

The overview and current status of the ALPACA experiment

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for The ALPACA Collaboration

TeVPA 2017 7-11 August 2017, Columbus, Ohio, USA

The **ALPACA** Experiment

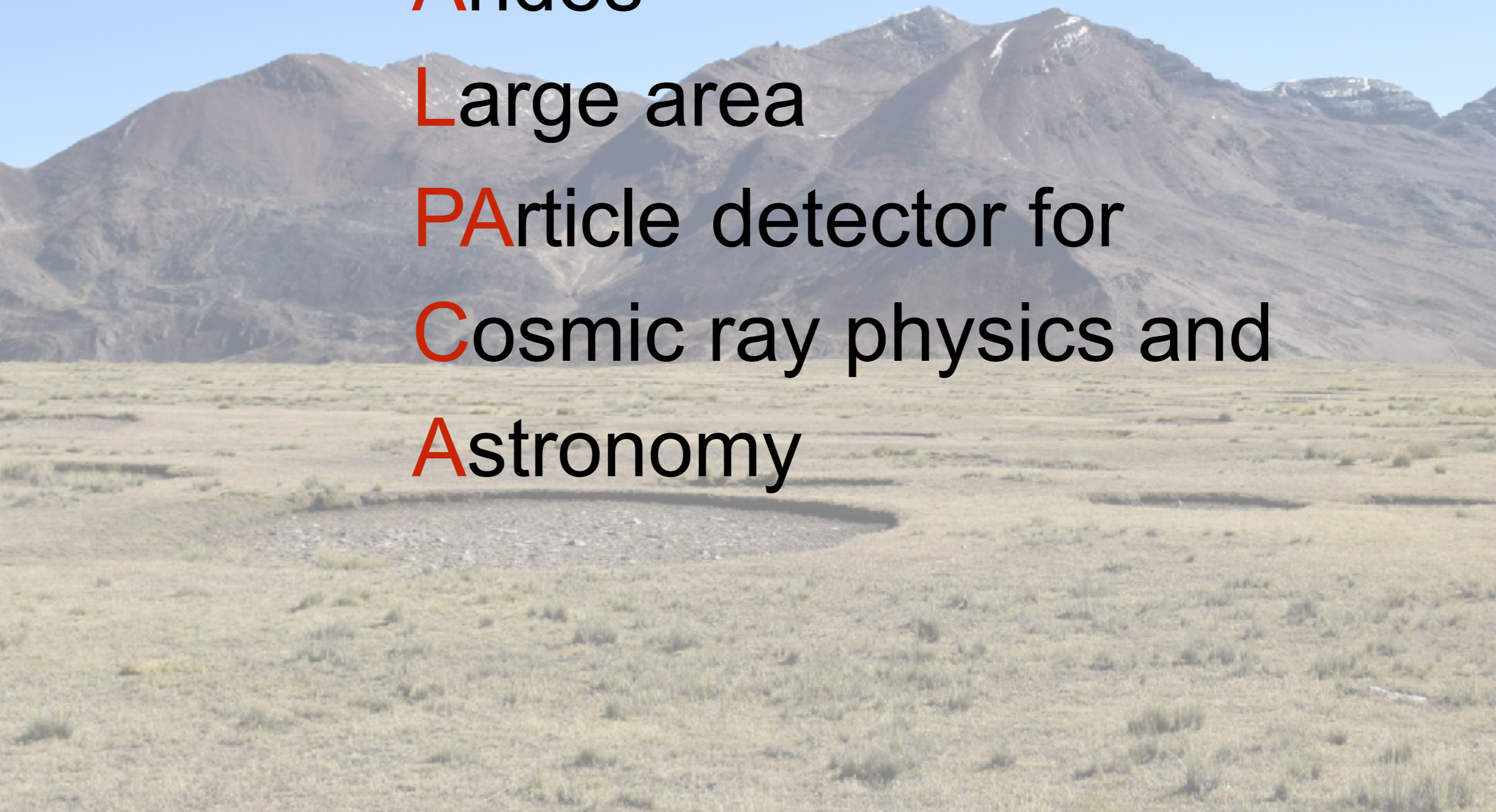
Andes

