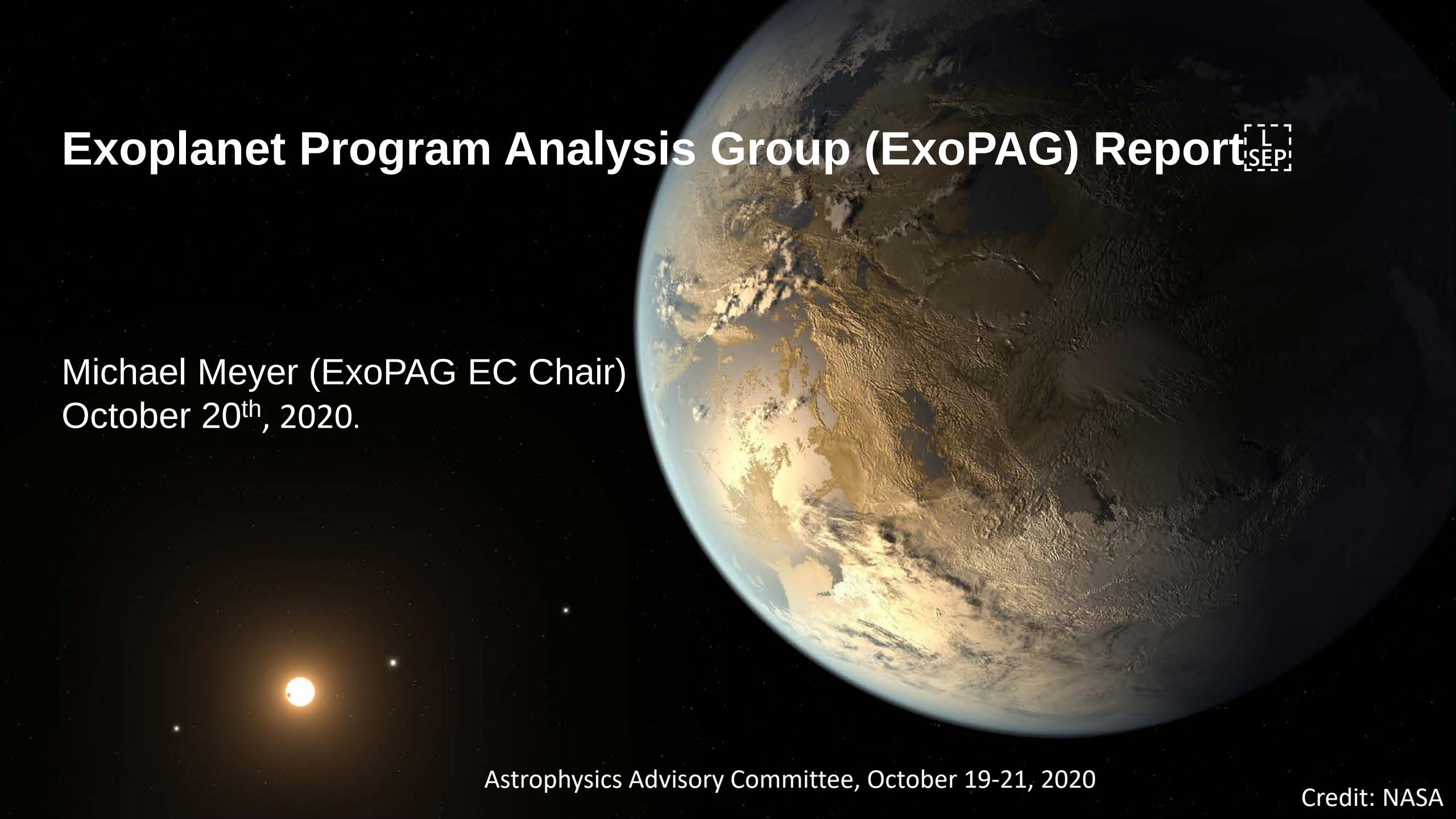
Exoplanet Program Analysis Group (ExoPAG) Report

Michael Meyer (ExoPAG EC Chair)
October 20th, 2020.

