Tunka Advanced Instrument for cosmic rays and Gamma Astronomy (TAIGA): status, results and perspectives

A.Borodin for TAIGA collaboration

TAIGA (Tunka Advanced Instrument for cosmic rays and Gamma - Astronomy)

Tunka Valley, Republic Buryatia
- 50 km to west
from Lake Baikal.

The main aim of TAIGA project:

Study of low flux high-energy (>30 TeV) Gamma rays from Galactic accelerators with large area array (~10 km^2)

TAIGA - collaboration

Germany

Hamburg University(Hamburg)
DESY (Zeuthen)
MPI (Munich)

Italy

Torino University (Torino)

Rumania

ISS (Bucharest)

Russia

MSU(SINP)(Moscow)
ISU (API) (Irkutsk)
INR RAS(Moscow
JINR (Dubna)
MEPHI(Moscow)
IZMIRAN (Moscow)
BINR SB RAS Novosibirsk)
NSU (Novosibirsk)
ASU (Barnaul)

Content of report

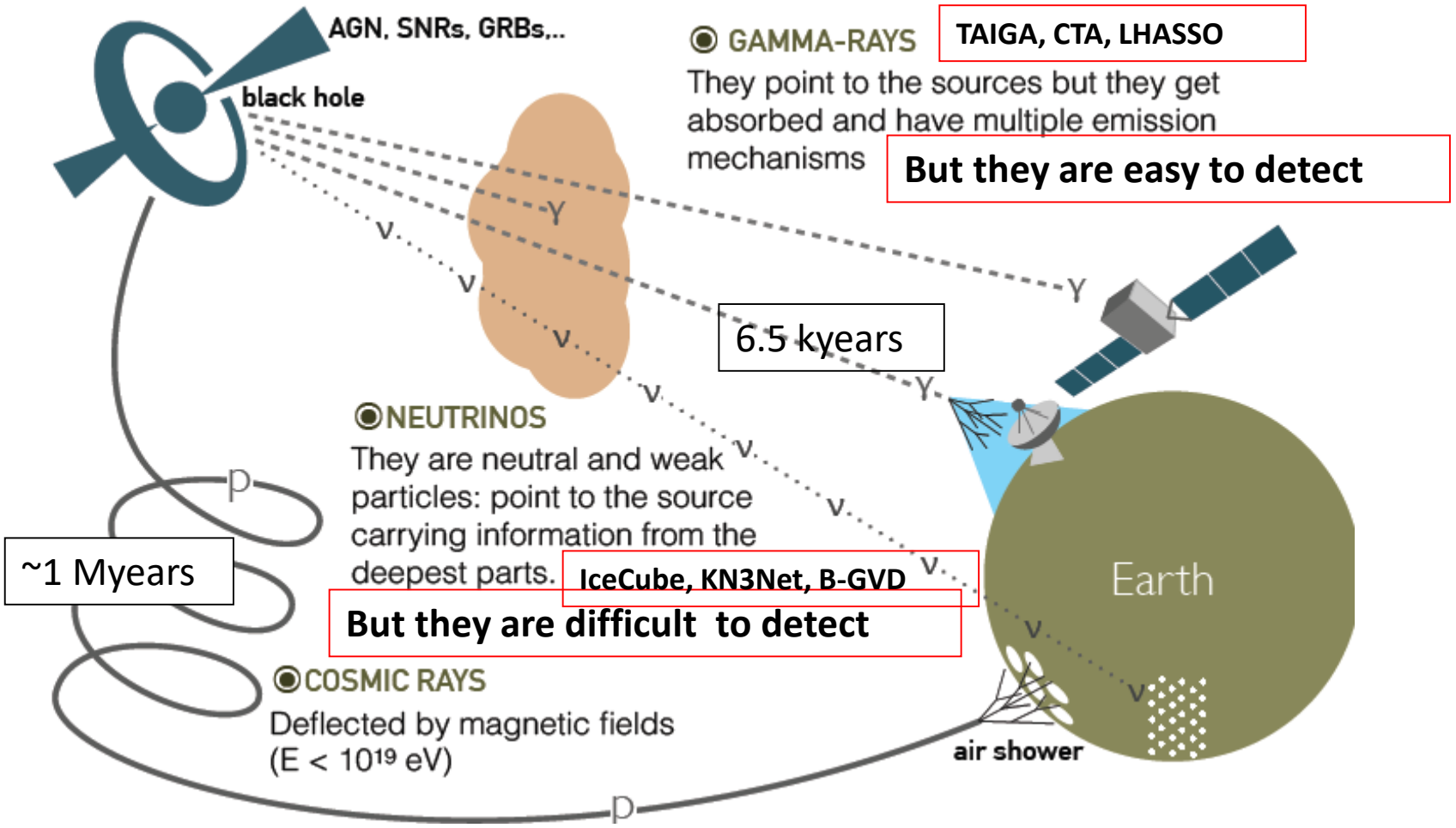
1. The main results of CR experiments in Tunka Valley

2. The procedure and the results of the PMT calibration

3. the mirror fabrication and its optical parameter measurements

Why gamma-ray astronomy?

