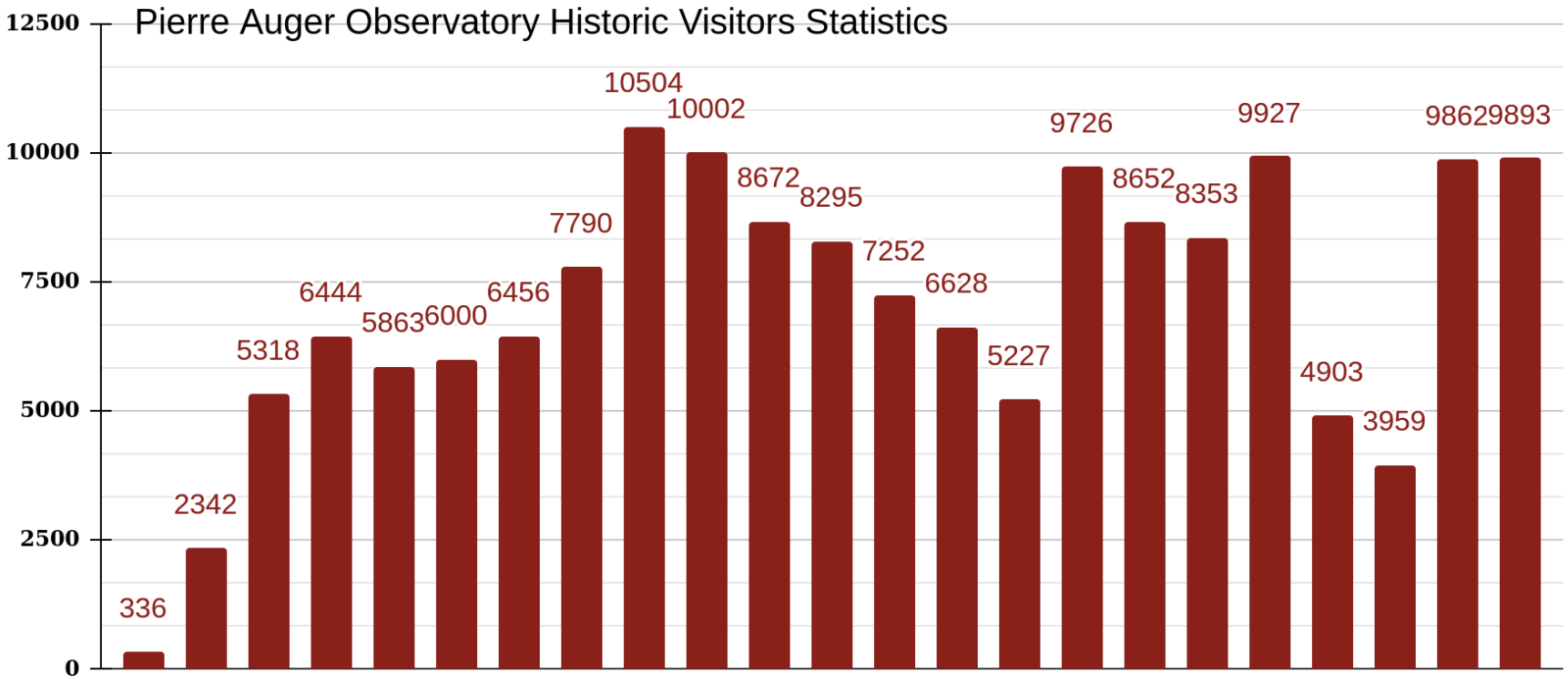


Guests Book

Virtual Ballon Flight (VR station)

Models, posters, experiments, guided visit, videos, etc.

Visitor Center



*Since 2001, at Malargüe, up to 3rd quarter of 2023

*~8000 visitors a year

Visitor Center

2024 Events (mainly International Days)

January
04 - International Day of Braille

February
11 - International Day of W&G in Science

March
08 - Women International Day
16 - Women and Girls in Science exhibition in the Convention Center, Malargüe

April
02-08 - Dark skies week
14-19 - Pierre Auger Meeting
21 - World Day of Creativity and Innovation

May
16 - International Day of Light
28 - Day of Kindergartens

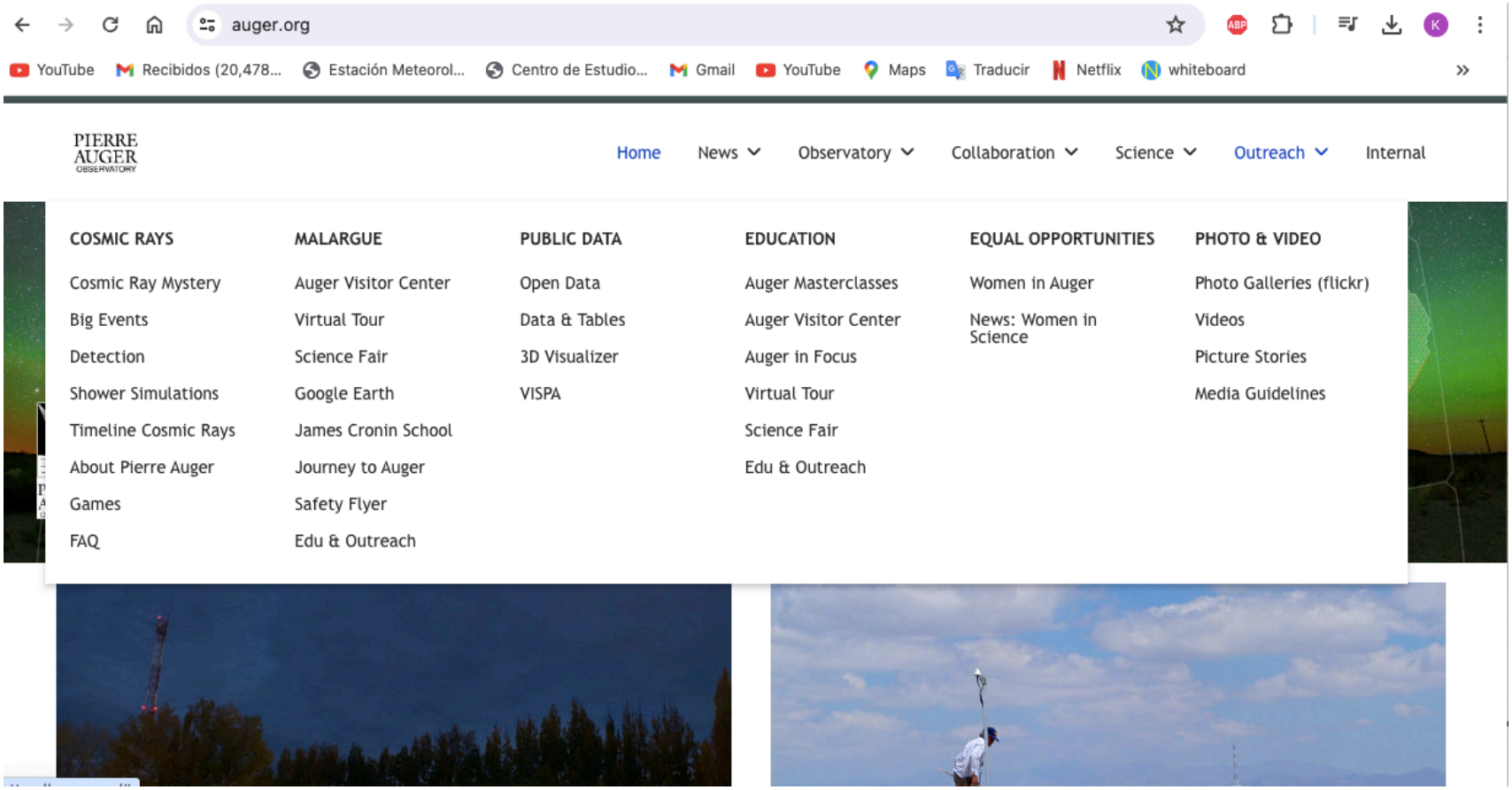
June
05 - **World Environment Day**
21 - Solstice
30 - International Asteroid Day
21 - International day of the Sun

