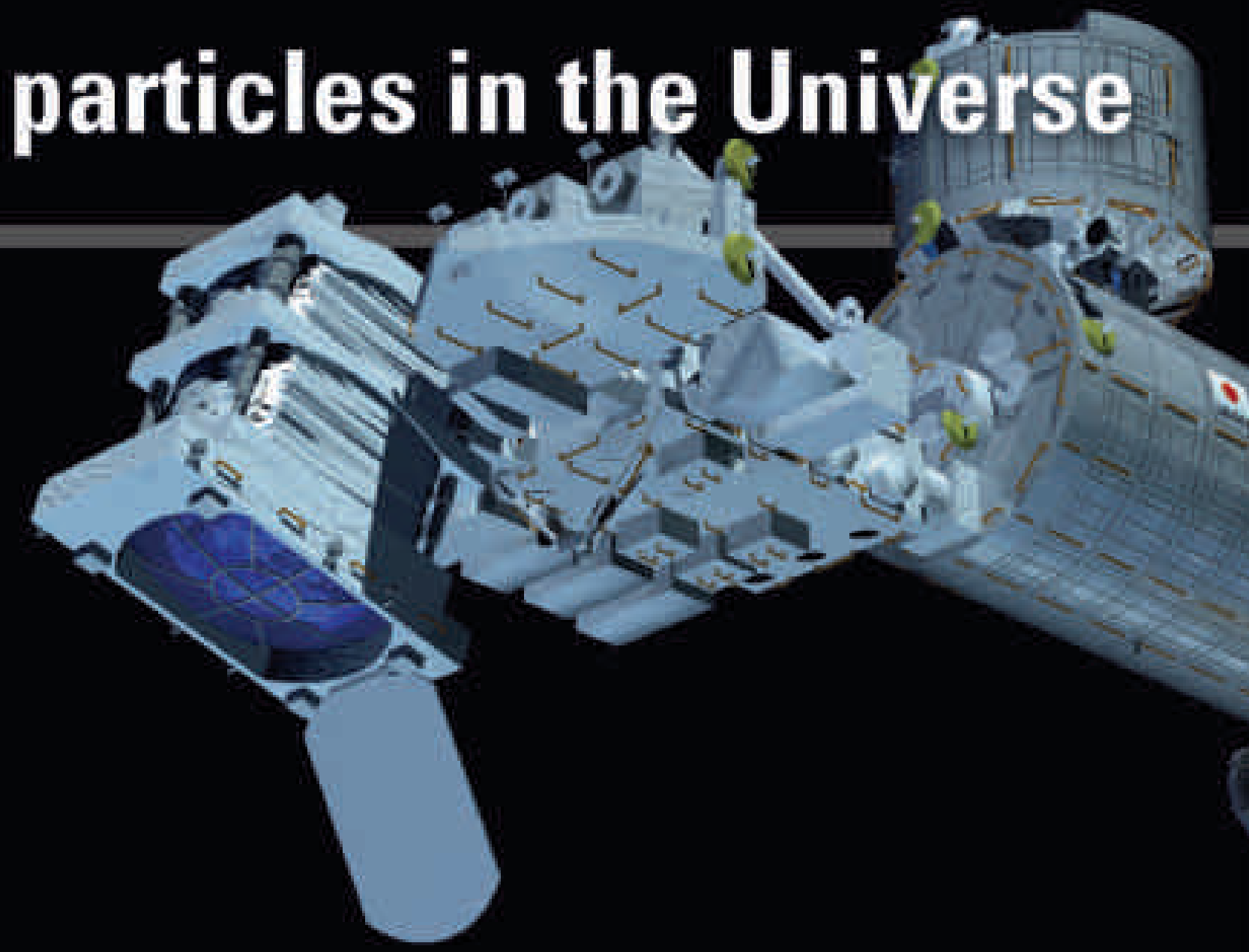


## Towards the JEM-EUSO mission

Lech Wiktor Piotrowski\*  
on behalf of JEM-EUSO collaboration

