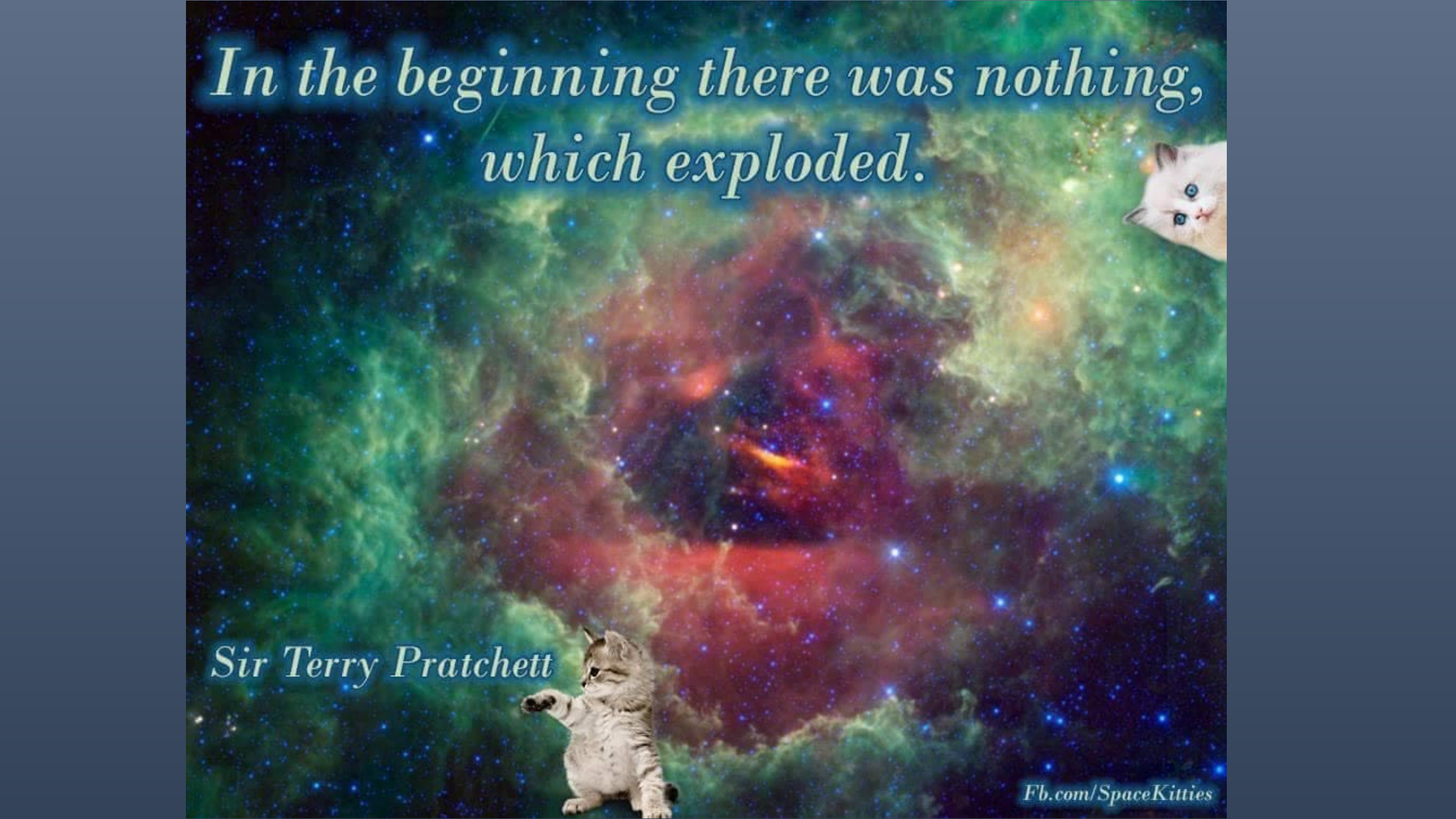


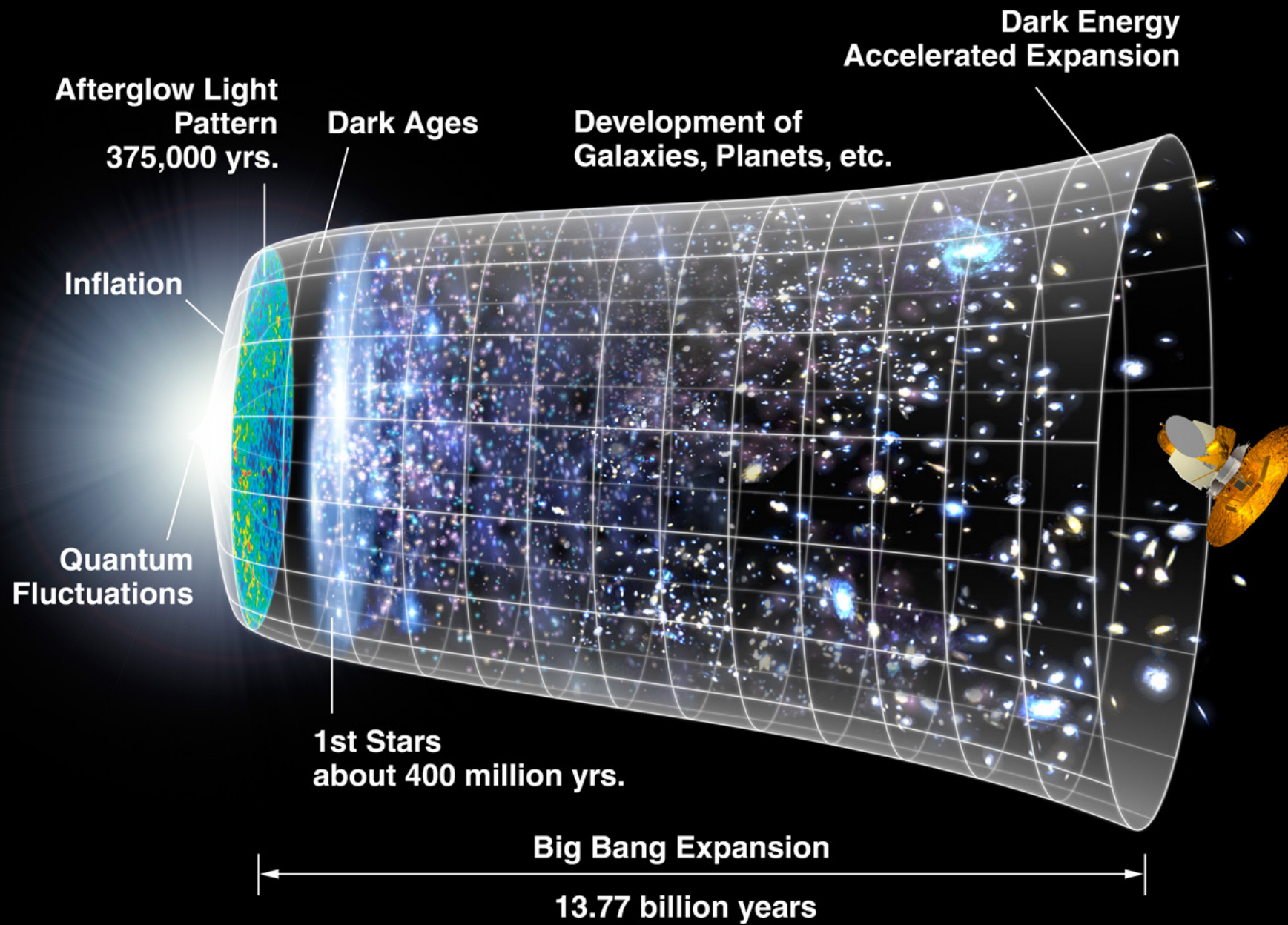
GALAXIES
and
NEBULAE



*In the beginning there was nothing,
which exploded.*

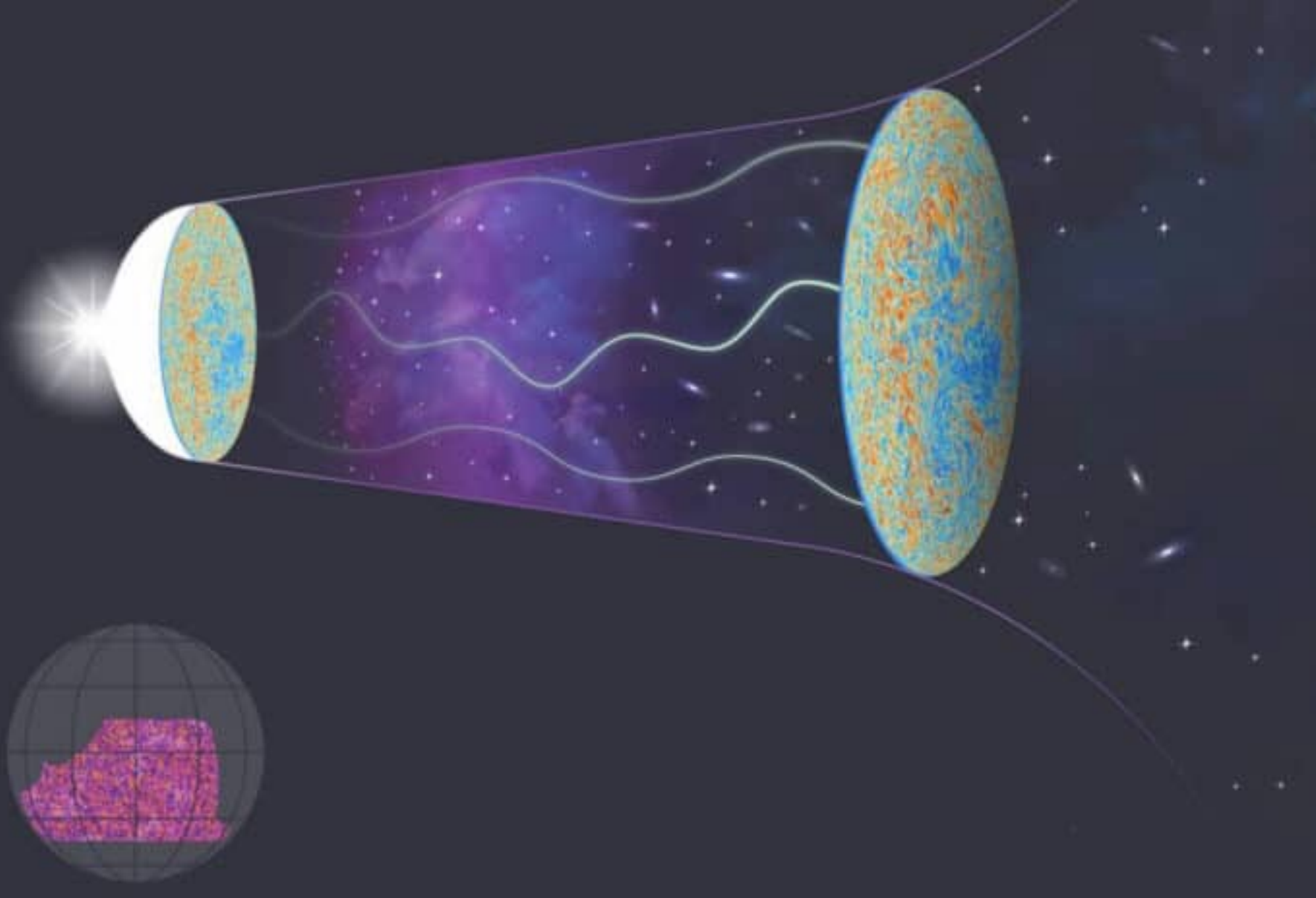
Sir Terry Pratchett

JUST PUBLISHED



WMAP Current View

Wilkinson Cosmic Microwave Background Radiation



Measured by the Wilkinson Microwave Anisotropy Probe (WMAP)
Imaged by Atacama Cosmology Telescope (ACT)

