Calibration of the LRO Diviner Lunar Radiometer Experiment

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Worked on Dawn Cameras, BepiColombo Laser Altimeter, LRO Diviner Calibration

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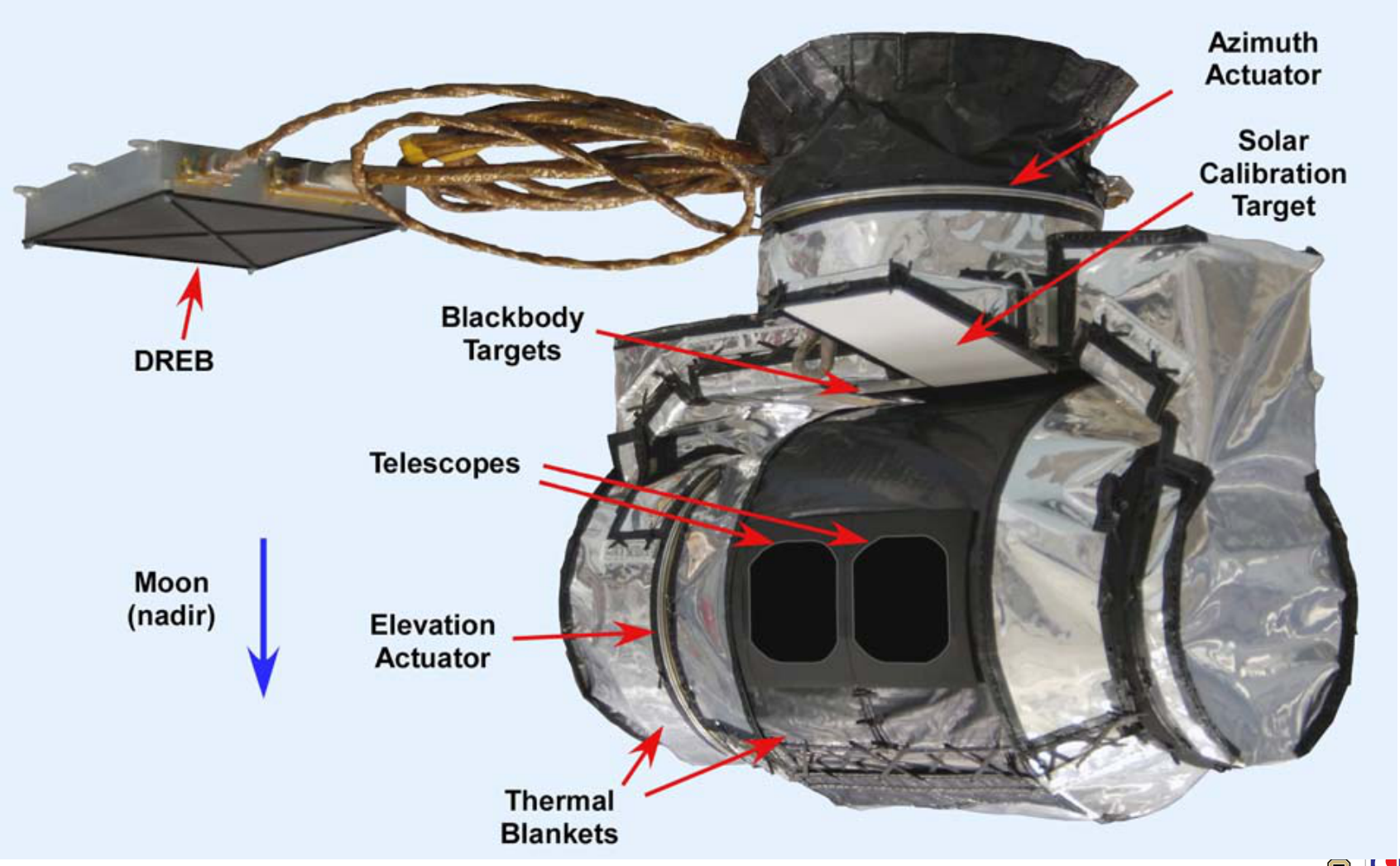
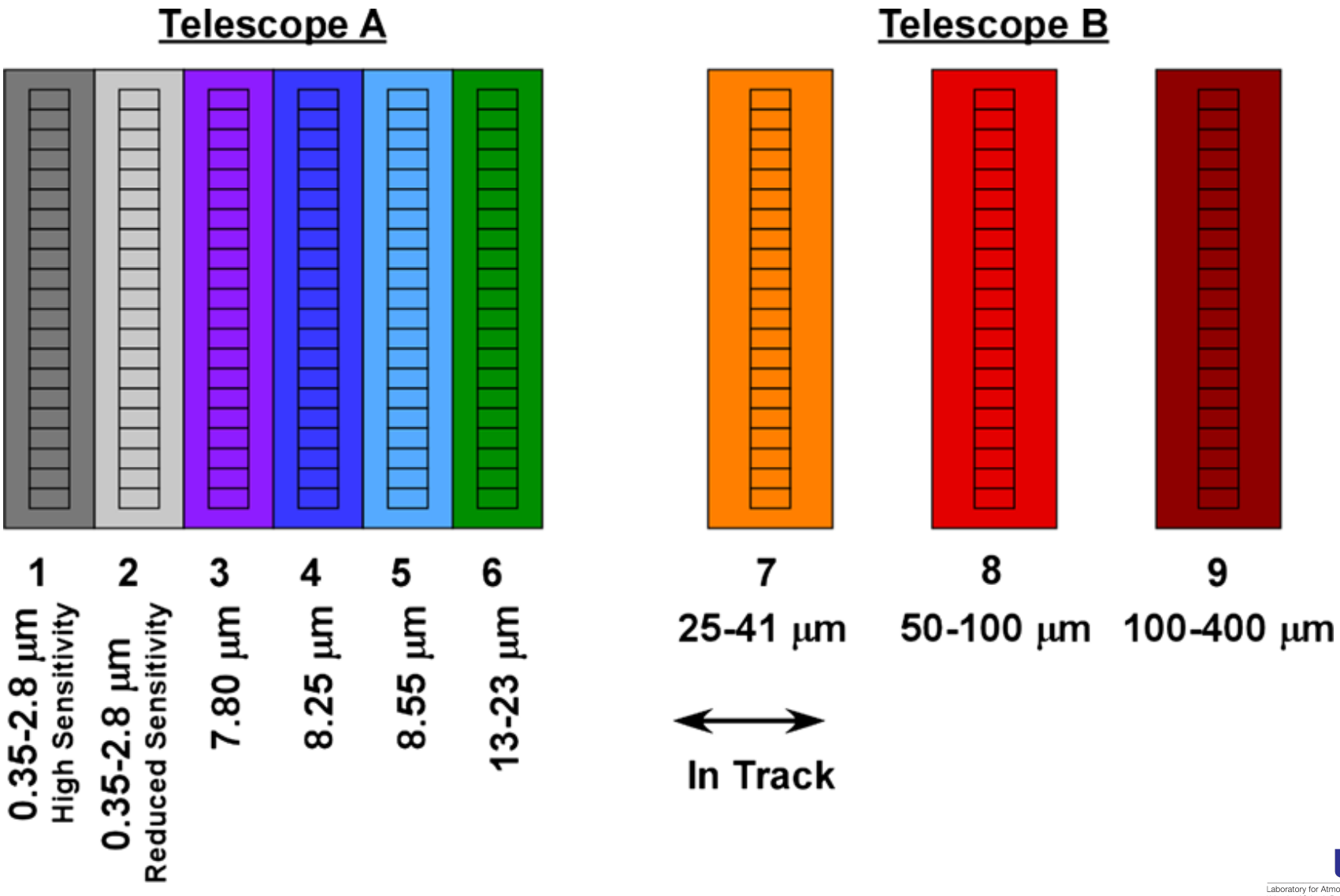
Outline

