TAIGA
facility in the Tunka valley

The TAIGA observatory - a hybrid array for high energy gamma astronomy and cosmic ray physics

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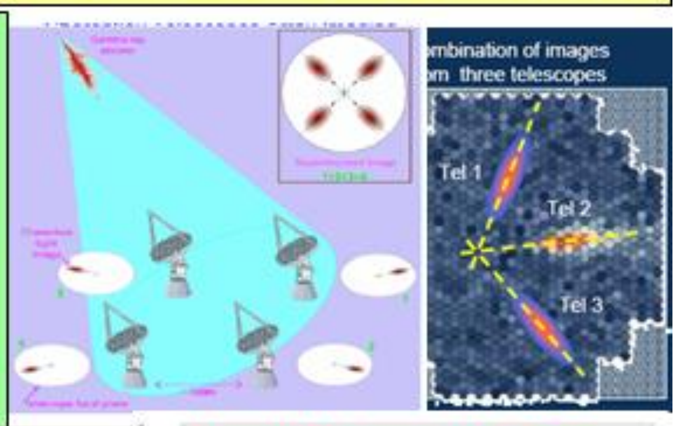
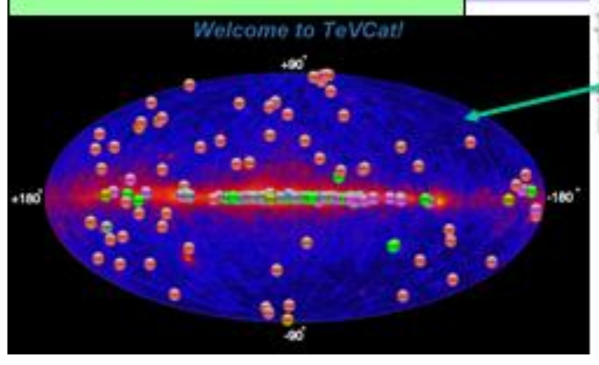
The TAIGA observatory addresses ground-based gamma-ray astronomy at energies from a few TeV to several PeV, as well as cosmic- ray physics from 100 TeV to several EeV.

Very high energy gamma astronomy IACT arrays

About 200 sources of gamma rays with energy more than 1 TeV were discovered with Imaging Atmospheric Cherenkov Telescopes arrays: HEGRA, HESS, MAGIC,VERITAS

