TAIGA-Observatory: First 5 years of operation of the HiSCORE Air-Cerenkov Array.

Andrea Porelli for The TAIGA Collaboration
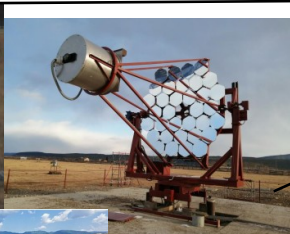
ICRC 2021, Berlin, 12-23 July 2021

TAIGA-HiSCORE (1): integrating Air Cherenkov timing array – 120 stations

TAIGA-IACT (2): 2 telescopes operating Telescope 3 in construction

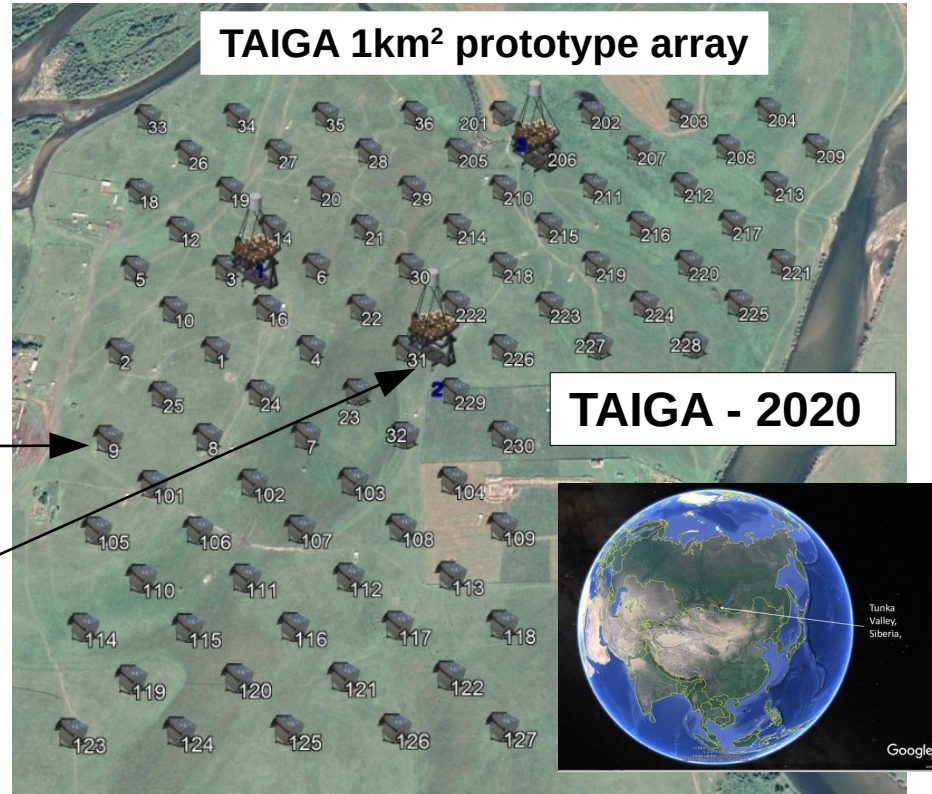**TAIGA-Muon (3)**: 240m^2 sparse surface and underground particle detectors

TAIGA 1km^2 prototype array

TAIGA - 2020

Tunka Valley, Siberia,

More info: TAIGA overview talk - N.Budnev

TAIGA-HiSCORE

Stable operation since fall 2015

- 2015-17: 1 cluster (30 stations); 2017-2019: 2 cluster (60 st.); 2019-20: 3 cluster (90 st.)

**HiSCORE in TAIGA: provide precise EAS core and direction reconstruction**

- Core: amplitude distribution fit
- Direction: time front fit

Integrated events count: 2015-2020

Event reconstruction

Reconstructed core distr.

