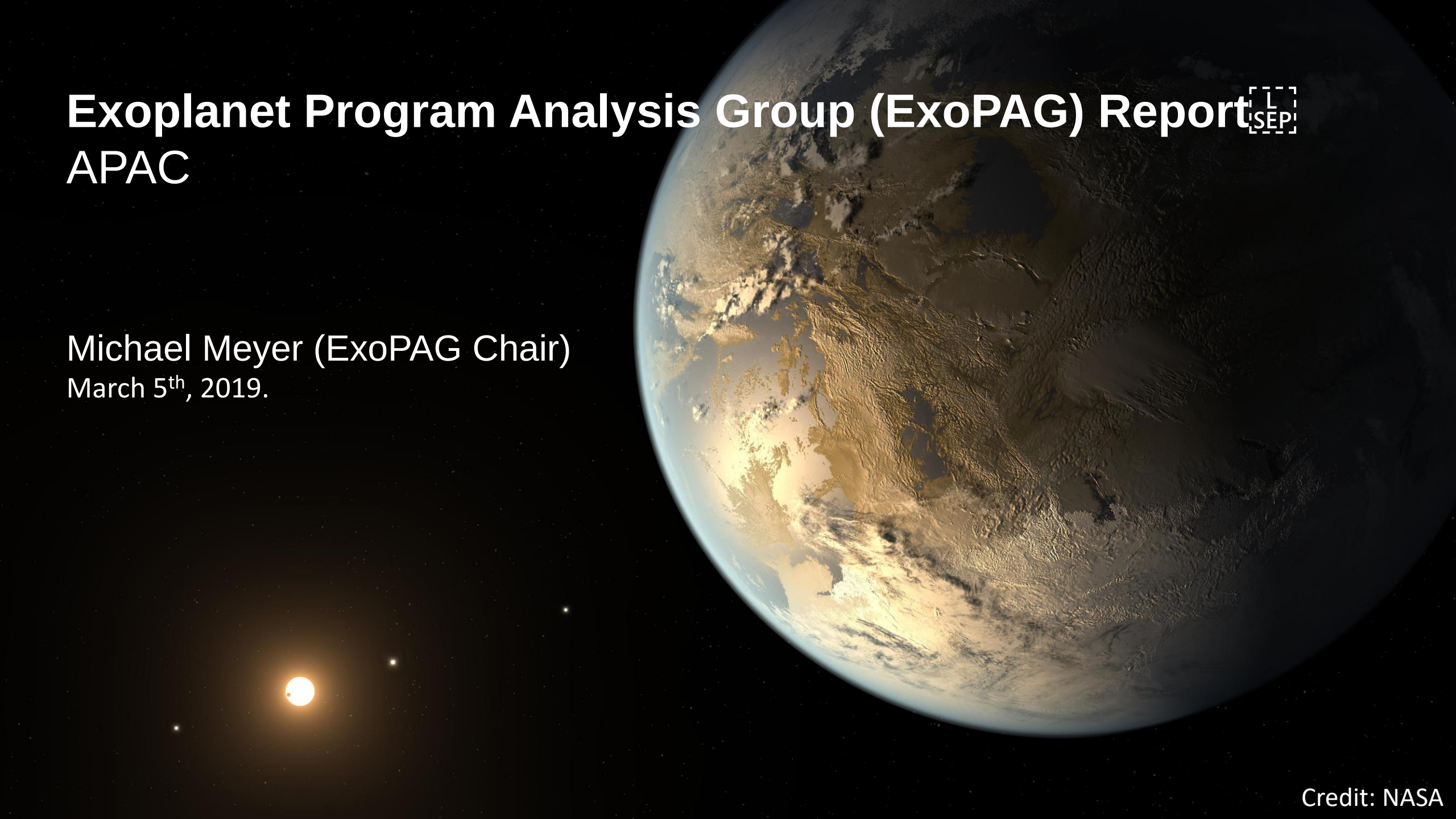
# Exoplanet Program Analysis Group (ExoPAG) Report
APAC

Michael Meyer (ExoPAG Chair)
March 5th, 2019.



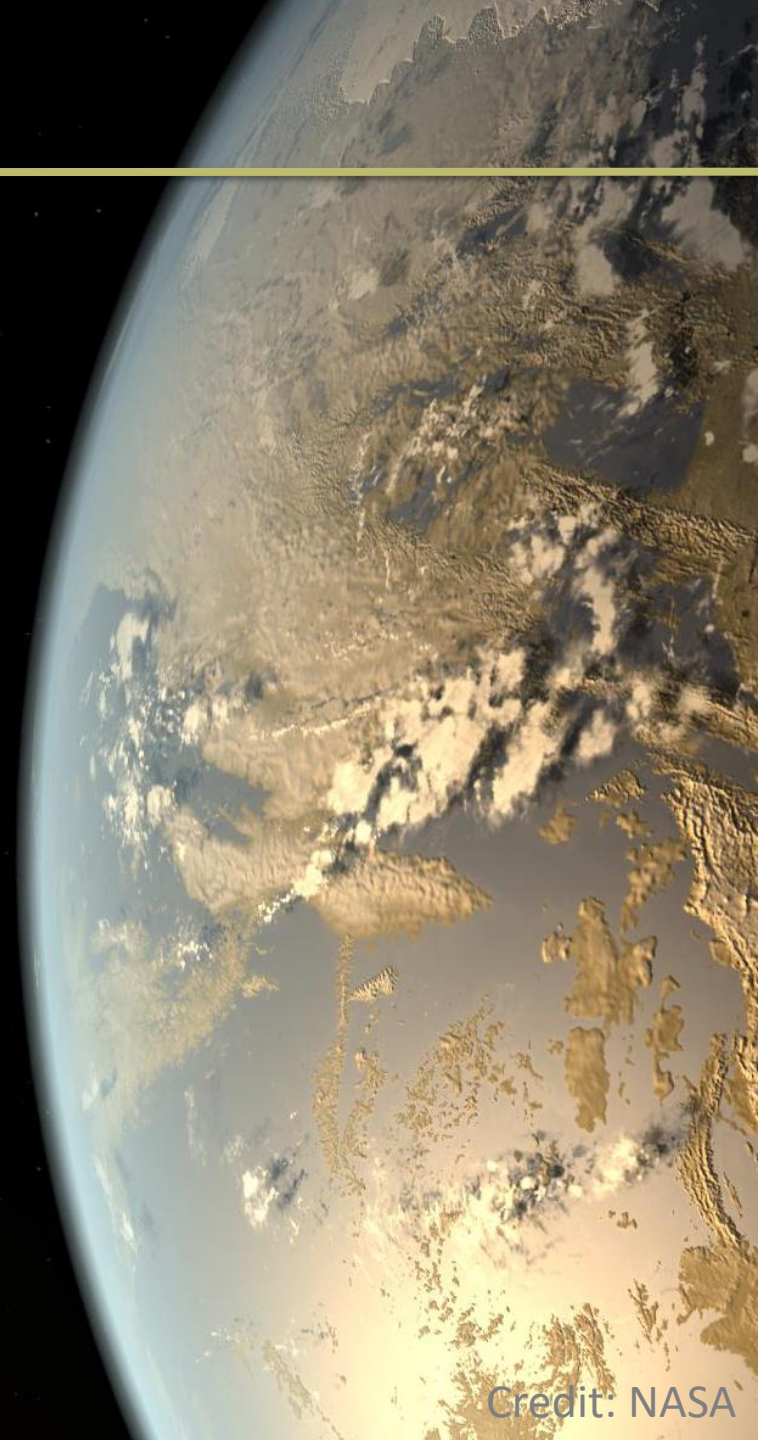
Credit: NASA

# ExoPAG Executive Committee

**ExoPAG activities and meetings are organized through an Executive Committee**

| | |
|---|---|
| **Michael Meyer (Chair)** | **University of Michigan** |
| Tom Barclay | University of Maryland |
| Jessie Christiansen | NExScI/Caltech |
| Rebecca Jensen-Clem | UC-Berkeley |
| Tiffany Kataria | JPL/Caltech |
| *Eliza Kempton* | *University of Maryland* |
| Josh Pepper | Lehigh University |
| Dmitry Savransky | Cornell |
| *Chris Stark* | *Space Telescope Science Institute* |
| *Johanna Teske* | *Carnegie Observatories* |
| Vikki Meadows (Past Chair) | University of Washington |
| Doug Hudgins (ex officio) | NASA |

Selected by NASA for 3-year terms. Selection of new members (20 applicants) in progress.



