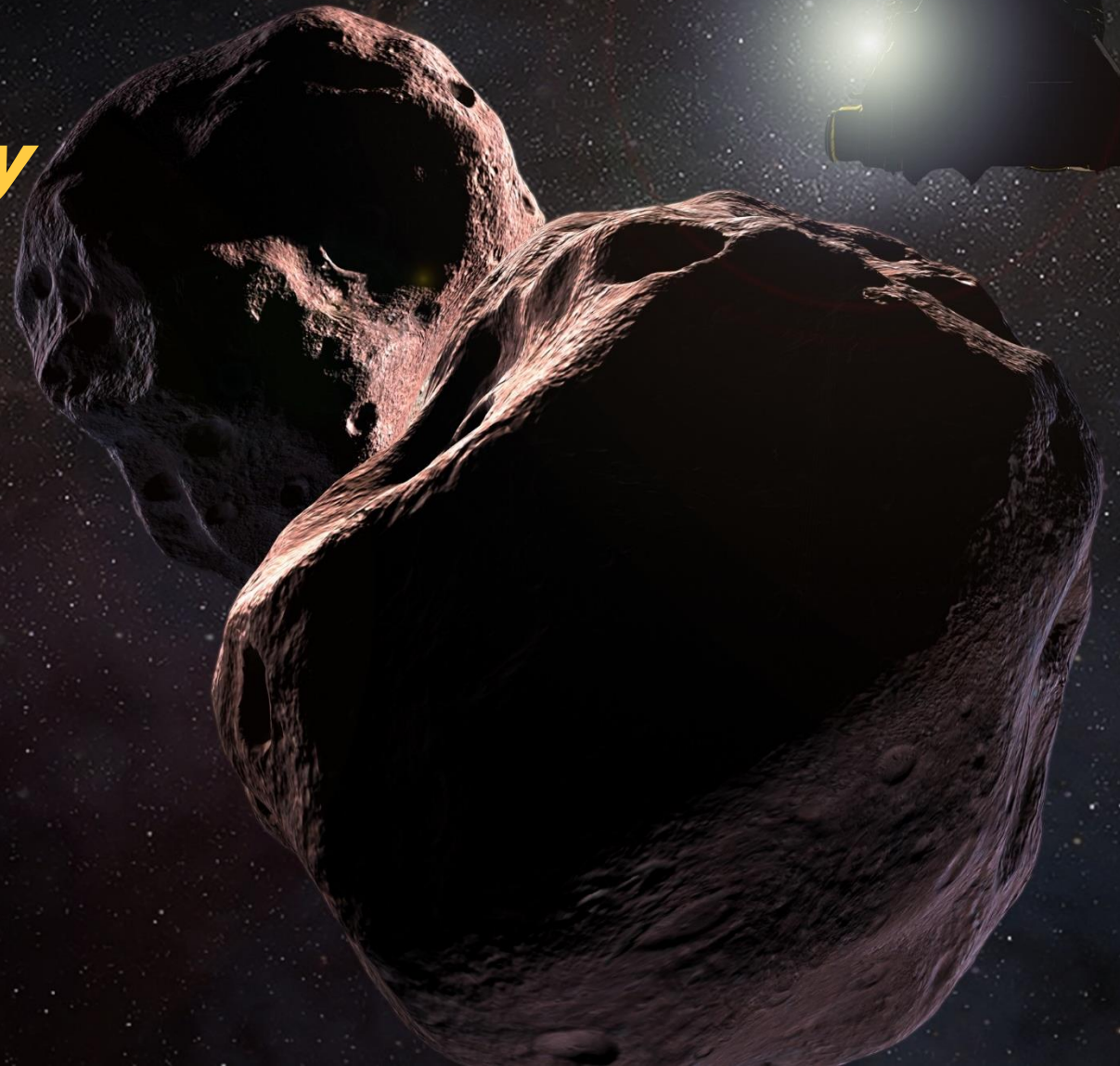


New Horizons **Beyond Pluto:** *The Ultima Thule Flyby*

October 24, 2018

American Astronomical Society
Division for Planetary Sciences

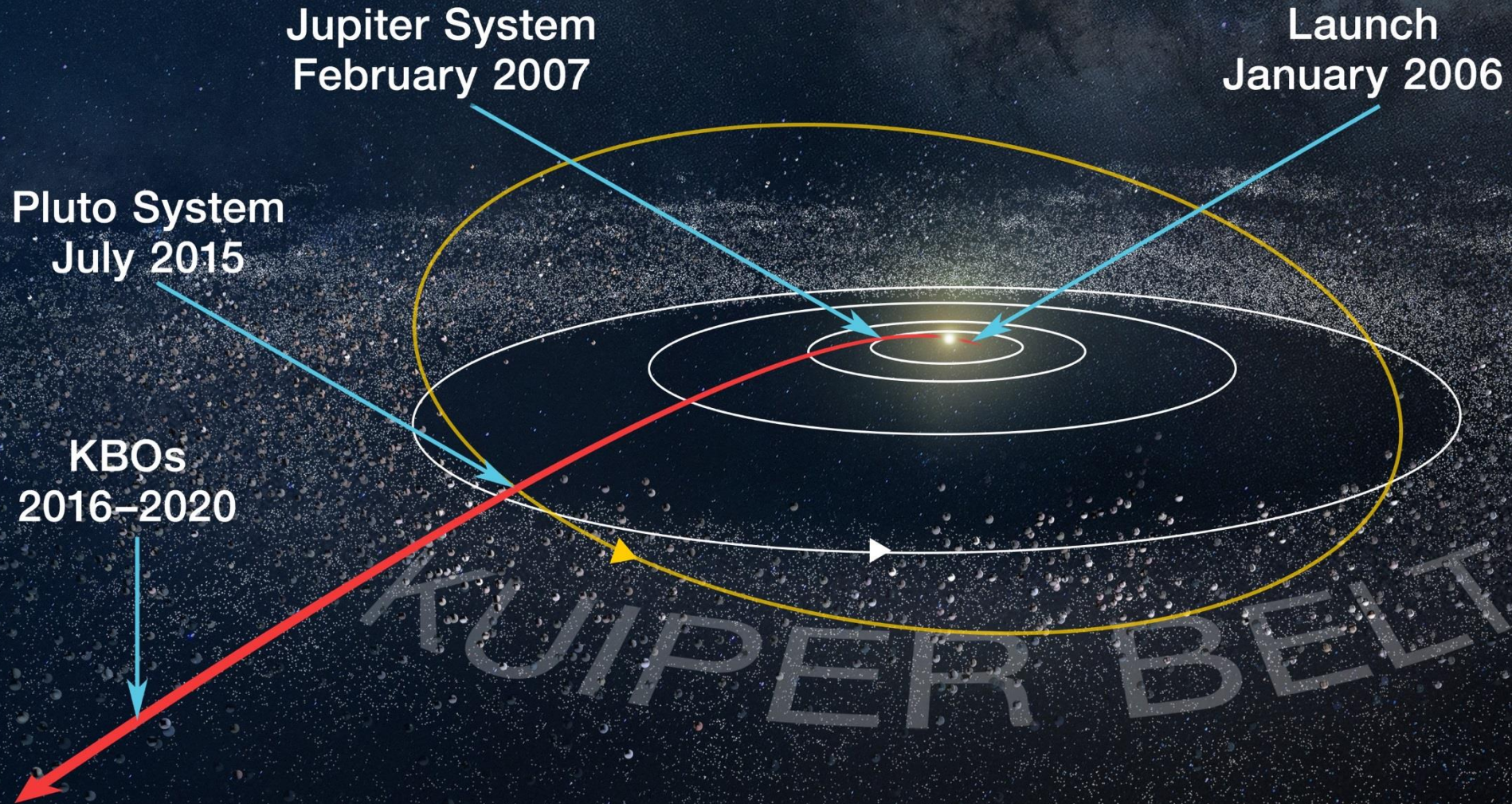


Mission Overview

Dr. Alan Stern

New Horizons Principal Investigator
Southwest Research Institute

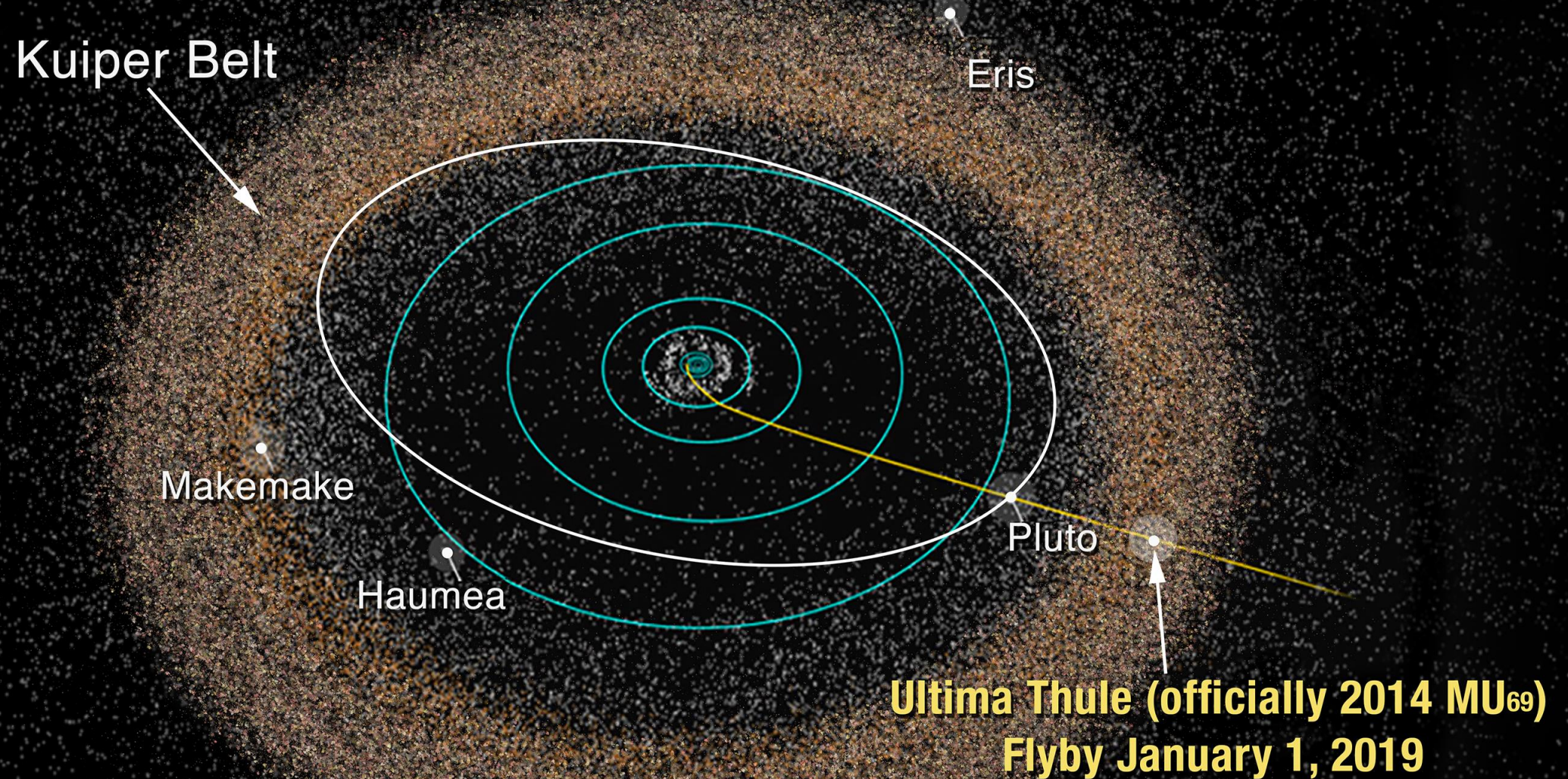