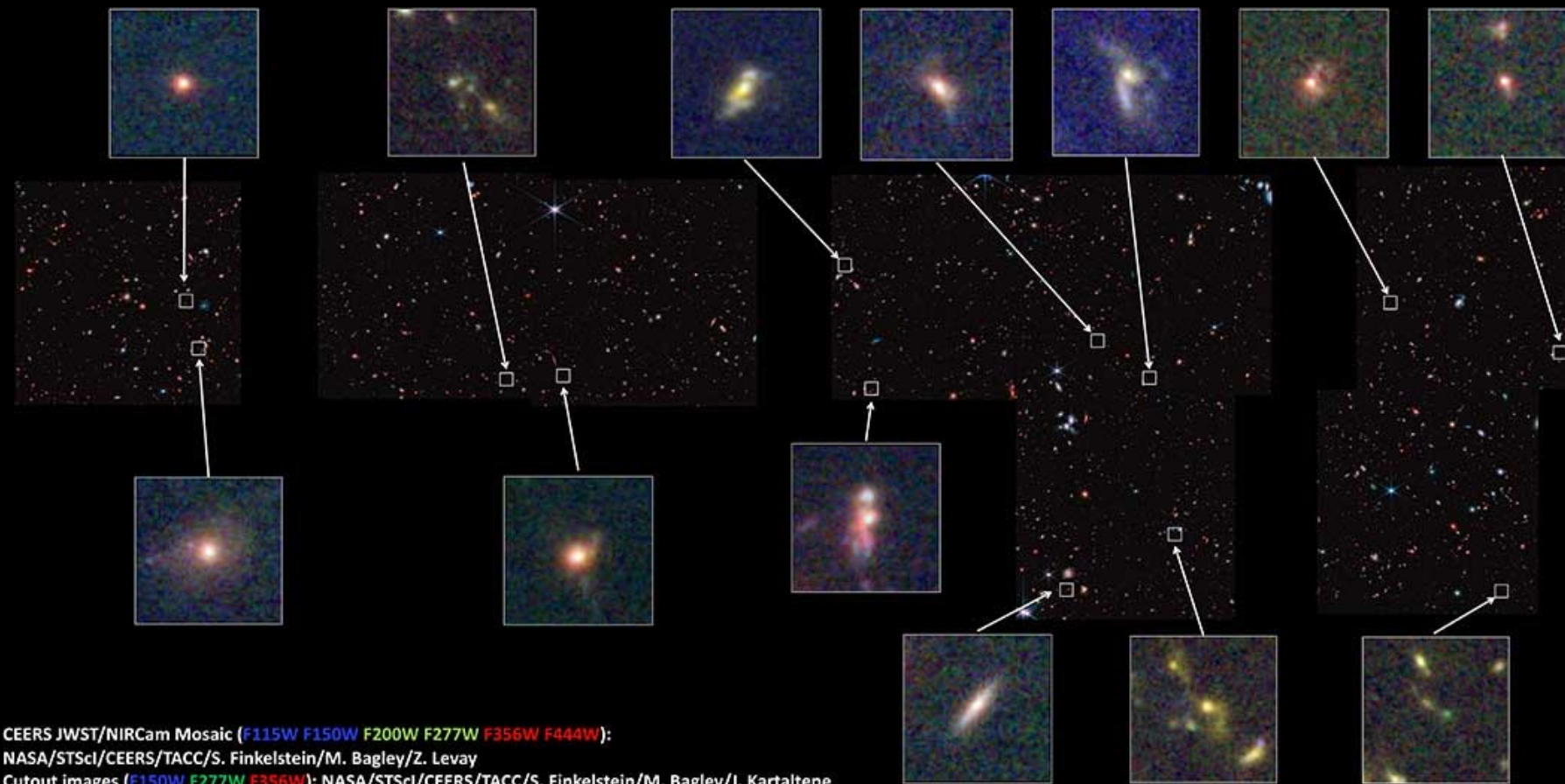


Hubble UDF (exposure time: 11.3 days)



Webb (exposure time: 0.83 days)





NASA / STScI / CEERS / TACC / S. Finkelstein / M. Bagley / Z. Levay;
Cutout images: NASA / STScI / CEERS / TACC / S. Finkelstein / M.
Bagley / J. Kartaltepe

JWST “early” galaxies spectra might have to be reexamined.

Best data that conforms to current theory puts evolution dates at $z=10$ (500Myrs ABB) rather than $z=12$ or 13 (less than 350Myrs ABB).

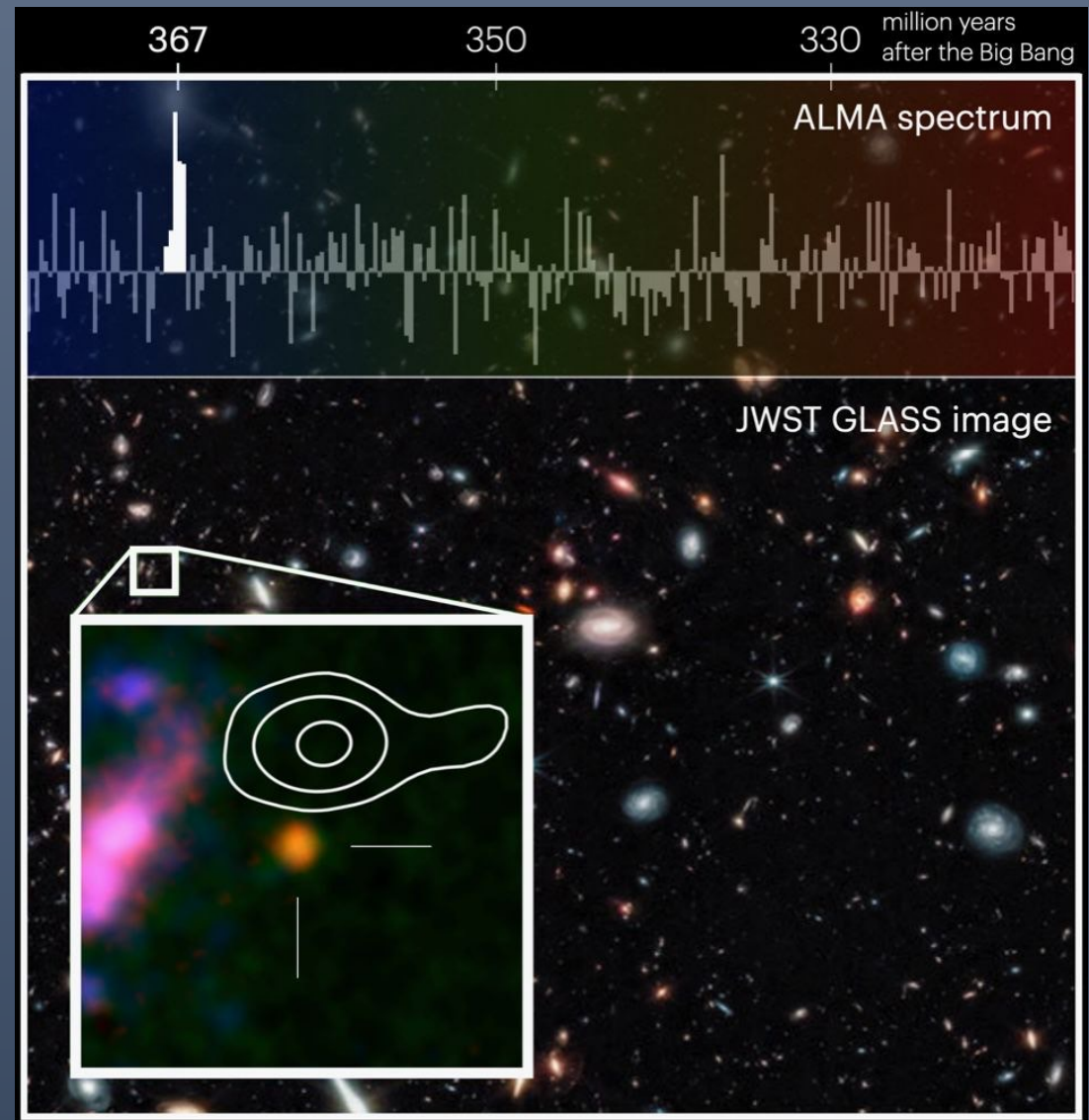
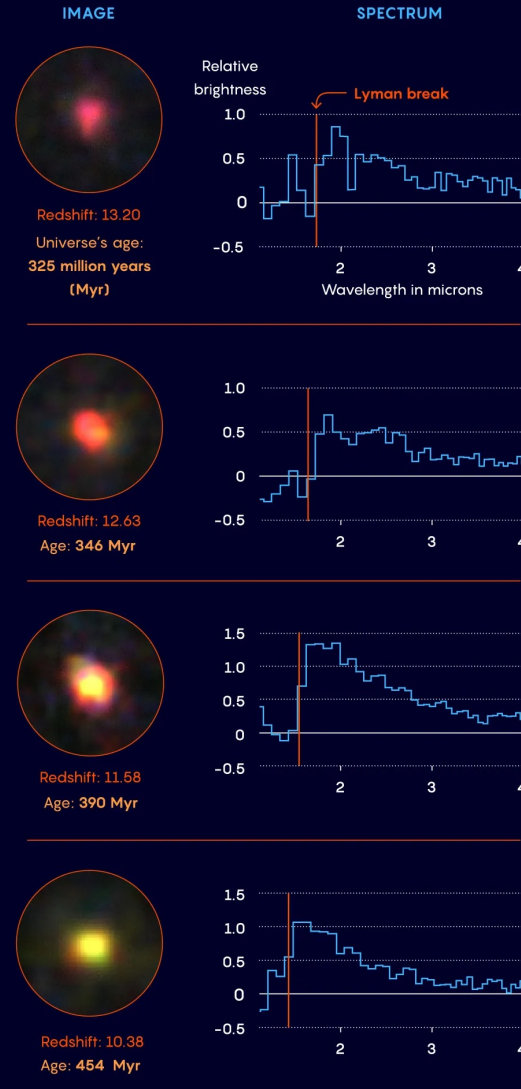
They are checking the calibration of the instruments.

