

# **New Horizons Kuiper Belt Extended Mission**

*The Ultima Thule Flyby*

December 31, 2018  
Press Conference



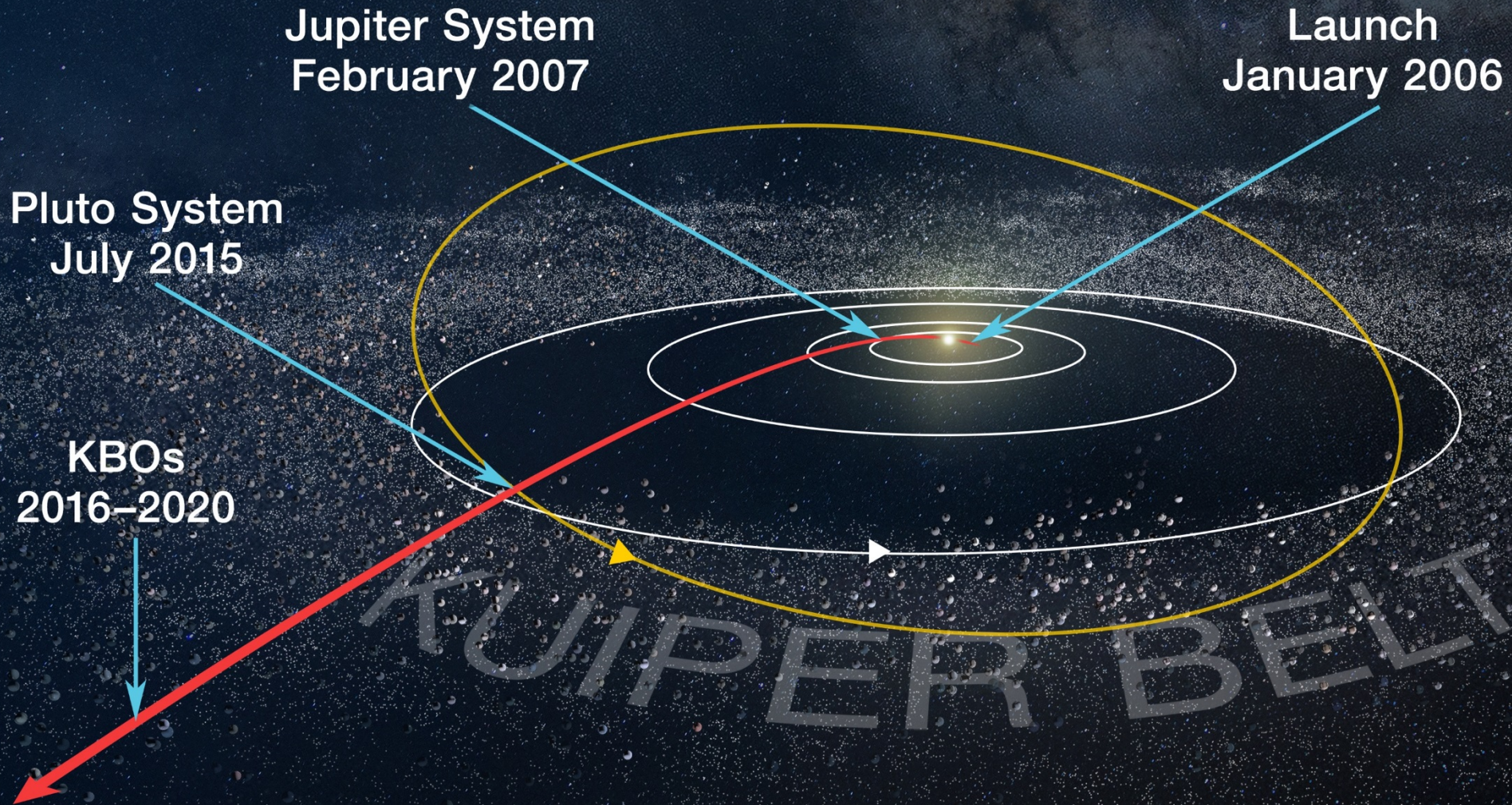
# Mission Overview

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**Alan Stern**

New Horizons Principal Investigator  
Southwest Research Institute

# A Historic Journey to the Solar System's Frontier



**2015:  
First Mission  
to Explore the  
Pluto System**



# 2016-2021: First Mission to Explore the Kuiper Belt

Kuiper Belt

Eris

Makemake

Haumea

Pluto

**Ultima Thule (officially 2014 MU<sub>69</sub>)**  
**Flyby January 1, 2019**

**The Solar System's  
Third Zone: A Relic of  
Solar System Formation**

# Ultima Thule Flyby: The Centerpiece of Extended Mission 1

- The most distant object ever explored
- The most primitive object ever explored
- Brief flyby compared to Pluto
- Much more challenging flyby than Pluto
- New Year's Eve and New Year's Day 2019
- Historic and record-setting

# **Ultima Thule: A More Challenging Flyby than Pluto**

- Uncertain orbit of Ultima Thule
- Unknown moons and hazard environment
- Lower lighting levels
- Longer communication times (12.25 hrs. round trip)
- Less spacecraft power—more power management

