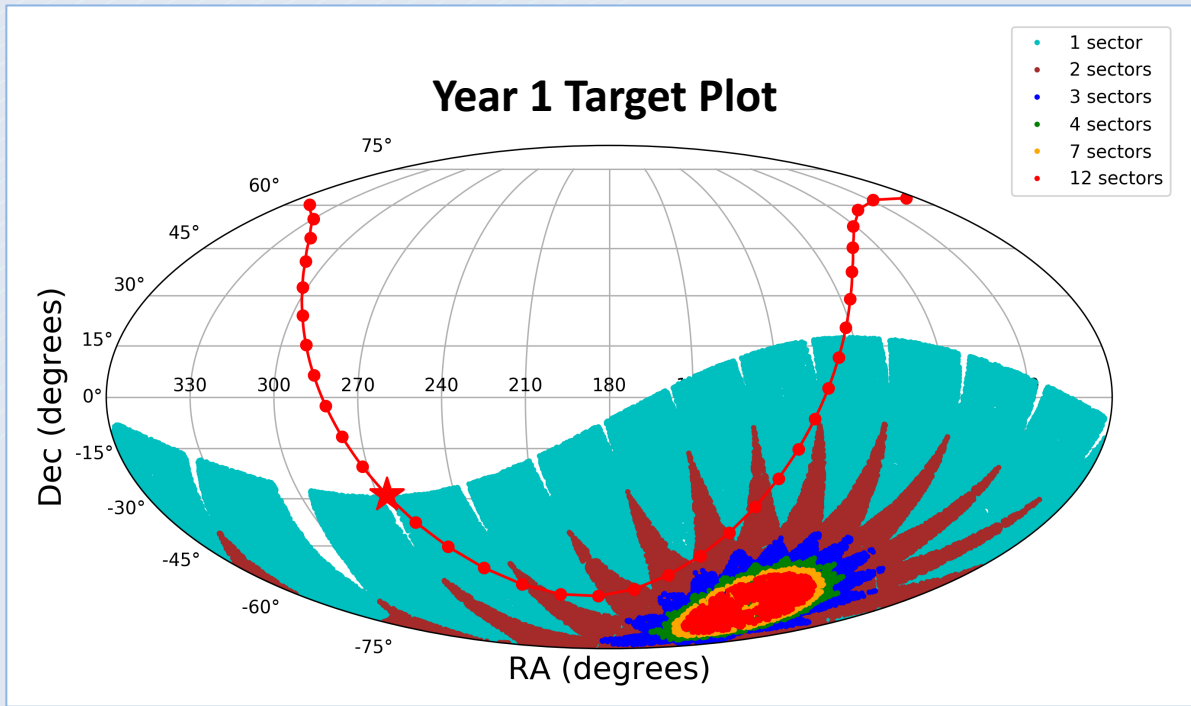


# TESS Observations in Year 2

Roland Vanderspek  
TSC I, 29 July 2019





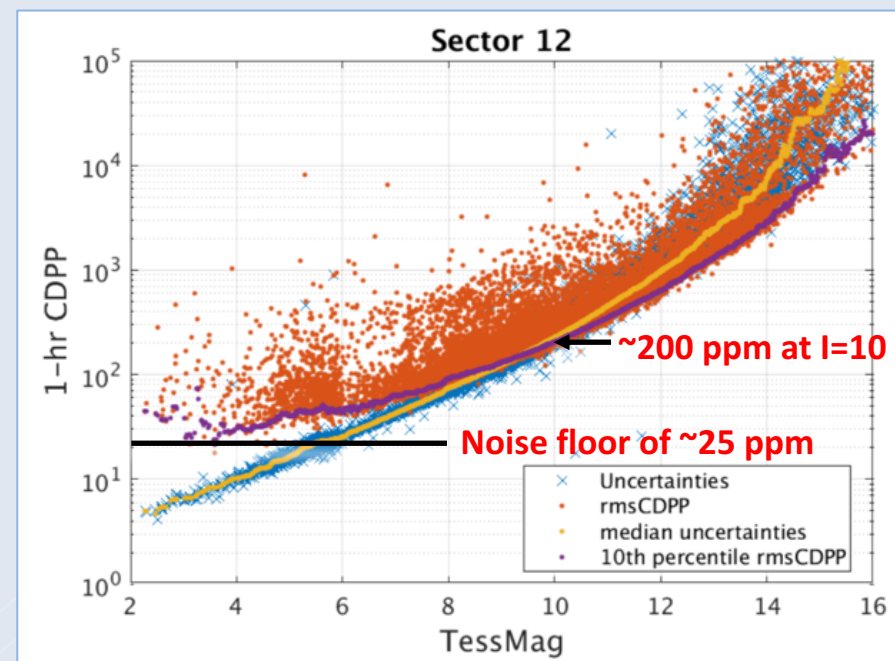
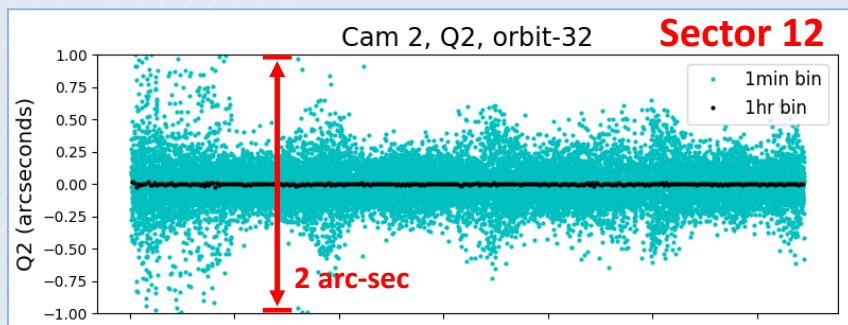
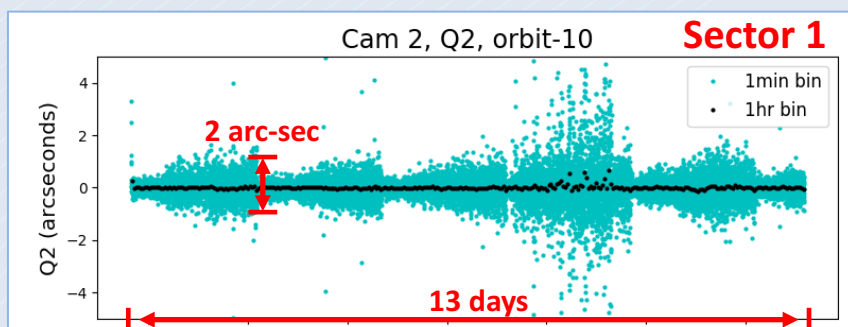
Target Category	Number Allocated per Sector	Total Observed	Typical Number Observed per Sector
Bright Stars (T<6)	All of them	5,300	660
Exoplanet	13,000-15,000	107,000	16,000
Asteroseismology	750	9,400	1,600
Guest Investigator	1500	34,700	5,400
DDT	1500	5,700	1,000

