ExoPAG 22 Agenda: Friday 2:30-3:30 pm EDT.

- Review SIGs/SAGs.
- Support for planetary decadal survey.
- Proposed discussion on potential “finding”:

  On the value of investing in interdisciplinary exoplanet science of scale over longer periods of performance (see full text shared through ExoPAG Announcement).

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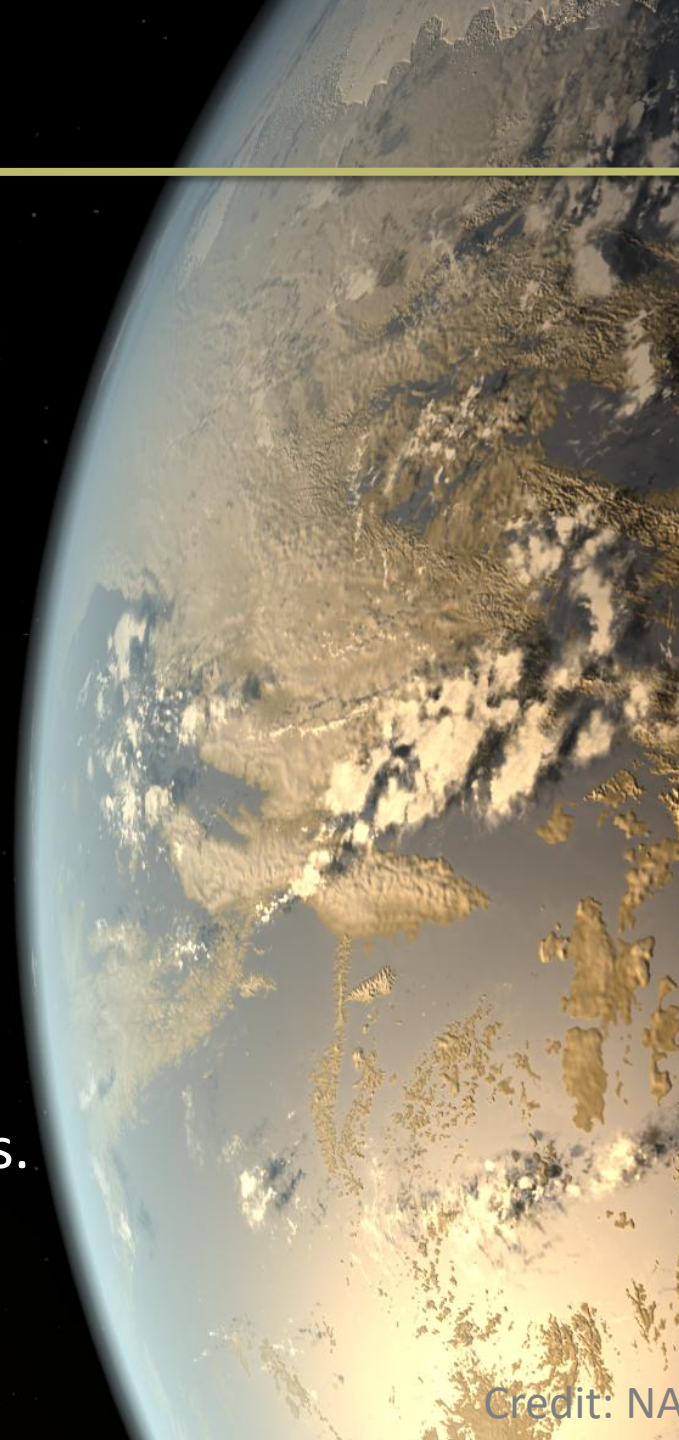

Credit: NA

ExoPAG 22 Agenda: Friday 2:30-3:30 pm EDT.

- **Review SIGs/SAGs.**
  - **SIG2/SIG3 updates (J. Christiansen & V. Meadows).**
  - **SAG-19 update (R. Jensen-Clem).**
  - **SAG 2X/2X+1 (B. Rackham & J. Pepper).**
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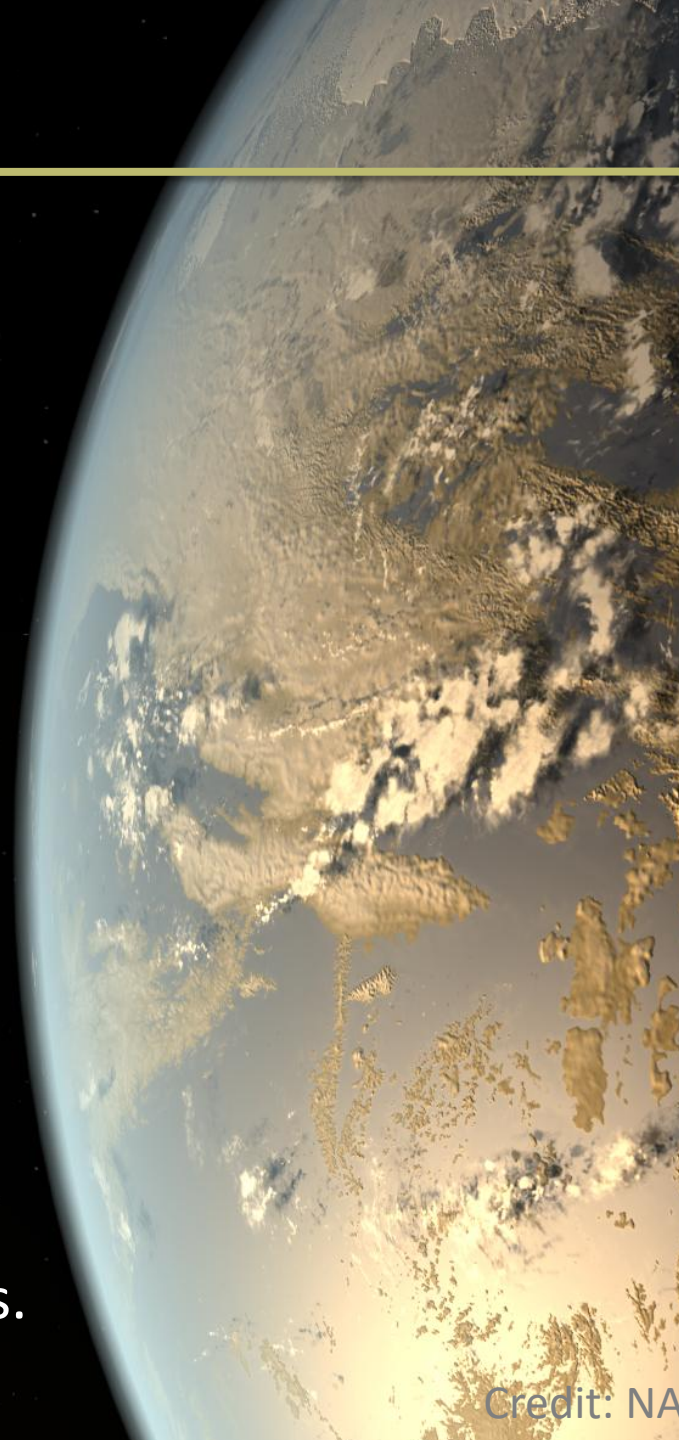
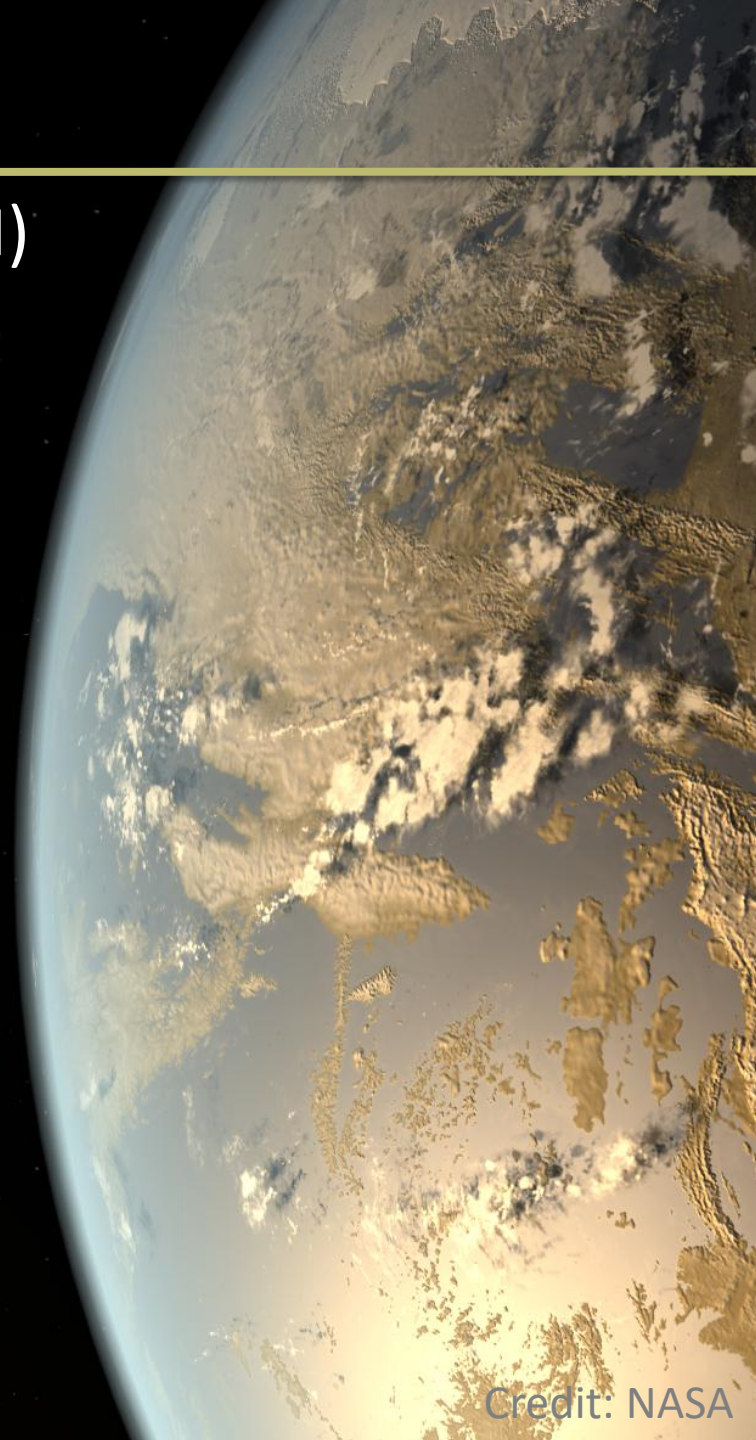


