

Are we alone in the Universe?



Class 2.

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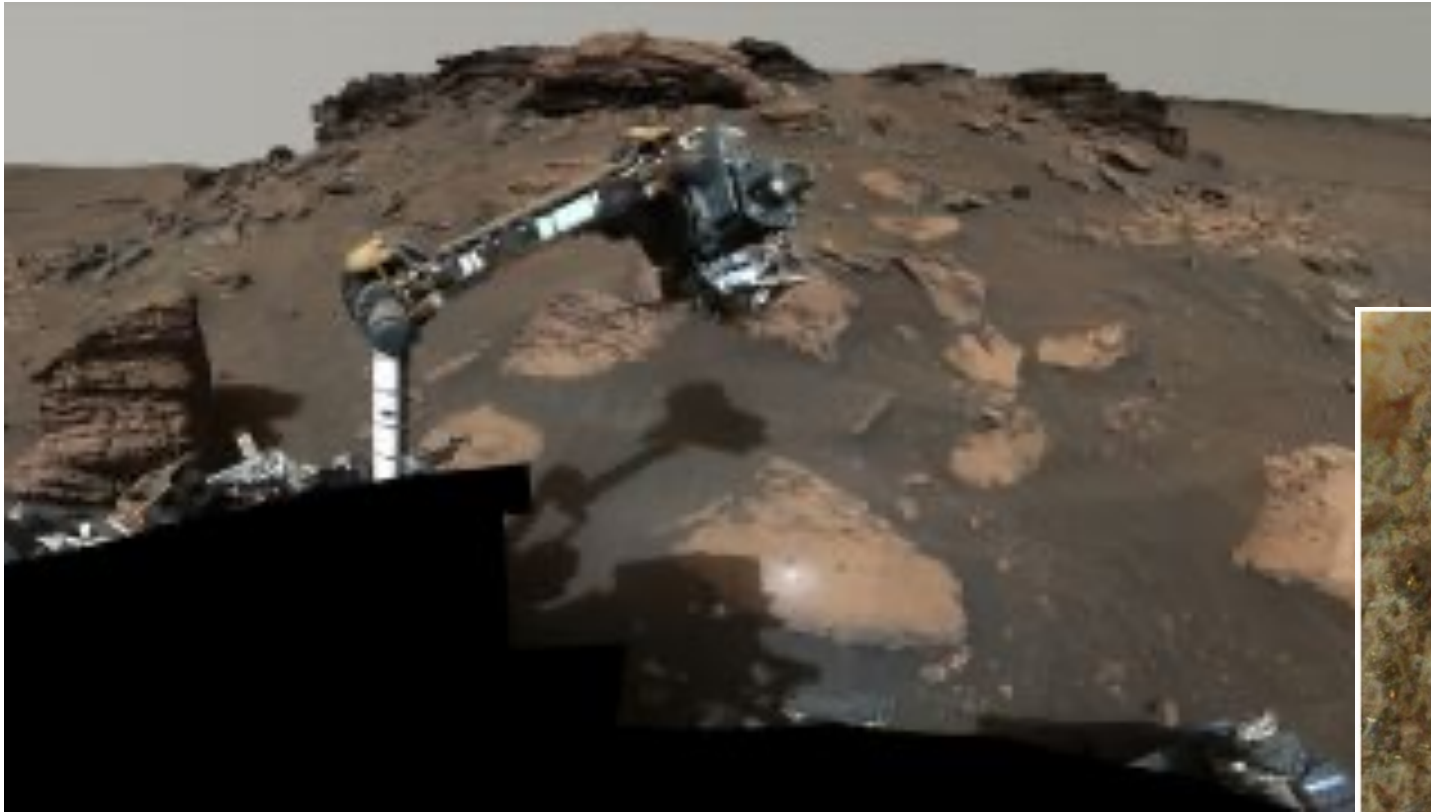


