All Sky Camera for the CTA CCF Atmospheric Calibration work package

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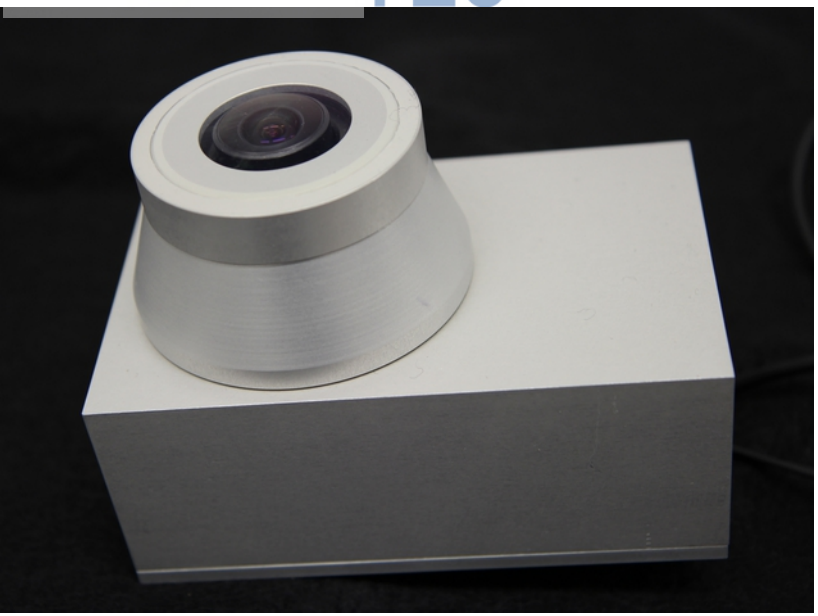
COM - Common Test Facilities and Components
CCF - Central Calibration Facilities
ATMO - Atmospheric Calibration
ASC – all sky camera

The overall condition of the given observatory atmosphere is very important information for the air Cherenkov gamma ray detectors. The document defines basic atmosphere monitoring instruments for CTA Observatory.

4.2 All-Sky Camera

The ASC is a passive noninvasive imaging system for night sky atmosphere monitoring. The operation of the ASC would not affect the measurement procedure of the CTA tele-

