NASA's ExoPAG Study Analysis Group (SAG) 21:

The Effect of Stellar Contamination on Space-based Transmission Spectroscopy

Nestor Espinoza (STScI) & Benjamin Rackham (MIT) on behalf of SAG21

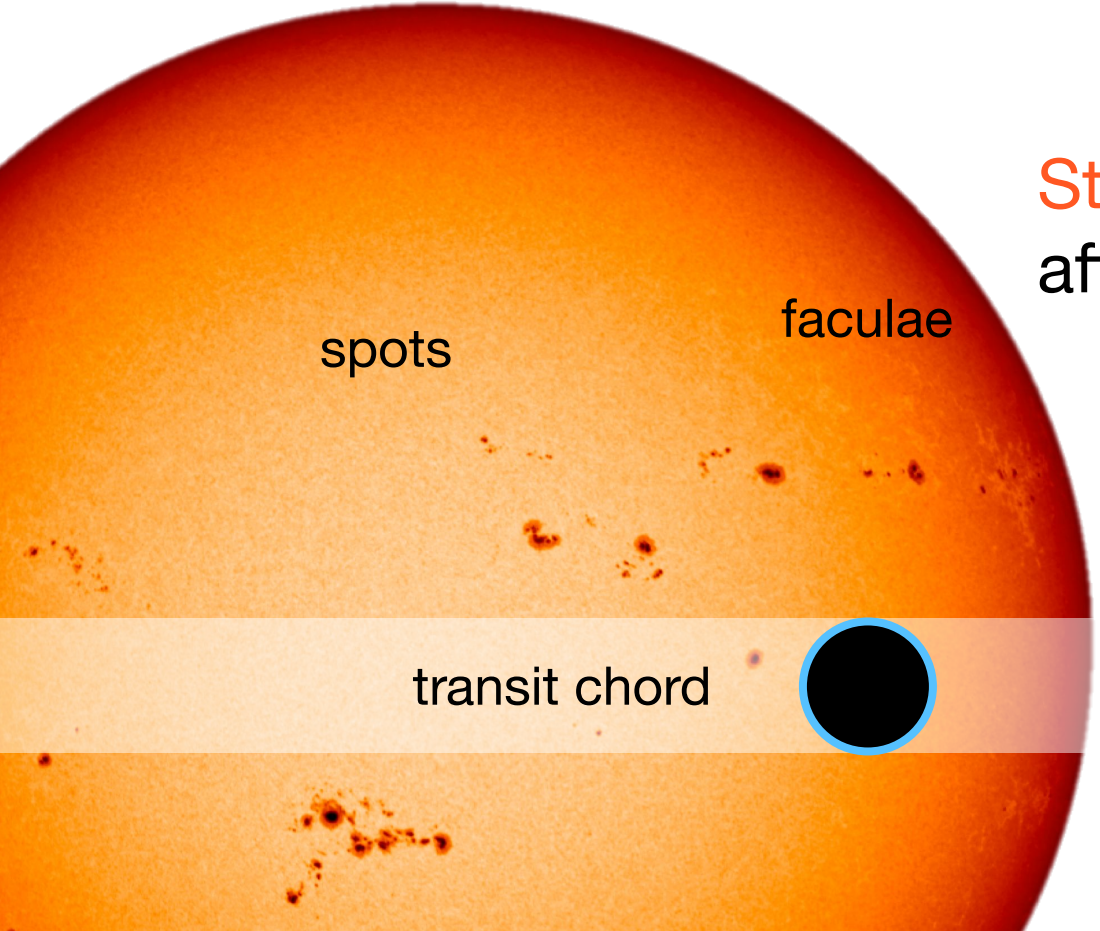
ExoPAG 23 Update | January 6th, 2021

Outline

1. What is and who is part of SAG21
2. Timeline of SAG21
3. Subgroups and Science Questions
4. Community Symposium

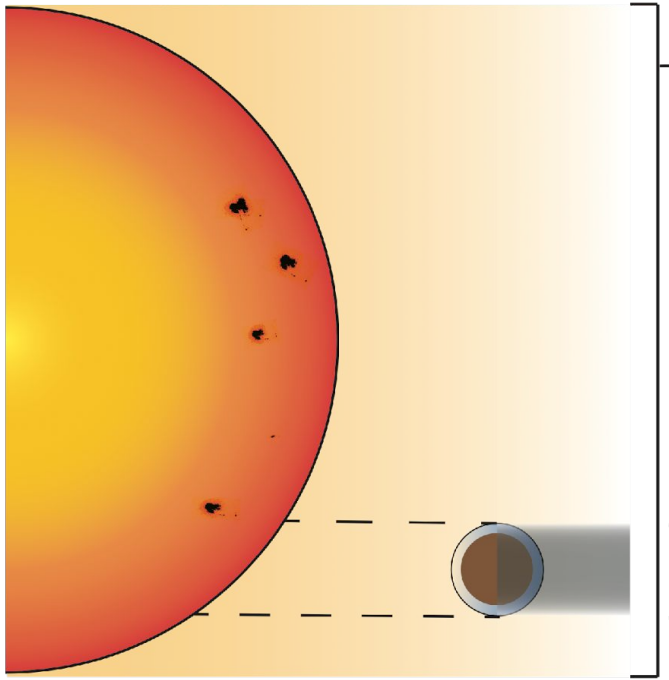
1. What is and Who is Part of SAG 21

The Challenge: "Stellar Contamination"

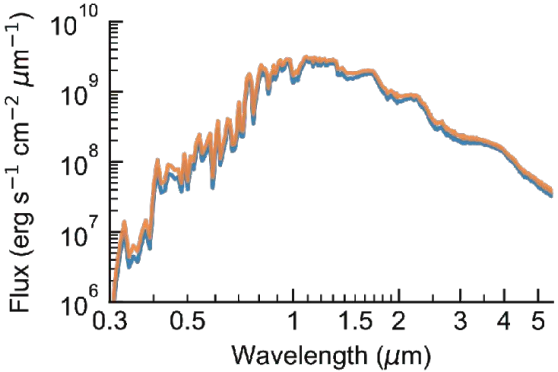


Stellar heterogeneity
affects transits depths too!

The Transit Light Source Effect

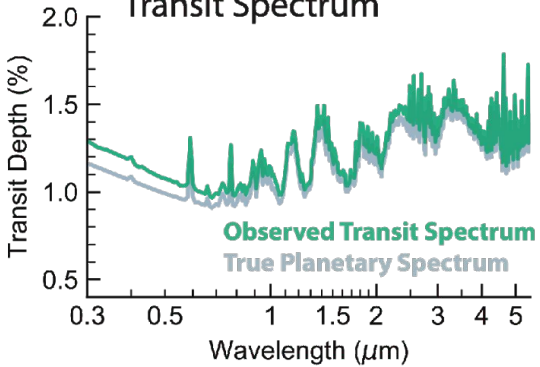


Pre-transit Stellar Disk is the **Assumed Light Source**



Actual Light Source is the Chord Defined by the Planet's Projection

Spectral Difference due to Different Spot/Faculae Contributions Contaminates Transit Spectrum

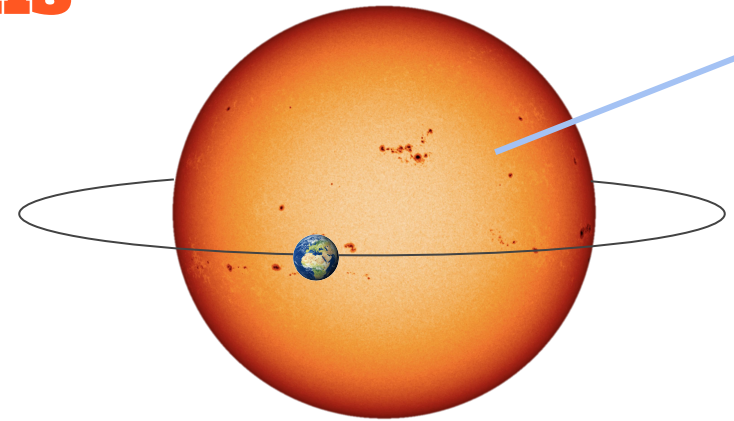


Rackham et al. (2018)

See also: Pont+08, Bean+10, Berta+11, Sing+11, Aigrain+12, Huitson+13, Jordán+13, Kreidberg+14, McCullough+14, Nikolov+15, Herrero+16, Zellem+17

To what extent will this impact space-based transmission spectra?

