Signal over Background discrimination for the ALTO observatory



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Cosmic Explosions 2019

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Very High Energy Gamma ray Astronomy

- Photon energy: 100 GeV to 100 TeV.
- Unlike Cosmic rays, γ-rays travel rectilinearly in the Universe.
- Helps to understand particle acceleration in extreme environments like AGN jets, accretion disks, supernova remnant etc.,



Crab Nebula

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Cen A

3C 279

VHE y-rays in Atmosphere

 Pair production and Bremsstrahlung radiation generates cascade of e⁺, e⁻ and γ-rays leads to air shower.

Ground based observation

- Air Cherenkov Telescopes H.E.S.S., MAGIC, VERITAS
- Particle Detectors ALTO, LHAASO, HAWC





The ALTO Observatory

ALTO is a future ground-based very high energy gamma-ray observatory based on water Cherenkov technique. The key features include,

- Wide field of view
- Hybrid detectors
- Excellent timing accuracy
- Modular design
- Simple to construct
- Long duration
- Open Observatory

- In the Southern hemisphere → Daily observations of Southern sources
- Continuous Monitoring → Observations may be done 24h per day
- At high altitude (> 5 km) \rightarrow Low threshold E \geq 200 GeV
 - → ~2 steradian

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- \rightarrow Improved S/B discrimination
- \rightarrow Improved ang. resolution(~ 0.1° at few TeV)
- \rightarrow Phased construction and easy maintenance
- \rightarrow Minimize human intervention at high-altitude
- \rightarrow Should operate for 30 years
- \rightarrow Distribute data to the community



Planned ALTO Detector Design

A unit of water Cherenkov detector with Scintillator base

An array of 1242 units



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Summary of Monte Carlo Simulation & Analysis





... follows S/B background discrimination and calculation of expected detector sensitivity.



Signal over Background Discrimination



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Signal over Background Discrimination

The best variables are analyzed using Multi Variate Analysis (MVA) – Boosted Decision Trees (BDT) in four different energy bins.

BDT classifier output: worst to best efficiency





Expected Sensitivity of ALTO

Sensitivity for 1 year live-time on a source at 32°



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ALTO Prototype in Linnaeus University



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Live Event Display



Thank you for your attention

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