*And like at Pluto, no second chances!*

# **Flyby Plans**

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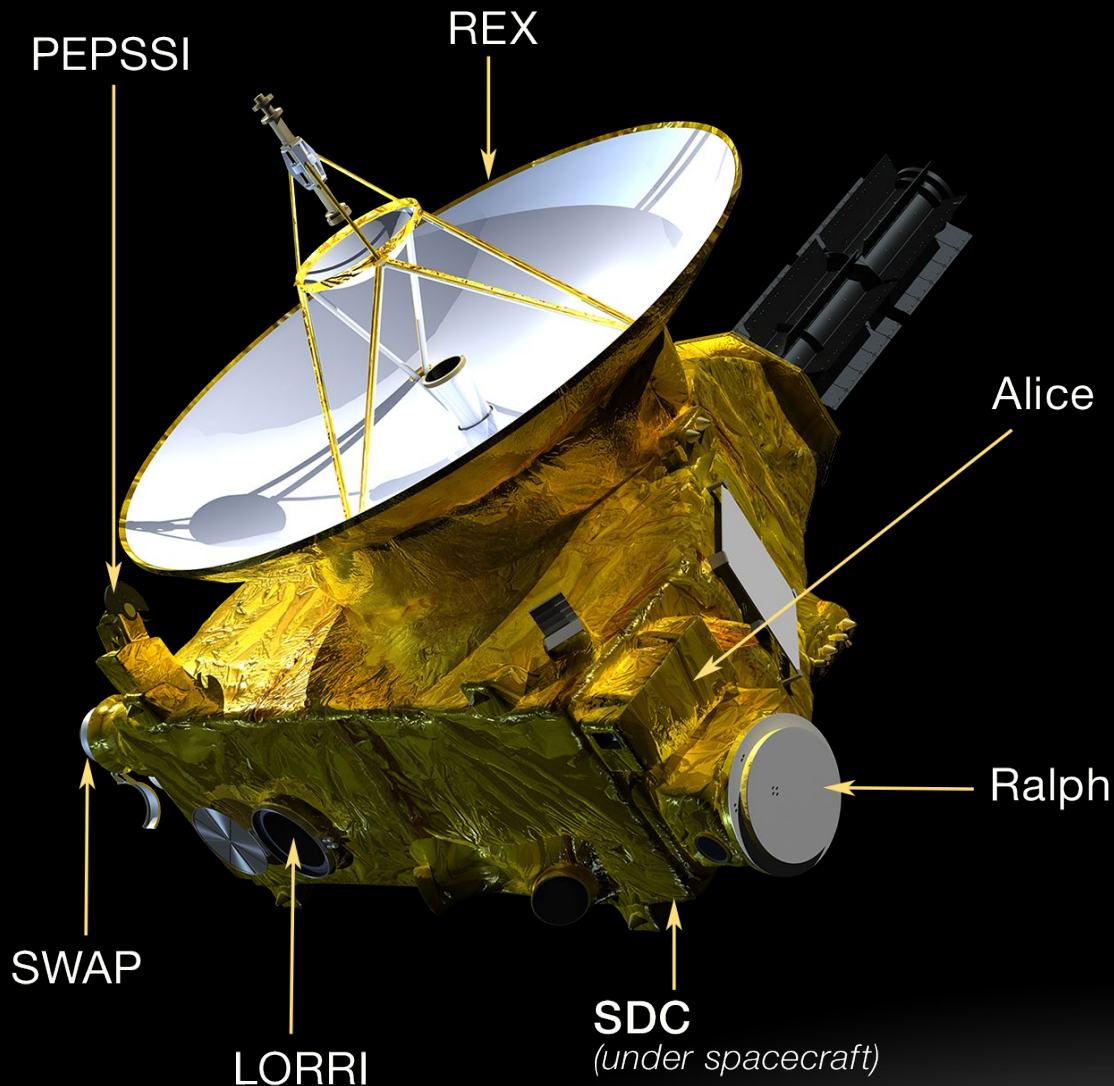
**Helene Winters**

