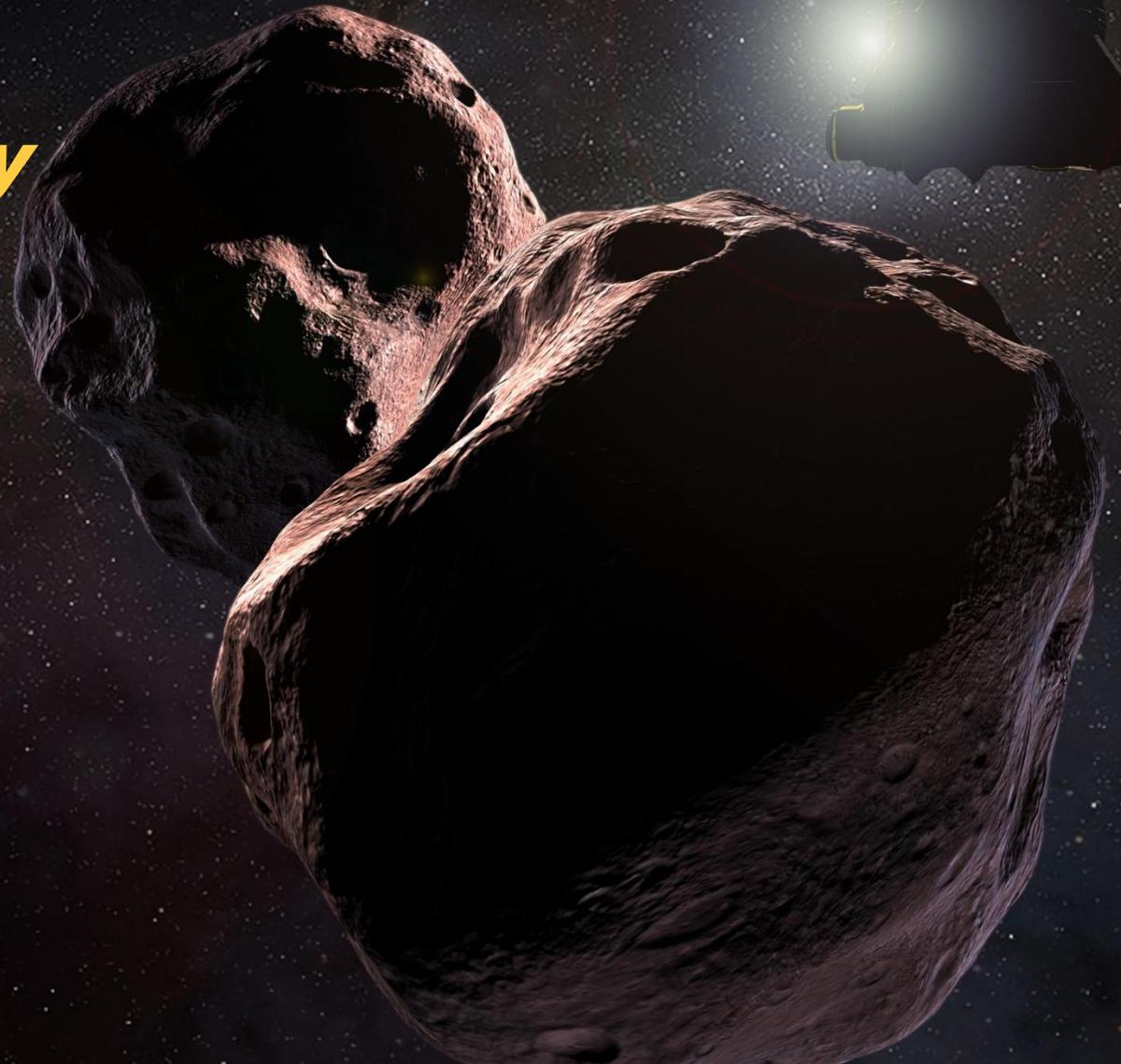


# **New Horizons** **Beyond Pluto:** *The Ultima Thule Flyby*

October 24, 2018

American Astronomical Society  
Division for Planetary Sciences



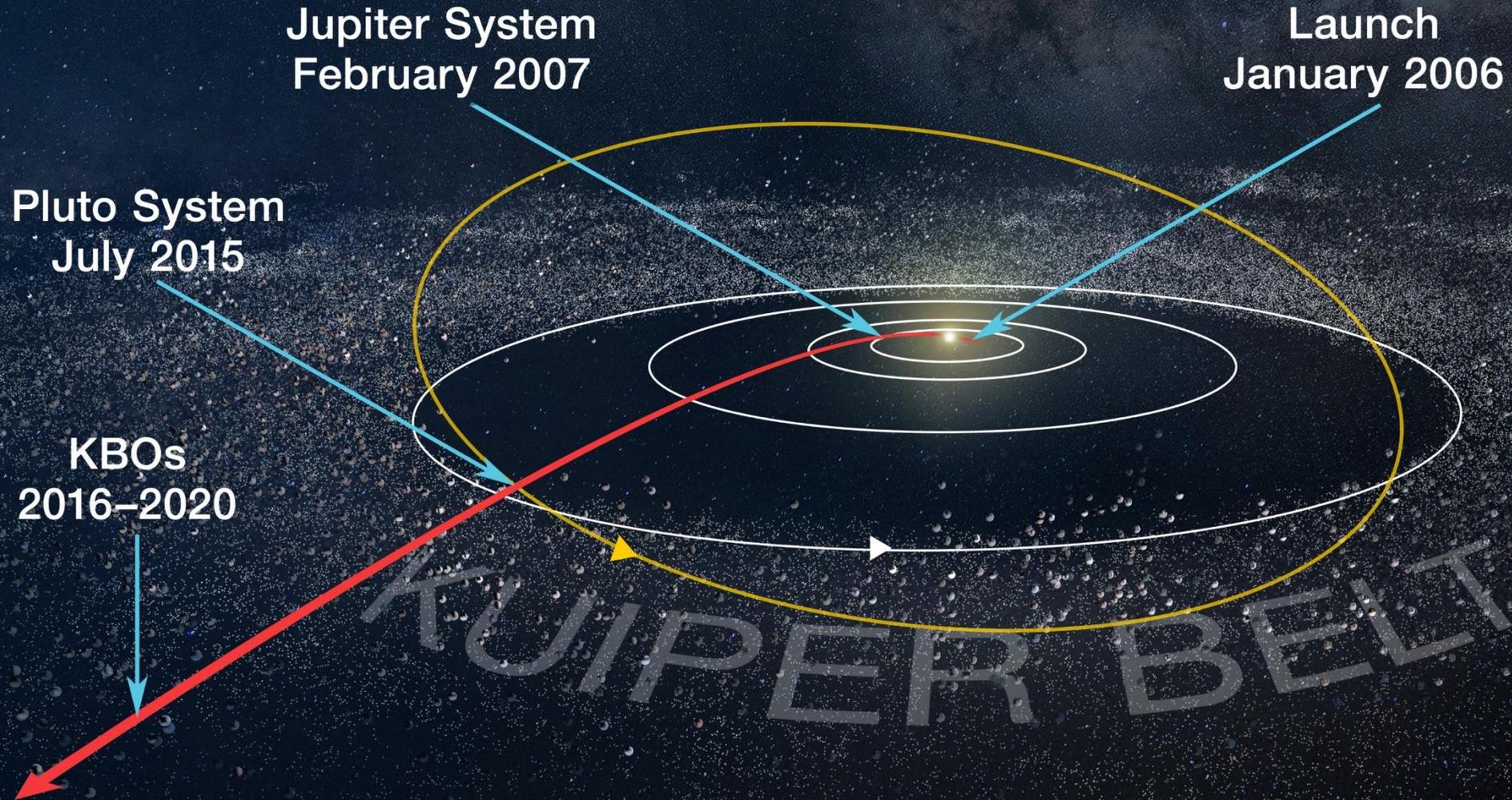
# **Mission Overview**

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**Dr. Alan Stern**

New Horizons Principal Investigator  
Southwest Research Institute

