



SIZE AND SCALE OF THE UNIVERSE



WHAT IS YOUR COSMIC ADDRESS?



Street

City

State

Country

Continent

Hemisphere

Planet

Orbit

Star?

...?

...

...

...

...



Size and Scale of the Universe

Realm	Guesses					
	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6
Earth	Salt grain	Salt grain	Salt grain	Salt grain	Salt grain	Salt grain
Sun						
Solar System						
Solar Neighborhood						
Galaxy						
Local Group (of galaxies)						
Local Supercluster (of galaxies)						
Universe						

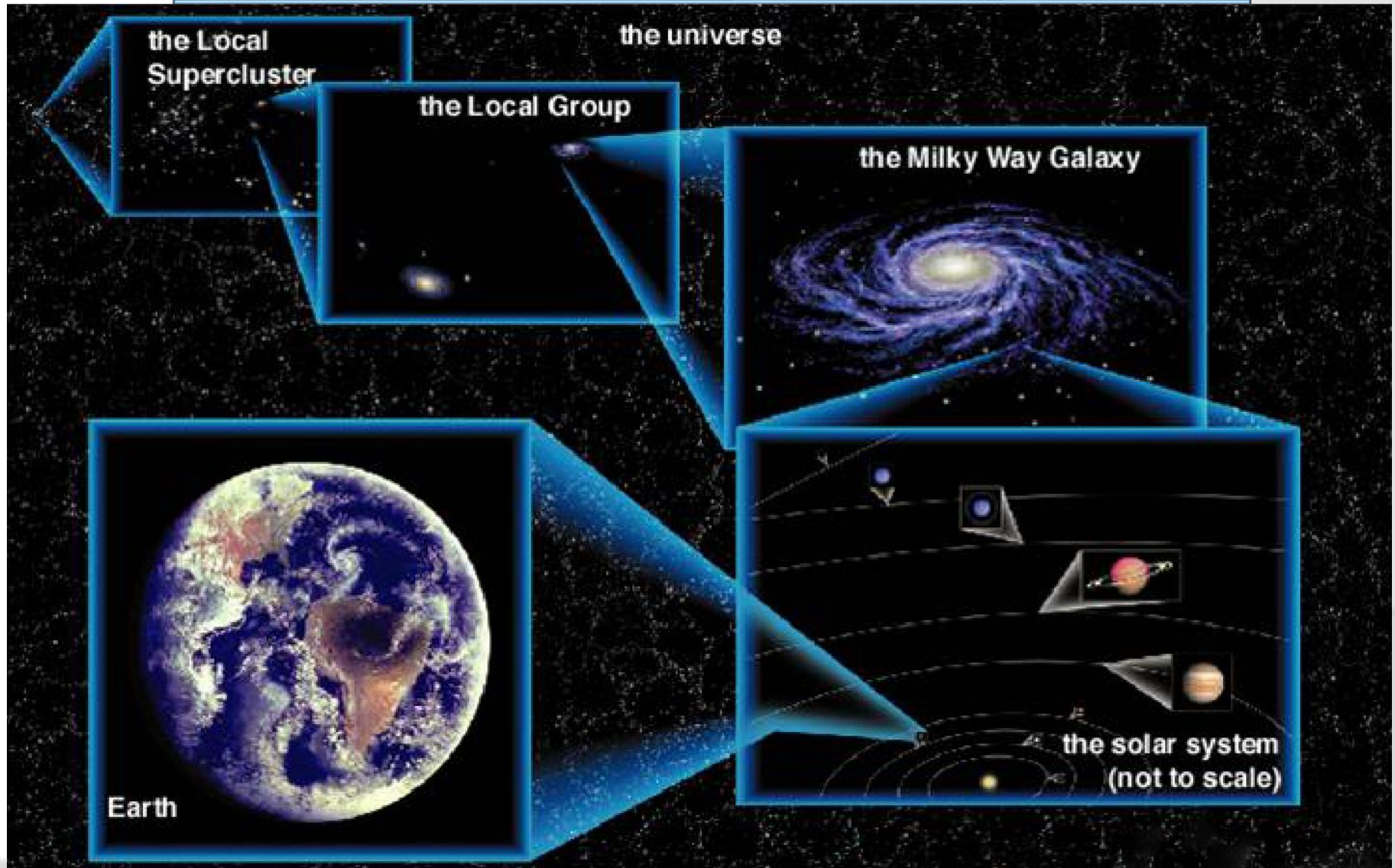


Size and Scale of the Universe

Realm	Actual Size (diameter in km)	Actual Size (in light-years)	Multiple "X" larger than Earth	Scale Model
Earth	12,700 (1.27E+4)	1.4 billionths (1.4E-9)	1	salt grain (0.1 mm)
Sun	1.39 million (1.39E+6)	1.5 ten-millionths (1.5E-7)	109 (1.09E+2)	gum ball (1.09 cm)
Solar System	30 billion (3.0E+10)	0.0032 (3.2E-3)	2.34 million (2.34E+6)	football stadium (234 meters)
Solar Neighborhood	378 trillion (3.78E+14)	40 (4.0E+1)	30 billion (3.0E+10)	~ size of Moon (3,480 km)
Galaxy	946 quadrillion (9.46E+17)	100,000 (1.0E+5)	75 trillion (7.5E+13)	5.4 Suns (7.5 million km)
Local Group (of galaxies)	62 quintillion (6.15E+19)	6.5 million (6.5E+6)	4.8 quadrillion (4.8E+15)	orbit of Mars -diameter (~3 AU)
Local Supercluster	1.2 sextillion (1.2E+21)	130 million (1.3E+8)	97 quadrillion (9.7E+16)	orbit of Neptune -diameter (~60 AU)
Universe	860.9 sextillion (8.6E+23)	91 billion (9.1E+10)	68 quintillion (6.8E+19)	Oort Cloud -radius (48,000 AU or 0.76 ly)



