Camera Control System in MAGIC telescope

77. DPG Frühjahrstagung

March 3th, 2013

Dresden

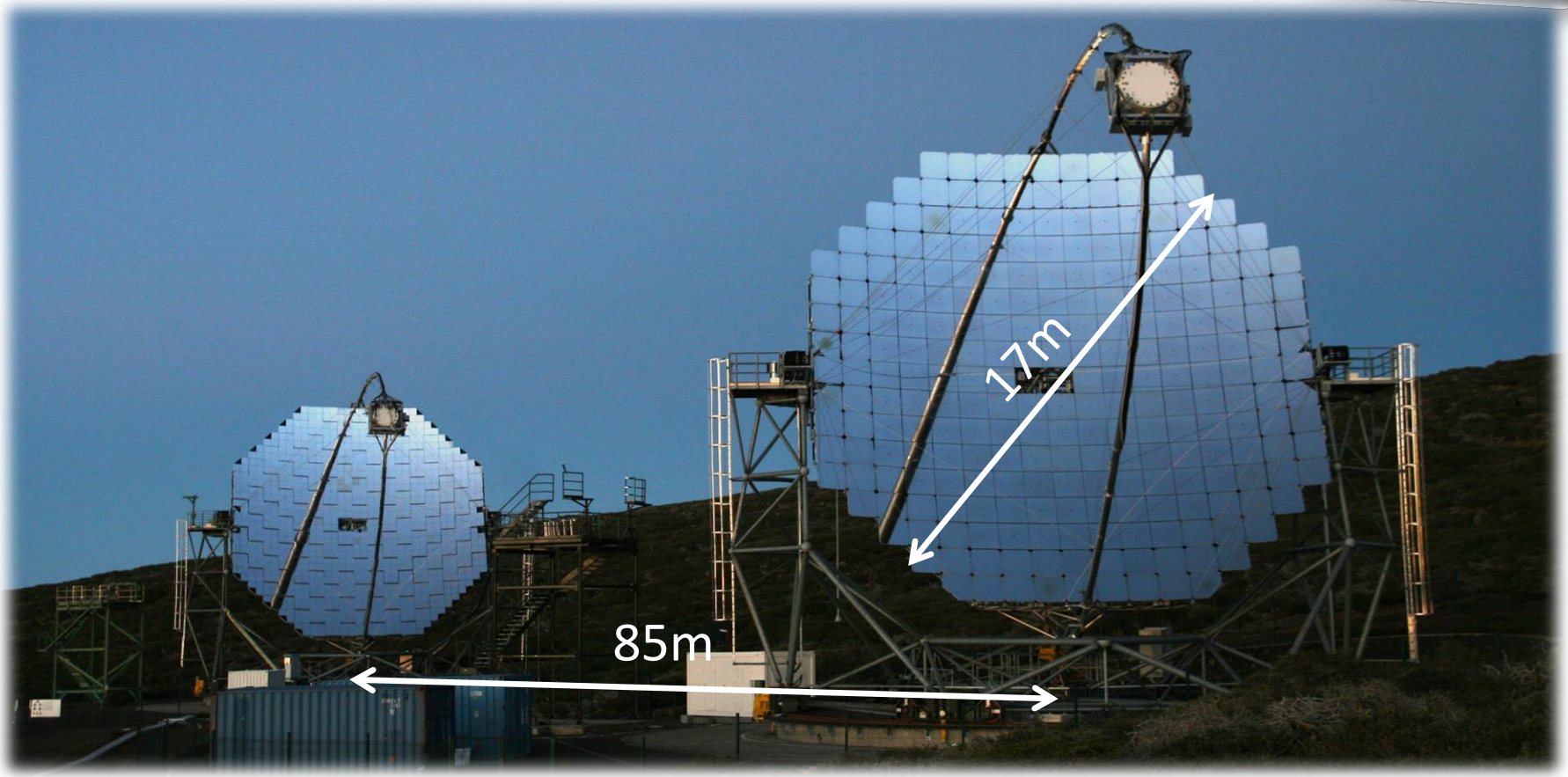
Takeshi Toyama
Max-Planck-Institut für Physik

