Main Features of Ashra Image Pipeline

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Ashra Detector

Light Collector
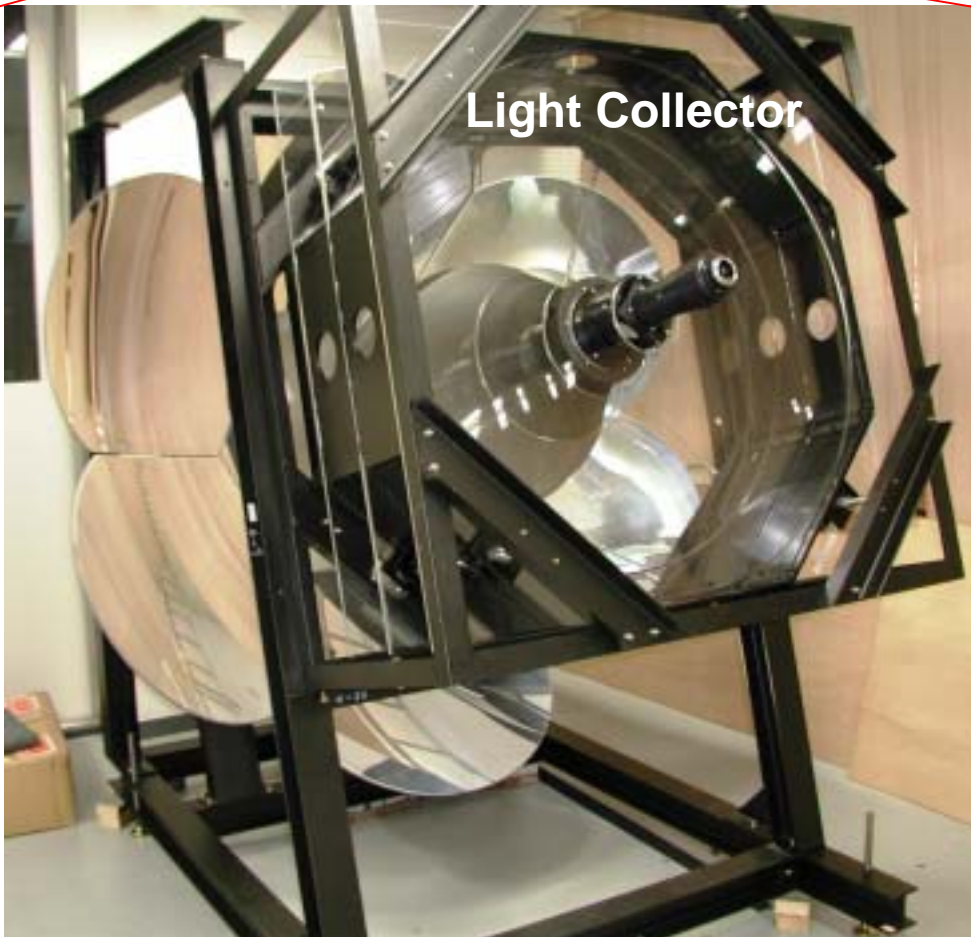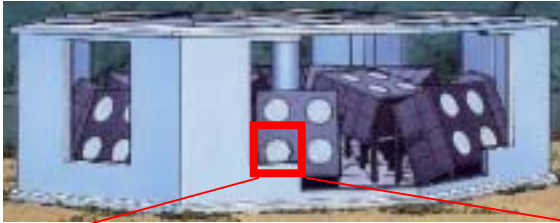
- **Optics:**
  - **Modified Baker-Nunn**

- **Components:**
  - **Correcting lens** (1.0~1.2mφ)
    3 acrylic lenses
  - **Spherical mirror** (2.2mφ)
    7 segment mirrors on adjustable mechanism
  - **Photoelectric Lens Image Tube** (0.5mφ)
   on adjustable mechanism