Sabanci University, FENS



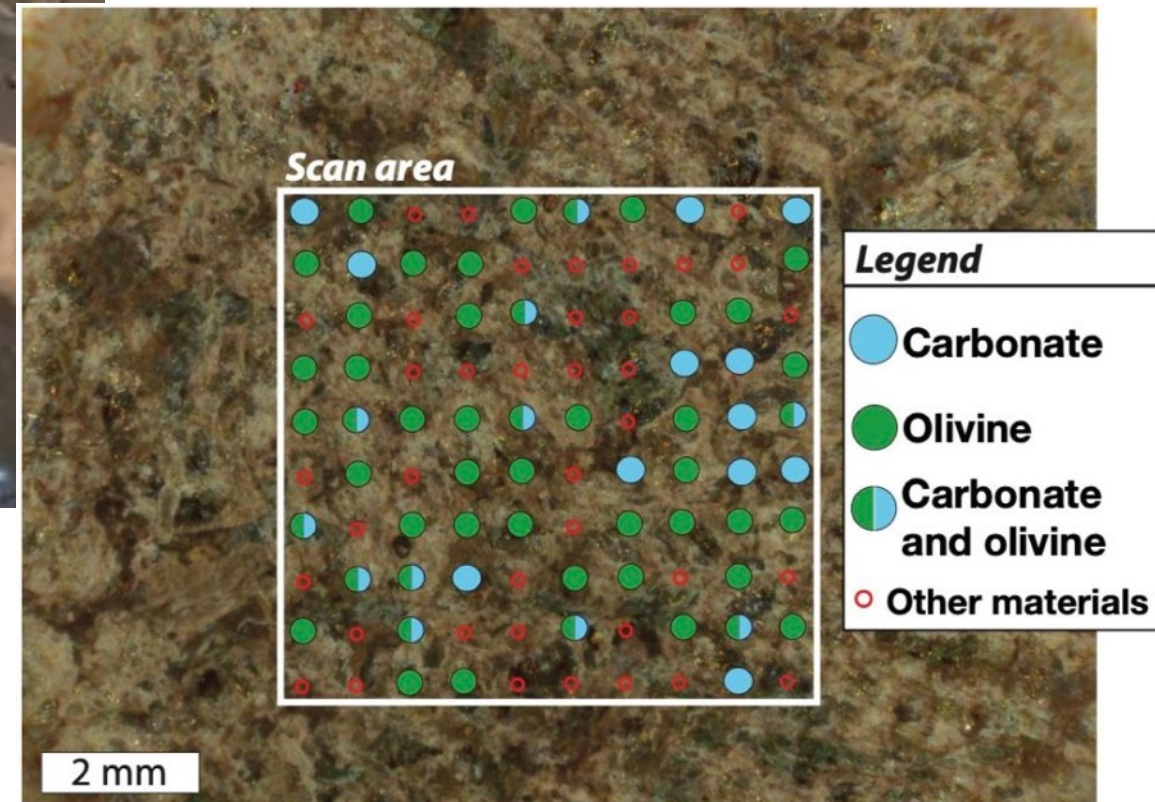
High School Summer Course, 2023

Biosignature on Mars?



<https://www.space.com/perseverance-rover-organic-molecules-mars>

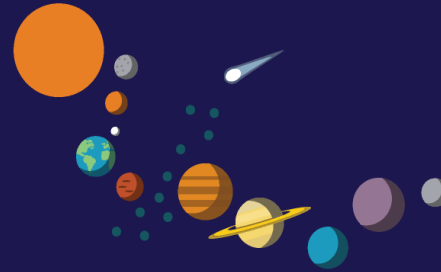
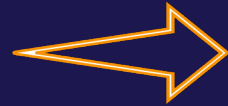
<https://www.nasa.gov/feature/jpl/searching-for-life-in-nasa-s-perseverance-mars-samples>



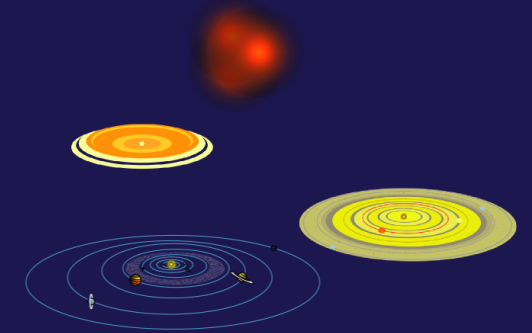
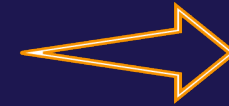
Our Map:



What are there in the Universe?
Scales involved in describing Universe



Our planet and Solar system



How did the Solar system form?
Is it unique?

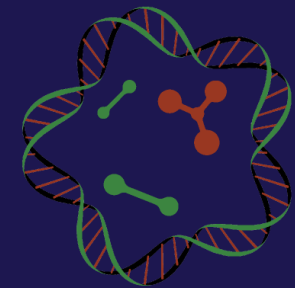
Are we alone in the universe?



What form of life would you look for and how? Possibility of life on other planets.



How can we look for ET life?
Atom and EM spectrum.



What is life?
How did life on Earth begin? Building blocks of life, first form of life on Earth.

A person is sitting on a dark rock in the foreground, looking up at a vast night sky filled with stars. The Milky Way galaxy is clearly visible, stretching across the sky from the bottom left towards the top right. The background is a gradient from dark blue to white on the right side.

Today's goals... (learning objectives)

Class 2.

By the end of this class, you should be able to:

1. State what **Drake equation** estimates
2. Define **lightyear**

Drake Equation

Astro

Chem/Bio

Intel/Tech



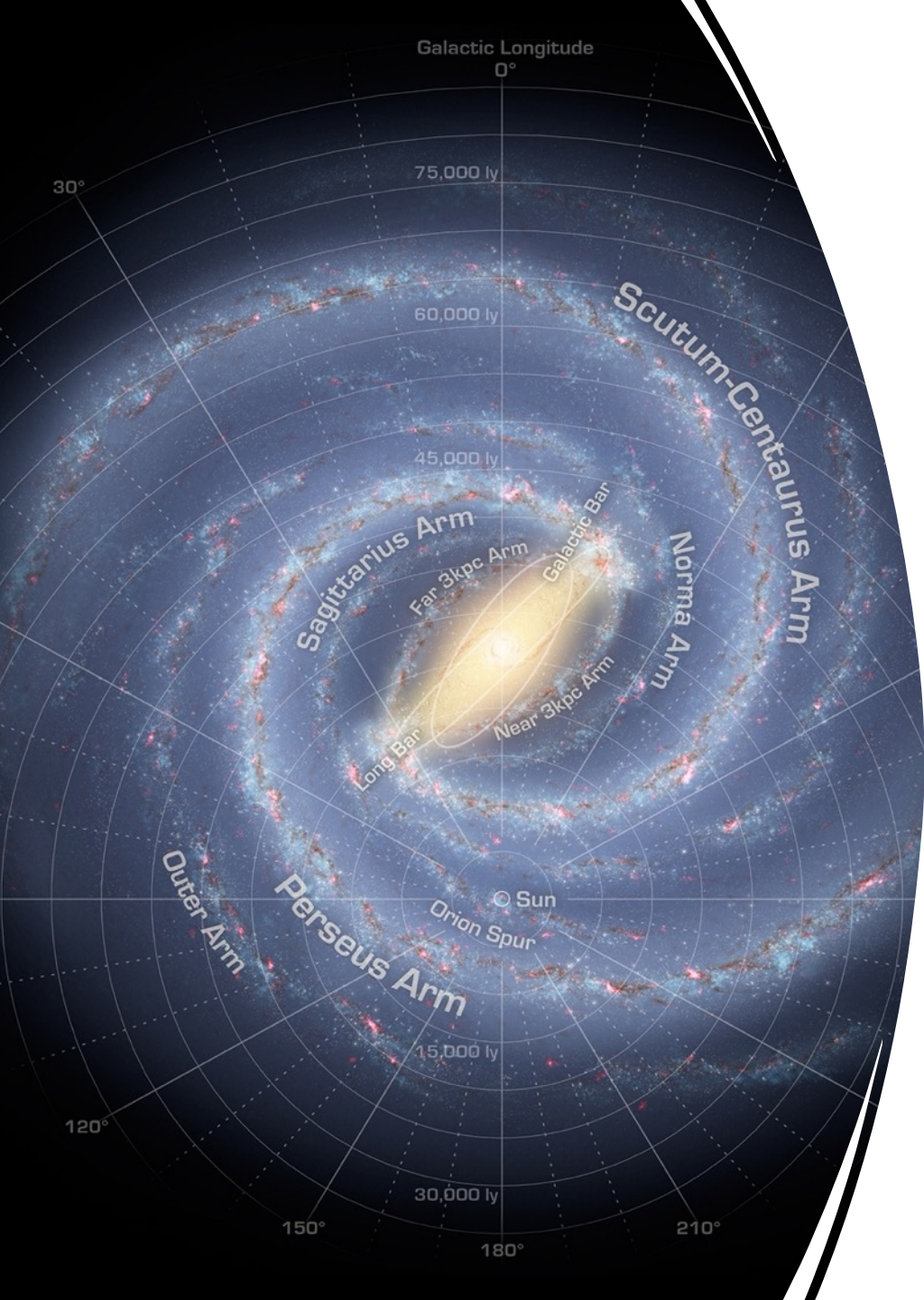
We will explore some of the factors that affect finding **intelligent** life in **our Galaxy**.

Places to Search?

Questions:

1. Where do we seek life in the solar system?
2. Where do we seek life outside the solar system?

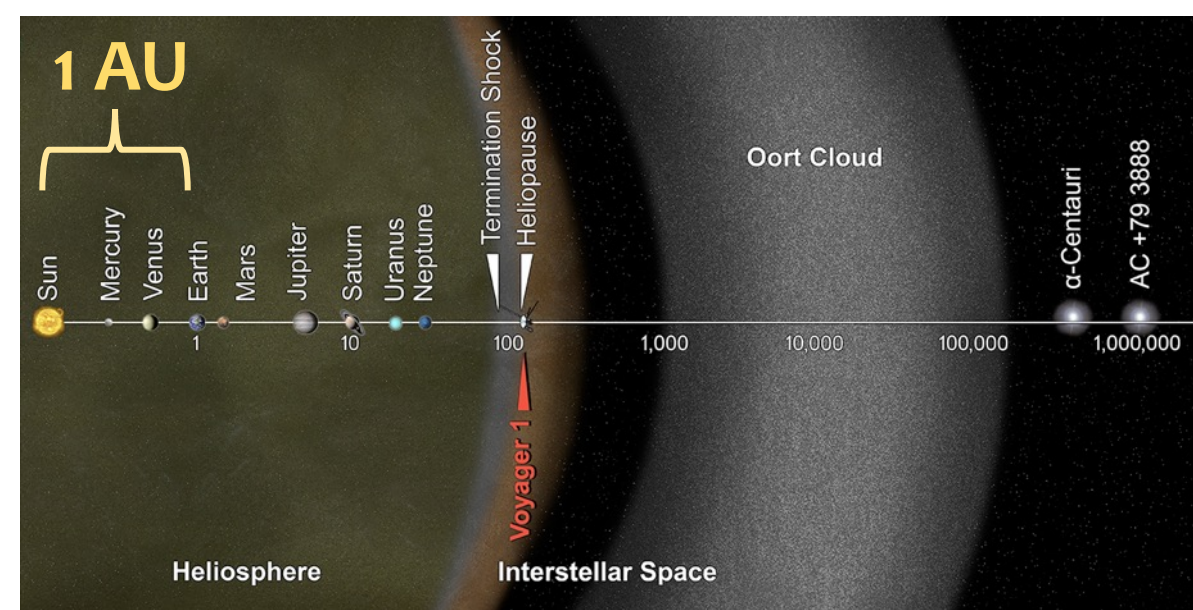




Life Outside the Solar System?

