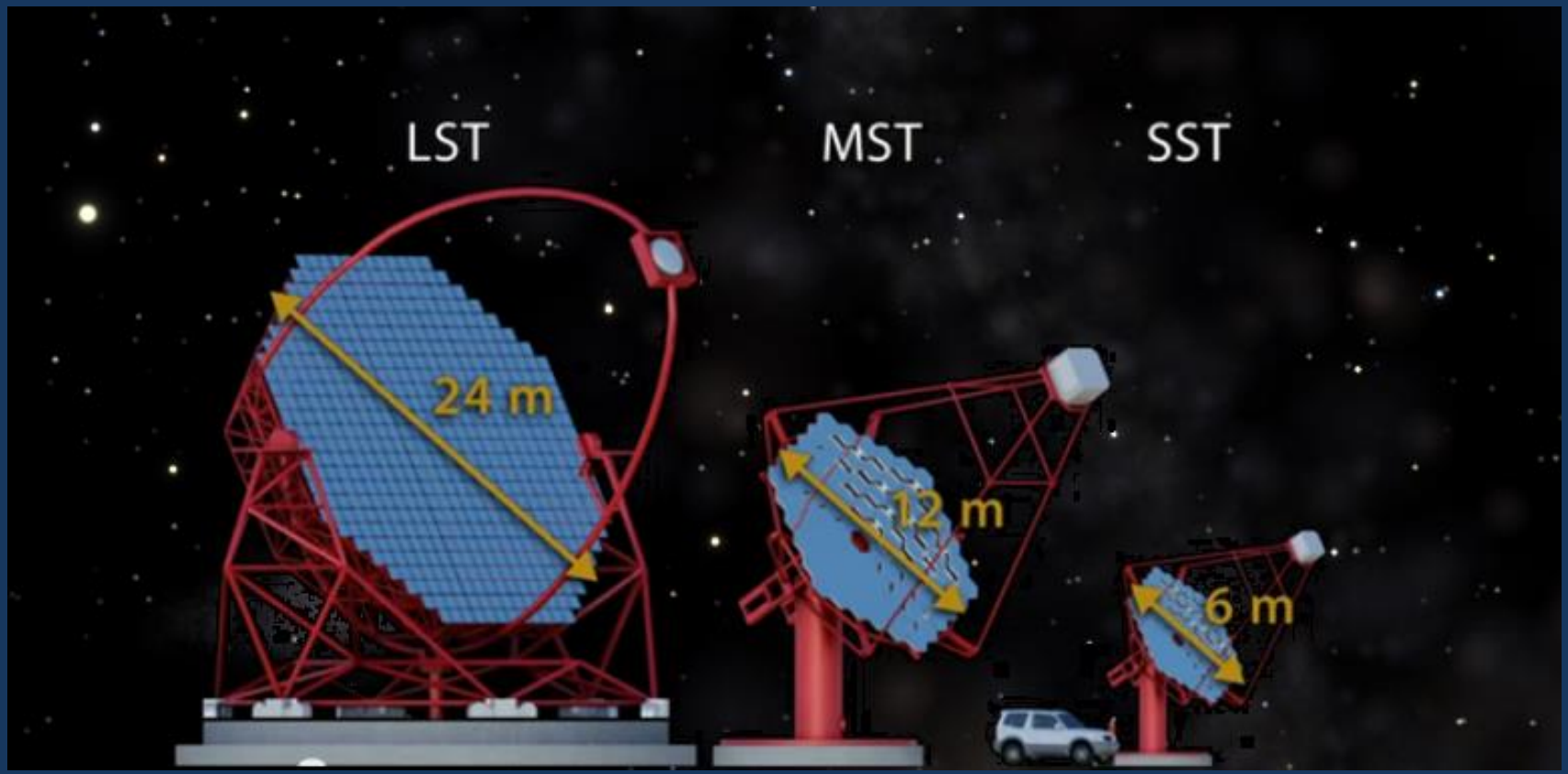
CTA CAMERAS:
An overview of the various telescope Cameras