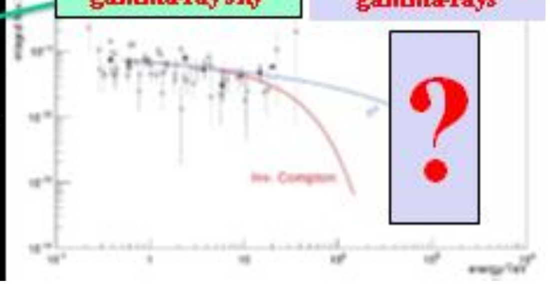
S ~ 0.01 km²



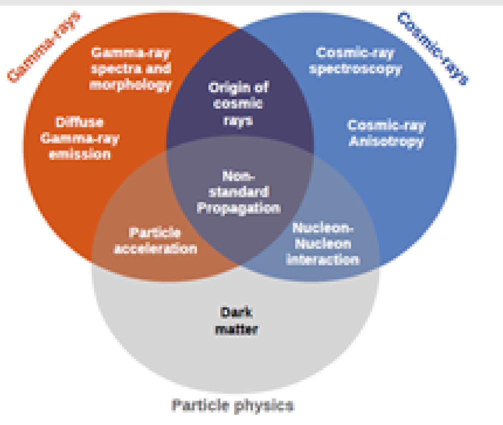


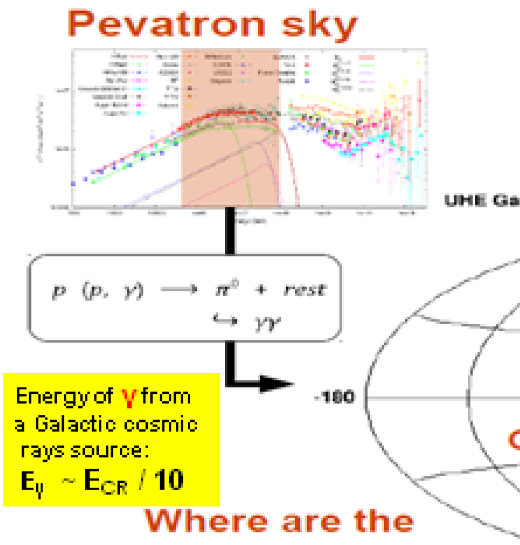
Very High Energy gamma-ray sky

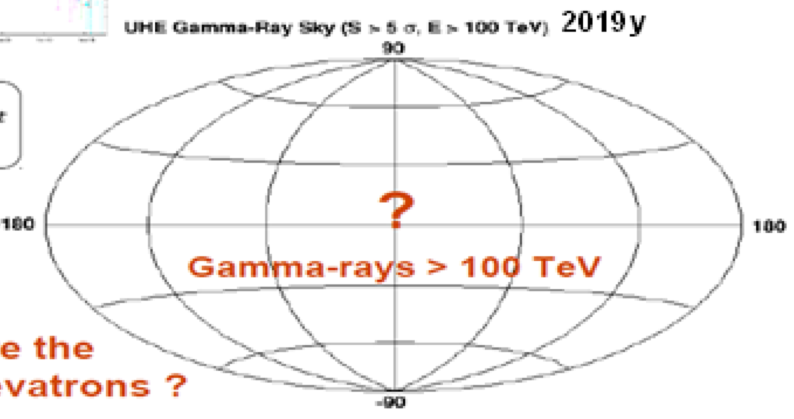
Ultra High Energy gamma-rays



