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Pachmarhi array of Cerenkov telescopes

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Abstract. Pachmarhi Array of Cerenkov Telescopes (PACT) consisting of 25 telescopes has been installed at Pachmarhi (longitude : 76° 26′ E, latitude : 22° 28′ N and altitude : 1075m) recently. The telescopes are deployed in the form of a 5×5 matrix spread over an area of 80m × 100m. The array is designed to detect celestial TeV γ-rays by wavefront sampling technique as against the standard imaging technique used at other γ-ray observatories elsewhere in the world. Each telescope consists of 7 parabolic reflectors of 90 cm diameter and an *f/d* ~1. Each telescope is independently steerable on separate equatorial mounts operated through a computer based control system capable of orienting them with an angular accuracy better than 0.2°. The pointing is monitored in real time to maintain a source tracking accuracy of better than 0.1°. We will discuss the array design, its suitability for wavefront sampling and its pointing capabilities.

Key words : VHE γ-rays, Atmospheric Cerenkov Technique, PACT.

1. Introduction

Atmospheric Cerenkov Technique is a unique ground based method to investigate the celestial γ-rays in the Very High Energy (VHE, 10 *GeV* – 10 *TeV*) range. In this technique, the primary γ-rays are detected indirectly through the emission of Cerenkov light by the secondary particles which in-turn are generated in the electromagnetic cascade initiated by the primary in the earth's atmosphere (Cronin et al., 1993). Since Cerenkov light is also produced by the secondaries of the hadronic cascades initiated by cosmic rays these form a formidable background (Fegan, 1997). Two complementary techniques are adapted to increase the signal to noise ratio by rejecting a bulk of the hadronic background. Firstly, the Cerenkov light is imaged by a large telescope and detected by an array of phototubes while the image characteristics are used to reject events of hadronic origin. On the other hand, we at Pachmarhi, chose to study the Čerenkov photon density distribution at the observation level by sampling it at various places using an array of Čerenkov telescopes. In this method, we plan to exploit the species dependent density fluctuations and timing characteristics, in order to reject the hadronic background (Chitnis & Bhat, 1998; Chitnis & Bhat, 1999)

2. Cerenkov Telescopes of the Array

PACT consists of 25 Cerenkov telescopes deployed in the 5 × 5 array over an area of 80 m × 100 m. Each telescope consists of 7 parabolic mirrors of 0.9 m diameter and *f/d* ~ 1. Each mirror has a fast phototube (EMI 9807B) at its focus defining a field of view of 3° (FWHM). The total reflector area of each telescope is 4.45 m^2. Each telescope is on an equatorial mount and is independently steerable (±45°) in E-W and N-S directions (Bhat, 1998).

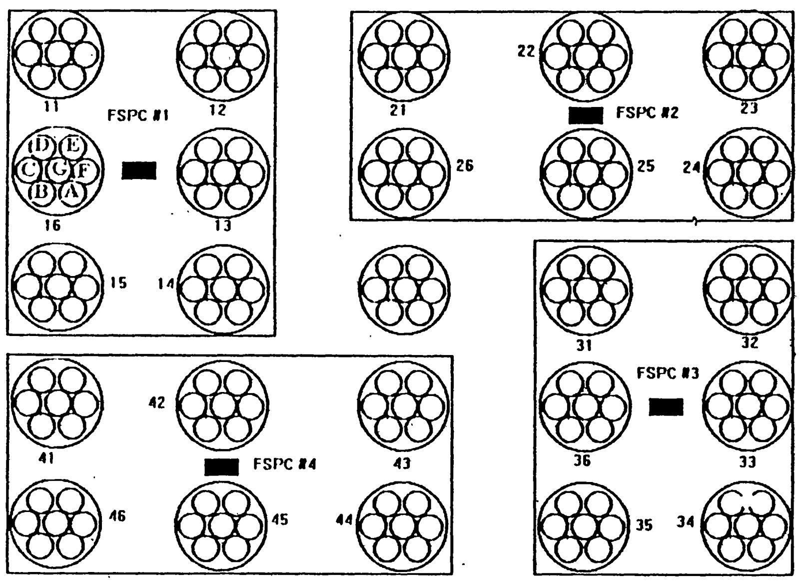

Figure 1. The deployment of the 25 7-mirror telescopes in a 80 m × 100 m field. The telescopes are divided into 4 groups of 6 telescopes for minimizing the signal losses during transmission. The signal processing & data acquisition is accomplished by a networked data acquisition system.

3. Pointing capability of PACT

The movement of the Cerenkov telescopes is remotely governed by a low-cost control system called automatic computerized telescope orientation system (ACTOS). The hardware consists of a semi-intelligent closed loop stepper motor control system which senses the angular position using a gravity based transducer called clinometer with an accuracy of 1′. The two clinometers, one in the N-S and the other in E-W direction are accurately calibrated using the stars. The system can orient to the putative source with an accuracy of ~ (0.003 ± 0.2)°. The source pointing is monitored with an accuracy of ~ 0.1° in real time.

4. Current status

All the 25 telescopes of the Pachmarhi Array of Cerenkov Telescopes are ready for observations. The telescope alignments and the data recording electronics are in the final stages of completion.

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