Osvaldo Catalano

INAF- IASF Palermo

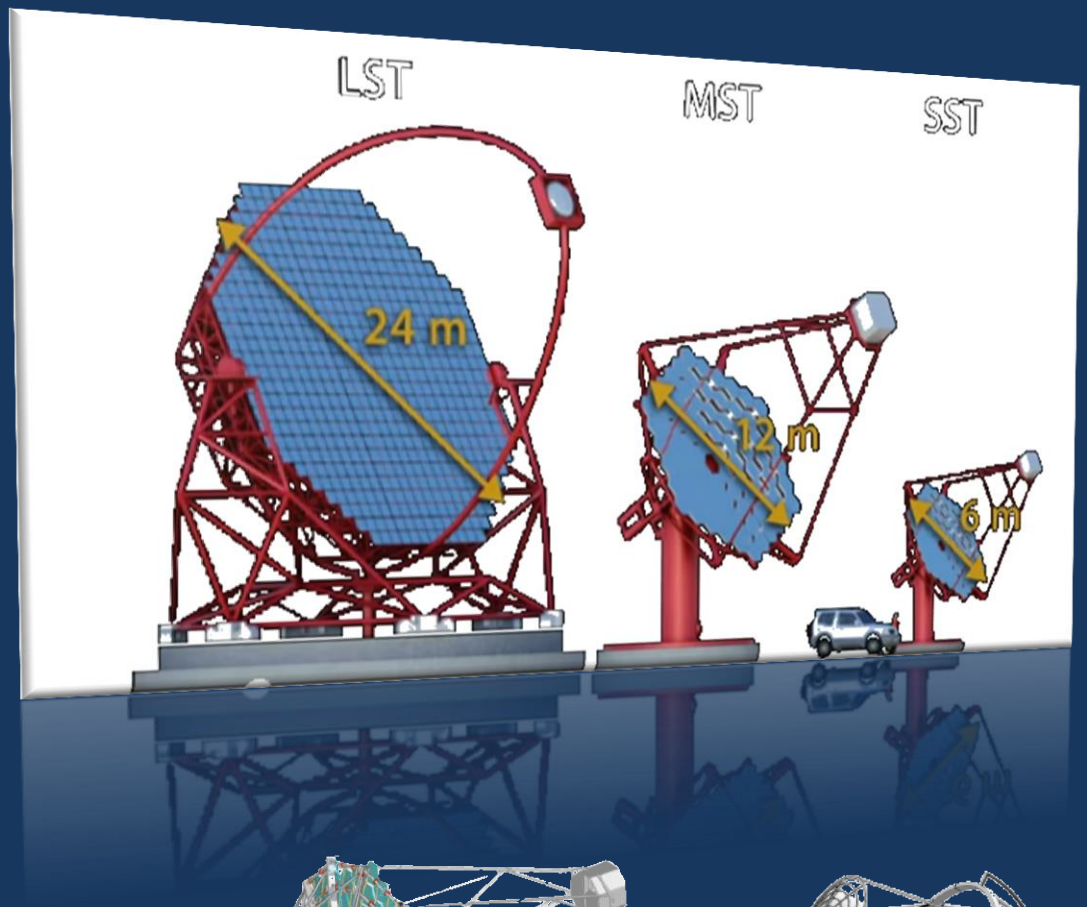
The CTA Telescopes

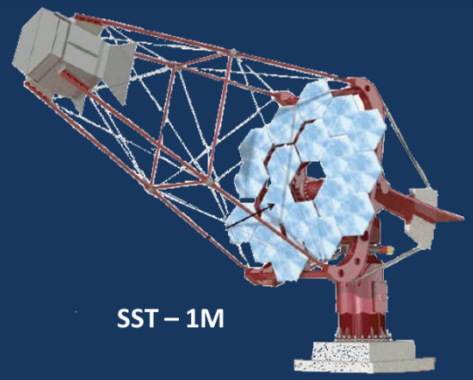
Several focal plane instrumentation options are currently being evaluated inside the CTA



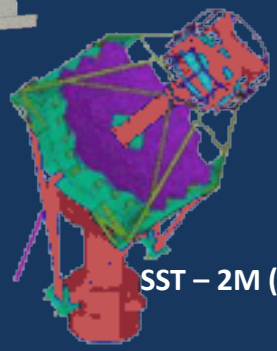
CTA telescope class types

The Telescopes

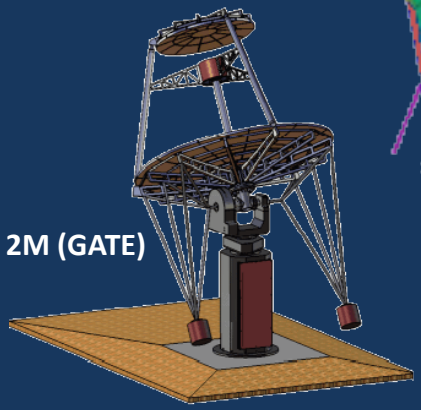




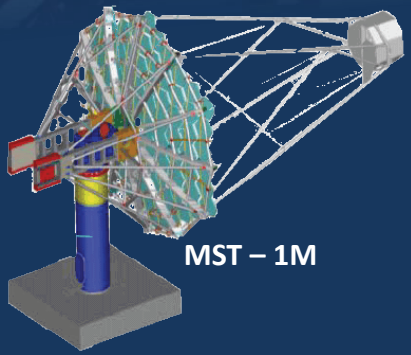
SST – 1M



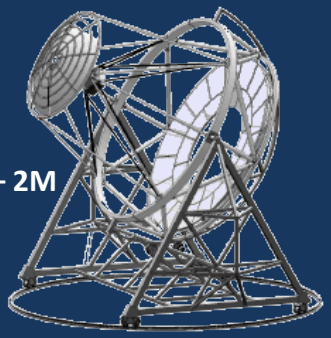
SST – 2M (ASTRI)



SST – 2M (GATE)



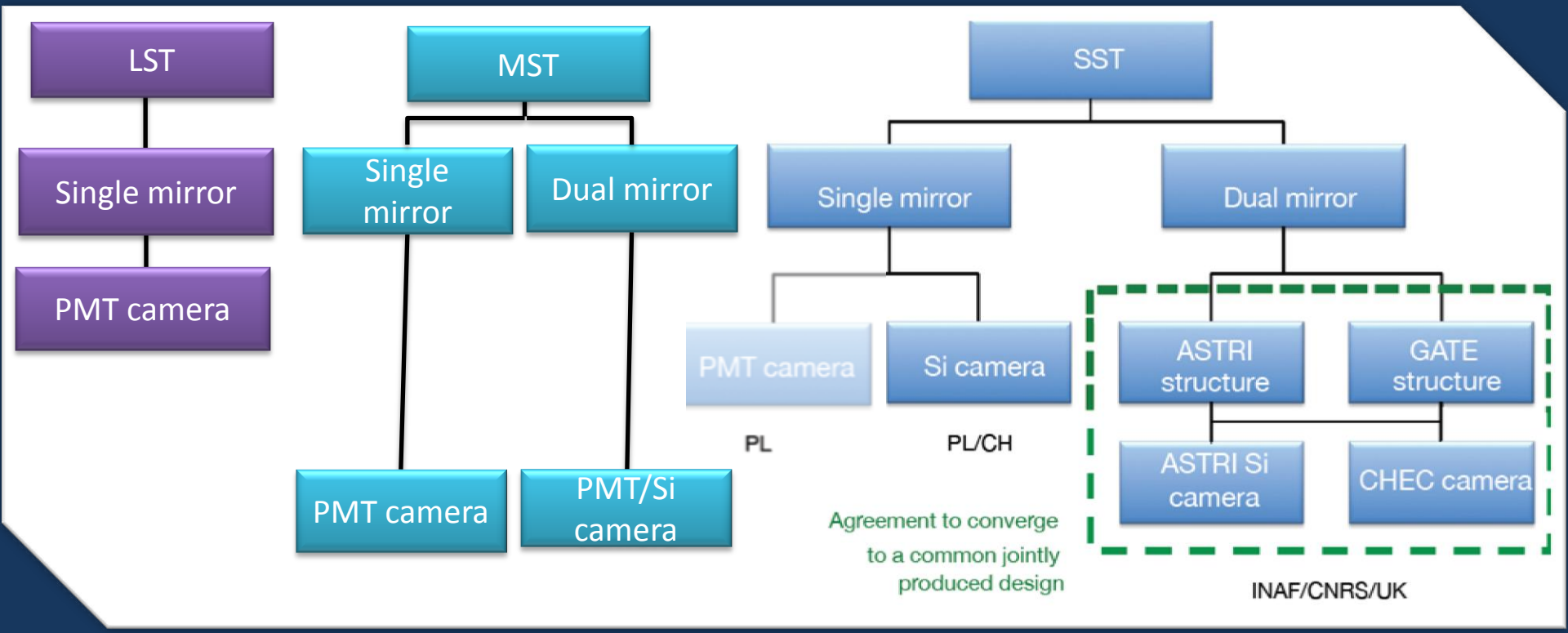
MST – 1M



SCT – 2M

Large Size Telescopes LST
(only child)