SIG 2 - Exoplanet Demographics

Chairs: Jessie Christiansen (NextSci/IPAC) & M. Meyer (UM)

- Successful symposium at ExoPAG 21 in Honolulu with focus on caution (and convergence) on yield estimates.
- Monthly telecons discuss new demographic results from multiple techniques (radial velocity, microlensing, transit, direct imaging).
- Drafting report on value of public database of demographic products.
- Curating a list of open questions/ongoing projects for the community.
- NextSci is hosting a related workshop in the fall. https://nexsci.caltech.edu/conferences/exodem/



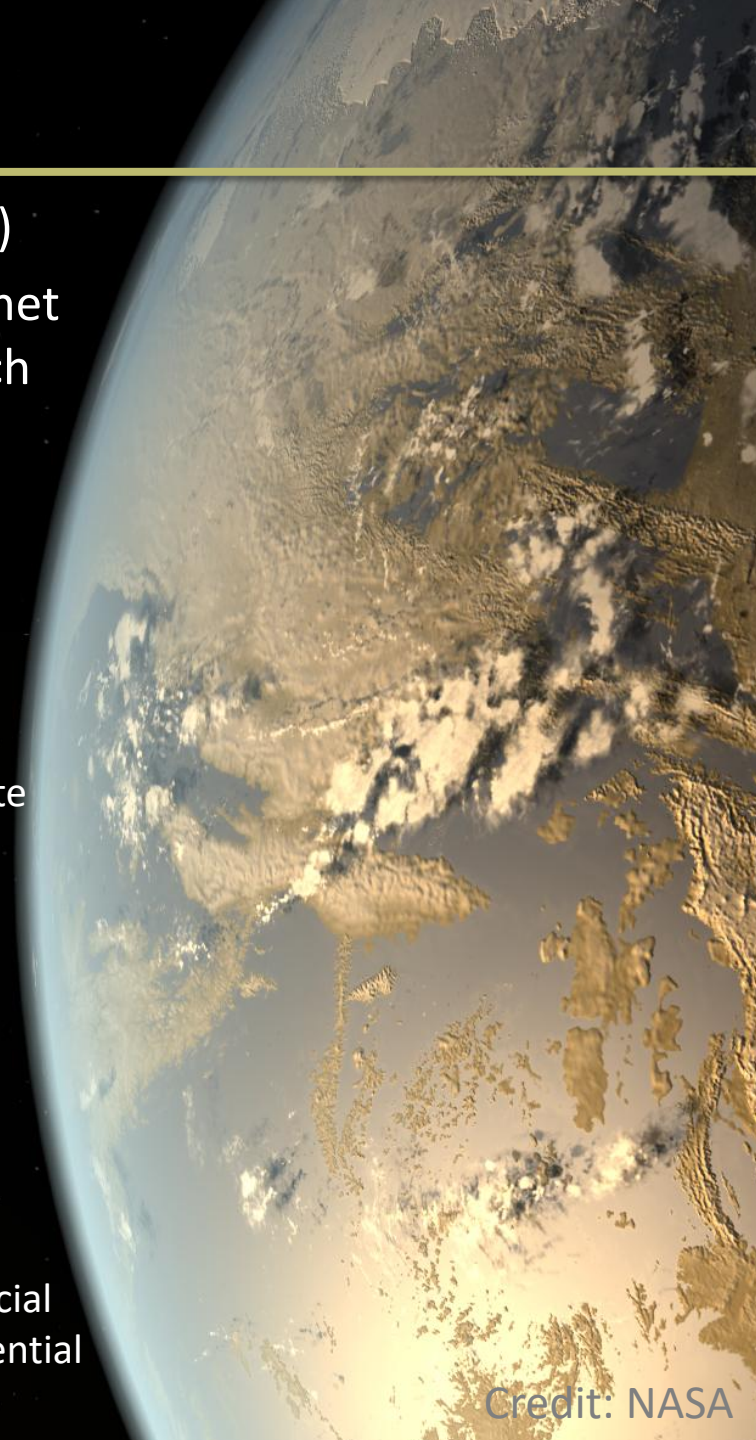
Credit: NASA

SIG 3 ExoSS Goals, Progress, Plans

- **Chairs:** Victoria Meadows (UW/NExSS/ExoPAG), Kathy Mandt (JHU/APL/OPAG)
- **Goal:** To provide a forum for interaction between the Solar System and exoplanet communities on topics of mutual interest, and to work to identify ways in which NASA and the scientific community could enhance these interactions.
- **Status:** The SIG3 is now approved (March 26, 2020) and open to all interested scientific community members (please contact meadows@uw.edu to join)

- Pre-Formation Activities:
  - Exoplanets In Our Backyard Conference, February 5-7, Houston: Findings to HQ and on website
  - ExoSS Slack Channel – all are welcome! (If you would like to join: meadows@uw.edu)

- Current and Upcoming Activities
  - Creation of community document to gather input on ExoSS synergies
  - Promoting community-led Planetary Decadal activities: List of lists - https://bit.ly/3fu6ang
  - Recruiting members from diverse scientific communities.
  - Inaugural SIG3 meeting planned for early July
  - Plan to organize ExoSS webinars, develop joint SIG reports/review papers that identify beneficial avenues for future joint research between the exoplanet and Solar System communities, potential collaboration with the upcoming NExSS Hab Worlds 2 conference.

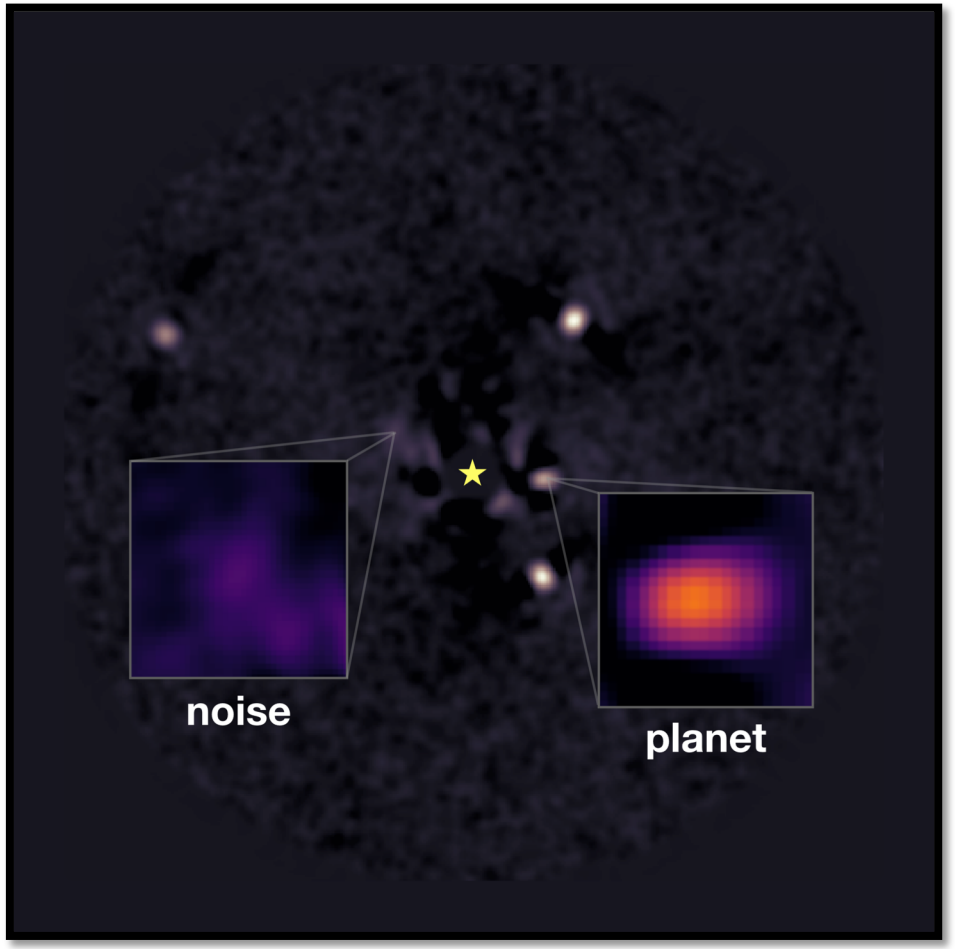


Credit: NASA

SAG-19

HCI Data Challenge for exoplanets

Status, results and future



Team: https://exoplanet-imaging-challenge.github.io/

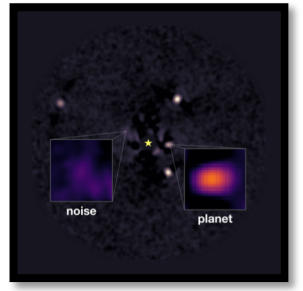
Carlos Gomez Gonzales (IPAG/BCS): Design and coordination
Faustine Cantalloube (MPIA): Design and communication
Raphael Bacher (UGA): Implementation
Correntin Doco (PHELMA): data set pre-processing
Tiffany Meshkat (IPAC): data gathering
Becky Jensen-Clem (UCSC): Testing the submission

