The ALPACA Experiment

Andes

Large area

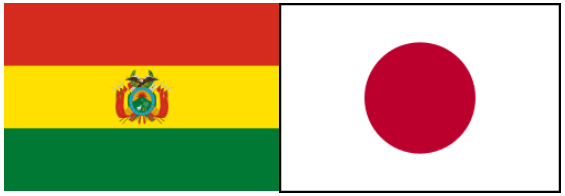
PArticle detector for

Cosmic ray physics and

Astronomy

Masato TAKITA, ICRR, the University of Tokyo,
May 2, 2016, @PARANINFO, UNIVERSITARIO, UMSA

The ALPACA Collaboration



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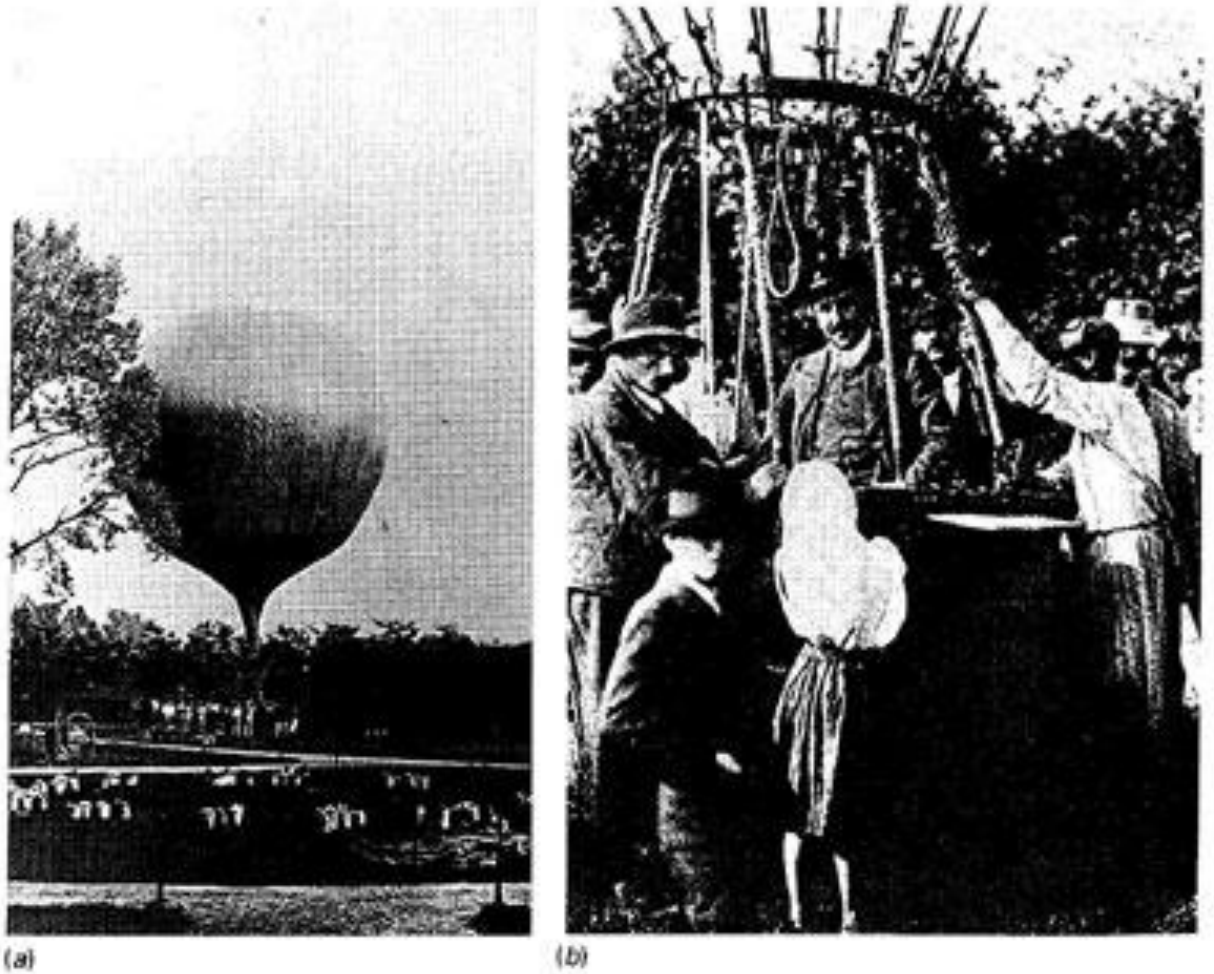
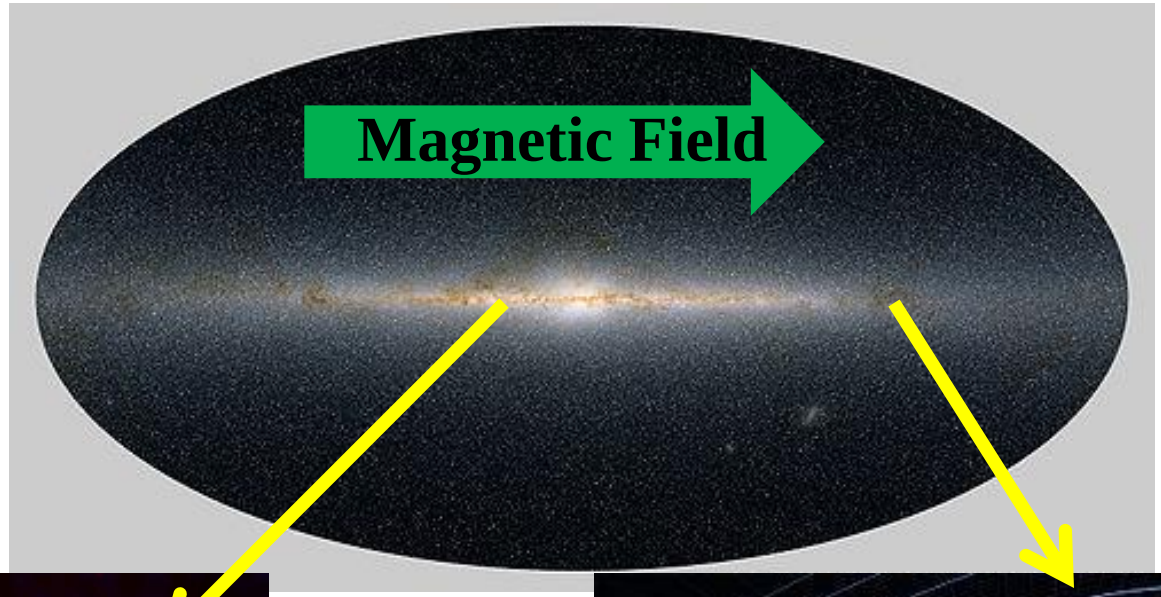
Discovery of cosmic rays by Victor HESS (in 1912) getting on the hot air balloon

