

"Earth is the cradle of mankind.  
But one cannot live in the cradle  
forever."

Konstantin E. Tsiolkovsky

PHOOIE ON SPACE  
EXPLORATION! WHAT'S  
IT EVER DONE FOR  
ME?

RADIATION  
BLOCKING LENSES

DIGITAL CELL  
PHONE TECHNOLOGY

HEARING AID  
AND BATTERY  
TECHNOLOGY

PROGRAMMABLE  
PACEMAKER

FIRE RESISTANT  
MORE INSULATING  
FABRIC

ADVANCES IN  
HEART PUMP

LIGHTWEIGHT  
COMPOSITE  
HIP REPLACEMENT

GLOBAL POSITIONING  
SYSTEM DEVICE  
(HE WANDERS A LOT)

VELCRO™

SUPER ABSORBENT  
MATERIAL  
(NOT SHOWN)



The **Yongle Emperor** (May 2, 1360 – August 12, 1424), born **Zhu Di** (*Chu Ti*), was the third emperor of the Ming Dynasty of China from 1402 to 1424.



He is generally considered the greatest emperor of the Ming Dynasty, and to be among the greatest Chinese emperors.

As part of his desire to expand Chinese influence, Emperor Yongle sponsored the massive and long term Zheng He expeditions.

These were China's only major sea-going explorations of the world

Some of the boats used were apparently the largest sail-powered boats in human history



The Ming Dynasty's fleet of giant ships predates the Columbus expedition across the Atlantic.

**The United States decided to move their large rocket launching operation to Cape Canaveral, Florida on July 24, 1950**



May 5, 1961 -- First NASA Astronaut In Space



## Alan Shepard

"Freedom-7"

Altitude: 116.5 statute miles

Orbits: 0

Duration: 0 Days, 0 hours, 15 min, 28 seconds

Distance: 303 statute miles

Velocity: 5,134 mph

Only 20 Days Later ...



**“I believe that this nation should commit itself to achieving the goal, before this decade is out, of landing a man on the moon and returning him safely to the earth “**



**President  
John F.  
Kennedy  
May 25, 1961**



Mission Commander  
Neil Armstrong,

Command Module  
Pilot Michael Collins

Lunar Module Pilot  
Edwin E. Aldrin Jr.

# Apollo 11 Moon Launch July 1969















# Apollo 11 Landing Site

Zoom image  
with  
Footpads of the  
LM and Early  
Apollo Science  
Experiments  
Package

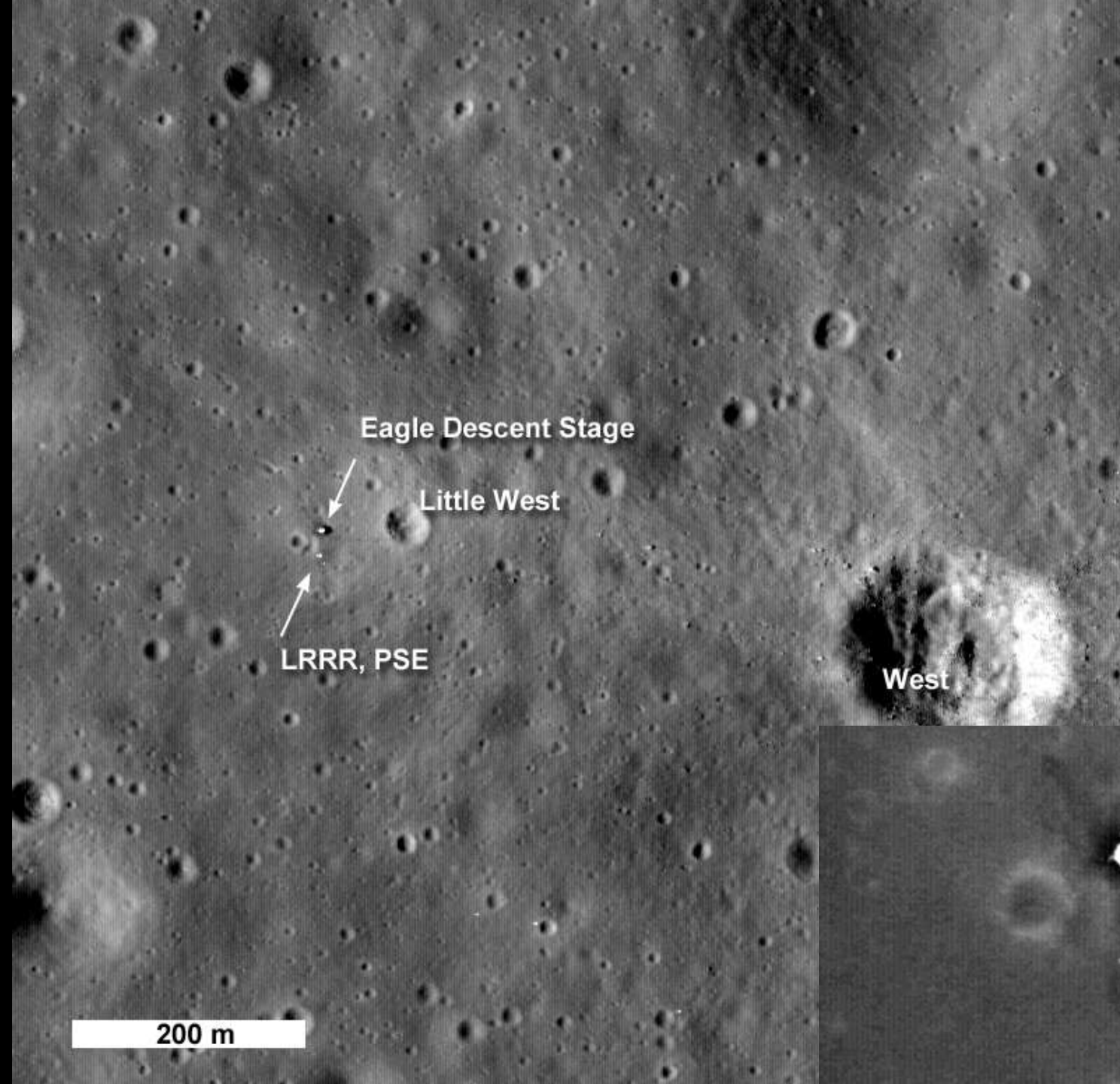
Eagle Descent Stage

Little West

LRRR, PSE

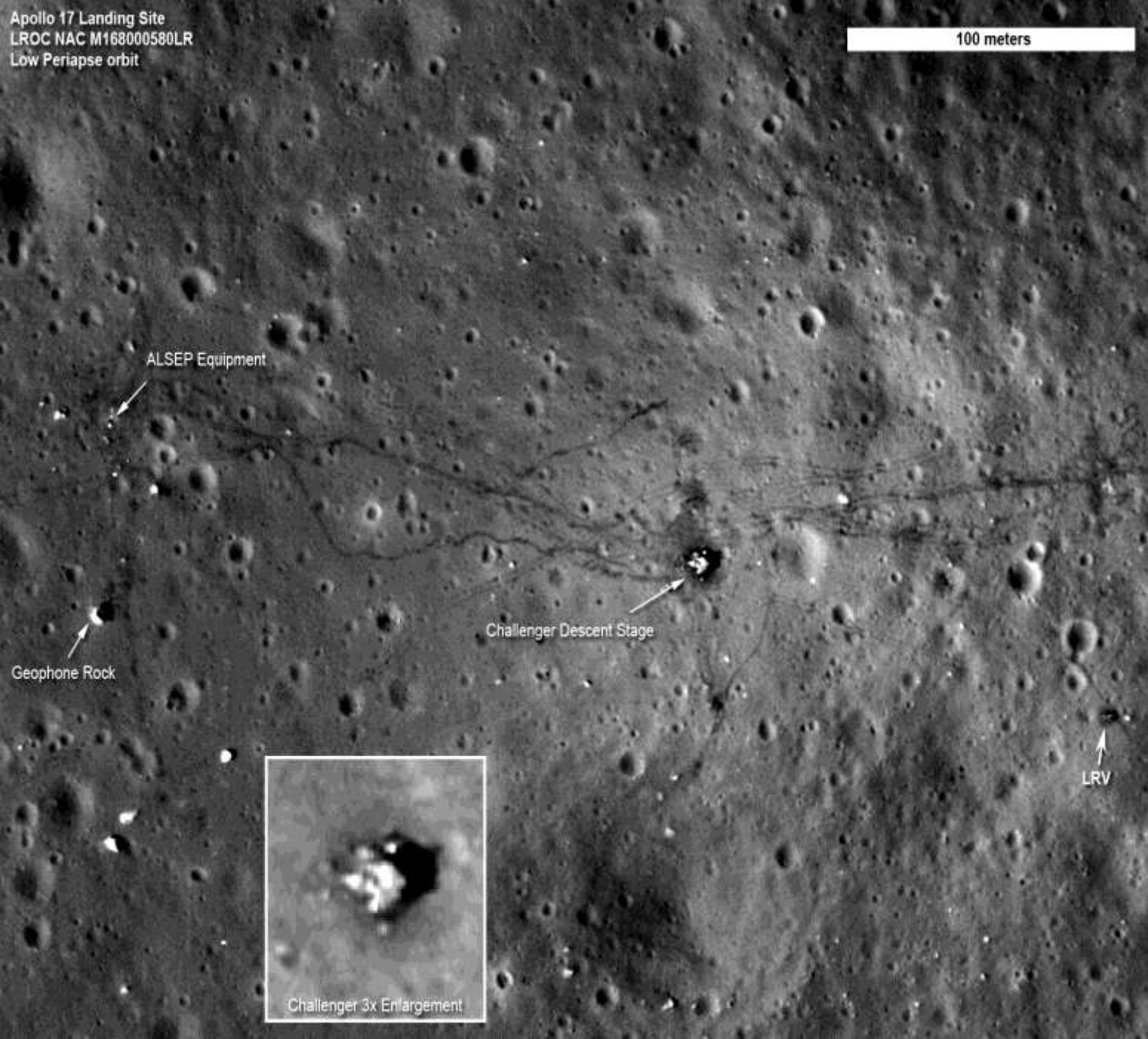
West

200 m



Apollo 17 Landing Site  
LROC NAC M168000580LR  
Low Periapse orbit

100 meters



December  
11 1972

Apollo 17  
landing Site





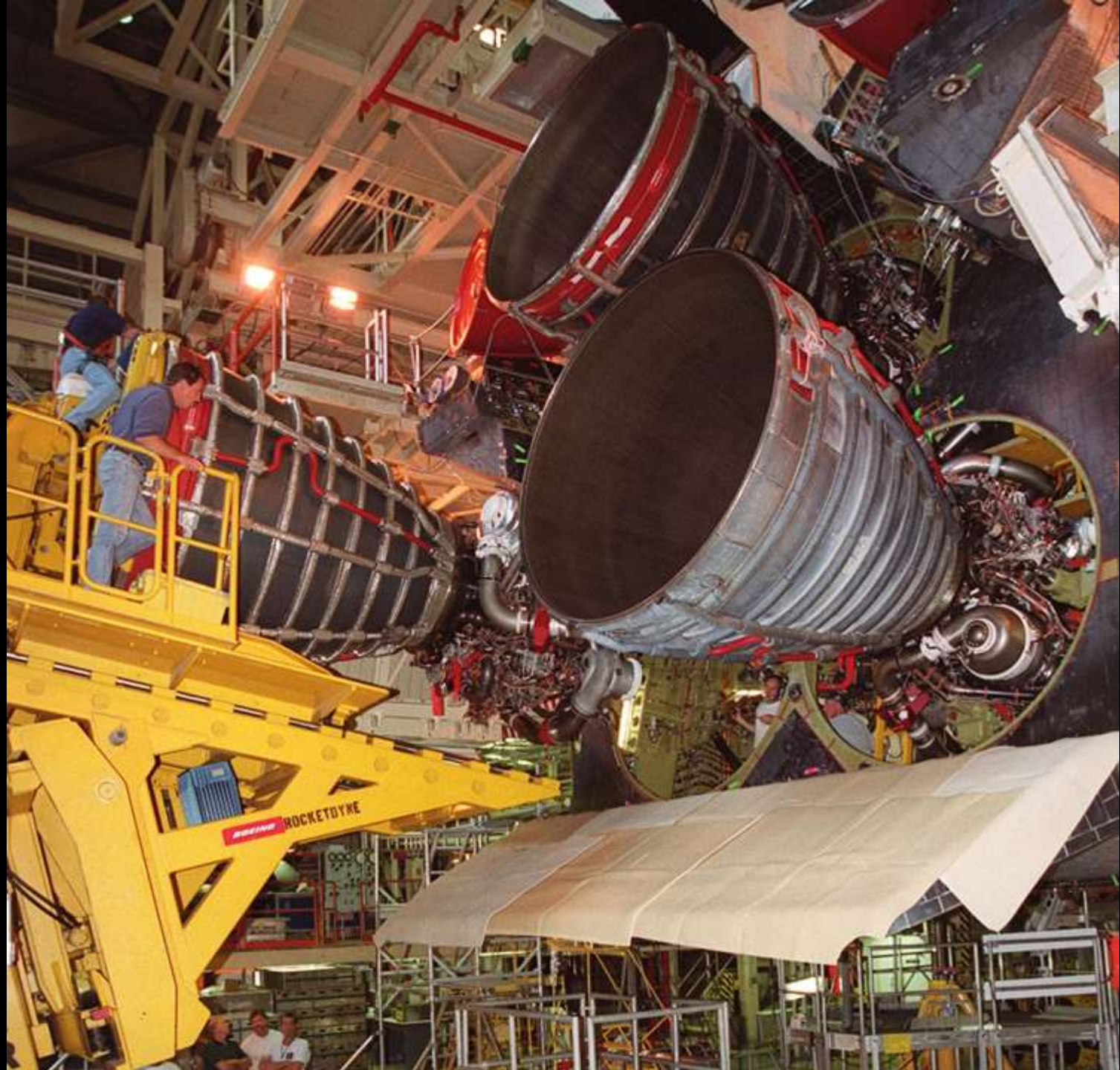
**“If We Can Land A Man On The Moon  
Why Can't We . . . . .”**