Astrophysics Advisory Committee, October 19-21, 2020

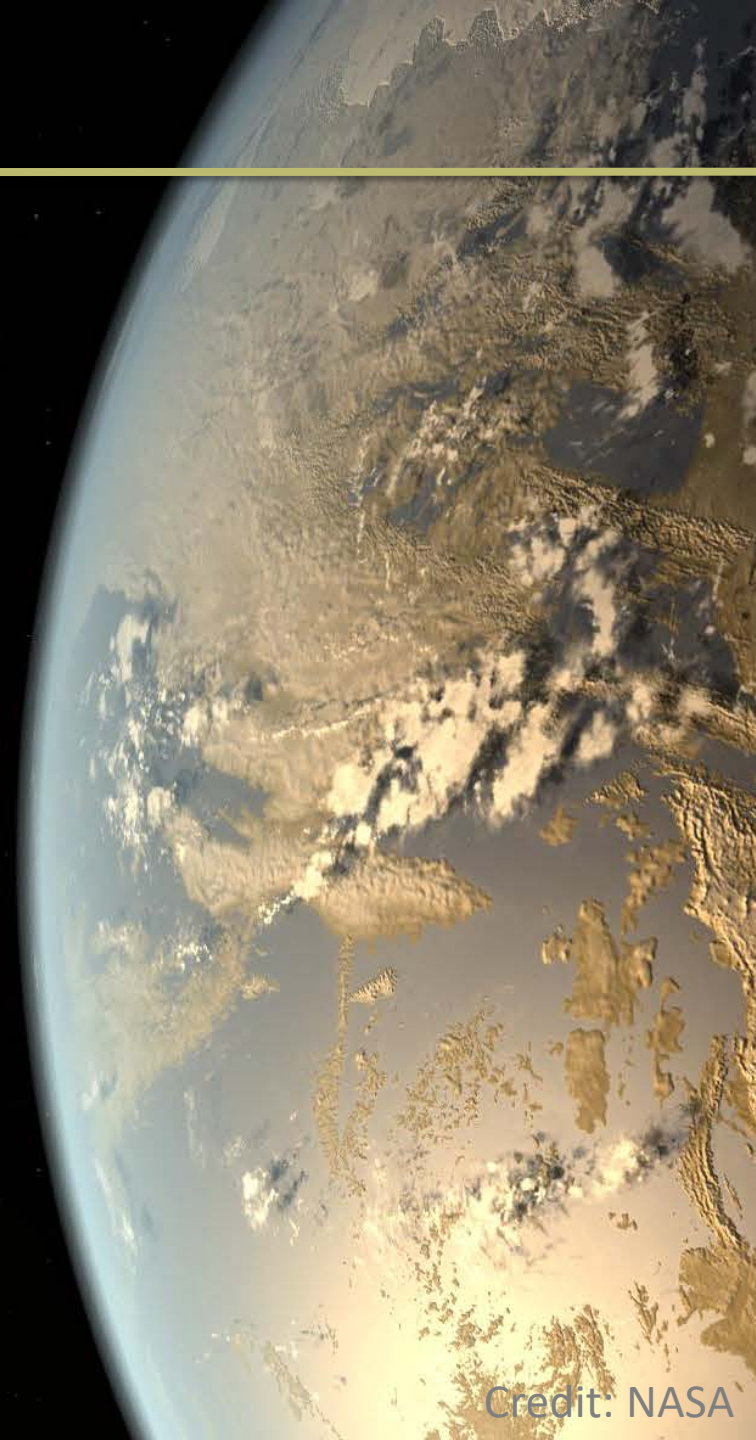


Credit: NASA

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
Douglas Hudgins (Astrophysics)	NASA HQ
Hannah Jang-Condell (ExEP DS)	*NASA HQ*
Doris Daou (Planetary Liaison)	NASA HQ
Richard Eckmann (Earth Liaison)	NASA HQ
Gaylan Fowler (Heliosph Liason)	*NASA HQ*

Our newest members!



Credit: NASA

ExoPAG Recent Activities (since last APAC)

- Presented to PSAC in August with other AGs.
- Participated in NExSS/P/AG roundtable in October.
- Review of ExEP Science Gap List completed (Sept. 30).
- Fall community forum: prepare for January ExoPAG
- Launch of Exoplanet Explorers!
- Cross PAG activities:
  - Propose AAS Special Session.
  - Discuss new cross PAG SAG on barriers to participation in AP Space Science.
  - Extended activities at AAS in January.
- Begin preparations for Exopag 23 (Jan. 5-6).

ExoPAG Community Forum – early December (TBS)

Describe scope of ExoPAG analyses.

Review past "Findings".

Discuss proposed finding:

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

Solicit community feedback and proposals for future findings.

Propose process to down-select findings for votes.