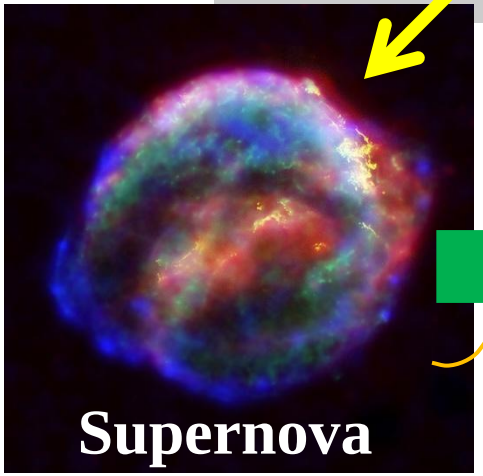


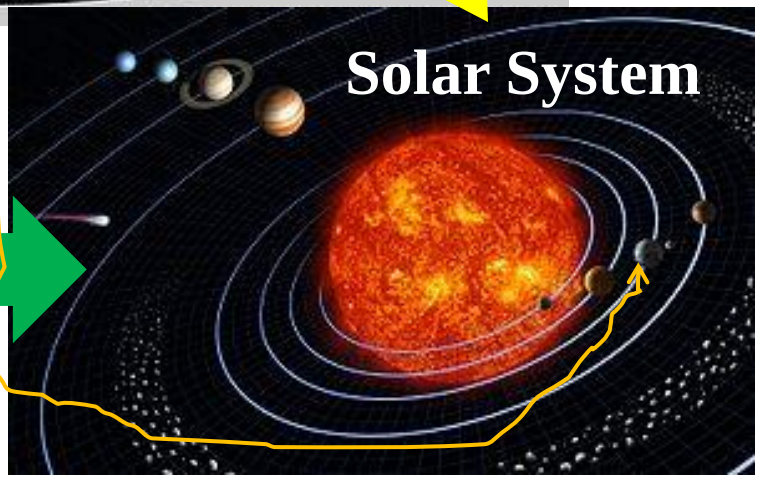
Cosmic rays: Particles from outer space (H, He, C, N, O,…Fe nuclei)