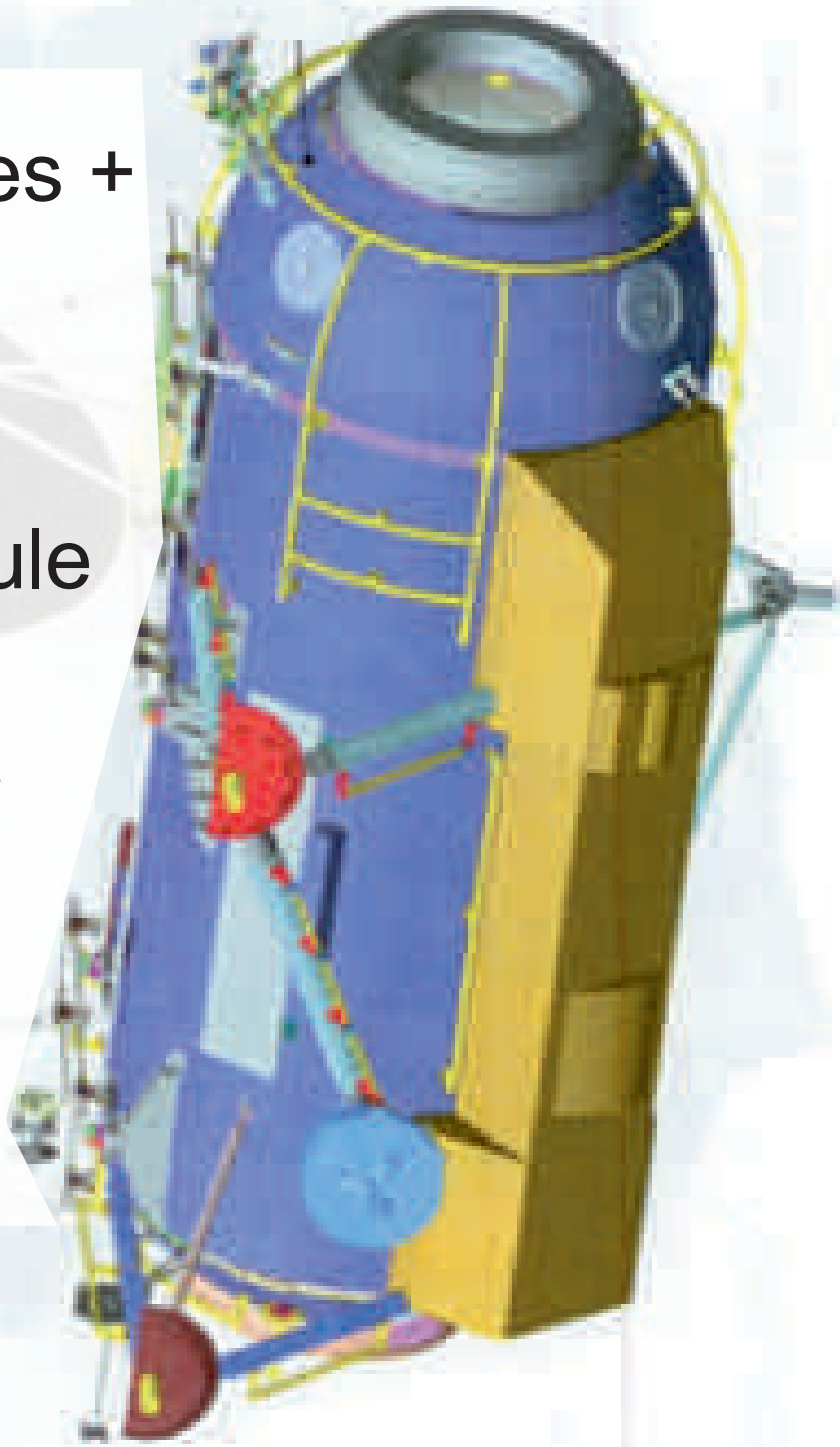
\*lech.piotrowski@riken.jp, RIKEN, Hirosawa 2-1, Wako-shi 351-0198, Saitama, Japan