To understand how Cosmic Accelerators work we need to detect cosmic rays, gamma – rays and neutrinos

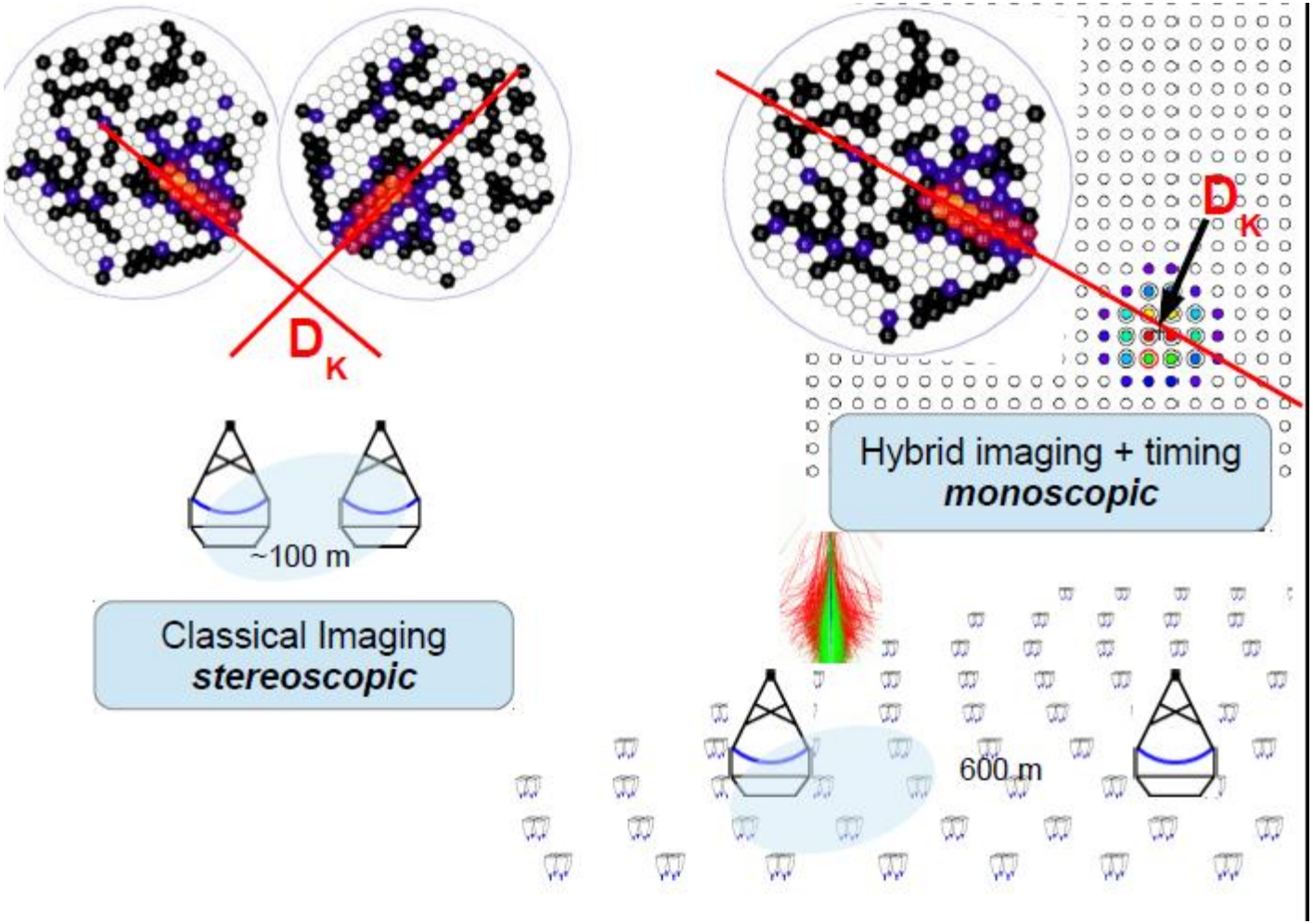


The TAIGA experiment - a hybrid detector for very High energy gamma-ray astronomy and cosmic ray physics in the Tunka valley

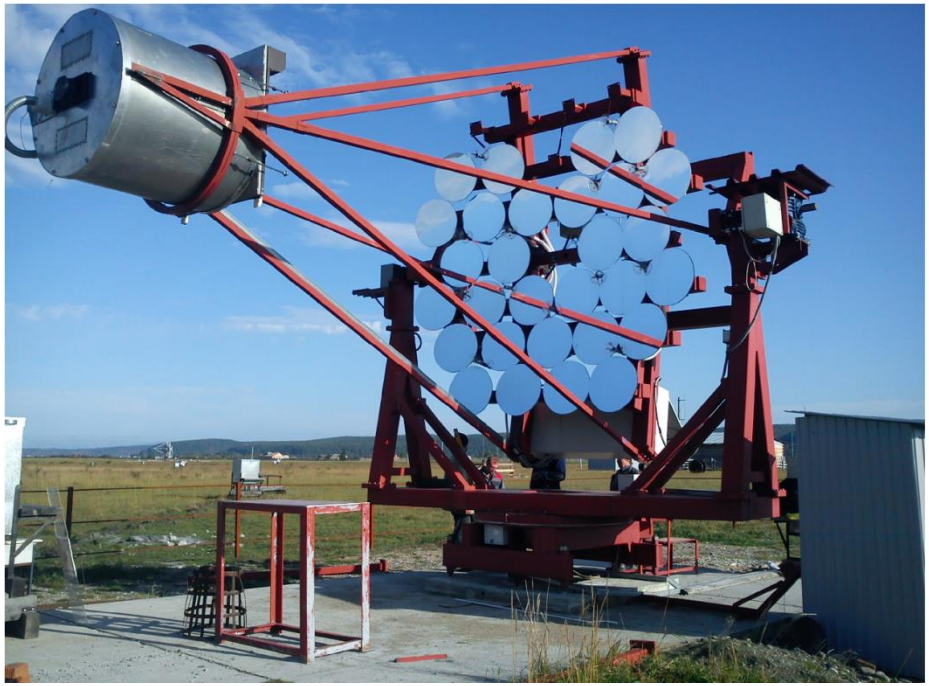
The main idea: A cost effective approach for construction of large areas installation is common operation of wide-field-of-view timing Cherenkov detectors (the *non-imaging technique) with a few relatively cheap, small-sized imaging Air Cherenkov Telescopes.*