Astroparticle Physics motivation for Ultra High Energy gamma astronomy



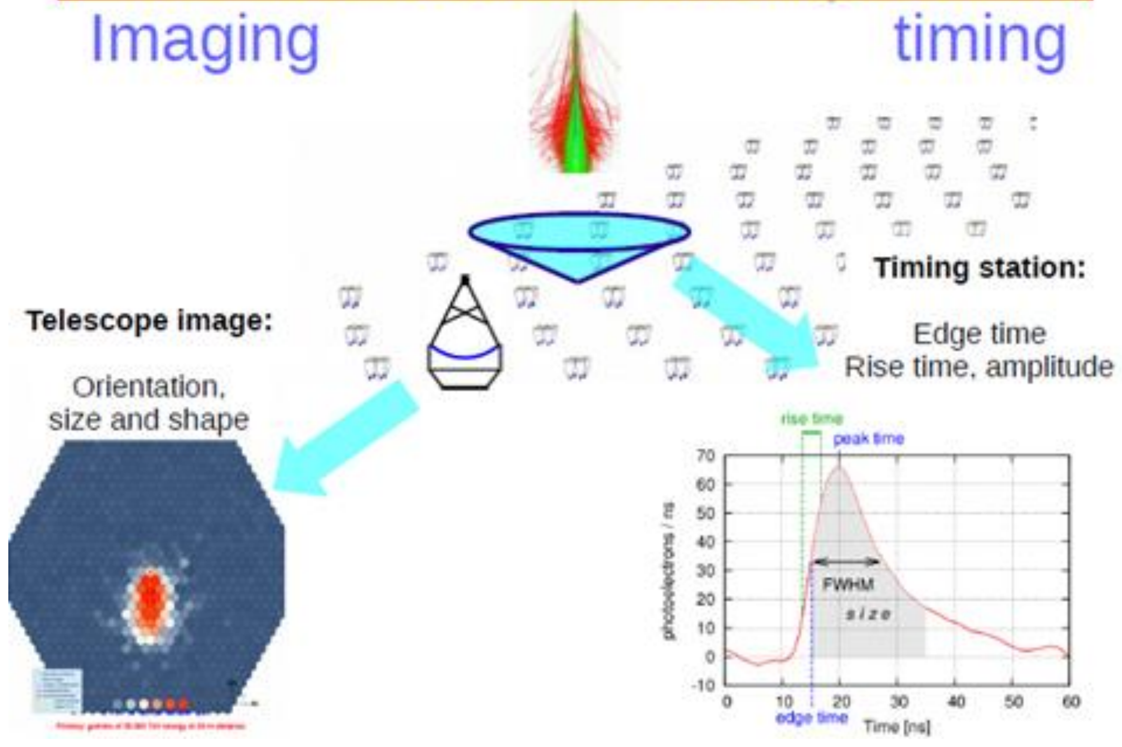




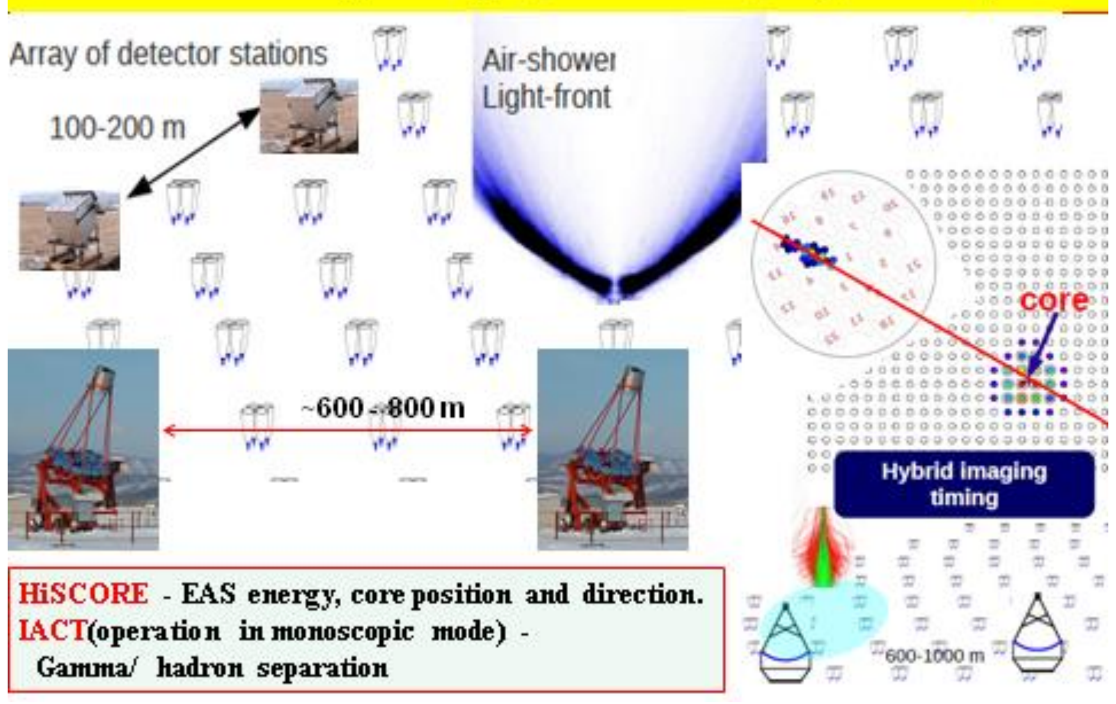
Where are the cosmic ray pevatrons ?

Two air Cherenkov techniques:

Imaging timing



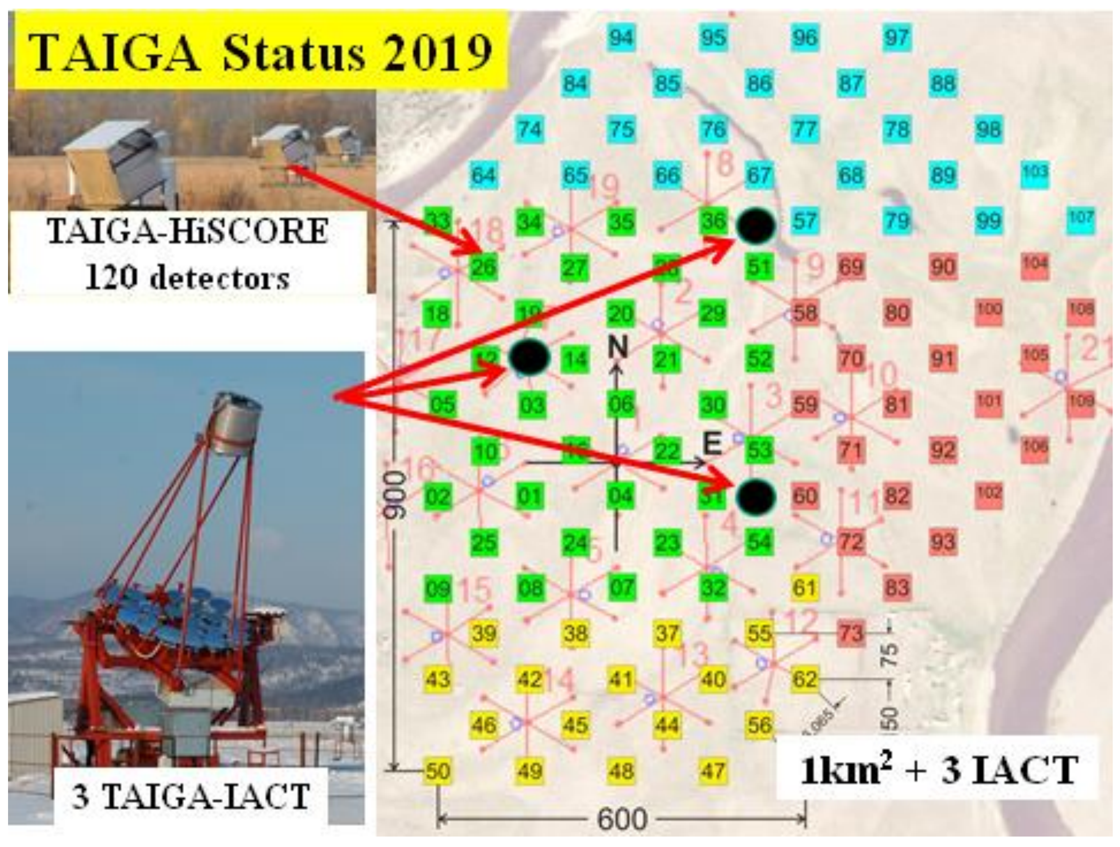
TAIGA (Tunka Advanced Instrument for cosmic rays and Gamma Astronomy): Imaging + non-imaging techniques



HiSCORE - EAS energy, core position and direction.
IACT(operation in monoscopic mode) - Gamma/ hadron separation

The TAIGA observatory is located in the Tunka valley, 50 km from Lake Baikal

TAIGA Status 2019

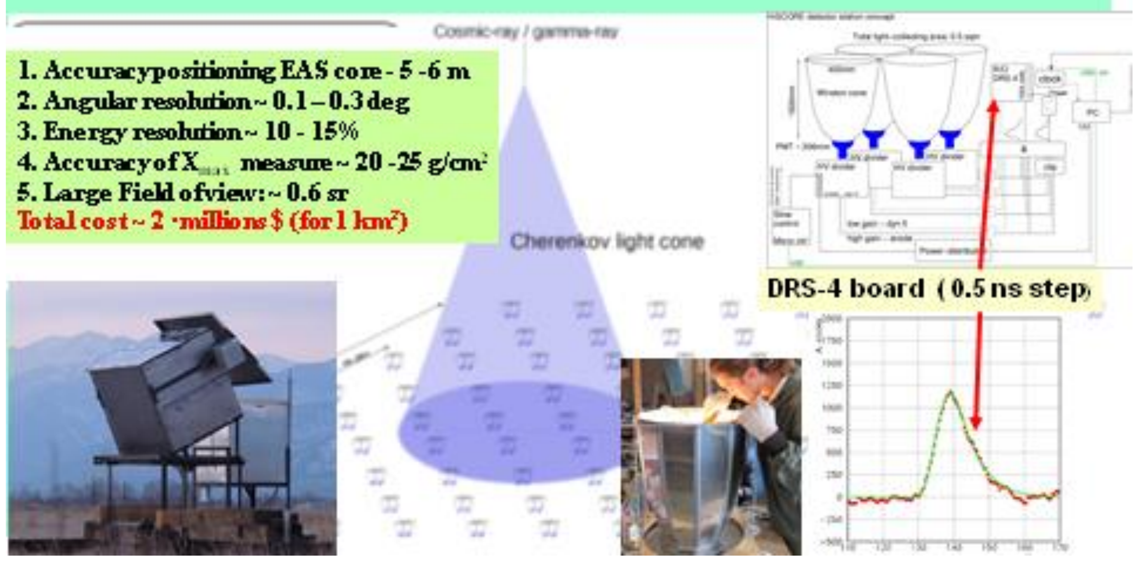


TAIGA-HiSCORE (High Sensitivity Cosmic Origin Explorer)