Telescopes vs. Cameras types

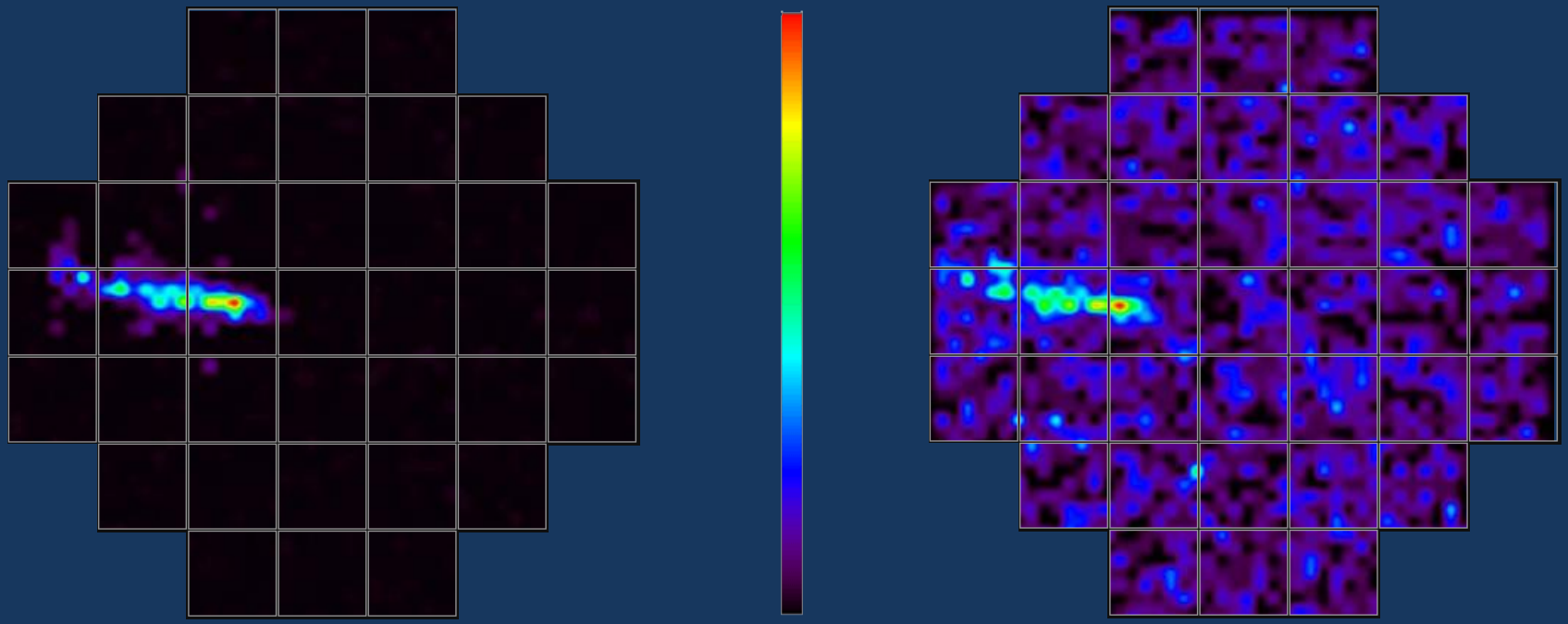


Reducing the number of independent solutions combining the best features is a “must”

The Cherenkov Imaging Cameras

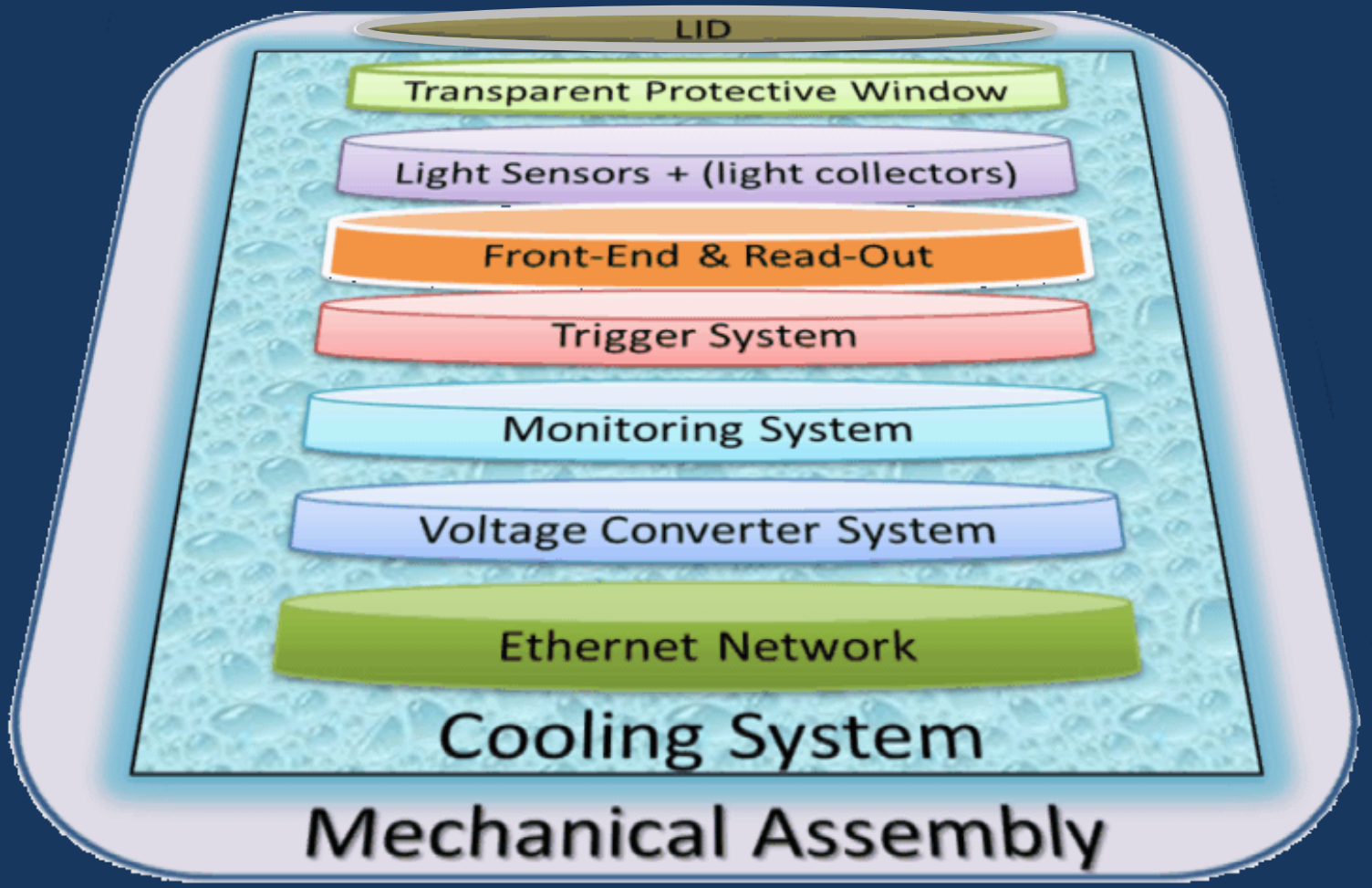
Cherenkov Signal

Cherenkov Signal & Night Sky Background



Cherenkov Signal produced by Air Shower lasts few ns
High pixelizzation required (of the order of 2000 pixels)

