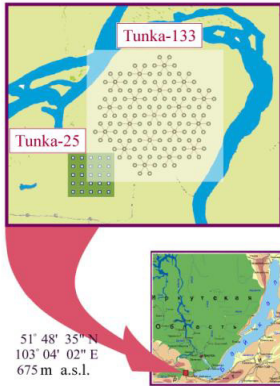


TUNKA Cherenkov Extensive Air Shower Experiment in Tunka Valley



Tunka-133, a large EAS Cherenkov array with about 1 km² sensitive area, is being installed in the Siberian Tunka Valley, 50 km from the Lake Baikal. This is a successor of the Tunka-25 array operated over several years at the same location. This array will permit a detailed study of the cosmic ray energy spectrum and the mass composition in the energy range 10¹⁵ - 10¹⁸ eV. The array will consist of 19 clusters, each composed of 7 optical detectors. The first cluster started operation in October 2006. We describe the data acquisition system and present preliminary results from data taken with the first cluster.

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Aim of experiment

Detailed study of cosmic rays energy spectrum and mass composition in the energy range 10¹⁵ - 10¹⁸ eV with a Cherenkov light array of about 1 km² area, i.e 10 times larger than the previous Tunka-25 experiment.

Tunka-133 Layout

133 optical detectors arranged in 19 clusters and 7 water tanks inside the area of about 1 km².

Energy threshold at 100% efficiency is 10¹⁵ eV.

Expected statistics from 1 year of operation (400 h):

- > 3 · 10¹⁵ eV ~ 5 · 10⁵ events
- > 10¹⁷ eV ~ 300 events
- > 10¹⁸ eV ~ 2 - 3 events

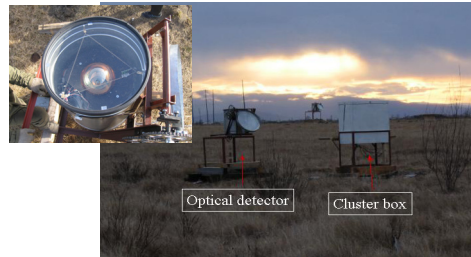
Accuracy of EAS parameters reconstruction

- accuracy of the core location ~ 6 m
- accuracy of E₀ determination ~ 15%
- accuracy of EAS maximum depth X_{max} ~ 25 g/cm²

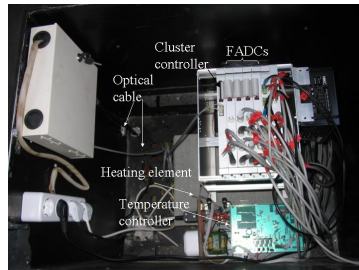
Seven optical detectors form a cluster (19 in total)

Water tank

Layout of Tunka-133 array



Optical detector and cluster box



Inside view of cluster box

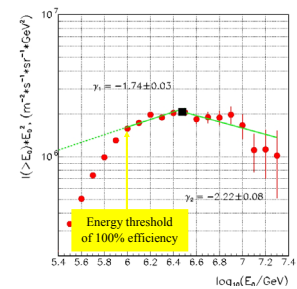
The cluster electronics consists of the cluster controller, 4 blocks of four-channel FADCs(200 MHz), an adapter module connecting with optical detector controller and temperature controller. All electronic modules (except the temperature controller) are in VME standard. Each cluster is connected to the DAQ center through a multi-wire cable containing four copper wires and four optical fibers.

Preliminary analysis of the data recorded with the first cluster during the winter 2006-2007

75 hours of operation from November 2006 to January 2007

Trigger: ≥ 3 pulses above 100 p.e. inside 0.5 μs

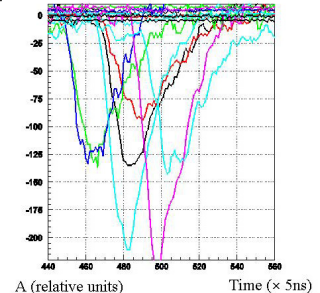
Trigger rate : ~ 0.2 Hz. Statistics: 16000 events, 5400 events with core location inside cluster area.



Preliminary integral energy spectrum taken with the first cluster of Tunka-133 array.

FADC records analysis

Usage both the amplitude and pulse FWHM in analysis makes it possible to estimate the EAS core distance and energy E₀ even for distant events.



An example of waveforms for a very distant experimental event. Pulses in different detectors are shown in different colors. The core distance of this shower from the cluster center is estimated as 600±100 m and the energy as (5±2) · 10¹⁷ eV.

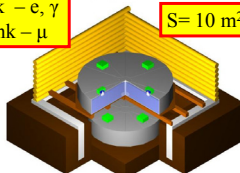
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2 level detector:
upper tank - e, γ
bottom tank - μ

Water Tank

S= 10 m², h=90 cm



The first 4 clusters (Tunka-28) are being deployed in summer and autumn and commissioned in October 2007. During the winter season 2007-2008, extended run will be performed.

The components of the rest of the array are planned to be produced in 2007/2008 and installed in Summer/Autumn 2008.