

The overview and current status of the ALPACA experiment

Takashi SAKO

for The ALPACA Collaboration

The ALPACA Experiment

Andes

Large area

PArticle detector for

Cosmic ray physics and

Astronomy

The ALPACA experiment

★ A New Project in Southern Hemisphere (Bolivia)

Bolivia side 5 members
 UMSA (Universidad Mayor de San Andrés)

Japan side 29 members
 (Some members from BASJE + GRAPES-3 + Tibet AS γ)

★ Targets

10 - 1000 TeV gamma-ray astronomy (Southern sky)

Cosmic-ray anisotropy

Sun shadow

Chemical composition at Knee region

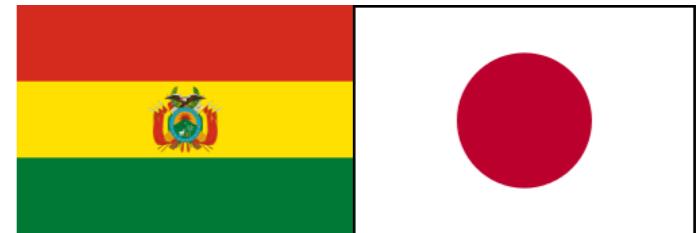
★ Site and Detectors

Halfway up Mt. Chacaltaya, Bolivia 4,740 m a.s.l.