Reconstructed direction distr.
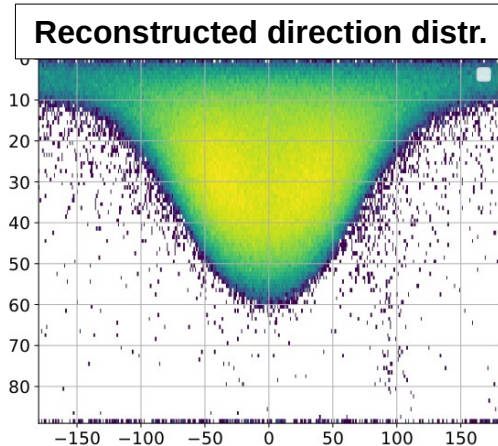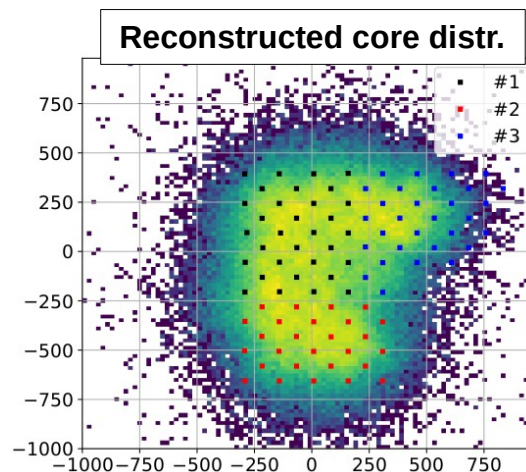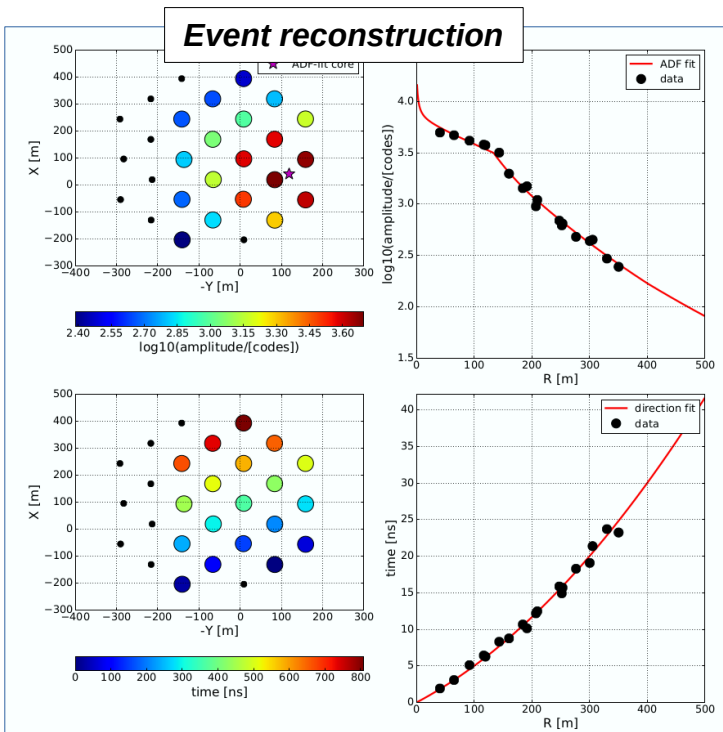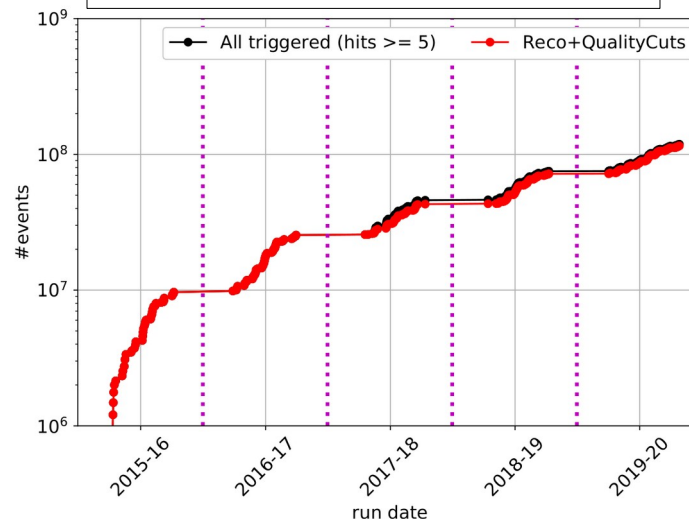
EAS direction reconstruction