### EUSO-KLYPVE (2018)

Intermediate stage EECR observations from the orbit

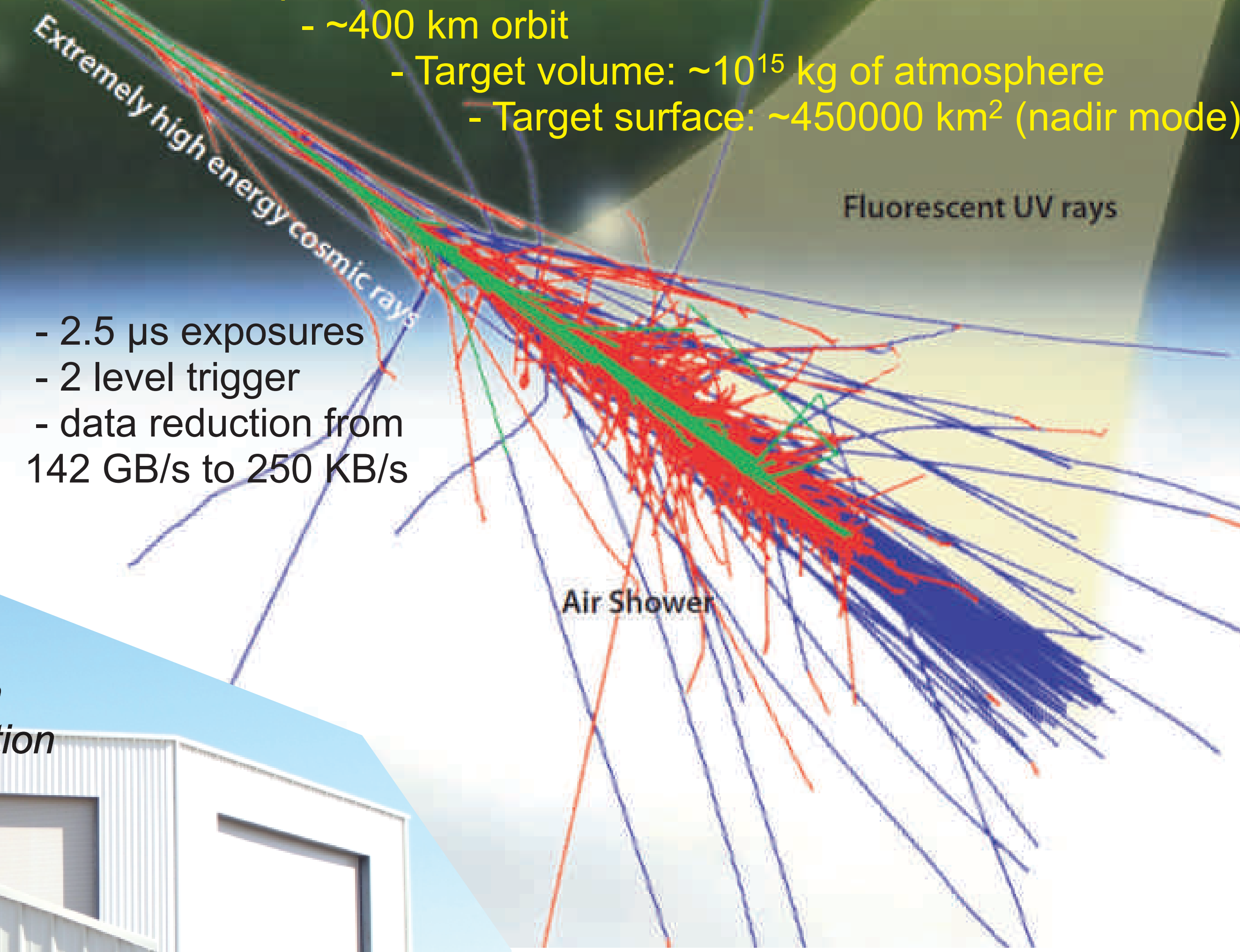
- $\sim \pm 12^\circ$  FoV
- Fresnel Lenses + mirror
- $\sim 60$  PDMs
- $\sim 500$  kg
- Russian module on ISS
- $\sim 400$  km orbit
- $> 0.5$  JEM-EUSO equivalent in tilted mode



