# Adventures in the CMZ


The Central Molecular Zone is the most active part of the galaxy. This doc discusses two structures - The Brick and Sagittarius B2.

# The Milky Way and the CMZ

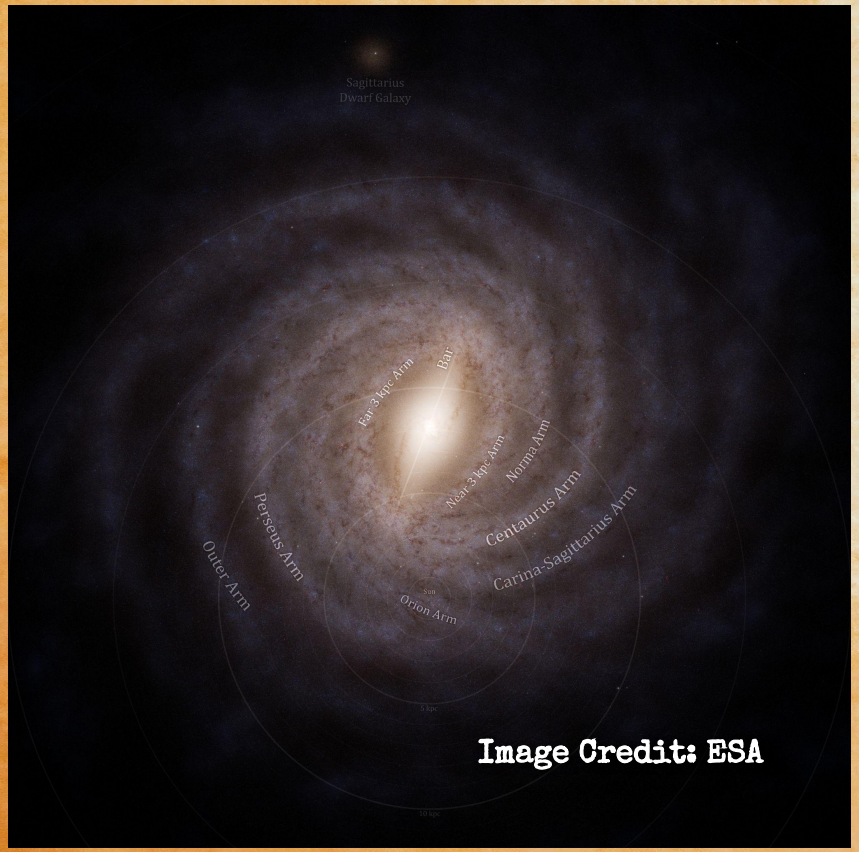
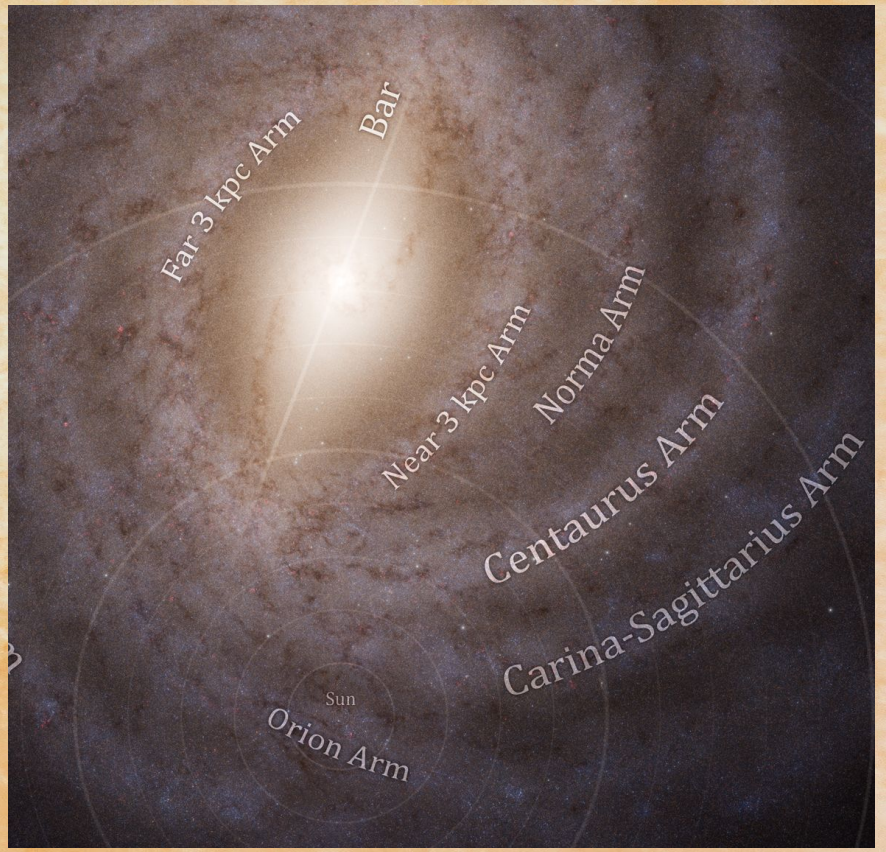