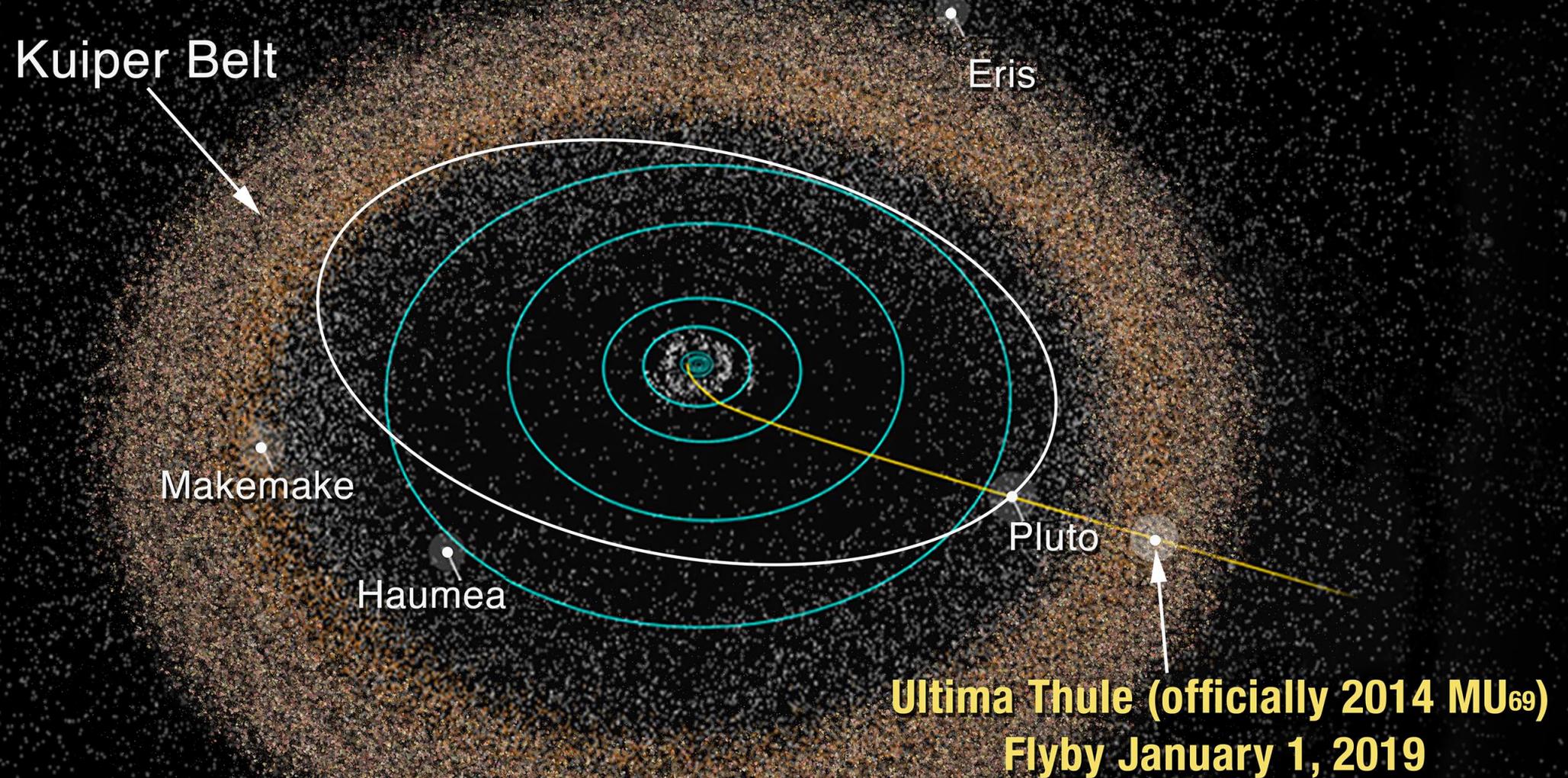
# A Historic Journey to the Solar System's Frontier



# First Mission to Explore the Pluto System



# First Mission to Explore the Kuiper Belt



# The Ultima Thule Flyby



# Ultima Thule Flyby: Attributes

- Ten times as wide and 1000x as massive as Rosetta's comet
- Most distant, most primitive object ever explored
- Quick
- Some danger and suspense
- Historic!