Our Galaxy

100,000 light year





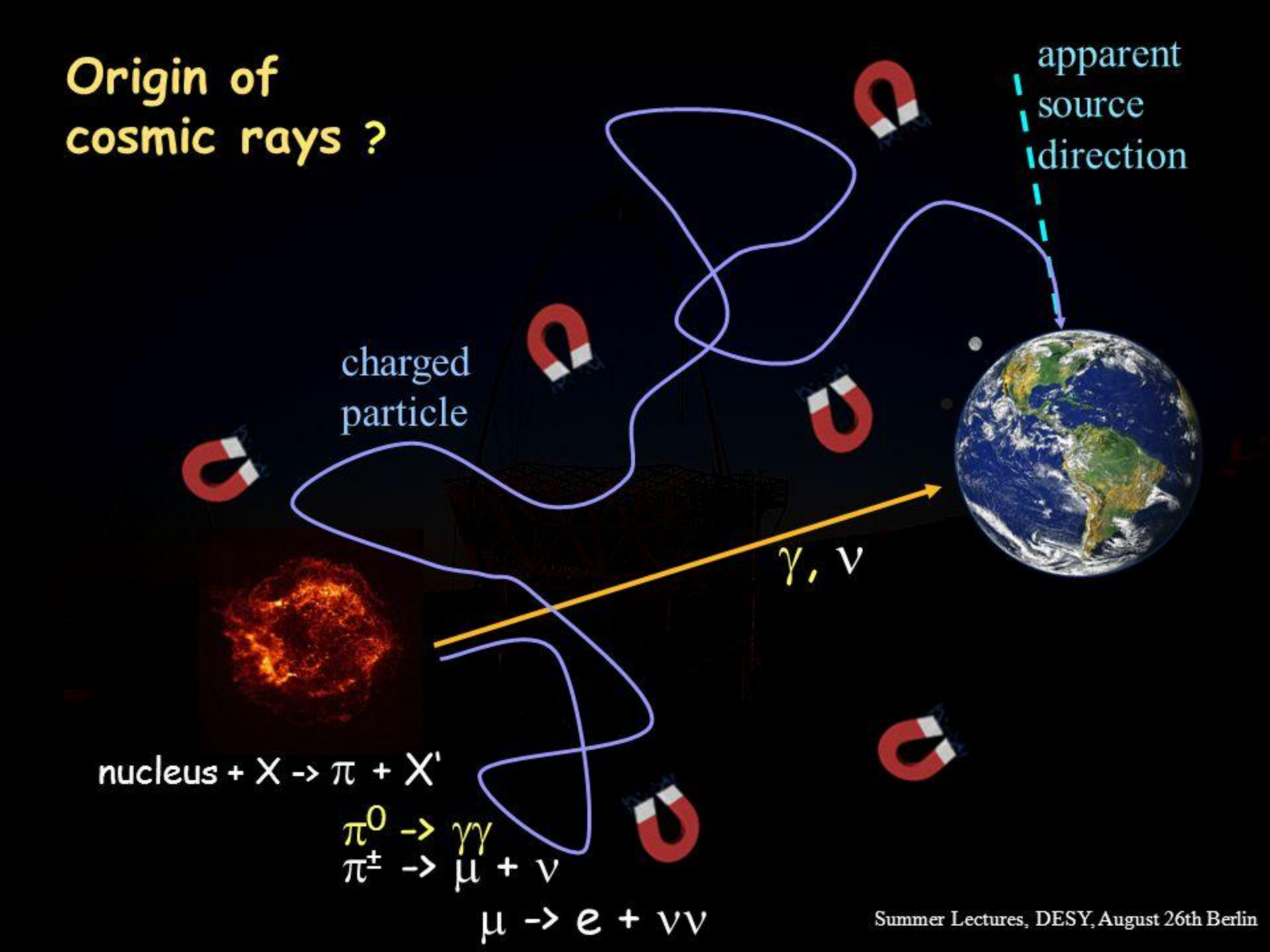


Cosmic Ray Trajectory

Origin of Comic Rays !?