Goals



What do we know &
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e.g., chromospheric activity, photometric monitoring, polarization

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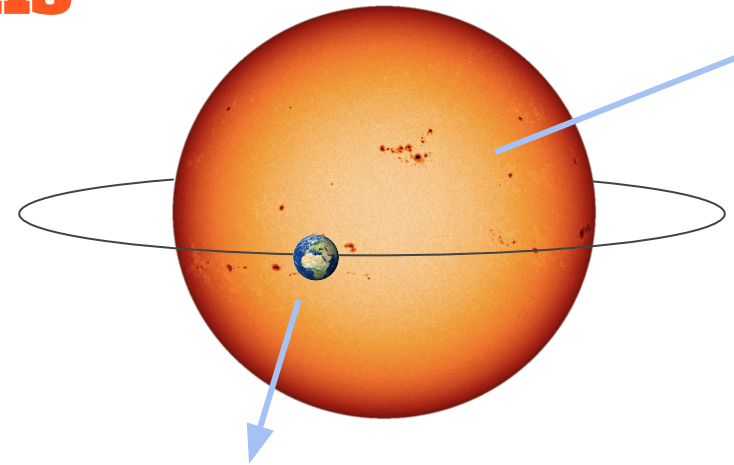

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Planet

e.g., transit spectroscopy

Star

e.g., unocculted surface, occulted active regions, flares.

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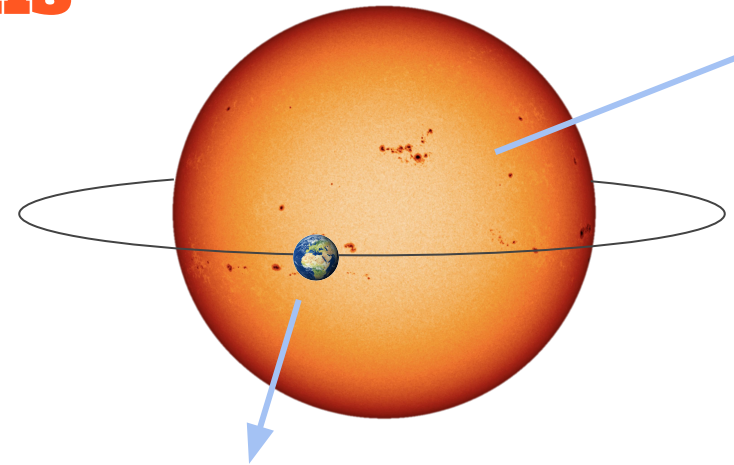

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What will the impact be on future studies?

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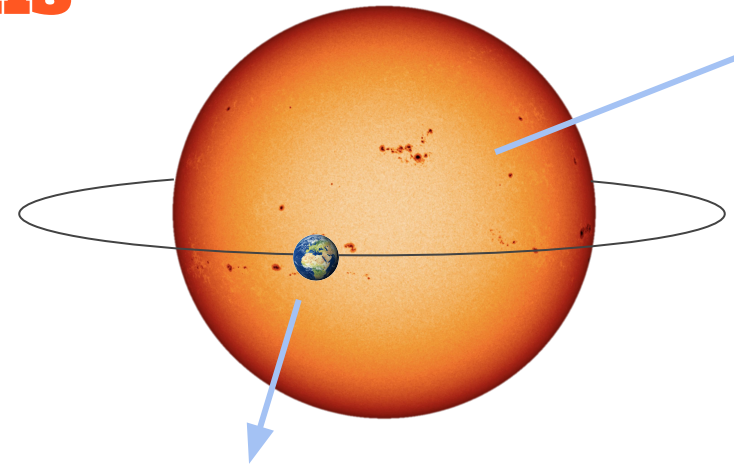

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e.g., transit spectroscopy

Star

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What will the impact be on future studies?

What complementary observations will be useful?

Main deliverable:
SAG21 report to NASA by mid-2021

Current members (106 researchers)

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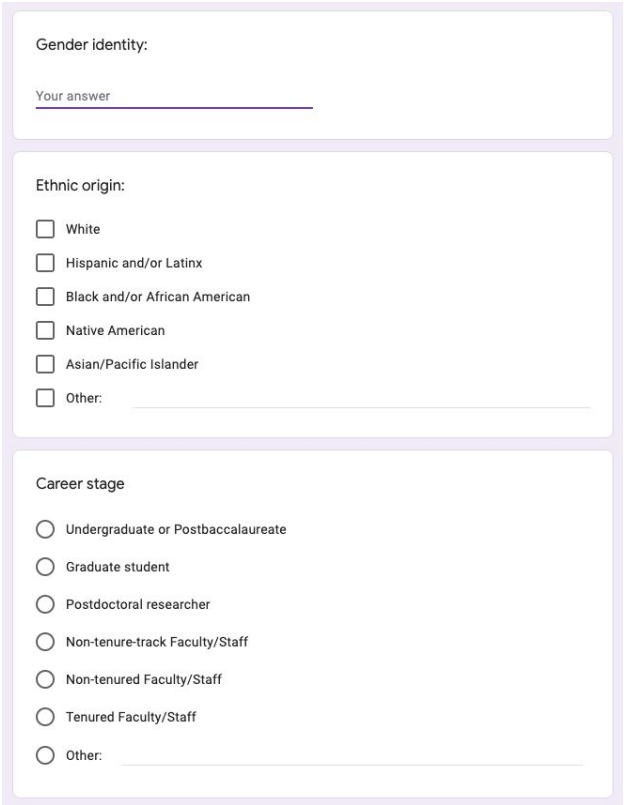

Gender identity:

Your answer

Ethnic origin:

- [ ] White
- [ ] Hispanic and/or Latinx
- [ ] Black and/or African American
- [ ] Native American
- [ ] Asian/Pacific Islander
- [ ] Other:

Career stage

- ○ Undergraduate or Postbaccalaureate
- ○ Graduate student
- ○ Postdoctoral researcher
- ○ Non-tenure-track Faculty/Staff
- ○ Non-tenured Faculty/Staff
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Current members (106 researchers)

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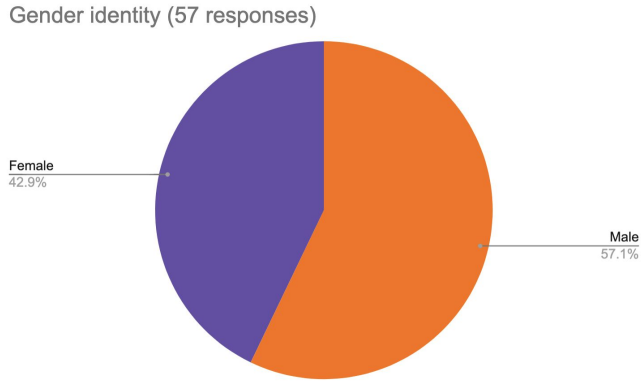
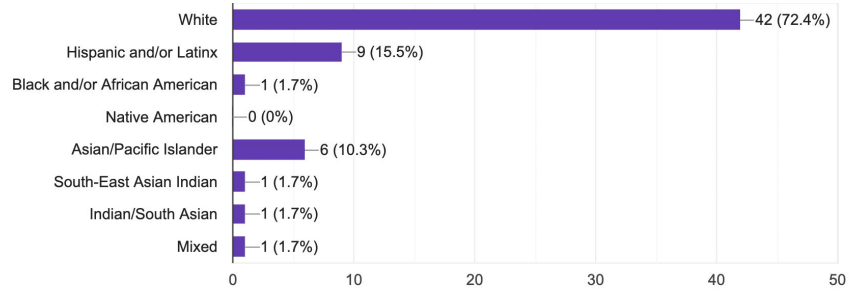


