Passive measurement of distance to cloud

220715

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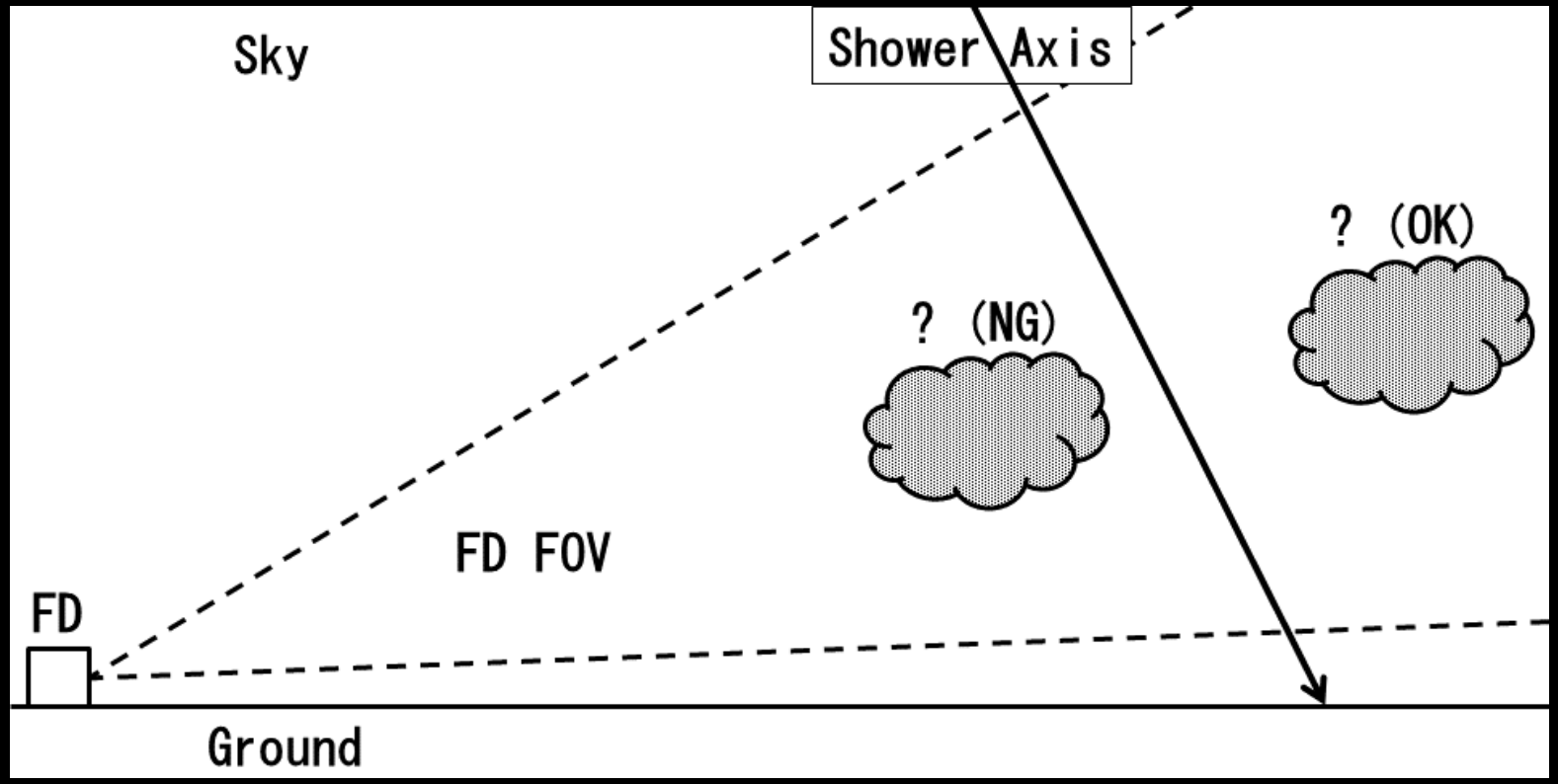
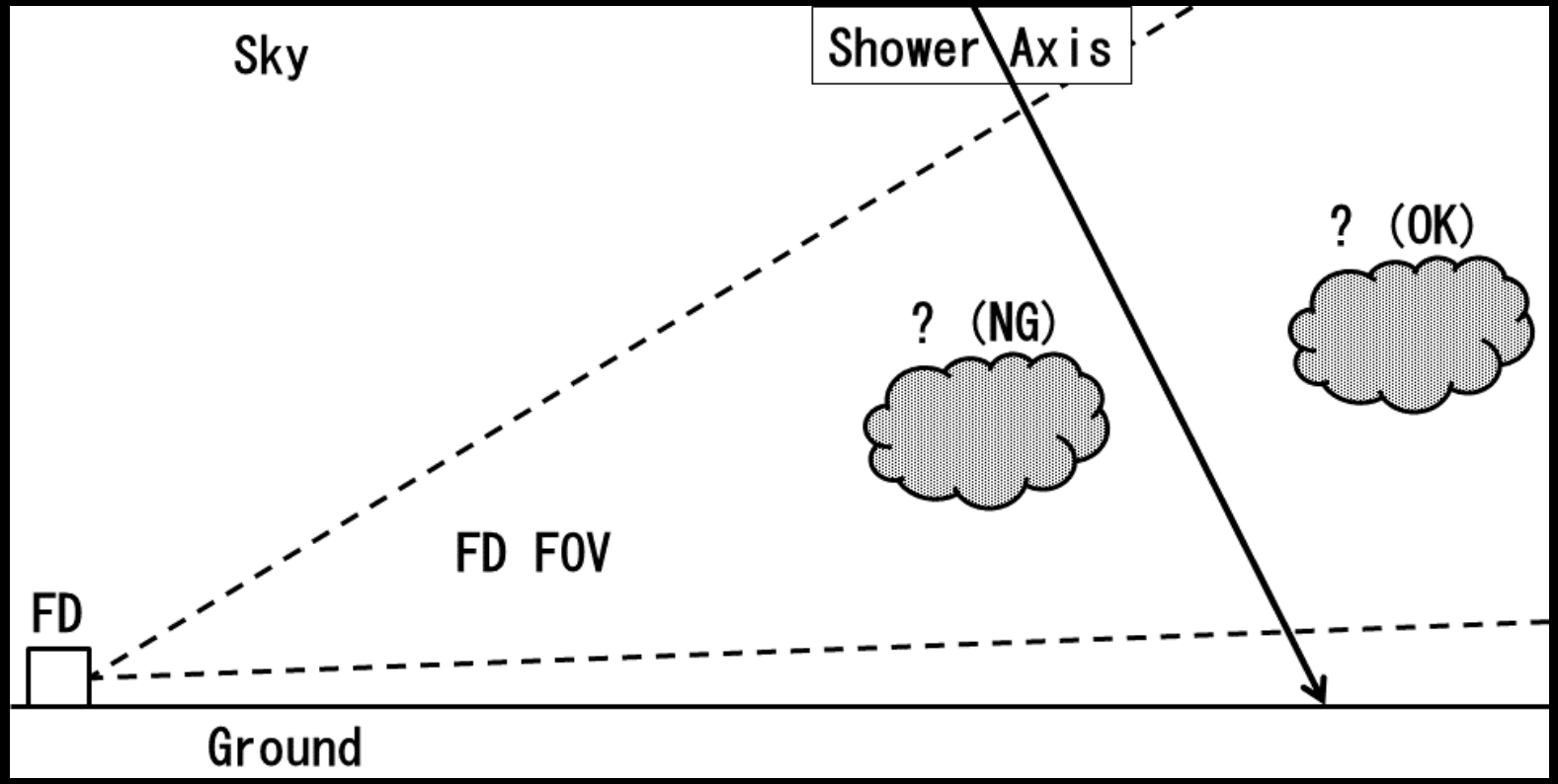
FD and cloud