Contents

- MAGIC Telescope
- Way to measure　VHE gamma ray
- Camera of MAGIC telescopes

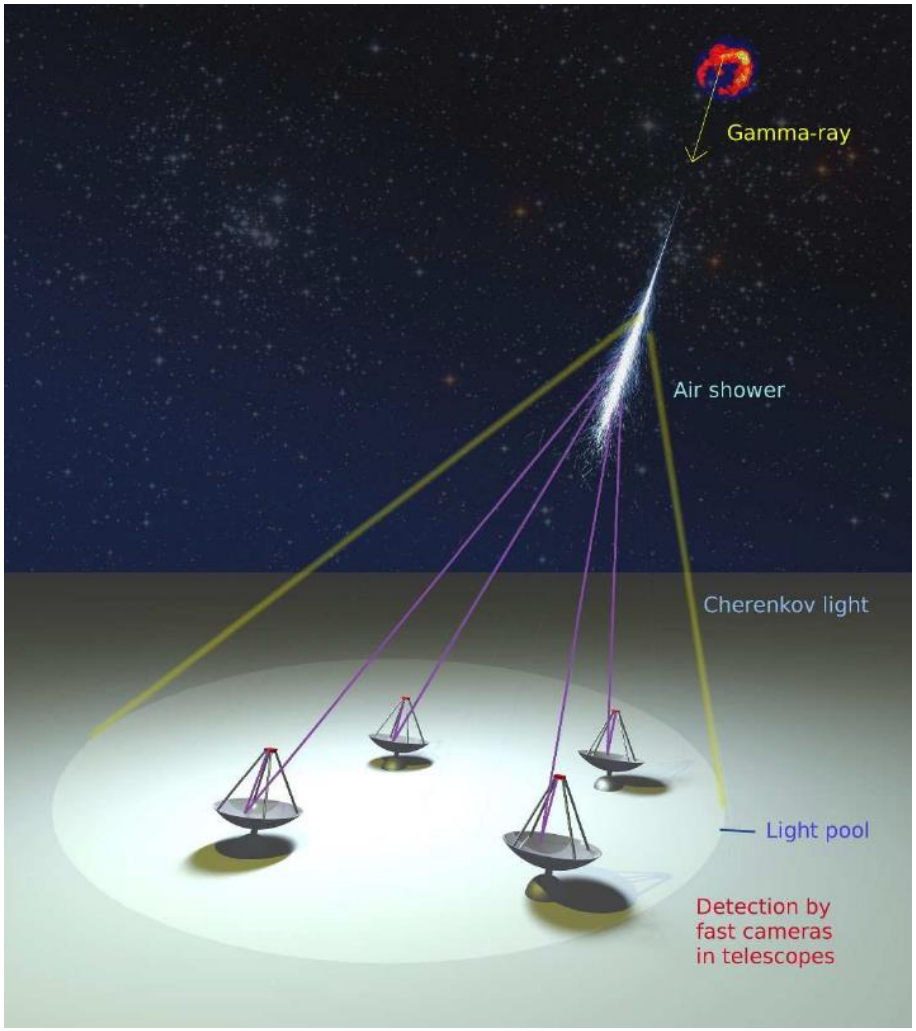
  -Devices, Function
- After upgrade
- Summary

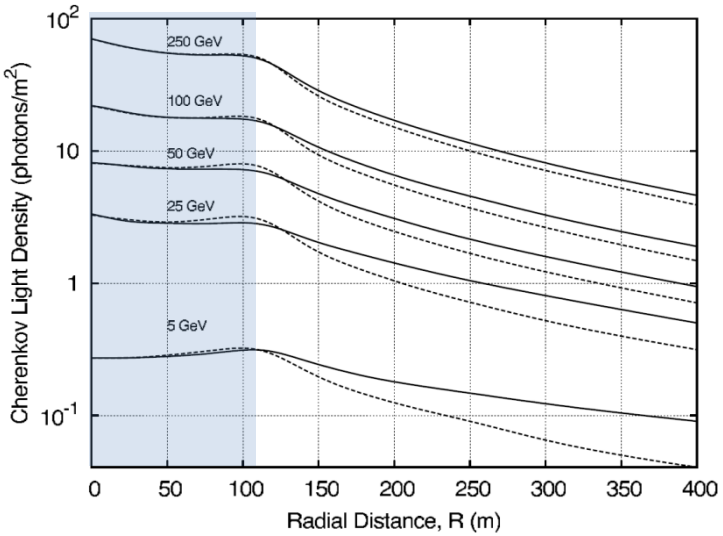
MAGIC telescopes



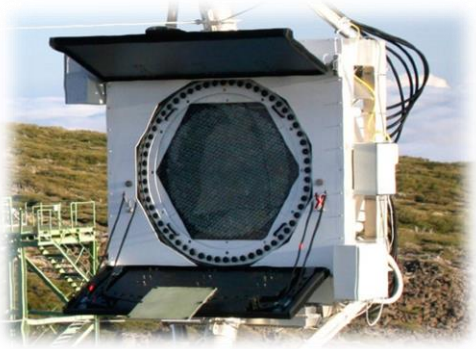
Location	Canary Island La Palma
Energy range	50GeV - 50TeV (threshold energy will be 25GeV with Sum Trigger)
Angular resolution	~0.06° (@1TeV)
Sensitivity	~0.06%Crab (@500GeV with 50h observation)

