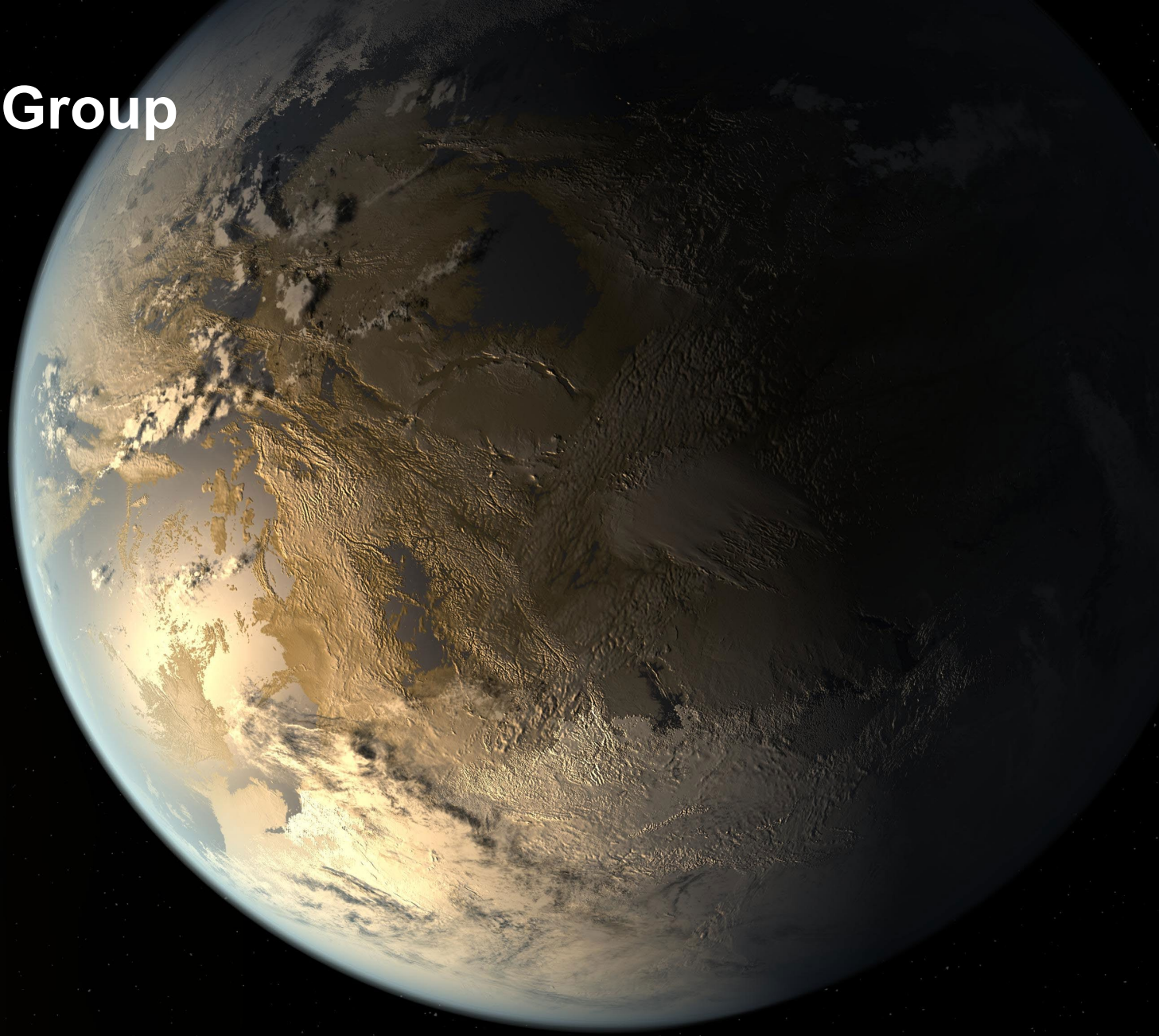
Exoplanet Program Analysis Group (ExoPAG) Report:



Michael Meyer (ExoPAG EC Chair)
March 16th, 2021.

