

# CASE

CONTRIBUTION TO ARIEL SPECTROSCOPY OF EXOPLANETS

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Jet Propulsion Laboratory  
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CASE is a NASA Partner Mission of Opportunity, partnering with the ESA M4 mission  
ARIEL.

## **Ariel 2020 Community Meeting**

**Mark Swain, Principal Investigator**

Featuring LCHS Advanced Art II

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# The Landscape for CASE

- Partner mission contribution to ARIEL (ESA M4)
- Conditionally selected July 2017
- Selected for implementation November 2019
- Studies atmospheres of planets found by Kepler and TESS
- Addresses NASA Science Plan (2014) objective: “Discover and study planets around other stars, and explore whether they could harbor life.”
- Outline
  - CASE science requirements
  - CASE hardware delivery
  - ARIEL science scope



# ARIEL Survey

What are planets made of?

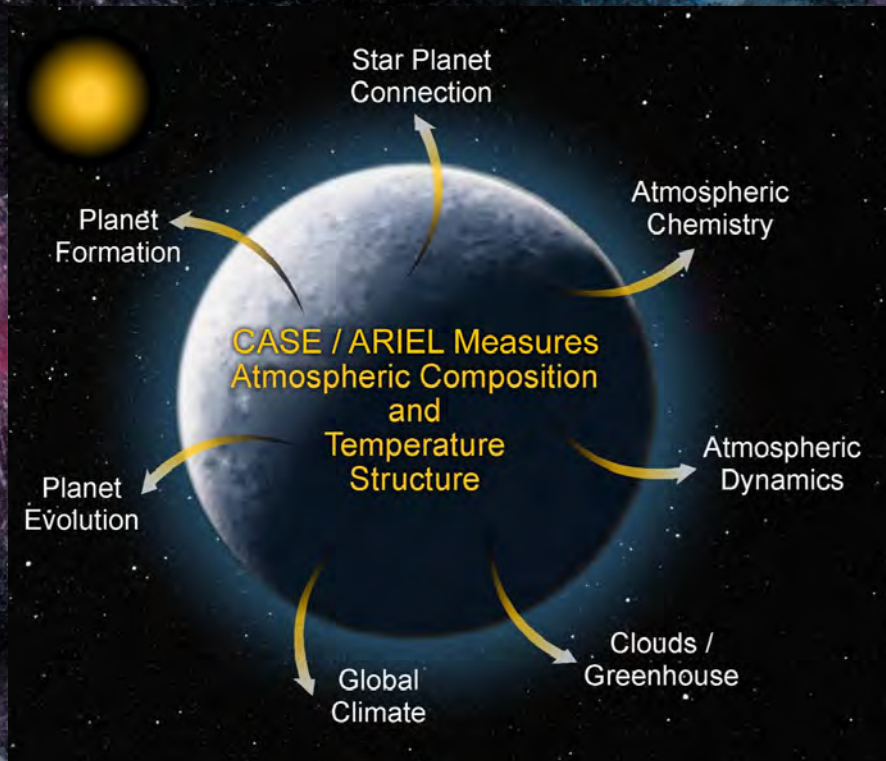
How do planets form?

How do planets and their  
atmospheres evolve?





# CASE/ARIEL Survey Synergistic with JWST and Planetary Community



- Connects: Astrophysics and planetary fields
- Reveals how JWST exoplanet observations fit into the larger exoplanet family