Way to measure VHE gamma ray



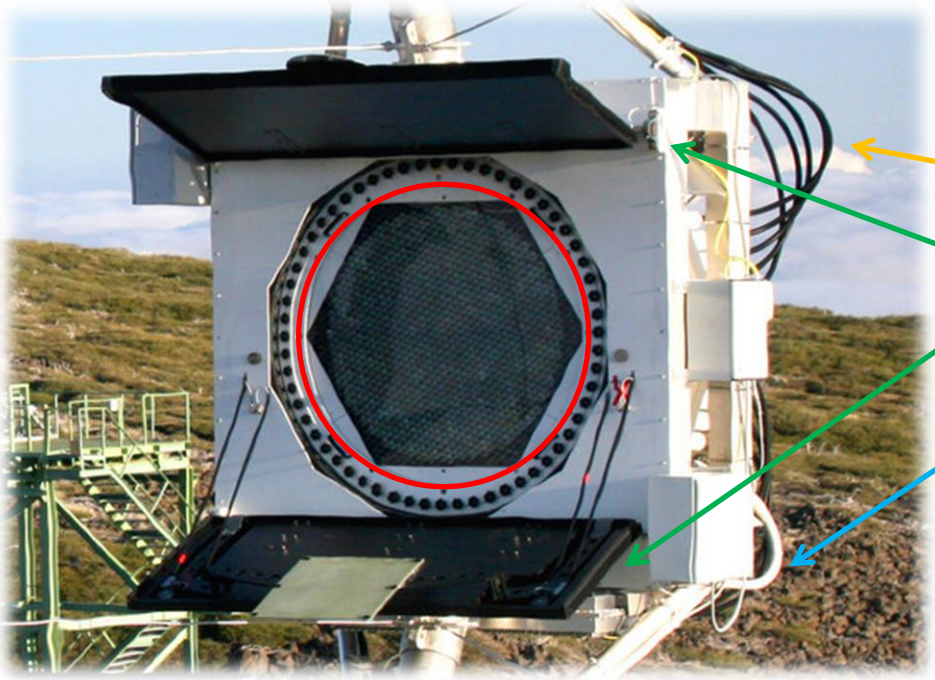


Signal is faint(~10ph/m^2) at 50GeV
and very short(a few nsec)



We need sensitive and **fast camera**

Camera of MAGIC telescopes



Camera consists of 1039 PMTs

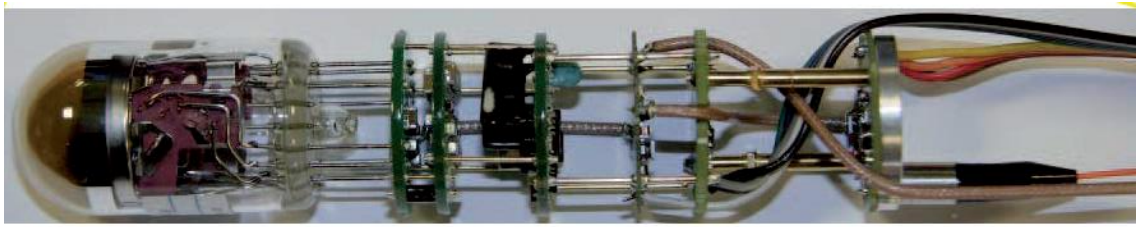
Cables for signal

Lid can be controlled by remote

Cable for cooling

Photo Multiplier Tube (PMT)

