A Journey Through The Universe
+
Eclipses

Teja Teppala

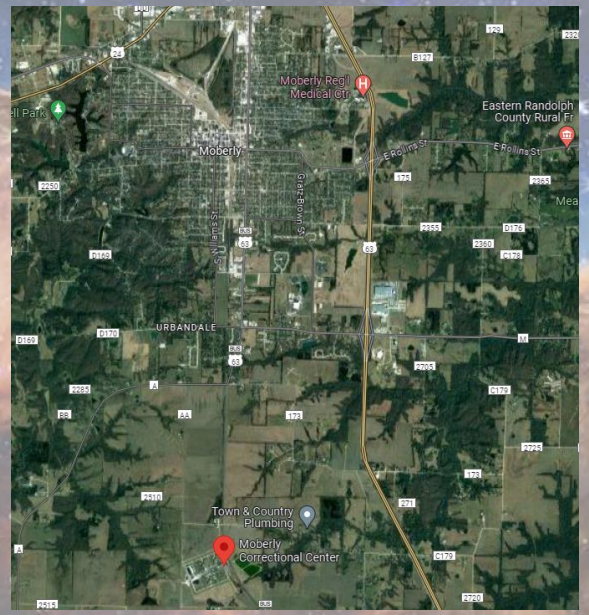
About me:

- Teja Teppala
- From Visakhapatnam, India
- PhD student in astronomy at the University of Missouri – Columbia

What is the size of the universe?

- Any guesses?

Where are we?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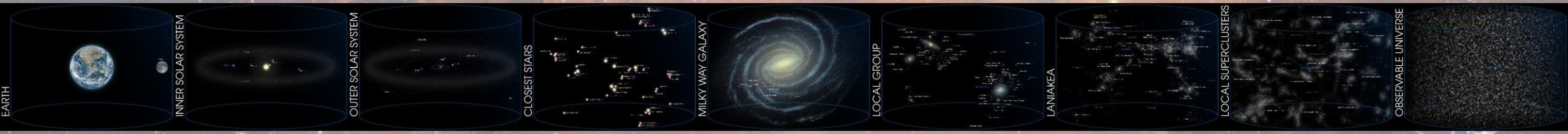
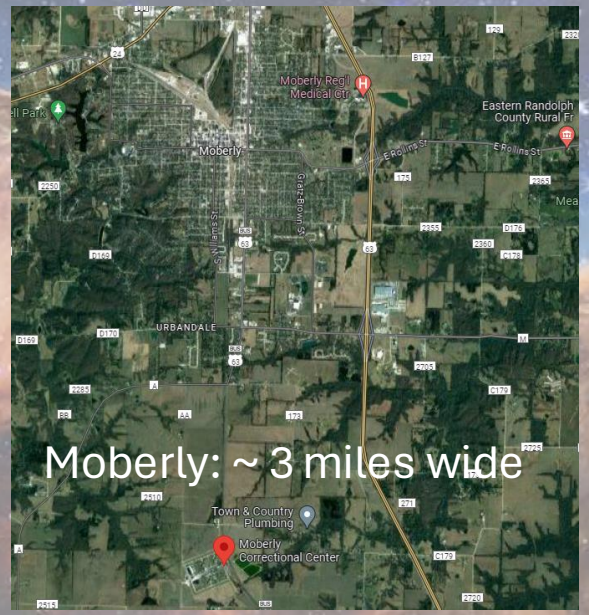
Eastern Randolph County Rural Fr
Moberly
E Rollins St
S Williams St
S Clark Ave
URBANDALE
Town & Country Plumbing
Moberly Correctional Center


EARTH
INNER SOLAR SYSTEM
OUTER SOLAR SYSTEM
CLOSEST STARS
MILKY WAY GALAXY
LOCAL GROUP
LANIAKEA
LOCAL SUPERCLUSTERS
OBSERVABLE UNIVERSE

Where are we?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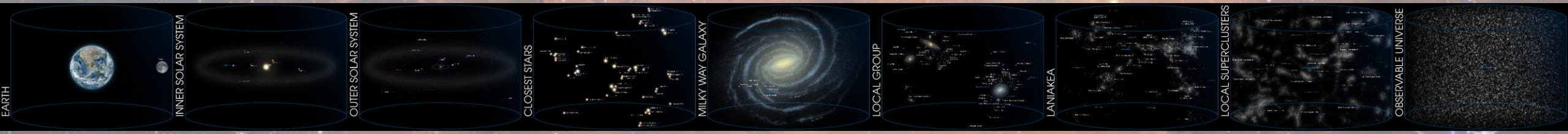
Moberly: ~ 3 miles wide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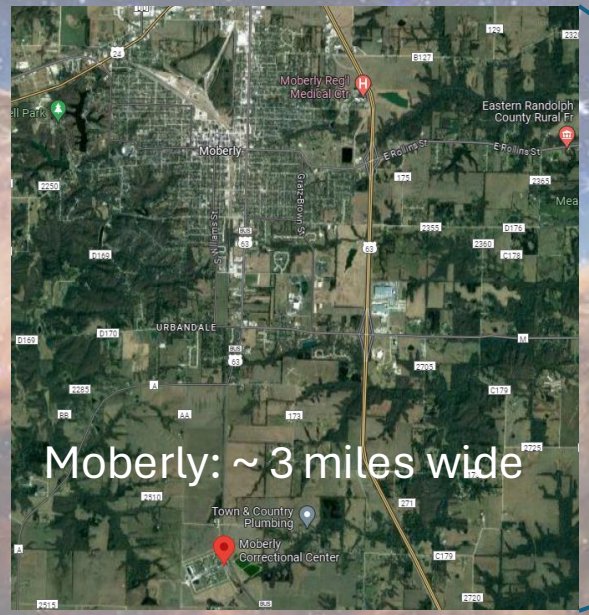
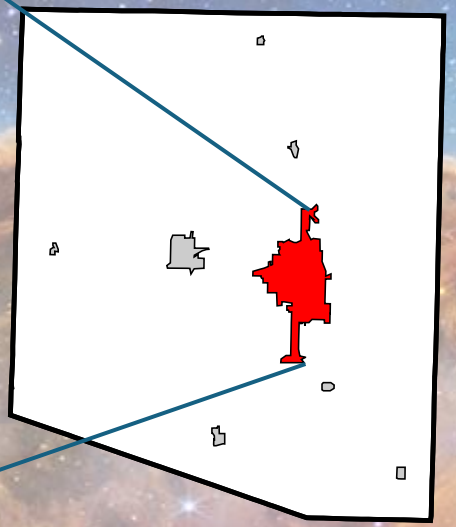
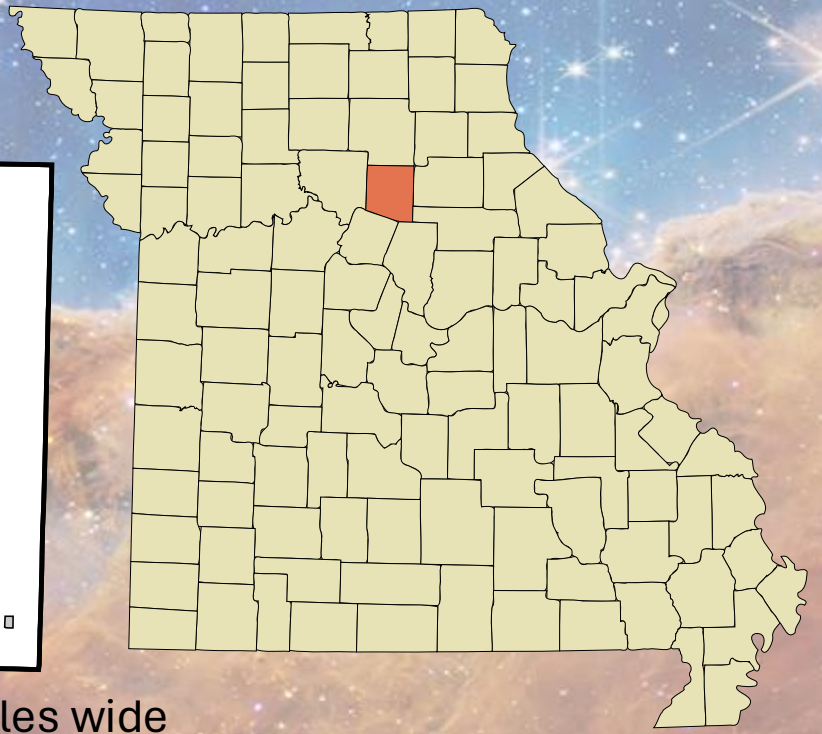
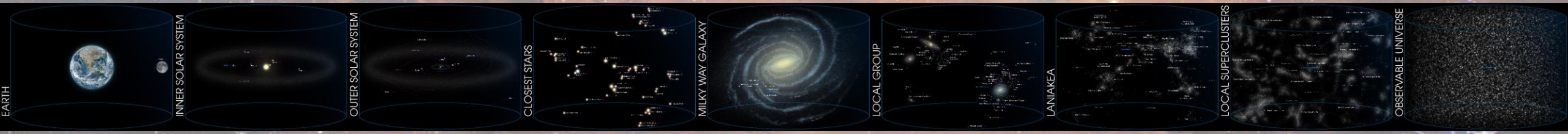






Randolph County: 20 miles wide



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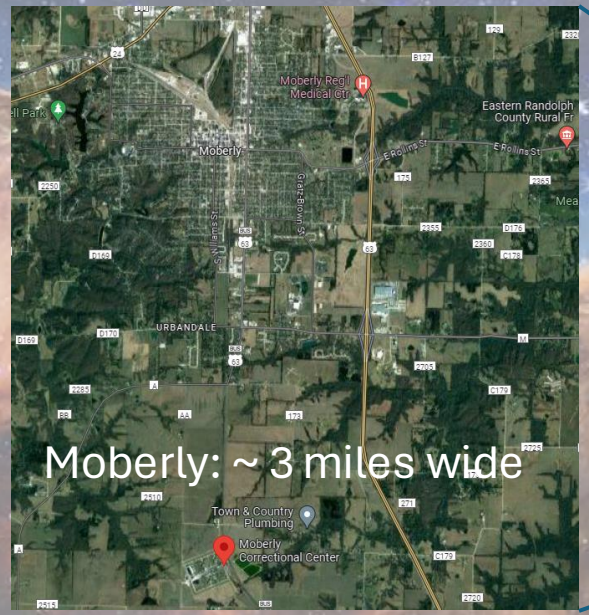
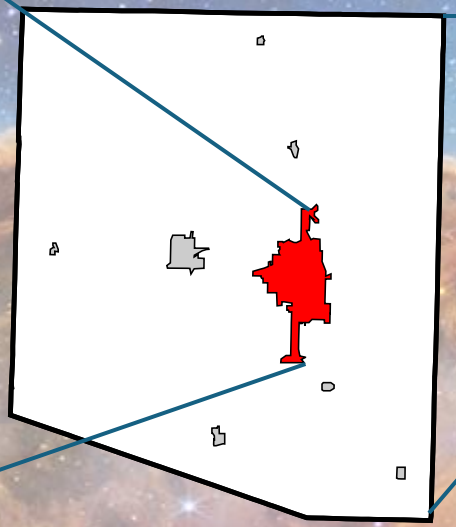
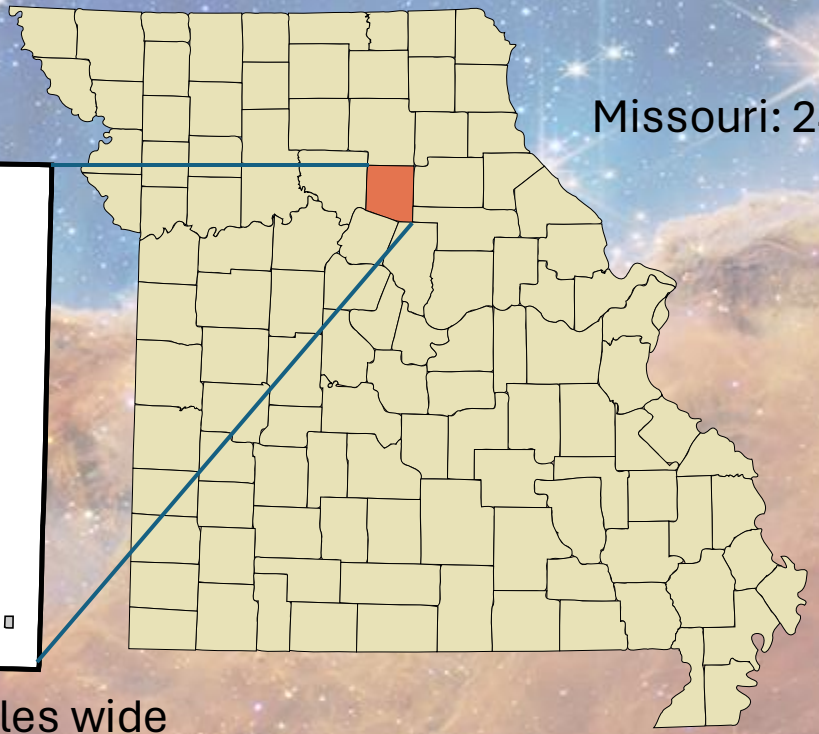