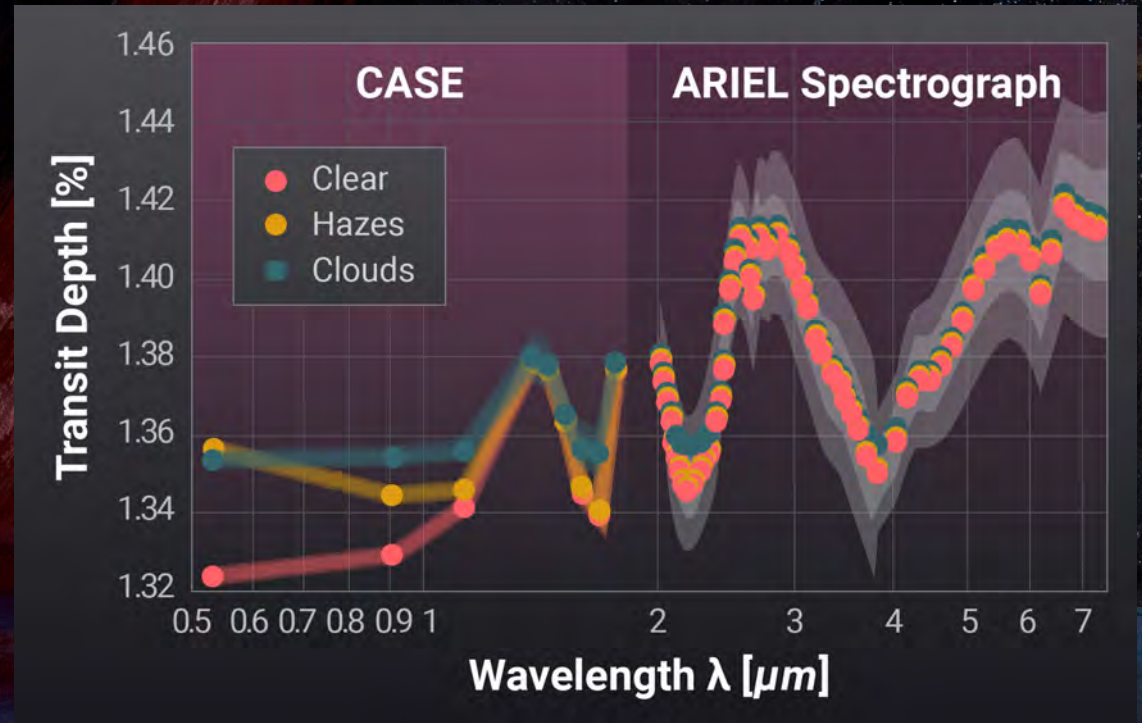
CASE and ARIEL revolutionize the field of exoplanet atmospheres



# Probing Atmospheres on Kepler and TESS Planets

## CASE Science Objectives

- Determine the occurrence rate of aerosols (clouds and hazes)
- Measure the geometric albedo of exoplanet atmospheres to constrain aerosol composition