  => arcmin. resolution
  => FOV 0.42sr

Ashra Image Pipeline

*Function: obtains event images by using self-trigger system*

Consists of…

1. **Photoelectric Lens Image Tube**
 - scales down an input image size

2. **Amplification Image Intensifier**
 - Amplifies the image brightness

3. **Relay Lens Systems**
 - splits the image and transfers these images

4. **Fiber System**
 - transfers images to trigger sensor

5. **Trigger Sensors**
 - issues trigger pulses

6. **Delay Image Intensifier**
 - makes trigger decision time

7. **CMOS Sensor**
 - obtains the AS images
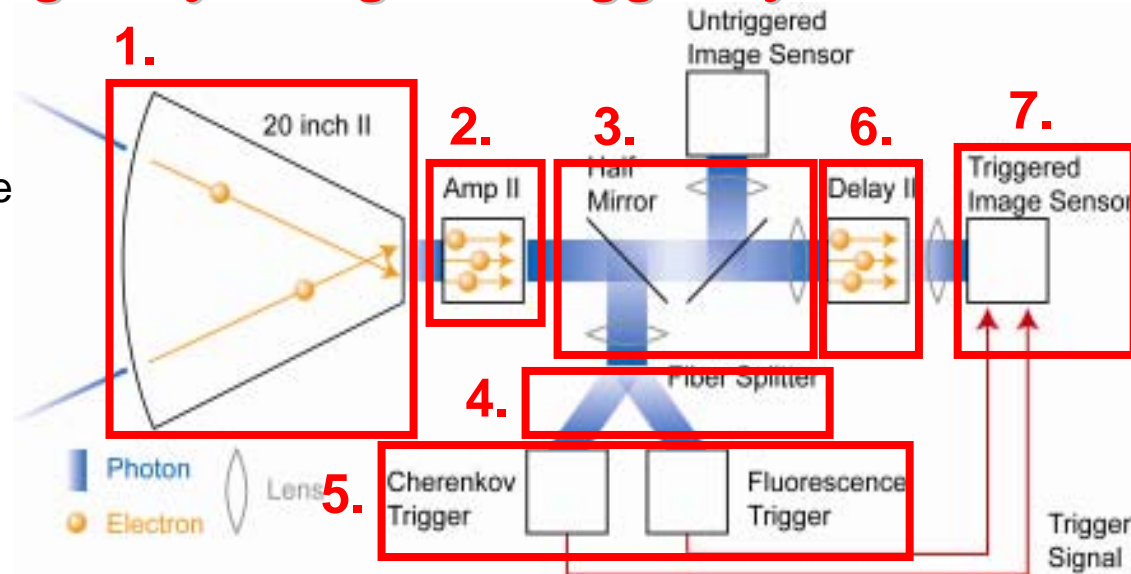
Independently, an untriggered image sensor obtains star images.

Prototype

Photoelectric Lens Image Tube

Functions:
1. Scales down images by the electric lens (x 1/20)
2. Amplifies image brightness (100 ph/pe)
3. Preserves image resolution