Credit: NASA

# Status of SAGs and SIGs (March 2020)

| Closeout Year | SAG or SIG | Title | Lead |
|---|---|---|---|
| -- | SAG 19 | Exoplanet imaging signal detection theory and rigorous contrast metrics (active - closeout expected in early 2020) | Mawet & Jensen-Clem |
| -- | SIG 2 | Exoplanet Demographics | Christiansen & Meyer |
| -- | SAG 20 | Impact of JWST Delay on Exoplanet Science (closeout expected 2019) | Teske & Deming |
| | SIG 3 | Exoplanet Solar System Synergies (proposed) | Meadows & Mandt |

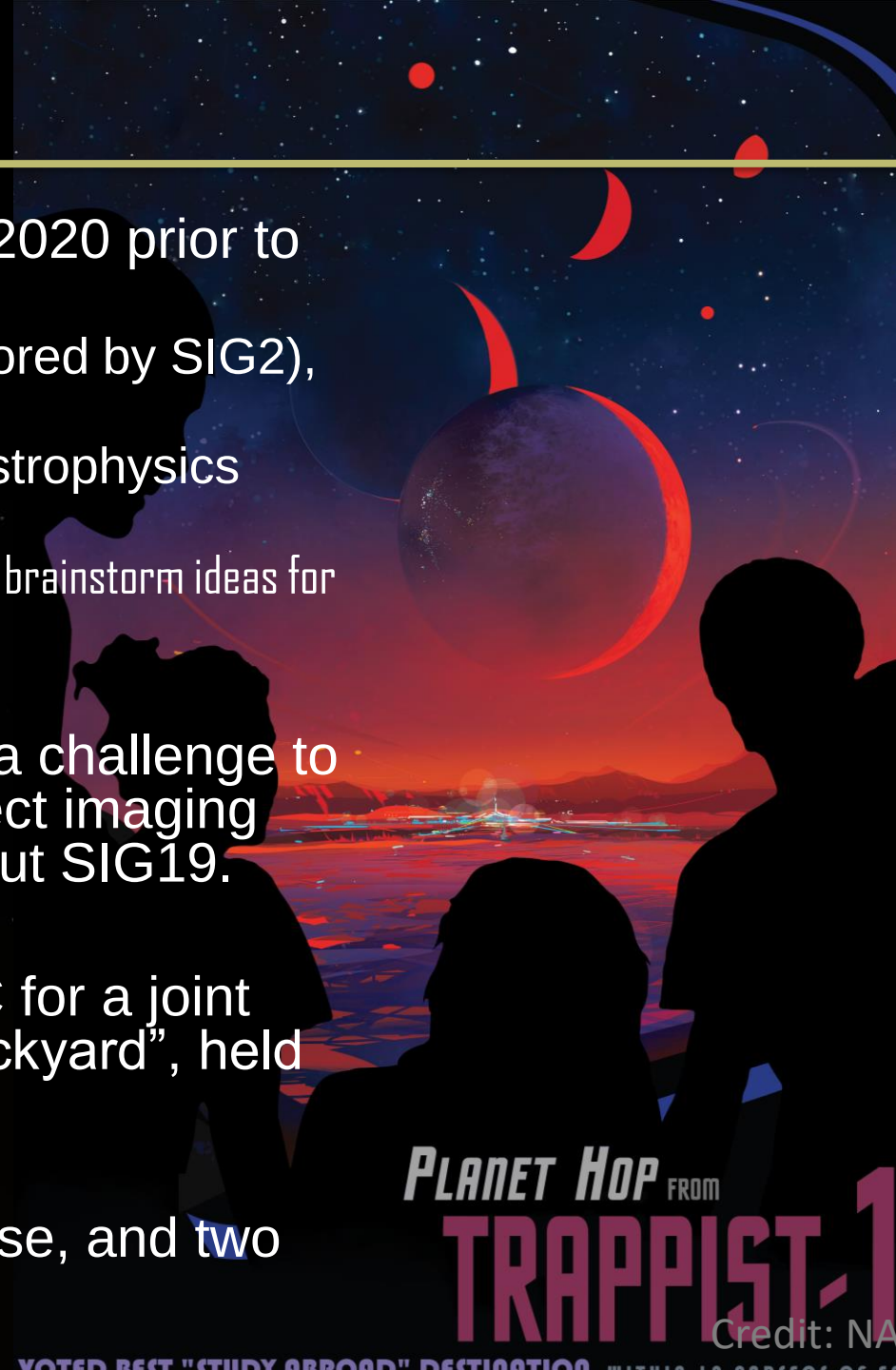
# ExoPAG Recent Activities

- Held the ExoPAG21 meeting in Honolulu, Hawaii Jan 3-4, 2020 prior to the 235th AAS:
  - Mini-science symposium on exoplanet demographics (sponsored by SIG2), interwoven with programmatic updates.
  - Exopag Business meeting discussed findings to present to Astrophysics Division.
  - The EC + ExEP held a 1.5 hr Executive Session following ExoPAG21 to debrief, as well as brainstorm ideas for SAGs and SIGs and discuss key priorities.

- Mawet and Jensen-Clem have organized a community data challenge to compare algorithms in finding planets in ground-based direct imaging datasets (with workshop end of January) as part of close-out SIG19.

- Meadows and Kataria served as ExoPAG reps on the SOC for a joint VExAG/ExoPAG/OPAG conference “Exoplanets in Our Backyard”, held Feb 5-7, 2020 in Houston, TX, following OPAG meeting.

- One new SIG has been proposed, one SAG is ready to close, and two SAGs are in formulation.