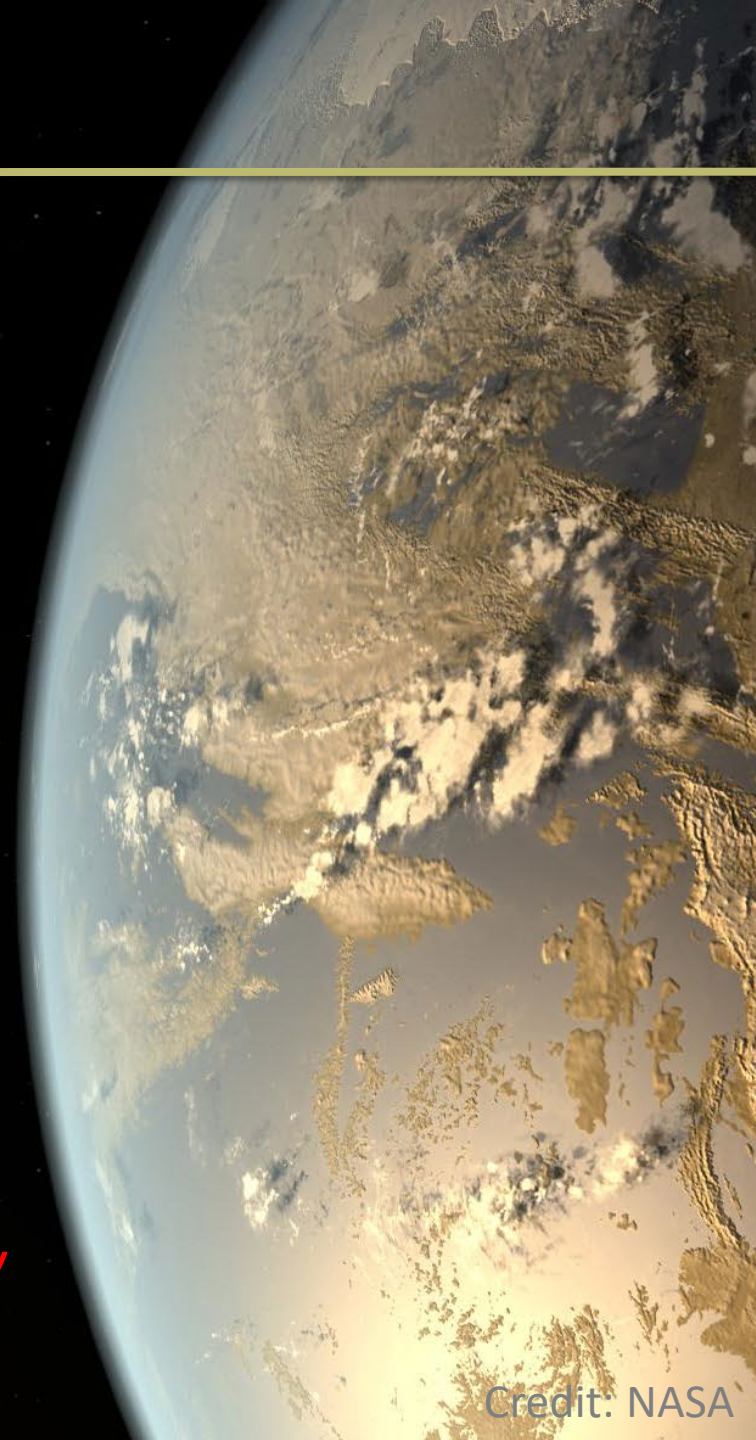
Astrophysics Advisory Committee

Credit: NASA

ExoPAG Executive Committee

Michael Meyer (Chair)	University of Michigan
Tom Barclay	University of Maryland
Natasha Batalha	NASA-Ames
Jacob Bean	The University of Chicago
Jessie Christiansen	NExScI/Caltech
Rebecca Jensen-Clem	UC-Santa Cruz
John Debes	Space Telescope Science Institute
Tiffany Kataria	JPL/Caltech
Josh Pepper	Lehigh University
Dmitry Savransky	Cornell
Laura Schaefer	Stanford University
Vikki Meadows (Past Chair)	University of Washington
Hannah Jang-Condell (ExEP DS)	*NASA HQ, Executive Secretary*
Douglas Hudgins (Astrophysics)	NASA HQ
Doris Daou (Planetary Liaison)	NASA HQ
Richard Eckmann (Earth Liaison)	NASA HQ
Gaylan Fowler (Heliophys Liaison)	NASA HQ