Ethnic origin:

58 responses



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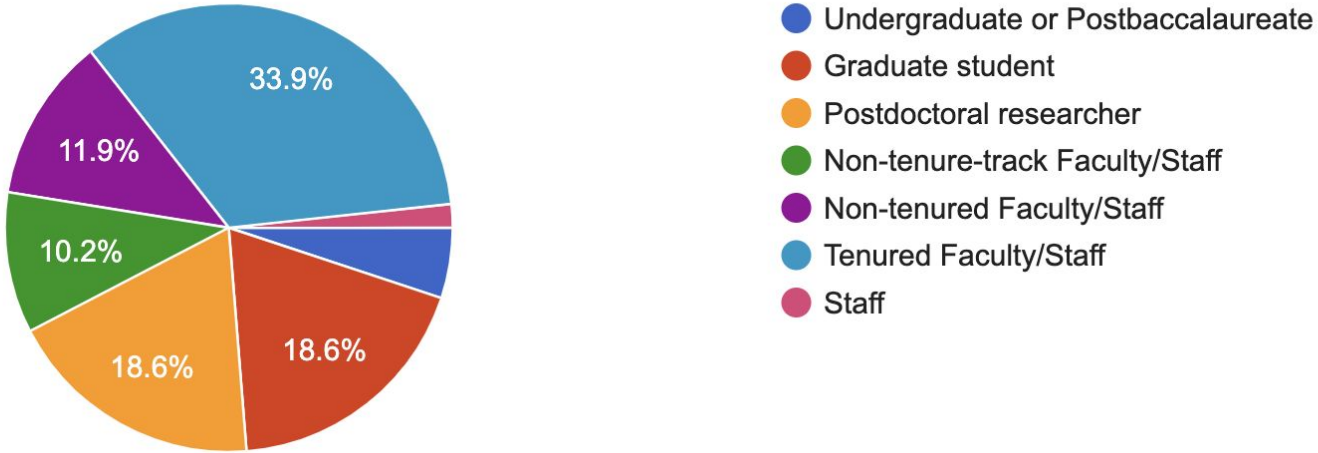
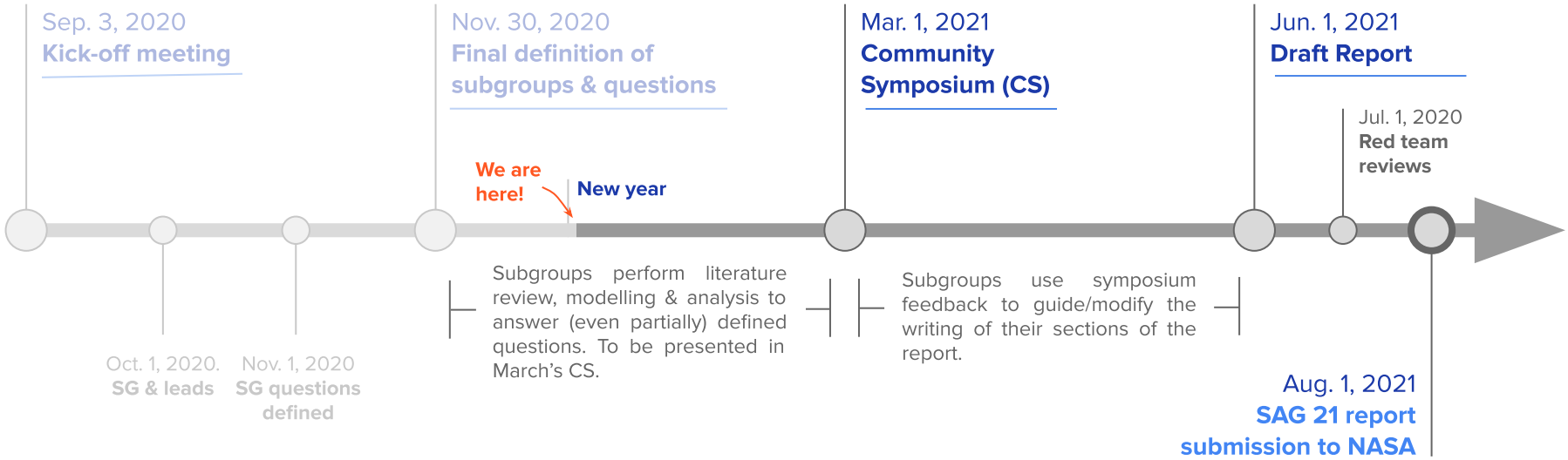