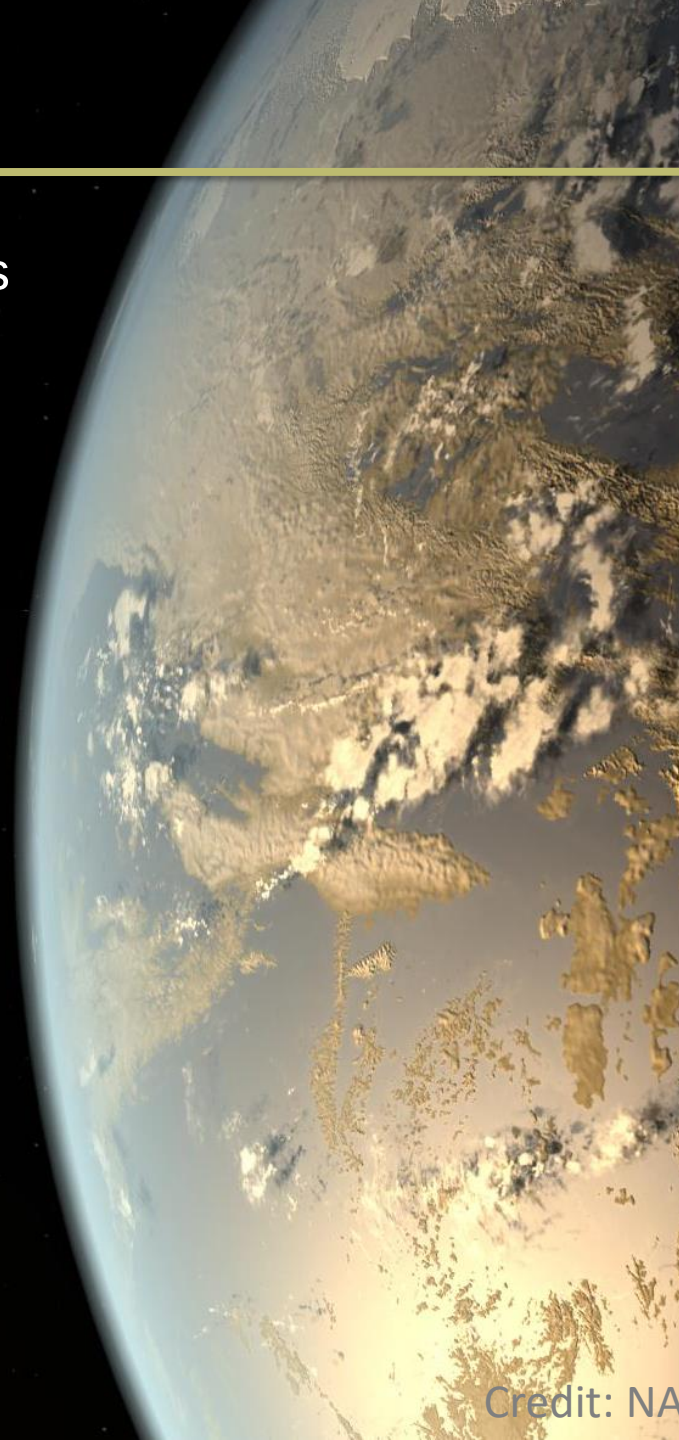
# SIG 2 – Exoplanet Demographics

- **Leadership:** Christiansen & Meyer (ExoPAG EC) + 2 community members

- **Motivation:** Exoplanet demographics reveal planet formation, migration and evolution processes, and are key to predicting the yields of future missions.

- **Progress to date:**

  - Monthly telecons discuss new demographic results from multiple techniques (radial velocity, microlensing, transit, direct imaging).
  - Curating a list of open questions/ongoing projects for the community.
  - Drafting report on value of public database of demographic products.
  - Mini-symposium held at ExoPAG21 (future meetings planned).
  - Discussed current status of small planet statistics ($R_p$,P) including uncertainties. Plan brief report in late winter/early spring.



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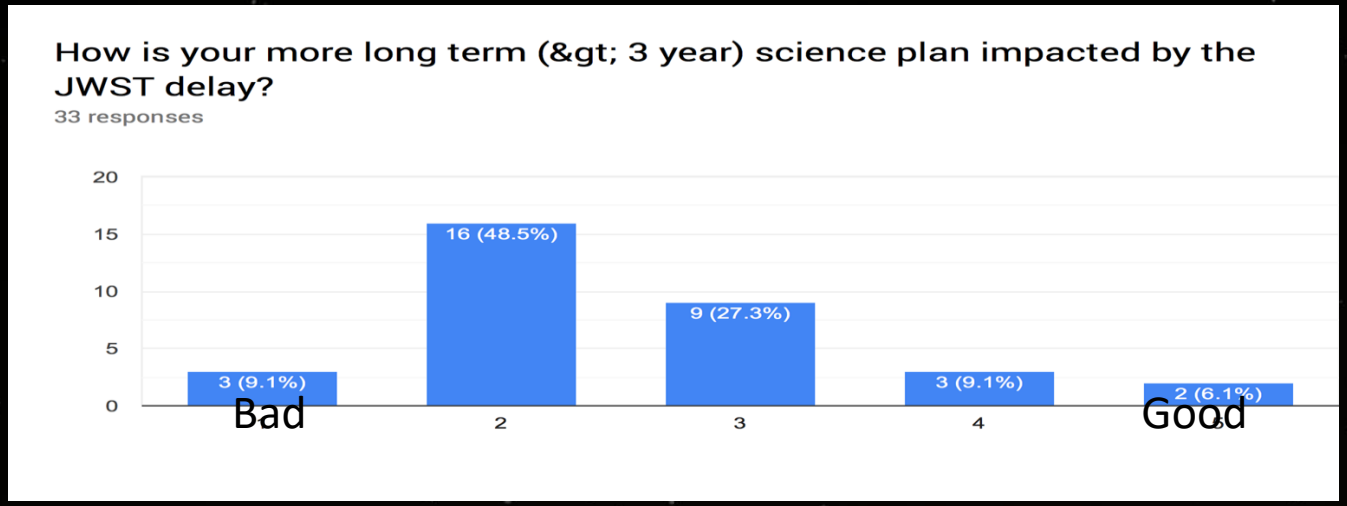
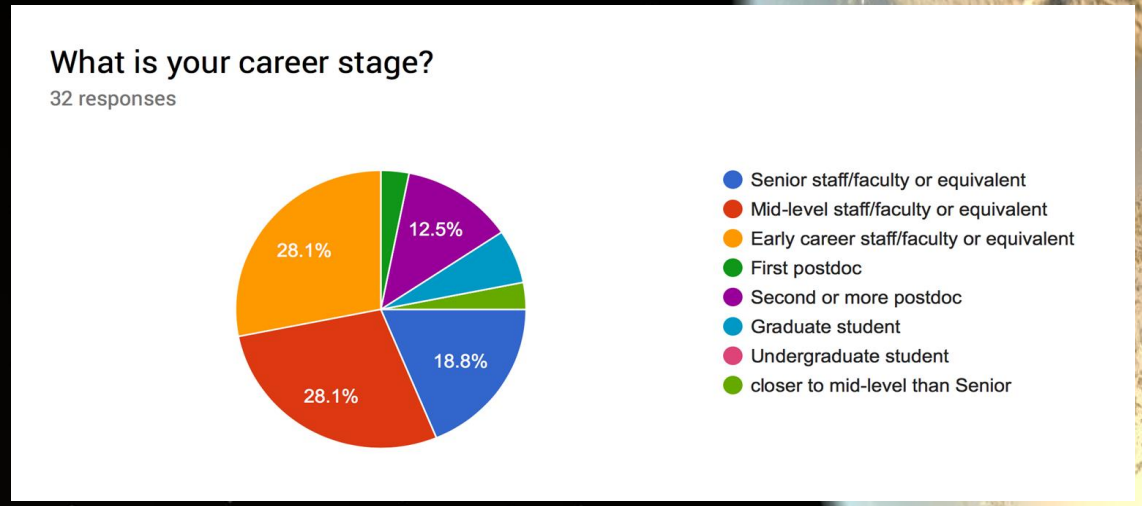
# SAG 20: Strategies for Mitigating the Impact of the JWST Delay on Exoplanet Science

- Leadership: Johanna Teske (ExoPAG EC) and Drake Deming (UMD)
- Survey Results: Adjustments being made by the community to prioritize ground-based observations and theory projects that will ultimately enhance JWST science observations, better target selection, analysis pipelines. Suggestions for mitigation include stepping up confirmation and characterization of TESS planets, community organization for large scale science projects, additional training in data analysis and retrieval, provision of simulated JWST data, and community venues to discuss data analysis techniques.
- Final report submitted to APAC for close-out.

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# ExoPAG 21 – Finding #1

*On the need to investment in databases to support programs related to achieving NASA's strategic goals.*

Whereas candidate missions plan to observe a limited number of nearby target stars, and whereas each mission has different criteria for selecting targets, and whereas a comprehensive catalog of the physical and environmental properties of all nearby stars and their planetary systems could make future surveys more efficient (e.g. understanding the multiplicity or composition of potential targets given apparent correlations between these properties and exoplanet demographics), perhaps more cost effective, and probably lower risk,

We find that assembling such a catalog can potentially save significant NASA resources, and would help candidate missions address ExoPAG Science Gaps 06, 07, and 10, which contribute significantly to achieving NASA's strategic goals.