### JEM-EUSO (2020+)

Extreme Universe Space Observatory onboard Japanese Experimental Module of International Space Station

- A Fresnel lens based "camera", observing Extremely Energetic Cosmic Rays (EECR,  $\sim 10^{19}$ - $10^{21}$  eV), from the orbit, registering UV (290-430 nm) light from electromagnetic showers induced in the Earth's atmosphere.
- $\pm 30^\circ$  FoV
  - 3 Fresnel lenses, 2.5 m diameter
  - 315648 pixels in 137 PDMs
  - $\sim 1000$  kg
  - Japanese module on ISS
  - $\sim 400$  km orbit
  - Target volume:  $\sim 10^{15}$  kg of atmosphere
  - Target surface:  $\sim 450000$  km<sup>2</sup> (nadir mode)

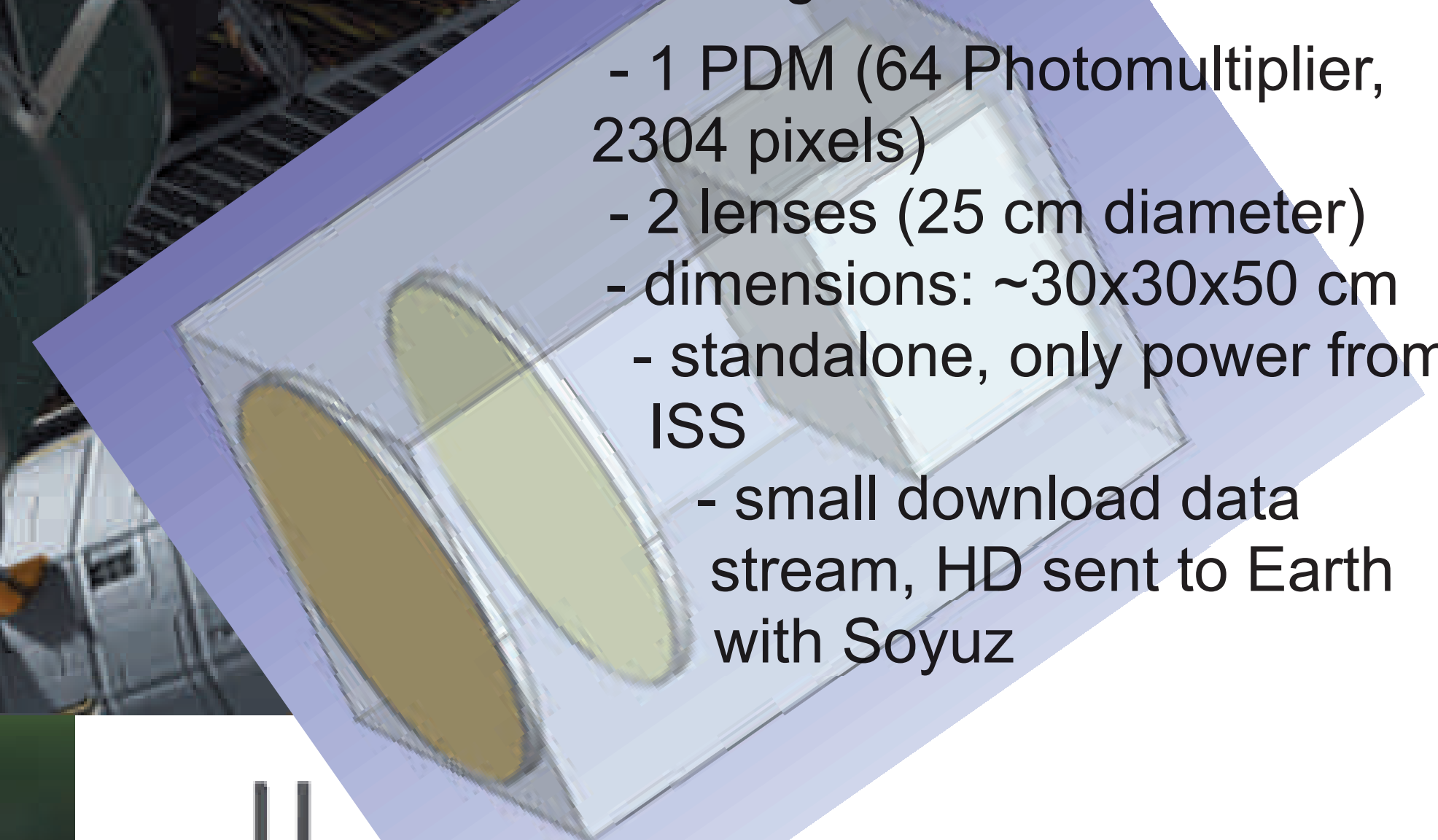


- 2.5  $\mu$ s exposures
- 2 level trigger
- data reduction from 142 GB/s to 250 KB/s

### MINI-EUSO (2015)

Measurement of UV background from inside ISS

- 1 PDM (64 Photomultiplier, 2304 pixels)
- 2 lenses (25 cm diameter)
- dimensions:  $\sim 30 \times 30 \times 50$  cm
- standalone, only power from ISS
- small download data stream, HD sent to Earth with Soyuz