Camera: The Ingredients



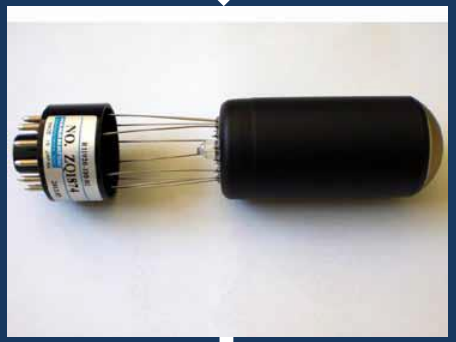
The Light Sensor – (large pixel)

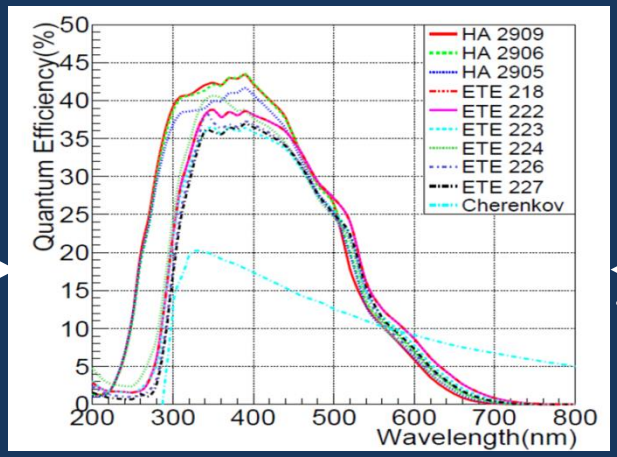
Electron Tubes Enterprises (ETE)

super-bialkali

Hamamatsu

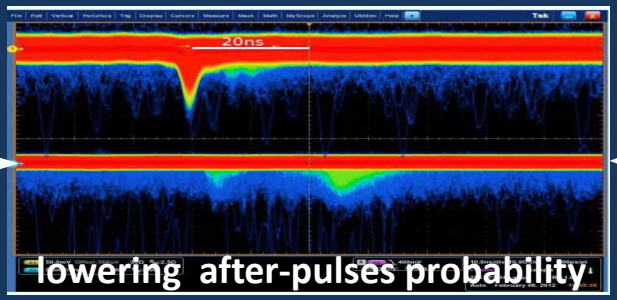
Company	PMT serial	Window -Type	Max applied HV	FWHM [ns]
Hamamatsu	R11920-100-5	Hemispherical, 1.5"	1200 V	2,35
Electron Tubes	9117B_477	Hemispherical 1.125"	1100 V	1,53





QE level moved towards 40%

The pe CE moved towards 95-98%

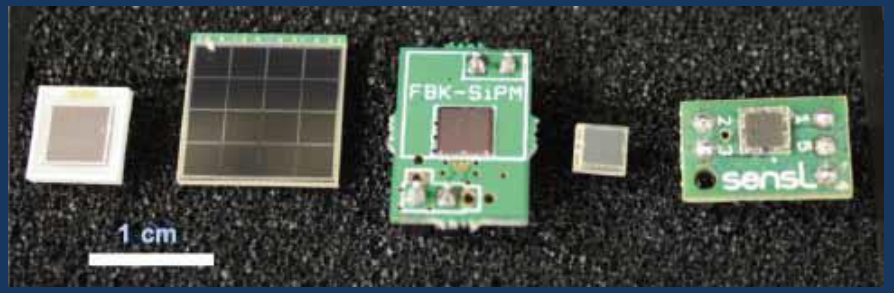


lowering after-pulses probability

The development work is entering into its last phase
Both Hamamatsu and ETE are on the way of developing the best PMTs for CTA

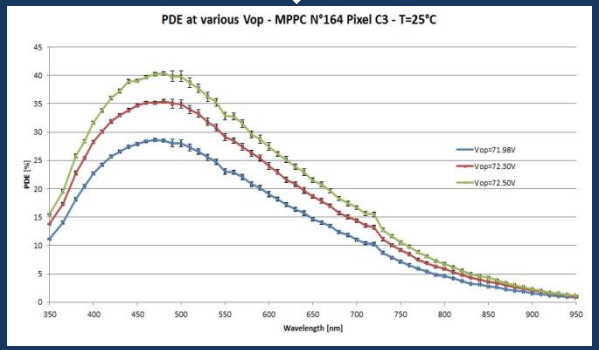
The Light Sensor – (small pixel)

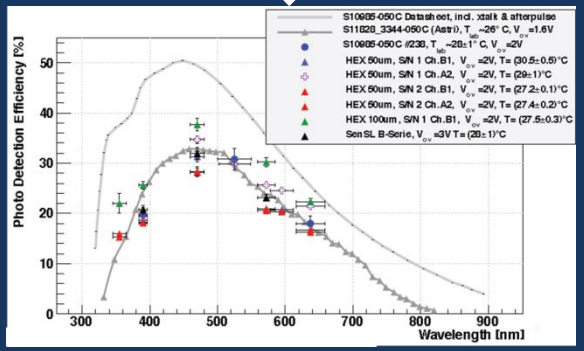
Hamamatsu 8x8 pixels MAPMT



Hamamatsu, Excelitas , sensL, FBK

SiPMs from different manufacturers are currently under tests and evaluation.

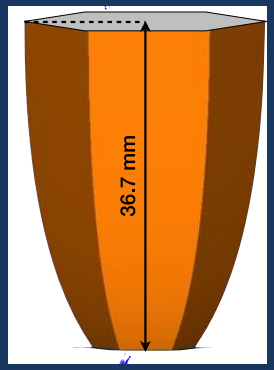


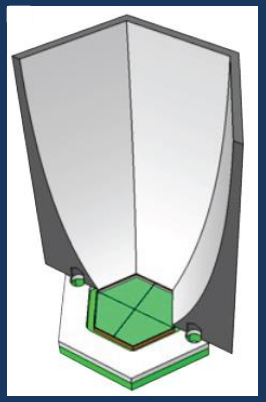


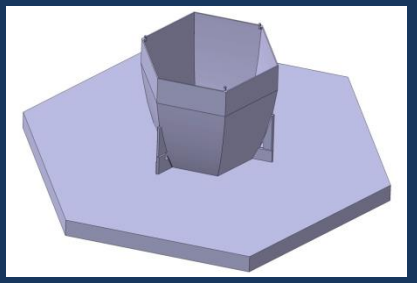
The Light Guides

Bridge gap between sensor and optical pixel size using Light Guides
Several solutions has been put forward in the last years

