TAIGA – Tunka Advanced Instrument for cosmic rays and Gamma Astronomy

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Cosmic Ray Physics in Space
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TAIGA

Complex instrument for studying astrophysical processes by means of detecting various components of air-showers in the very-high energy range.

The goals of the observatory are:

* search for galactic sources of gamma rays with energies higher than 20-30 TeV;
* gamma-radiation fluxes from the Crab nebula and Tycho SNR;
* gamma rays from the most bright blazars;
* search for possible violations of Lorenz-invariance and axion-photon transitions;
* flux of ultra-high energy primary cosmic rays (energy spectrum and mass composition).

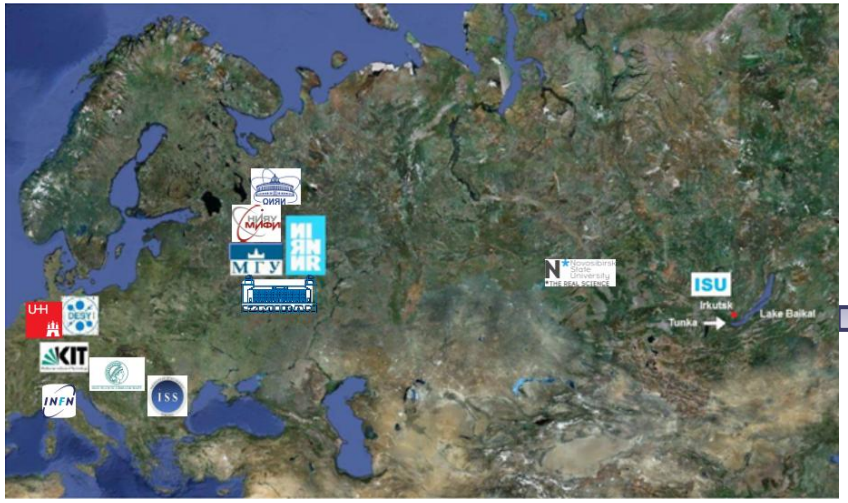
Cosmic ray detectors

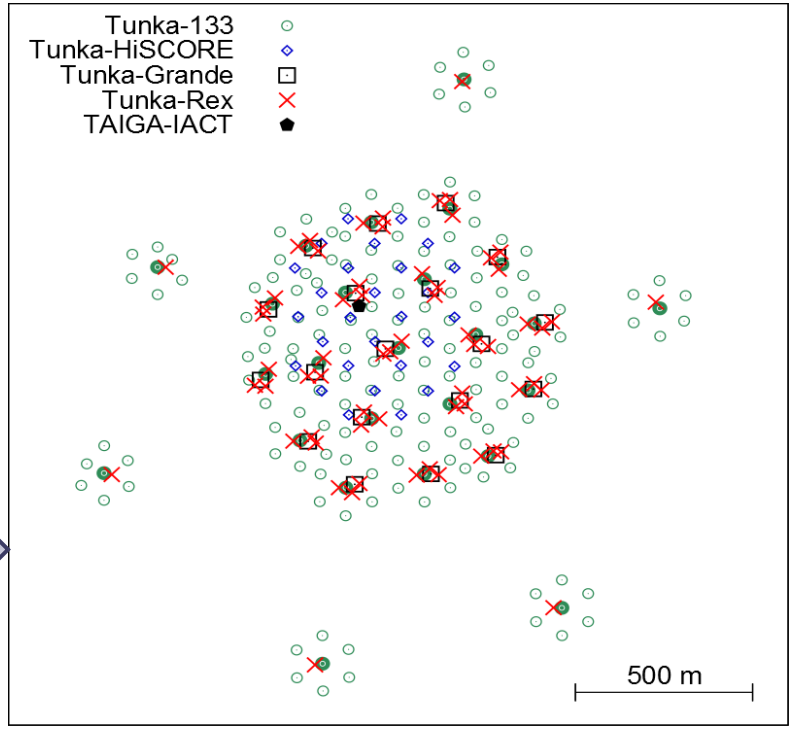
Tunka-133 air-Cherenkov
Tunka Radio Extension (Tunka-Rex)
Tunka-Grande scintillators