This is cutting edge, ‘new’ science.

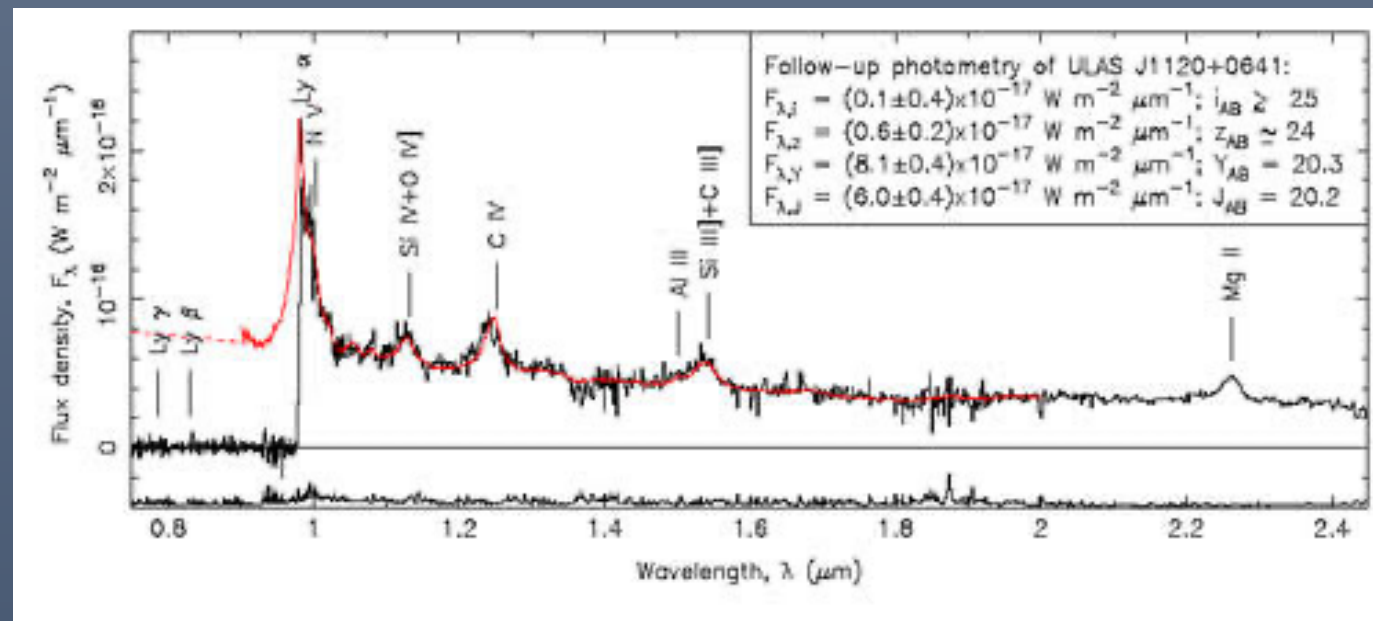
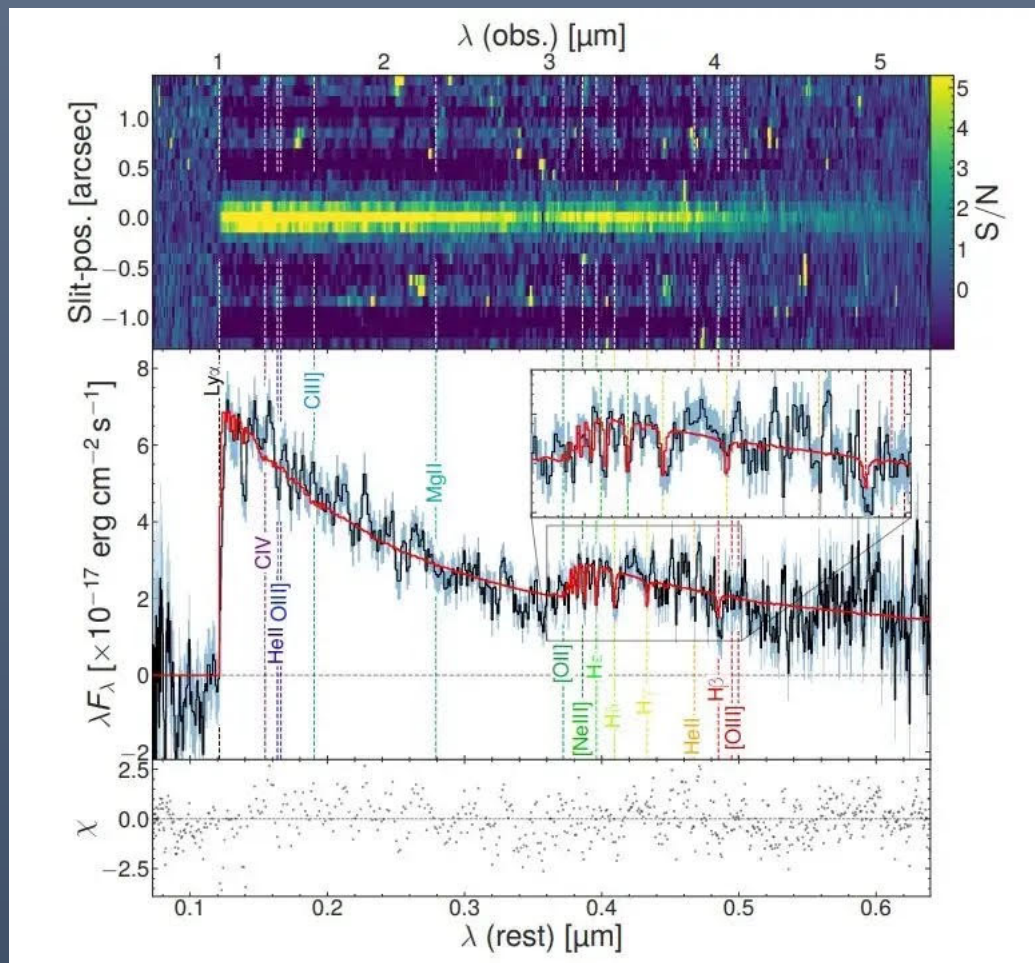
Earliest Known Galaxies