0.001 light year

Origin of cosmic rays ?



nucleus + X -> π + X'

$\pi^0 \rightarrow \gamma\gamma$

$\pi^{\pm} \rightarrow \mu + \nu$

$\mu \rightarrow e + \nu\nu$

Main purpose of ALPACA

- Locating origin of comic rays!

  by detecting very high-energy gamma rays from the origin.

  Gamma (γ) rays: very high energy optical light photons , much more energetic than X-rays)

Why in Bolivia

- Flat land at high altitude: (> 4000m)

  Cosmic rays absorbed in atmosphere before reaching sea level

- Galactic Center: Observable in the southern hemisphere (not in the northern hemisphere)

  Most promising candidate of the origin of cosmic rays

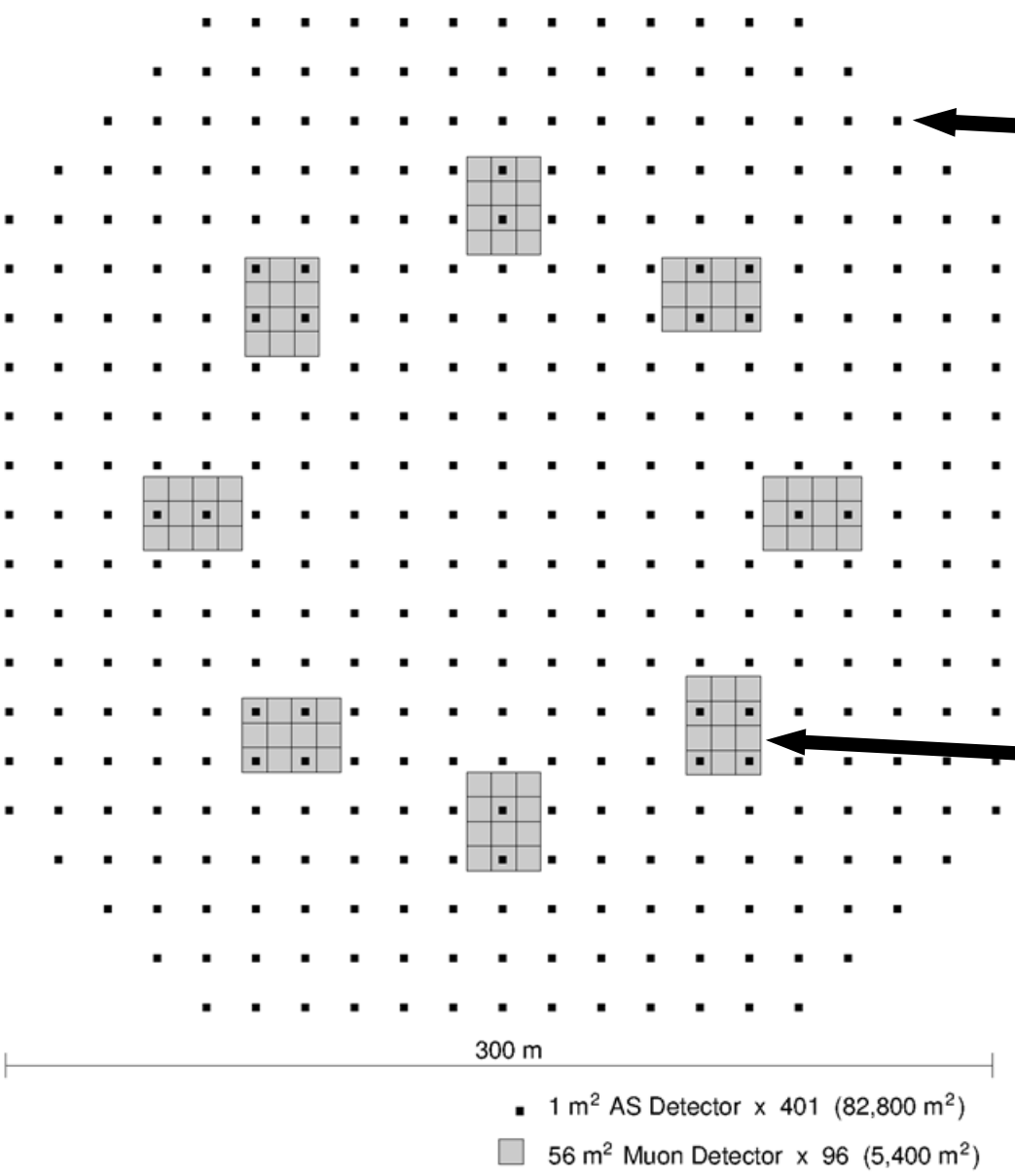
- Long-term collaboration between Bolivia and Japan

