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Stephen W. Long
Science Director

Instansiation LLC

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Art Activities

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Science Activities

Special Projects 04

**Class Schedules
and Payment Portal**



On-Line Software and
Mindbody Connect Applications

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Special Projects 08

**Stephen's
Special
Projects**

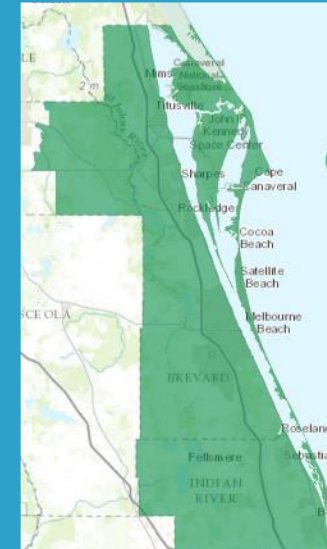


**Gallery and
Special Events**

**Deborah's
Art and
Projects**



**Florida's 8th
Congressional
District**



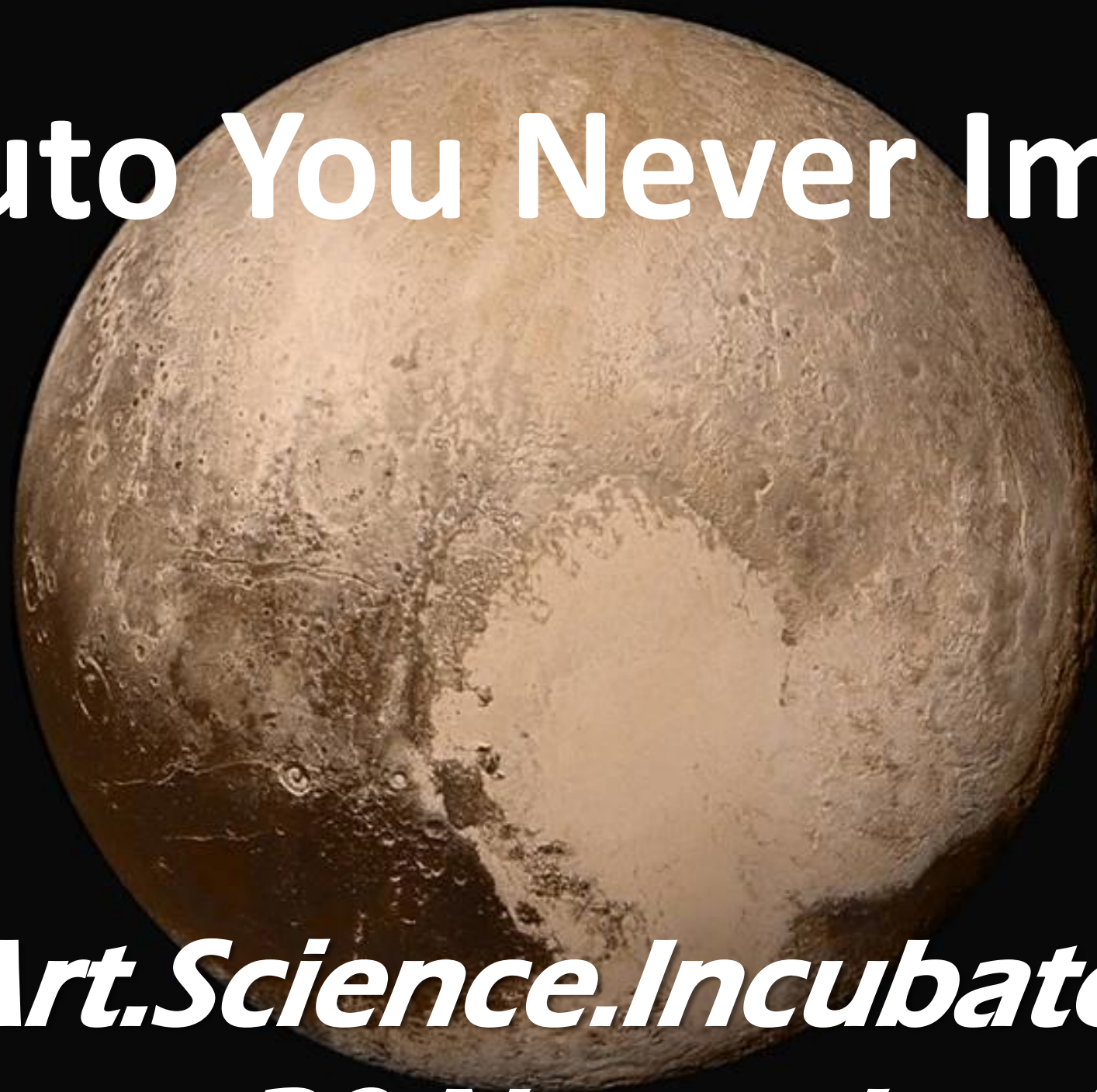
Special Projects 13

Special Projects 14

Special Projects 15

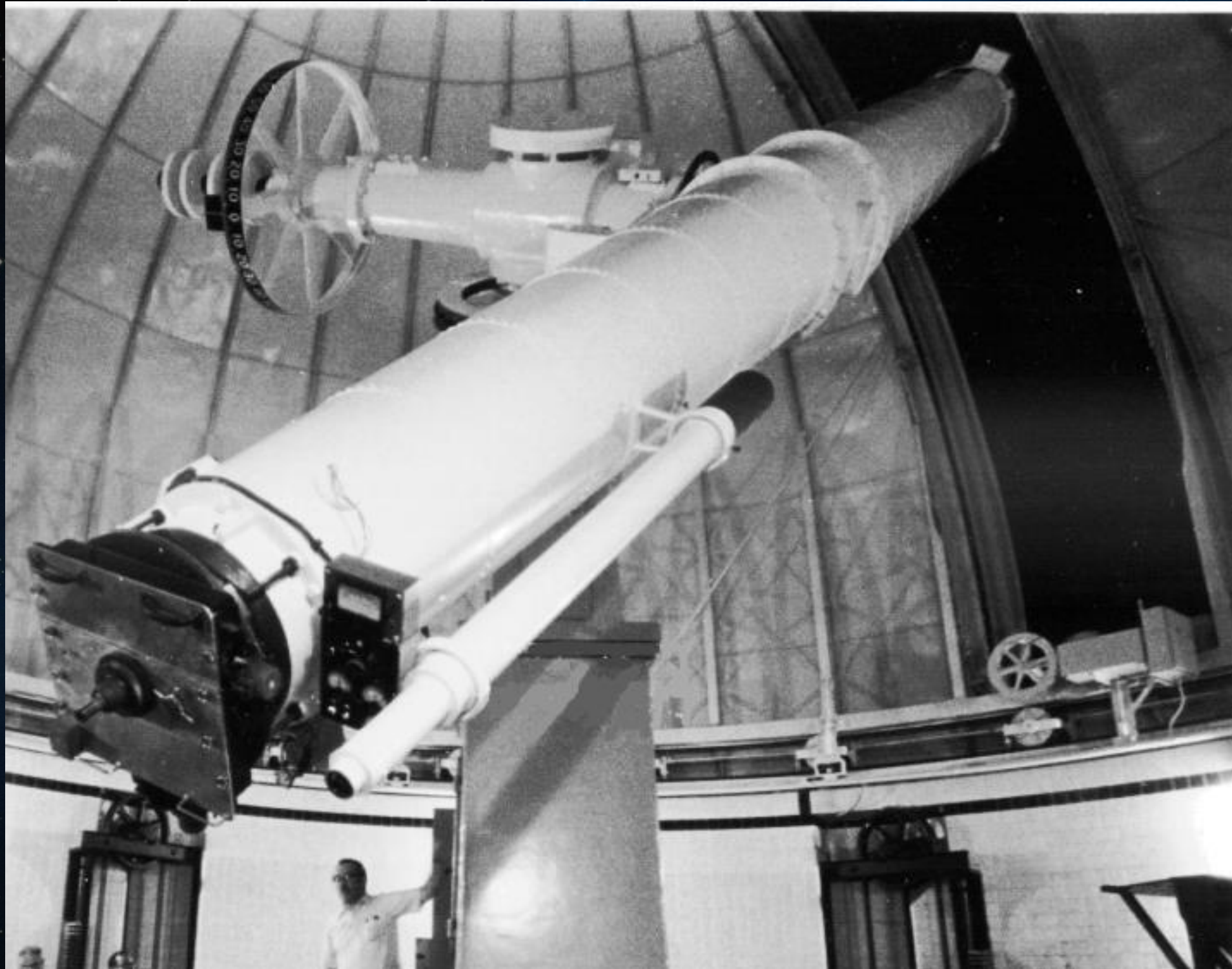
Special Projects 16

“The Pluto You Never Imagined”



Art.Science.Incubator
Lecture 20 November 2015
Stephen Long

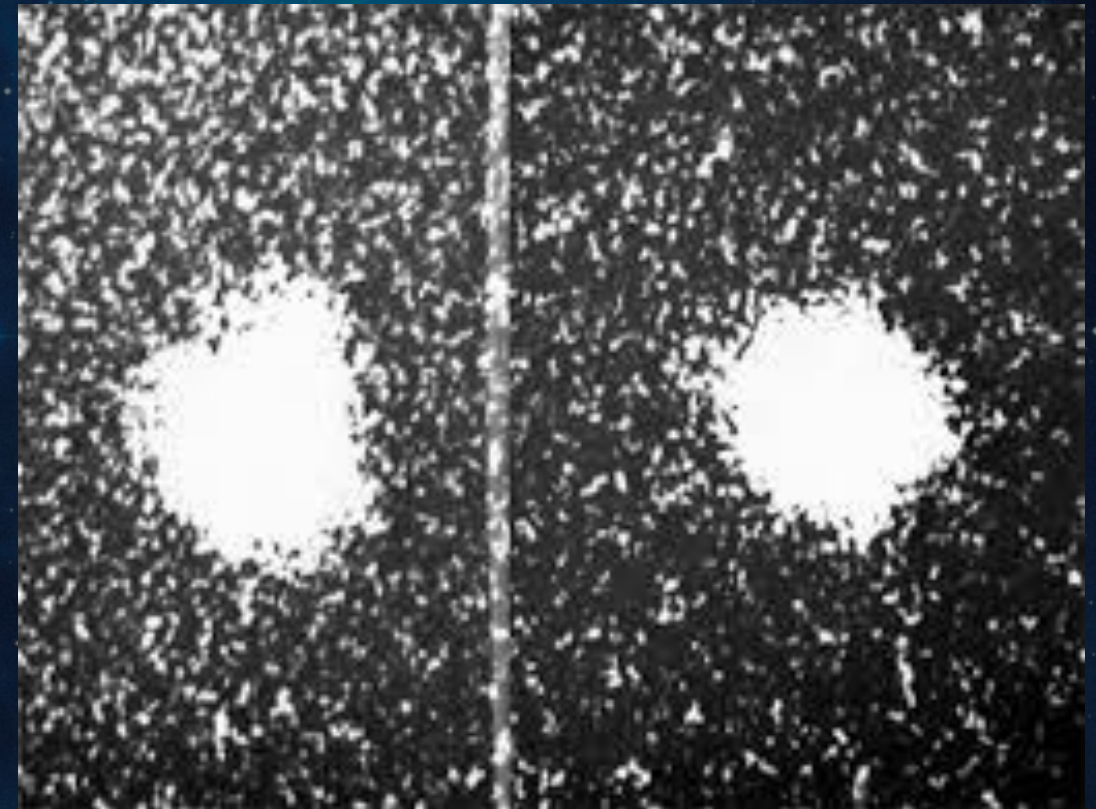
1887 Discovery of Moons of Mars



In 1887 the then worlds largest refracting telescope – located on the grounds of the United States Naval Observatory (USNO) in DC - discovered the moons of Mars. This historic telescope was in still in working order in the late 1970s and was used for community Astronomy gatherings.

