

An artistic rendering of the James Webb Space Telescope in space, showing the telescope's large sunshield and primary mirror array. The Earth is visible in the background.

"JWST", the *James Webb* *Space Telescope*

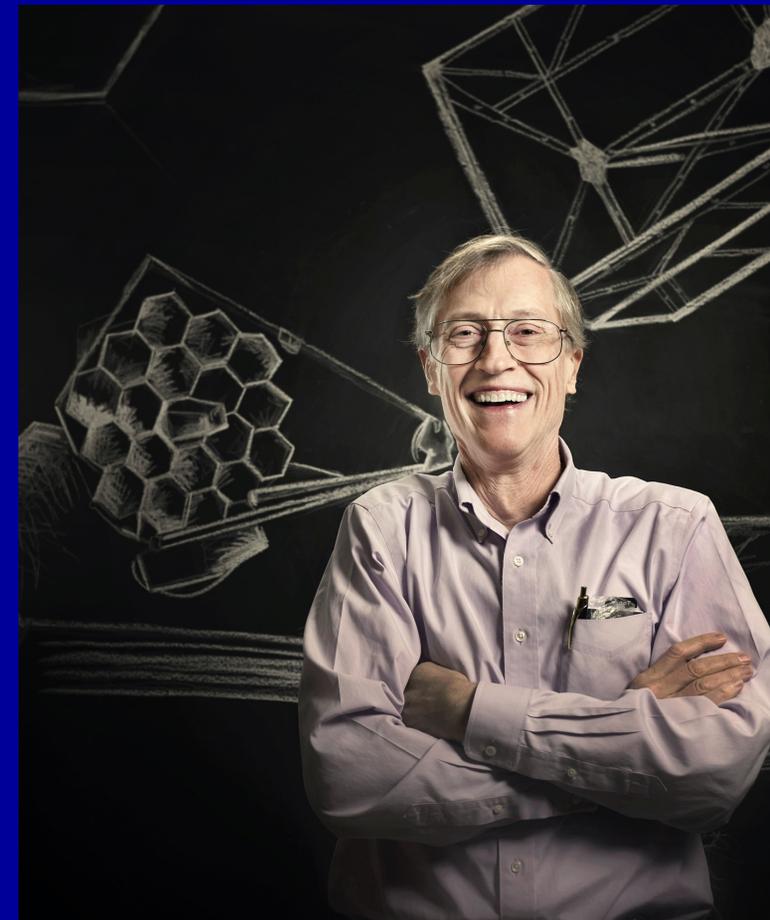
Ollie Open House
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*"Sometimes I wonder if there's more to life than
unlocking the mysteries of the universe."*