[61 Yes, 0 No, 1 Abstention]

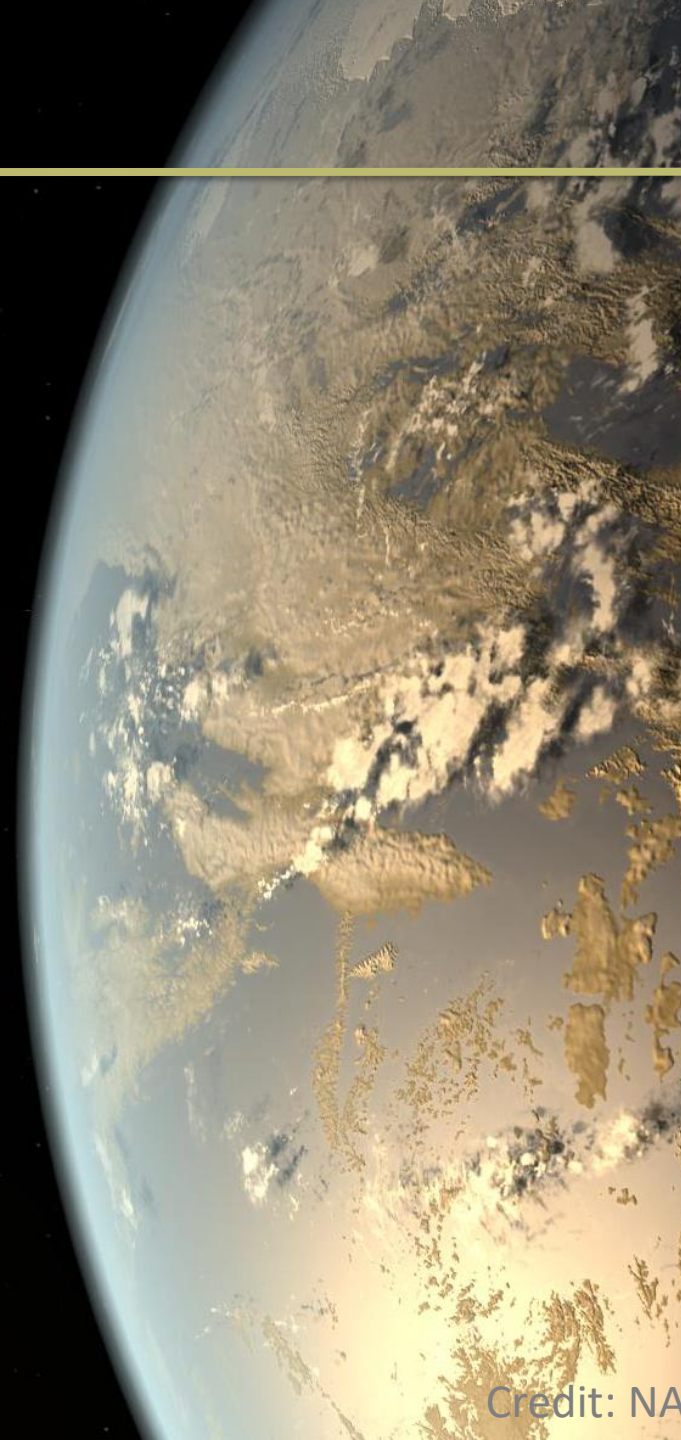
# ExoPAG 21 – Finding #2

*On the topic of ExoPAG providing input to other Divisions and programs on topics related to Exoplanets.*

Whereas ExoPAG is inherently an interdisciplinary research community whose expertise and interests are relevant to some programs covered by the Earth Science, Heliophysics, Planetary Science, and Astrophysics Divisions, and whereas some programs administered by NASA, such as XRP, draw resources from multiple divisions, and whereas new initiatives, such as the Lunar Development and Analysis Program, could benefit from input from communities such as ExoPAG,

We find that multiple audiences would benefit from exposure to reports and findings generated by the ExoPAG to help shape their research programs, and that ExoPAG could benefit from receiving relevant reports and findings from other Program Analysis Groups.

[58 Yes, 0 No, 2 Abstentions]



# ExoPAG 21 – Finding #3

*On the topic of evolution in the Exoplanet Research Program (XRP) outcomes and funding lines.*

Whereas the Exoplanet Research Program (XRP) has been one of NASA's most successful R&A programs in addressing critical elements of NASA's strategic goals specifically related to exoplanet science, and whereas the research community is growing and dynamic having the highest rate of new NASA R&A PIs of any other program, and whereas the success rate has dropped to the lowest rate of any other R&A program (with the exception of the FINNEST fellowships), and whereas the funding mechanisms, as well as the scope of the calls, are expected to evolve in the coming year as other divisions participate,

We find that close monitoring of the program, scrutiny of success rates, along with feedback from and communication with the community might help avoid unintended consequences during this evolution."

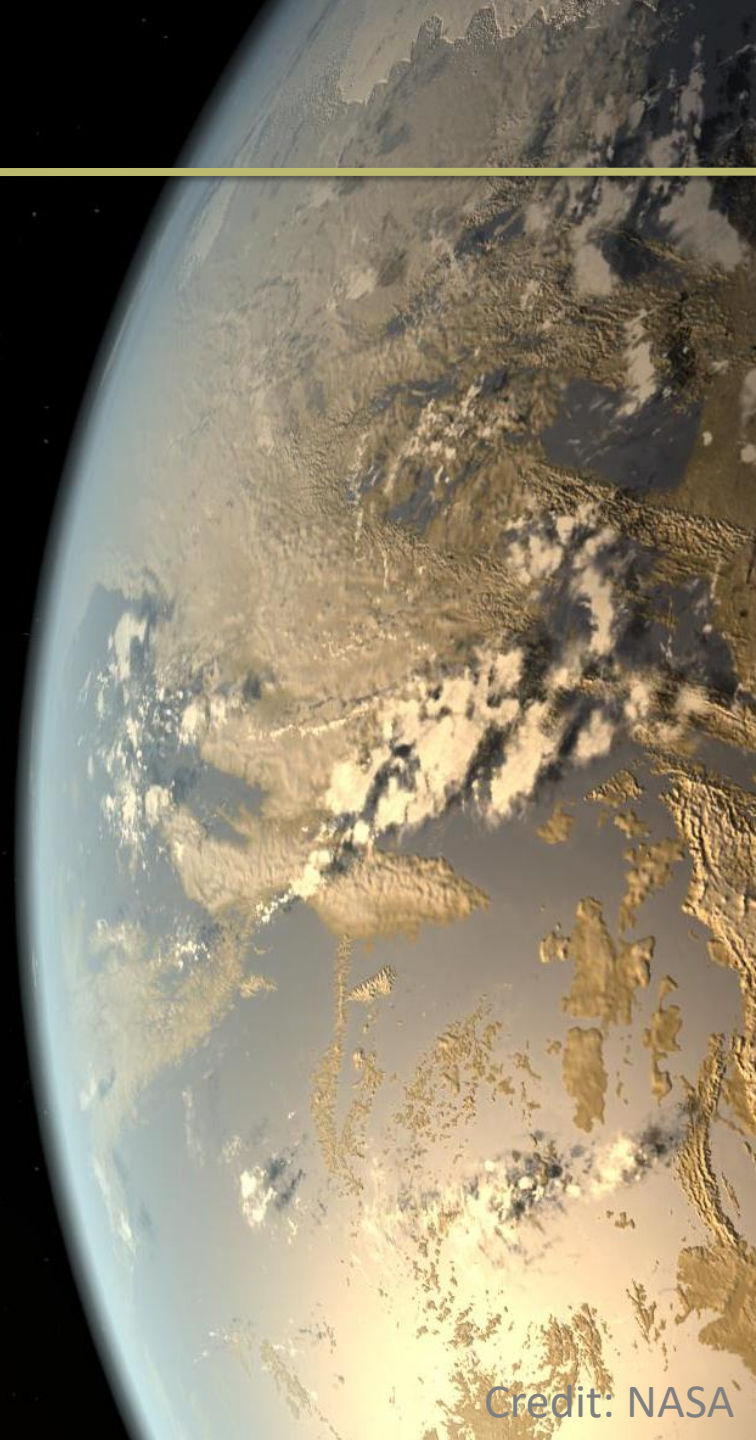
[58 Yes, 0 No, 5 Abstentions]

# SIG 3 ExoSS Synergies – Context

- We propose to initiate an ExoPAG Science Interest Group on Exoplanet/Solar System Synergies to:
  - Provide opportunities for ongoing discussions on Exo/SS comparative planetology
  - Explore how exoplanet and Solar System missions can benefit from each other.