→ *Contact us if you want to join !*

zenodo
Data set host

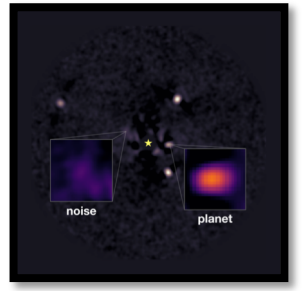
CodaLab
Data challenge host

Context & Goals



- Goals
  - Provide a **library** of pre-processed HCI datasets to test the various algos.
  - Provide tools to **compare new algorithms** to the state-of-the-art.
- Context
  - **Collaborative initiative** between several institutes worldwide.
  - Direct **support** from the Grenoble Alpes Data Institute (France)
  - **Feedback** from a large international team of researchers.

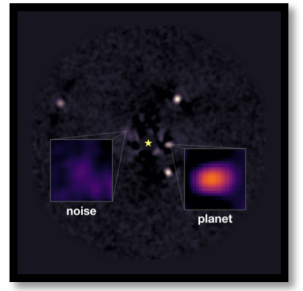
Data sets



- **Pupil tracking** sequences (ADI) and **multispectral** sequences (mSDI)
- **ADI**: 9 data set ($_{3x}$LMIRCam, $_{3x}$NIRC2, $_{3x}$SPHERE-IRDIS)
- **SDI**: 10 data set ($_{5x}$GPI, $_{5x}$SPHERE-IFS)
- All data are cropped into 20 λ/D x 20 λ/D frames
- Data are given with the pixel scale (arcsec/px) of the instrument

- **Injected** synthetic exoplanet signals: 0 to 5 per image
- Injections are **standard** (no smearing, photometric variability, anisoplanetism etc.).
- For multispectral, a **specific spectrum** is used.
- The (separation; position angle) is randomly picked in the field-of-view
- The contrast is randomly chosen within a range close to the 5-sigma detlim of a PCA

Metrics

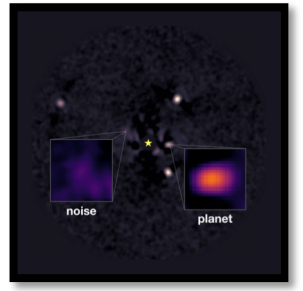


Outputs: detection maps + unique detection thresholds.

Current Metrics:

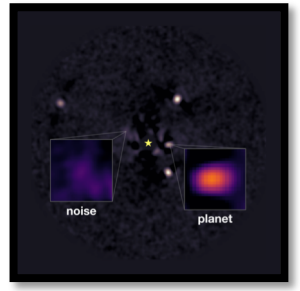
- True Positive Rate (TPR): **TPR = TP / $N_{injections}$**
- False detection rate (FDR): **FDR = FP / $N_{detections}$**
- Precision or positive predictive value (PPV): **PPV = TP / $N_{detections}$**
- Final F1-score (or harmonic mean of TPR): **F1 = 2*PPV*TPR / (PPV + TPR**)

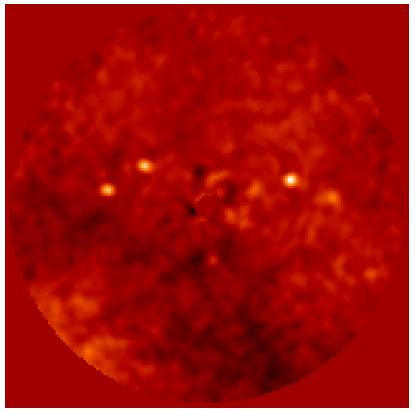
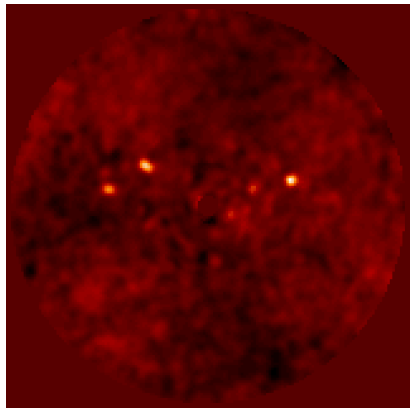
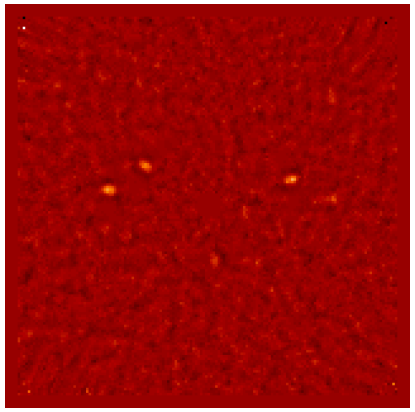
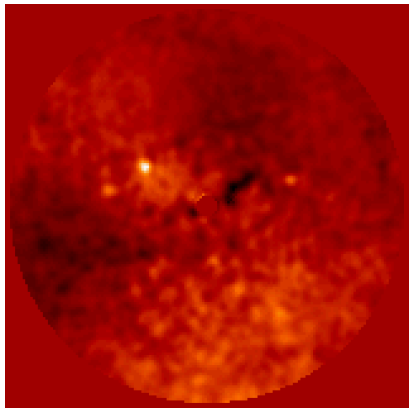
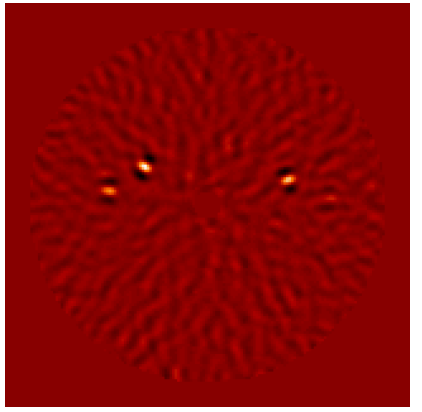
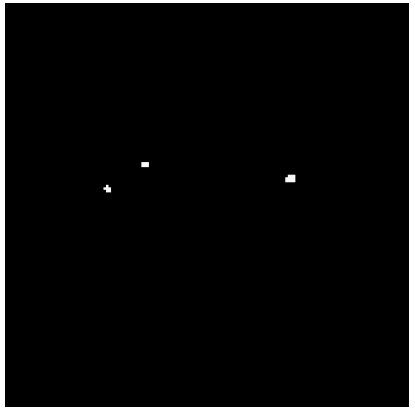
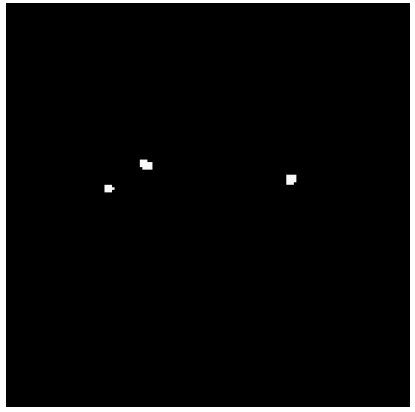
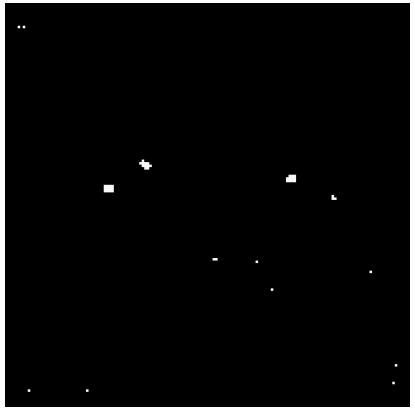
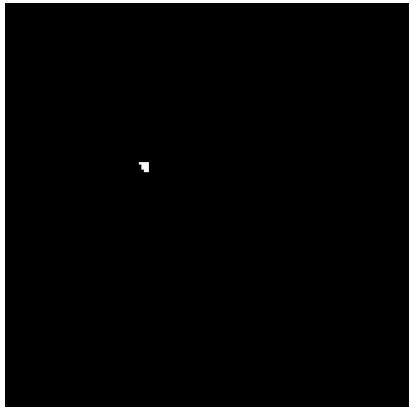
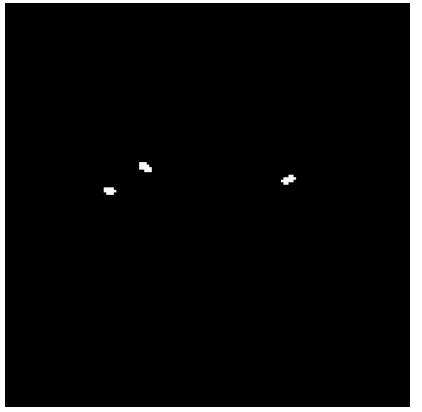
Current status



