TESS Users Committee (TUC) Session

TESS Science Conference
August 1 2024

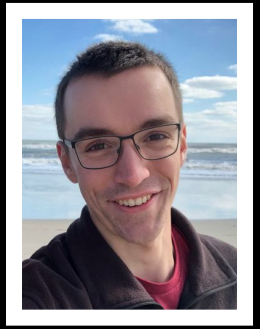
We want to hear from you about how to make TESS the best possible mission for our community!

QR code to anonymously submit questions & comments:

Community Members of the TESS Users Committee

Daniel Huber (Chair)
University of Hawai'i & University of Sydney

Marcel Agüeros
Columbia University



Luke Bouma
Caltech

Nora Eisner
CCA & Princeton

Adina Feinstein
CU Boulder => Michigan State University

Teruyuki Hirano
National Astronomical Observatories of Japan

Savita Mathur
Instituto de Astrofísica de Canarias

Armin Rest
Space Telescope Science Institute

Malena Rice
Yale University

Krista Lynne Smith
Texas A&M University

Ex-officio Members

NASA GSFC

- Allison Youngblood (TESS Project Scientist)
- Knicole Colón (TESS Deputy Project Scientist)
- Rich Burns (TESS Project Manager)
- Robert Stone (TESS Mission Director)
- Christina Hedges (TESS GI Program Lead)

MIT

- George Ricker (TESS PI)
- Roland Vanderspek (TESS Deputy PI)

NASA HQ

- Janet Letchworth (TESS Program Executive)
- Joshua Pepper (TESS Program Scientist)
- Hannah Jang-Condell (TESS Deputy Program Scientist)

TESS Users Committee Charge

*The TUC shall **provide broad-based input to the TESS Project about the needs and priorities of the TESS user community** during TESS's operational phase. Its primary purpose is to **ensure that the interests of the TESS science community are served by the TESS Project** in planning for and executing TESS operations.*

All TUC material is publicly available at:
https://heasarc.gsfc.nasa.gov/docs/tess/TUC.html

QR for questions

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TUC Timeline

- May-June 2023: Committee formed
- July 2023: First Online Meetings
- **November 2023: In-person meeting at NASA Goddard**
- December 2023: First recommendations submitted to TESS Project
- **Dec 2023 - Jan 2024: Community Survey**
- **March 2024: Ammended recommendations submitted**
- **June 2024: Call for EM3 Science Pitches**

QR for questions

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TUC Discussion Topics

- Extended Mission Planning
- General Investigator Program
- TESS Software & Databases
- Diversity, equity, inclusion, and accessibility
- Science Working Groups (TFOP, TASC, etc)
- Community Feedback Mechanisms
- Your idea here!

QR for questions

QR for questions

TUC Recommendations: EM Planning

The TUC recommends that the TESS project performs feasibility studies of non-standard observing modes for EM3 … and organizes opportunities for community participation in the EM planning process.

Call for EM3 science pitches (see Allison's talk) & documentation for EM3 possible changes (see Roland's talk)

QR for questions

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TUC Recommendations: GI Program

The TUC recommends to re-evaluate the 70% new data eligibility effort threshold for the General Investigator (GI) program … and that the default period of performance of small and large General Investigator programs be extended from one to two years.

25% threshold for Cycle 7;
Selected large GI programs will have 2 year performance period for Cycle 7

QR for questions

QR for questions

TUC Recommendations: Data Products

The TUC recommends that the TESS project increases the production and archival of mission-generated SPOC FFI light curves … this may require shifting resources away from processing and analyzing 2-minute cadence data.

Resource requirements for this are being investigated

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Full set of Recommendations available at:
https://heasarc.gsfc.nasa.gov/docs/tess/TUC.html

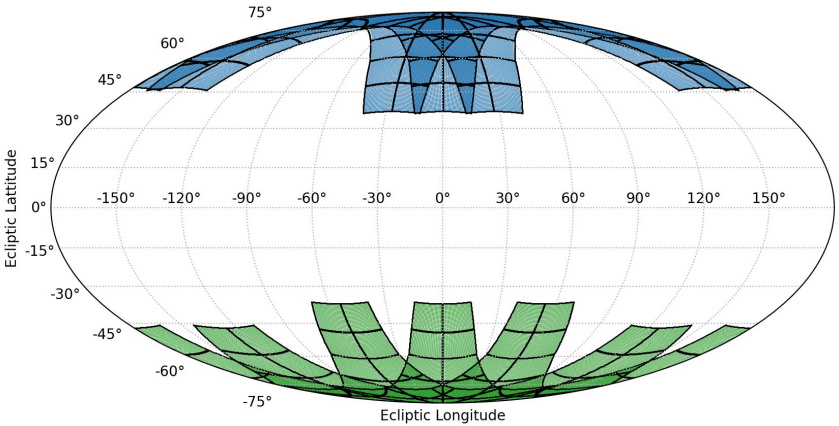
QR code to anonymously submit questions & comments:

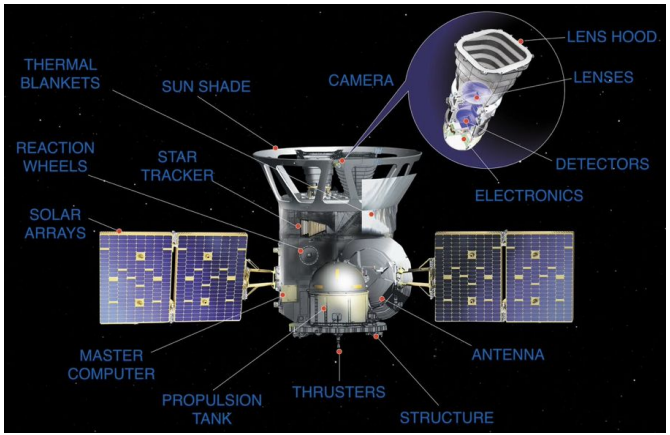
EM3 Operational Possibilities and Constraints

- Just listing possible modifications to operational and observational modes
  - In part motivated by suggestions from the Community

55-Day Sectors

- Very recent analyses show that extending the duration of a sector from ~27 days to ~55 days is currently possible without danger to the SC
- However, the new orientation of the spacecraft to the Sun may cause thermal surfaces to age faster than they currently are
- More analysis is needed