Gamma ray detectors

TAIGA-HiSCORE
TAIGA-IACT
TAIGA-muon

approx. 50 km from Lake Baikal in the Tunka valley





Reconstruction resolution: arrival direction ~ 0.1-0.3°, axis position ~ 5–10 m, E_{pr} ~ 15%, X_{max} ~ 28 g/cm^2

Tunka-133

* 3 km^2 Cherenkov array
* 25 clusters, 7 wide-angle optical detectors in each cluster
* Operated since 2009

Tunka-Grande

* Particle detector
* 19 scintillation stations, each of them with surface and underground parts, detecting EAS electrons and muons respectively

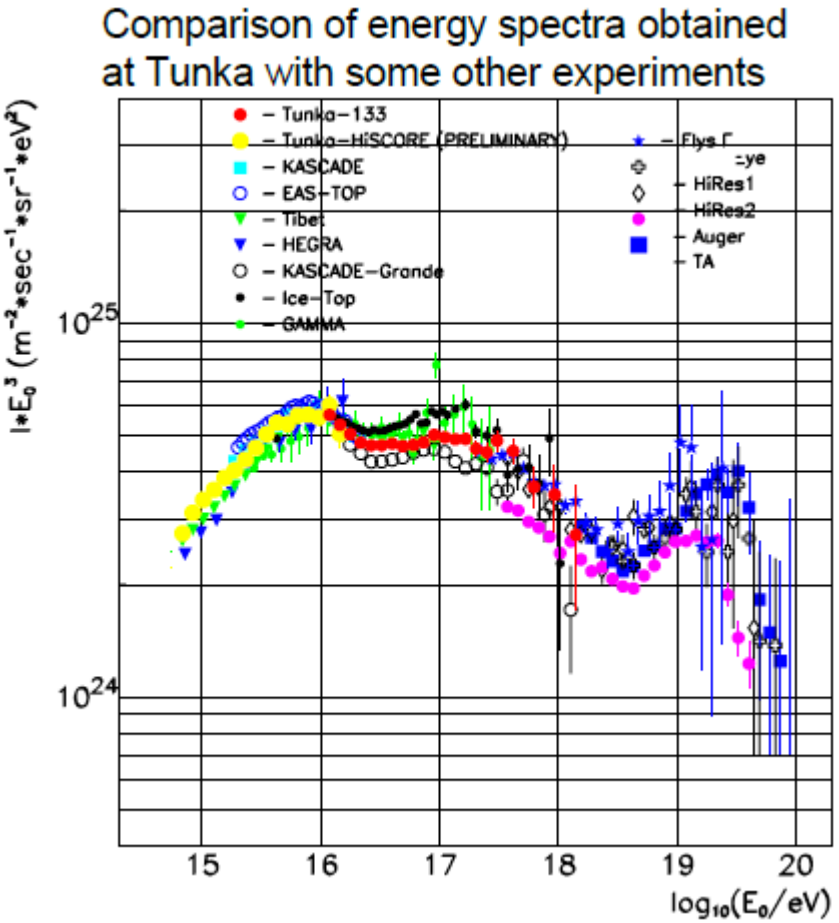
Tunka-Rex

* Radio array (30-80 MHz)
* 63 antenna stations on 1 km^2
* triggered by Tunka-133 and Tunka-Grande