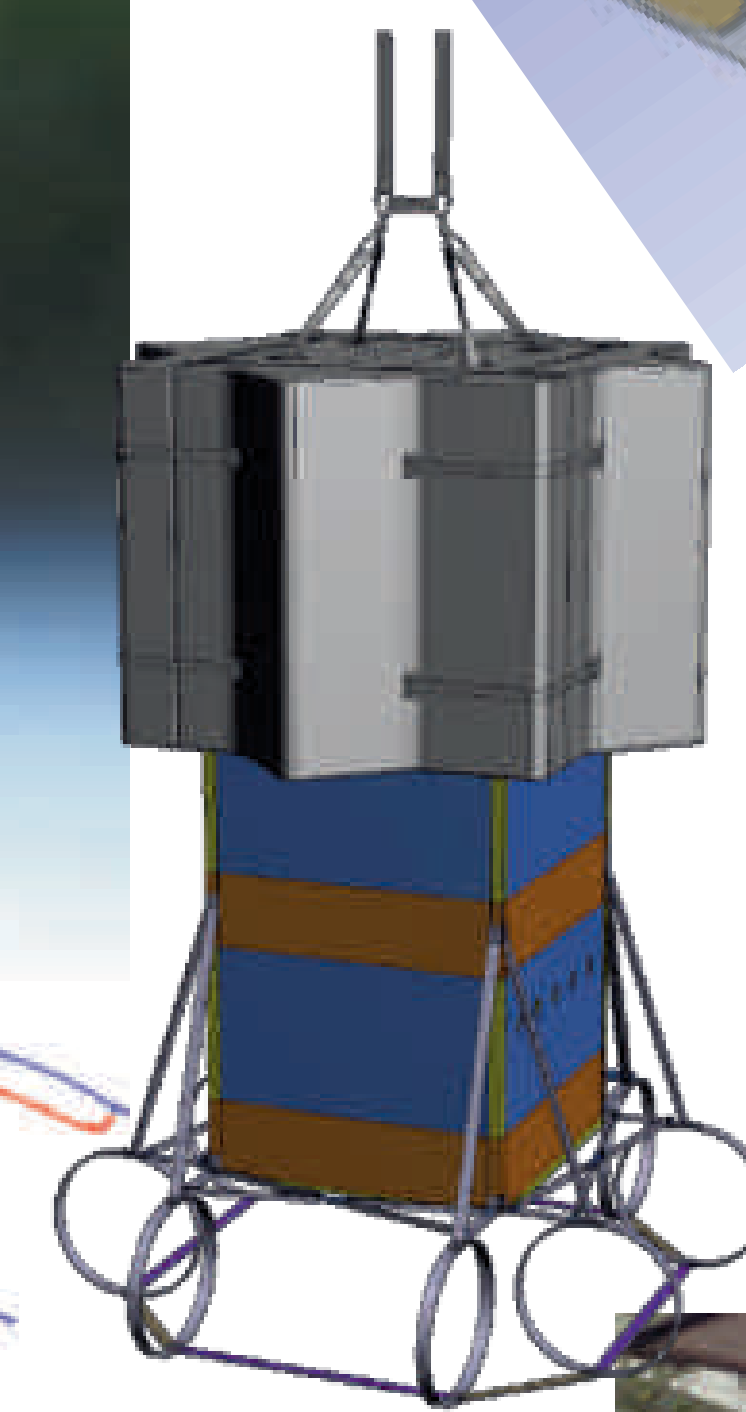


### EUSO-BALLOON (2014)

First dedicated observations of cosmic rays from above

- $\pm 6^\circ$  FoV
- 1 PDM (64 Photomultiplier, 2304 pixels)