Selection process for new members underway

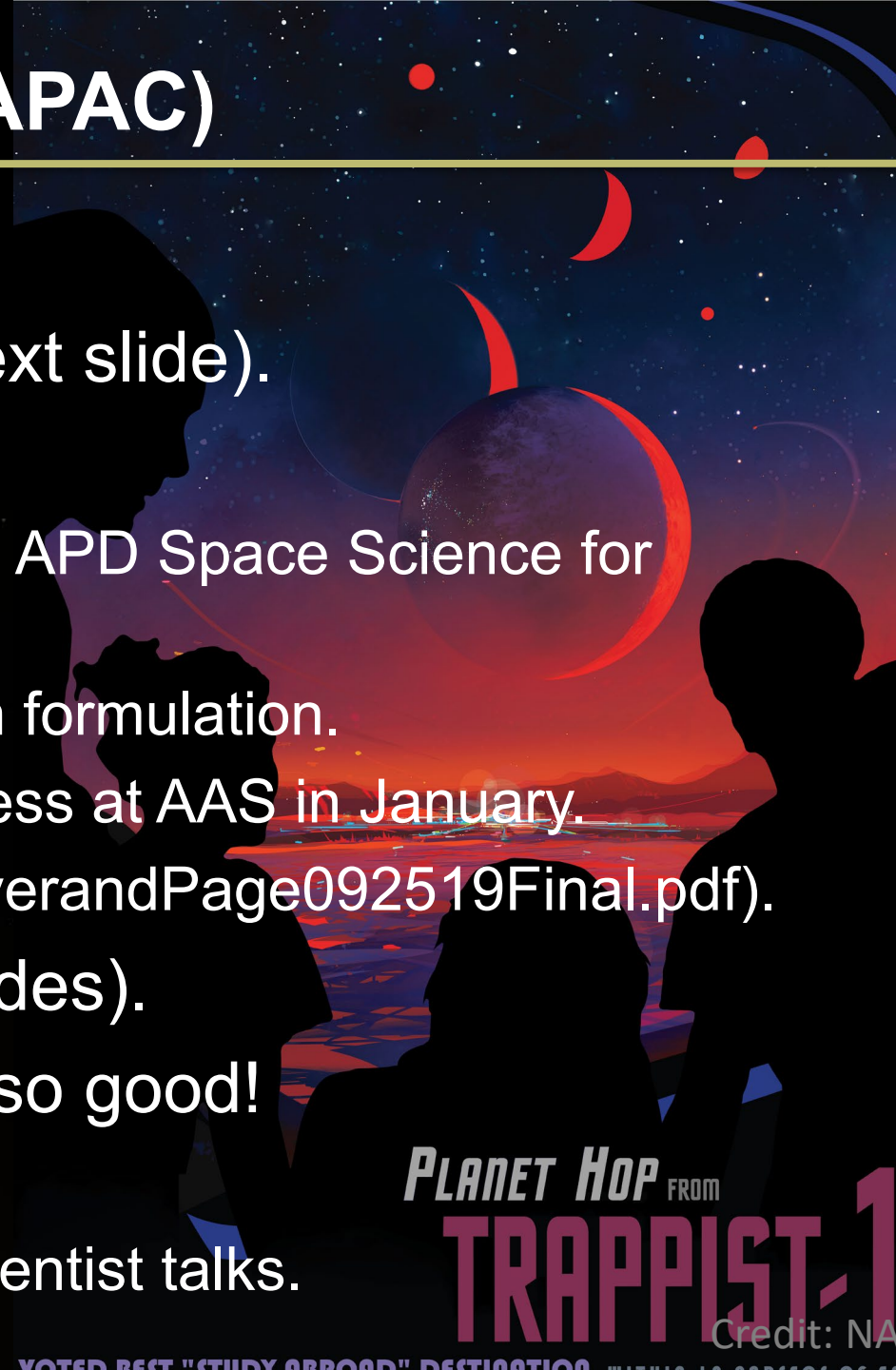


Credit: NASA

ExoPAG Recent Activities (since last APAC)

- Community forum prepared for ExoPAG23 (next slide).
- APD Cross PAG activities:
  - AAS Special Session on Barriers to Participation in APD Space Science for Minority Serving Institutions.
  - Cross PAG SAG on URM in APD Space Science in formulation.
  - Overview of APD Biannual Tech Gap Review Process at AAS in January.

  (https://apd440.gsfc.nasa.gov/images/tech/ABTRCoverandPage092519Final.pdf).
- ExoPAG 23 Jan. 5-6 before AAS (see next slides).
- First Exoplanet Explorers events held - so far so good!
  - Over 100 participants.
  - Both senior scientists and mentoring plus junior scientist talks.



ExoPAG Community Forum – Held December 15.

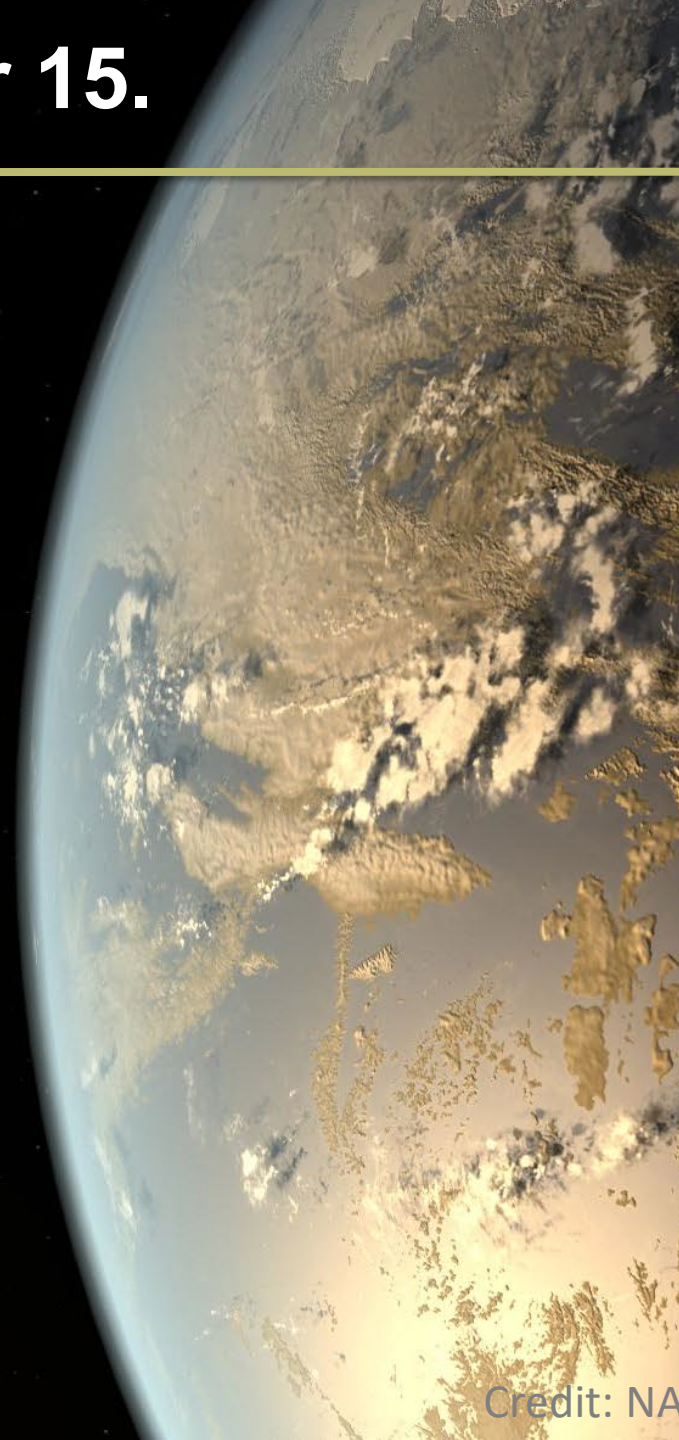
There were 23 participants at a 90-minute virtual zoom meeting.