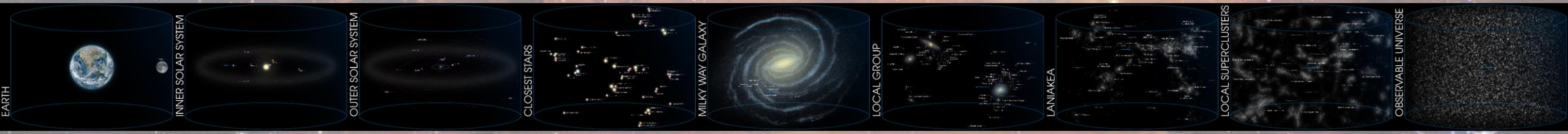
Moberly: ~ 3 miles wide



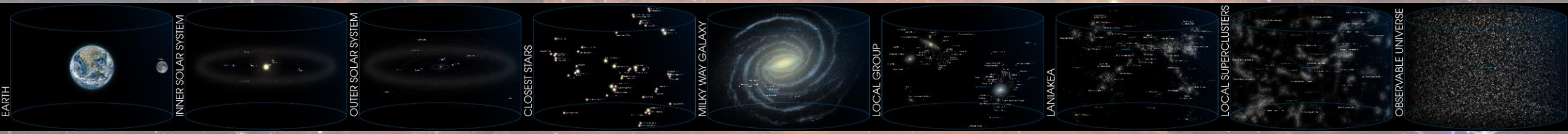
Randolph County: 20 miles wide



Missouri: 240 miles wide

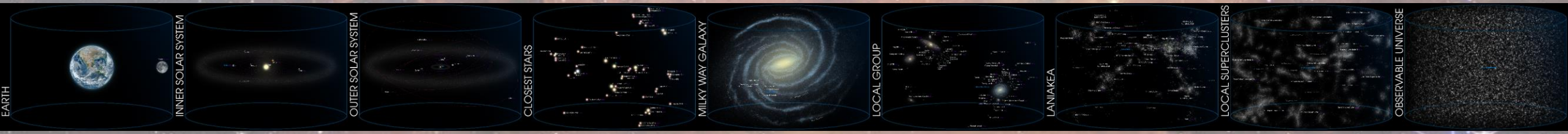


Going further…

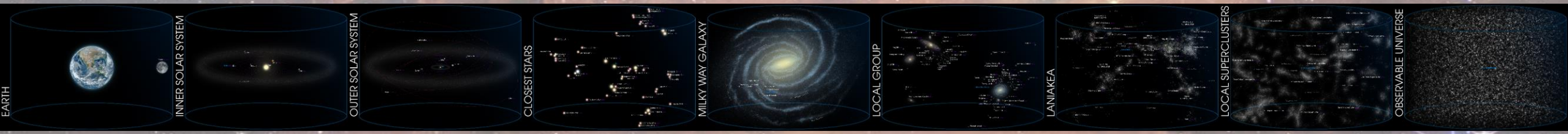


Going further…

Earth: ~ 8,000 miles wide.



Meet our natural satellite: The Moon!



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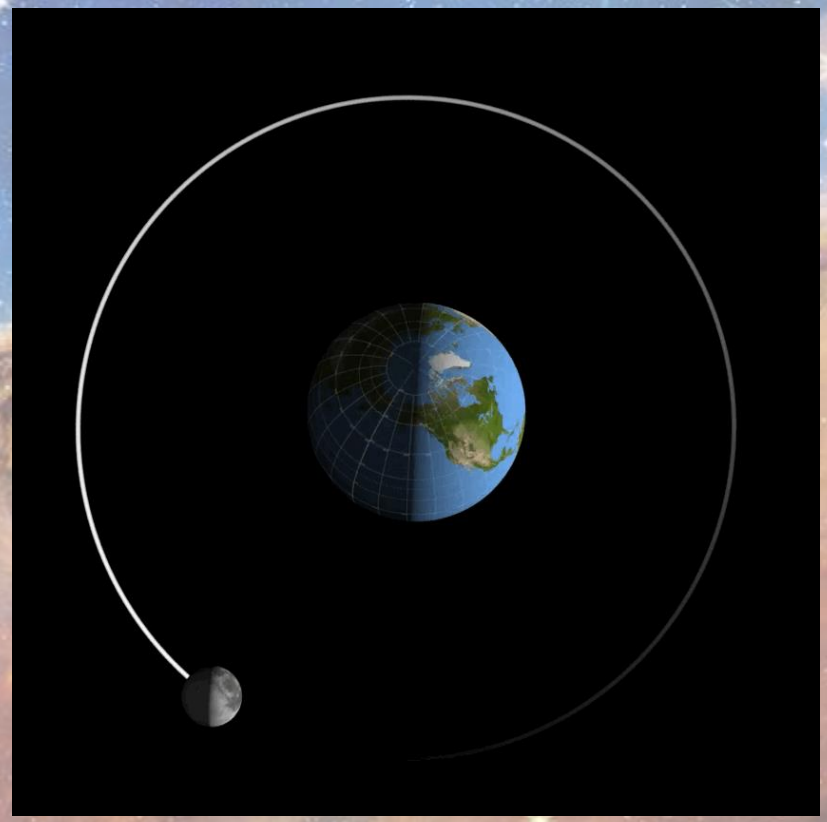
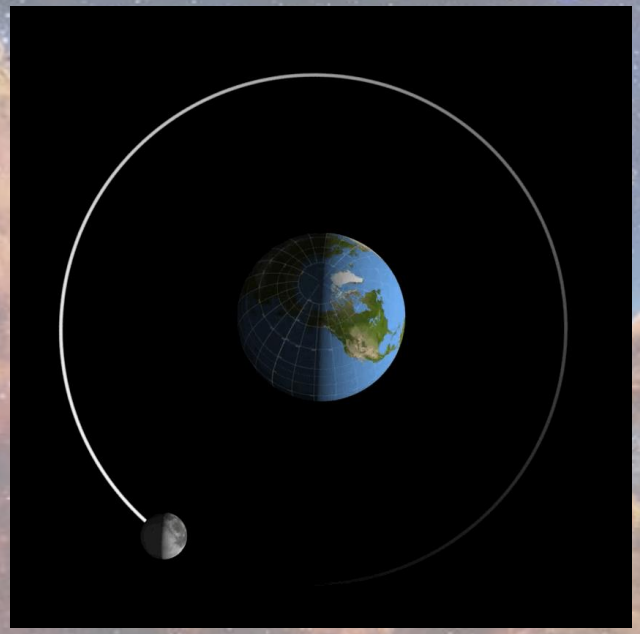


2000 miles wide, ~240,000 miles away from us!
Moon orbits the Earth in about 29 and half days.

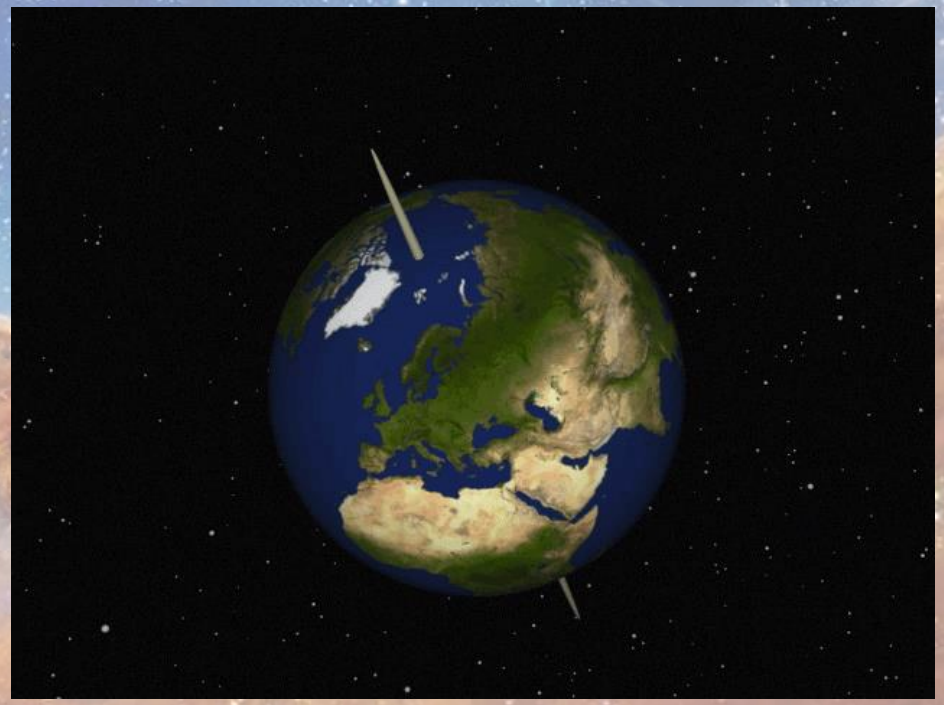
We’re rotating about out an axis, and tilted!

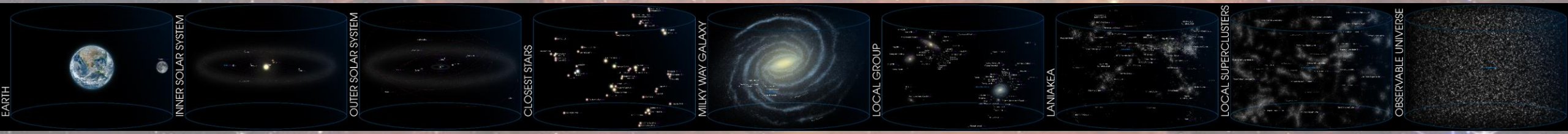


It takes about 24 hours.

That’s why we have days and nights!

We’re tilted by an angle of 23.5°.