History of the Universe

PRESENT
DAY

MODERN
GALAXIES
FORM

FIRST
GALAXIES
FORM

FIRST
STARS
FORM

THE
BIG BANG



HUBBLE

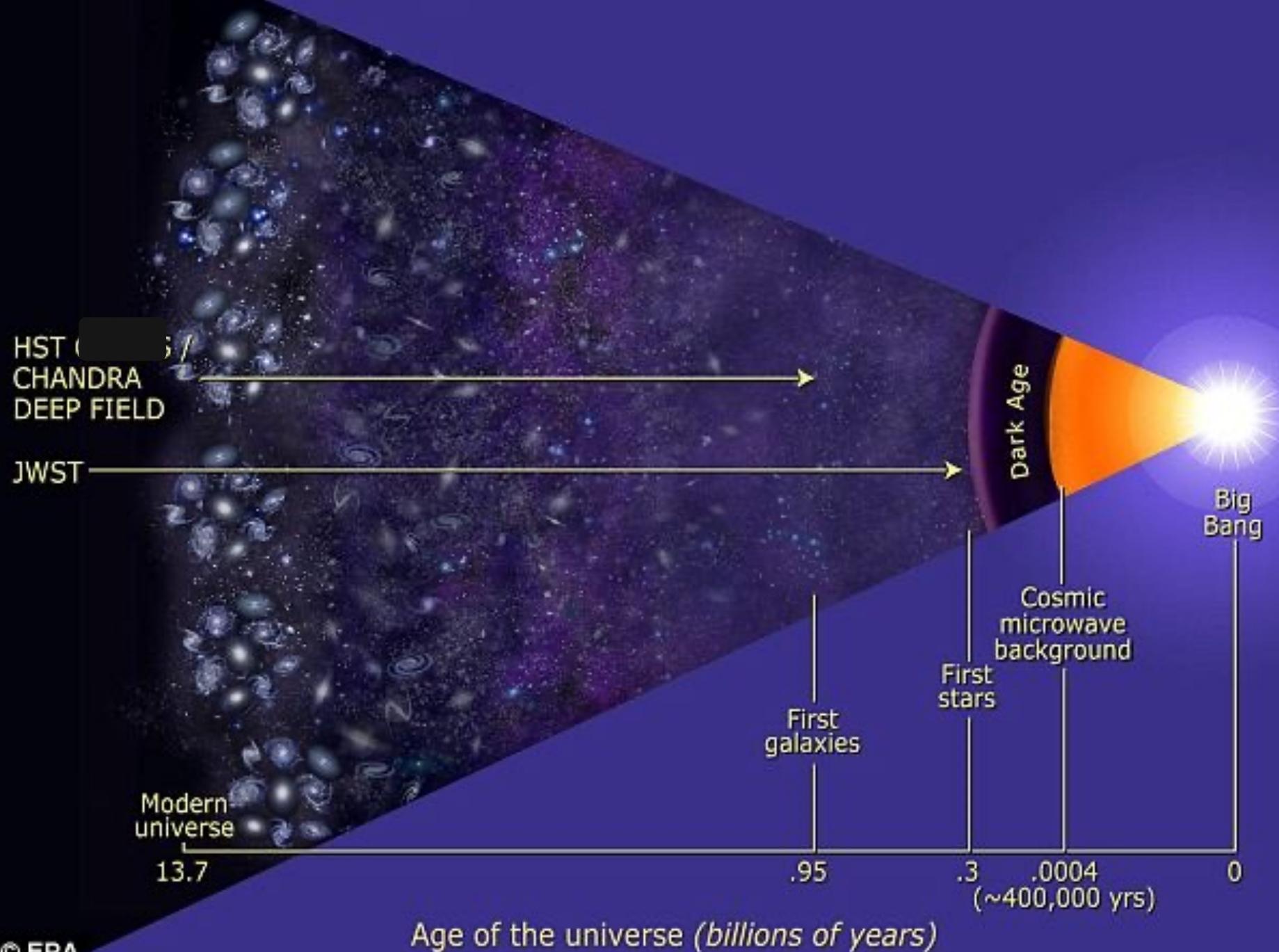


JWST

RANGE

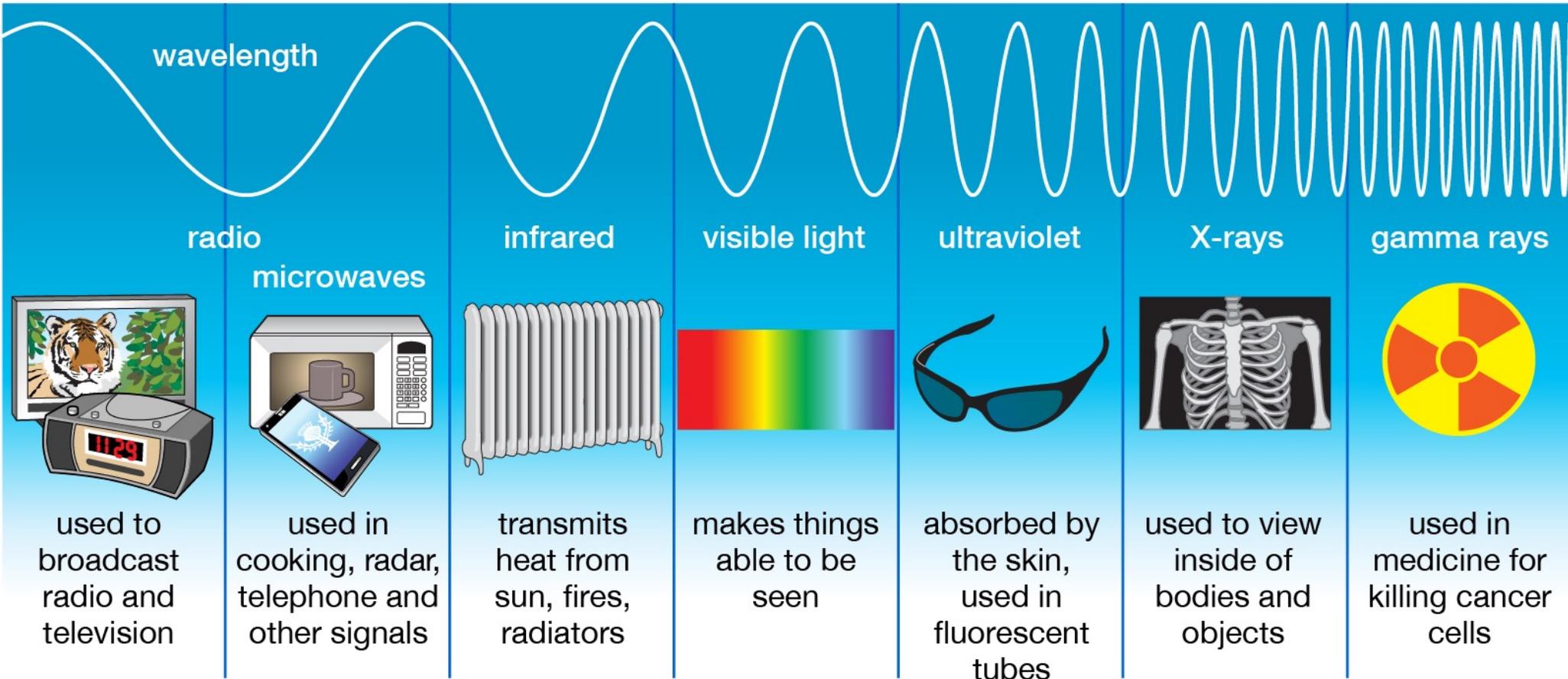
the first stars came into life.

Seeing back into the cosmos



Electromagnetic spectrum

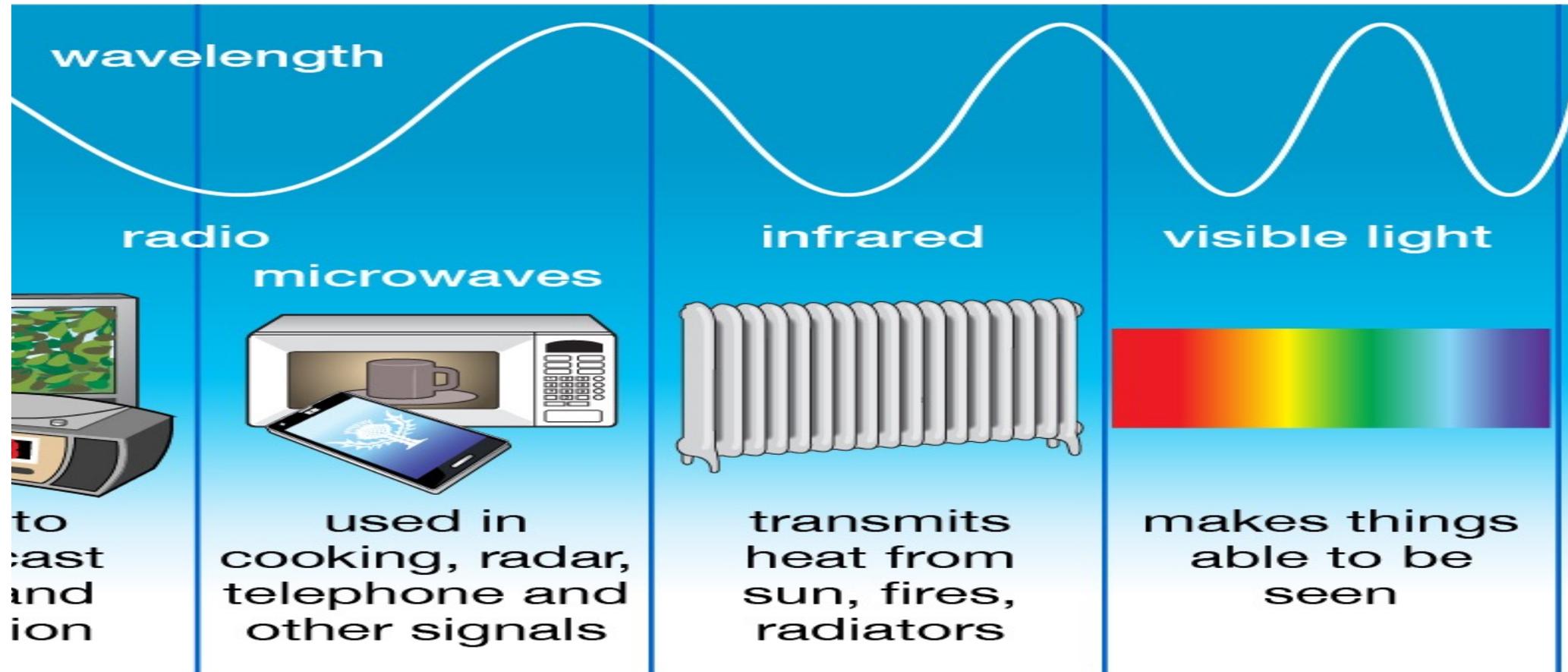
Types of Electromagnetic Radiation



When the Universe expands, so does the radiation, making its wavelength larger. The further it travels, the larger the expansion. Visible light becomes infrared light.