Image Credit: ESA

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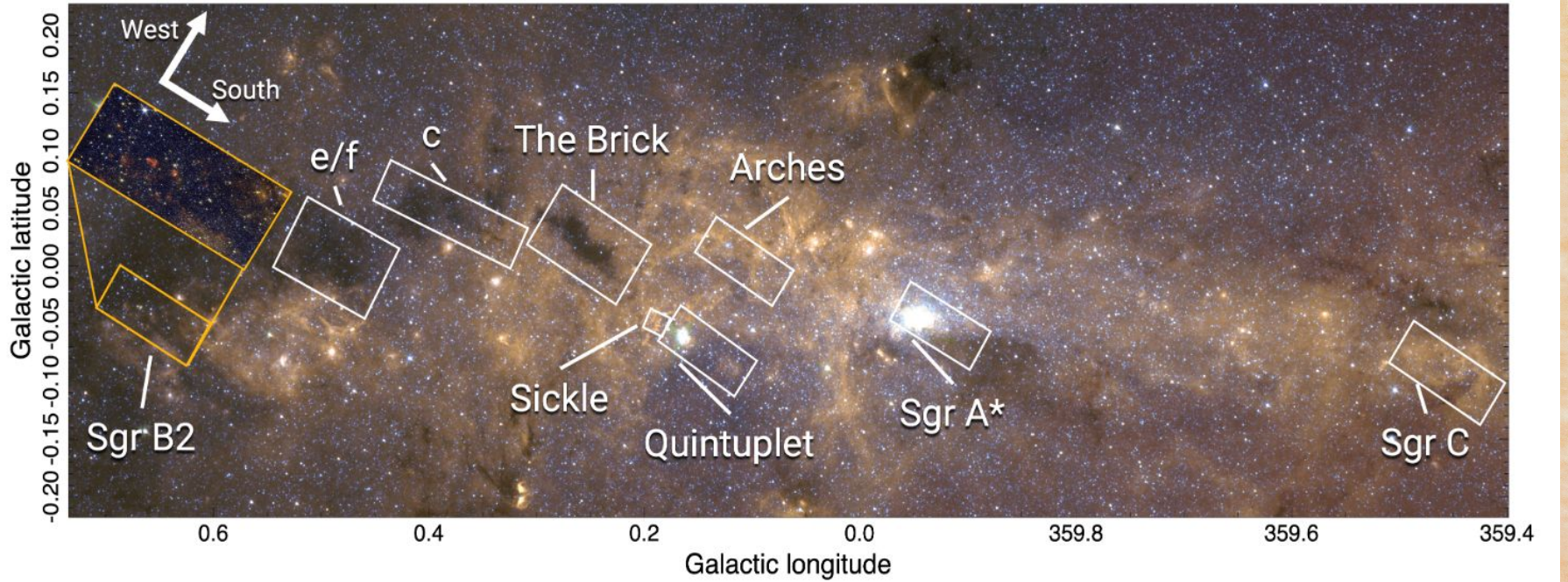
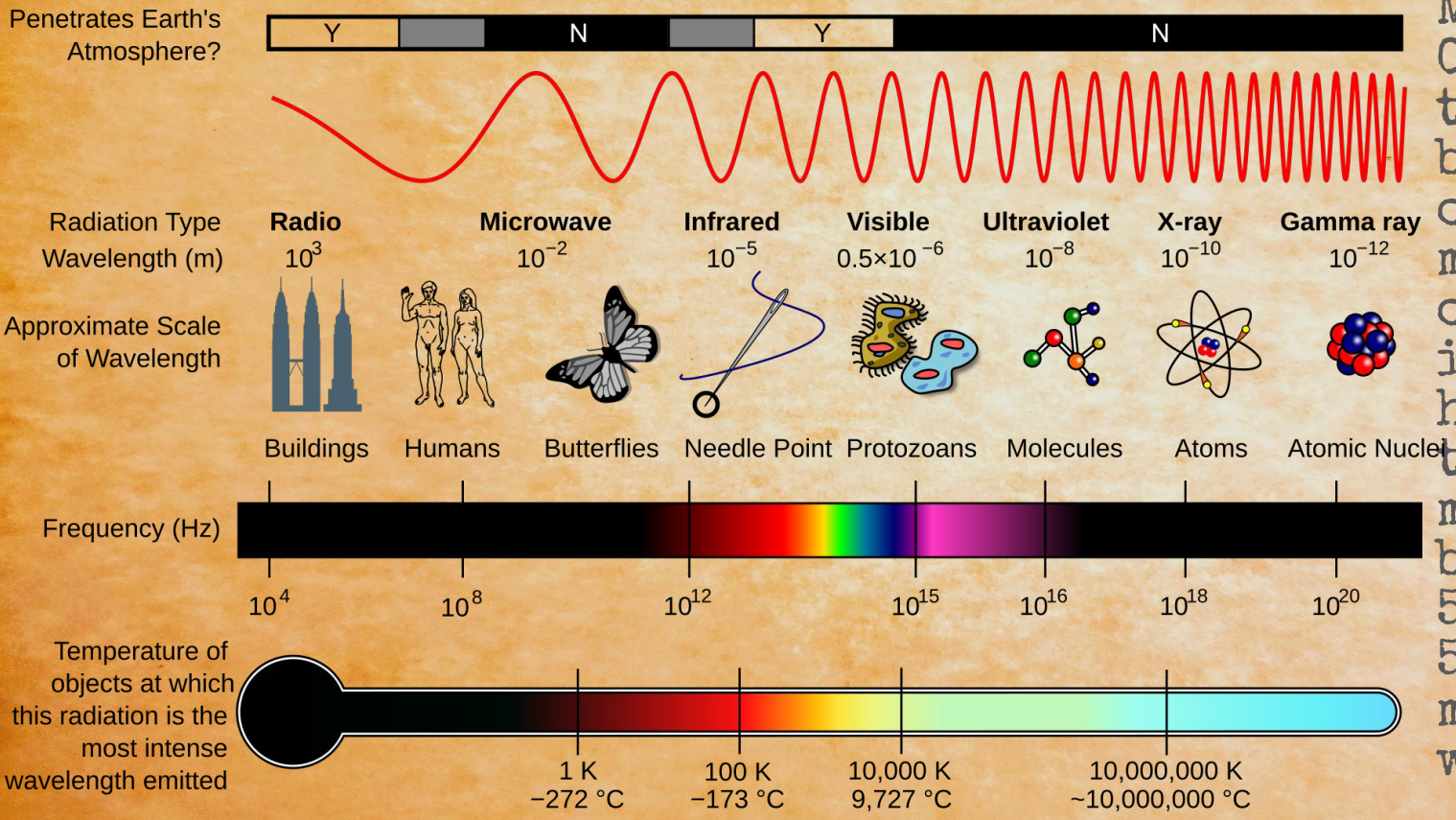
# Spitzer Map of the CMZ