Coated with multi-layer dielectric filter
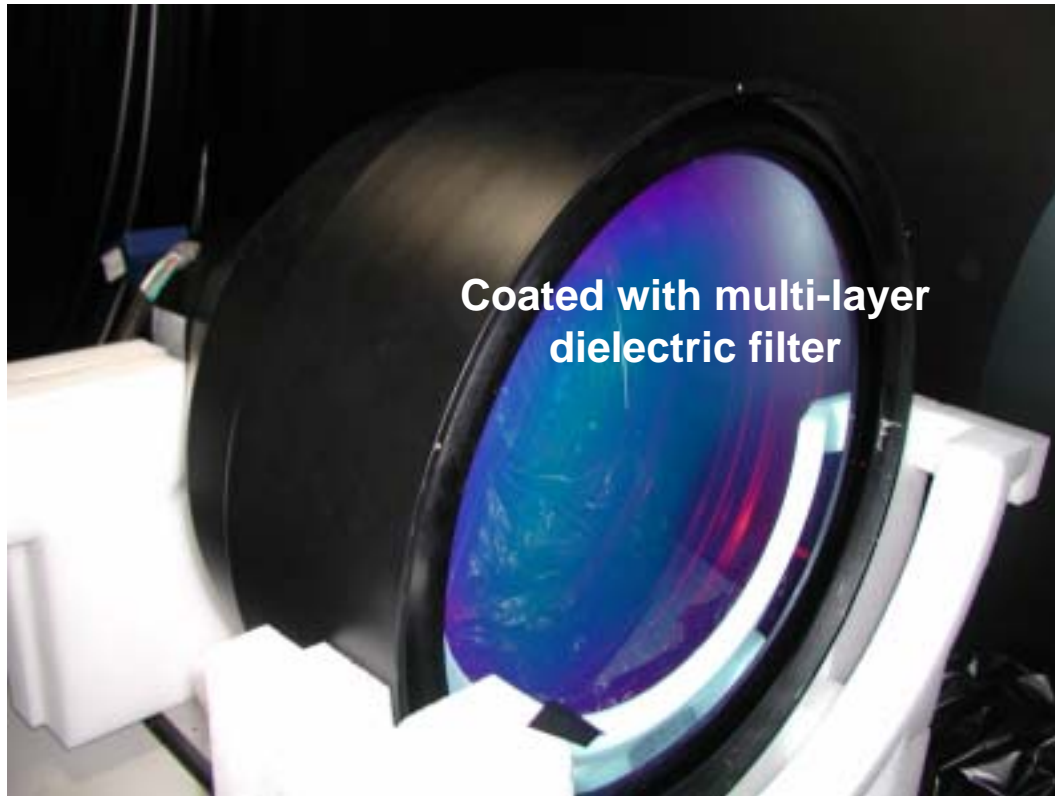
Amplification process

1. An input photon is converted to a photo-electron by the photo-electric effect.

2. The photo-electron is accelerated by high voltage.

3. The accelerated photo-electron is re-converted to photon.
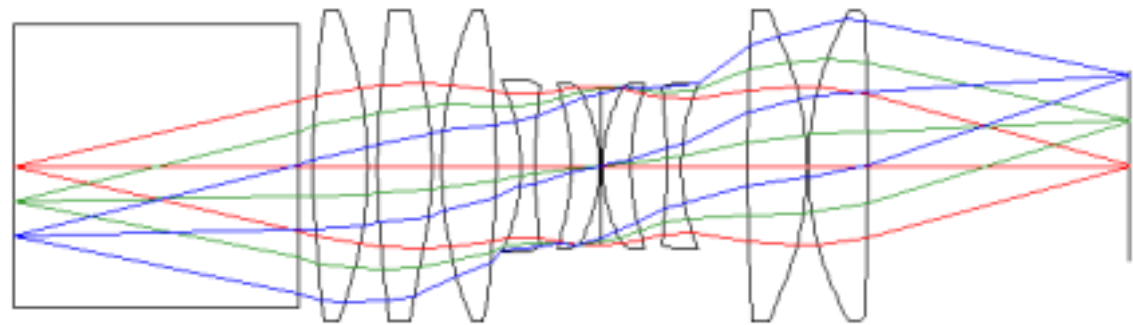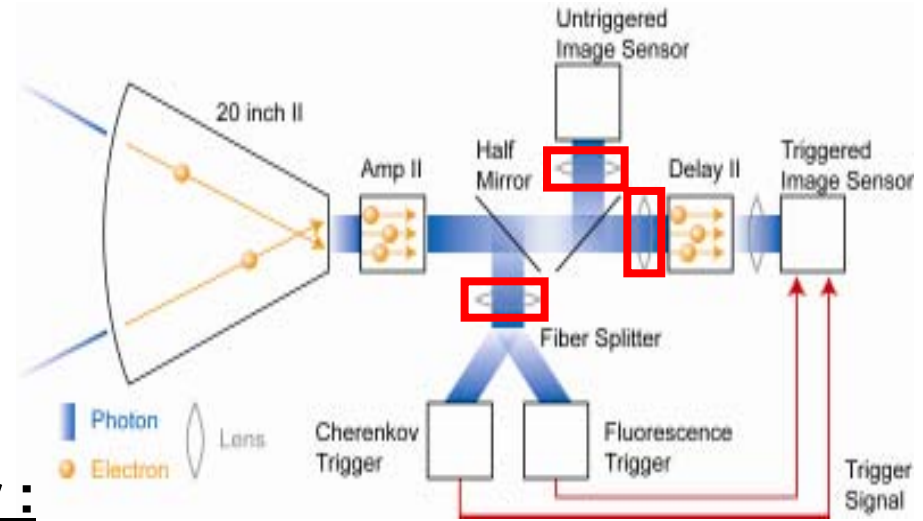
Key technology for the uniqueness of the Ashra