The James Webb Space Telescope captured images and spectra of four extremely distant galaxies, confirming that their light was emitted less than 500 million years after the Big Bang.

The farther away a galaxy is, the more its wavelengths of light have stretched, becoming “redshifted.” Astronomers gauged each galaxy’s distance by identifying the redshift of its **Lyman break**, a drop in intensity due to the light’s absorption by hydrogen gas.



But wait, the data from ALMA records that galaxy at $z=12.2$, aprx 367 Myrs ABB. This is how the science process works.

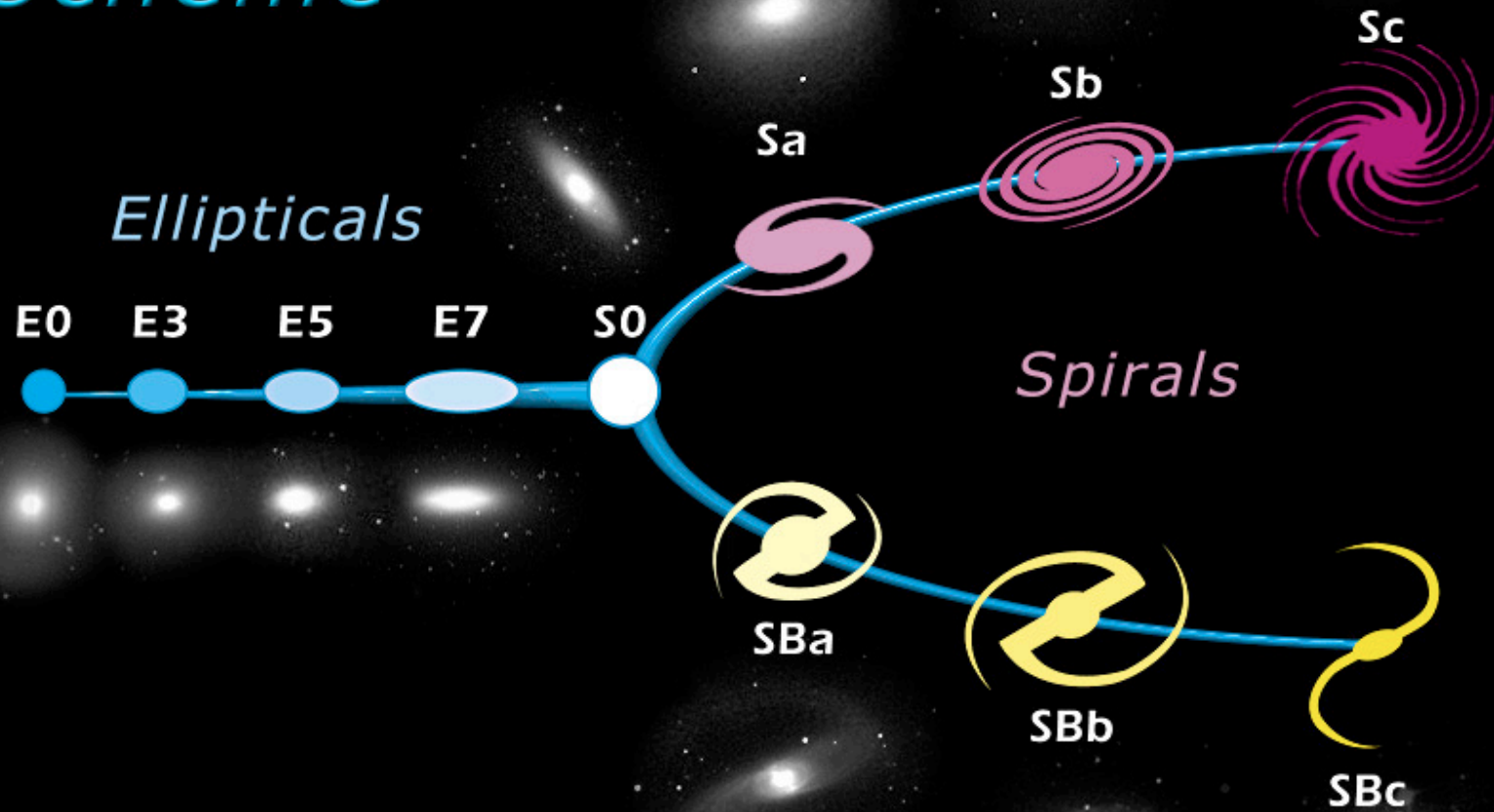


Galaxy (?)