Credit: NA

Exoplanet Explorers Program

Steering Committee (all 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

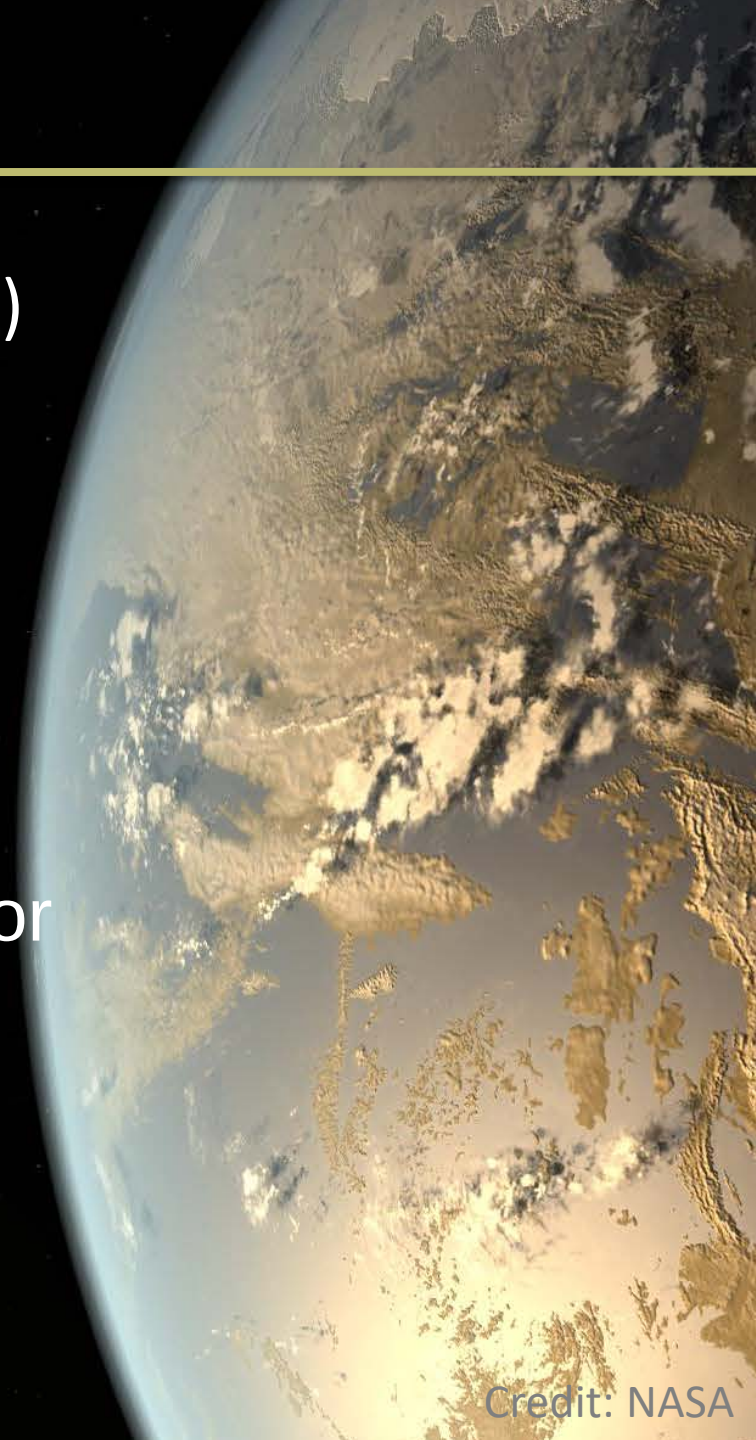
Current Status of SAGs and SIGs

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

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).
- Drafting report on value of public database of demographic products.
- Curating a list of open questions/ongoing projects for the community.
- NExSci is hosting workshop in the November. https://nexsci.caltech.edu/conferences/exodem/



Credit: NASA

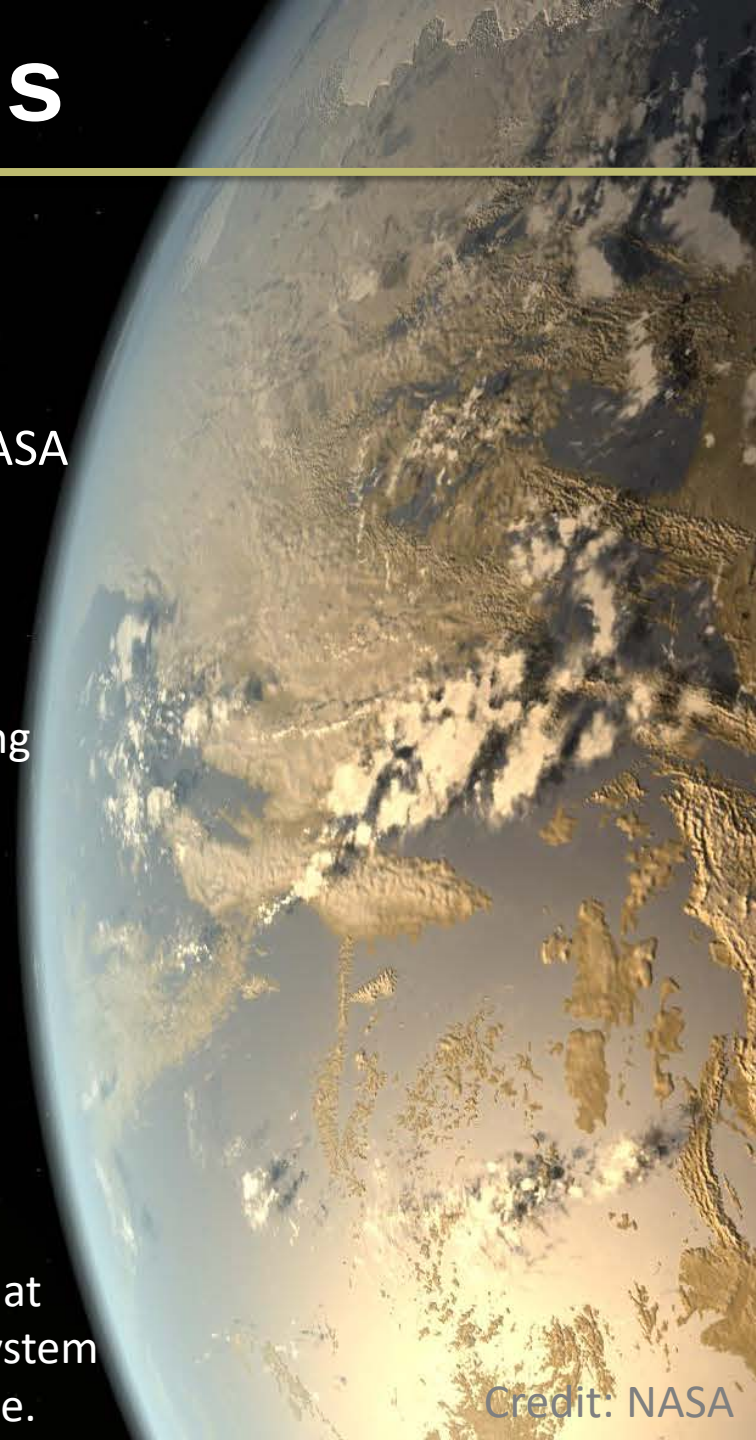
SIG 3 ExoSS Goals, Progress, Plans

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 open to all and moving full steam ahead!

