In a scenario like `npole` (Fig. 1) the boresight of the spacecraft must form a right angle with the ecliptic. The typical way that this scenario is described – 'just rotate the spacecraft 36° about spacecraft $+Y$' (cf. Fig. 2) – is probably wrong.

This is because such a rotation would put Camera 4 only 45° in ecliptic latitude away from pointing directly at the Sun. Following the lens hood model (Fig. 3) this means $\sim 10^{-7}$ suppression, or around 18 magnitudes. The Sun has $V = -26$, which means with suppresion it's a source with $V = -8$ spread 'uniformly' (not actually uniform, but OK for OOM calculations). Winn 2013's tabulation of the photon fluxes indicates an $I = 0$ G2V star produces $1.6 \times 10^6\,\mathrm{ph/s/cm^2}$. Saying V=I, being 8 mags brighter than $I = 0$ means $\sim 1600\times$ as much flux, or $2.5 \times 10^9\,\mathrm{ph/s/cm^2}$. Since each lens has an effective observing area of $69\,\mathrm{cm^2}$, this gives 1.7×10^{11} ph/s across an entire lens. The requirements are quoted in ct/s/px, so divide by $4096^2\,\mathrm{px^2}$, and get 10^4 ph/s/px. 100% QE brings 10^4 ct/s/px. This is $\sim 30\times$ the 'treshold' we set when noting 'risky fields' for dropping in Bouma et al Sec1.6, and means (multiply by 2 to get the mean ct/px per 2 sec image, then take a sqrt to estimate the variance) an additional ~ 140 ct/px RMS per 2 sec image. This is Bad. It means $\sim 50\%$ of stars that could be observed at sub-mmag precision over 1hr no longer can (cf precision plot and text of Bouma et al 2016). It means $10\times$ worse precision for M dwarfs ($I \gtrsim 13$).

We can get around this – somewhat – by doing a different rotation. Start from the configuration shown in Fig. 2, and rotate by 36° about spacecraft $+Y$. Then rotate by 90° about spacecraft $+Z$ (same as ecliptic pole direction). All cameras are then 90° from the antisolar direction. The lens hood model says we now get a suppression of 10^{-9}, or 23 magnitudes, so the sun is $V = -3$, uniformly spread. Repeating the calculation, this gives 10^2 ct/s/px, or an additional ~ 14 ct/px RMS per 2 sec image. This isn't great, and is a slight hit on M dwarf precision, but it's way preferable to the scenario described above. However, an obvious problem with this arrangement is that it must block at least one solar panel, unless I am missing something.

When we chatted about this, you mentioned it wouldn't be a problem. **Am I missing something?**

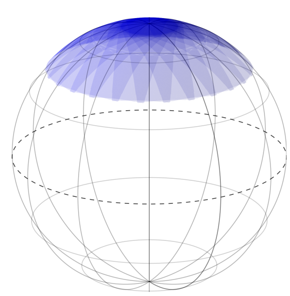

Figure 1: `npole` scenario

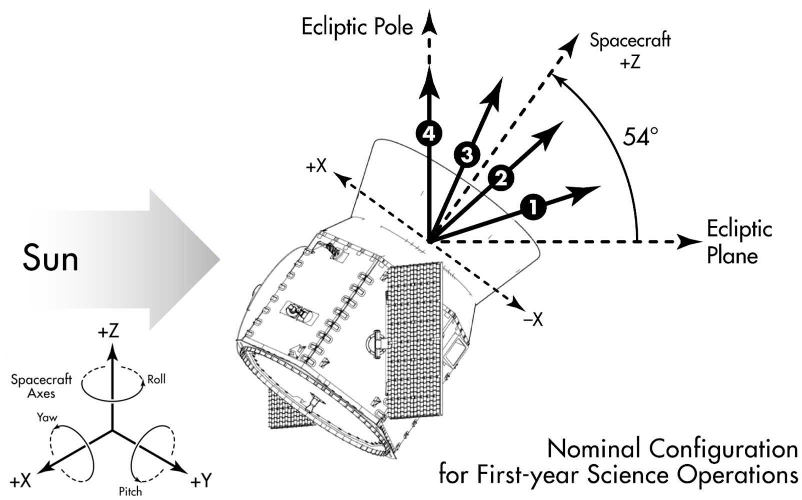

Figure 2: The spacecraft must point so that incident sunlight is collected by the solar panels, and not the cameras. TESS's solar panels pitch about the $+Y$ axis. (Adapted from Orbital ATK design document)

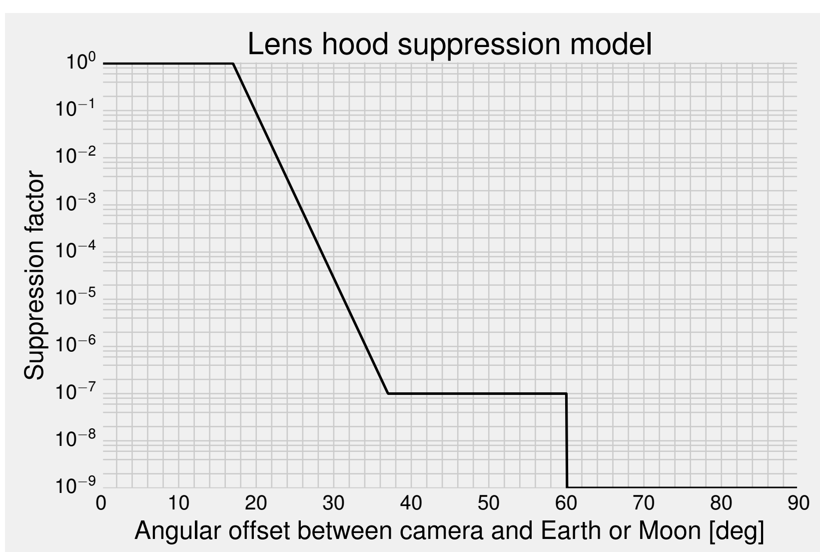

Figure 3: TESS's lens hood suppression.