# Ultima Thule: More Challenging than Pluto

- Uncertain position
- Unknown moons and hazard environment
- Lower light levels
- Longer communication time
- Older spacecraft with less power

# The New Year Will Bring ...

- News from the edge of our solar system
- New knowledge gained
- New records set



***New Year's Day ...  
Be There!***

# **Beyond Pluto: Ultima Thule in Context**

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**Dr. Carey Lisse**

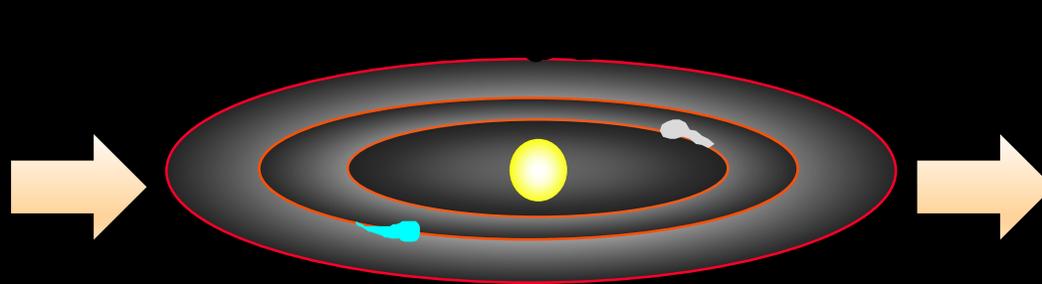
New Horizons Science Team Collaborator  
Johns Hopkins Applied Physics Laboratory

# From Dust to Planets

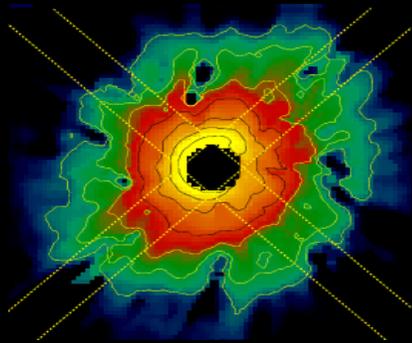
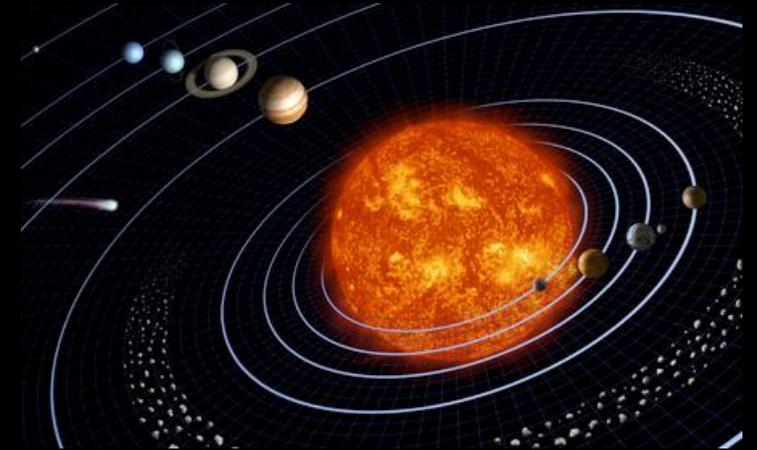
Primordial Disk:  
Dust + Gas → Comets,  
Gas Giants



Terrestrial Planet Disk  
Forming Asteroids, Earths

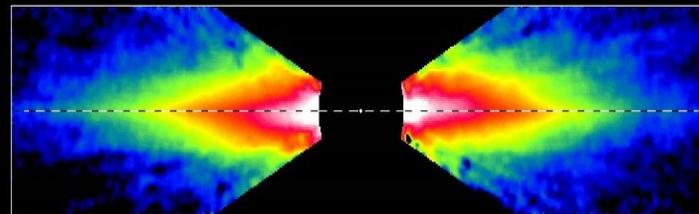


Mature Solar Systems:  
Planets, KBOs, Asteroids,  
Comets

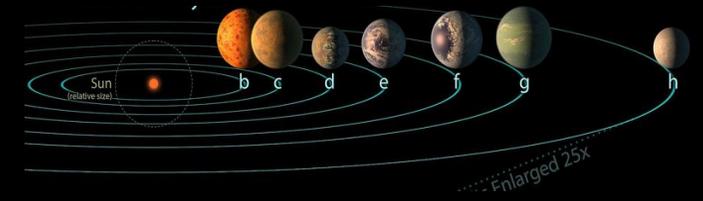


HD 100546

Size of Pluto's Orbit

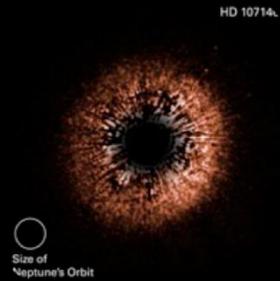


Beta Pic

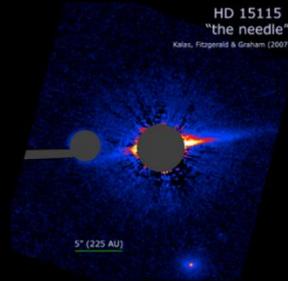


TRAPPIST-1 System

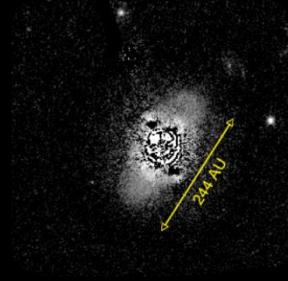
# Hubble Views of 'Other' Kuiper Belts



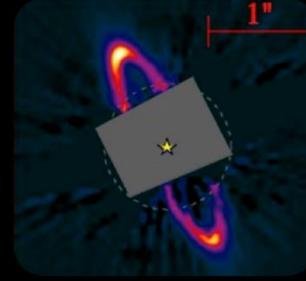
**HD 107146**  
Ardila et al. 2005



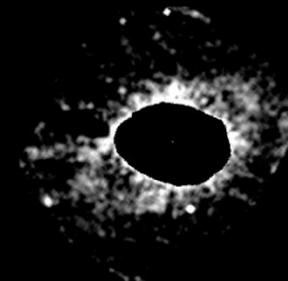
**HD 15115**  
"the needle"  
Kalas, Fitzgerald & Graham (2007)