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

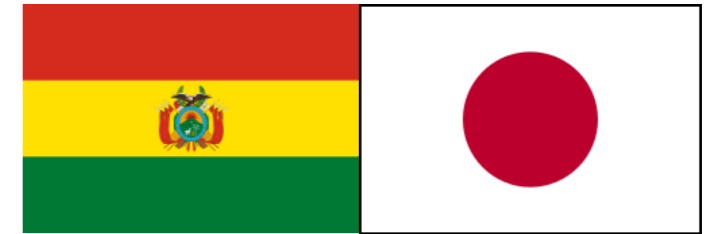
★ Site and Detectors

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



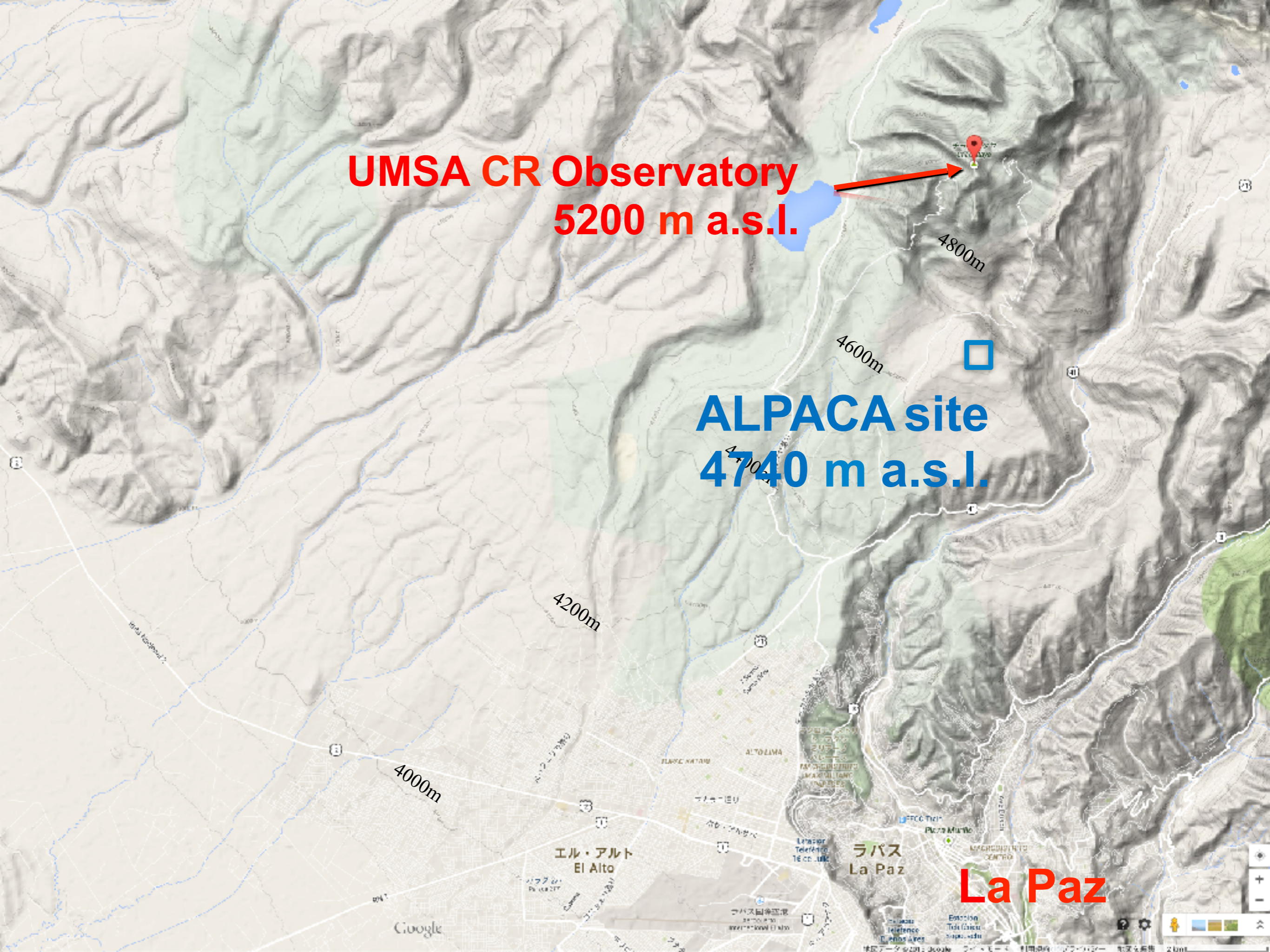
UMSA CR Observatory
5200 m a.s.l.



ALPACA site
4740 m a.s.l.