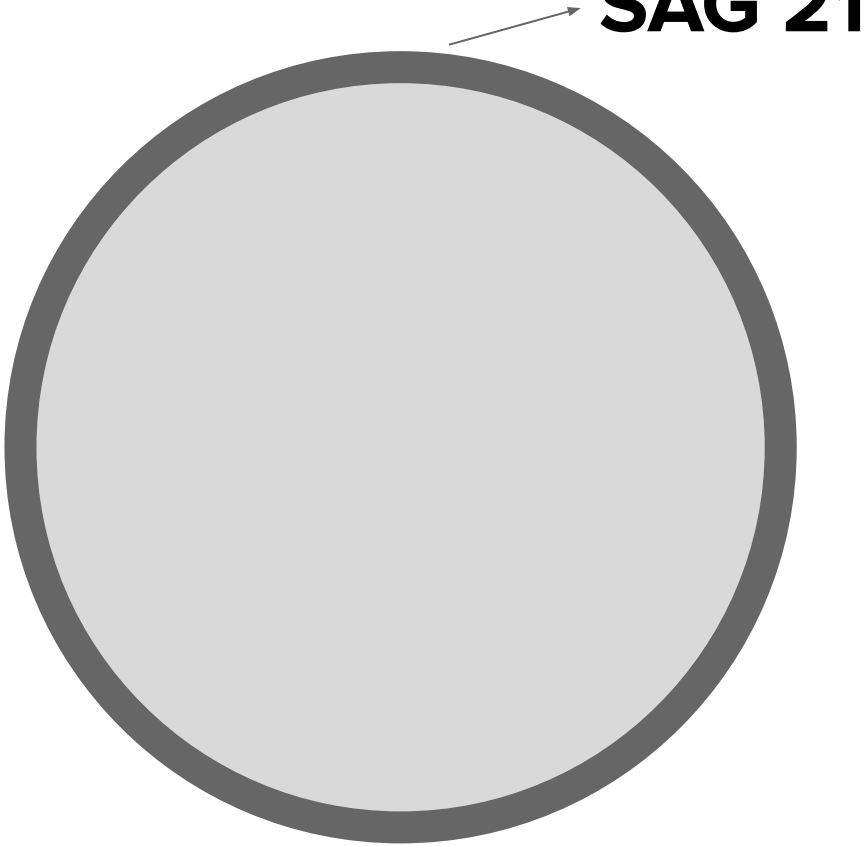
2. Timeline of SAG21

SAG21 Timeline



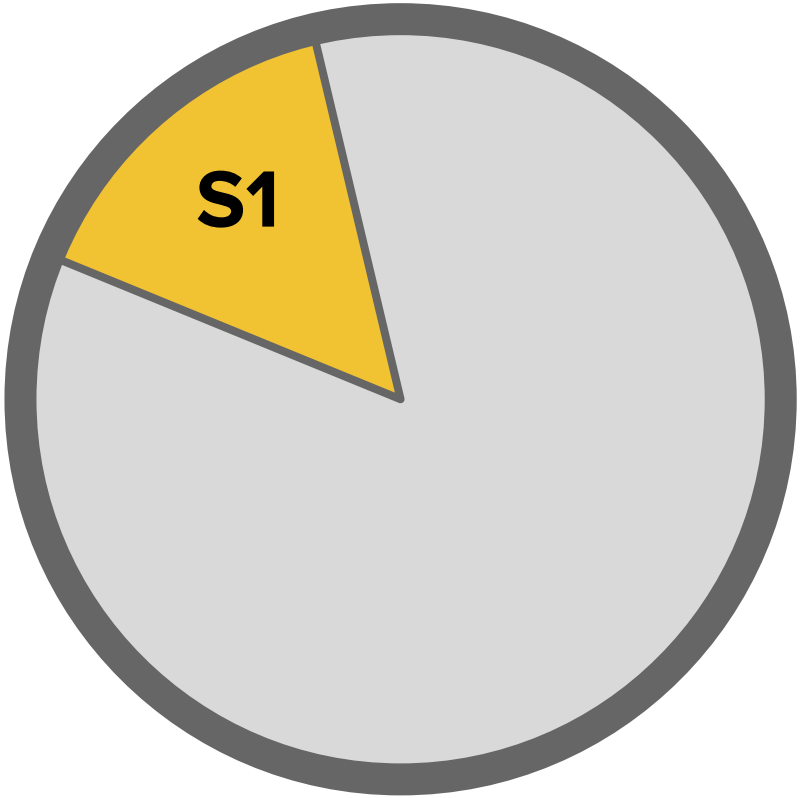
3. Subgroups and Science Questions

Subgroups



S1: Stellar Photospheric Heterogeneity

Leads: Svetlana Berdyugina, Heidi Korhonen & Alexander Shapiro



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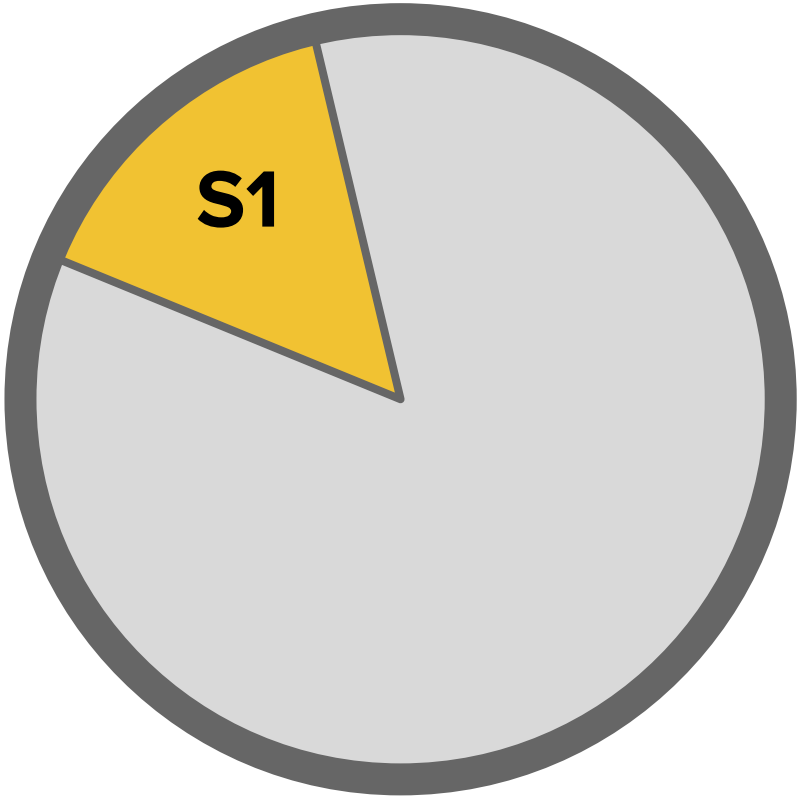
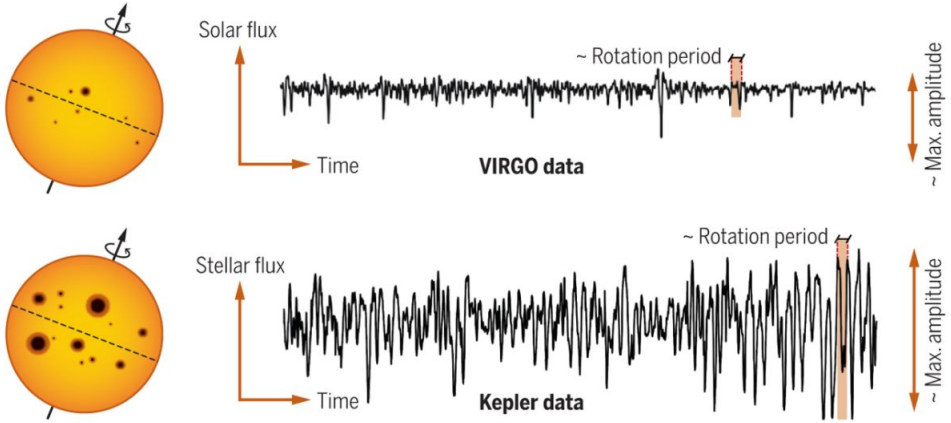


Photometric monitoring

Figure source: Santos & Mathur (2020)



S2: Stellar Spectral Decomposition

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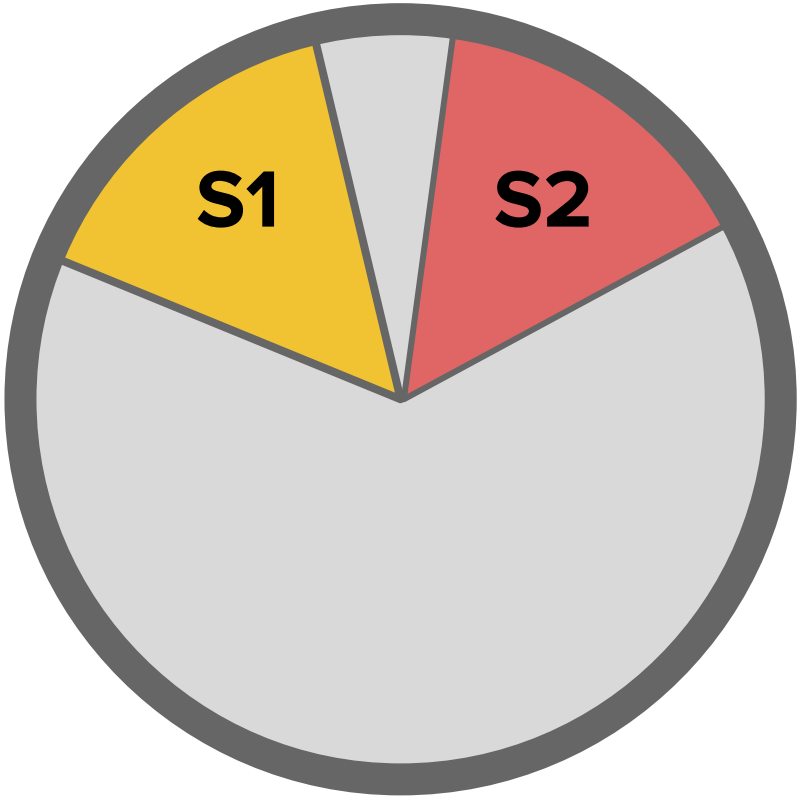