Surface air shower array ~83,000 m²

Underground muon detector array ~5,400 m²

The ALPACA Collaboration



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ALPACA Site

Mt. Chacaltaya, Bolivia

16°23'S, 68°08'W

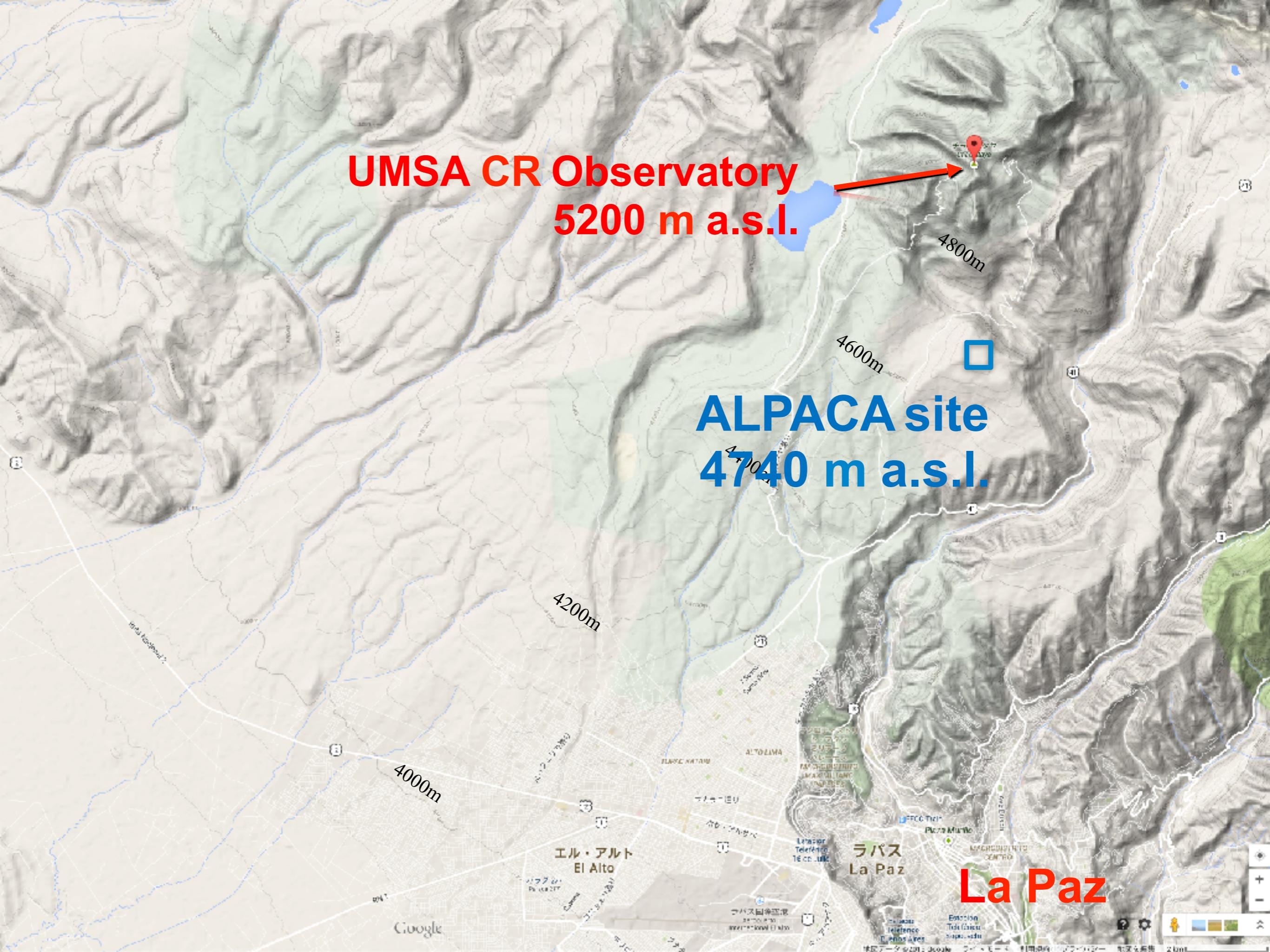