1978 Discovery of Pluto's Moon: Charon

- In June 1978, Astronomer James W. Christy, U.S. Naval Observatory (USNO) in Washington, D.C. was making routine measurements of photographic plates taken with the 1.55-meter (61-inch) Kaj Strand Astrometric Reflector at the USNO Flagstaff Station in Arizona
 - Christy was working to refine the orbit of the far-flung planet Pluto to help compute a better ephemeris
 - Computing the positions of stars (and planets) was part of the mission of the larger Astrometric Team at the USNO – part of providing Celestial Navigation Tables for the US Navy (and USAF ...)
- Christy noticed that a number of the images of Pluto appeared elongated, Other plates showed the planet as a tiny, round dot. Conclusion: a new moon had been discovered.
- Christy proposed the name "Charon", after the mythological ferryman who carried souls across the river Acheron surrounding Pluto's underworld.

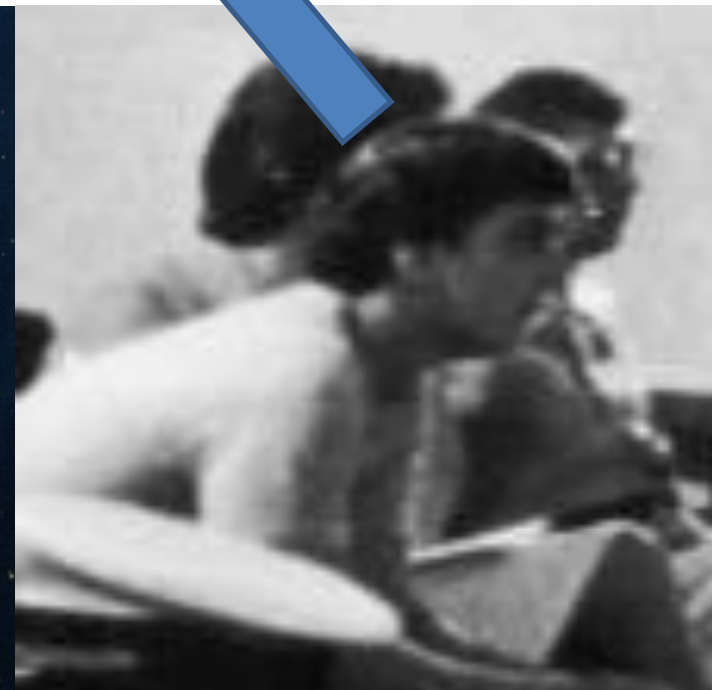


In July 1978 the discovery was announced to the world via a press conference conducted at the USNO.

This previously unknown moon orbiting Pluto was measured at a distance of about 19,600 kilometers (12,100 miles) with a period of just over six days.

Discovery of Pluto's Moon and Personal Story Intersection

- In the late 1970's there were 3 Astrometric teams at the USNO – the 61in scope in Flagstaff, the 8" scope and 6" scope in DC.
- 6" Astrometric Telescope team included a 21 year old GS-2 Summer Employee studying Physics at American University. Employee soldered wires for telescope cable connectors - not a thrilling job but the USNO was very cool place to work.
- The 6" Astrometric scope was the first "totally digital" computerized telescope used for precision measurements – a digital imaging sensor was mounted at the eyepiece and all astrometric measurements were computerized – using a PDP-11 Computer that was booted using paper tape
- It was exciting to be there when the discovery of Charon was announced – a part of science history.



The Solar System We Grew Up With



What Happened to Pluto?

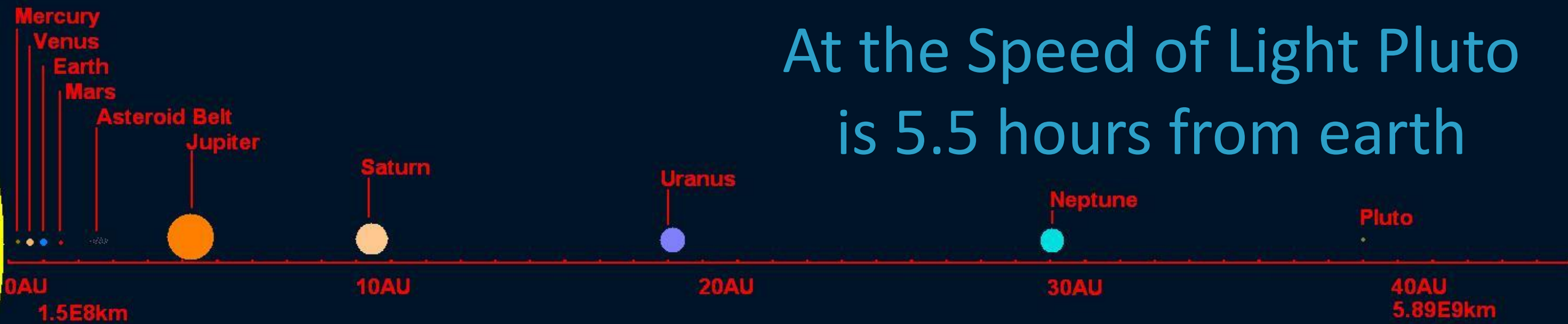
Pluto was demoted to
“dwarf planet” status in 2006

New Horizons

- New Horizons Mission was launched on Jan. 19, 2006
- It swung past Jupiter for a gravity boost and scientific studies in February 2007
- Core objectives were to conduct six-months of reconnaissance of Pluto and its moons.
- New Horizons had its closest approach to Pluto on July 14, 2015.



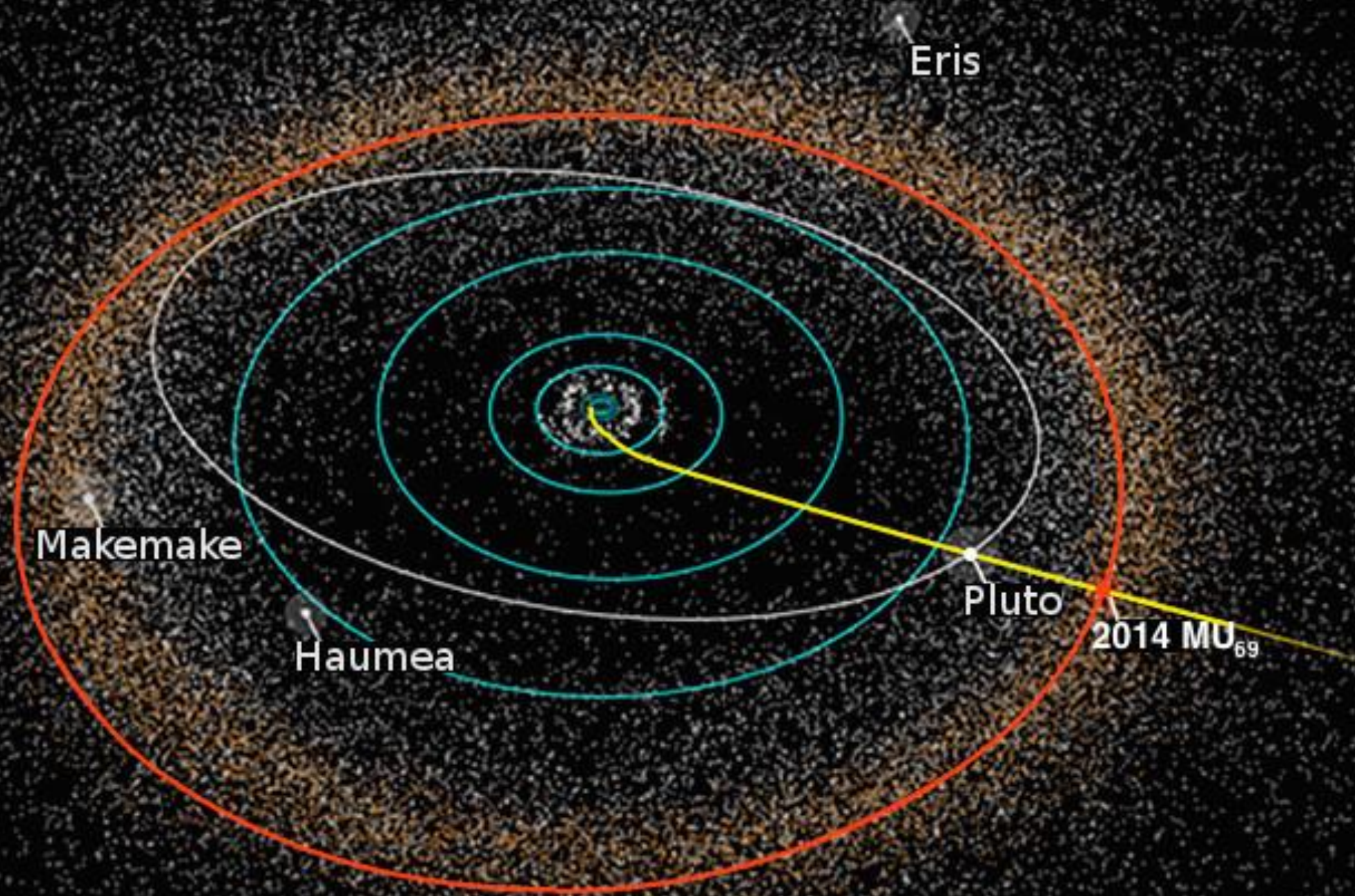
Pluto is Really Far Away



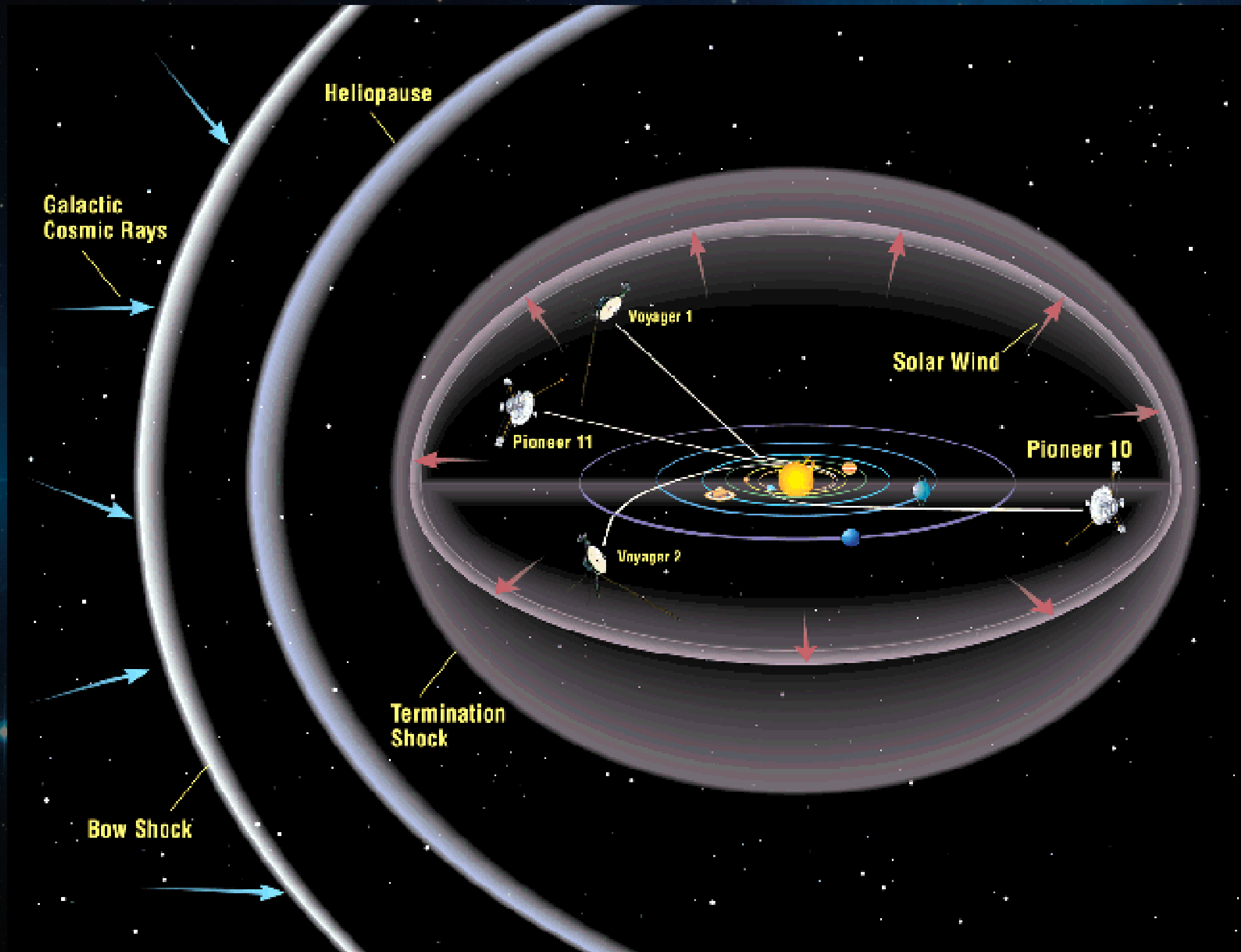
At the Speed of Light Pluto is 5.5 hours from earth