- 400 billion stars in the Milky Way; is finding life truly possible?
- Stars are extremely far away; fastest current spaceships could not make it in your lifetime
- Look for the "debris" of other civilizations, such as radio signals or other telltale signatures of intelligent life

Distance scales in Astronomy



The distances within the Solar system can be expressed in terms of

- **1 Astronomical Unit (AU)** = 150 000 000 000 m = 1.5×10^{11} m ~ 8 light-minutes

The distances outside the Solar system

- **1 light year** = Distance traveled by light in a year
= 300,000 km/s x 365 days x 86400 s/day ~ 10 trillion (10^{13}) km

The distances for a galaxy and beyond:

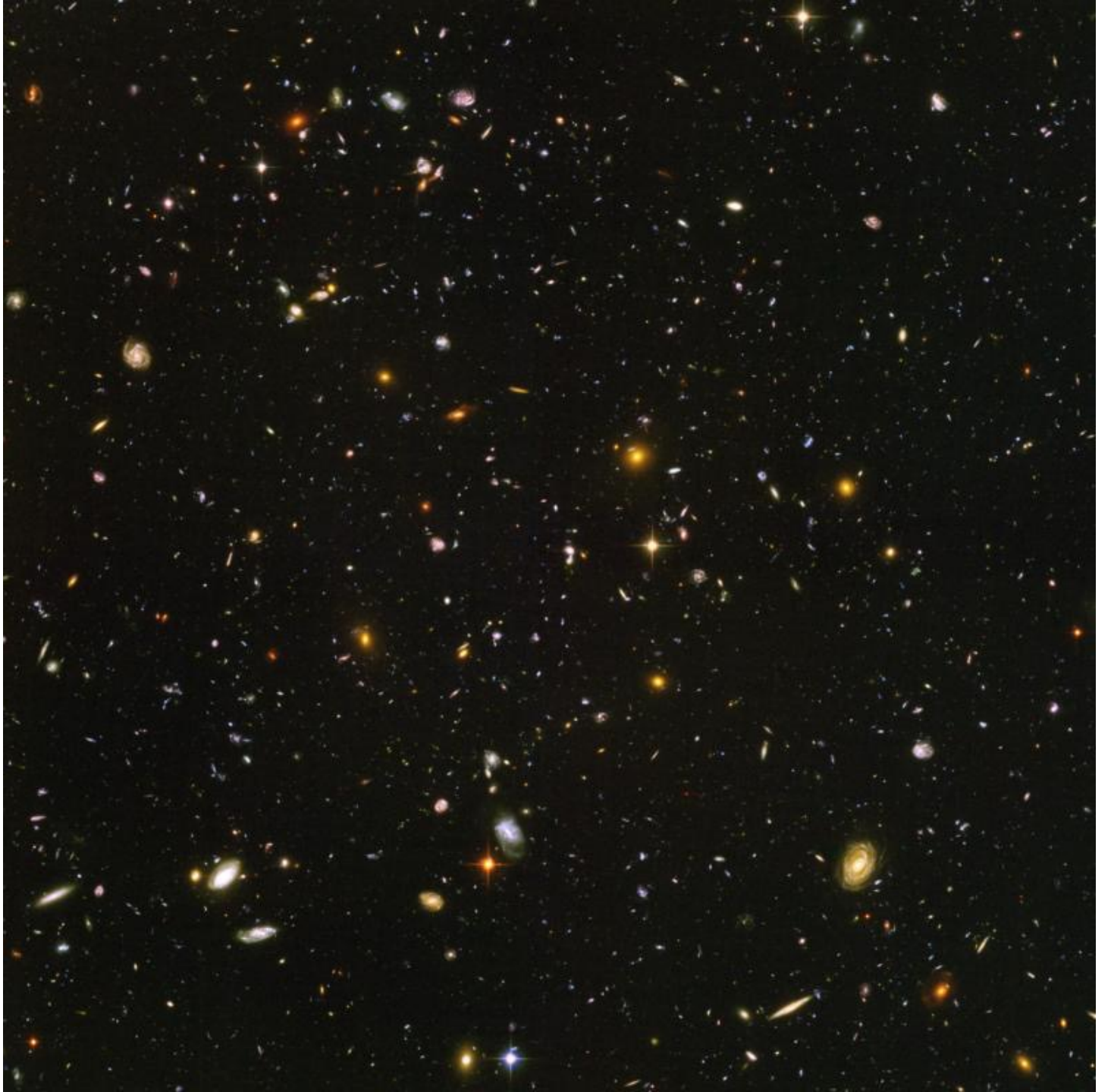
- **1 parsec (pc)** ~ 206,264.8 AU ~ 3.085×10^{16} m ~ 3.26 light years