New Horizons Project Manager

Johns Hopkins Applied Physics Laboratory



# New Horizons Instruments



**LORRI:** High-Resolution Panchromatic Imager: Geology, Navigation, Searches for Moons and Rings

**Ralph:** Color Imager and Infrared Composition Mapper

**Alice:** Ultraviolet Spectral Imager: Atmospheric Searches

**REX:** Radio Science Experiment: Surface Temperature and Radar Reflectivity

**SWAP:** Low-Energy Charged Particle Detector: Solar Wind Interaction with Ultima

**PEPSSI:** High-Energy Charged Particle Detector: Search for Emitted Ions

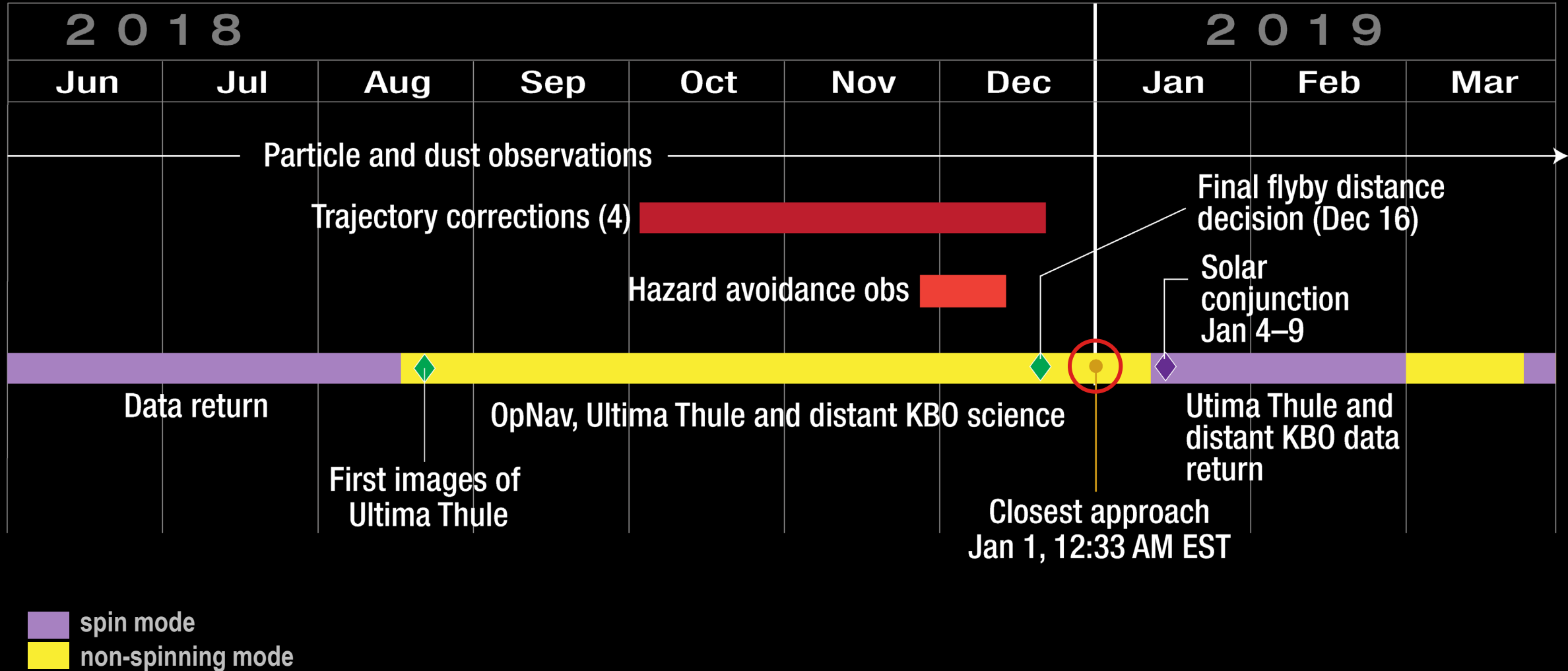
**SDC:** Dust Impact Detector

# Tracking Ultima Thule

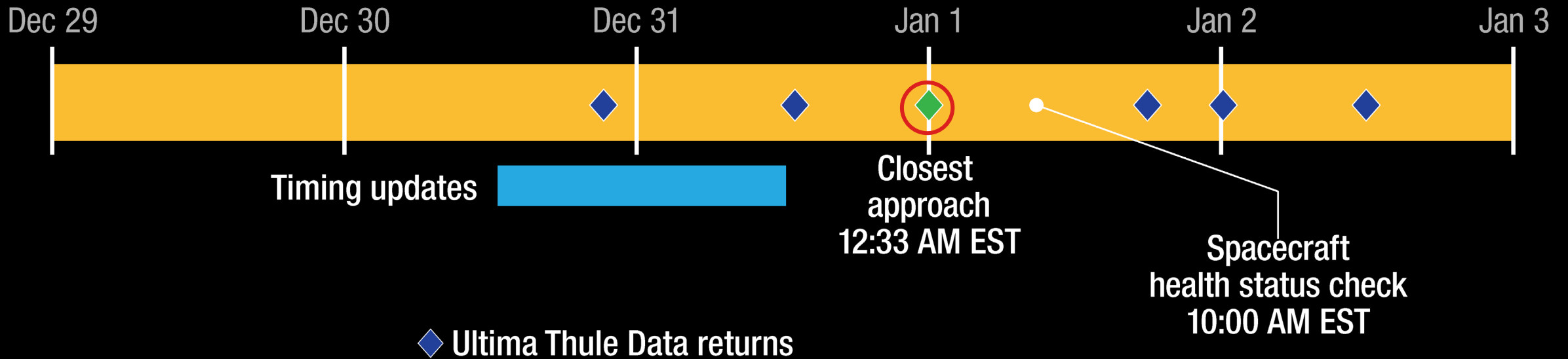


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# Approaching Ultima Thule



# Flying By Ultima Thule



# Navigation Challenges

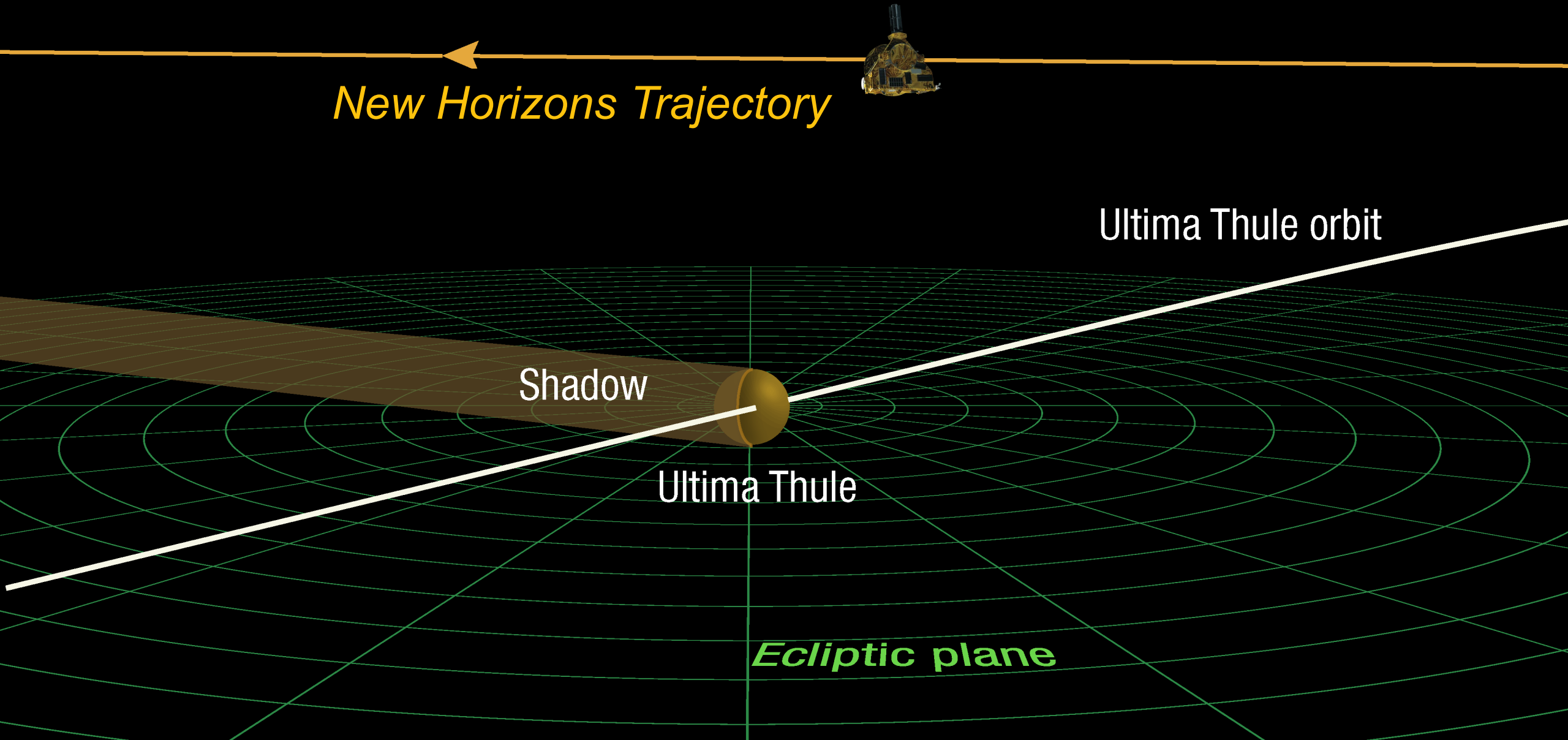
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**Fred Pelletier**