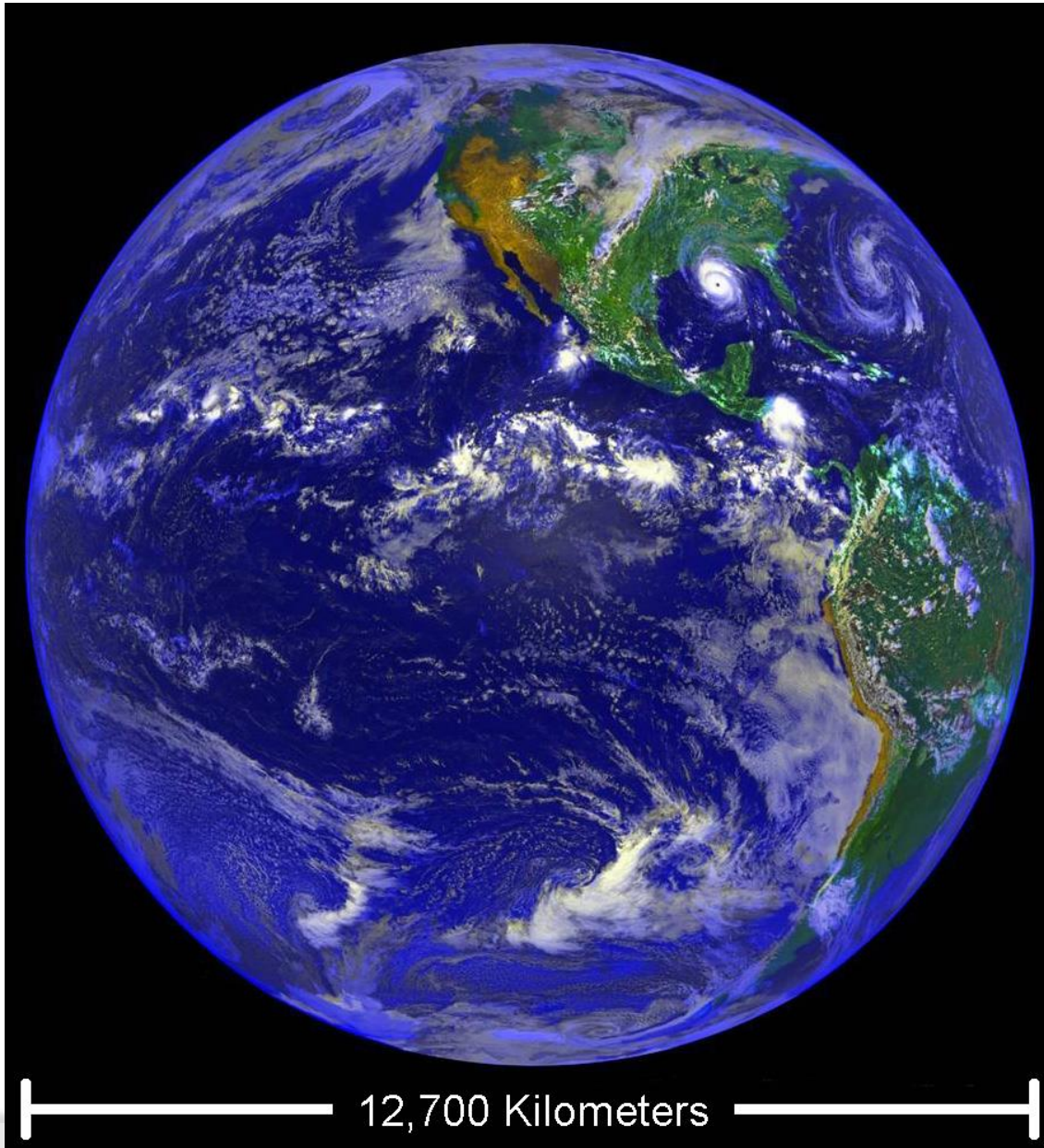
REALMS OF THE UNIVERSE





EARTH

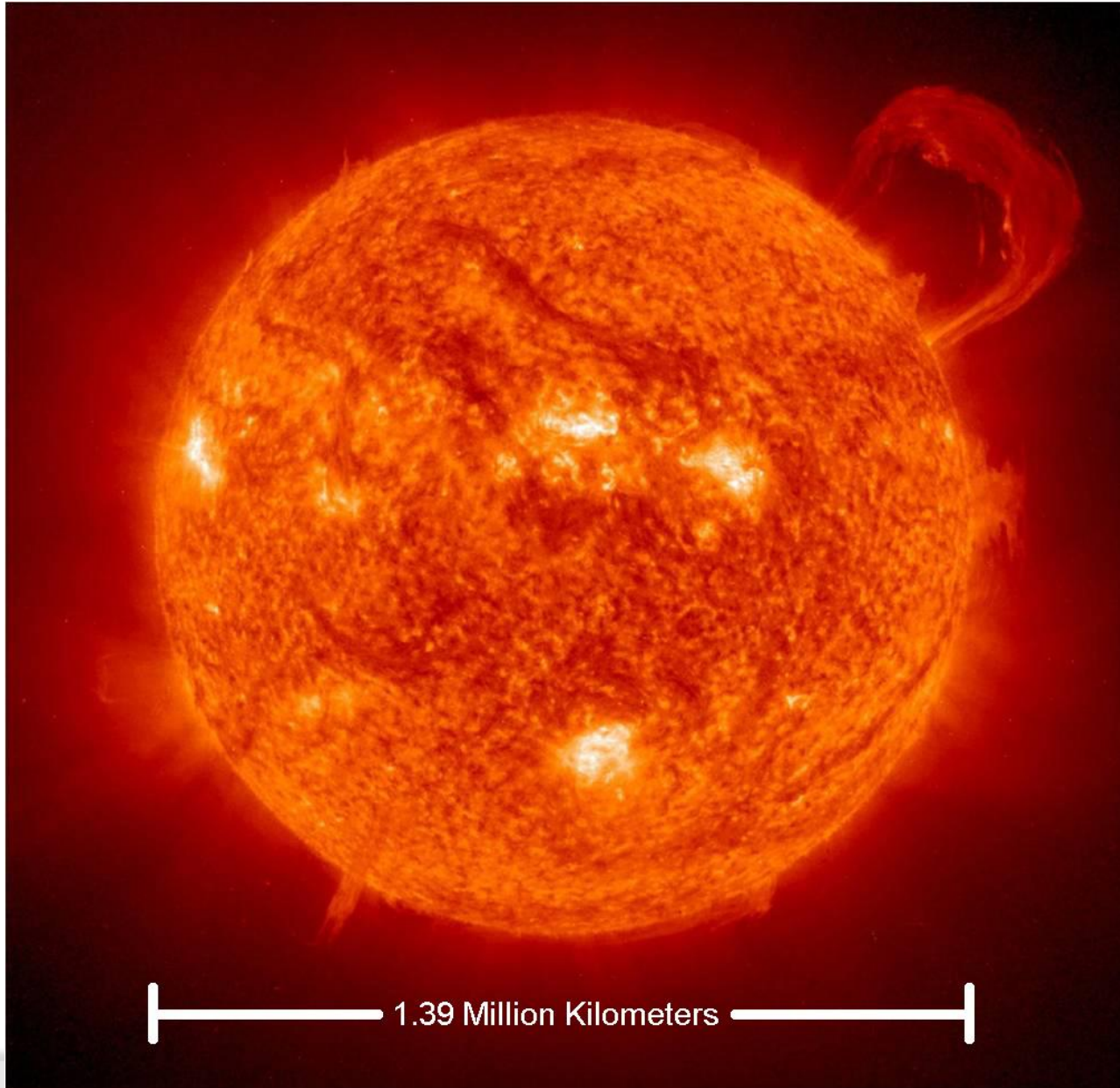
- Planet where we all live
- Comprised primarily of rock
- Spherical in shape
- 12,700 km in diameter
- It would take 17 days to circumnavigate the globe driving a car at 100 km/hr (62 mph)
- At the speed of light, it would take 0.13 seconds to go all the way around Earth





SUN

- The star that Earth orbits
- Composed primarily of hydrogen and helium gas
- Uses nuclear fusion in its core to generate heat and light to allow itself to resist the crushing weight of its own mass
- Spherical in shape
- 1.39 Million km in diameter