At the Speed of Light Sun is 8 minutes from earth

Our Solar System is Big: Add the Ort Cloud



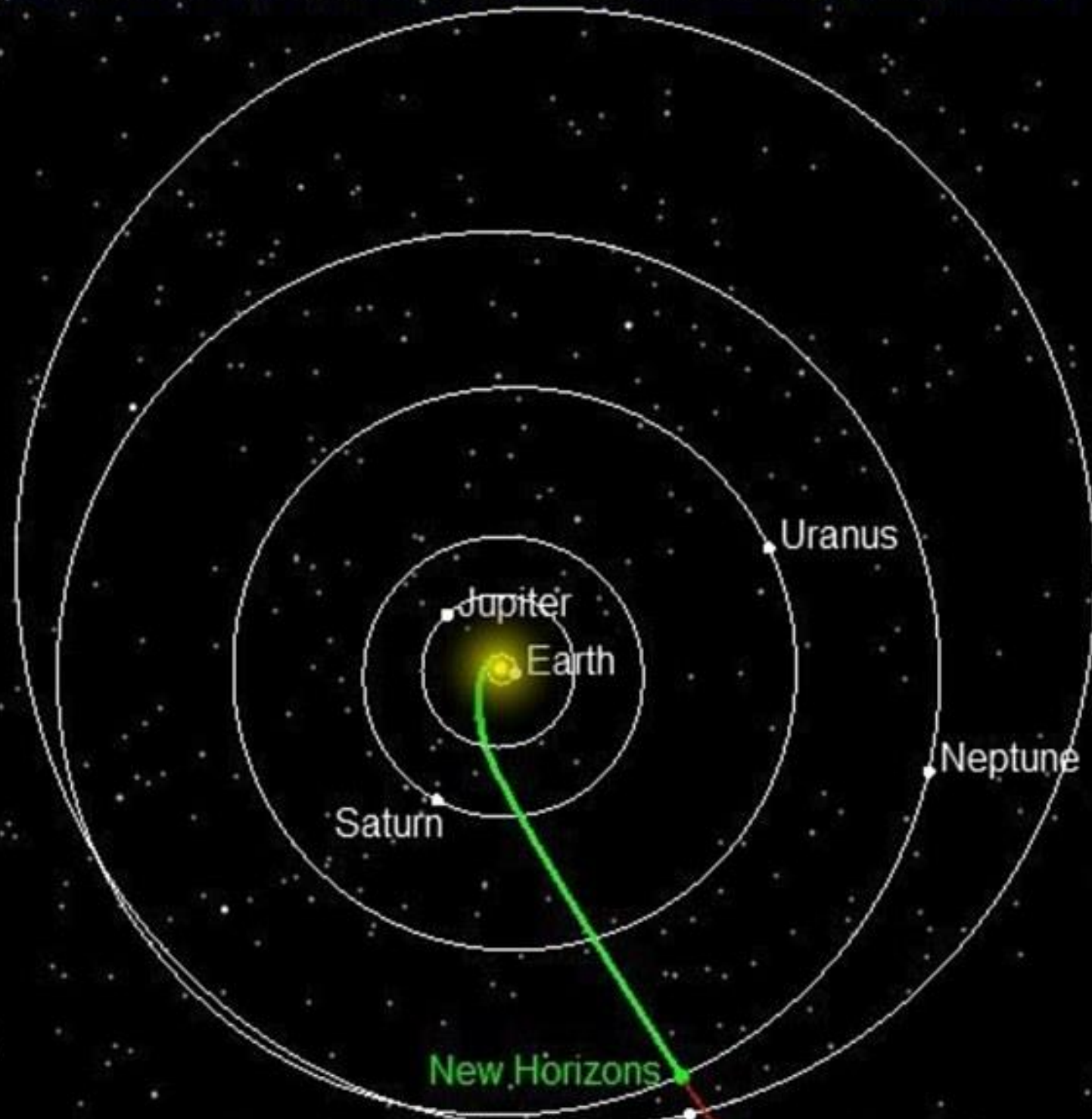
Intrepid Explorers



Traveling to Pluto

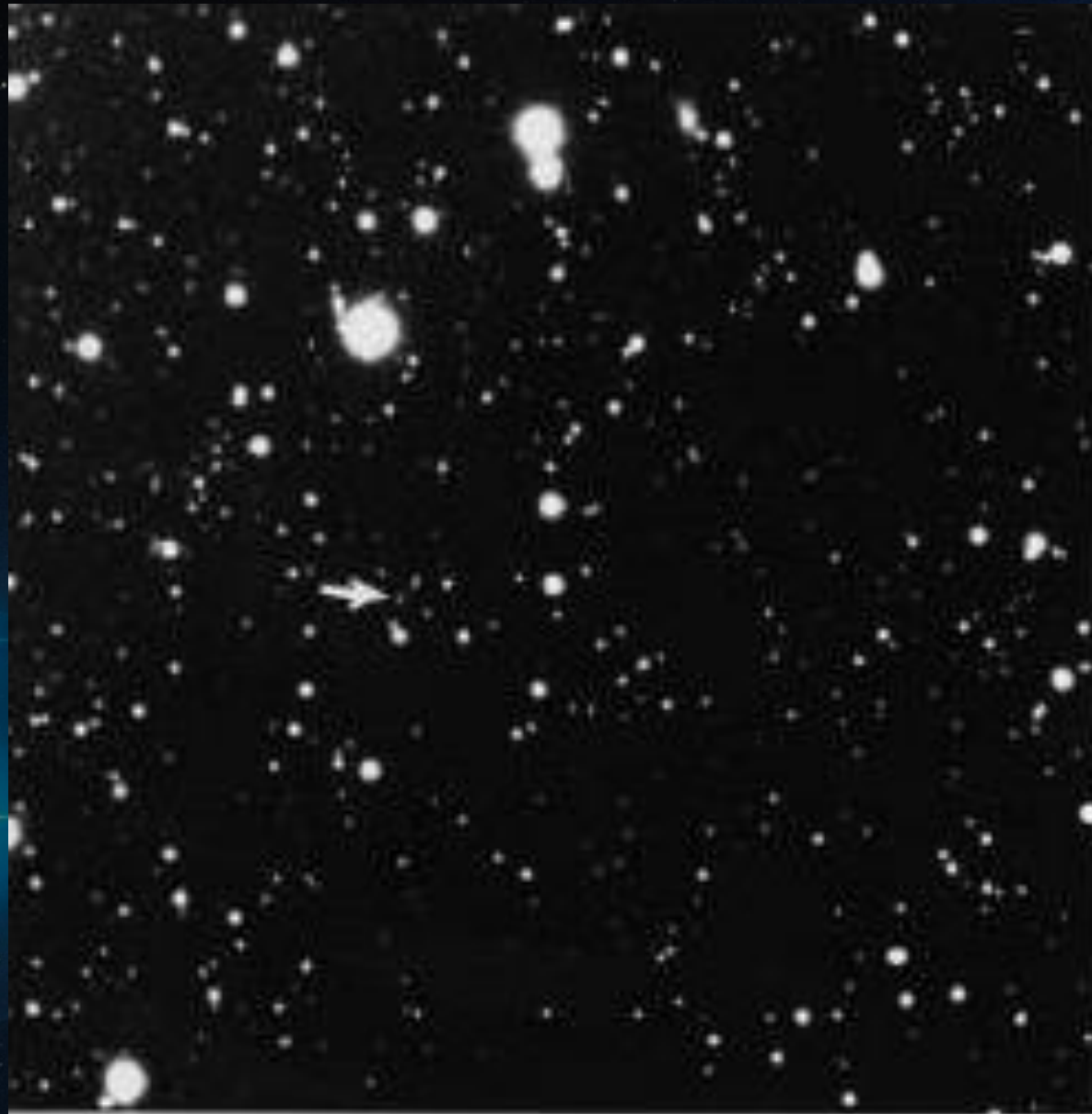
New Horizons Full Trajectory - Overhead View

Distance from Sun (AU): 30.22 Heliocentric Velocity (km/s): 14.69

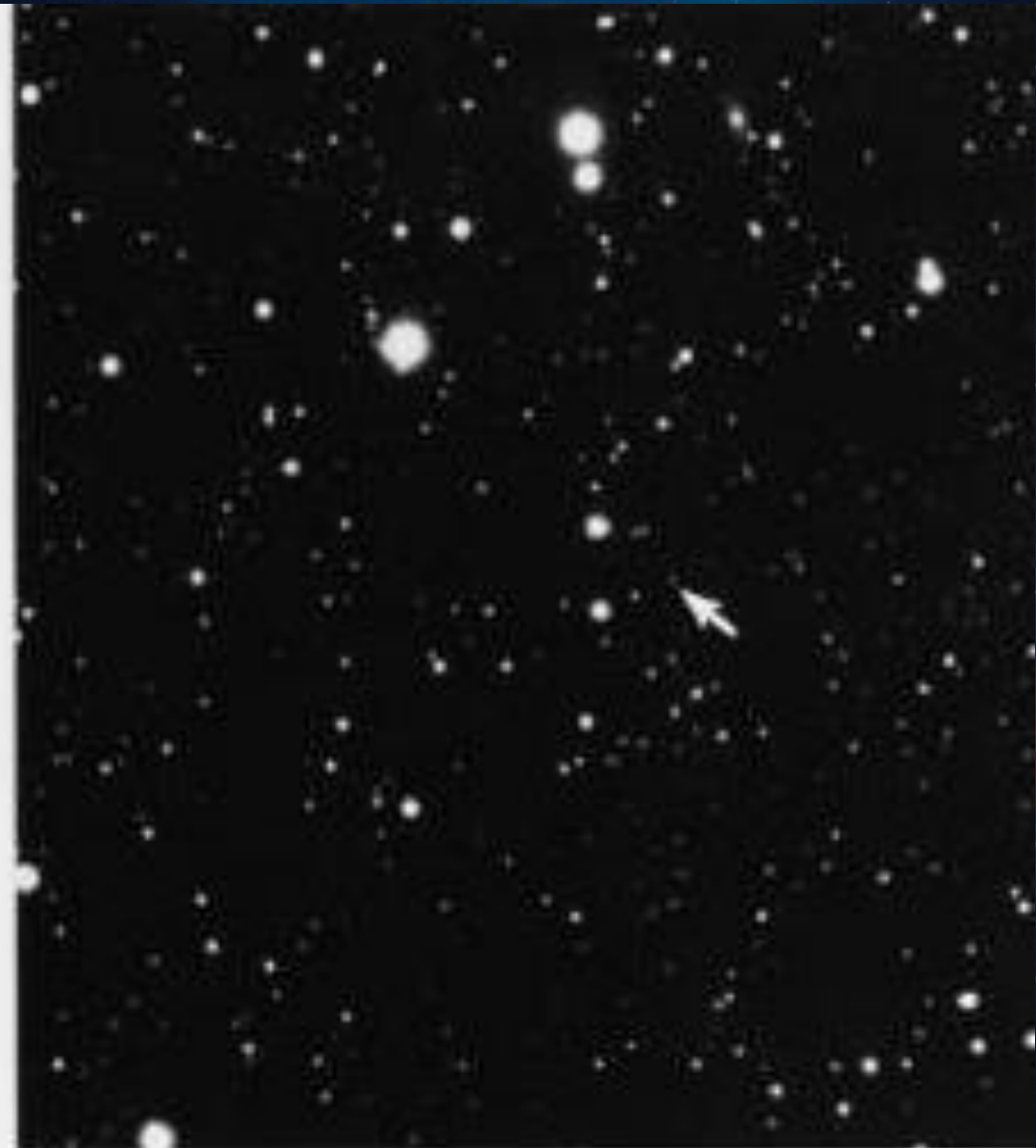


Distance from Earth (AU): 29.58
Distance from Pluto (AU): 2.56
Round-Trip Light Time (hh:mm:ss): 08:12:01
26 Aug 2014 13:00:00 UTC