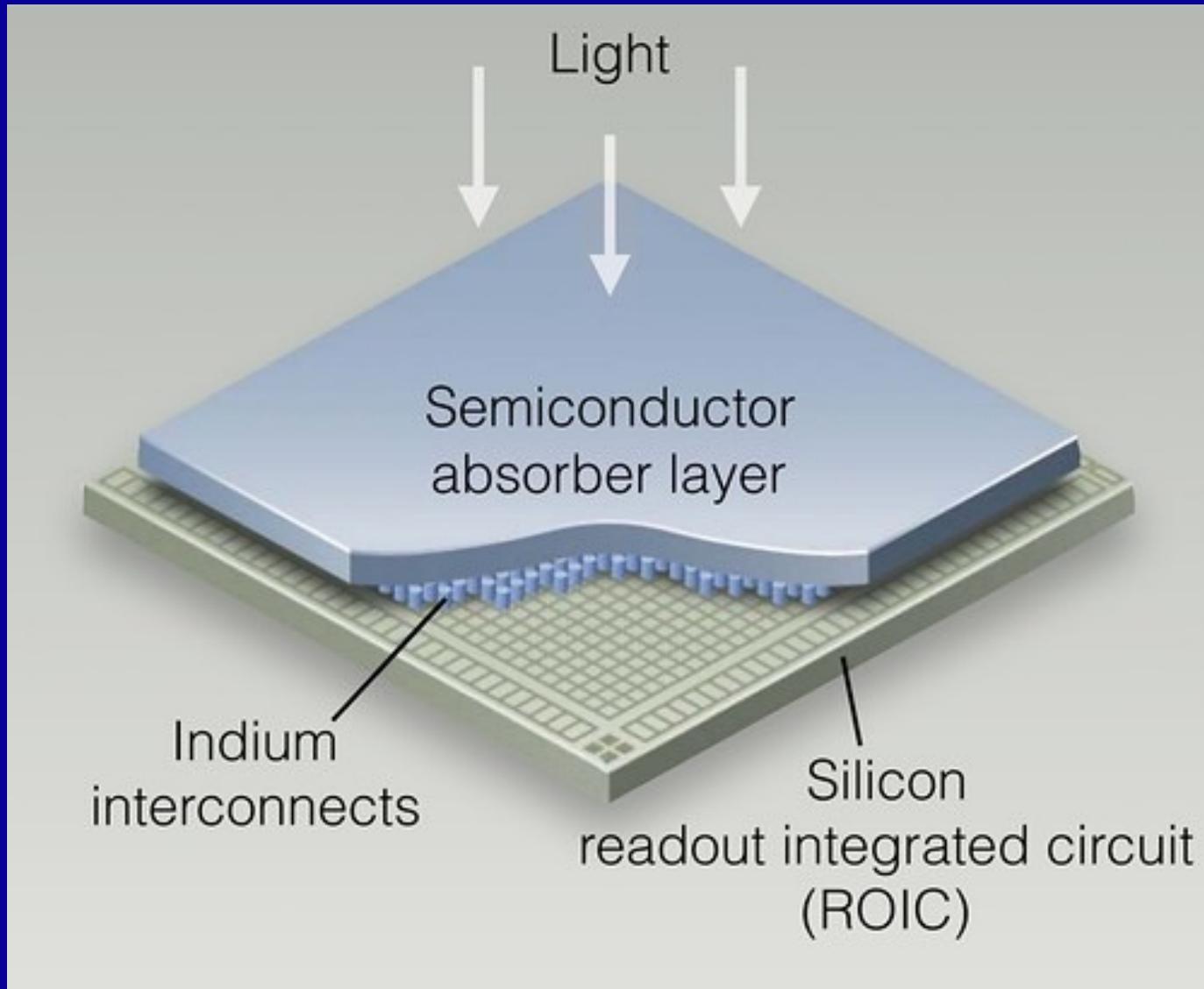
Visible light becomes infrared.

of Electromagnetic Radiation

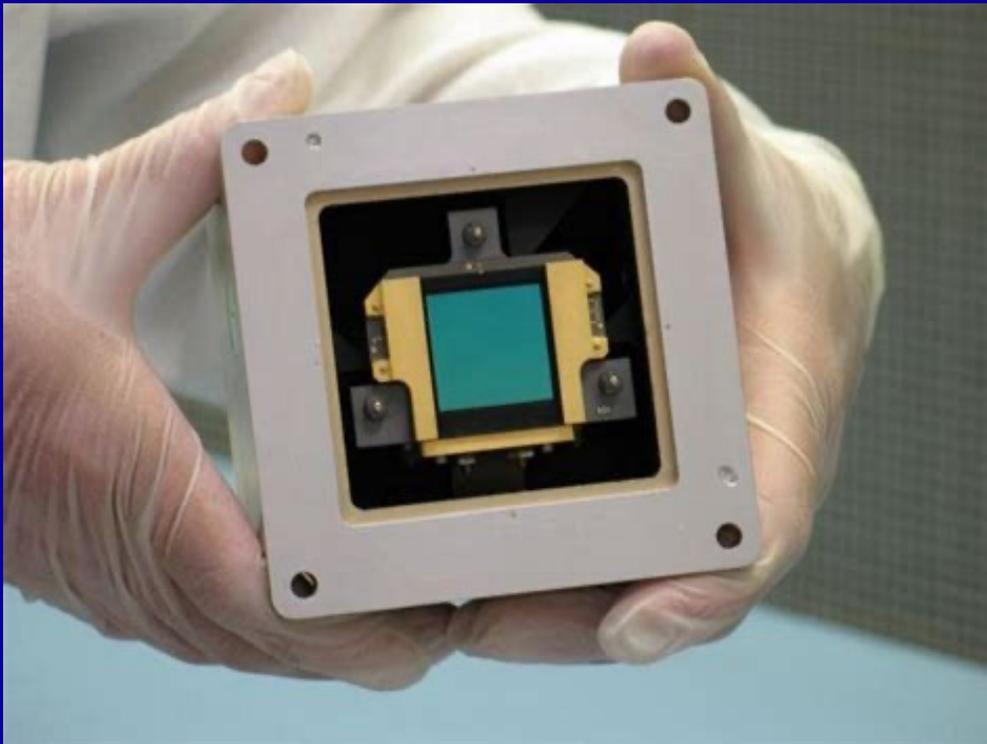


cyclopædia Britannica, Inc.

An infrared detector



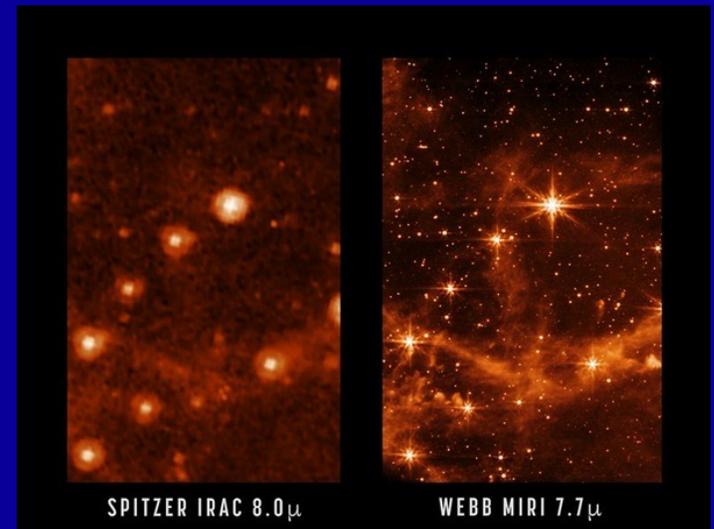
JWST has infrared detectors to see deeper into the universe.



Also an ir detector made with mercury-cadmium-telluride

It has a 1024x1024 pixel array of arsenic doped silicon pixels.