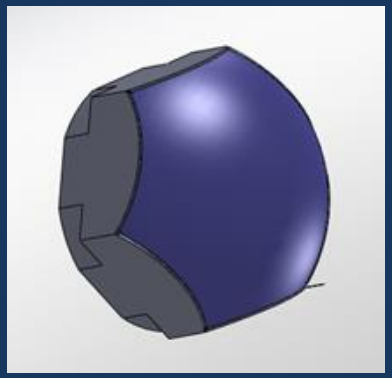
Classical hollow Winston cone





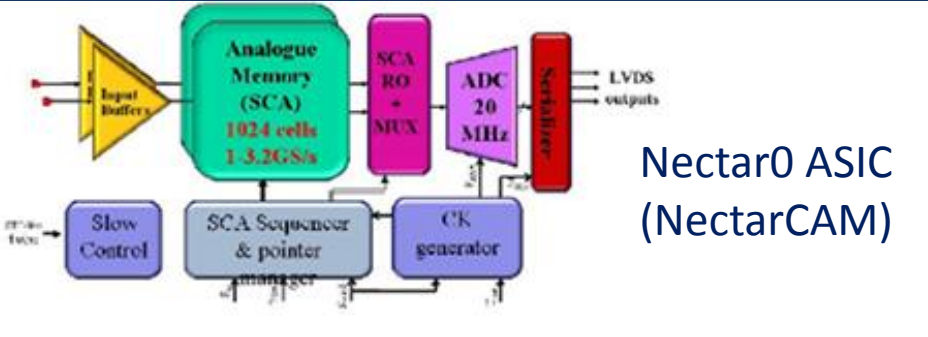


Plano---convex concentrating lens

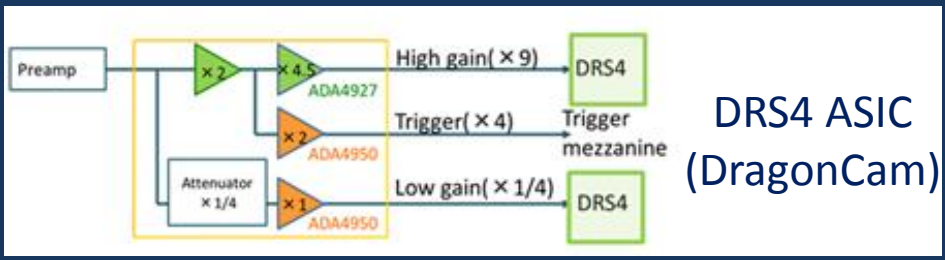


Signal Processing: Front-End

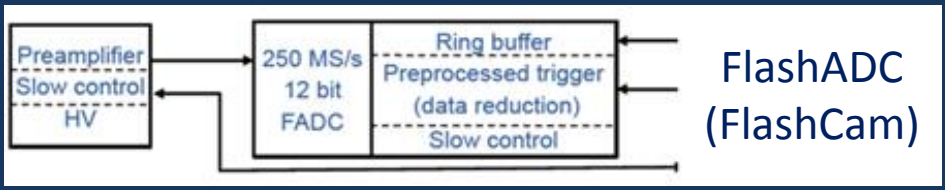
Based on waveform sampling



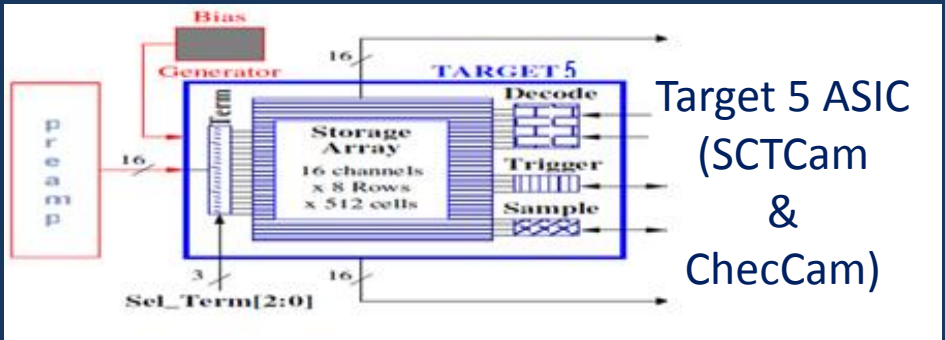
Nectar0 ASIC
(NectarCAM)



DRS4 ASIC
(DragonCam)

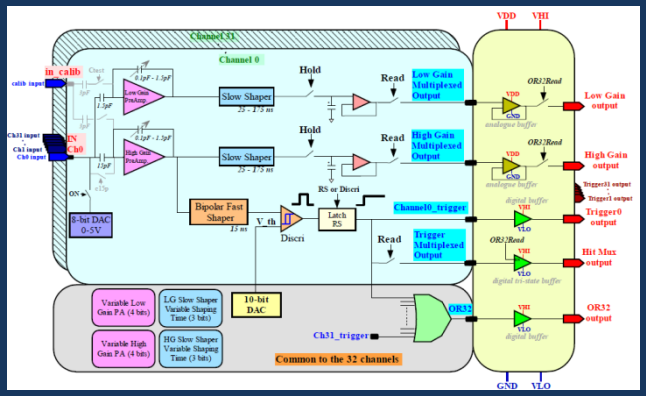


FlashADC
(FlashCam)



Target 5 ASIC
(SCTCam
&
ChecCam)

Based on shapers and peak detector



CITIROC ASIC
(ASTRICam)

The Cameras

FlashCam
(SiPM /MAPMT – FADC)

ChecCam
(SiPM /MAPMT – Target5 ASIC)

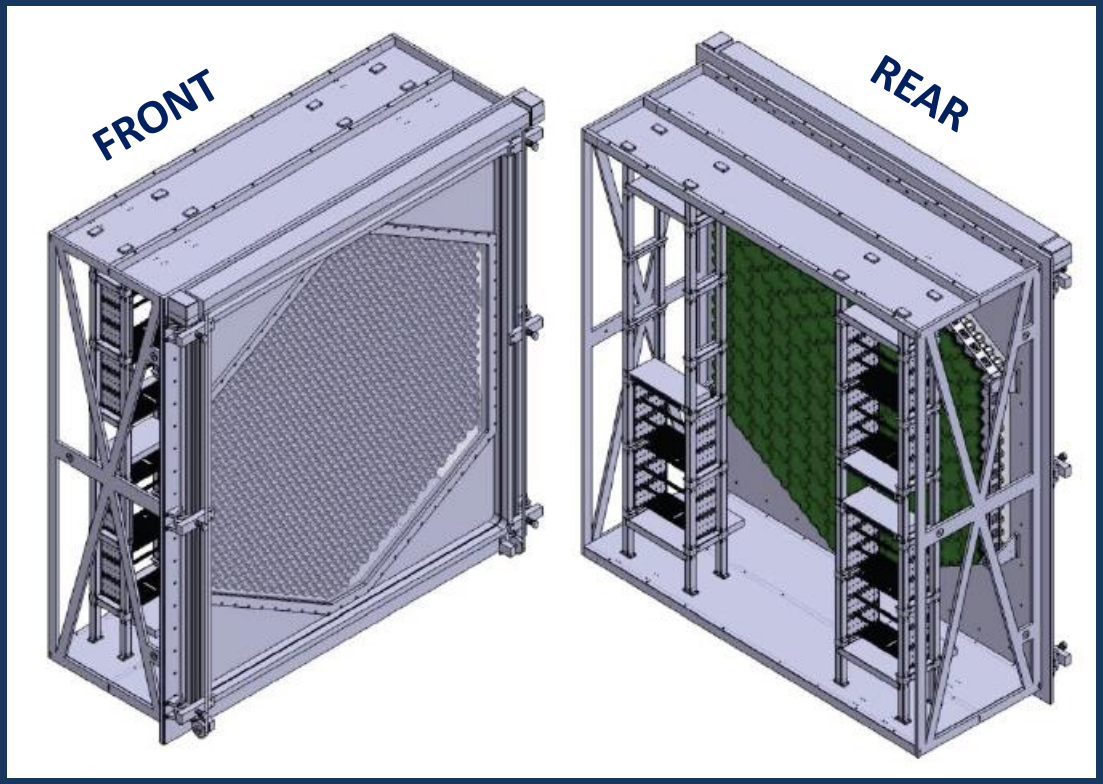
NectarCAM
(PMT– Nectar0 ASIC)