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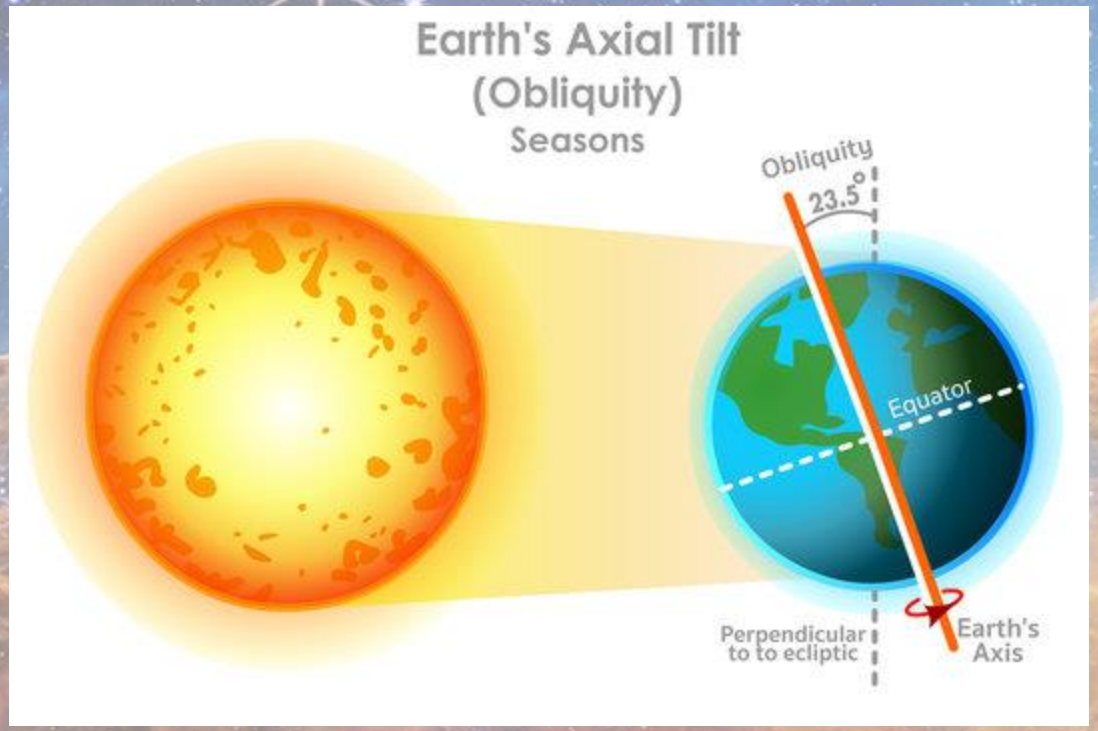
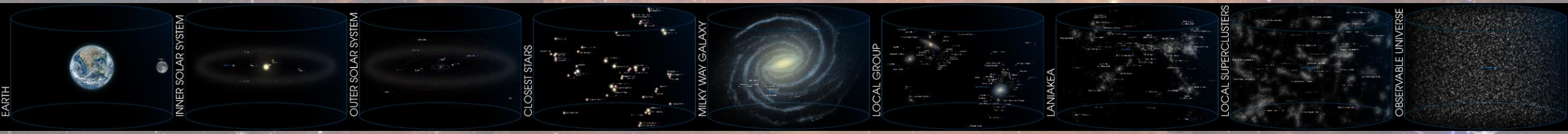
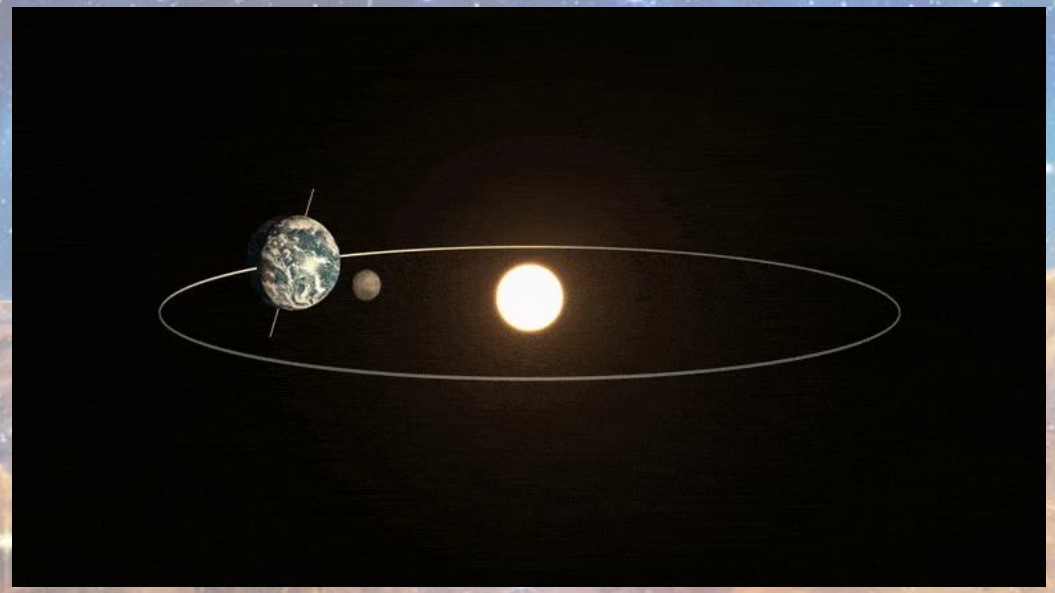


The reason behind seasons!



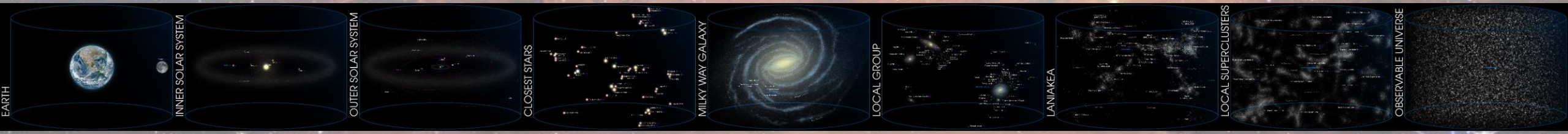
We’re also revolving around the Sun!



Takes about 365.25 days, a year to complete one revolution.

We’re about 93 million miles away from the Sun!

It takes ~ 8 minutes for Sunlight to reach the Earth.

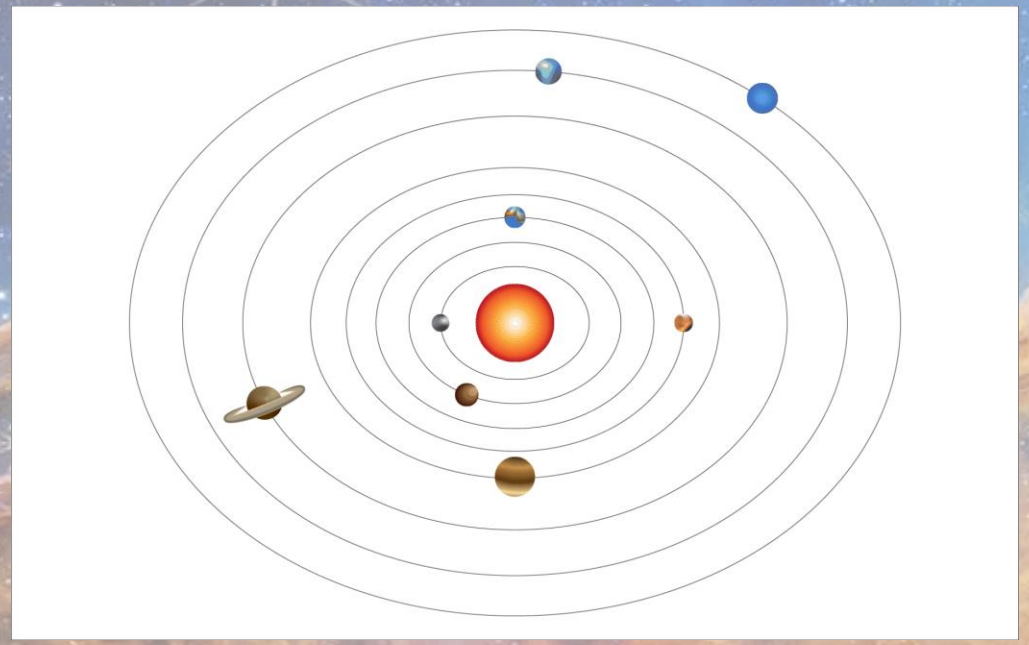


We have 7 other planets doing the same!

4 inner planets:

Mercury
Venus
Earth
Mars

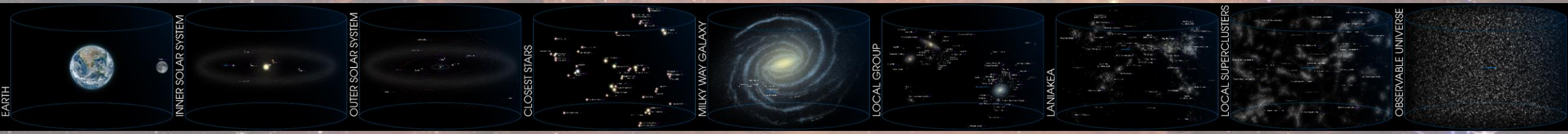
Rocky planets.



4 outer planets:

Jupiter
Saturn
Uranus
Neptune

Gassy planets.

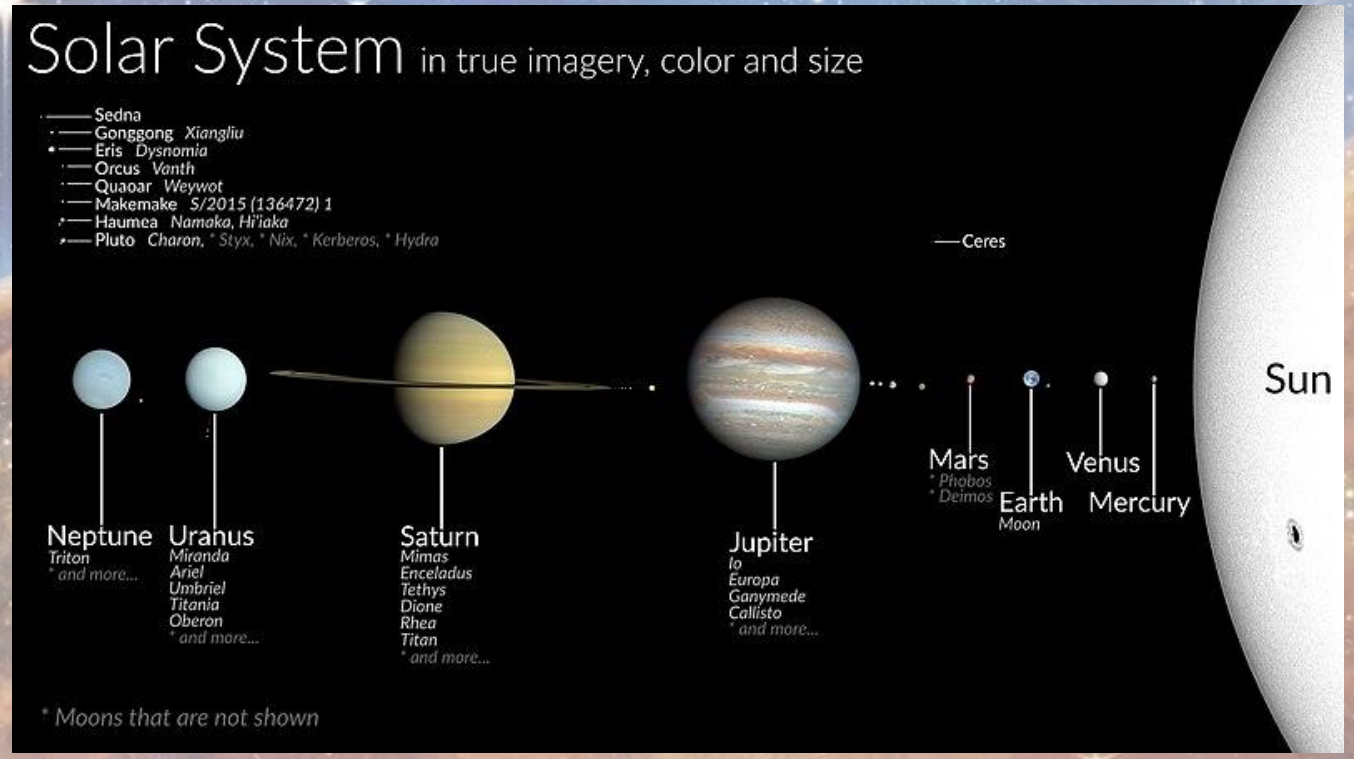


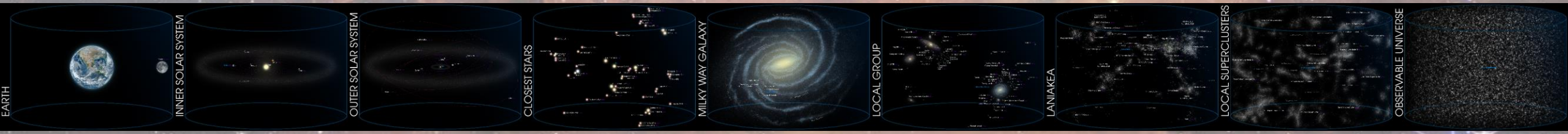
The Solar System

8 planets, lots of moons, dwarf planets, asteroids, comets etc.