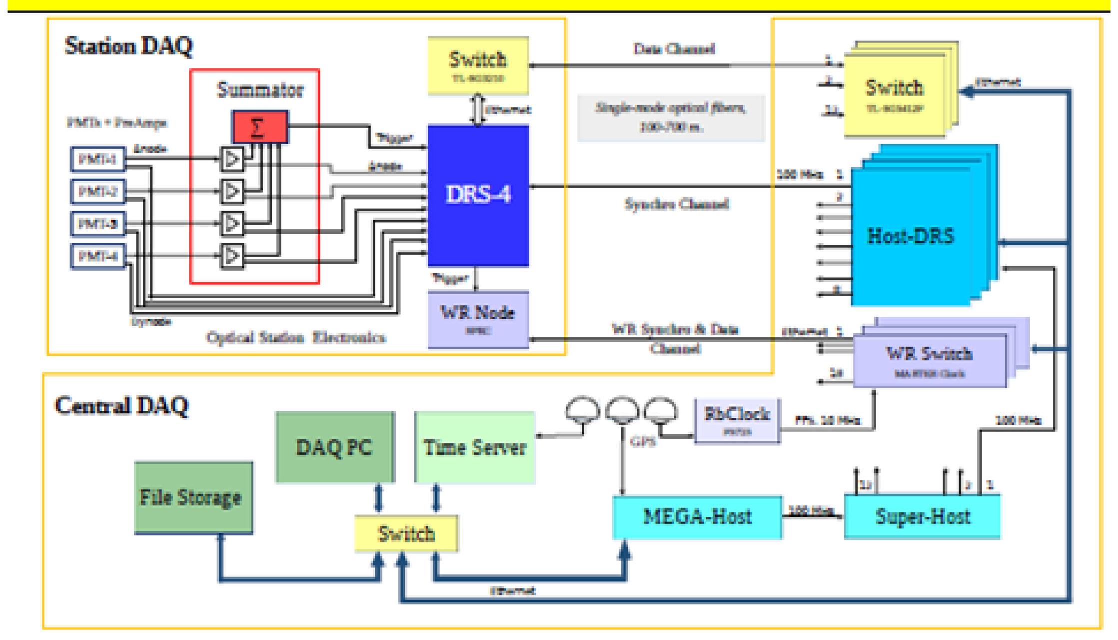
- Wide-angle time- amplitude sampling non-imaging air Cherenkov array.
- Spacing between Cherenkov stations 80-100 m ~ 100-150 channels / km².

1. Accuracy positioning EAS core - 5 - 6 m
2. Angular resolution ~ 0.1 – 0.3 deg
3. Energy resolution ~ 10 - 15%
4. Accuracy of X_{max} measure ~ 20 - 25 g/cm²
5. Large Field of view: ~ 0.6 sr

Total cost ~ 2 "millions $ (for 1 km²)

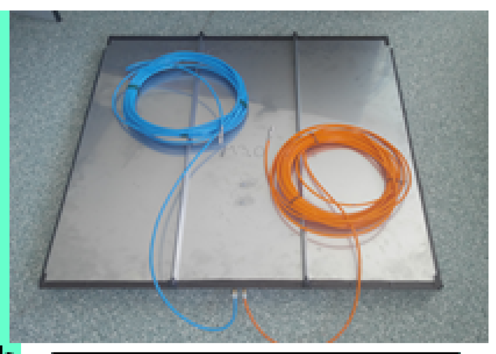


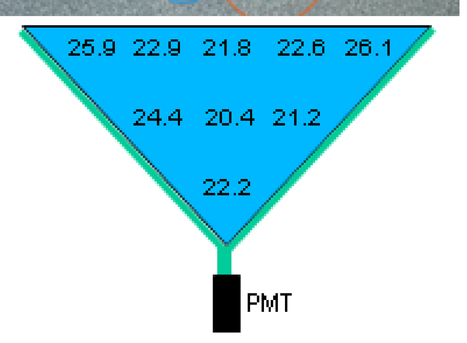
TAIGA-HiSCORE DAQ system: stations and central part, including redundant GPS/RbClocks.