  Since 1962 in the field of cosmic rays, for example, BASJE

Experimental Cite : Cerro Estuqueria

4,740 m above sea level (16˚23′S, 68˚08′W)

Schematic view of ALPACA



Air Shower Array

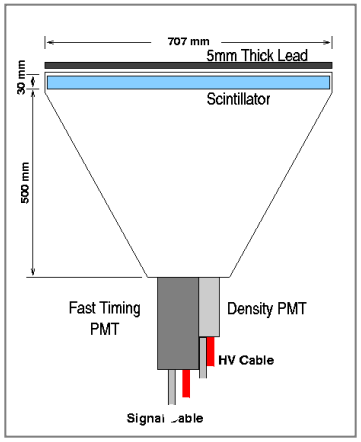


Image of 1m² plastic scintillation detector

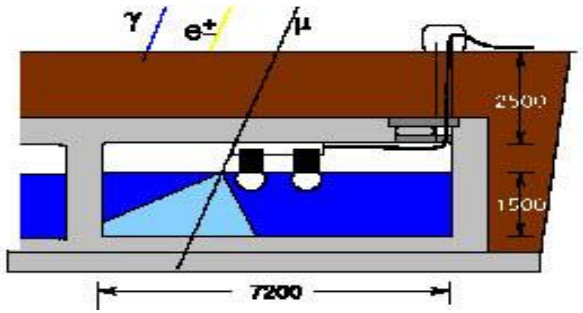


Image of unit (56m²) underground water Cherenkov muon detector

Image of ALPACA

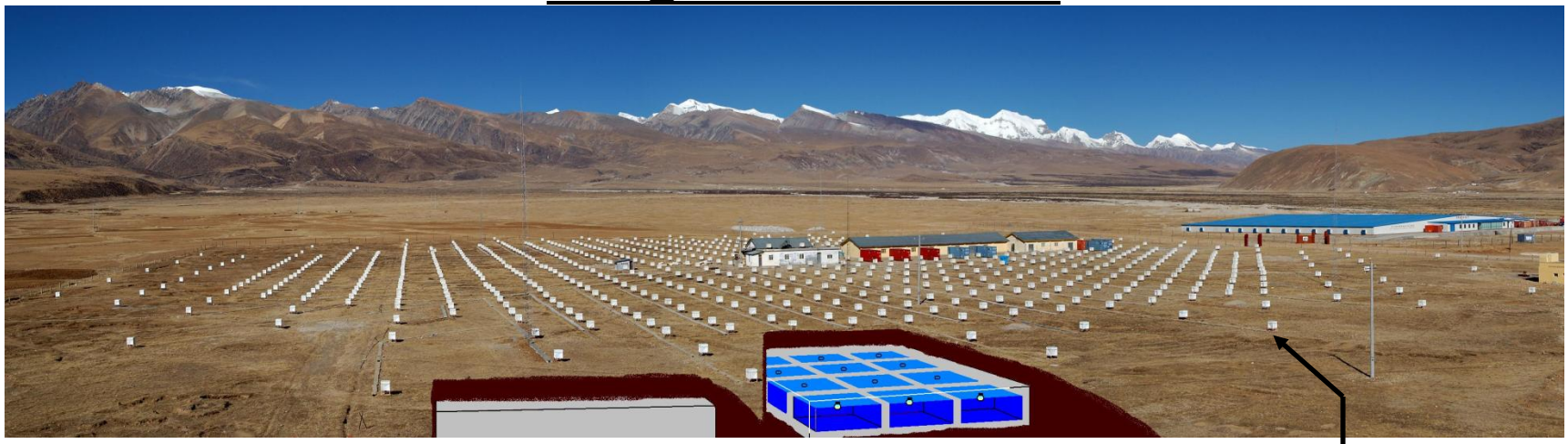


Image of underground water Cherenkov ↑ muon detectors 5,400m^2 in total

Location: 4,740 m above sea level (16˚23ʹS, 68˚08ʹW)