Views of Pluto Through the Years (Discovery in 1930)



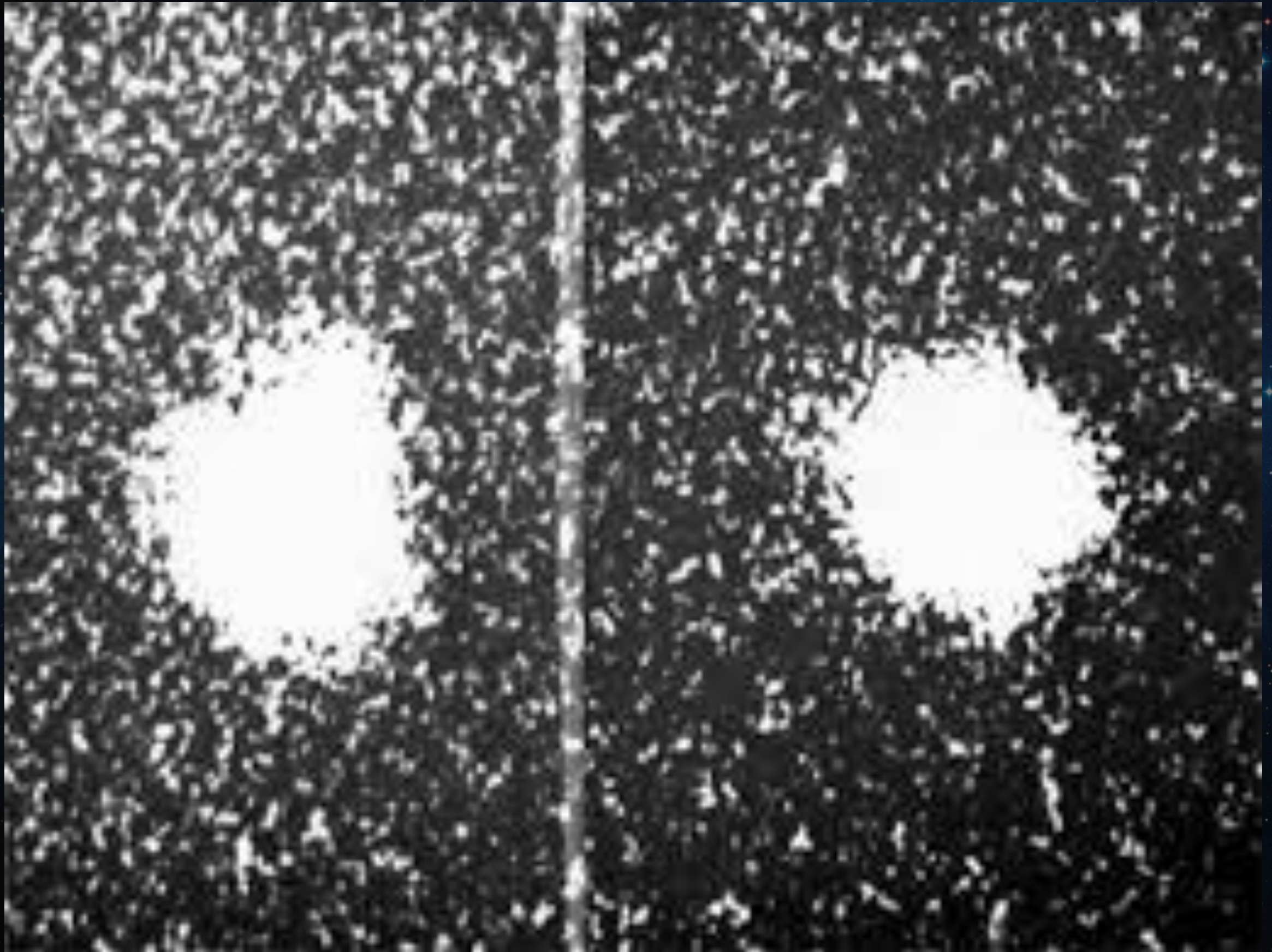
January 23, 1930



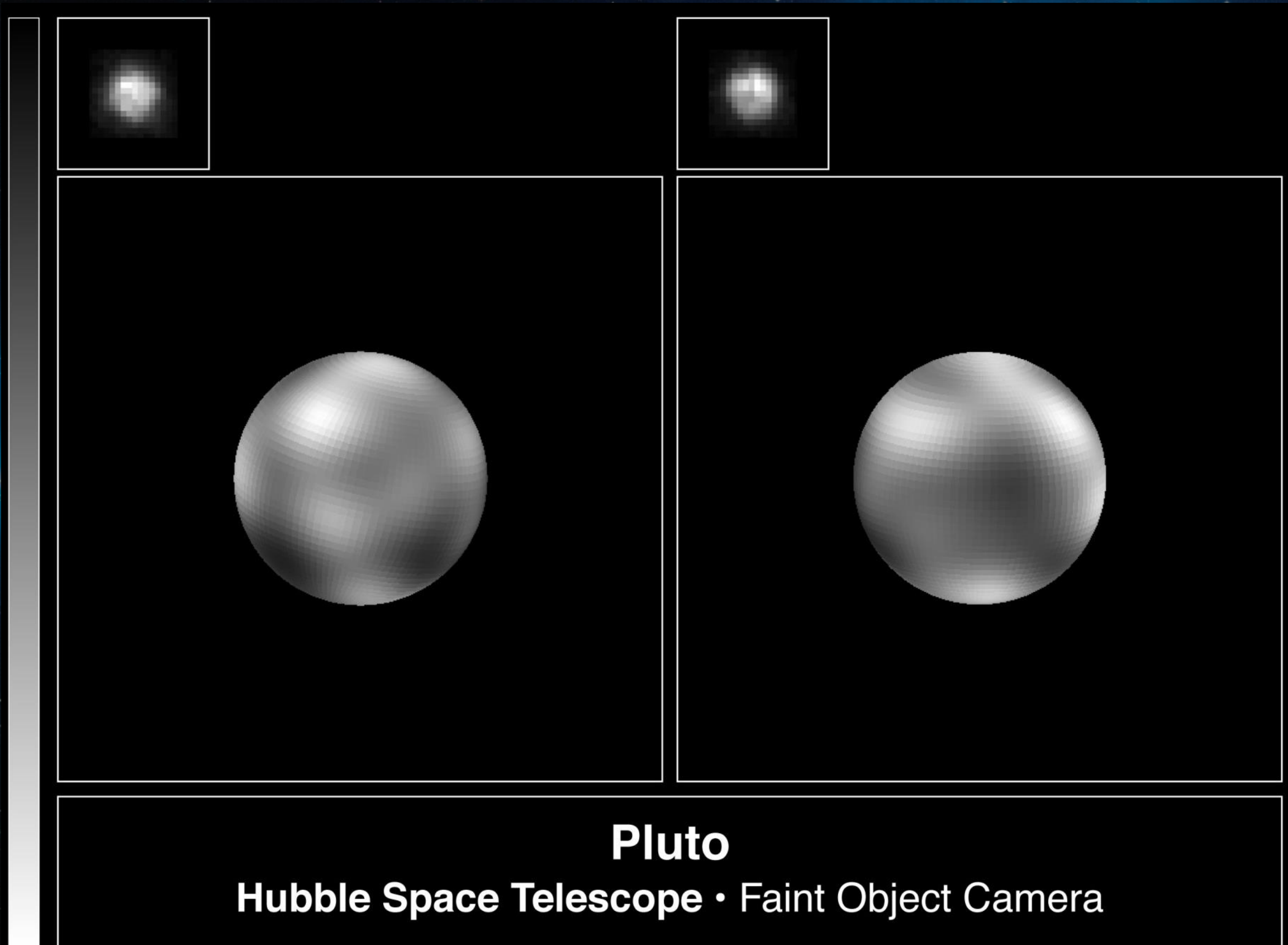
January 29, 1930

These are copies of small sections of the discovery plates showing images (those marked) of Lowell's mathematically predicted trans-Neptunian planet afterward named PLUTO. It was found by Mr. C. W. Tombaugh on February 18, 1930, while engaged in the search program and upon examination of these plates.

Views of Pluto Through the Years (Discovery of Charon 1978)



Views of Pluto Through the Years (1996)



Views of Pluto Through the Years

New Horizons April 2015



Views of Pluto Through the Years

New Horizons June 2015

NEW HORIZONS LORRI IMAGES OF PLUTO

CLOSEST APPROACH
HEMISPHERE

OPPOSITE
HEMISPHERE

ROTATIONAL
AXIS



JUNE 5, 2015

PLUTO CENTRAL
LONGITUDE: 200°



JUNE 8, 2015

PLUTO CENTRAL
LONGITUDE: 39°



JUNE 12, 2015

PLUTO CENTRAL
LONGITUDE: 175°

JUNE 13, 2015

PLUTO CENTRAL
LONGITUDE: 79°

JUNE 18, 2015

PLUTO CENTRAL
LONGITUDE: 197°



JUNE 15, 2015

PLUTO CENTRAL
LONGITUDE: 356°

Global Mosaic of Pluto in True Color

New Horizons July 2015



This Feature Called
“The Heart”