Described scope of ExoPAG analyses and reviewed past "Findings".

Discuss proposed finding: On the value of investing in interdisciplinary exoplanet science of scale over longer periods of performance (full text available in backup slide).

Solicited proposals for future findings, received pre-meeting input, and outlined process to down-select findings for votes, including community meeting in advance of meeting to vote on finding.

Significant changes were made in response to community input.



Credit: NA

ExoPAG 23 January 5-6, 2021 Virtual

Solar System / Exoplanet Synergies Mini-Symposium!

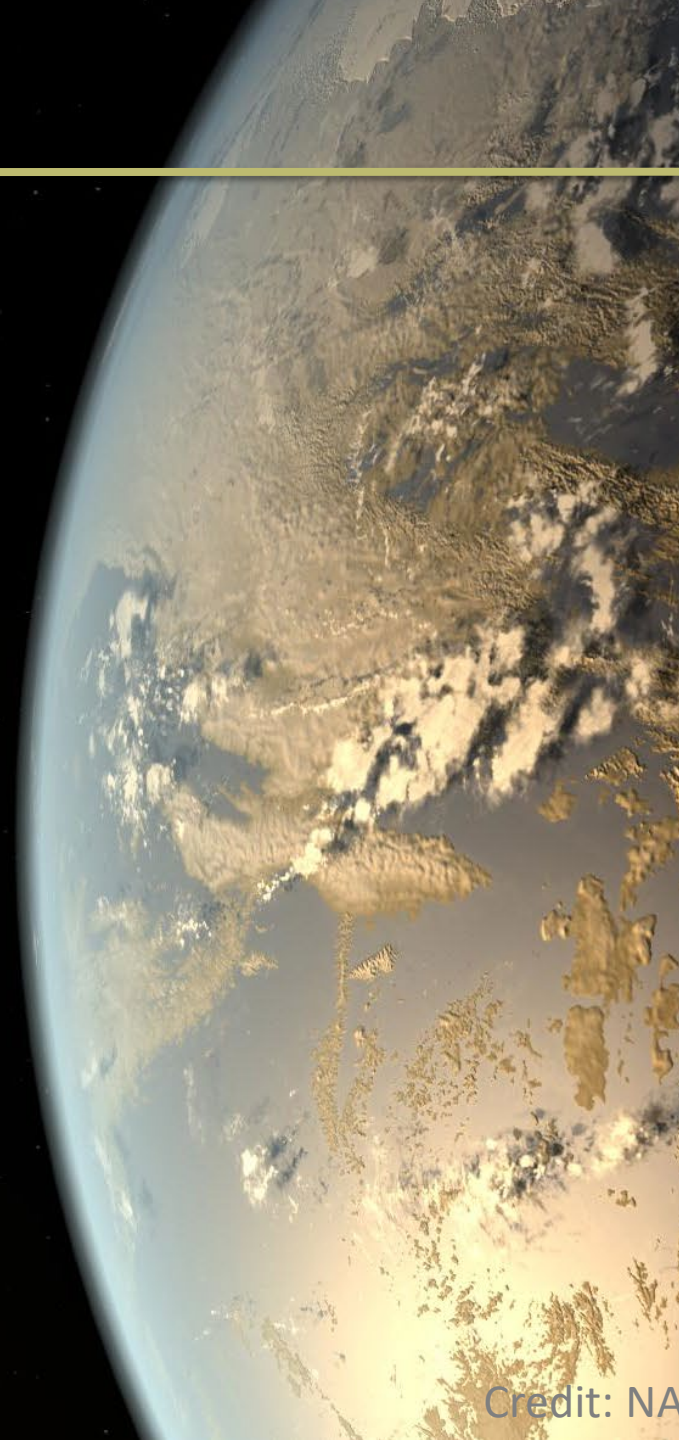
- *SIG3 Update (V. Meadows).*
- *talks on Venus (M. Wong) and Ice Giants (K. Mandt).*
- *Habitable Worlds Meeting Pre-Meeting Update (C. Unterborn)*
- *Early-career scientist presentations.*
- *Panel Discussion (*Ty Robinson, Erin May, Laura Mayorga, Giada Arney).