The TAIGA-Muon particle counter.

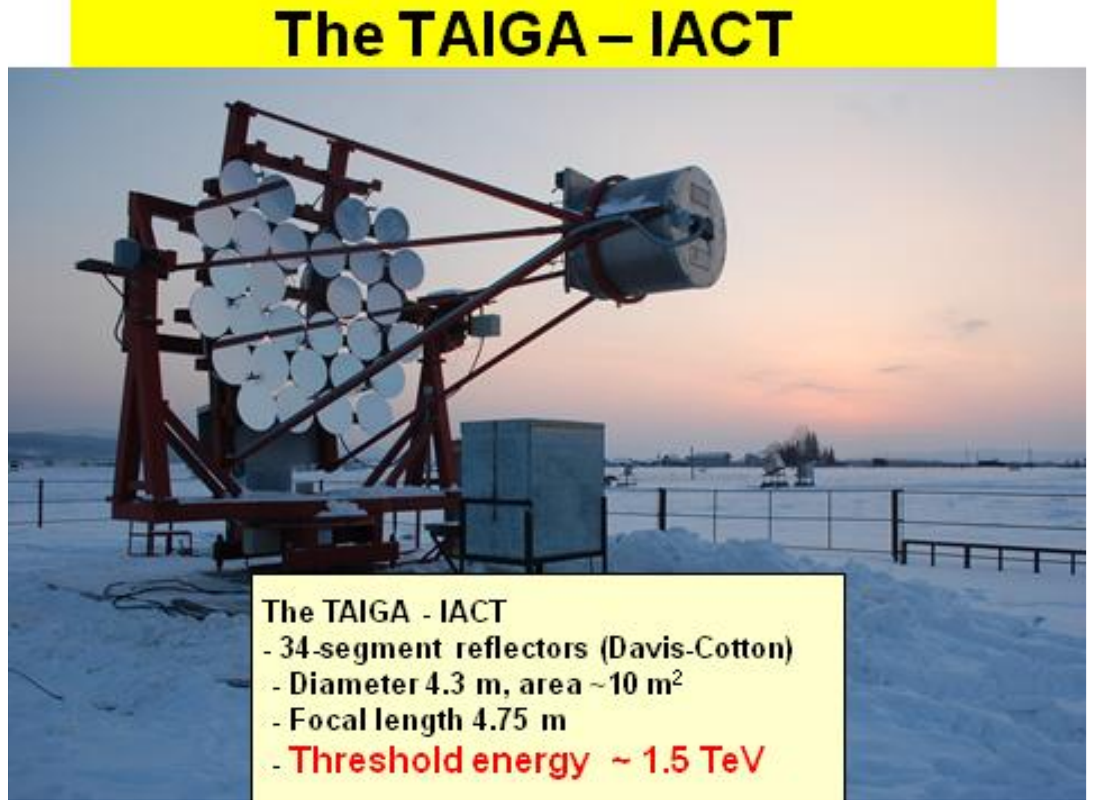
- Counter dimension 1x1 m².
- Wavelength shifting bars are used for collection of the scintillation light on the PMT
- Mean amplitude from cosmic muon is 23.1 photoelectrons with ±15% variation (minimum to maximum).
- A clear peak in amplitude spectrum is seen from cosmic muons in a self trigger mode.





¼ of full scale detector

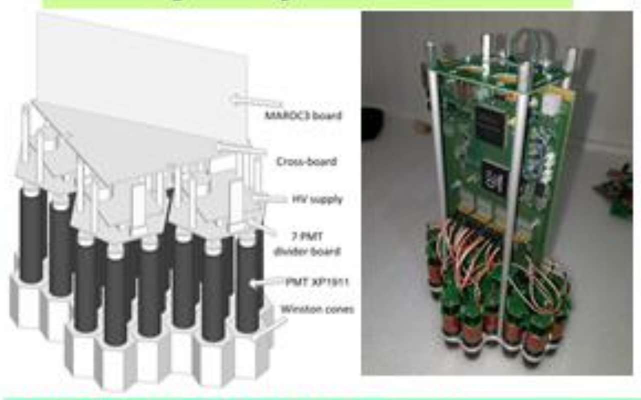
The TAIGA – IACT



The TAIGA - IACT
- 34-segment reflectors (Davis-Cotton)
- Diameter 4.3 m, area ~10 m²
- Focal length 4.75 m
- Threshold energy ~ 1.5 TeV