Global Mosaic of Pluto in True Color

New Horizons July 2015



**But We Know
What it Should be Called**

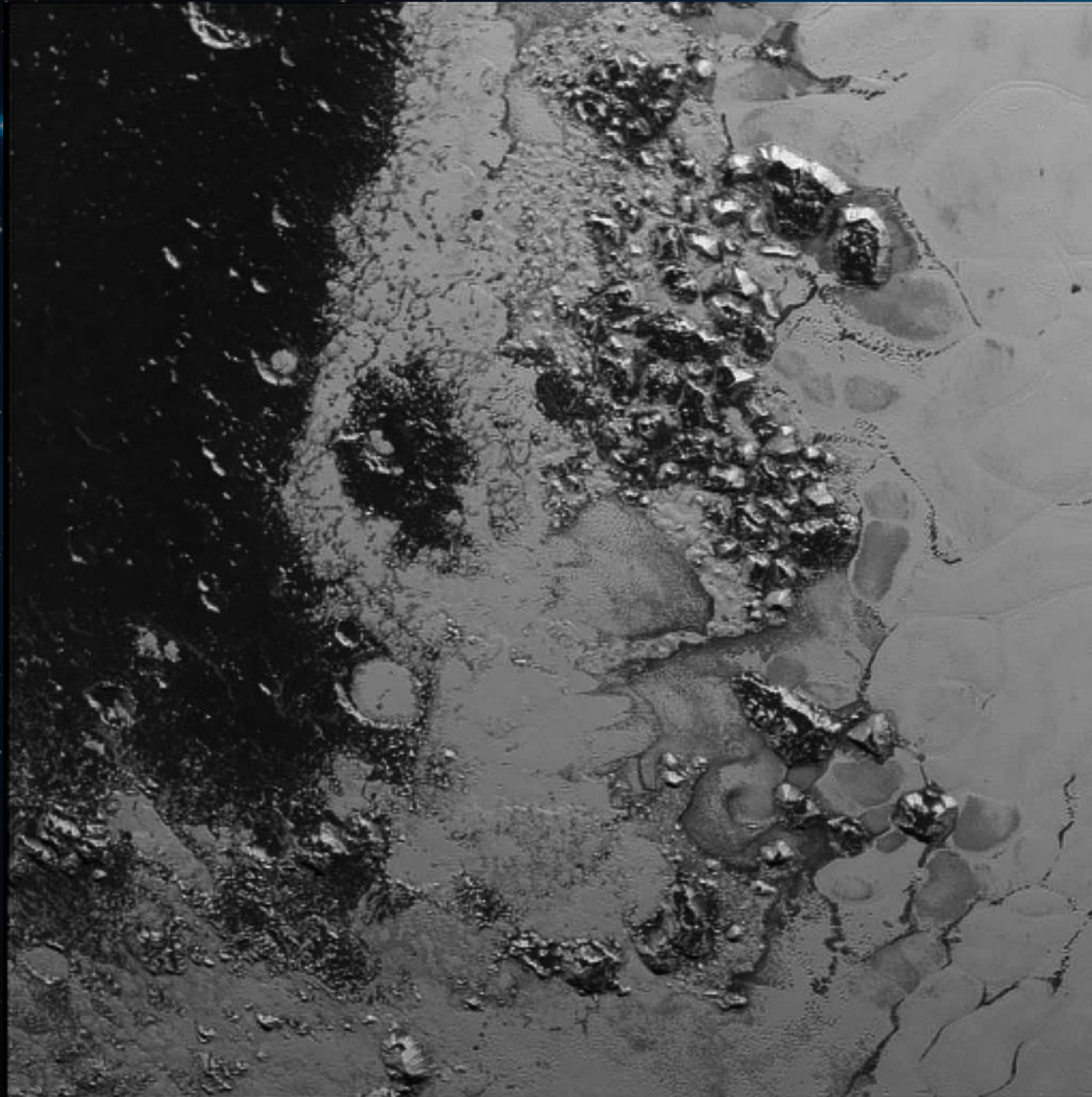
Pluto Dazzles in False Color



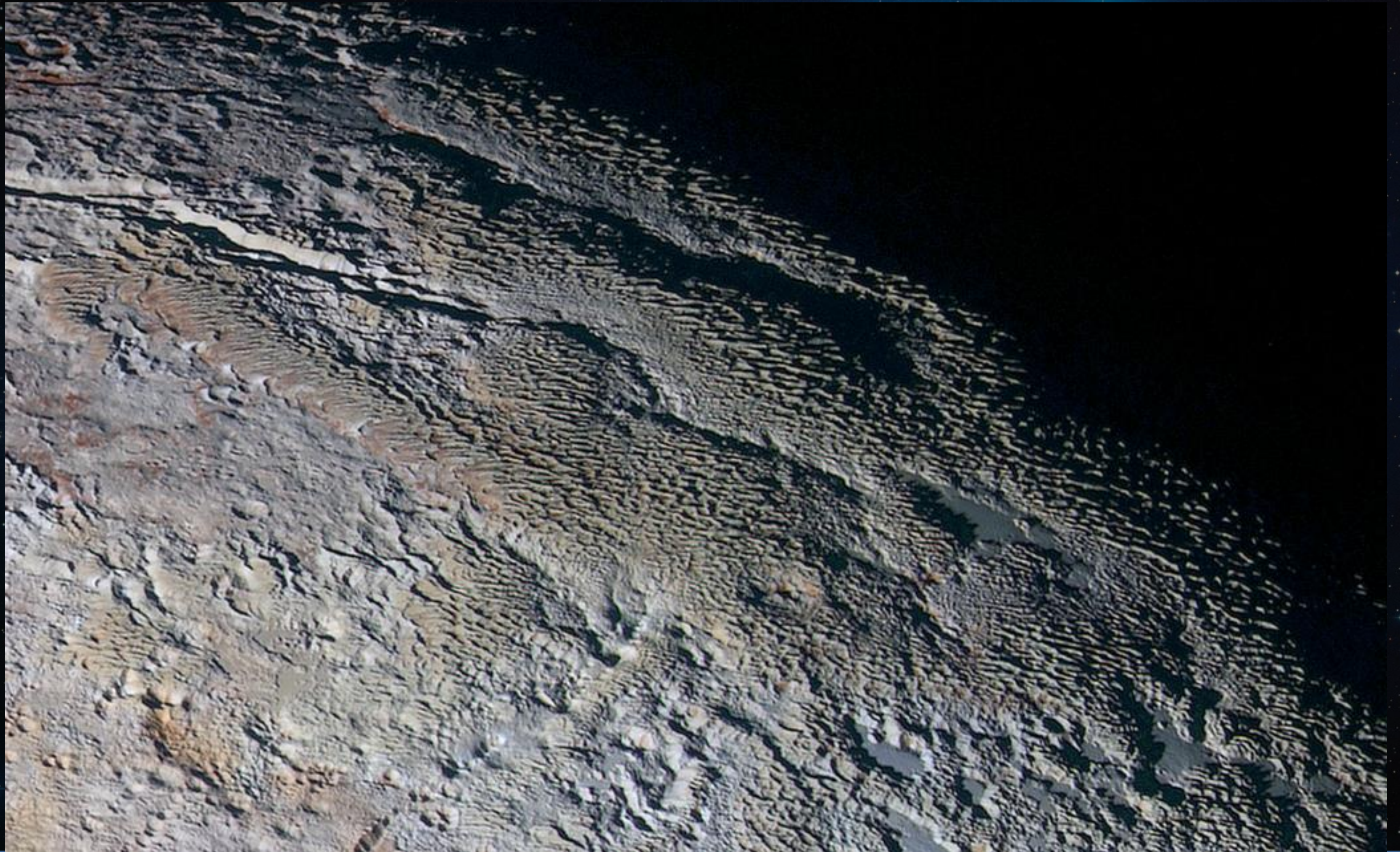
Pluto's Brilliant 'Heart'



NASA's New Horizons Finds Second Mountain Range in Pluto's 'Heart'