New Horizons Navigation Team Chief

KinetX, Inc.

# January 1<sup>st</sup> Closest Approach



*New Horizons Trajectory*

Ultima Thule orbit

Shadow

Ultima Thule

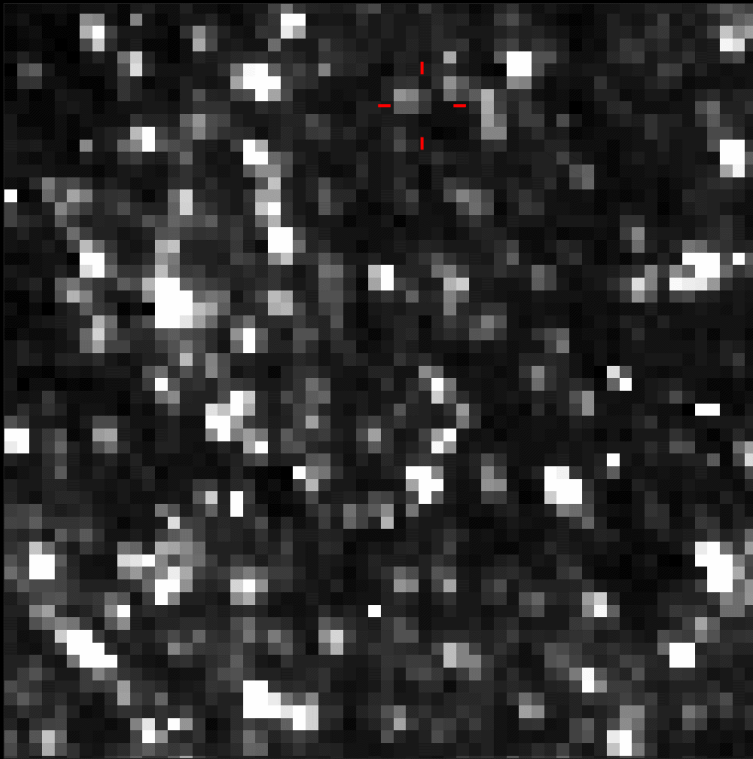
*Ecliptic plane*

# Getting to Ultima

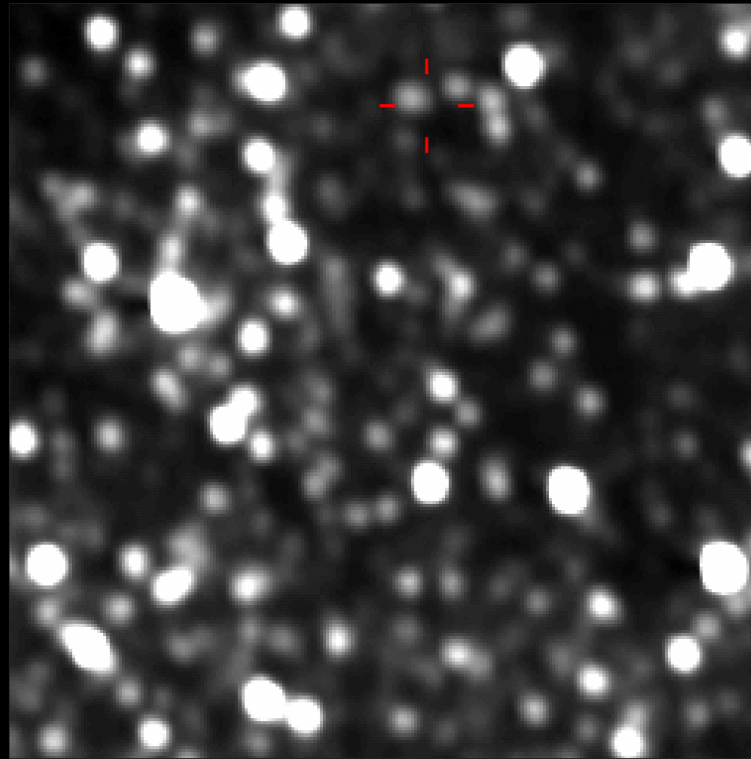
- Spacecraft tracked by Deep Space Network
- Ultima tracked by Hubble, then New Horizons
- Differences in Ultima's position compared to nominal resulted in course corrections up to Dec. 18
- On Dec 30, we transmitted pointing and timing corrections to New Horizons