A Historic Journey to the Solar System's Frontier



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

Dr. Carey Lisse

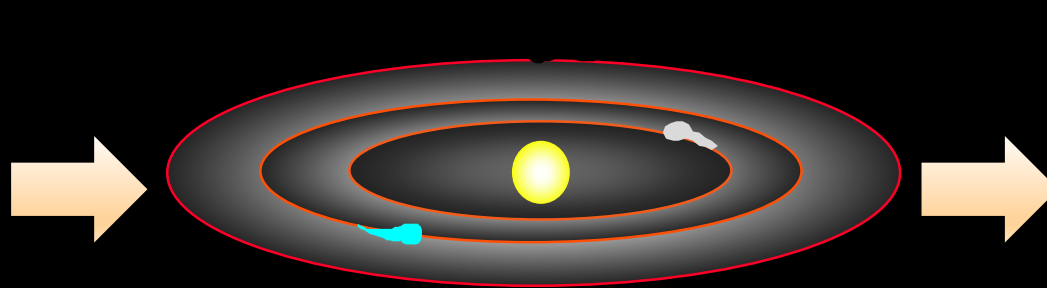
New Horizons Science Team Collaborator
Johns Hopkins Applied Physics Laboratory

From Dust to Planets

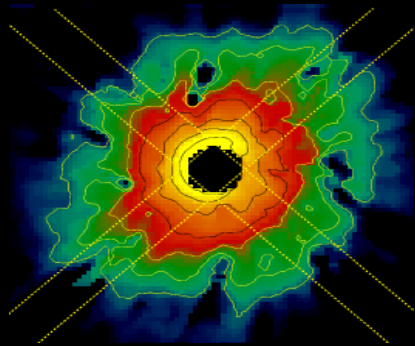
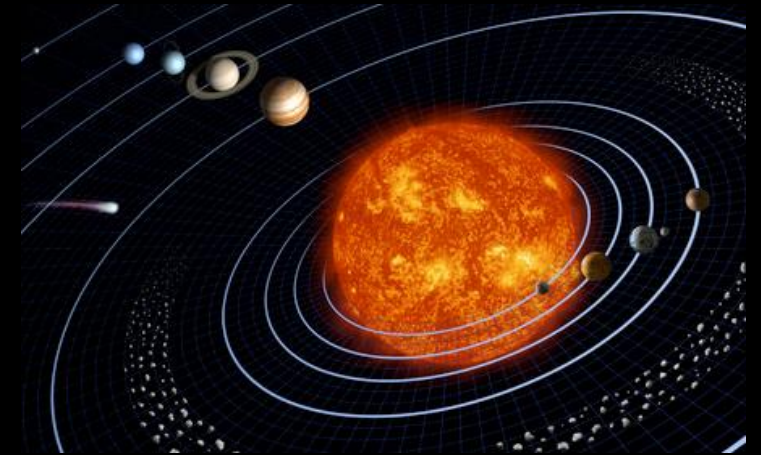
Primordial Disk:
Dust + Gas → Comets,
Gas Giants



