Status of the HEGRA Experiment at La Palma

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THE HEGRA COLLABORATION

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[a] *Supported by the CICYT (Comision Interministerial de Ciencia y Tecnologia)*
[b] *Supported by the BMBF (Bundesministerium für Bildung und Forschung)*
[c] *Supported by the DFG (Deutsche Forschungsgemeinschaft)*

Abstract

A status report of the HEGRA experiment at La Palma is presented. A brief description of its several subarrays aimed to make combined measurements of the different components of the extended air showers in the energy range 0.5 TeV - 10 PeV is given.

1 General

The HEGRA (High Energy Gamma Ray Astronomy) experiment is operated by an international collaboration formed by groups from the Universities of

Hamburg, Kiel, Madrid and Wuppertal, two Max-Planck Institutes (MPI für Physik, Munich and MPI für Kernphysik, Heidelberg) and the Yerevan Physics Institute (Armenia). The experiment (2240 m asl) covers an square area of 40000 m^2 (28.8° N, 17.9° W). In figure 1 a layout of the experimental area is shown. The HEGRA experiment present configuration (summer 1995) can be summarized as follows: 1) An array of 243 scintillator counters; 2) 17 Geiger towers; 3) An array of 49 (+28) wide angle-air Cherenkov detectors [1]; 4) 2 imaging Cerenkov telescopes out of 6 units [2]; 5) 10 drift chamber modules of the CRT project [3]; 6) 2 test UV Cherenkov telescopes from the CLUE collaboration [4].

The trigger signals of the scintillator ($\geq$14 fired huts within 150 ns) and AIROBICC ($\geq$6 fired huts within 200 ns) arrays and also of the Cherenkov telescopes are 'OR'ed and the data of the two arrays are read out together with the Geiger towers each time an 'OR'ed 'master' trigger occurs. The total daytime trigger rate is 12.5 Hz and 20-24 Hz during moonless clear nights. In parallel the Cherenkov telescopes have their own data taking chain (2-5 Hz). The different HEGRA sub-arrays are briefly described in what follows and in other specific contributions presented to this conference. Physics results are given in separated contributions. Detailed MC studies on γ/hadron separation and chemical composition using different approaches are also presented in these proceedings [5].

2 Scintillator Matrix.

Chronologically the scintillator matrix is the first array built at the HEGRA site, the detectors are regularly distributed at the area forming two interleaved configurations (main and central denser arrays). The main array consists of 169 scintillator counters placed in a 13 x 13 grid with 15 m grid spacing. The central denser array has 52 counters (+24 extra) placed in a 15 m grid and located with an offset against the main array of 1/2 grid space. The scintillator detector unit consists of a 1 m^2 plastic scintillator (3-5 cm thickness) viewed from below by two photomultipliers, a fast one for small amplitude and timing measurements and a slow one for amplitude measurements within a large dynamic range.

3 AIROBICC array

This array consists of 49 (+28 in summer 1995) individual stations arranged in a 7 x 7 matrix with a 30 m grid spacing. Its area matches closely that of the scintillator matrix. Each individual counter consists basically of a 20 cm diameter photomultiplier (surrounded by a Winston cone) that views the night sky with a 1 sterad angular acceptance. A filter (300-470 nm) reduces the background from the night sky difusse light. The hardware γ-energy threshold is about 13 TeV ($>$ 6 huts) and 30 TeV for protons (vertical incidence); the average angular resolution 0.1-0.2^o; and the uptime about 15%/year. The individual counter threshold is 2800 phe/m^2. For more details see contribution HE3 to this conference and references therein.

4 Geiger Tower Array

It consists of 17 Geiger towers of 18 m^2 located in the central part of the HEGRA array. Each Geiger tower consists of a support structure of gaseous concrete with 6 planes of Geiger tubes and two layers of lead (2.5 cm) below the two upper Geiger planes. The towers measure the total energy deposition and reconstruct and identify tracks of muons ($>$ 300 MeV) and electrons ($>$ 400 MeV). Each tower may also serve as an independent high resolution muon flux monitor. Therefore the Geiger towers operate as energy and geometry calibration instruments for the other HEGRA subarrays and add extra information to gamma/hadron separation and chemical composition studies.

Figure 1: Layout of the HEGRA experiment (summer 1995)

5 System of Imaging Air Cherenkov Telescopes

The complete HEGRA air Cherenkov telescope subarray will eventually consist of 6 units. The first one (a prototype) is located at the center of the array and became operational in 1992. It has a mirror of 5 m^2, a 37 (127, since early 1995) pixel camera and a trigger rate of 0.5 Hz at an energy threshold of 2 TeV. In 1993 a second telescope (the first of the system of 5) was installed at a distance of 92 m from the first one. It was equipped with a mirror of 8.5 m^2, a 61 pixel camera and has a 3 Hz trigger rate at a threshold of 1 TeV. In summer 1995, a third telescope with the same size as the previous one will be installed with a 5^o high resolution camera (271 pixel) designed to search for gamma emissions from extended sources. By the end of 1995 the system of 5 telescopes will be installed, with the 4 outer telescopes having 127 pixel cameras. In its final form, in early 1997, it will consist of 5 telescopes of 8.5 m^2 with 271 pixel camera each.

6 Conclusions and Acknowledgment

HEGRA is one of the most powerful tools for the investigation of cosmic rays in the North Hemisphere in the energy region 0.5 TeV - 10 PeV. The simultaneous measurements at ground level of the shower front components (low energy e^+, e^-, γ, Cherenkov photons and muons) with different detectors of excellent angular resolution offer the possibility to determine the energy spectrum and the chemical composition of cosmic rays in a large energy range. This unique combination of different techniques placed in the same experimental area with its cross-calibration possibilities and its γ/hadron separation capabilities opens new prospects in γ-ray astronomy.

The HEGRA collaboration wants to thank the Instituto Astrofisico de Canarias for the permission to use the HEGRA site at the Roque de los Muchachos and their facilities.

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