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TAIGA

Imaging Atmospheric Cherenkov Telescope for the TAIGA observatory – JINR participation

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IACT is one of the key parts of the TAIGA observatory and designed for study of gamma rays and charged cosmic ray in the energy range of 10^{13} eV - 10^{18} eV. The first IACT was designed and fabricated at JINR workshop and has been operating since 2016 in the Tunka valley. The second one has been assembled there at September 2018 and the production of the third one is in progress to be transported to the Tunka valley in August 2019. The R&D method of the focusing glass mirrors fabrication is developed at JINR. The report presents the TAIGA IACT main characteristics and the results of the comparison between the JINR glass mirrors and composite mirrors (Media Lario company, Italy).

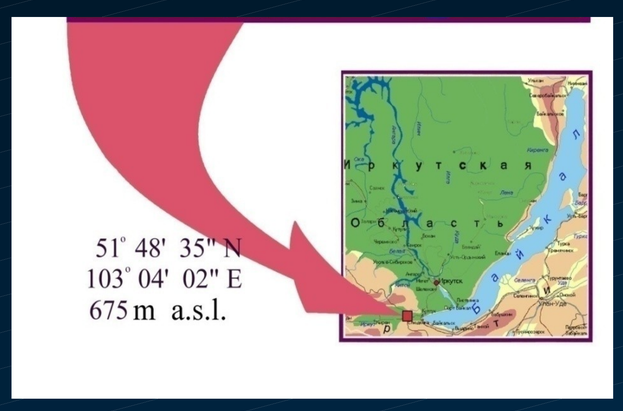
TAIGA experiment and the first IACT

Experimental challenges of TAIGA

In γ-ray astronomy:
- Search for galactic PeVatrons
- VHE spectra of few known sources & absorption on CMB
- Diffuse emission, galactic plane, local supercluster

In cosmic rays:
- Spectrum and mass composition for E ~ 10^{14} – 10^{18} eV

In particle physics:
- Study of possible Lorentz invariance violation
- Axion/photon possible conversion
- Pp cross-section measurement, …



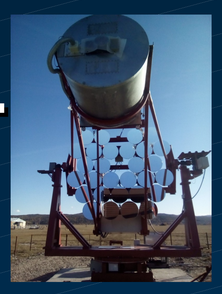
Idea of the hybrid detector

500 wide angle optical stations on the 5 km² area, energy threshold 30 TeV

+

Muon detectors with total area 2.0 10^3 m²

+



up to 16 IACTs (~10 m² mirrors)

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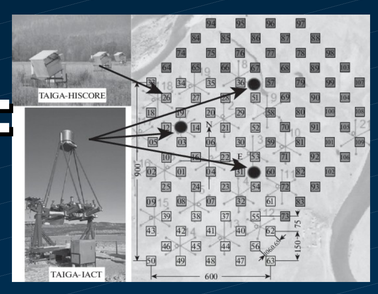


The main parameters of the first IACT

Camera:
- 547 hexagonal-shaped pixels
- PMT XP1911: window of DIA 15 mm
- Winston cone: 30 mm input size, 15 mm output
- FOV of single pixel: 0.36°
- Full FOV: 9.72°

Mirror:
- Davies-Cotton optic type
- Focal length: 4750 mm
- 34 spherical mirror segments
- Diameter of each segment: 60 cm
- Diameter of the mirror: 4.3 m

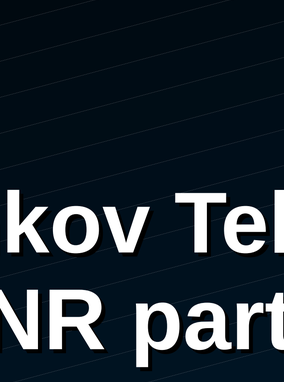
The second IACT is waiting for mechanical tests

The second IACT was transported to the Tunka Valley in September 2018

Fabrication of the third IACT

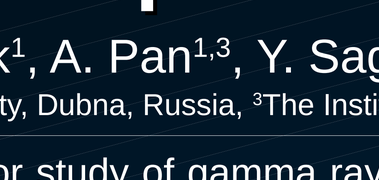
The third IACT is planning to be assembled in the Tunka Valley in August 2019

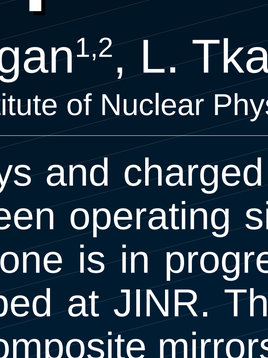
Mirror fabrication and control methods at JINR