- 3 Fresnel lenses (1 m<sup>2</sup>)
- $\sim 40$  km altitude

First flight scheduled for autumn 2014



Transport of EUSO-BALLOON lenses from RIKEN to France

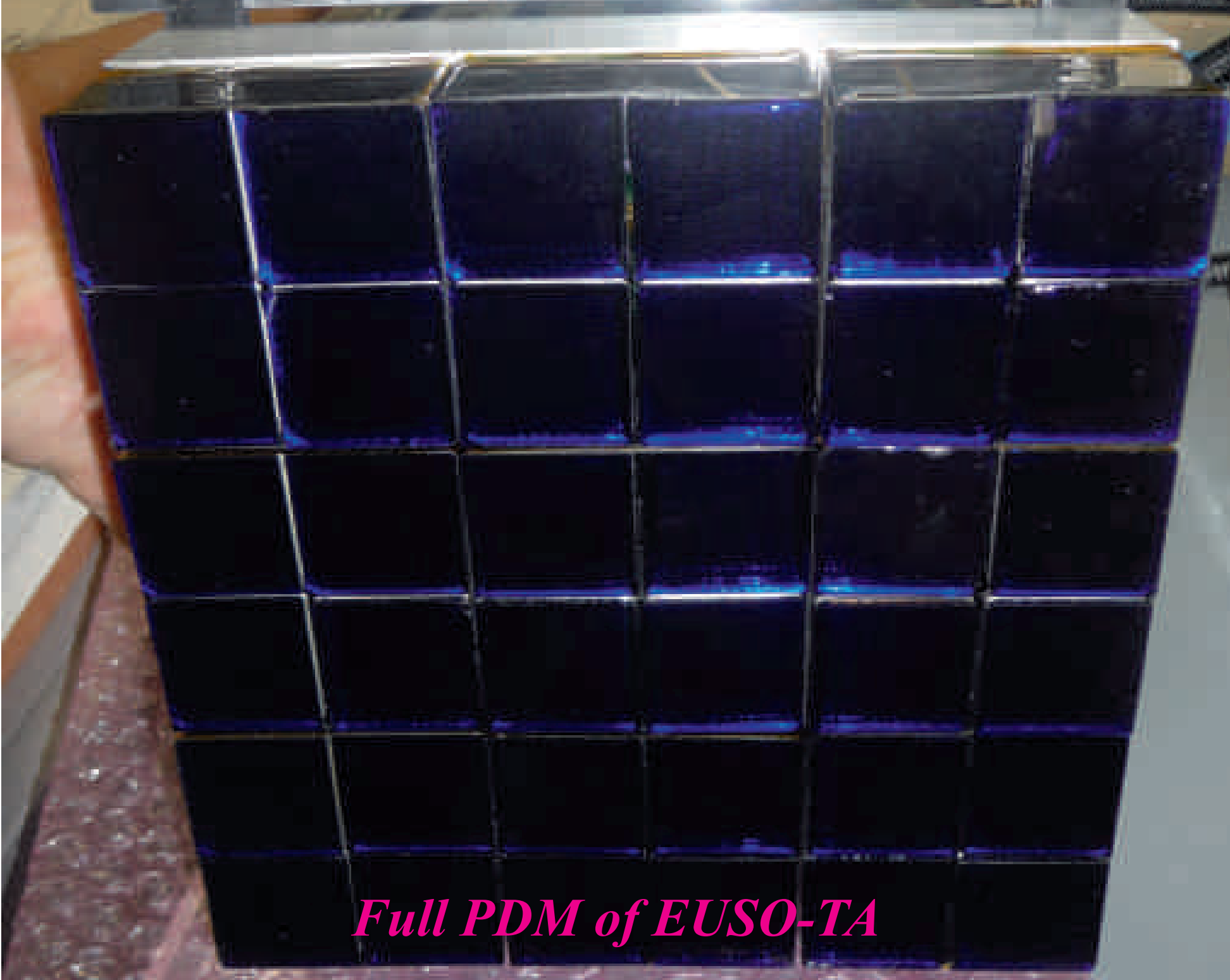
### EUSO-TA (2014)