The Tartarus Dorsa Mountains Rise Up Along Pluto



Pluto's Varied Terrain



Pluto's Incredible Diversity of Surface Reflectivities and Geological Landforms

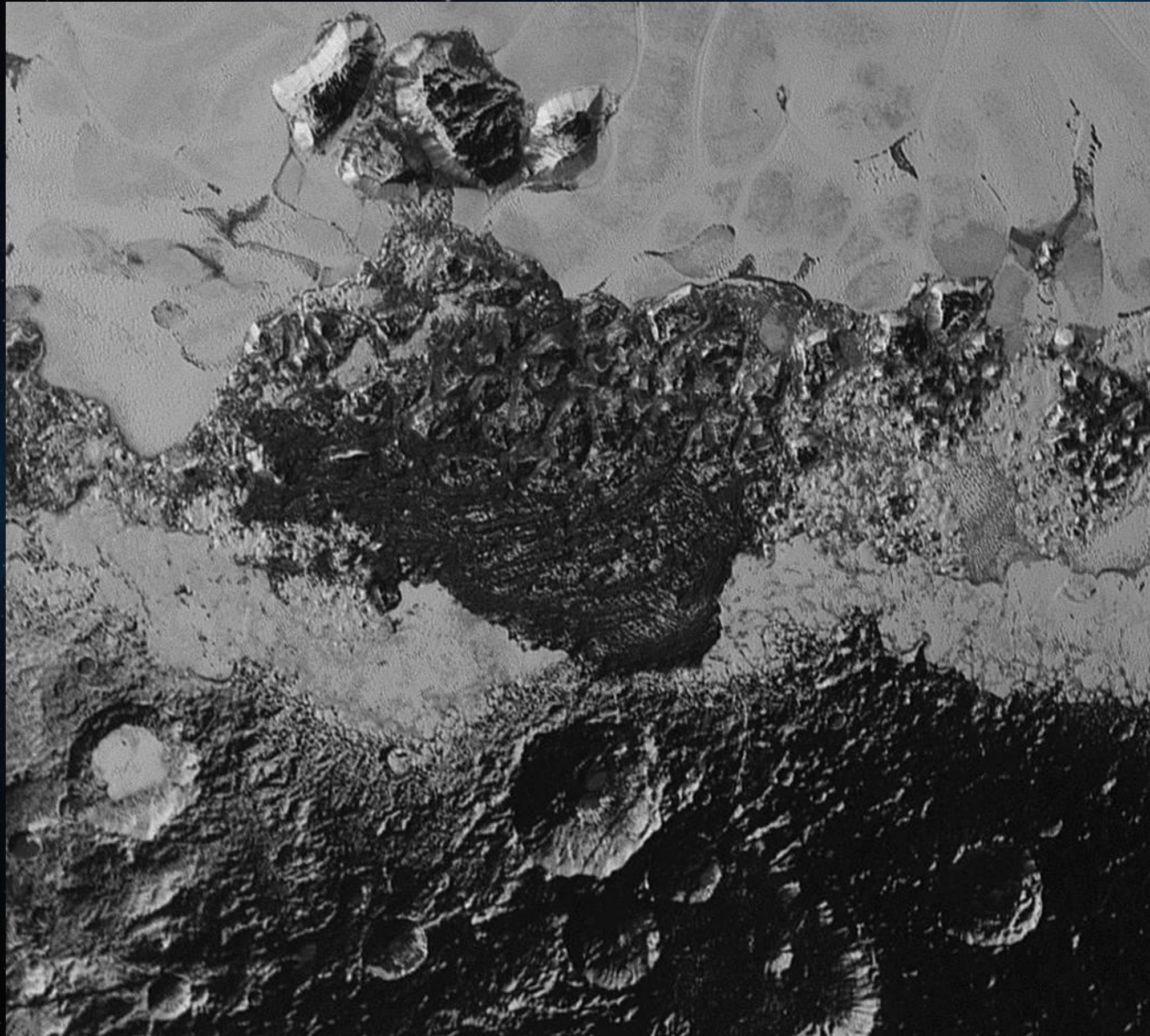
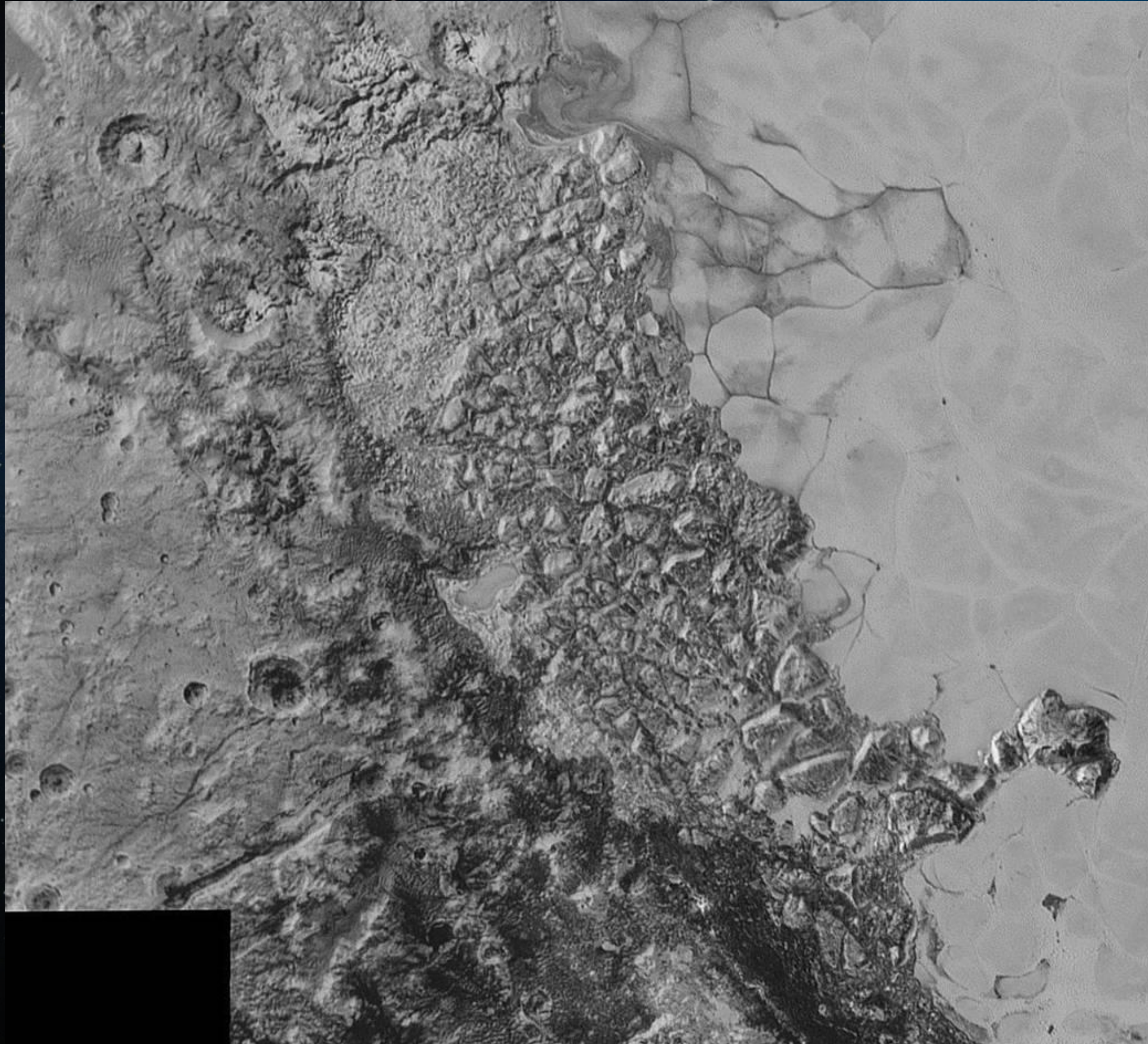
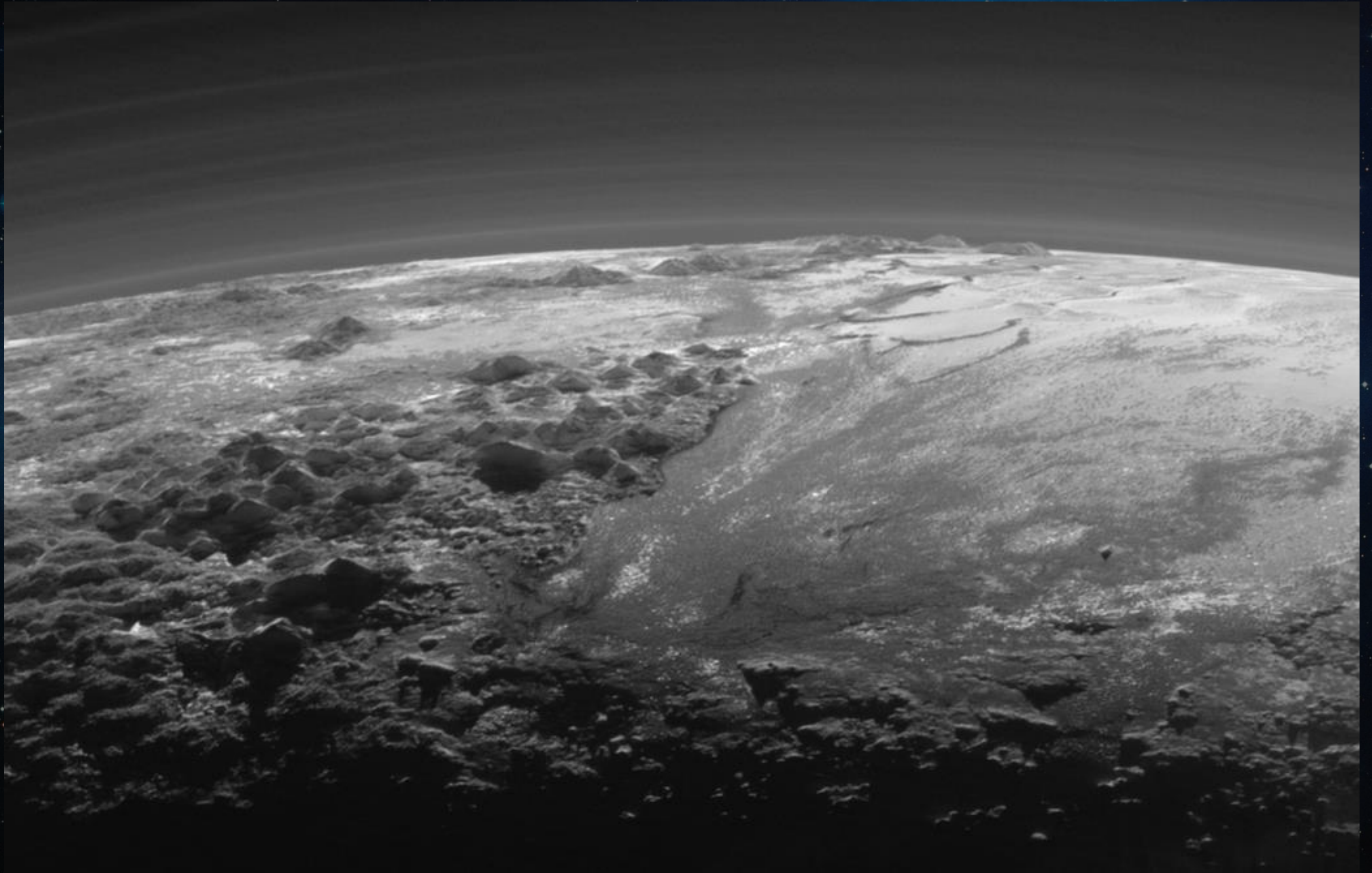


Image of Pluto's Vast, Icy Plain Informally Called Sputnik Planum



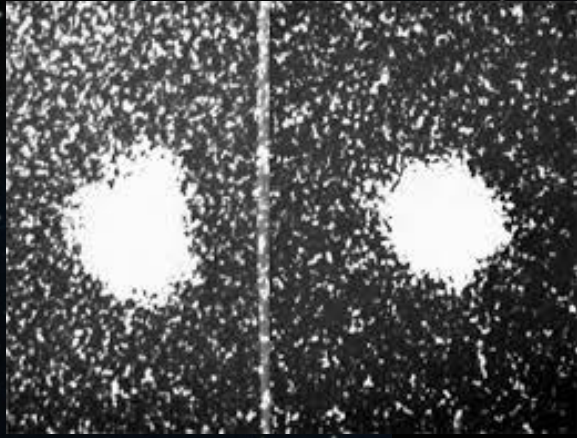
Closer Look: Majestic Mountains and Frozen Plains



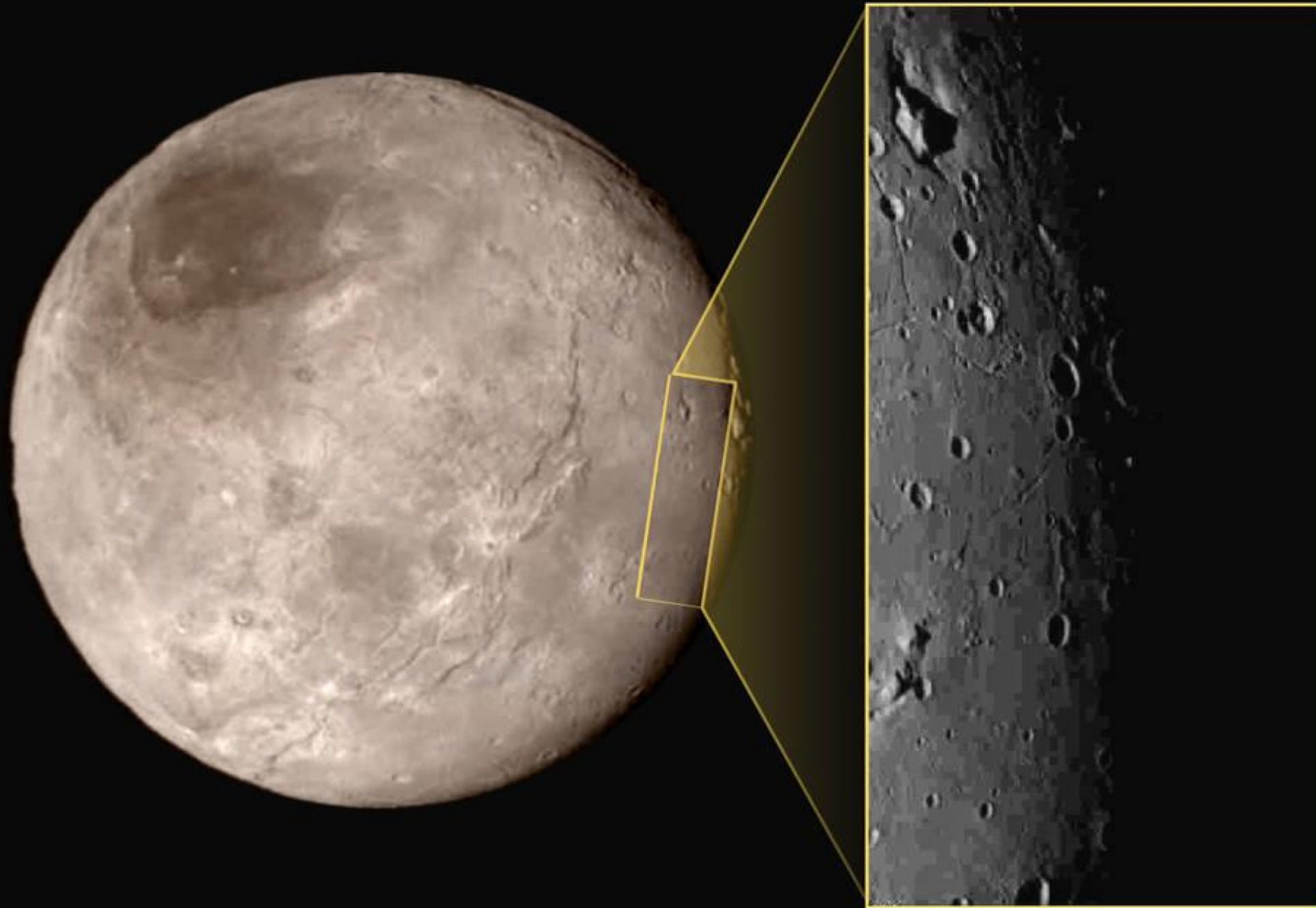
Pluto and Charon in Natural Color



Charon's Surprising, Youthful and Varied Terrain



New Horizons Close-Up of Charon's 'Mountain in a Moat'