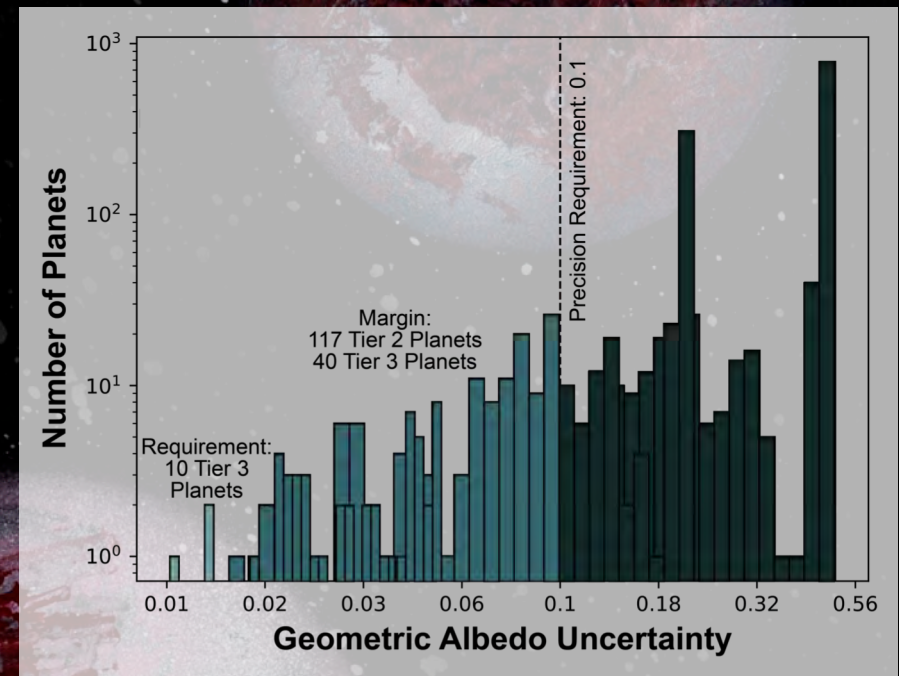
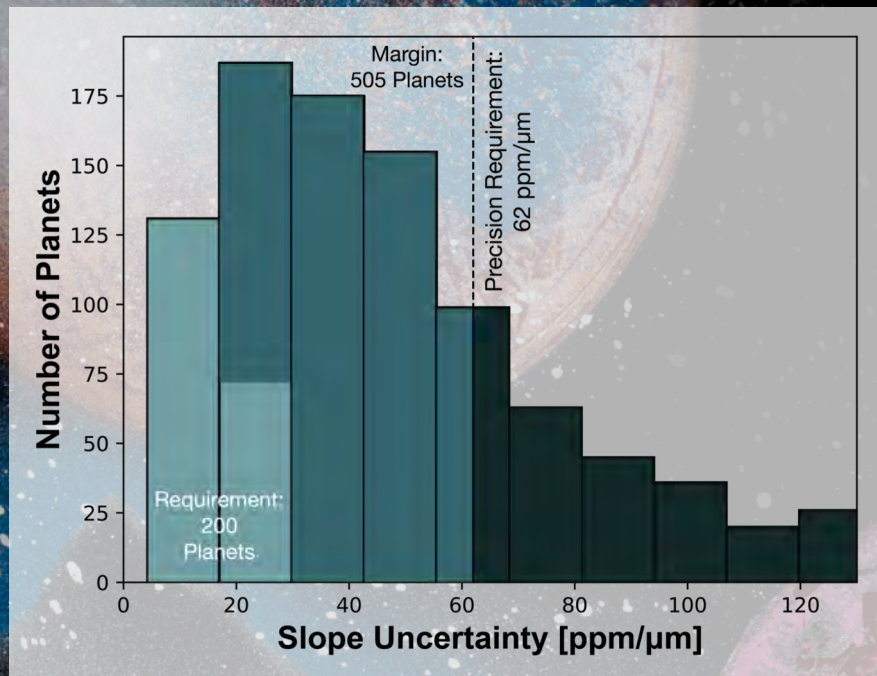


CASE provides aerosol and albedo data products



# Large Science Margins

- Aerosol slope precision requirement 310 % margin
- Albedo precision requirement 400 % margin



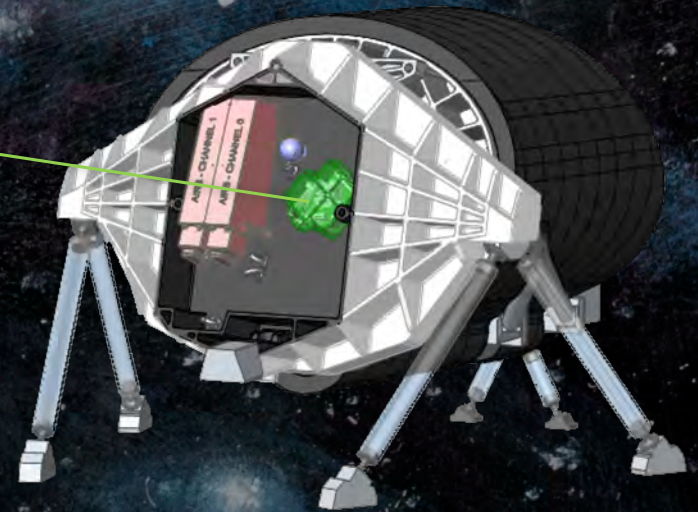
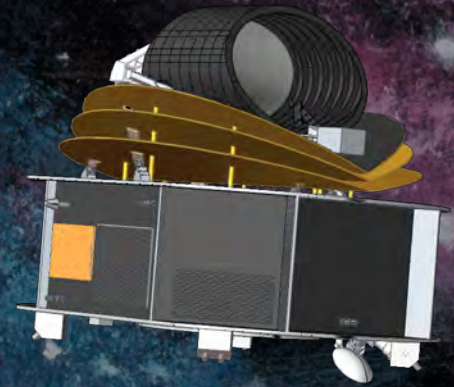