The first stage of TAIGA - 1 km^2 area installation with 100 wide-angle timing detectors and 3 IACTs.
Commissioning of installation in 2019

Hybrid approach to CR rejection



The first and second IACT today (autumn, 2018)



TAIGA-IACT (the most North telescope)

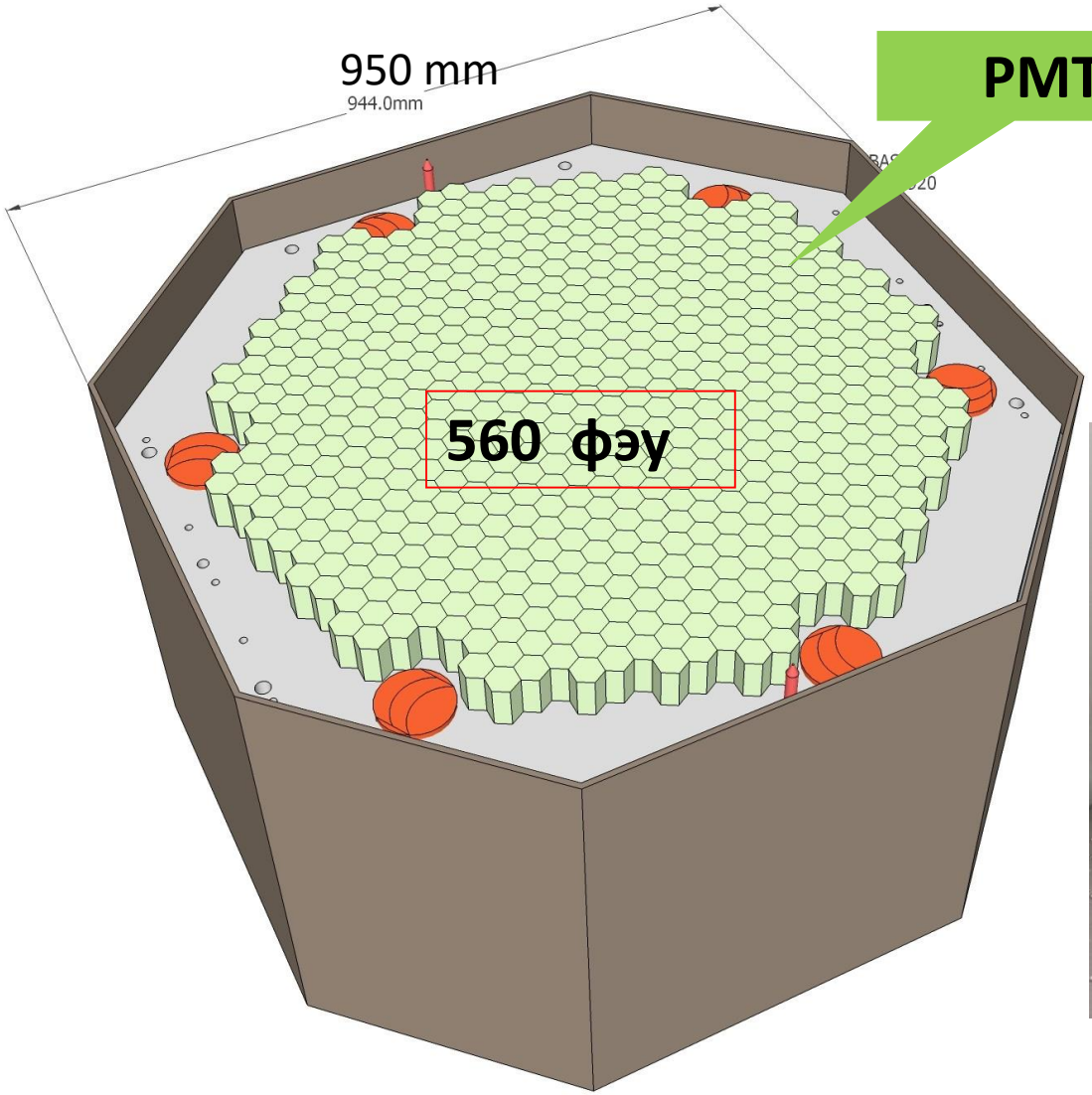
D = 4.32m F = 4.75m

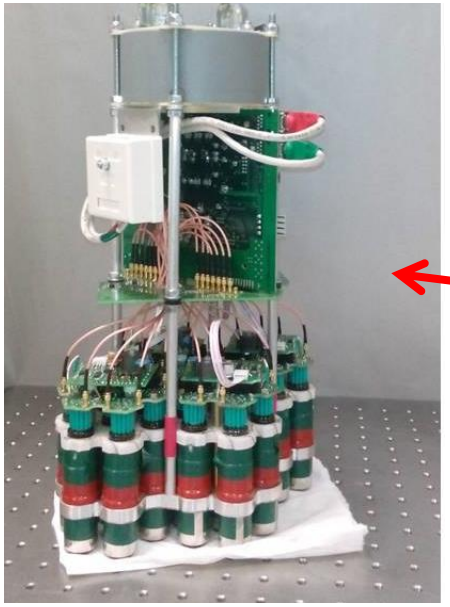
34 mirrors of 60 cm diameters (

Camera : 560 PMTs (XP 1911) with 15 mm useful diameter of photocathode
Winston cone: 30 mm input size, 15 output size
1 single pixel = 0.36°
FOV diameter ~ 9°