**UMSA CR Observatory
5200 m a.s.l.**



**ALPACA site
4740 m a.s.l.**

La Paz



Observation Cite: **Chacaltaya Hill**

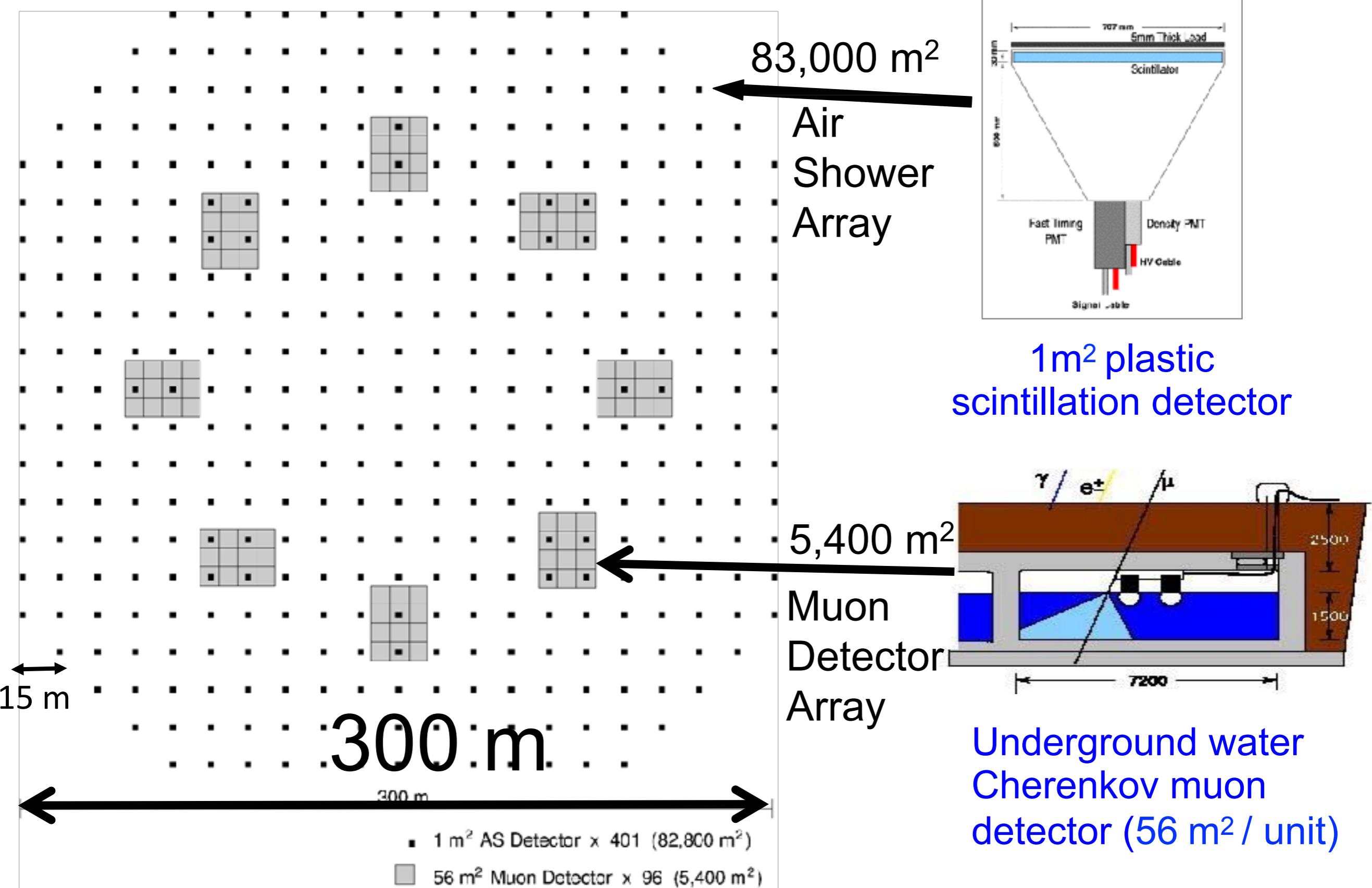
500 m × 500 m flat within $\pm 1^\circ$

4,740 m above sea level (16°23'S, 68°08'W)