Terrestrial Planet Disk
Forming Asteroids, Earths

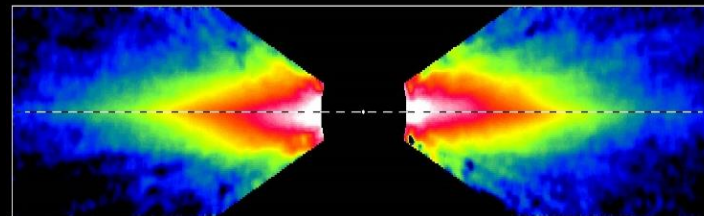


Mature Solar Systems:
Planets, KBOs, Asteroids,
Comets

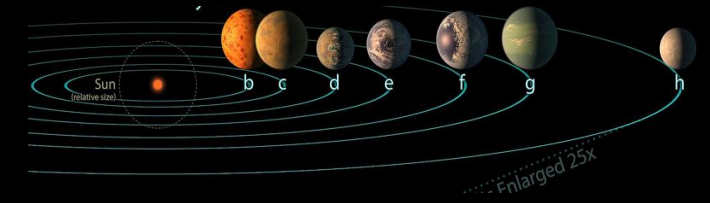


HD 100546

Size of Pluto's Orbit

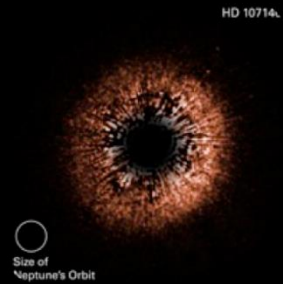


Beta Pic

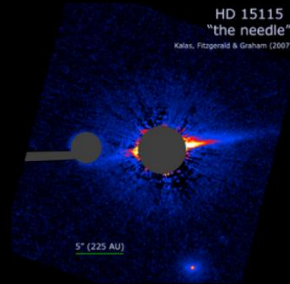


TRAPPIST-1 System

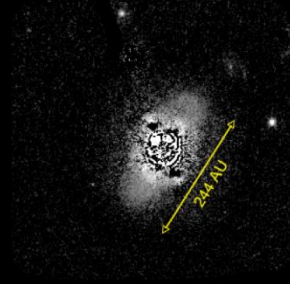
Hubble Views of 'Other' Kuiper Belts



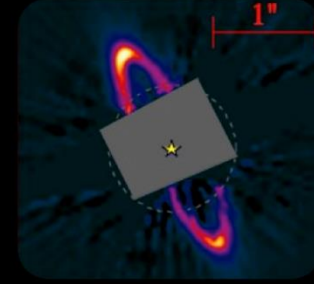
HD 107146
Ardila et al. 2005



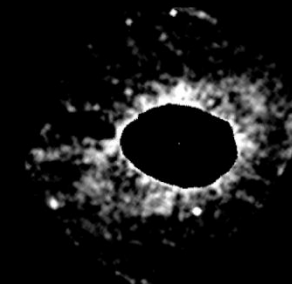
HD 15115
"the needle"
Kalas, Fitzgerald & Graham (2007)