[If the Moon Were Only One Pixel](#)

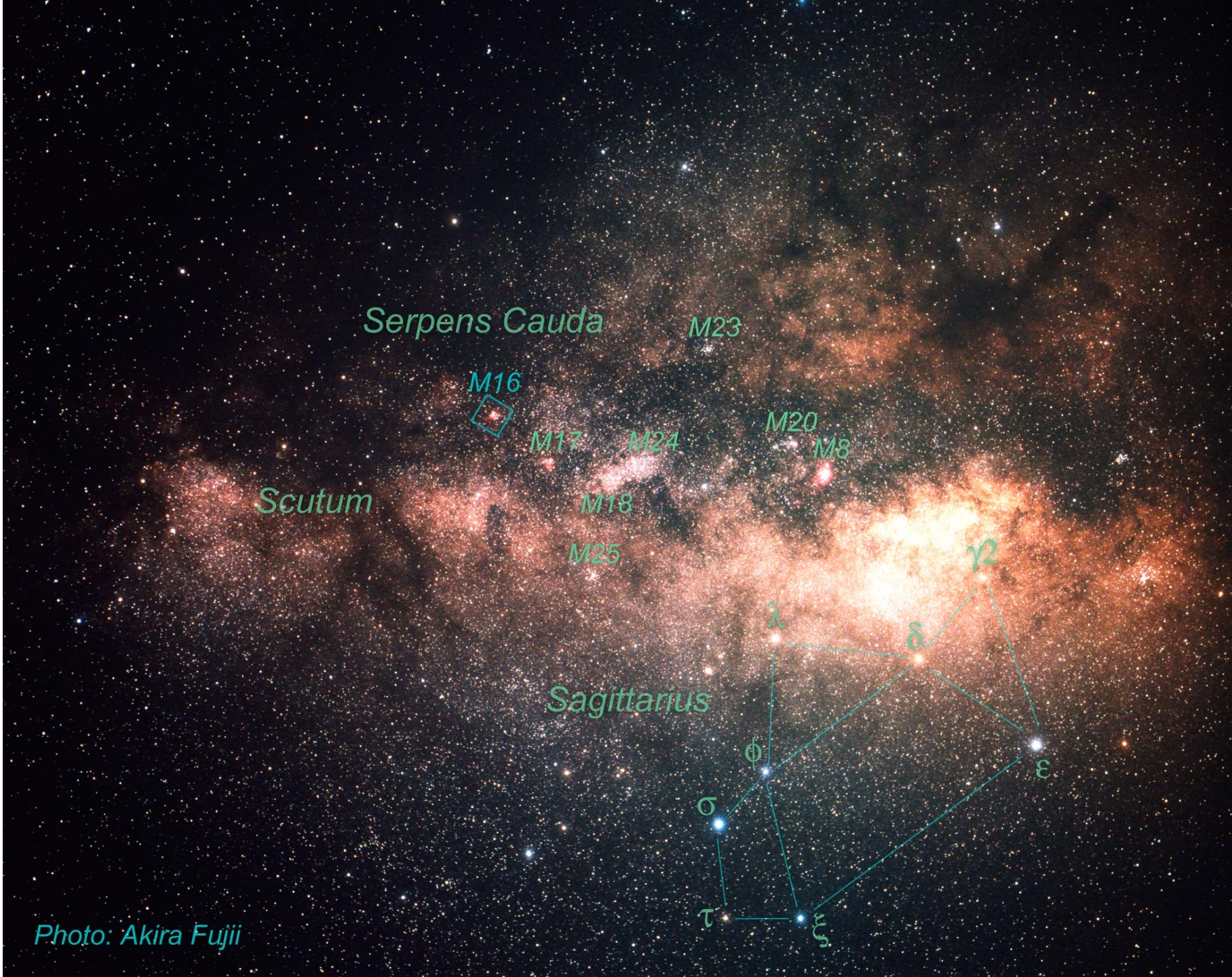
Hubble Ultra Deep Field

~ 10,000 galaxies

<https://esahubble.org/images/heic0611b/>







Serpens Cauda

M23

M16