Three different detectors cover 0.6 to 28 microns



An origami telescope and sun shield: an engineering marvel

- Started 1995, estimated cost \$1.6B
- Original launch date 2013
- Mirror area: 5 x HST
- Final cost ~\$10B, launched Dec. 25, 2021
- 334 single-point failures
- Instruments at $-220^{\circ}\text{C} = -364^{\circ}\text{F} = 53\text{Kelvin}$
- Gold-plated beryllium mirrors
 - 5 gm of gold total (0.17 oz)

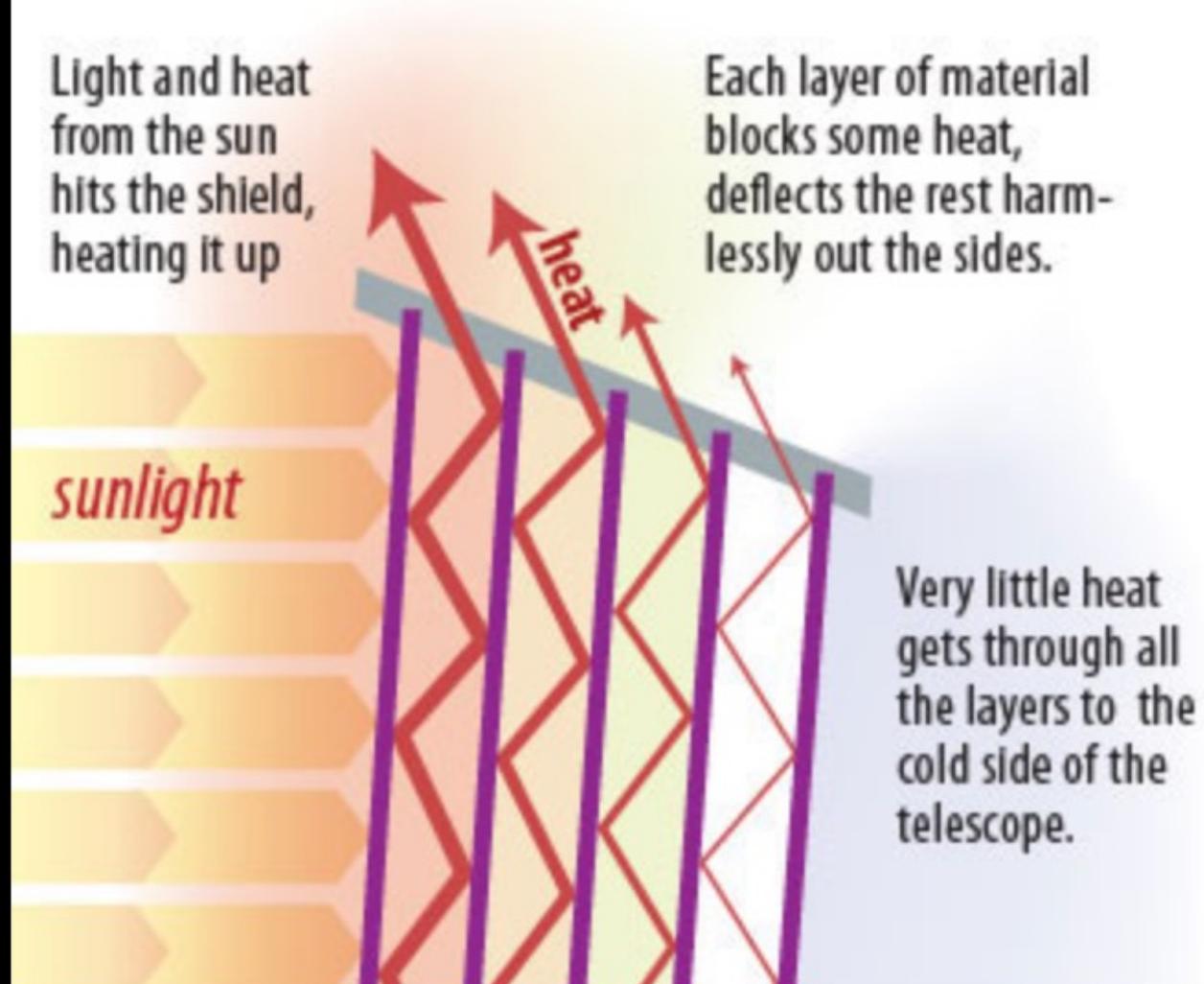




Cross-Section of Webb's Five-Layer Sunshield

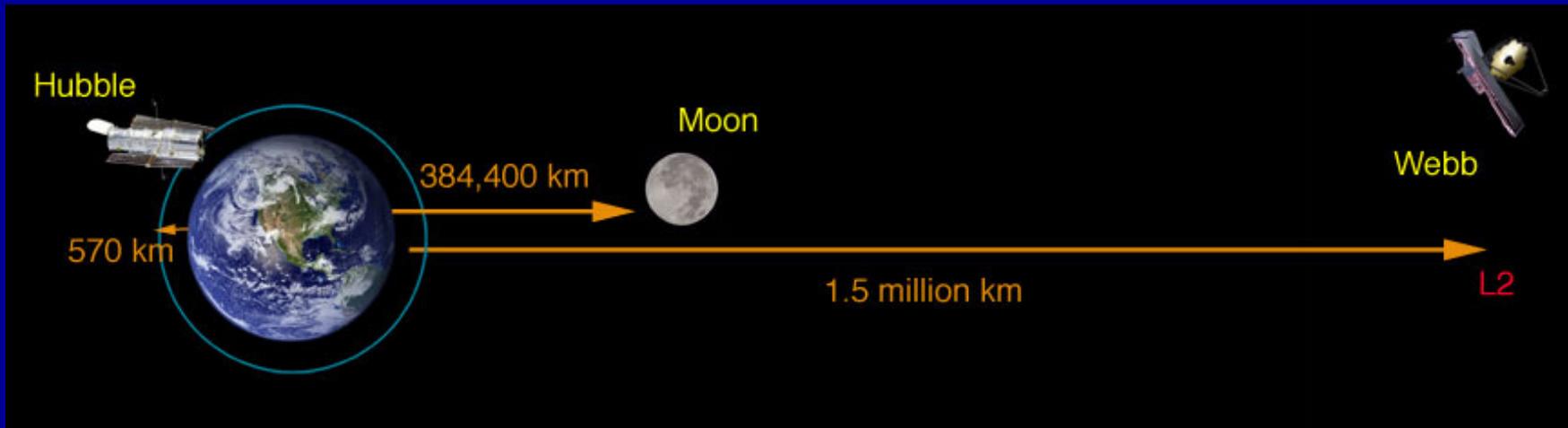
Light and heat from the sun hits the shield, heating it up

Each layer of material blocks some heat, deflects the rest harmlessly out the sides.