- Virtual and audio Tours
- https://izi.travel/en/6095-pierre-auger-observatory/en

Visitor Center

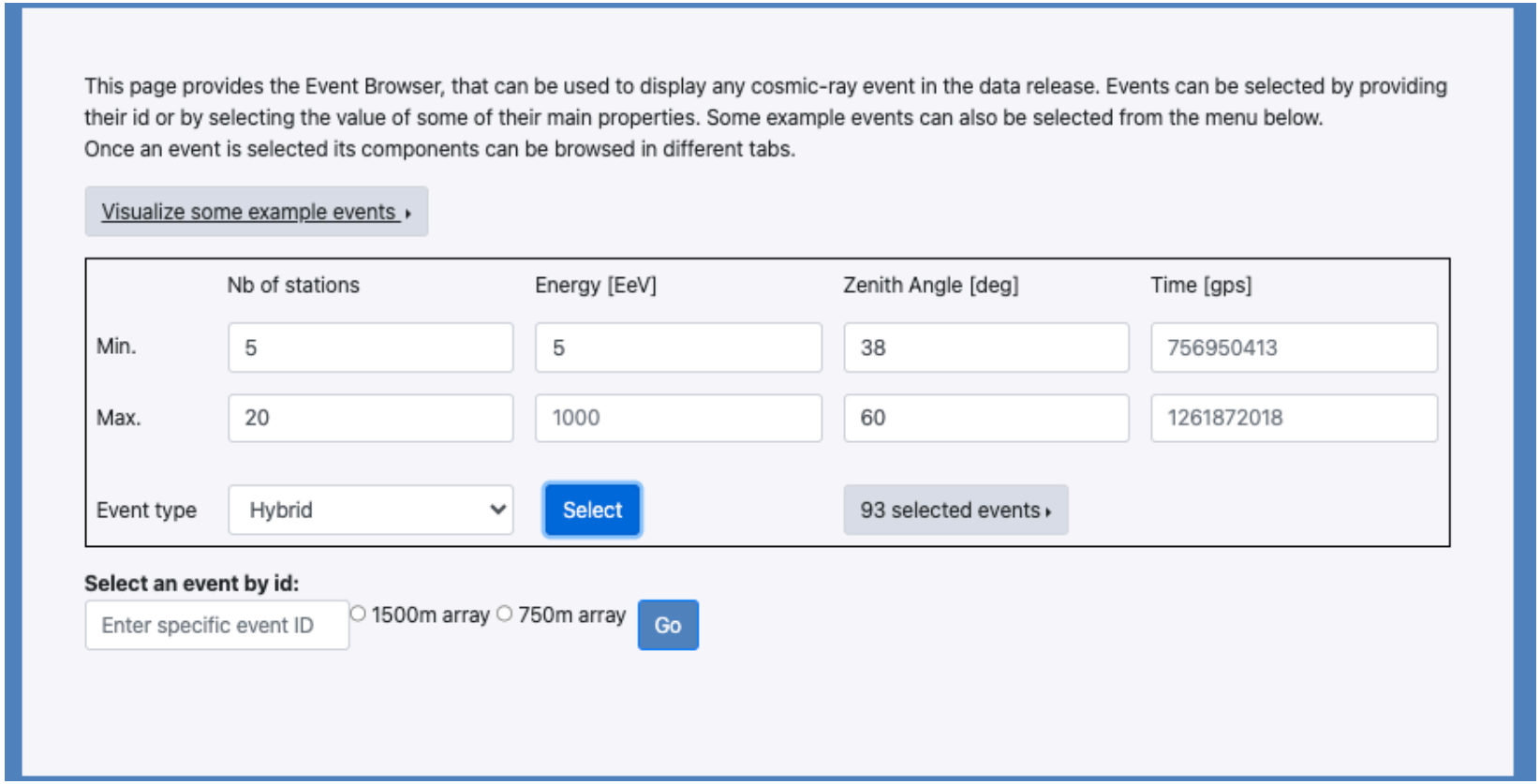
- Anual parade during the November Meeting in Malargüe Anniversary