**Level 1 req't of 100,000 stars observed:** ✓  
**Level 1 req't of 5,000 stars observed for 240 days:** ✓

<https://tess.mit.edu/science/ddt/>

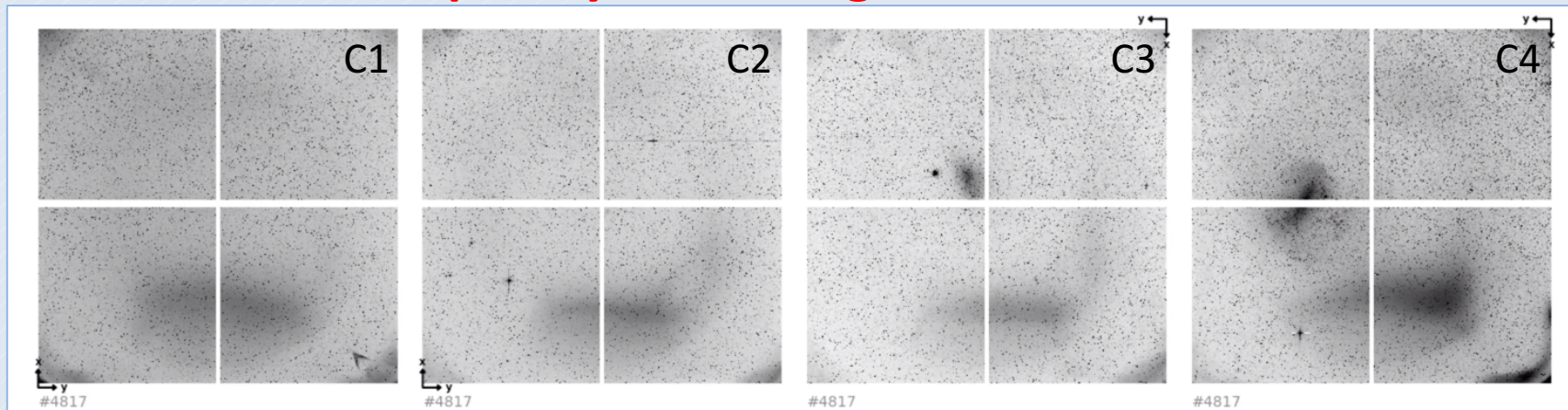


- ◆ Spacecraft Stability has improved dramatically since the beginning of Year 1

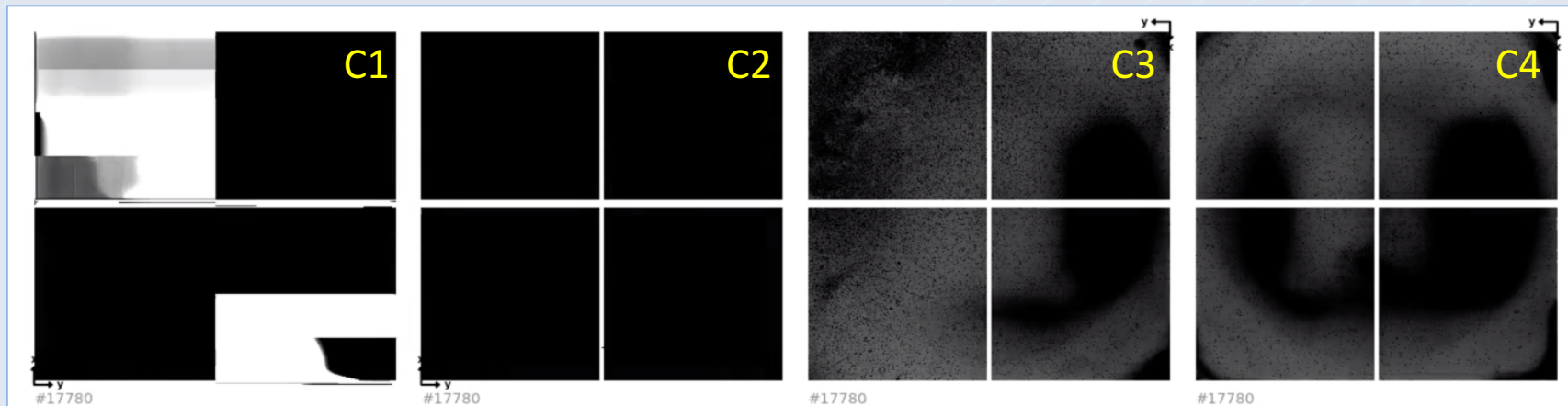


- ◆ Momentum dump frequency has decreased
  - From every 2.5 days to every 3.375 days (~3 per orbit)
  - MIT, NGIS, and GSFC are working together to reduce the number further
  - They won't go away anytime soon

## Low-level, patchy, diffuse light seen in all cameras

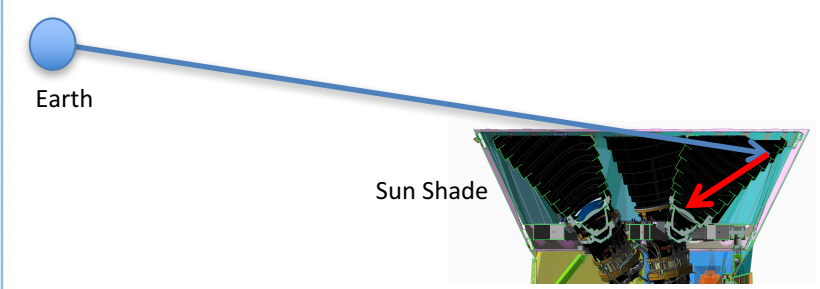


## Very high light levels, seen primarily in Camera 1

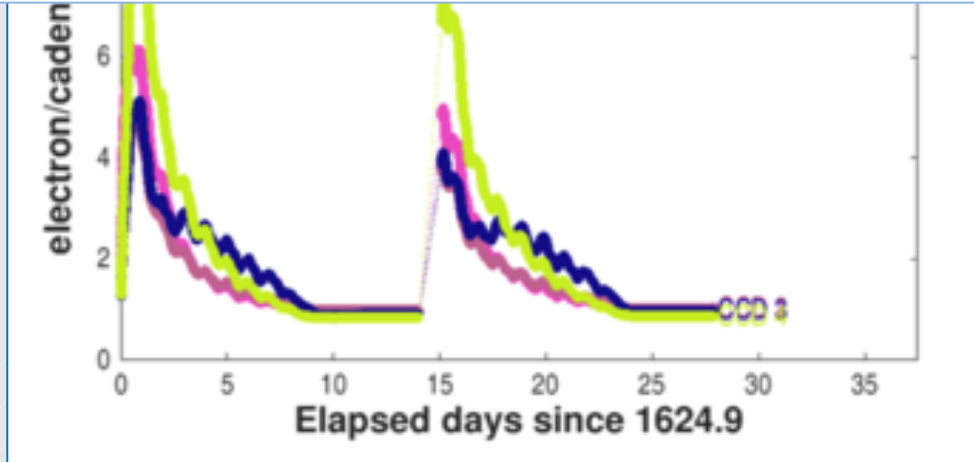
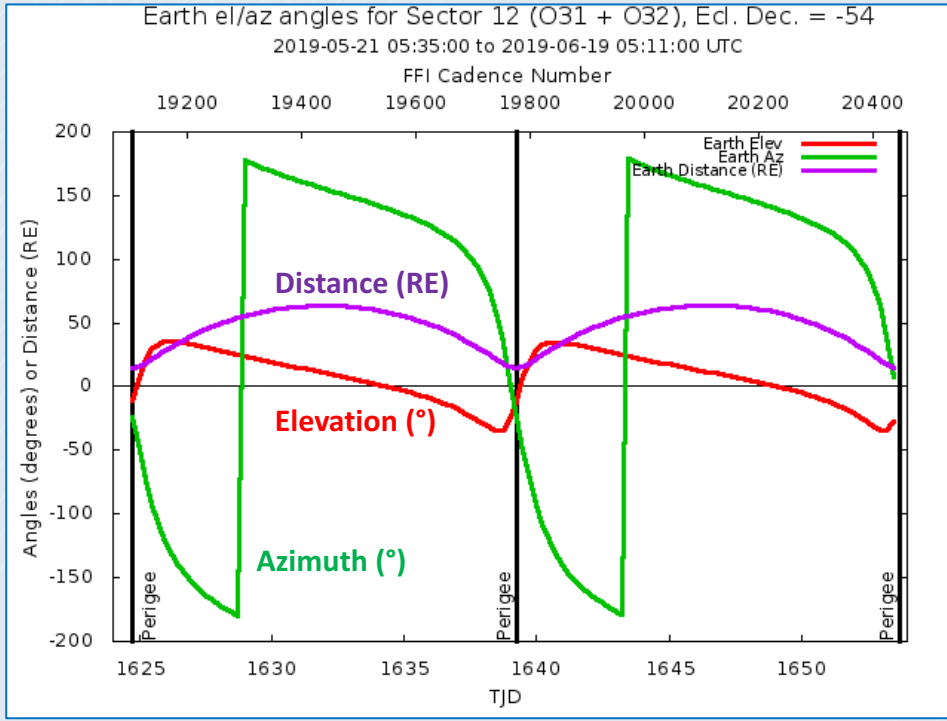
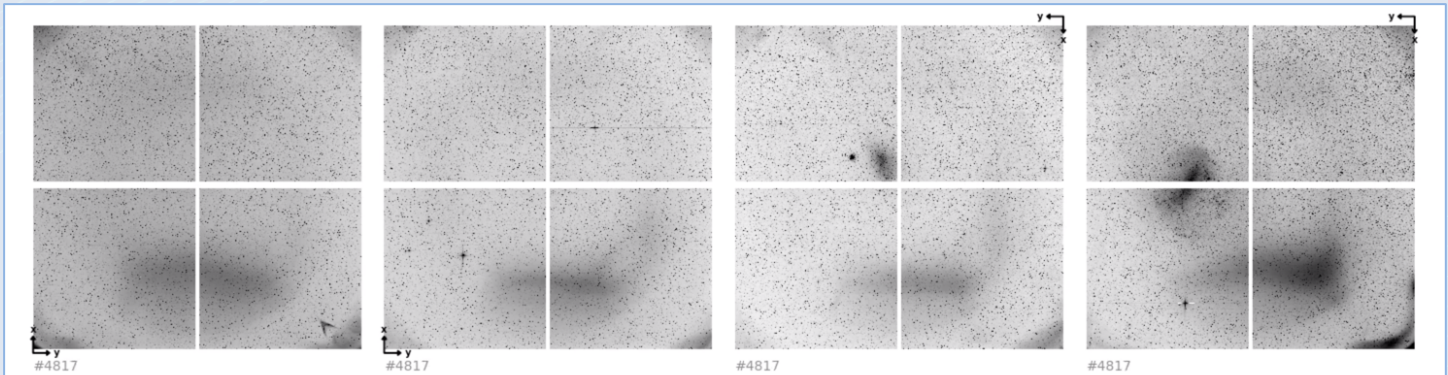