La Paz



Observation Cite: **Chacaltaya Hill**

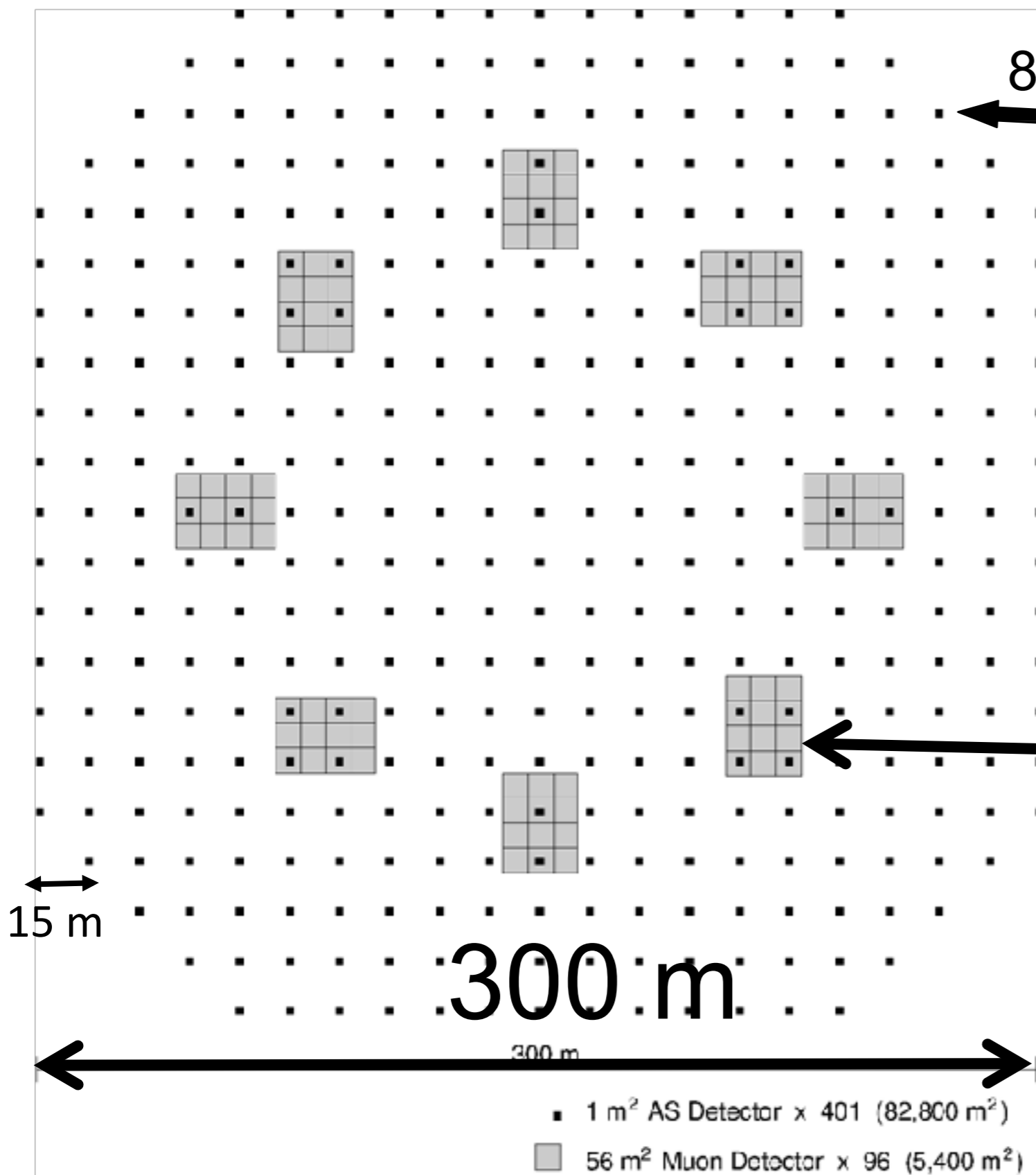
500 m × 500 m flat within $\pm 1^\circ$

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



28 April 2016

Schematic view of ALPACA

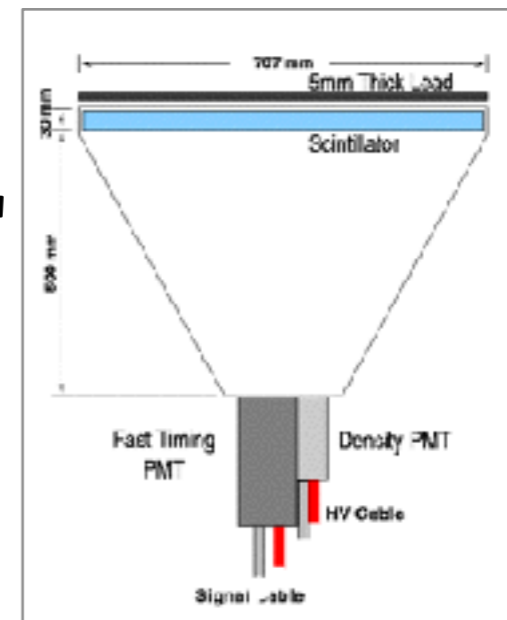