ExEP Program Topics (HQ, Program Office at JPL, NExSci)

Science Updates

- *TESS Mission Updated and program notes.*
- *Microlensing Review.*
- *FARSIDE overview (lunar radio interferometer).*
- *Earth Science Exoplanet Synergies (HQ overview and science talk)*

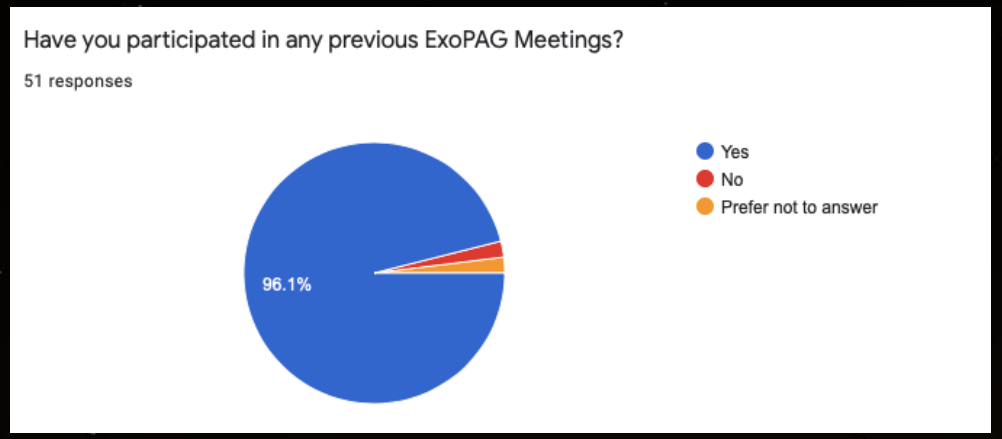
Business Meeting – cancelled (due to Capital insurrection).

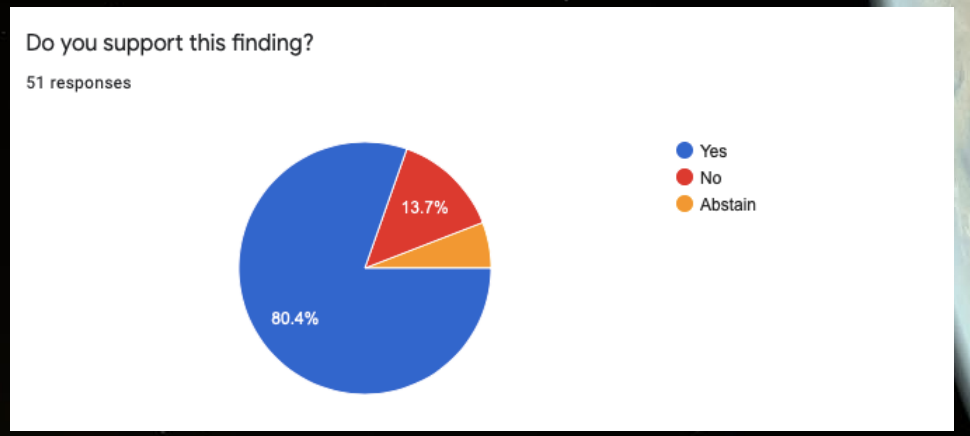


ExoPAG Proposed Finding: On-line Poll March 1-10

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

- Meant to mimic process of in person votes (public, vote once).
- 50 participants vs. ~ 60 at face-to-face meeting.
- 41 yes, 7 no, 2 abstentions.
- Since more than 2:1 in favor, finding will be shared with APD.





Credit: NA

Current Status of SAGs and SIGs:

https://exoplanets.nasa.gov/exep/exopag/overview/

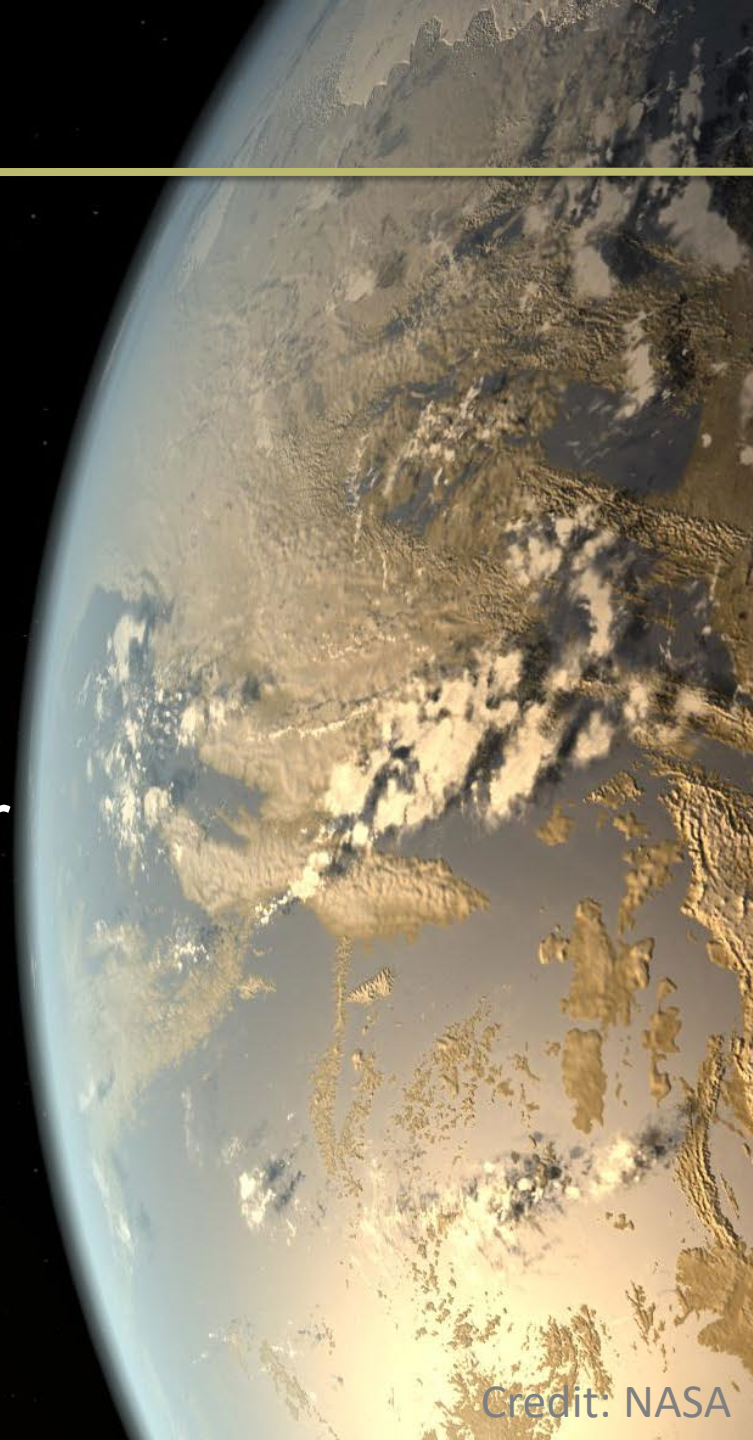
Close Year	SAG or SIG	Title	Lead
2020	SAG 19	Exoplanet imaging signal detection theory and rigorous contrast metrics (final report submitted)	Mawet & Jensen-Clem
----	SIG 2	Exoplanet Demographics.	Christiansen & Meyer
----	SIG 3	Exoplanet Solar System Synergies.	Meadows & Mandt
----	SAG 21	Stellar Contamination on Transit Spectra.	Rackham &Espinoza (Barclay)
----	SAG 22	Exoplanet Host Properties Database (report in summer)	Pepper, Stark, & Hinkel