The atmospheric Fluorescence telescopic Detector(FD) observes very far incident UHECR airshower to cover large area because of low statistics.
The observation does not take place in overcast night. However, the cloud status changes quickly and sometimes there are some isolated clouds.

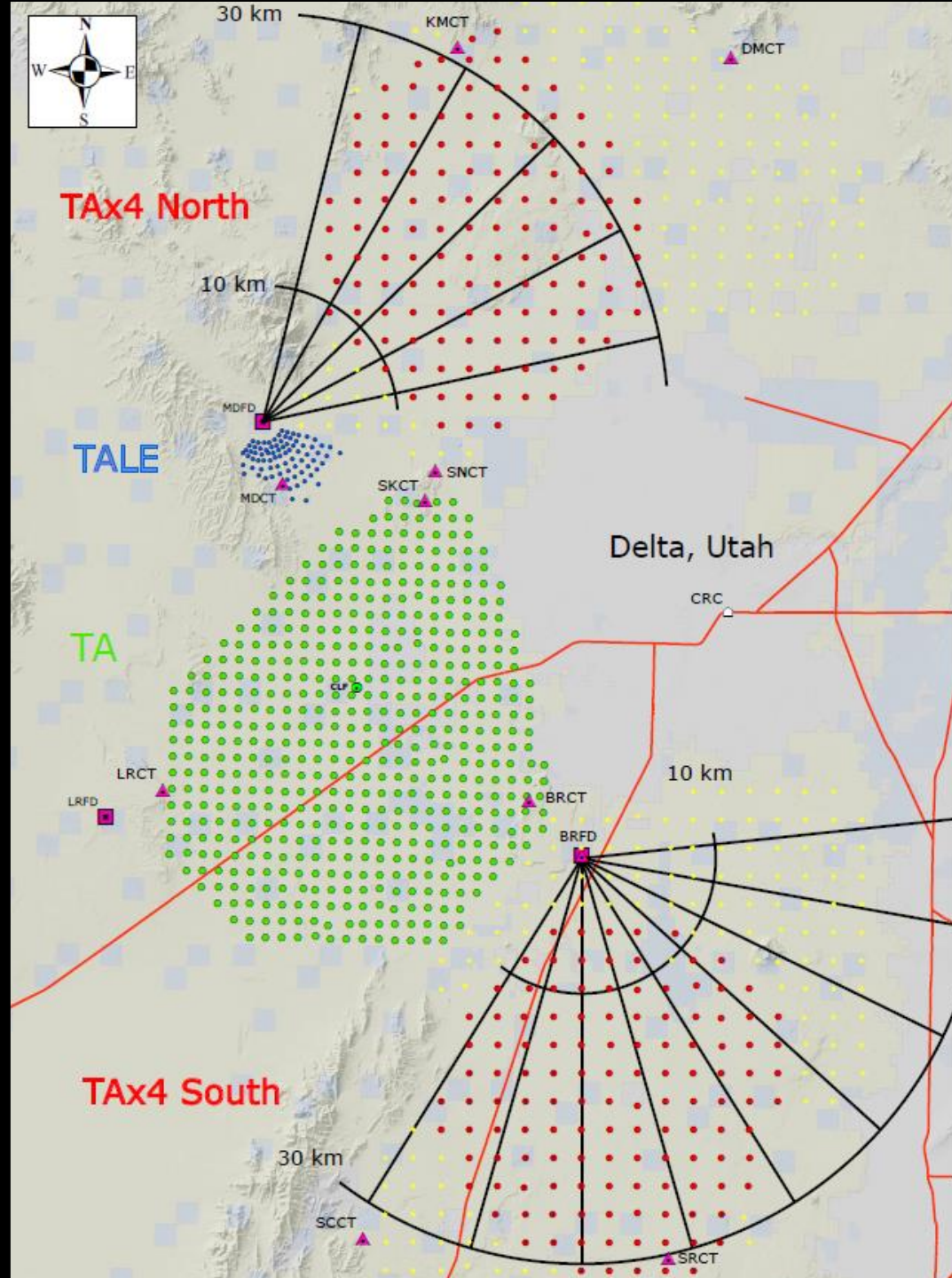


Method to measure distance to cloud

Radar is too expensive and large power consumption.
The lidar field of view is very narrow.
It cannot cover area whose cloud status changes quickly.
As passive method, Telescope Array Cloud Ranging Test(TACRT) has started to test the method for evaluating the correction of exposure.
Stand alone stereo cloud cameras was installed near one of FD site.



Telescope Array
(39.3° N, 112.9° W, altitude 1382 m)
extended TAx4 experiment from 2019.