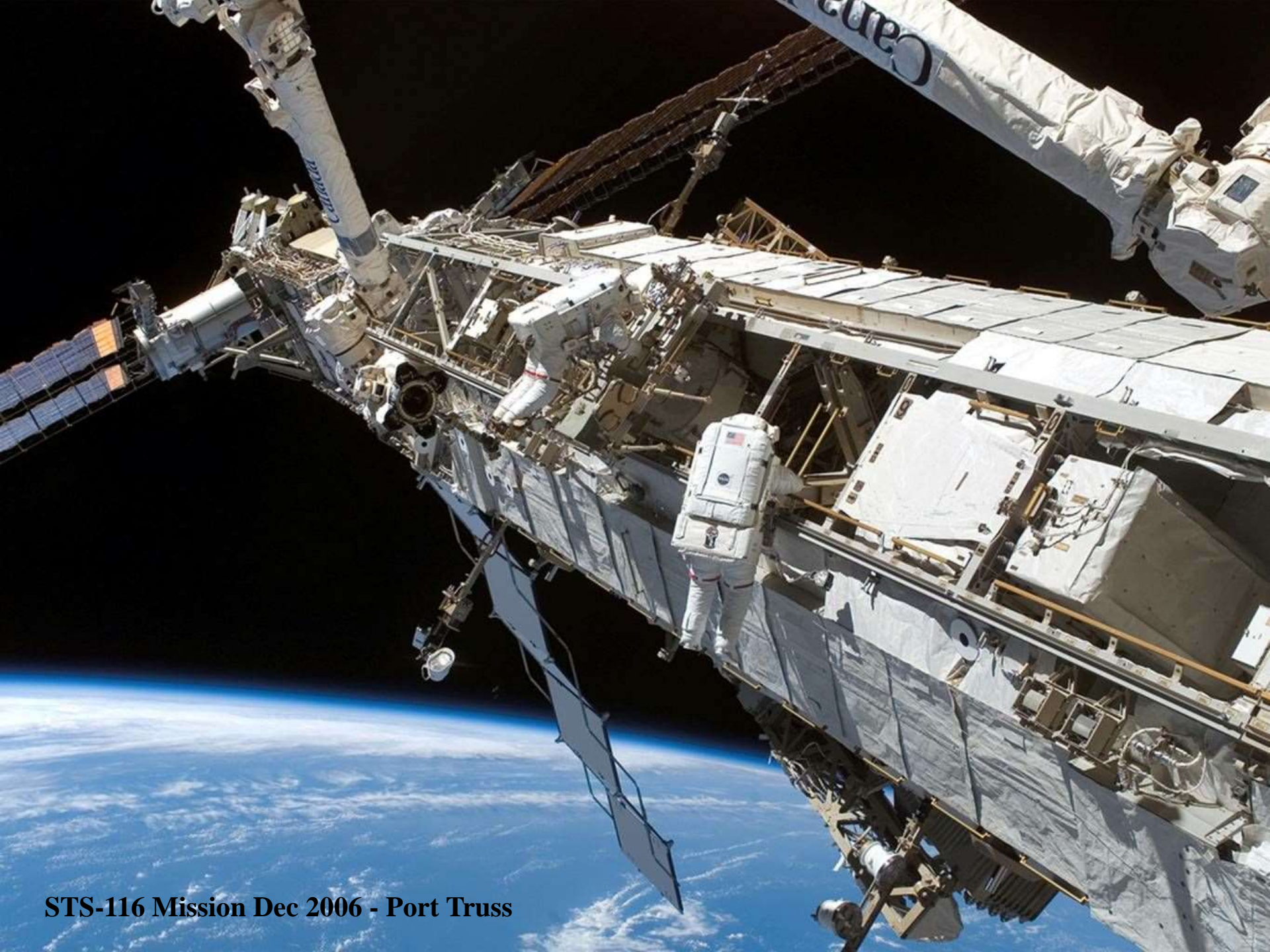




Ferry Carbow







**STS-116 Mission Dec 2006 - Port Truss**

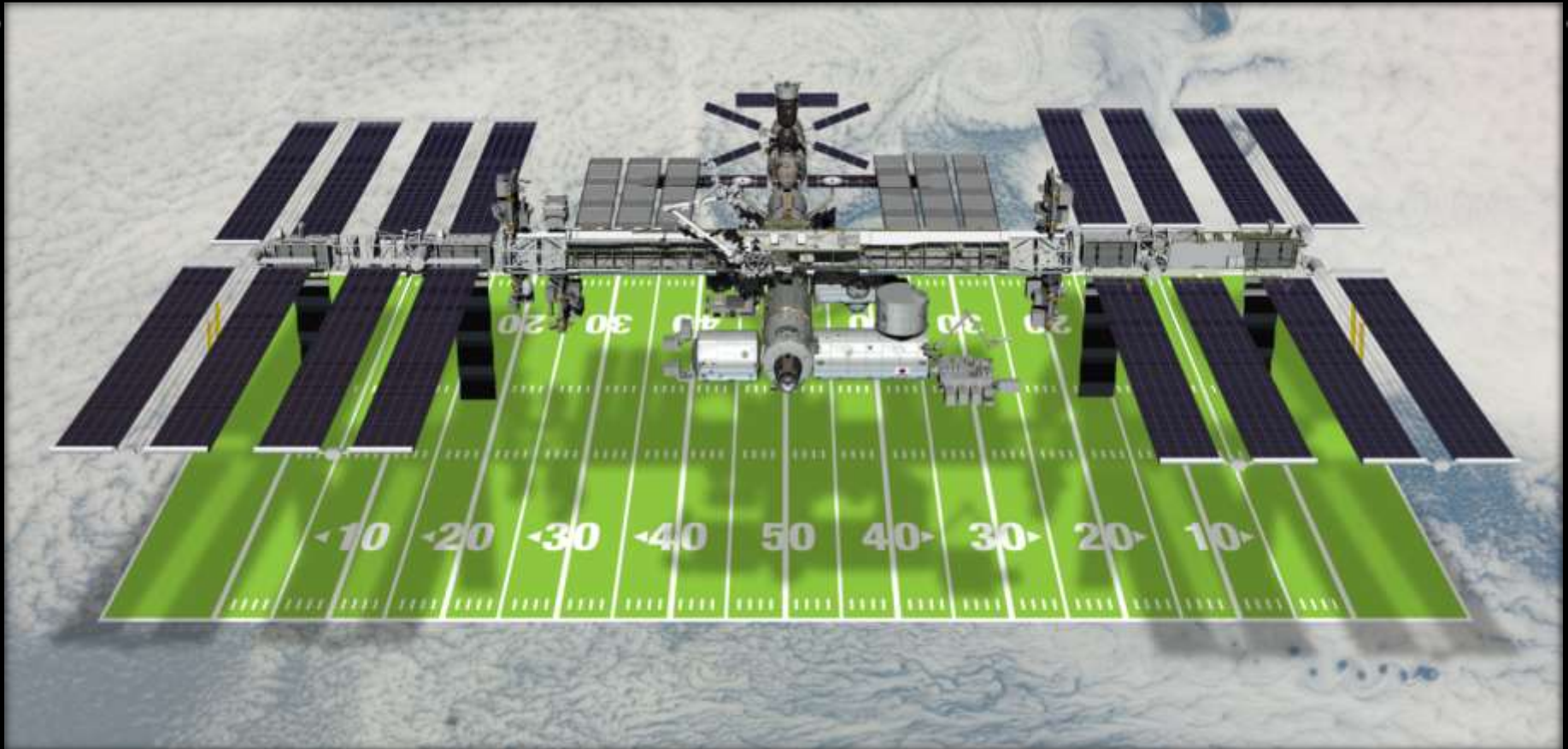


Atlantis

esa



# ***International Space Station (ISS)***



**Wingspan : 361 feet**

**Spacecraft Mass:  $\approx 900,000$  lb ( $\approx 408,233$  kg)**

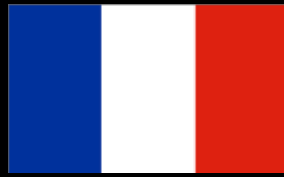
**Spacecraft Pressurized Volume:  $32,333$  ft<sup>3</sup> ( $916$  m<sup>3</sup>)**

**Velocity:  $17,500$  mph ( $28,200$  kph)**

**Science Capability: Laboratories from 4 international space agencies –  
US, Europe, Japan, and Russia.**



**Belgium**



**France**



**Spain**



**The Netherlands**



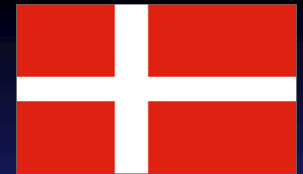
**Germany**



**Japan**



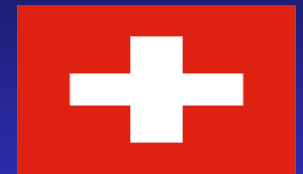
**Sweden**



**Denmark**



**Canada**



**Switzerland**



**Norway**



**Italy**



**Russia**



**United Kingdom**



**United States**





# *ISS Launch Vehicles*



***Shuttle***  
*(retired)*



***Soyuz***



***Ariane***  
***& ATV***



***HIIA &***  
***HTV***



***Falcon 9***  
***& Dragon***



***Taurus II***  
***& Cygnus***

# Earth Reliant ISS Transportation

Facilitate a robust commercial crew and cargo capability for routine transportation to low Earth orbit

## Commercial Cargo

**Orbital Cygnus**  
Operational



**SpaceX Dragon**  
Operational



## Commercial Crew

**Boeing CST-100**  
**Starliner**  
First crew test 2023



**SpaceX Crew**  
**Dragon**  
First crew launch May  
2020  
**Operational**





# **In The Middle of a Rocket Revolution**





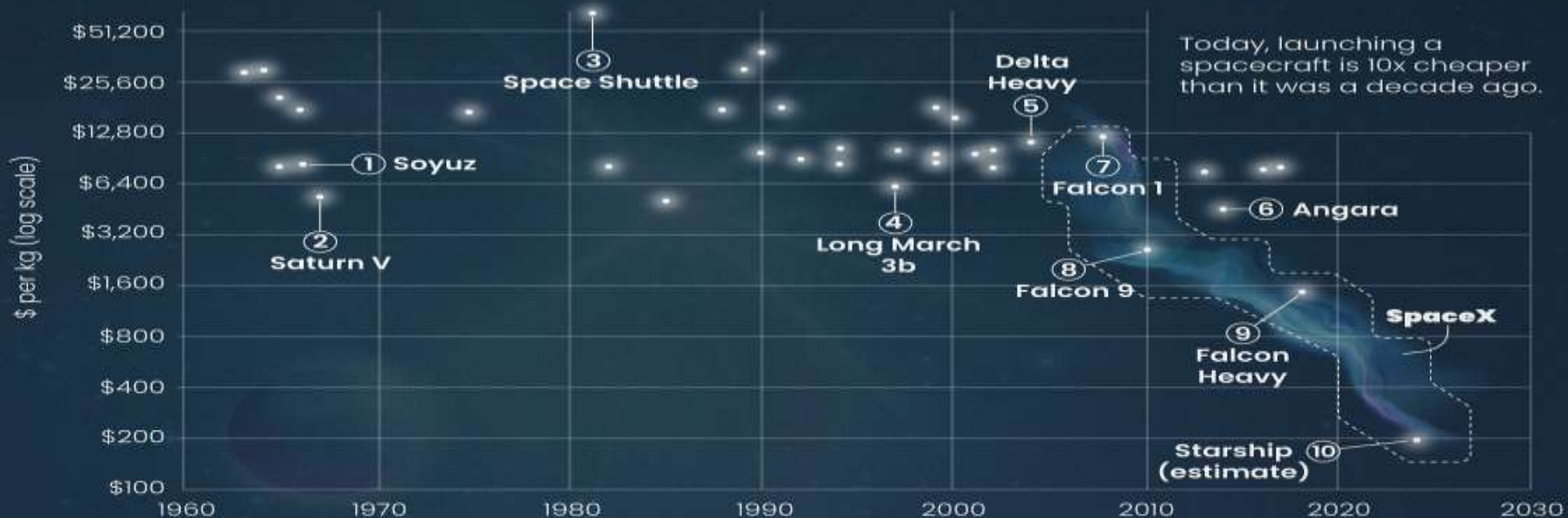
Elon Musk is a South African-born Canadian American business magnate, investor, engineer, and inventor. He is the founder, CEO, and lead designer of SpaceX; co-founder, CEO, and product architect of Tesla, Inc.; and chairman of SolarCity.

Born: June 28, 1971 (age 52), Pretoria, South Africa

Net worth: 187 billion USD (2023) Currently #2 in the world)

# The Cost of Space Flight

How much does it cost to launch a spacecraft into orbit? A lot less than it used to, thanks to innovation by SpaceX. Here's a look at the cost per kilogram for space launches across the globe since 1960.





T- 00:00:32

UPCOMING LIFTOFF

### STARTUP

THE FALCON HEAVY FLIGHT COMPUTERS HAVE TAKEN CONTROL OF THE COUNTDOWN

## FALCON HEAVY TEST FLIGHT



SPACEX

T+ 00:07:37

STAGE 2 TELEMETRY	
SPEED	ALTITUDE
 20884 km/h	 176 km



### FALCON HEAVY TEST FLIGHT



# Jeff Bezos

Third Richest Person in the World



Owns nearly  
**17%**  
of Amazon

Net Worth  
**121 Billion**



**Founded Amazon**  
in a garage in Seattle in 1994

Net worth increased by  
**\$10 Billion**  
in a day on 27 October,  
after Amazon's share  
price jumped

**13.22%**  
thanks to better than  
expected 3<sup>rd</sup> quarter  
earnings



**amazon**

Having started as an  
online book seller,  
**Amazon is now valued at**

**Over 1 Trillion \$**



**Bezos' aerospace** company, Blue Origin,  
is developing a reusable rocket that can  
carry passengers into space.

# **Blue Origins Processing Facility Kennedy Space Center**

**Home of New Glenn manufacturing, orbital launch and support facilities**



**750,000-square-foot building**

The *New Glenn* made its initial human test launch in 2021. Design work on the vehicle began in 2012. *New Glenn* is a 7-meter-diameter (23 ft), two or three rocket. The *New Glenn's* first stage is designed to be reusable



**"The survival of the human race depends on its ability to find new homes elsewhere in the universe ... It is important for the human race to spread out into space for the survival of the species "**

**Stephen Hawking  
June 13, 2006**

# NASA has built a New Rocket

# Space Launch System

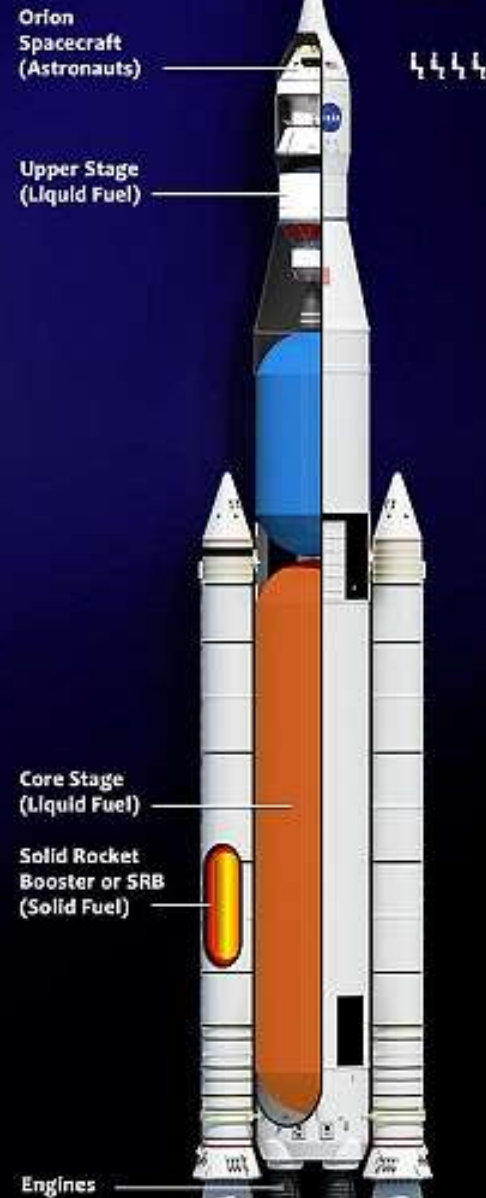
*“Evolving the Nation’s Deep Space Rocket”*

The first static firing 2020  
First launch – 11/16/2022

If you wonder how NASA’s Space Launch System, or SLS, compares to earlier generations of NASA launch vehicles...