M17

M24

M20

M8

Scutum

M18

M25

Sagittarius

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γ2

ε

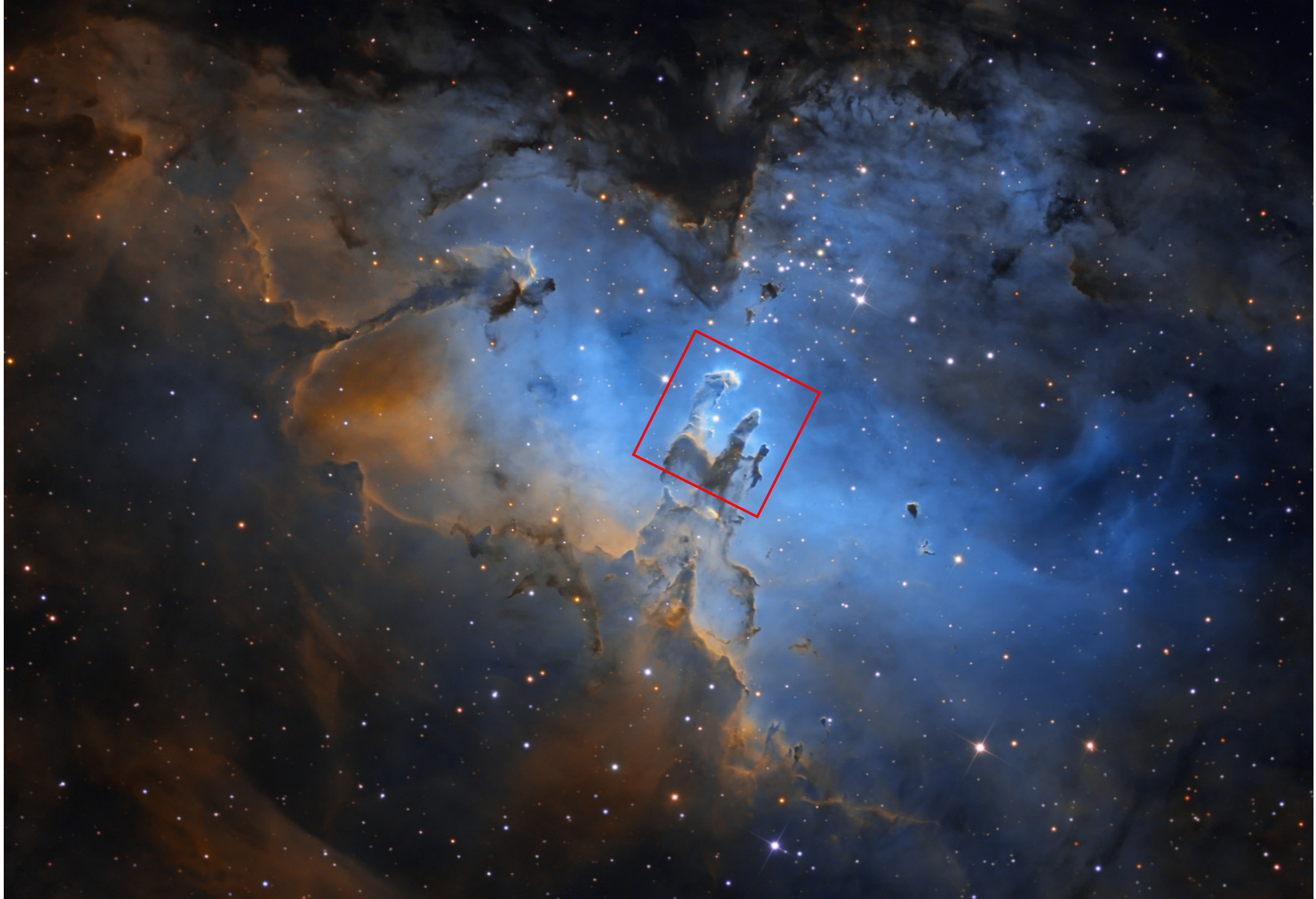
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