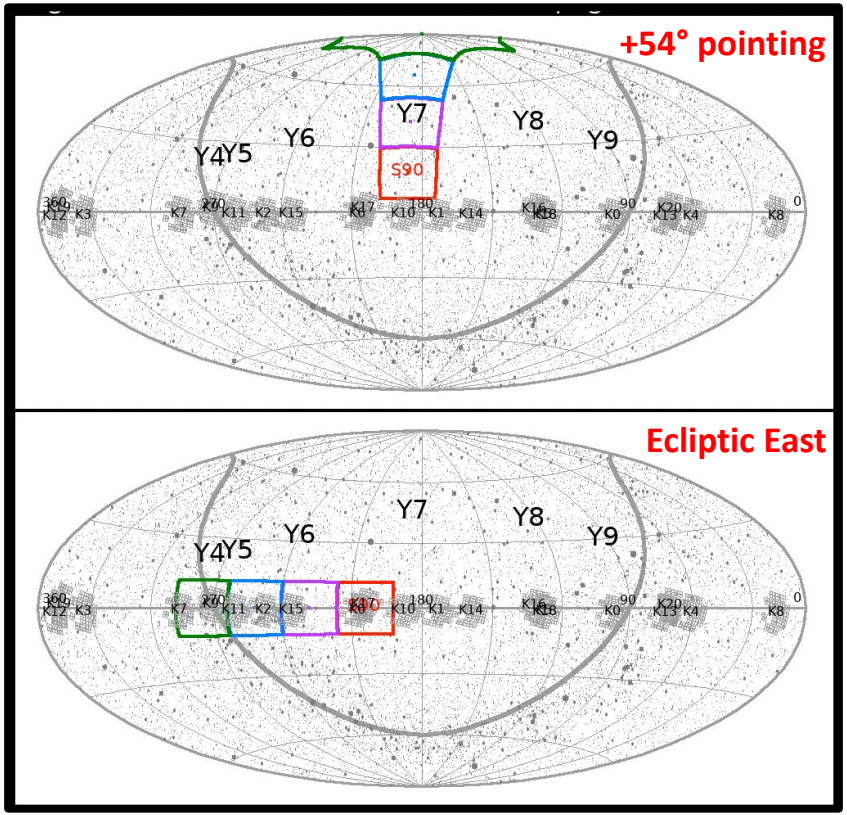


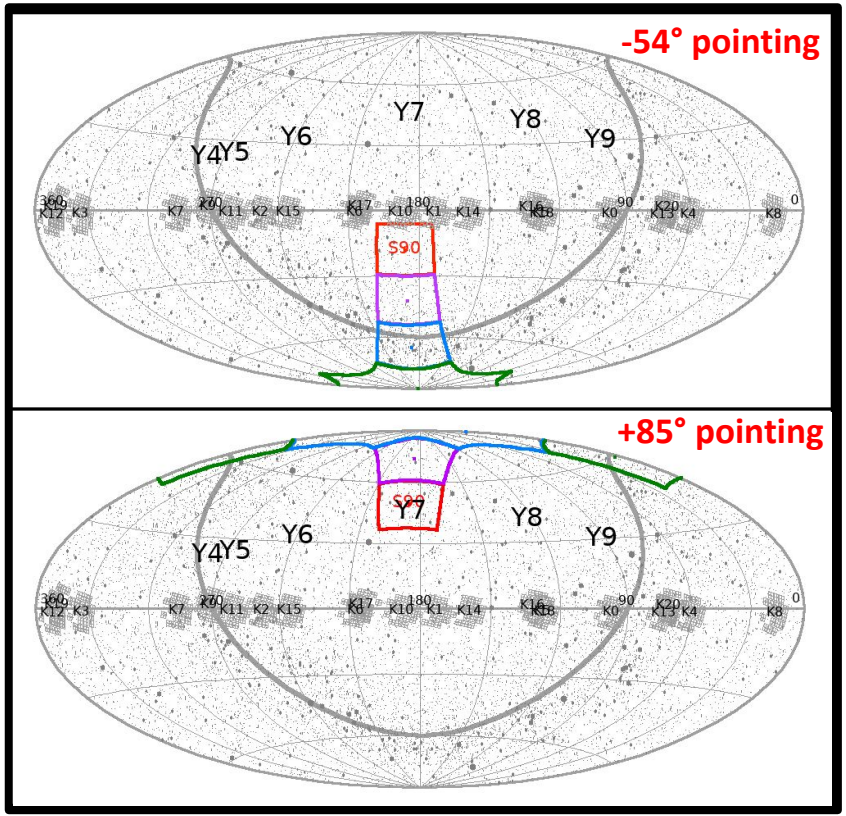


Pointing Possibilities

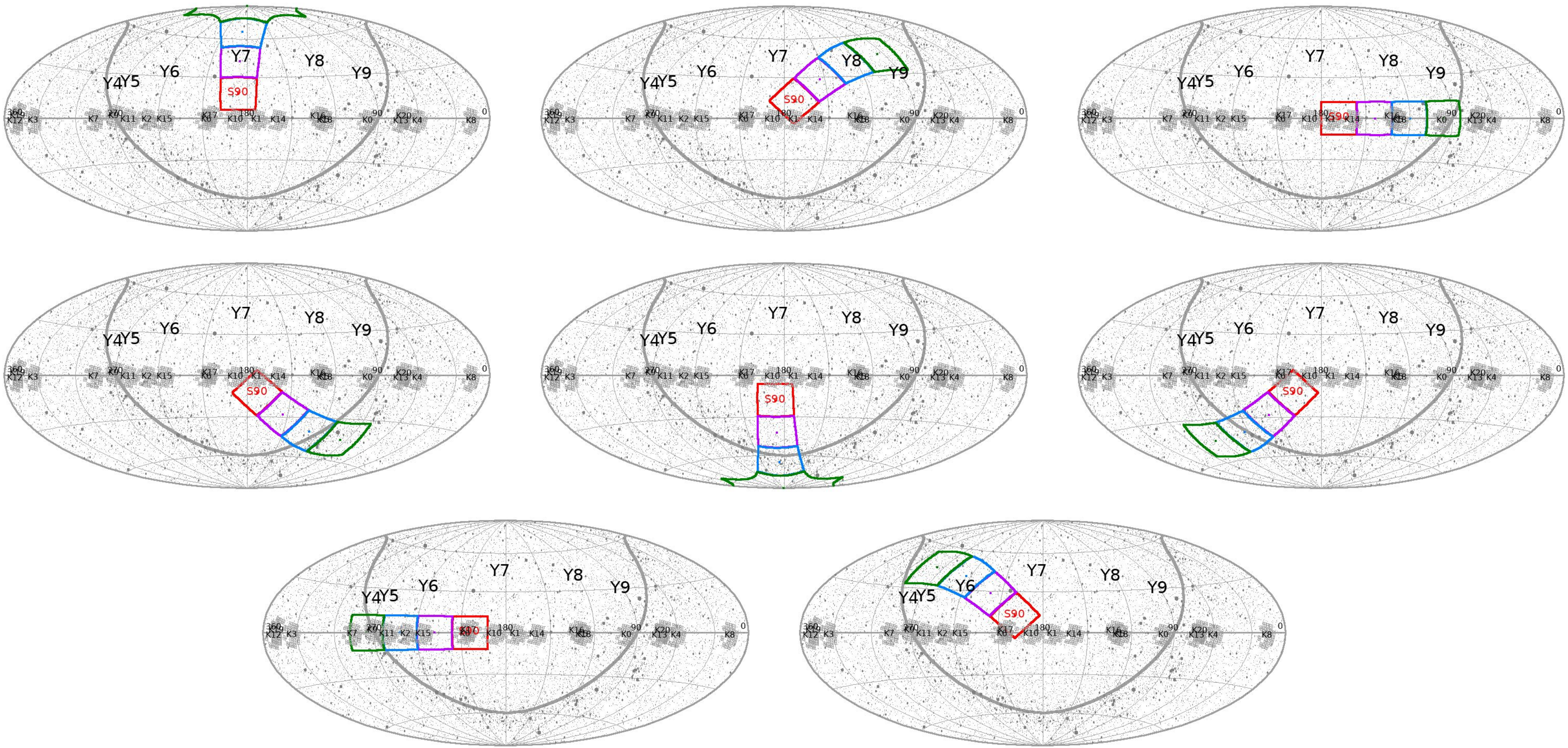
- The orientation of the FOV on the sky can be varied by rolling the spacecraft around the instrument boresight
  - Centerline of the long axis of the FOV must pass through antisolar point at the middle perigee of the sector
- The pitch (”ecliptic latitude” of the FOV can be varied as well)