Temperature sensor



Cockcroft Walton Circuit

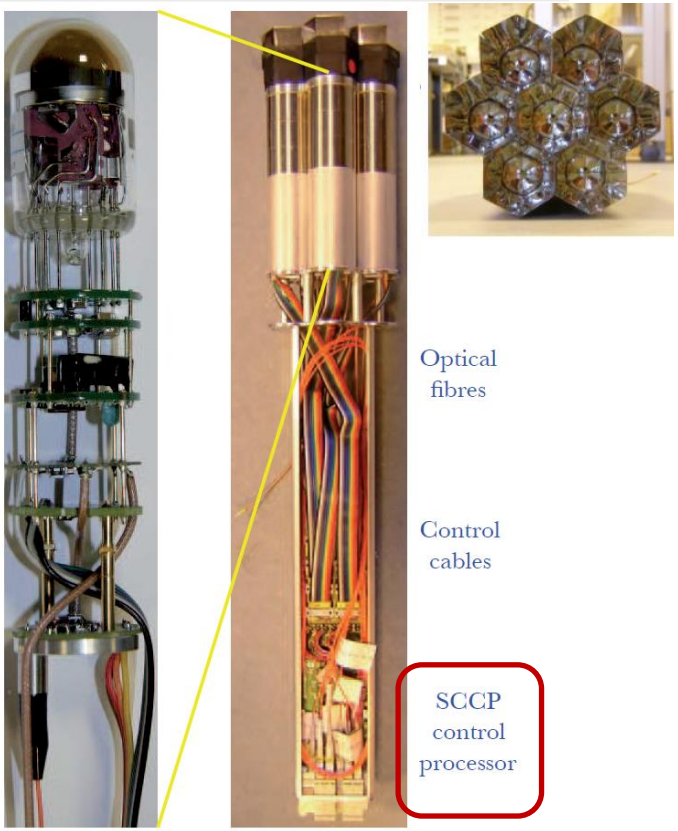
VCSEL

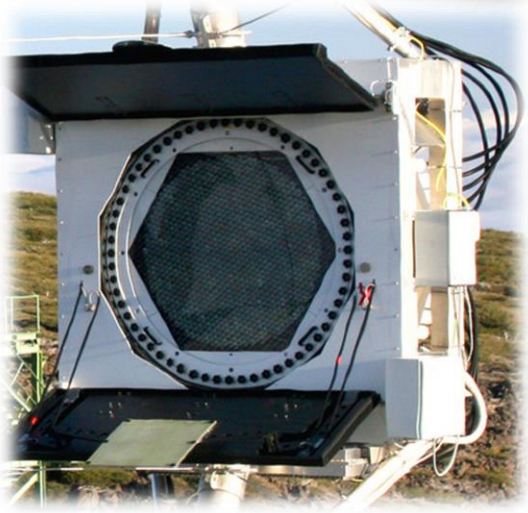
We need to

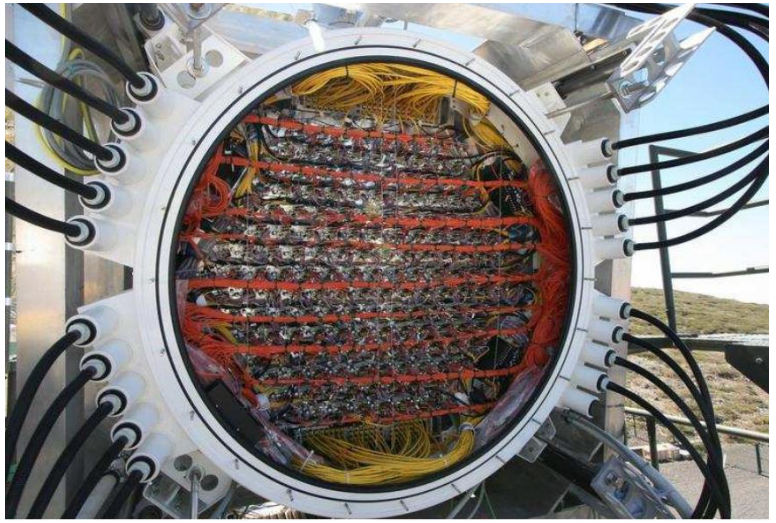
1.control HV (~1000V)

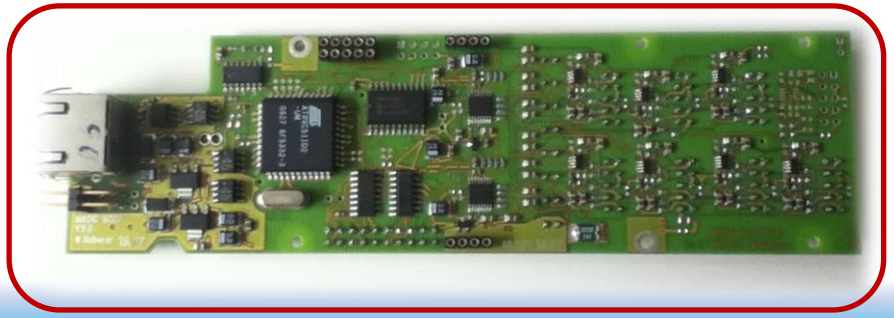
2.protect PMT from strong light (Moonlight, Car flash, Bright star)

Camera Control System(CaCo)









What is CaCo doing?

Essential Function

- Monitor/Set HV
- Monitor DC from PMT

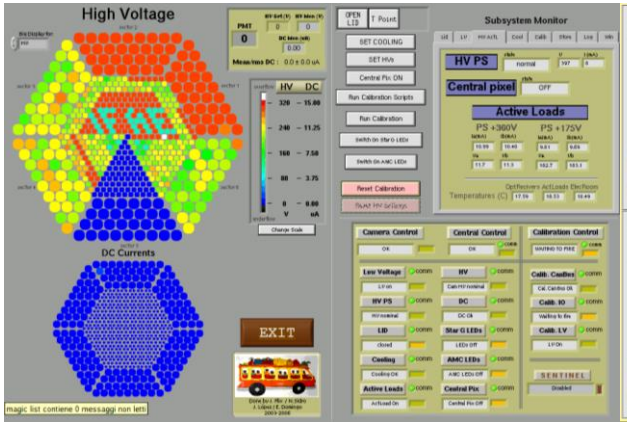
- Open/Close a Lid
- Monitor Camera temp/ humi
- Monitor weather (temp/humi/wind/dust/seeing)
- Switch ON/OFF a Pulse injection
- Attenuation of Pulse injection
- Set BIAS voltage for VCSEL
- Monitor Photo Diode from VCSEL
- Deal with Hot Pixel※
- Report