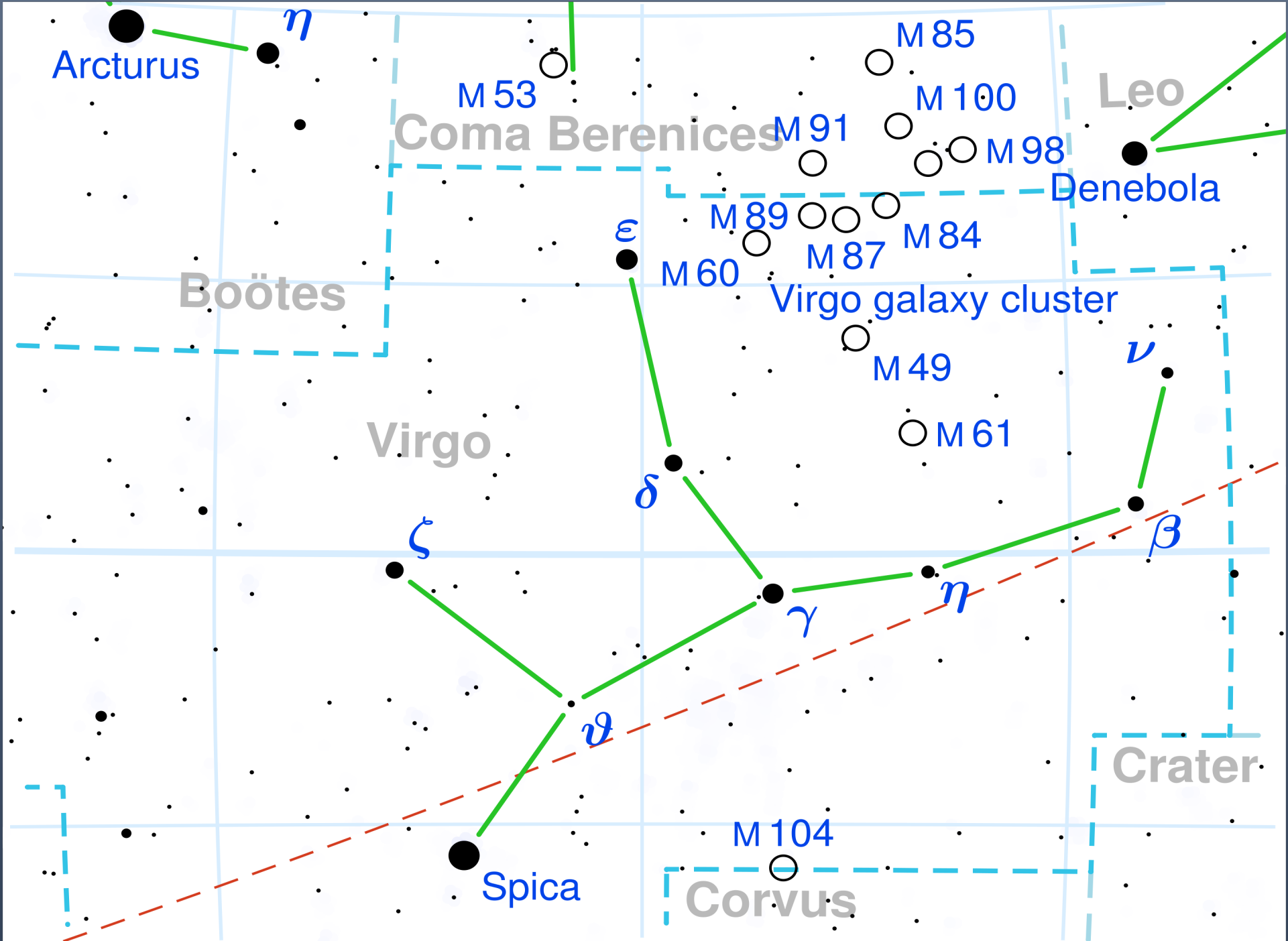
Quasar

JWST recent spectra of distance "objects"