# CASE and the ARIEL Payload

- Off-axis 1.1 m × 0.7 m elliptical telescope
- ARIEL Infrared Spectrometer (AIRS):  
Resolution  $\lambda/\Delta\lambda=30-200$ , 1.95 – 7.8  $\mu\text{m}$
- Fine Guidance System (FGS)

- Vis-Phot: 0.50 $\mu\text{m}$  – 0.55 $\mu\text{m}$
- FGS1: 0.8 $\mu\text{m}$  – 1.0 $\mu\text{m}$
- FGS2: 1.0 $\mu\text{m}$  – 1.2 $\mu\text{m}$
- NIR-Spec: 1.25 $\mu\text{m}$  – 1.95  $\mu\text{m}$  ( $\lambda/\Delta\lambda=10$ )

CASE





# CASE Delivers Simple, Well-Defined Hardware

Focal Plane Modules (FPM) x2

Sensor Chip Assemblies

FPM Enclosure

Focal Plane Electronics (FPE) x1

FPE Radiator

Cold Front End Electronics x2

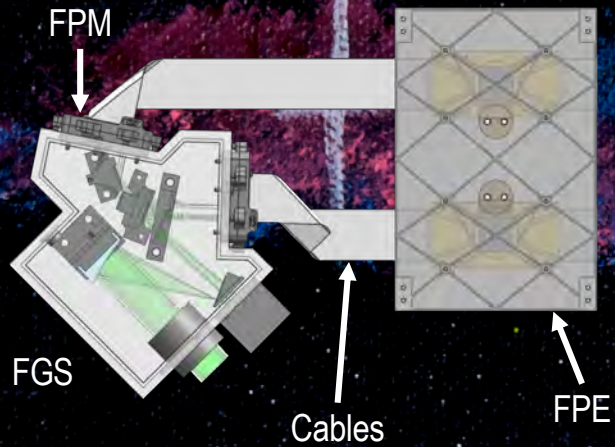
FPE Enclosure & Struts

Cables (CFC) x2

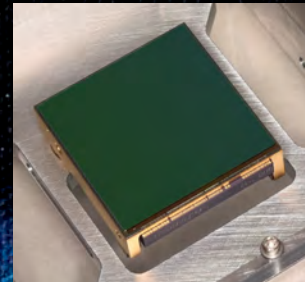


# CASE Approach Ensures Successful Implementation

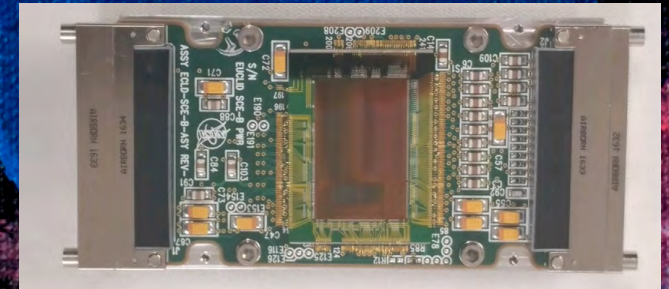
CASE is a subsystem of the ARIEL FGS



CASE reuses Euclid hardware designs



SWIR Detector from Euclid



SIDE CAR SCE electronics from Euclid

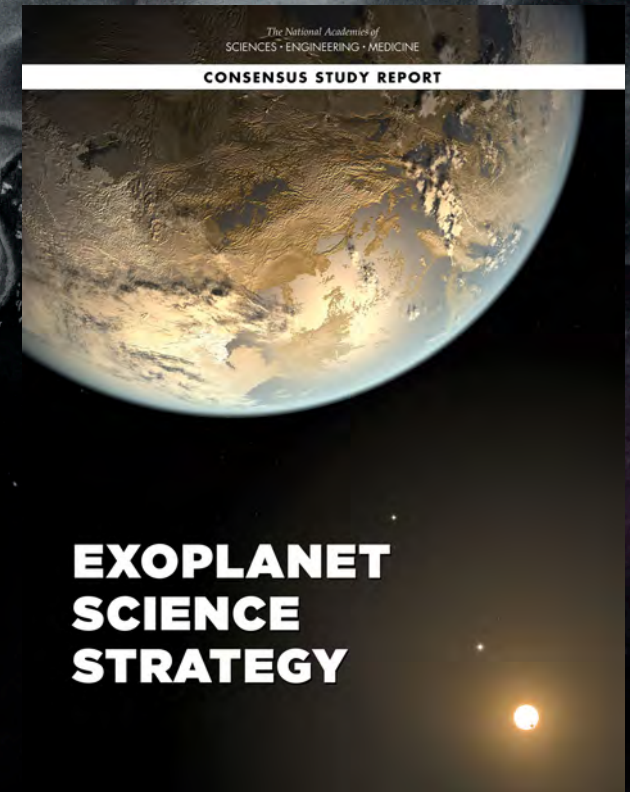
The CASE team is well-integrated with the ARIEL payload team