Spacecraft Orientations Used to Date

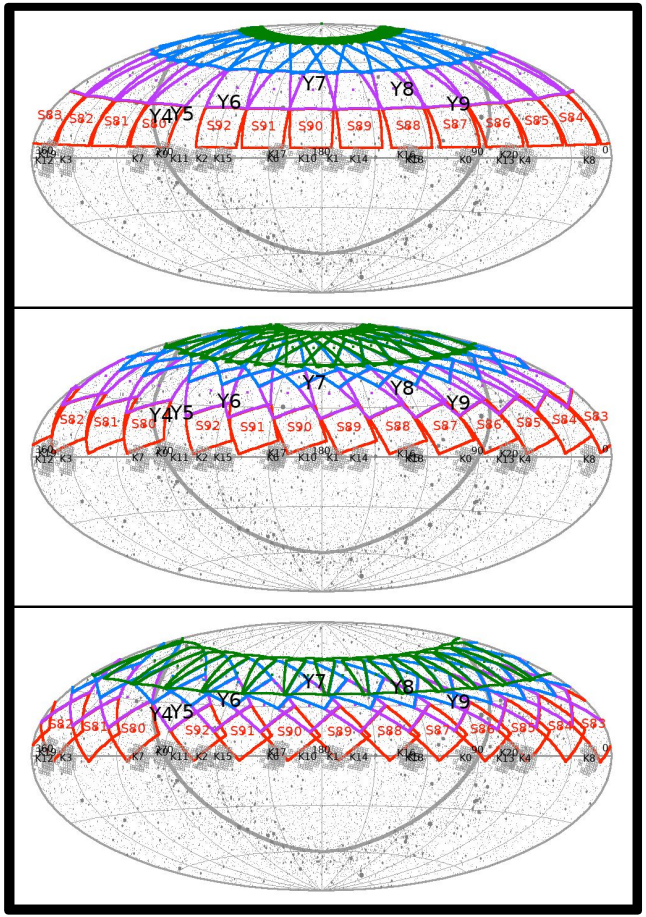




Standard 54° pointing, different rolls



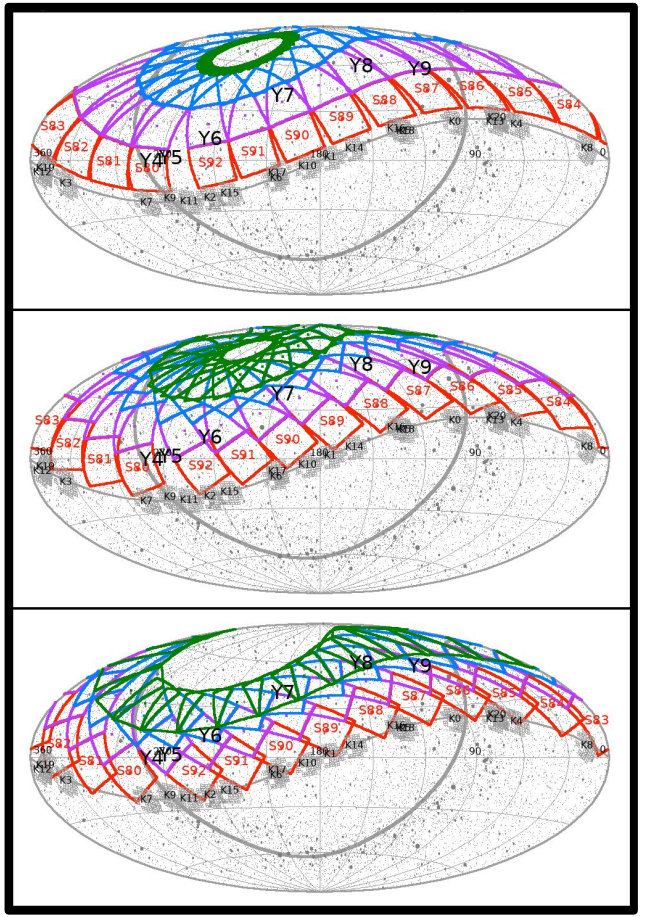
Standard 54° pointing



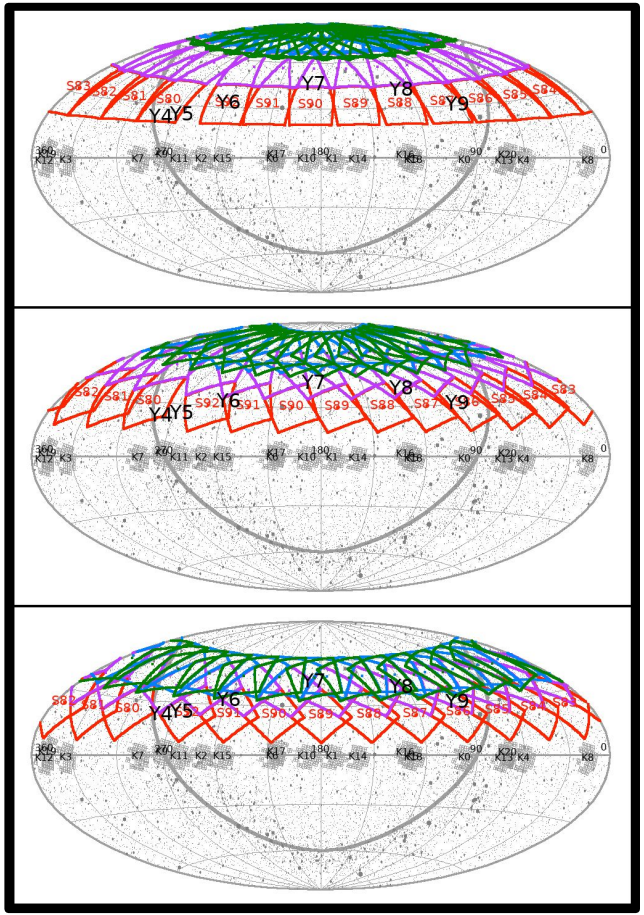
0° roll

20° roll

40° roll



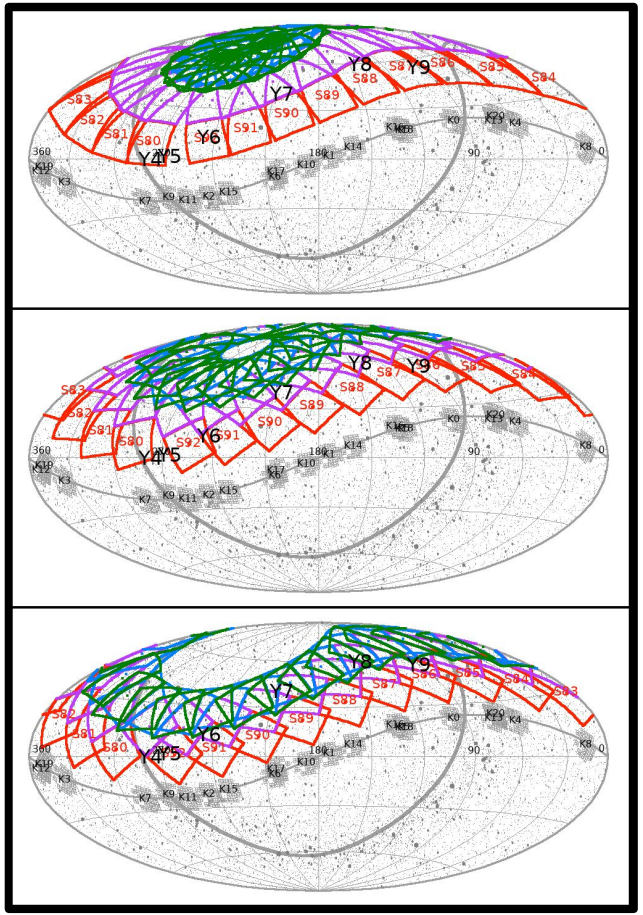
68° pointing



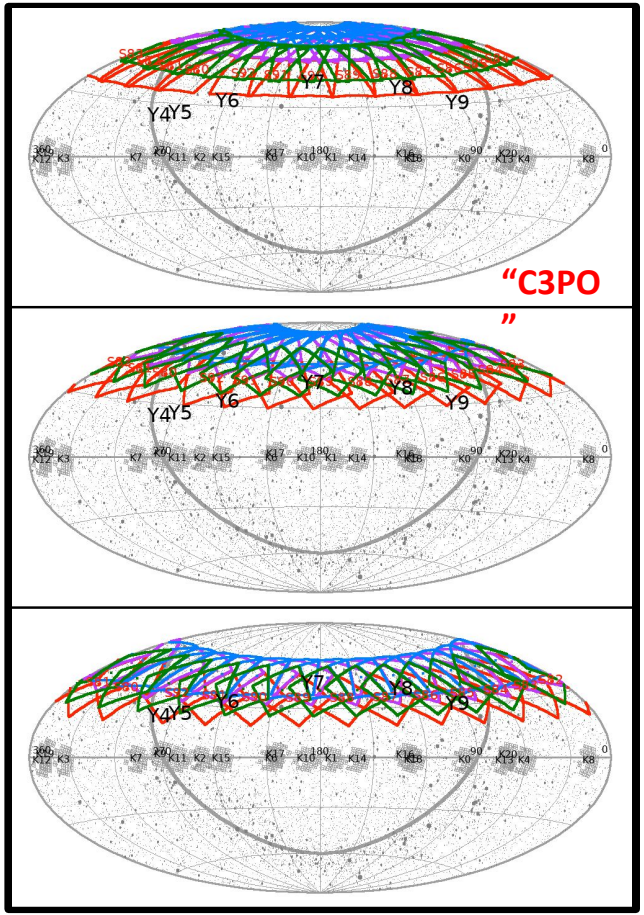
0° roll

20° roll

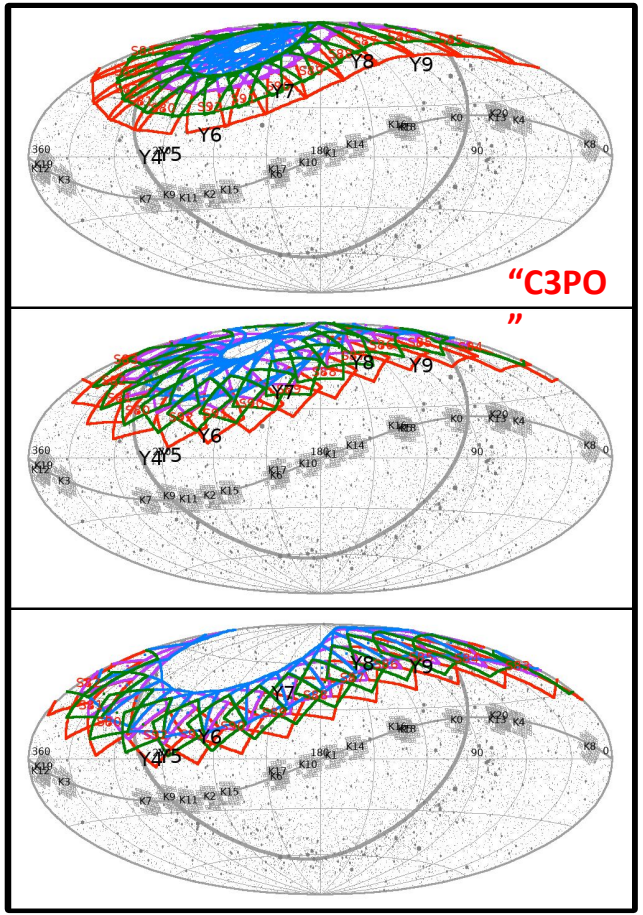
40° roll



85° pointing



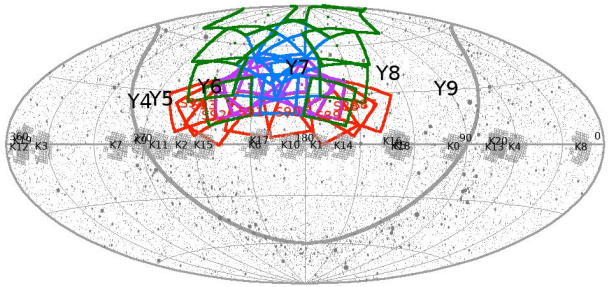
0° roll



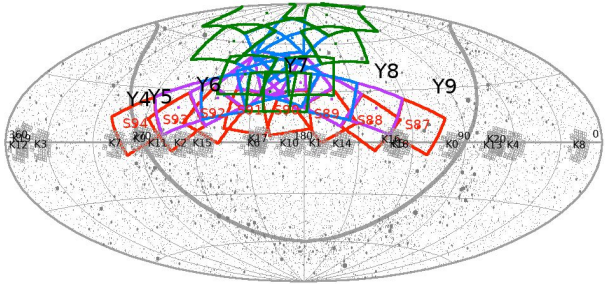
20° roll

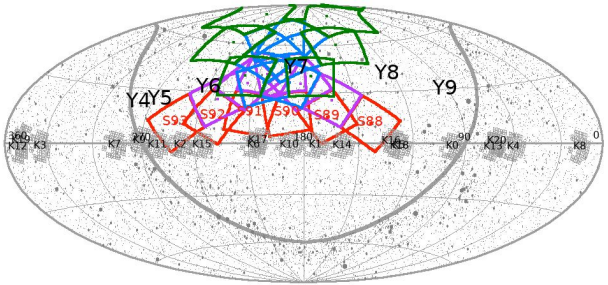
40° roll

Non-Standard Orientations



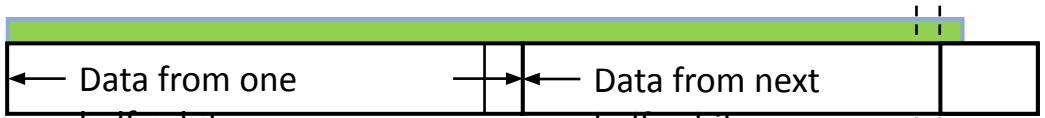
- Different roll in each sector
- Can adjust spacecraft pitch per sector





Summary of Target/Cadence Possibilities

Change	Operational Impact	Comments
Increase number of 2m and/or 20s targets	Higher SSR fill, more data to process and store	20s processing should scale gracefully, some minor modifications may be necessary. More 20s targets currently means more 2m targets, because all 20s targets are also observed at 2m NB: TPS is not run over 20s data
Add 2s target mode	Higher SSR fill, some additional ops planning, data processing, archiving	Changes in FSW are in development. Data processing and archiving TBD



75% fill/half orbit + missed contact = ~4 days lost
3 missed contacts/year = ~2 weeks lost

"Lost" Observations

Summary of Target/Cadence Possibilities

Change	Operational Impact	Comments