Web page



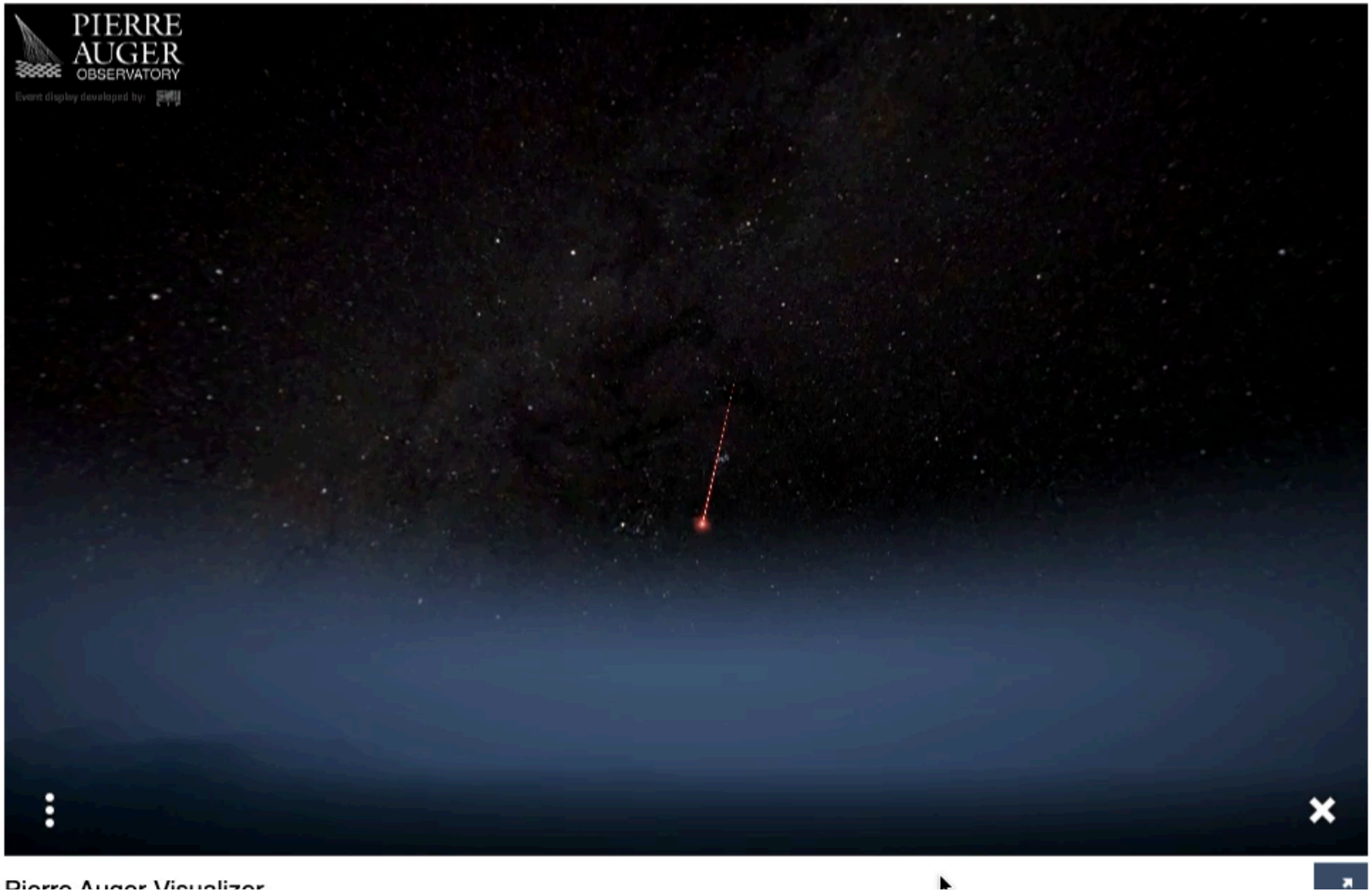
- https://auger.org/

Web page



- https://auger.org/

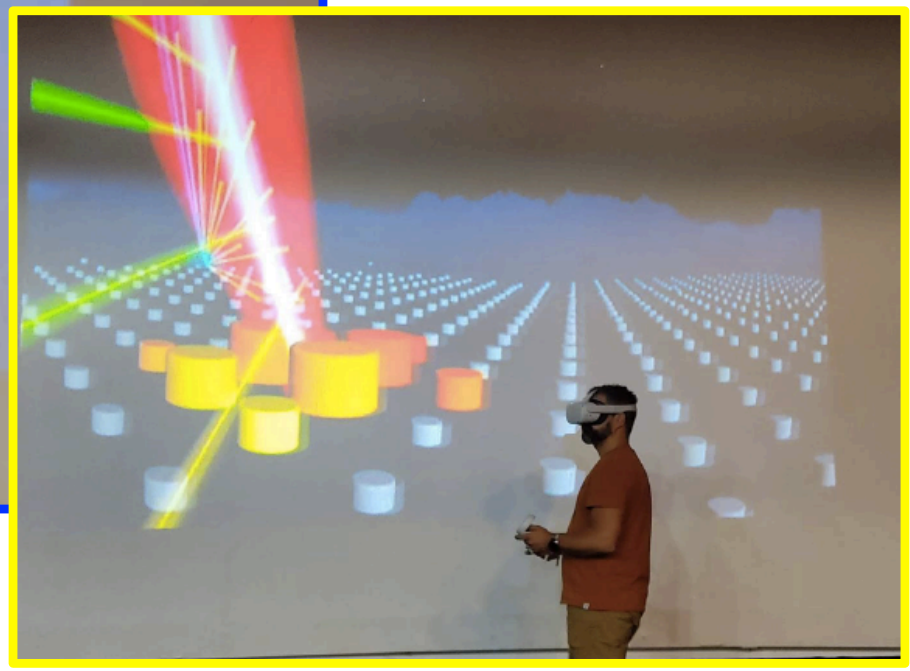
Web page



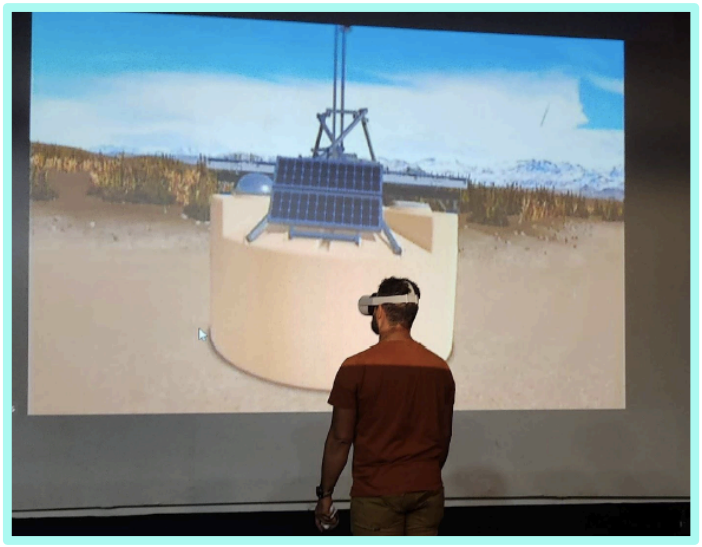
VR3D

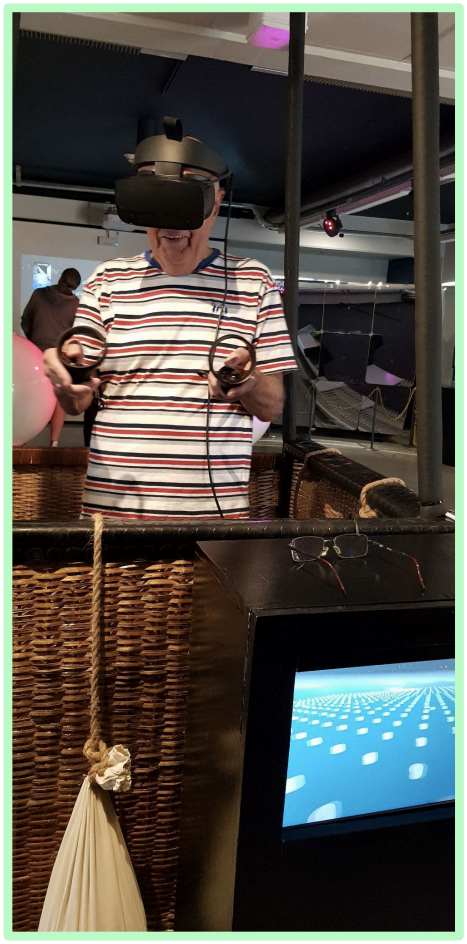

Activate Slow Rotation
Rotate
Change To Detector
Next Event
Previous Event

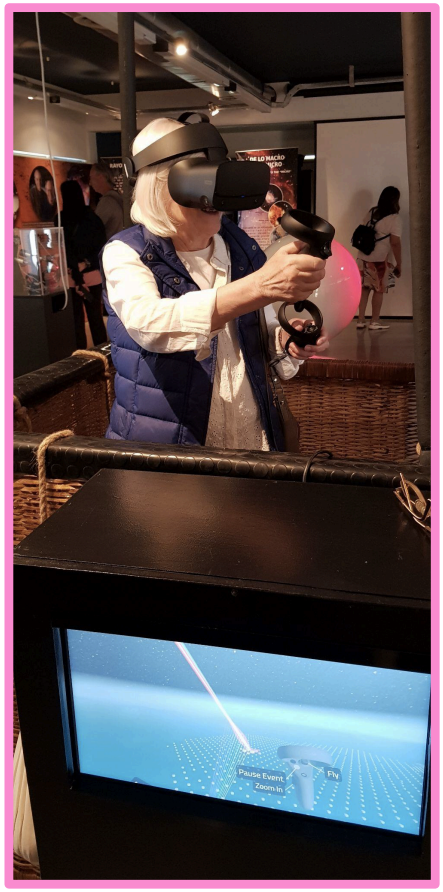

QUEST 2
oculus
from FACEBOOK



VR3D





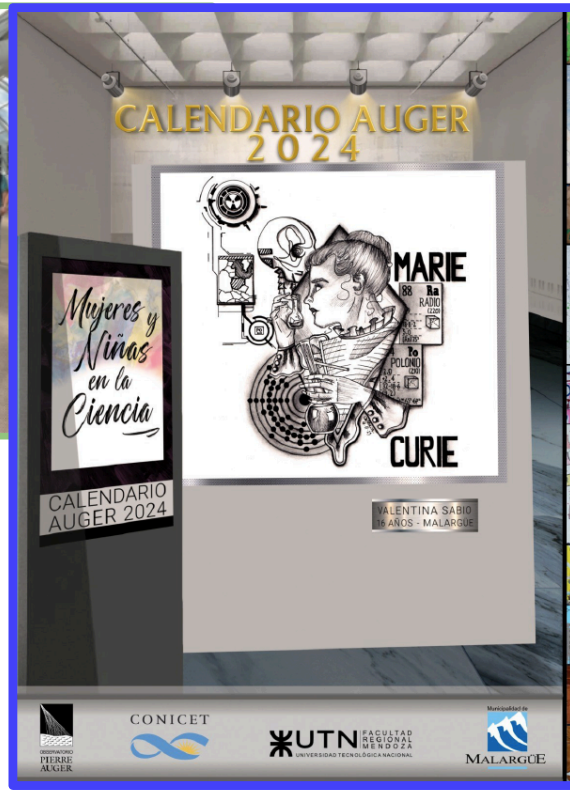


Women in Science

Women hold up half the sky

https://izi.travel/en/c824-women-hold-up-half-the-sky/en
https://izi.travel/en/c824-las-mujeres-sostienen-la-mitad-del-cielo/es

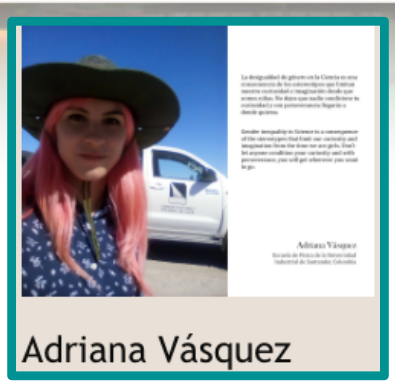
Women in Science



Exhibitions, Drawing contests and calendar for International Day of Women and Girls in Science

Women in Science

Women's day March 8th


Adriana Vásquez


Antonella Castellina


Bianca Keilhauer


Carola Dobrigkeit


Carla Aramo