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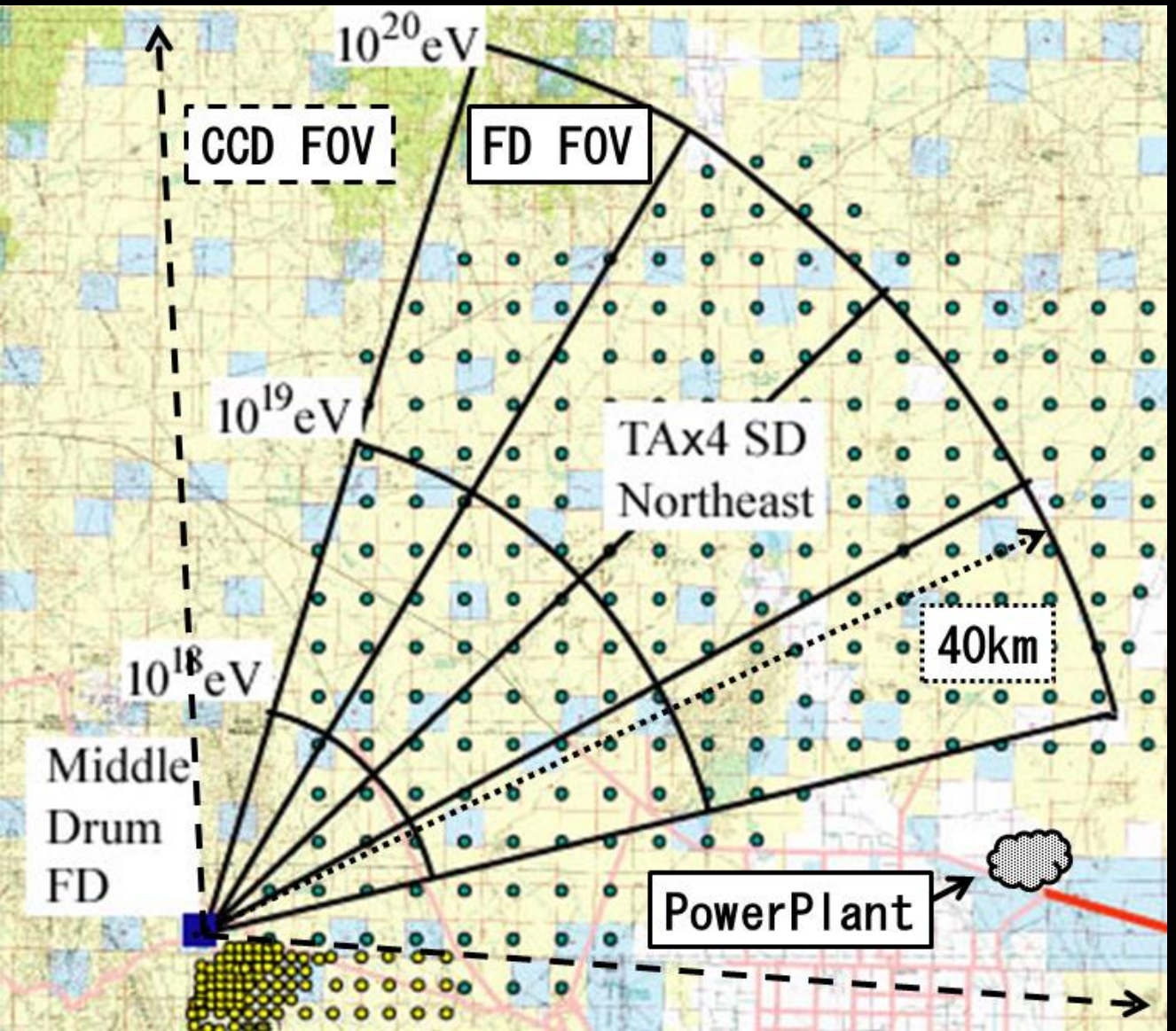