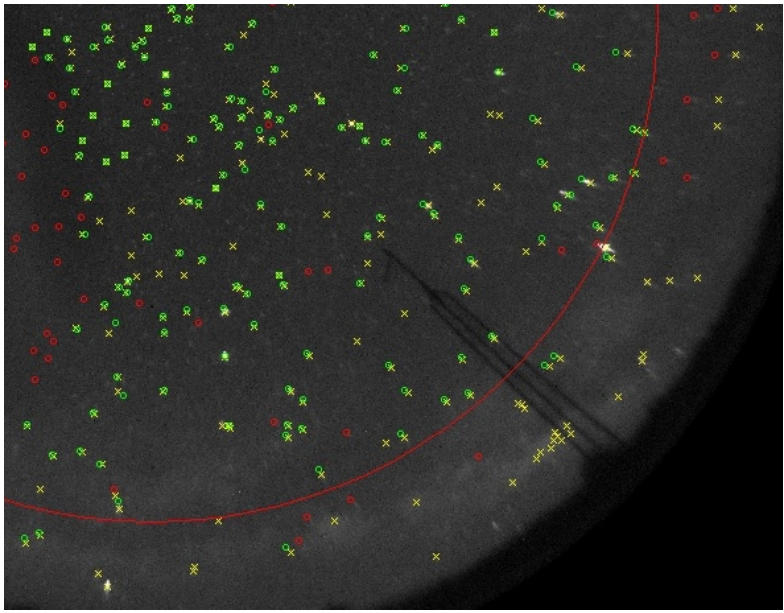
from ASC SITE WP to ASC CCF ATMO WP



ASC SITE WP

installation

SPM
TEN
METEO
YAVAPAI
SAC/LEONCITO++
LEONCITO
CHILE
HESS
AAR



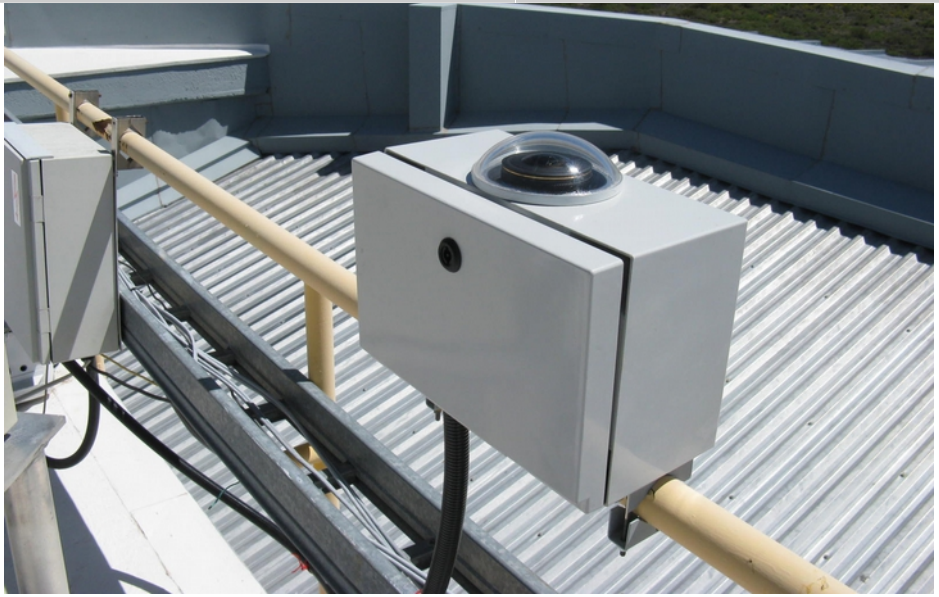
clouds analysis

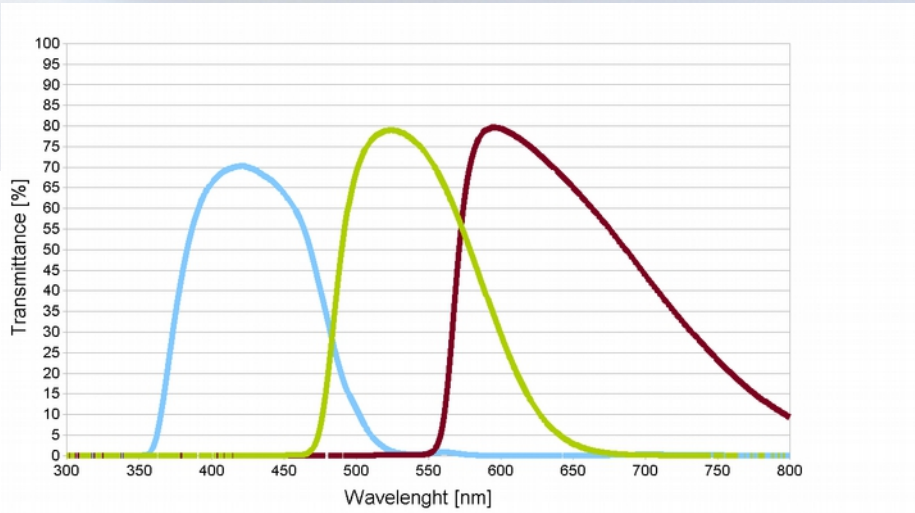
The ASC SITE WP cameras were successfully used for nightsky monitoring of the clouds of the CTA candidate sites.

The clouds monitoring and analysis is very well understood and applied within the CTA SITE WP. The next step is to use similar instrument for the future CTA observatory.

All Sky Camera for CCF ATMO

camera type	CCD chip	resolution	angular pixel resolution [deg]	pixel size	chip area	reading time	cooling parameters	filter wheel
G2-4000	KAI-4022	2056 × 2062	0.12	7.4 × 7.4 µm	15.2 × 15.3 mm	~ 5.7 s	50 °C below ambient temp.	5 pos.