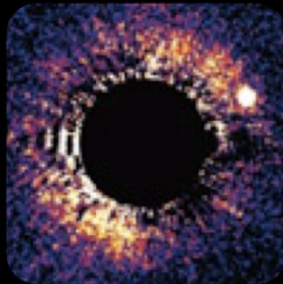
HD 92945
Clampin et al. 2006



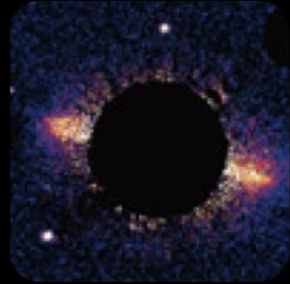
HR 4796
Schneider et al. 1999



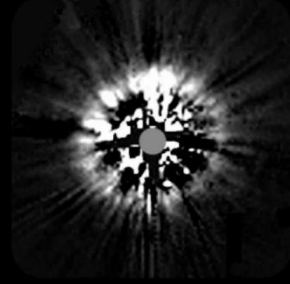
HD 207129
Stapelfeldt et al. 2007



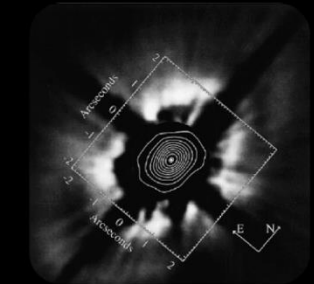
HD 139644
Kalas et al. 2006



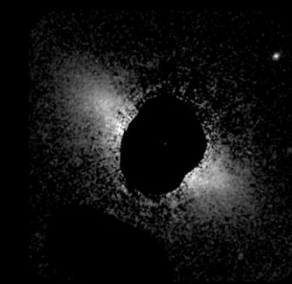
HD 51543
Kalas et al. 2006



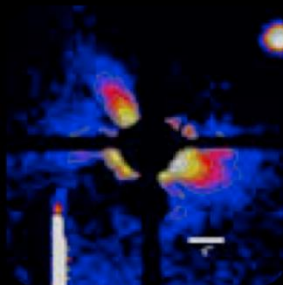
HD 181327
Schneider et al. 2006



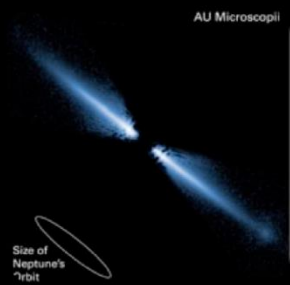
HD 141569A
Weinberger et al. 1999



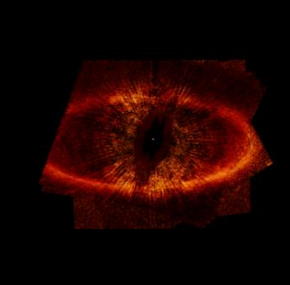
HD 10647
Stapelfeldt et al. 2007



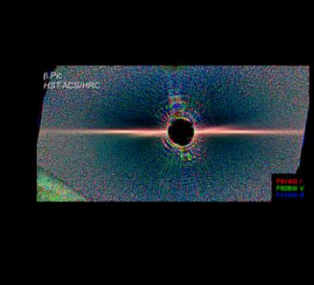
HD 32297
Schneider et al. 2006



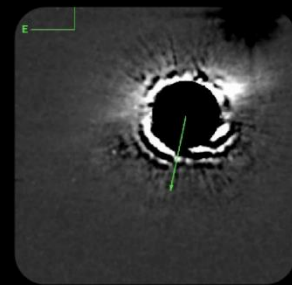
AU Mic
AU Microscopii
Krist et al. 2005



Fomalhaut
Kalas et al. 2005



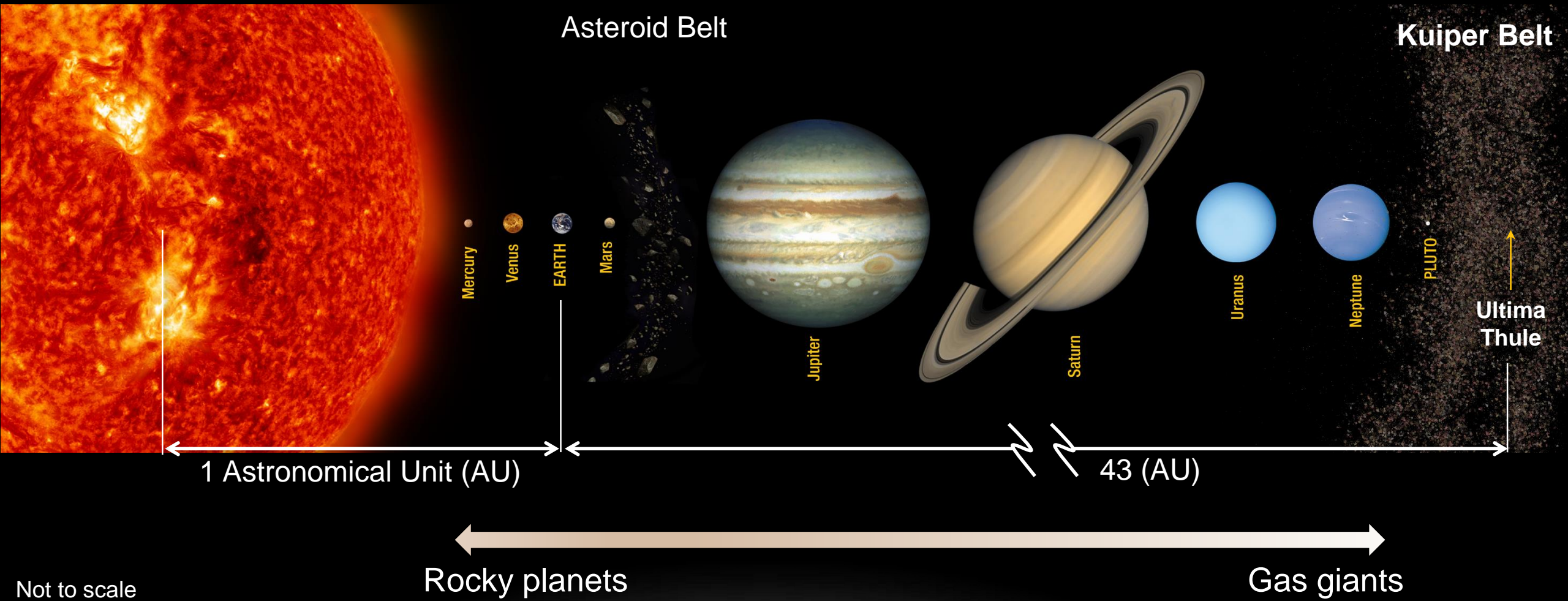
β Pictoris
Golimowski et al. 2005



HD 202917
Clampin et al. 2007

Credit:
Mark Clampin
2010

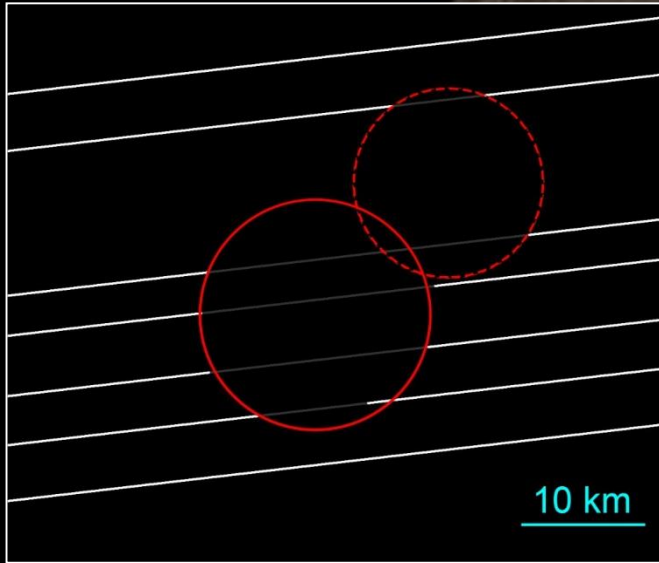
Solar System Structure



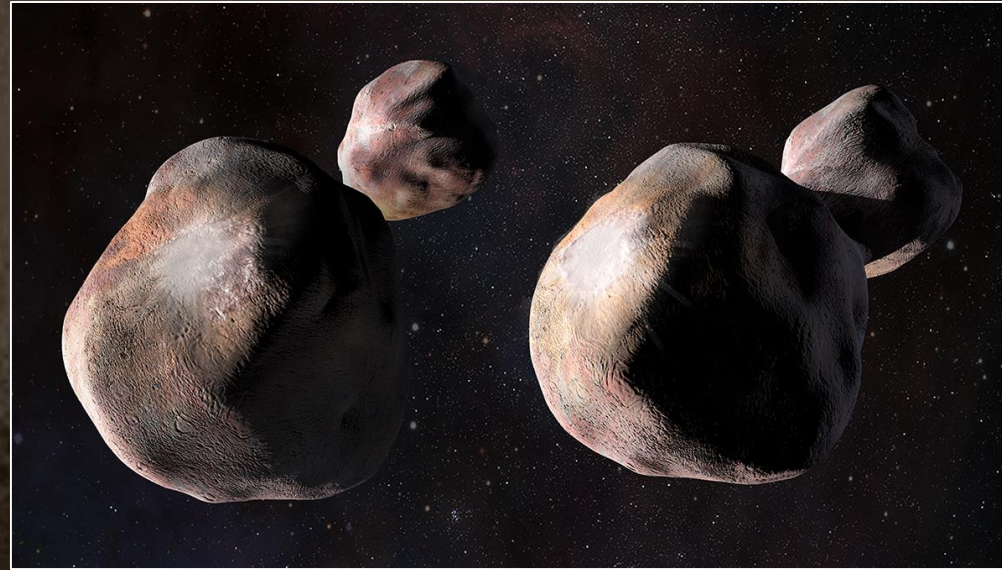
Building a Kuiper Belt Object



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?