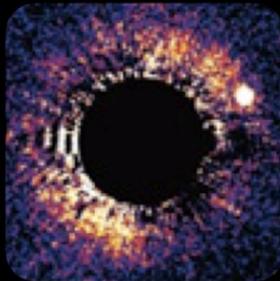
**HD 92945**  
Clampin et al. 2006



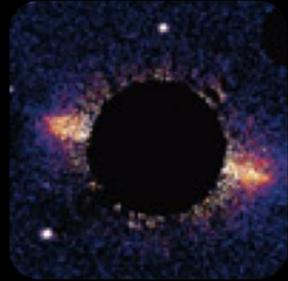
**HR 4796**  
Schneider et al. 1999



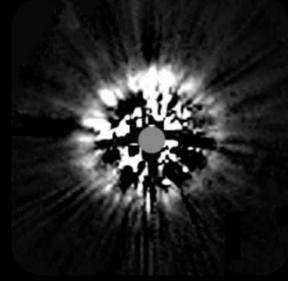
**HD 207129**  
Stapelfeldt et al. 2007



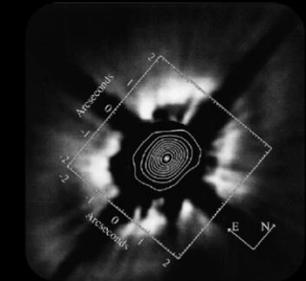
**HD 139644**  
Kalas et al. 2006



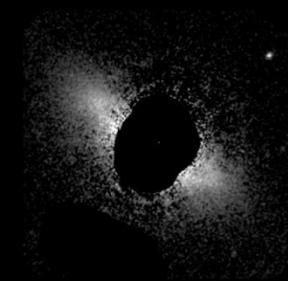
**HD 51543**  
Kalas et al. 2006



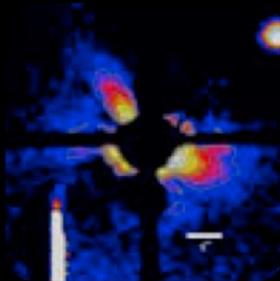
**HD 181327**  
Schneider et al. 2006



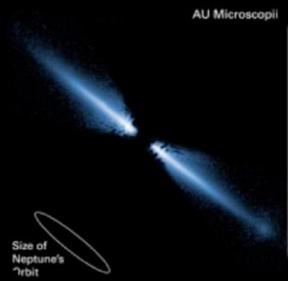
**HD 141569A**  
Weinberger et al. 1999



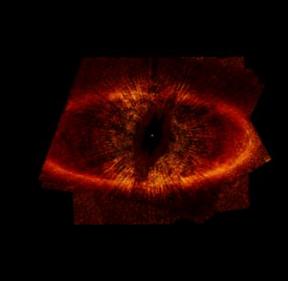
**HD 10647**  
Stapelfeldt et al. 2007



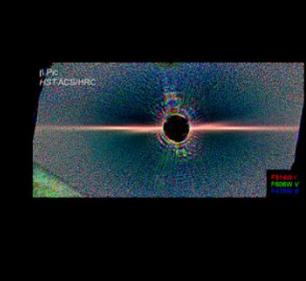
**HD 32297**  
Schneider et al. 2006



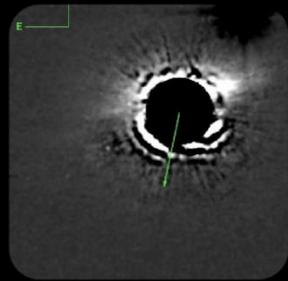
**AU Mic**  
AU Microscopii  
Krist et al. 2005



**Fomalhaut**  
Kalas et al. 2005



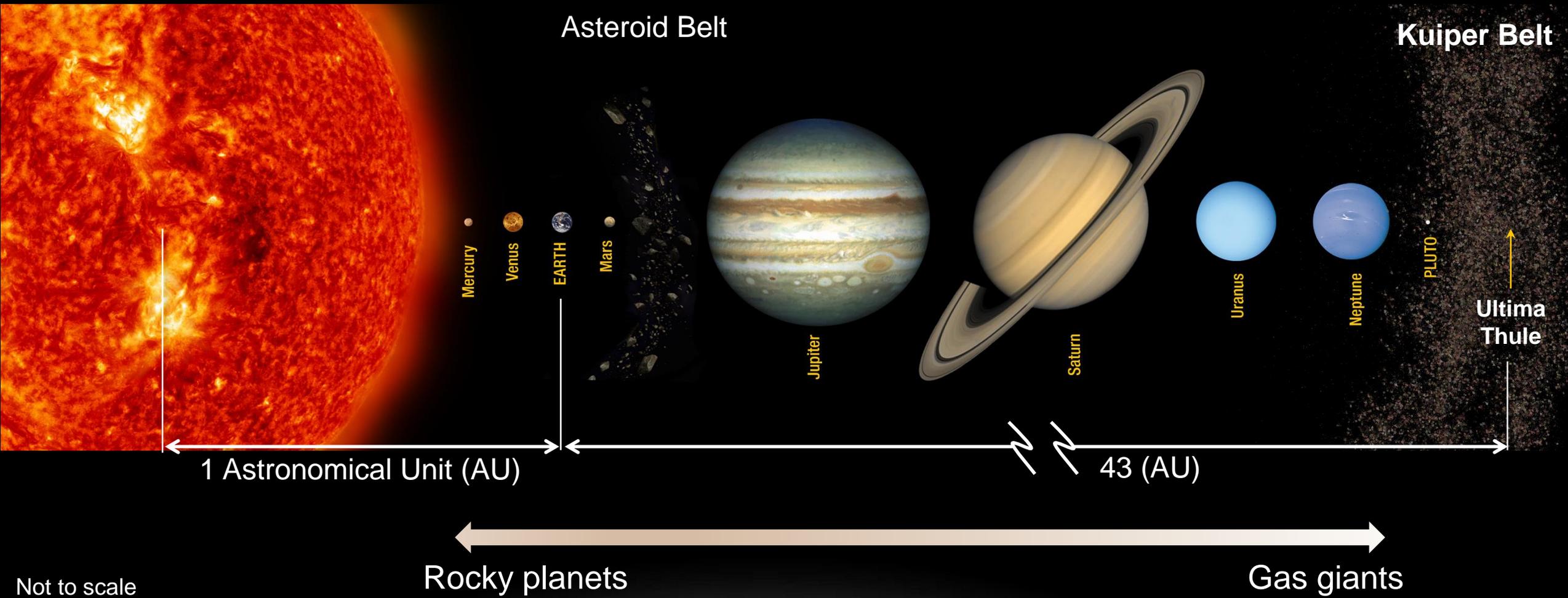
**$\beta$  Pictoris**  
Golimowski et al. 2005