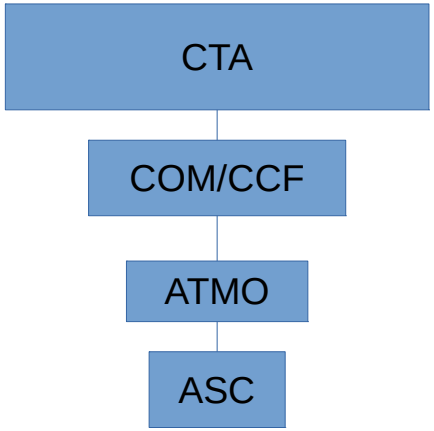


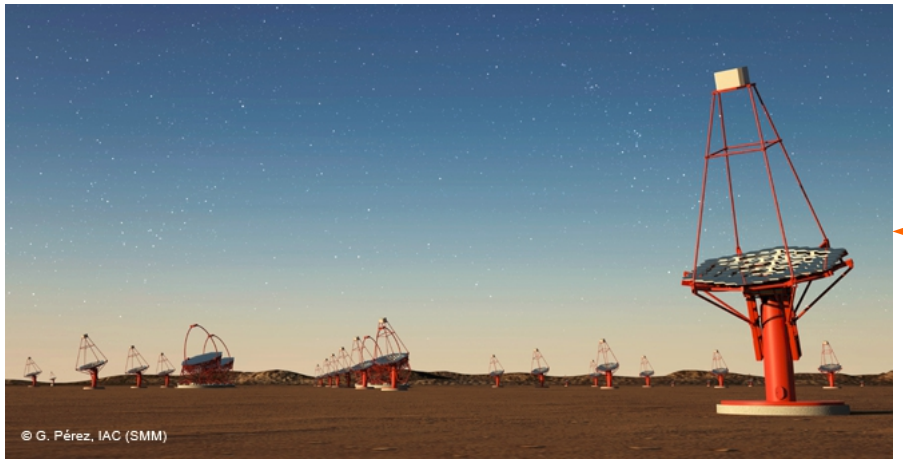


The camera is tested now at the top of Auger Los Leones fluorescence telescope building

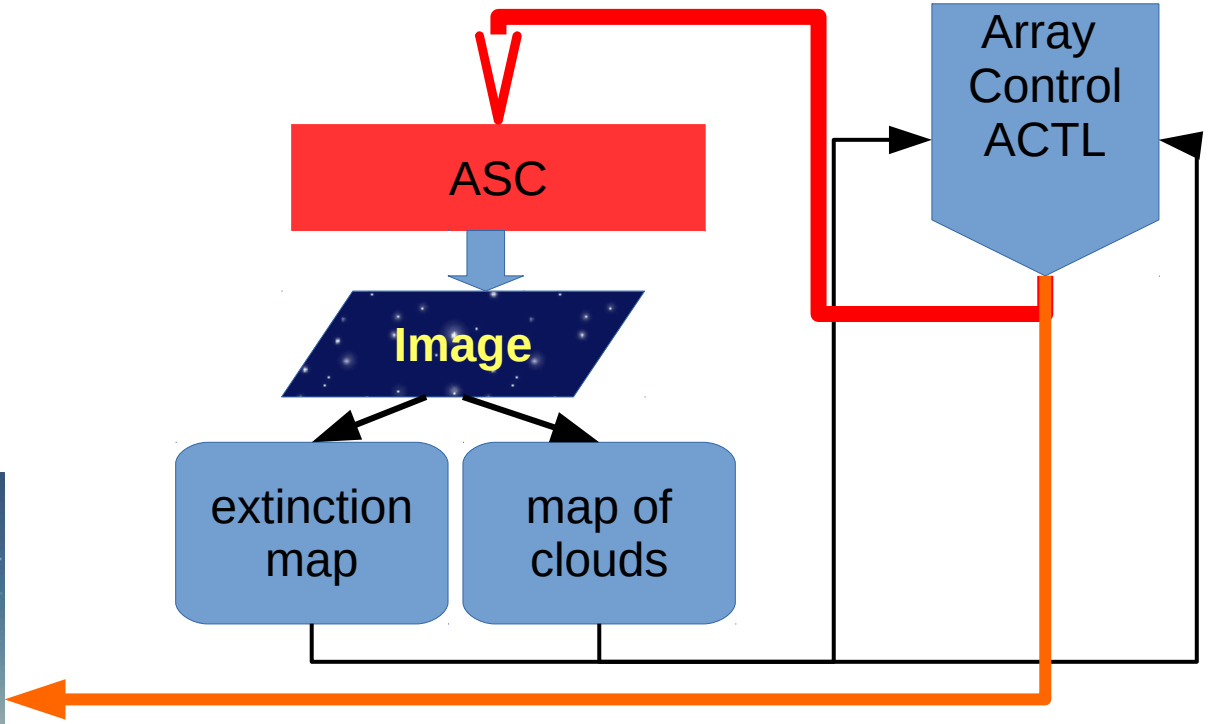
Implementation of the ASC within the CTA CCF