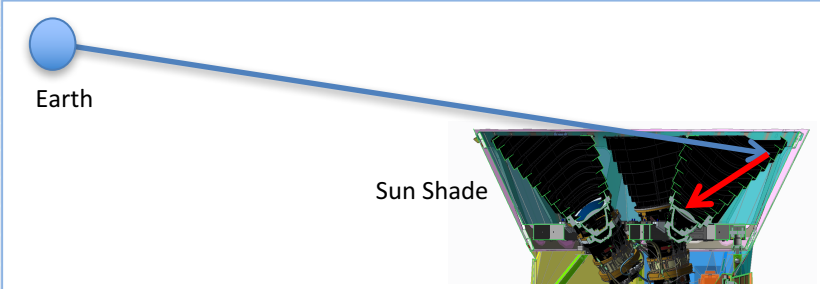
# Patchy Scattered Light Visible When Earth is "Up"



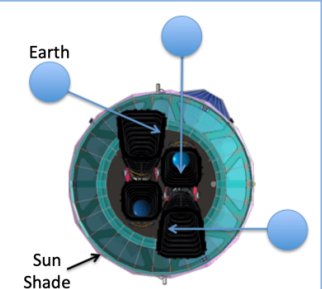
Patch brightness changes with Earth elevation and distance (and albedo)



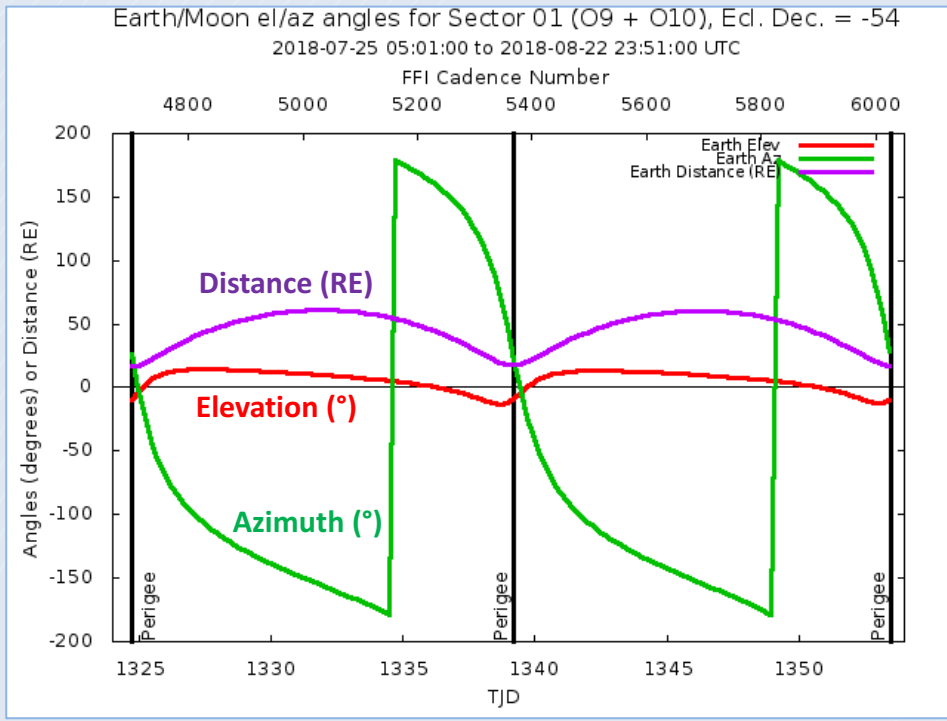
Taken from Data Release Notes from Sector 12



