LATTES

A new detector concept for gamma-ray astrophysics

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(on behalf of the LATTES team)



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(Very) High Energy Gamma Rays

Astrophysical gamma rays
 Energy region of interest from GeVs to hundreds TeVs



(Very) High Energy Gamma Rays

Astrophysical gamma rays

Energy region of interest from GeVs to hundreds TeVs

Scientific interest:

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- Key to understand the acceleration mechanism of cosmic rays in our galaxy
- Violent astrophysical phenomena: pulsars and black holes
- Galactic magnetic fields
- Photon radiation fields in the Universe
- Indirect search of dark matter (WIMP interactions)
- Test fundamental properties of quantum gravity

The era of multi-messenger observations



- Simultaneous observation of a Gravitational Wave + electromagnetic counter parts
- Allows to test the dynamics of our surrounding Universe
- Study of transient phenomena in all energy windows is one of the main ingredients

How to detect?



How to detect?



How to detect?



Arrays at high-altitude = large field of view + large duty cycle + low energy











Built IACT Built Array Planned IACT Planned Array

LHASSO

ARGO





LHASSO

ARGO





Complementary to the powerful Cherenkov Telescope Array project



Requirements to build a Wide FoV gamma-ray observatory



Requirements to build a Wide FoV gamma-ray observatory



LATTES @ ALMA site Large Array Telescope for Tracking Energetic Sources

LATTES array

 Joint Brazil / Italy / Portugal initiative
 Interest from Czech group

Possible site:

- Atacama Large Millimeter Array site
- Chajnantor plateau
- 5200 meters altitude in north Chile
- ♦ Good position to survey the Galactic Center

The concept: a hybrid detector





RPCs : time and spatial resolution WCDs: e.m. energy, g/h discrimination and trigger

Array configuration



- ♦ LATTES compact core array
 - ♦ 3600 LATTES stations
 - \diamond Array of roughly 20 000 m²



Towards LATTES sensitivity...



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LATTES sensitivity

(accepted to publication on Astropart. Phys.)

LATTES concept **can cover the energy gap** between satellite borne and ground base experiments

R. Conceição

The future...

- LATTES is a novel detector concept for gamma-rays able to cover the energy gap between satellite borne and ground base experiments
- Capabilities of the LATTES concept are far from explored
- High-energy extension with a sparse array is being studied
 - ♦ Energies up to 100 TeV

Acknowledgements

Backup slides

Improve detector concept!

- Thin lead converter plate (Pb)
 - Improve shower geometry reconstruction
- Resistive Plate Chamber (RPC)
 - Measure charged particles with high spatial and time resolution
- Water Cherenkov Detector (WCD)
 - Collect shower secondary photons/electrons to improve trigger at low energy

LATTES performance at glance

(Very) High-Energy Gamma-Rays

Array configuration

- ♦ LATTES compact array
 - ♦ 3600 LATTES stations
 - ♦ Circular array of radius 70 m
 - \diamond Array of roughly 20 000 m²
 - ♦ 0.5 m space for access detectors

Detector simulation

- LATTES detector
 simulation package
 - ♦ Based on the Geant4 toolkit
 - Interfaced to read directly CORSIKA simulations output binary files
 - Resampling of the showers with randomized core

Ongoing developments and tests on RPCs, electronics and read-out systems

Why gamma rays?

protons are deflected by the galactic magnetic fields

gammas travel in straight lines but can be absorbed in the way

neutrinos travel in straight lines but are very difficult to detect

trategies for primary discrimination

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Built IACT
 Built Array
 Planned IACT
 Planned Array

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Station: HAWC vs LATTES

HAWC (present detector)

LATTES (next generation)