Implementation within The CTA consortium



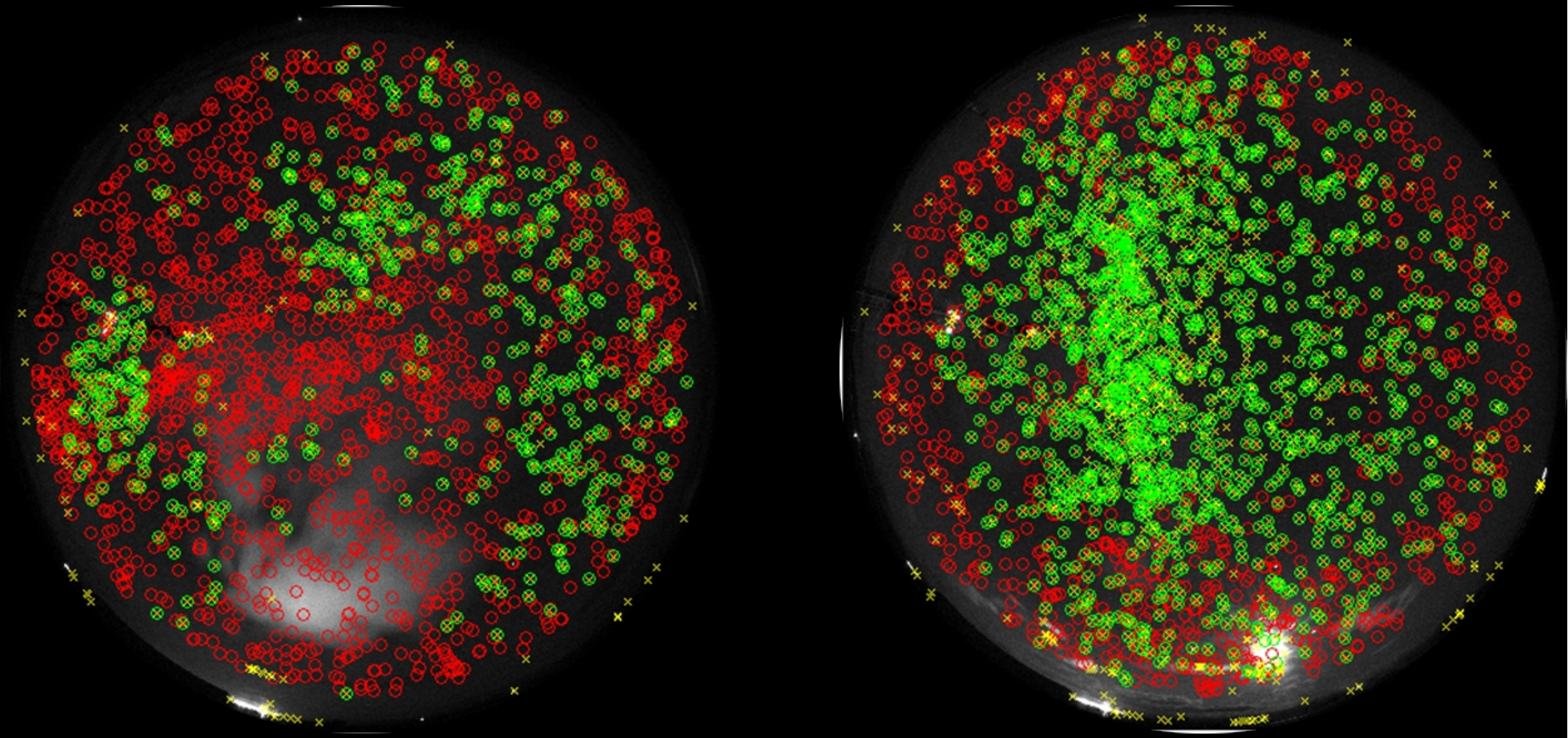


implementation within the CTA OBSERVATORY



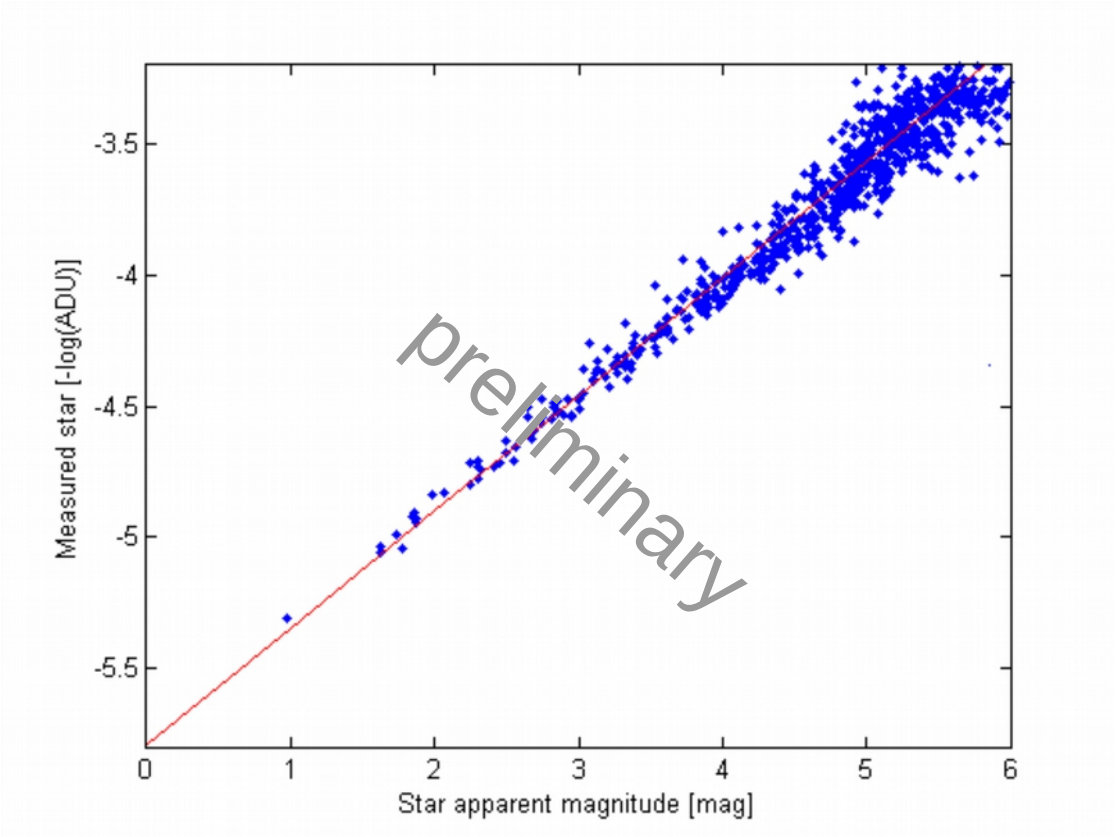
The CTA All Sky Camera ASC will be controlled and operated by Array Control – ACTL (provides Instrument control and data acquisition). ASC will be providing periodical measurement and analysis of all sky clouds and extinction maps. The result of the measurement and analysis will be used for the Array Control operation.

Clouds and sky quality monitoring



For expected stars position from the catalogue (red circle), we look for a detected star (yellow cross) within the angular limit ± 2 pixels = 0,4 °. If a star that fitting these criteria is found, then the catalogue and detected stars are flagged as paired (green circle). Unpared stars are covered with a clouds.