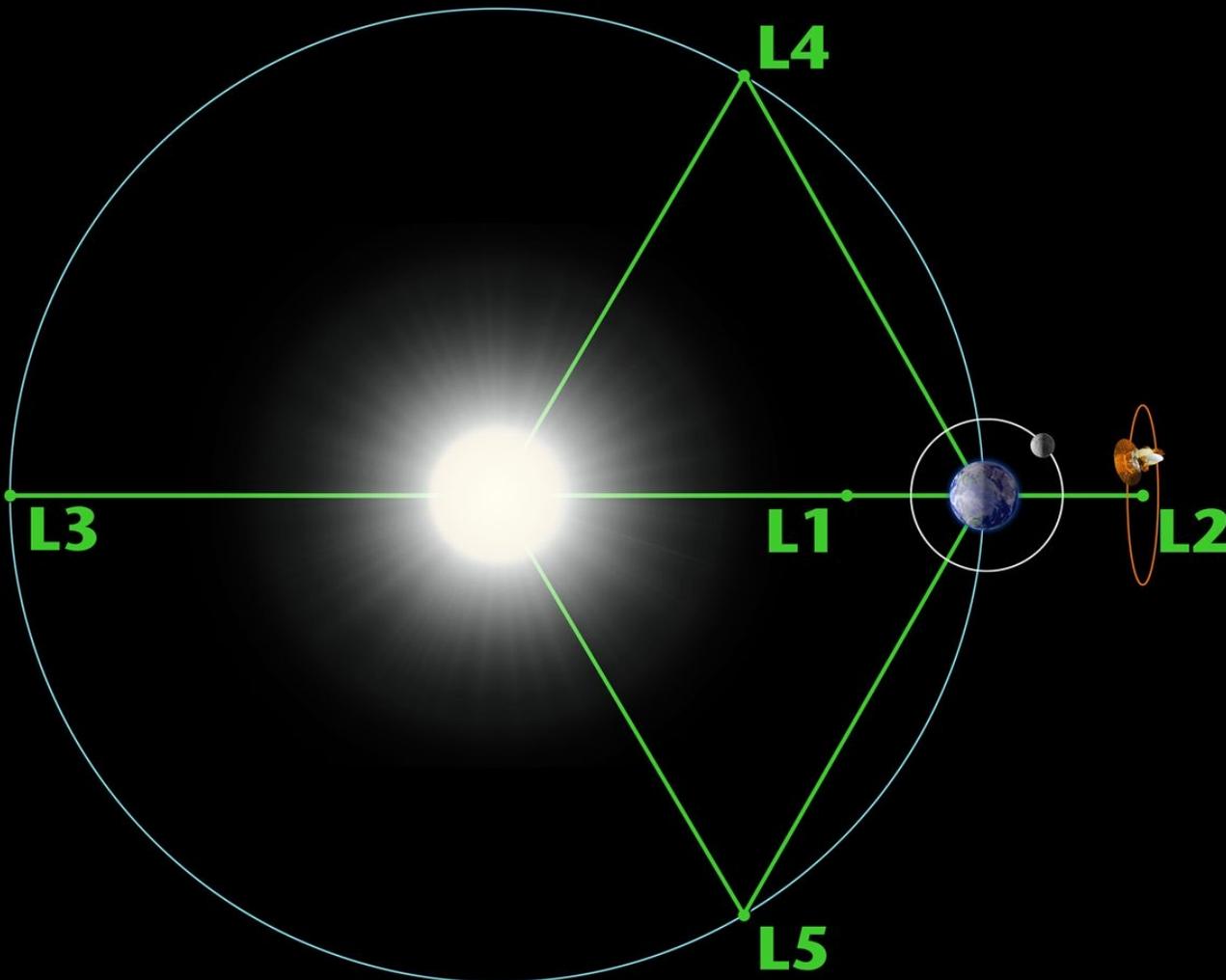


Very little heat gets through all the layers to the cold side of the telescope.

1430 W/ m²



Lagrange Point 2 orbit



Sun and Earth pull the Satellite into alignment, but the satellite needs thrusters to keep it at the right distance from the Earth.

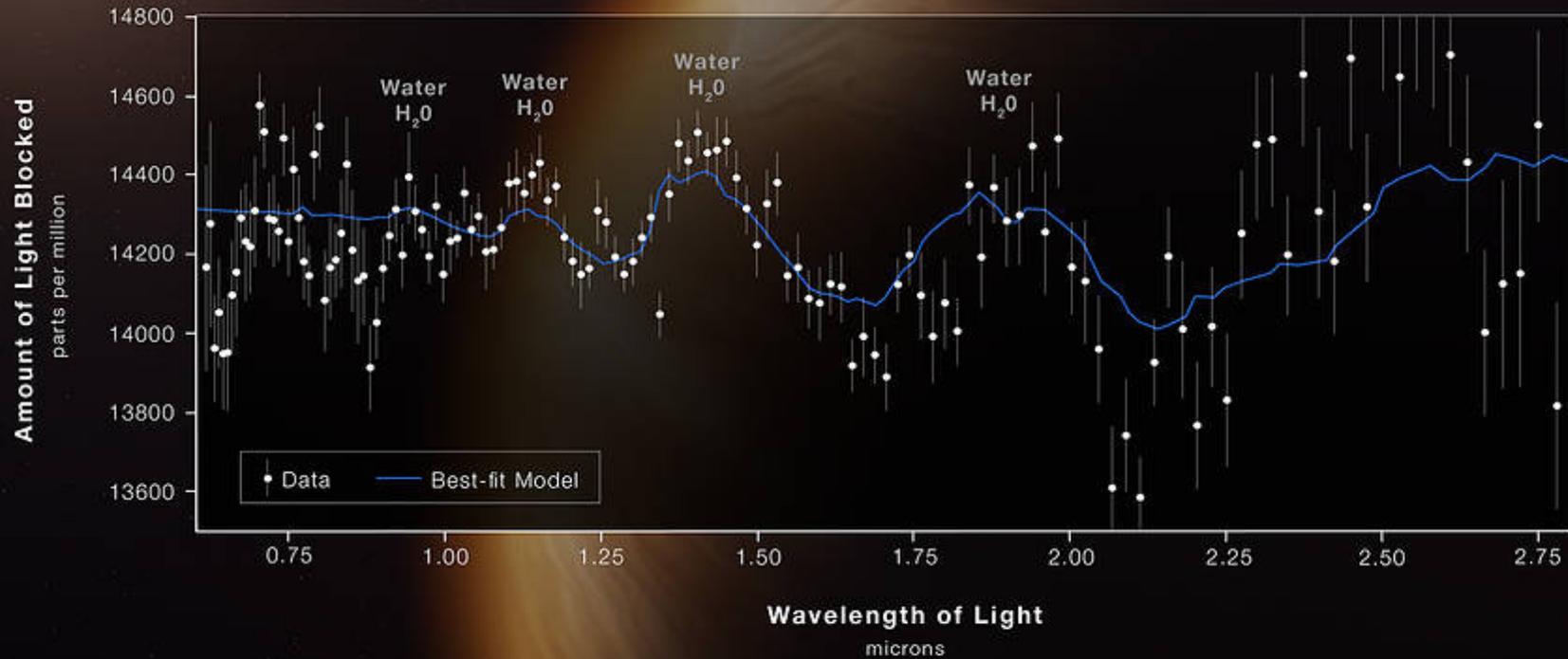
Fuel is available for orbiting around L2 for almost 20 years.