※Hot Pixel is a Pixel having high Direct Current

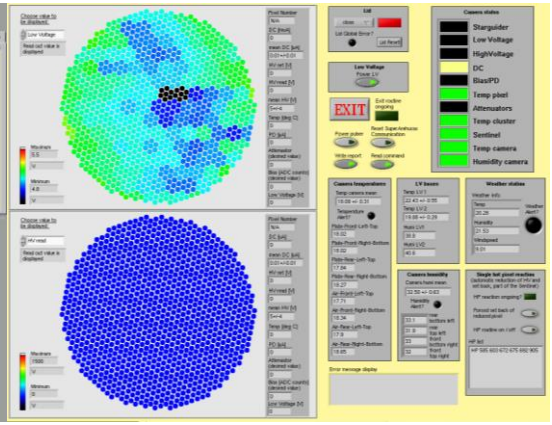
CaCo can contribute safety of device、Data quality check、Convert electrical signal to optical signal

After camera upgrade (Nov 2012)

Old M1 Software (guagua)



Old M2 Software(CaCo2)

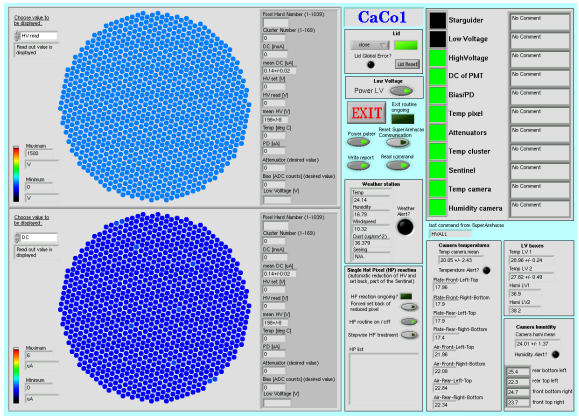


Purpose:

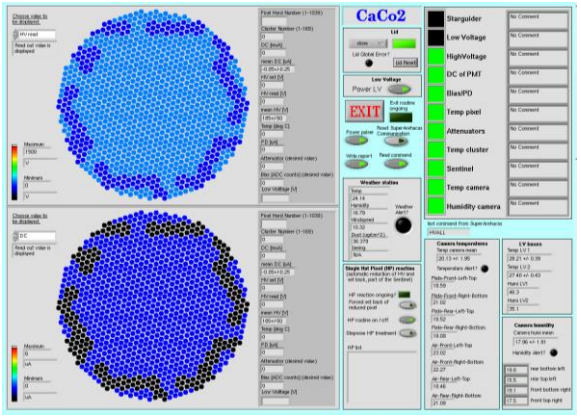
- Operator can control easily
- Making easy to debug CaCo