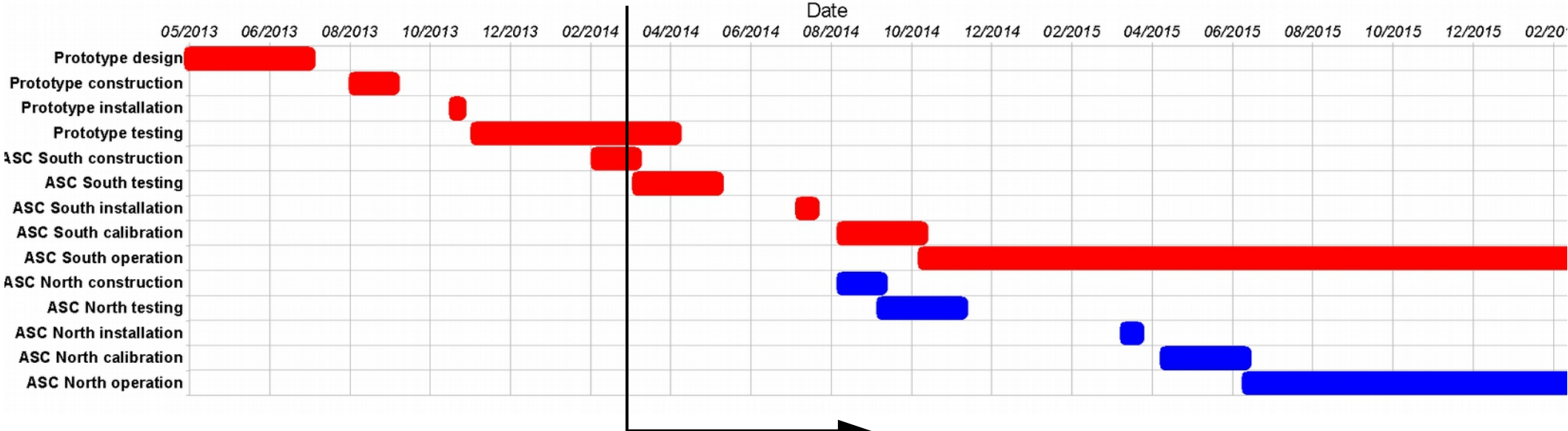
Camera calibration – the total flux from stars is compared to their catalogue values (Yale Bright Star Catalog).
The set of “clear” night was selected from the dataset.
Atmospheric extinction is in process.



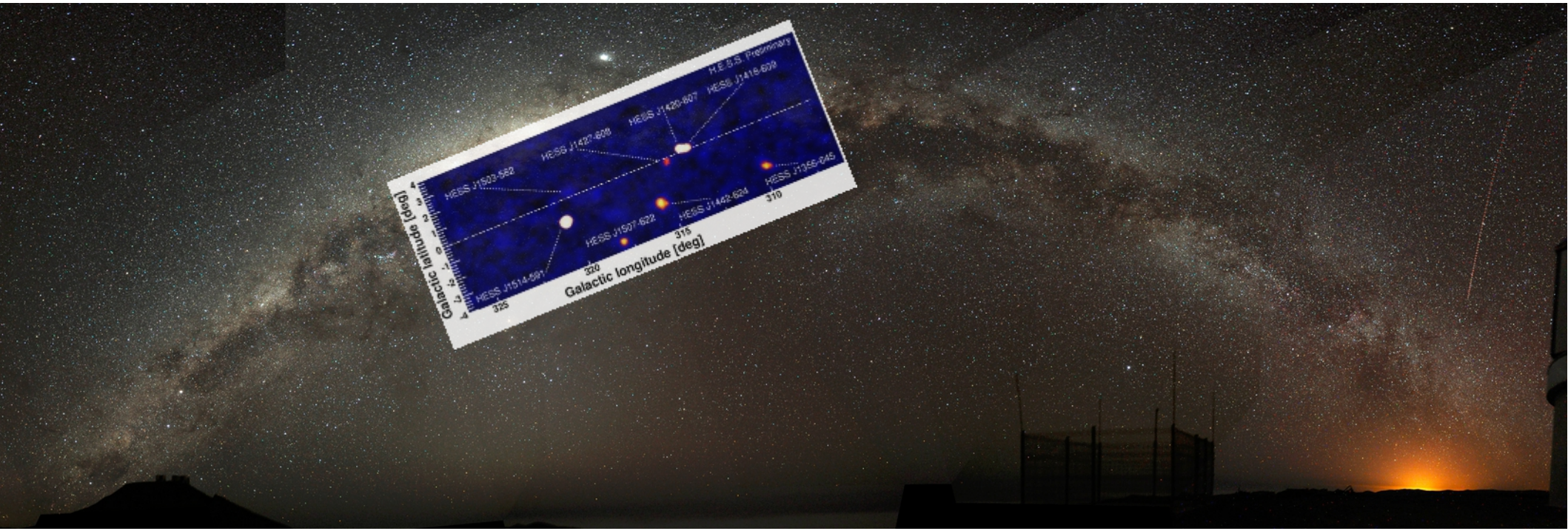
Stars in R filtr, clear nights, zenith angle (43 – 45 deg).