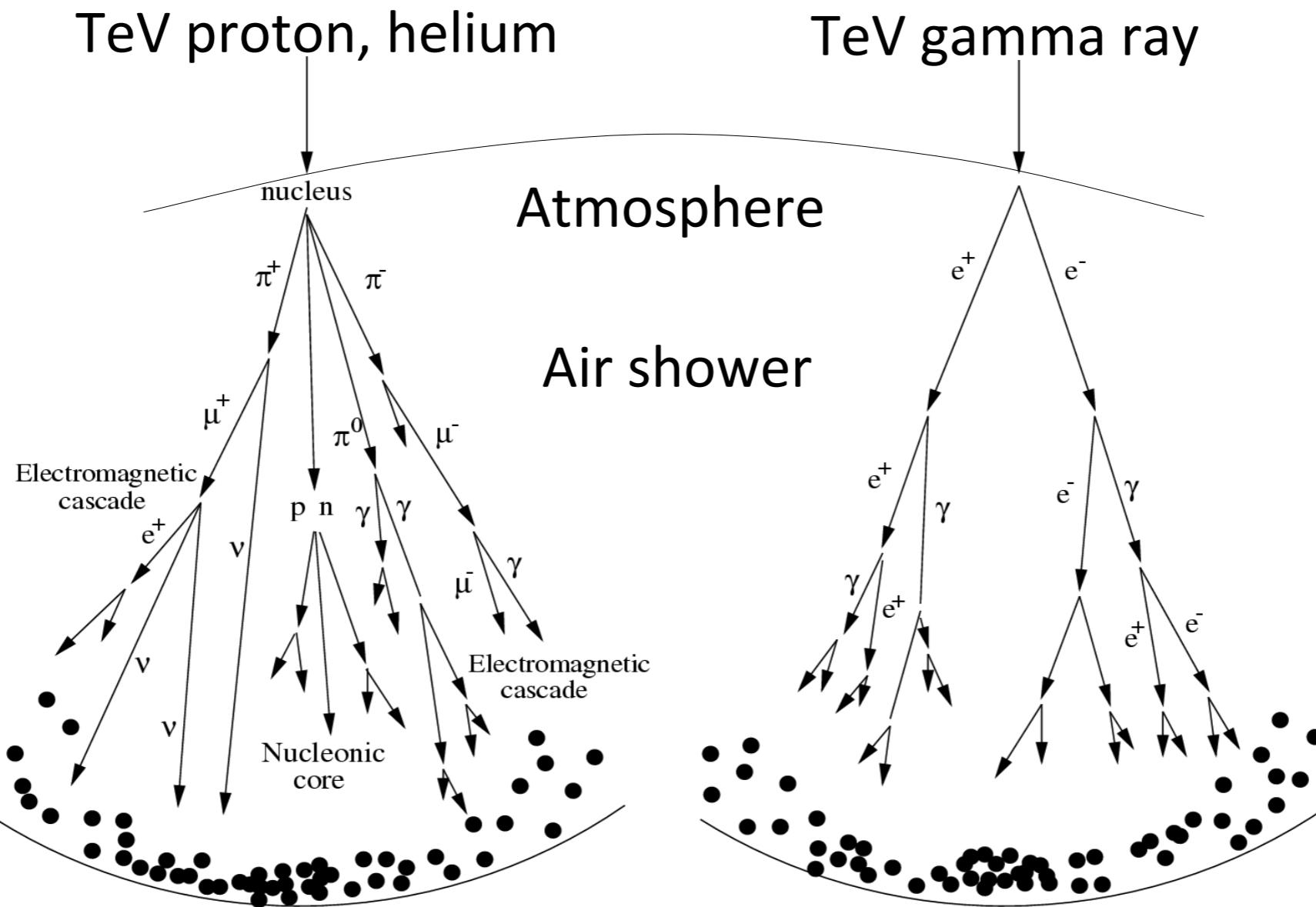


28 April 2016

Schematic view of ALPACA



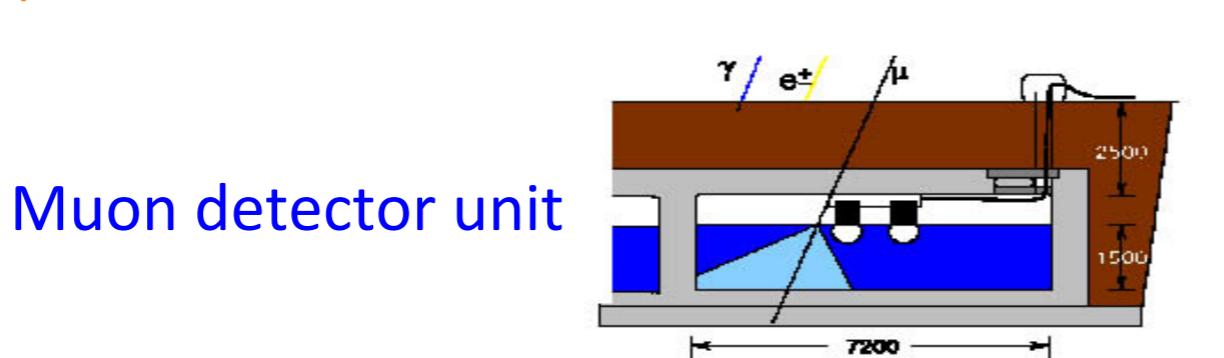
p/ γ discrimination by counting # of muons