**HD 202917**  
Clampin et al. 2007

Credit:  
Mark Clampin  
2010

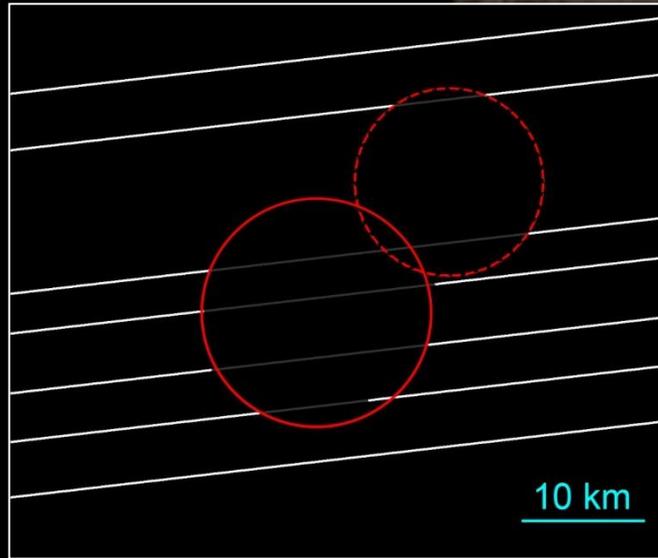
# Solar System Structure



# Building a Kuiper Belt Object



# What Can We Expect for the Form of Ultima Thule?



Ultima Thule occultation results  
July 17, 2017



Binary or bi-lobed object?



Single elongated object?

Pluto (in background, not to scale),  
100x bigger than UT and spherical

# What Can We Expect for the Surface of Ultima Thule?

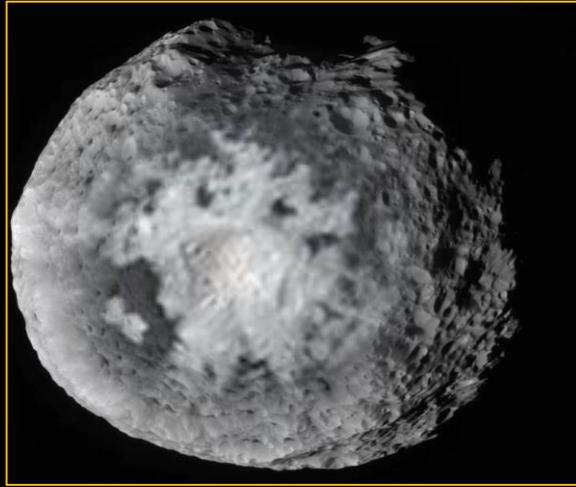
Comet Wild 2  
(little processed, many sublimation pits + craters)



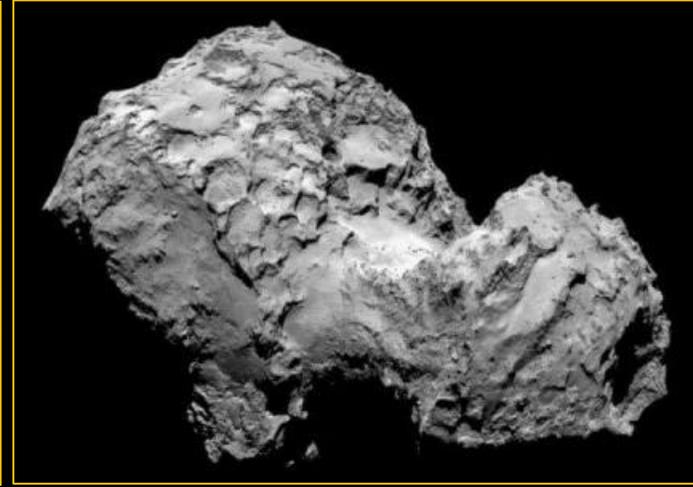
Moon Phoebe  
(captured KBO, well cratered, some pits)



Moon Hyperion (extremely pitted sponge-like surface)



Comet 67P (highly re-melted but well-textured surface)



(These surfaces are darker than coal, but have been artificially brightened to highlight their surface features.)



# **Flyby Science Plans**

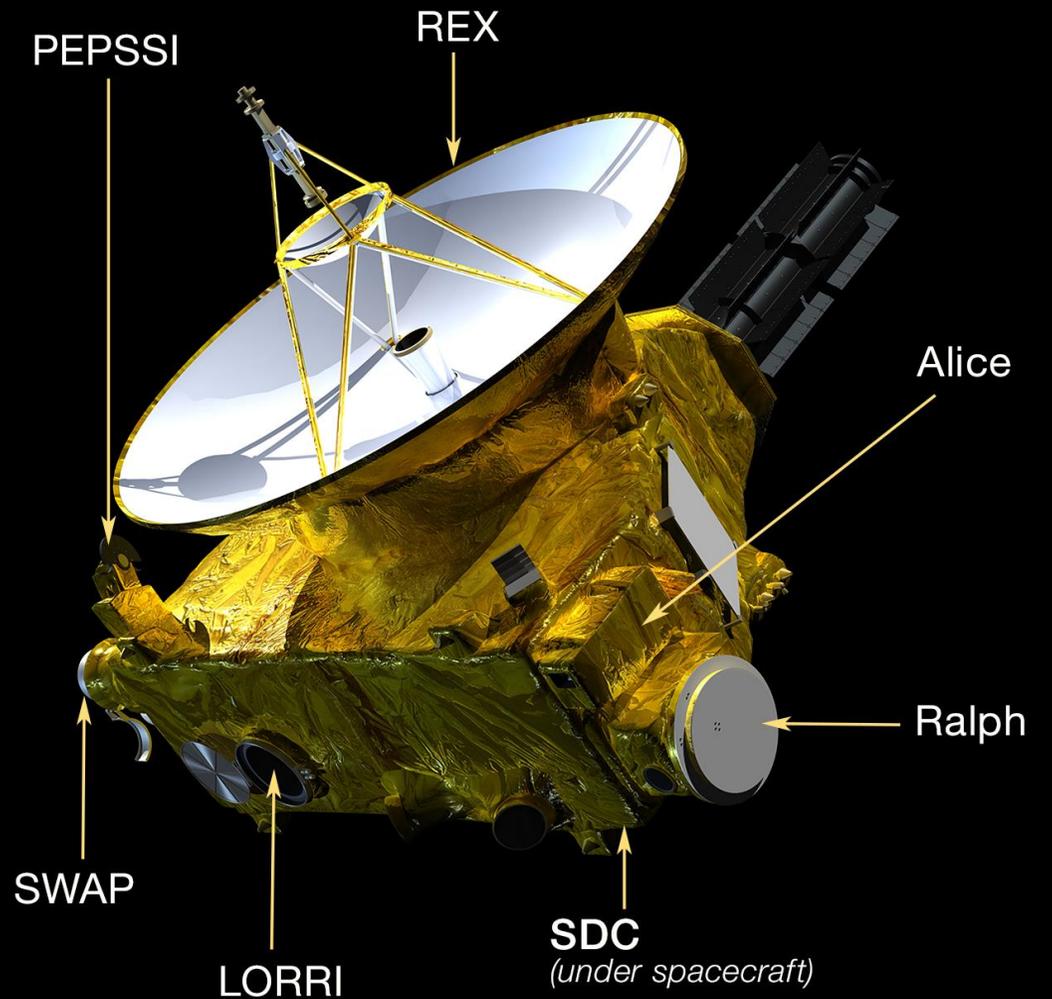
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**Dr. Hal Weaver**