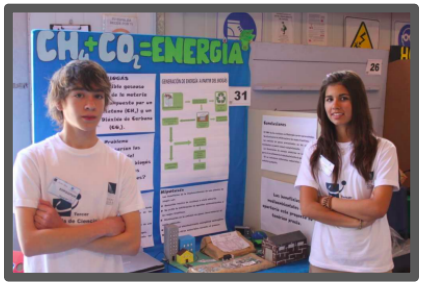

Gabriella Cataldi

https://www.youtube.com/watch?v=e69ccX5RwOY
https://www.auger.org/index.php/edu-outreach/women-in-science

Talks and Science fairs

Talks and Science fairs

Science fair every year



Data release and Software approach

The Pierre Auger 2021 Open Data is the public release of 10% of the Pierre Auger Observatory data presented at the 36th International Cosmic Ray Conference held in 2019 in Madison, USA, following the Auger collaboration open data policy.

This website hosts the datasets for download. An online event display is available to explore the released events, and example analysis codes are provided. See below for a brief overview of the Pierre Auger Observatory and of the Auger Open Data.

Datasets

the complete released datasets and their complementary data

Visualize

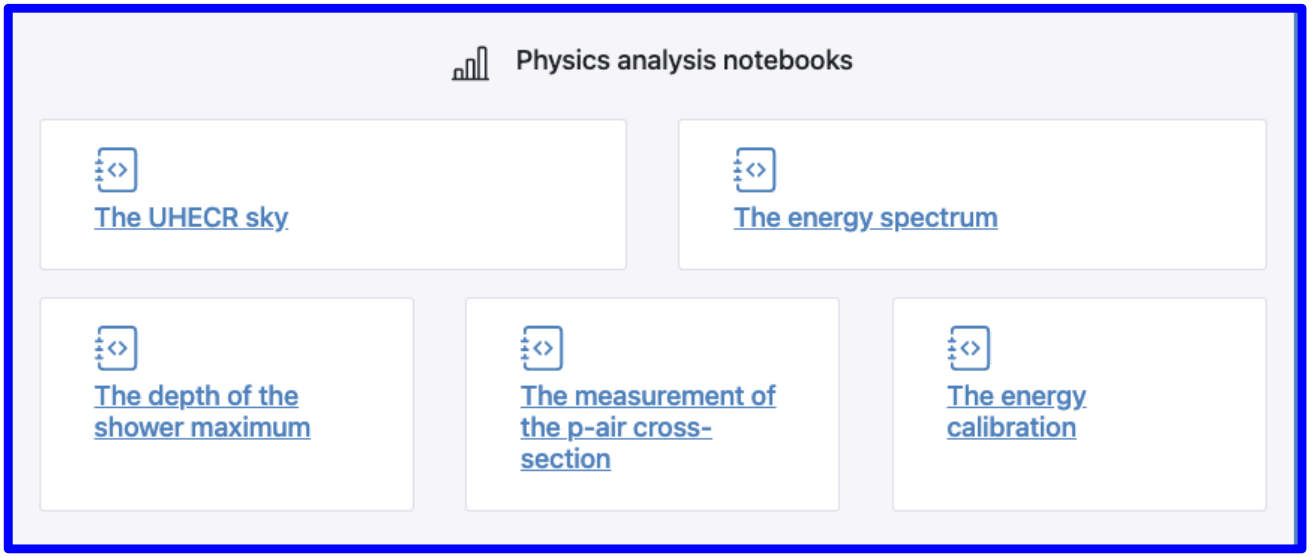
an online look at the released pseudo raw data

