The EAS-TOP Atmospheric-Čerenkov-Light Telescope and Its Combined Operation with the e.m. Detector (*).

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(ricevuto il 2 Giugno 1993; approvato il 30 Giugno 1993)

Summary. – The study of extensive air showers is performed at EAS-TOP by means of the combined operation of the first imaging Čerenkov telescope and the particle e.m. array. We discuss the technical characteristics of the Čerenkov detector and its resolutions. First data on the shape of the Čerenkov-light spots as a function of the EAS detection geometry, and on a first approach to the study of the longitudinal development of the cascades are also presented.

PACS 94.40 – Cosmic-ray interactions with the Earth.

1. – Introduction.

The study of cosmic rays at UHE requires a complete description of the cascades (Extensive Air Showers, EAS) that they produce in the atmosphere.

The EAS-TOP array at Campo Imperatore [1-4] (2005 m a.s.l., Gran Sasso Laboratory) has been planned to perform measurements of the different EAS components (e.m., GeV and TeV muons, hadrons, atmospheric Čerenkov light) with high resolutions both on the energy content and the geometrical parameters.

The shape of the Čerenkov-light images of EAS carries significant information on the longitudinal development of the electromagnetic cascades in the atmosphere for studies of primary interactions, composition and selection of γ-primaries.

We have therefore developed an atmospheric-Čerenkov-light telescope suited for operating as a standalone detector in the field of VHE γ-ray astronomy and in coincidence with the whole array for UHE cosmic-ray studies. The imaging detector is based on a multipixel photomultiplier, that provides good sensitivity and coupling with our optics, and simplicity of operation on the field. Telescopes are steerable for source tracking and for fixed operation in different geometrical configurations (i.e. for performing observations at different atmospheric depths and in coincidence with the detectors operating in the deep underground laboratories [5, 6]).

In the present paper we describe therefore the atmospheric-Čerenkov-light detector of EAS-TOP (mounting, optics, imaging device), and its resolving power, and we present an analysis of the images in association with the e.m. particle detector both from the phenomenological point of view, and in connection with the reconstruction of the EAS longitudinal development.

The full Čerenkov array will consist of eight similar telescopes, and is now in advanced phase of construction.

Fig. 1. - Drawing of the EAS-TOP Čerenkov-telescope mounting.