SCTCam
(SiPM– Target5 ASIC)

ASTRICam
(SiPM – CITIROC ASIC)

DragonCam
(PMT– DRS4 ASIC)

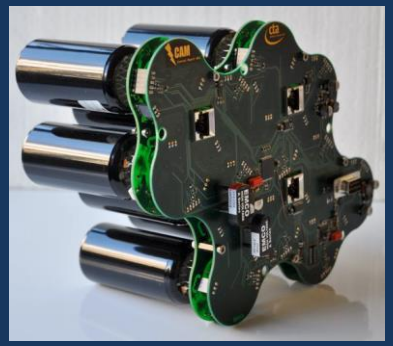
The Cameras: FlashCam



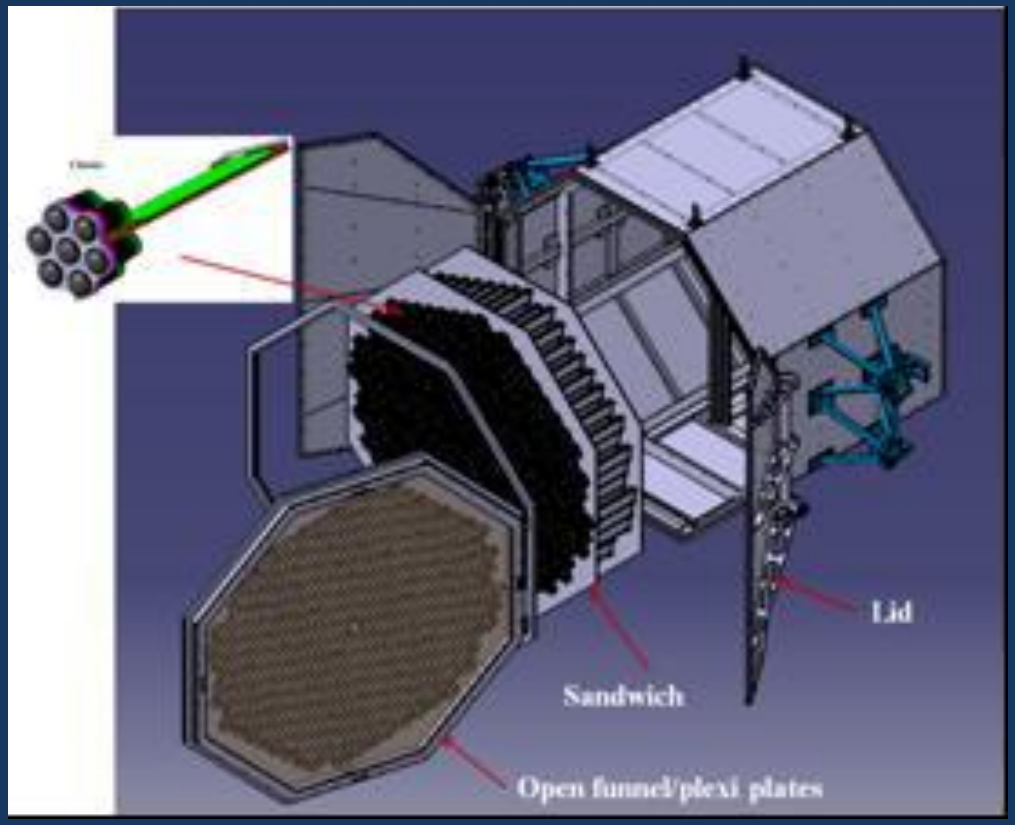
PMT-based camera:
racks in the rear of the camera body
Air flow through crate for cooling
Analog transmission via CATx (typ. 5 m)

12 pixel PMT PDP module incl. HV

Data handling



The Cameras: NectarCAM



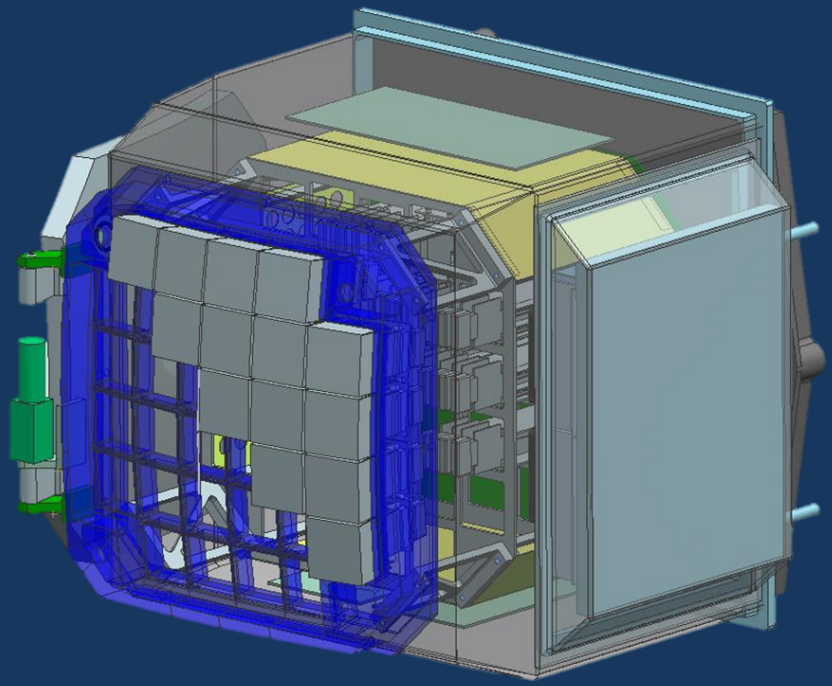
PMT-based camera:
All parts fully integrated in the Camera body