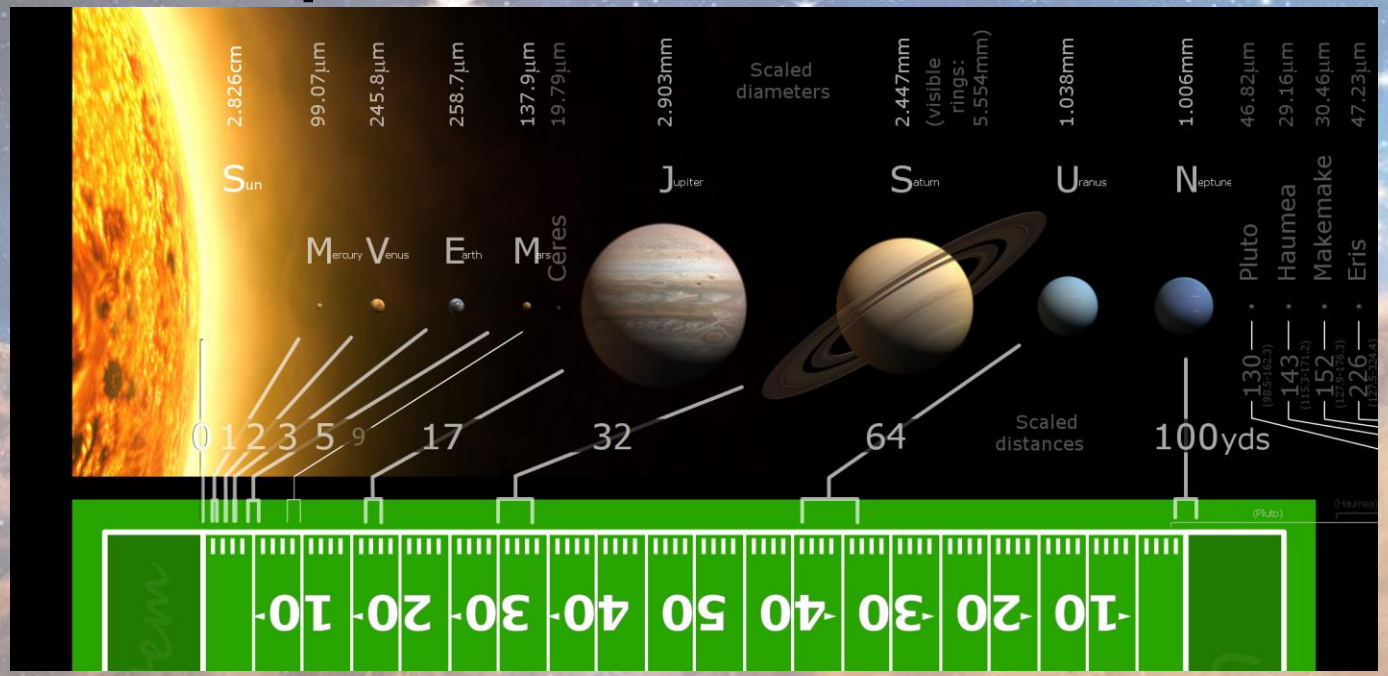
Size of the solar system: 18.6 trillion miles, or about 3 light years.

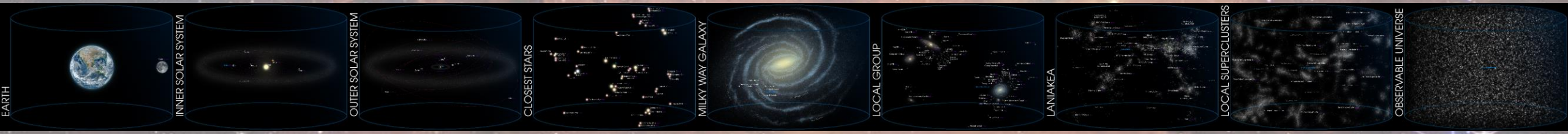
It takes 3 years for the Sunlight to reach the end of solar system!



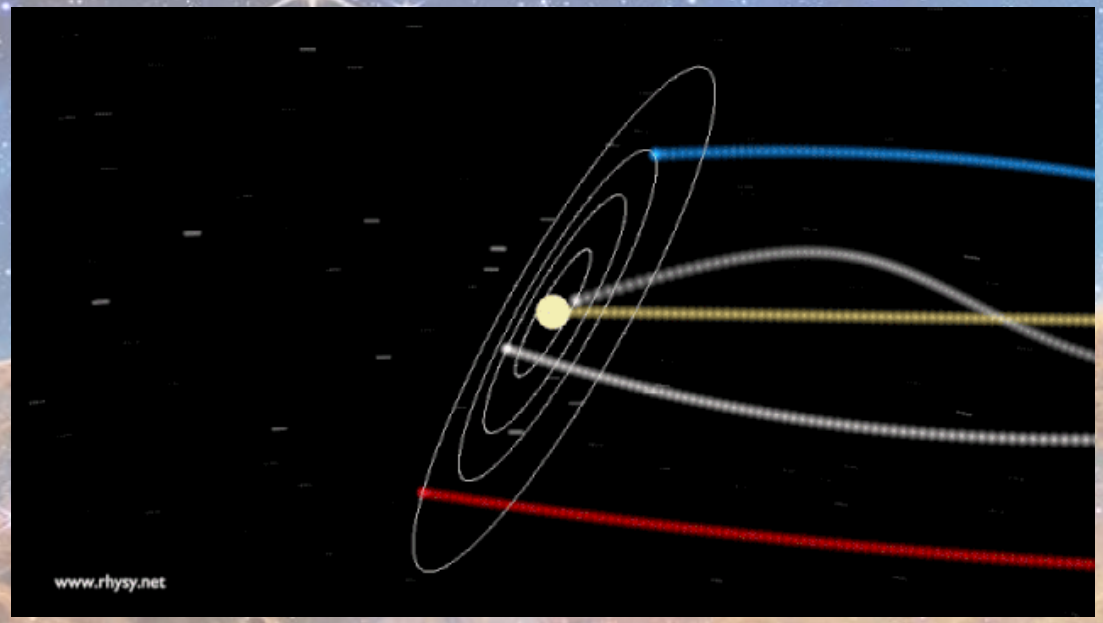


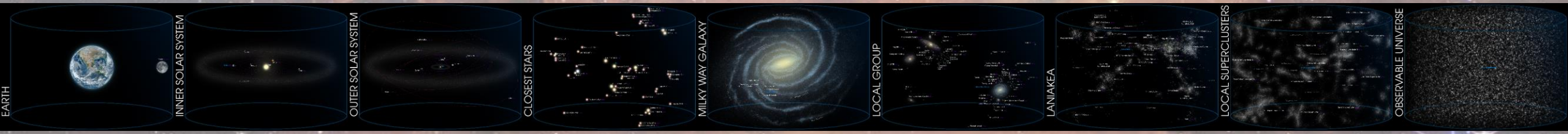
Where are the planets on a football field?





The Solar System is also moving!



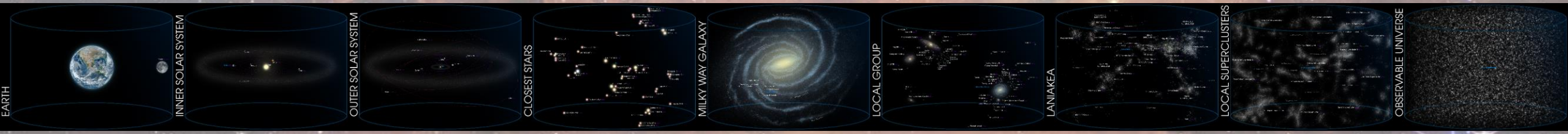


Let’s look at the closest stars!

Our Solar System is moving through the Local Interstellar Cloud, or “Local Fluff”.

Roughly 30 light years across.

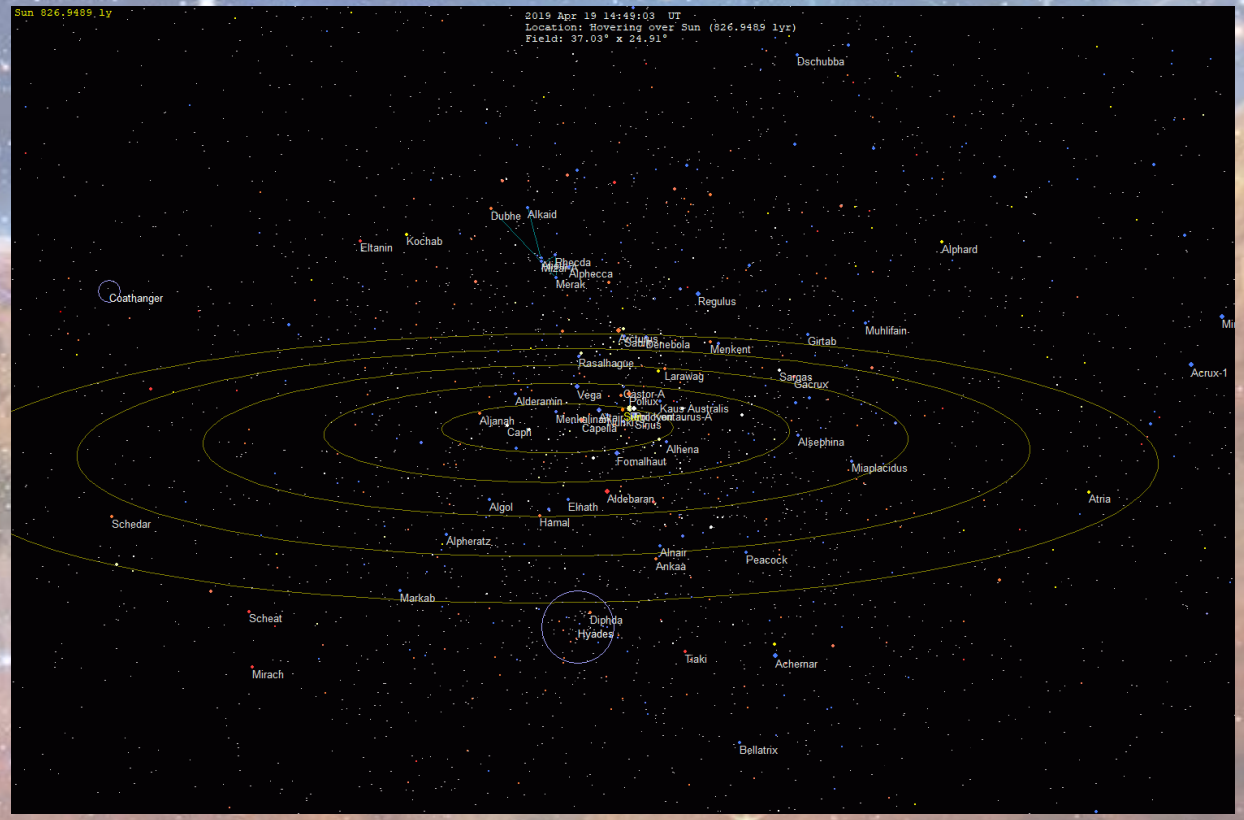
Closest star: Proxima Centauri (4.25 light years).

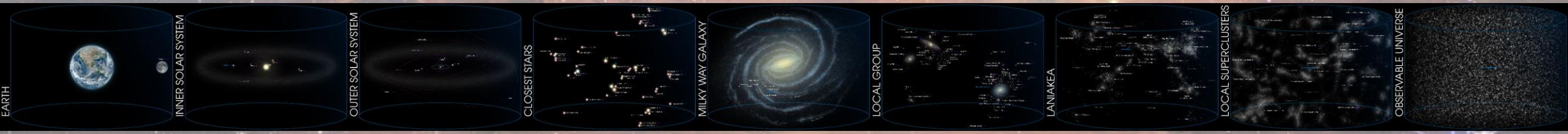


And how are they moving with respect to us?

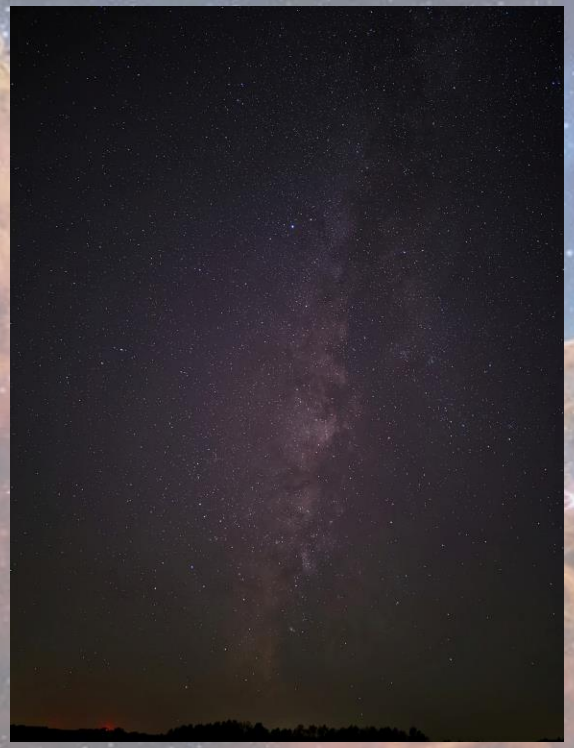
Things get out of hand real fast!