83,000 m²

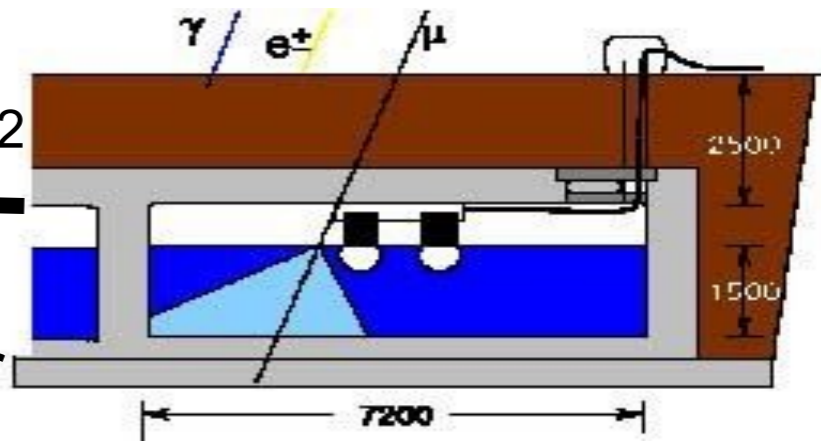
Air Shower Array

5,400 m²

Muon Detector Array

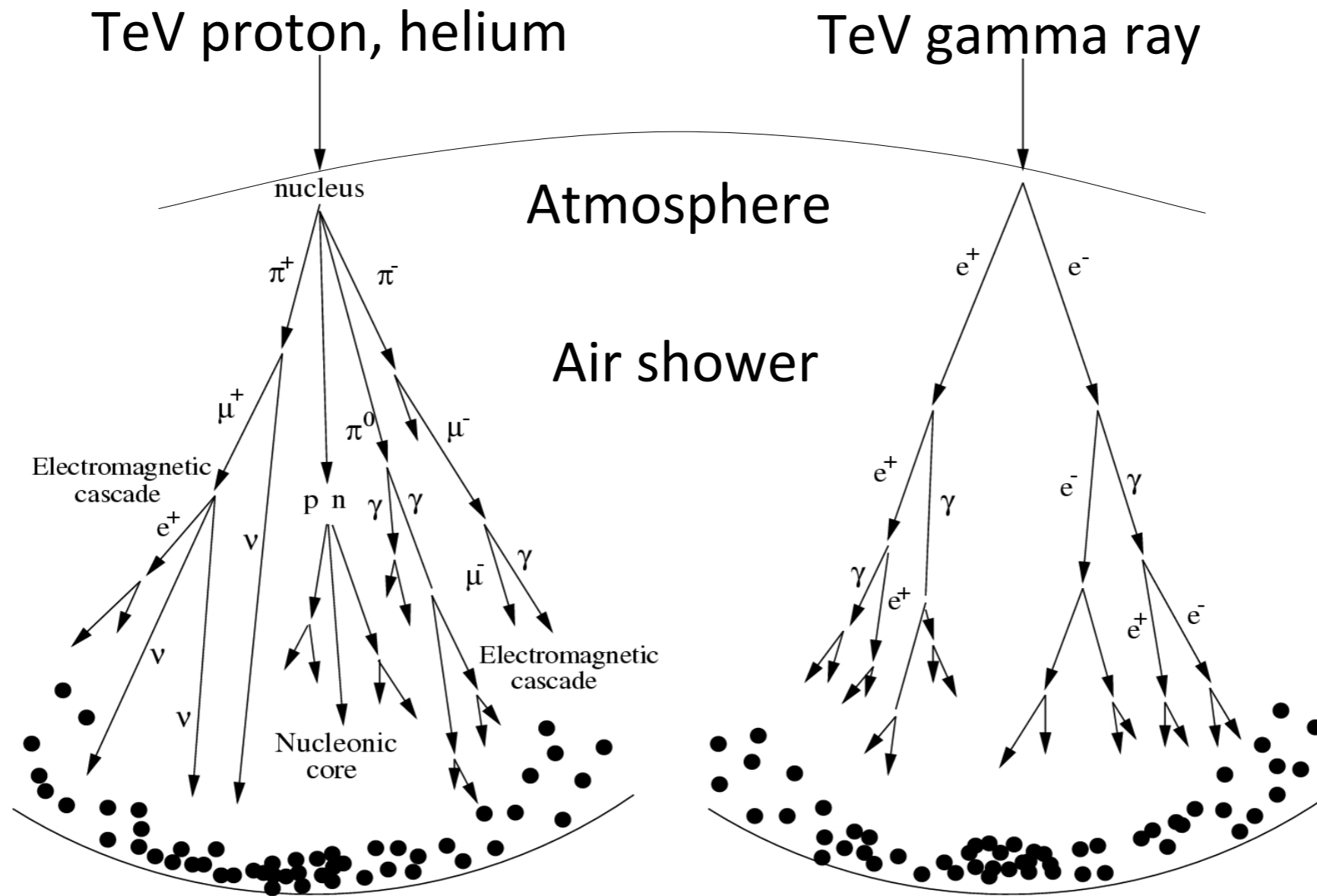


1 m² plastic scintillation detector



Underground water Cherenkov muon detector (56 m² / unit)