The Spitzer telescope ran its cold mission from 2003 to 2009, and its warm mission from ‘09 to ‘20. It mapped infrared objects across the night sky, including the CMZ. Originally it was thought to be around 550 LY across, but is now generally agreed to be 1500 to 1900 LY in diameter. It may fill the inner 40% of the galaxy.

# The EM Spectrum




Much of the CMZ is opaque to most bandwidths of light, so most of the observations in this doc have been in the near- and mid- IR bands, 1.5 to 5 micron and 5 to 25 micron wavelengths.

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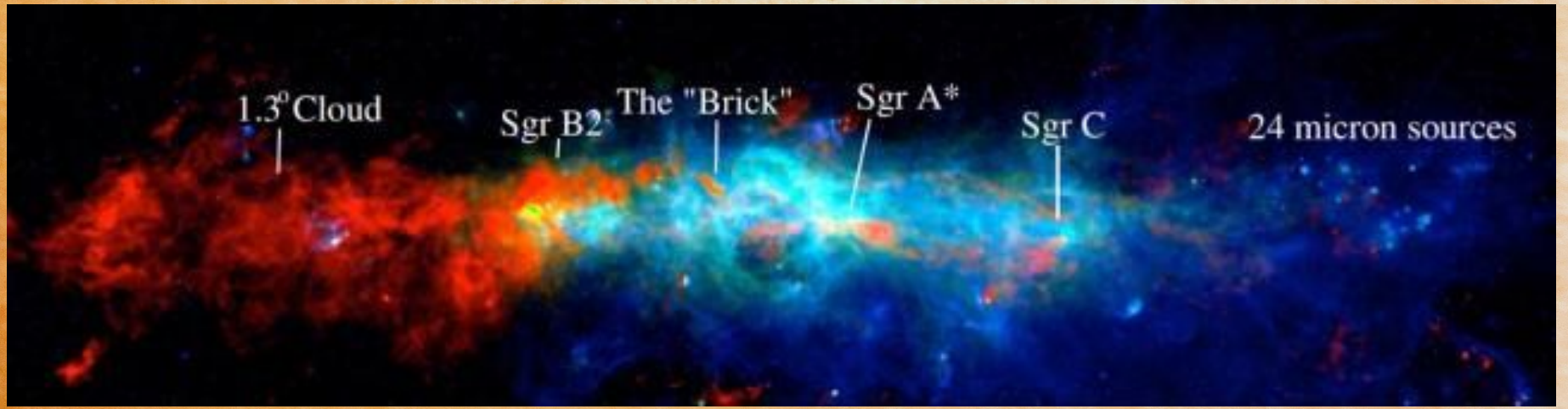
# The Milky Way Bulge in the Visible Spectrum

This is a photo of the Milky Way's central bulge over the Rocky Mountains. Inlaid is a Hubble image of the galactic center. The Bulge is loaded with stars, yet it has both bright and dark patches. The CMZ is about 27,000 LY from Earth.