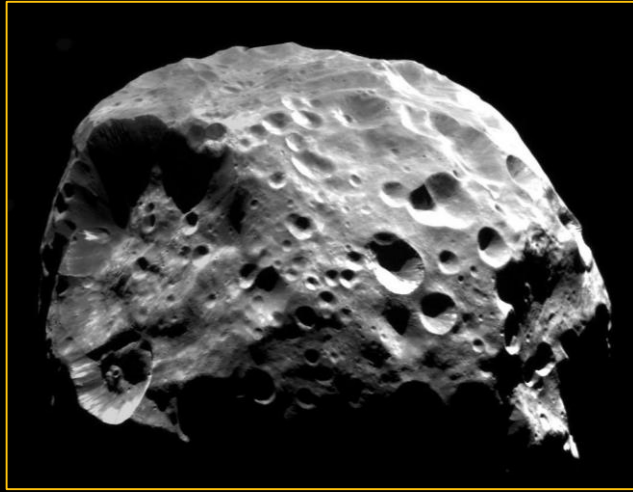
Pluto (in background, not to scale),
100x bigger than UT and spherical

What Can We Expect for the Surface of Ultima Thule?

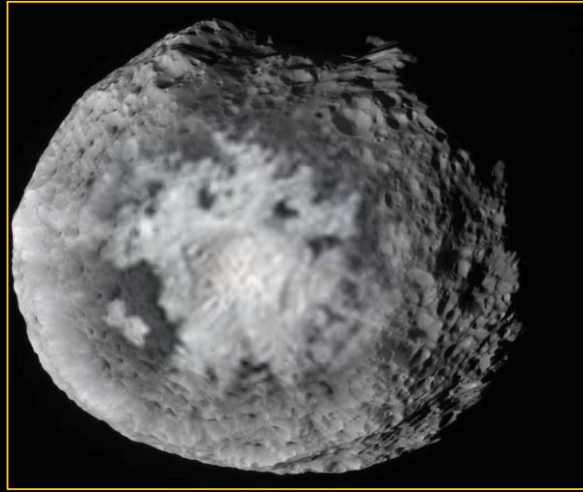
Comet Wild 2
(little processed, many sublimation pits + craters)



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.)