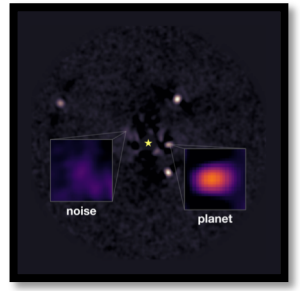
- **Launched** on April 2019 !
- **Communication** mainly through mailing-lists in astrophysics.
- After the Codalab crash in July 2019 the DC had to be fully restarted
- January 2020 **Workshop** “HCI post-processing” linked to the data challenge
- **SPIE-2020** abstract submitted (Cantalloube, Gomez-Gonzalez, Mouillet, Absil)

Current results (1)



Baseline	André M.	Dino M.	Thomas Fuhrmann	Faustine C.
				
				

Current results (2)



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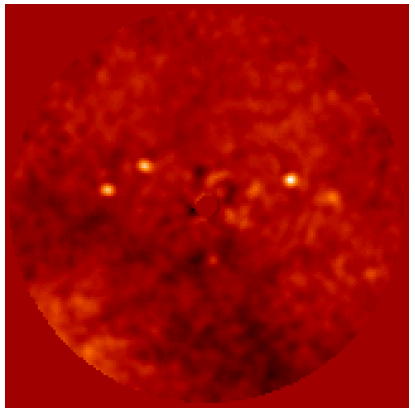
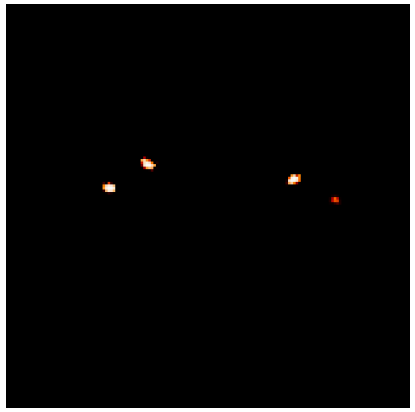
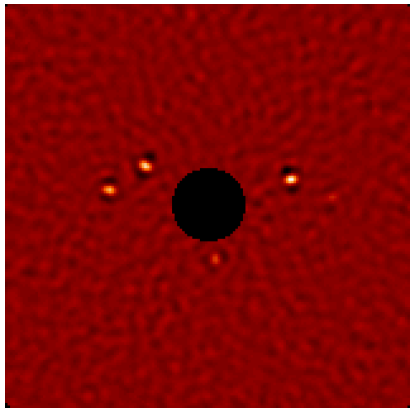
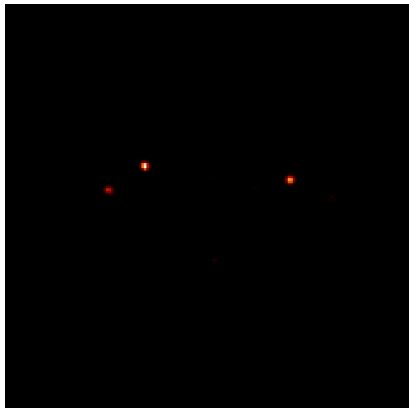
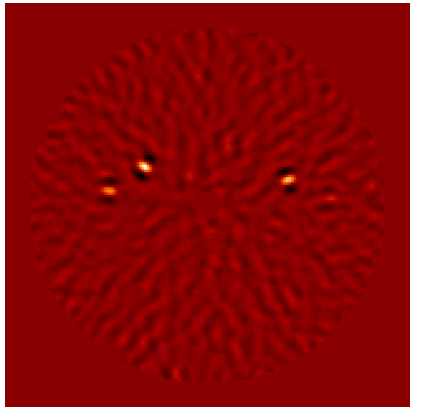
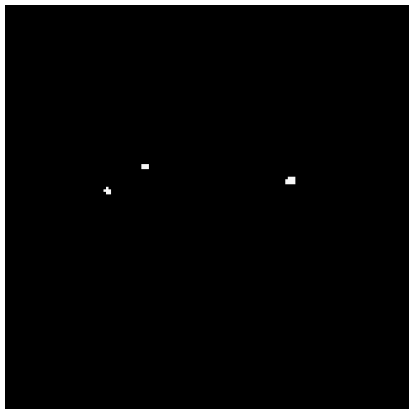
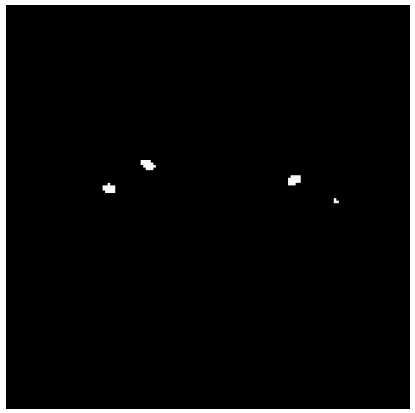
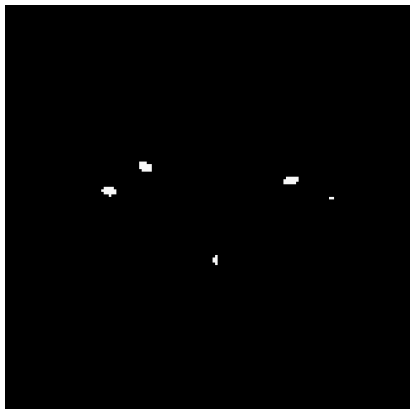
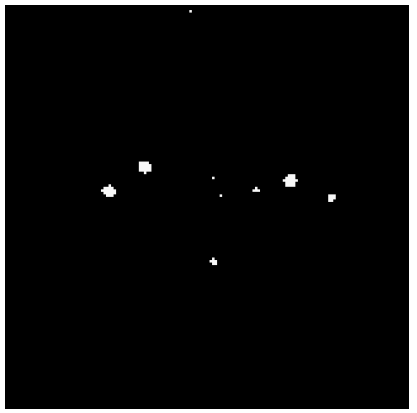
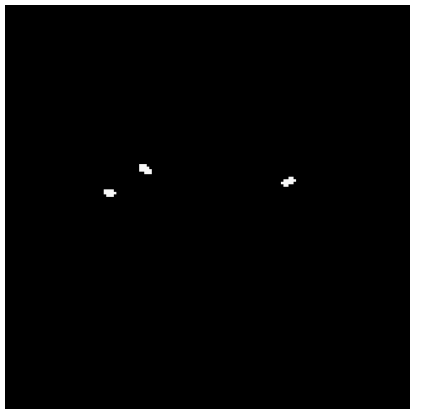
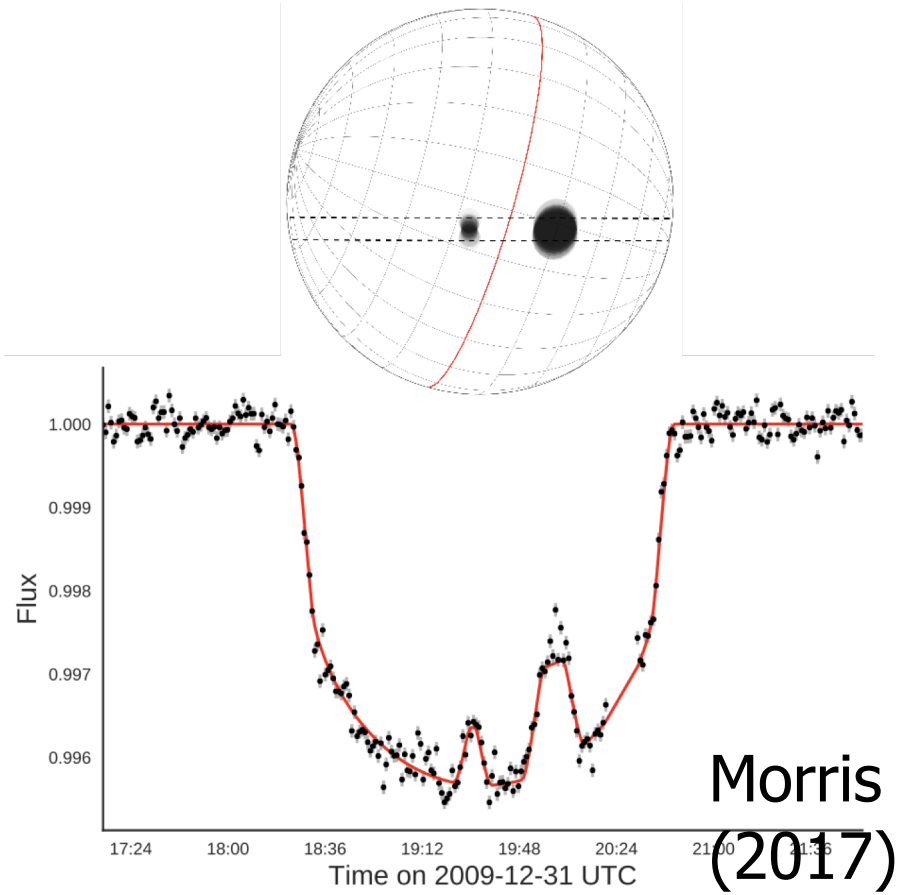
				