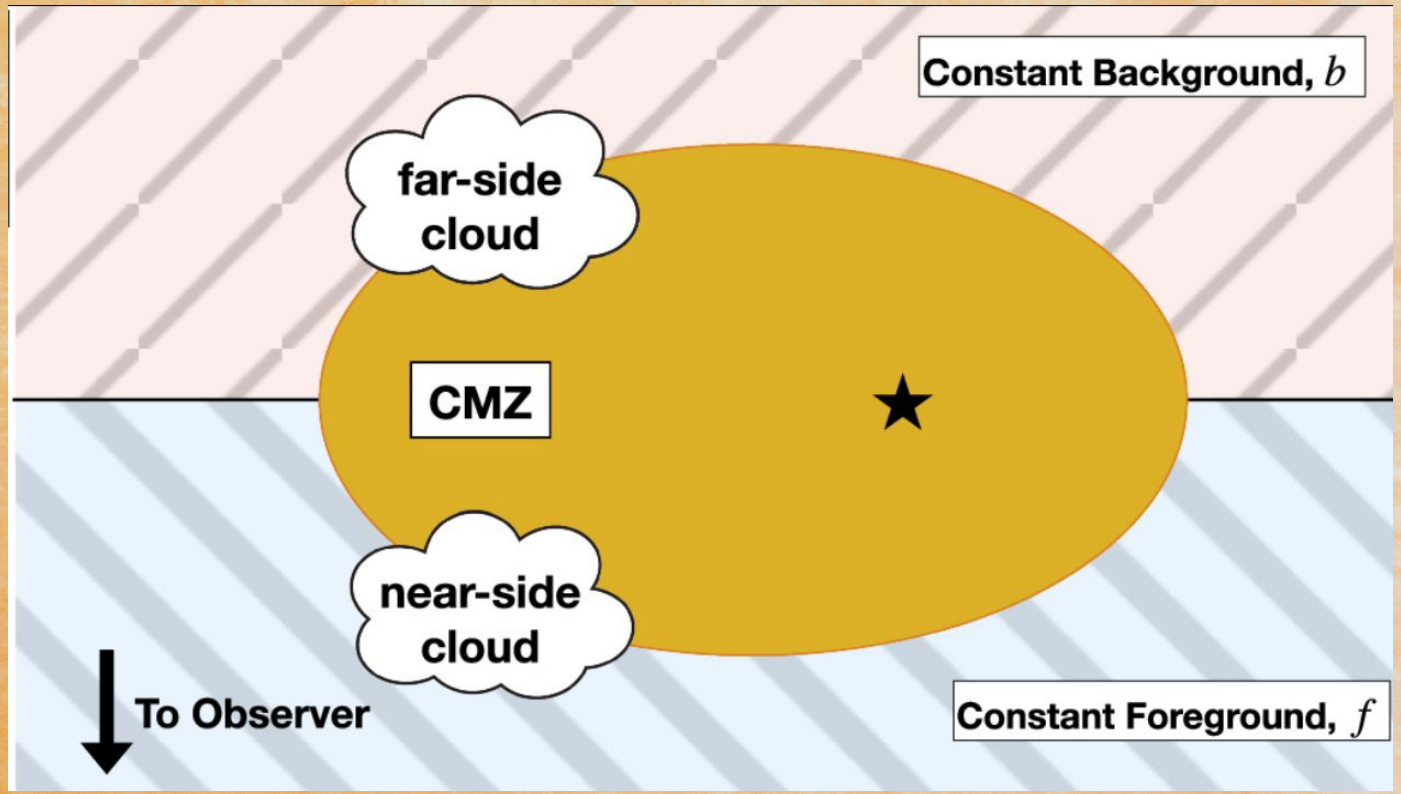
# Lots of Gas and Dust in the CMZ

Gas density in the CMZ averages in the magnitude of 10000 molecules/cc, about 10x that of the galactic disc. Air on earth has a molecular density of about 2.7 x 10^19 molecules/cc. However, density is 5 to 100x higher in molecular clouds and star clusters, and lower outside of them.



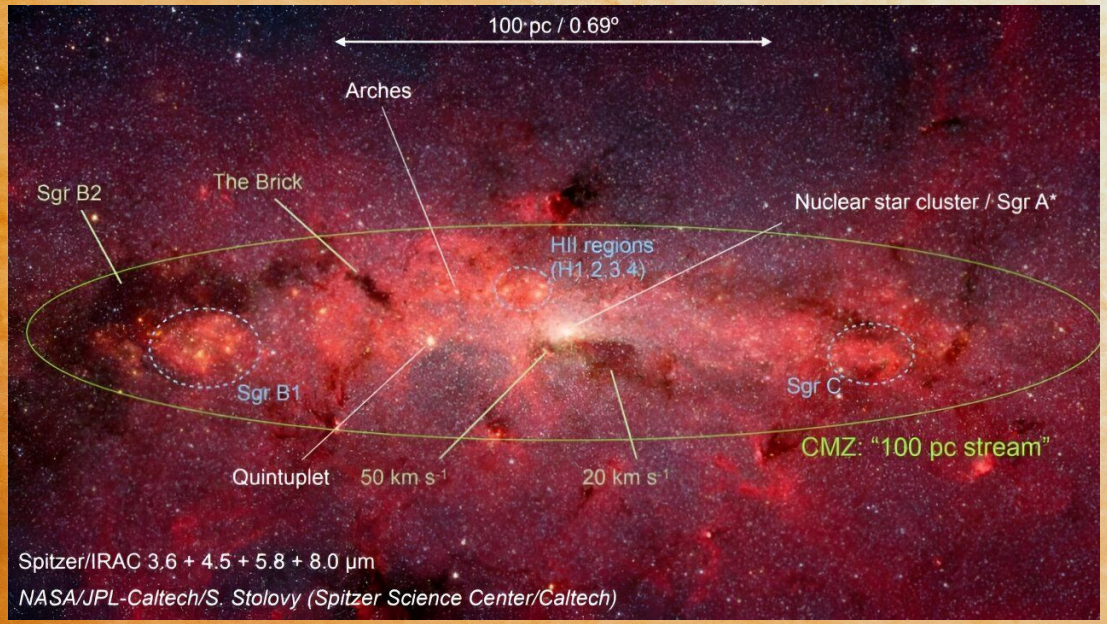
# Extinction of Stellar Light in the CMZ