All are very active and open to participation if any community members would like to know more!

SIG 2 - Exoplanet Demographics

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

- 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.
- Working groups drafting report on value of public database of demographic products, covering all techniques, to be submitted this spring.



Credit: NASA

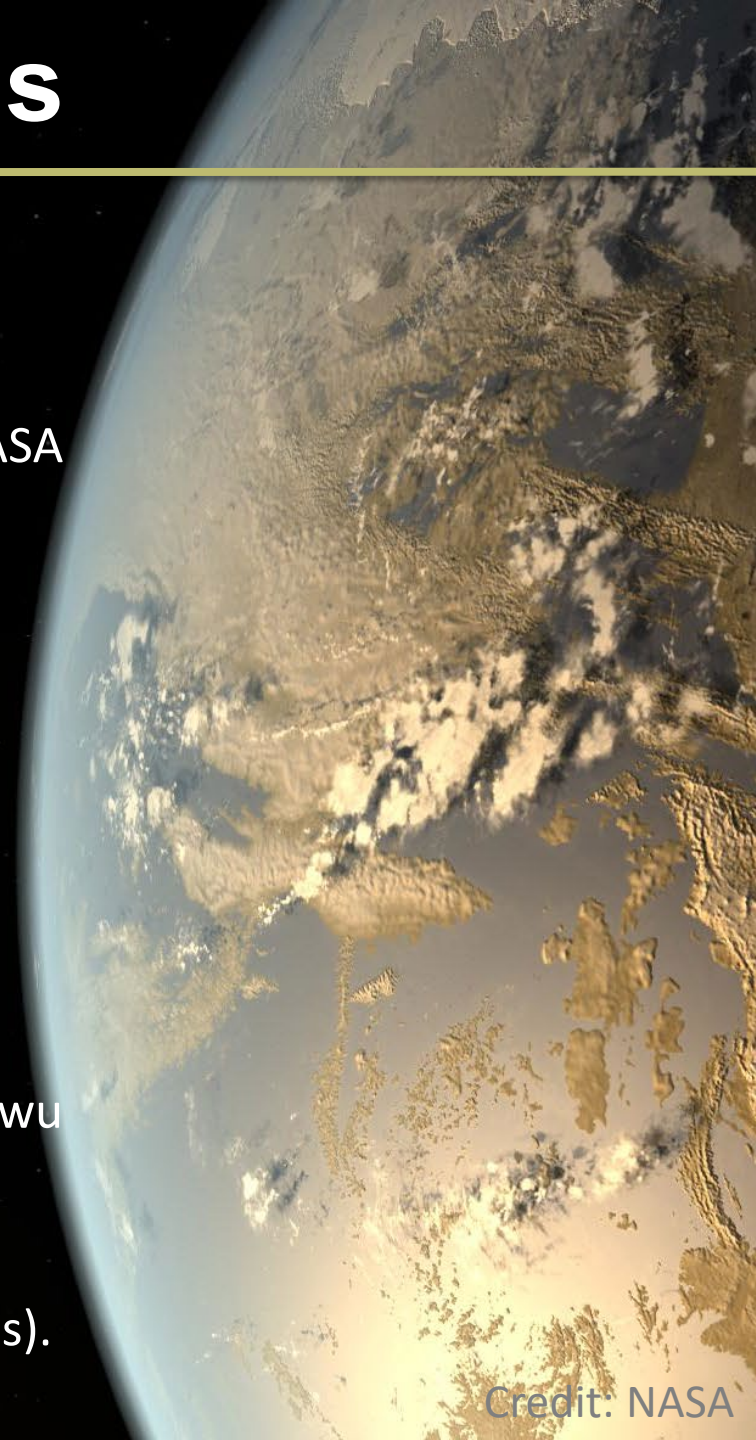
SIG 3 ExoSS Goals, Progress, Plans

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 active and open to all.