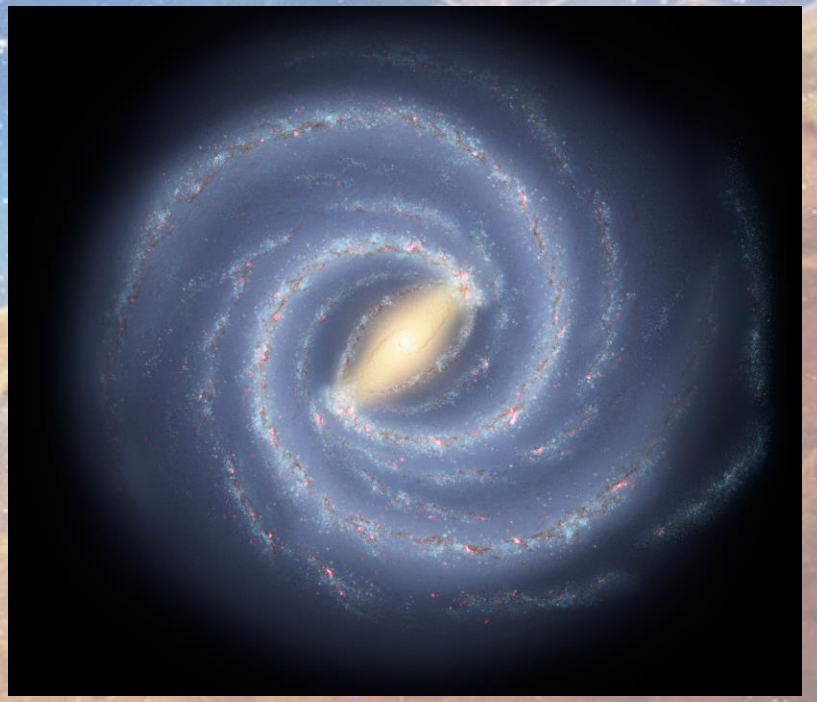
Not sensible to use miles anymore.

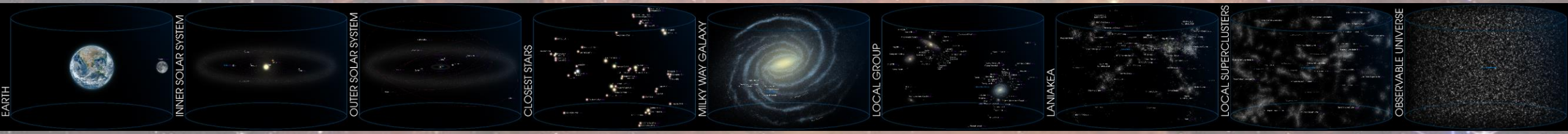




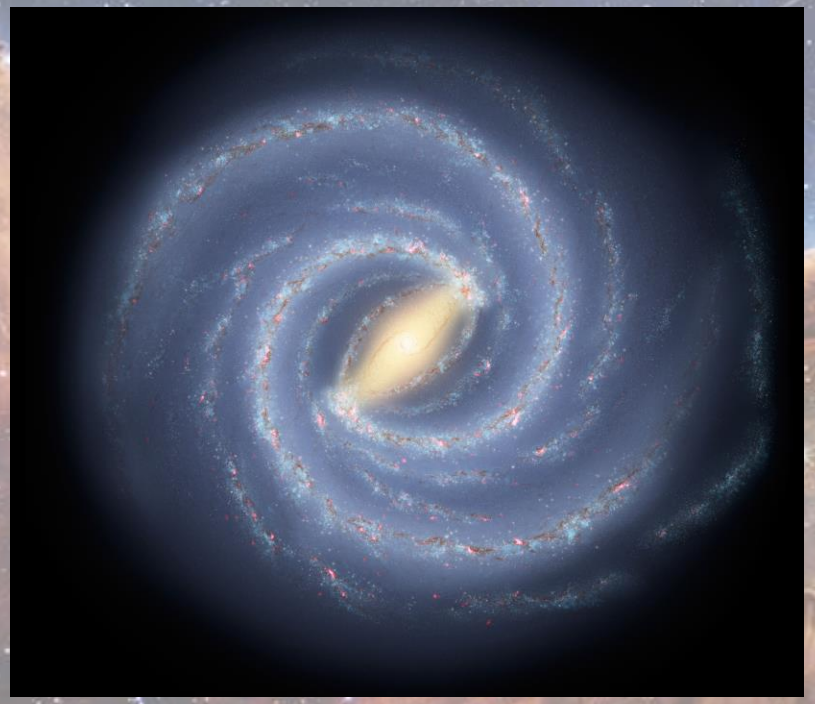
Going further… we reach the Milky Way!

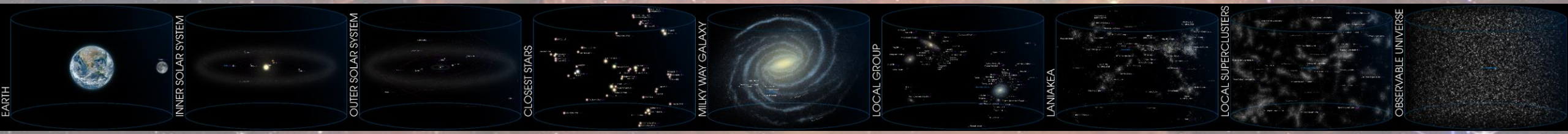






Can you guess where we are?





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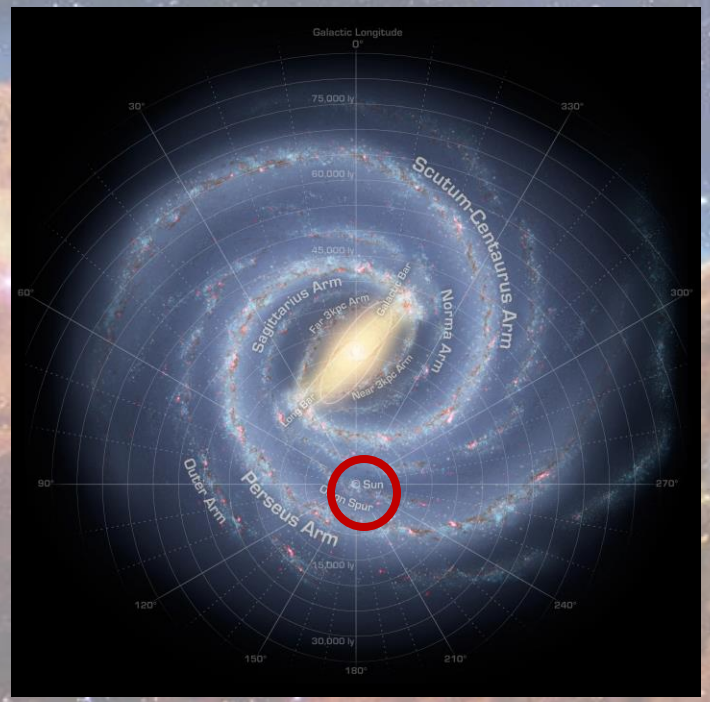
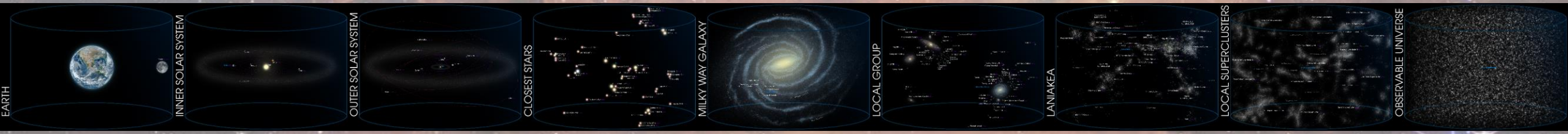


Our Galaxy, the Milky Way, is 100,000 light years wide!

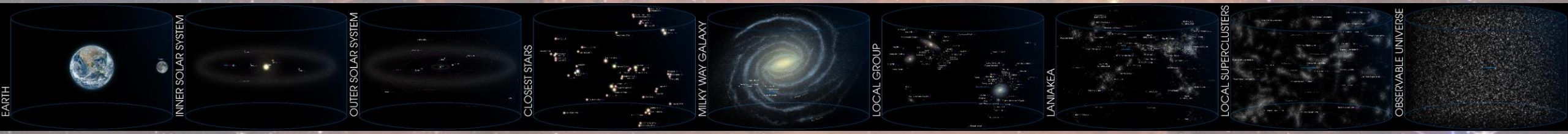
Our Sun is located 28,000 light years away from the center of our Galaxy.



Milky Way is a part of a Local Group…

4 million light years wide.

Closest galaxy: Andromeda galaxy

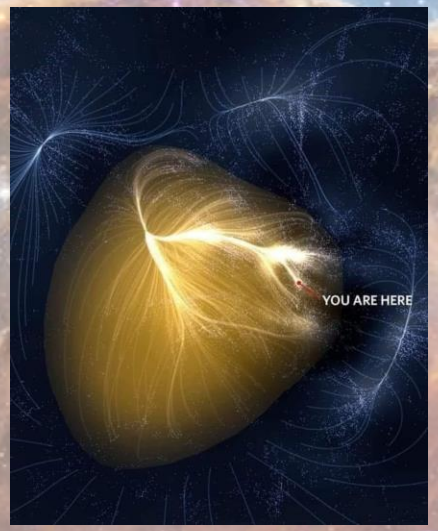


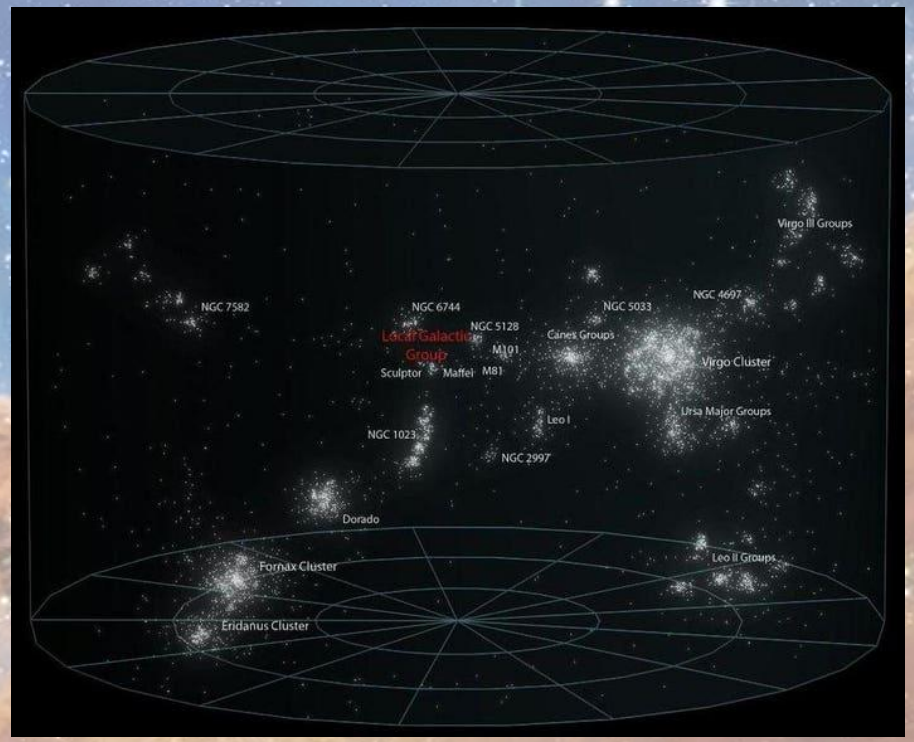
The Local Group is a part of the Laniakea Supercluster…

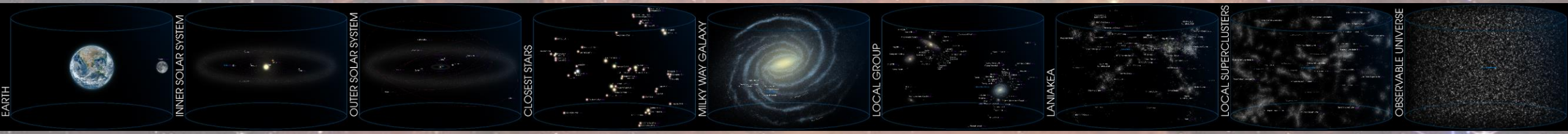
520 million light years wide.