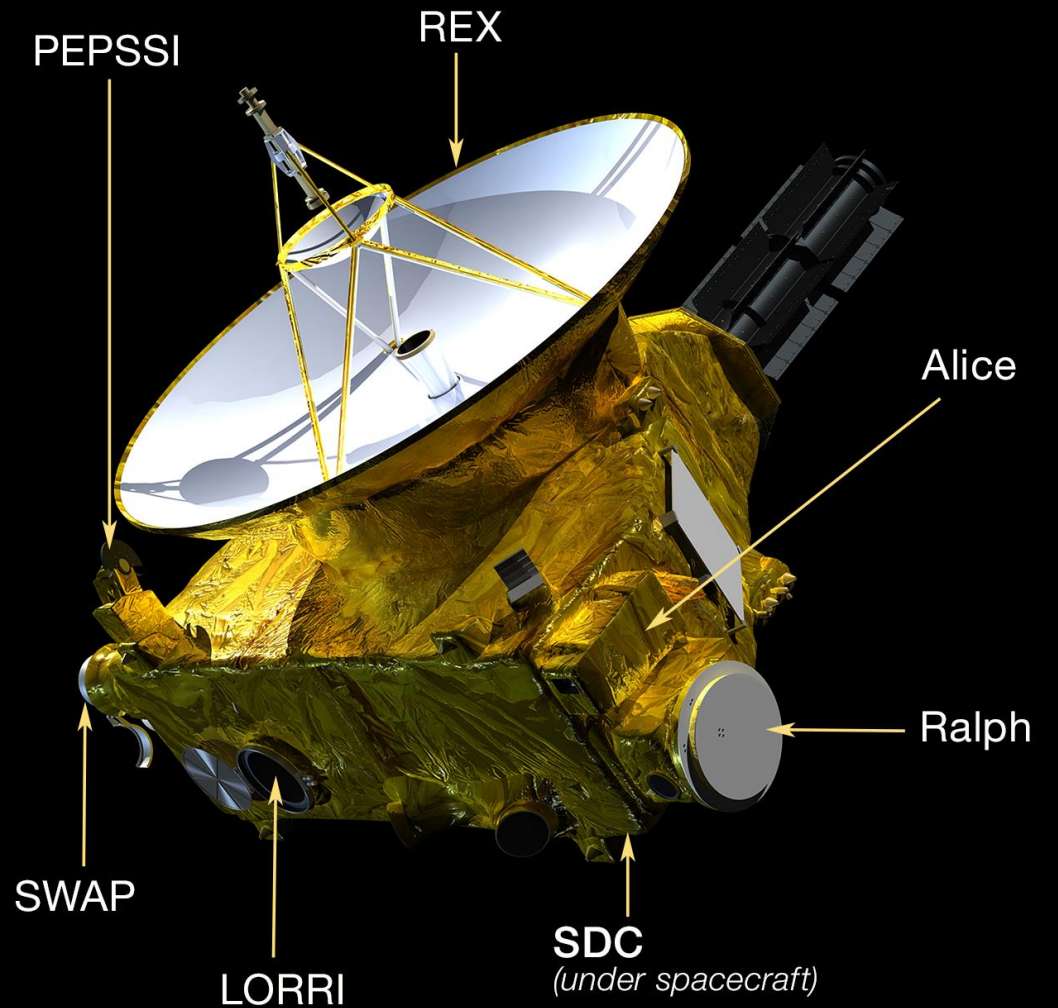
Flyby Science Plans

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

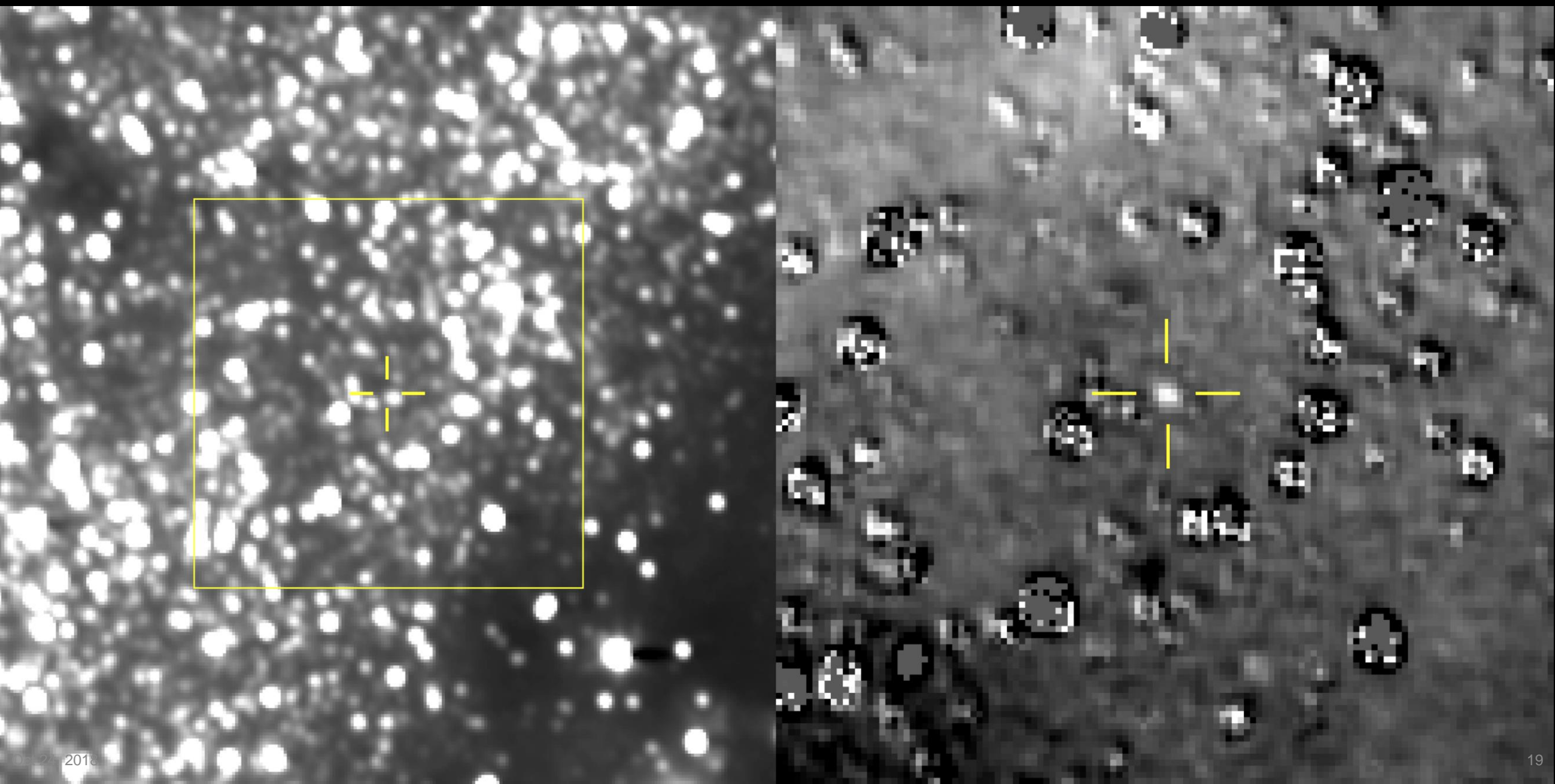
REX: Radio Science Experiment

SWAP: Solar Wind Particles

PEPSSI: Energetic Particles

SDC: Student Dust Counter

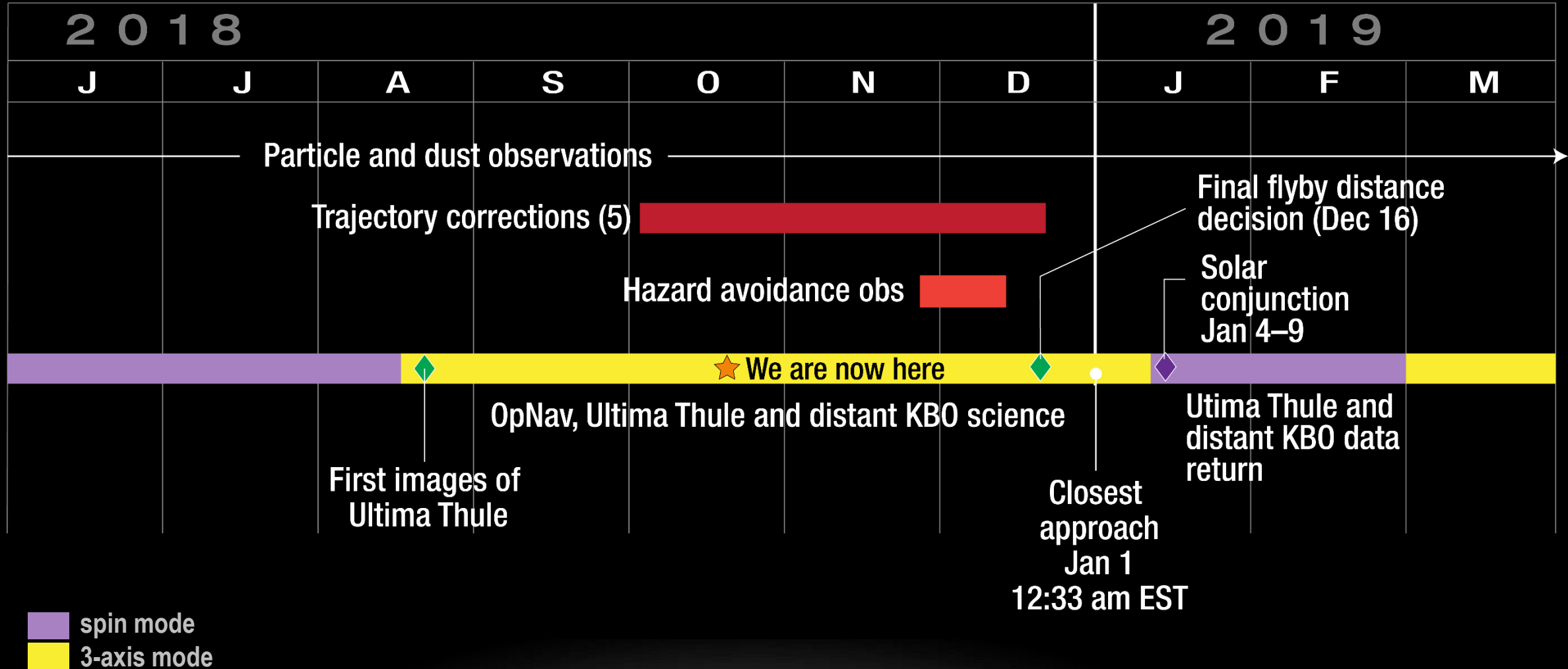
Tracking Ultima Thule



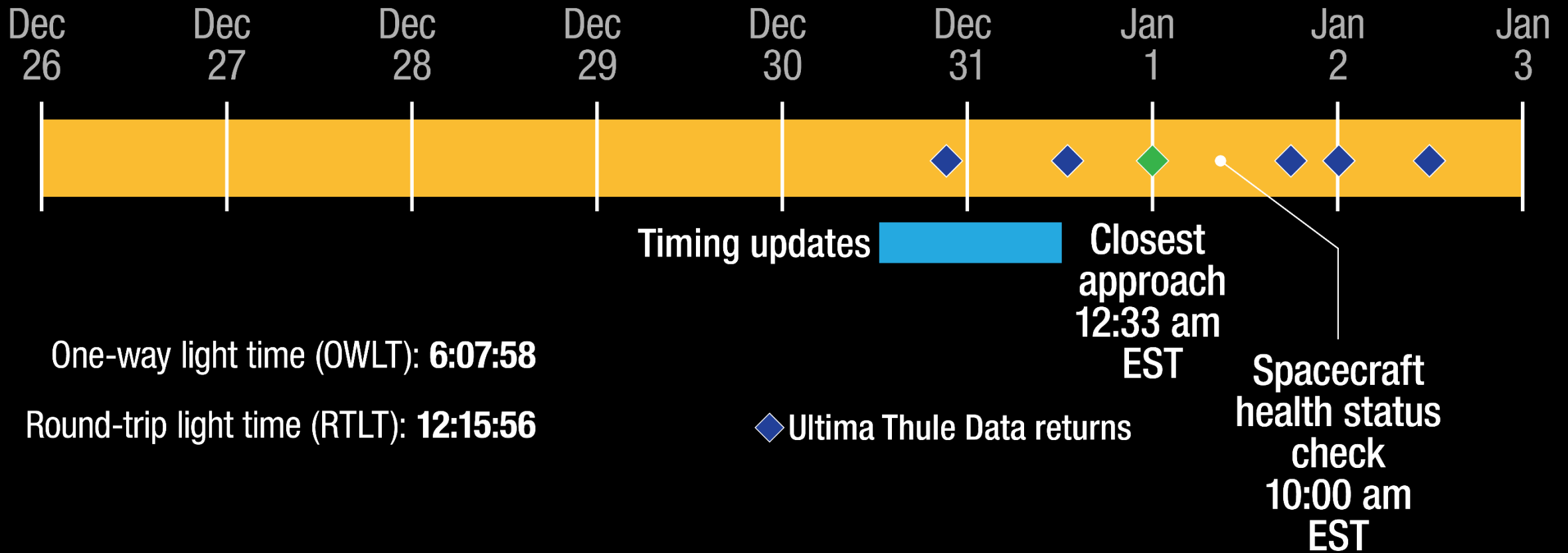
Preparing for the Unknown

- 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



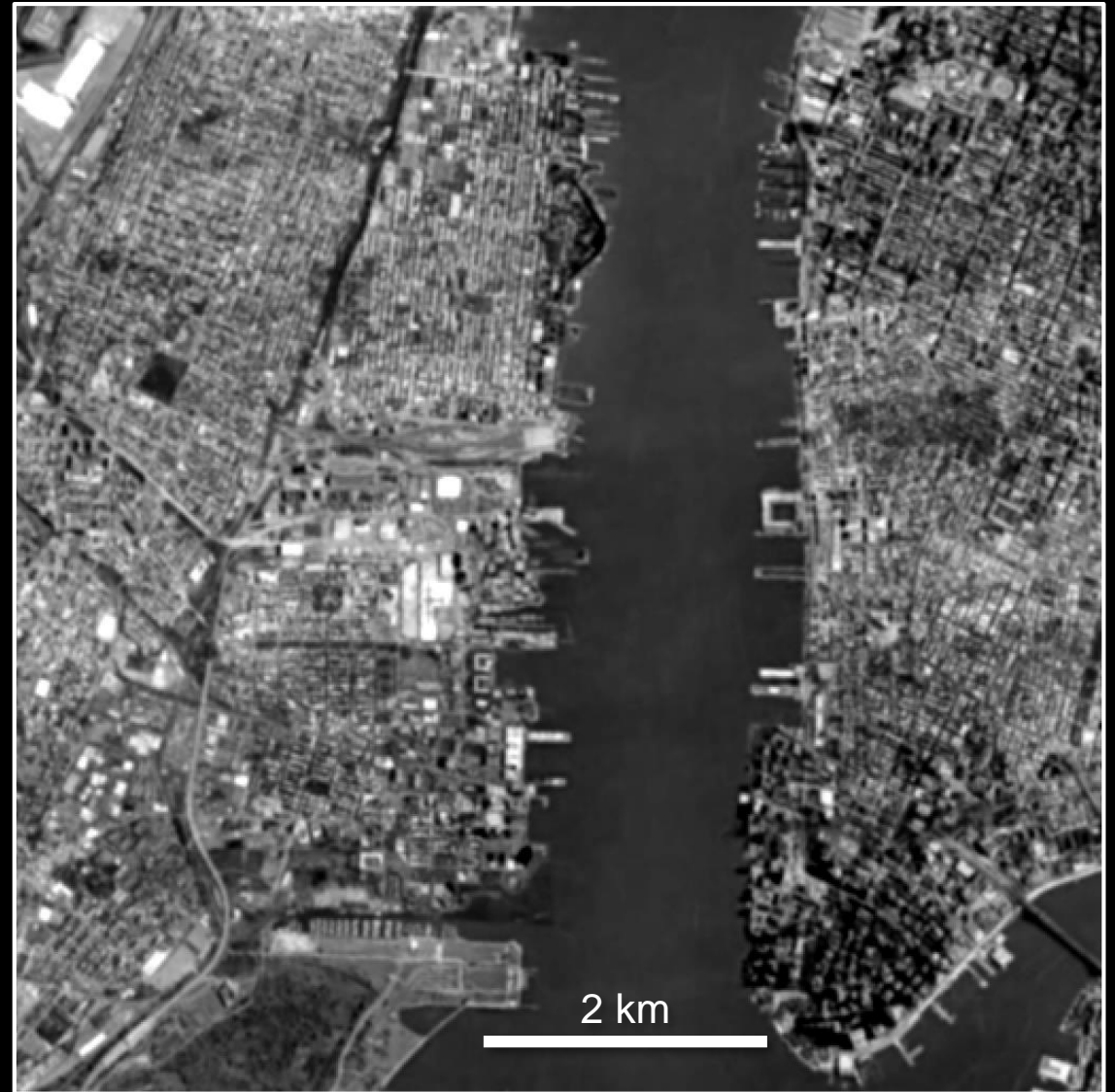