- Promoted community-led Planetary Decadal activities: List of lists - https://bit.ly/3fu6ang
- Initiated monthly SIG3 Tutorial/Journal Club to explain key concepts to each other
  - July tutorial on Solutions and Solubilities by Laura Schaefer.
  - Sept tutorial on the Planetary Data System by Nancy Chanover.
  - Oct tutorial on the *M dwarfs as Planet Hosts* by Elisabeth Newton.
- ExoSS Slack Channel – all are welcome! (If you would like to join: meadows@uw.edu)
- Gathering community input on key ExoSS synergies: https://tinyurl.com/yxbnyfwu
- Recruiting members from diverse scientific communities (including DPS and PEN).
- Plan to continue 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 21: The Effect of Stellar Contamination on Space-based Transmission Spectroscopy

Coordinators: Néstor Espinoza, Ben Rackham, & Tom Barclay

SAG 22 – Exoplanet Host Properties

Coordinators: Joshua Pepper, Chris Stark, & Natalie Hinkel

Discussed at last APAC meeting and approved by APD.

Both SAGS have several dozens of participants, initiated monthly telecons, drafted work plans, and split up into working groups.

ExoPAG 2020 Future Activities

- Close-out SAG 19 (Exoplanet Imaging Signal Detection).
- Possible areas for action: zodiacal dust and high contrast imaging.
- Continue monthly ExoPAG EC, SIG2/SIG3/SAG-21/SAG-22 telecons
- ExoPAG23 planned for January 5-6, 2020 (before winter AAS) including mini-symposium on Exoplanet & Solar System Synergies.
- Help organize AAS Special Session on Barriers to Participation.
- Help formulate cross PAG SAG on lack of equity in AP Space Science.
- Continue discussions regarding cross PAG initiatives:
  - Technology roadmap synergy.
  - Analyses related to Astro2020.
- Support cross division conversations:
  - Participate in Planetary Science Advisory Committee.
  - Participate in Nexus Exoplanet System Science discussions.

Credit: NA

BACKUP

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]

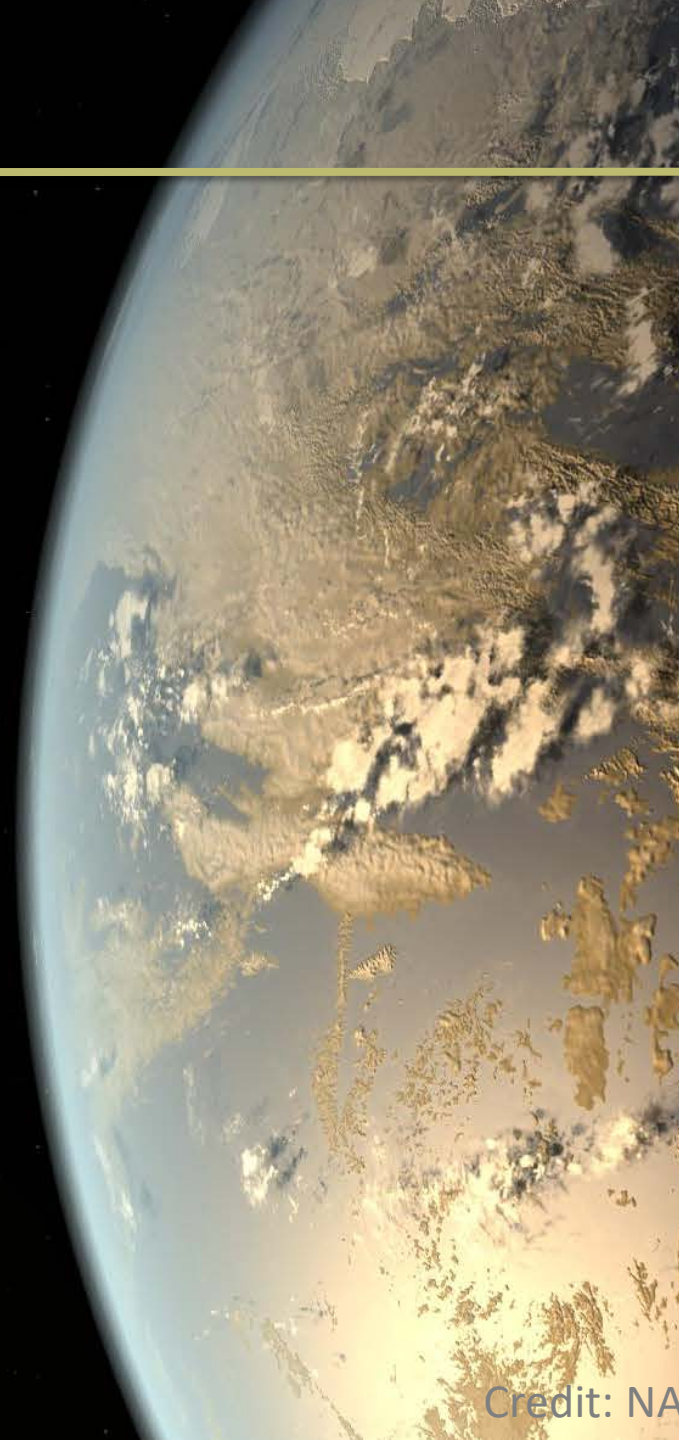
ExoPAG 21 – Finding #2

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."