Change FFI cadence	Shorter cadence means higher SSR fill = more data to process and store	Compatibility of new FFI cadence with previous FFIs?
Shift start time of FFI cadences	Random shift: no impact Fixed shift: FSW change	Depending on shift, FFIs may not align with 2m or 20s target boundaries

TUC Community Survey

Results Summary

Luke Bouma for the TESS Users Committee (TUC)

Aug 1, 2024

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Nov 2023

First TUC meeting

One day in-person;
We needed a survey!

Dec 2023

Survey distributed

Email lists; Slack groups;
TSSC newsletter

Jan 2024

Survey closed

Survey ran for five weeks;
Feb 13 TUC virtual discussion

Mar 2024

TUC report #1

14 recommendations;
Sent TUC → TESS project.

+ **Monday & Tuesday** of this week: re-opened survey (advertised in Avi's opening remarks), in case you did not have a chance to respond.

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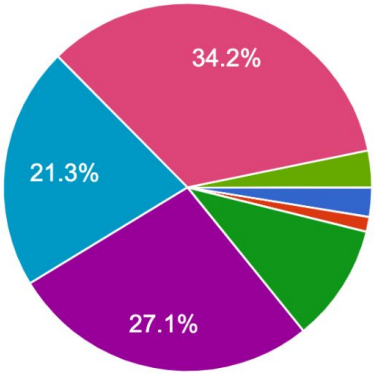
Who responded?

What is your career stage?

160 responses

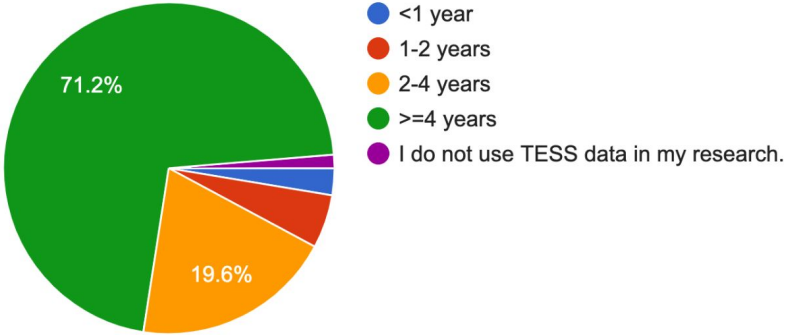


- Citizen scientist
- Undergraduate student
- Post-baccalaureate student
- Graduate student
- Postdoctoral Researcher
- Assistant professor or staff equivalent
- Tenured professor or staff equivalent
- Emeritus professor or staff equivalent

_N_ = 160 people

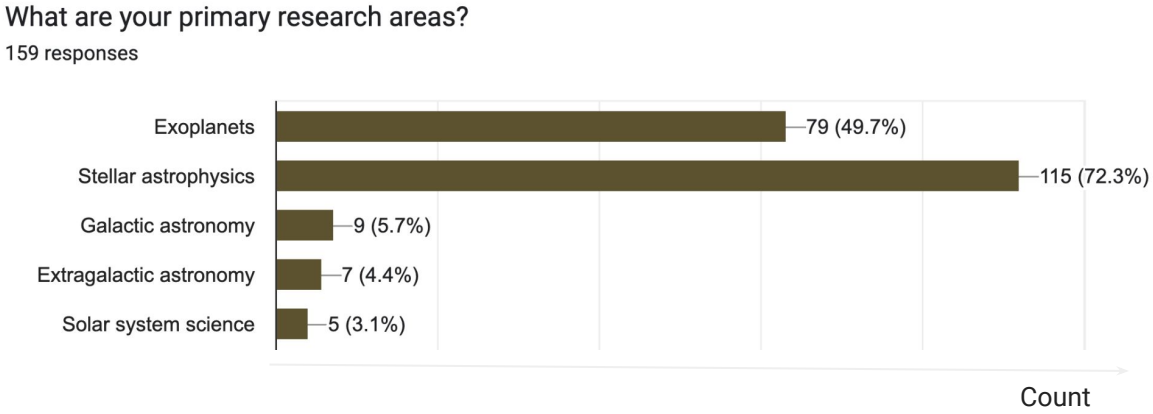
55% faculty or staff;
28% postdoc;
10% grad students;
9% other

How many years have you been using TESS?



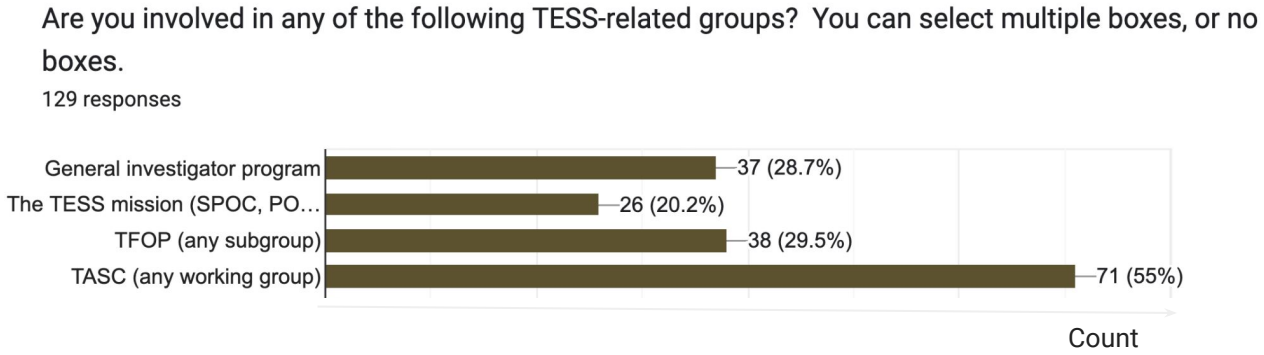
Who responded?