# Optical Navigation

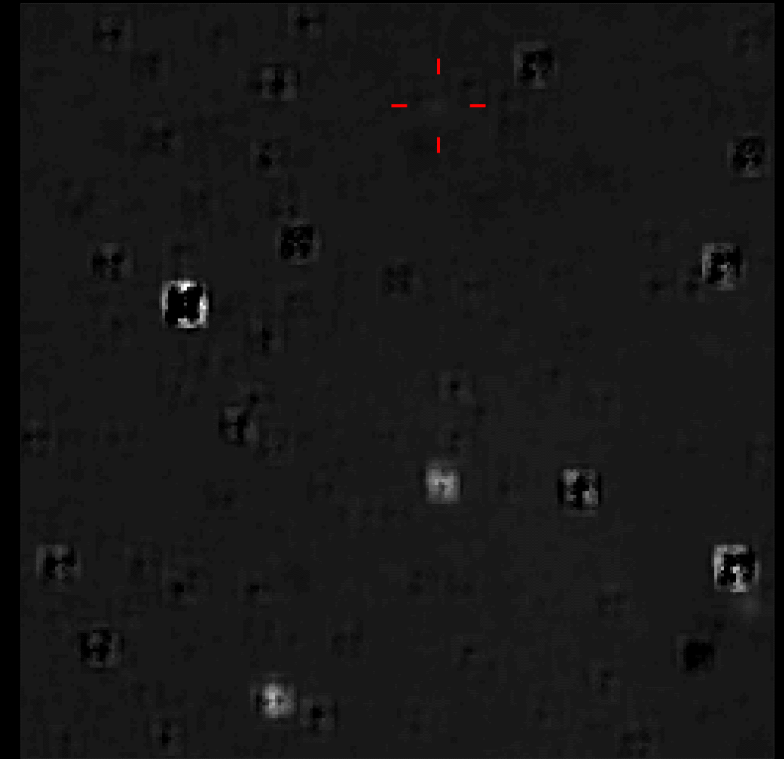
Raw Image



Processed



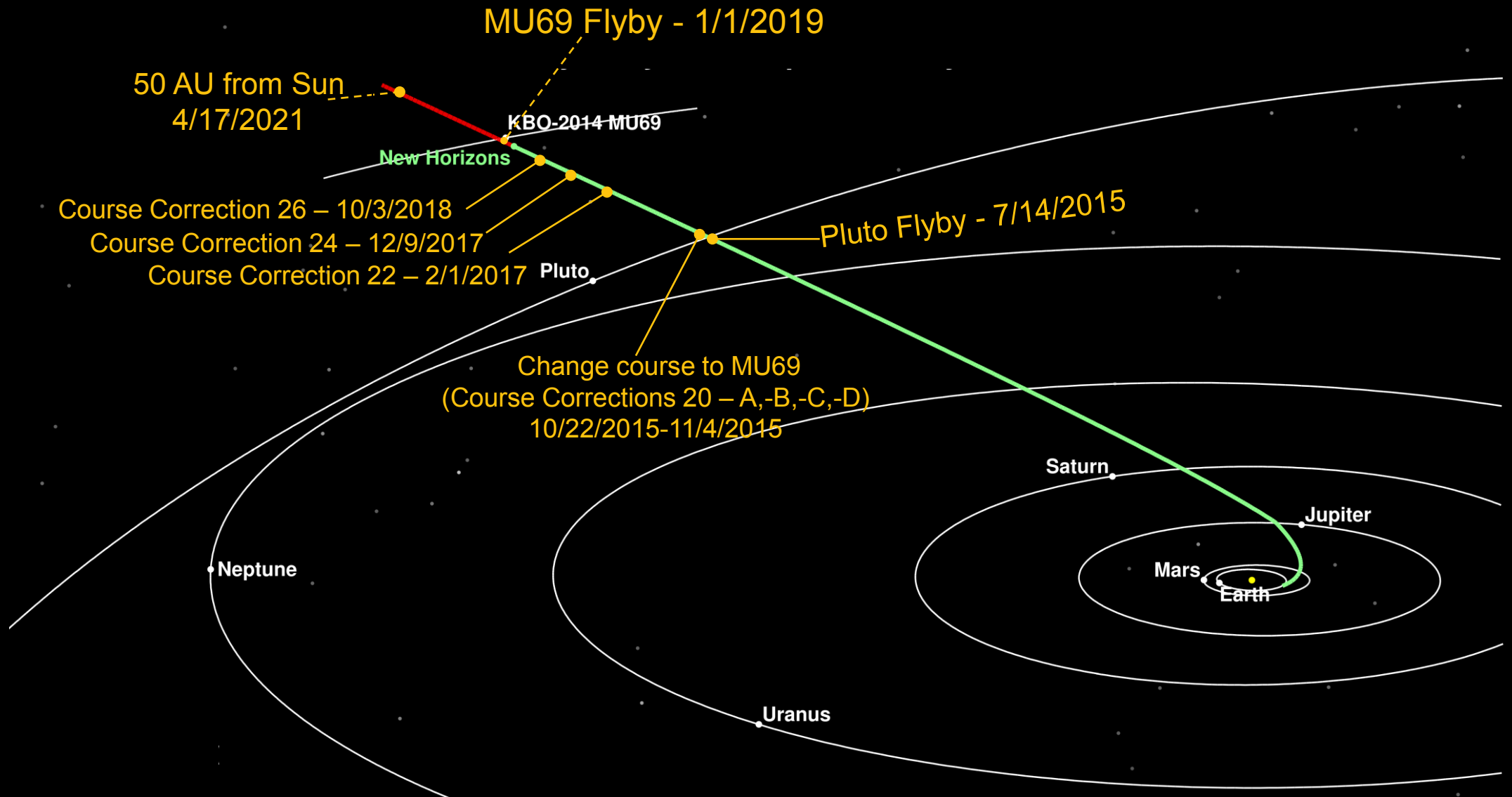
Stars Subtracted



AUGUST 16, 2018



# New Horizons Trajectory



# **Mission Objectives**

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**John Spencer**

New Horizons Deputy Project Scientist

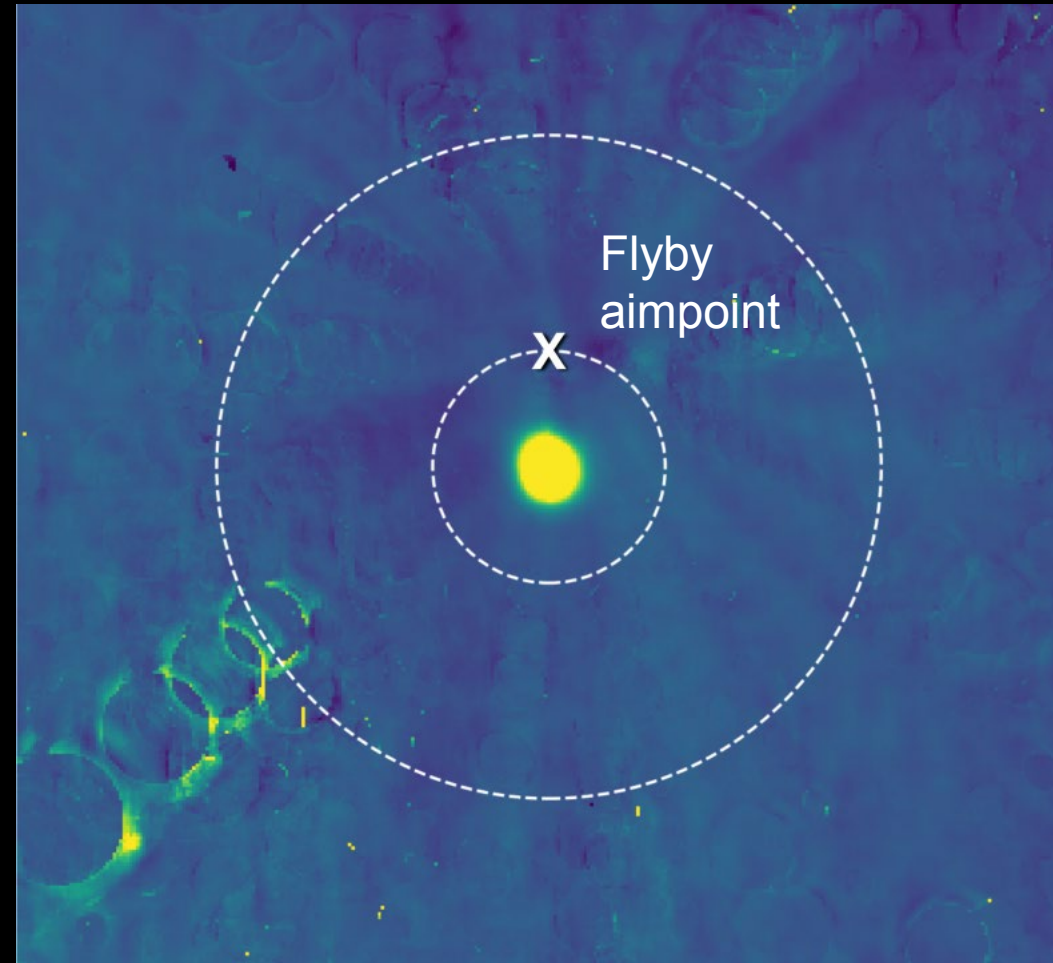
Southwest Research Institute