Analyze

example analysis codes in online python notebooks to run on the datasets

https://opendata.auger.org/

Data release and Software approach



https://opendata.auger.org/

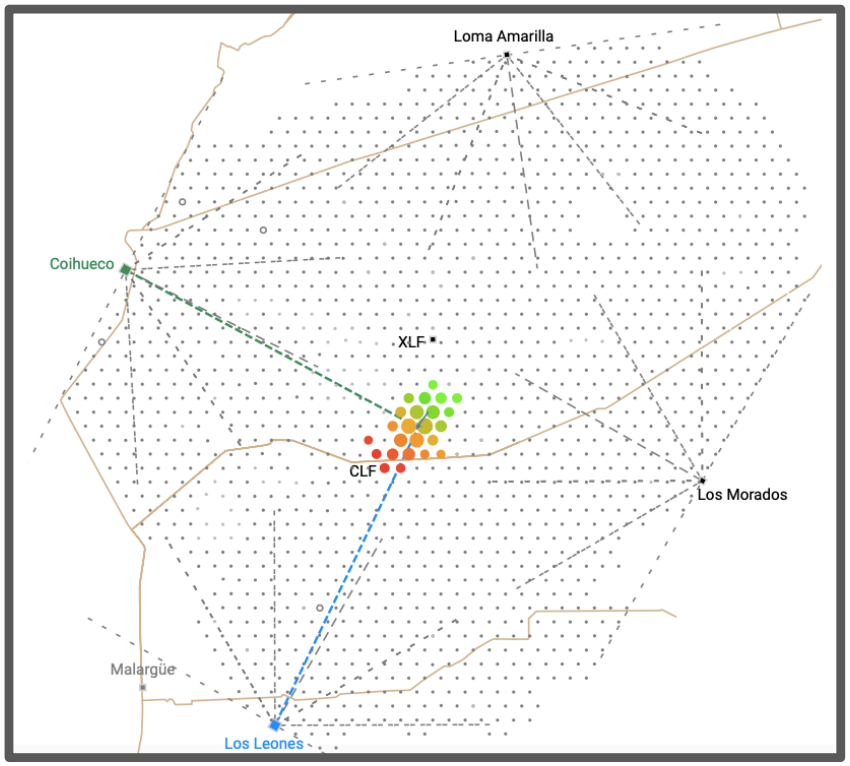
Data release and Software approach

Pierre Auger Observatory Open Data

February 2021 release

Pierre Auger Observatory Open Data

March 2024 release



PROCEEDINGS OF SCIENCE

ONLINE ICRC 2021

The 2021 Open-Data release by the Pierre Auger Collaboration

V. Scherini[a,b,*] **on behalf of the Pierre Auger Collaboration**
(a complete list of authors can be found at the end of the proceedings)

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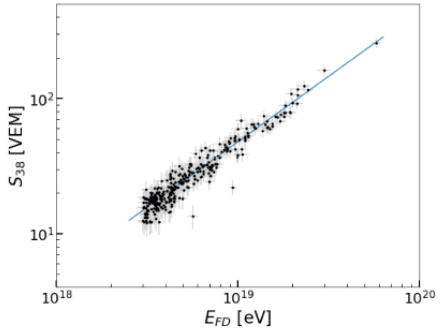
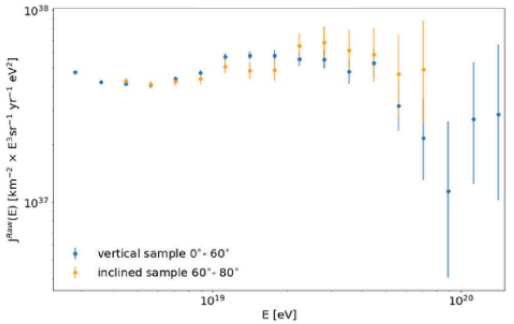
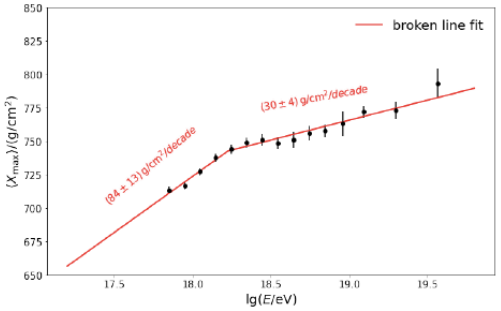
E-mail: spokespersons@auger.org

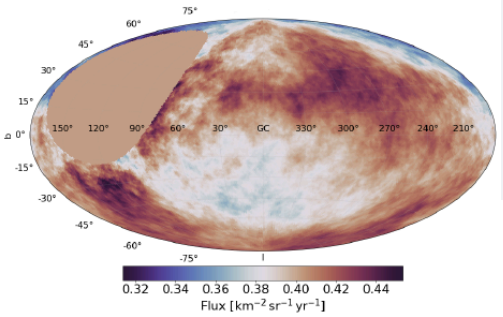
https://opendata.auger.org/

Data release and Software approach









The Pierre Auger Observatory Open Data

Pierre Auger Collaboration • A. Abdul Halim (Adelaide U.) Show

Sep 28, 2023

18 pages

e-Print: 2309.16294 [astro-ph.HE]

Experiments: AUGER

View in: HAL Science Ouverte, ADS Abstract Service

https://opendata.auger.org/

Masterclasses

International Masterclasses (astro)particle physics

http://physicsmasterclasses.org

- Every year ~13000 **high-school students** from 60 countries
- "Scientists for one day with the hands on particles"
- **Auger premiered at the IPPOG IMC2023!**

Masterclasses

International Masterclass 08/03/2024
08 MARCH 2024
- Prague - CZ
- Braga - PT

International Masterclass 12/03/2024
12 MARCH 2024
- Tokyo - JP
- Beijing - CN
- Ciudad Juárez - MX

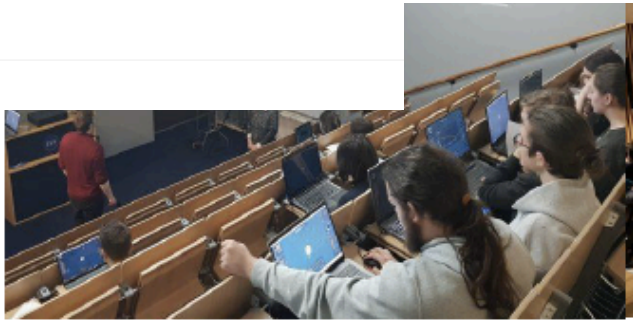
International Masterclass 19/03/2024
19 MARCH 2024
- Debrecen - HU
- Constantine - DZ
- Lecce - IT
- Milan - IT

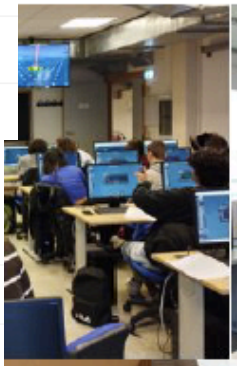
International Masterclass 16/03/2024
16 MARCH 2024
- Lisbon - PT
- Funchal - PT
- Bucharest - RO
- Évora - PT

International Masterclass 01/03/2024
01 MARCH 2024
- Nairobi - KE
- Naples - IT
- L'Aquila - IT