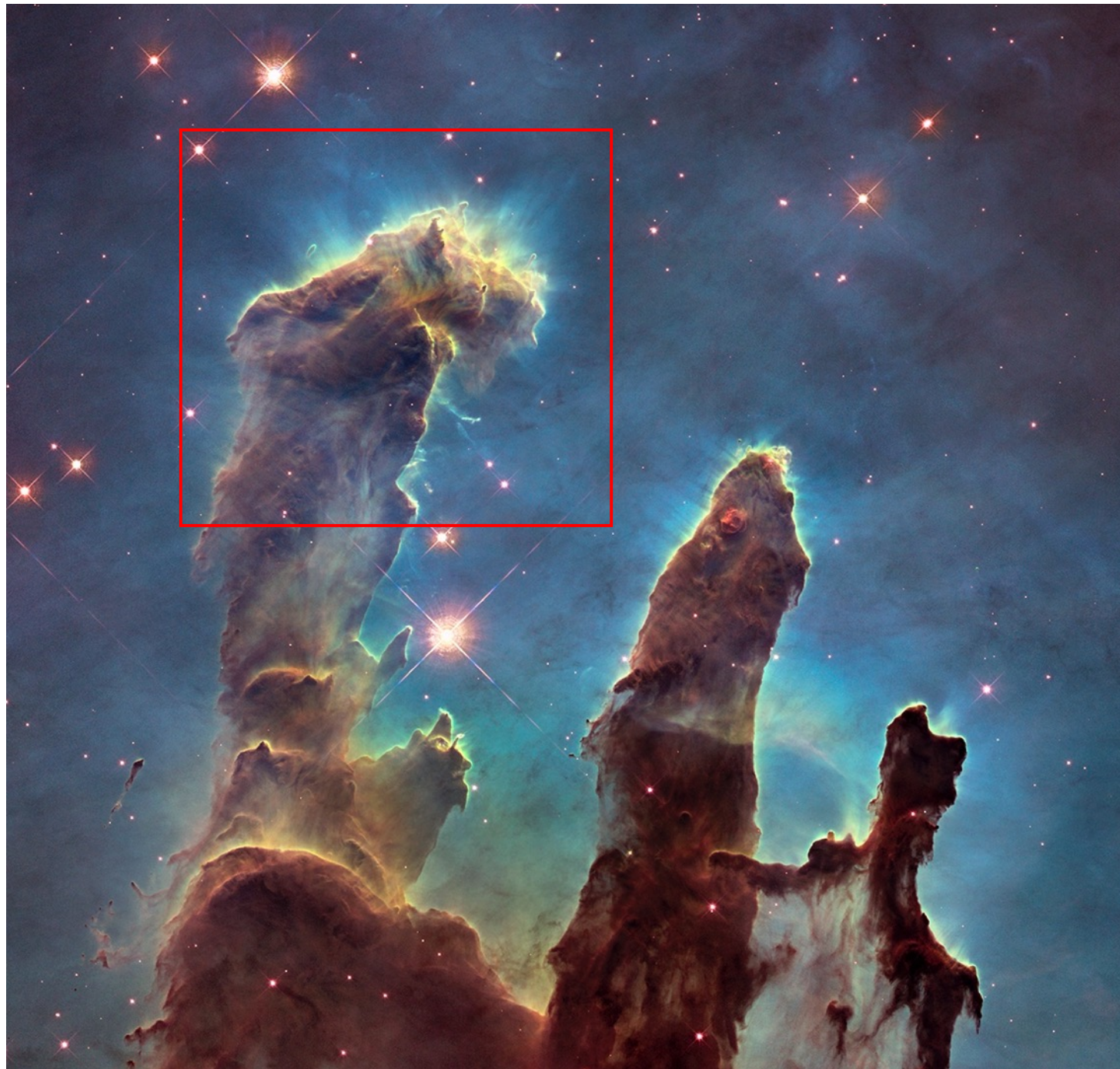
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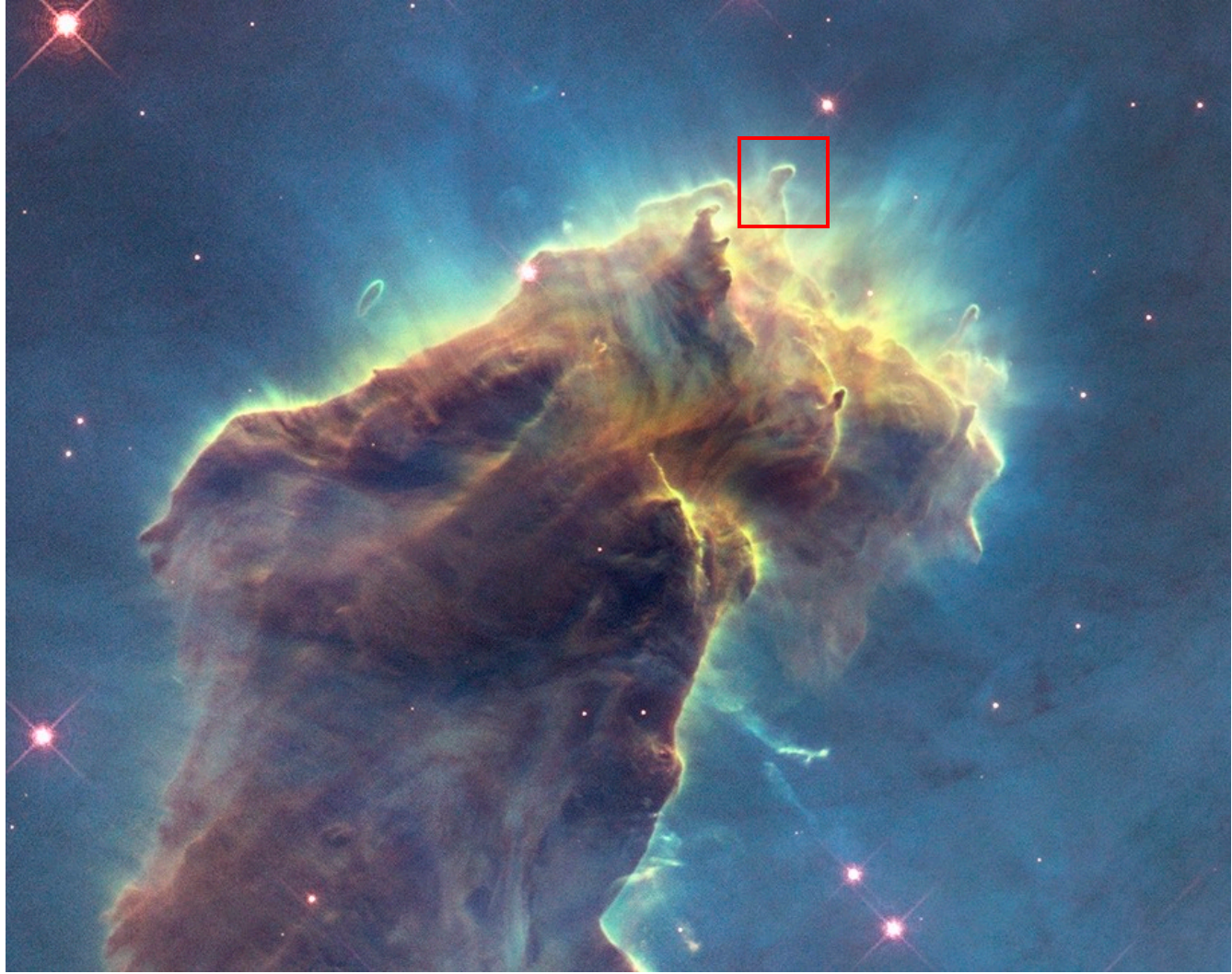
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