CASE ExoPAG Presentation June 18 2020

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Featuring LCHS Advanced Art II

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.”
ARIEL Mission Overview

- ESA M4 mission
- Launch 2028
- L2 orbit
- 3.5 year prime mission
- Telescope 1 m effective diameter
- 0.5-7.8 μm wavelength coverage
- Surveys exoplanet atmospheres
- Observers ~1000 planets
- Tiered survey strategy
- Payload consortium consists of 17 ESA member states + US contribution

https://arielmission.space
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 μm
- Fine Guidance System (FGS)
  - Vis-Phot: 0.50μm – 0.55μm
  - FGS1: 0.8μm – 1.0μm
  - FGS2: 1.0μm – 1.2μm
  - NIR-Spec: 1.25μm – 1.95 μm ($\lambda/\Delta\lambda=10$)
CASE Delivers Simple, Well-Defined Hardware

- Focal Plane Modules (FPM) x2
- Cables (CFC) x2
- Sensor Chip Assemblies
- FPM Enclosure
- Focal Plane Electronics (FPE) x1
- FPE Radiator
- Cold Front End Electronics x2
- FPE Enclosure & Struts
The CASE team is well-integrated with the ARIEL payload team.
• “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.”
What are Exoplanets Really Like?
Capturing the Imagination
Extraordinary Value

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

Zellem et al. 2019
Relevant New Results

Micro physics model of haze formation
Lavvas et al. 2019

Sub-Neptune & super-Earth envelope evolution
Estrela et al. 2020

Simulated hot-Jupiter atmosphere produces aerosol material
Fleury et al. 2019
CASE Science Community Engagement

- Three major community engagement areas
  - Input on defining the observing priorities – JWST results will likely have a significant impact
  - Precursor observations (examples include ephemeris maintenance, improved planet and stellar parameters, system characterization)
  - Access to CASE/ARIEL data products
- CASE project will provide science data products to the community through NExScI
  - Aerosol and albedo data products
  - NExScI will also mirror ARIEL science archive data products
- CASE science team community engagement
  - Community meetings planned to start later this year
  - Opportunity for US community to provide input on ARIEL observing priorities through the CASE Science Team
  - Opportunity to participate in CASE modeled on the TESS community science team
CASE/ARIEL Benefit to the US Community

• 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.