- In 2010 ExoPAG SAG 2 held and reported on a workshop that explored the potential for exoplanet science measurements from Solar System probes.
  - workshop completed a decade ago
  - SAG had relatively narrowly focus on exoplanet advantages from Solar System missions.

- The proposed SIG3 will be broader in scope, ongoing, and will endeavor to identify multiple initiatives that could be mutually beneficial for both communities.

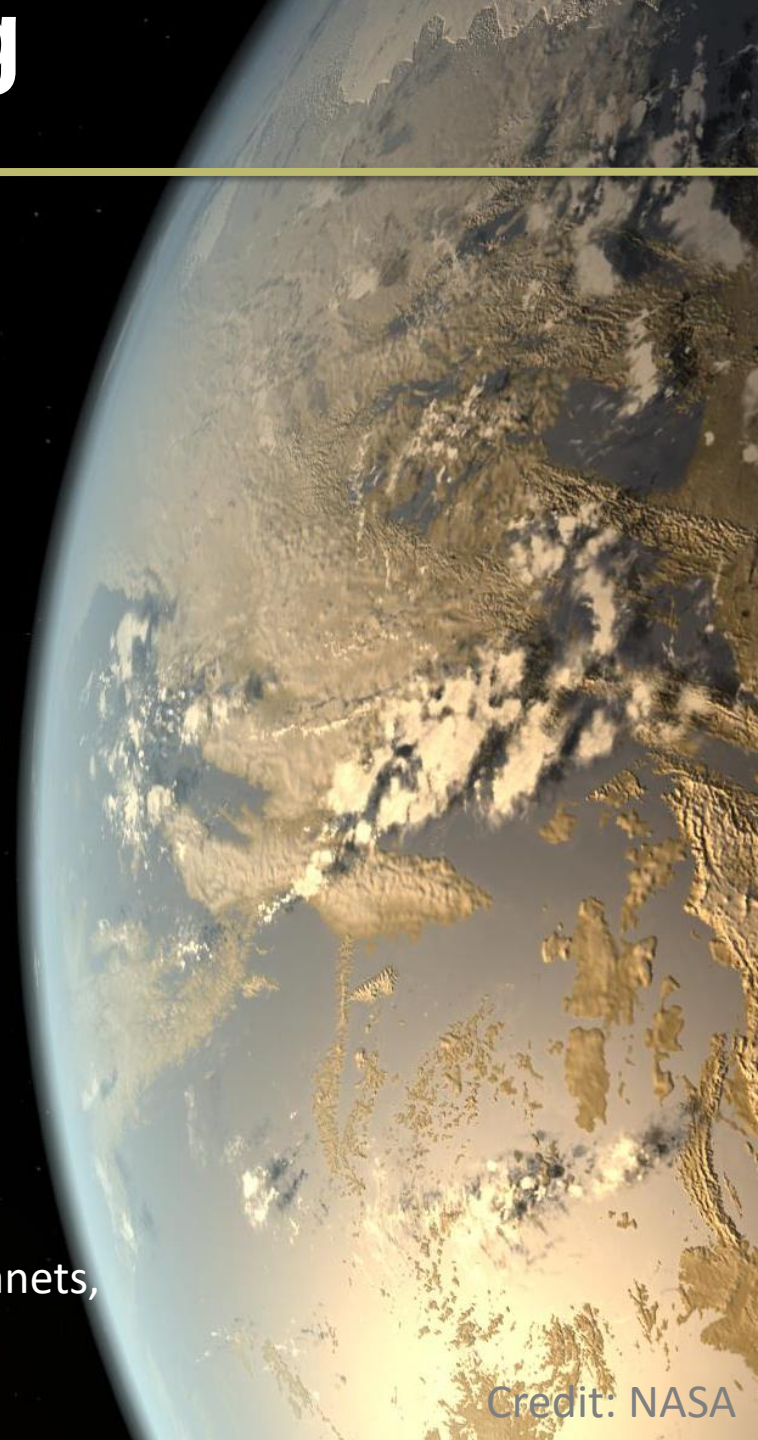


Credit: NASA

# SIG 3 ExoSS Synergies – Founding Team

| | |
|---|---|
| **Victoria Meadows (Co-Chair)** | **University of Washington, ExoPAG EC** |
| **Kathy Mandt (Co-Chair)** | **JHUAPL, OPAG EC** |
| Giada Arney | GSFC, VExAG EC |
| Chuanfei Dong | Princeton |
| Tony Del Genio | GISS/retired |
| Shawn Domagal-Goldman | GSFC |
| Noam Izenberg | JHUAPL, VExAG Deputy Chair |
| Stephen Kane | UC-Riverside |
| Tiffany Kataria | JPL/Caltech, ExoPAG EC |
| Mark Marley | NASA Ames |
| Niki Parenteau | NASA Ames |
| Abi Rymer | JHUAPL, OPAG EC |
| Karl Stapelfeldt | JPL/Caltech, ExEP |

Founding team members span ExoPAG, OPAG and VExAG, and include expertise in exoplanets, Solar System science, Earth science and star-planet interactions.