Time calibration and angular resolution

2015/16: Hybrid time calibration offfsets

Direction reconstructionfit residual
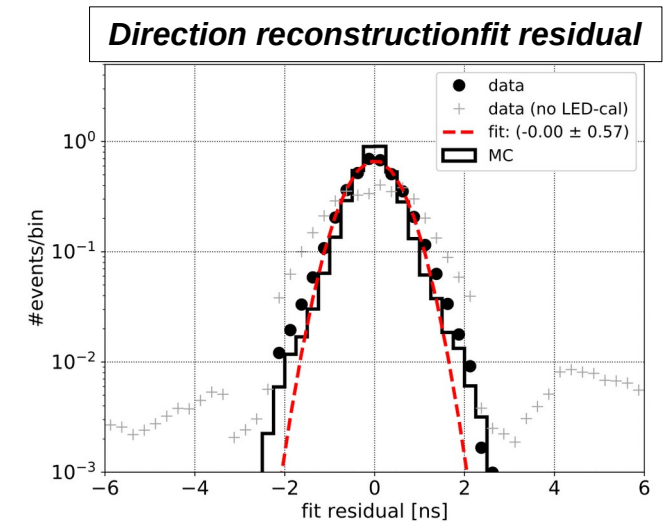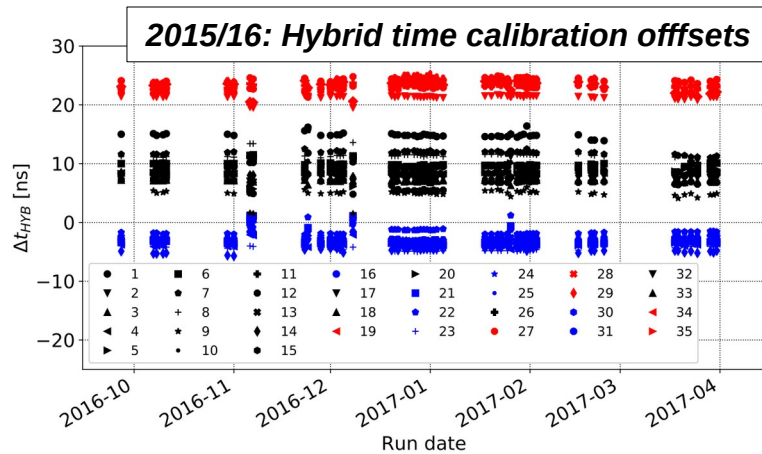
**Correction of unknonw station time offsets: Hybrid calibration**

- EAS (full array) + external LED (only few stations)
- Stable over time
- Final sub-nsec relative time synchonization between stations

Angular resolution test: Chessboard method

- Array split in two interspersed sub-arrays
- Two (semi-)independent reconstructed directions for each event
- Angular error: ~0.2° @10 hits; ~0.1° @20 hits.

Absolute pointing test: 0.1° with external satellite LIDAR

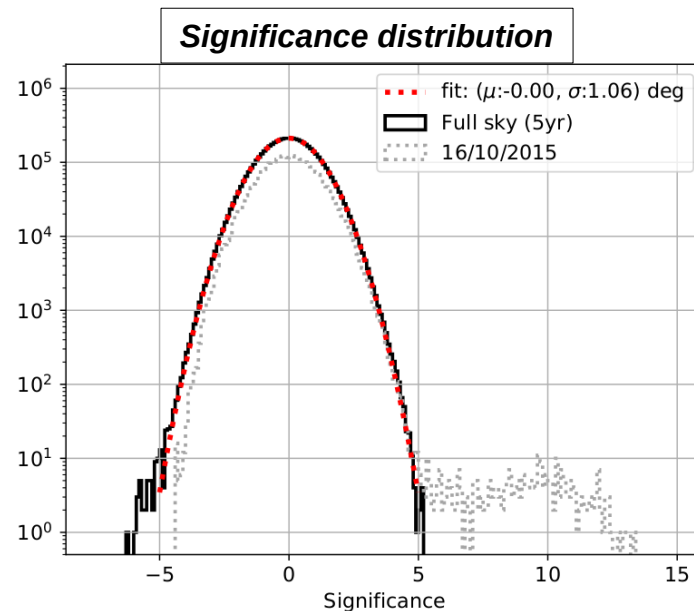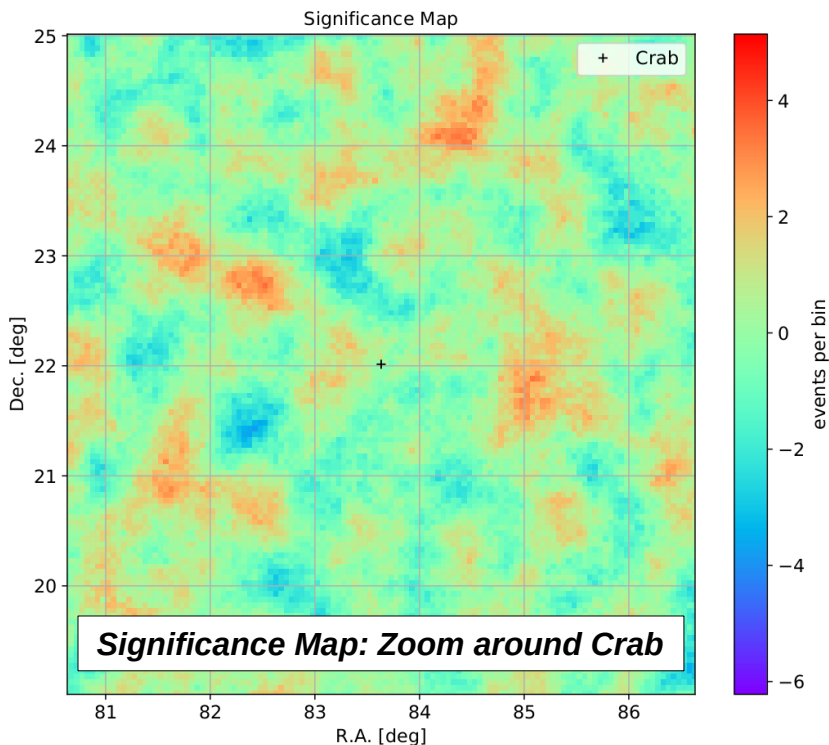- *see TAIGA-CALISPO - A.Porelli ,ICRC21*