Charon and the Small Moons of Pluto



Farewell Pluto



New Definition of Planet

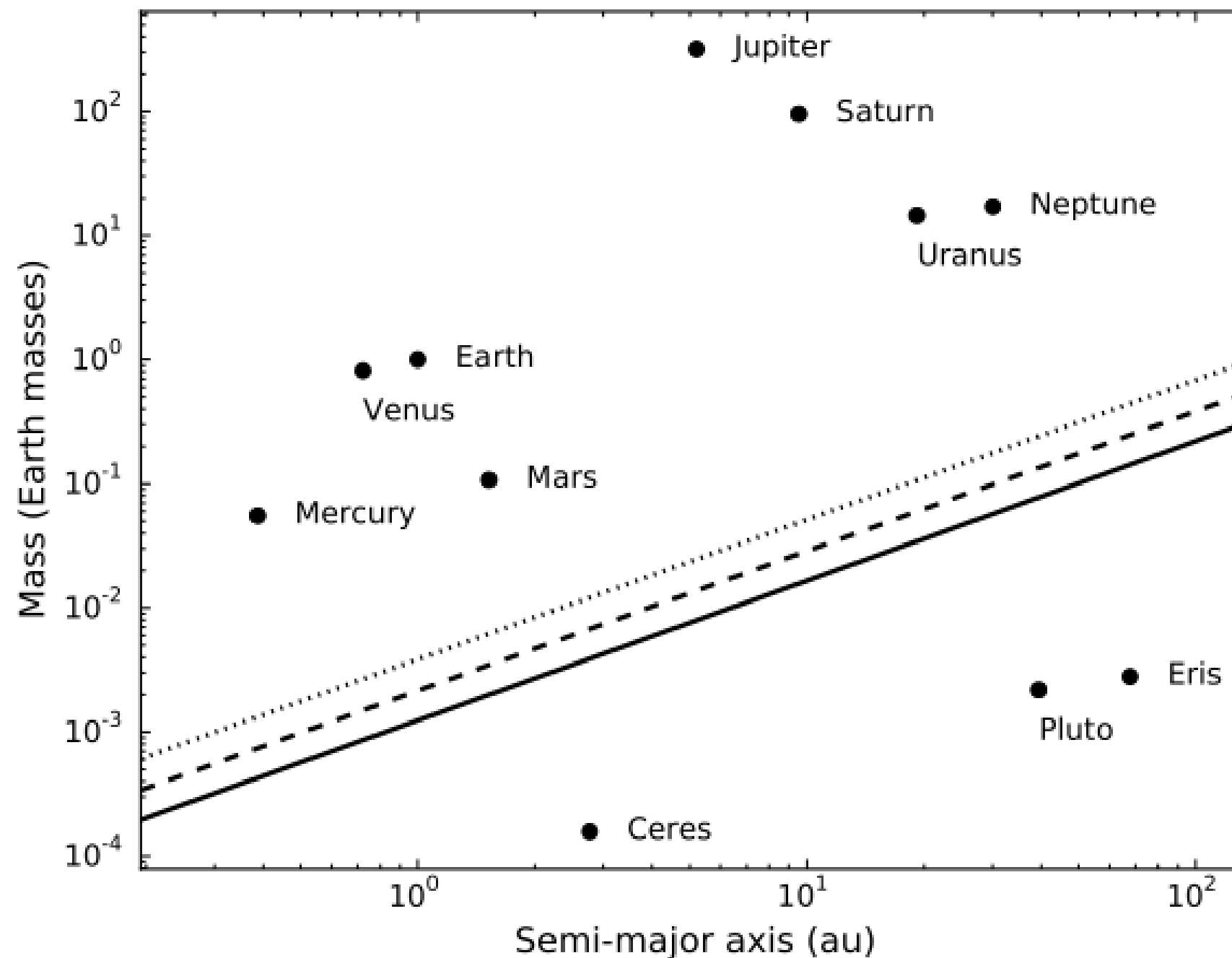
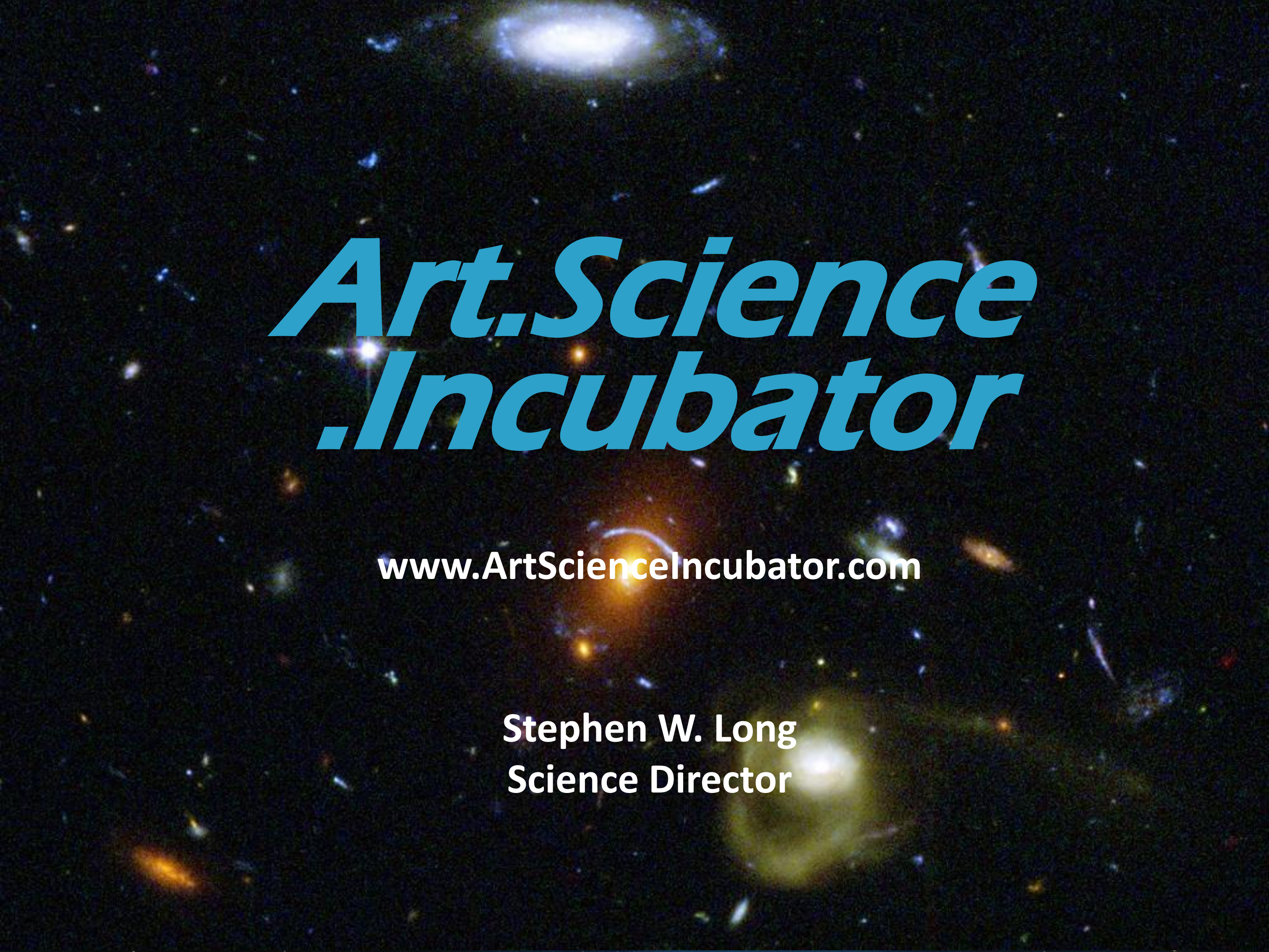


Figure 1. Mass required to clear an orbital zone as a function of semi-major axis for a host star of mass $1 M_{\odot}$. The top two lines show clearing to 5 Hill radii in either 10 billion years (dashed line) or 4.6 billion years (dotted line). The solid line shows clearing of the feeding zone ($2\sqrt{3}$ Hill radii) in 10 billion years.



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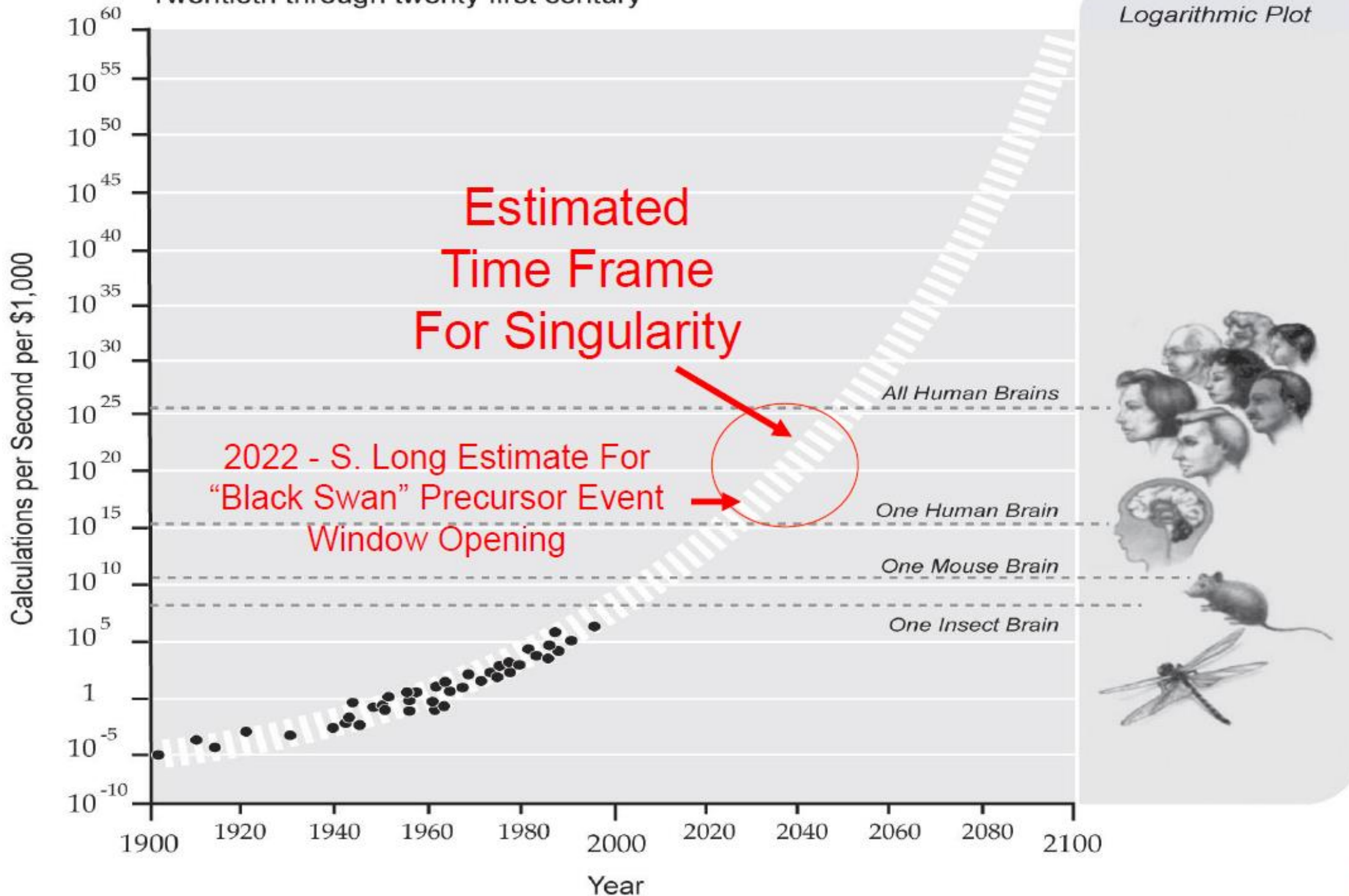
Future Lectures: December 2015