# Ultima Thule Science Objectives

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

# Search for Satellites and Rings

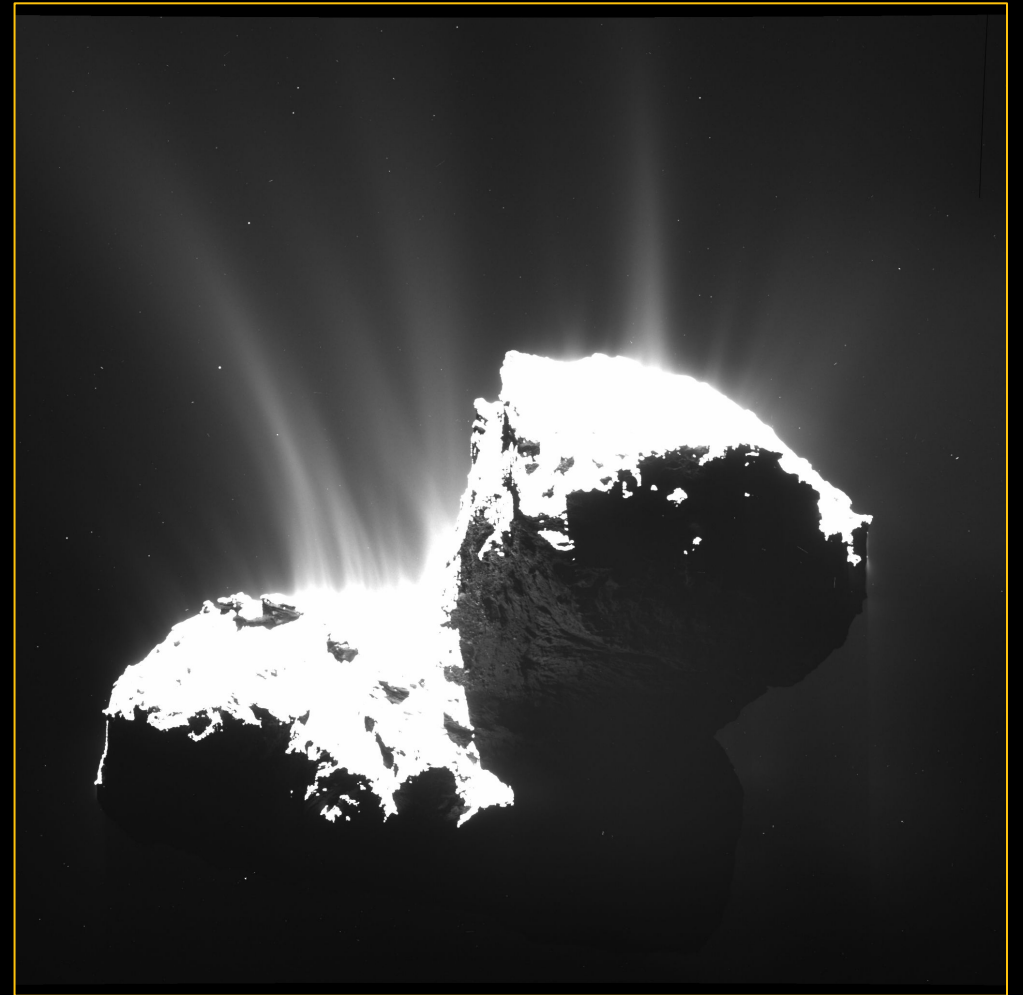
- Search for moons as small as 200 feet/60 meters diameter
- Search for backlit faint rings after the flyby



Early search for hazardous satellites and rings:  
No moons bigger than ~2.5 miles/4 kilometers  
across

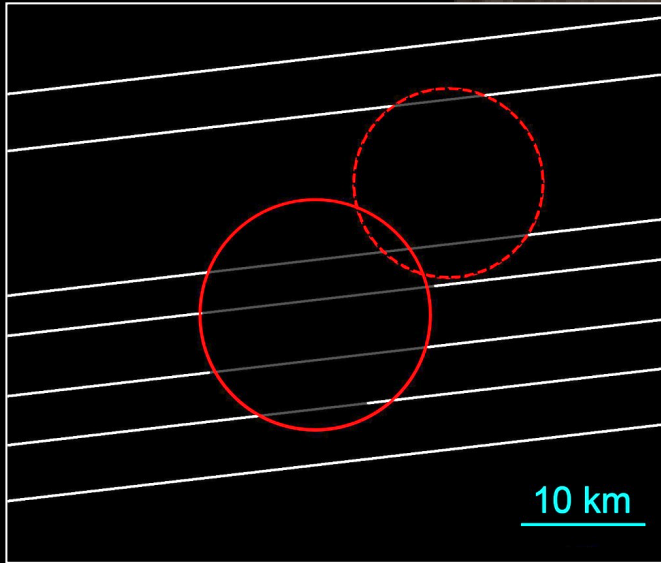
# Search for Gas and Dust

- Not likely!
