TAIGA-IACT pointing control and monitoring software status

*Zhurov Dmitriy,
Gress Oleg,
Lukyantsev Dmitriy
for the TAIGA Collaboration

* Speaker

The TAIGA-IACT telescopes

- TAIGA-IACTs are Imaging Atmospheric Cherenkov Telescopes:

  – 4.3 m diameter reflector, 9.6o FoV

  – Camera with PMTs+Winston cones

  – Drive system + CCD-camera for pointing

- TAIGA-IACT is part of the TAIGA hybrid detector:

  – IACT telescopes + Timing Arrays

  – Location: **Tunka valley**, Siberia, Russia

- Status: 1st and 2nd TAIGA-IACT in operation, 3rd in construction

The TAIGA-IACT control software

The TAIGA-IACT control software:

- based on EPICS framework and written in C/C++ and Python

- GUI is Qt-based (EPICS Qt Framework), graphical an audio information in control room

- Automated observation and calibration run control

The telescope is operates in wobble mode, switching every 20 minutes. Offset from the camera center 1.2°
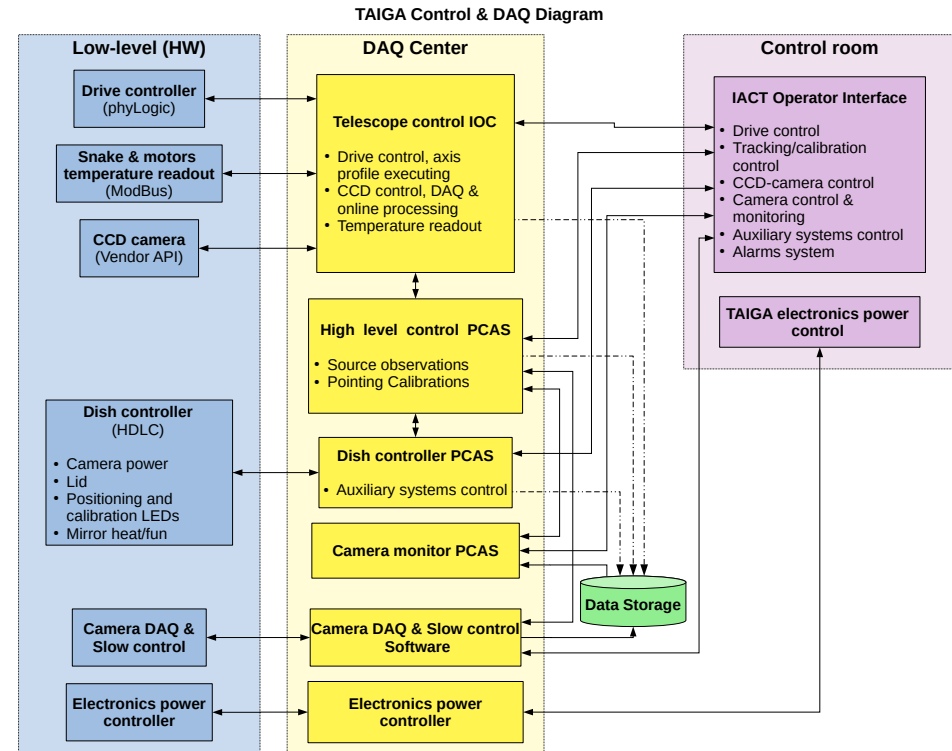
EPICS (Experimental Physics and Industrial Control System) - a framework for distributed control system software development

TAIGA Control & DAQ Diagram

Low-level (HW)

- Drive controller (phyLogic)
- Snake & motors temperature readout (ModBus)
- CCD camera (Vendor API)
- Dish controller (HDLC)
  - Camera power
  - Lid
  - Positioning and calibration LEDs
  - Mirror heat/fun
- Camera DAQ & Slow control
- Electronics power controller

DAQ Center

- Telescope control IOC
  - Drive control, axis profile executing
  - CCD control, DAQ & online processing
  - Temperature readout
- High level control PCAS
  - Source observations
  - Pointing Calibrations
- Dish controller PCAS
  - Auxiliary systems control
- Camera monitor PCAS
- Camera DAQ & Slow control Software
- Electronics power controller

Data Storage

Control room

- IACT Operator Interface
  - Drive control
  - Tracking/calibration control
  - CCD-camera control
  - Camera control & monitoring
  - Auxiliary systems control
  - Alarms system
- TAIGA electronics power control

The TAIGA-IACT coordinate transformations

The TAIGA-IACT pointing and mapping to the sky:

- Direction measurements: by encoders applying the pointing model +

  CCD camera corrections

- Arbitrary source position estimation using telescope camera model

- Calibration measurements performed in the small moon and with the unrolled calibration screen

Astrometry of an image example
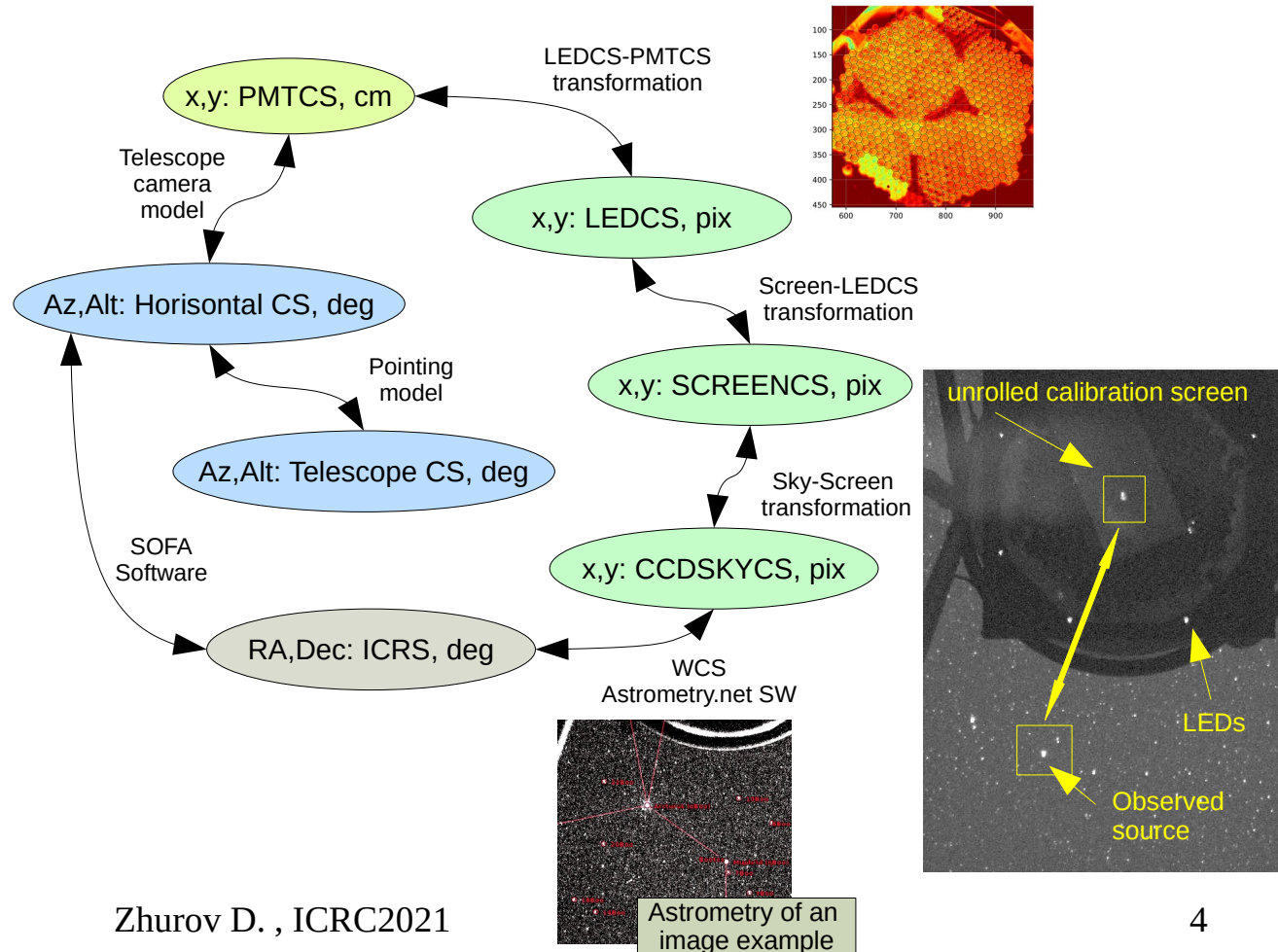
The results of the calibration

The pointing results with calibration screen (different altitudes, small offsets from camera center):

- Model - measured standard deviation is about 0.01^o by both x and y axes.

- The mean deviation predicted position form measured for different months not exceed 0.01^o for the 2020-2021 season

The pointing results with anode current on the PMTs (different altitudes and offsets from camera center):

- Model - measured deviation not exceed 0.02^o

The conclusion: the telescope pointing and mapping to the sky accuracy is not worse than 0.02^o.

TAIGA-IACT02 example