Edwin Hubble's Classification Scheme



SPIRAL GALAXIES



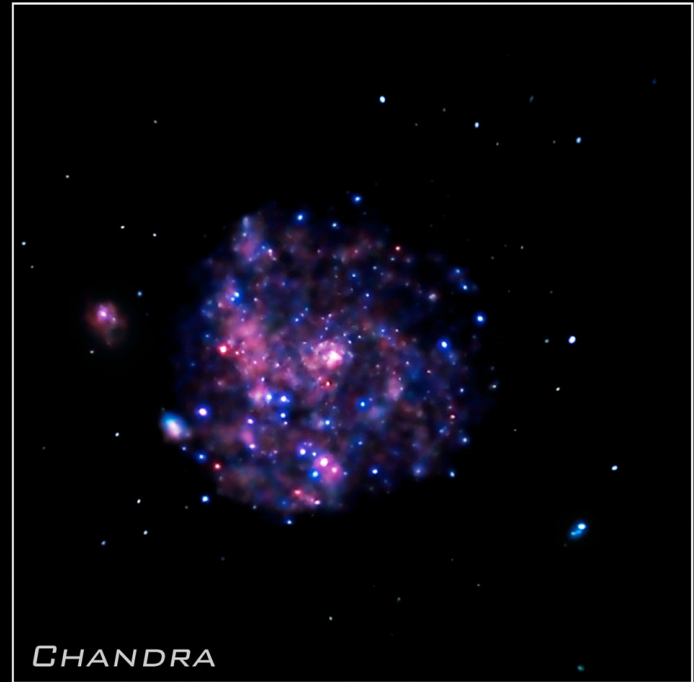
M101 Pinwheel



NASA, ESA, CXC, SSC, AND STScI



HUBBLE



CHANDRA

STScI-PRC09-07B

Spiral Galaxy

M66

NGC 3628



M95



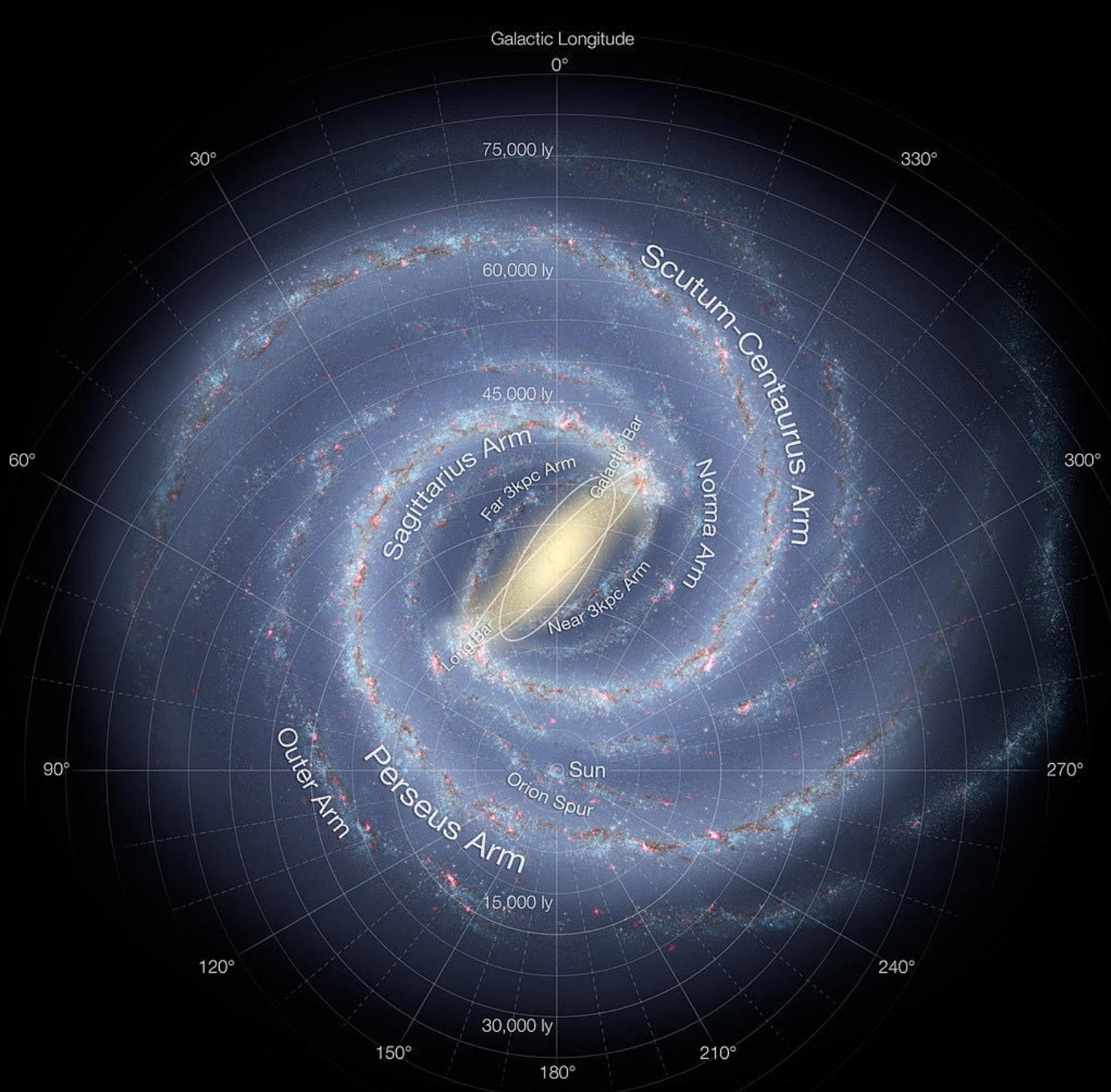
M65

Leo Triplet



NGC 1097
Eye of Horus

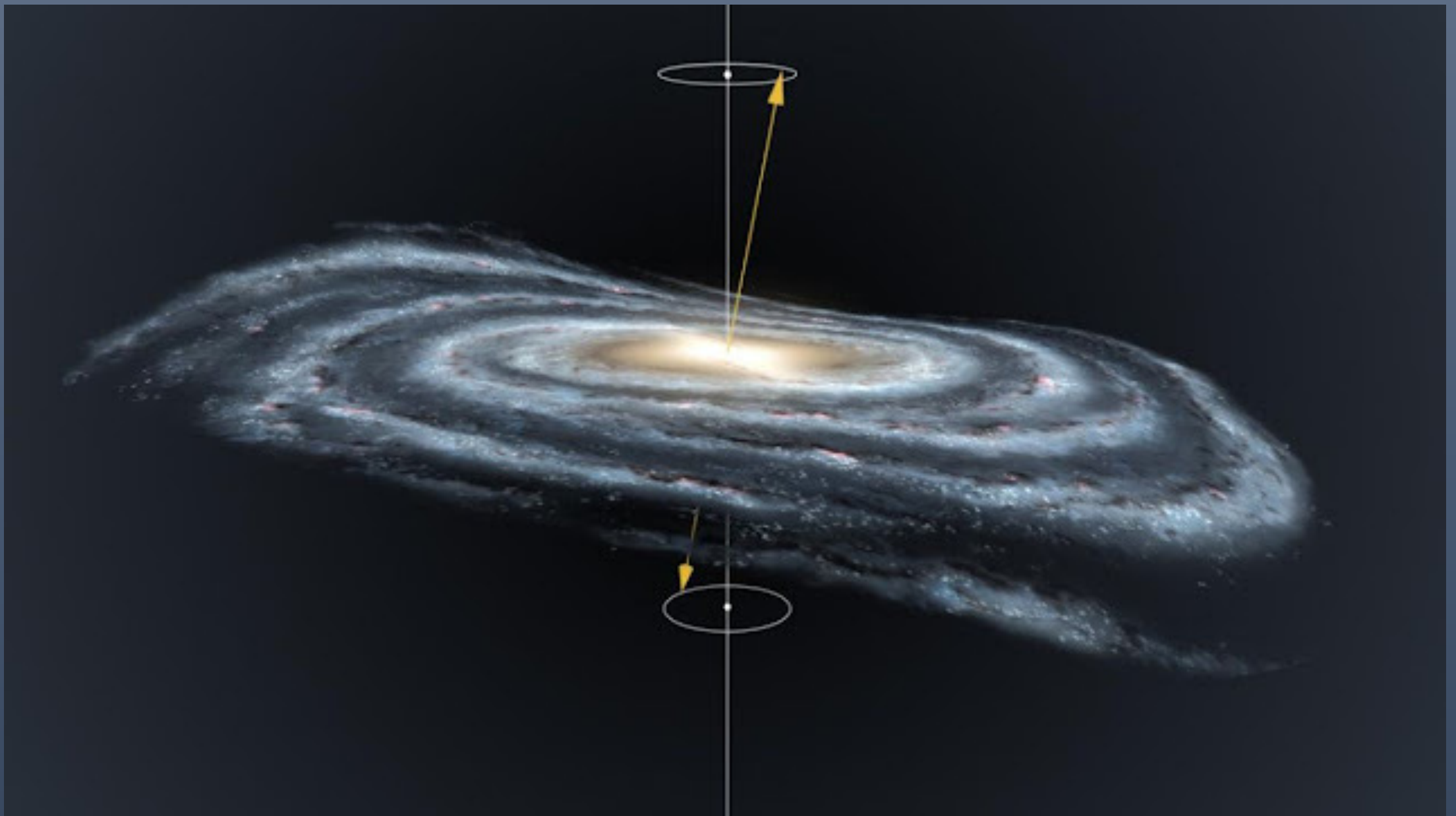
Barred Spiral
Galaxy



Milky Way

Barred Spiral

Artist Rendering



News: Warp in Milky Way disc



M51a Spiral
M51b Irregular

Interacting
galaxies



Arp 78 or NGC 772

Peculiar Spiral Galaxy

Gemini
Observatory

The image shows the M82 galaxy, also known as the Cigar Galaxy, which is an irregular galaxy. It has a prominent, elongated central region that appears as a bright, yellowish-white band. This central region is surrounded by a diffuse, reddish-orange glow, which is likely due to emission nebulae. The galaxy is set against a dark background of space, with several bright stars visible. The overall appearance is that of a galaxy with a complex, irregular structure.