Home to the Milky Way and approximately 100,000 other nearby galaxies.

Do you see a pattern?

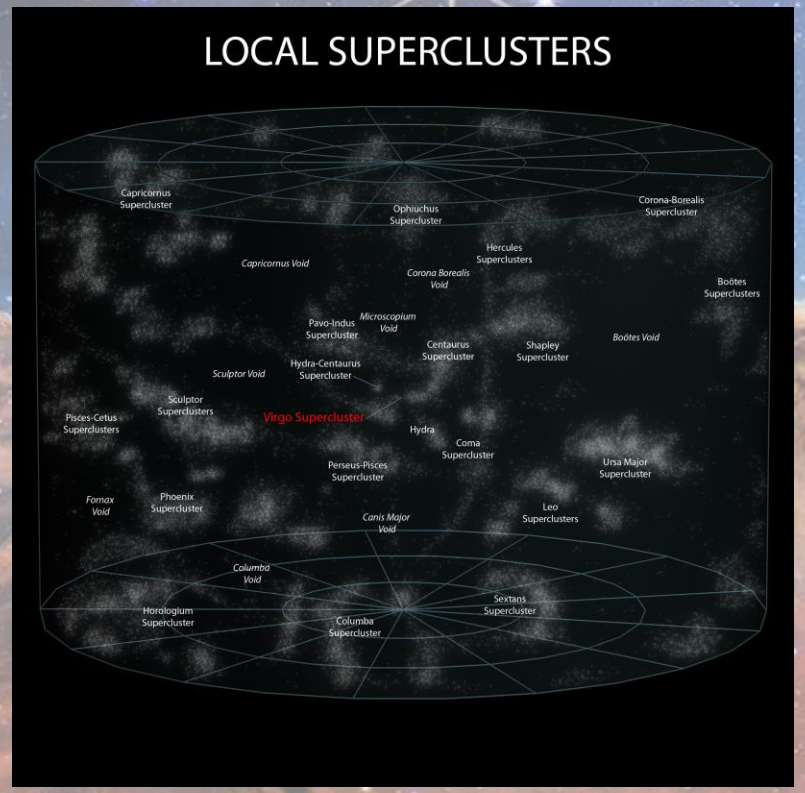


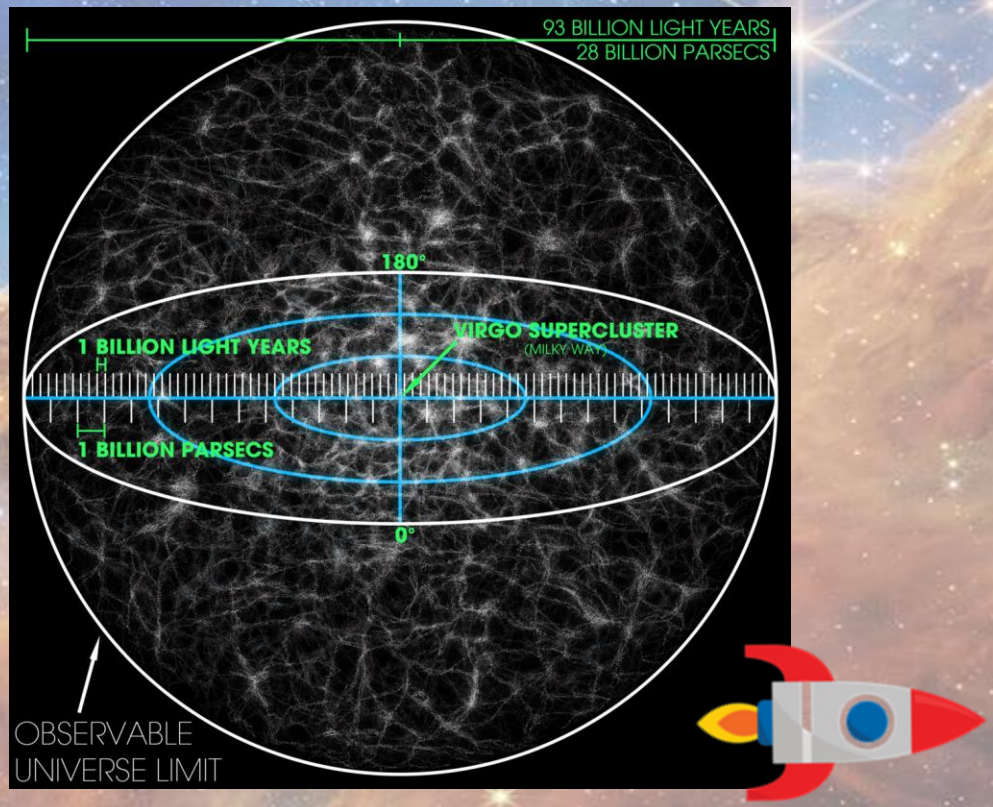


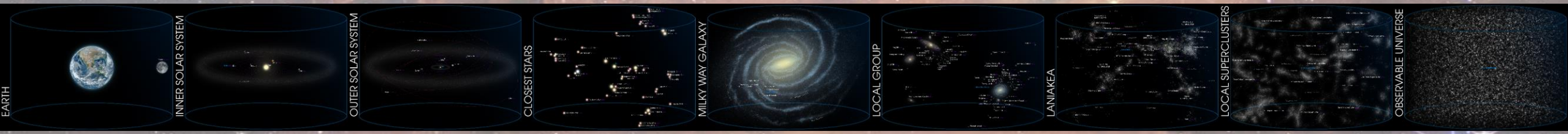


Which is a tiny part of the Universe!

The Cosmic Web!

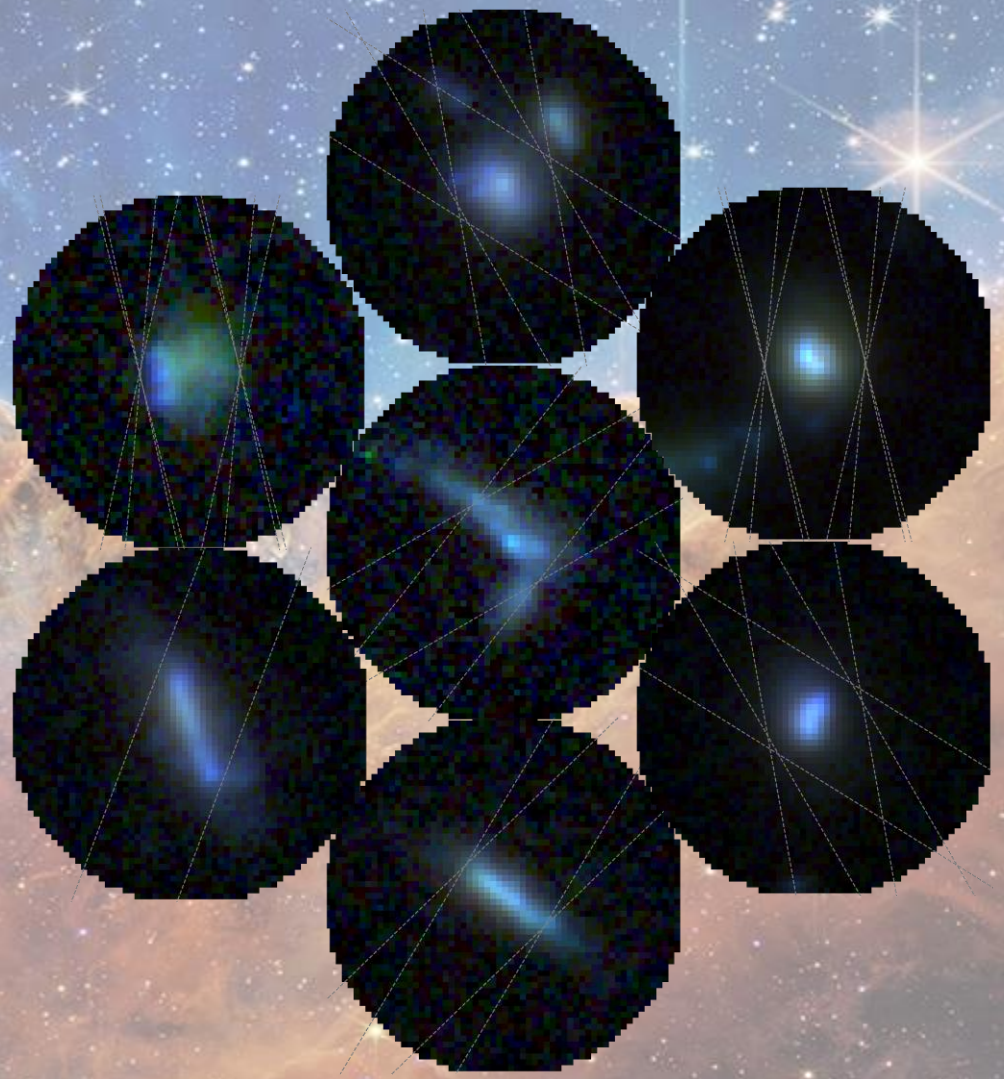






What do I do?

- I look at light from galaxies which are 7-9 billion light years away.
- These galaxies are 100 to 1000 times less massive than our Galaxy. These are very common in the universe.
- Our Galaxy is about 1-2 trillion times the mass of the Sun.



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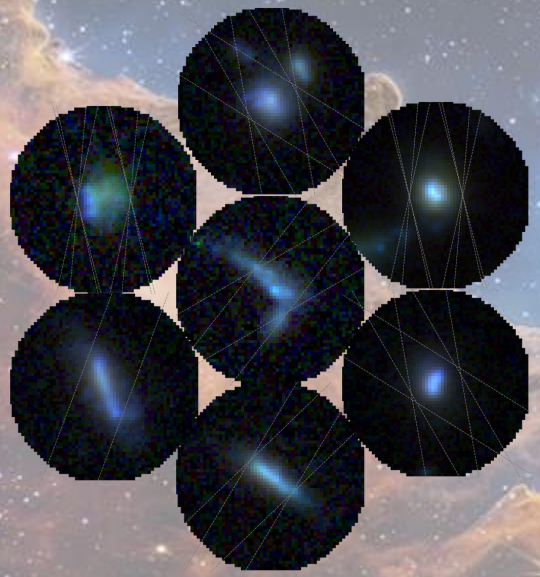
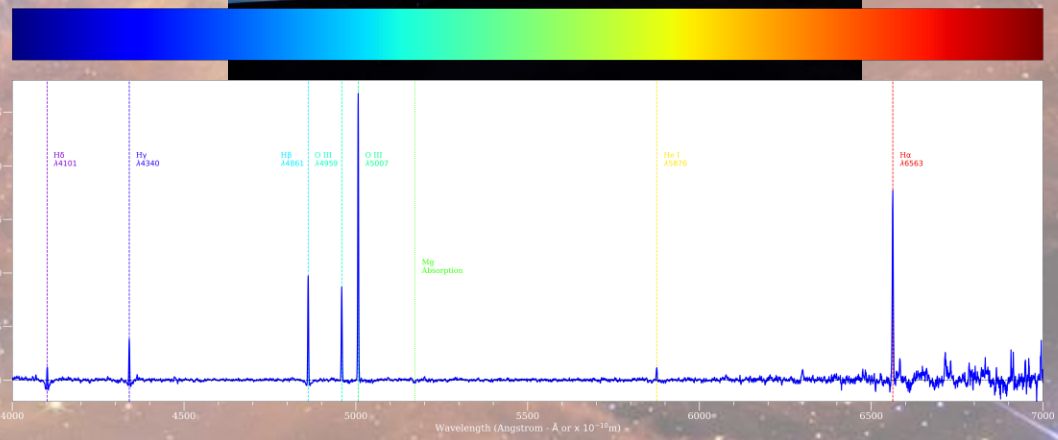




- Using telescopes in Hawaii and in space, I collect their light and split the light.

