Extended TESS Mission Science Priorities and Strategy

1 Meeting Purpose

TESS's primary mission, a two-year survey of the entire sky, is scheduled to end in late 2019. There appear to be no fundamental obstacles to continuing observations for another 5-10 years. We would like to start thinking about what *TESS* should do after the primary mission. The *TESS* Simulations Working Group is planning to investigate different observing plans, using the code that was developed for the primary mission by Sullivan et al. (2015). The purpose of this meeting is to gather ideas on (A) the criteria by which to compare and evaluate different observing plans; and (B) particular observing plans that should be evaluated.

2 Context

Proposals for an Extended Mission would be submitted to the NASA Senior Review of Operating Missions, which takes place every two years. The first opportunity for such a proposal would be late 2018. Given the two-year cadence of the senior review process, such a proposal would likely be for a two-year program of observations.

There is also a possibility that the *TESS* primary mission will effectively be extended to a third "bonus" year, if enough of the budget reserves remain intact throughout the primary mission.

Therefore, we would like to consider both one-year plans (for the possible bonus year) as well as two-year plans (for an Extended Mission).

3 To think about before the meeting

We encourage you to read the work by Sullivan et al. (2015), to remind yourself of the characteristics of the primary mission, and become familiar with the capabilities and limitations of the existing simulation code.

Metrics for Evaluation. During the primary mission, *TESS* will spend each year scanning one ecliptic hemisphere. Each hemisphere is divided into 13 sectors of ecliptic longitude, which is observed for 28 days. The priority is achieving nearly all-sky coverage for short-period planets. However, the survey will miss many planets with periods longer than 10 days. Furthermore, some areas of the sky will not be observed, in particular a 10° band surrounding the ecliptic.

Given these characteristics, what are the most important metrics for evaluating the scientific impact of a particular observing plan? Some possible examples:

1. Number of newly detected planets orbiting bright stars (beyond those detected in the primary mission).
2. Number of newly detected long-period planets ($P > 10$ days).
3. Number of newly detected habitable-zone planets.
4. SNR enhancement for objects for which the primary mission led to only marginal detections.
5. Increase in number of transits observed, to enable searches for transit-timing variations. This can be for planets found in the *TESS* primary mission, or by any other project (*Kepler*, *K2*, or ground-based surveys).
6. Number of astrophysical false positives expected.

Some Possible Observing Plans. Here are some ideas that have already been suggested. Additional ideas are most welcome.

1. Repeat the primary mission survey, to enhance SNR and period sensitivity. We would likely shift the sectors by 13° in longitude to cover the inter-sector gaps in the primary mission's sky coverage.

2. Dwell entirely on a single hemisphere for two years (Fig. 1, left). We might also double the observing time per sector to 56 days.
3. Dwell on a single $24^\circ \times 96^\circ$ field for as long as possible (consistent with engineering requirements for the orientation of solar panels, etc.).
4. Focus on one of the ecliptic poles (Fig. 1, center). We would center the combined field of view on one of the ecliptic poles, and advance the long axis of the field of view in ecliptic longitude by 28° every lunar month.
5. Focus on the ecliptic plane, which is not covered during the primary mission (Fig. 1, right). We would orient the combined field of view along the ecliptic, and center it in an approximately anti-solar direction.
6. Focus on the galactic plane, for a microlensing survey.

Thank you in advance for participating in this meeting. We're looking forward to an interesting and productive discussion.

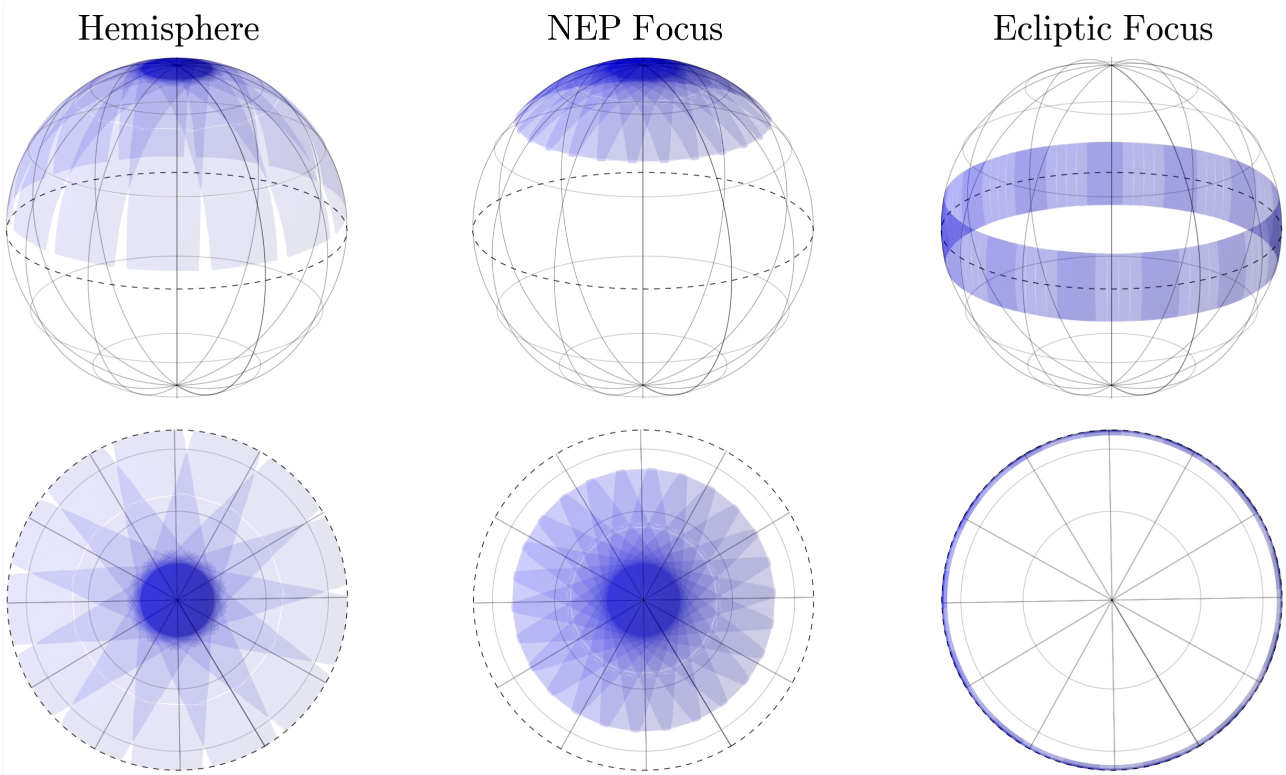

Figure 1: Tilted (*top*) and polar (*bottom*) projections of a few possible observing plans, shown in ecliptic coordinates on the celestial sphere. Lines of constant latitude in the polar projections correspond to ecliptic latitudes of 60°, 30°, and 0°, proceeding radially outward. *Left*: dwell on a single hemisphere. *Center*: focus on an ecliptic pole, advancing the long axis of the field of view every lunar month. *Right*: point all cameras towards the ecliptic plane.