see also talk by D.Kostunin

Combined (γ, μ, e, radio) measurement of air showers

Tunka-133 results for 5 years of operation



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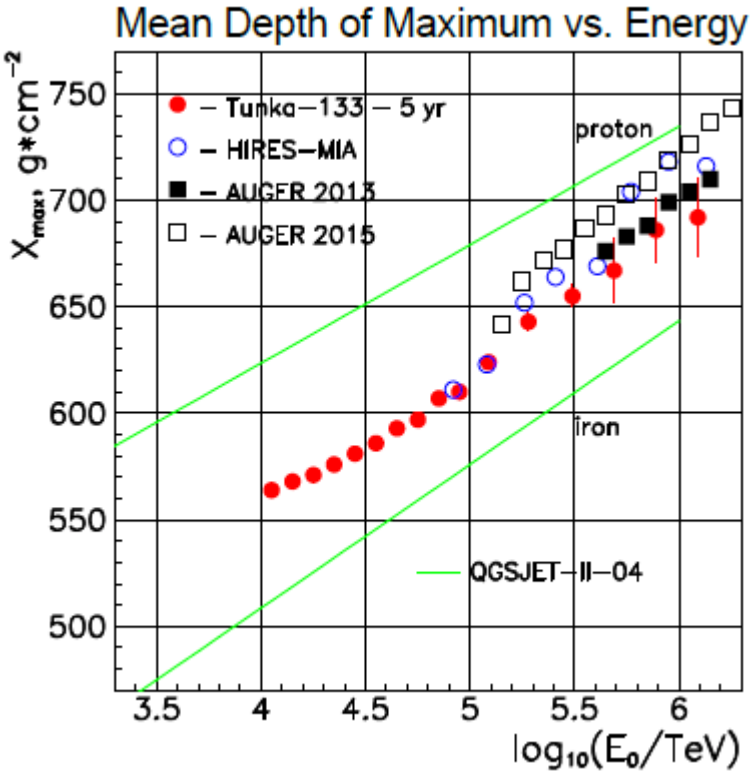

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DOI: 10.1088/1742-6596/718/5/052031

Reconstruction resolution: arrival direction ~ 0.1°,
axis position ~ 5–6 m, E_{pr} ~ 10–15%, X_{max} ~ 20–25 g/cm^2

TAIGA-HiSCORE

* Non-imaging Cherenkov array
* will consist of 500 optical detectors on the area 5km^2 (now 28 detectors on area 0.25km^2)
* FOV ~ 0.6 sr, angular resolution ~ 0.1°
* Good sensitivity to the EAS parameters

TAIGA-IACT

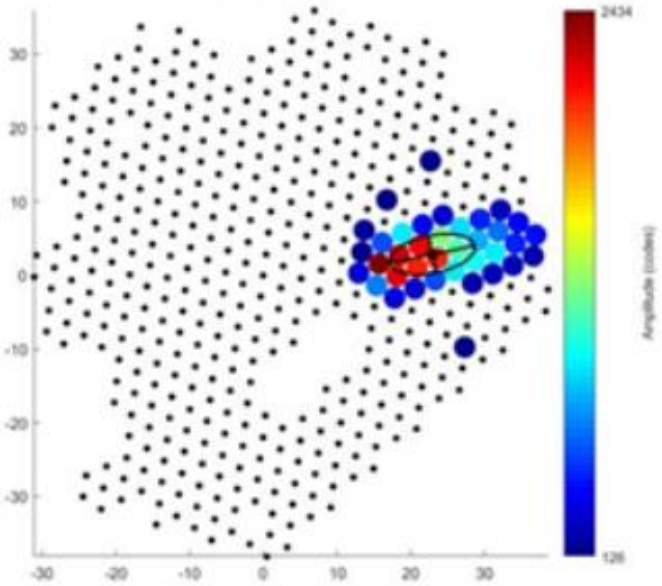
* Imaging air-Cherenkov telescopes
* Optical system: Davis-Cotton design reflector and photomultiplier-based camera
* FOV - 9.72x9.72°, angular size 0.36° per pixel
* will comprise 16 telescopes with spacing of 600-1000 m.
* Gamma/hadron separation using imaging technique

TAIGA-Muon

* Underground muon detector (started in autumn 2017)
* will improve the selection efficiency for better gamma-hadron separation at low energies (10–100 TeV)

Combined approach of the imaging and timing techniques: inter telescope-distance can be significantly increased!

Example IACT event



TAIGA-HiSCORE and TAIGA-IACT point source sensitivity in comparison with other experiments