Joint observation of cosmic rays with Telescope Array experiment, for calibration and testing

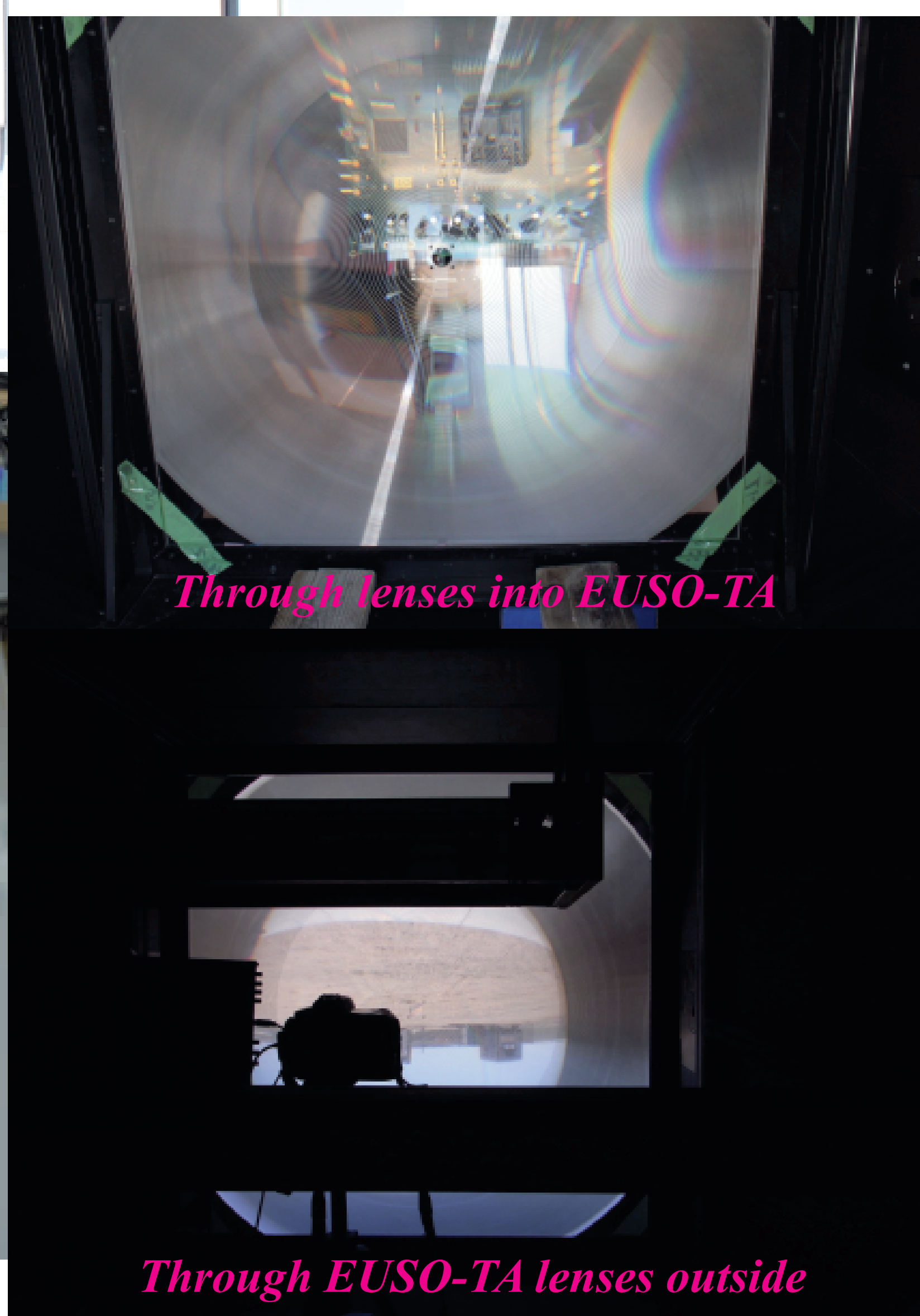
- $\pm 4^\circ$  FoV
- 1 PDM (64 Photomultiplier, 2304 pixels)
- 2 Fresnel lenses (1 m<sup>2</sup>)
- first stage of installation finished in March 2013