Number of muons within <100m from air-shower core

~50 μ for 100 TeV proton

~1 μ for 100 TeV γ

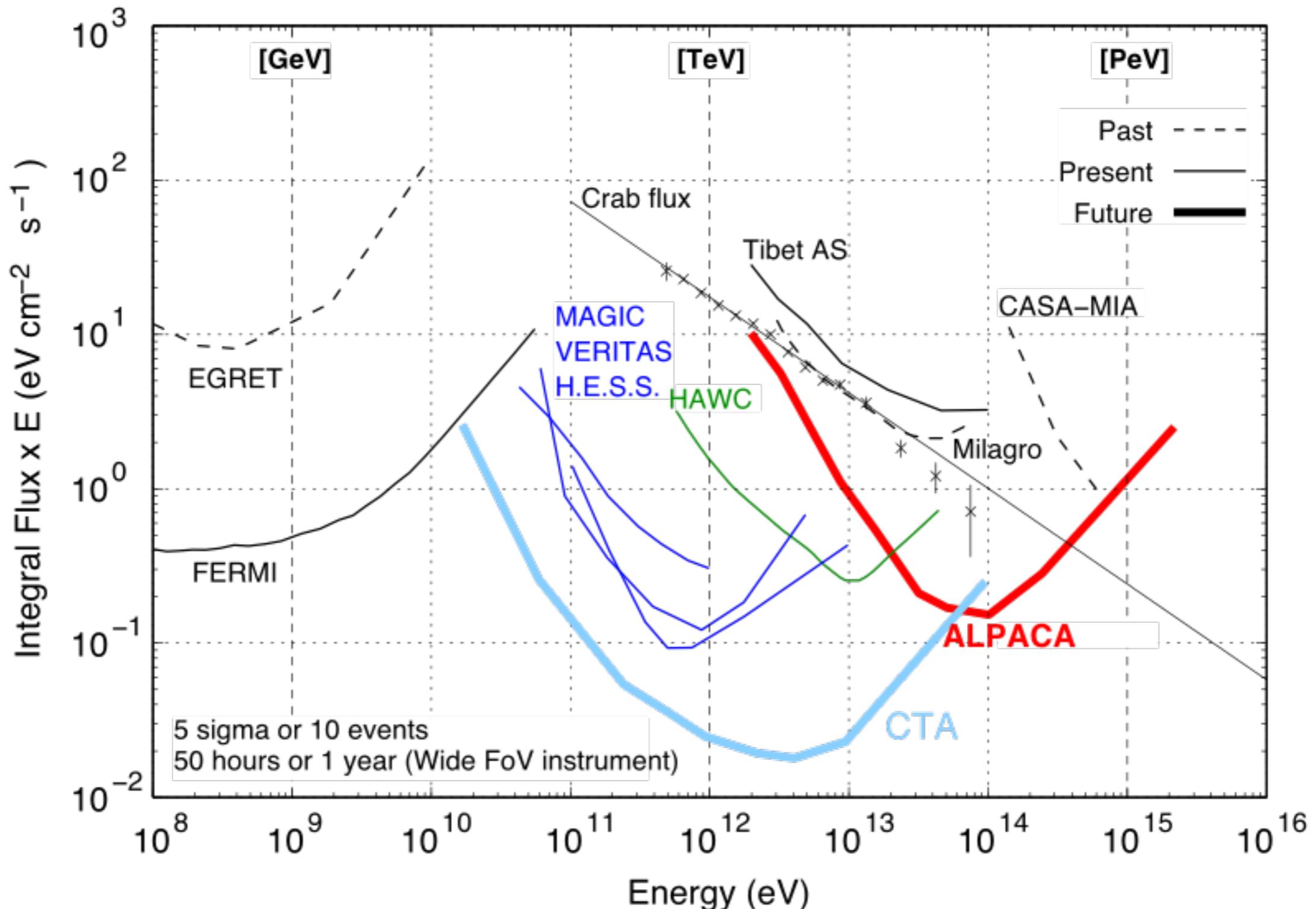


Performance of ALPACA

Location: 4,740 m above sea level (16°23' S, 68°08' W)