p/ γ discrimination by counting # of muons

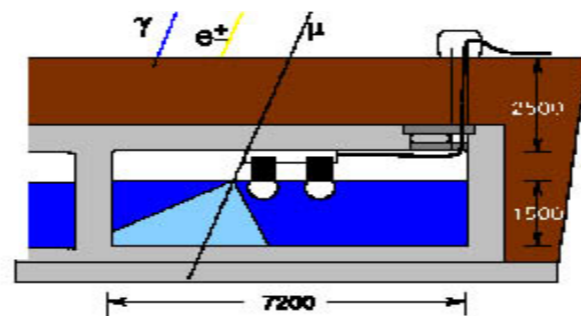


Number of muons within $<100\text{m}$ from air-shower core

$\sim 50 \mu$ for 100 TeV proton

$\sim 1 \mu$ for 100 TeV γ

Muon detector unit

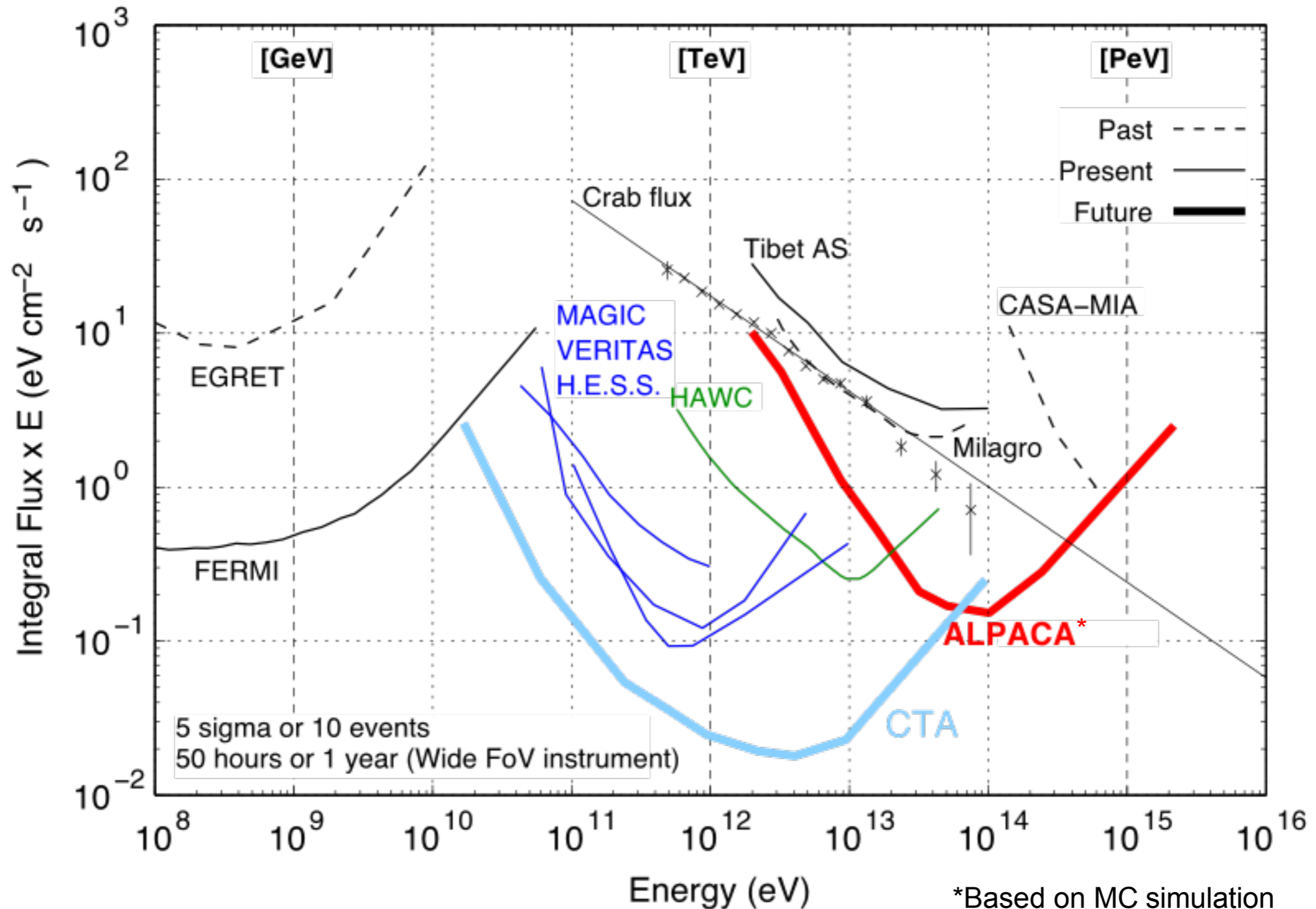


Performance of ALPACA

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