Relay Lens Systems

Requirements:

1. **High collection efficiency**
2. **High resolution**
3. **Mechanical limit**
4. **High cost performance**

Features of relay lens for the trigger :

- **Consists of only 4 kinds of lenses**
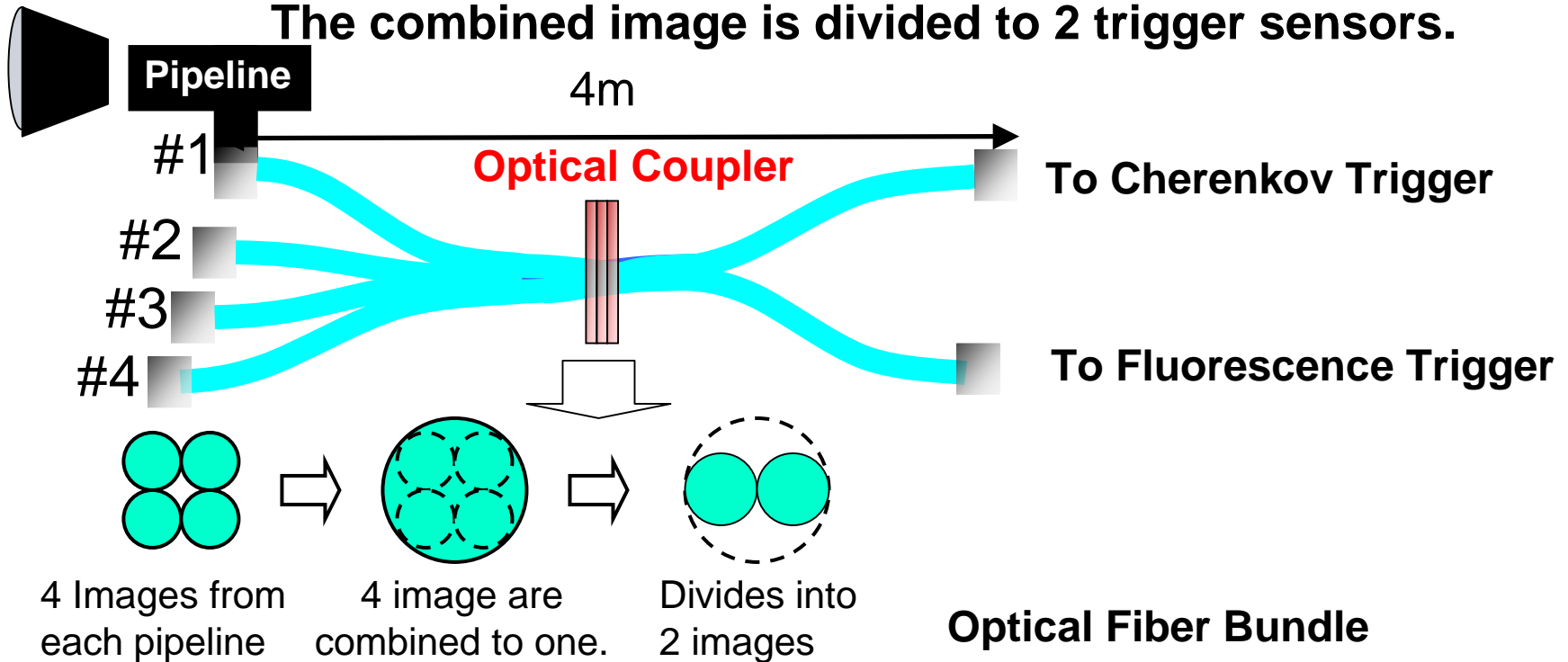
- **The design meets our requirements.**