# of scintillation detectors	1.0 m ² × 401 detectors
Effective area of	~83,000 m ²
Modal energy	~5 TeV
Angular resolution	~0.2° @ 100 TeV
Energy resolution	~20% @ 100 TeV γ -rays
Field of view	~2 sr
Duty cycle	>90%
CR rejection power	>99.9%@100TeV (γ ray efficiency ~90%)

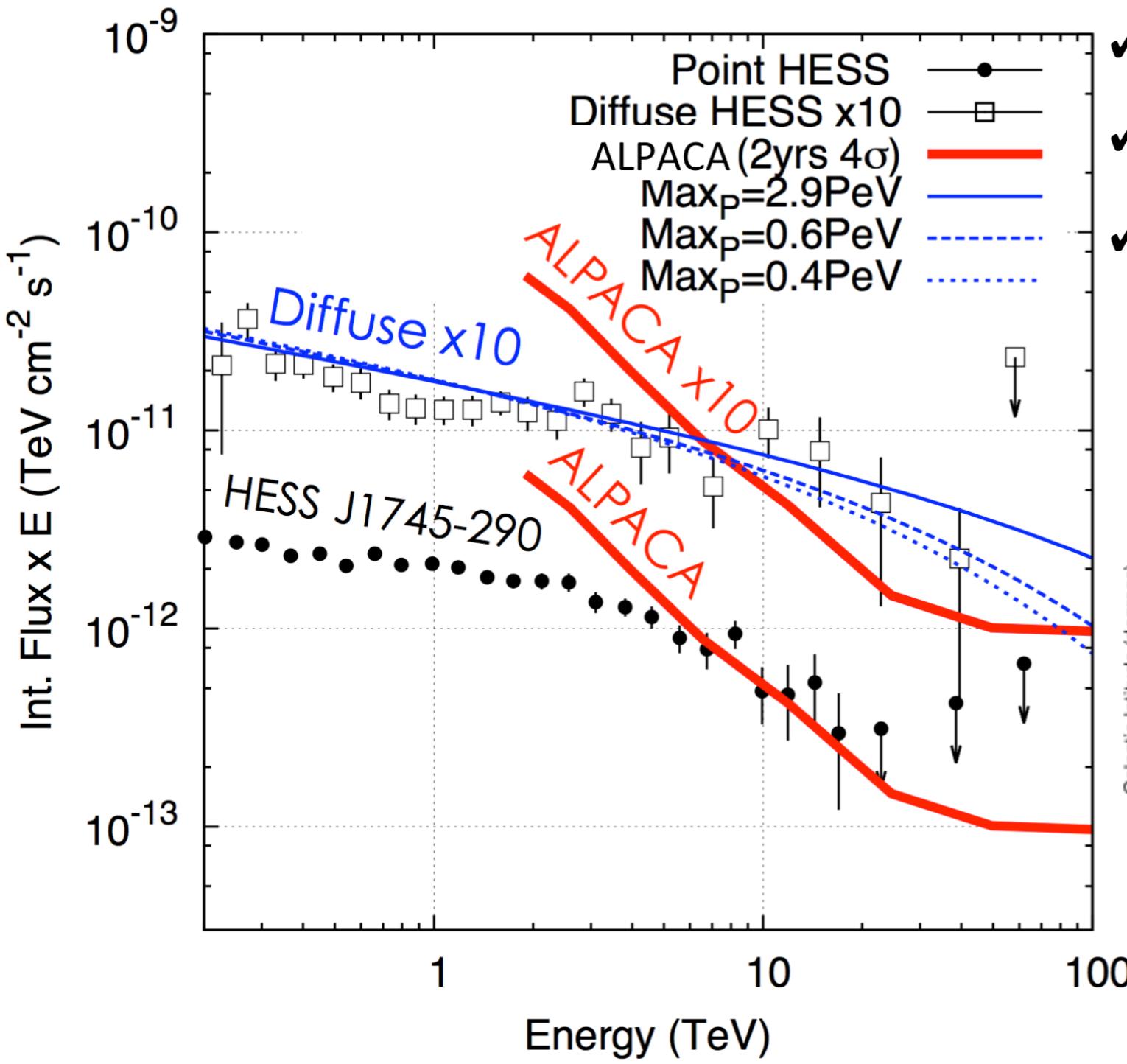
Sensitivity to γ -ray Point Source



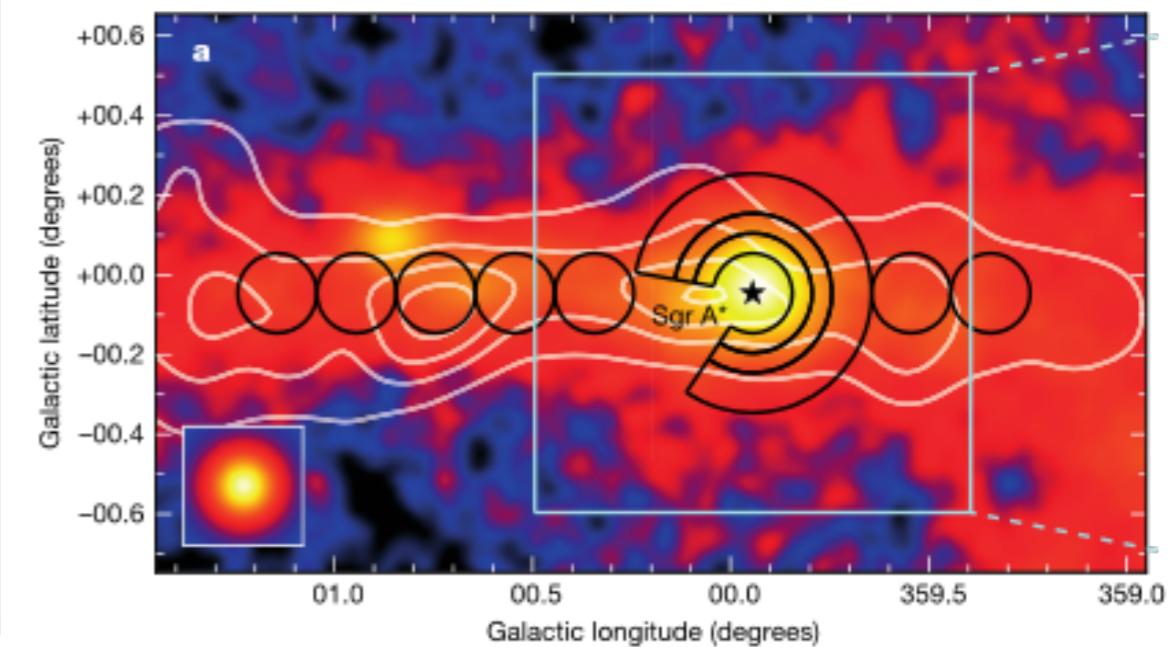
CTA Review by Kubo (JPS 2015)

M. Daniel, Proc. of 28th Texas Sympo. (2015)

Galactic Center as PeVatron!?