Diviner Instrument

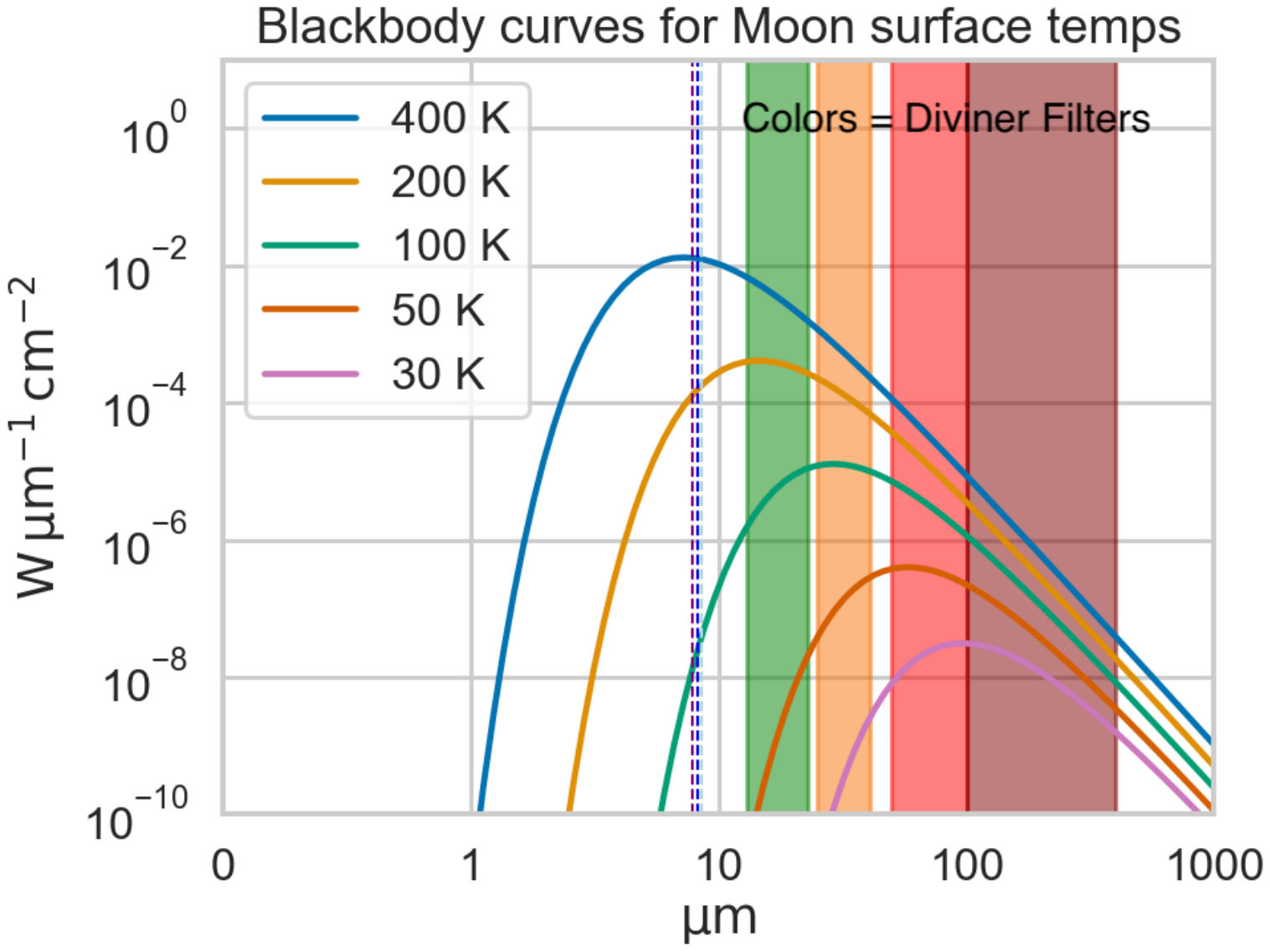


Diviner channels

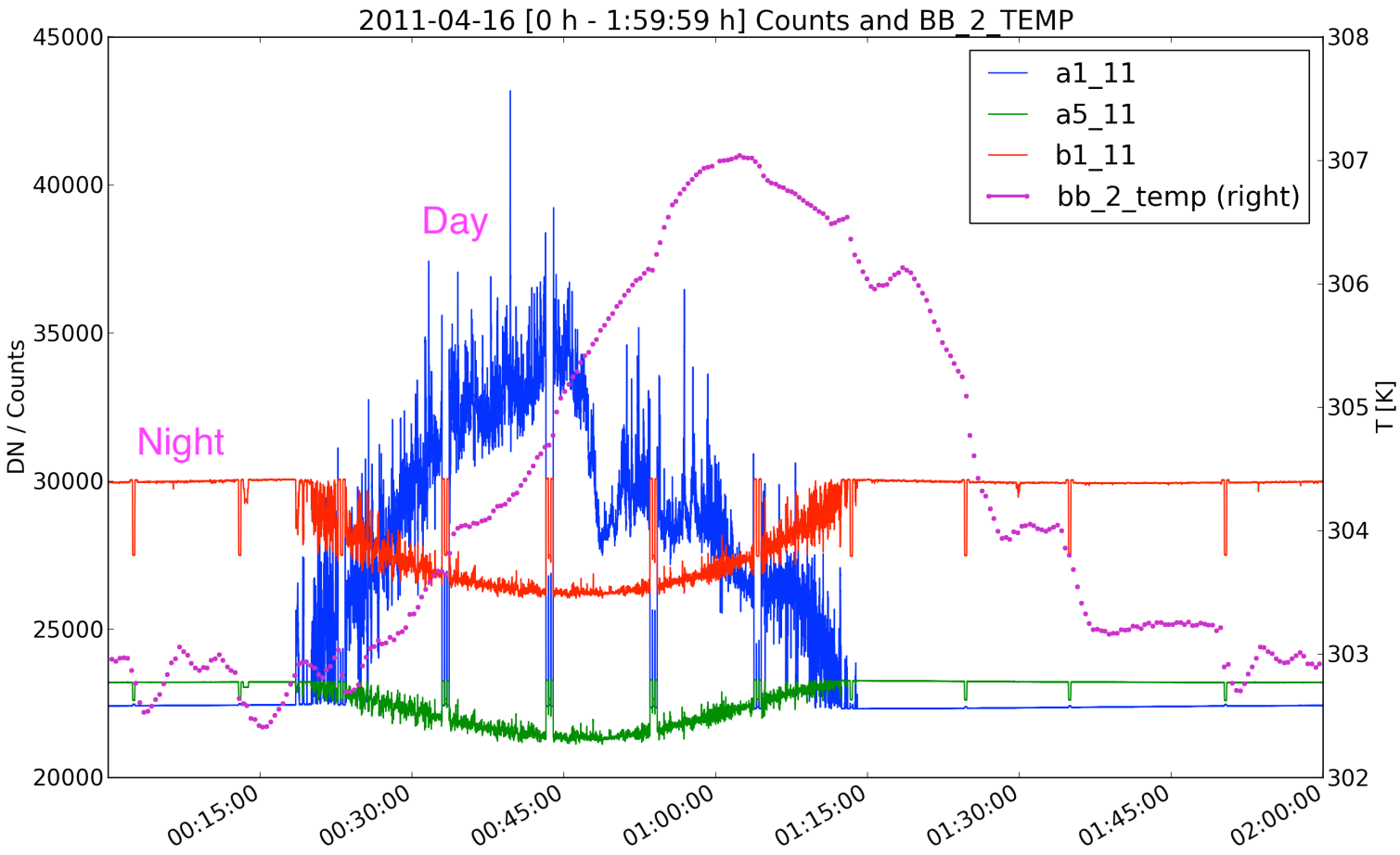