We have completed design of all lens systems.

Fiber Transmission System

Functions: **4 images are combined to one image.**

The combined image is divided to 2 trigger sensors.

Pipeline

4m

#1

Optical Coupler

To Cherenkov Trigger

#2

#3

#4

To Fluorescence Trigger

4 Images from
each pipeline

4 image are
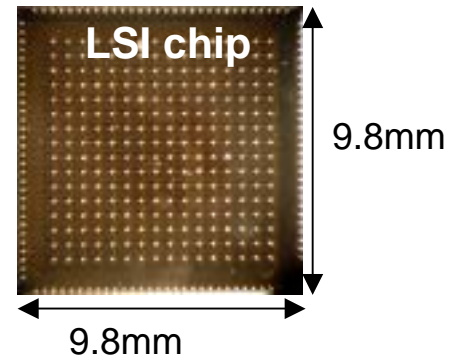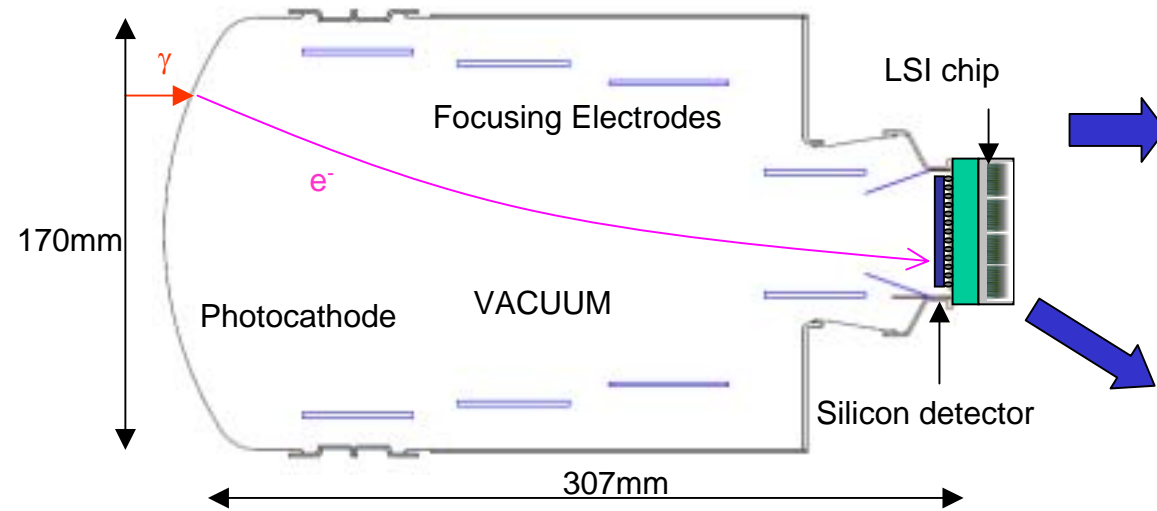combined to one.

Divides into
2 images

Optical Fiber Bundle

- 64×64 fibers (0.5mmϕ)

- 0.67deg-FOV / fiber

We can obtain higher sensitivity than only one light collector.