SUN & EARTH

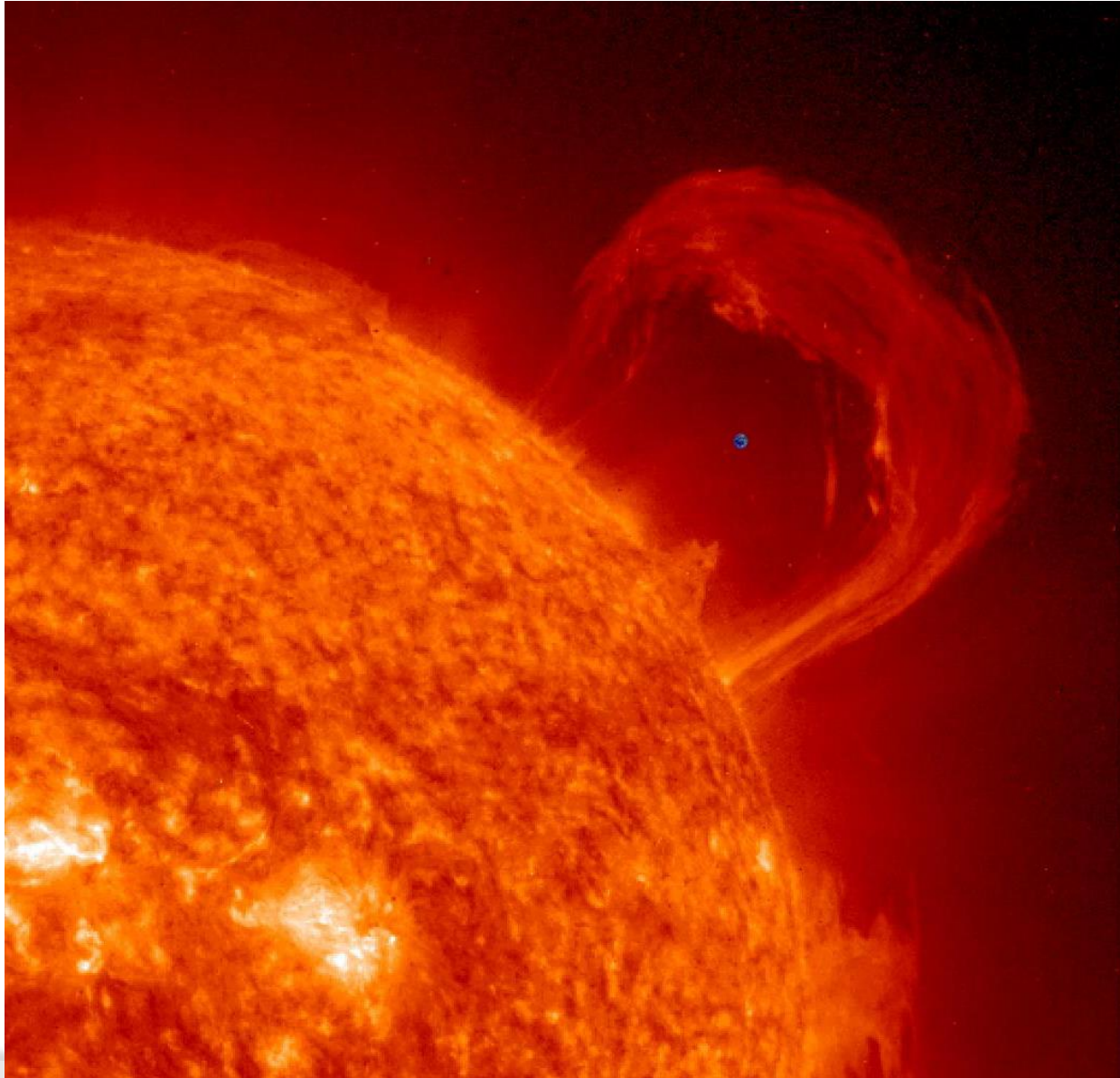


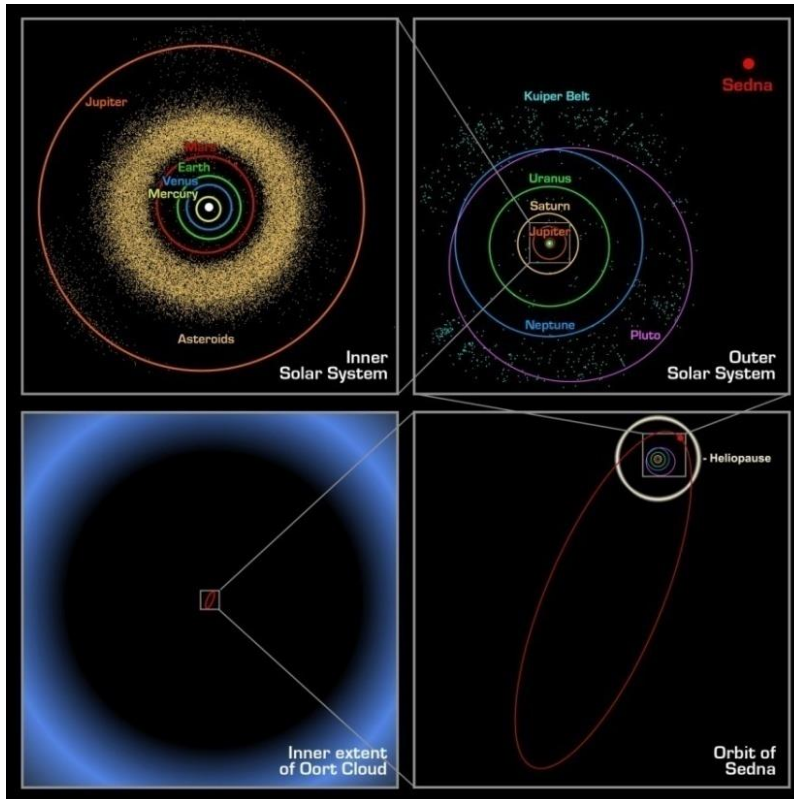
Image Credit: SOHO/NASA/ESA

- The Sun's diameter is 109 times greater than that of Earth
- Over 1 million Earths would fit inside the Sun's volume
- The average distance between the Earth and the Sun is called an Astronomical Unit (AU) - it is about 150 million kilometers
- It would take 11,780 Earths lined up side to side to bridge the gap between Earth and Sun (or 107 Suns)



Size and Scale of the Universe

Image credit: NASA/JPL-Caltech/R. Hurt



- The Sun blows a constant wind of charged gas into interstellar space, called the Solar Wind
- The boundary between the Solar Wind and interstellar space (the **Heliosphere**) is around 100 AU from the Sun (200 AU diameter)

THE SOLAR SYSTEM

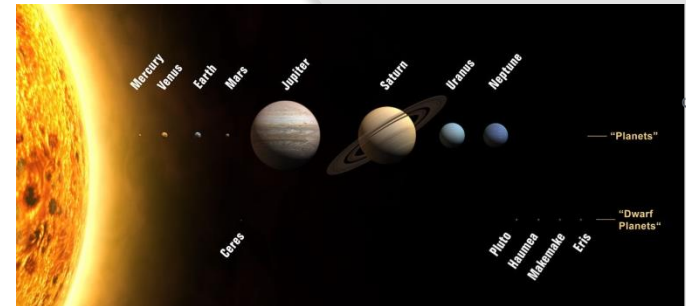


Image credit: NASA

- 8 planets, several dwarf planets, thousands of asteroids, and trillions of comets and meteoroids
- Mostly distributed in a flat disk
- Pluto orbits ~40 AU from Sun