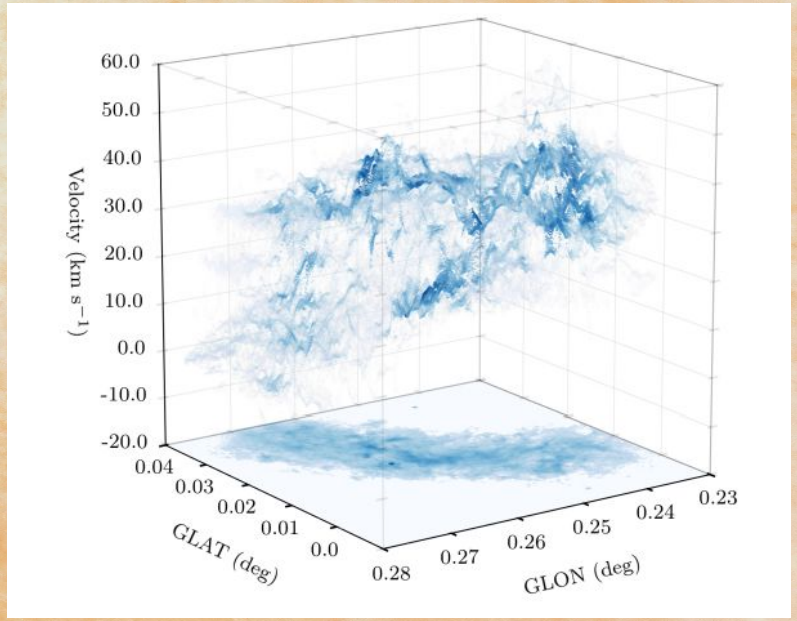
Dust and thick gasses in the CMZ absorb specific wavelengths of light as it passes through. Bluer light is absorbed more readily than redder light. As a result, background light sources appear more red than foreground sources. Some are blocked entirely. This process is called extinction.



# The Brick and Sgr A*

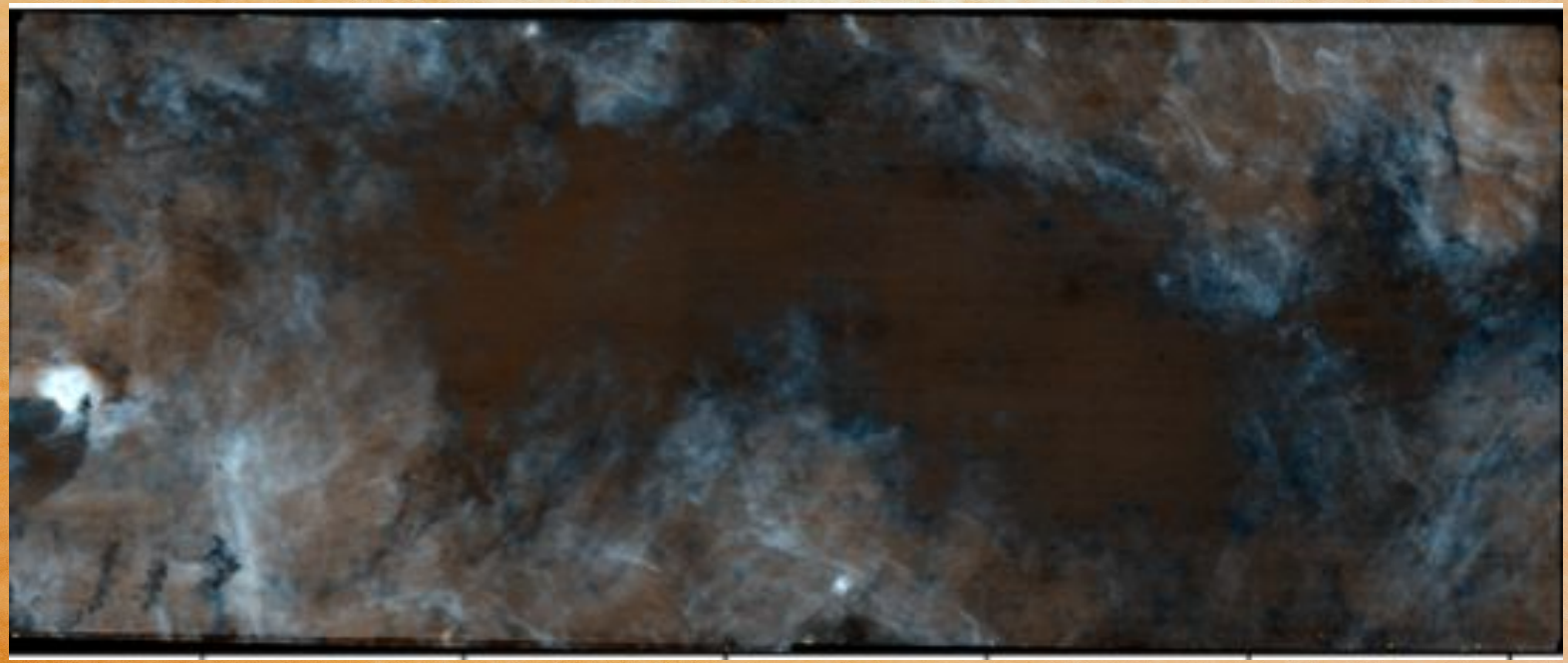
Sgr A* includes our galaxy's central SMBH and its accretion disc. The Brick is a massive molecular cloud about 24,000 LY from Sgr A*. It contains about 100,000 Solar Masses of material. Radiation from Sgr A* heats gasses in The Brick, propelling the material to velocities up to 90 miles per second. The speed of sound in Earth's air is 0.2 mps.