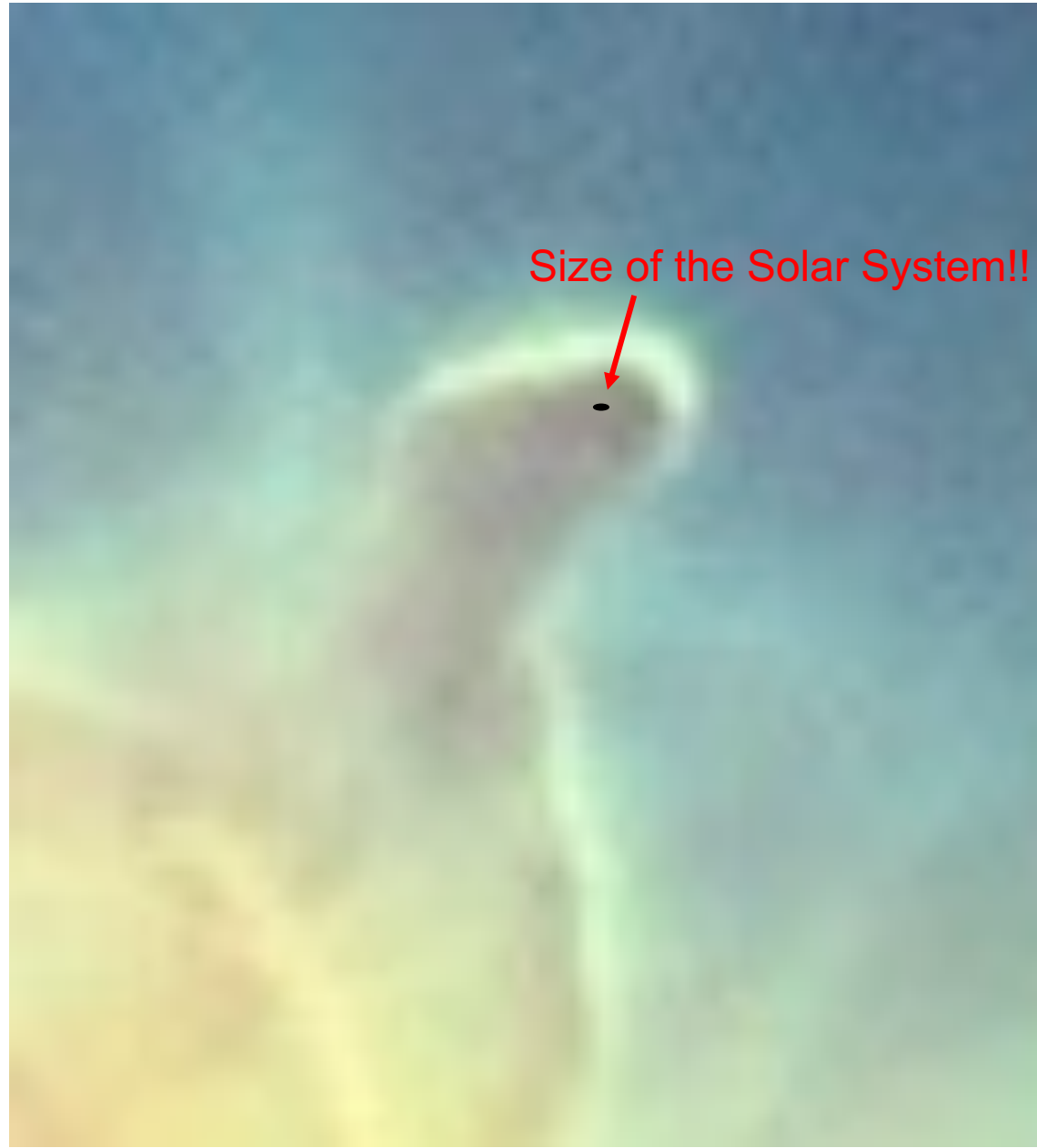
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Photo: Akira Fujii









Size of the Solar System!!

Scale of the Universe

<https://htwins.net/scale2/>