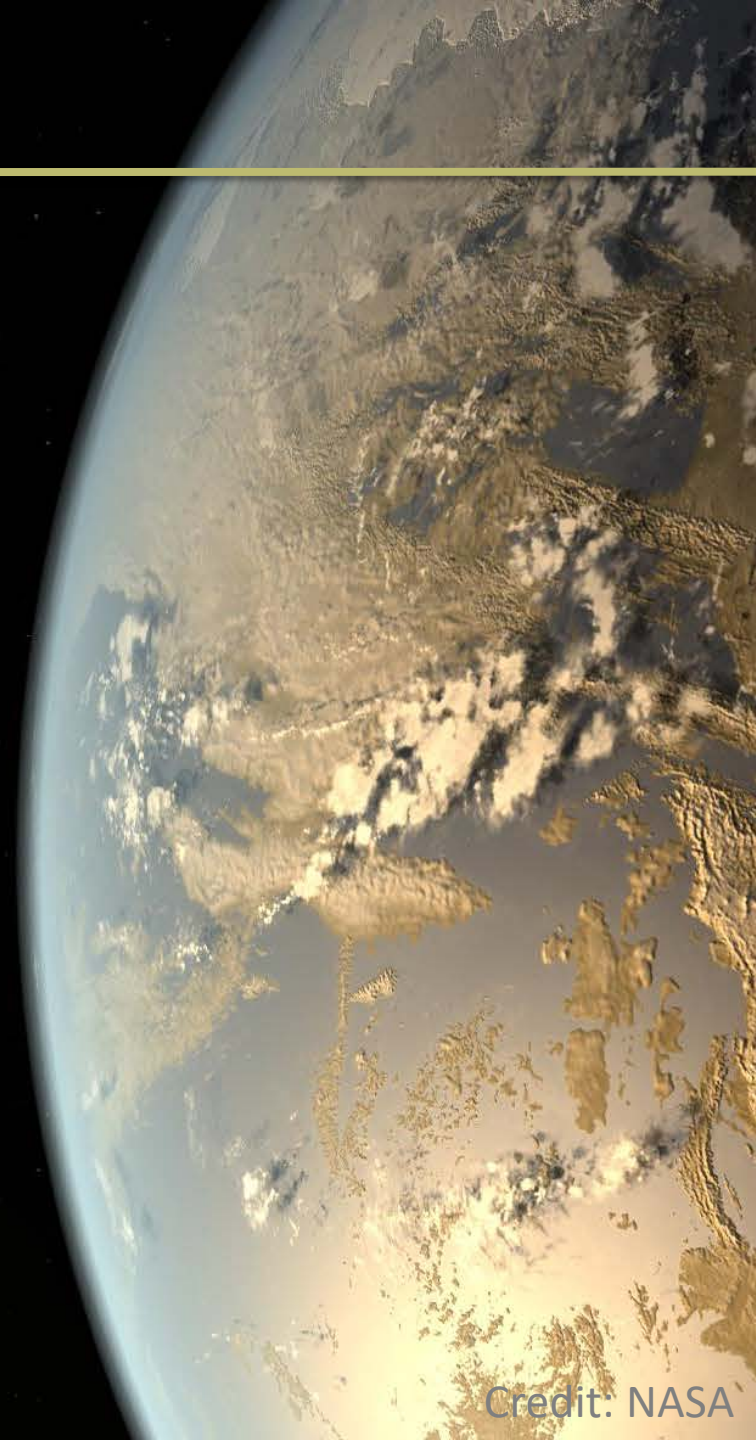
[58 Yes, 0 No, 5 Abstentions]

