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Status of VERITAS

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Abstract. The Very Energy Radiation Imaging Telescope Array System (VERITAS) in its first phase of operation will consist of an array of 4 Imaging Atmospheric Cherenkov Telescopes (IACTs) arranged in a 'Mercedes' star configuration. To be located at a high, dark site in Southern Arizona the full array is expected to see first light in October 2006. In February of 2005 the first VERITAS telescope achieved first light at a temporary location near to the final site. This poster summarises the status of the VERITAS instruments as of summer 2005.

Keywords. telescopes, instrumentation: detectors, gamma rays: observations

1. Hardware

The VERITAS telescopes are of an f/1 Davies-Cotton design with a 12 m aperture. The tracking of the mount is measured to be accurate to $< 0.01^\circ$ and has a slewing speed of $\sim 0.3\,^\circ/\mathrm{s}$, but will soon be upgraded to give a slew speed of $1\,^\circ/\mathrm{s}$. The reflector is segmented: consisting of 350 individual hexagonal mirror facets of $0.332\,\mathrm{m}^2$ each, providing a total mirror area of $\sim 100\,\mathrm{m}^2$. The mirrors are measured to have a reflectivity >85% from 280 to 450 nm. The point spread function (PSF) of the telescope for the observations outlined in this paper was 0.09° at 80° elevation, which is well within the pixel size of the camera. Even so, the telescope alignment has subsequently been further refined and the current PSF is 0.06°.

The camera consists of 499 Photonis XP2970/02 photomultiplier tubes (PMTs), with a 0.15° spacing giving a total field of view of 3.5°. Contained in the camera are pre-amplifier and anode current monitoring circuits. The signals from each PMT then pass through 50m of cable, where they are digitised by a custom designed 500 Mega-Sample-Per-Second Flash-ADC system.

The trigger is a 3 level system: the first level (L1) being a programmable constant fraction discriminator (CFD); the output of which is then passed to the second level (L2) pattern recognition system which is pre-programmed to recognise triggers resembling true Cherenkov light flashes; the final stage (L3) will be an array level trigger to discriminate coincident multiple telescope triggers. The observations detailed here have been performed with a conservative CFD threshold of 6.7 photo-electrons and a 3-fold adjacent pixel pattern trigger, which corresponds to a telescope raw trigger rate of ~ 150 Hz.

2. Observations & Data Analysis

A full simulation chain for Telescope 1 (T1) has been developed and shows good agreement with actual data: both in terms of image parameter distributions and in terms of raw trigger rates. For a Crab like spectrum (Hillas *et al.* (1998)) this results in T1 having a threshold energy of 150 GeV, giving a gamma-ray trigger rate of $\sim 22\gamma$/minute. Since the muon background for a single telescope (Vacanti *et al.* (1994)) is very large some hard imaging cuts are made on single telescope data in order to maximise the significance of a signal, these in turn push up the threshold energy of T1 to ~370 GeV.

Due to its steady signal the Crab nebula is the standard candle for TeV astronomy, therefore observations of this object are useful for gauging the performance of T1 and comparing its performance to current and previous instruments. A total of 3.9 hours on source observations taken at high elevation resulted in a 19.4 σ detection at a rate of $\sim 2.5\gamma/\text{min}$, which gives an idea of how harsh the cuts are that maximise significance. This shows that T1 has a sensitivity of 10 $\sigma/\sqrt{\text{hour}}$ for a Crab-like source, demonstrating the improvement in performance over its predecessor, the Whipple 10 m IACT (Finley *et al.* (2001)).

Mrk 421 is a Blazar at a redshift of $z \sim 0.031$. This is a highly variable source most easily seen when it is in a high flaring state, but close enough that it can still be observed in its quiescent phase. For 13.1 hours on source observations a signal was detected significant at the 12.5 σ level.

Mrk 501 is another Blazar, at a similar distance to Mrk 421, with a redshift of $z \sim 0.034$. Again this a highly variable source that was not in a high flux state at the time of observations, but still yielded a 7.1 σ significance for 6.7 hours of on source observation time.

3. Summary

The first of the VERITAS telescopes has been operating since February 2005 at a temporary site. Despite this site being at a lower elevation and having a brighter background light than is ideal, the telescope has met all technical specifications and is demonstrably an improvement over its predecessor.

The major mechanical components of all four telescopes have now been delivered and testing the array trigger will commence in late 2005 also at this temporary site. Further improvements foreseen for the system will be the addition of light cones, which will decrease the amount of dead space between the pixels in the camera and increase the photon collection area.

Most of the major infrastructure at the final Kitt Peak site is in place and, following a stop-gap site access issue, it is foreseen that the finished array should see first light in October 2006.

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