- Successful mini-symposium at ExoPAG 23 in January 2021.
- Promoted community-led Planetary Decadal activities: List of lists - https://bit.ly/3fu6ang
- Monthly SIG3 Tutorial/Journal Club to explain key concepts to each other
- ExoSS Slack Channel – all are welcome! (Email: meadows@uw.edu)
- Gathering community input on key ExoSS synergies: https://tinyurl.com/yxbnyfwu
- Recruiting members from diverse science communities (e.g. DPS and PEN).
- Promote potential collaboration between the exoplanet and Solar System communities, such as the recent NExSS Hab Worlds 2 conference (~ 350 persons).



Credit: NASA

SAG 21: The Effect of Stellar Contamination on Space-based Transmission Spectroscopy

Coordinators: Néstor Espinoza & Ben Rackham.

Community Symposium March 8-9 (~ 100 participants) => https://sites.google.com/view/sag21symposium

SAG 22 – Exoplanet Host Properties

Coordinators: Joshua Pepper, Chris Stark, & Natalie Hinkel

Both SAGS have several dozens of participants, initiated monthly telecons, drafted work plans, and split up into working groups. Both reports are expected in summer 2021.

SAG 19 Exoplanet Imaging Signal Detection Theory and Rigorous Contrast Metrics

Summary of Findings

- The contrast curve represents a single choice of a detection threshold, false positive fraction, and true positive fraction (e.g. a 3σ contrast curve indicates a detection threshold of 3σ, a false positive fraction of 0.001 assuming the noise follows a Gaussian distribution, and a true positive fraction of 0.5). Fixing these values with respect to separation from the central star may not be optimal for all applications.
- A contrast curve can be invoked as a frequentist upper limit on the detectability of a planet with a certain separation and brightness. However, a Bayesian upper limit is better suited to rejecting hypotheses regarding a particular planet's detection because it is a statement about the probability of a parameter (e. g. a planet's brightness) to lie within a given interval in the data.
- The contrast curve includes the implicit assumption that the noise in the science image follows a Gaussian distribution. However, the presence of speckles near the coronagraph's inner working angle in the final post-processed science image indicate that the noise is not fully whitened.
- Modern techniques for speckle subtraction (e. g. the Regime-Switching Model detection map; Dahlqvist et al., 2020), generally outperform first-generation techniques (e. g. LOCI; Lafrenière et al., 2007) when applied to the same datasets. However, machine learning techniques (e. g. SODINN; Gomez Gonzalez et al., 2018), do not yet outperform first-generation techniques.

Four publications can be traced to the work of this SAG from 2018-2020!

Credit: NASA

Upcoming Activities:

1. Initiatives under consideration:
   - Ground- and space-based direct imaging synergies?
   - Review status of debris disk knowledge for imaging planets?
   - Common standards for publishing/archiving exoplanet discoveries?
2. Planning for reaction to NAS Decadal Survey Astro2020.
3. Organize ExoPAG 24:

   Two-day 12-5 pm EST between June 14-18 or June 21-25

Business for APAC: Advise APD to accept the final report from SAG-19 and formally end this SAG.