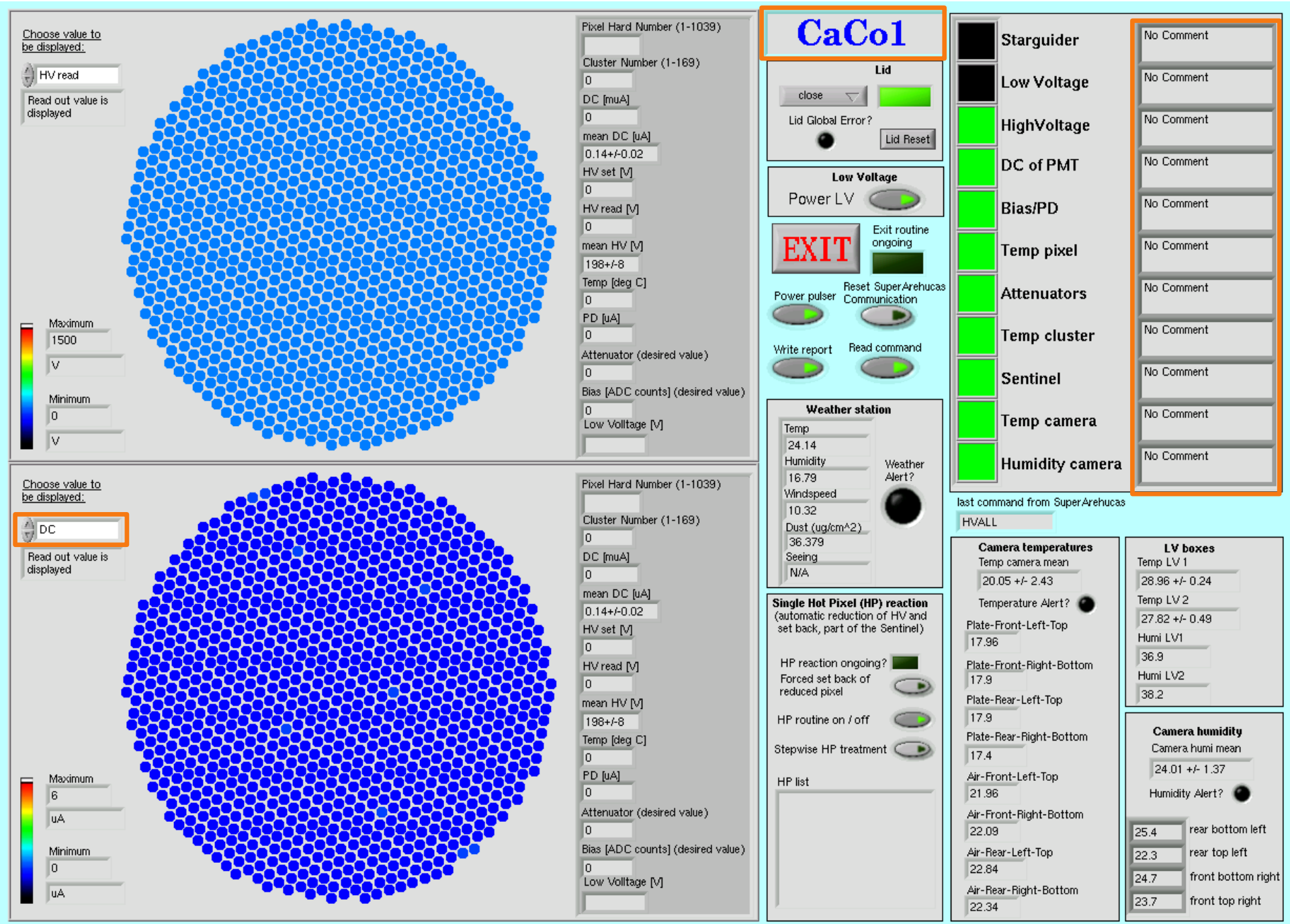
Camera Control software is **unified**

New M1 software(**CaCo**)