NASA’s SLS 70 Metric Ton Launch Vehicle



# Artemis Phase 1: Path to The Lunar Surface

Artemis I: First human spacecraft to the Moon in the 21st century  
November 2022

Artemis II: First humans to orbit the Moon in the 21st century  
May 2024

Artemis Support Mission: First high-power Solar Electric Propulsion (SEP) system  
2025

Artemis Support Mission: First pressurized module delivered to Gateway  
2027

Artemis Support Mission: Human Landing System delivered to Gateway  
2027

Artemis III: Crewed mission to Gateway and lunar surface  
2028

## Commercial Lunar Payload Services

- CLPS-delivered science and technology payloads

## Early South Pole Mission(s)

- First robotic landing on eventual human lunar return and In-Situ Resource Utilization (ISRU) site
- First ground truth of polar crater volatiles

## Large-Scale Cargo Lander

- Increased capabilities for science and technology payloads

## Humans on the Moon - 21st Century

First crew leverages infrastructure left behind by previous missions

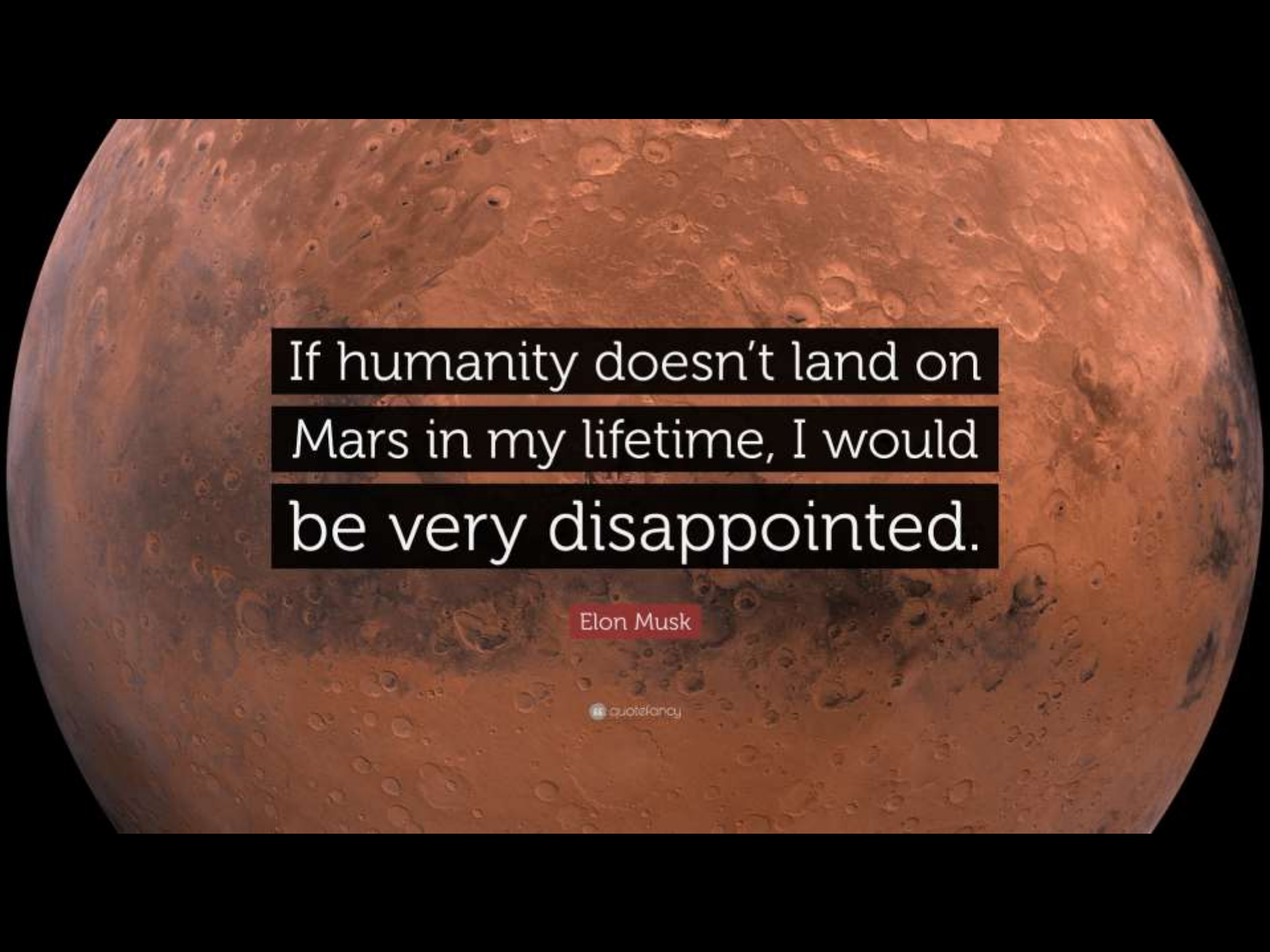
## LUNAR SOUTH POLE TARGET SITE

2022

2028







If humanity doesn't land on  
Mars in my lifetime, I would  
be very disappointed.

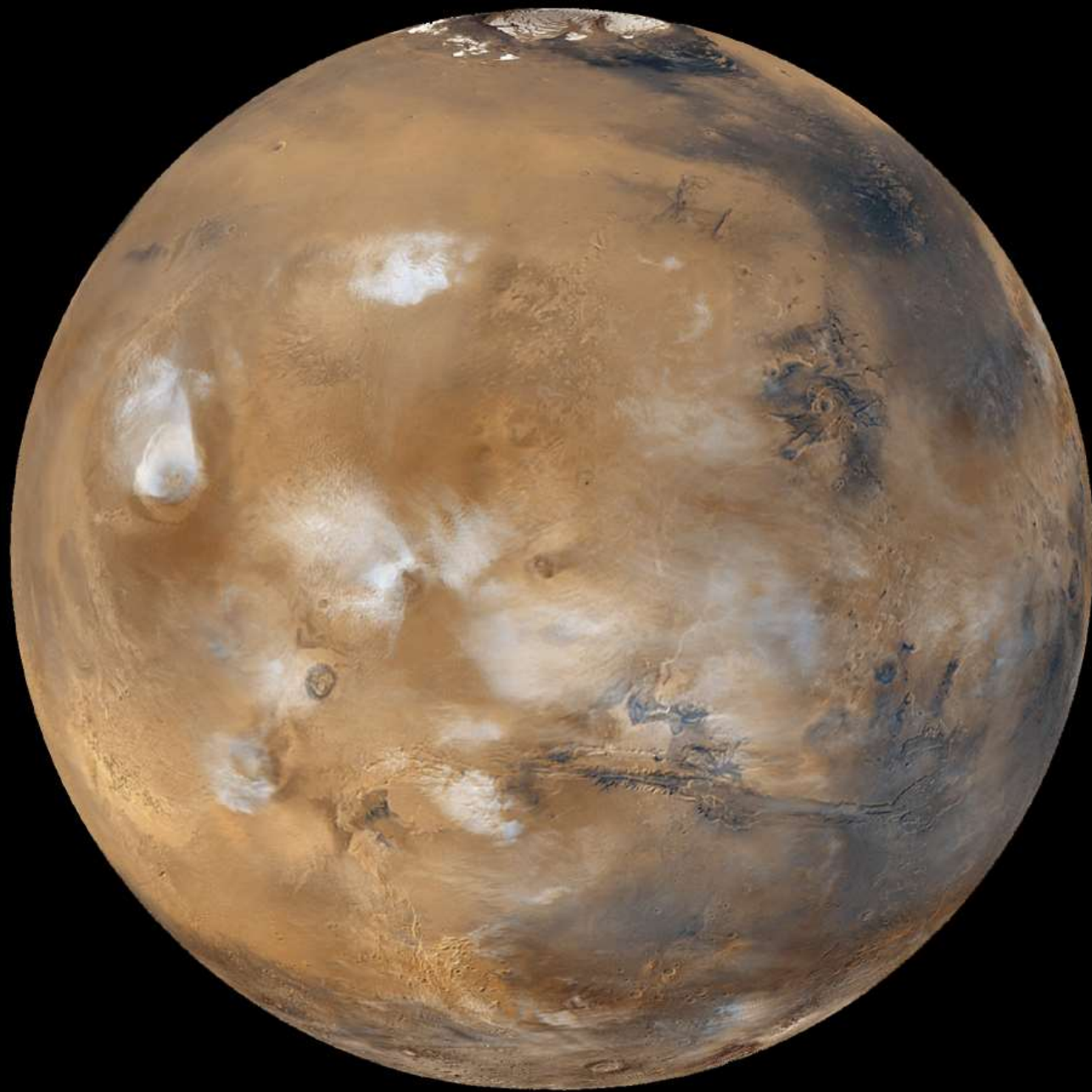
Elon Musk

 quote fancy



**Before We Send Humans  
We Send Robots**





Exploring  
Mars

# Mars Fact Sheet

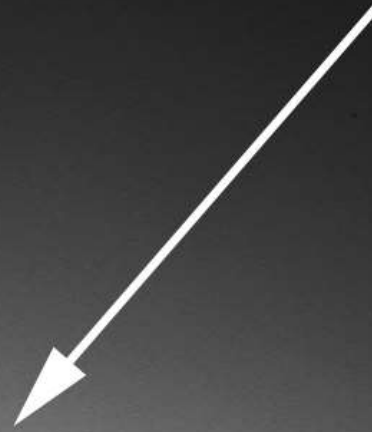
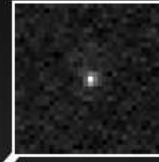


- Average Distance from Sun 142 million miles
- Mass 0.107 Earth's mass
- Diameter 4,222 miles (Earth =7,926 m)
- Length of Day 24.6 Earth hours
- Length of Year 687 Earth days
- Surface Gravity 0.377 that of Earth (If you weigh 80 pounds, you would weigh about 30 pounds on Mars.)
- Known Moons 2 Phobos & Deimos
- Escape Velocity 11,229 mph (Earth is 25,022 mph)
- Temperatures on Mars average about -67 degrees F. However, temperature's range from around -207 degrees F. in the wintertime at the poles, to +80 degrees F. over the lower latitudes in the summer. (Earth -129 to +136 F)



# Earth From Mars

**You are here**



**This is the first image ever taken of Earth from the surface of a planet beyond the Moon. It was taken by the Mars Exploration Rover Spirit one hour before sunrise on the 63rd Martian day, or sol, of its mission.**

# Mars 2020 Perseverance Rover

Launch: July 30, 2020

Landing: Feb. 18, 2021, Jezero Crater, Mars

-

**Main Job:** Seek signs of ancient life and collect samples of rock and regolith (broken rock and soil) for possible return to Earth.

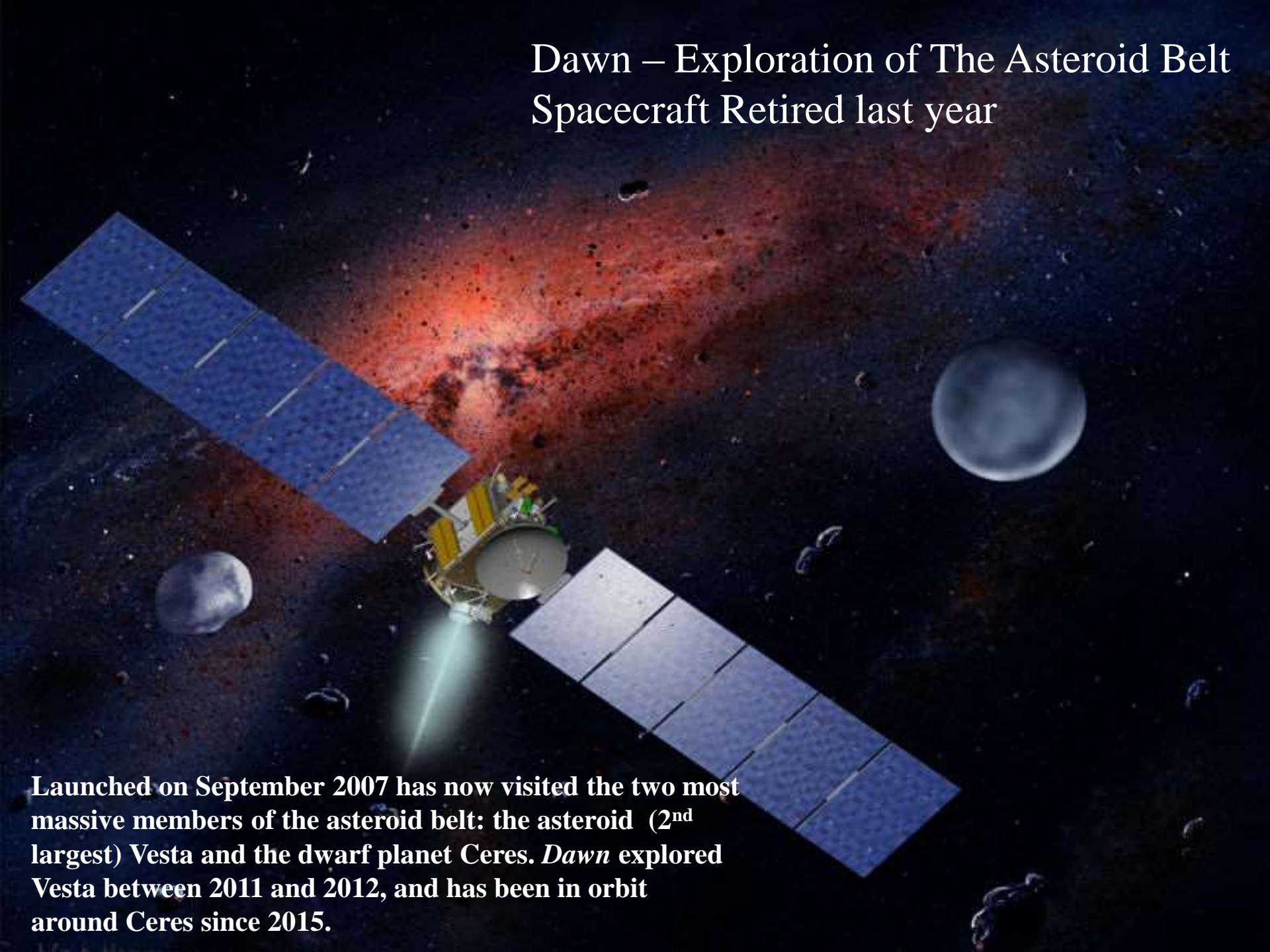
The Mars **Helicopter, Ingenuity**, is a technology demonstration to test powered, controlled flight on another world for the first time.