Credit: NA

Back-up

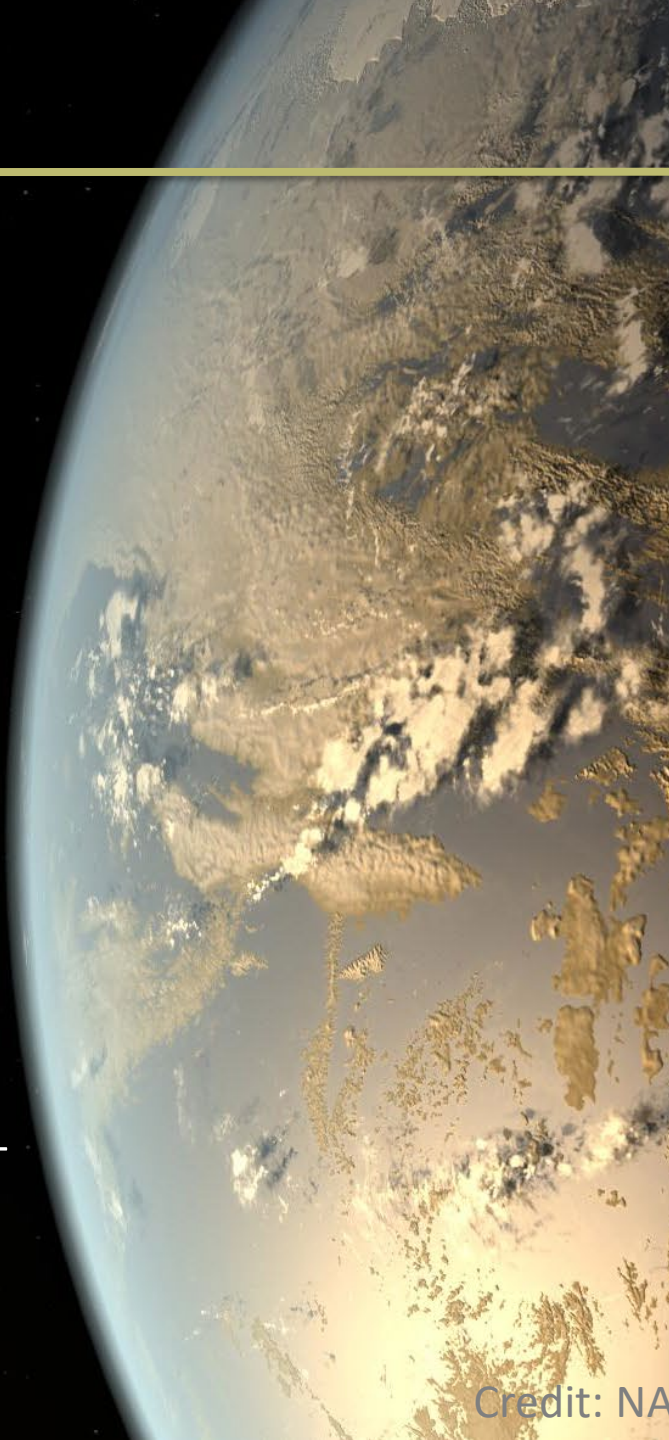
Credit: NA

ExoPAG 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, statistics, 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 teams 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, provided that such new opportunities did not come at the expense of existing programs which are also extremely valuable to help NASA achieve its strategic goals."



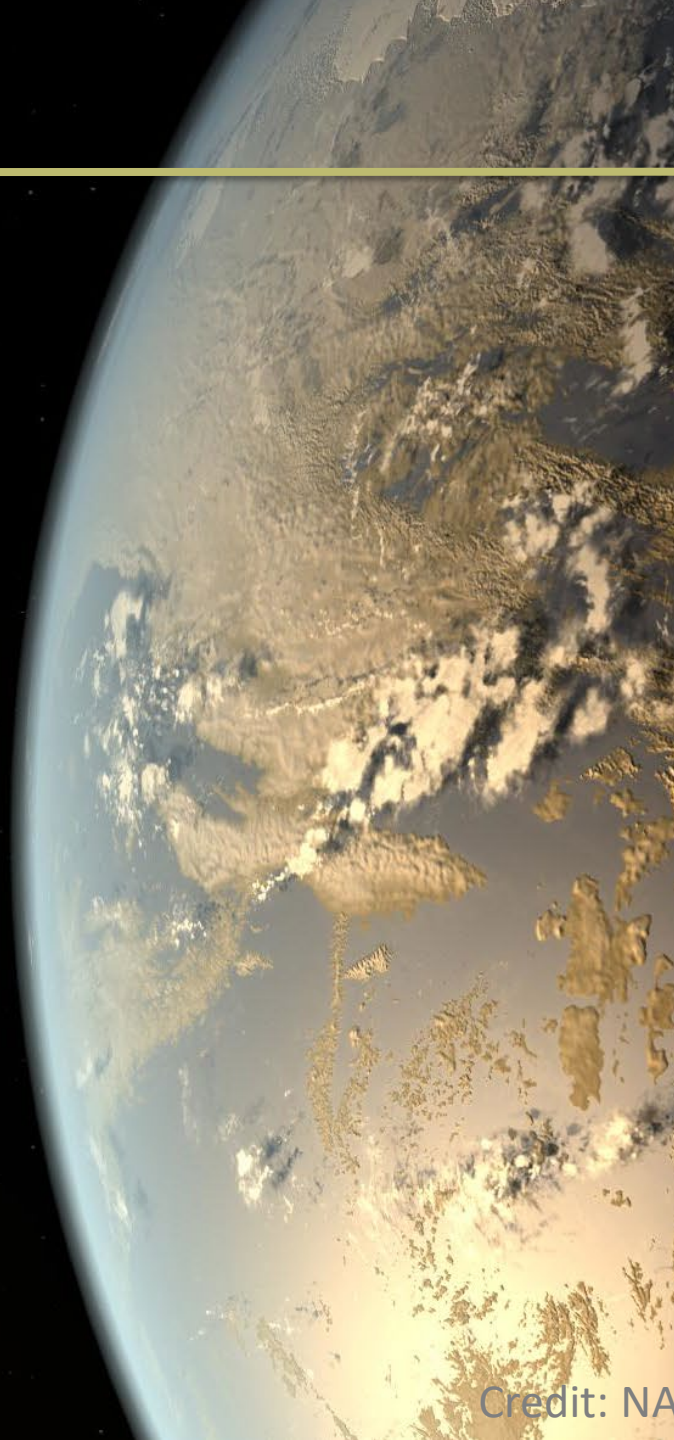
Credit: NA

Exoplanet Explorers Program Launched!

Steering Committee (all are members of ExoPAG EC):
T. Kataria (JPL), N. Batalha (NASA-Ames), J. Christiansen (IPAC), & J. Pepper (Lehigh)

Early career (grad students & postdocs) cohort for speakers series.
Half-hour monthly seminar series.
Stipend for presentation and weekly interaction with cohort.
Monthly professional development interaction with senior scientists in the field.
Additional professional development workshops to be decided by cohort.
Proposals due November 5, 2020! To be selected by ExoPAG EC.
Pilot Program January-June 2021.

For more information: https://exoplanets.nasa.gov/exep/exopag/exoexplorers/



Credit: NA