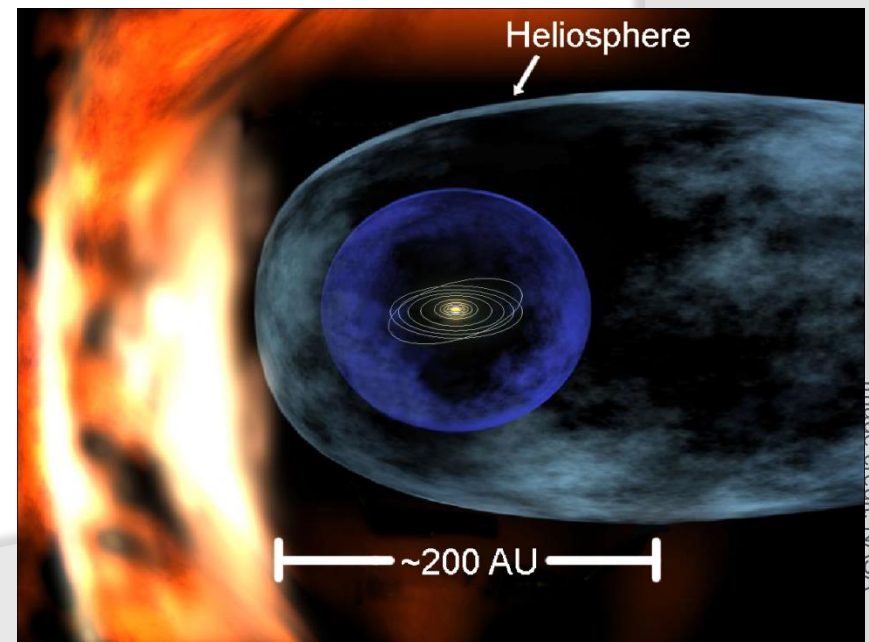


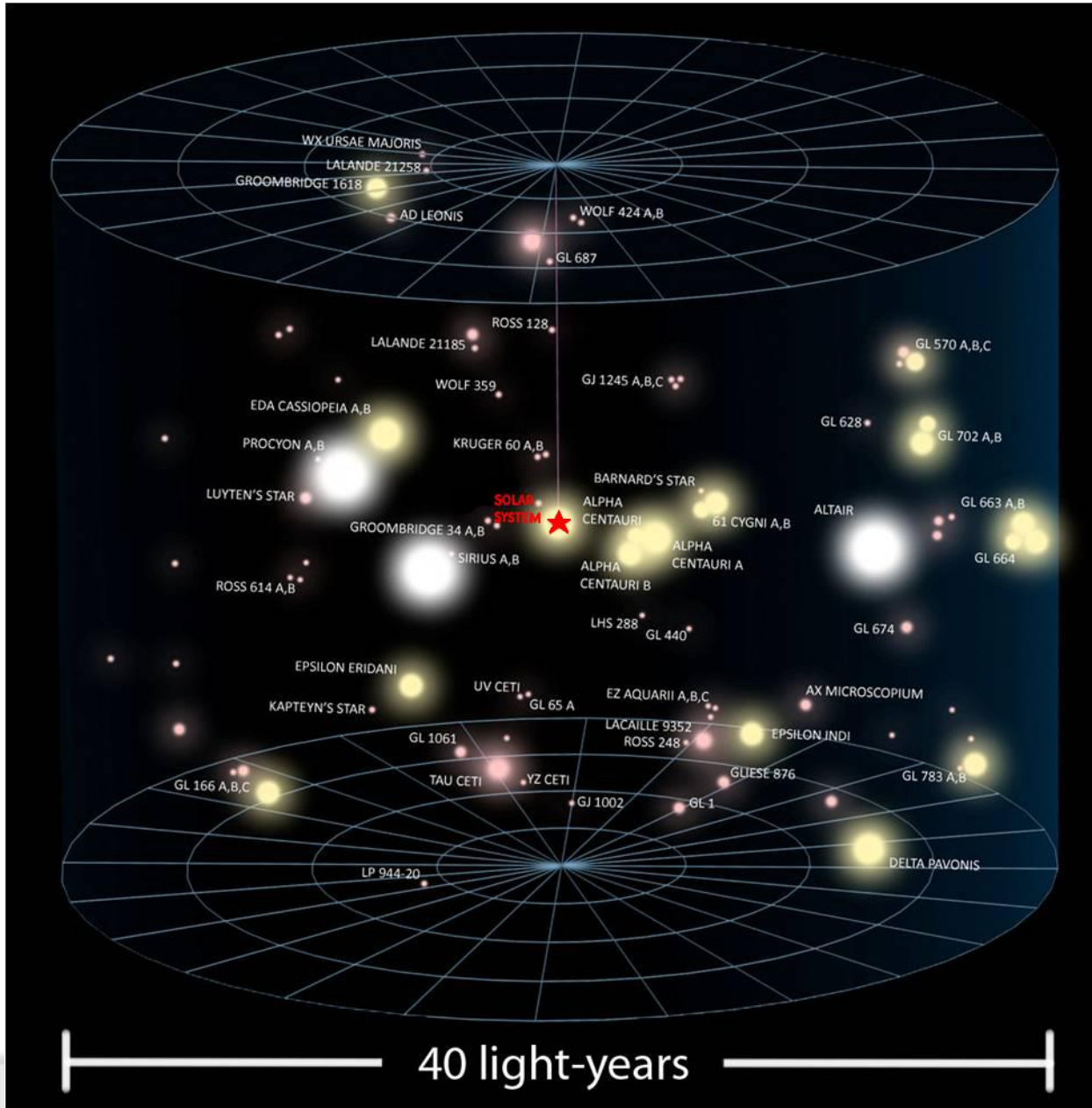
Image credit: NASA



THE SOLAR NEIGHBORHOOD

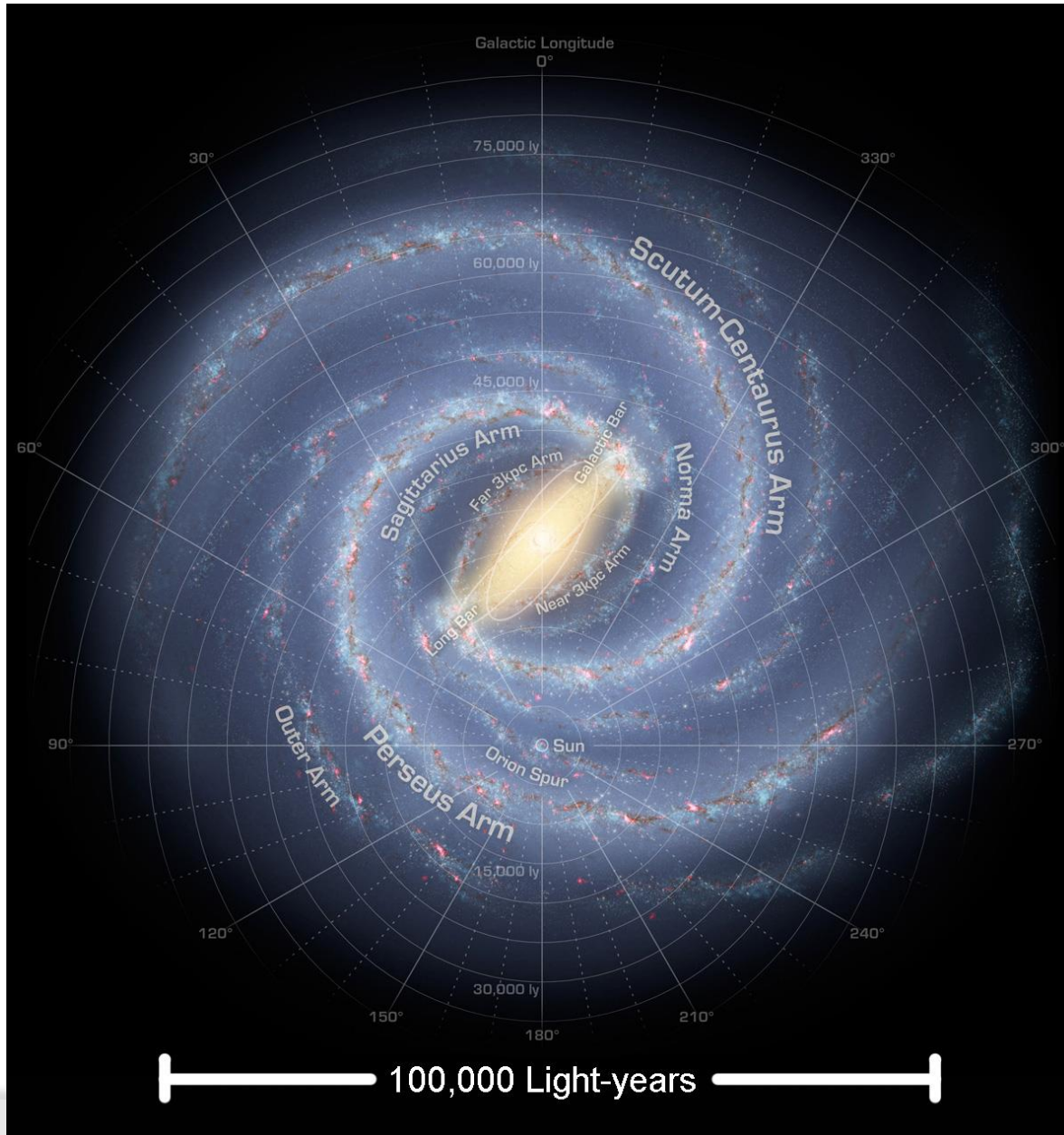
- The region of the Galaxy within about 20 light-years of the Sun (40 light-years diameter)
- A light-year is the ***distance*** that light travels in one year (~10 trillion kilometers or 63,000 AU)