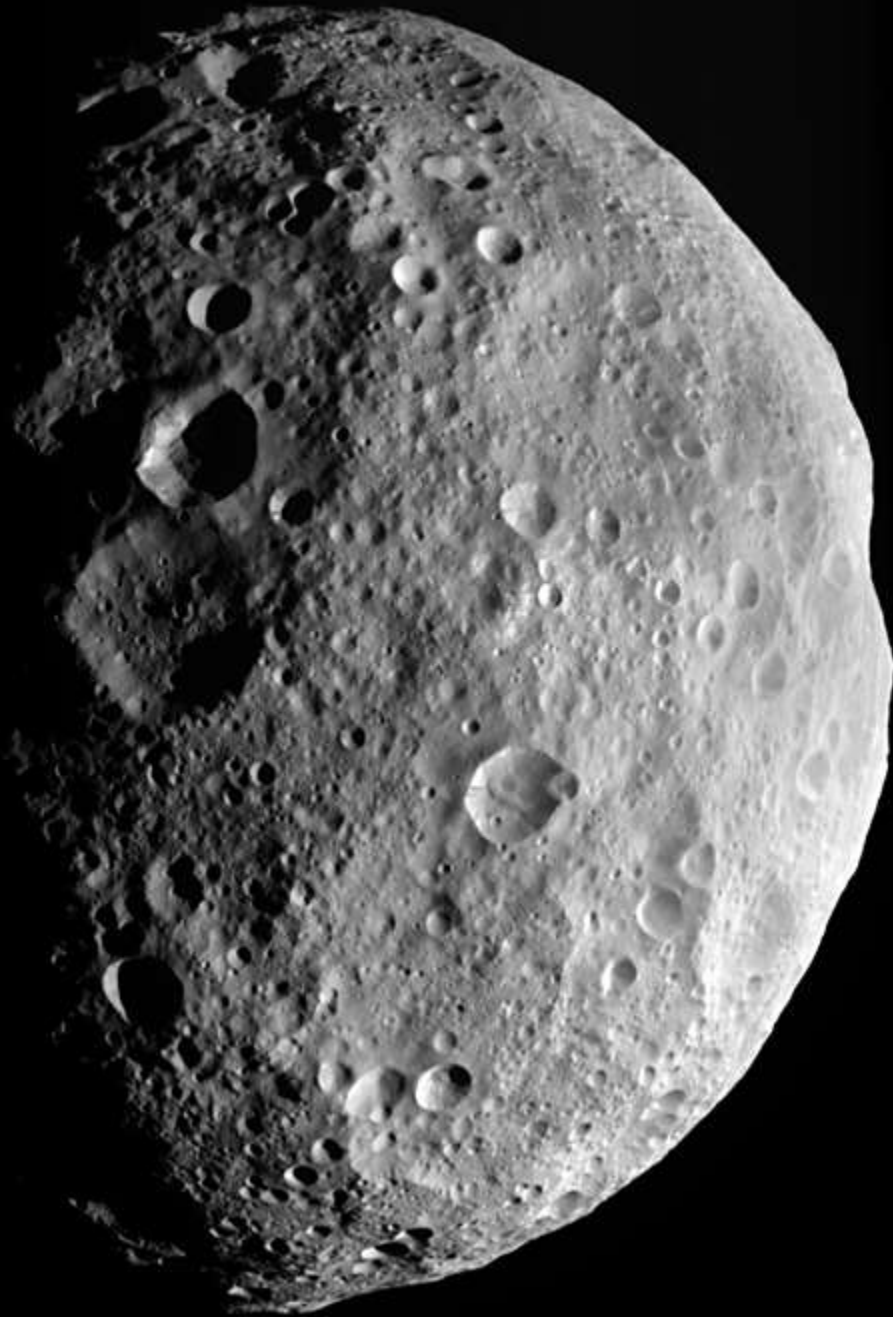


# Dawn – Exploration of The Asteroid Belt Spacecraft Retired last year

An artistic rendering of the Dawn spacecraft in the asteroid belt. The spacecraft, with its two large blue solar panel wings, is positioned in the center, emitting a bright green laser beam. The background is a dark space filled with numerous asteroids of various sizes and colors, including a prominent reddish-orange one. A large, grey, spherical dwarf planet is visible on the right side of the frame.

**Launched on September 2007 has now visited the two most massive members of the asteroid belt: the asteroid (2<sup>nd</sup> largest) Vesta and the dwarf planet Ceres. *Dawn* explored Vesta between 2011 and 2012, and has been in orbit around Ceres since 2015.**

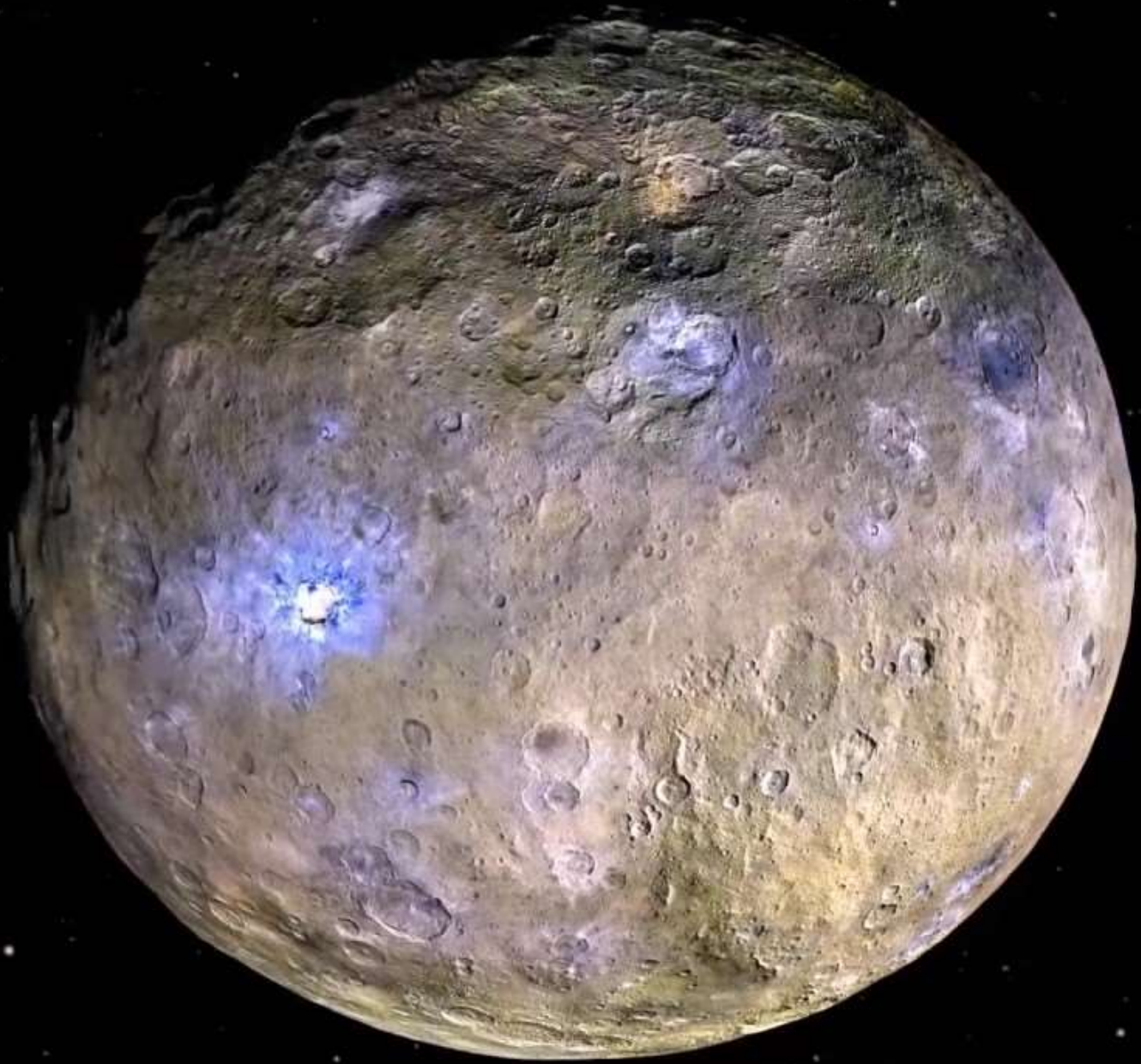
# Dawn – Exploration of The Asteroid Belt



This full view of the giant asteroid Vesta was taken by NASA's Dawn spacecraft  
September 5, 2012

—  
This image is from the last sequence of images NASA's Dawn spacecraft obtained of the giant asteroid, looking down at Vesta's north pole as it was departing for the last time  
Average diameter of Vesta = 326 Miles

Ceres



# Tunguska Event – June 30 1908



The explosion, is believed to have been caused by the air burst of a large meteoroid or comet fragment at an altitude of **3–6 miles above the Earth's surface**. Estimated in size to be about **300 feet**. It is the largest impact event on or near Earth in recorded history.

The meteoroid or comet appears to have burst in the air rather than hitting the surface, this event still is referred to as an impact. Estimates of the energy of the blast estimated at 10–15 megatons of TNT roughly equal to **1,000 times more powerful than the atomic bomb dropped on Hiroshima, Japan**.



The Tunguska explosion **knocked down an estimated 80 million trees over an area covering 830 square miles**. It is estimated that the shock wave from the blast would have measured 5.0 on the Richter scale. An explosion of this magnitude is capable of destroying a large metropolitan area.<sup>[10]</sup>

Jupiter ■ July 23, 2009  
*Hubble Space Telescope*  
Wide Field Camera 3



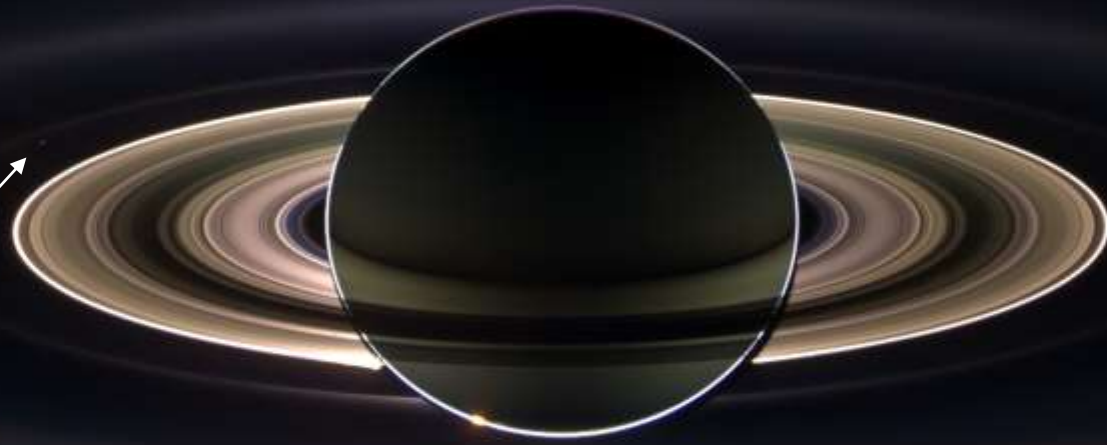
NASA, ESA, H. Hammel (Space Science Institute), and the Jupiter Impact Team



1970 4422

This is an astronomical image showing a central yellowish-white point source, likely the asteroid 1970 4422. The image features several concentric, semi-transparent contours centered on the main source, indicating a detection or search region. There are several other faint, cyan-colored point sources scattered across the field of view. The background is a dark, noisy field of stars. The text '1970 4422' is located in the bottom-left corner of the image.

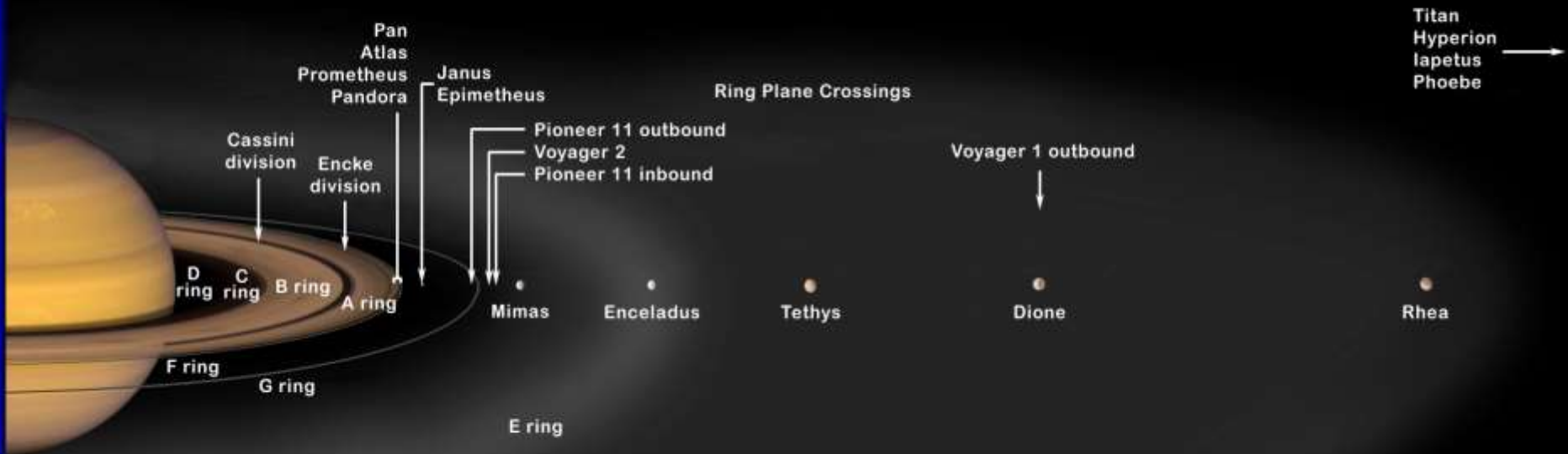
# In The Shadow of Saturn



Earth from 1 Billion  
Miles Away

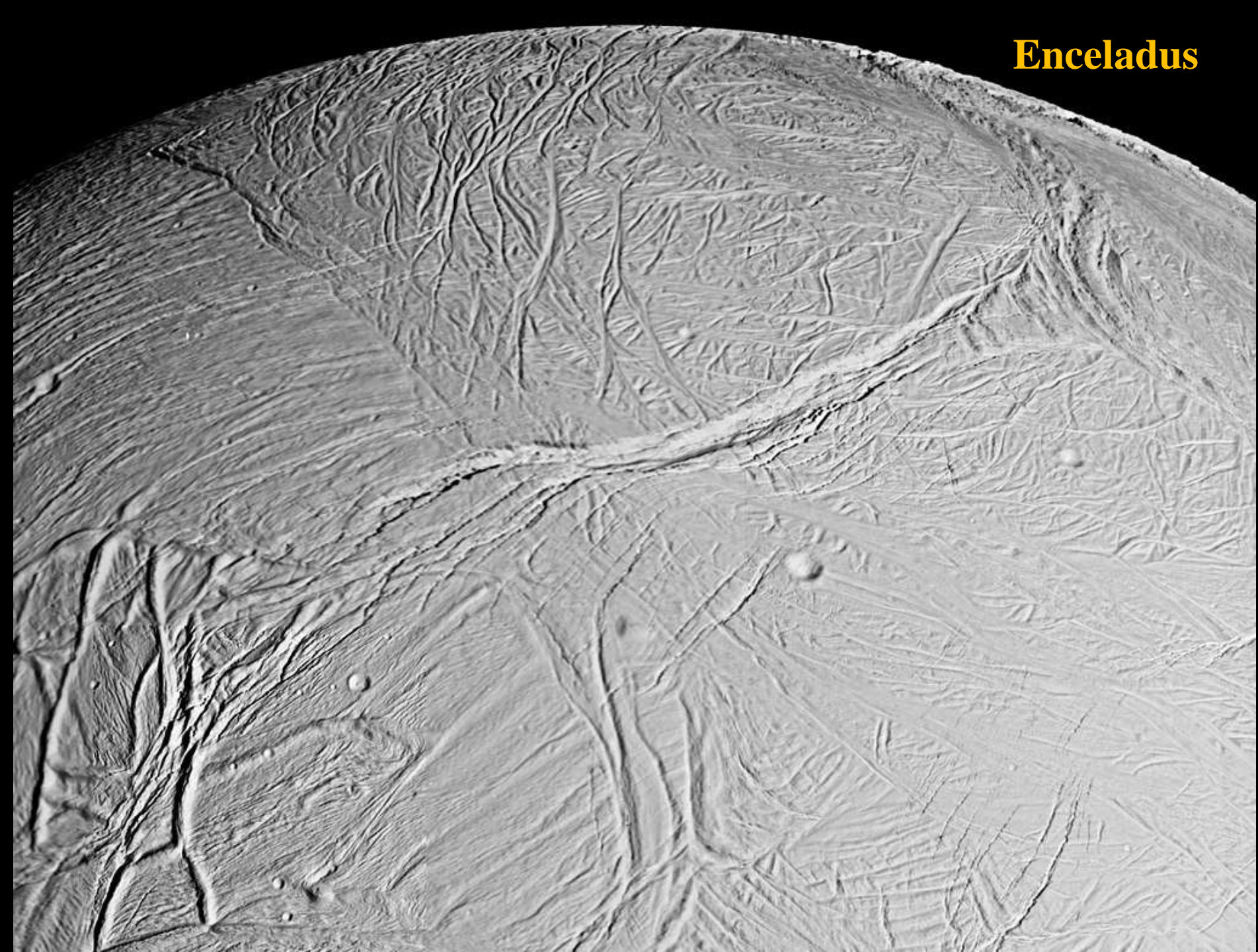
*Cassini-Huygens* studying the planet Saturn and its  
moons launched **October 15, 1997** and entered into orbit  
around Saturn on **July 1, 2004**  
**Cassini Plunged into the Saturn atmosphere for the last  
time in late 2017**