Energy threshold ~1.5 TeV

Camera of the TAIGA-IACT





Maroc-3
64 channel
board

DAQ - MAROC3

Cluster – 28 PMTs

One of TAIGA high-priority goals: operate 58 HiSCORE stations with the 1st IACT

13 new stations (2017)

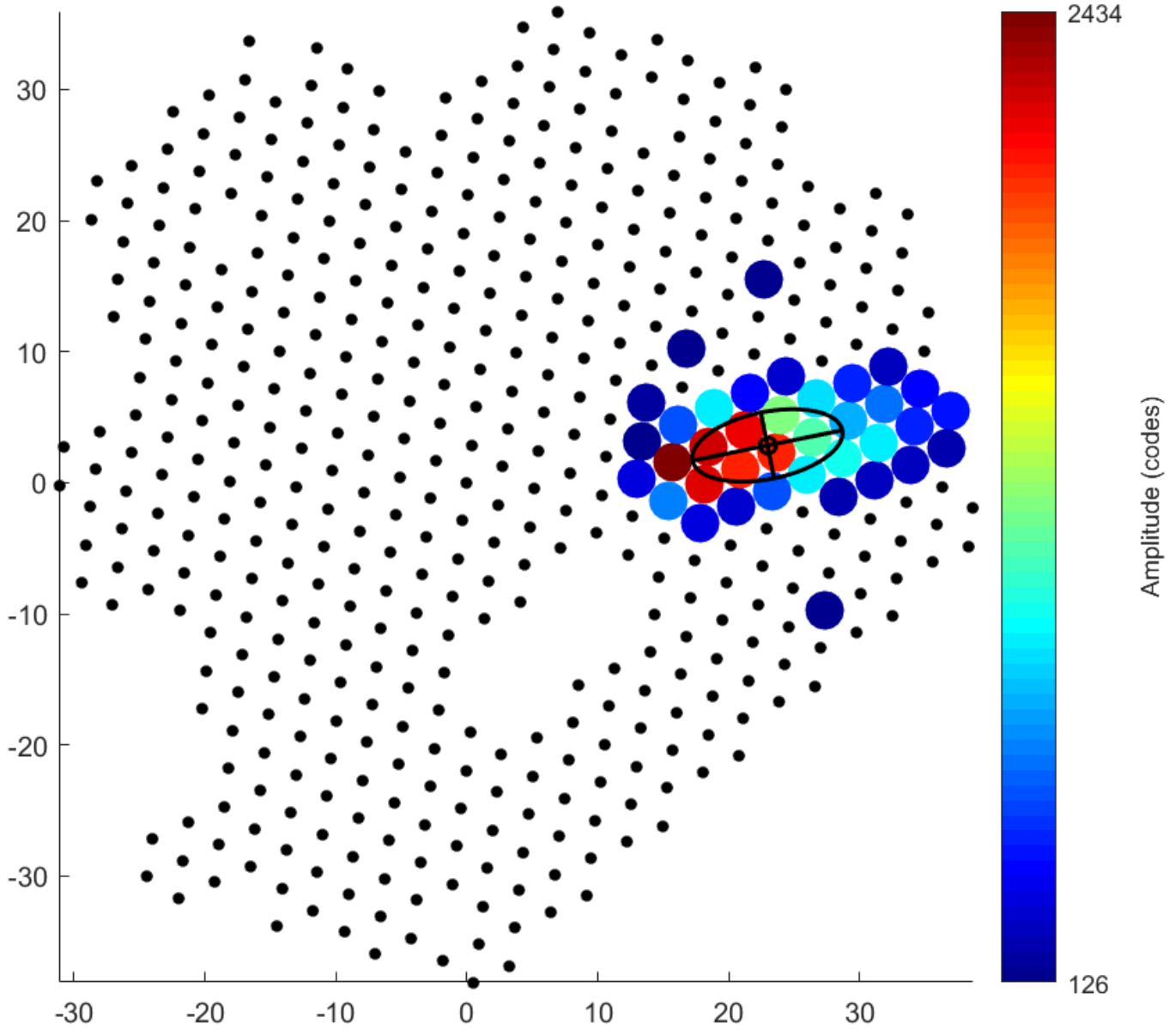
N

17 new stations (2016)