Strongest representation in exoplanets & stellar astrophysics.



Involvement:

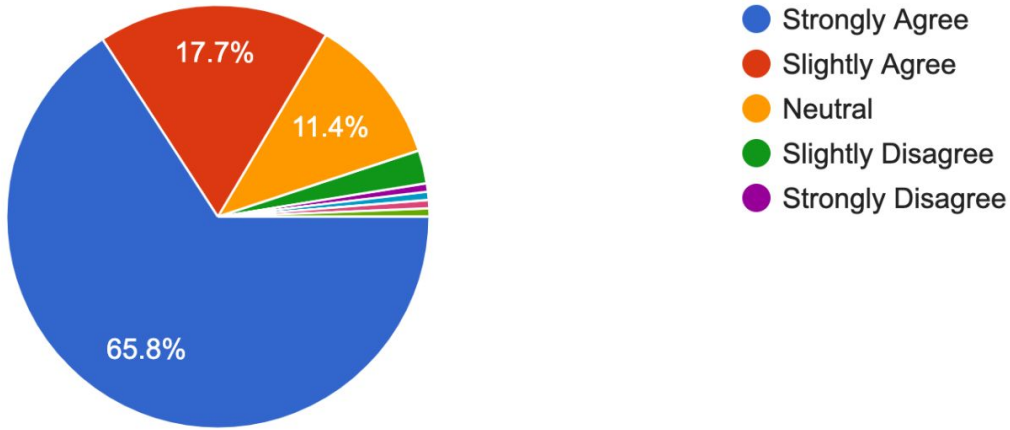
- 30% GI
- 20% Mission
  (S)POC/TSO/MAST/ExoFOP/GSFC
- 30% TFOP
- 55% TASC
- 18% none



Extended Mission: Pointing Strategy

TESS should continue to observe the entire sky at least one time by the end of 2028 (by the end of 2025, the cumulative fraction of sky observed will be slightly above 95%).

158 responses

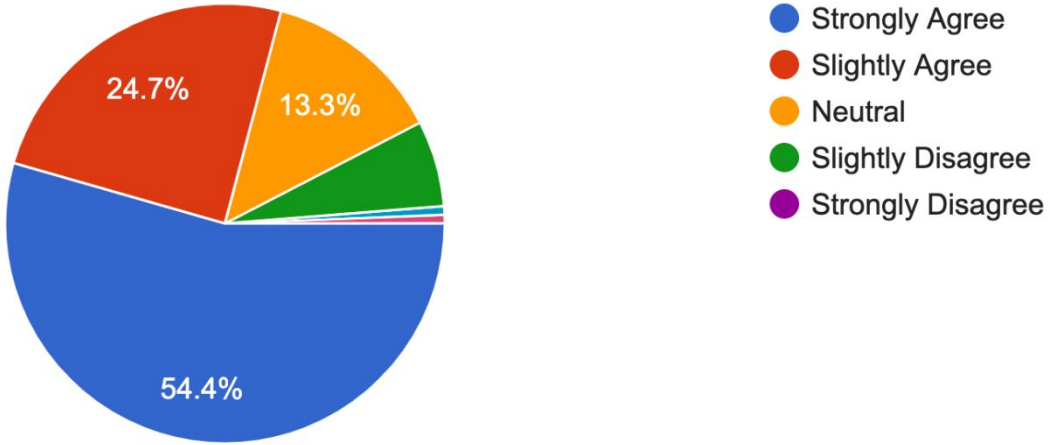


Strong support for EM3 including fields that have not previously been observed.

(83% strongly or slightly agree)

Extended Mission: Pointing Strategy

Assuming it is technically feasible (pending engineering analysis), **it is important that the duration of a "TESS sector" will be extended beyond one lunar month** (e.g., the spacecraft can dwell on a particular field for two to three consecutive months).

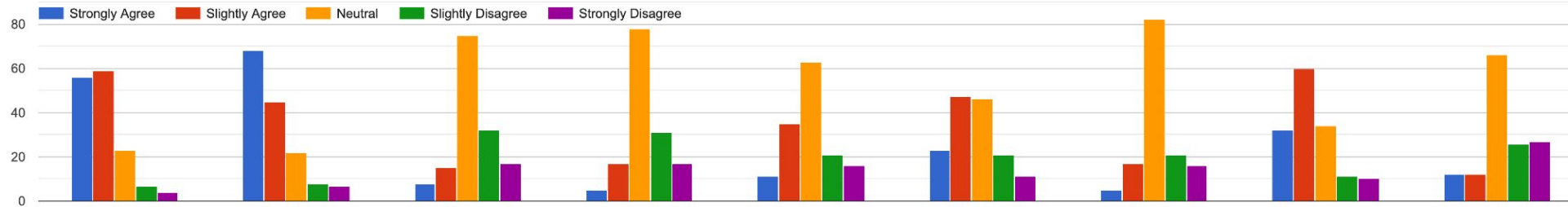


Strong support for exploring option of extending TESS sector duration in EM3.
Aligns with TUC recommendation #1. (79% strongly or slightly agree)

Extended Mission: Pointing Strategy

Strongest support (75%) for "**all sky**" strategy similar to past, and for **filling the gap**.
Strong support (63%) for considering **PLATO** field. Least support (47%) for emphasizing **CVZs**.
Minimal support (15%) for weighting toward one hemisphere.

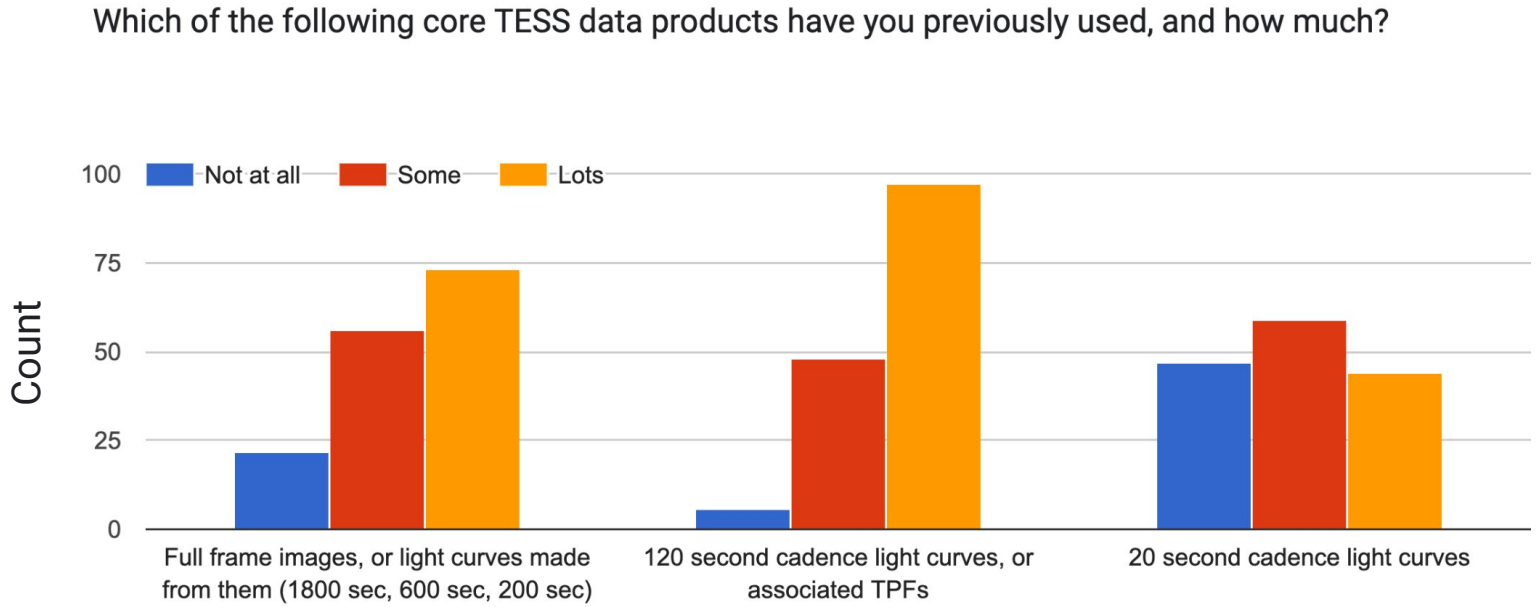
Please indicate your preference for **where in the sky** TESS should focus its observations in **2025-2028**. "CVZ" refers to the continuous viewing zones.



The **CVZ** should receive preferential weight.