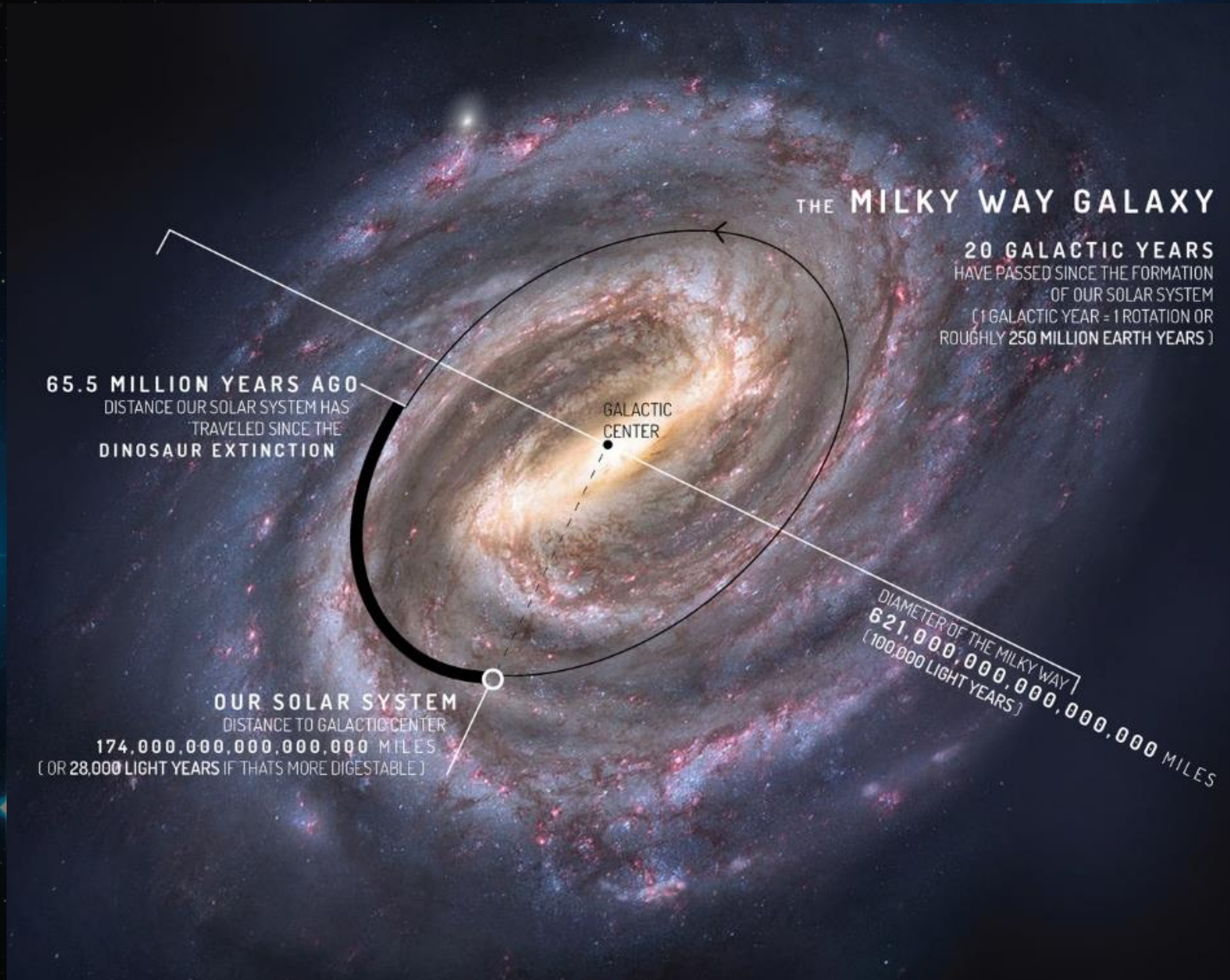
Office of the Under Secretary of Defense for Intelligence

Exponential Growth of Computing

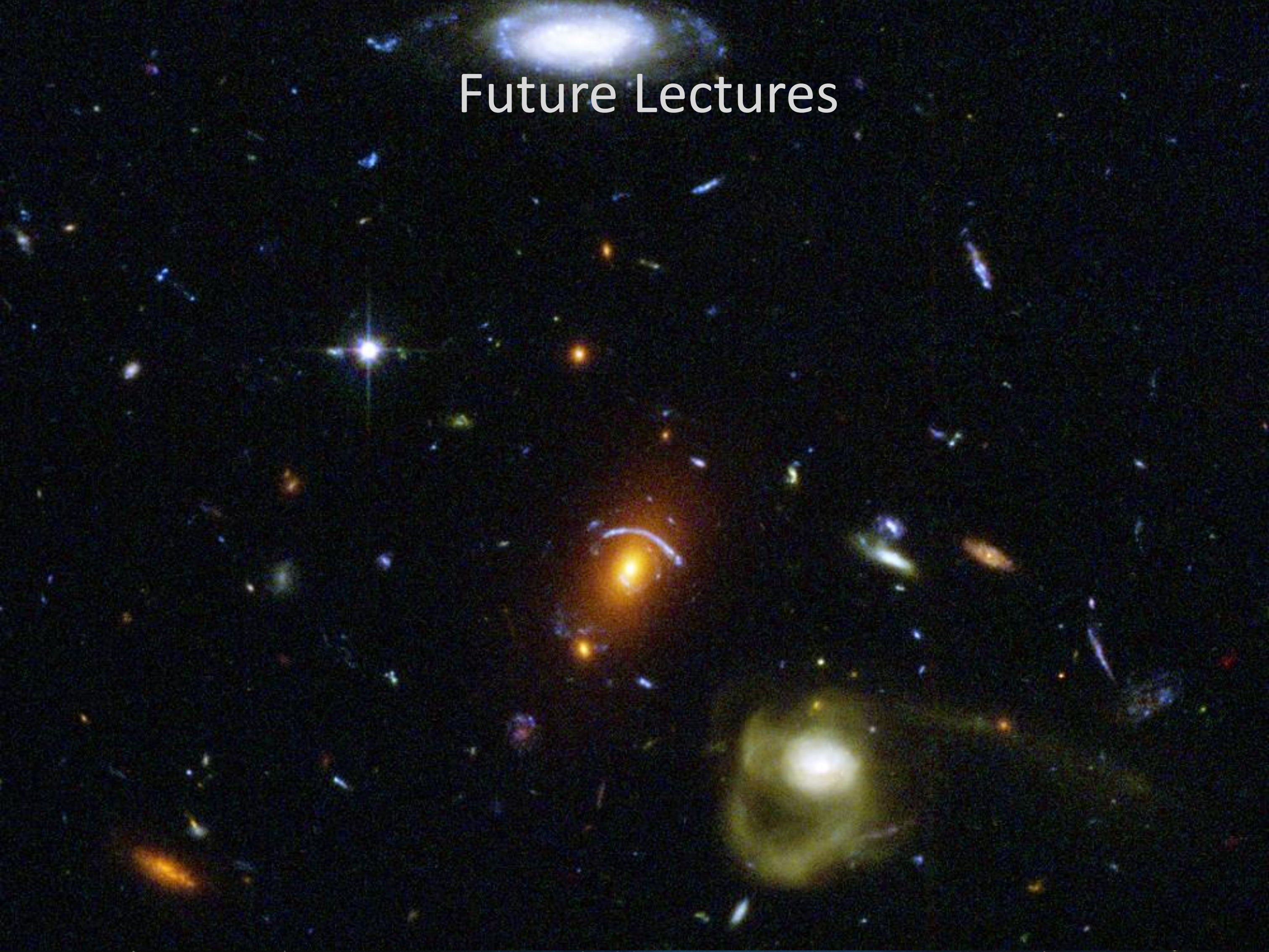
Exponential Growth of Computing
Twentieth through twenty first century

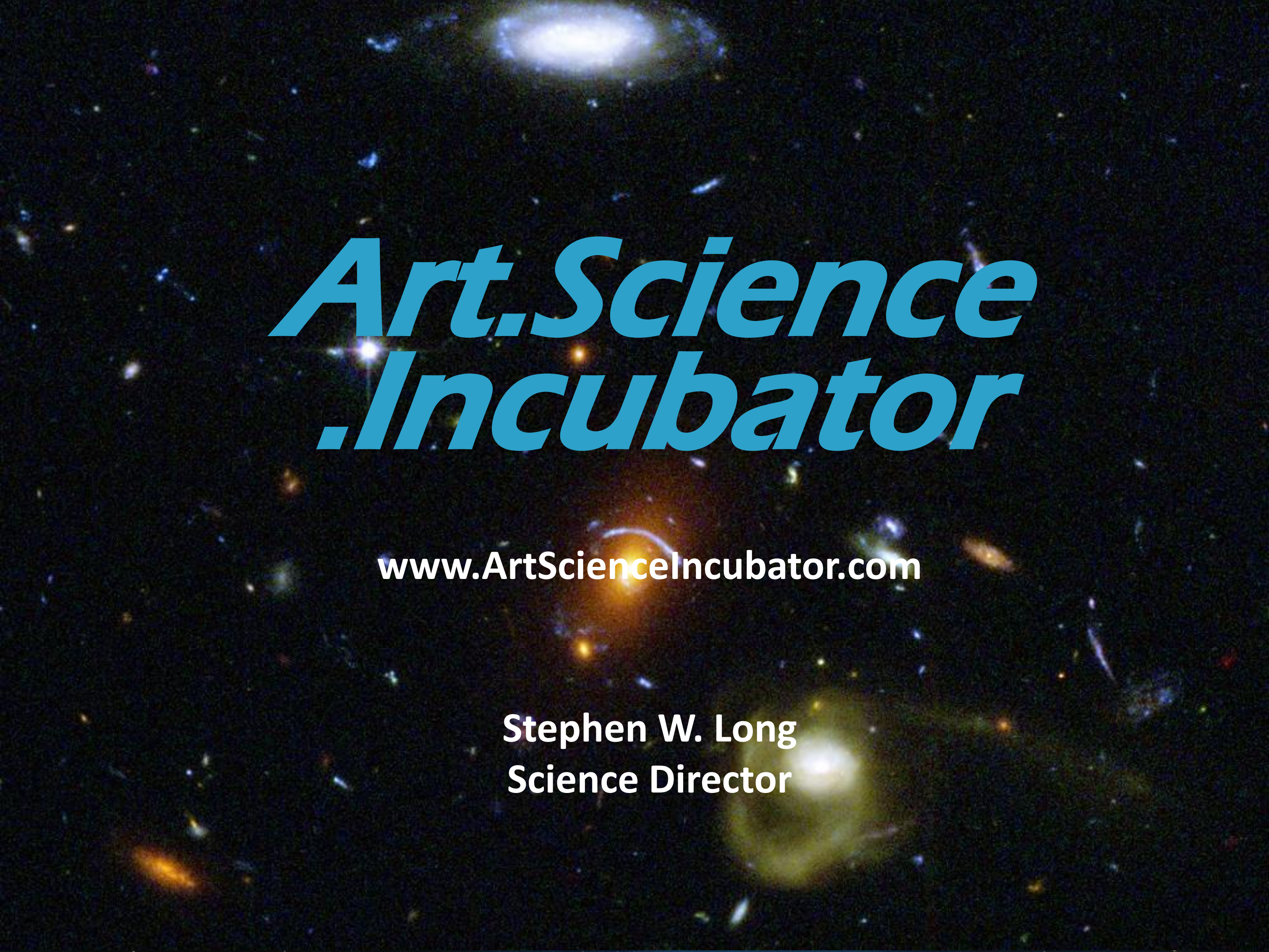


Future Lectures



Future Lectures





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