A = 0.6 km²

58 stations

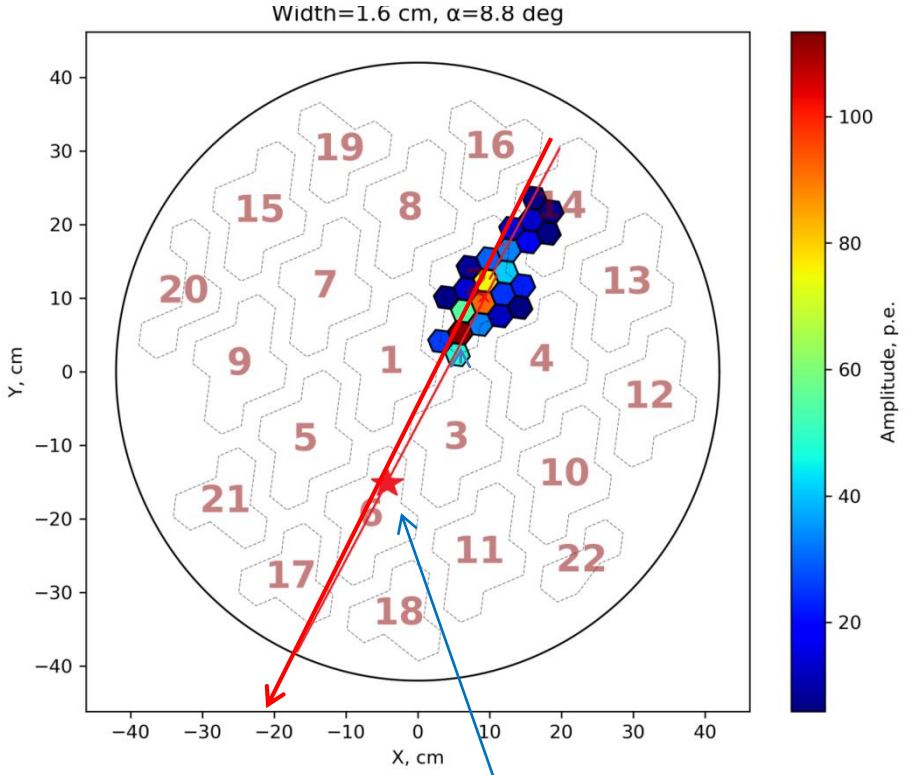
IACTs


30
20
10
0
-10
-20
-30
-30
-20
-10
0
10
20
30
2434
126
Amplitude (codes)

FIRST EXAMPLE OF HYBRID "GAMMA-LIKE" EVENT

IACT data

Width=0.13°, length=0.69°, alpha=8.9°, size=709p.e.

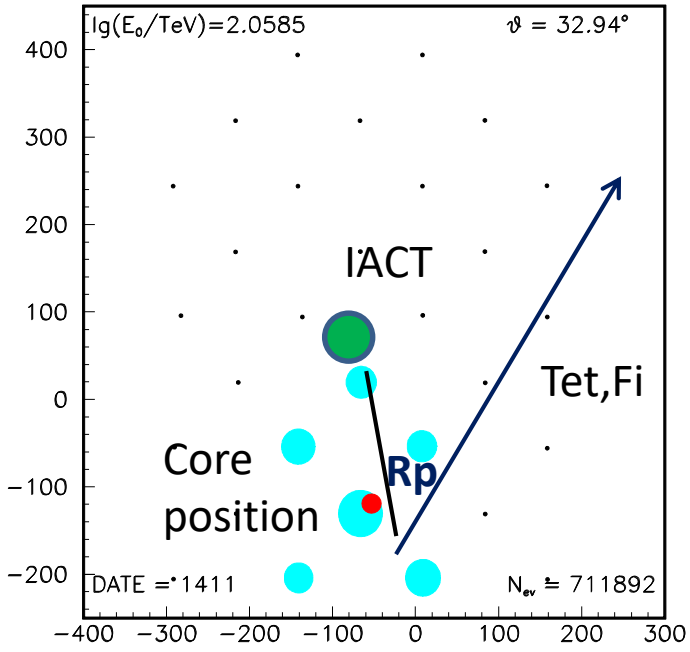


Recalculated core position in IACT plane after introduction of scaling factor Rp' = Rp/1500