Surface radiation from the Moon

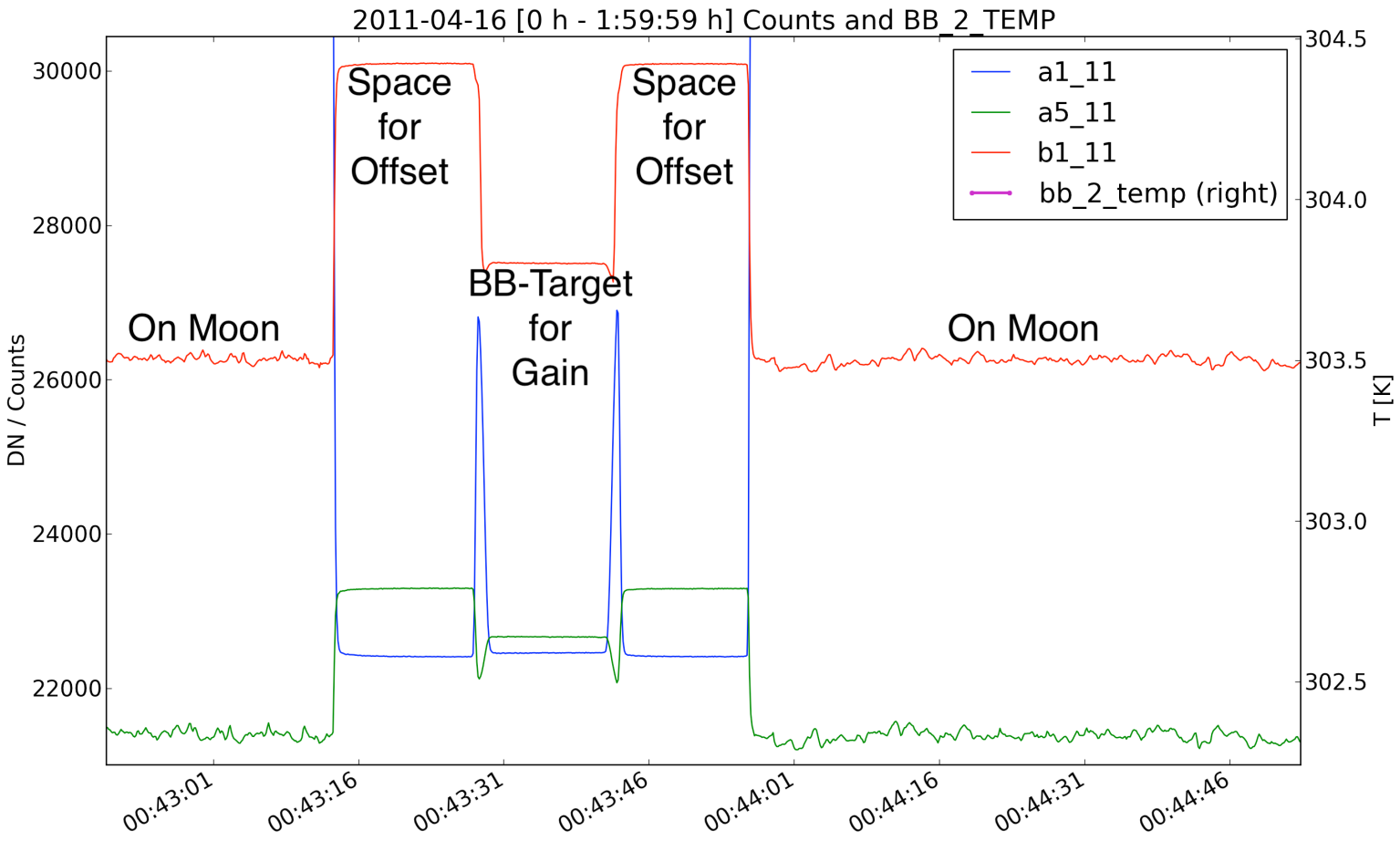
Blackbody curves



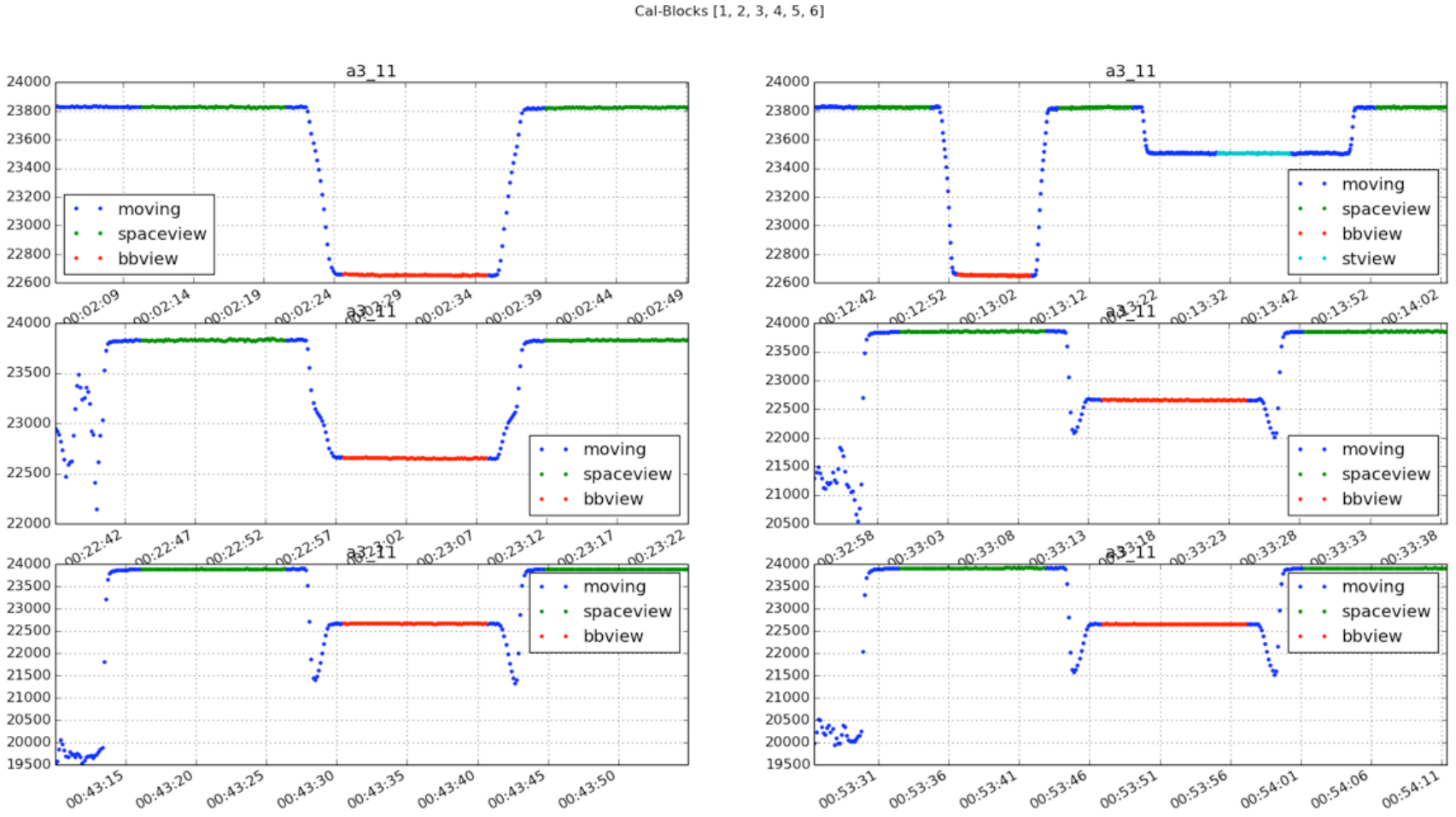
Calibration Observations 1



Calibration Observations 2



Calibration Observations 3



Principle Calibration Method

Steps performed for every calibration observation

Offset

Determine offset C_{space} from *counts* while looking into "space"