Credit: NASA

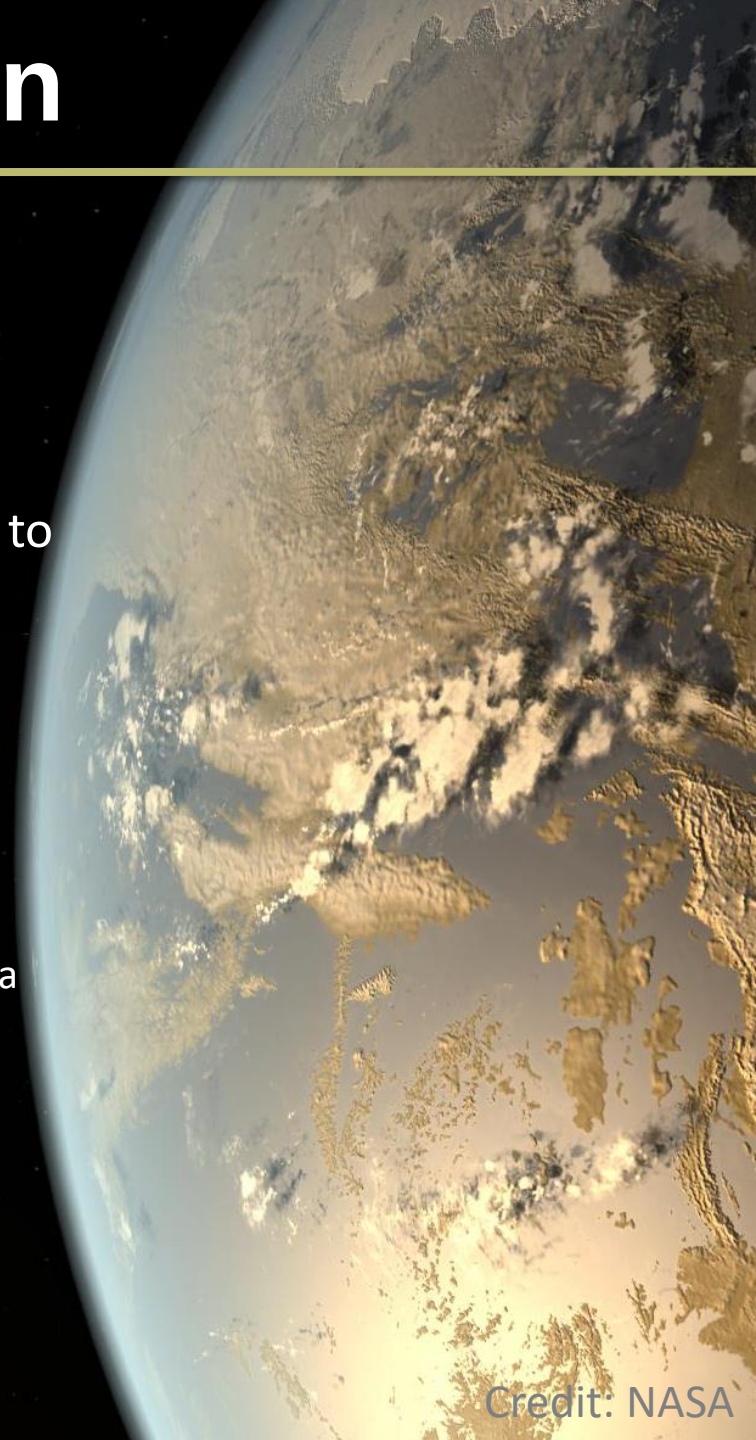
# SIG 3 ExoSS Synergies – Motivation

- Characterization capabilities for exoplanets is improving
  - Large statistical datasets
  - Observations of a diversity of ice giant to giant exoplanets
  - Beginning attempts to observe terrestrial exoplanet atmospheres.

- Both communities are moving towards a systems- and process-based approach to understanding planet formation, evolution, habitability, biosignatures.
  - Requires synthesis of observations, theory and laboratory research from multiple disciplines.

- The two fields have unique perspectives that can benefit each other
  - knowledge and techniques developed from detailed studies of Solar System planets, including Earth, benefit exoplanet science.
  - The diversity of worlds beyond those in our Solar System provides key statistics to understand a broader range of planetary processes, including star-planet interactions.
  - Exoplanets are the broader cosmic context for Solar System planets/architecture.

- Comparative planetology that spans Solar System and exoplanets has the potential to greatly expand our understanding of planets as a whole.
- Effort is needed to encourage communities to interact and collaborate.



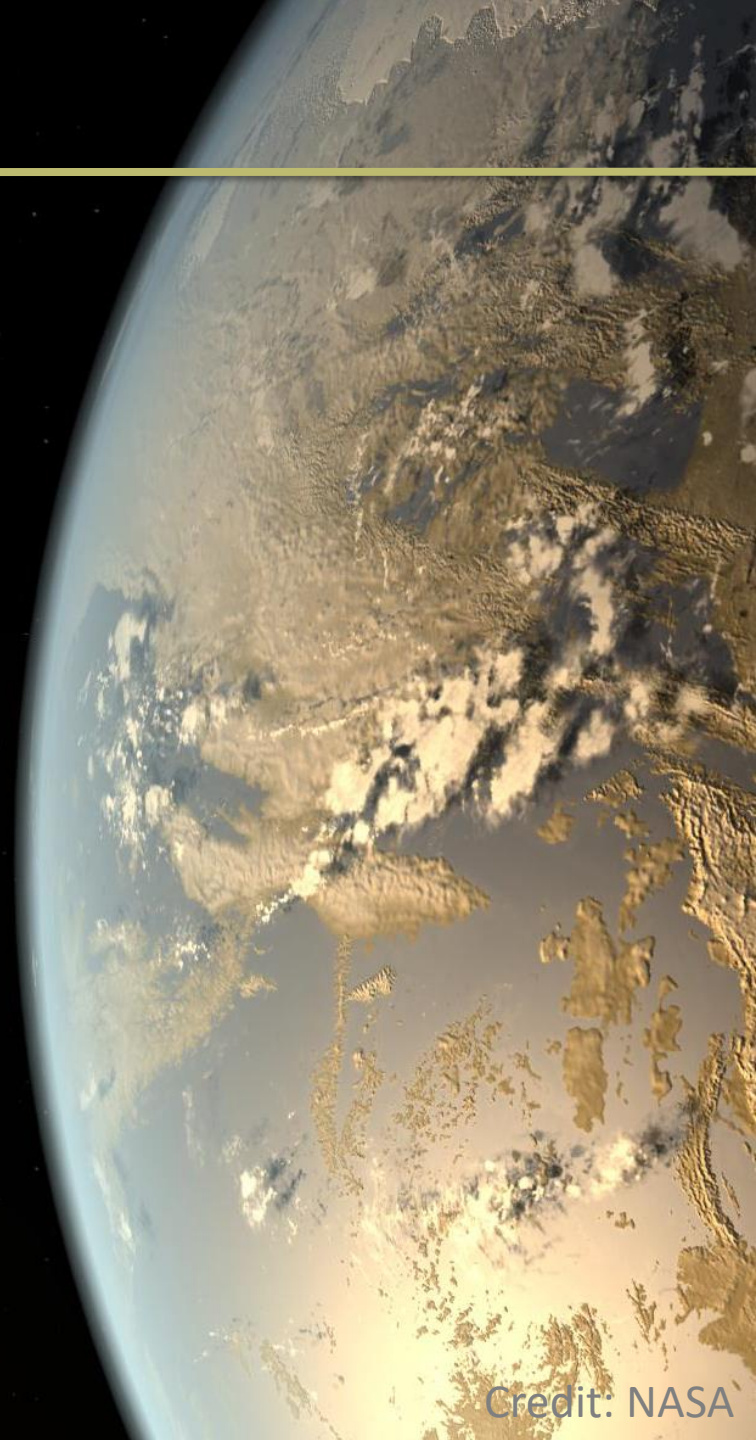
Credit: NASA

# SIG 3 ExoSS Synergies – Goals

- We propose 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 could enhance these interactions.

- Example activities:
  - coordination of monthly webinars with Solar System/exoplanet presenters,
  - discussion fora,
  - development of workshop proposals (e.g. Exoplanets in Our Backyard Feb 5-7, after OPAG),
  - other cross-PAG/AG activities and presentations,
  - joint SIG reports/review papers that identify beneficial avenues for future joint research between the exoplanet and Solar System communities.

- As a longer term goal, this SIG will encourage cross-disciplinary interaction between PAGs/AGs in all four NASA Divisions.
- It will report at least twice per year to the ExoPAG EC through their monthly telecons, and at least once annually at the bi-annual ExoPAG meetings.
- This SIG3 will be open to all interested community members (please contact Vikki or Kathy if interested!)