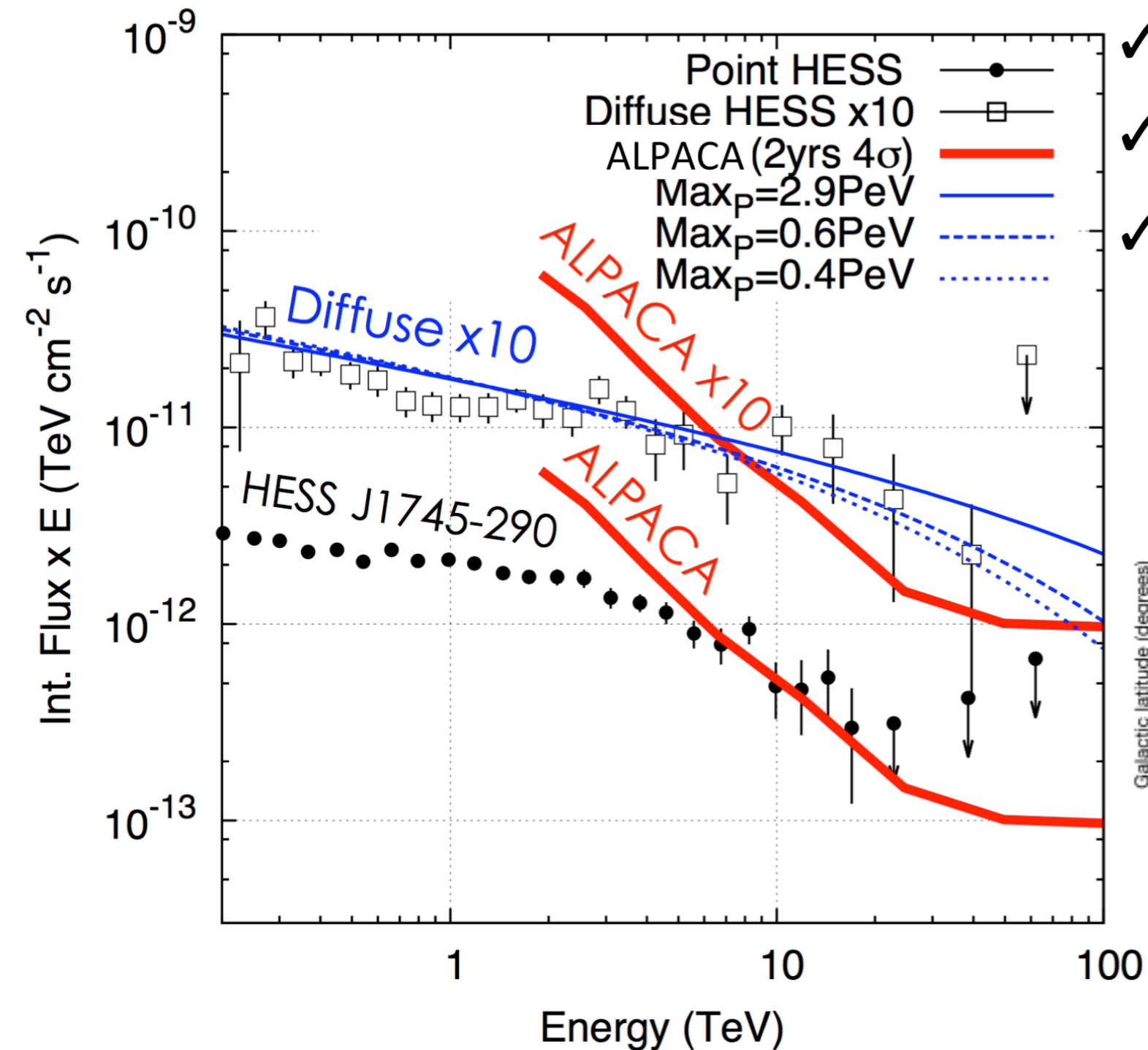
# of scintillation detectors	1.0 m ² × 401 detectors
Effective area of	~83,000 m ²
Modal energy	~5 TeV
Angular resolution	~0.2° @ 100 TeV
Energy resolution	~20% @ 100 TeV γ -rays
Field of view	~2 sr
Duty cycle	>90%
CR rejection power	>99.9% @ 100 TeV
	(γ ray efficiency ~90%)

