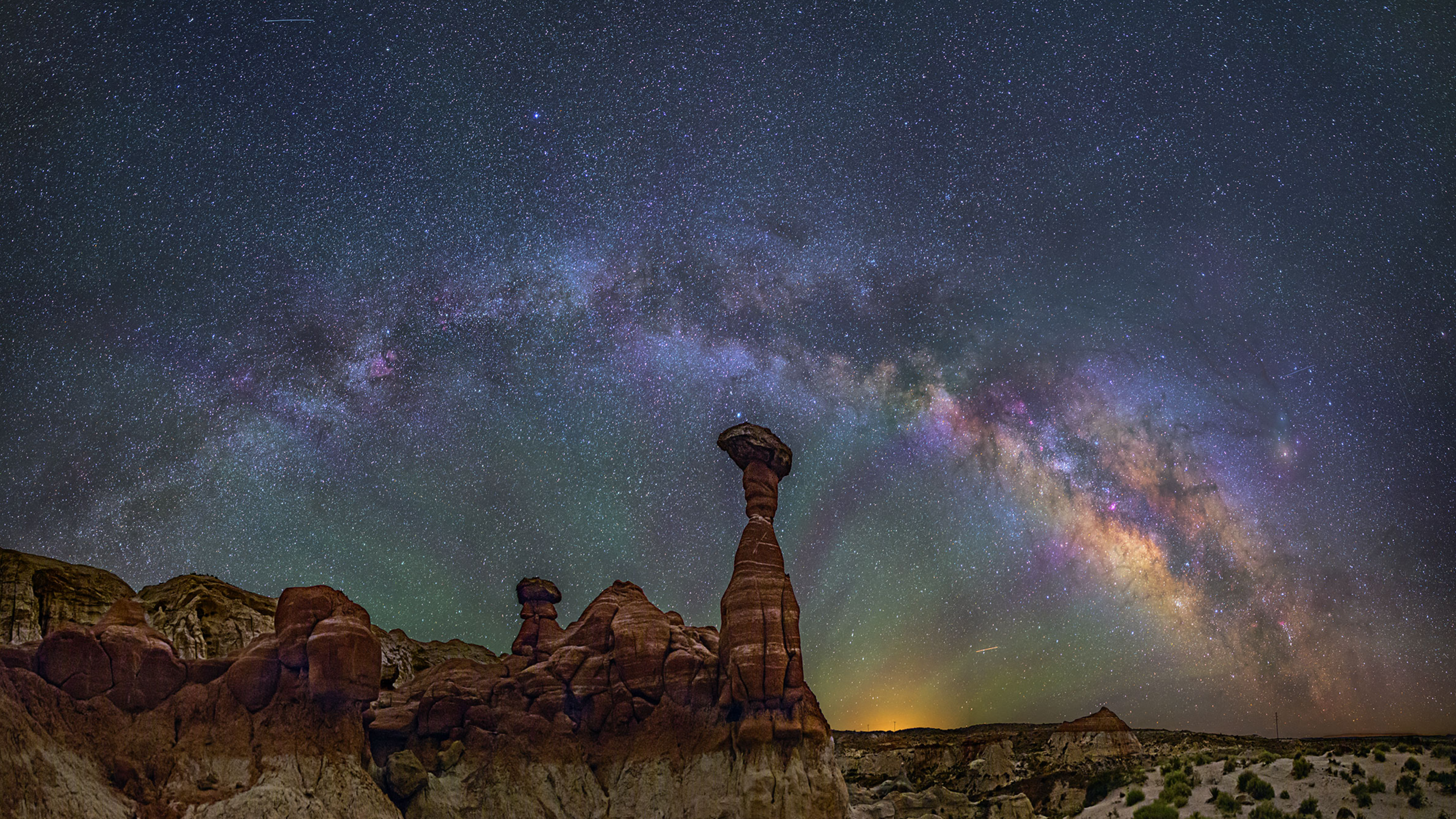