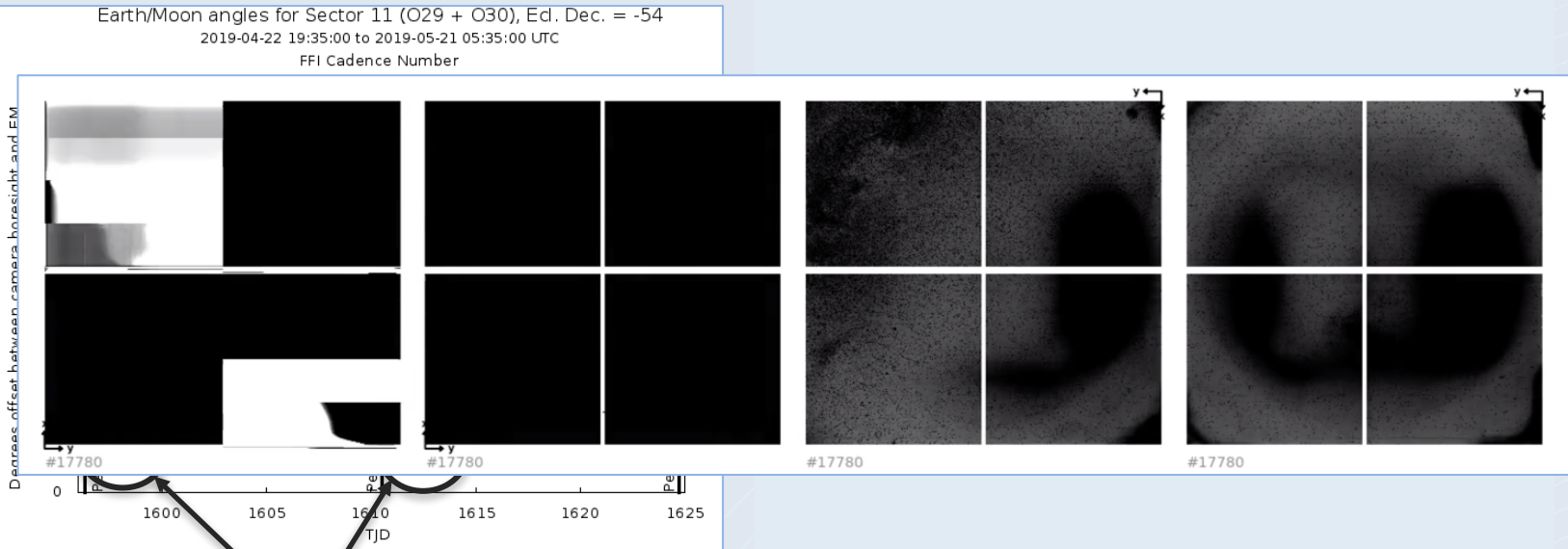
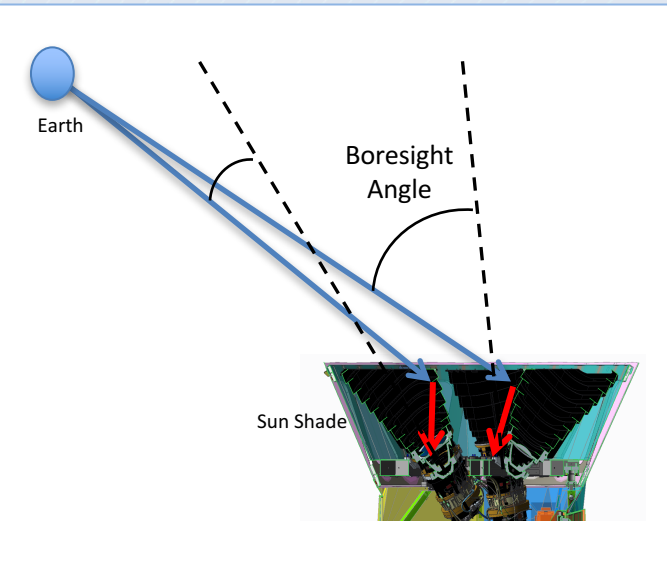
**Patch brightness changes with Earth elevation and distance (and albedo)**



**Patch location changes with azimuth**



- ◆ Scattered light from Earth/Moon starts becoming a problem when the angle to the boresight of a camera is  $<35^\circ$ 
  - A major problem  $<25^\circ$
  - Affects a few sectors in Year 1

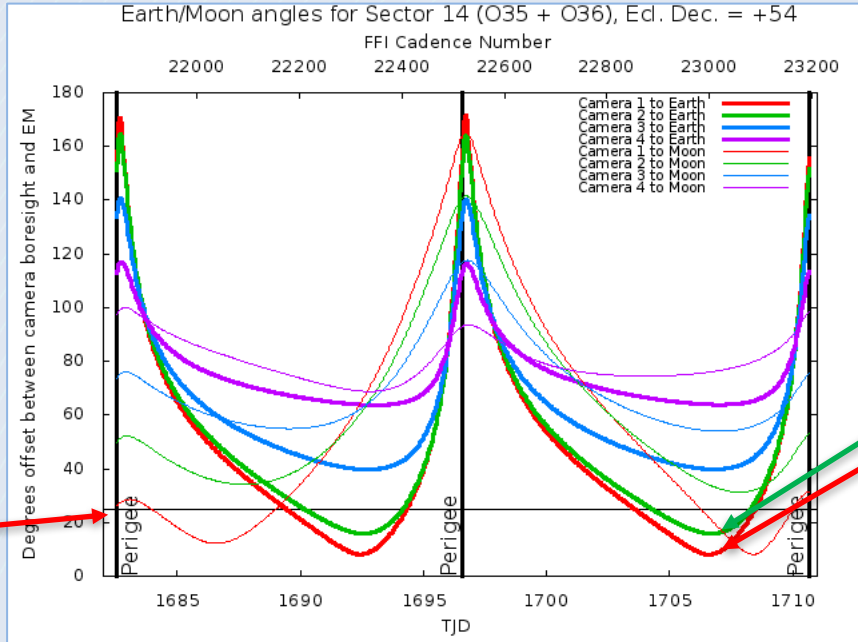


**Camera 1 useless for transit searches**



**During certain sectors in Year 2, at the nominal pointing, the Earth will be close enough to cameras 1 and 2 to render large fractions of sectors not useful for transit detection**

### Sector 14

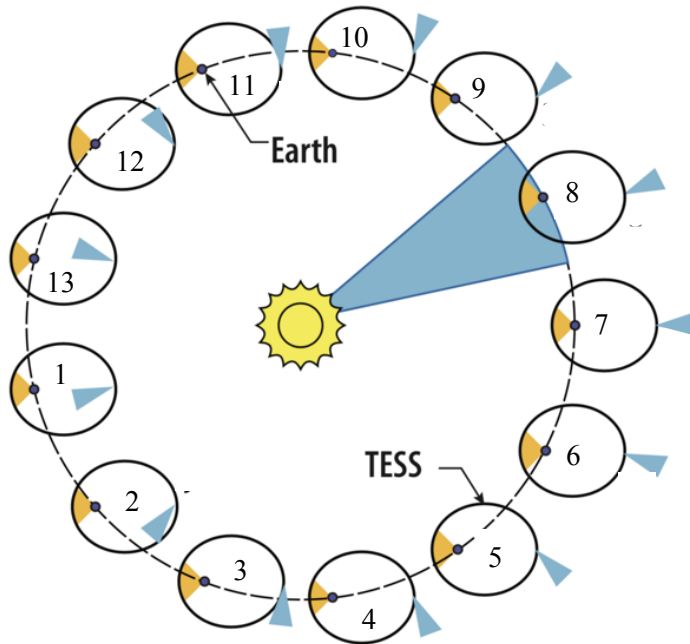


Cameras 1 and 2 are affected for many days in S14 at nominal pointing (+54° ecliptic latitude)