New Horizons Project Scientist

Johns Hopkins Applied Physics Laboratory

# Advanced Science Instruments



**Ralph:** Color Camera and Infrared Spectral Imager

**Alice:** Ultraviolet Spectral Imager

**LORRI:** Hi-Res Camera

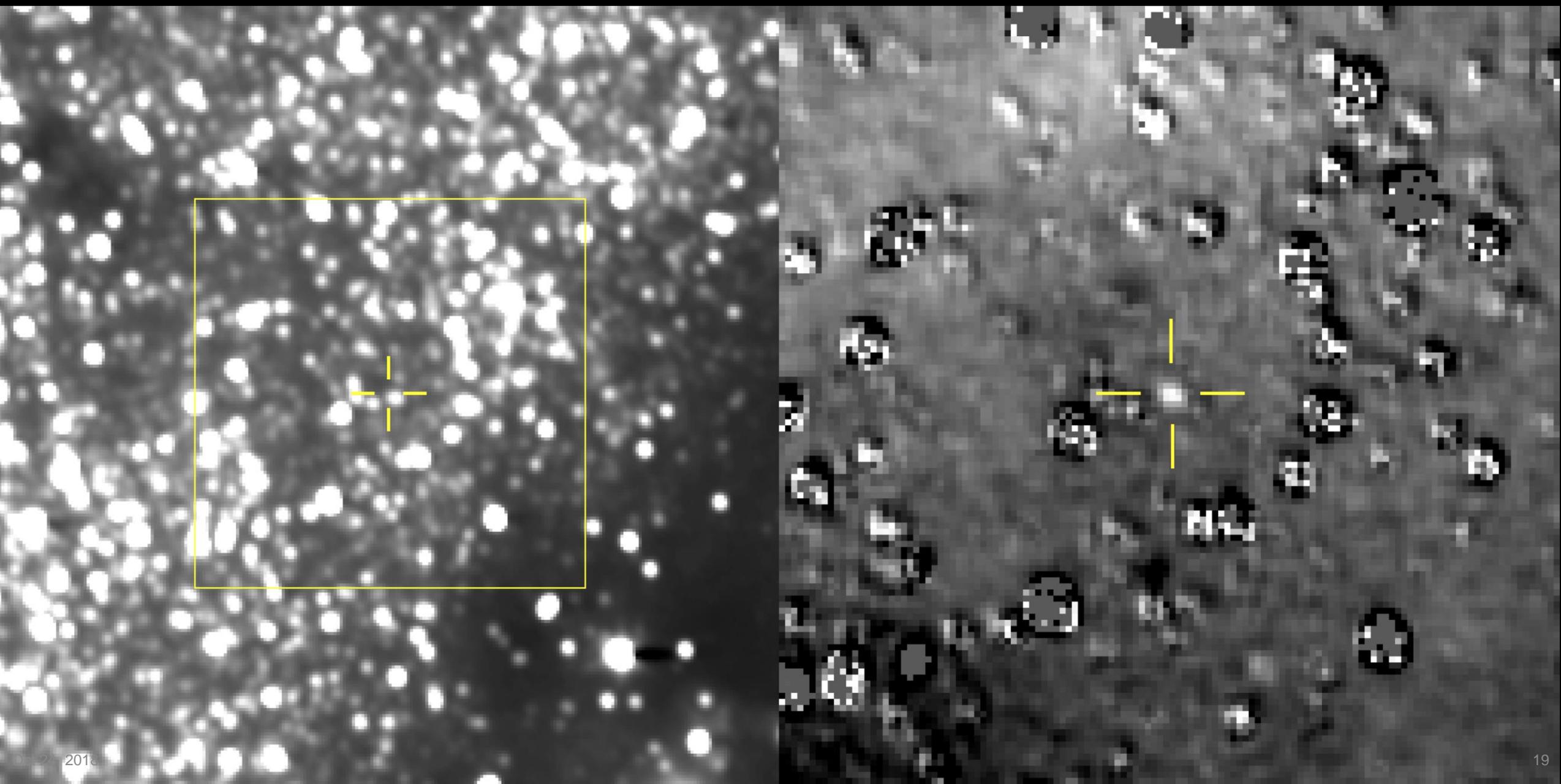
**REX:** Radio Science Experiment

**SWAP:** Solar Wind Particles

**PEPSSI:** Energetic Particles

**SDC:** Student Dust Counter

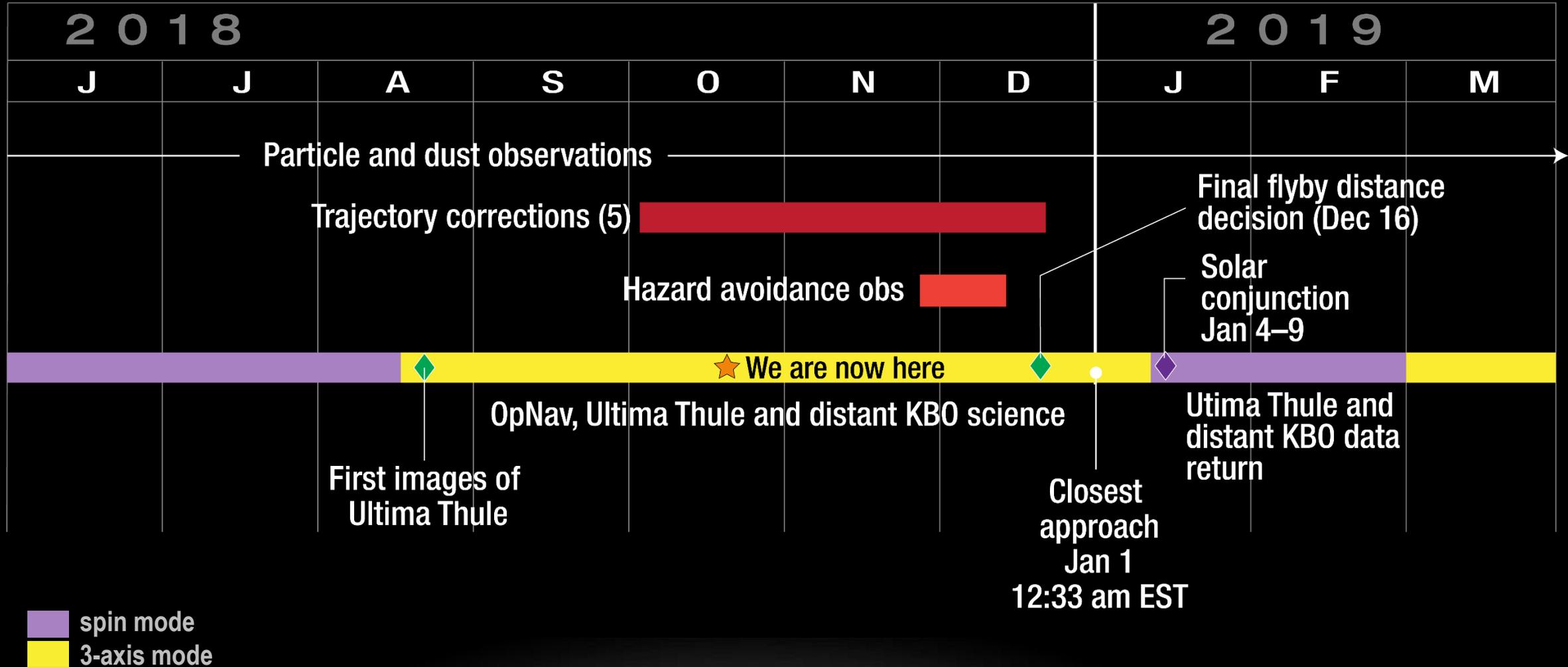