Gain

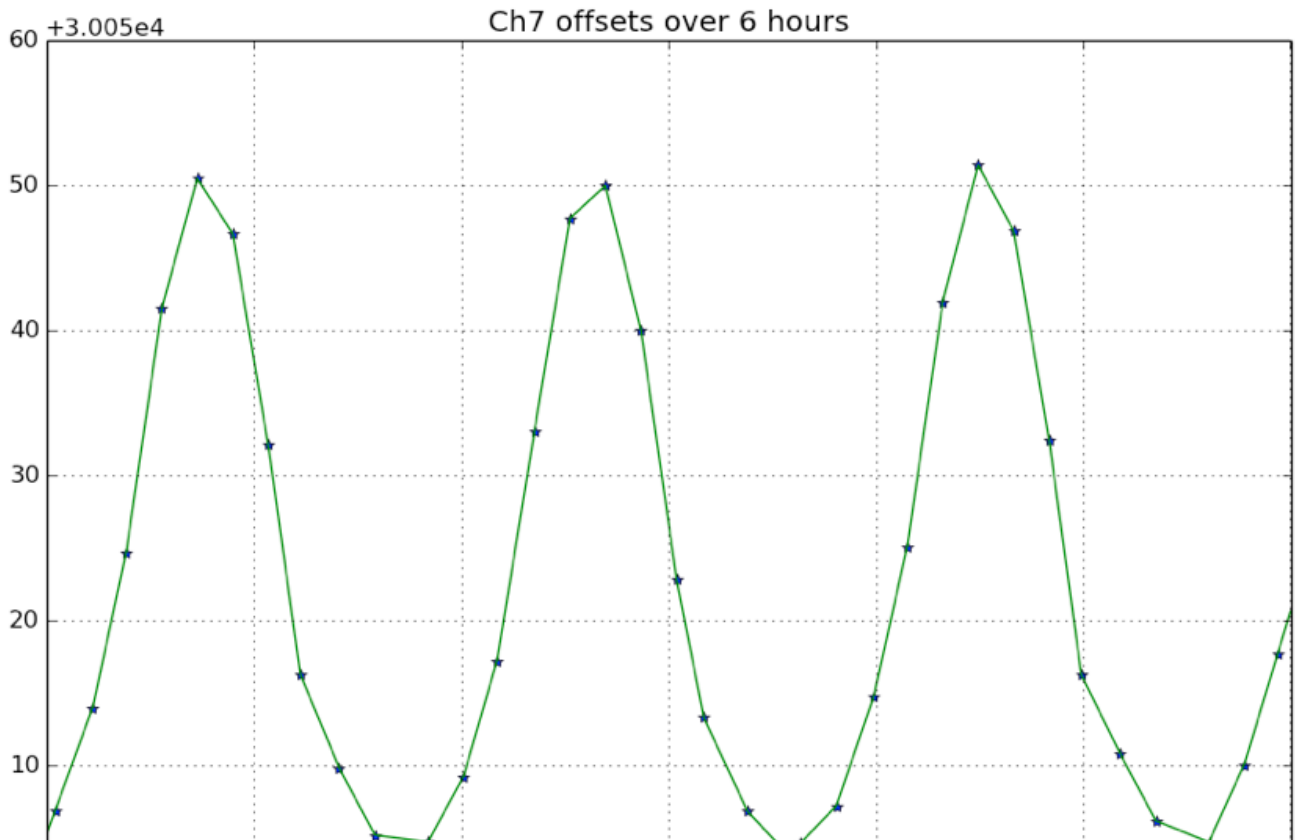
- Look up internal target temperature T_{BB}
- Convert this temperature into radiance R_{BB} from lab data
- Look up the detector *counts* C_{BB} for this radiance
- $gain = \frac{R_{BB}}{C_{space} - C_{BB}}$

Counts to Radiance

- For every 189 detectors, and 10 cal obs per orbit:
- $Radiance = (Counts - Offset(C_{space})) \times gain$

General Complications

- Calibration offsets and gains need to be interpolated to the data
- Simple interpolations are incorrect in high curvature areas (errors small though)