Rayleigh scattering still not taken into account.

Calendar of activities



In case of partly cloudy night-sky, the cameras will identify uncovered regions of the sky during the CTA operation time, and pinpoint those regions where observation targets can be viewed without atmospheric disturbance.



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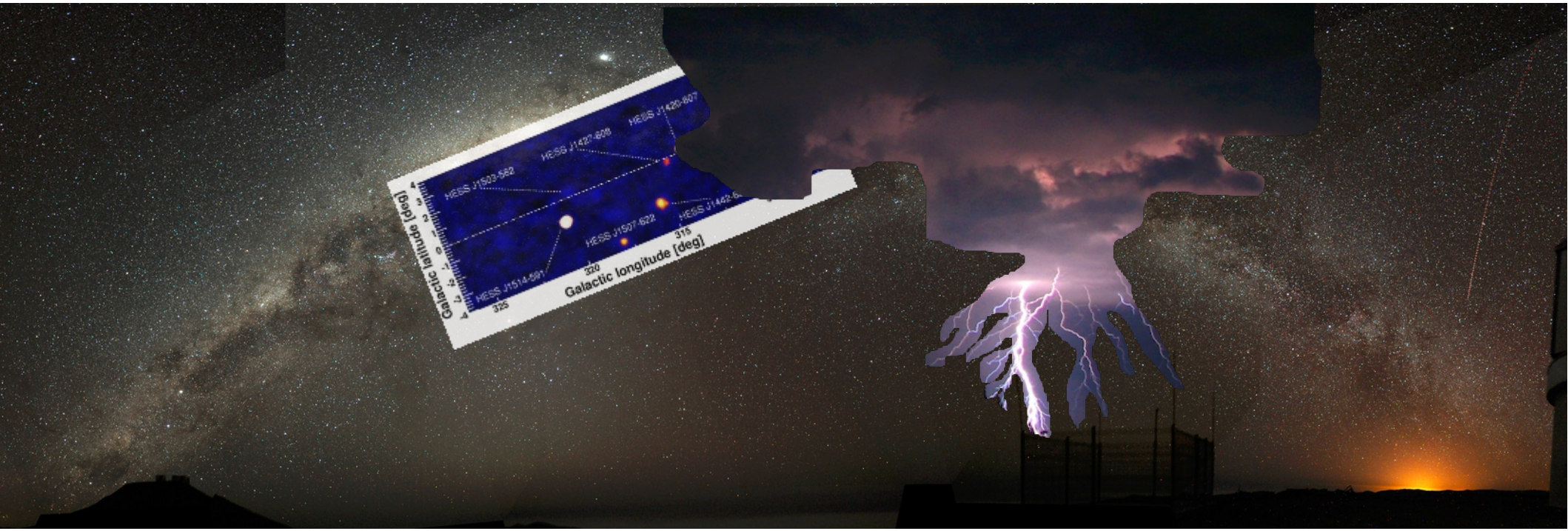