HiSCORE data

E = 55 TeV

Tet = 32.9, Fi = 33. 58



Stand for the PMT calibration and the examples of results

The main view of stand

Gain ratio


P_XY_dark_step1.vi
File Edit Operate Project Windows Help
13pt Application Font
waiting time min
30
Initial voltage
1000
Nº of points
7
path
c:\AAAraw_data\dark1II_69.txt
start
408
stop
503
Run number
69
50 minutes
HV in progress
1300
history
anode mode
Lights off
HV ON , HVLeCroy=800V
waiting 30 mn .....
HVLeCroy=0V
pedestals measurement
new HV value
ten seconds of stabilisation
and dark current
measurement
new HV value
ten seconds of stabilisation
and dark current
measurement
new HV value
ten seconds of stabilisation
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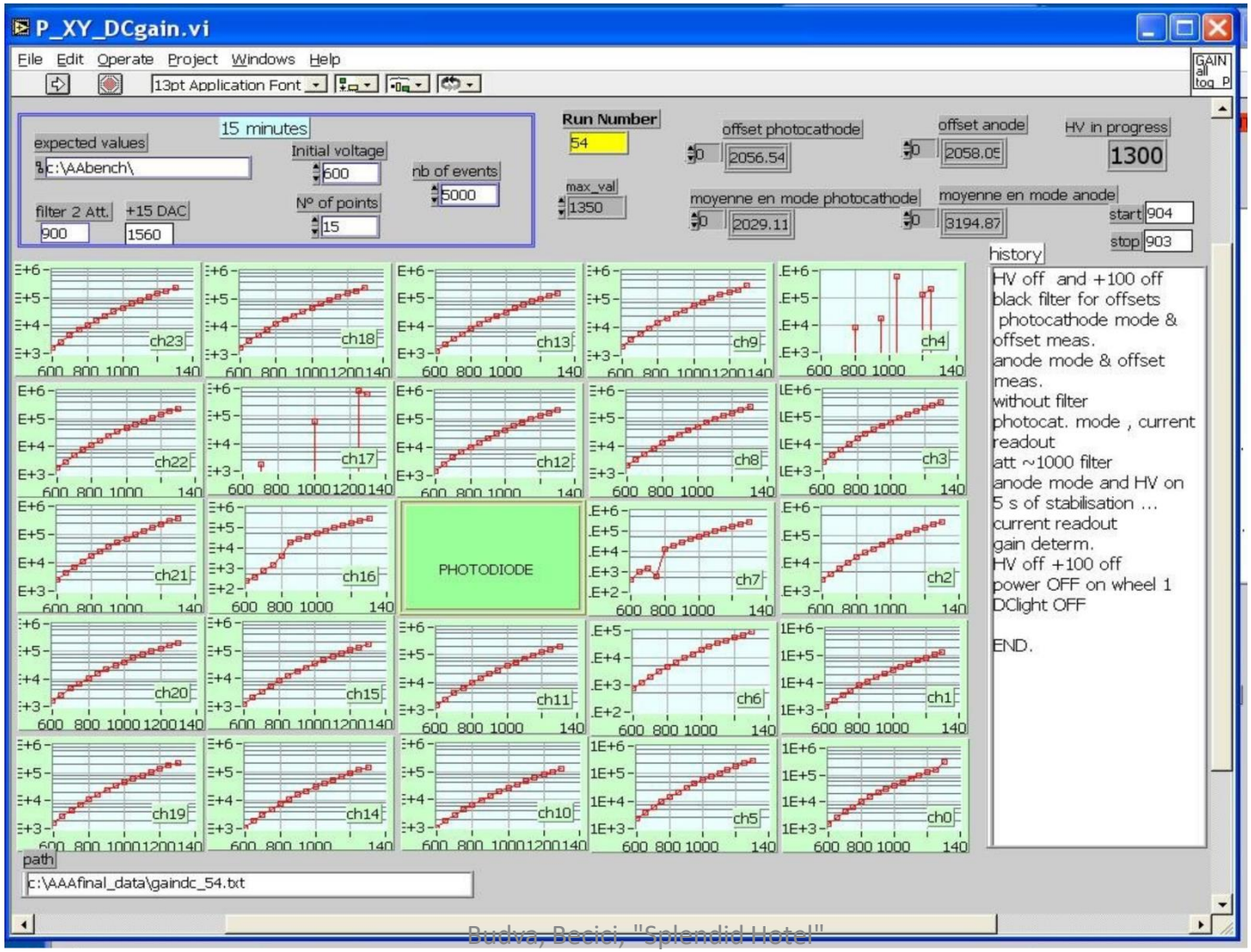
and dark current
measurement
ch23
ch18
ch13
ch9
ch4
ch22
ch17
ch12
ch8
ch3
ch21
ch16
PHOTODIODE
ch7
ch2
ch20
ch15
ch11
ch6
ch1
ch19
ch14
ch10
ch5
ch0
dark currents(nA)
0.462 0.459 0.395 0.561 0.002 0.345 1.010 1.110 0.860 0.573 0.626 0.761 0.317 1.395 1.057 0.590 60.71 0.795 0.234 2.114 1.124 0.932 0.267 1.963
dark pedestals