M82
Cigar
Irregular
Galaxy

Emission nebula in the foreground



M32
In Andromeda



M49
In Virgo



M86
In Virgo

Elliptical Galaxies



M87

M87*
Virgo A*



First photographed Black Hole



Atacama Large Millimeter Array
(ALMA)

Antofagasta, Chile (Alt: 16,597 ft)



M104 Sombrero
Elliptical Galaxy
Seyfert Type

NEBULAE

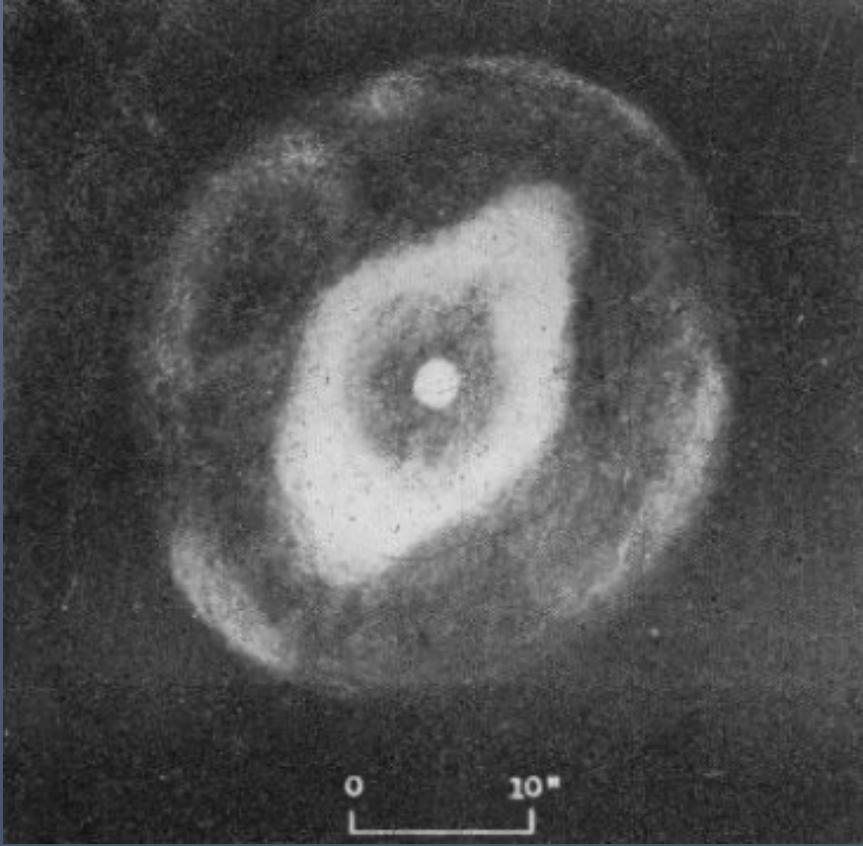
SEE NOTE SHEET



M57
Ring
Planetary Nebula
in
Lyra

NGC 3242

Ghost of Jupiter



James Kaler

Hydra



CW Leonis or IRC +10216



JUST PUBLISHED

VLT 2009



JWST 2023

Nebula M1-67
Around
WR 124 (Wolf-Rayet)
In Sagitta (The Shield)

The spikes are not part of the nebula, and are related to the imaging instrument. The O dwarf core is in the center.



NGC 2237
Caldwell 49

Rosette Nebula

HII region in
Monoceros

NGC 2170

Angel

**Dark
&**

**Emission
Nebulae**





IC2118
Witch Head

Reflection
Nebula
In Orion



Sharpless 308
The Dolphin
Illuminated by
WR 6
(EZ Canis Major)



M 20

Trifid

Red = Emission
Blue = Reflection
Black = Dark

In Sagittarius



Barnard 59

The Pipe

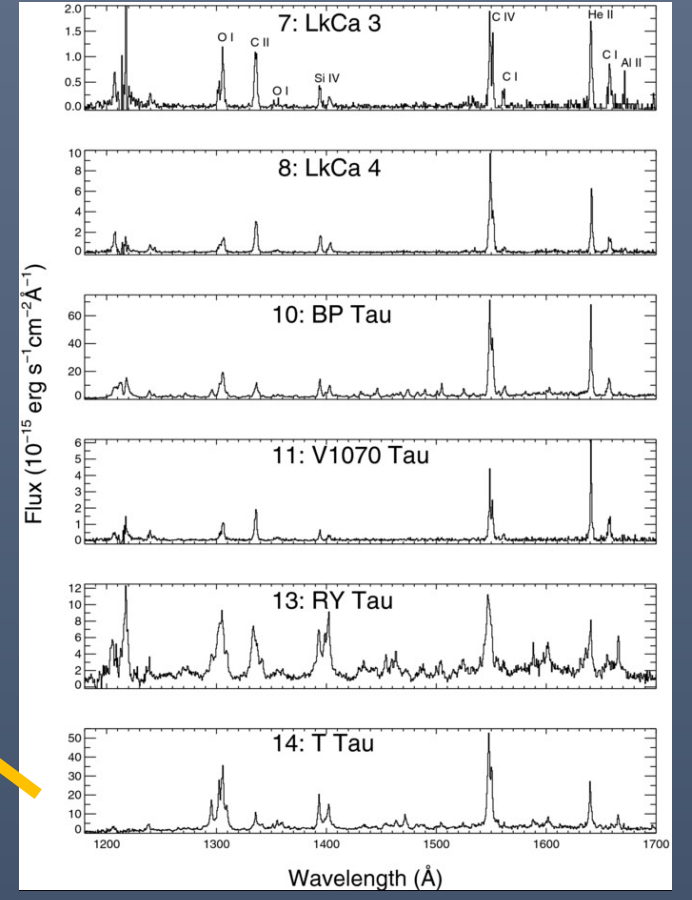
Dark
Nebula
in Ophiuchus



OB



T Tauri stars



ASSOCIATIONS