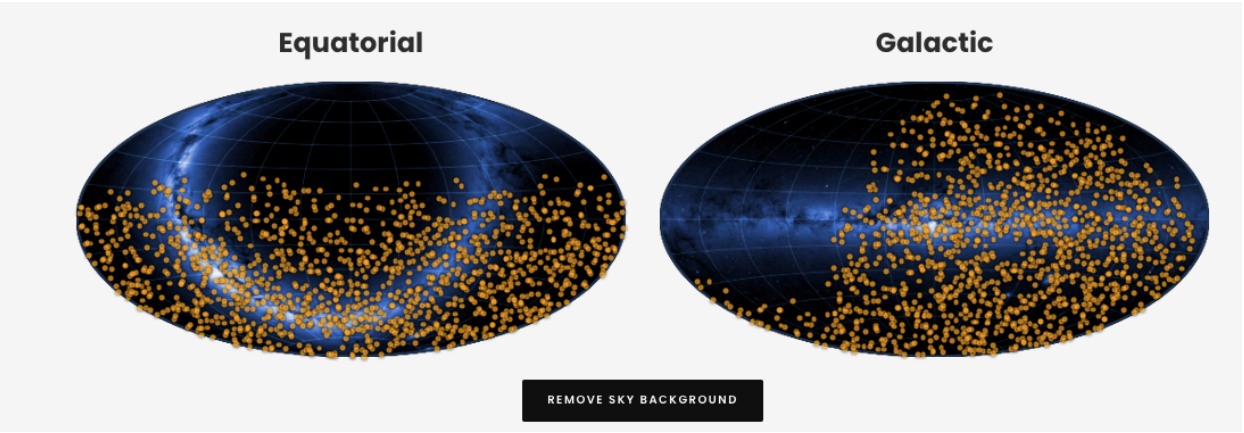
ENEF2024
17 FEBRUARY 2024

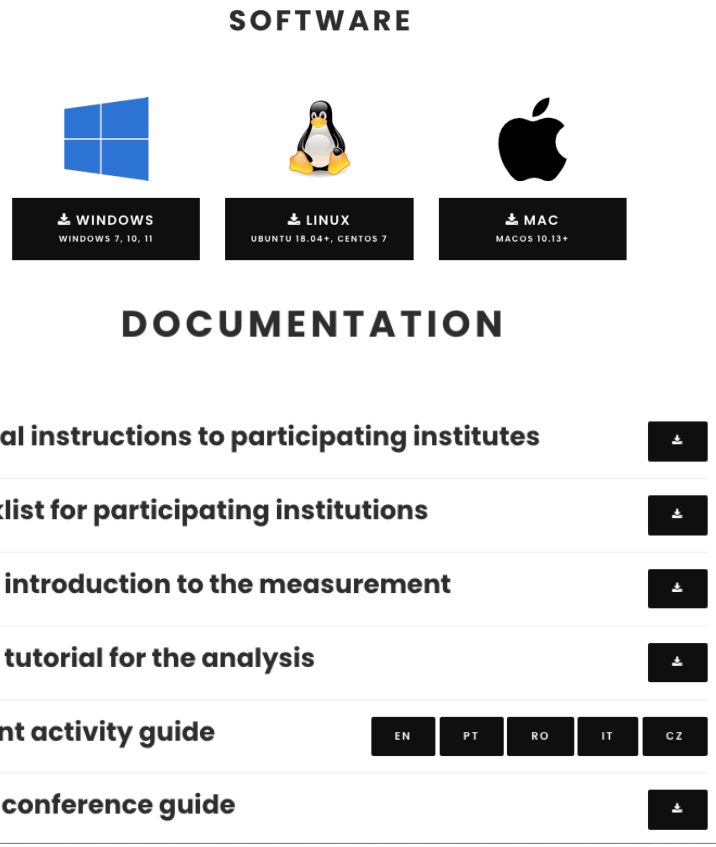
https://augermasterclasses.lip.pt/





Masterclasses





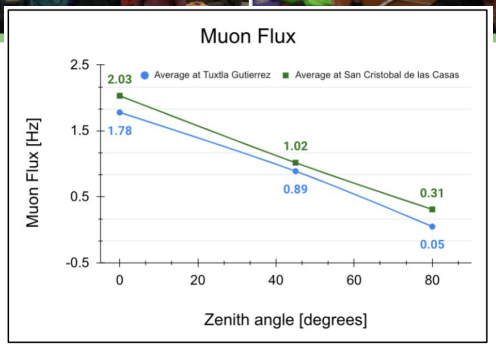
https://auger.org/outreach/education/auger-masterclasses
https://augermasterclasses.lip.pt/

PIERRE AUGER OBSERVATORY

Auger goes to School

International Cosmic Day and other events

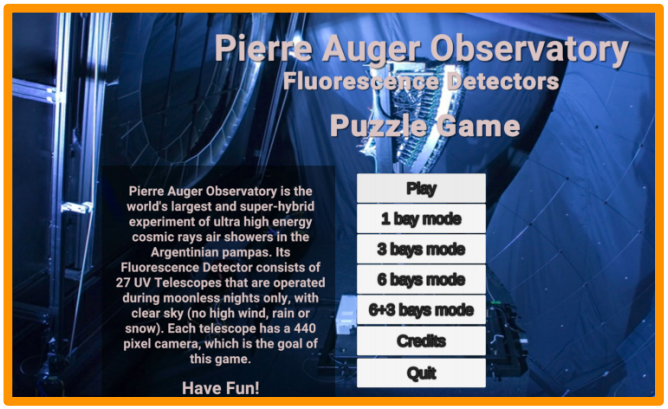
- ICD-Organized every year by DESY
- Detecting muons simultaneously in the same day all around the world.
- Writing a report
- Many Auger members all over the world