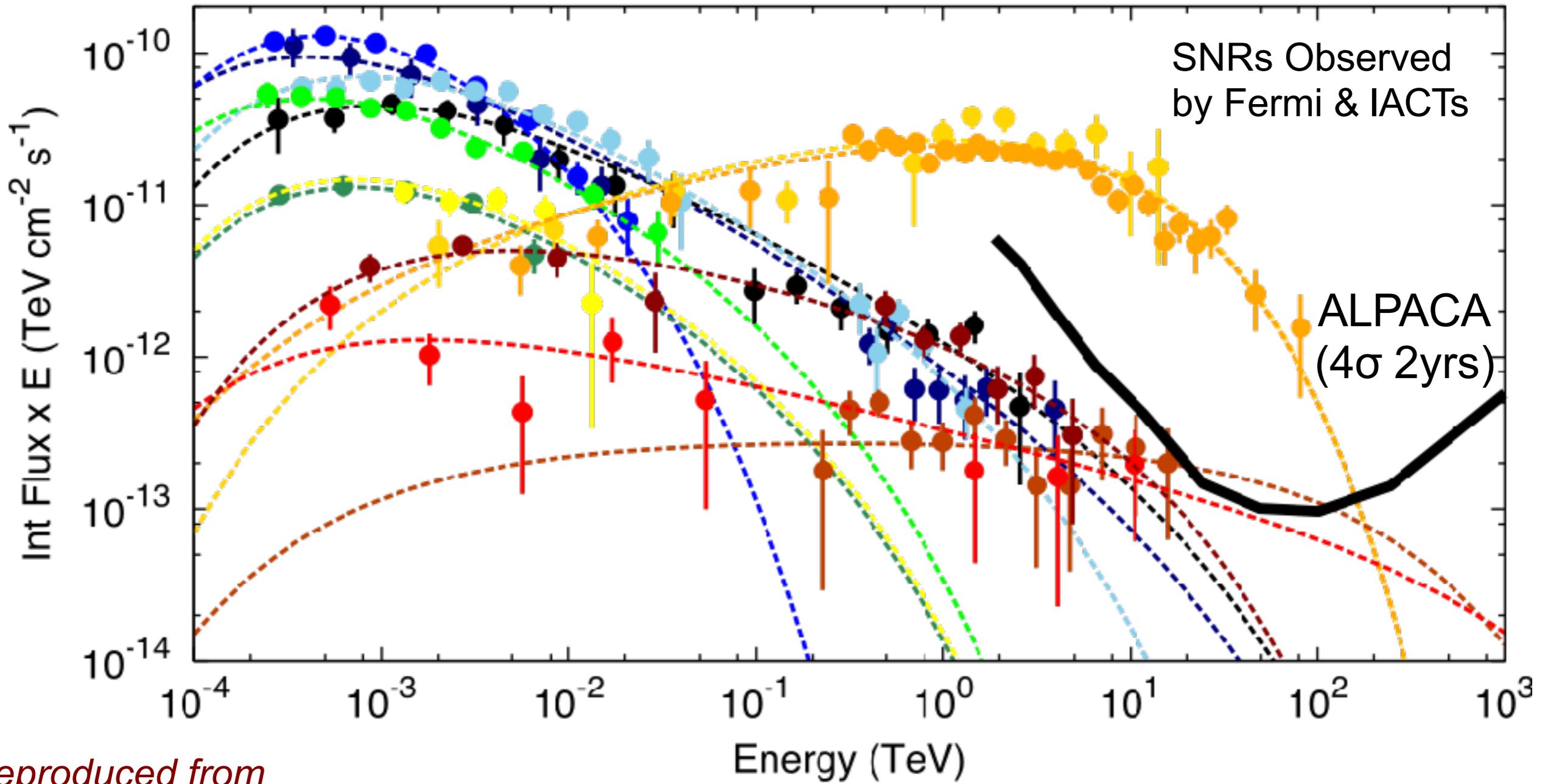
- ✓ Detection of diffuse component
- ✓ sub-PeV γ -rays expected
- ✓ Promising candidate for PeVatron



Abramowski, et al, Nature (2016)

$\delta \sim -29^\circ$

Young SNRs



*Reproduced from
slides presented by
S. Funk (TeVPA 2011)*

W51C (35k yrs)	—●—	PuppisA (3.7k yrs)	—●—
W28 (30k yrs)	—●—	RXJ0852 (2.5k yrs)	—●—
W44 (20k yrs)	—●—	RXJ1713 (2.0k yrs)	—●—
IC443 (10k yrs)	—●—	SN1006 (1.0k yrs)	—●—
Cyg Loop (5.0k yrs)	—●—	Tycho (0.4k yrs)	—●—
W49B (4.0k yrs)	—●—	CasA (0.3k yrs)	—●—