PMTs +HV

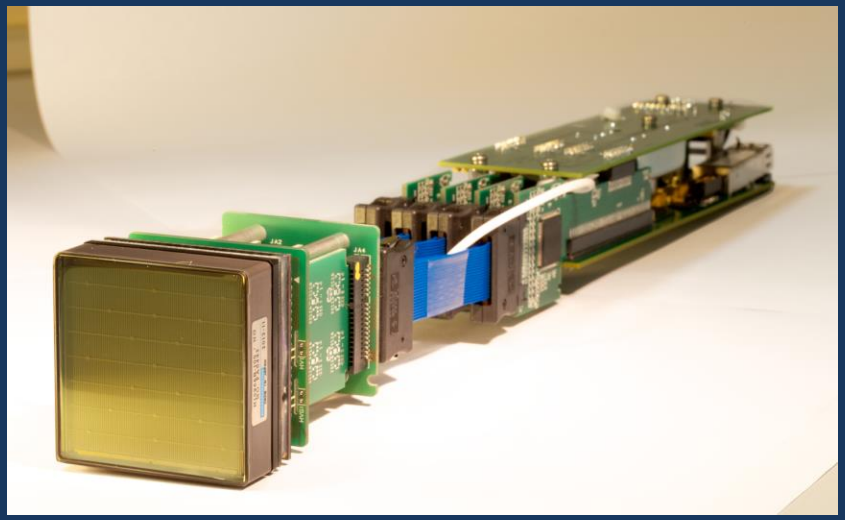
Backplane & L1 dist

NECTAr
ASICs

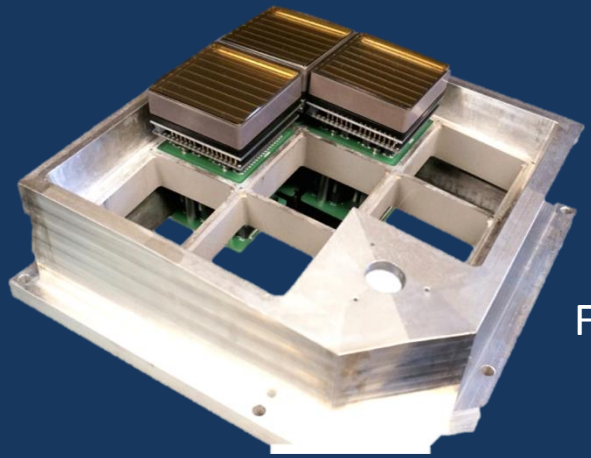
The Cameras: ChecCam



PMT/SiPM -based camera:
All parts fully integrated in the Camera body



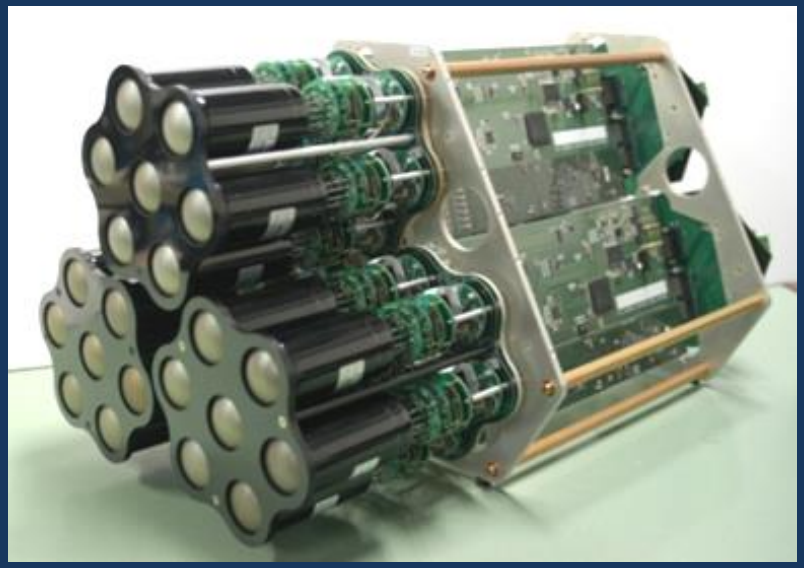
FEE Assembly



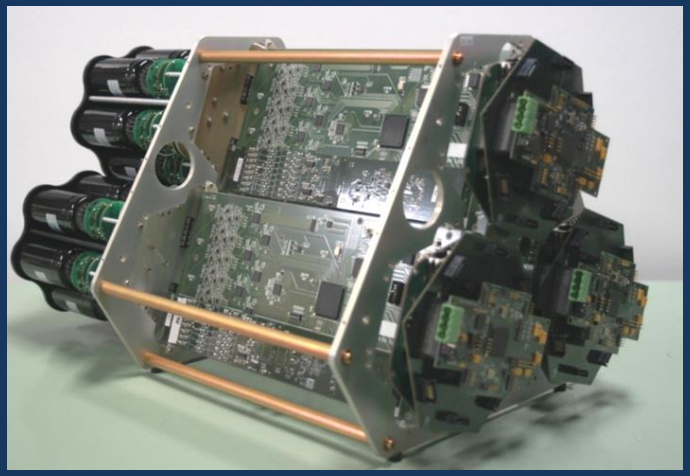
Focal plane plate: ¼ camera demonstrator

The Cameras: DragonCam

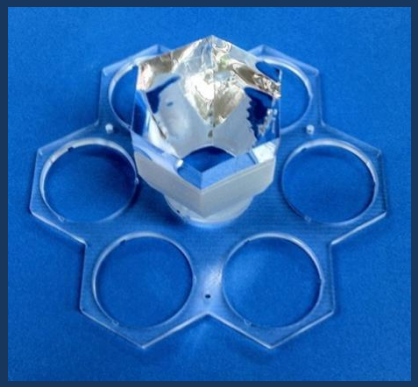
PMT-based camera:
All parts fully integrated in the Camera body