I have no preference; anywhere that meets engineering constraints is fine

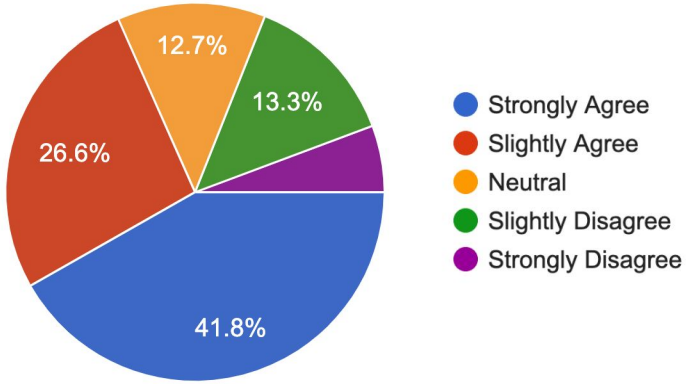
Extended Mission: Observing Cadence



Most respondents use 120-second data (90%), many use FFI data (80%).

Extended Mission: Observing Cadence

I can accomplish my science using 200 second cadence light curves, assuming they were produced in the same manner as 120 second cadence light curves produced by the TESS Science Processing Operations Center (SPOC).



Most respondents (68%) can accomplish comparable science at 200 second cadence as at 120 seconds. Yielded high priority recommendation: “The TUC recommends that the TESS Project increases production and archival of mission-generated SPOC FFI light curves”

Community Survey Summary

- *N* = 160 (83% faculty / staff / postdoc)
- Mostly stellar and exoplanet communities (55% TASC; 30% TFOP)
- Strongest support within surveyed sample for:
  - ➢ Strategy similar to past, but filling gaps and extending sector duration.
  - ➢ Increased production of mission-generated FFI light curves.
- Some support for:
  - ➢ Observing strategy that considers PLATO.

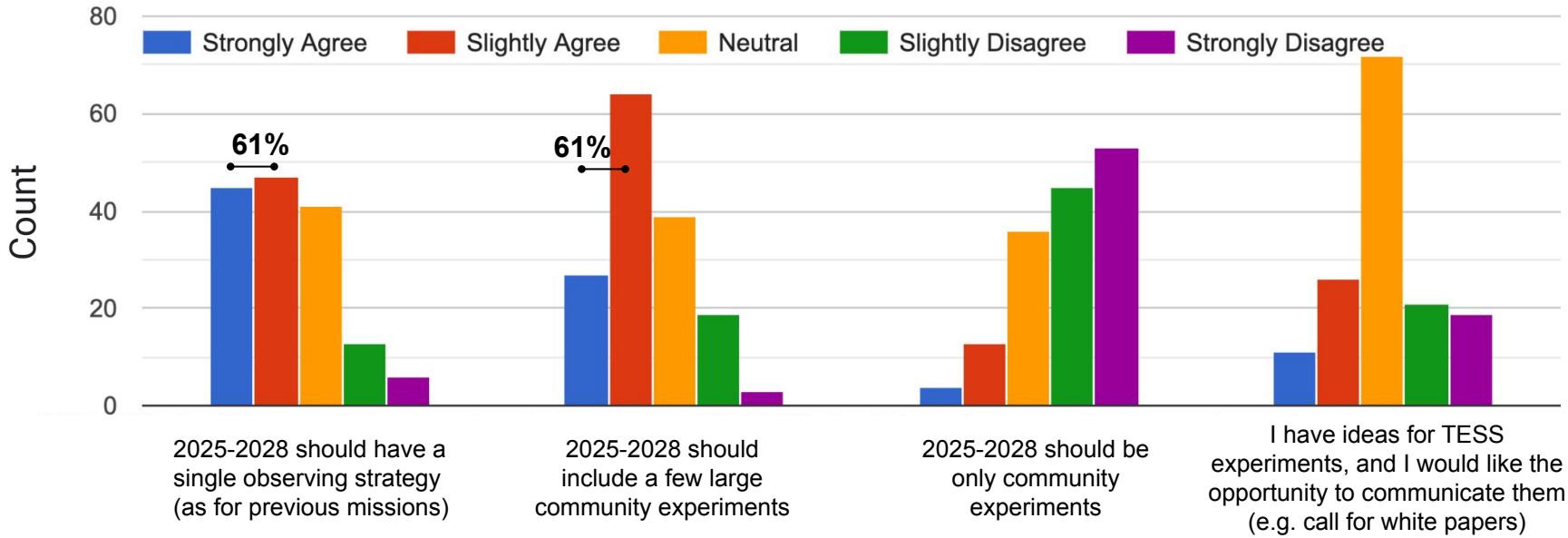
QR for questions

QR for questions

Bonus slide
for community survey results

Extended Mission: Observing Strategy

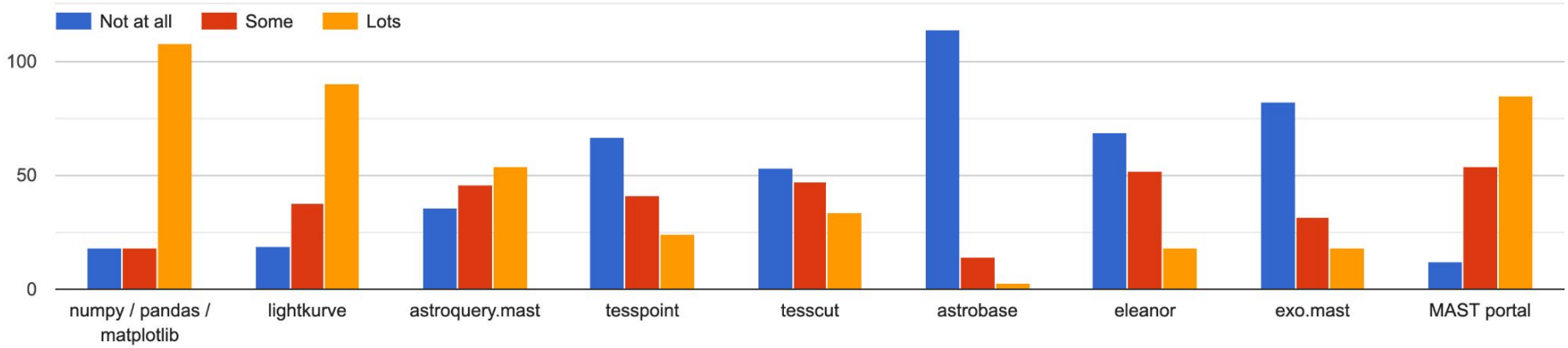
Between 2025-2028, one possible approach for pointing TESS could be to perform a single coherent observational strategy[…] Another possibility could be to spend two years on a coherent strategy, and to spend one year on a few large, community-proposed experiments. Such experiments could encourage novel pointing strategies, subject to engineering constraints. [...] Please indicate your preference for such observing strategies.



Strongest support for single coherent observing strategy.
Some support for limited community experiments.

Extended Mission: Tools and Data Products

Which of the following software tools do you or your collaborators use to analyze TESS data, and how much?



Discussion: Community uses a variety of software tools, including those developed by the community. Supports recommendation to maintain community-produced software (TUC recommendation #5)

GI Program

If you answered "Slightly Disagree" or "Strongly Disagree" to the previous question, please feel free to elaborate here:

Nice to have an archival category. I know they want us to go to XRP/ADAP, but HST/JWST have archival and TESS has a butt-load of archival data. Be nice if there were a category for different kinds of observing patterns (cadences, on-chip binning, pointings, etc).

Currently not possible to propose large multiwavelenth programs or surveys. Esp. for unique capabilities at Xray or UV wavelength, one would have to go through Swift, HST, Chandra, call for proposals, etc.---but weighing the science case by including TESS is questionable in the outside calls.

Joint programs help, but they are relatively limited in scope.

I am not an an institution with students, so ,y minimum fundable unit is a postdoc, and that doesn't fit into any but the key programs which are offered rarely.

The community needs funding streams for intramural (NASA/MIT) and extramural (university/institute) methodological advances for TESS light curve analysis (i.e. alternatives to TOI approaches). The quality of TOI lists is not high enough today.