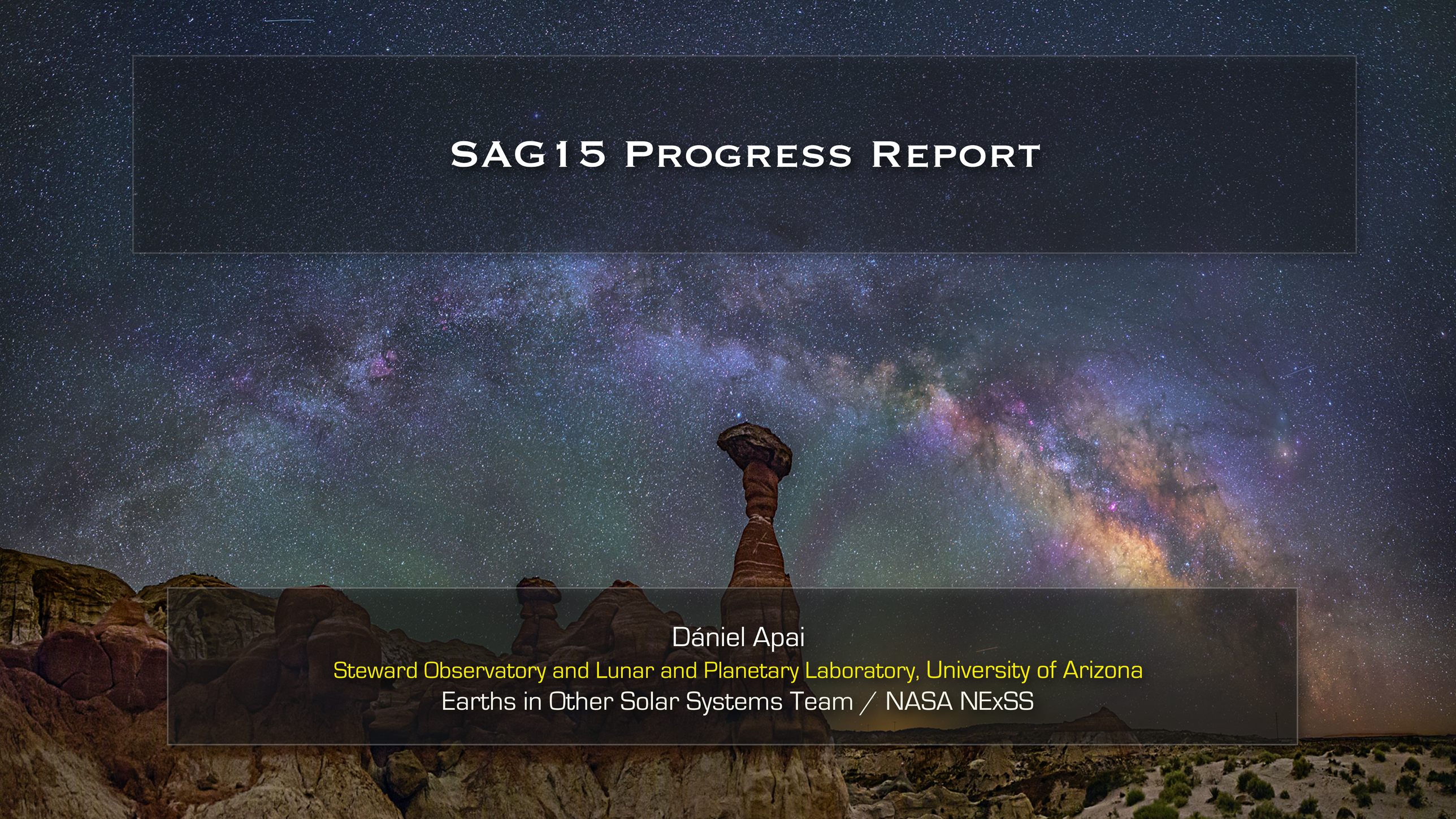