HOT GAS GIANT EXOPLANET WASP-96 b

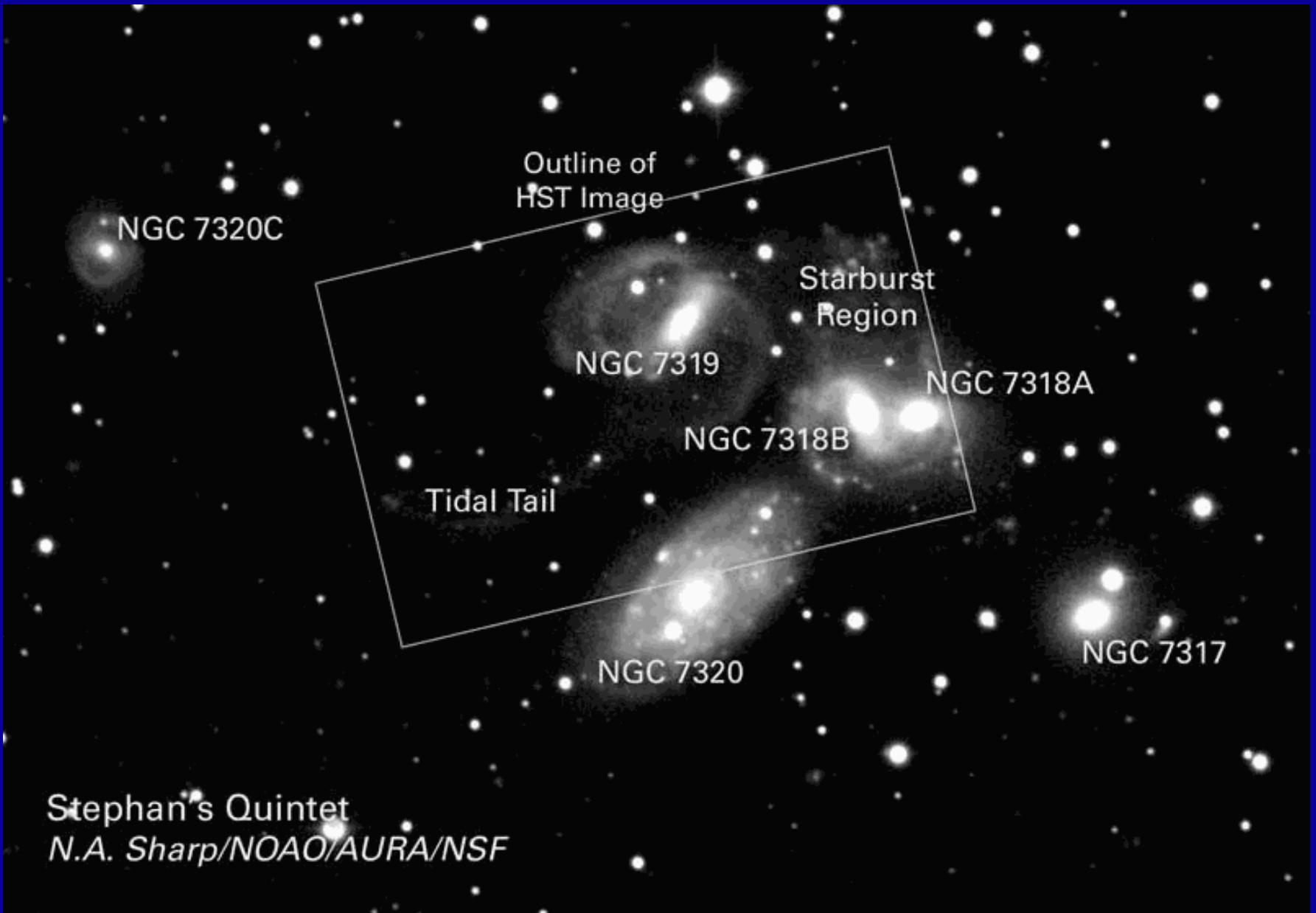
ATMOSPHERE COMPOSITION

NIRISS | Single-Object Slitless Spectroscopy



Four galaxies interacting





NGC 7320C

Outline of
HST Image

Starburst
Region

NGC 7319

NGC 7318A

NGC 7318B

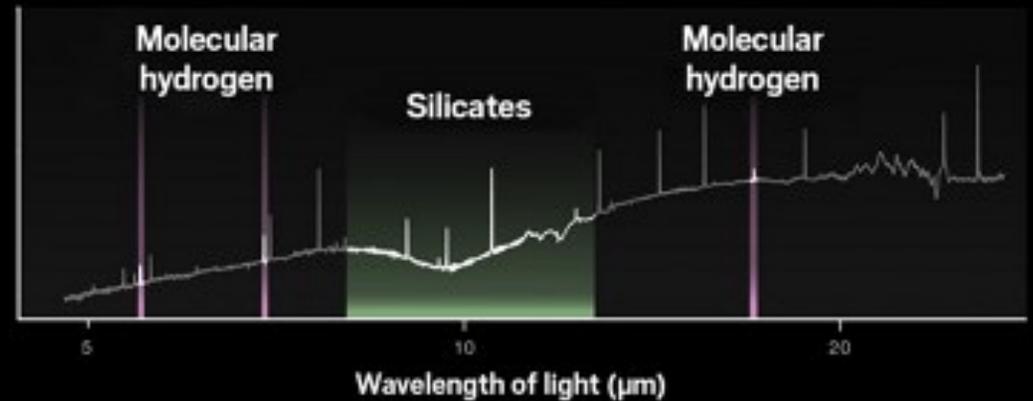
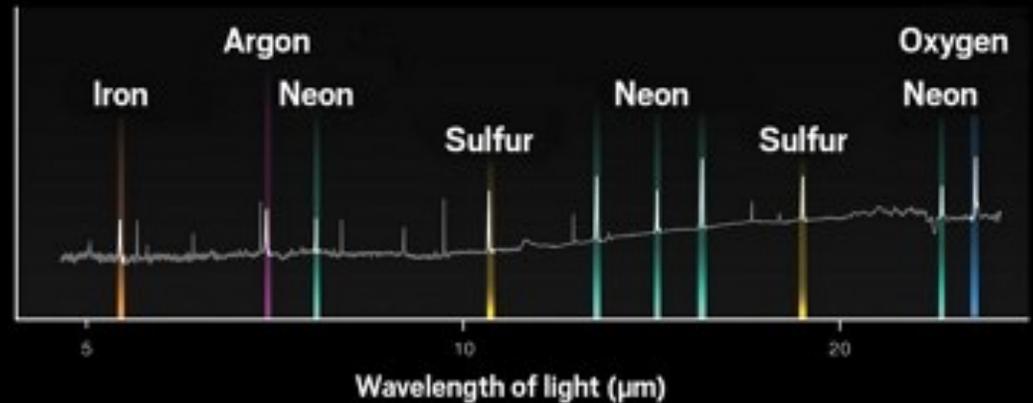
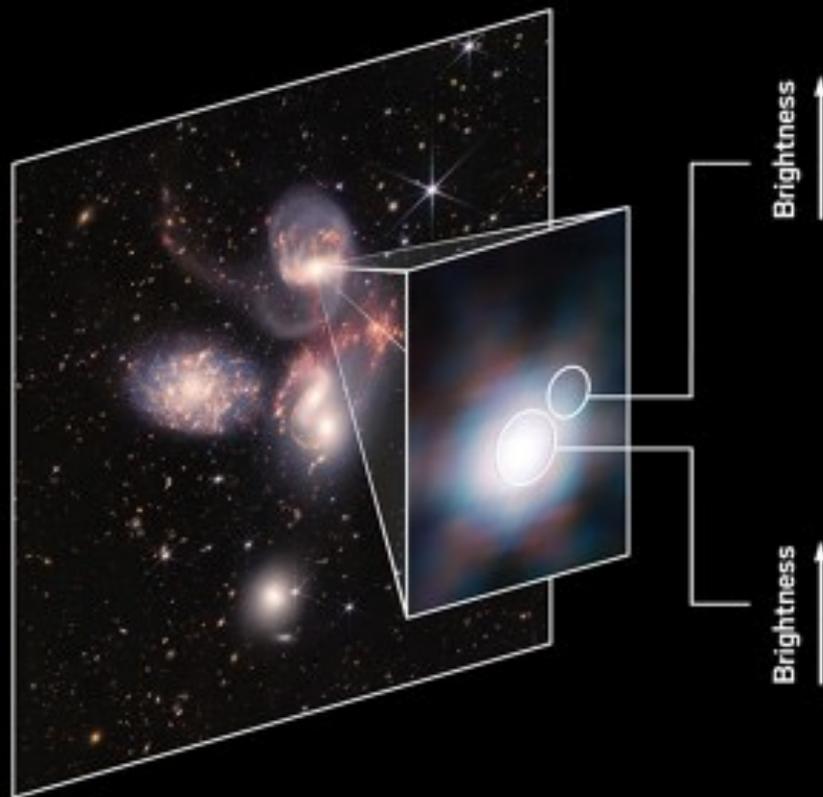
Tidal Tail