The categories have been useful, but I would be interested in larger (than small) options for developing light curves and tools that can benefit the community

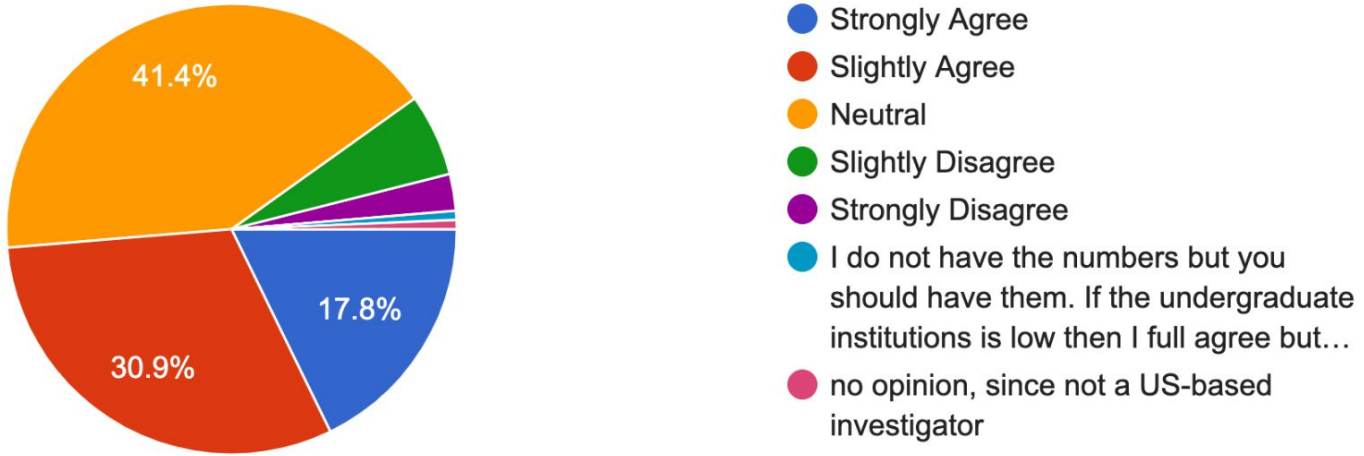
A medium funding category would allow for more substantive investigations as the large programs are much less likely to be funded.

High-level summary: Community supports this idea (<10% slight or strongly disagree)

GI Program

The TESS GI program should consider including dedicated funding initiatives that aim to increase the involvement of primarily undergraduate institutions (PUIs) in TESS science investigations.

152 responses

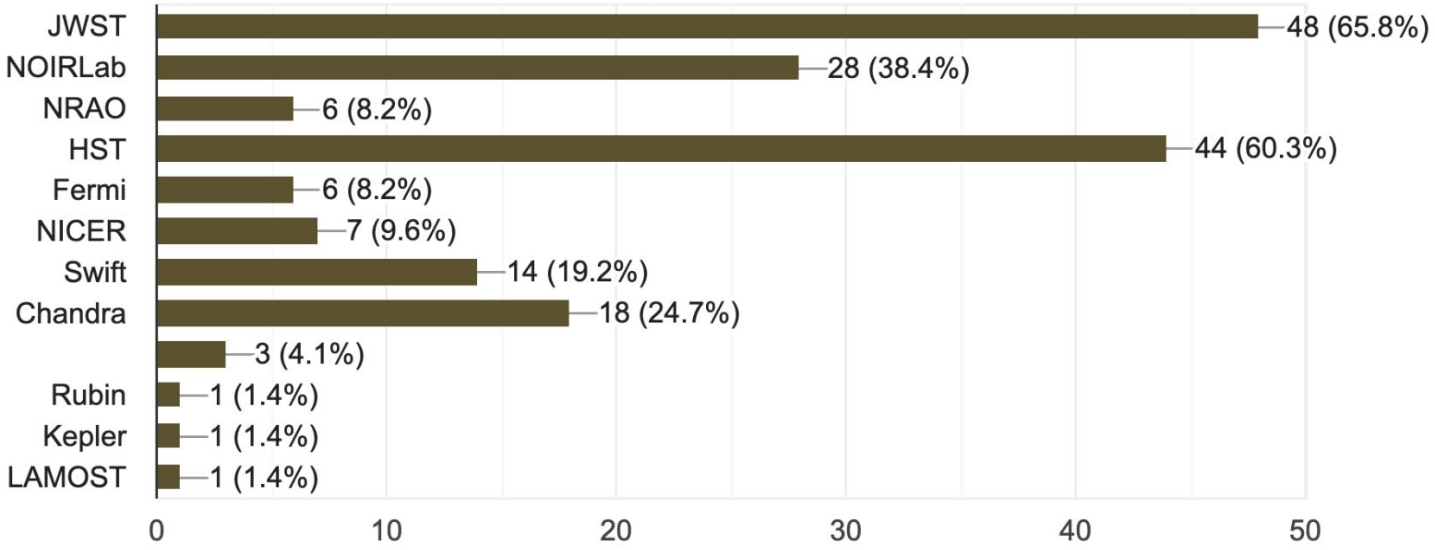


High-level summary: Community supports extension of coordination with other facilities

GI Program

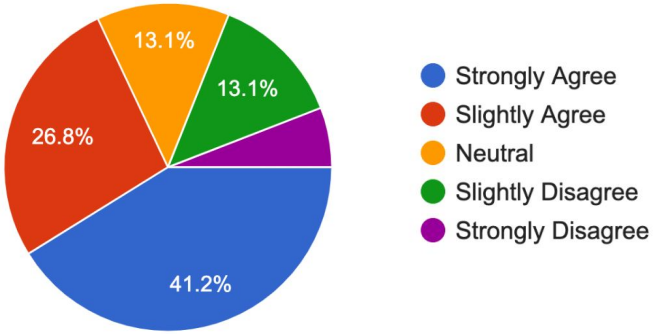
The TESS GI program currently enables coordination with facilities including HST, Fermi, NICER, and Swift. Would your science be supported by coordina...ditional facilities? You can check multiple boxes.

73 responses

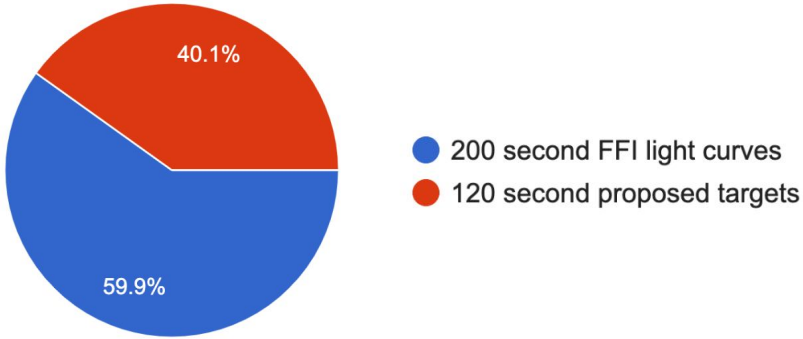


Extended Mission: Observing Cadence

I can accomplish my science using 200 second cadence light curves, assuming they were produced in the same manner as 120 second cadence light curves produced by the TESS Science Processing Operations Center (SPOC).



Which SPOC-processed light curves would you rather have, assuming only one can be available?



Significant support (60-70%) for SPOC-produced FFI light curves. The TUC noted that the first question should be given more weight since it does not make a distinction between proposed and non-proposed targets. Discussion of results was used to formulate TUC recommendation #12 (addendum).

QR for questions

QR for questions

Community Science Pitch Summary

Allison Youngblood
TESS Project Scientist
NASA/GSFC

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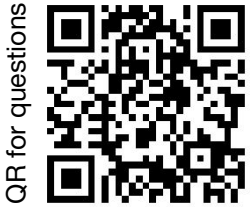


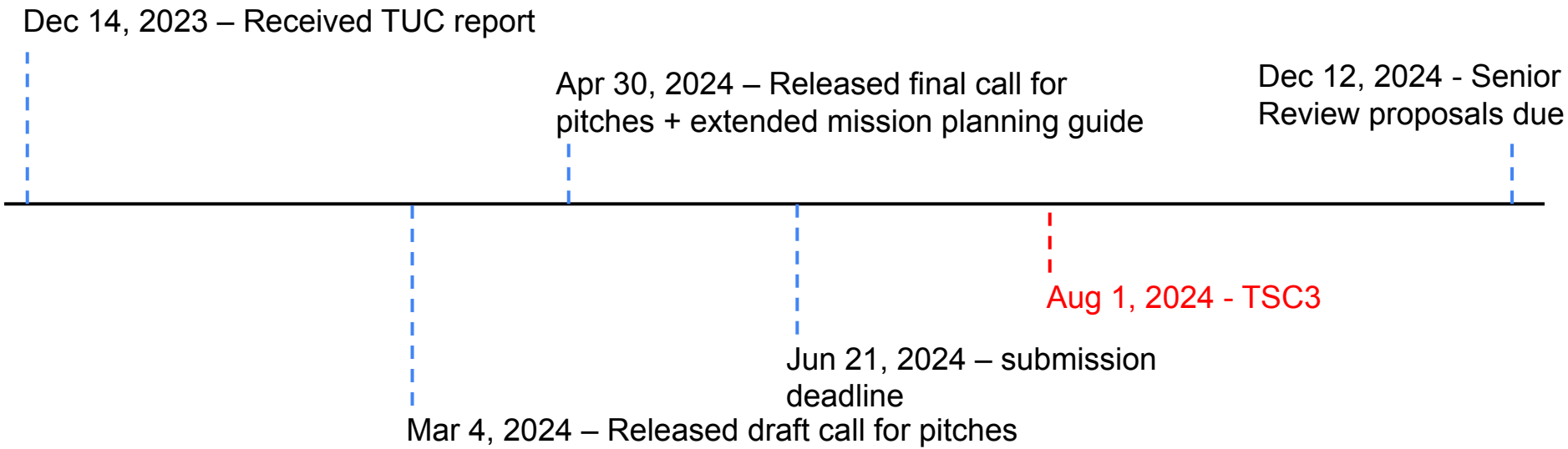
TUC recommended call for science pitches

2. The TUC recommends that the TESS project organizes opportunities for community participation in the EM planning process. The committee strongly endorses increased community participation in the upcoming EM3 planning process. Community engagement on this topic could come in the form of a call for white papers for EM3 observing concepts, a form asking for the submission of brief "science pitches" for EM3 concepts (akin to the process used for core community survey science pitches by the Roman Mission), a dedicated discussion at special sessions during the 2024 AAS meetings, or an extra day at the 2024 TESS Science Meeting. Communication of the technical feasibility of possible observing scenarios (see recommendation 1) to the community is an important prerequisite for this process, and should be prioritized.