- The neighborhood stars generally move with the Sun in its orbit around the center of the Galaxy
- The 'Solar Neighborhood' is a vague term not scientifically defined

Note: the size of the stars in this image represents their brightness, they would actually all be specks at this distance





THE MILKY WAY GALAXY



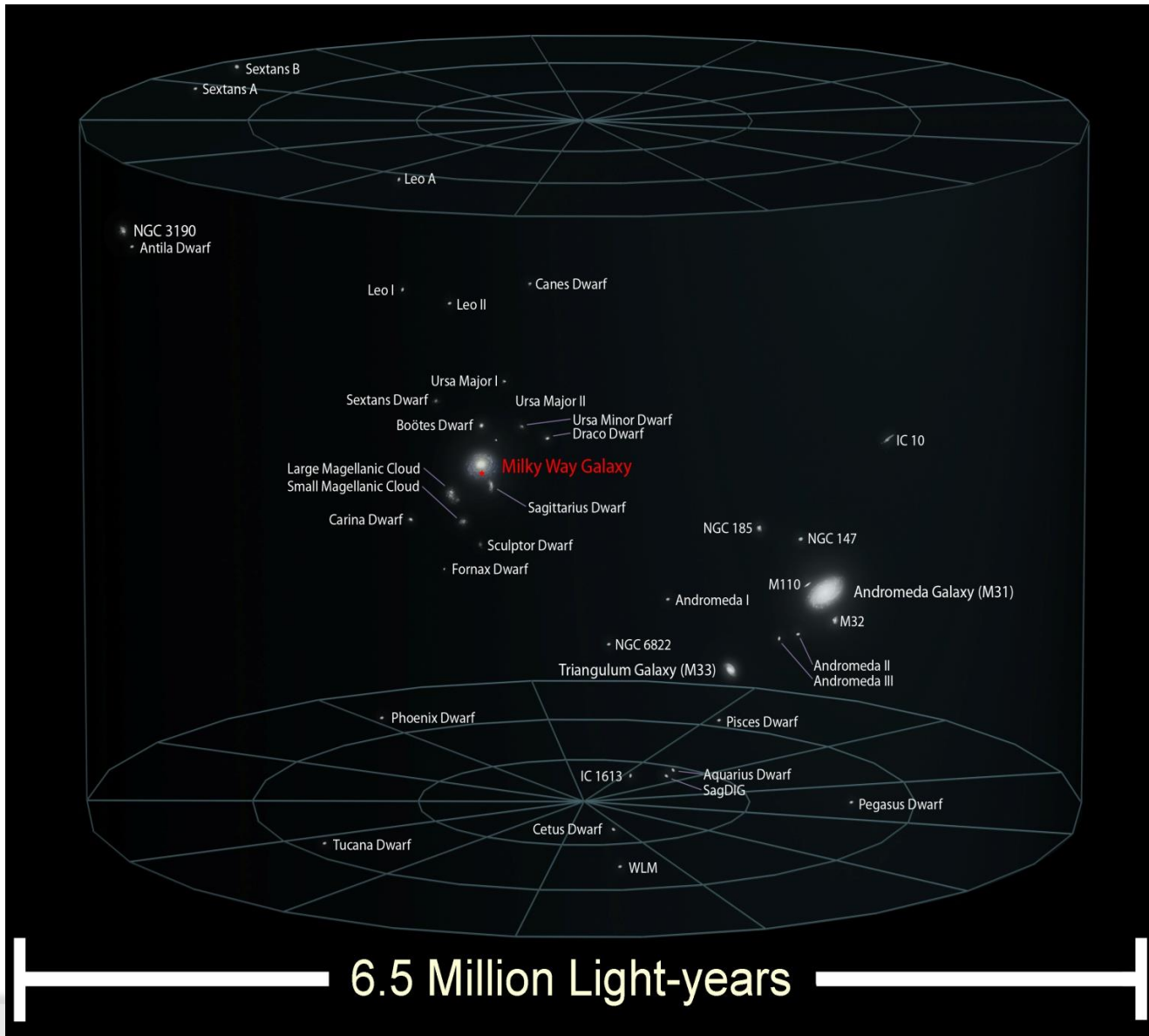
- The Milky Way Galaxy is a giant disk of stars 100,000 light-years across and 1,000 light-years thick
- The Sun is located at the edge of a spiral arm, 30,000 light-years from the center
- It takes about 250 million years for the Sun to complete one orbit
- There are over 200 billion stars in the Milky Way