NGC 7320

NGC 7317

Stephan's Quintet
N.A. Sharp/NOAO/AURA/NSF

What spectroscopy can do



Scientific Objectives (stay tuned)

- First generation stars
- See stellar formation in opaque dust clouds, study the stellar life cycle
- See the faintest early galaxies
- Study atmospheres of planets

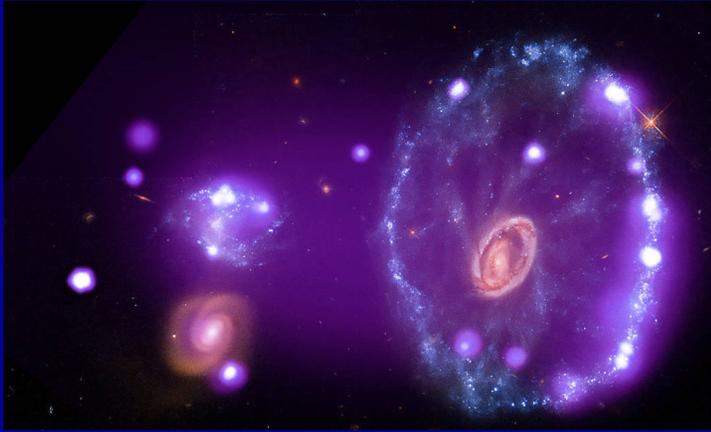
HST image of Carina nebula
Star-forming region with impenetrable dust