Dark current



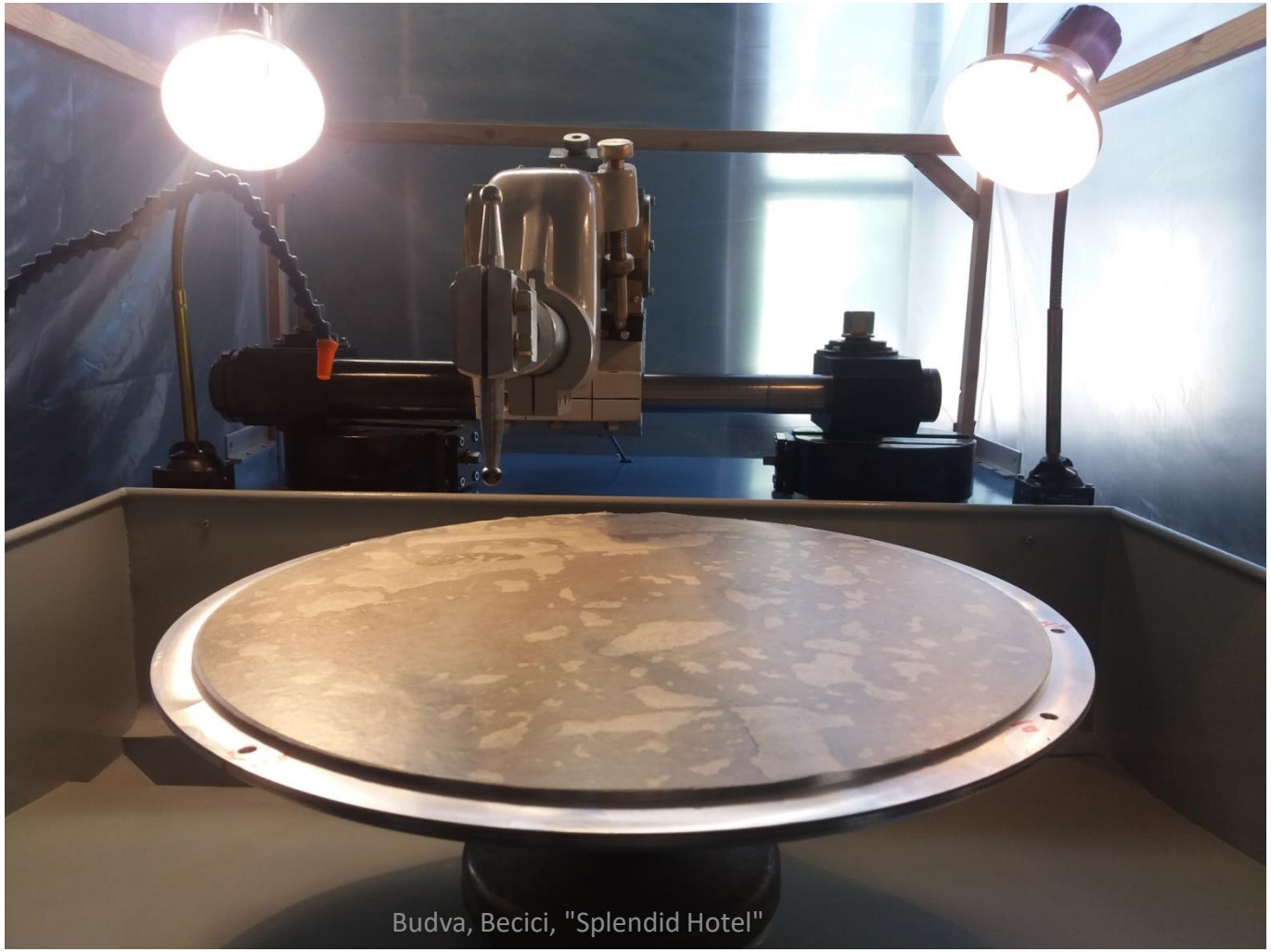
Optical part manufacturing

bending furnace

bending glass in the furnace

grinding polishing machines in workshop

aluminum mold for mirror polishing



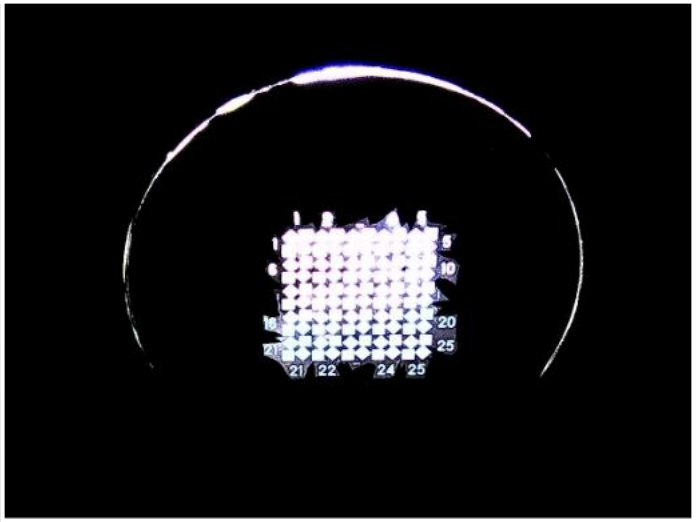
Budva, Becici, "Splendid Hotel"

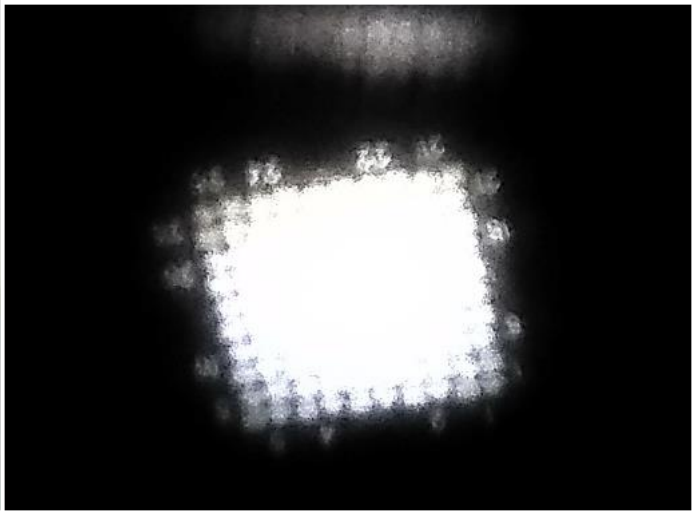
Optics workplace

Control of the mirror Measuring curvature radius. the radius of curvature: accuracy 50 mm

Surface roughness control

Stand for checking the quality of the surface shape and the radius of the mirror curvature