THE LOCAL GROUP

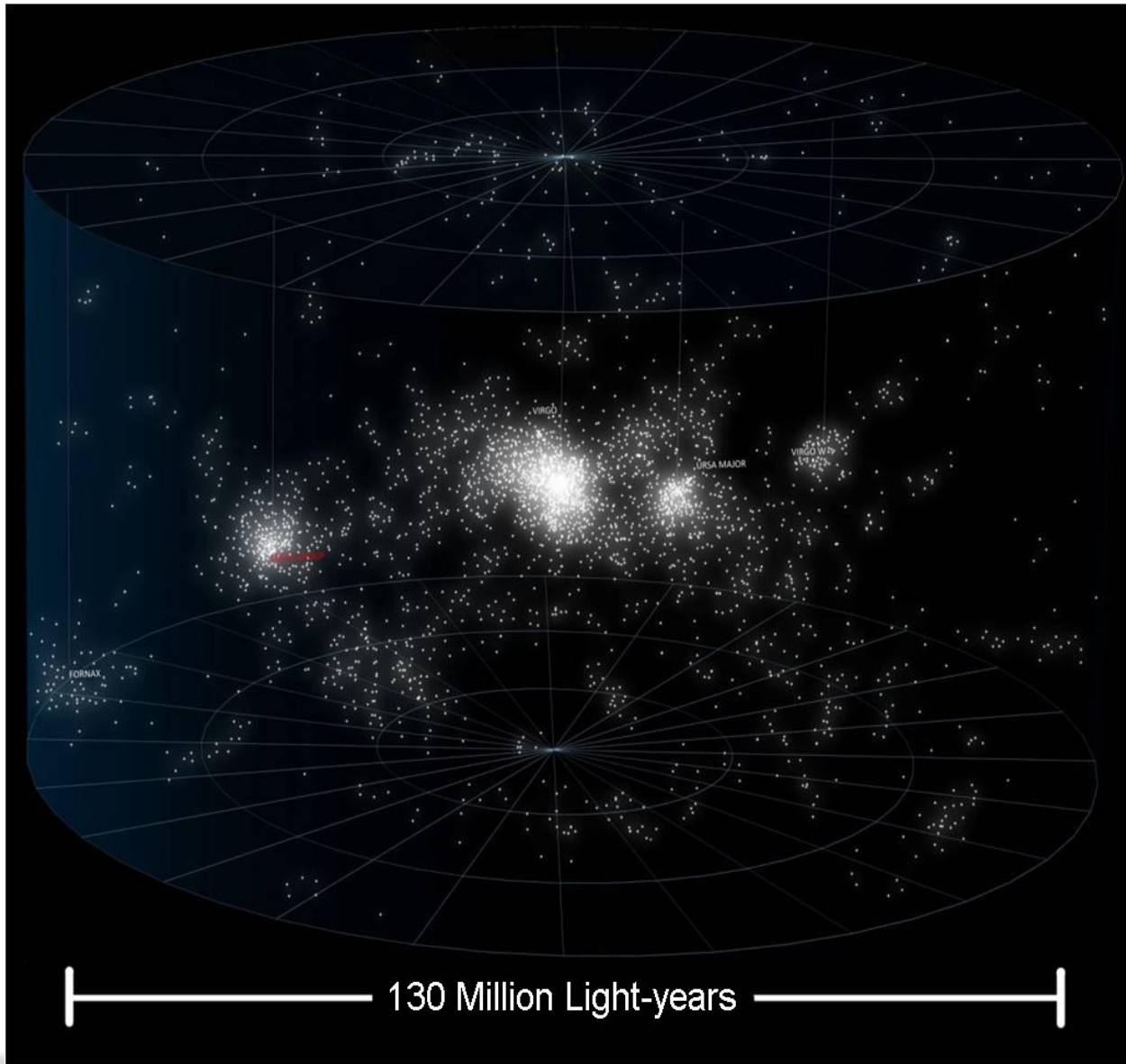
(OF GALAXIES)

- About 6.5 million light-years in diameter
- Contains 3 large spiral galaxies -- Milky Way, Andromeda(M31), and Triangulum(M33) -- plus a few dozen dwarf galaxies with elliptical or irregular shapes
- Gravitationally bound together—orbiting about a common center of mass
- Roughly shaped like a football





THE LOCAL SUPERCLUSTER



- The Local Supercluster is about 130 million light-years across
- It's a huge cluster of thousands upon thousands of galaxies
- Largest cluster is the Virgo cluster containing well over a thousand galaxies
- Clusters and groups of galaxies are gravitationally bound together, however the clusters and groups spread away from each other as the Universe expands
- Roughly pancake shaped