25°

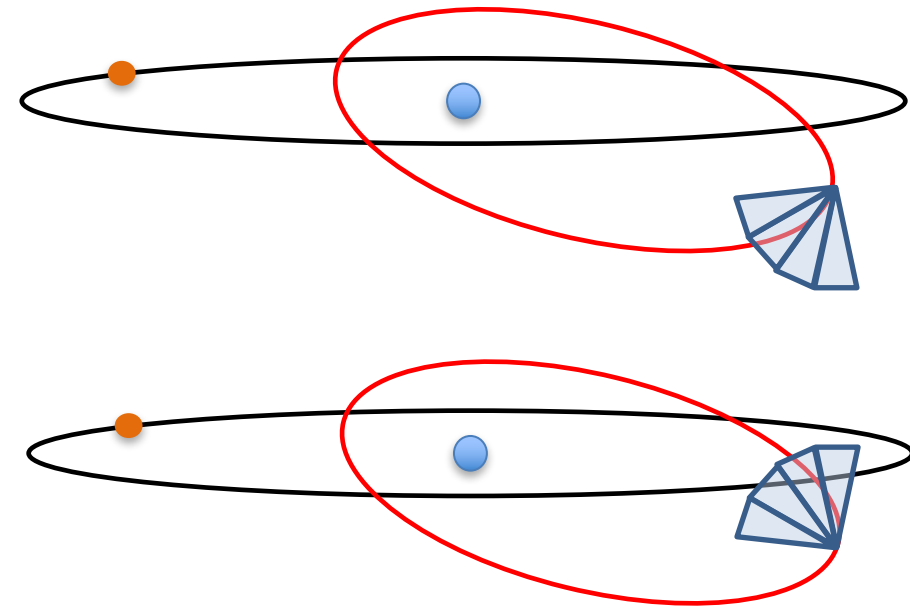


## Scattered Light Has Seasons

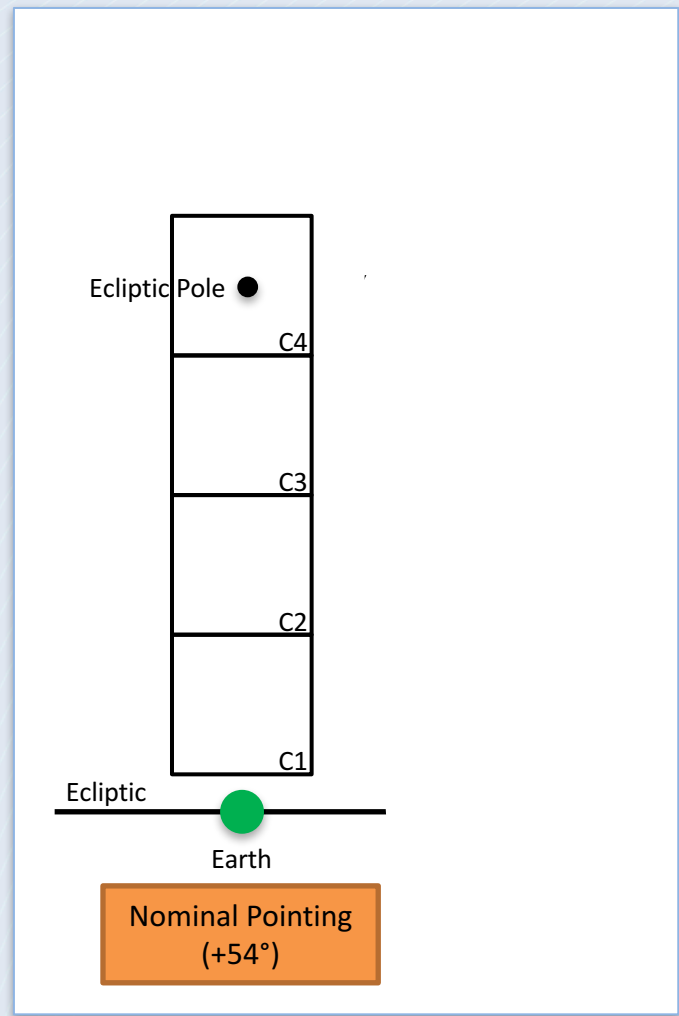


- Impact of scattered light is highest when the Earth is near antisolar near orbit apogee
- TESS primary mission: May-September

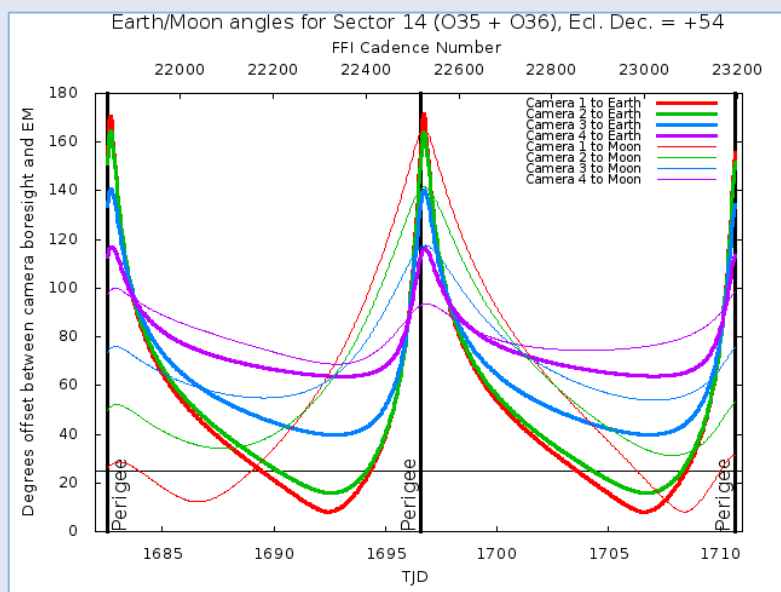
## Scattered Light Is Worse When Pointing North



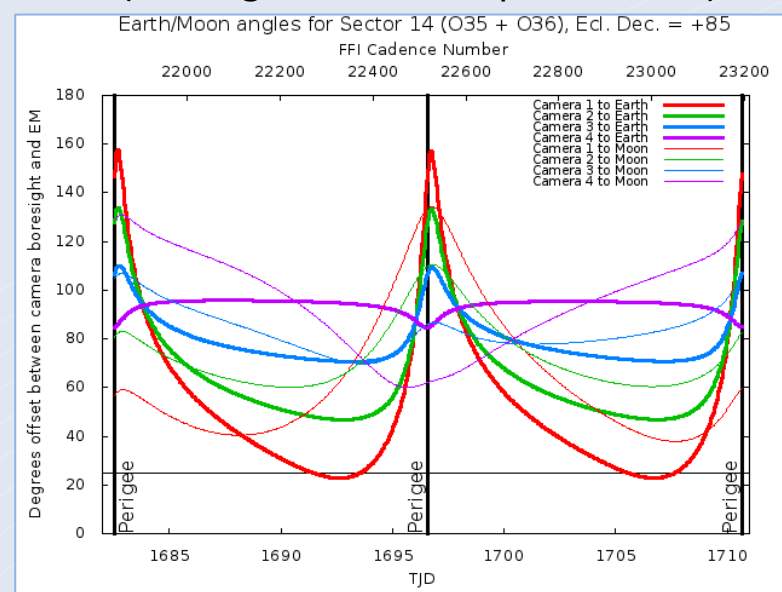
- Because orbit apogee is in the southern ecliptic hemisphere, the Earth is more likely to be in the FOV when pointing north



### Sector 14, Nominal Pointing (Boresight at $+54^\circ$ ecliptic latitude)



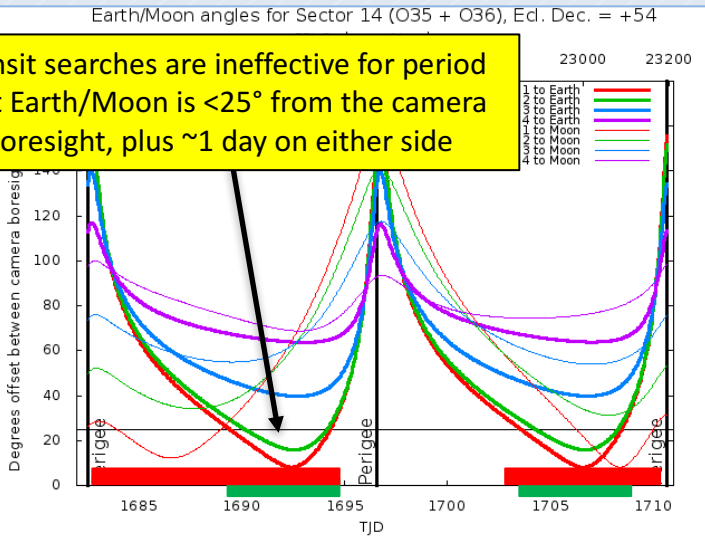
### Sector 14, Offset Pointing (Boresight at $+85^\circ$ ecliptic latitude)



## S14

Transit searches are ineffective for period that Earth/Moon is  $<25^\circ$  from the camera boresight, plus  $\sim 1$  day on either side