				

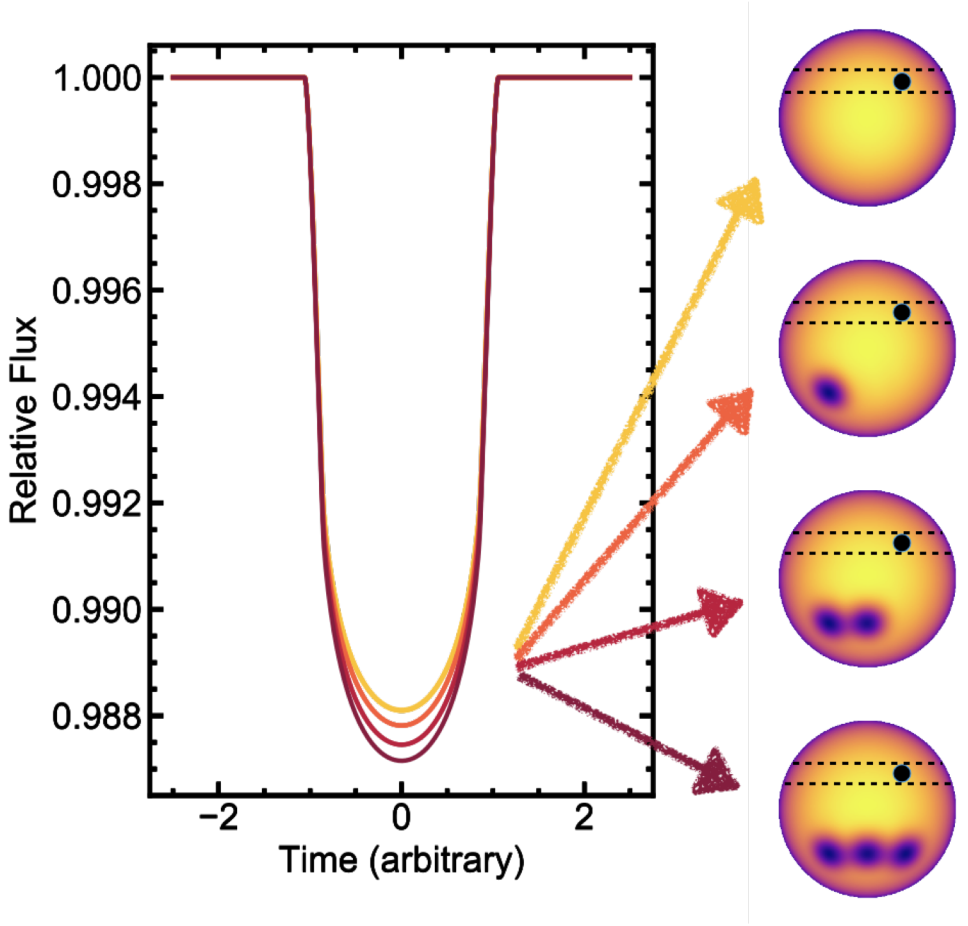
Proposed ExoPAG SAG
The Effect of Stellar Contamination on Space-based Transmission Spectroscopy

Néstor Espinoza, Ben Rackham

Occulted and unocculted active regions contaminate transmission spectra

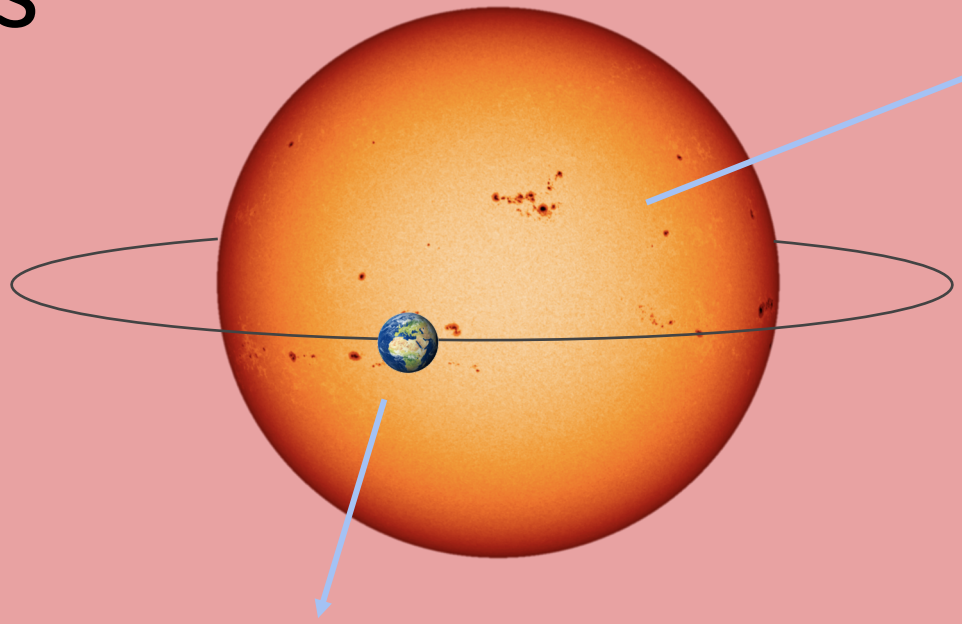


Morris et al. (2017)



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

Goals



What do we **know** &
what can we **learn from the star**?

e.g., chromospheric activity,
photometric monitoring, polarization

What can we l**earn from transits**?

Planet

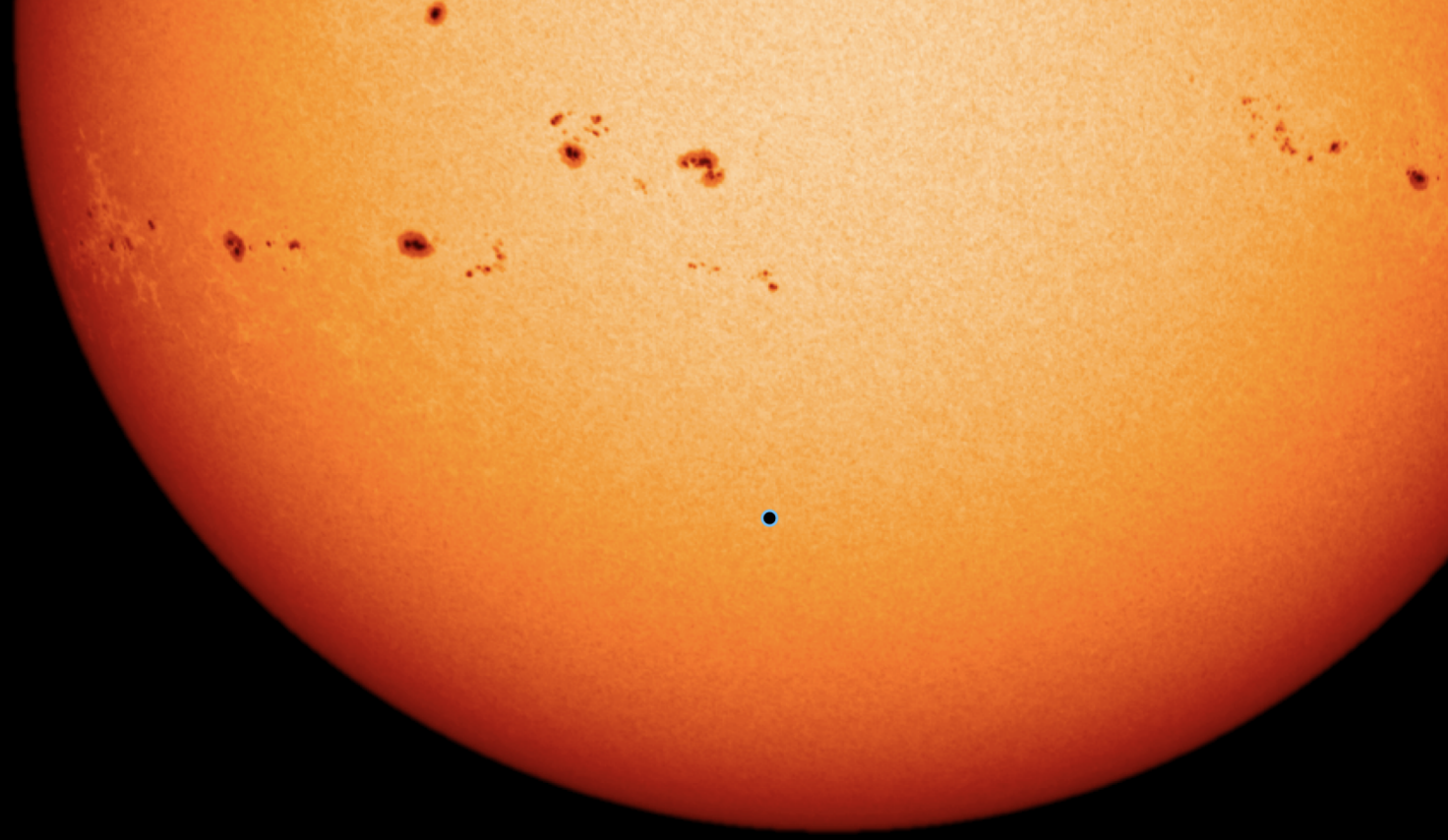
e.g., transit spectroscopy

Star

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

What will the impact be on f**uture studies**?