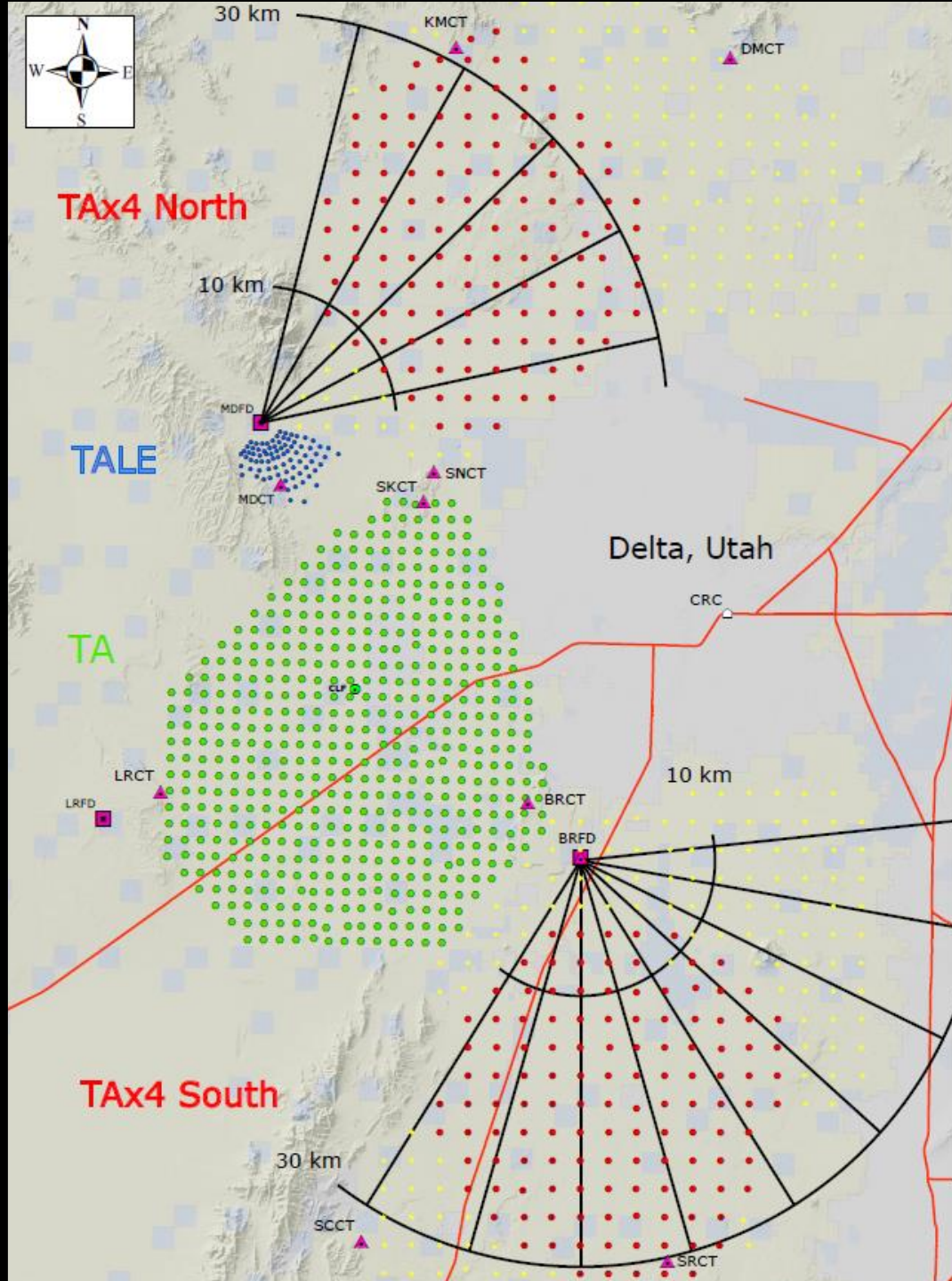

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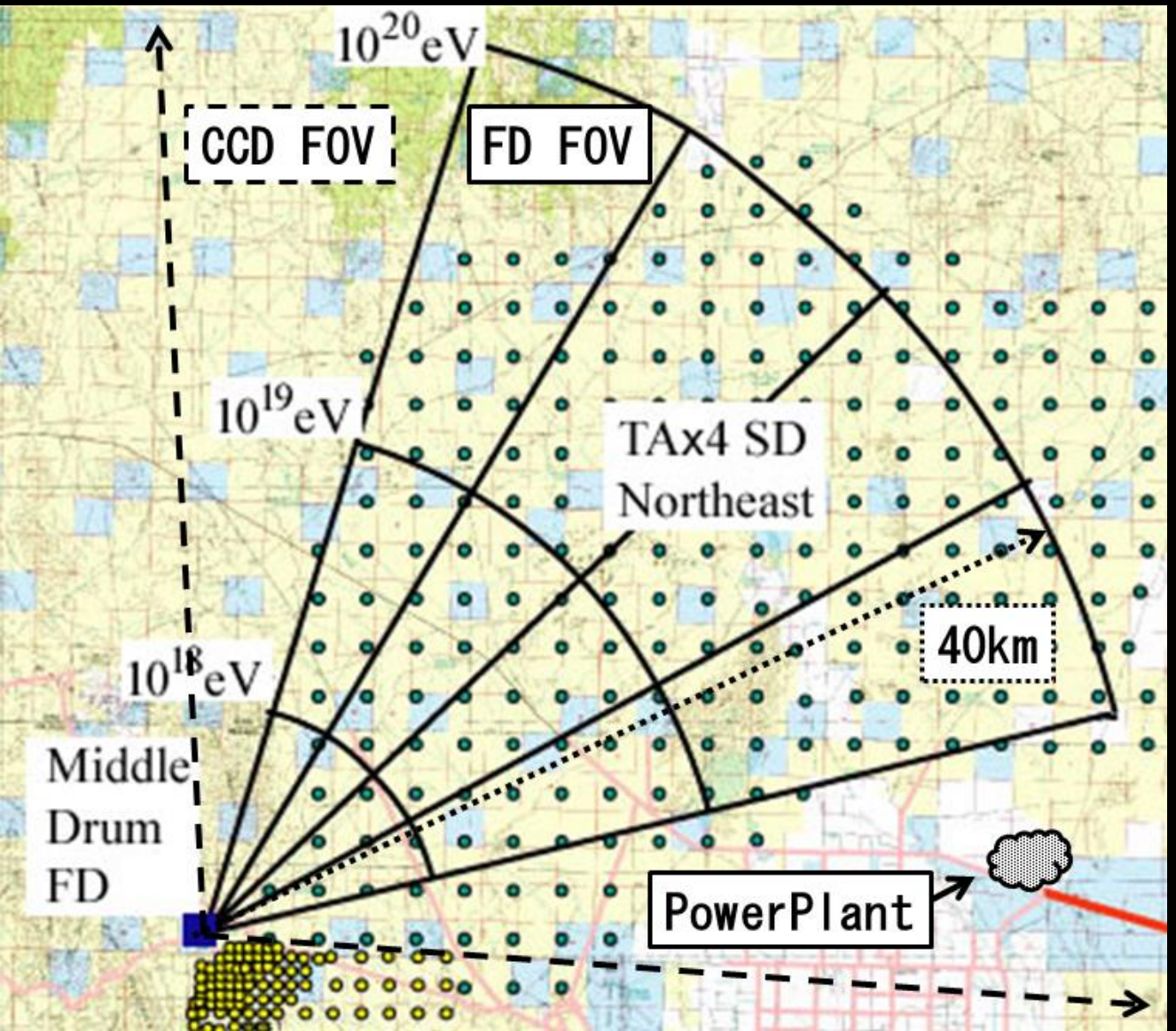