# of scintillation detectors	1 m^2 x 401 detectors
Effective area of	~83,000 m^2
modal energy	~5TeV
angular resolusion	~0.2 @100 TeV
energy resolution	~40% @100TeV
field of view	~2 sr

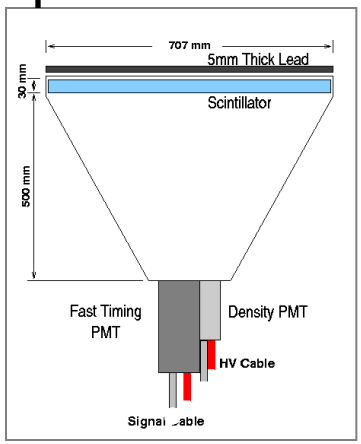
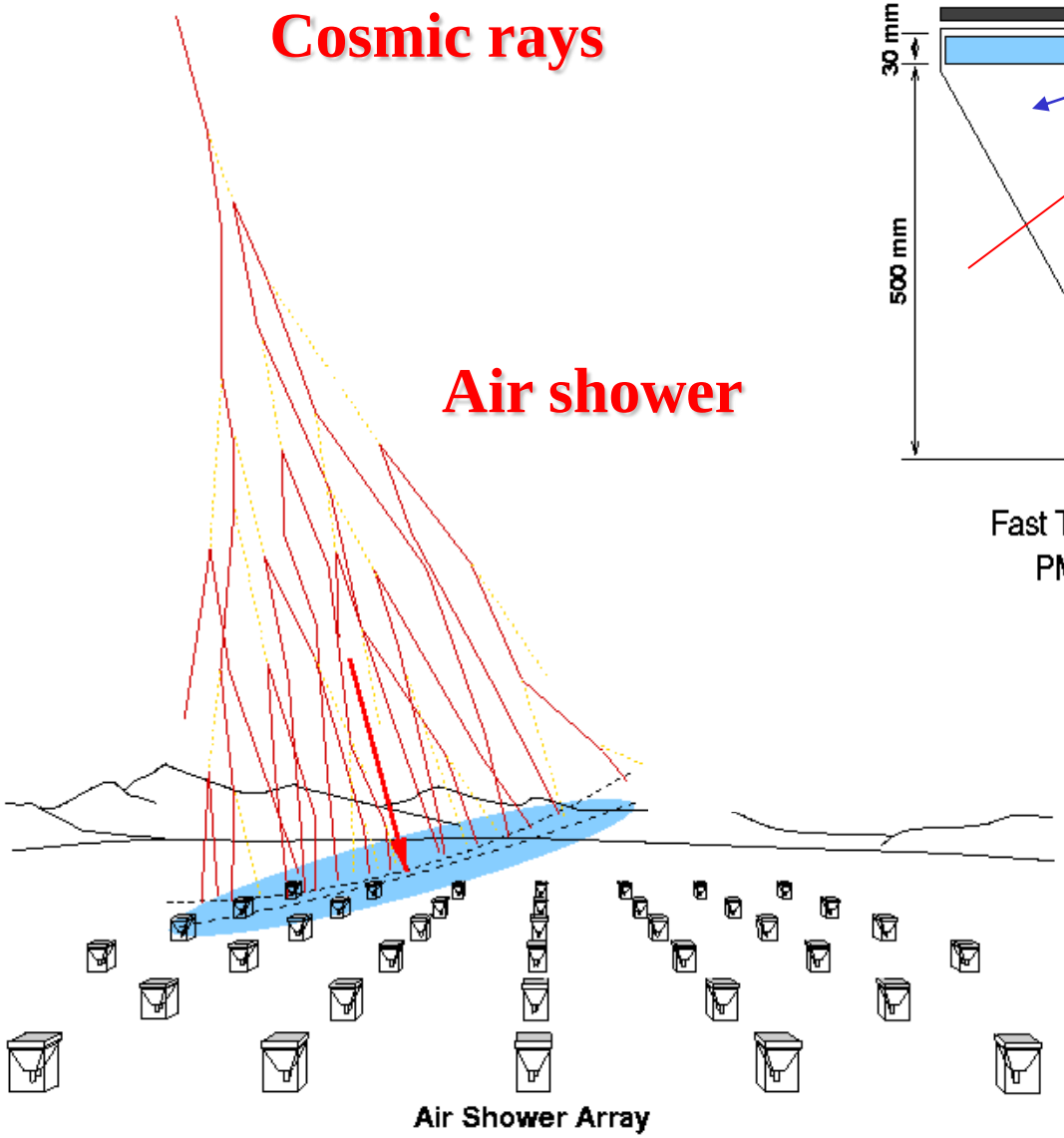
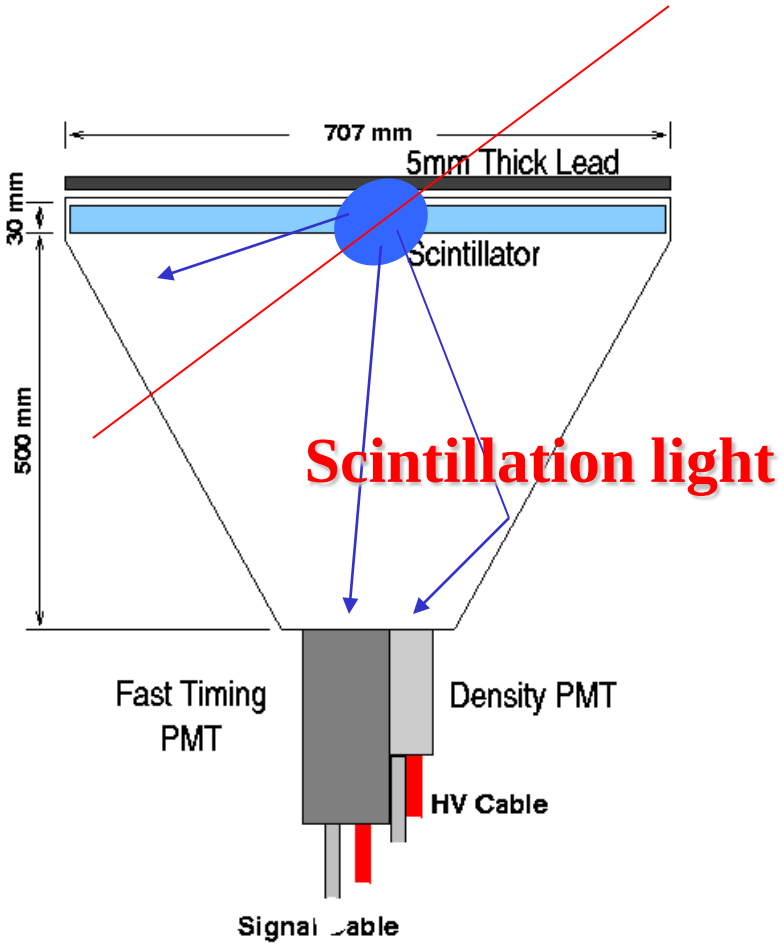