  - Ultima's volatile ices have had 4 billion years to escape
- But the solar system is full of surprises
  - So we're looking using images and ultraviolet measurements, just in case



Dust jets from Comet C-G (probably not what we'll see at Ultima)

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



Ultima Thule Occultation Results  
July 17, 2017



Binary 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?

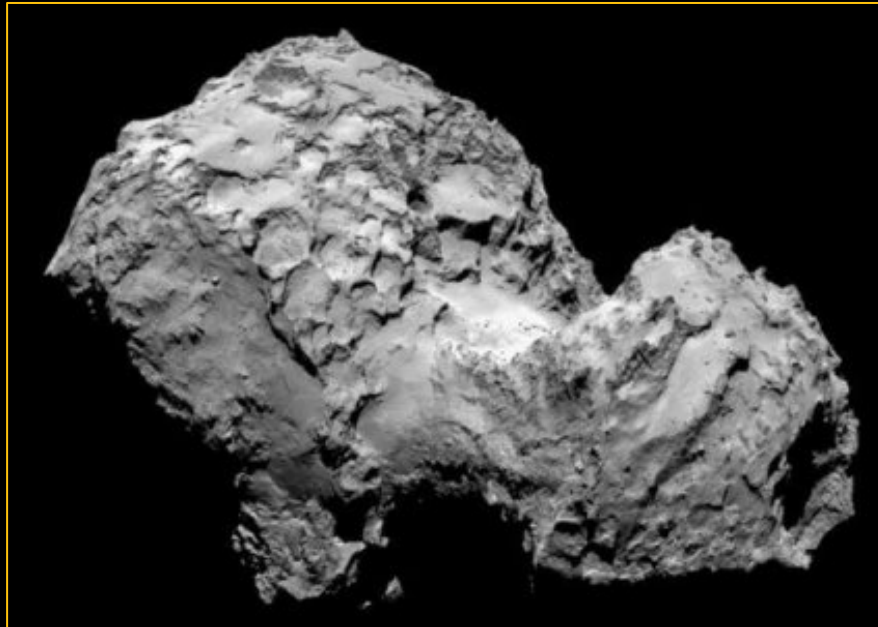
Craters?