# National Academy of Science

## Consensus Study Report: Exoplanet Science Strategy

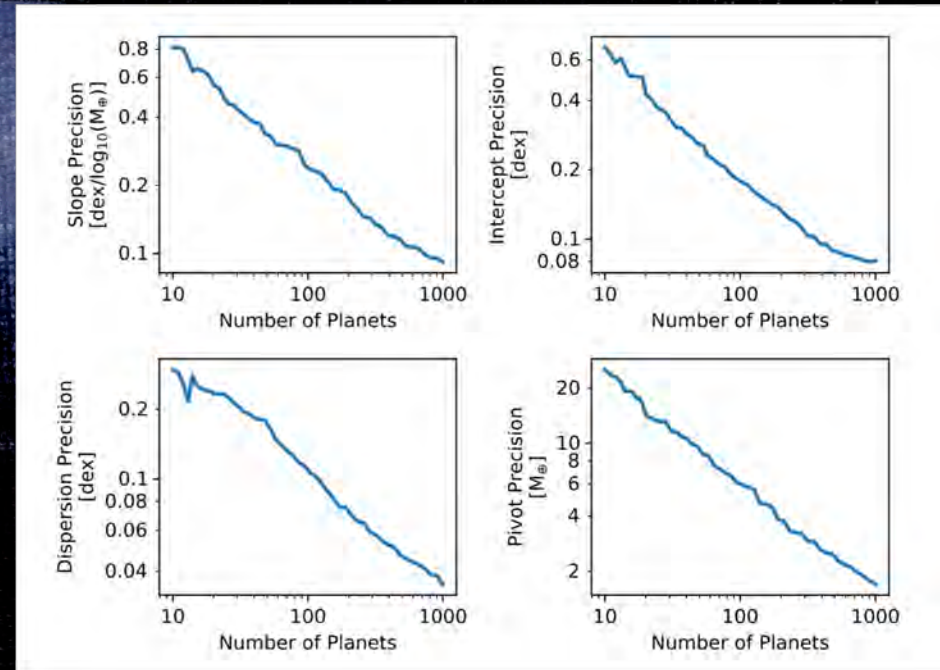
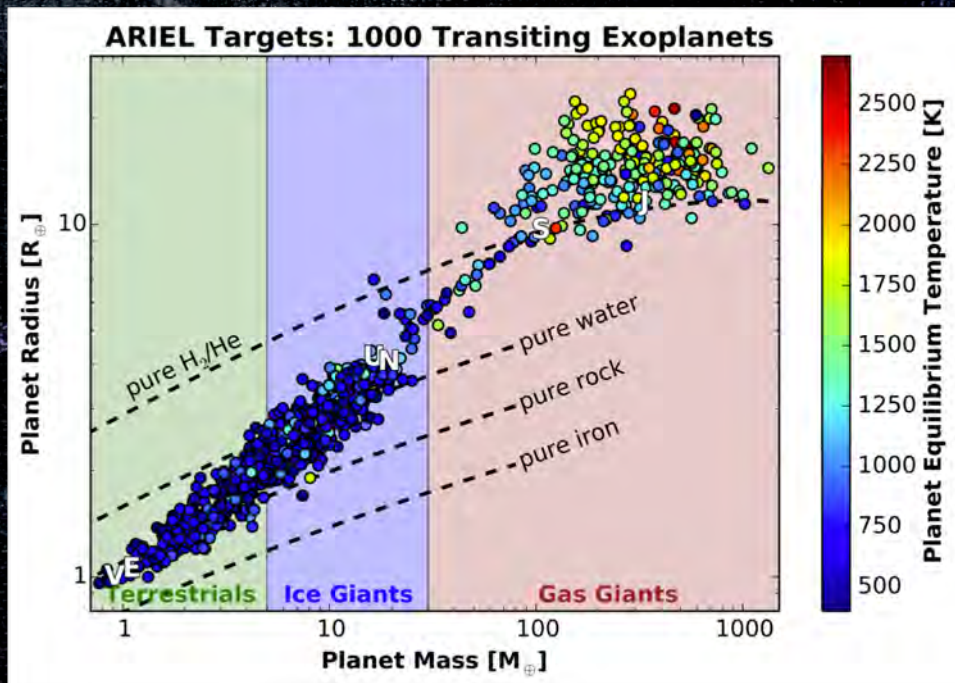
- “The U.S. exoplanet community would benefit from participation in ARIEL.”