JWST: Cosmic Cliffs

7600 light-years away in what's called the Carina Nebula





Images of the cartwheel Galaxy

From HST + X-ray to
JWST infrared



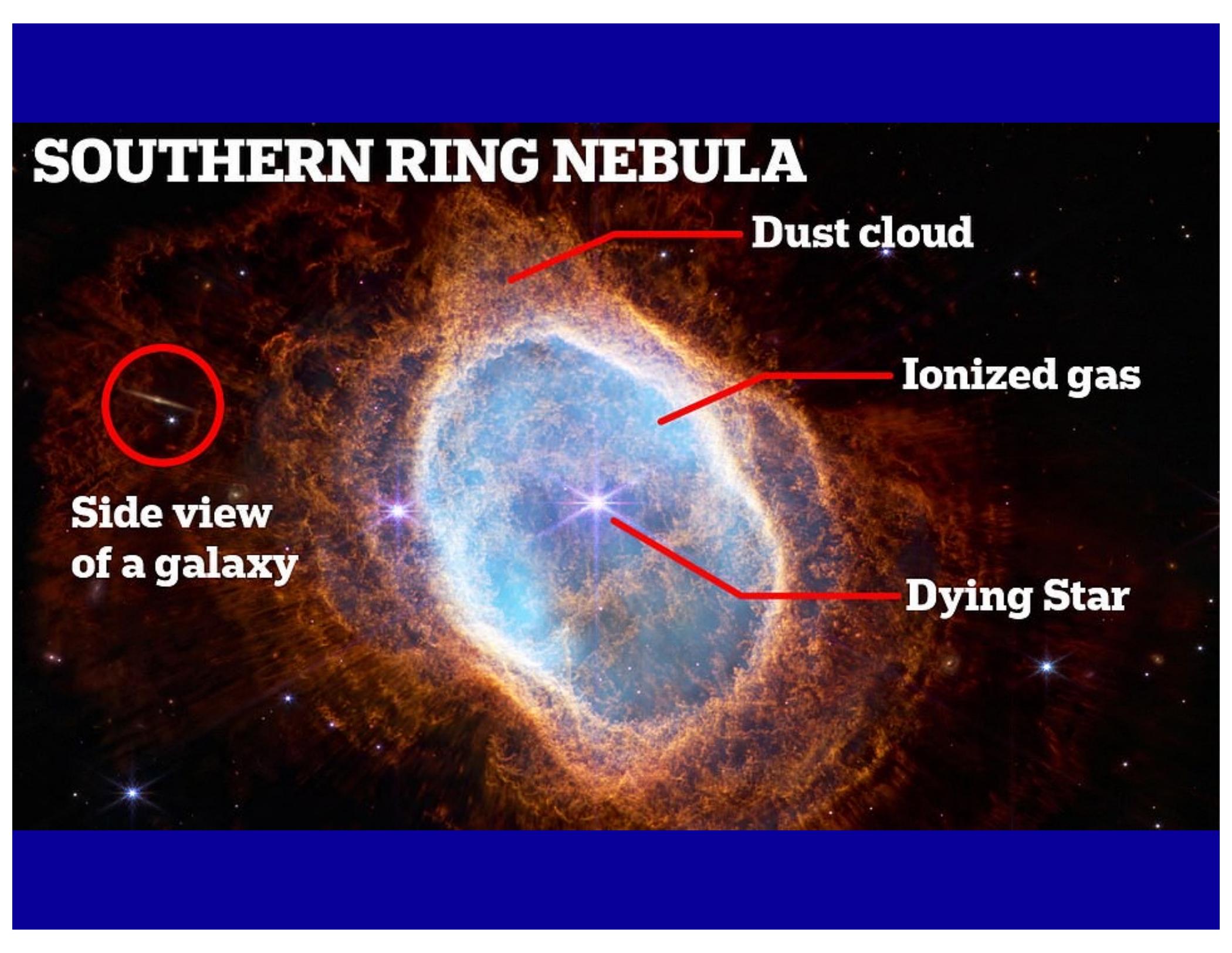
SOUTHERN RING NEBULA

Dust cloud

Ionized gas

Dying Star

Side view
of a galaxy



Southern Ring Nebula



HST

JWST

JWST: hydrocarbons forming on dust grains
Dead star revealed next to known star

Colliding galaxies stimulate star formation

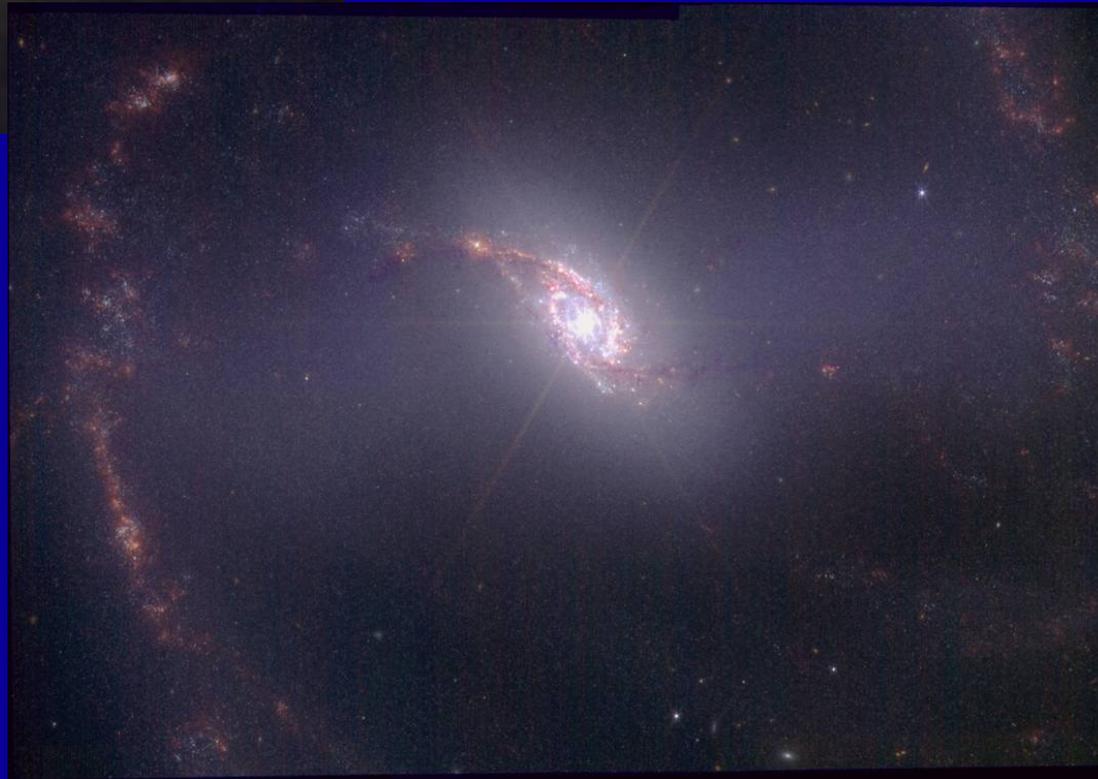


JWST discoveries



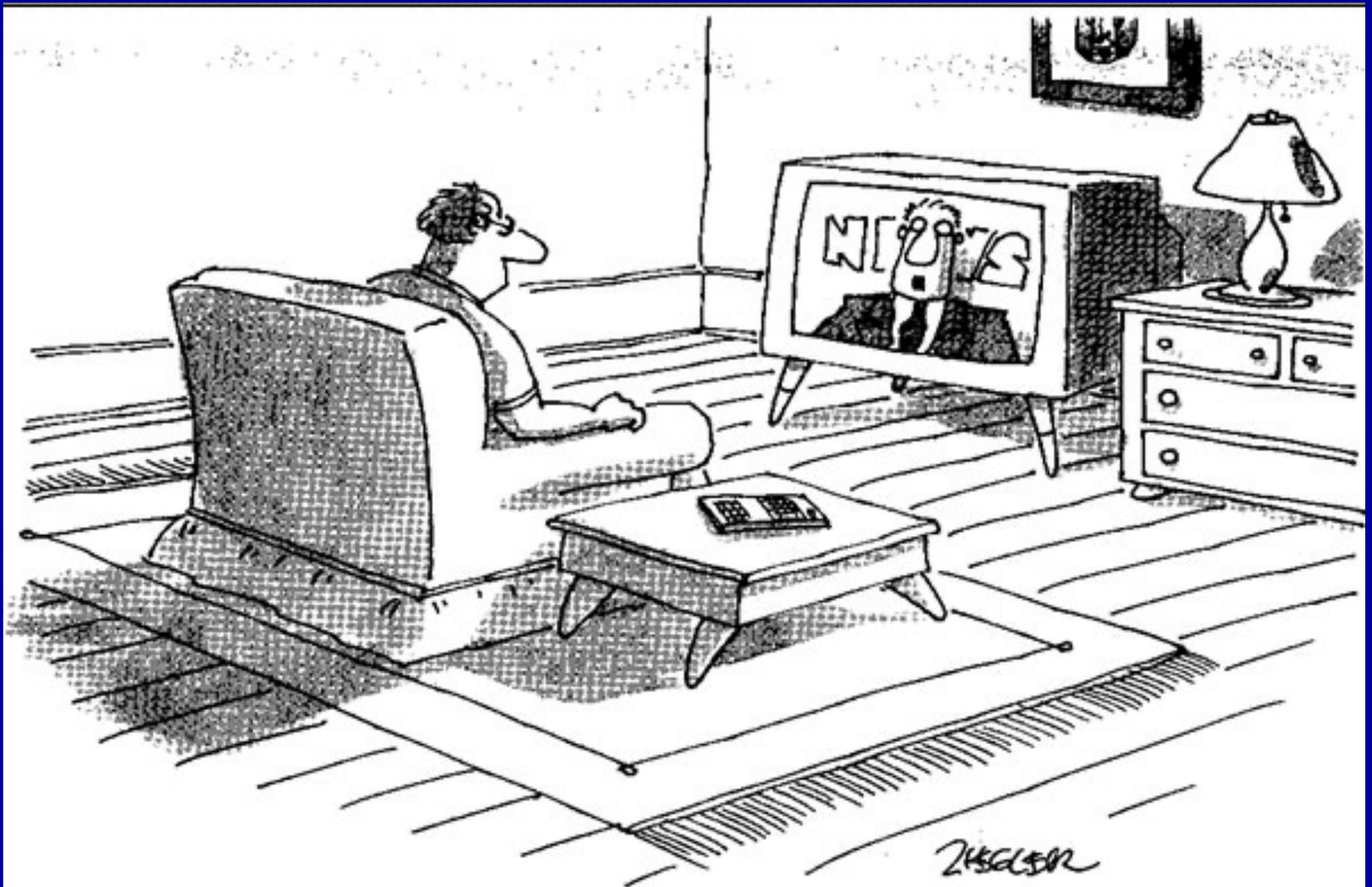
Above, a supernova, an exploding star

Right: a small galaxy orbiting
around the Milky Way



Jupiter by JWST





"Scientists confirmed today that everything we know about the structure of the universe is wrongedy-wrong-wrong."