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

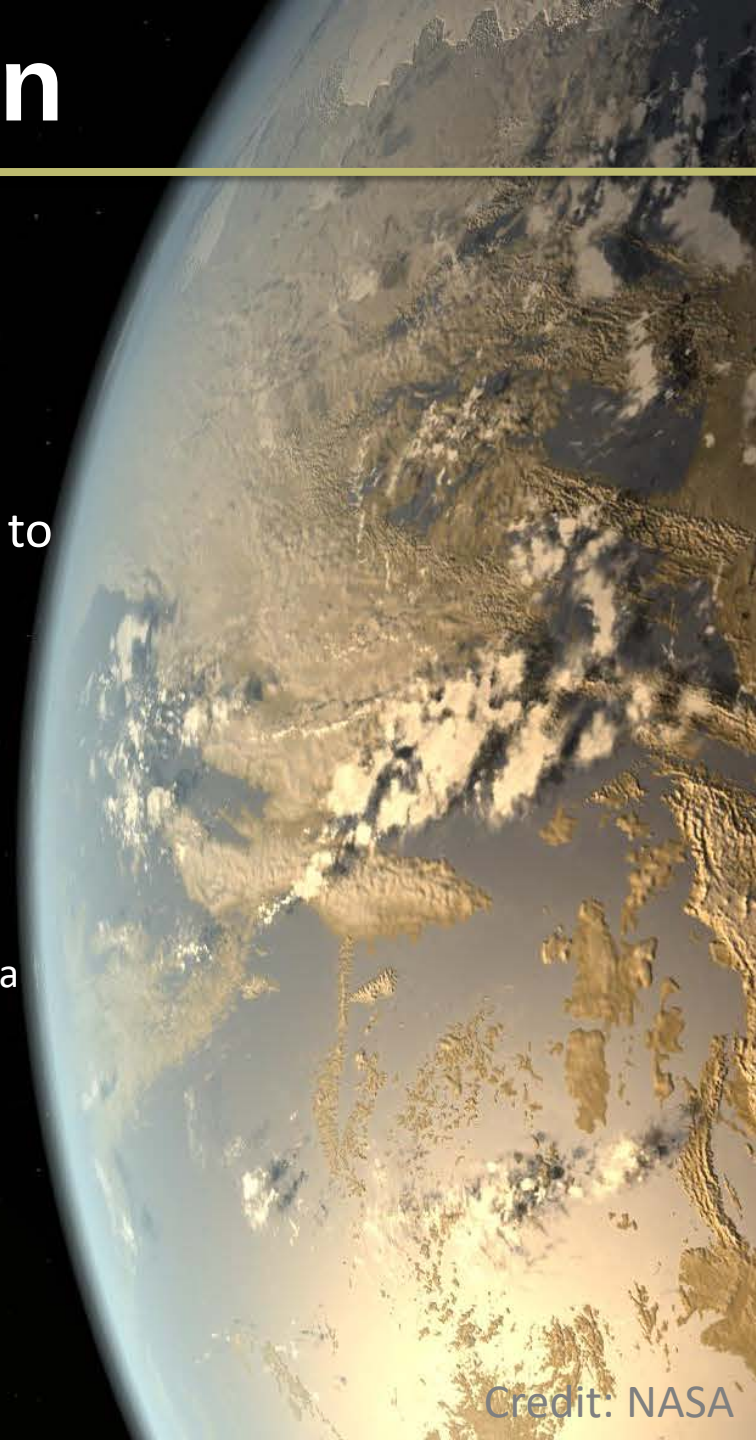
SIG 3 ExoSS Synergies – Motivation

- 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.