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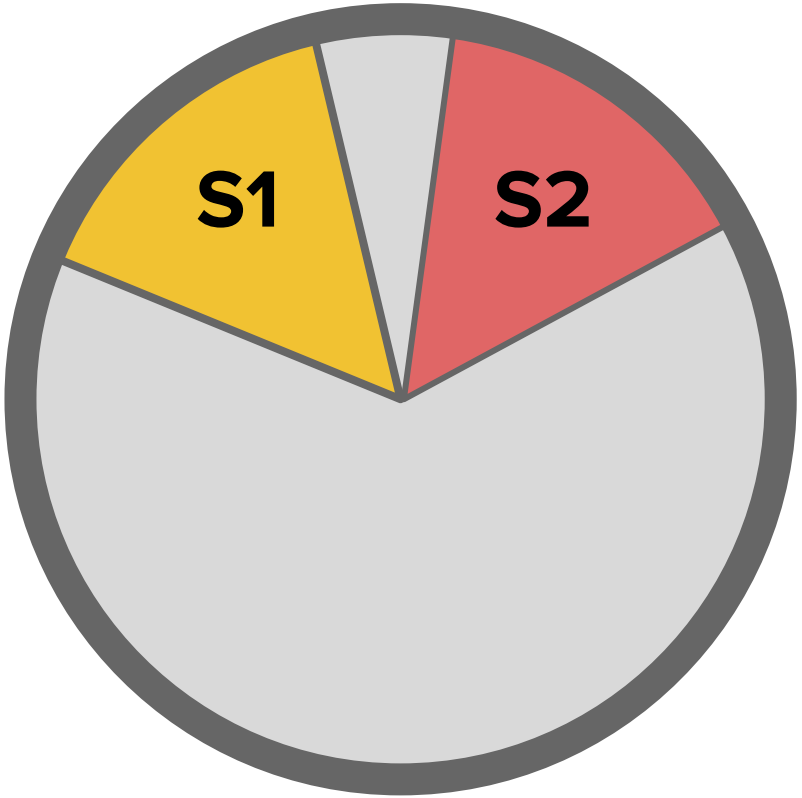
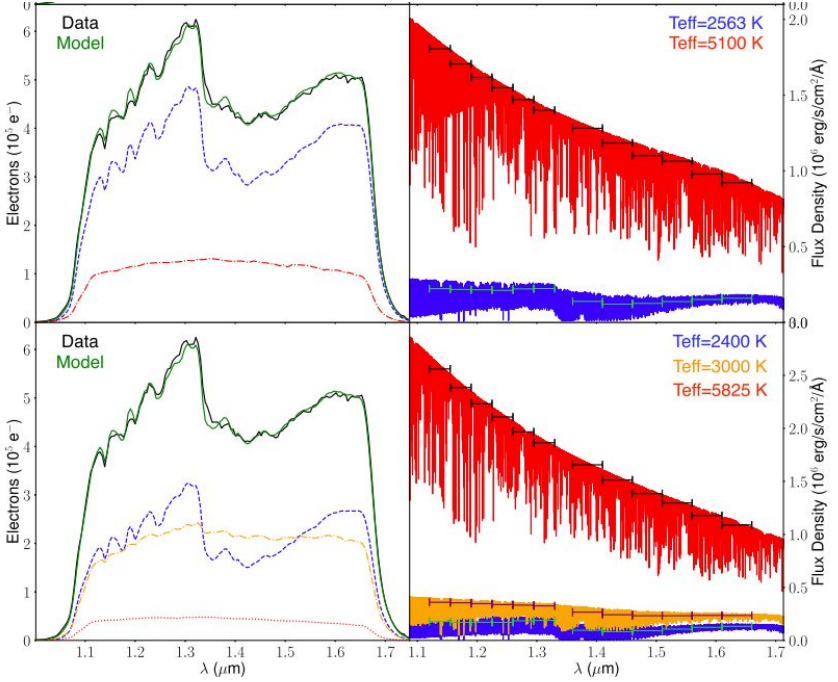


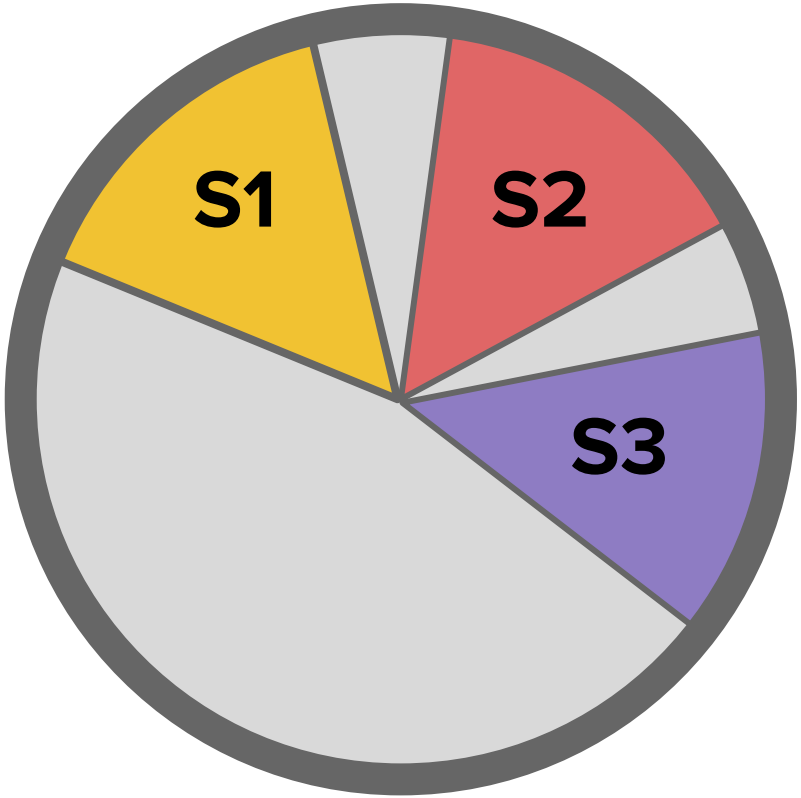
The case of TRAPPIST-1

Wakeford et al. (2019)