(Saturn's moon Phoebe:  
possible captured KBO)



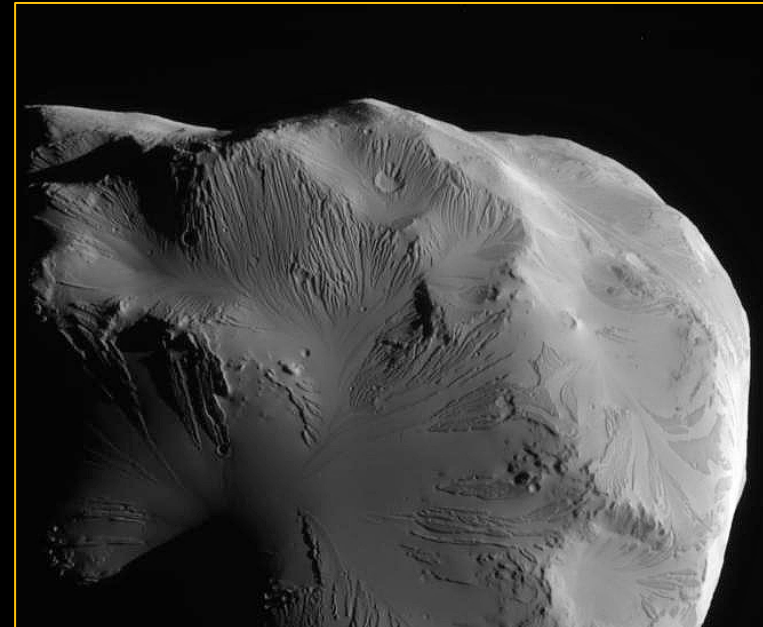
Sublimation Erosion?

(Comet C-G:  
likely Kuiper Belt escapee)



Something Wild?

(Saturn's moon Helene)



More Likely

Less Likely

# Early Imaging Releases (Simulated)

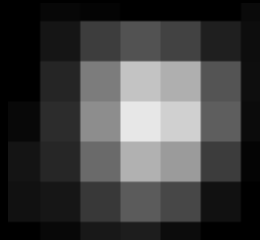
Dec. 31



6 mi/pixel

2–3 pixels  
across

Jan. 1



3.4 mi/pixel

5–6 pixels  
across

Jan. 2



0.2 mi/pixel

100 pixels  
across

Jan. 3

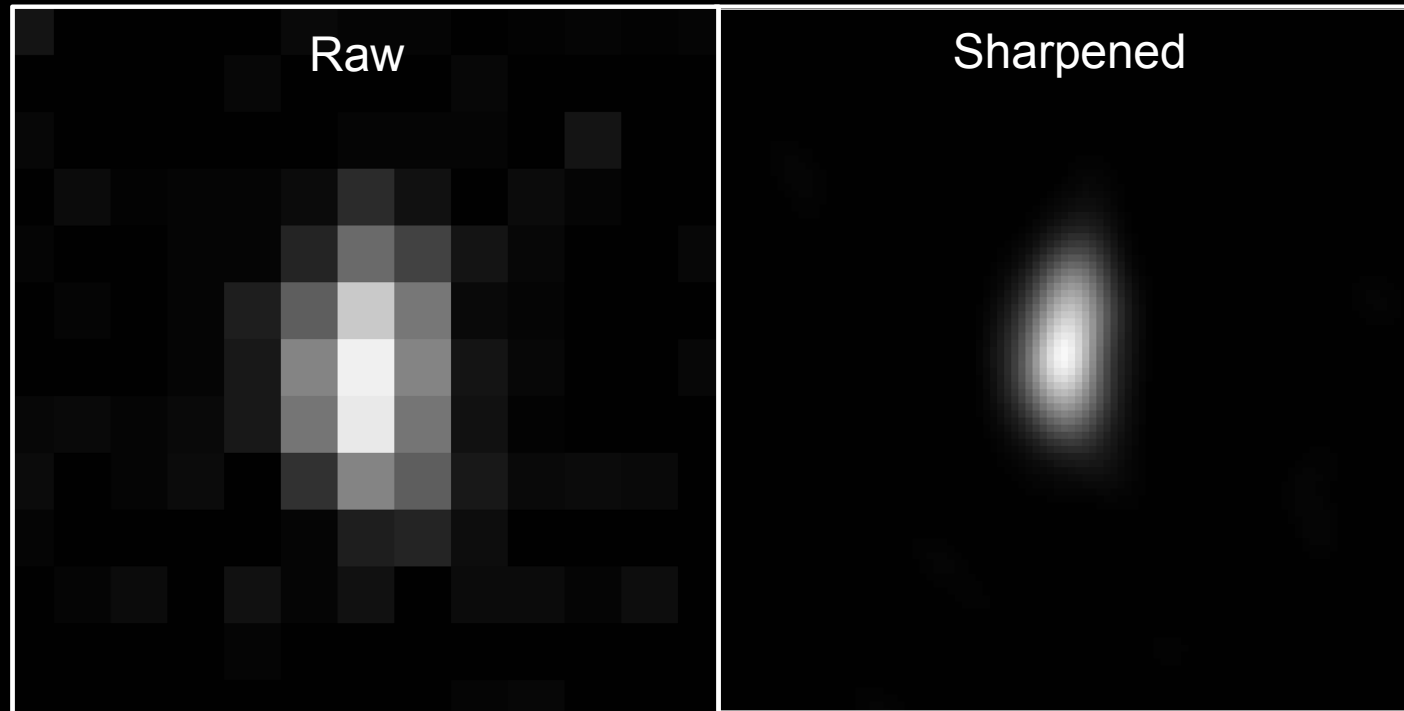


0.09 mi/pixel

215 pixels  
across



# First Images of Ultima's Shape



- Images taken at 16:56 UT (11:56 a.m. EST) December 30, 2018
  - 37 hours before closest approach
- Range to Ultima: 1.2 million miles (1.9 million kilometers)
- Original pixel size: 5.8 miles (9.4 kilometer)