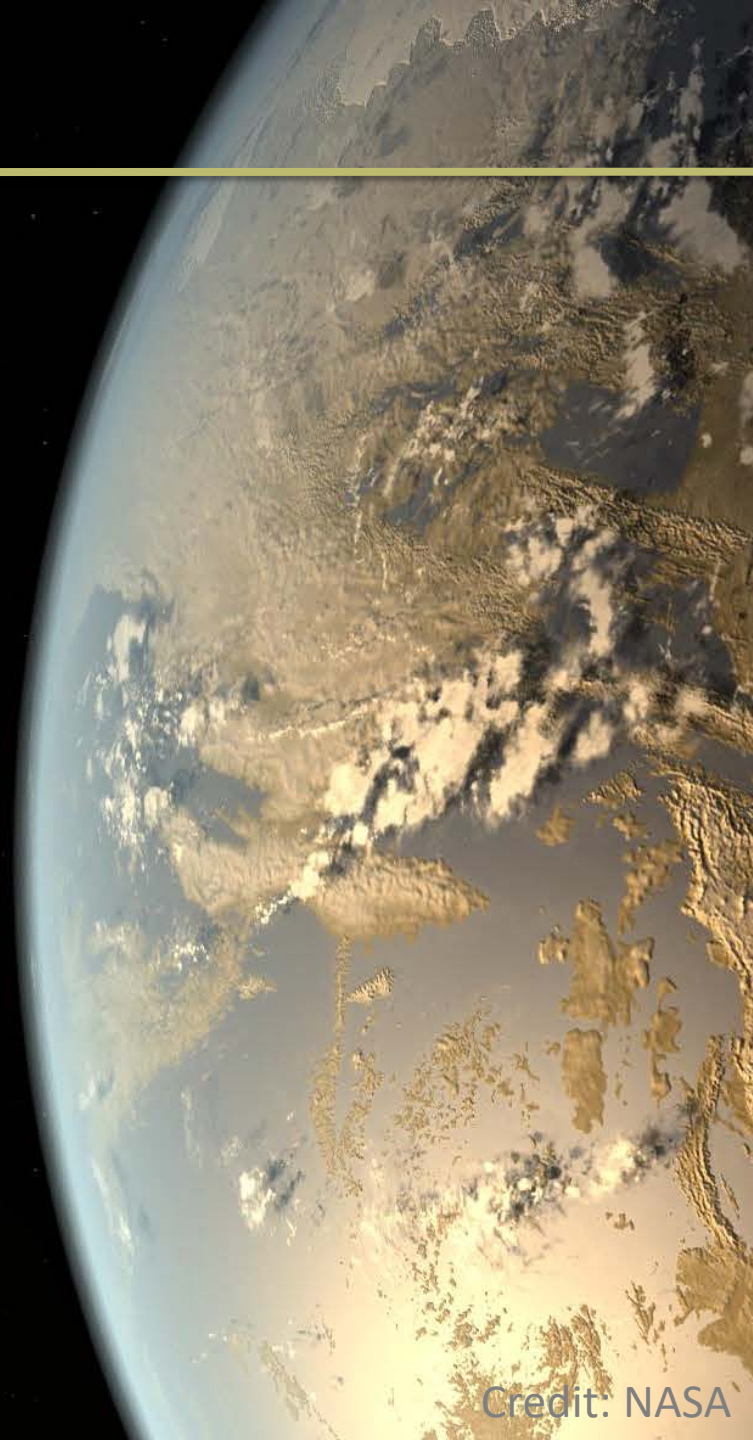
Credit: NASA

SIG 3 ExoSS Synergies – Goals

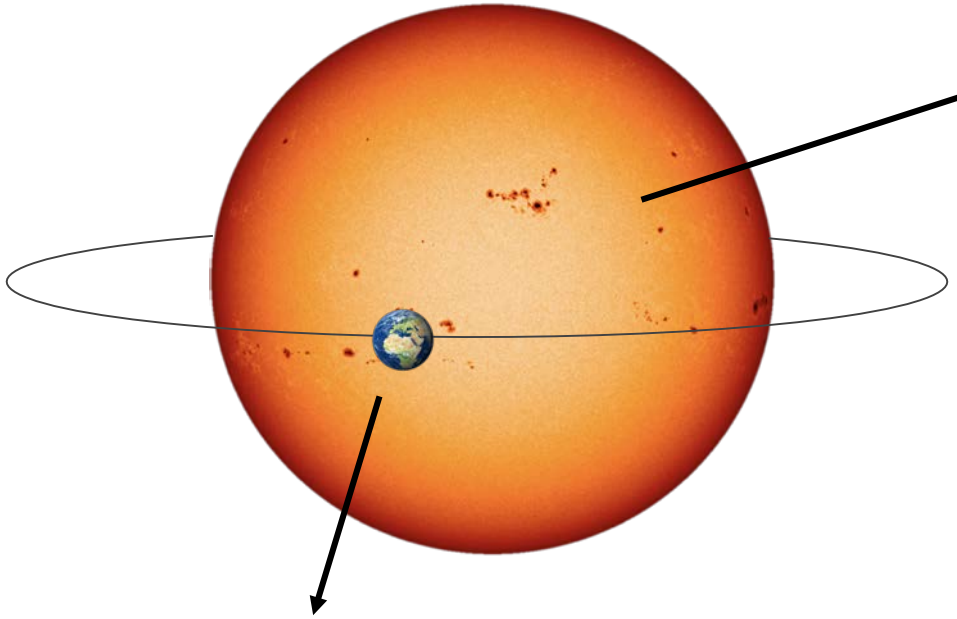
- We propose to provide a forum for interaction between the Solar System and exoplanet communities on topics of mutual interest, and to work to identify ways in which NASA could enhance these interactions.

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



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

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

What can we **learn from transits**?

Planet

e.g., transit spectroscopy

Star

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

What will the impact be on **future studies**?

What **complementary observations** will be useful?

Coordinators: Néstor Espinoza, Ben Rackham, & Tom Barclay

Proposed SAG – Exoplanet Host Properties

Lead by Joshua Pepper, Chris Stark, Natalie Hinkel

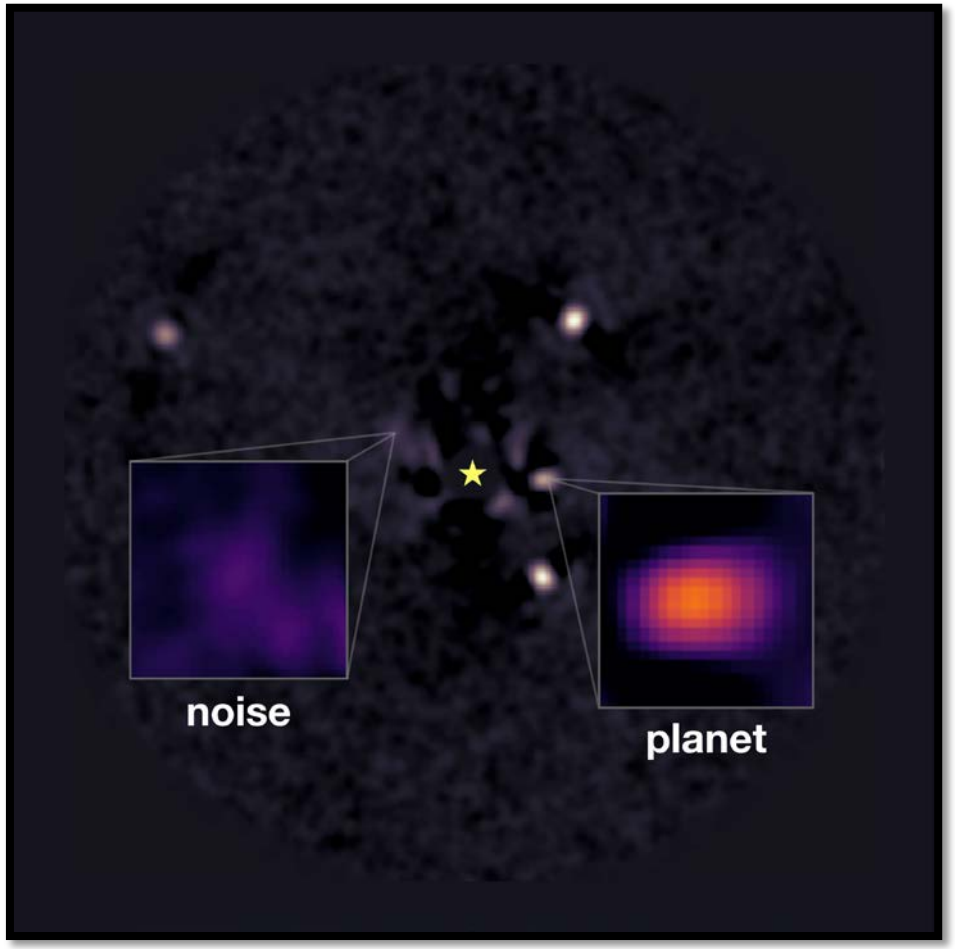
- Define a high priority stellar sample to study that is relevant to many of the NASA exoplanet-related missions
- Survey the broad exoplanet community (e.g., including planetary scientists, geologists, biologists) to determine data required for characterizing stellar and planetary systems
- Define what 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.