Smart measurement scheduling

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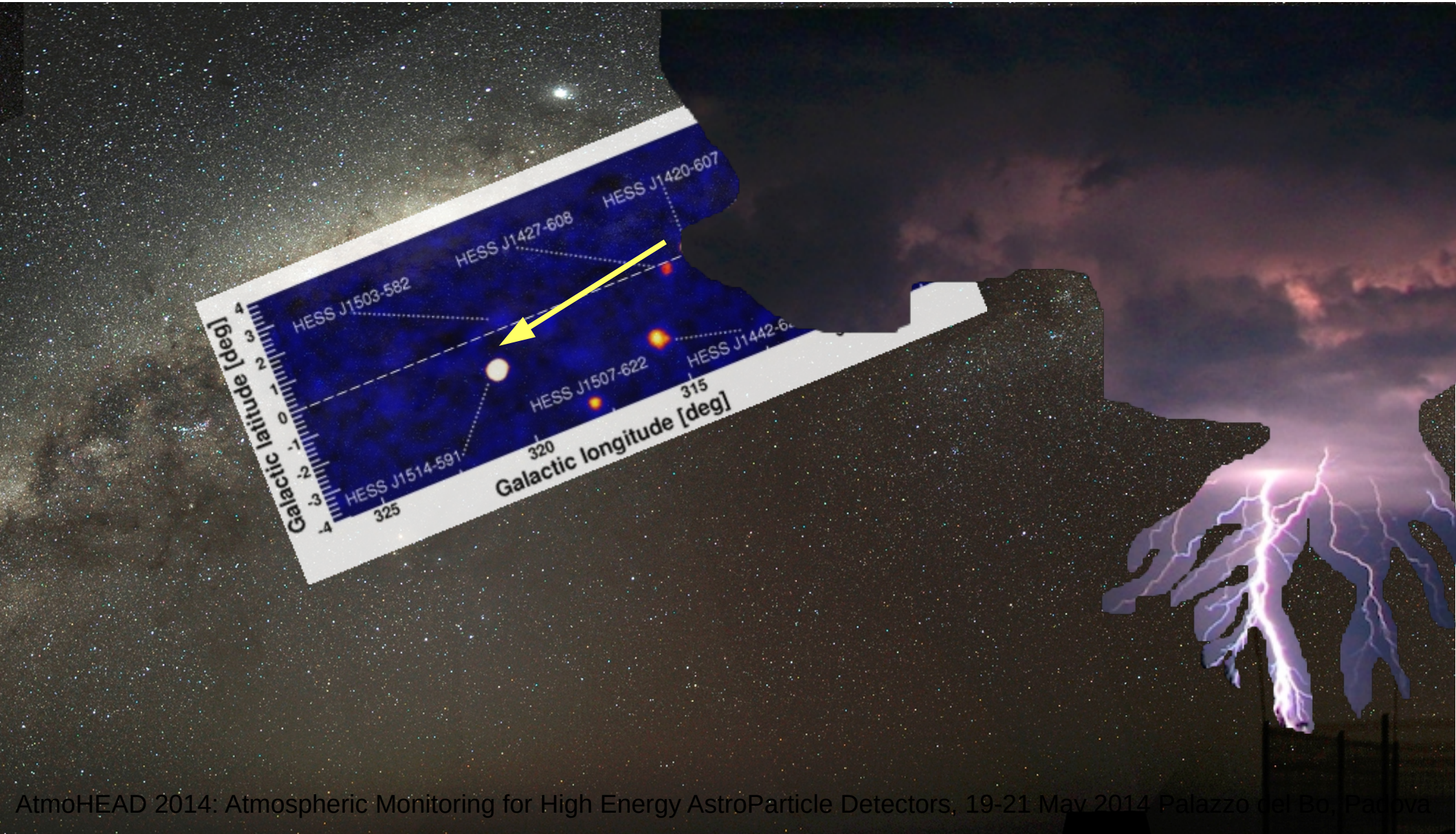

Conclusions

- The All-Sky-Camera is a passive non-invasive imaging system for rapid night sky atmosphere monitoring.
- The operation of the ASC will hence not disturb standard operation of the CTA telescopes, however results from the measurements will help to improve the accuracy and effective duty-cycle of the CTA observatory.
- The goal of ASC, and recently developed intelligent image analysis algorithms, is to identify the position of clouds, atmospheric attenuation and time evolution of the local sky conditions.
- The monitoring will be able to predict the night-sky quality on a short term basis.