Ultima Thule Flyby Closest Approach



Pluto vs Ultima Thule Resolution



70 m/pixel



30 m/pixel

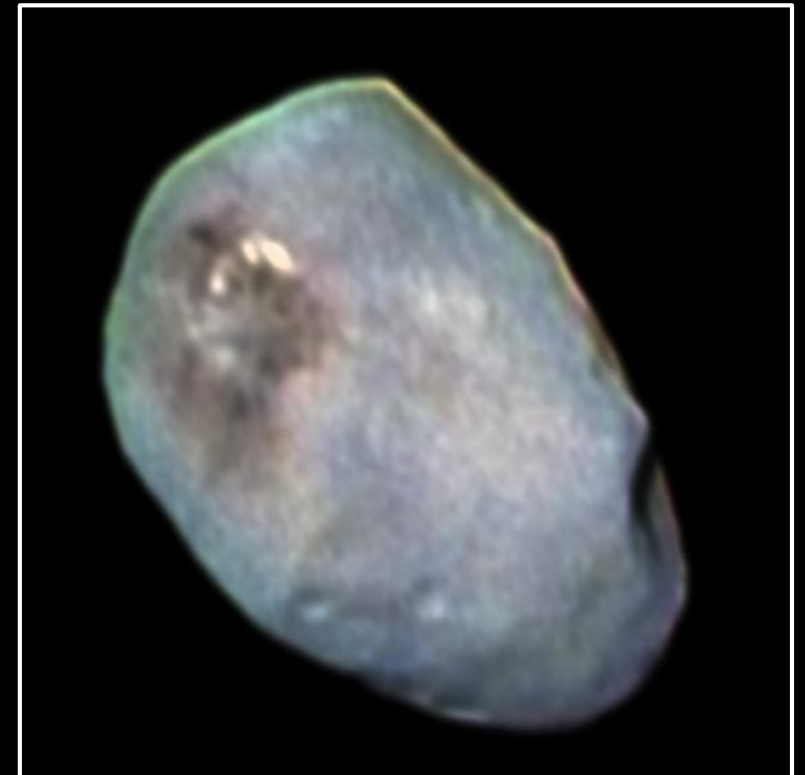
Google Earth

Mission Objectives

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

Ultima Thule Science Objectives

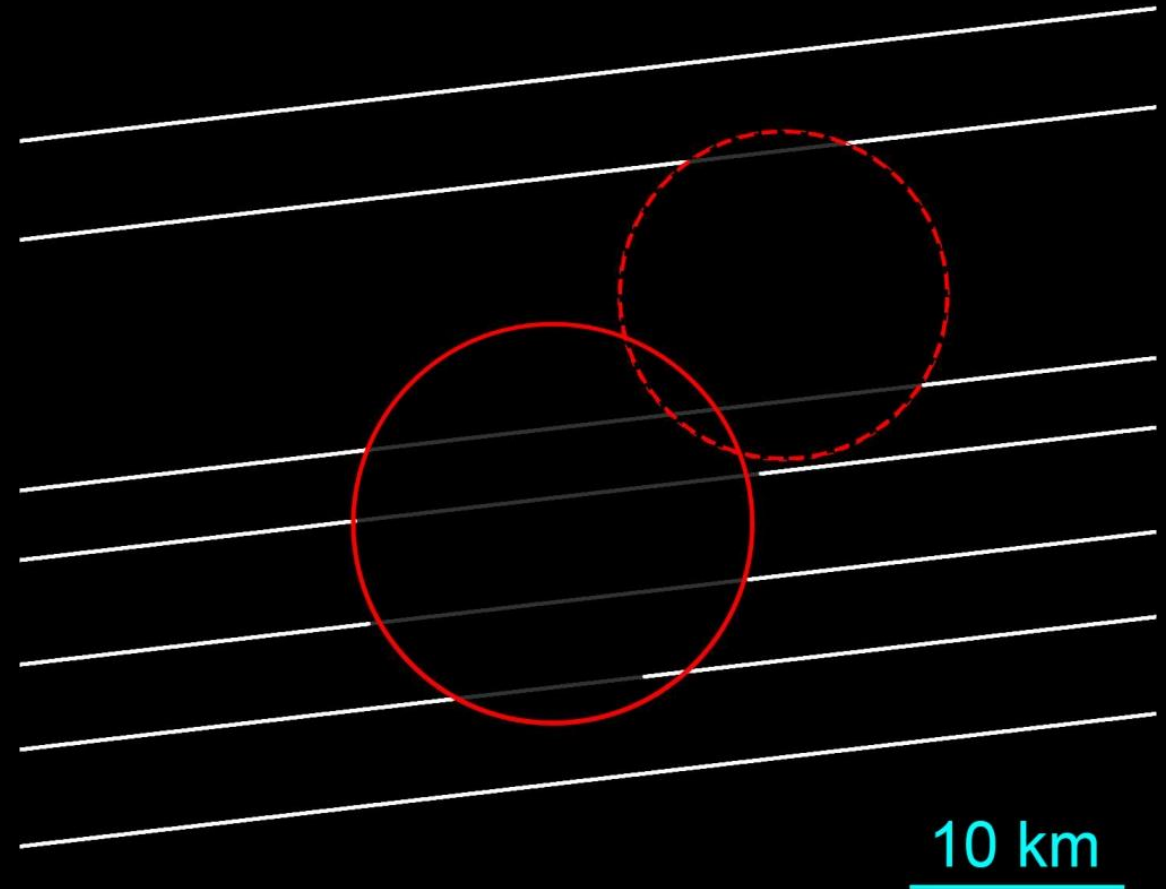
- Map geology and morphology
 - Craters, grooves, topography
- Map surface color and composition
 - Search for ices: ammonia, carbon monoxide, methane, water ice
 - What makes Ultima Thule dark and red?