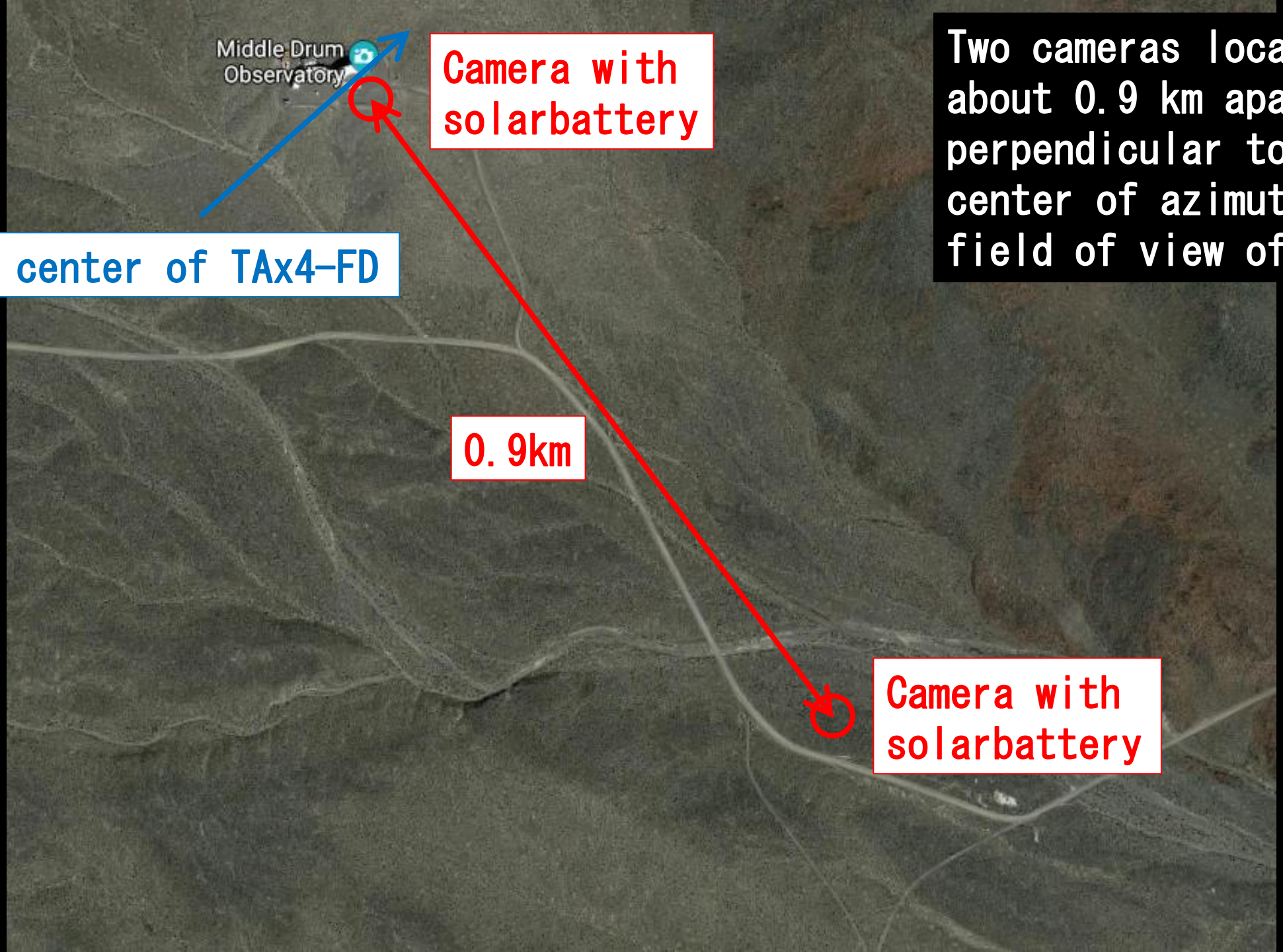
Cloud at FD site is darker than sky.

Cloud (edge) distance can be evaluated by the visibility of the background star.

The field of view of camera is about 95° horizontally.

The camera has monochrome 8 bit 1024x768 pixels.

The horizontal resolution is roughly 0.1° per pixel.



Two cameras located about 0.9 km apart perpendicular to the the center of azimuth of field of view of TAx4FD.

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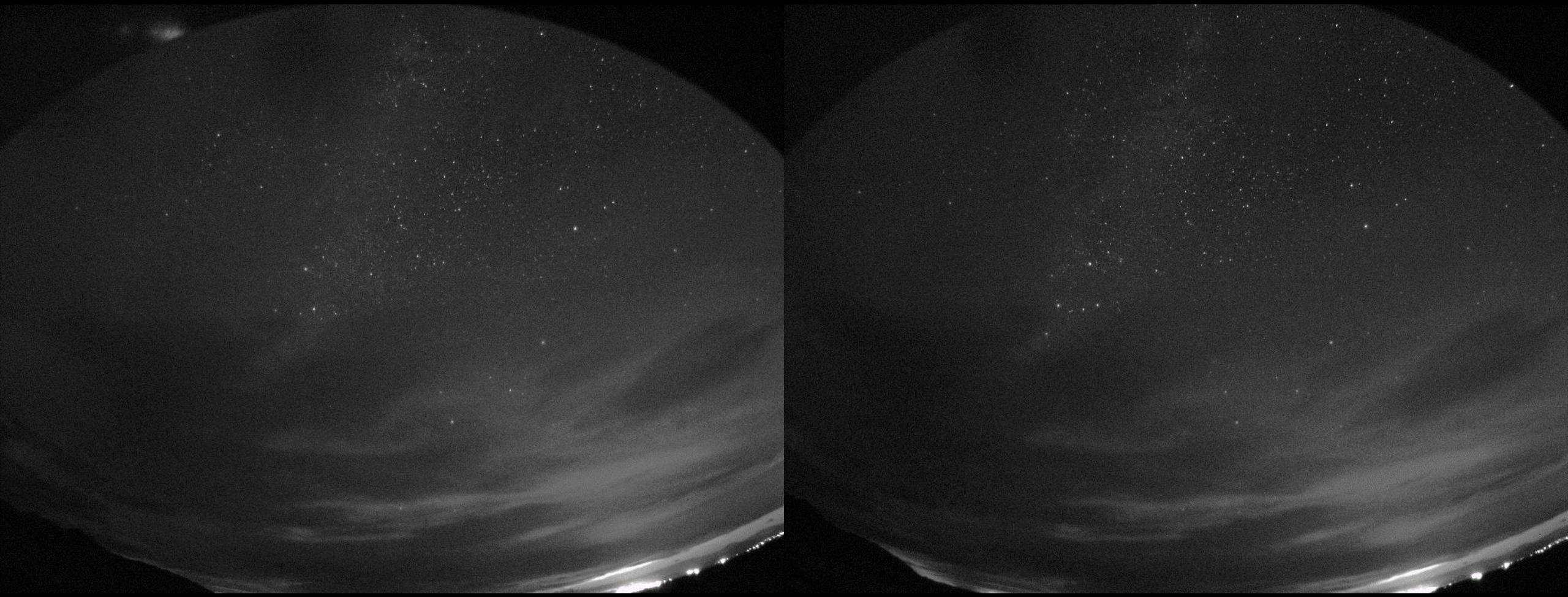
Two cameras located about 0.9 km apart perpendicular to the the center of azimuth of field of view of TAx4FD.