Trigger Sensor

γ

e⁻

Focusing Electrodes

Photocathode

VACUUM

170mm

307mm

LSI chip

Silicon detector

Prototype

LSI chip
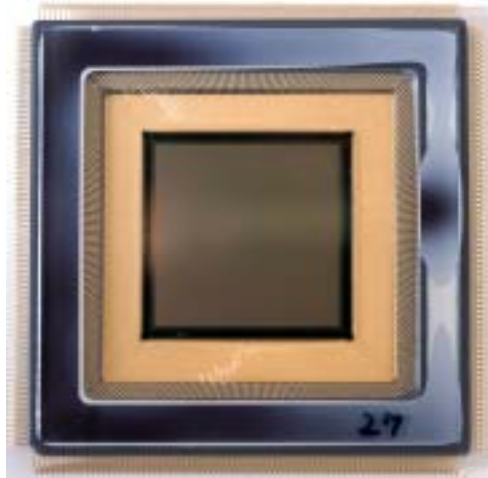
9.8mm

9.8mm

Trigger sensor consists of:

1. Electron tube

   - scales down images (x 1/5)

2. 64x64 pixel silicon detectors

   - converts photoelectrons to current

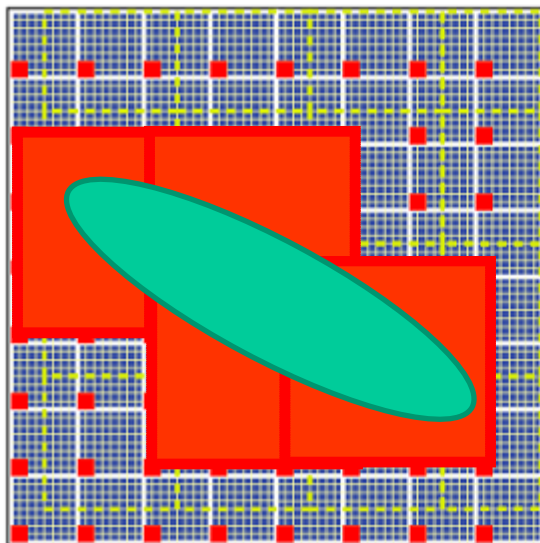3. LSI readout circuits

   - discriminates AS signals

Fast pattern recognition can be performed by the trigger sensor.

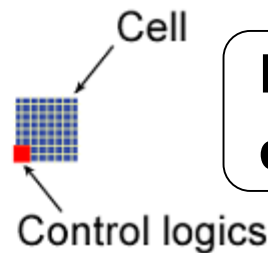# CMOS Fine Sensor

18.8mm

- Made by Standard CMOS process
- Number of pixels   2048×2048
- Number of Cells   128×128
- Pixels in the Cell   16×16
- Pixel size   8×8μm
- Readout   12.8μs/Cell