SAG15 Progress Report



Dániel Apai
Steward Observatory and Lunar and Planetary Laboratory, University of Arizona
Earths in Other Solar Systems Team / NASA NExSS

SAG15 Charge

In SAG15 we will identify the key questions in exoplanet characterization and determine what observational data obtainable from direct imaging missions is necessary and sufficient to answer these.

1) What are the most important science questions in exoplanet characterization apart from biosignature searches?

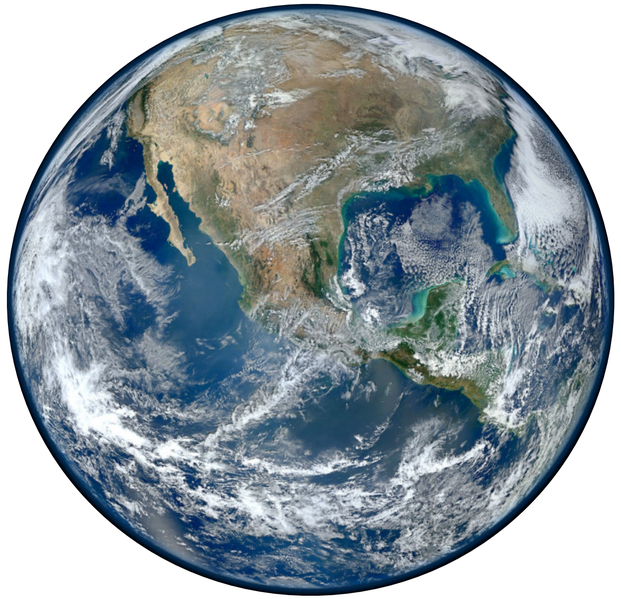
2) What type of data (spectra, polarization, photometry) with what quality (resolution, signal-to-noise, cadence) is required to answer these science questions?

The report developed by this SAG will explore high-level science questions on exoplanets ranging from gas giant planets through ice giants to rocky and sub-earth planets, and — in temperatures — from cold (~200 K) to hot (~2,000 K). For each question we will study and describe the type and quality of the data required to answer it.

SAG15 Charge

What is not included:

1) Biosignatures (but habitable planets are!)
2) Evaluation of instrument capabilities or advocacy for mission architectures



Uses of the Report

1) Future STD teams will be able to easily connect observational requirements to missions to fundamental science goals;

2) By providing an overview of the key science questions on exoplanets and how they could be answered, it may motivate new, dedicated mission proposals;

3) By providing a single, unified source of requirements on exoplanet data in advance of the Decadal Survey, the science yield of various missions designs can be evaluated realistically, with the same set of assumptions.

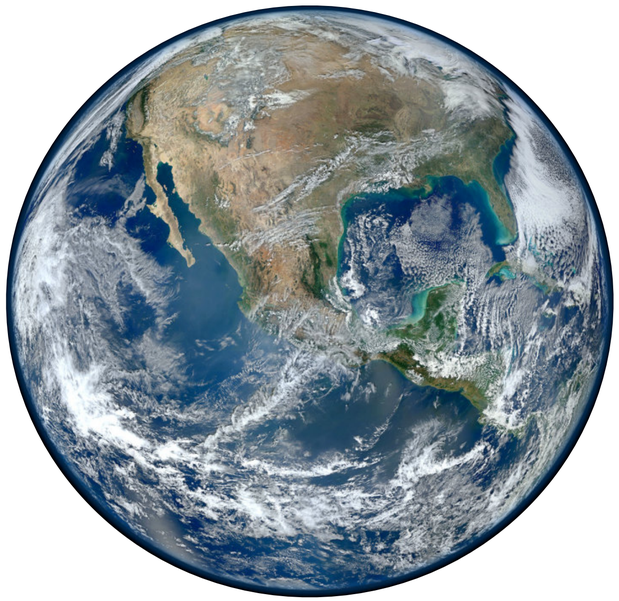
The SAG15 Team

Daniel Apai (Chair)	(Univ. Arizona)
Travis Barman	(Univ. Arizona)
Alan Boss	(Carnegie DTM)
Nicolas Cowan	(McGill Univ.)
Ian Crossfield	(Univ. Arizona)
Shawn Domagal-Goldman	(GSFC)
Ravikumar Kopparappu	(GSFC)
Mark Marley	(Ames)
Caroline Morley	(UC Santa Cruz)
Peter Plavchan	(Missouri State Univ.)
Mark Swain	(JPL)
Margaret Turnbull	(SETI Institute)