Sensitivity to γ -ray Point Source

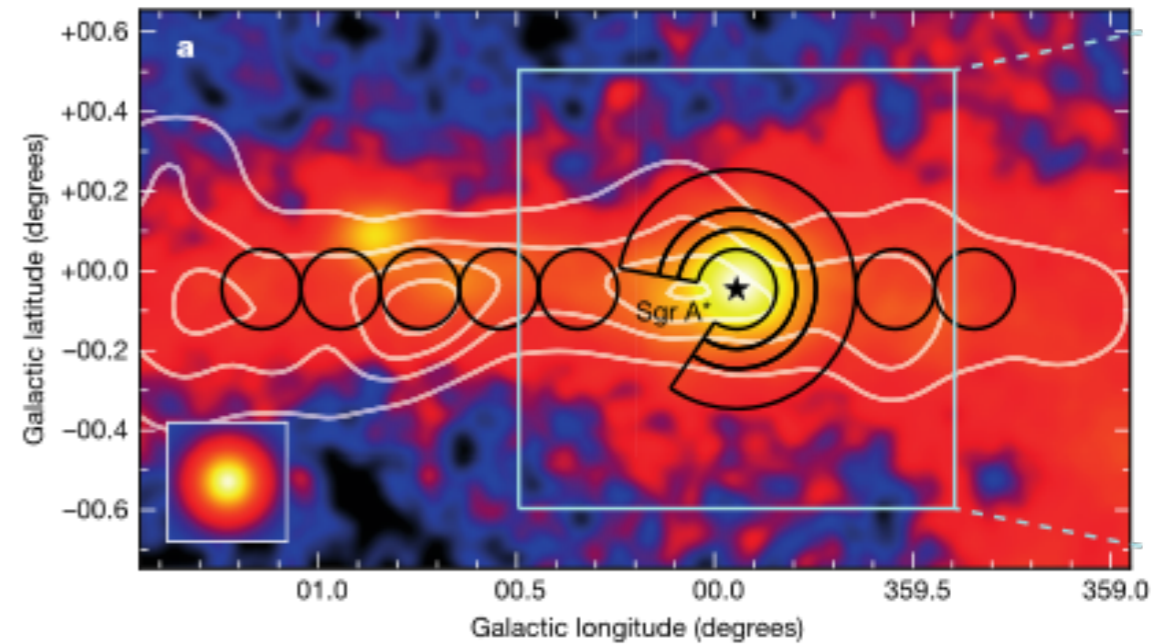


*Based on MC simulation
for the TibetAS+MD

Galactic Center as PeVatron!?



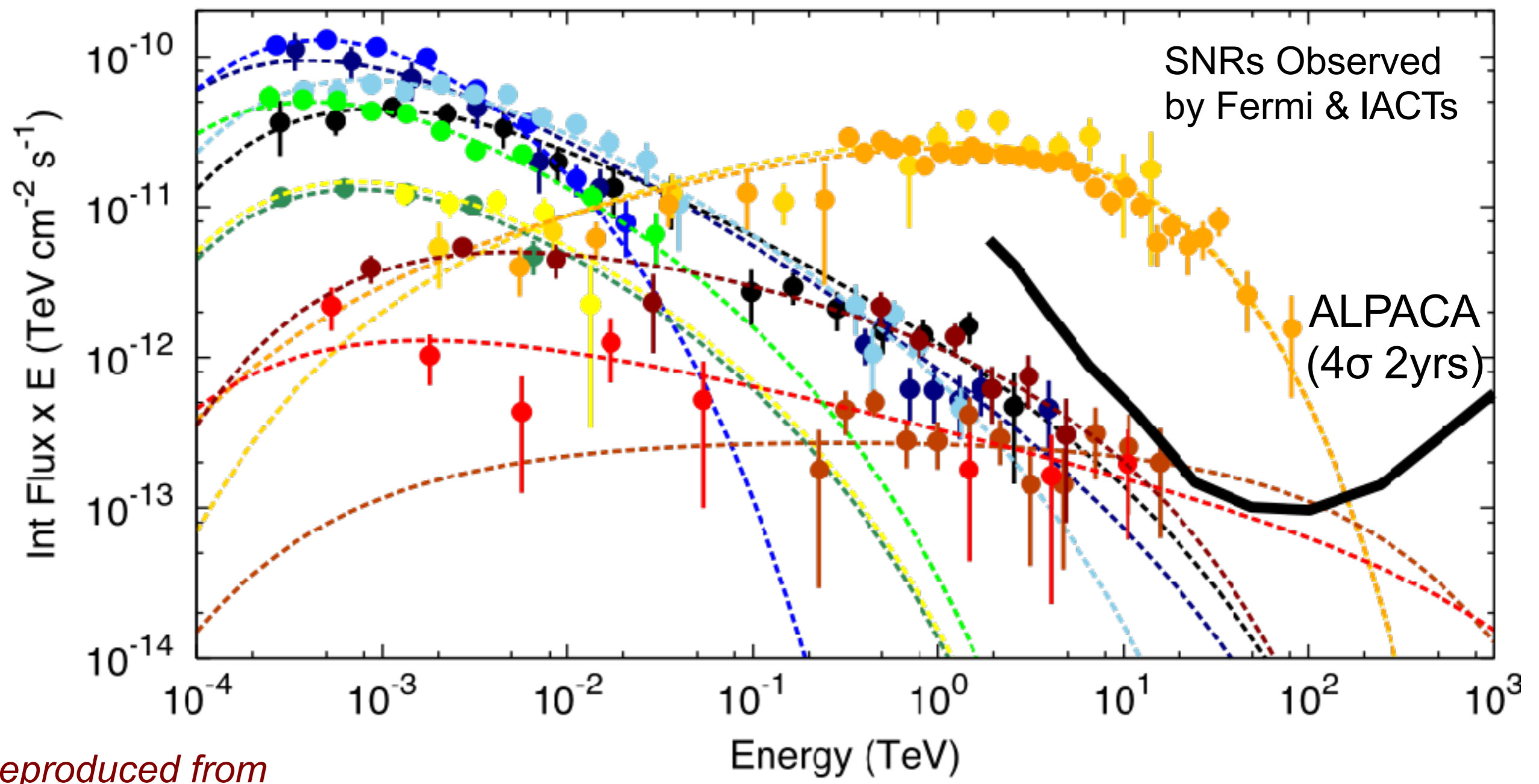
- ✓ Detection of diffuse component
- ✓ sub-PeV γ -rays expected
- ✓ Promising candidate for PeVatron