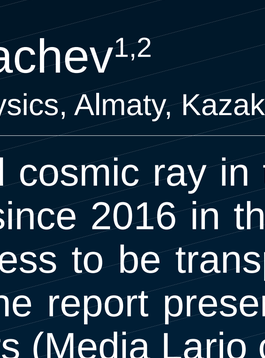


Glass-bending oven and the polishing machine

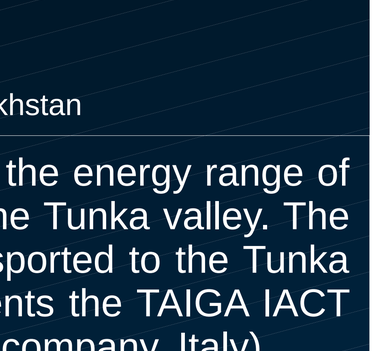
Vacuum camera for covering mirror facets by the reflective and protective layers



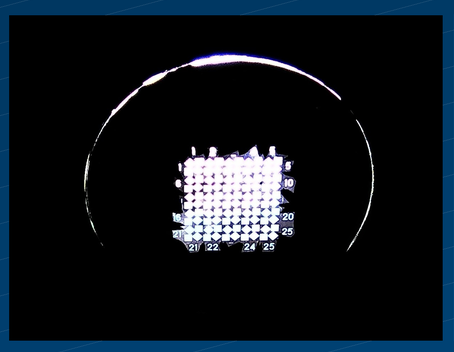


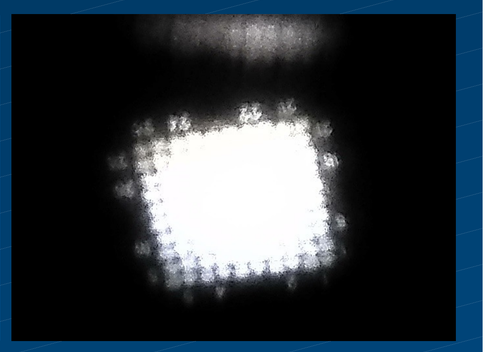


Control of the surface curvature and roughness

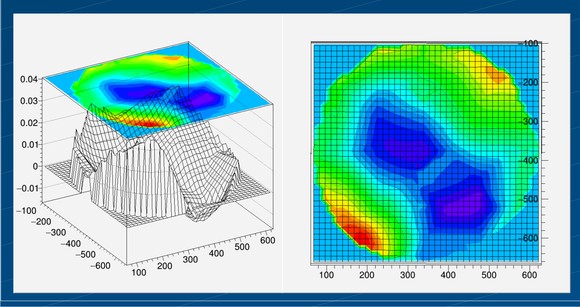


Test sample



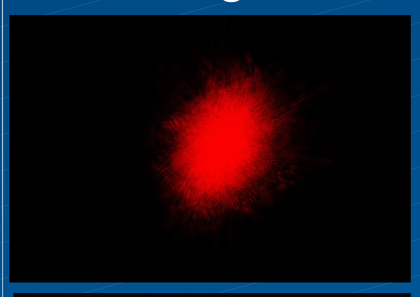


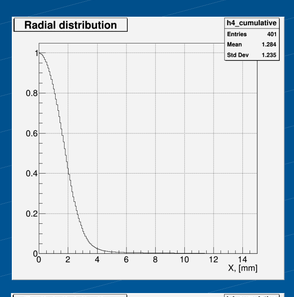
Left: Stand for checking the quality of the surfase shape and the radius of the mirror curvature
Top: Source and its image when testing a mirror from the curvature center.
The size of the line target (pattren) is 15 mm

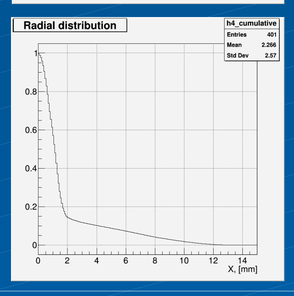


Measurement results of the mold for the mirror production.
Mirror of this shape gives 1-2 mm spot size in the focal plane

JINR glass mirrors with the composite mirrors







The spot shape and the relative energy distribution comparison for the composite mirrors of the Media Lario company (top) and the mirrors fabricated at JINR (bottom). The real length and width of the shots is 23,7 and 15,6 mm

Conclusions: The first IACT was designed and fabricated at JINR workshop and has been operating since 2016 in the Tunka valley. The second UACT has been assembled there at September 2018 and now is waiting for tests. The third IACT is in production at JINR workshop and suppose to be transported to the Tunka valley in August 2019. Also JINR has developed a technology for IACT glass mirror facets fabrication and control.