What do I do?

- I look for signatures of bursty star formation, and try to test the current understanding of cosmology.
- Theory will take you only so far…
- We can see the bursts, but we don’t know how long they last, that is the question I am trying to answer.


INTERMISSION

Eclipses!

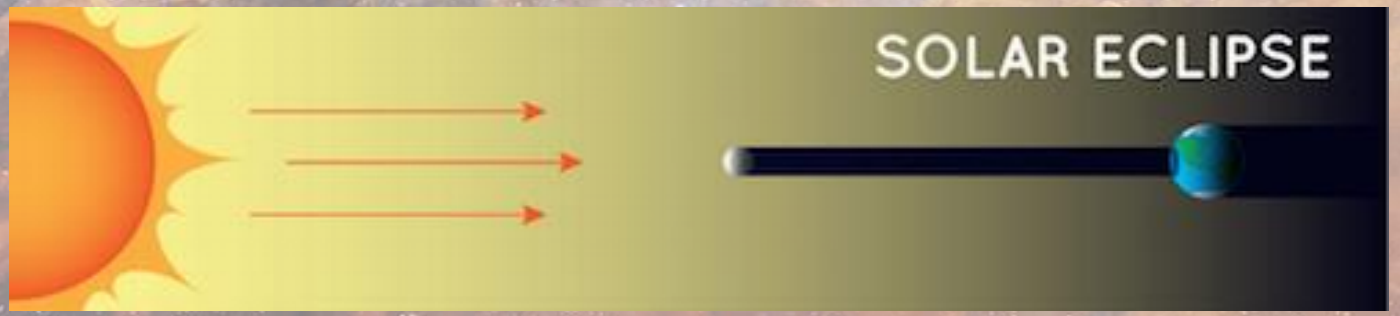
Have you ever seen an eclipse?

What is an eclipse?

- An eclipse is an astronomical event that occurs when an astronomical object is temporarily obscured, by passing into the shadow of another body or by having another body pass between it and the viewer.

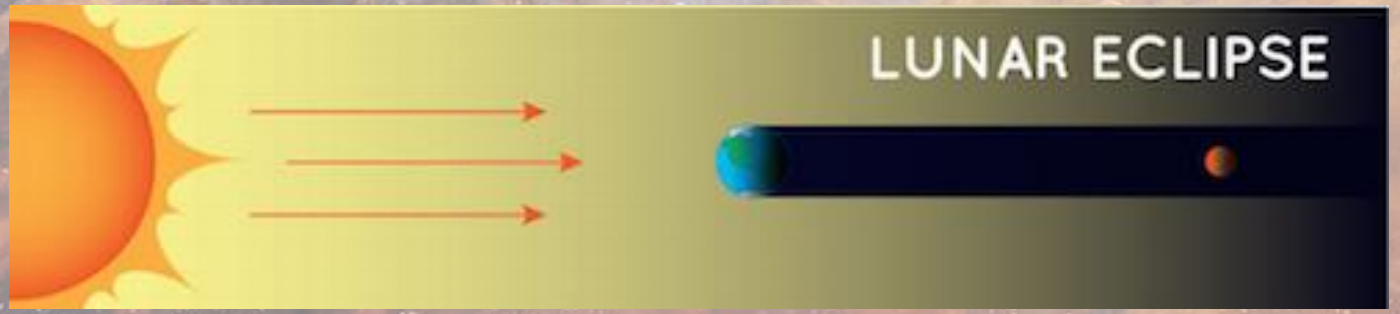
Types of eclipse: Solar eclipse

- A solar eclipse occurs when the Moon passes between the Sun and Earth.
- A shadow is cast over parts of Earth and blocks the face of the Sun.



Types of eclipse: Lunar eclipse

- During a lunar eclipse, the Earth blocks most of the sunlight that normally reaches the Moon.
- The Earth is between the Sun and the Moon.

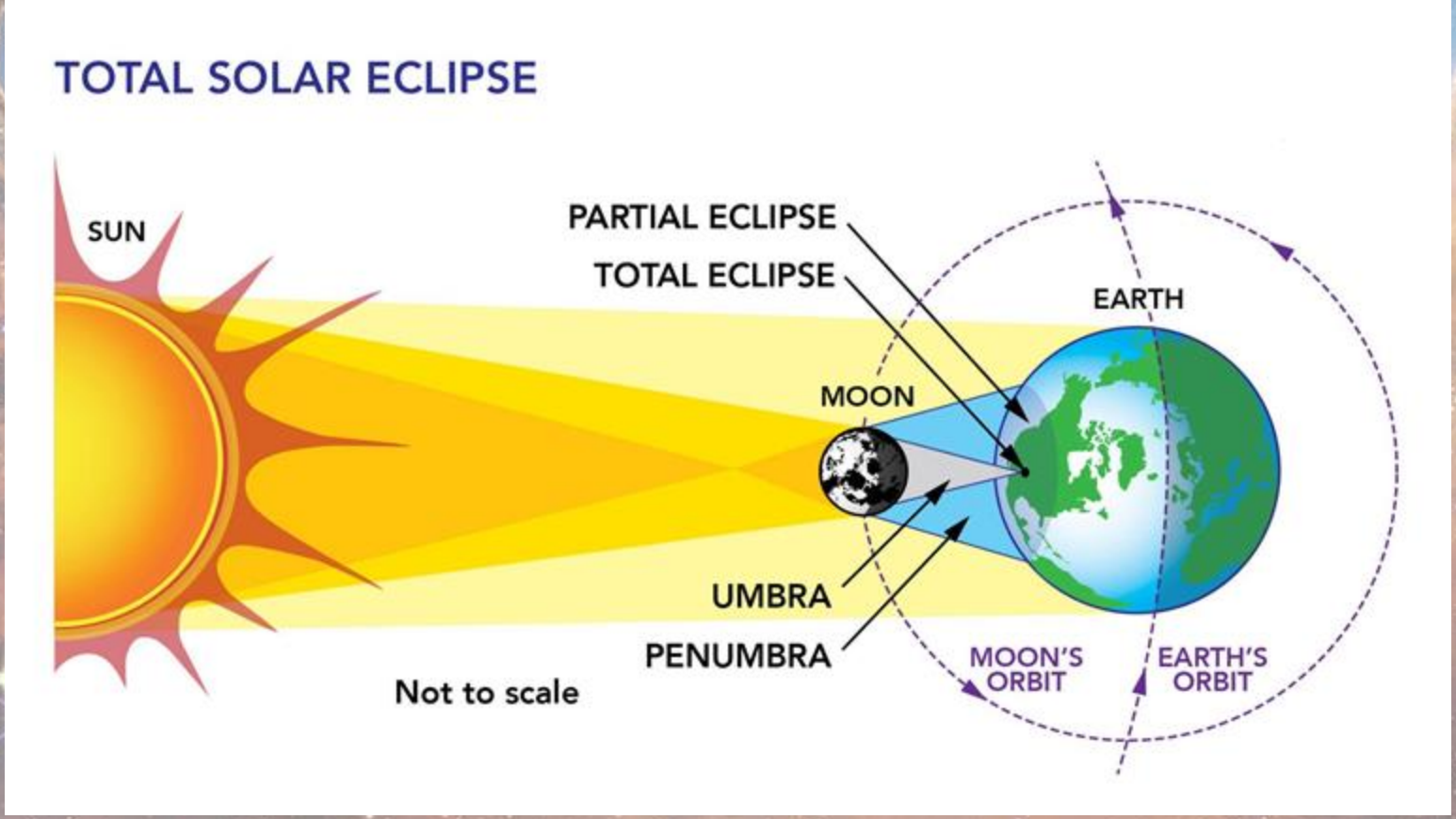


What’s the difference?

- In a solar eclipse, the Sun gets darker; in a lunar eclipse, the Moon gets darker.
- Today our focus is on solar eclipses…

Solar eclipse as seen from space:

Moon’s shadow: Umbra & Penumbra



Types of solar eclipses:

Total

Annular

Partial

Total vs Annular Solar Eclipse?

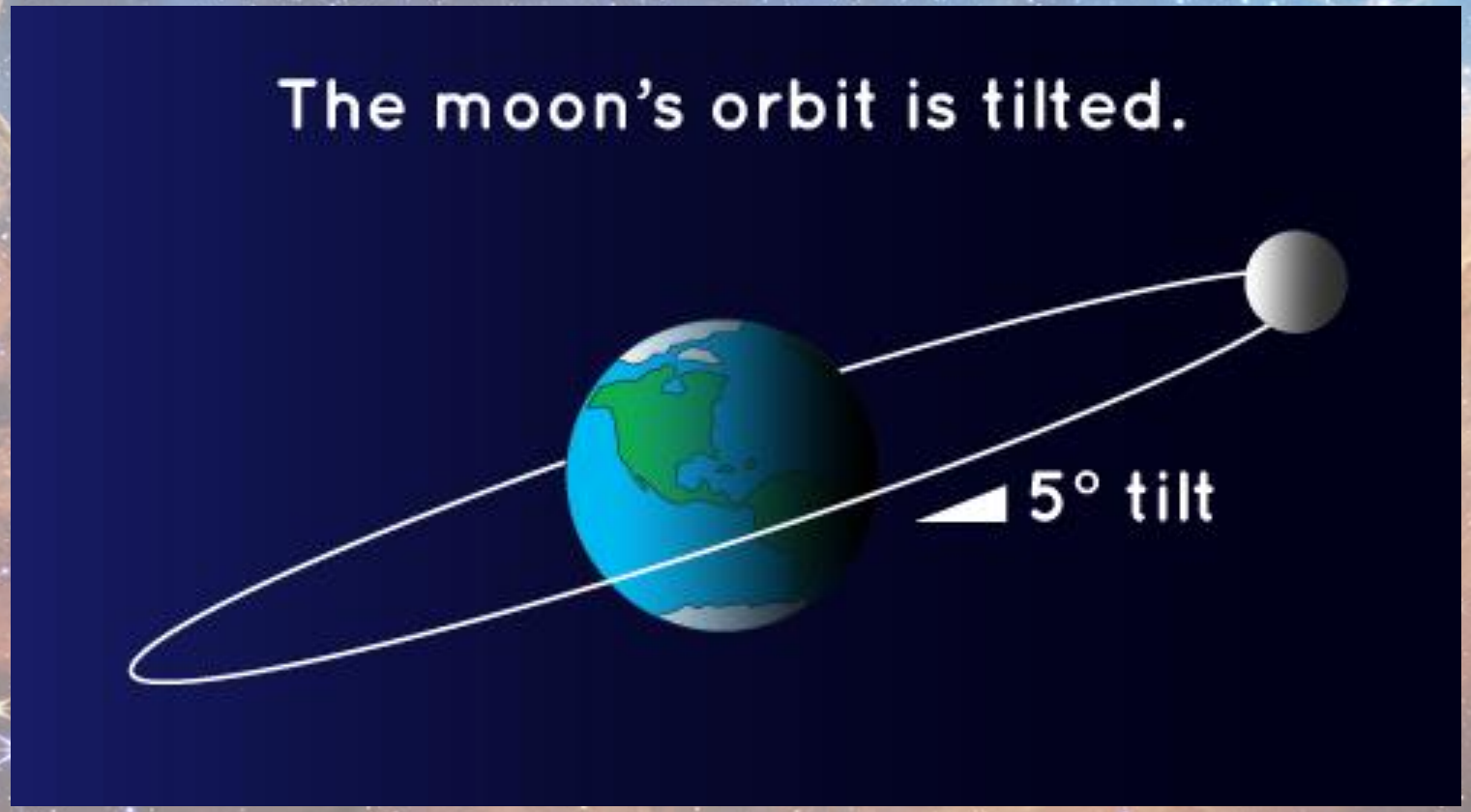
- Due to the Elliptical Orbit of the Moon.
- Different Distance between the Moon and the Earth.

Why is a total solar eclipse possible?

- The Sun's diameter is about 400 times wider than that of the Moon, but the Sun is also about 400 times farther away from Earth.