This configuration correspond to about 12 pixels shift on image for 40 km distance, which is enough to test the method.

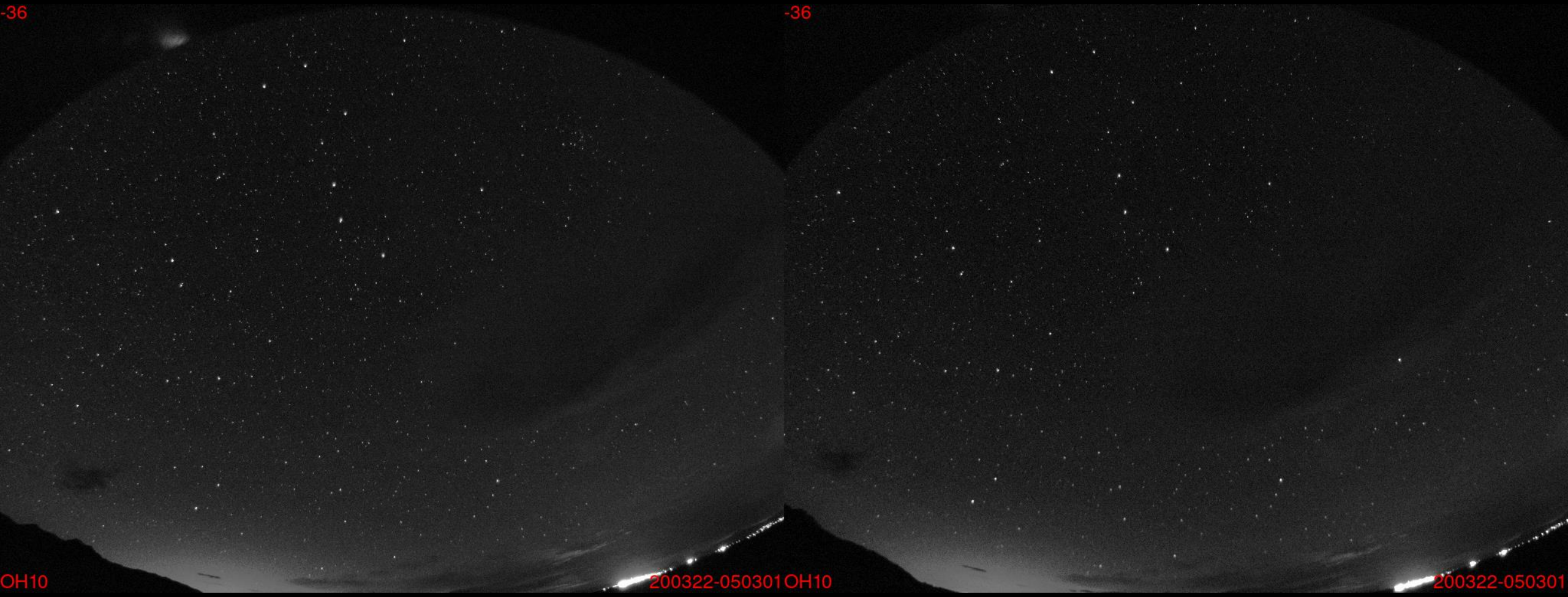
Test image just after stereo istallation at moonrise



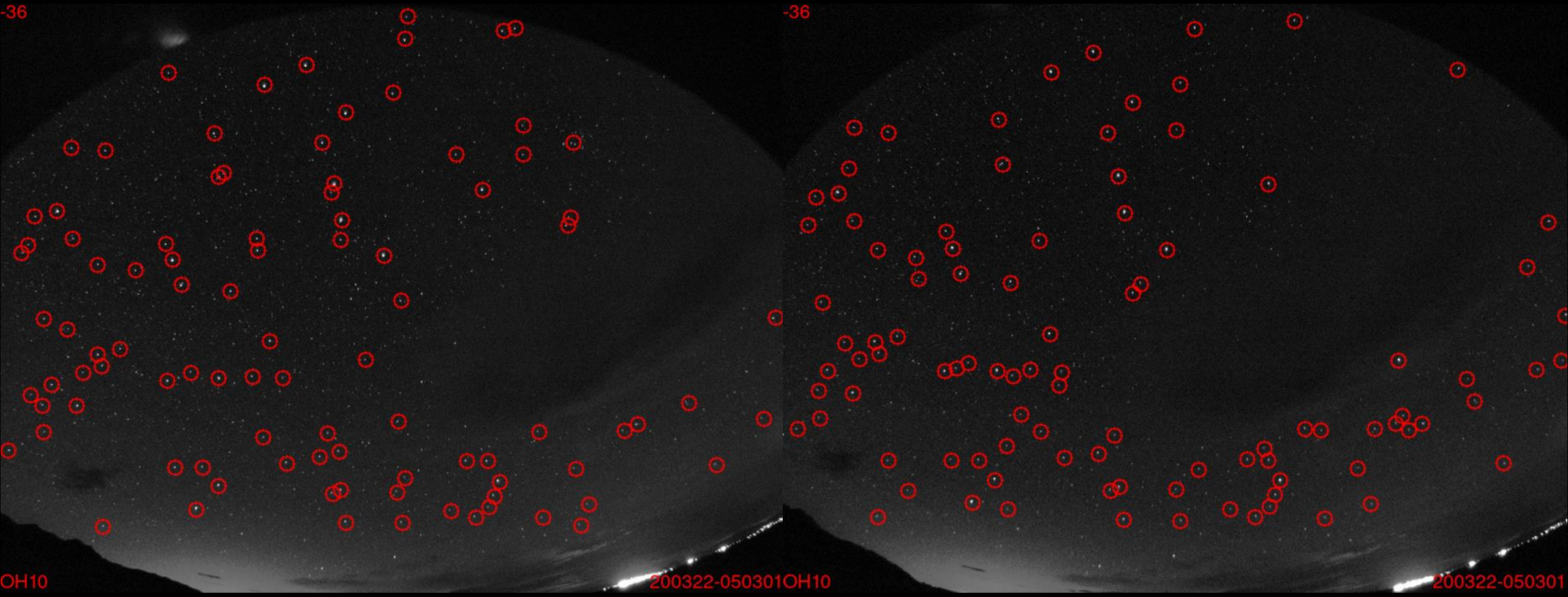
Simultaneous stereo image is acquired every 1 min.