# Tracking Ultima Thule



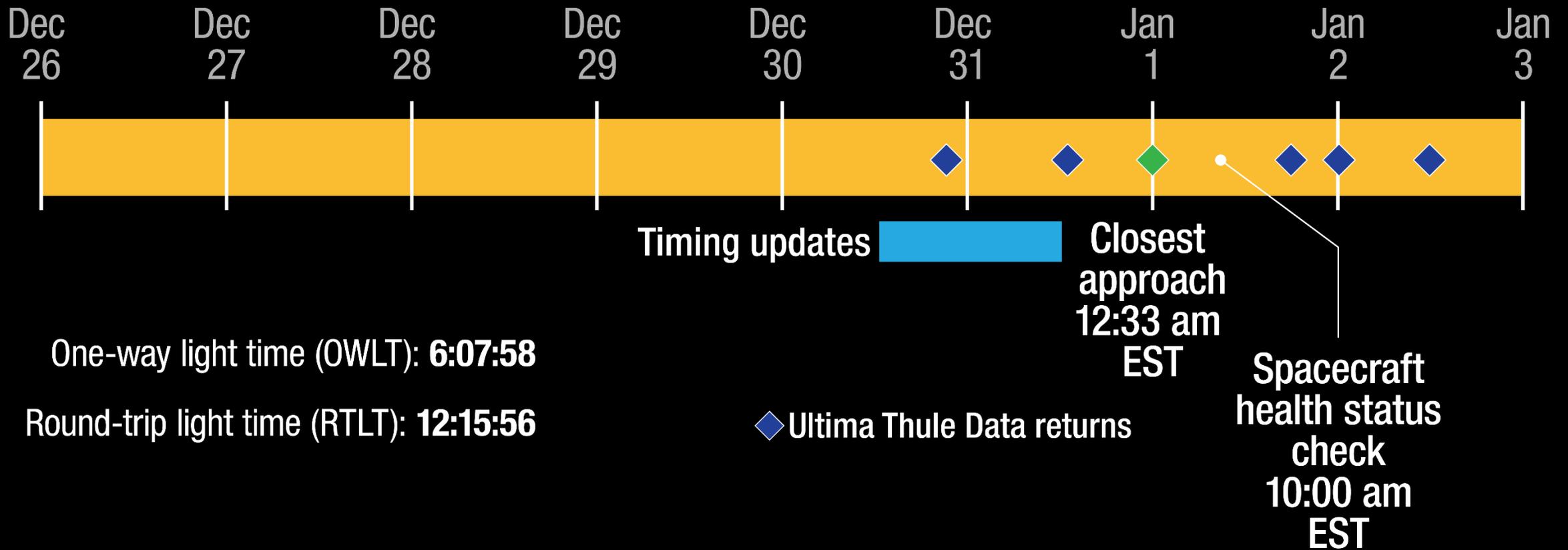
# Preparing for the Unknown

- Now that New Horizons has detected Ultima Thule, the team will:
  - Monitor brightness variations to inform size, shape, rotation
  - Search for moons
  - Survey surroundings for debris
  - Refine navigation
- Can divert to a more distant flyby of Ultima Thule as late as mid-December 2018, if necessary
  - Nominal flyby distance: 3,500 km (2,170 miles)
  - Alternate flyby distance: 10,000 km (6,200 miles)