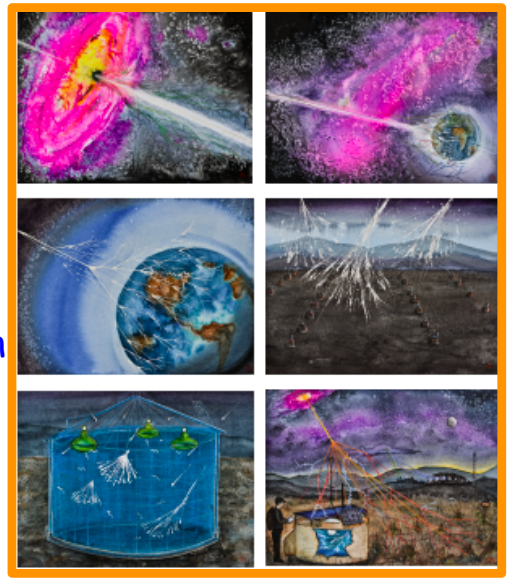


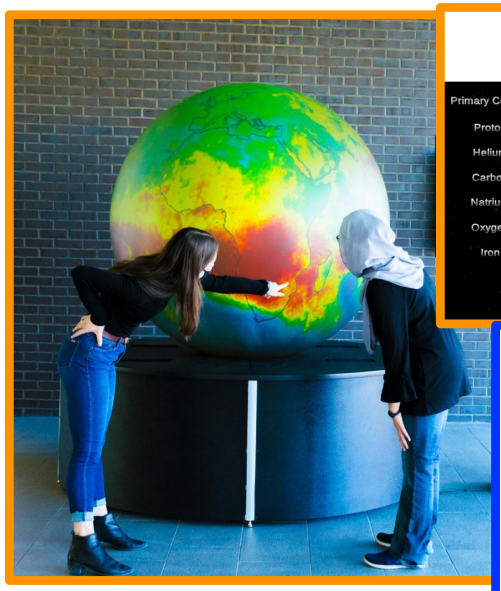
https://icd.desy.de/

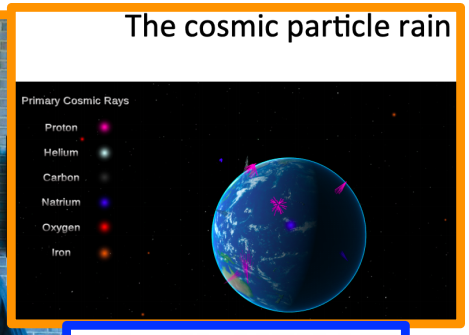
Other events and efforts

- Puzzle games and cosmic rain
- Summer Camps
- Schools
- Workshops
- Artwork based on Auger
- A projection Globe
- Inauguration of James Cronin School (16/11/2006)









- Auger stamp (2007)
- Planetarium Inauguration & production of 2 full dome shows (9/8/2008)

QR ,Wikipedia, videos, brochure and Auger in Focus

PIERRE AUGER OBSERVATORY Quarterly Report (PAO-QR)
October, November, December 2023

A. Institutional actions

1. Visits and Visitor Center

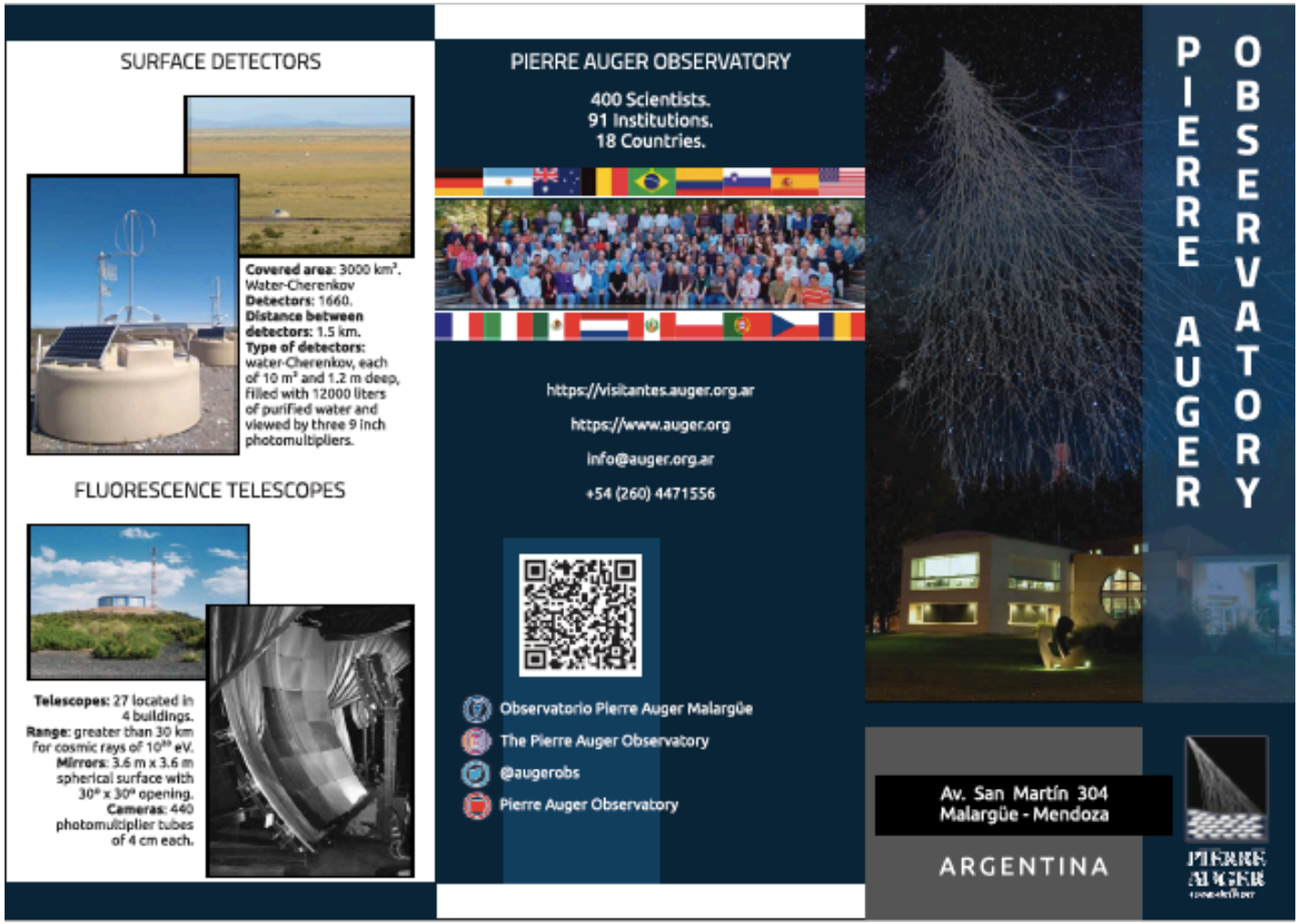
With new records, we have the Pierre Auger Headquarter full of visitors along the last quarter and the year. In Figure 1, the statistics of visitors is presented. A record 13,426 visitor in 2023 is part of the efforts of the scientists and staff of PAO throughout the year. Many of the students and teachers and professors visited the observatory after the program "The Observatory goes to the school"

https://youtu.be/1QO41a8A-hQ

Interviews, Documentaries, etc.

QR ,Wikipedia, videos, brochure and Auger in Focus

QR ,Wikipedia, videos, brochure and Auger in Focus



QR ,Wikipedia, videos, brochure and Auger in Focus

ULTRA - HIGH ENERGY COSMIC - RAYS

Cosmic rays are charged particles that constantly bombard the Earth and are one type of the cosmic messengers that help us understand our Universe. At the highest energies, the deflection of the trajectories by the Galactic and extragalactic magnetic fields is reduced, thus opening a new window of charged-particle astronomy. The goal of the Pierre Auger Observatory is to study the nature and origin of these Ultra-Energy Cosmic-Rays with unprecedented accuracy and statistical precision.

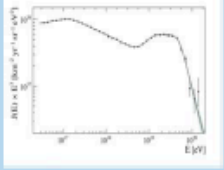
A BRIEF HISTORY OF THE OBSERVATORY

The Pierre Auger Observatory was conceived in the 1990s by Jim Cronin, Alan Watson and other colleagues, to address the mysteries of the origin and nature of the highest-energy particles. It was clear that only a very large detector would provide the exposure to collect enough events to answer the questions raised during nearly a century of earlier experiments.