S3: Occulted Active Regions

Leads: Mahmoud Oshagh & Brett Morris



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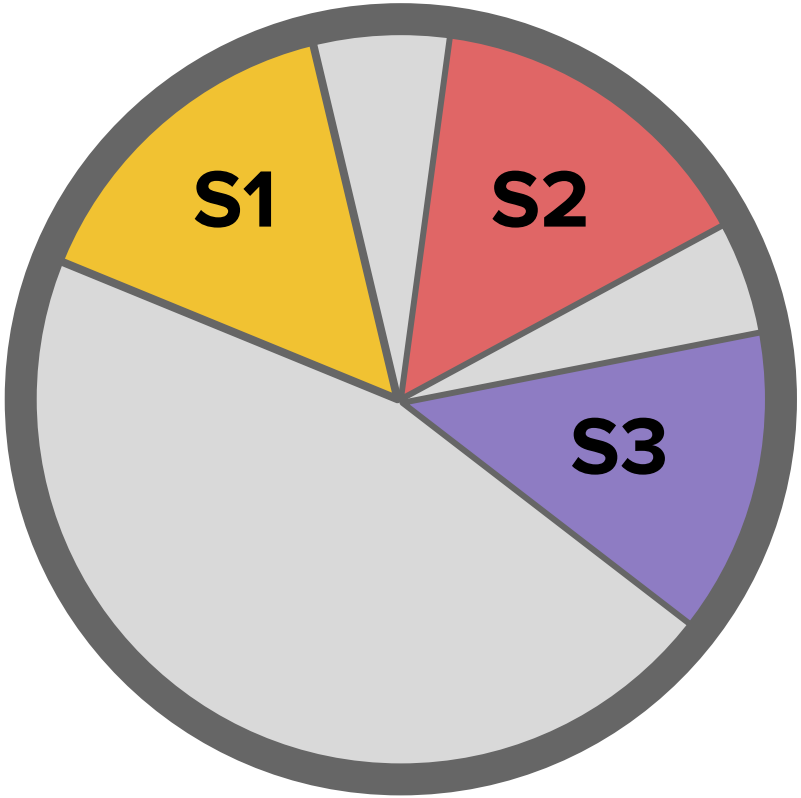
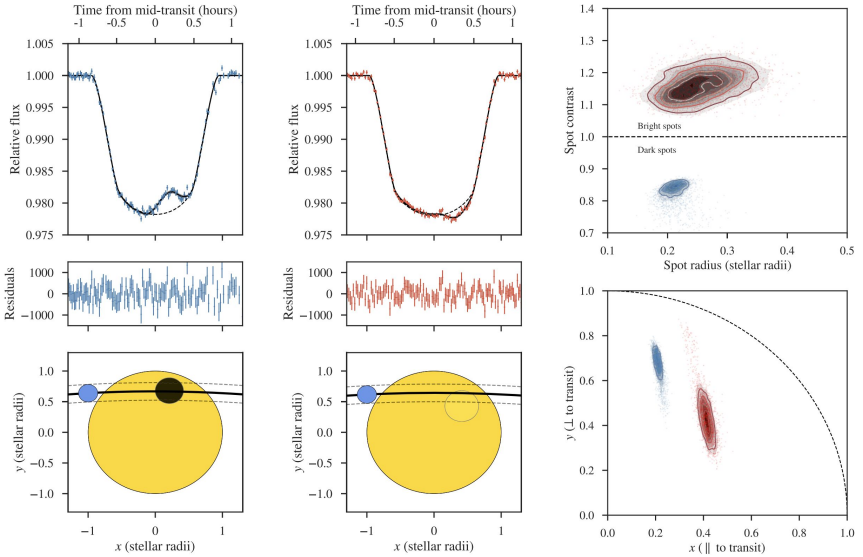


The case of WASP-19b

Figure source: [Espinoza et al. (2019)]



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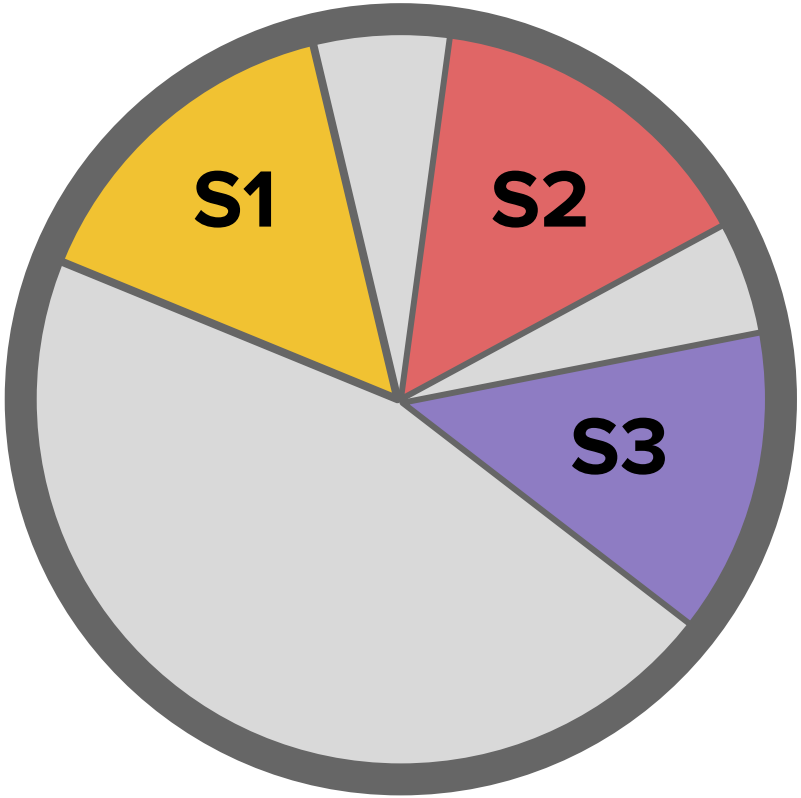

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S4: Unocculted Active Regions

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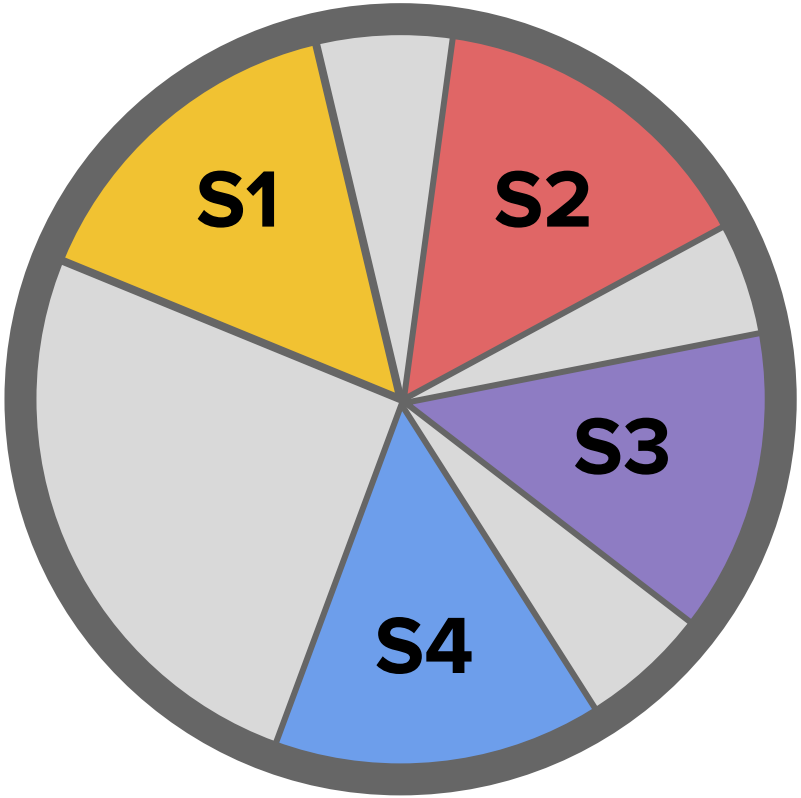