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



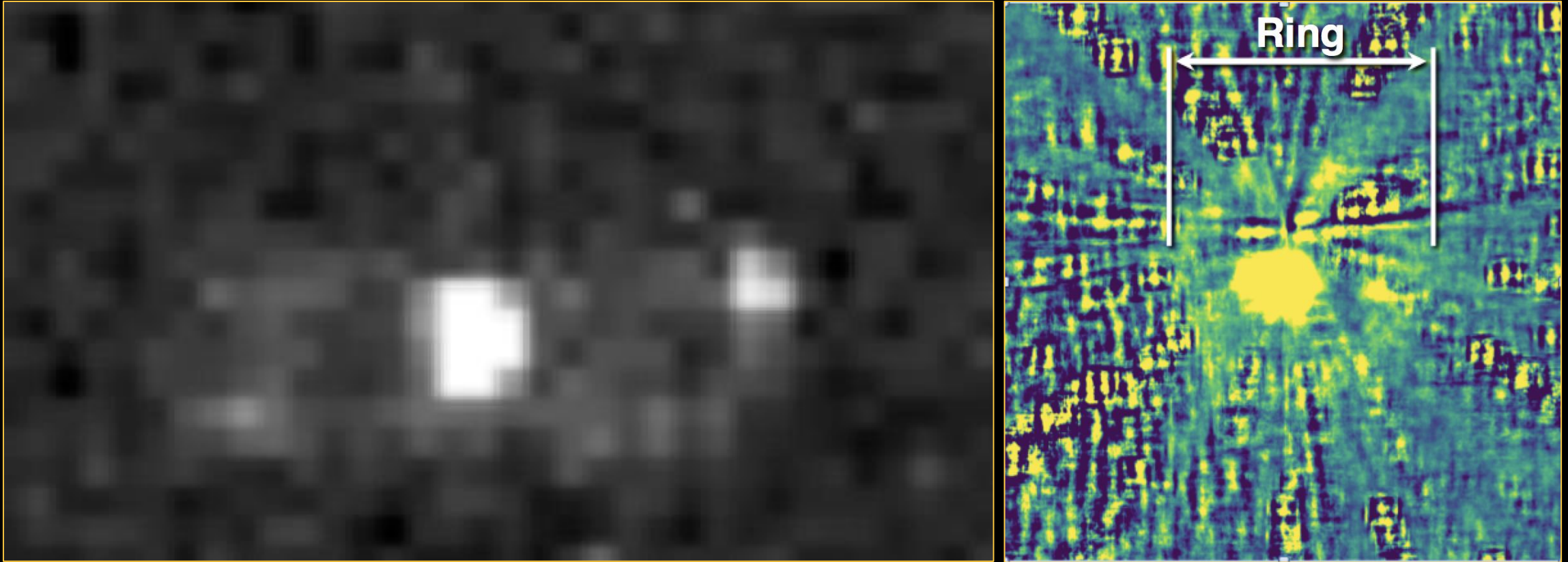
Saturn's moon Phoebe
at 30 m/pixel with
4 pixels of smear and
estimated signal levels

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

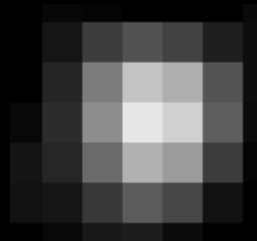
Dec. 30
Late Evening (EST)



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

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- On the Web

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

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