SAG 19 Topic: SAG 19: Exoplanet Imaging Signal Detection Theory and Rigorous Contrast Metrics

Leads: Dimitri Mawet, Rebecca Jensen-Clem

Status: On-going, to be closed out soon.

Overview: As planning for the next generation of high contrast imaging instruments (e.g. WFIRST, HabEx, and LUVOIR, TMT-PFI, EELT-EPICS) matures, and second-generation ground-based extreme adaptive optics facilities (e.g. VLT-SPHERE, Gemini-GPI) are halfway through their large main surveys it is imperative that the performance of different designs, post-processing routines, observing strategies, and survey results be compared in a consistent, statistically robust framework. SAG19, exoplanet imaging signal detection theory and rigorous contrast metrics, is overarching to all direct imaging instrument, strategies, and methods.



HCI Data Challenge for exoplanets

Status, results and future

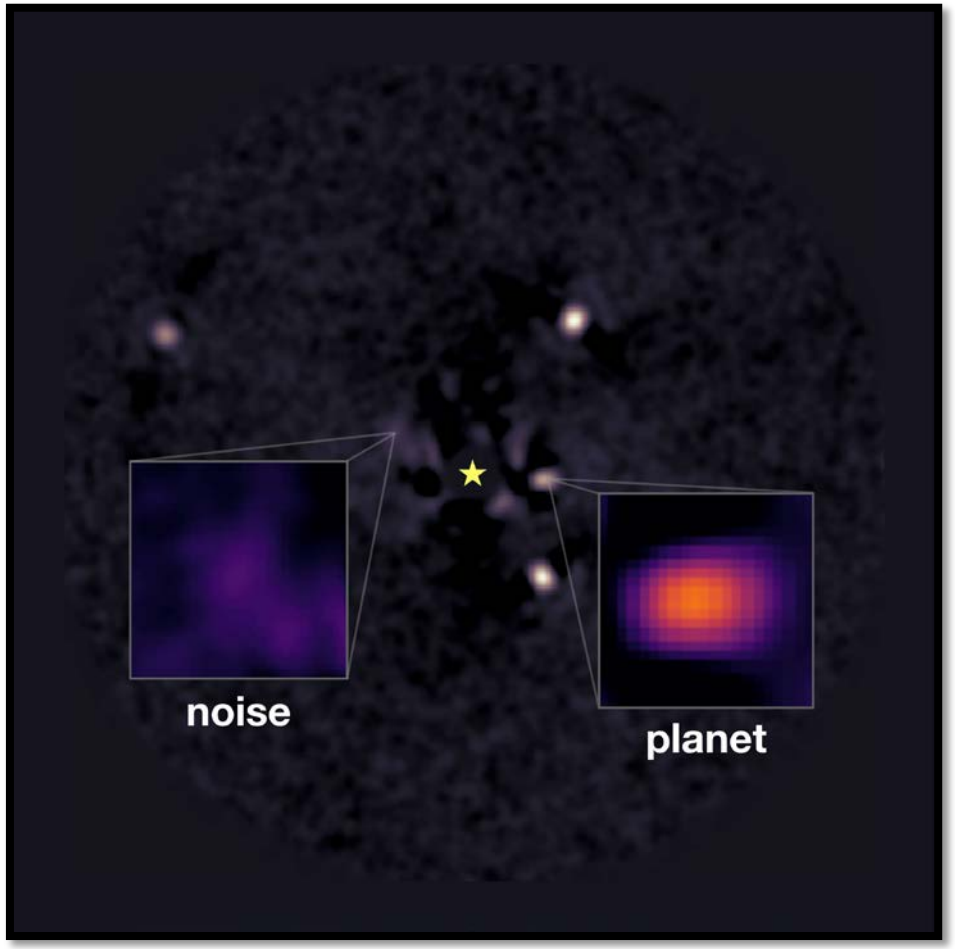
Team: https://exoplanet-imaging-challenge.github.io/

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



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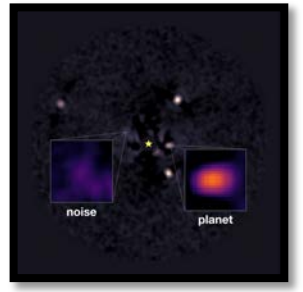
Current status



- **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)