Movie for pptx

Stereo image



Stereo image with coarse star detection



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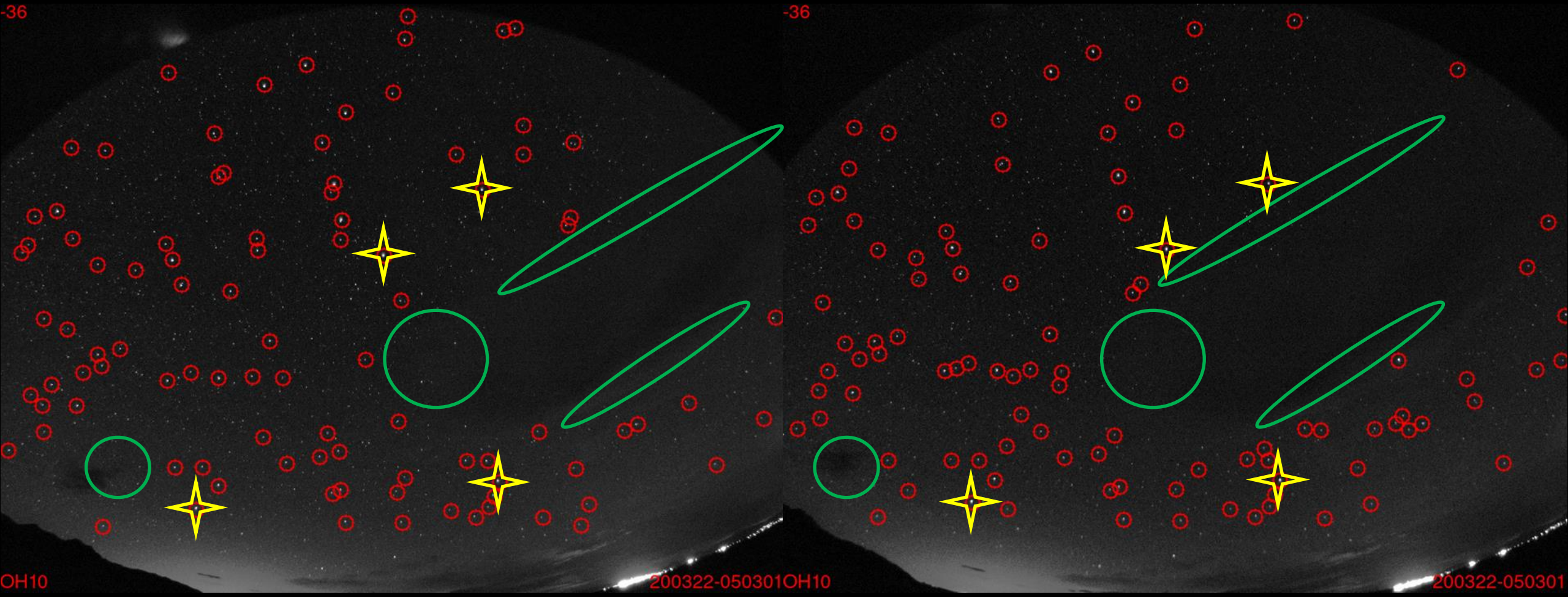
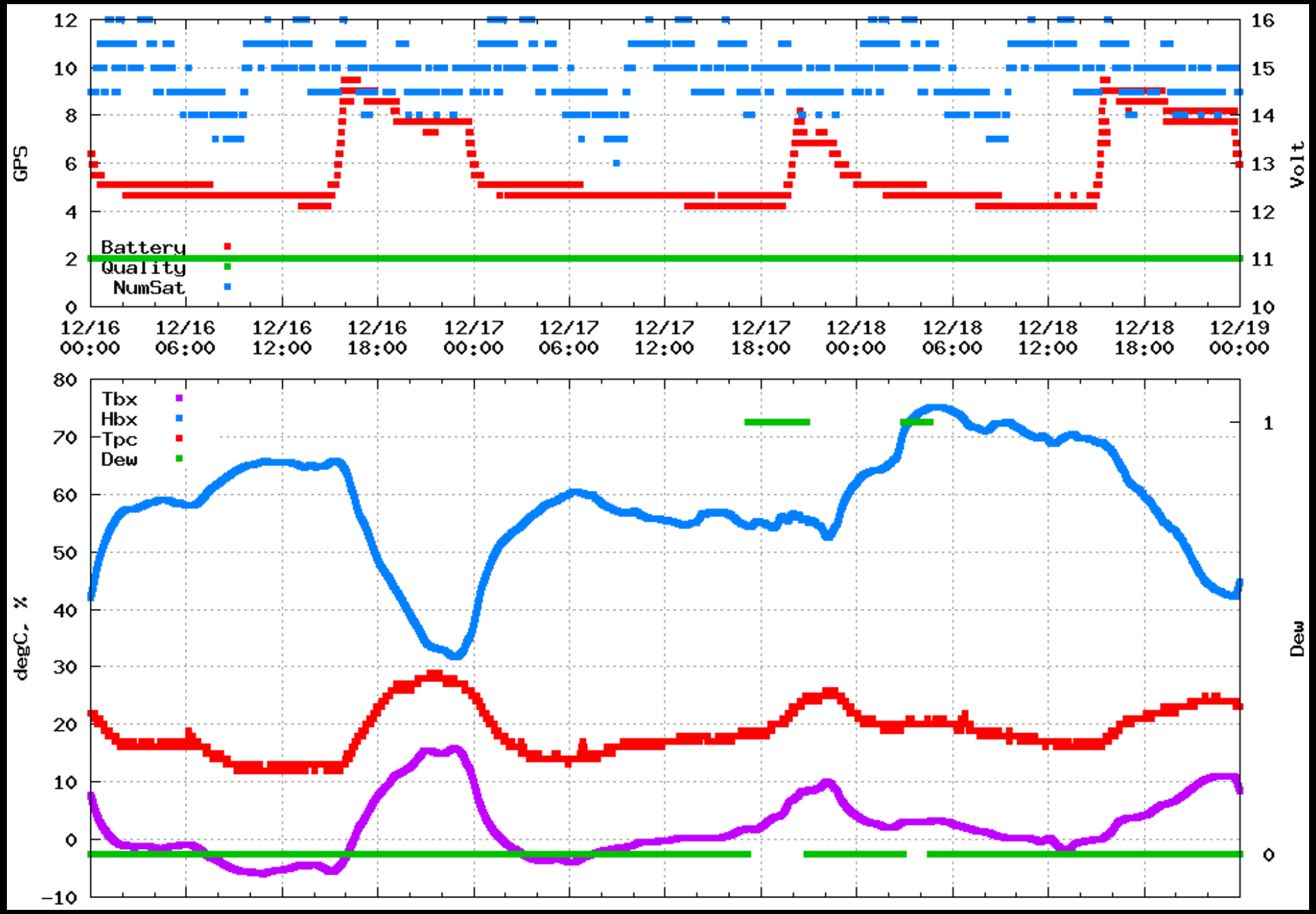