# Saturn's Satellites and Ring Structure





# Enceladus



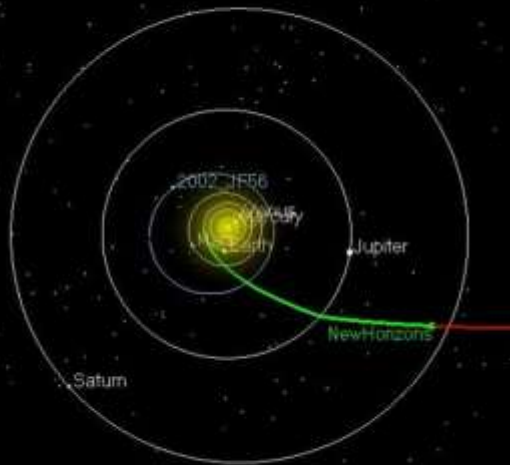
# Pluto New Horizons



New Horizons Current Position

April 2, 2008

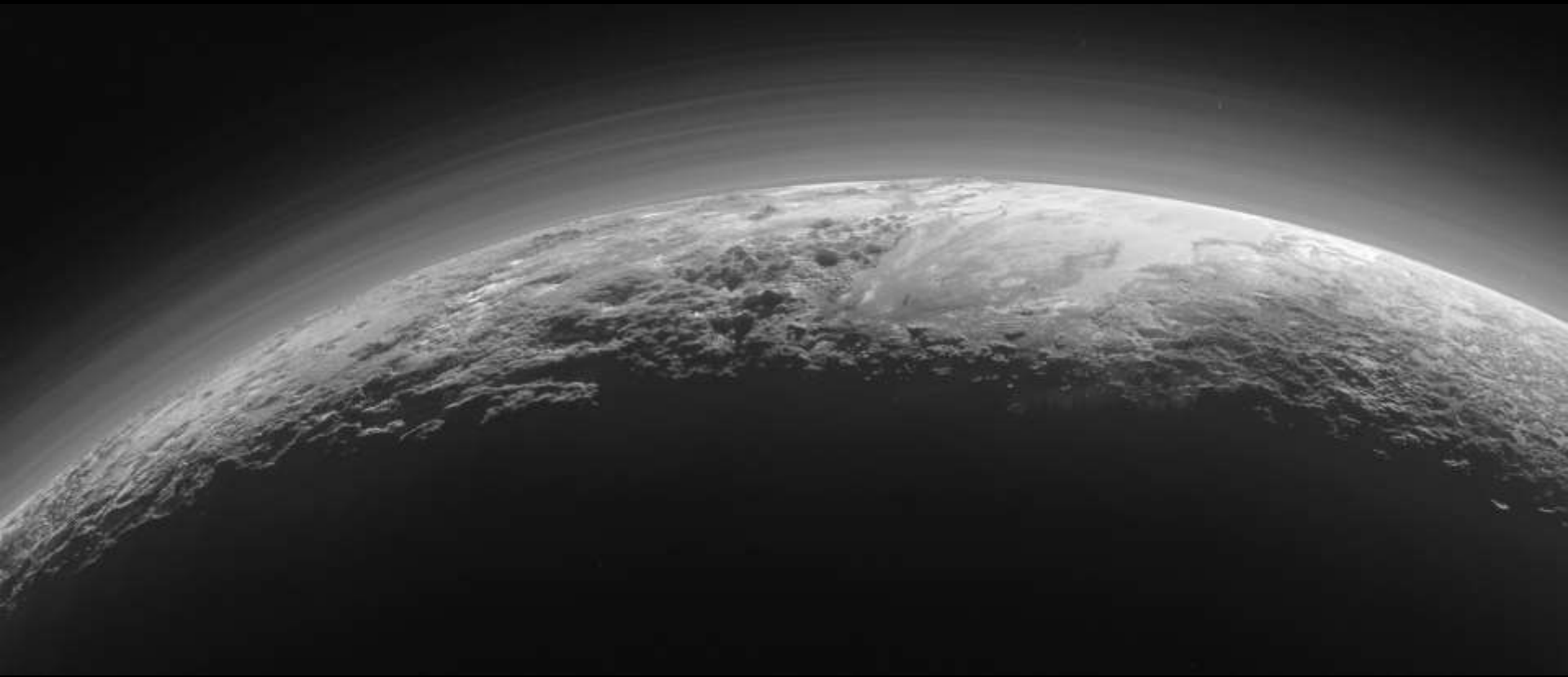
Distance from Sun (AU): 9.41    Heliocentric Velocity (km/s): 18.60



**Pluto New Horizons** was the first spacecraft to fly by and study the dwarf planet Pluto and its moons, Charon, Nix, and Hydra. Launched on January 19, 2006 and a flyby of Jupiter on February 28, 2007, it arrived at Pluto on July 14, 2015

Distance from Earth (AU): 9.15  
Distance from Jupiter (AU): 4.54  
Distance from Pluto (AU): 22.12  
2 Apr 2008 14:00:00 UTC

# Pluto's Majestic Mountains, Frozen Plains and Foggy Hazes



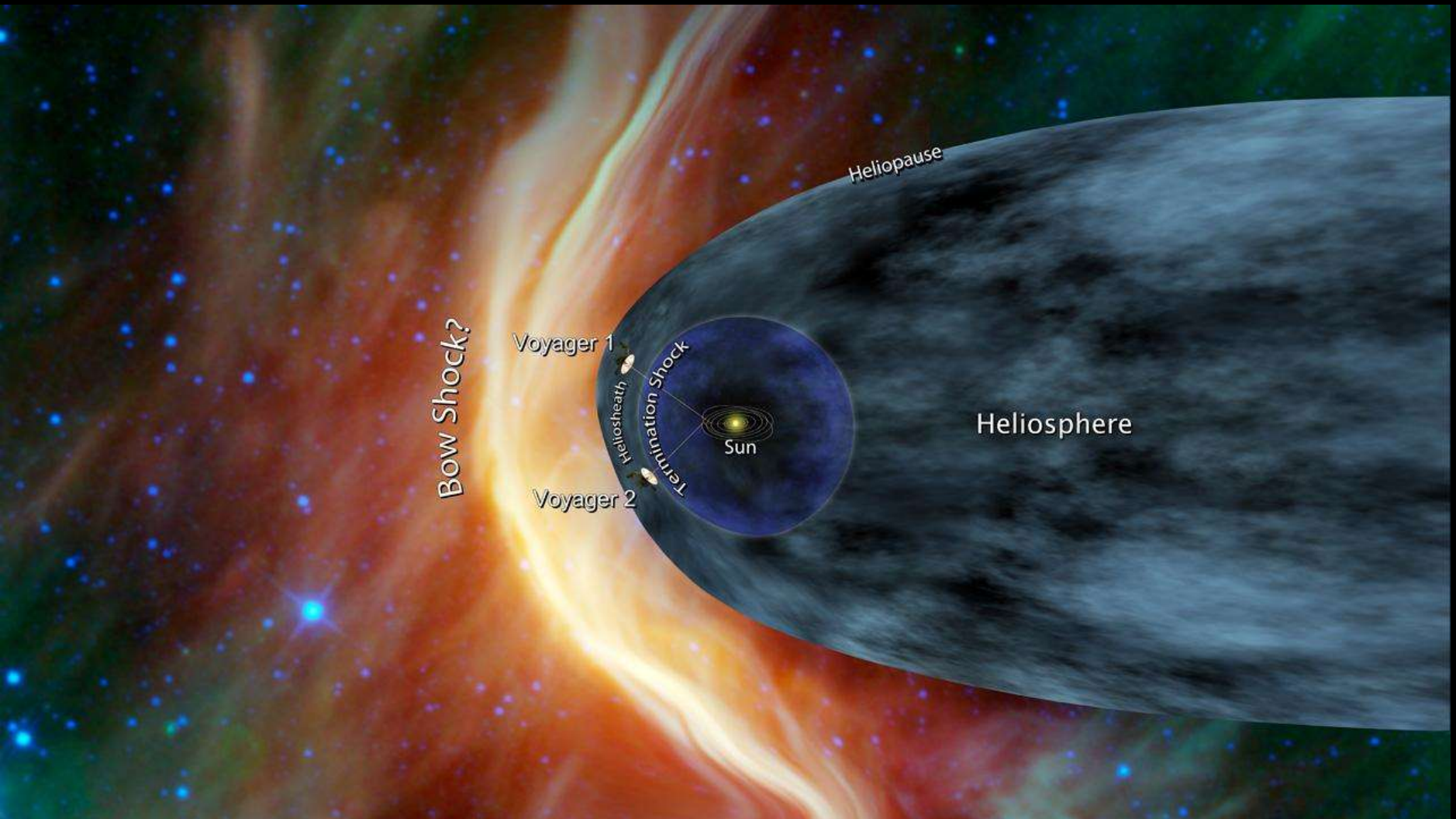


Some of the mountains  
are 11,000ft (3,300m)

Mountains made  
of water-ice

Smooth uncratered terrain  
suggests region has been  
geologically active in the  
last 100 million years

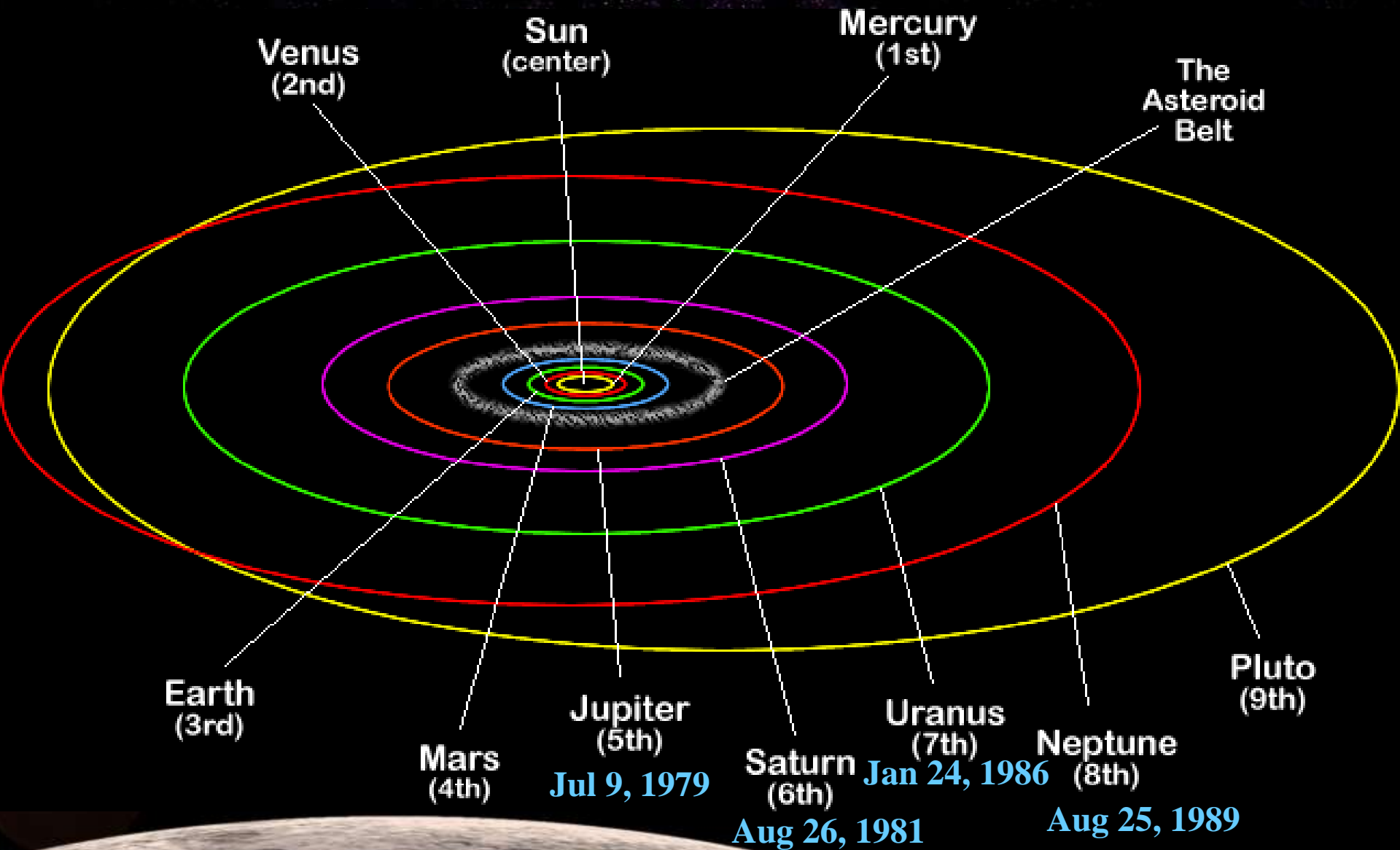
Voyager is the first human-made object to enter interstellar space as of 2012



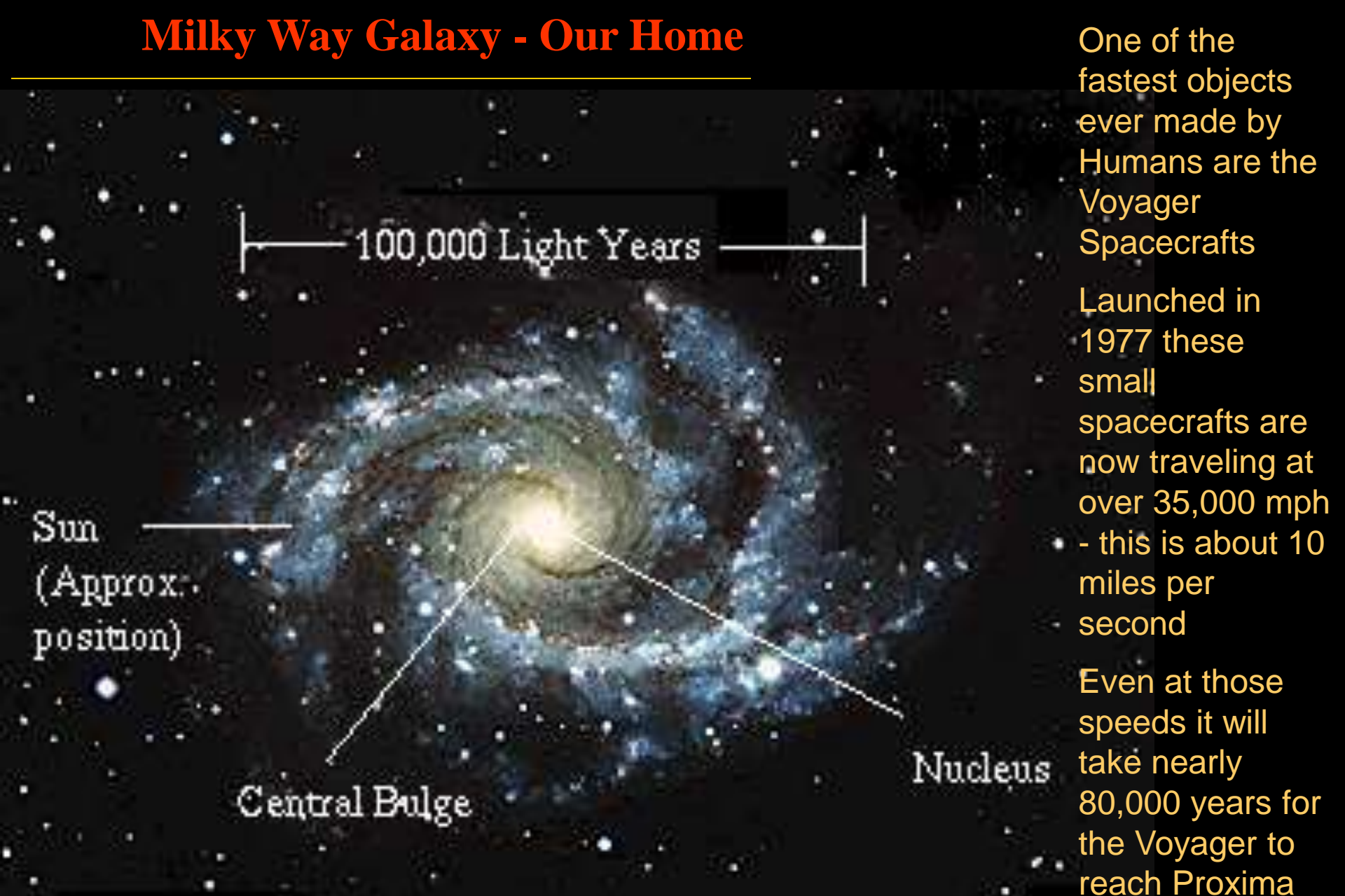


How Big is this challenge?