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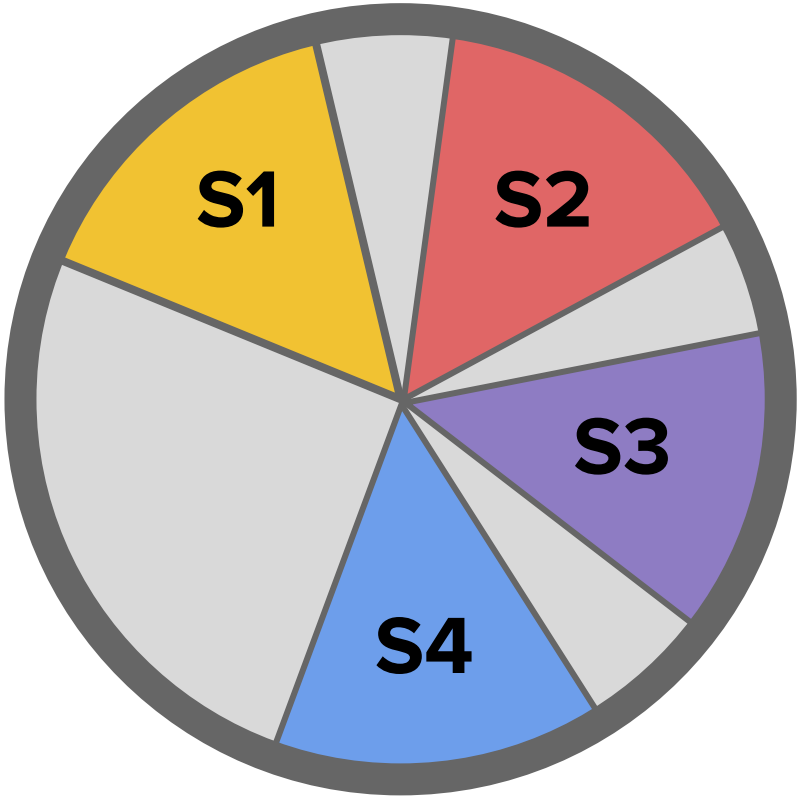
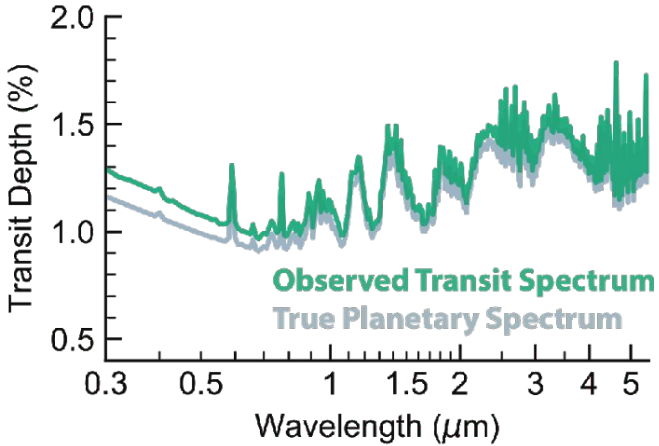


The Transit Light Source Effect

Figure source: Rackham et al. (2018)



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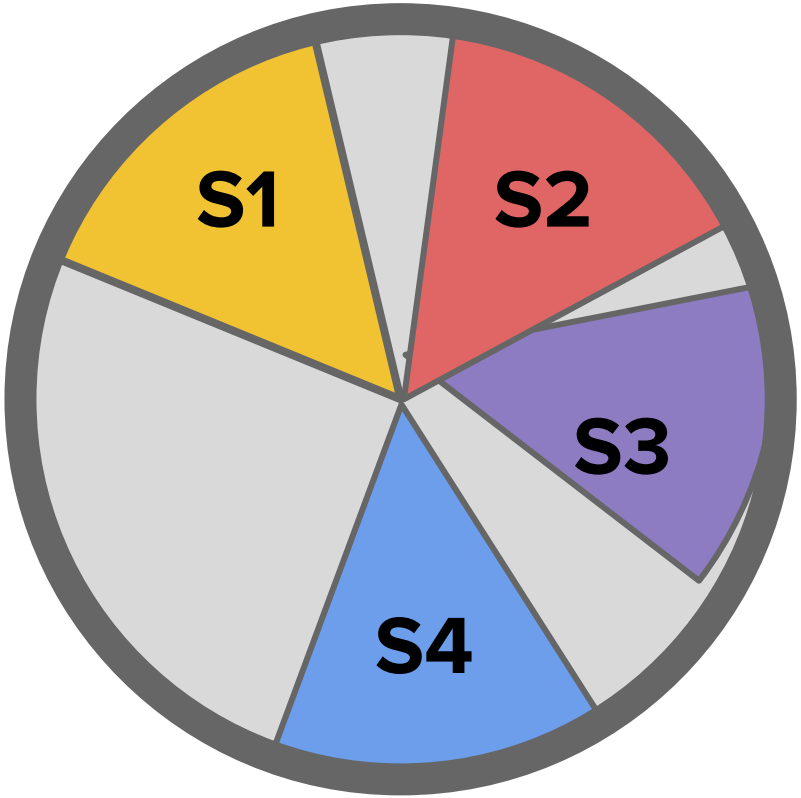
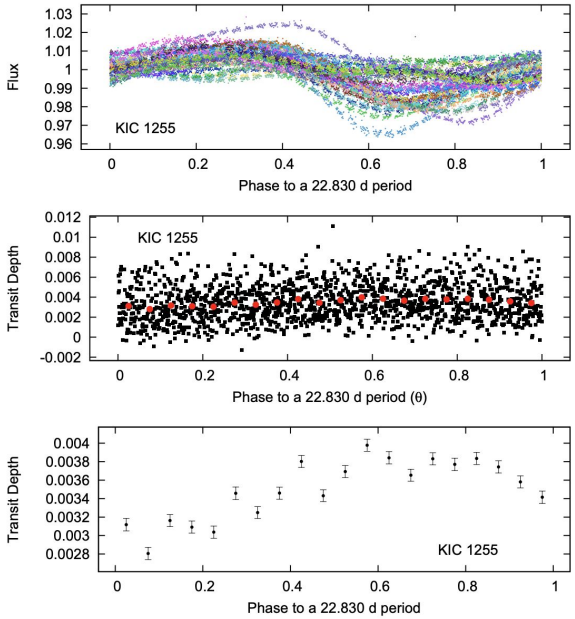


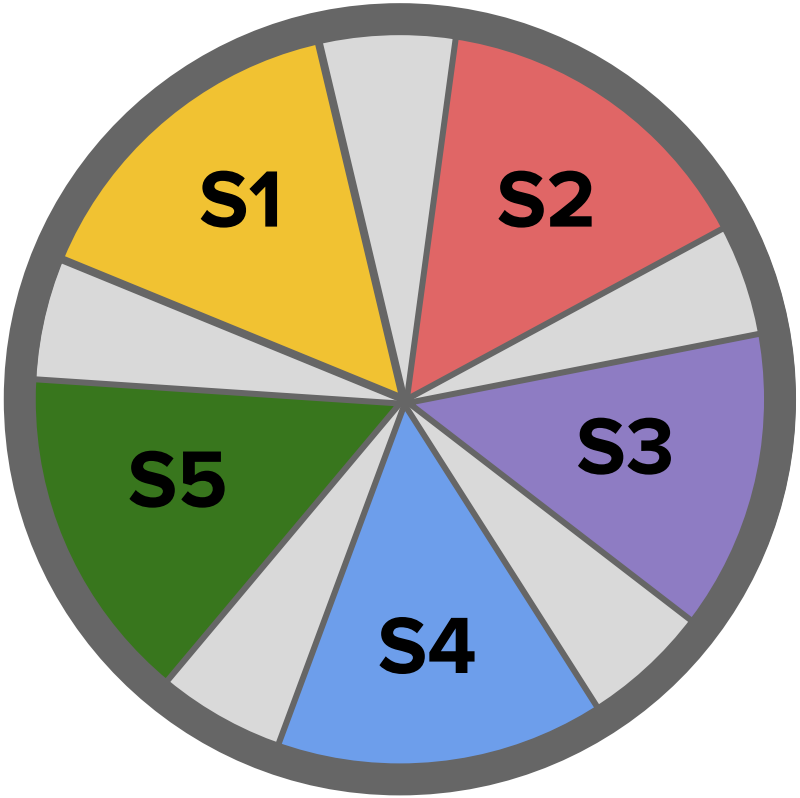
Transit depth variations in time

Figure source: Croll et al. (2015)



