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STATUS OF THE H.E.S.S. EXPERIMENT

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ABSTRACT

The H.E.S.S. experiment (High Energy Stereoscopic System) is a new generation atmospheric Cherenkov detector measuring high-energy ($> 100\,\mathrm{GeV}$) gamma radiation from the Universe. This paper briefly explains the imaging Cherenkov technique and describes the H.E.S.S. project and its current status.

1 Introduction

The detection of high-energy gamma rays in ground-based experiments opened a new window for the exploration of non-thermal processes in the Universe. Unlike the charged component of the cosmic radiation, detected gamma rays point back to their origin. This property makes them an excellent tool for locating the sources of the cosmic radiation where hadron acceleration is likely accompanied by gamma ray emission. The measured energy spectra of sources test our understanding of stellar objects and theoretical models of the acceleration mechanisms. Among others, active core regions of galaxies and remnants of supernovae explosions are discussed as acceleration sites. The first source of TeV gamma radiation, the Crab nebula, was discovered in 1989. To date, a handful of TeV gamma sources are known to exist.

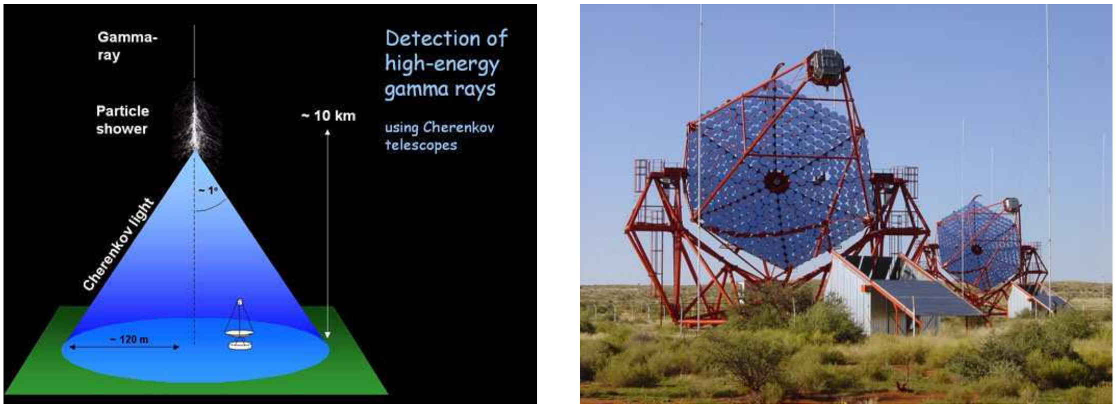

Figure 1: *Illustration of the imaging atmospheric Cherenkov technique (left) and picture of two of the four Phase I H.E.S.S. telescopes. See text for explanations.*

2 The Imaging Atmospheric Cherenkov Technique

High-energy gamma rays and hadrons hitting the Earth's atmosphere create extended air showers. The shower development starts in a height of about 25 km and the shower maximum is reached at a height of around 8 km. The charged secondary particles in the shower produce Cherenkov light that forms a light pool with about 240 m diameter on the ground (Fig. 1 (left)). This light can be detected in clear moonless nights by so-called Imaging Atmospheric Cherenkov Telescopes (IACTs) placed in the light pool. The telescopes use a spherical mirror to map the shower image onto a digital camera. Analysis of the camera image allows to infer the type, energy and direction of the primary particle.

3 The H.E.S.S. Experiment

The H.E.S.S. experiment [1, 2] applies the so-called stereoscopic observation mode where the same shower is recorded under different angles by more than one telescope in the light pool. This technique allows for better reconstruction of shower directions and improved separation of gamma-induced showers from the more irregular hadronic showers.

The H.E.S.S. experiment is located at 1800 m above sea level in the Khomas Highland of Namibia which was chosen for its good optical conditions and favourable climate. In its first phase, the experiment will consist of four IACTs located on the corners of a 120 m square. Each telescope (Fig. 1 (right)) is movable in azimuth and altitude and has a focal length of 15 m. The spherical mirror (diameter 15 m) is made up of 380 individual mirrors with a diameter of 60 cm. The total mirror area is 107 m^2 per telescope. The camera has a diameter of 1.5 m and a 5° field of view. It consists of 960 photo-multiplier tubes each of which covering 0.16°. The camera houses all the required trigger and readout electronics.

The sensitivity of the H.E.S.S. experiment is expected to be an order of magnitude better than that of existing IACT systems. Sources with 1 % of the flux of the Crab nebula will be detectable. The energy threshold is about 100 GeV and the energies of primary particles can be reconstructed with an accuracy of 20 %. The resolution of shower directions is 0.1° per event.

4 Status

The first H.E.S.S. telescope was commissioned in June 2002. At the time of writing, two of the four Phase I telescopes are used for routine data-taking and a central trigger is being commissioned. The full system with four telescopes is expected to be complete and operational in early 2004.

Since June 2002, H.E.S.S. has recorded data both in single telescope mode and in stereoscopic observation mode. Clear signals are observed for the Crab nebula [3] and the active galactic nucleus PKS 2155–304 [4]. The latter observation confirms the earlier detection by the Durham experiment [5]. The analysis of other sources is in progress.

5 Acknowledgements

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