- “U.S. scientists would benefit from the CASE mission by participating in the planning, execution, and exploitation of the ARIEL survey.”





# Extraordinary Value

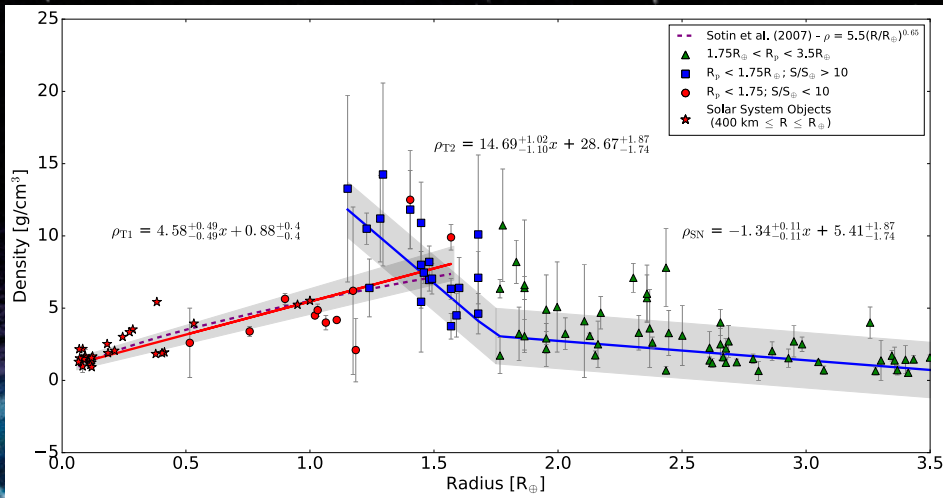
CASE team simulation finds ARIEL Tier 1 survey sample provides excellent constraints on the mass-metallicity relation