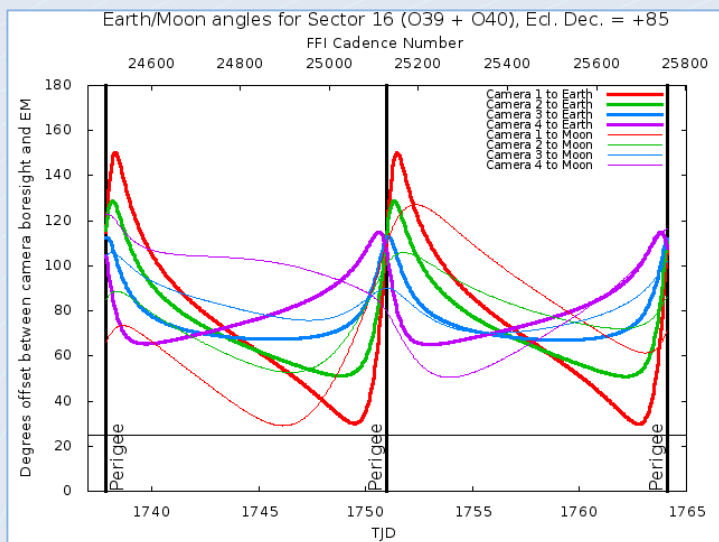
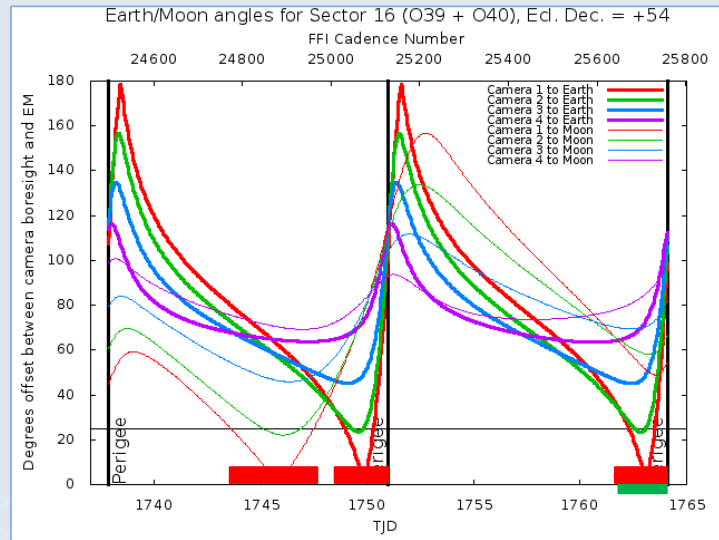
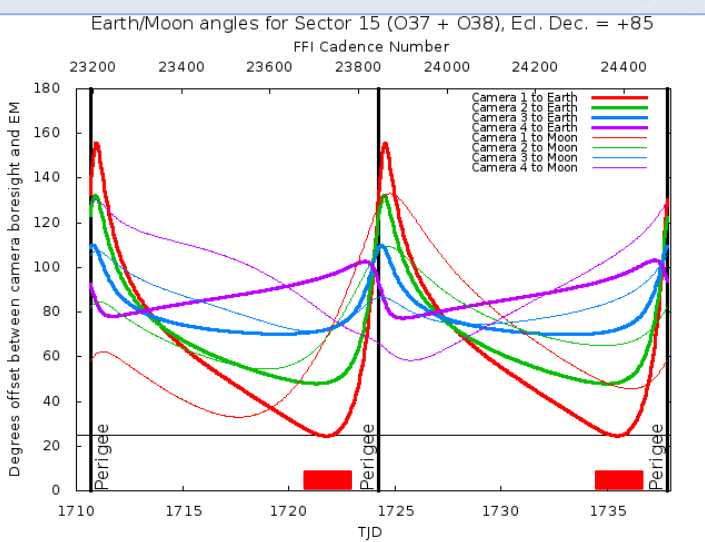
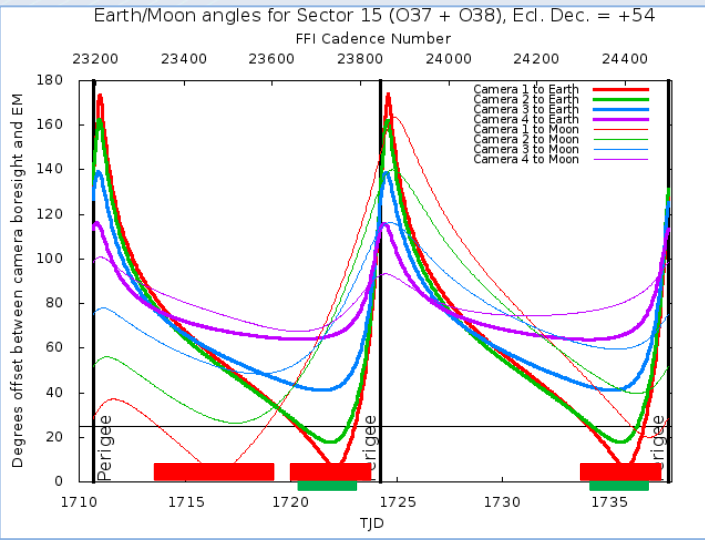
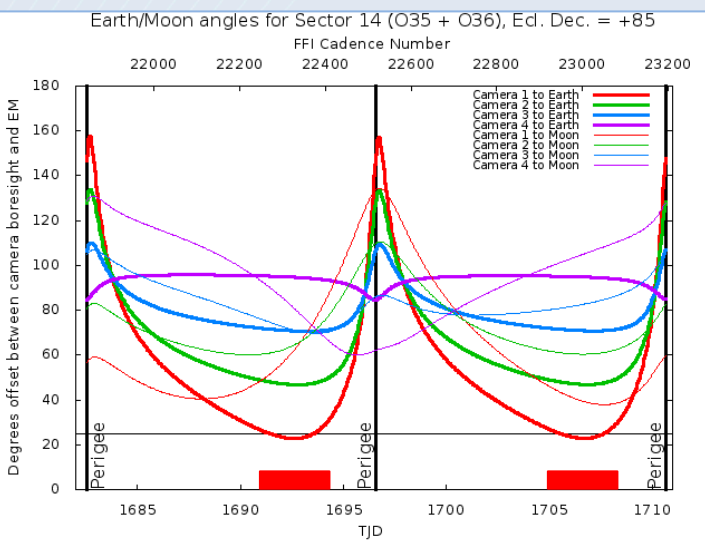
+54°