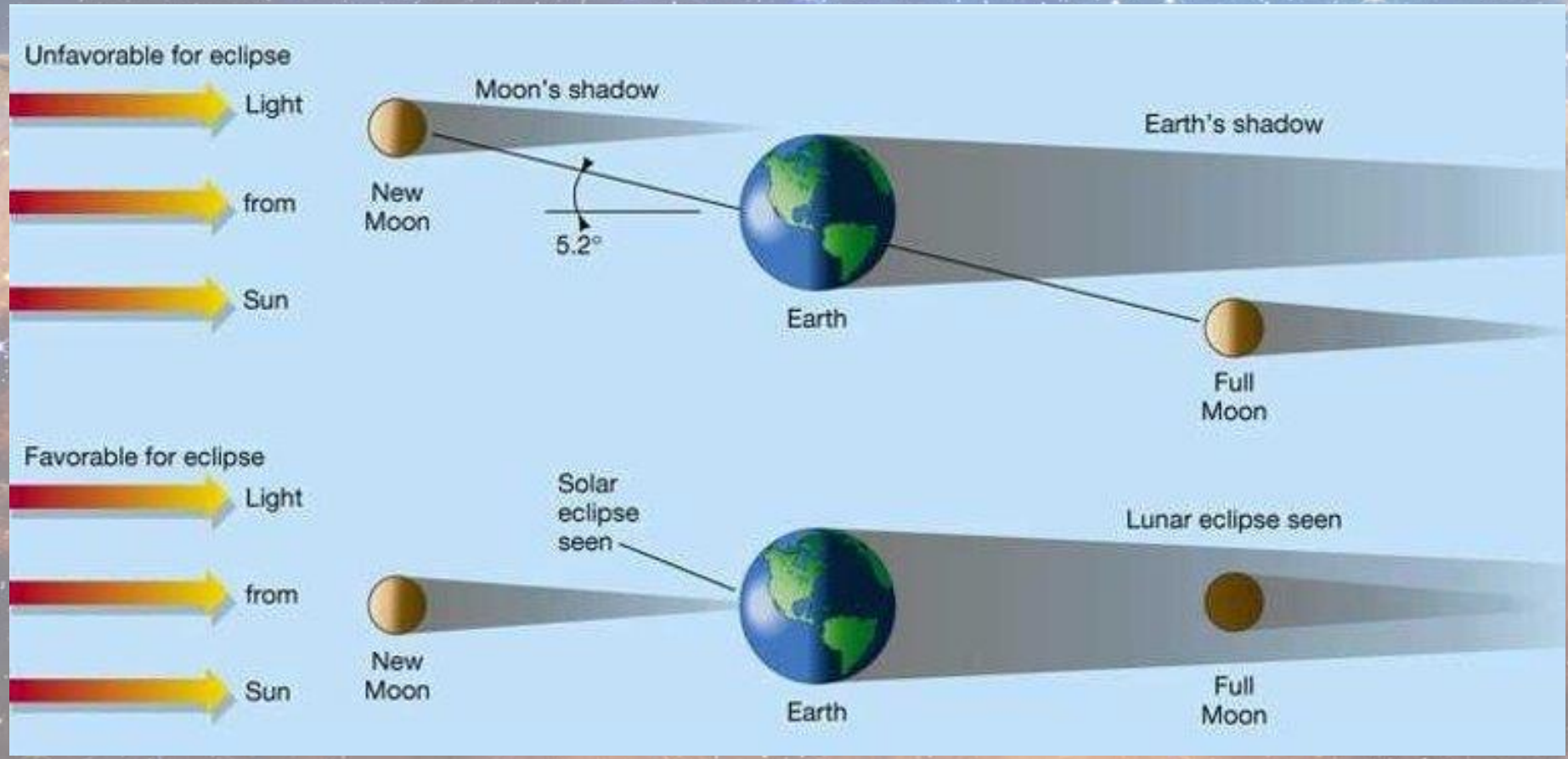
- Cosmic coincidence!

Why don’t we see the Solar Eclipses often?



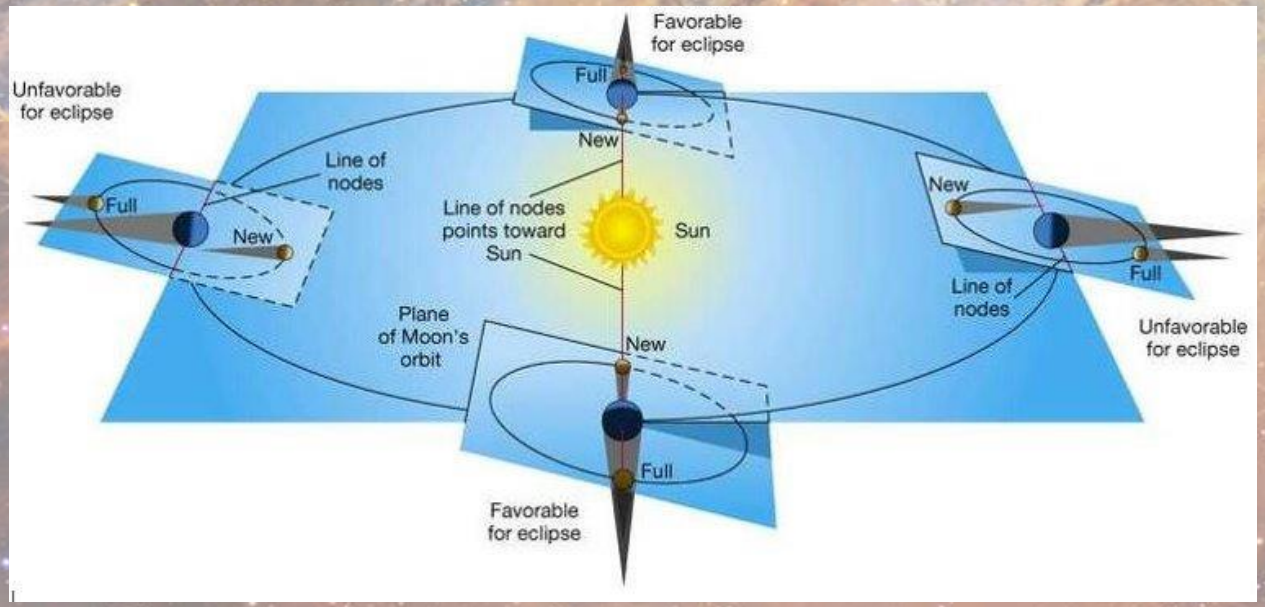
Why don’t we see the Solar Eclipses often?

Not favorable always!

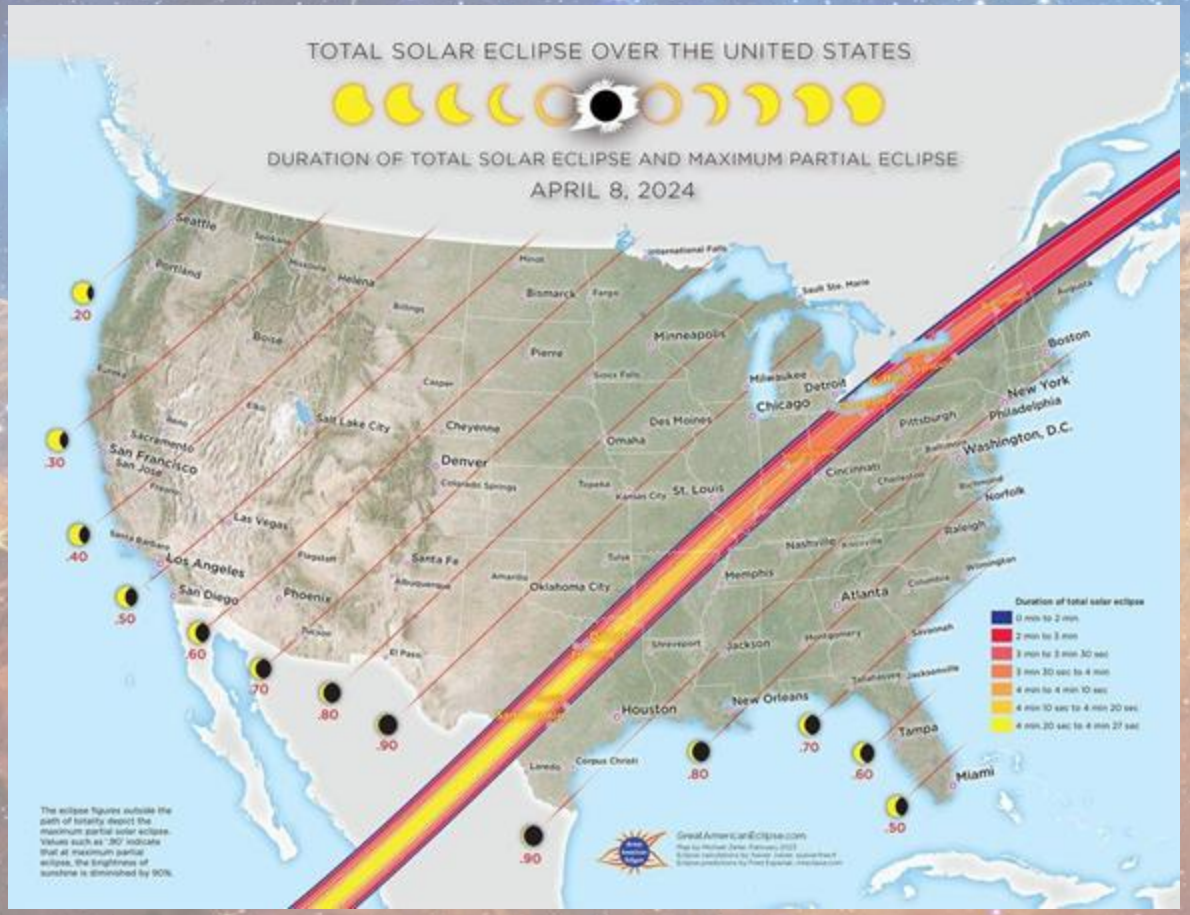


Some geometry:

- Line of nodes: the intersection of Earth's orbit plane and Moon's orbit plane.
- An Eclipse only happens when the Sun, Earth, and Moon are all in the line of nodes.



Solar eclipse on April 8, 2024



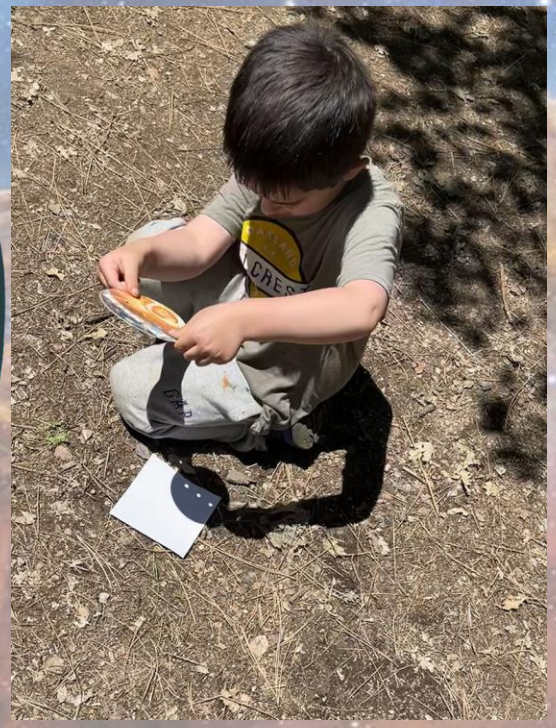
Everyone in North America Should See at Least a Partial Eclipse…

…If It’s Clear Out!

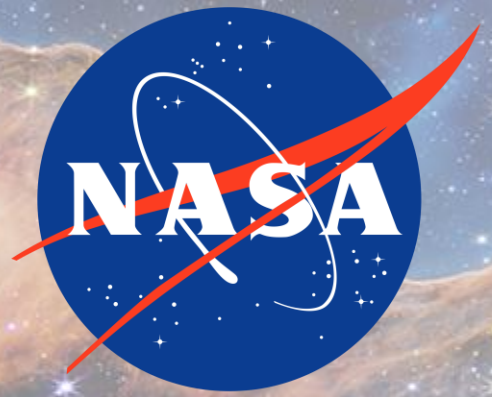
Safe Eclipse Viewing: Safety Glasses

Always use proper safety equipment to observe the Sun at any time!

Safe Eclipse Viewing: Shadows



Questions?



University of Missouri