# Voyager 2 - Launch Aug 20 1977



# Milky Way Galaxy - Our Home



One of the fastest objects ever made by Humans are the Voyager Spacecrafts

Launched in 1977 these small spacecrafts are now traveling at over 35,000 mph - this is about 10 miles per second

Even at those speeds it will take nearly 80,000 years for the Voyager to reach Proxima Centauri, the nearest star.

It would take 1, 895,730,000 years to travel 100,000 light years across the Milky Way Galaxy



# Voyager 2 - Launch Aug 20 1977

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**The Great  
Andromeda  
Galaxy**

**It would take  
47,393,360,000  
years to reach our  
closest sister  
Galaxy – The  
Great Andromeda  
Galaxy**





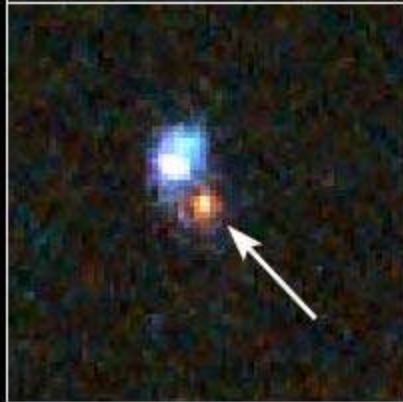
# To Exploring the Far Reaches of the Universe with the Hubble Space Telescope



**A Window on  
the Universe**

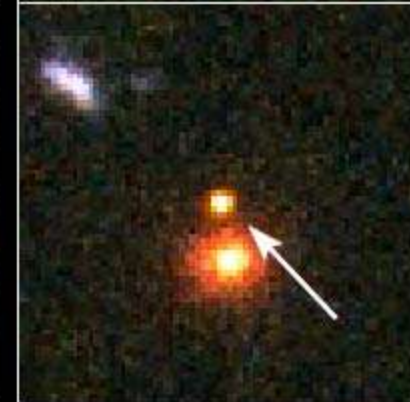
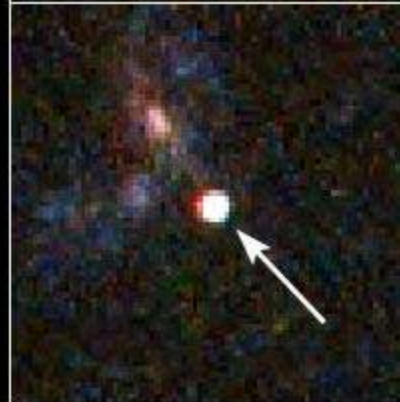
# The Accelerating Universe

Distant Supernovae



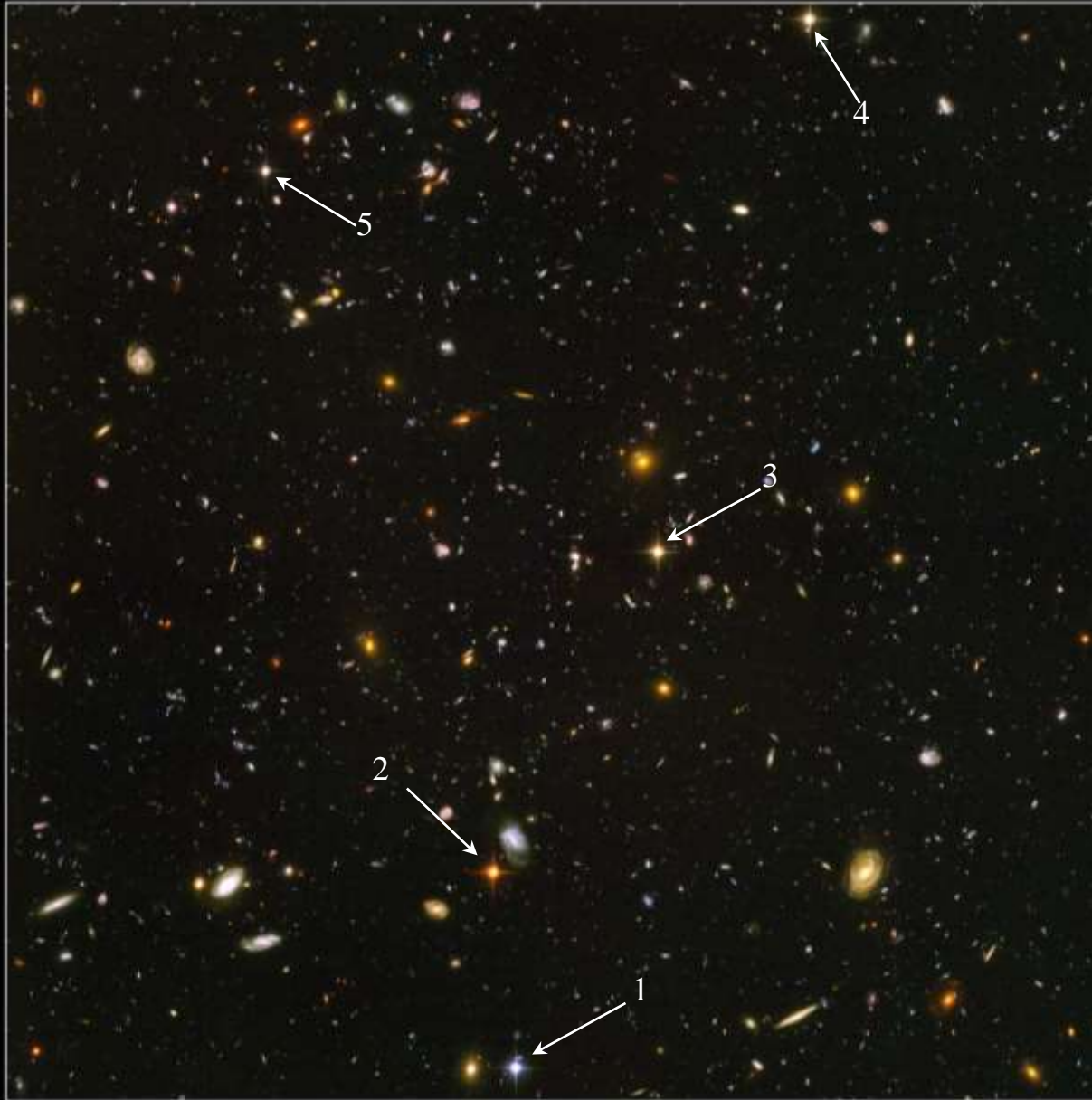
NASA and A. Riess (STScI)

Hubble Space Telescope - ACS



STScI-PRC04-12

# Hubble Space Telescope Deepest Views of the Early Universe



This view of nearly 10,000 galaxies is the deepest visible-light image of the cosmos.

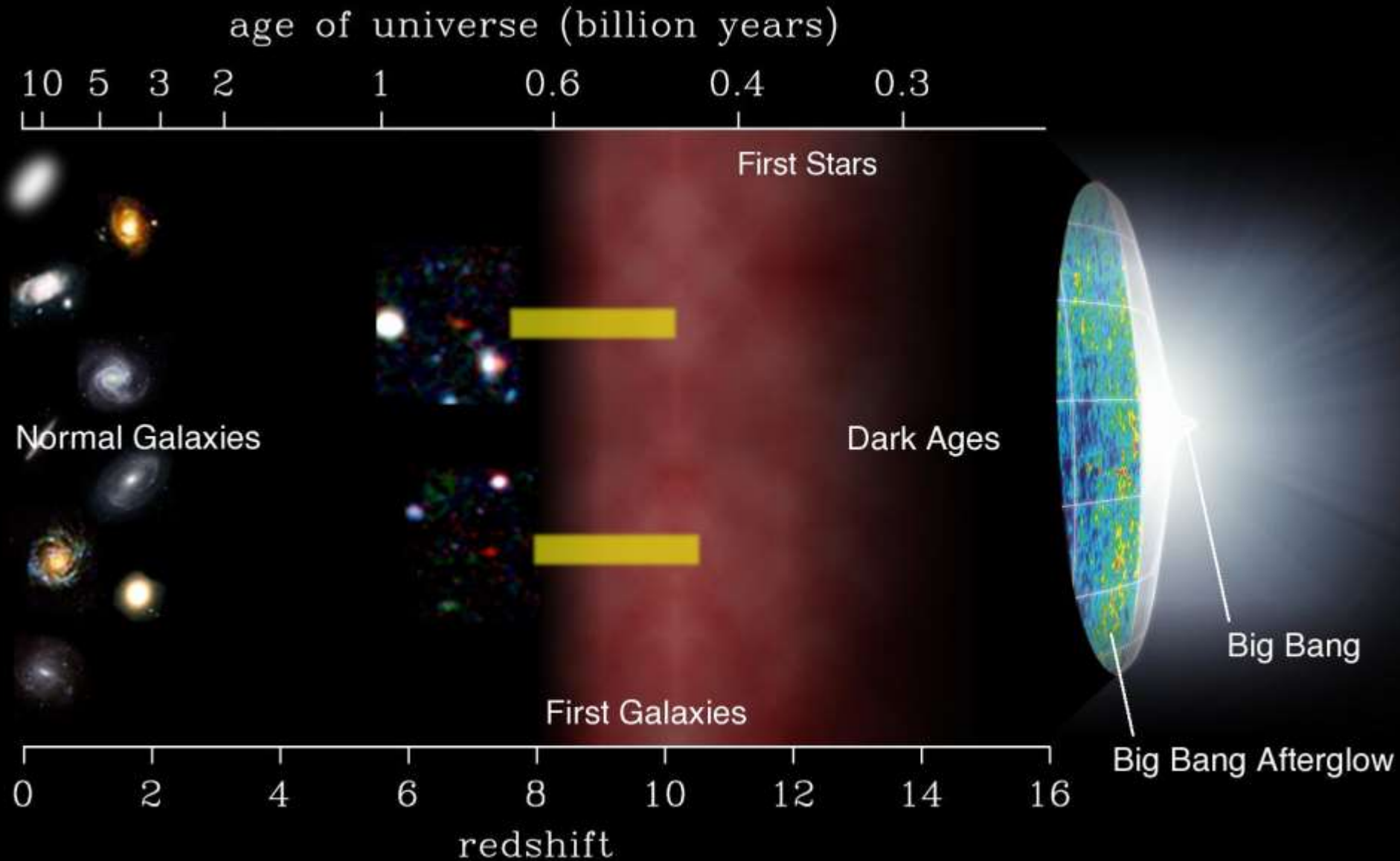
The smallest, reddest galaxies, about 100, may be among the most distant known, existing when the universe was just 800 million years old.

The nearest galaxies - the larger, brighter, well-defined spirals and ellipticals - thrived about 1 billion years ago, when the cosmos was 13 billion years old.

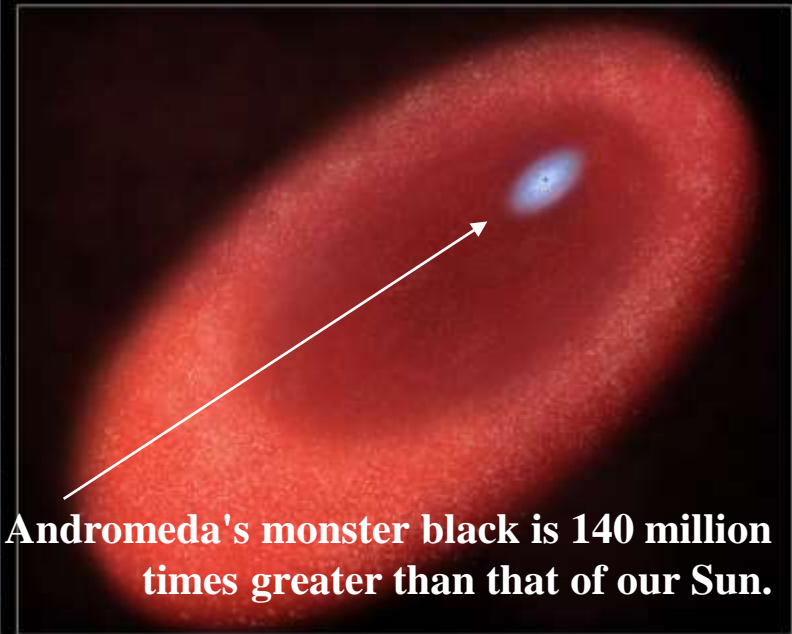
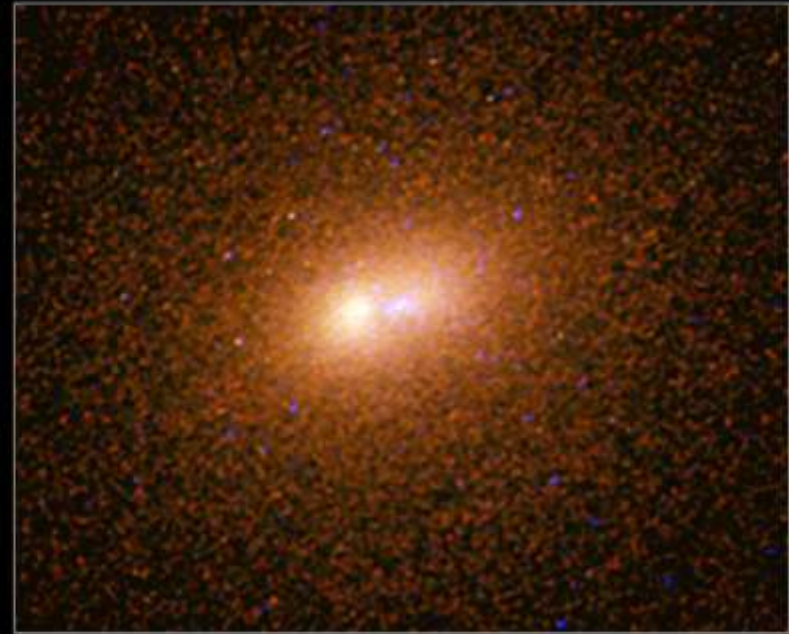
Peering into the Ultra Deep Field is like looking through an eight-foot-long soda straw.