Cell

Control logics

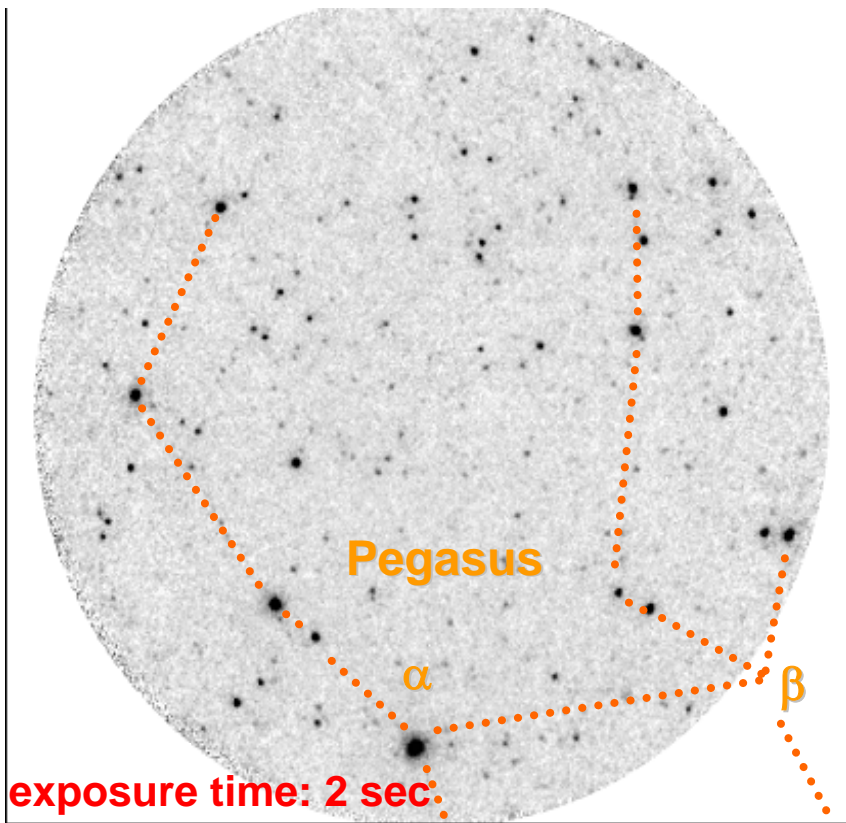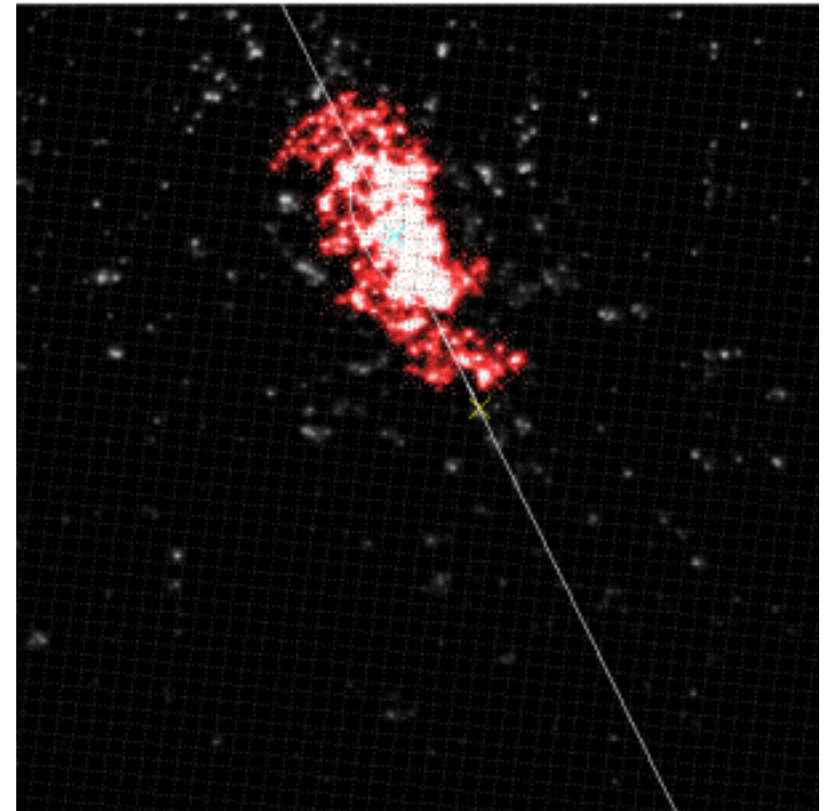**Exposure cells**
Shower image

Ashra fine sensor

Exposure and readout for each cell can be performed.

We have succeeded in obtaining images with the CMOS fine sensor.

Results of Image Pipeline Test

Untriggered image

Triggered Cherenkov image

We have confirmed image pipeline was operated as we expected.

We will move on to the observation step.