## S15

## S16

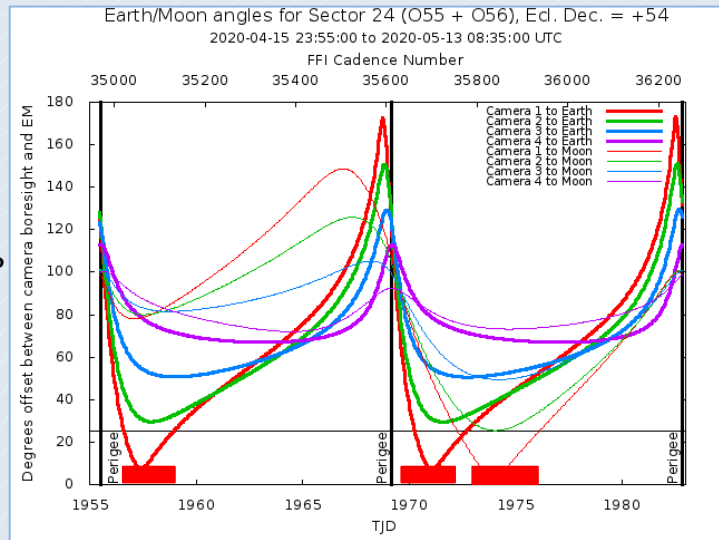
+85°



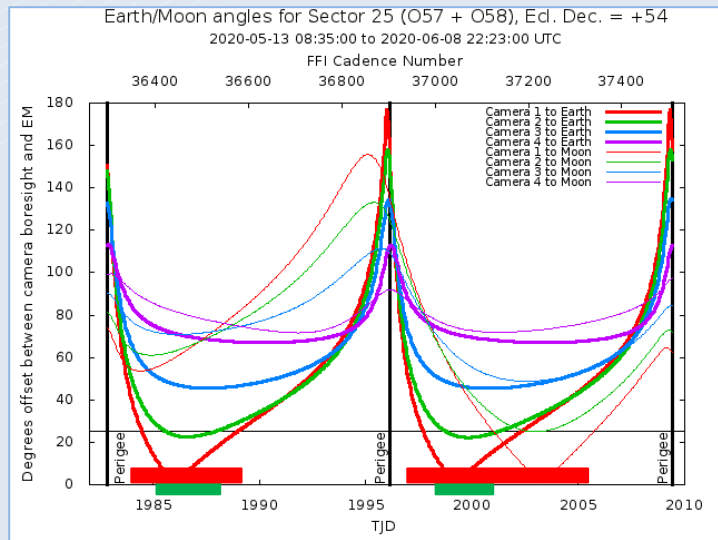


+54°

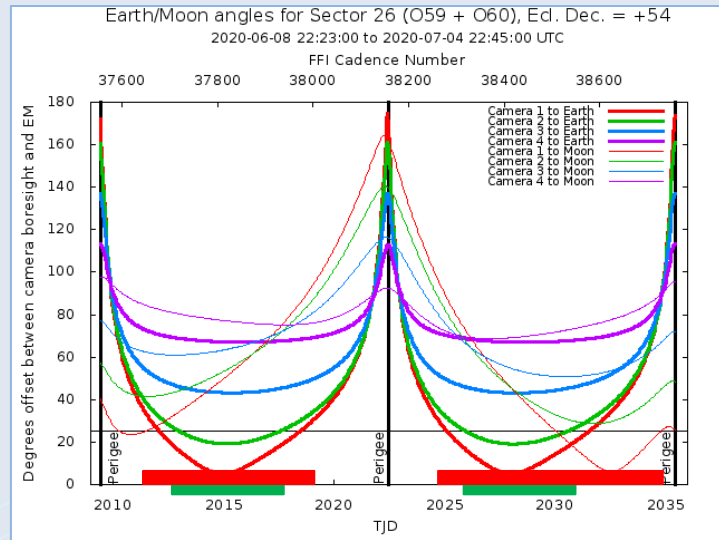
S24



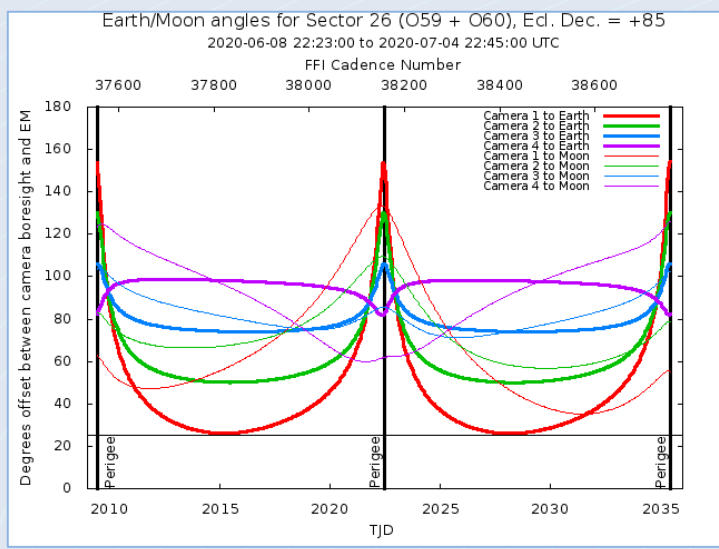
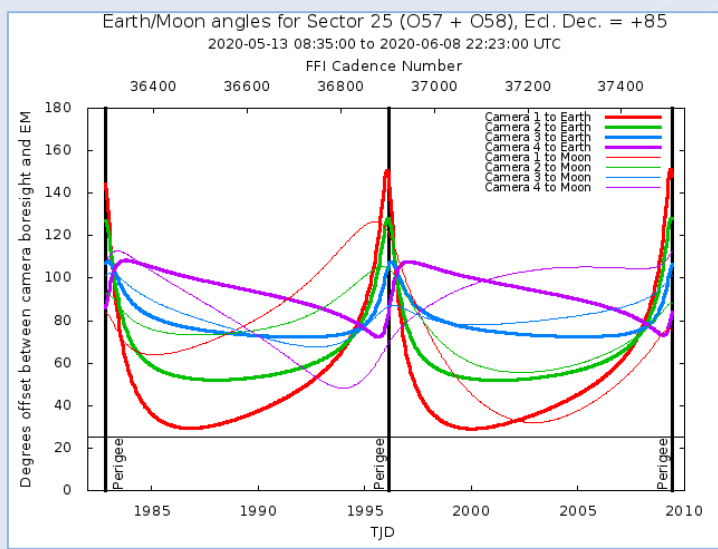
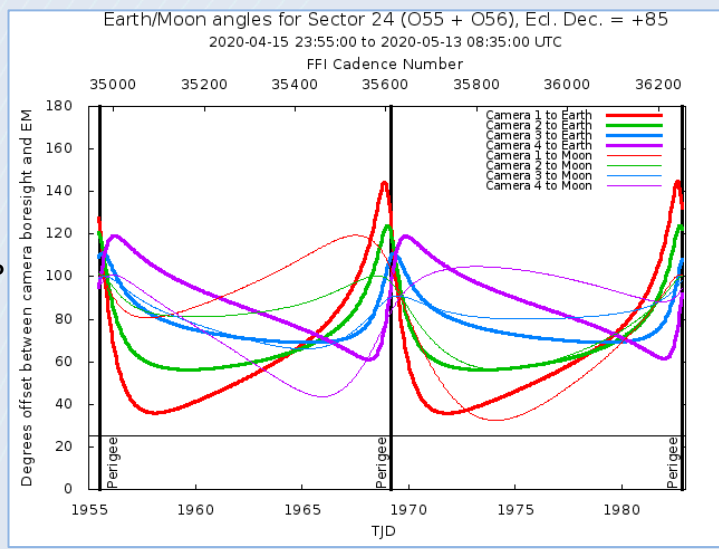
S25



S26



+85°

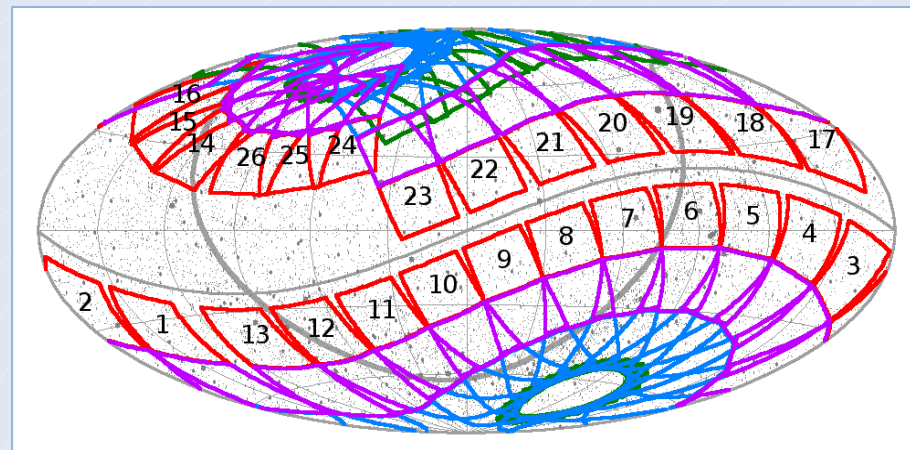
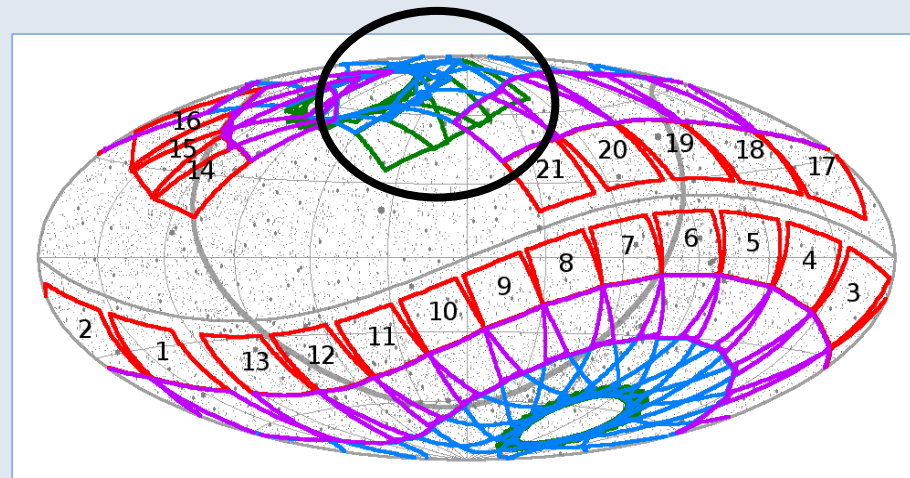