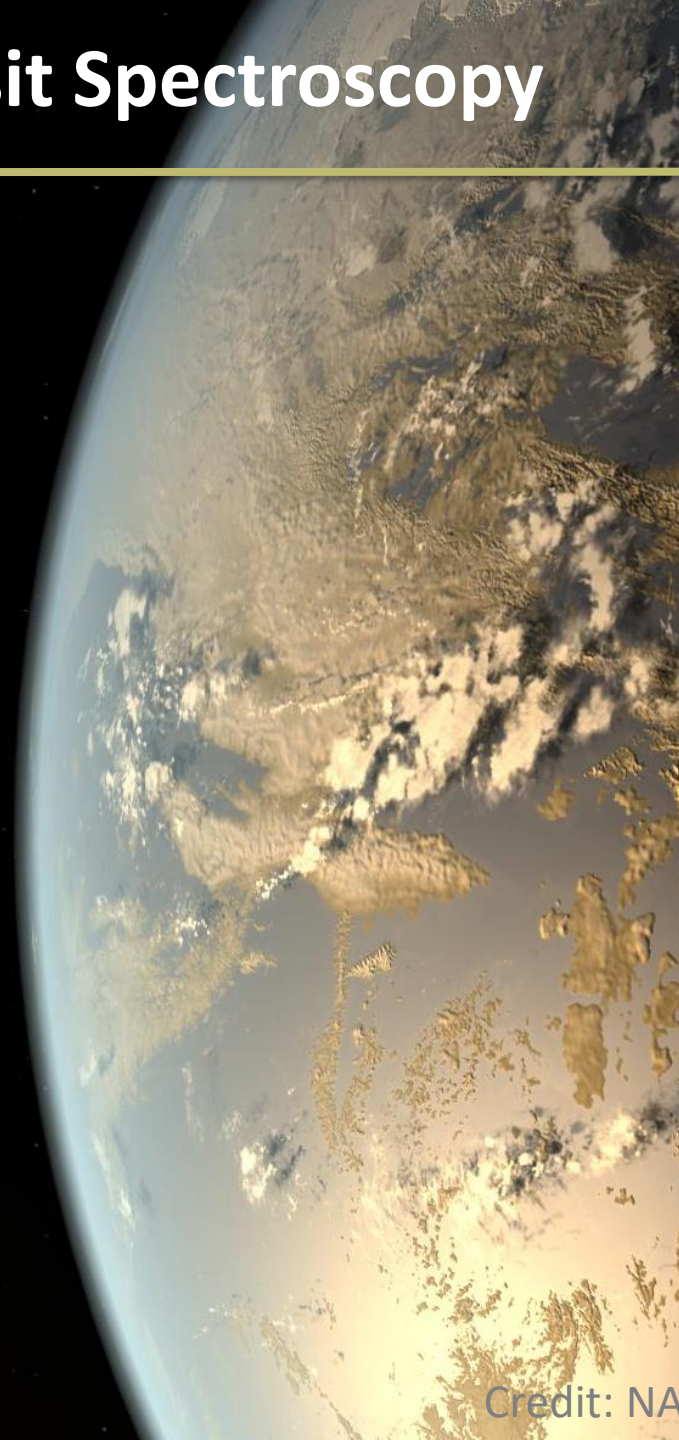
Credit: NASA

# Proposed SAG on Stellar Contamination and Transit Spectroscopy

During the next two decades transmission spectroscopy is expected to be a major source of information on the atmospheres of small exoplanets. Transmission spectroscopy relies on a precise understanding of the wavelength-dependent brightness of the star being occulted. However, stars are not homogeneous constant light sources but have photospheres and chromospheres covered by inhomogeneities like spots and faculae. The surface features on the star change, both intrinsically, and to an observer as the star rotates. To make the most of future NASA facilities like JWST, it is important we quantify the impact of stellar contamination on transmission spectroscopy and develop methods

The ExoPAG plans to establish a SAG to bring together an interdisciplinary team of scientists from the heliophysics, stellar astrophysics, and exoplanet atmosphere research. The SAG will (a) Report on what effect stellar contamination could have on the future space-based transmission spectroscopy measurements; (b) Recommend measures that should be taken to understand the magnitude of the stellar contamination and the population of stars where it is a problem, (c) Recommend what modeling efforts need to be performed to understand stellar contamination; (d) Pinpoint complementary observations that can be combined with transmission spectroscopy to mitigate or correct for contamination; and (e) Identify resources that the Agency could provide that would aid in mitigating or correcting for contamination.

If you are willing to *lead* this group please include your name, affiliation, email address, URL for website or profile, if available, 1-3 sentence statement of expertise, and a brief statement of any other qualifications you feel would make you a good candidate for leadership of this activity. We ask that those interested in volunteering to lead please respond by **March 13, 2020**.



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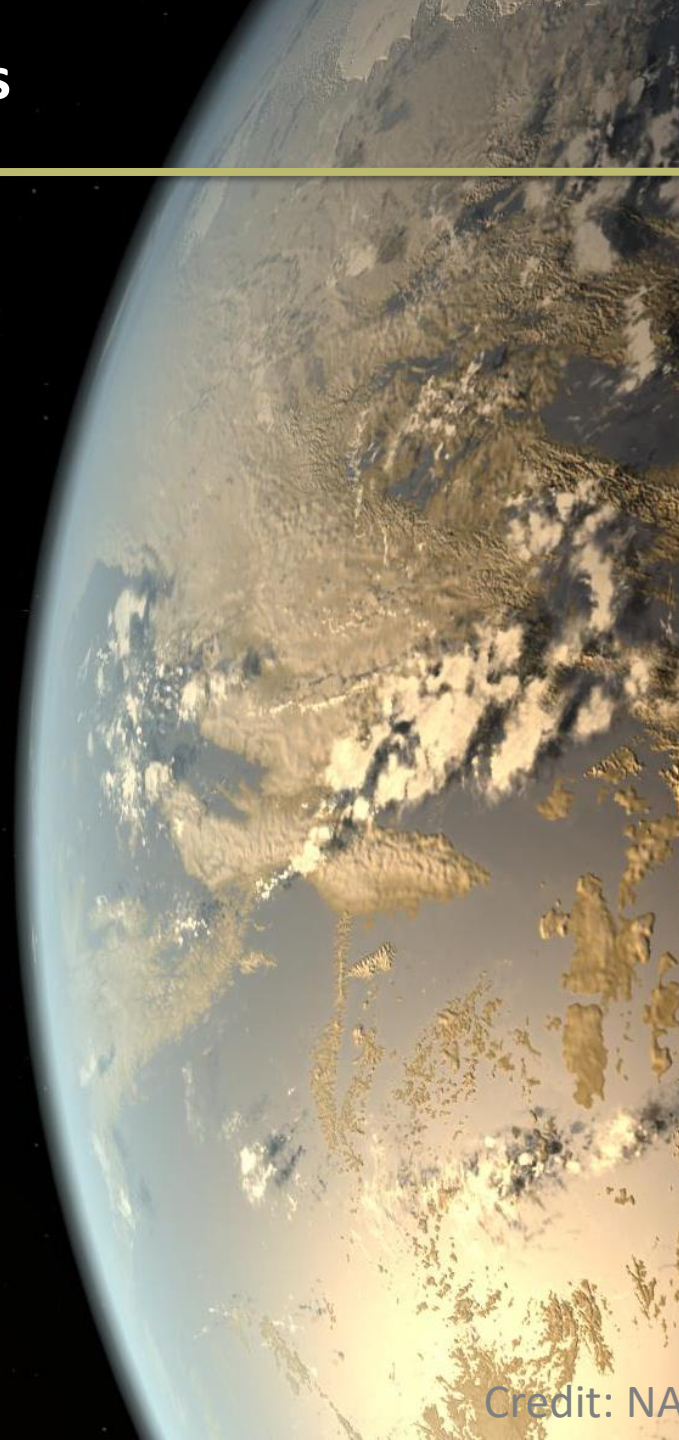
# Proposed SAG on Cataloguing Stellar Properties for Future Missions

At the ExoPAG 21 meeting, we discussed the need for a comprehensive catalog of star properties from among possible targets for future exoplanet missions (see https://tinyurl.com/tmp3fgw). The ExoPAG will be proposing a SAG to define the details and scope of this need in the next several months. The SAG will be tasked to identify the set of stellar information to be included in the catalog, review the number and types of stars to be included, and to consider the attributes of a living catalog that can be maintained, improved, and curated. The SAG may also identify particular types of stellar information that are not currently in hand that should obtained.