Final installation planned for spring 2014

EUSO-TA assembled in TA site, Black Rock Mesa, Utah, USA



Full PDM of EUSO-TA



Through lenses into EUSO-TA

Through EUSO-TA lenses outside



Balloon front lens

Balloon middle lens

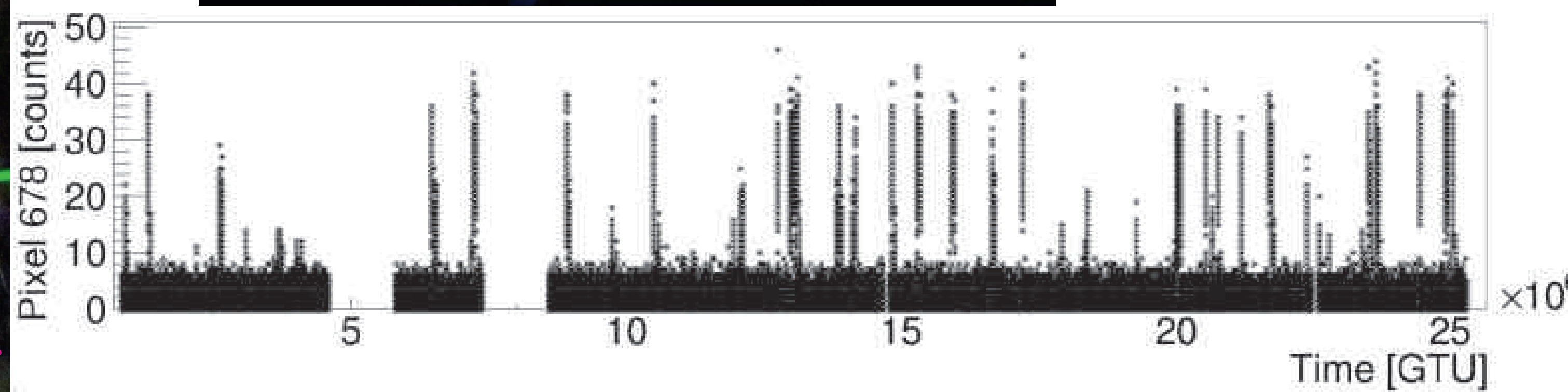
Balloon rear lens

EUSO-BALLOON mechanical structure

EUSO-BALLOON launch site - Timmins, Canada



EUSO-TA tests with laser on RIKEN roof



EUSO-TA observation for UV laser spot moving through field of view

JEM-EUSO collaboration

13 Countries, 80 Institutes as of March, 2013