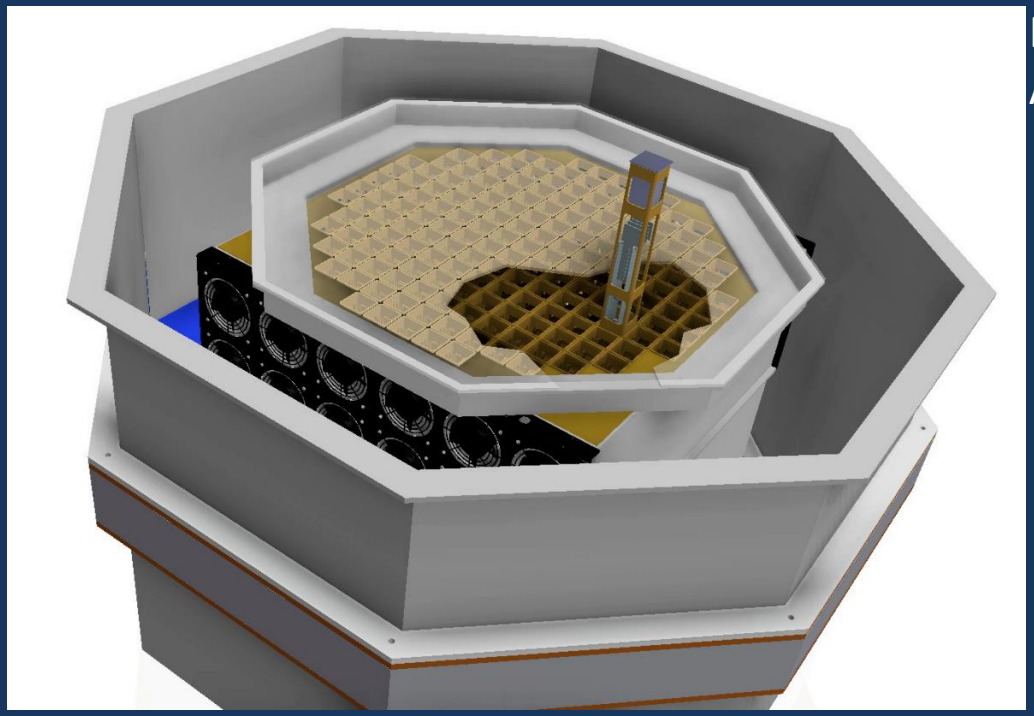
3-cluster camera



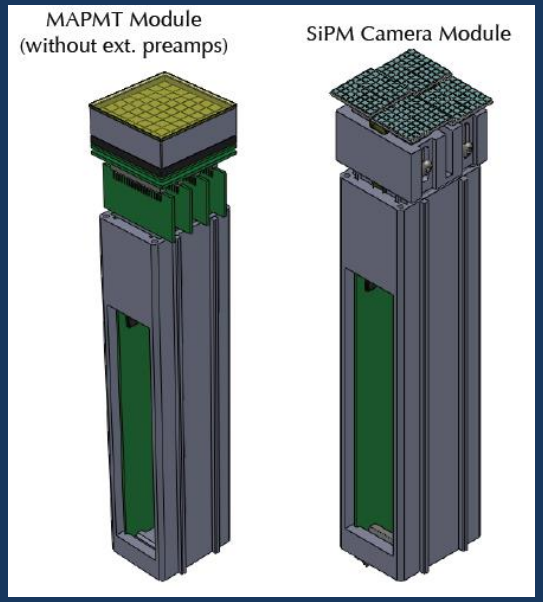
Winston cone prototype

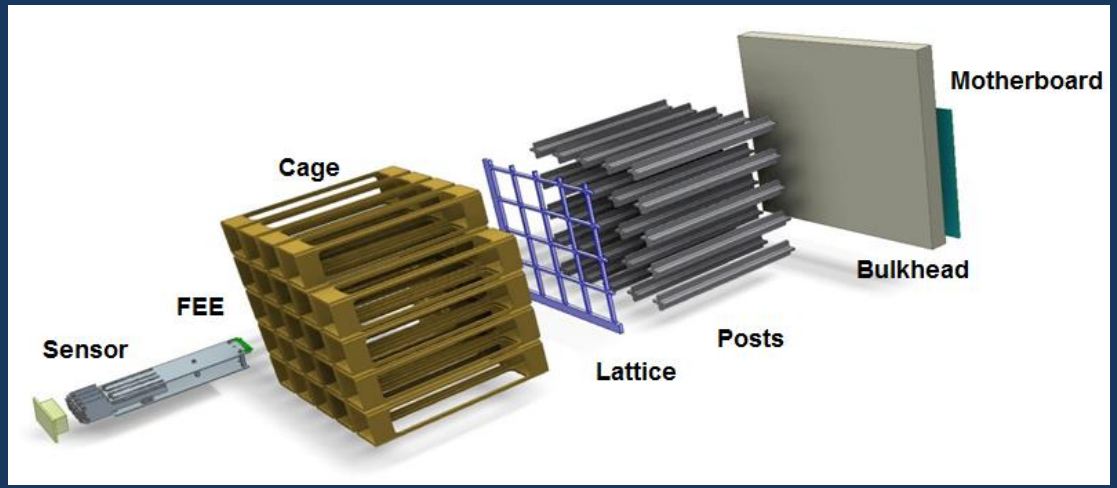


The Cameras: SCTCam



PMT/SiPM -based camera:
All parts fully integrated in the Camera body

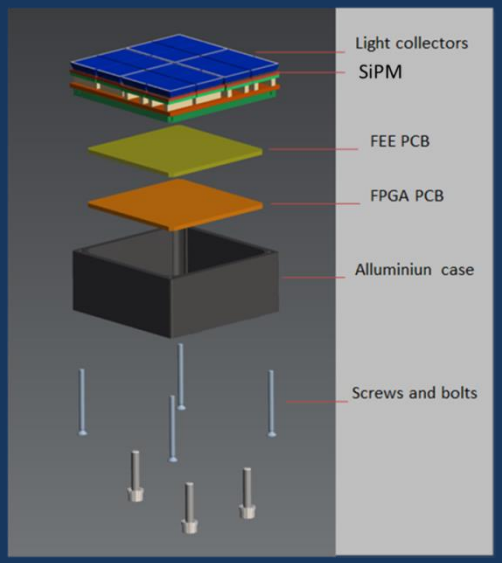




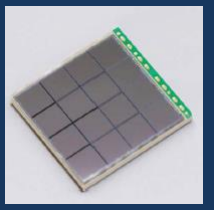
The Cameras: ASTRICam

INNOVATIVE TELESCOPE: 2 Mirrors + SiPM + F/E

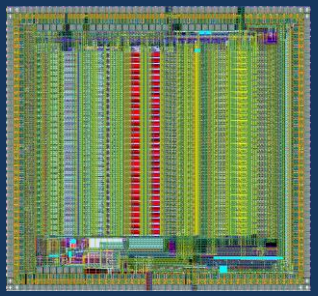
SiPM -based camera:
All parts fully integrated in the Camera body



PDM module

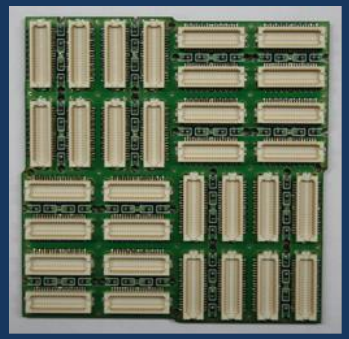


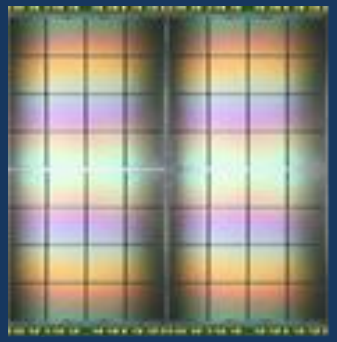
Hamamatsu SiPM



CITIROC ASIC

50 cm x 50 cm x 50 cm





SiPM PCB

THANKS