Image of 1m^2 scintillation detector

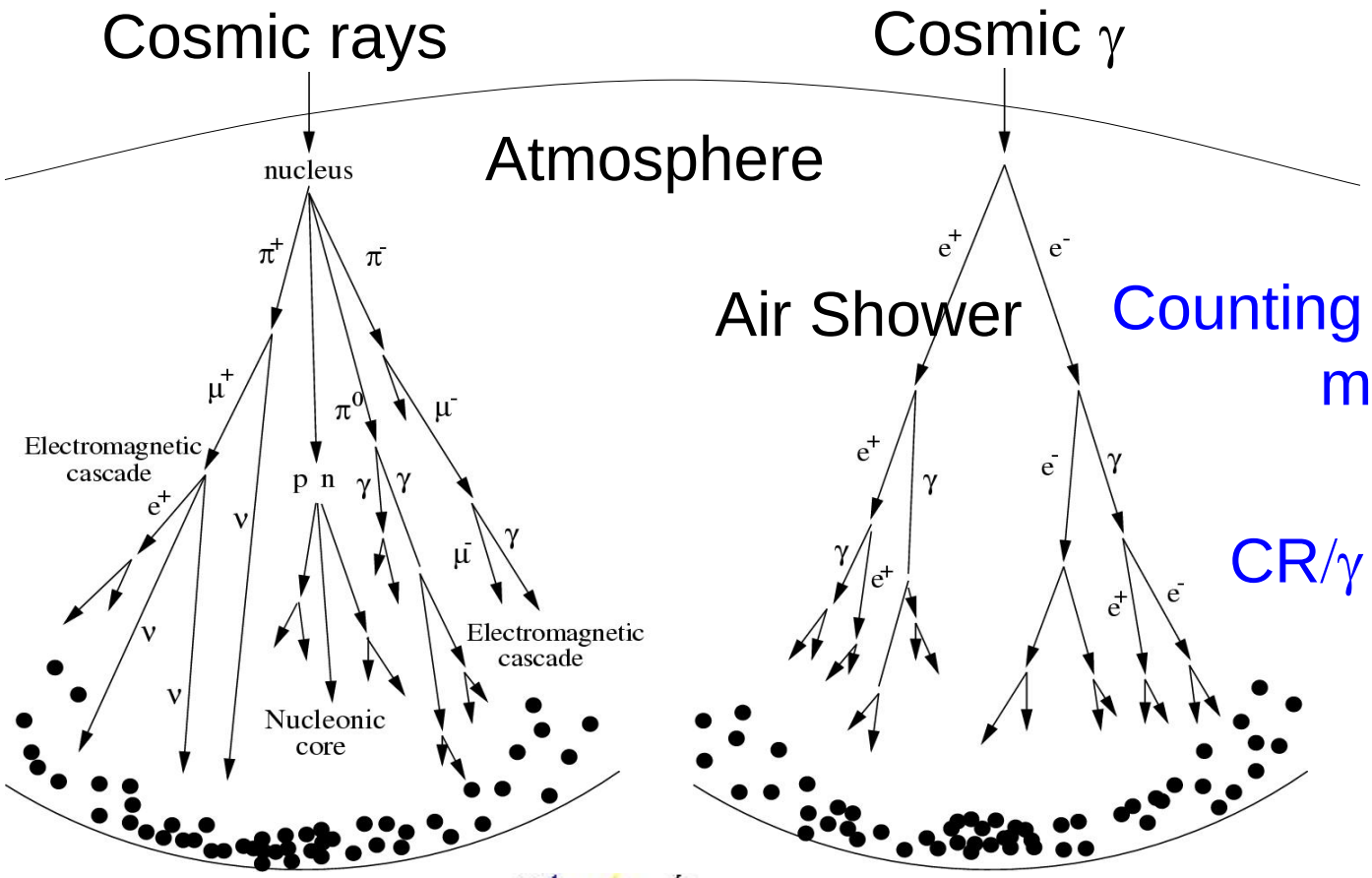
Detection Principle





Measurement of cosmic ray energy and cosmic ray direction

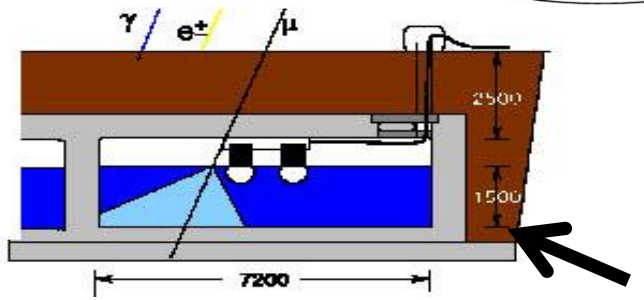
Cosmic ray/Cosmic γ discrimination by muons (an elementary particle)



Counting number of muons

CR/γ discrimination

Cosmic rays
Many muons



Cosmic γ
Muon-less

Muon detector

Gracias por escucharme.
Por favor, apoyen el experimento
ALPACA