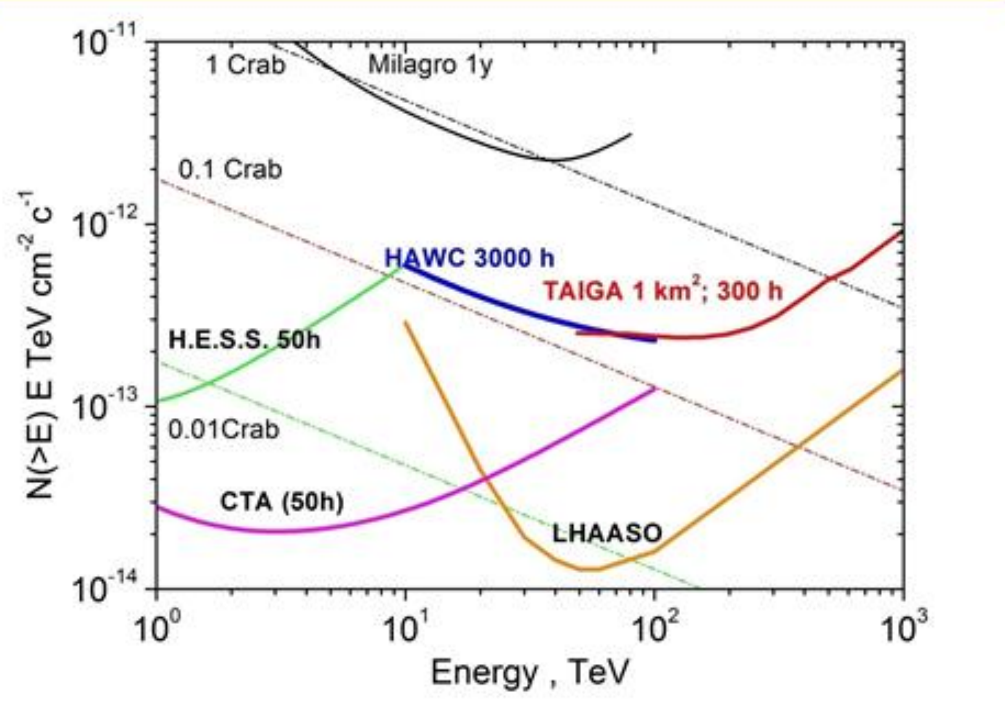
The Camera of the TAIGA-IACT

- 560 PMTs (XP 1911) with
- 15 mm useful diameter of photocathode
- Winston cone: 30mm input size
- each pixel = 0.36 deg
- FOV ~ 9.6°, PSF ~ 0.07°
- Pointing accuracy ~0.05



Basic cluster: 28 PMT-pixels. Signal processing: PMT DAQ board based on MAROC3 ASIC

The 1 km² TAIGA setup integral point source sensitivity



TAIGA is a hybrid instrument, that combines HiSCORE, an array of wide-angle air Cherenkov timing stations for shower-front sampling, and Imaging Air Cherenkov Telescopes (IACTs). This hybrid concept allows cost-efficient instrumentation of gamma telescopes of multi km2-scale. The capabilities of these Cherenkov arrays are enhanced by muon detectors (TAIGA-Muon. The 2019y TAIGA setup will comprise the tree IACT and a HiSCORE array with 120 stations on 1.0 km² instrumented area. The detection sensitivity installation for point sources in the energy range of 30 – 200 TeV is expected to be 2,5 10^{-13} TeV cm^{-2} sec^{-1} for 500 h of observation or 10 detected events. The study of gamma radiation in the ultra high energy range by TAIGA is of interest not only for astrophysics, but also for testing theories predicting a violation of Lorentz invariance and to search for super-heavy dark matter