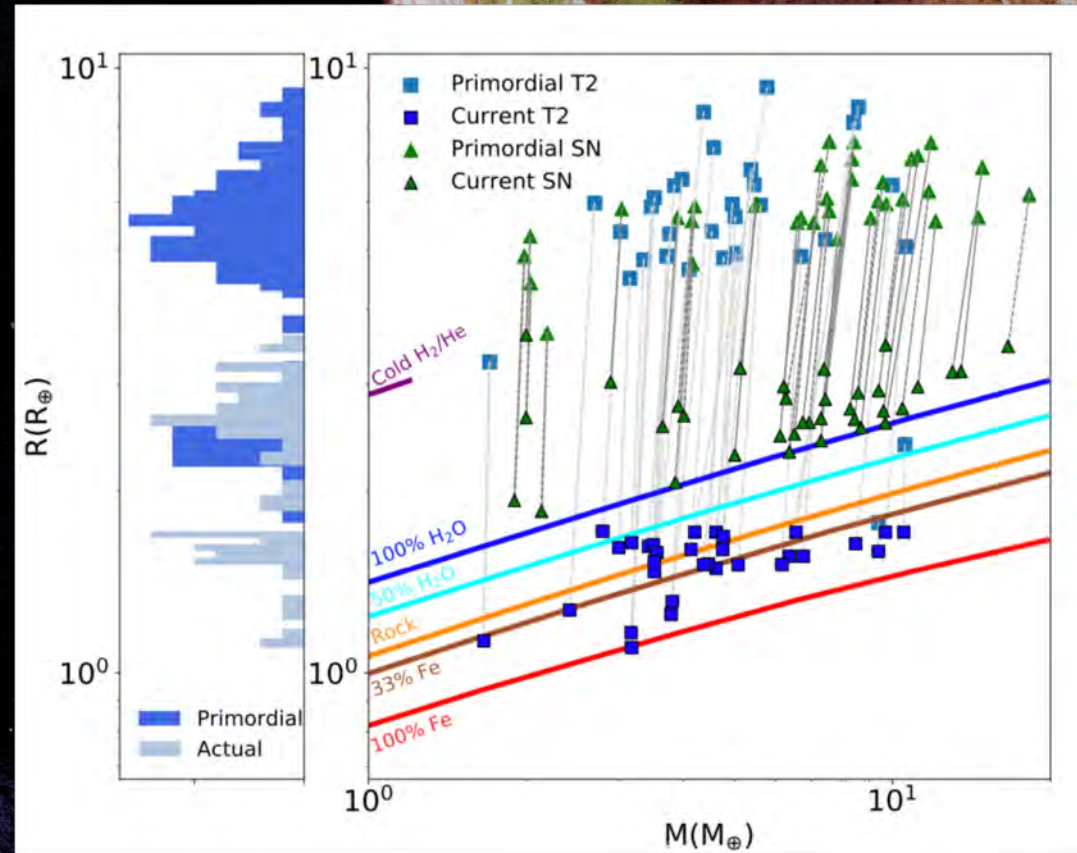
Zellem et al. 2019



# ARIEL: provides access to new science opportunities



Swain et al. 2019



Atmospheric evolution: close orbiting sub-Neptunes < 3.5 R<sub>earth</sub> have lost ~70% of their primordial H/He envelope. Estrela et al. 2020 submitted.



# What are Exoplanets Really Like?

## Capturing the Public's Imagination



Kennedy Agron, 5<sup>th</sup> Grade Student at Santa Clarita Elementary School, participating in an outreach event

The Unknown



# CASE/ARIEL Benefit to NASA

- CASE/ARIEL data will be used for decades to come, providing a context for future discoveries
- CASE/ARIEL results will be the foundation of the emerging field of exoplanet atmospheres, the field in which the discovery of life outside of our solar system will be made
- A legacy that goes beyond the science and shows, for the first time, how our solar system fits into the extended planet family

CASE – a historic NASA opportunity