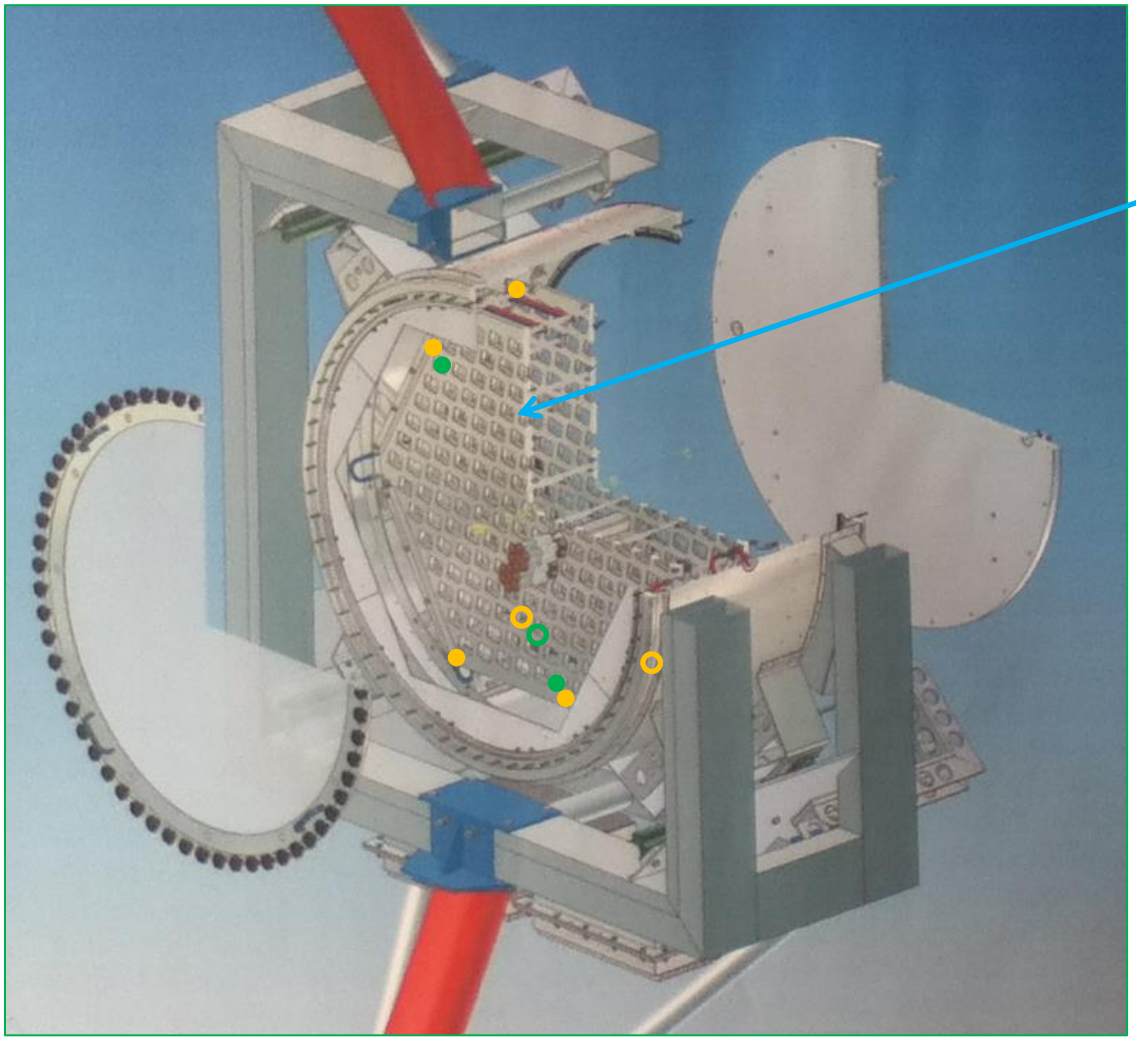


New M2 Software (**CaCo2**)