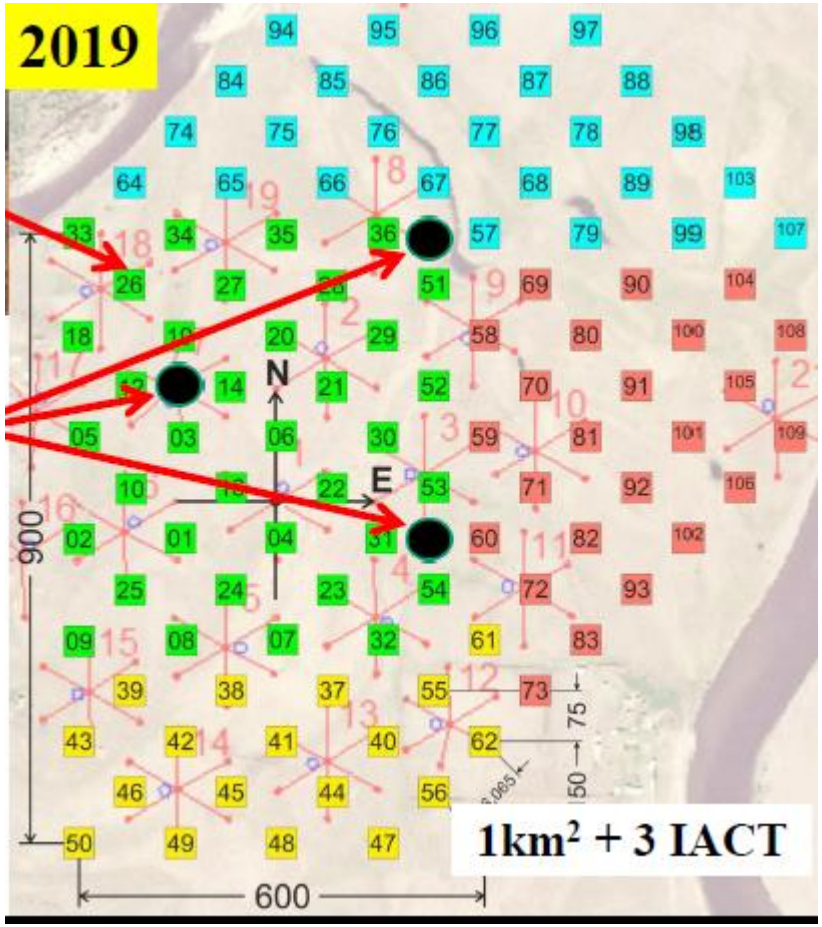




The first prototypes of mirrors

Plan for 2018-19

100 stations



For 100 hours

$3 \cdot 10^5$ hybrid events
(CR mass composition)

50-100 hybrid events from Crab (E ≥.40 TeV)

Thank you

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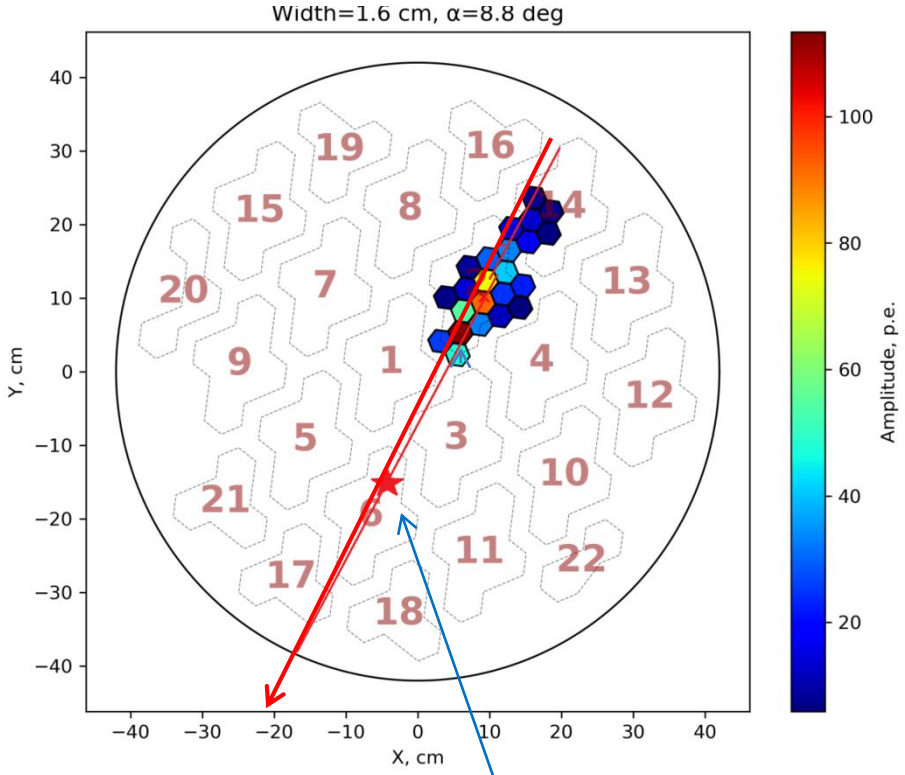

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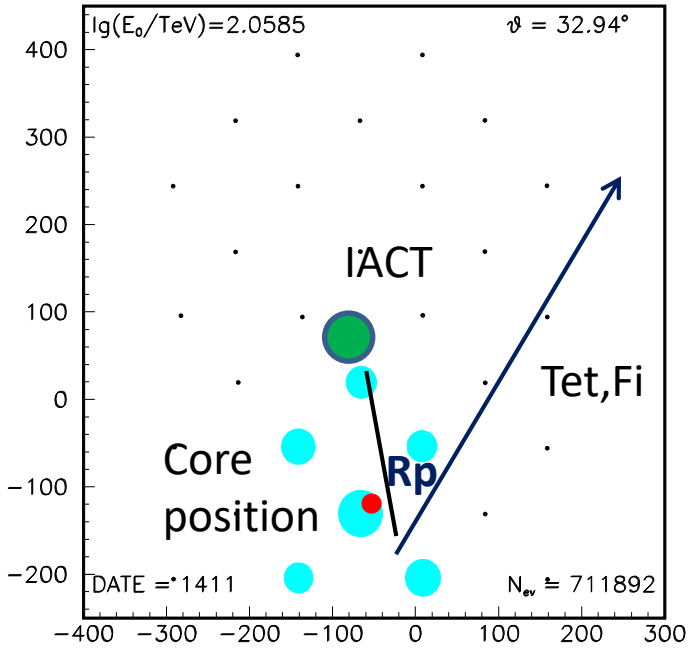

Efficiency of light collectioning