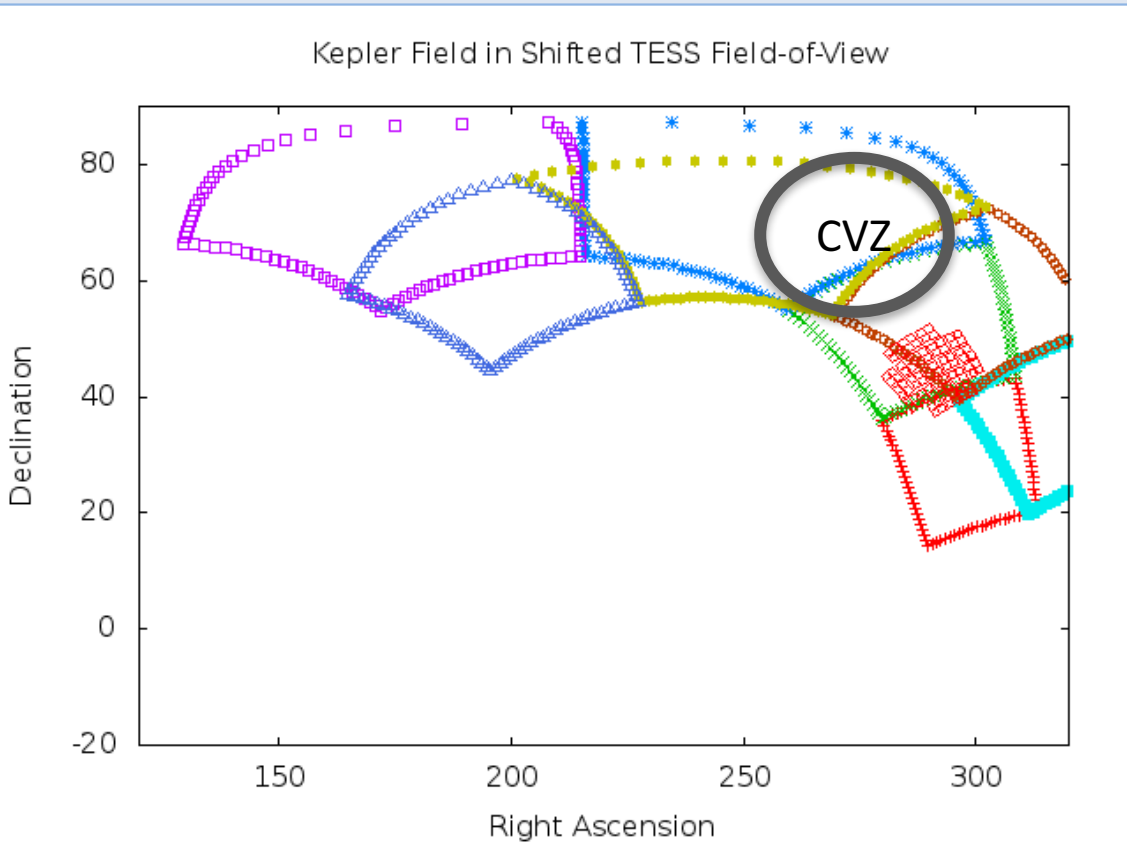
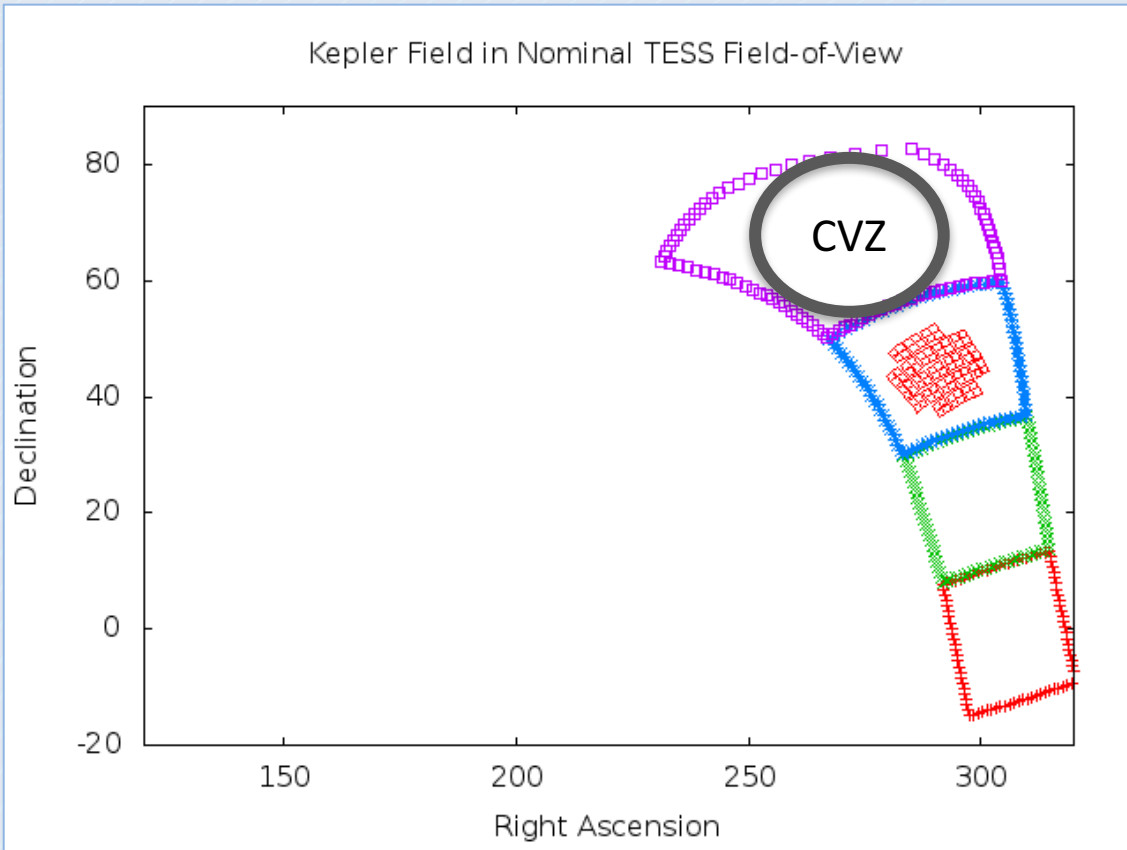
## ◆ Upsides:

- Camera 1 and 2 are nearly completely free of interruptions to transit searches
- Fields on “the other side of the pole”, onto which camera 4 would shift, are observed twice
- No impact to Level 1 requirements
- No risk to spacecraft health and safety

## ◆ Downsides:

- Certain fields near the ecliptic will not be observed in the prime mission
  - Any data would have been strongly contaminated by Earth- and moonlight
  - **But: will be available during a second extended mission**
- Small fraction of selected Cycle 2 GI proposals affected





\* Continuous Viewing Zone