The Observatory design evolved to a "hybrid" detector system consisting of an array of 1660 particle detectors, deployed over 3000 km^2, and overlooked by 27 telescopes used to detect the auroral-like emission from the atmosphere, detectable on dark nights. This 'so-called' fluorescence radiation enables the energy of the events to be determined without assumptions about the nature of the primary particles or off the hadronic interactions involved.

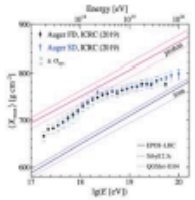
1991. Concept of the Pierre Auger Observatory developed.
1993. Collaborators recruited.
1995. Six-month design study at Fermi Lab.
1995. Argentina selected as the country to host the site of the Observatory during meeting at UNESCO in Paris.
1999. 19 March, Ground-breaking Ceremony and International Agreement signed in Malargüe.
2001. Construction initiated with the Engineering Array.
2004. 1 January: Science data taking started.
2008. June: Construction completed, with Inauguration later in year.
2015. International Agreement renewed.
2016. First upgraded-detectors positioned on the Pampa.
2019. A bright future beckons with start of full-scale construction of the upgrade.

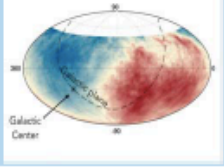
MAIN RESULTS OF THE OBSERVATORY



Confirmation of existence of a strong suppression of the flux of the highest energy particles. Its origin is not yet fully understood. [(ICRC2019) 450].

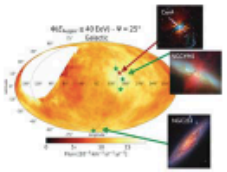
First indication that the primary composition of ultra-high energy cosmic-rays is getting heavier at higher energies. [(ICRC2019) 482].

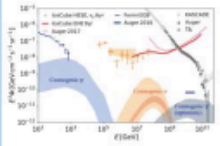




Discovery of a large-scale anisotropy in the arrival directions of ultra-high energy cosmic rays indicating that their origin is outside our Galaxy. [Science357 (2017) 1266].

Intermediate scale anisotropies suggested by correlation with different astrophysical catalogs. [ApJL 853:L29, 2018].





Best upper limits on the flux of UHE neutral primaries and a key role in the field of multi-messenger astrophysics. [JCAP 1910 (2019) 022], [JCAP 1704 (2019) 009].

A BRIGHT FUTURE

Spurred by the science results obtained so far, the Observatory is currently undergoing an upgrade ("AugerPrime"), aimed mostly at improving the sensitivity of the surface detector to primary mass composition. New electronics are being installed with a small PMT in each water-Cherenkov detector. With additional complementary detectors with the aim of a better separation of the electromagnetic and muonic components on an event-by-event basis, with three types of detectors.

The new detectors are:

* a slab of scintillators, over the surface detectors,
* radio antennas (30-80 Mhz), recording the radio signal from extensive air showers, both to be installed atop of the existing stations,
* an array of buried muon counters in the dense part of the array.

The additional observables are critical to the selection of the subset of showers likely to arise from lighter primaries, which in turn may hold the key to identifying and studying the cosmic accelerators outside our own galaxy.

More generally, the data collected with AugerPrime will be used to explore fundamental particle physics at energies beyond those accessible at terrestrial accelerators, and perhaps allow the observation of new physics phenomena.

QR ,Wikipedia, videos, brochure and Auger in Focus

Bulletin

AUGERINFOCUS

2024

WHO WE ARE

To decode the enigma of ultra-high-energy cosmic rays, the Pierre Auger Observatory, where over 400 scientists, engineers, technicians, and students from 18 countries work, measures the particle cascades that occur each time a cosmic ray collides with molecules in the upper atmosphere. This allows them to determine the energy, direction of arrival, and nature of cosmic rays of the highest observable energies. The Observatory is located in the Southern Hemisphere, in the Malargüe area, Mendoza Province, Argentina, and consists of a network of 1,660 detectors, spaced 1.5 km apart, covering a total area of 3,000 square km.
The surface detector network is complemented by a set of 27 highly sensitive telescopes that, on clear nights around the new moon, scan the atmosphere to observe the faint ultraviolet light produced by cosmic ray cascades as they pass through the air.

AUGERINFOCUS OBJETIVES

The Pierre Auger Observatory receives an average of 10,000 visitors per year. During each visit, a series of questions arise that would require more detailed explanations than those provided during a tour. In this context, the Observatory decided to select specific topics that are repeated as part of the public's questions. These texts can be consulted by those interested in learning more about the research and developments of the Observatory, and in particular by teachers, as they are designed as educational and dissemination material.
This is how Auger en Foco was born

COMUNICATIVE STRATEGY

Information about the Pierre Auger Observatry can be found on it´s websites:

www.auger.org
www.auger.org.ar

In addition, an online audio guide allows you to take a virtual tour (Spanish,English)

AUGERINFOCUS

No. 1, May 2024 www.auger.org.ar

SPARK CHAMBER

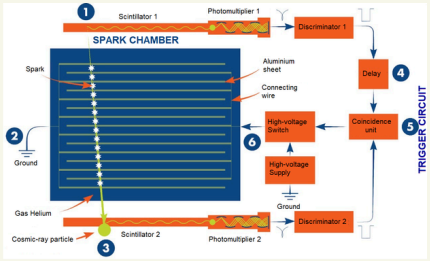
A large part of natural environmental radioactivity is due to cosmic rays, which come from space and are mainly atomic nuclei of hydrogen (protons), helium, carbon, oxygen, etc., accelerated to a very high speed. When entering the atmosphere, cosmic particles collide violently with atmospheric gas molecules and produce "atmospheric showers" or "atmospheric showers" of secondary particles. Some of these particles generated in the atmosphere, mainly muons and electrons, reach the ground and can be detected. The "Spark Chamber" is a device that allows the existence of these particles to be verified, at least those that have an electric charge. This equipment detects them and allows their trace or path that they followed to be visualized, thanks to the sparks that are produced in their passage.

WORKING PRINCIPLE

At the top and bottom of the chamber (see figure) there are 2 plastic scintillator plates (1 and 3). The chamber has several modules, formed by 2 parallel grounded plates (2) and a plate in the center, connected to a high-voltage generator (6). The chamber is filled with helium. When a charged particle, normally a muon, passes through the entire device, it ionizes the gas contained in the chamber and also causes the emission of light in the scintillators.

DESCRIPTION OF OPERATION

- The light from each scintillator plate is converted into an electrical signal; the two electrical signals arrive almost simultaneously. This coincidence is detected by a small electronic circuit that produces a very fast 8 kV pulse (depending on the design) transmitted to each electrode (5).



Spark Chamber diagram. The numbers are explained in the text. (Image modified from: Discovering particles: fundamental building blocks of the Universe)

- The central plate suddenly drops to -8000 V, and sparks can be formed where the gas has been ionized by the passage of the charged particle.
- The sparks align along the track and allow the particle's trajectory to be visualized, slightly delayed.
- After the passage of a muon, the chamber has a dead time, which is necessary to recharge the capacity of the electrical circuit made up of resistors and capacitors.

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PIERRE AUGER OBSERVATORY

Thank you!


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