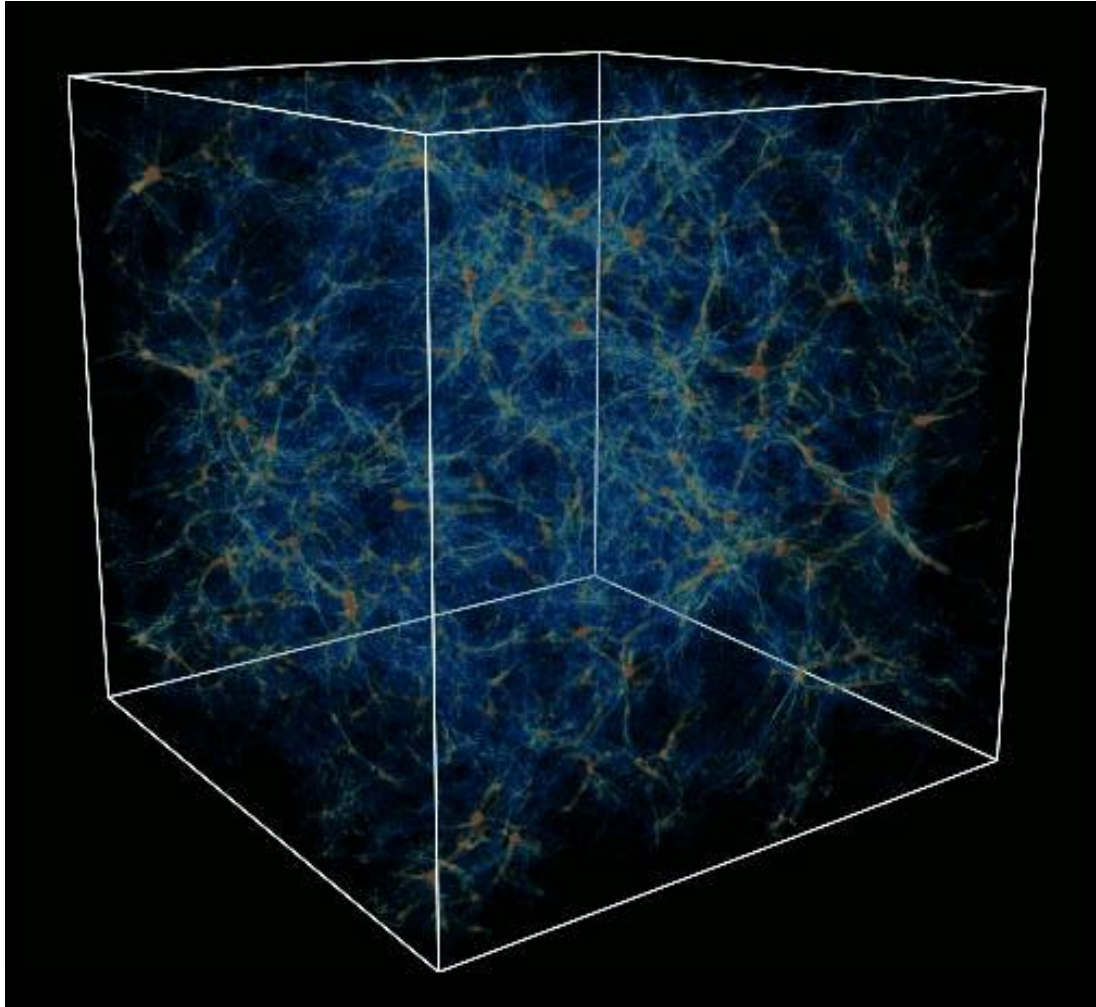


Image Credit: G.L. Bryan, M. L. Norman, UIUC, NCSA, GC3

- Computer simulations also show a similar structure, often called the “Cosmic Web”

THE UNIVERSE

(THE OBSERVABLE PORTION)

- Great walls and filaments of galaxy clusters surrounding voids containing no galaxies
- Probably at least 100 billion galaxies in the Universe
- Surveys of galaxies reveal a web-like or honeycomb structure to the Universe

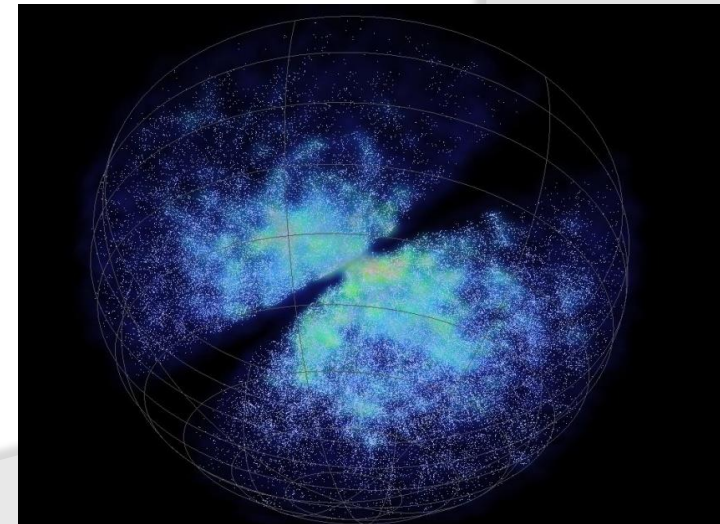


Image Credit: Dr Chris Fluke, Centre for Astrophysics and Supercomputing, Swinburne University of Technology



THE UNIVERSE

(THE OBSERVABLE PORTION)

- The Observable Universe is currently about **91 billion light-years** across
- There could be (and likely is) much more beyond that, but we cannot see it from this point in spacetime
- *Note: The matter that we can see glowing shortly after the Big Bang (detected by the light it emitted 13.7 billion years ago) is now about 46 billion light-years away due to the ongoing expansion of the fabric of the Universe*