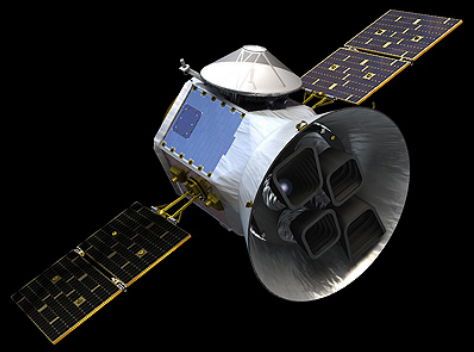
What **complementary observations** will be useful?



Contact **Néstor Espinoza (nespinoza@stsci.edu)** or **Ben Rackham (brackham@mit.edu)** to participate!

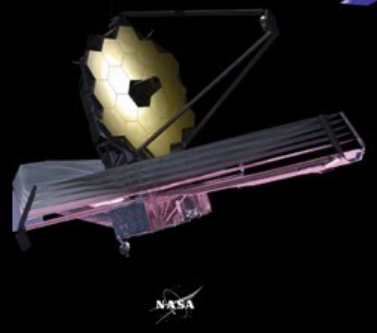
Current/Upcoming NASA Exoplanet Missions

2018



TESS

2021



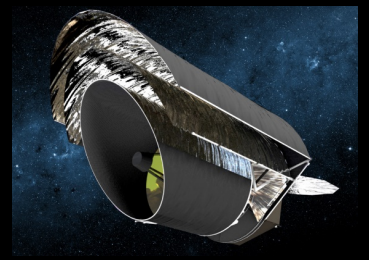
JWST

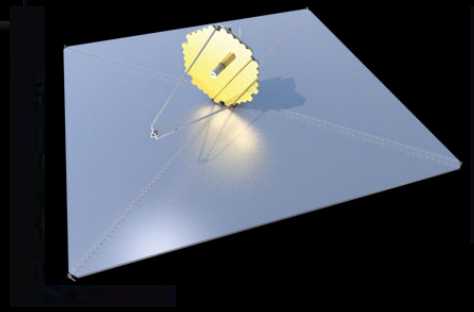
2025

Roman Telescope

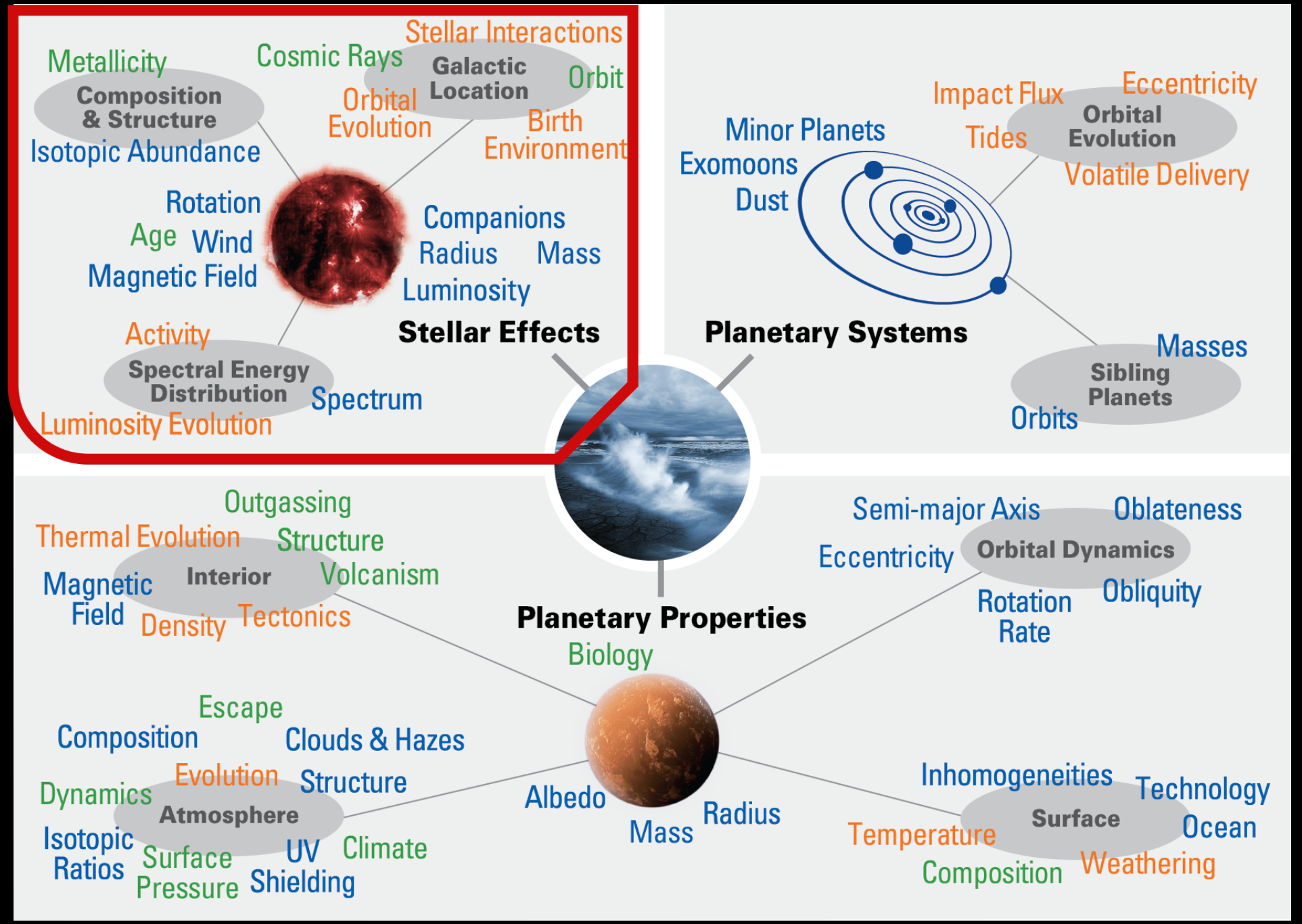
2028

ARIEL+ CASE





OST, LUVOIR or HabEX



Meadows & Barnes (2018)

Proposed ExoPAG SAG – Exoplanet Host Properties

Lead by Joshua Pepper, Chris Stark, Natalie Hinkel

- Define a high priority stellar sample to study that is relevant to many of the NASA exoplanet-related missions
- Survey the broad exoplanet community (e.g., including planetary scientists, geologists, biologists) to determine data required for characterizing stellar and planetary systems
- Define what properties are most important to include
- Identify categories of typical end users of this catalog
- Find community consensus regarding methods for archive implementation and maintenance, based on high priority and low priority data products needed for characterization.

ExoPAG 22 Agenda: Friday 2:30-3:30 pm EDT.

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  On the value of investing in interdisciplinary exoplanet science of scale over longer periods of performance (see full text shared through ExoPAG Announcement).