Status

Approved in October 2015
SAG 15 Team Assembled
Initial telecon
Process, timeline, and publications identified

Content and Organization of the Report



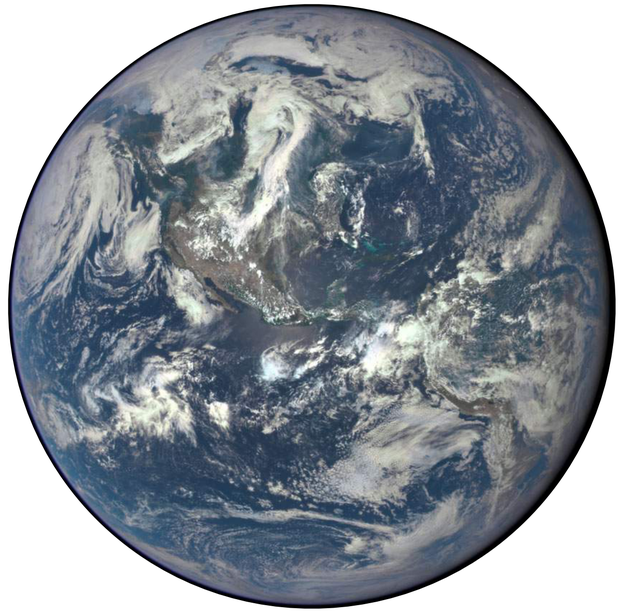
High-level Science Questions

↓

Observables

↓

Required Data Type/Quality



Milestones

2016

Feb 15: List of science questions complete; list of observables complete; necessary sub-studies identified.

June 15: First draft, describing complete set of ideas and topics; preliminary results from sub-studies. Action items for completion

Sep 15: Advanced draft ready, start of finalizing manuscript

Dec 15: Shorter version ready for submission as review paper to refereed journal

2017

Feb 15: Final draft version of the report circulated

April 15: Submission of the report to EXOPAG and APS

Data Types

Photometry and Spectroscopy: wavelengths, cadence, polarization, signal-to-noise

Optical - Thermal Infrared

Example Observables

Summary of observables for different types of individual planets.					
	Gas Giants	**Ice Giants**	**Super-Earths**	**Earths**	**Sub-Earths**
Hot (>600 K)	Size. Orbit. Gas-phase abundances. Cloud and haze coverage (lon/lat/alt). Cloud evolution. Rotational period. Albedo. Presence of giant satellites.				
Warm (400-600K)					
Cold (<400 K)					

Example Preliminary High-level Questions

1) What are viable categories/classes for planets?
2) How representative is the Solar System?
3) How diverse can planetary evolution be and what are the key factors influencing it?
4) How do stellar properties influence the properties and habitability of planetary systems?
5) How does the formation process/location of a gaseous planet influence its bulk atmospheric composition?
6) What processes set the density distribution/bulk composition of super-earths?
7) What processes set the atmospheric composition of rocky planets?
8) How does the presence of oceans depend on planet properties?

Daniel Apai
THE UNIVERSITY OF ARIZONA
COLLEGE OF SCIENCE
Astronomy
& Steward Observatory

Coordinating with SAG16, WFIRST-PS, and STDTs

Summary

- SAG15 underway, in early stages
- Target date for completion Spring 2017
- Report + refereed publication are foreseen
- Interactions with WFIRST PS and STDTs important
- Interested in contributing? Contact me