See full report at: https://heasarc.gsfc.nasa.gov/docs/tess/TUC.html

QR for questions

Community input timeline to senior review planning



See the final call for community input text: https://heasarc.gsfc.nasa.gov/docs/tess/docs/call-for-community-input.pdf

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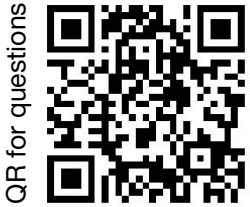


Process for evaluating submissions

- Assembled a team of 12 science and engineering leaders from across the TESS mission team to review submissions and:
  - Identify common scientific and operational themes
  - Synthesize options for operations strategies that would maximize scientific return
- Open discussion at TSC3 (today)

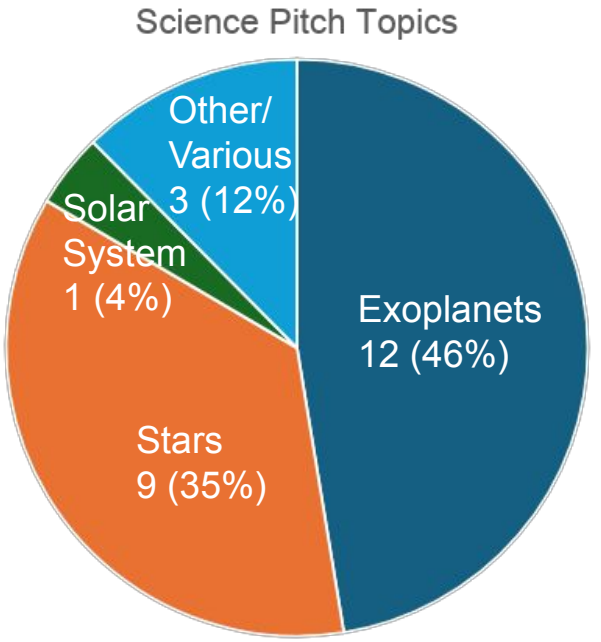
Thank you for taking the time to submit your ideas!

QR for questions

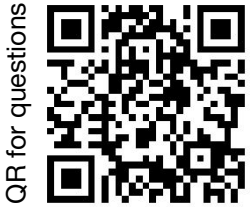
QR for questins

Science themes from submissions

- 26 pitches received from 26 people at 25 institutions across the US, Europe, and Australia
  - Exoplanets
    - long-period temperate or circumbinary planets, completing the census of nearby transiting exoplanets, complementarity to Kepler or PLATO, preparation for HWO, accurate ephemerides
  - Stars
    - long rotation periods, open clusters, pulsations and oscillations, cataclysmic variables, compact binaries, eclipsing binaries, magnetic activity and flares
  - Solar system
    - asteroids
  - Other or multiple topics
    - e.g., exocomets, stars and exoplanets



QR for questions



Operational themes from submissions

- 13 (50%) pitches addressed sector durations
  - 11 called for longer durations, 2 for keeping them as-is
- 9 (35%) addressed cadence and/or data products
  - 3 – keep as-is
  - 3 – reduce aliasing
  - 2 – increase fast cadence slots and/or introduce 2-s
  - 2 – self-consistent data processing
- 16 (62%) addressed pointings – driving factors: open clusters, Kepler/PLATO/Rubin fields, 100% sky coverage, RV follow-up capabilities, individual desired stars.
  - 1 advocated for ecliptic pointings and/or all-sky coverage
  - 4 called for focusing exclusively on a single hemisphere (north or south)
  - 4 emphasized the poles, but 1 pitch emphasized middling latitudes

QR for questions

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Options to consider

Sky coverage

A. “All-sky” – both hemispheres + ecliptic plane (status quo)

B. Focus on single hemisphere + ecliptic plane

Pole centering

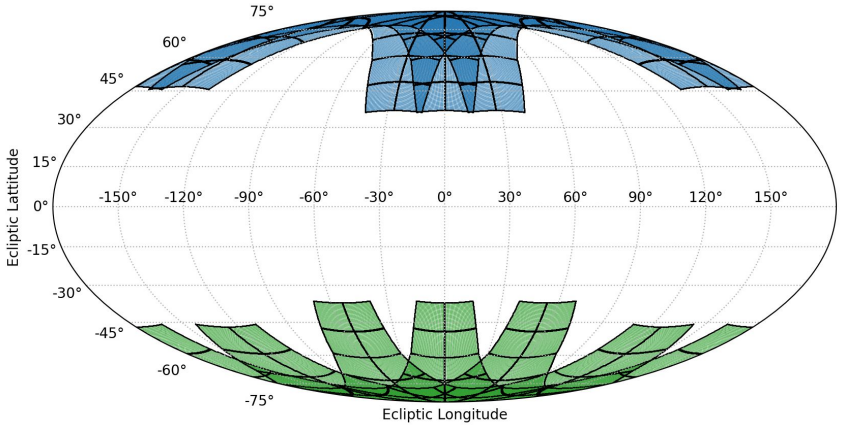
A. Camera 4 centered on ecliptic pole (similar to status quo)

B. Camera 3 centered on pole (C3PO)

Sector durations

A. 27-day sectors (status quo)

B. Longer sector durations (pending analysis by Northrop Grumman)



C3PO pointings in a single hemisphere with 27-day sectors (blue) or 54-day sectors (green). Image credit: Christina Hedges.

QR for questions

Options to consider

+ opinions from mission team

Sky coverage (acceptable options but no consensus)

A. “All-sky” – both hemispheres + ecliptic plane (status quo)

B. Focus on single hemisphere + ecliptic plane

Pole centering (intrigued by Option B)

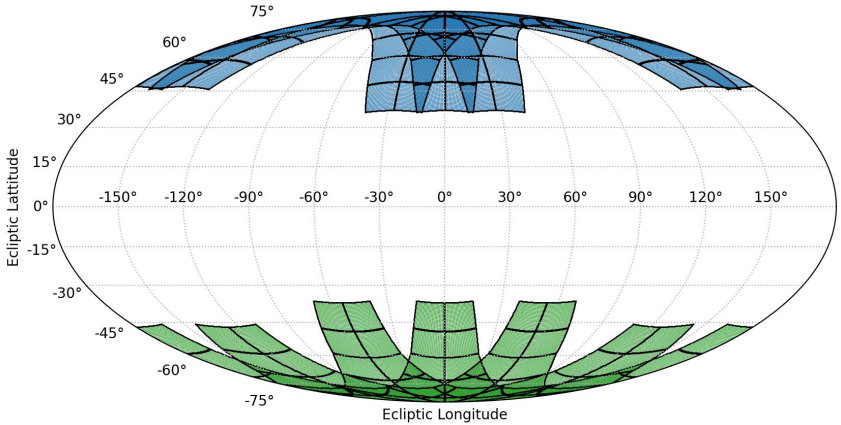
A. Camera 4 centered on ecliptic pole (similar to status quo)

B. Camera 3 centered on pole (C3PO)

Sector durations (in favor of Option B)

A. 27-day sectors (status quo)

B. Longer sector durations (pending analysis by Northrop Grumman)



C3PO pointings in a single hemisphere with 27-day sectors (blue) or 54-day sectors (green). Image credit: Christina Hedges.

TESS Users Committee Session

- **Third TESS Extended Mission:** Where & for how long should the telescope point?
- **Tools & data products:** Should the mission produce different data products?
- **GI program:** Which changes would further enable community science?
- **Other topics:** e.g.: data accessibility, DEIA, TOI catalog, TFOP, ExoFOP, ROSES, MAST

QR for questions

QR for questions