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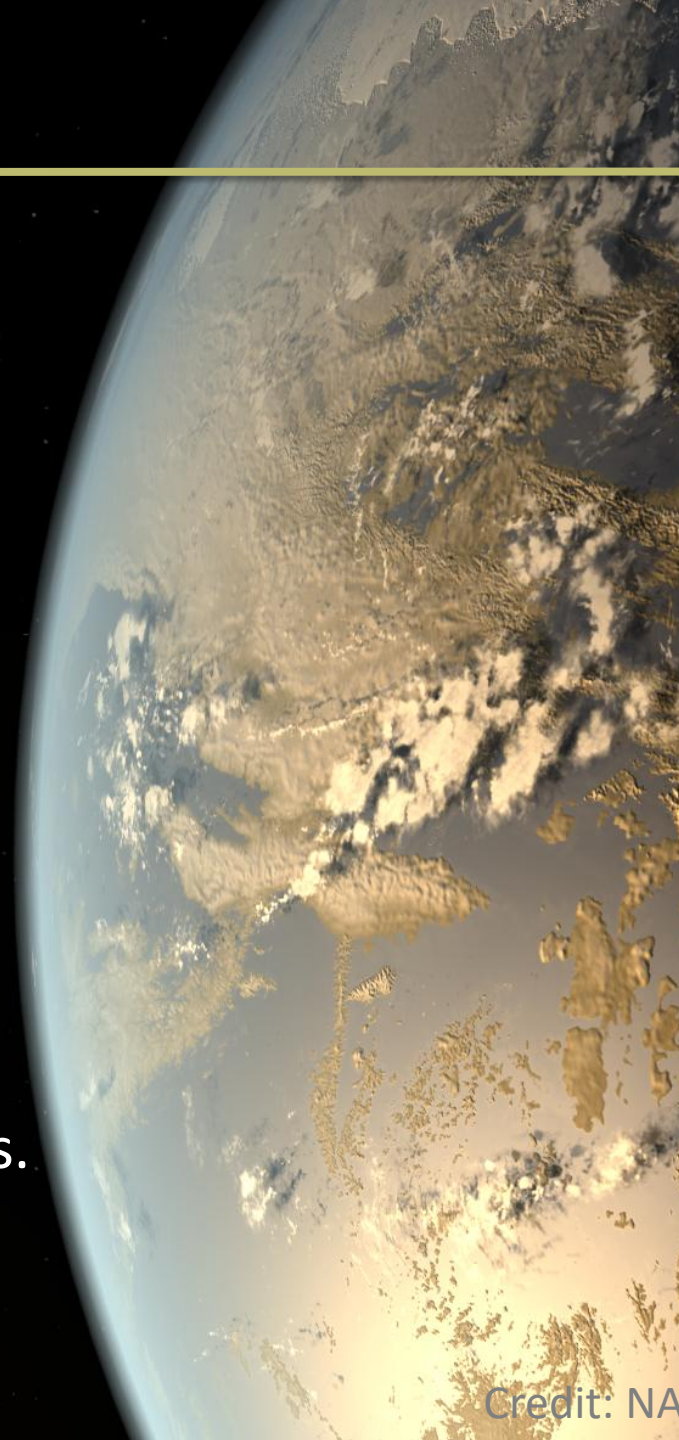


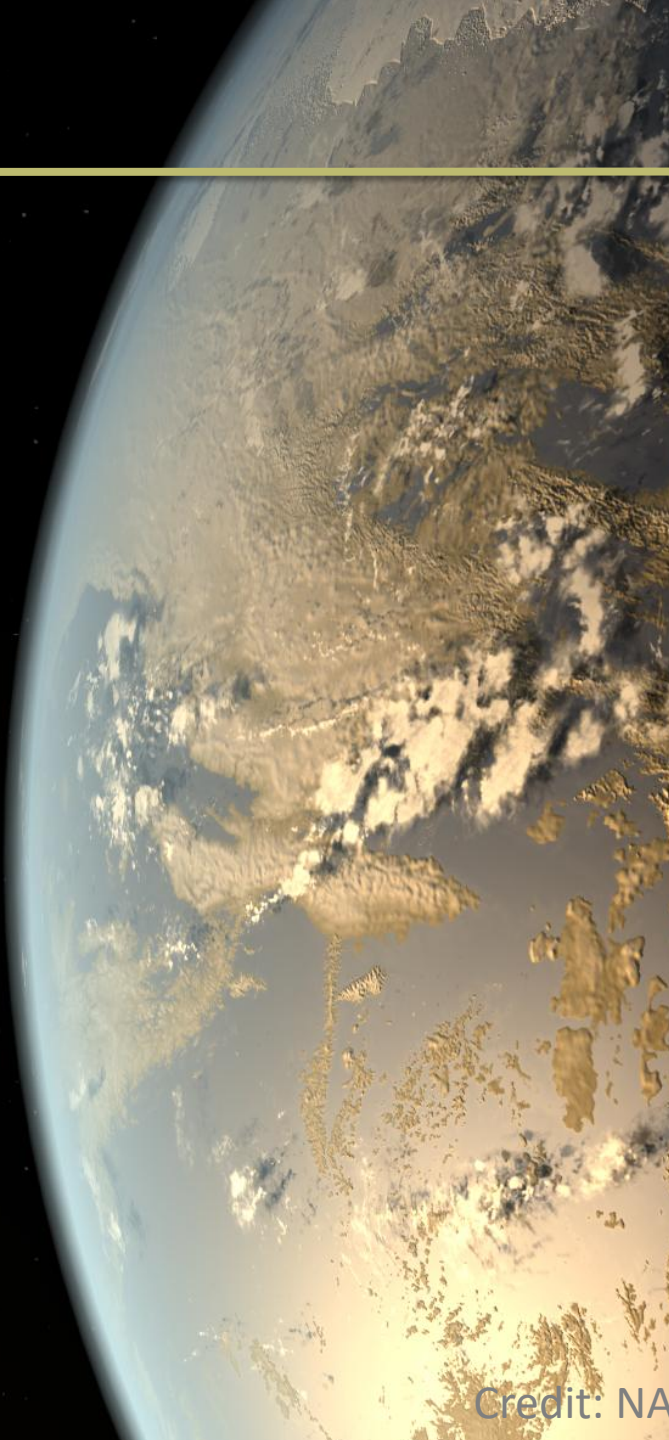
Credit: NA

ExoPAG 22 Proposed Finding:

On the value of investing in interdisciplinary exoplanet science of scale over longer periods of performance.

Whereas exoplanet science is inherently interdisciplinary, requiring expertise in heliophysics, earth science, planetary science, and astrophysics, among other disciplines, as well as deep and broad knowledge in theory, computation, observation, experiment, and instrument development, and whereas interdisciplinary research can require longer timeframes and greater resources to take full advantage of such diverse expertise within a collaboration, and whereas existing opportunities of scale that permit longer periods of performance to support interdisciplinary research networks are restricted to areas that specifically address the goals of the astrobiology program,

We find that longer term programs of scale (e.g. five year periods of performance and up to several million USD awards) would enable NASA to rapidly and efficiently address linked sets of the Exoplanet Exploration Program Science Gaps, for example 01-03, 02, 04-06, and 07-08-10, which contribute significantly to achieving NASA's strategic goals.



Credit: NA

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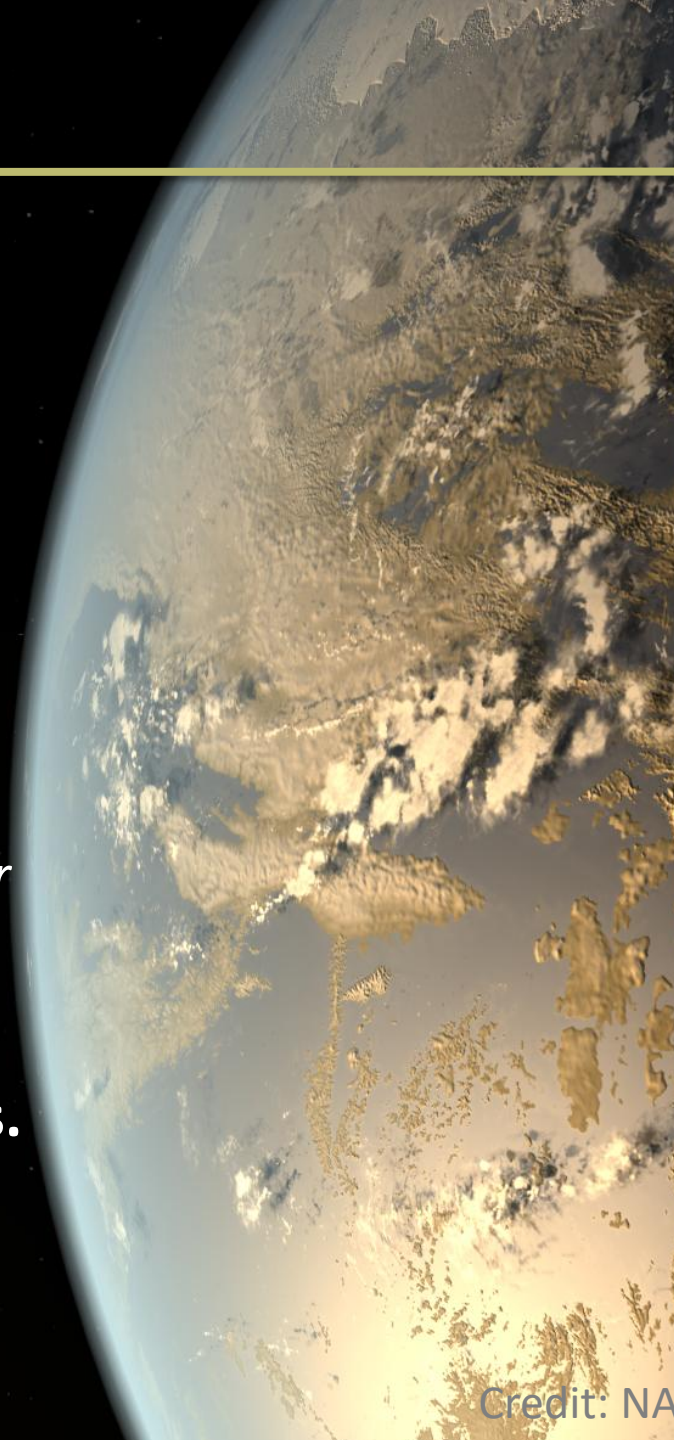
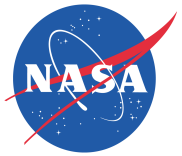


Credit: NA



Suggestions List for ExoPAG 22 Business Meeting

Eric Mamajek
Deputy Program Chief Scientist
NASA Exoplanet Exploration Program Office
Jet Propulsion Laboratory, California Institute of Technology