The image required 800 exposures taken over the course of 400 Hubble orbits around Earth.

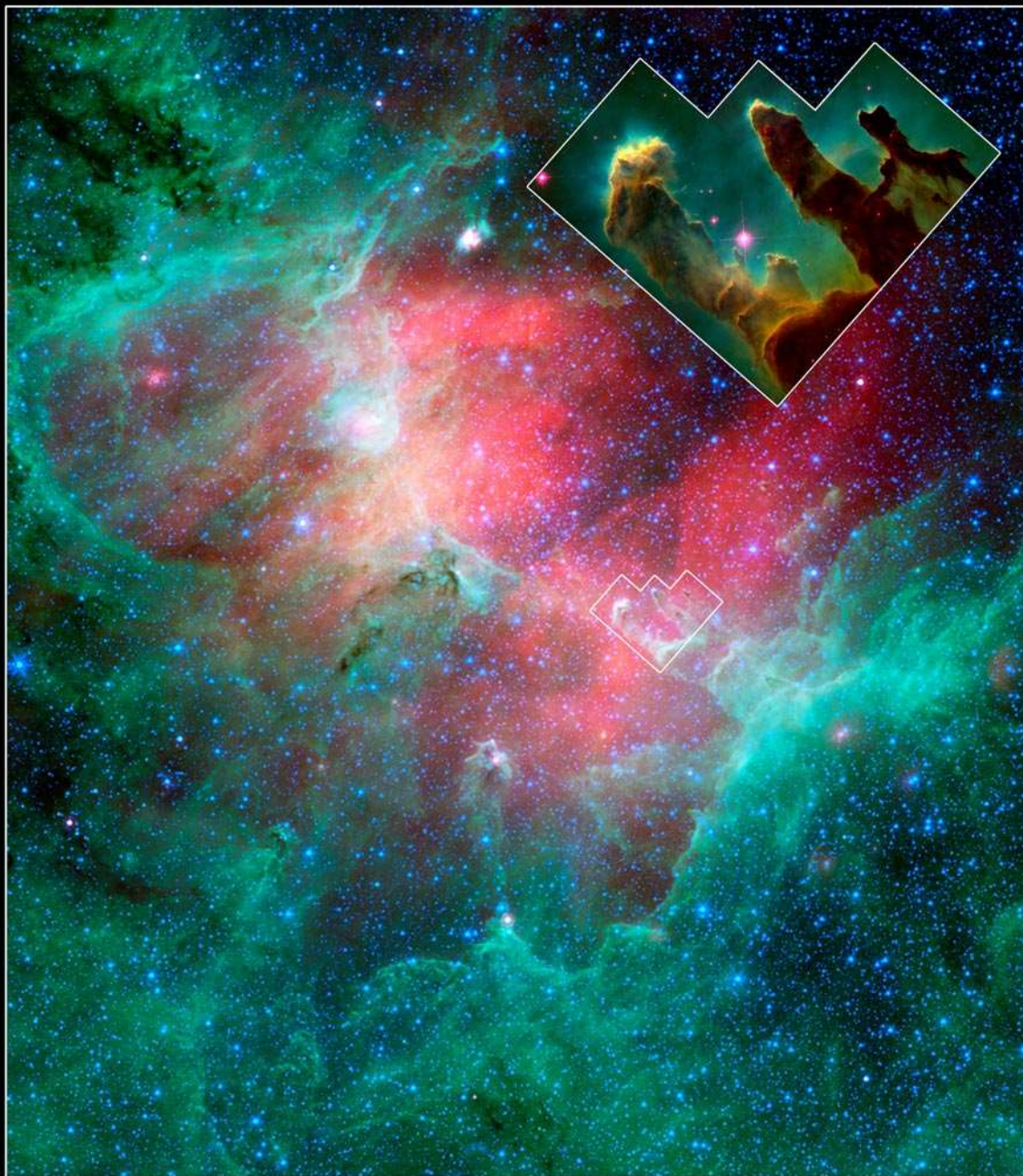
# Age of the Universe ~ 13.7 Billion Years Old



# Monster Black Holes are Everywhere



**Andromeda's monster black is 140 million times greater than that of our Sun.**

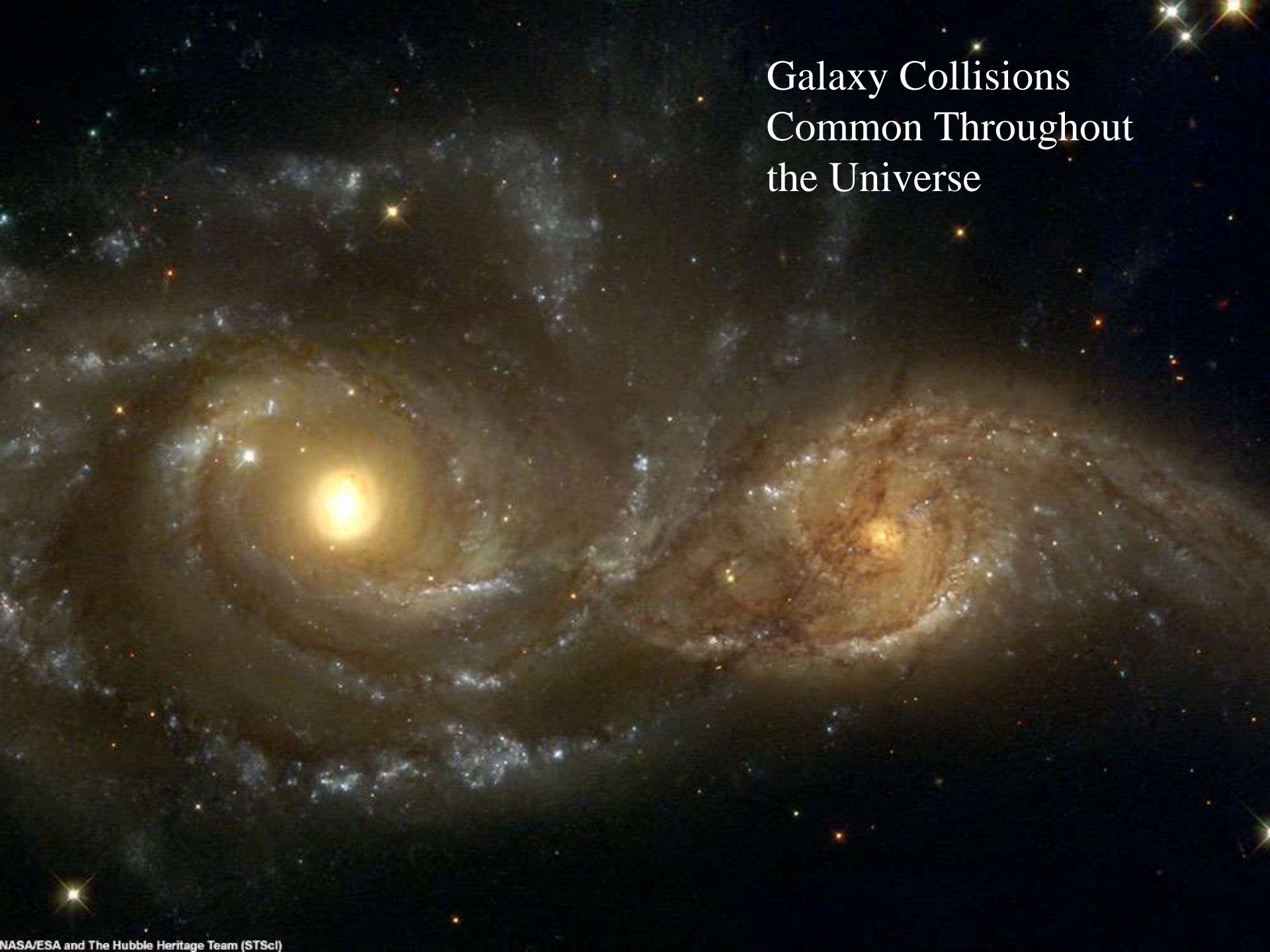


# Birthplaces of New Planetary Systems

Infrared Eagle Nebula and  
the "Pillars of Creation"

Spitzer Space Telescope • IRAC • MIPS  
Hubble Space Telescope (inset)

Galaxy Collisions  
Common Throughout  
the Universe

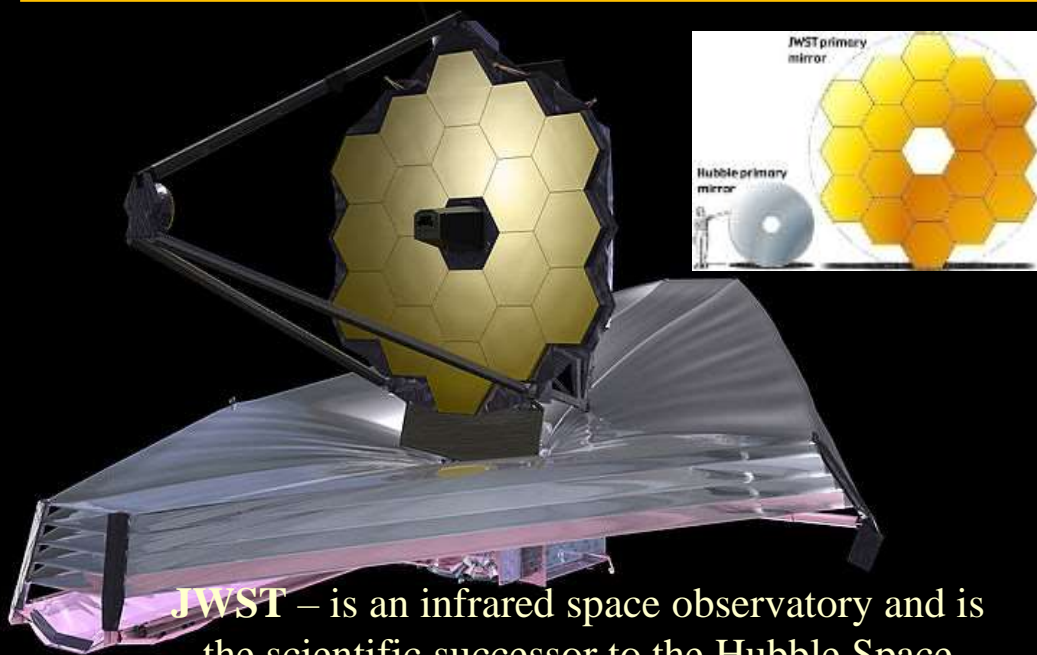




# Unprecedented Details of Stars Death

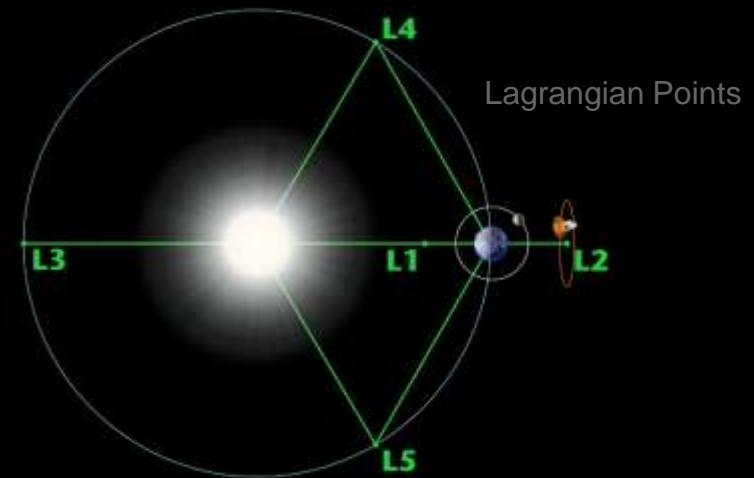


# James Webb Space Telescope (JWST)



**JWST** – is an infrared space observatory and is the scientific successor to the Hubble Space Telescope. The JWST 's main scientific goal is to observe the most distant objects in the universe beyond the reach of either ground based instruments or the Hubble.

- Organization - NASA / ESA / CSA
- **Launched date - Dec 25 2021**
- Launched from Guiana Space Centre ELA-3 Kourou, French Guiana
- Launch vehicle - Ariane 5
- Mission length - 5 years (design) 10 years (goal)



- JWST is capturing pictures of the very first stars in the universe and will help scientists study the atmosphere of planets orbiting stars outside our solar system to see if they might be habitable.
- JWST reached its final destination in space a million miles away - January 2022
- JWST Will Have 'Tremendous Impact' on Search for Alien Life

# James Webb Telescope Looking Back To the Beginning of Time

What did the First  
Galaxies and Stars Look  
Like

Are There Signs Of Alien  
Life In Our Galaxy

What Is The True Rate  
Of Universal Expansion

How Did the Universe  
Form

Is the Earth Unique



# Transiting Exoplanet Survey Satellite (TESS)

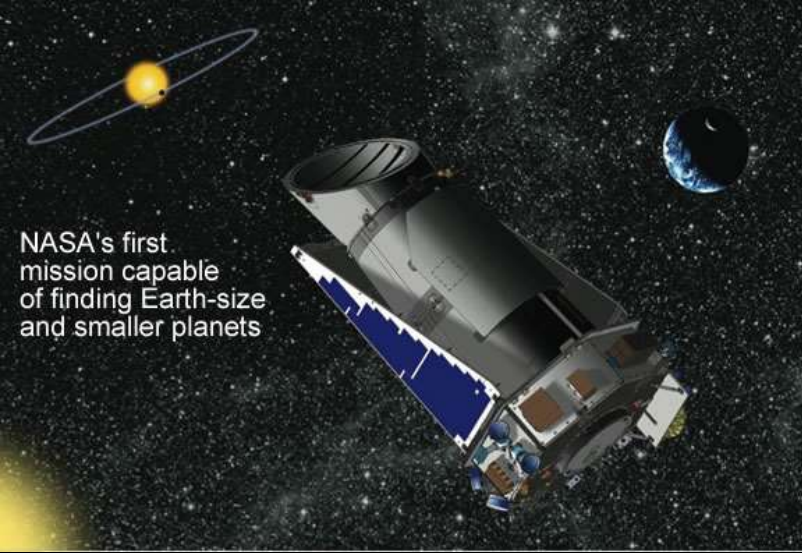


Launched on a Falcon 9 in April 18 2018

In the first-ever spaceborne all-sky transit survey, TESS will identify planets ranging from Earth-sized to gas giants, orbiting a wide range of stellar types and orbital distances.

The principal goal of the TESS mission is to detect small planets with bright host stars in the solar neighborhood, so that detailed characterizations of the planets and their atmospheres can be performed.

TESS will provide prime targets for further, more detailed characterization with the James Webb Space Telescope (JWST). So far, TESS has discovered over 5,000 alien worlds outside of our own solar system.