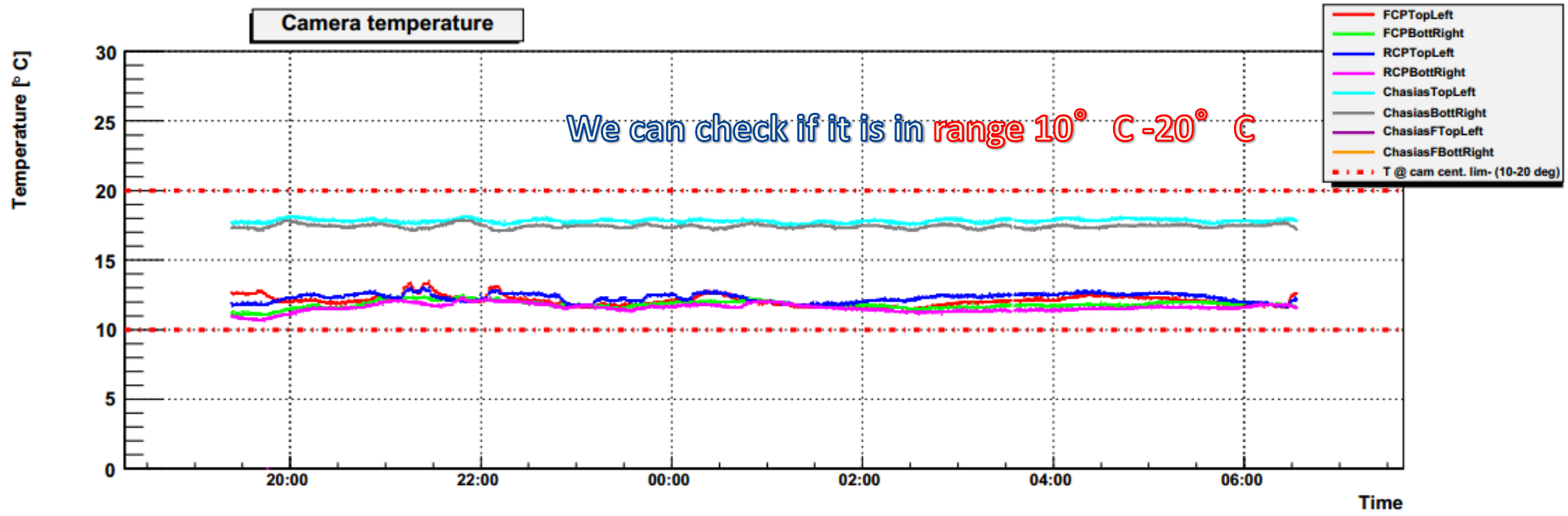


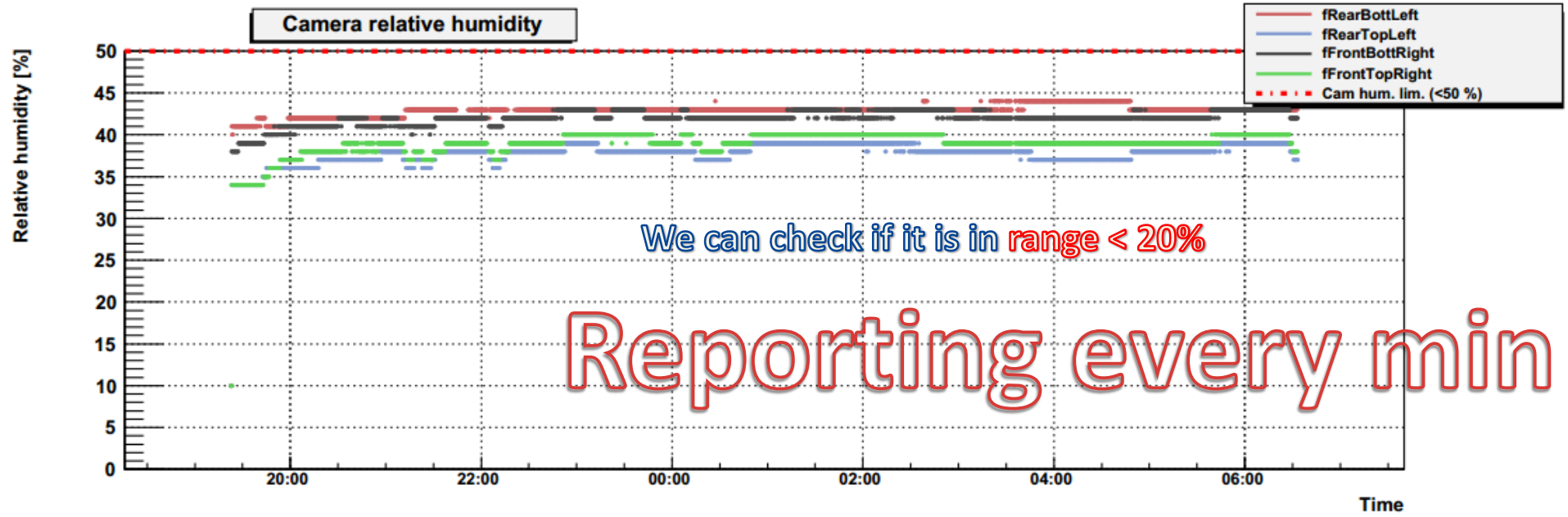

Choose value to be displayed:
HV read
Read out value is displayed
Maximum
1500
V
Minimum
0
V
Pixel Hard Number (1-1039)
Cluster Number (1-169)
0
DC [muA]
0
mean DC [uA]
0.14+/-0.02
HV set [V]
0
HV read [V]
0
mean HV [V]
198+/-8
Temp [deg C]
0
PD [uA]
0
Attenuator (desired value)
0
Bias [ADC counts] (desired value)
0
Low Volltage [V]
Choose value to be displayed:
DC
Read out value is displayed
Maximum
6
uA
Minimum
0
uA
Pixel Hard Number (1-1039)
Cluster Number (1-169)
0
DC [muA]
0
mean DC [uA]
0.14+/-0.02
HV set [V]
0
HV read [V]
0
mean HV [V]
198+/-8
Temp [deg C]
0
PD [uA]
0
Attenuator (desired value)
0
Bias [ADC counts] (desired value)
0
Low Volltage [V]
CaCo1
Lid
close
Lid Global Error?
Lid Reset
Low Voltage
Power LV
EXIT
Exit routine ongoing
Power pulser
Reset SuperArehucas Communication
Write report
Read command
Weather station
Temp
24.14
Humidity
16.79
Windspeed
10.32
Dust (ug/cm^2)
36.379
Seeing
N/A
Weather Alert?
Single Hot Pixel (HP) reaction
(automatic reduction of HV and set back, part of the Sentinel)
HP reaction ongoing?
Forced set back of reduced pixel
HP routine on / off
Stepwise HP treatment
HP list
Starguider
Low Voltage
HighVoltage
DC of PMT
Bias/PD
Temp pixel
Attenuators
Temp cluster
Sentinel
Temp camera
Humidity camera
No Comment
No Comment
No Comment
No Comment
No Comment
No Comment
No Comment
No Comment
No Comment
No Comment
last command from SuperArehucas
HVALL
Camera temperatures
Temp camera mean
20.05 +/- 2.43
Temperature Alert?
Plate-Front-Left-Top
17.96
Plate-Front-Right-Bottom
17.9
Plate-Rear-Left-Top
17.9
Plate-Rear-Right-Bottom
17.4
Air-Front-Left-Top
21.96
Air-Front-Right-Bottom
22.09
Air-Rear-Left-Top
22.84
Air-Rear-Right-Bottom
22.34
LV boxes
Temp LV 1
28.96 +/- 0.24
Temp LV 2
27.82 +/- 0.49
Humi LV1
36.9
Humi LV2
38.2
Camera humidity
Camera humi mean
24.01 +/- 1.37
Humidity Alert?
25.4
rear bottom left
22.3
rear top left
24.7
front bottom right
23.7
front top right

Devices for safe operation



- Temperature sensors
- Humidity sensors
- Cooling Plate
- Device to measure wind speed





Reporting every min

Summary

- Camera Control System is not only controlling HV and monitoring DC&HV, but also protecting camera with monitoring humidity temperature wind speed.
- After upgrade in Nov 2012, Camera Control Software is unified.
- Camera Control System makes a report every min to log HV, DC, Temp etc.