ExoPAG Suggestions Status

- New suggestions can be submitted via Slido (event code *exopag22, under "Ideas"*) https://app.sli.do/event/9dkm05fk/live/ideas
- Findings from ExoPAG 21:
  - On the need to invest in databases to support programs related to achieving NASA's strategic goals → **New SAG forming for this issue**
  - On the topic of ExoPAG providing input to other Divisions and programs on topics related to Exoplanets → **PSD and ESD liasons to ExoPAG have been named**
  - On the topic of evolution in the Exoplanet Research Program (XRP) outcomes and funding lines → **Being discussed internally at NASA HQ**
- Science Analyses:
  - coordinate/monitor research on exoplanet demographics (Christiansen/ Meyer) → **SIG2 very active; NexScI-sponsored ExoDem conference 11/2020**
  - coronagraph metrics & data challenges (Jensen-Clem) → **SAG 19 (data challenge closed at the end of Jan, need new update)**
  - strategies for mitigating JWST delays (Teske / Deming) → **SAG 20 (Closed: final report posted to ExoPAG website)**

ExoPAG Suggestions Status

- <u>Connections to policies in development:</u>
  - Define RV strategy to reach precision of 1 cm/sec, per recommendation of NAS ESS report → **EPRV WG presentation is completed and posted, NASA HQ factoring into FY21 budgeting decisions, EC can choose to monitor implementation. Full EPRV WG report is being written.**
  - Should ExoPAG respond in any way to NAS ESS & Astrobiology reports, and if so how ? (EC & all) → **There has been no clamor to do this, seems like the time has passed for any action**
  - Ongoing discussions of issues affecting future exoplanet exoplanet flagships. One clear issue is the likelihood that PRV will not be able to provide masses/orbits for a large fraction of HabEx/LUVOIR targets. Should flagships skip those targets? Take data and develop a strategy for interpreting spectra with no mass info? Or push for astrometry capability that could take up the slack? What technologies needed for astrometry? → **ExEPO holding internal discussions, welcomes EC input on ways to go forward**

ExoPAG Suggestions Status

- <u>Connections to policies in development (continued):</u>
  - Coordination of exoplanet inputs to decadal surveys (Meadows, outside of ExoPAG) → **Done for Astro2020, ongoing for Planetary Decadal (advertised multiple times since 5/17/20). So far 7 white papers listed.**

ExoPAG Suggestions Status

- Interaction with other NASA Programs:
  - Invite Lori Glaze to visit ExEP JPL staff and facilities (Stapelfeldt) **→ (on hold for now due to COVID-19)**
  - Great observatories joint PAG with PCOS & COR (Meyer) **→ Done, report posted** https://cor.gsfc.nasa.gov/sags/sag10-draft.php
  - Invite OPAG and VEXAG present to ExoPAG **→ Done at ExoPAG 20. What is next step in terms of external PAG participation in ExoPAG? SIG3 to consider?**
  - Make ExoPAG members aware of next VEXPAG and OPAG meetings so they may possibly attend (Meadows/Kataria) **→ Pending; tied into the possibility of appointing potential cross-PAG observers**
  - ExoPAG presentations at VEXPAG and OPAG (Meadows/Kataria) **→ Pending; tied into the possibility of appointing potential cross-PAG observers**
  - Joint ExoPAG / planetary PAGs meetings (Meadows) **→ Exoplanets in our Backyard Meeting took place at LPI in Feb 2020. Possible sequel?**

ExoPAG Suggestions Status

- <u>Supporting resources for the community:</u>
  - Expand access to ground telescopes for K2 & TESS followup (Blackwood/Hudgins) → **TESS GI program has been augmented to support this. Southern PRV: Chiron & MINERVA Australis**.
  - Assess demand for funding support for ground telescope followup (Hudgins / Barclay)
    → HQ internal assessment of XRP proposal pressure in this area
  - Assure that NASA exoplanet archive can handle upcoming vast increase in planet counts (Hudgins / Blackwood)
    → Done, addressed in 2019 budget cycle
  - How2 guides for new actors getting involved in TESS followup, tailored to different audiences of amateurs, small colleges, and professionals (Christiansen / Barclay). **→ No actions taken: suggest ExoPAG get an update from astronomers involved w/TESS followup, then decide how to proceed.**

ExoPAG Suggestions Status

- <u>Supporting resources for the community (continued):</u>
  - Is further coordination needed of TESS community followup, especially spectra ? (Barclay / Christiansen) → **Seems like this would be covered by the T-FOP. What else might be needed?**
  - Opacity webserver for atmosphere modelers (Kempton) **→ Get an update from Batalha & Lewis**
  - Mission stars target list for Exoplanet Archive **→ ExEPO scientists refining lists from mission studies, need to vet for missing stars, will post at NExScI later in 2020. Proto-SAG to recommend scope of Archive holdings needed.**

ExoPAG Suggestions Status

- <u>Topics to cover at future EC telecons or ExoPAG f2f meetings:</u>
  - Citizen science → **Schedule presentation from Marc Kuchner (GSFC)**
  - Small sats → **Done - 3 presentations at ExoPAG 21**
  - Create new exoplanet animations
    → **Need detailed inputs to the ExEP Comms team, none received since the summer 2018 suggestion**
  - Synergy of ground & space observations
    → **Some discussions of this topic between ExEPO and CfAO community in the context of high contrast imaging**
  - Microlensing progress review talk
    → **Invite speaker for a talk at ExoPAG 23**

New Suggestions

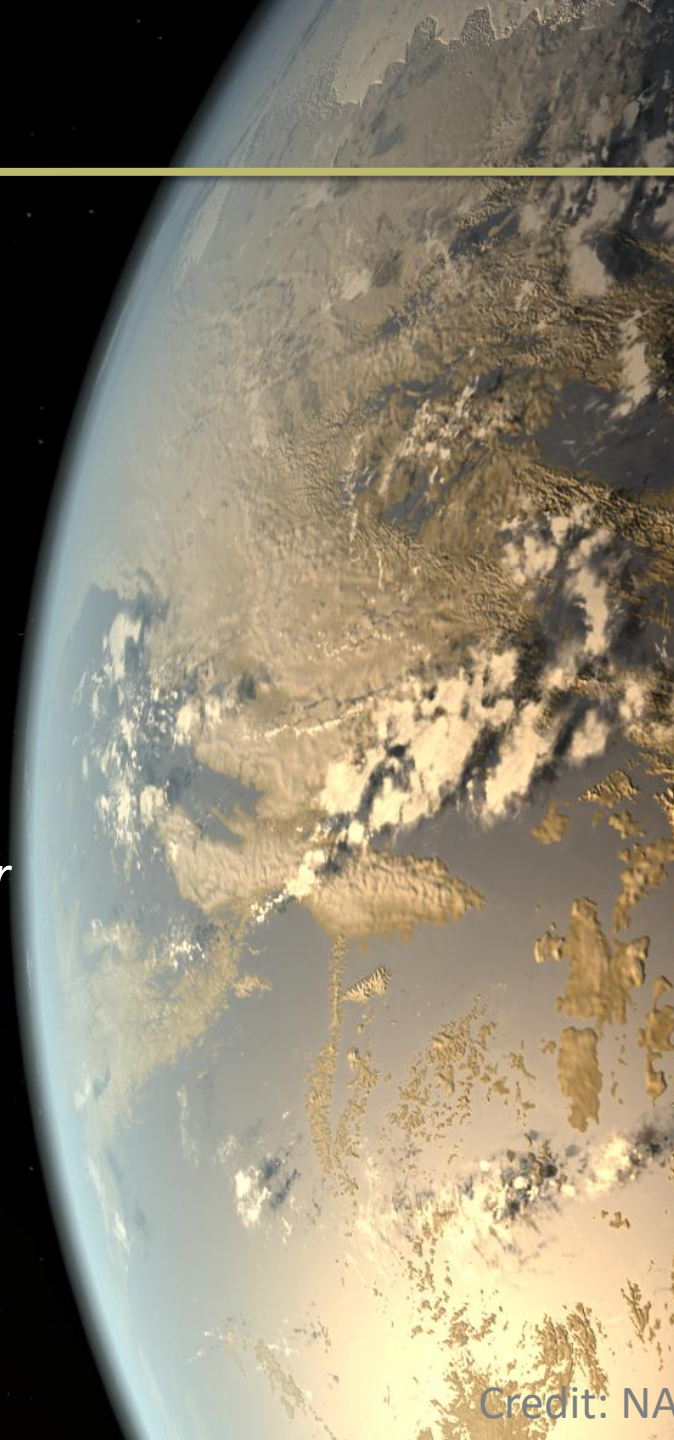
New Suggestions

ExoPAG 22 Agenda: Friday 2:30-3:30 pm EDT.

- Review SIGs/SAGs.
- Support for planetary decadal survey.
- Proposed discussion on potential “finding”:

  On the value of investing in interdisciplinary exoplanet science of scale over longer periods of performance (see full text shared through ExoPAG Announcement).

- Review actions/share new ideas for ExoPAG priorities and activities.
- **Any other business/Announcements?**



Credit: NA