S5: Future Complementary Observations

Leads: Elisa Quintana & Rob Zellem



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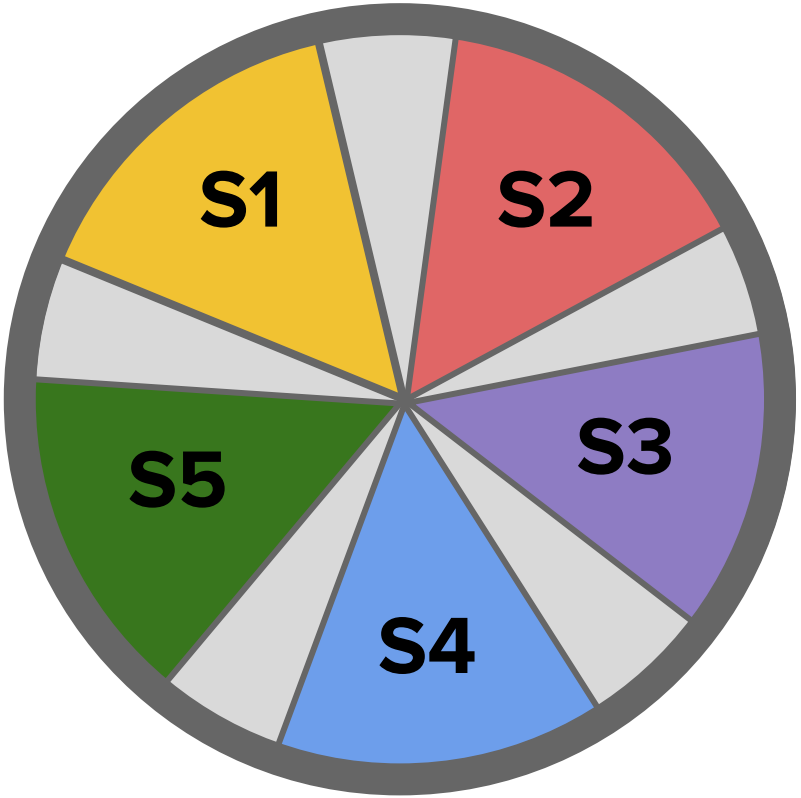
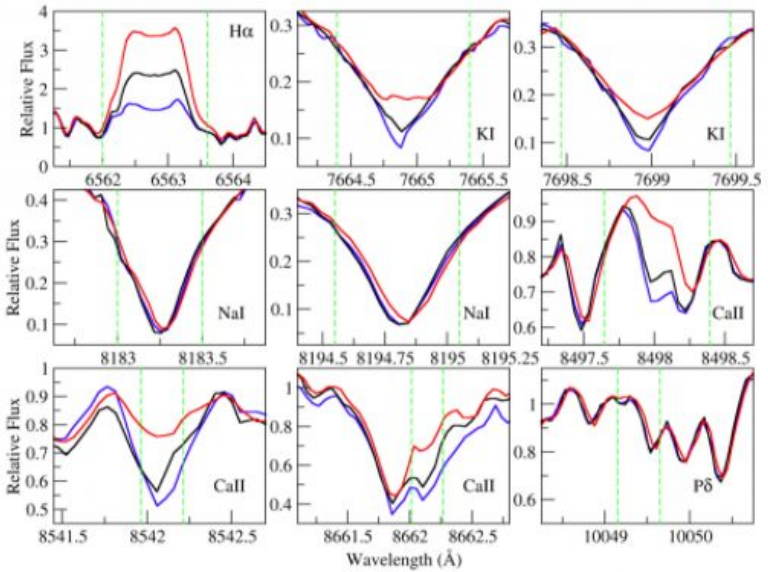


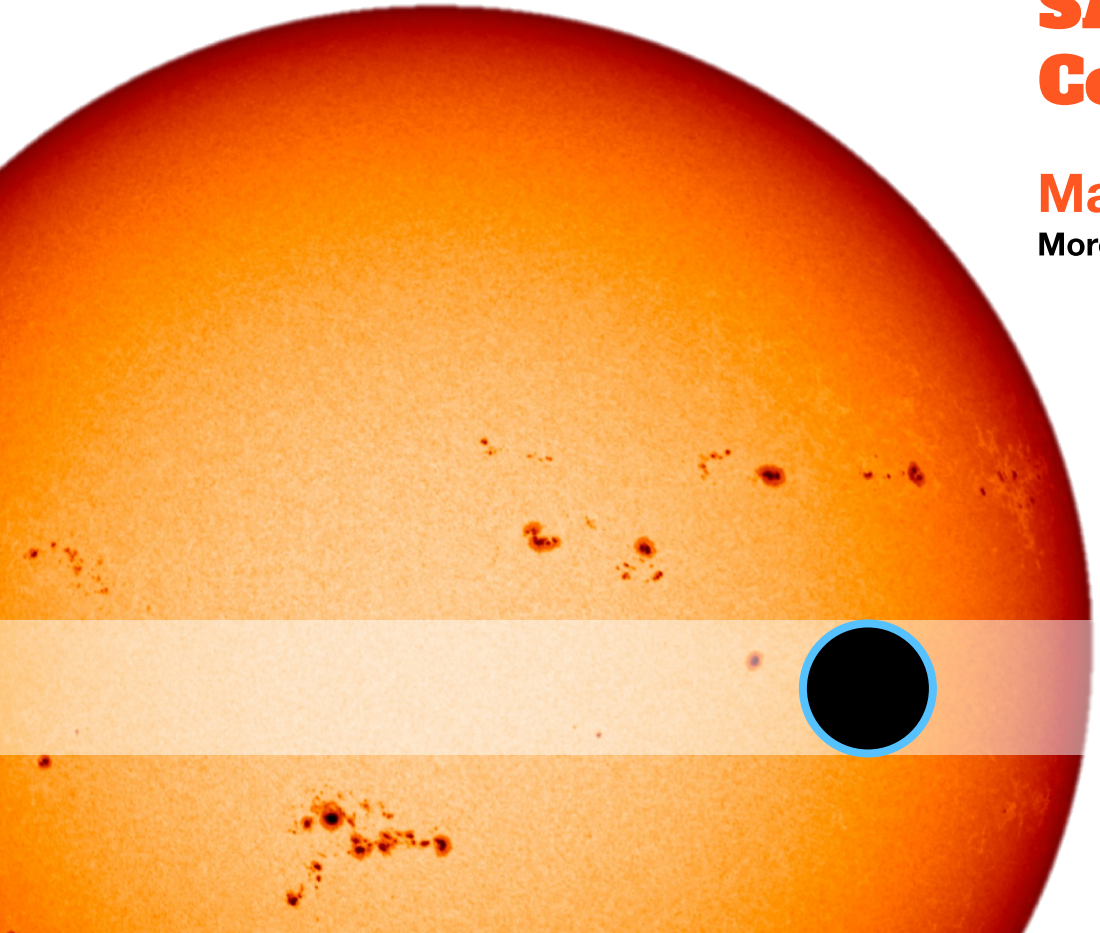
Spectroscopic monitoring

Figure source: Robertson (2016)



All this information (+more):
sites.google.com/view/sag21

4. Community Symposium



SAG21's (virtual) Community Symposium

March 8 and 9, 2021

More info: sites.google.com/view/sag21symposium

Presentations from subgroup leads

Contributed talks from the community

RSVP open!

Summary

1. **SAG21's goal is to deliver a report to NASA by mid-2021:** currently over 100 members, with over 50 "active" members divided in 5 sub-groups.

2. **SAG21 is on track with its self-defined timeline:** currently working on literature reviews, methods & analyses on defined questions.

3. **SAG21's Community Symposium registration is open until January 18th, 2021**: objective is to both share SAG21 work to the community and receive input from it.