# Ultima Thule Timeline Overview



# Ultima Thule Flyby Closest Approach



# Pluto vs Ultima Thule Resolution



70 m/pixel



30 m/pixel

Google Earth

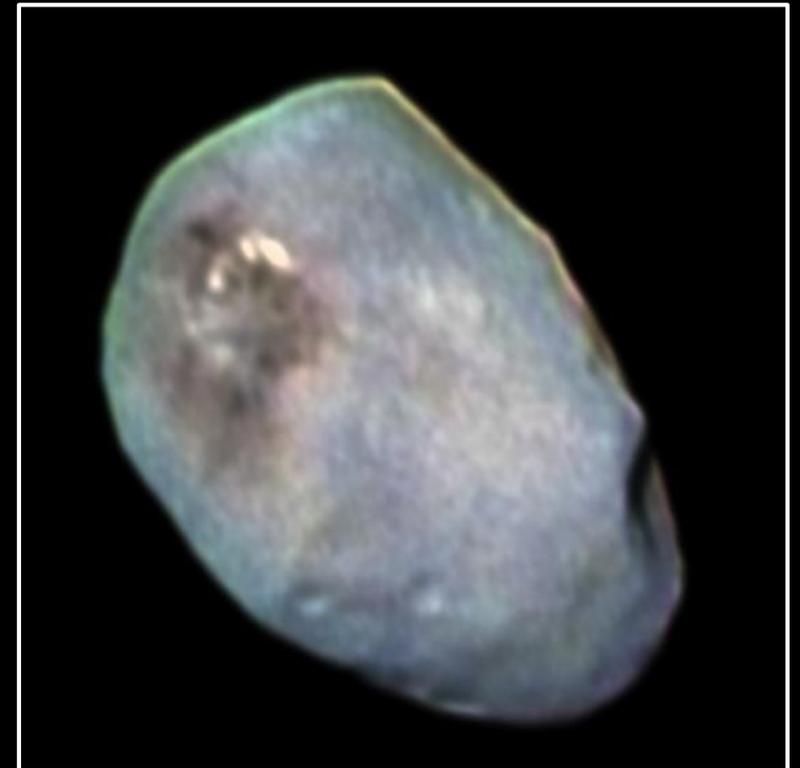
# **Mission Objectives**

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**Dr. Kelsi Singer**  
New Horizons Co-Investigator  
Southwest Research Institute

# Ultima Thule Science Objectives

- Map geology and morphology
  - Craters, grooves, topography
- Map surface color and composition
  - Search for ices: ammonia, carbon monoxide, methane, water ice
  - What makes Ultima Thule dark and red?



NH Color Image of Nix

# Ultima Thule Science Objectives

- Structure: Single body?  
Binary?
- Search for and study satellites and rings
- Search for a coma (atmosphere and/or dust/ice grains)



# Simulated Ultima Highest Resolution



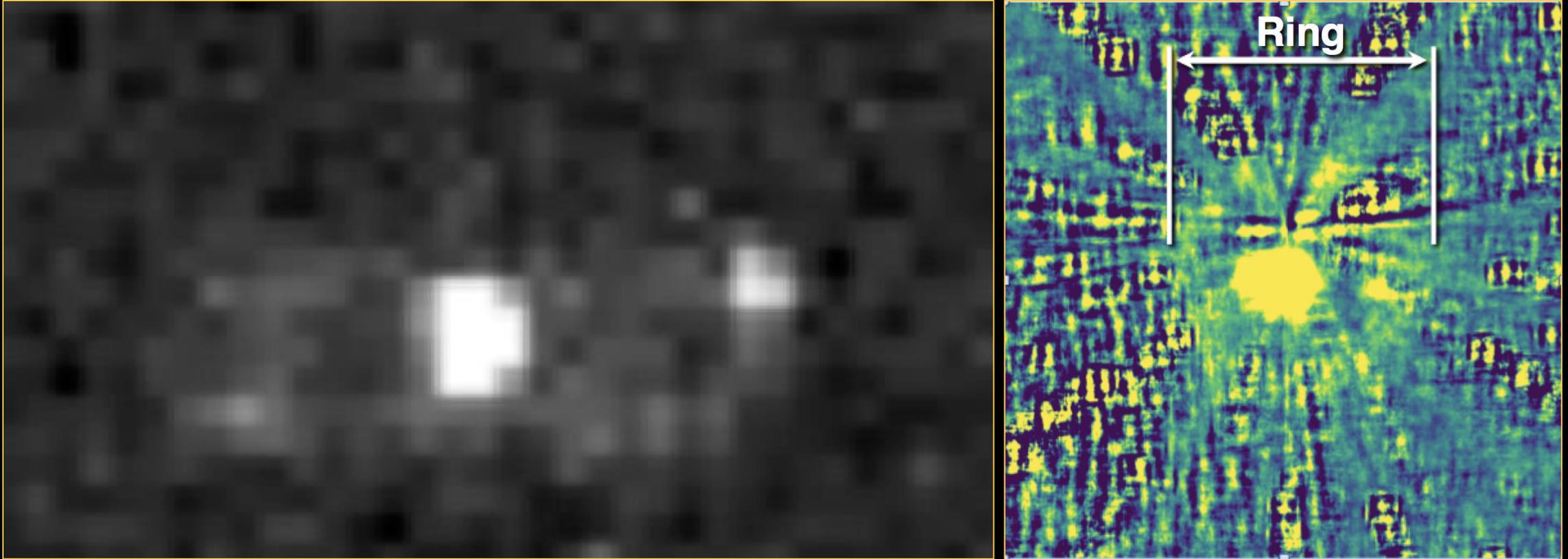
Saturn's moon Phoebe  
at 30 m/pixel with  
4 pixels of smear and  
estimated signal levels

# Simulated Ultima Best Color Image



Mars' moon Phobos  
at 400 m/pixel

# Search for Satellites and Rings



LORRI 4x4 on approach

# Early Data Return: LORRI

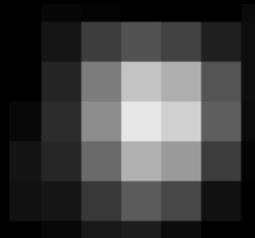
Dec. 30  
Late Evening (EST)



10 km/pixel

2–3 pixels  
across

Dec. 31  
Afternoon



5.4 km/pixel

5–6 pixels  
across

Jan. 1  
Evening



0.3 km/pixel

100 pixels  
across

Jan. 2  
Early morning



0.14 km/pixel

215 pixels  
across

# Earliest Data Returns

Arrival Time (EST)	Color	Composition	Atmospheric	Thermal	Dust	Charged Particles
Dec. 31 Afternoon	21 km/pixel	75 km/pixel	Alice Airglow		✓	✓
Jan.1 Afternoon/ Evening	1.5 km/pixel		Alice Airglow, UV Surface, Solar Occultation		✓	
Jan. 2 Evening		1.8 km/pixel		Nighttime Scan		✓

# Follow New Horizons

- Media Contacts

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[joanna.r.wendel@nasa.gov](mailto:joanna.r.wendel@nasa.gov)  
202-358-1003

- On the Web

- [www.nasa.gov/newhorizons](http://www.nasa.gov/newhorizons)
- <http://pluto.jhuapl.edu>
- Twitter: @nasanewhorizons
- Twitter: @NewHorizons2015
- Facebook:  
[www.facebook.com/new.horizons1/](http://www.facebook.com/new.horizons1/)

- Ultima Flyby Media Registration:  
<http://pluto.jhuapl.edu/News-Center/Media-Registration.php>