NASA's first mission capable of finding Earth-size and smaller planets

# Kepler

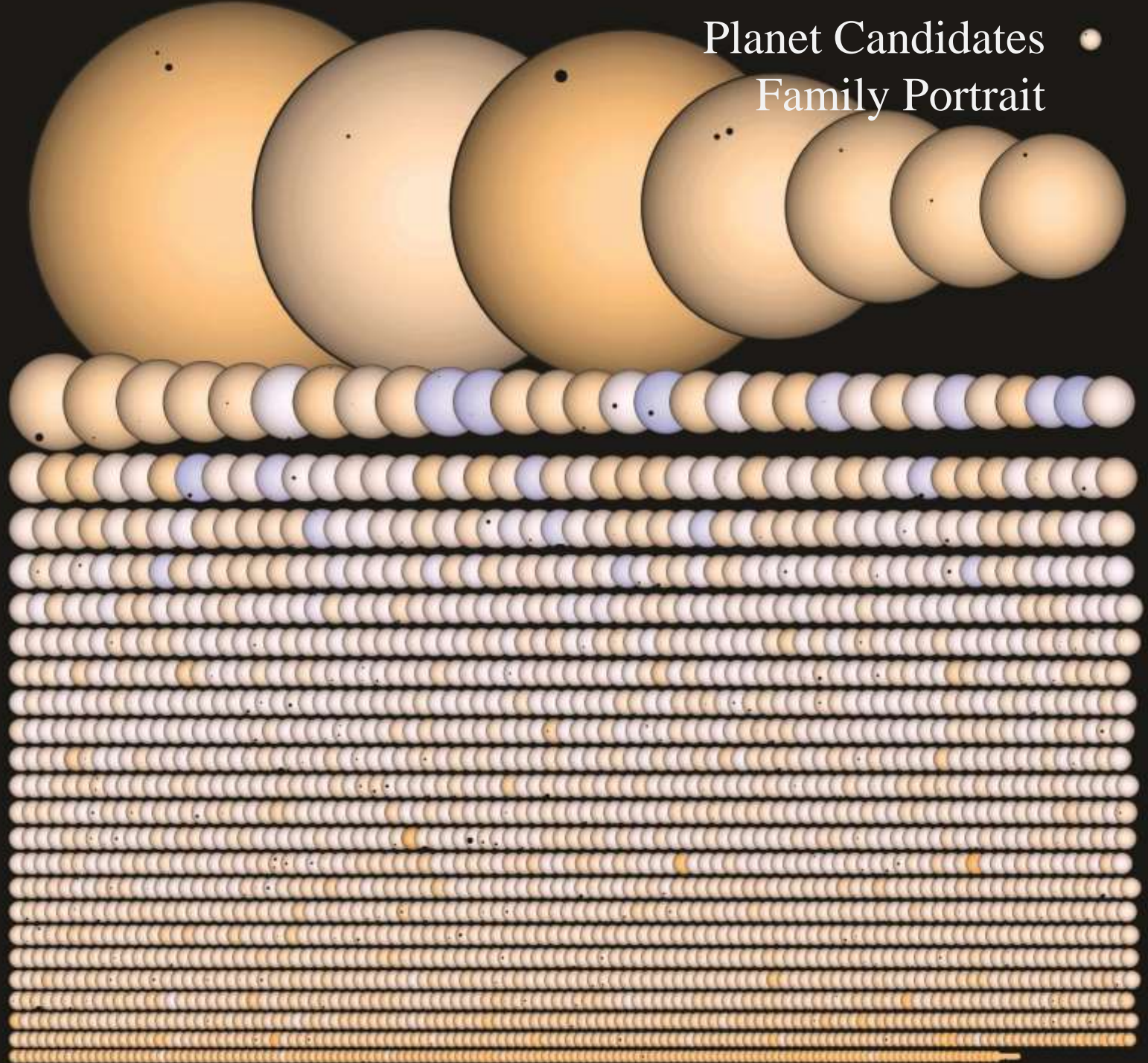
Survey our region of the Milky Way galaxy to discover Earth-size planets in or near the habitable zone

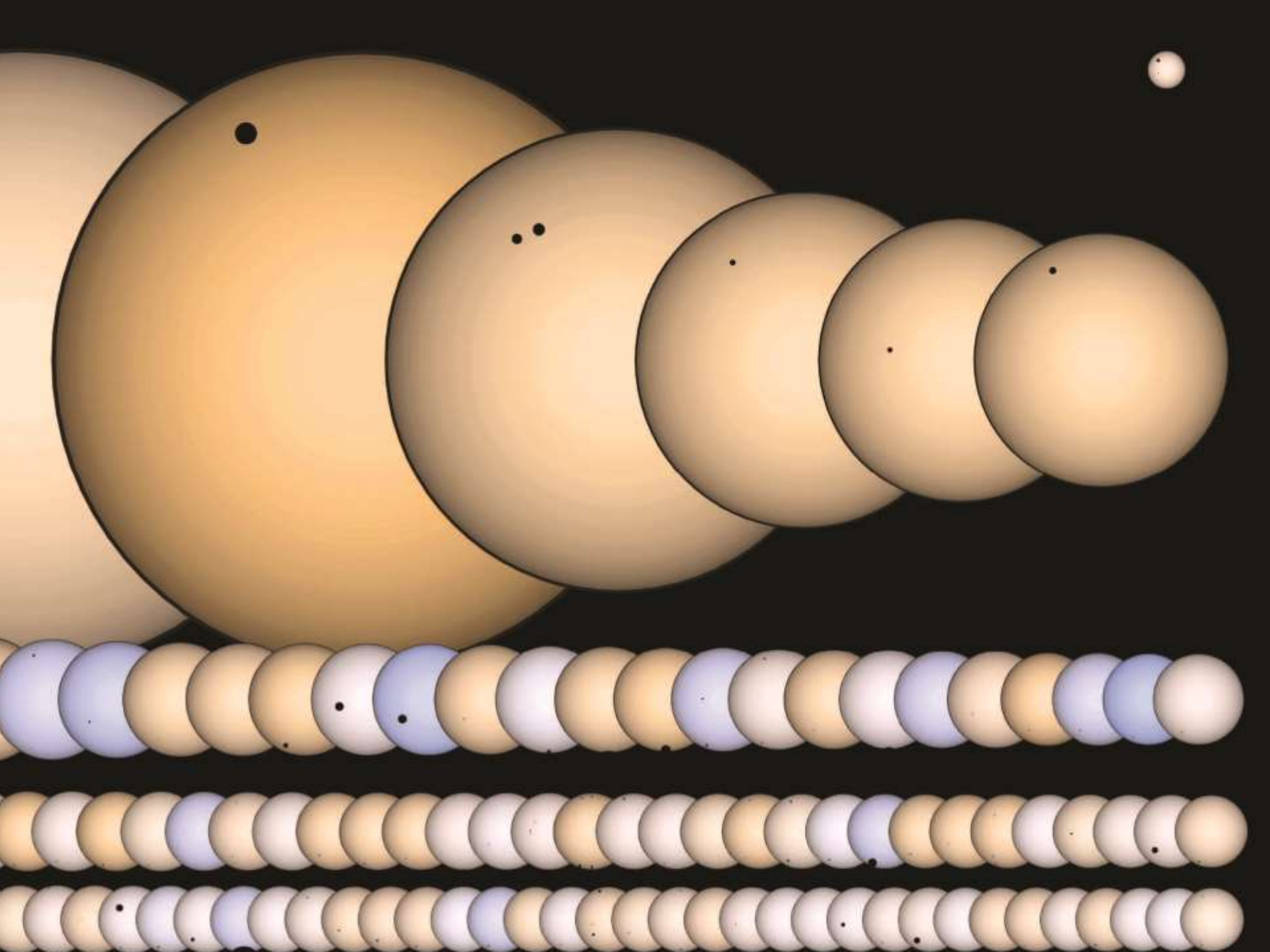
3000 light years

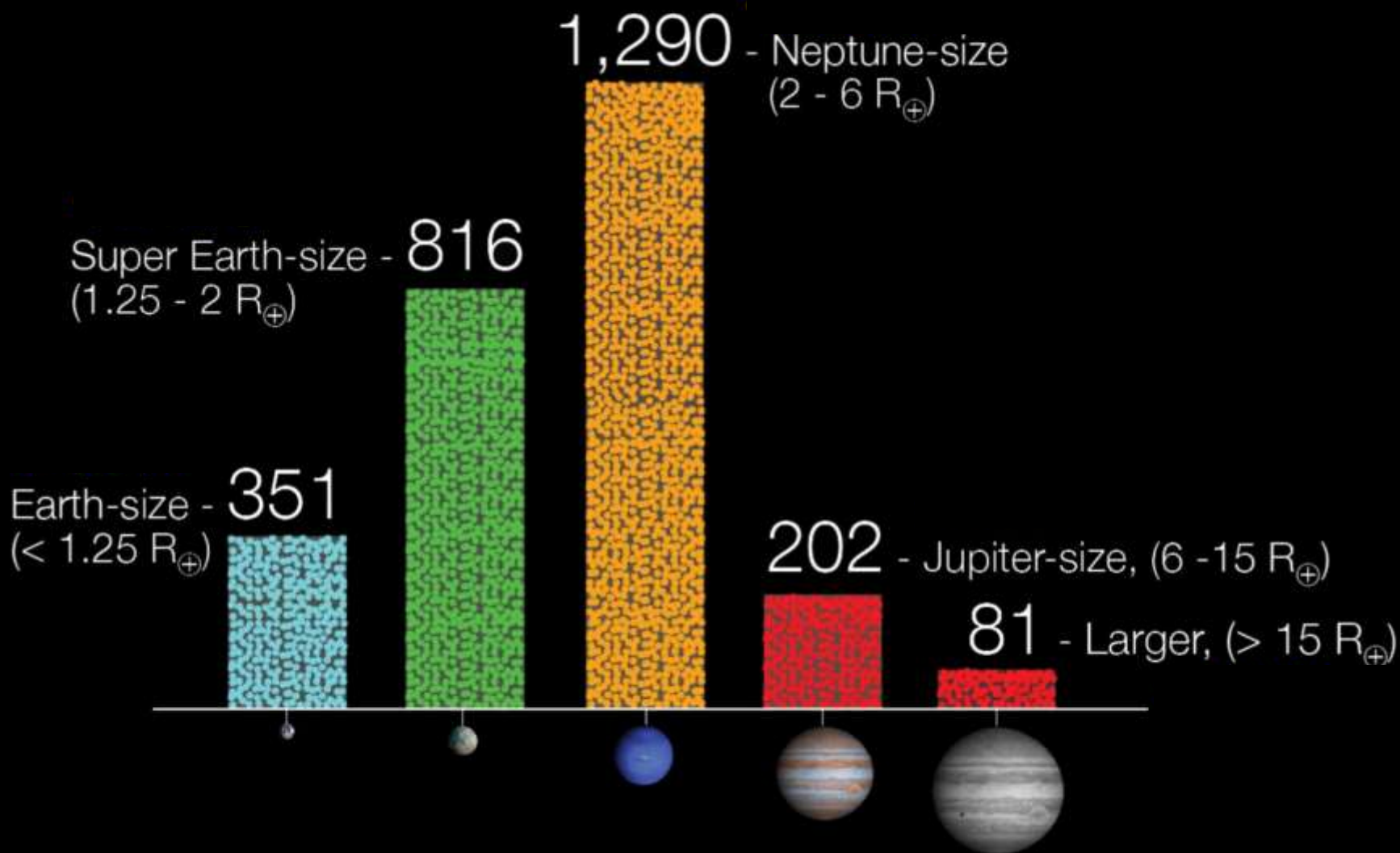
100,000 stars



# Planet Candidates Family Portrait









## Kepler Findings

Based on Kepler space mission data, there could be as **many** as **40 billion** Earth-sized **planets** orbiting in the habitable zones of **Sun-like** stars and red dwarf stars within the **Milky Way galaxy**. 11 billion of these estimated **planets may** be orbiting **Sun-like** stars.

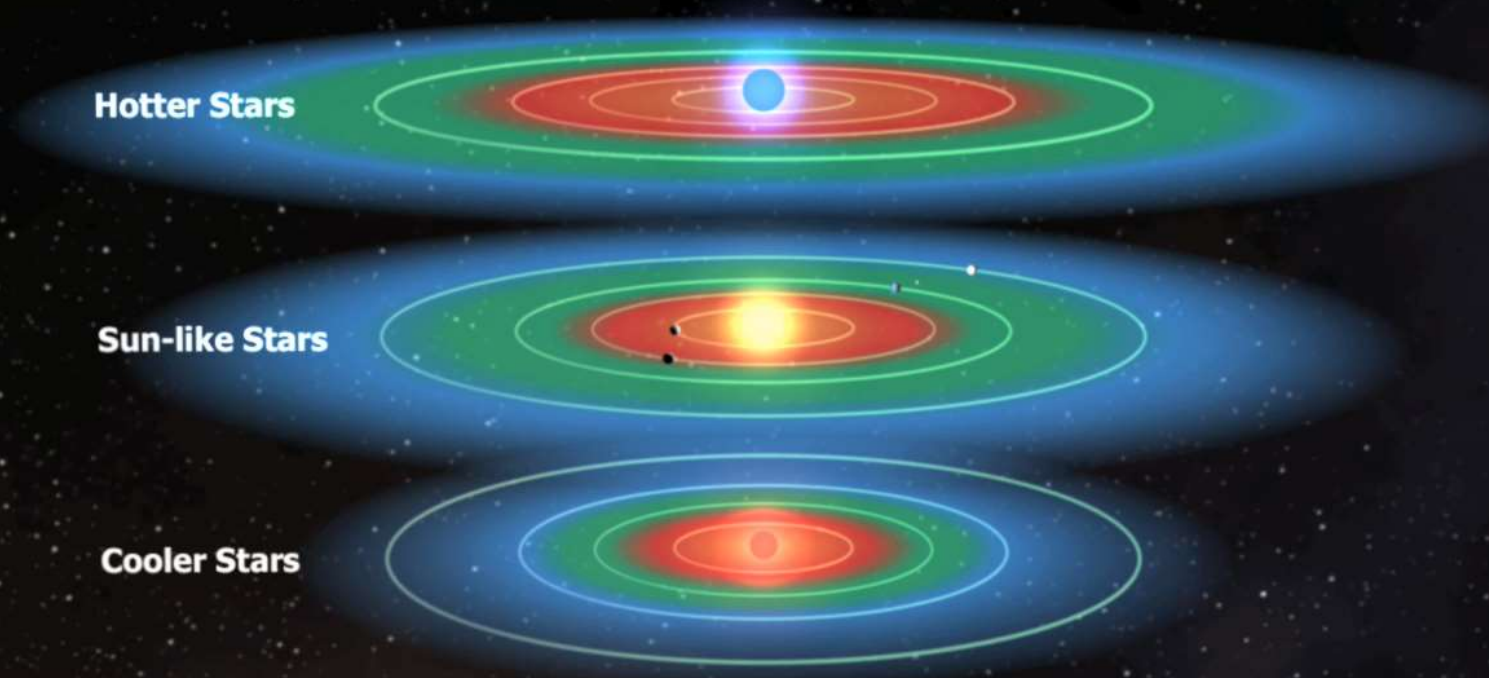
(We haven't considered large moons that could be paved with protoplasm, such as the fictional satellite Pandora in the movie "Avatar")

### Habitable Zones Are Dependent on Their Stars

Hotter Stars

Sun-like Stars

Cooler Stars



All civilizations become either  
spacefaring or extinct.



--CARL SAGAN