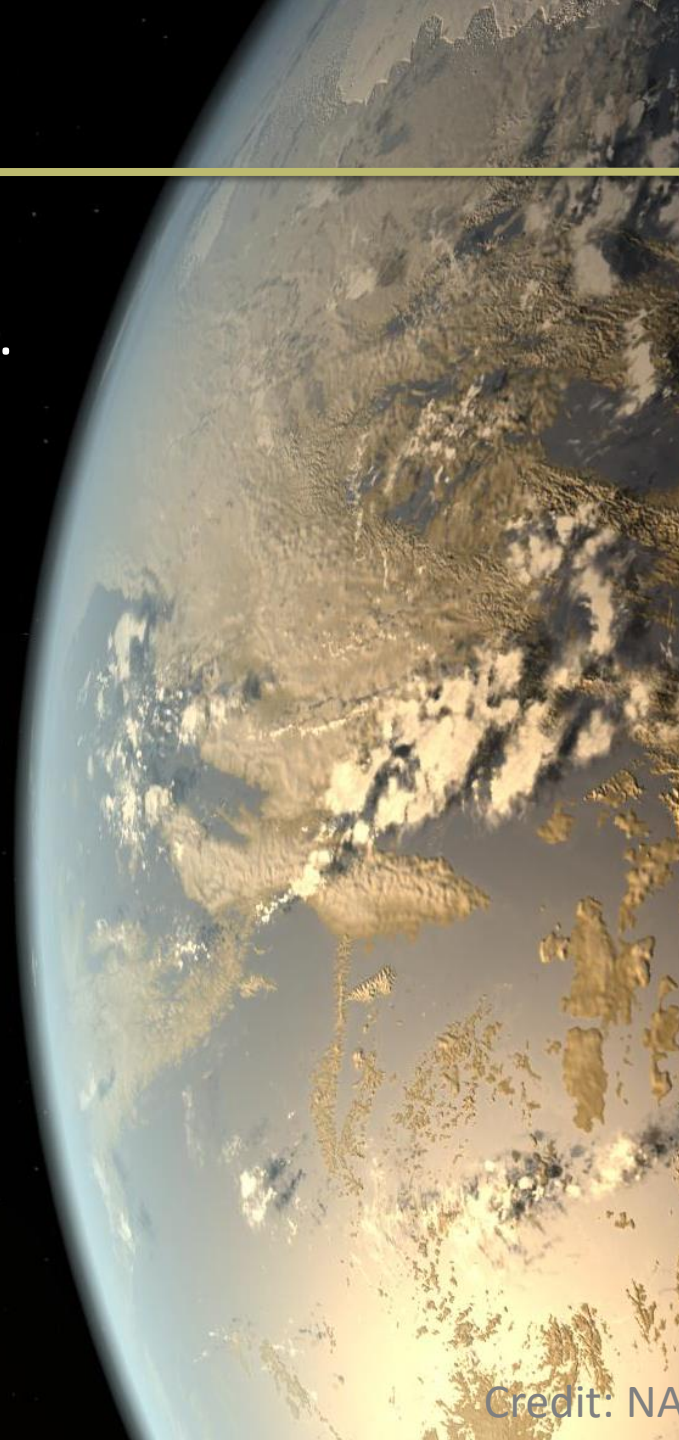
Please email exopag-info@jpl.nasa.gov if you are interested in participating in this effort. If you are willing to *lead* this group please include your name, affiliation, email address, URL for website or profile, if available, 1-3 sentence statement of expertise, and a brief statement of any other qualifications you feel would make you a good candidate for leadership of this activity. We ask that those interested in volunteering to lead (or nominate others to do so) please respond by **March 13, 2020**. Members of the ExoPAG are welcome to nominate others to lead this effort as well.

Please contact Joshua Pepper (jap612@lehigh.edu) or Michael Meyer (mrmeyer@umich.edu) if you have any questions.



# ExoPAG 2020 Future Activities

- Develop new ideas from EC+ExEP Brainstorming (e.g. zodiacal dust).
- Work with ExEP to map the Science Gap List to key areas for ExoPAG inputs. (Start new process to review).
- Collect community input at ExoPAG22.
  (e.g. to develop findings for discussion at ExoPAG 23).
- Continue monthly ExoPAG EC and SIG2 telecons
- Final reports and request closeout SAG-20.
- Formal proposals for two new SAGs at summer meeting.
- ExoPAG22 on July 19, 2020, prior to Sagan Summer School.
  - Mini-symposium to track Science Gap List.
  - Variety of Program & community presentations including students.



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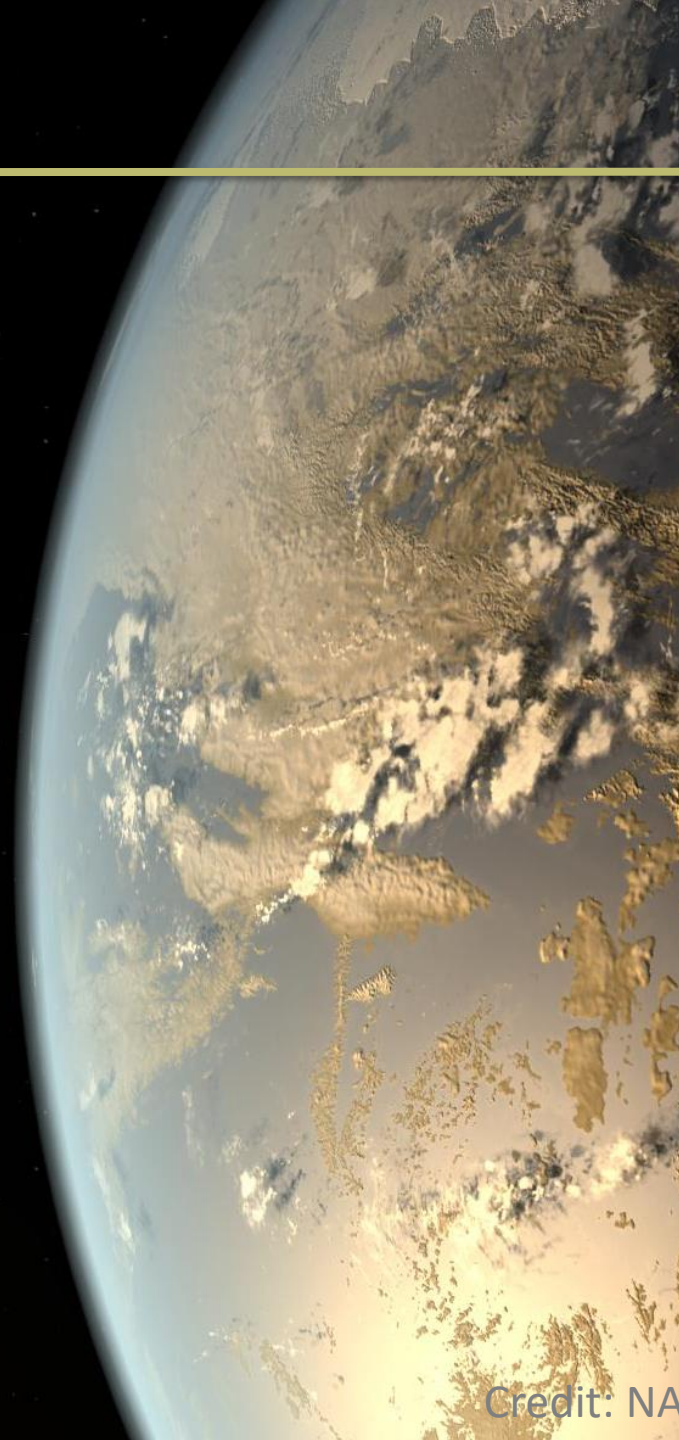
# Historical Note:  SIG #1 – Close out request.

**Toward a Near-Term Exoplanet Community Plan:**

The goal of this Science Interest Group is to begin the process of developing a holistic, broad, unified, and coherent plan for exoplanet exploration, focusing on areas where NASA can contribute. To accomplish this goal, the SIG will work with the ExoPAG to collect community input on the objectives and priorities for the study of exoplanets. Using this input, it will attempt to develop a near-term (5-10 year) plan for exoplanets, based on the broadest possible community consensus. The results of this effort will serve as input to more formal strategic planning activities that we expect will be initiated near the end of the decade in advance of the next decadal survey.

Creator (and former ExoPAG EC Chair) Scott Gaudi concurs.



# Action Requested by ExoPAG EC

- Close-out SAG 19.
- Close SIG1.
- Initiate SIG3.
- Comments welcome on new SAGs.