Components of TACRT

- Solar battery stand
- Camera enclosure
- Relay for Iris and Film Heater
- WLAN module
- GPS
- Thermohydrometer
- Dew sensor

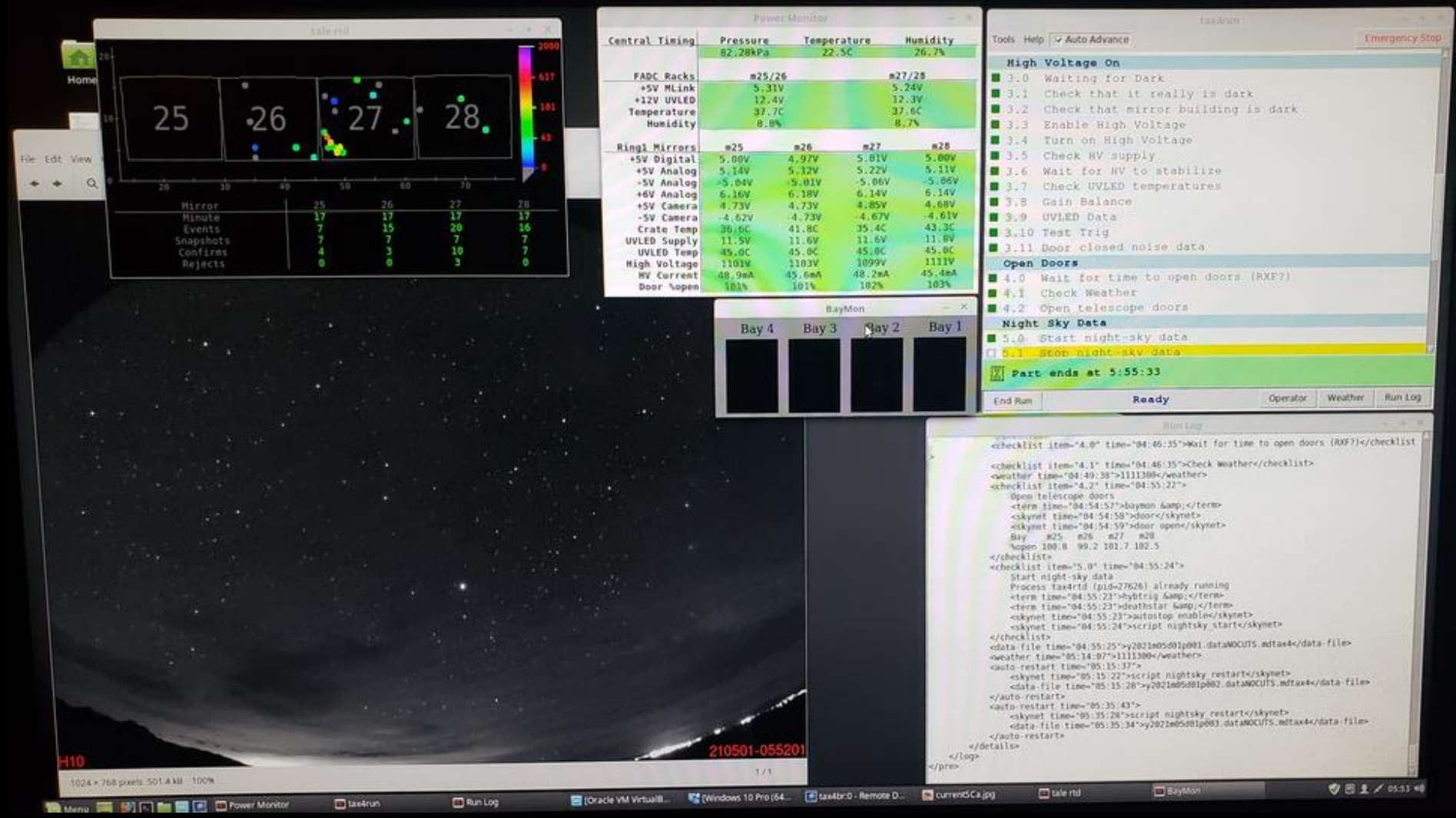


By-product for FD operation

The compressed sky image is transferred to WWW every 10 minute to check sky from anywhere online before FD observation.

In night time, sky image is transferred to TAx4FD PC every 1 minute to support FD observation.

As by-product, TACRT works to support quasi remote FD operation under pandemic.



Summary

TACRT is test of the method to measure cloud distance for evaluating the correction of FD exposure.
However, it also works to support quasi remote operation under pandemic.

The analysis of stereo image is on going.

Two CRT system observe cloud distance uniquely.
Therefore, uncertainty of cloud distance cannot be evaluated by this system.
If there is the third CRT, different pair of CRT supplies cross calibration.
The materials for the third CRT is already stored near observation site.
The third CRT will be installed in the future depending on various circumstances.

End