Ang.Res. Chessboard method
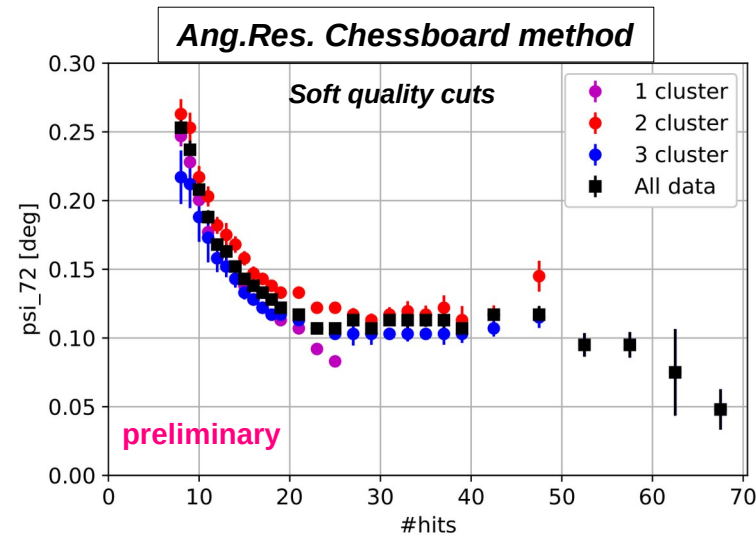
Point source analysis

TAIGA-HiSCORE 5yr data set

Developed full sky point source analysis for TAIGA-HiSCORE

- Selection: Nhits >= 10 (ang.res. ~0.2°) + reco quality cuts
- Background: Direct Integration (100 fake events per true event)
- Search radius: 0.3°
- Significance: Li&Ma (eq.17) with α = 0.01

Significance Map: Zoom around Crab

Significance distribution

Results:

- Stable and reliable Bkg estimation
- Significance: Gauss(μ = 0, σ = 1)
- Serendipitous detection of satellite LIDARS signal on 16/10/15 (*see TAIGA-CALISPO - A.Porelli ICRC21*)
- No gamma source signal observed above 5s
- Results compatible with MC expectation

- *In progress: binned analysis; g/h separation for HiSCORE stand alone operation*

Summary

- **TAIGA-HiCSORE: stable operation since 2015**

  – Established rountine data analysis for the first 5 years

  – 120 stations in fall 2021 (4 cluster)

- **EAS direction reconstruction**

  – Sub-nsec relative timing accuracy

  – Angular resolution ~0.1° (cheeboard method)

  – Absolute pointing ~0.1° (external satellite LIDAR)

- **Point source analysis**

  – Implemented stable and reliable method

  – Source detection limited by large background

  – *Work in progress: analysis optimization*

Thank you

Contact

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