ALPAQUITA: prototype AS array

of scintillation detectors

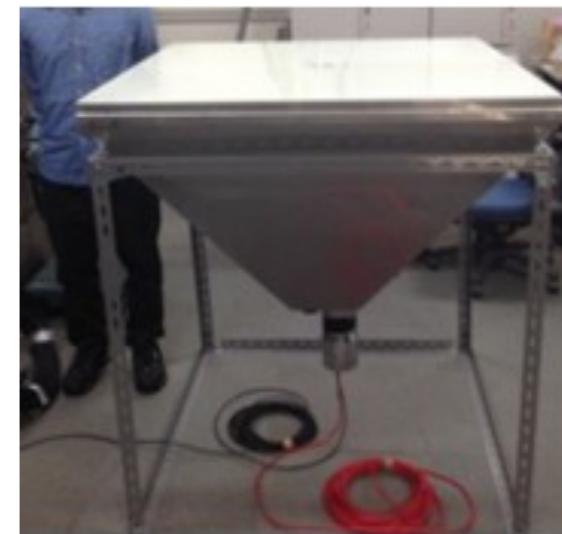
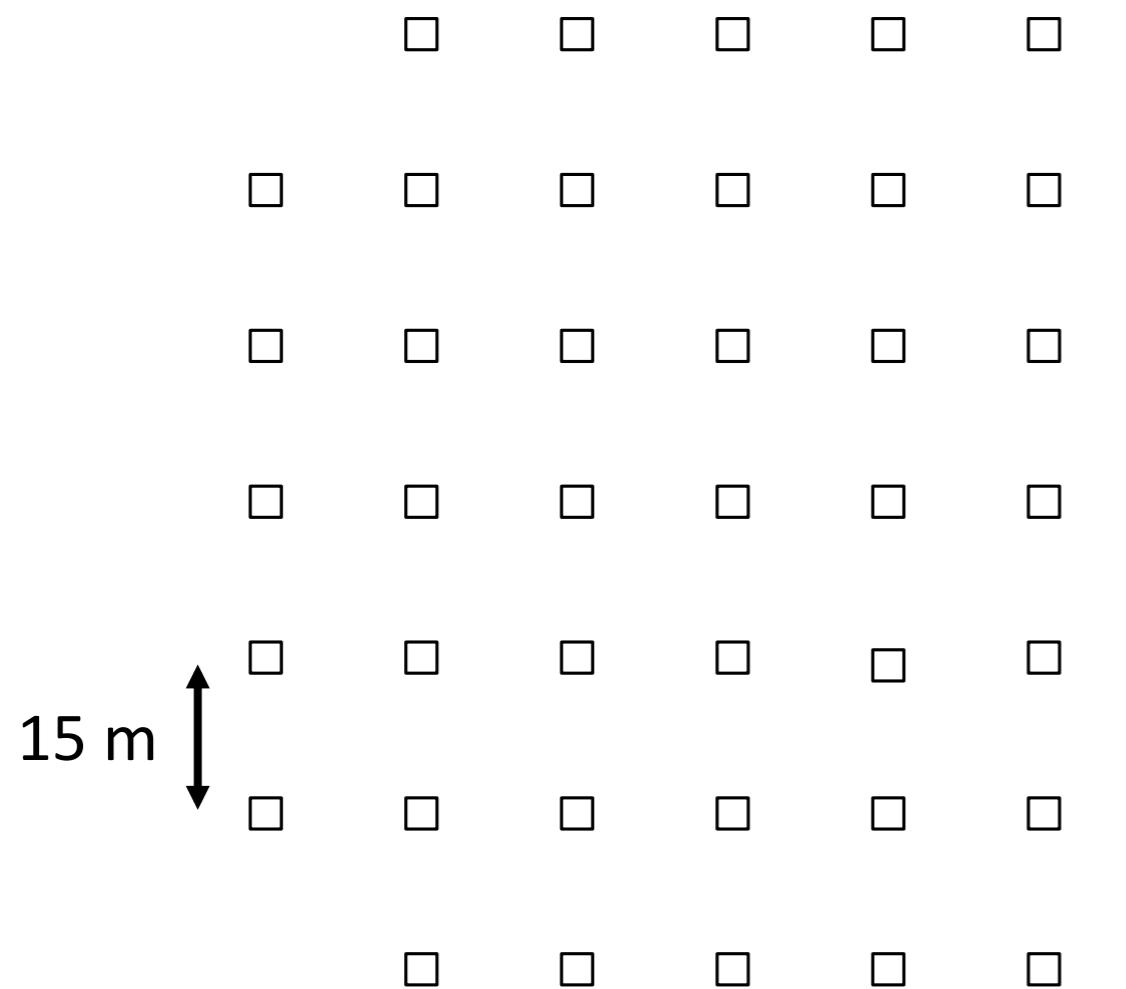
$1.0 \text{ m}^2 \times 45 \text{ detectors}$

Effective area

$\sim 8,000 \text{ m}^2$

Start data taking

end of 2017 or beginning of 2018



Summary

★ new project **ALPACA** in southern hemisphere

Halfway up Mt. Chacaltaya, Bolivia	4,740 m a.s.l.
Surface air shower array	~83,000 m ²
Underground muon detector array	~5,400 m ²

★ Targets

- 10 - 1000 TeV gamma-ray astronomy (Southern sky)
- Cosmic-ray anisotropy
- Sun shadow
- Chemical composition at Knee region

★ ALPAQUITA: prototype AS array

45 x 1.0 m² scintillation detectors (~8,000 m²)

Thank you for your attention!

Why in Bolivia

- ◆ Long-term collaboration between Bolivia and Japan
 - Since 1962 in the field of cosmic rays, e.g. BASJE
- ◆ Galactic Center observable in the southern hemisphere
 - Promising candidate for the origin of PeV cosmic rays
- ◆ Vast & flat land at high altitude > 4000m
 - Cosmic rays/ γ -rays absorbed in atmosphere before reaching sea level
- ◆ Electric power lines easily accessible
- ◆ Abundant water for water tanks of the observatory
 - Background CR rejection for γ -ray observation