Abramowski, et al, Nature (2016)

$\delta \sim -29^\circ$

Young SNRs

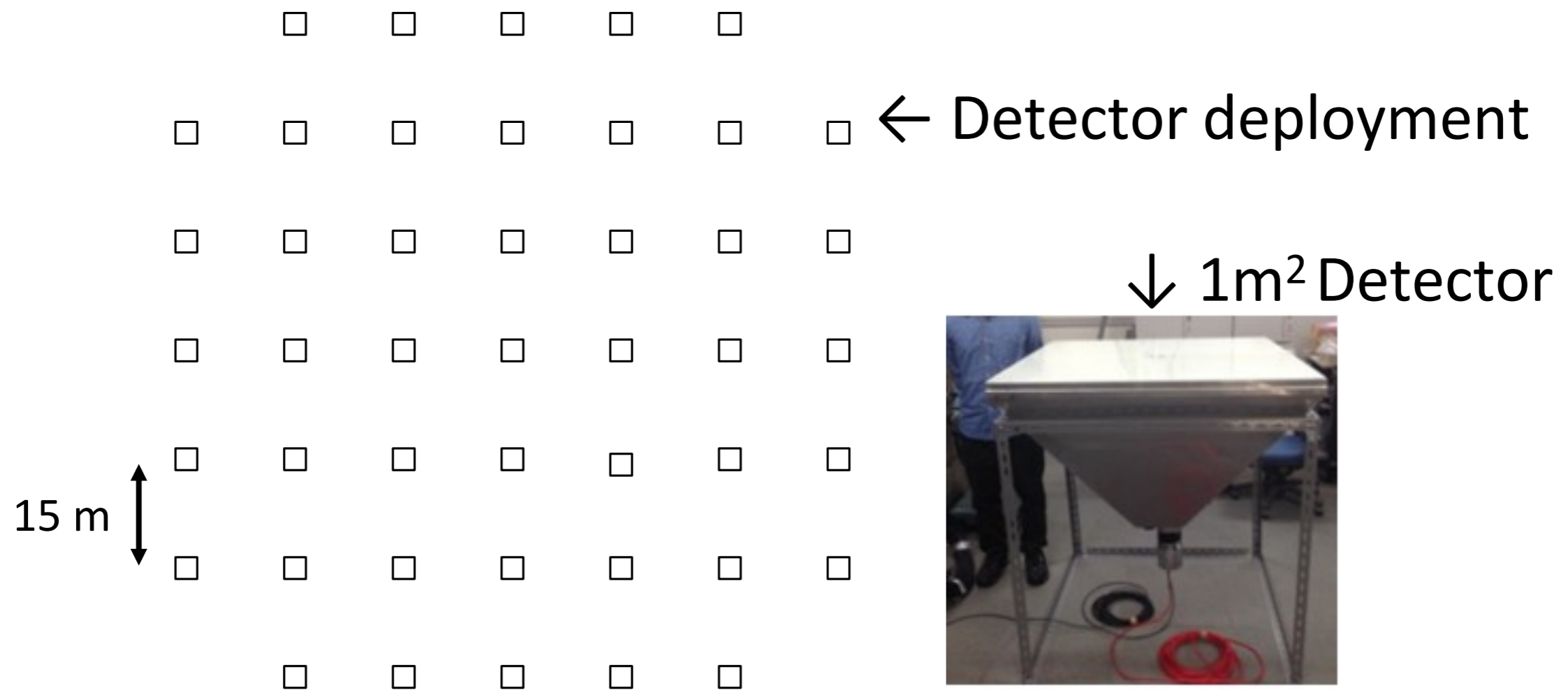


Reproduced from slides presented by S. Funk (TeVPA 2011)

- | | | | |
|---------------------|-----|--------------------|-----|
| 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 m ² × 45 detectors
Effective area	~8,000 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
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★ ALPAQUITA: prototype AS array

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