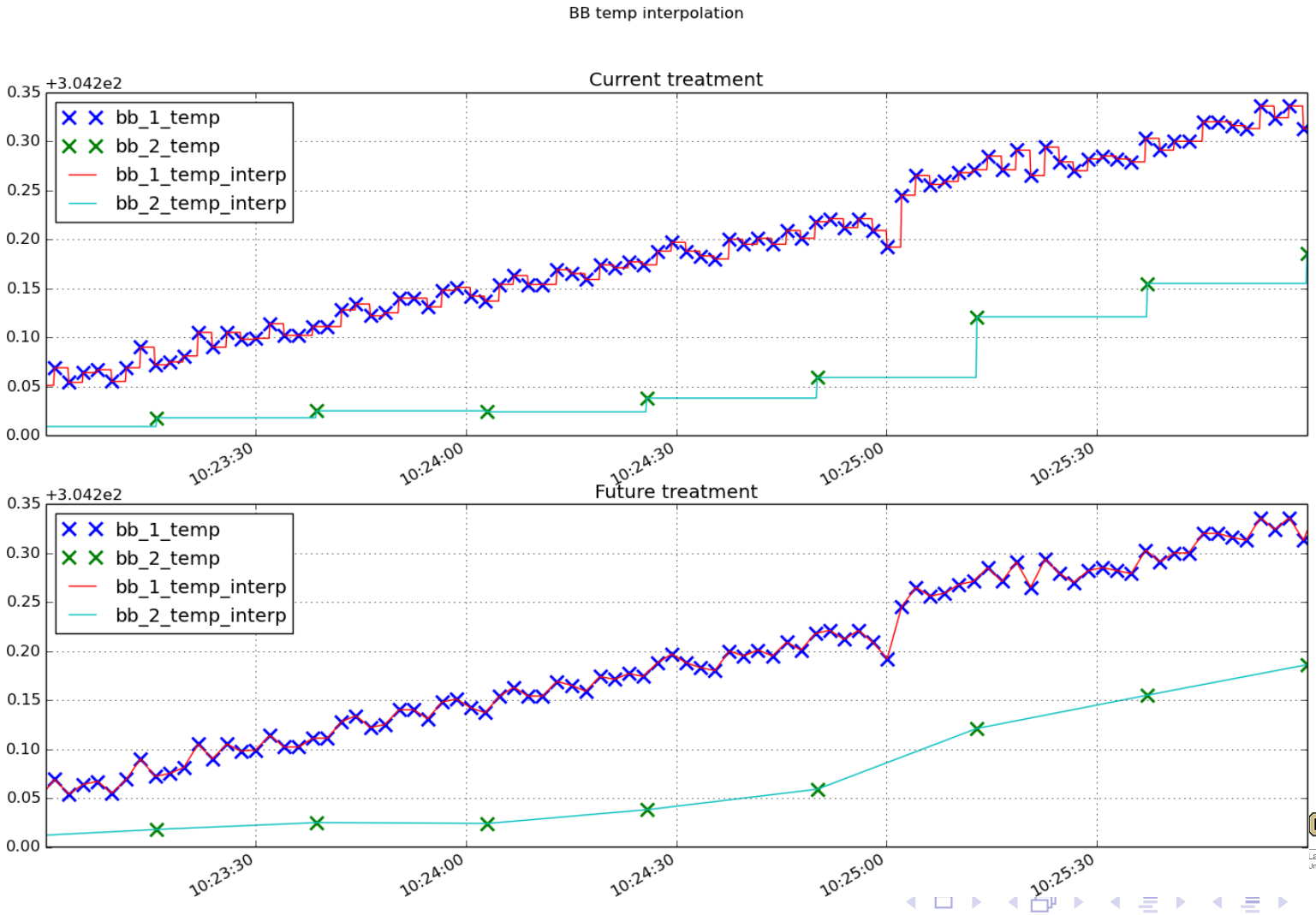


Offset Complications

- At the lunar poles, the signal to noise is very low for coldest temperatures
- the offset needs to be well determined
- But: Hot cliffs on the surface can heat up the detector marginally
- This will create a bad offset.
- Work around: Use offsets from different orbit angles where cliff was not in FOV

Gain Complications

- Architectural heritage reduced available data rates for BB_{temp}
- Original calibration implementation did not interpolate well.



Summary

- Principal idea is simple but the devil is in the detail
- Electronic and thermal drift of a high gain detector demands regular calibration Observations
- Original calibration is sub-optimal but corrections should only be a few percent
- No full thermal model of the instrument exists, and we do see a small heat leakage, caused by an instrument element that is re-radiating heat after hot surfaces
- In general, the Diviner maps are very reliable and are being used by NASA for future mission planning

For Further Reading I


Paige et al.
The Lunar Reconnaissance Orbiter Diviner Lunar Radiometer Experiment.
Space Sci Review, 2010.