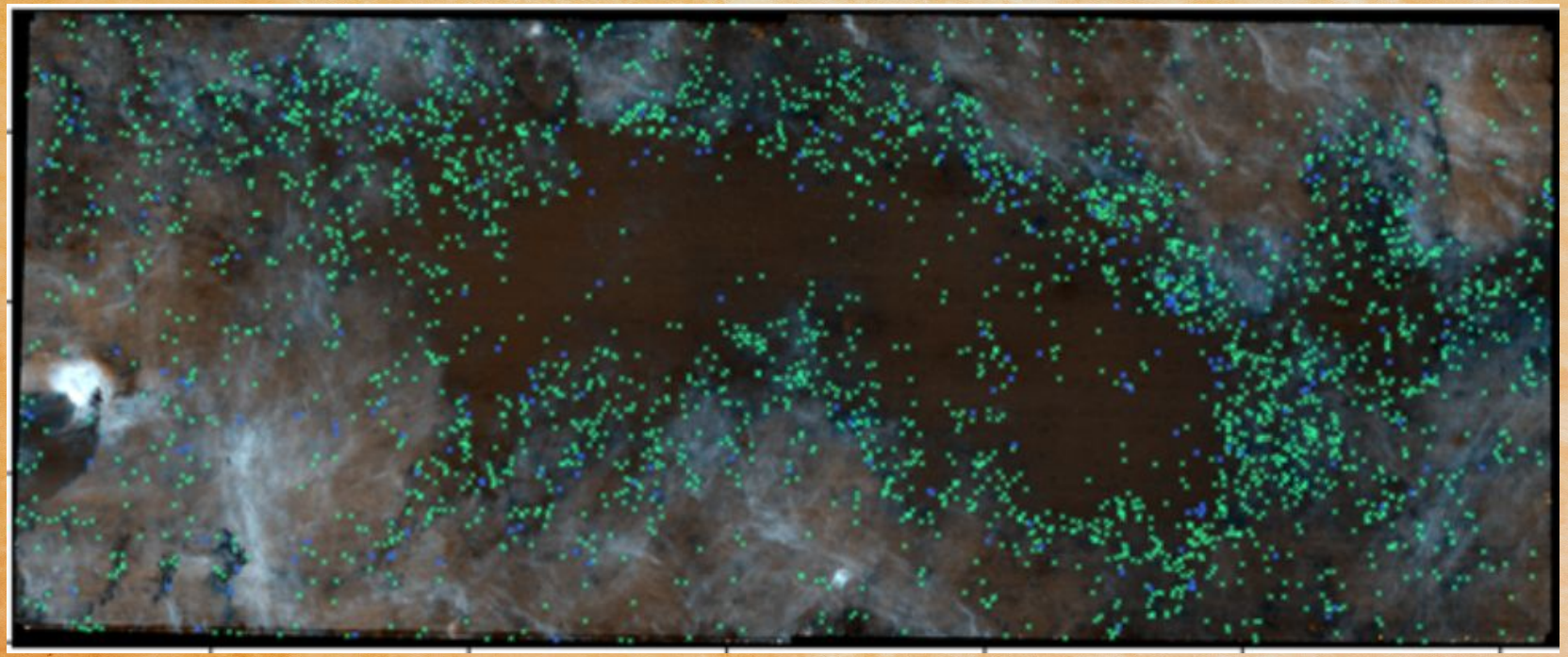



# The Brick is Loaded With Complex Molecules

The interstellar medium is about 74% H, 24% He, and 2% other atoms. The Brick was thought to be heavily composed  heavily of dust, but recent studies have shown it to be rich in CO ice, along with other organic molecules. This indicates that it's a likely product of heavy star and supernovae remnants. The complex molecules give The Brick it's hazy, dark brown color.

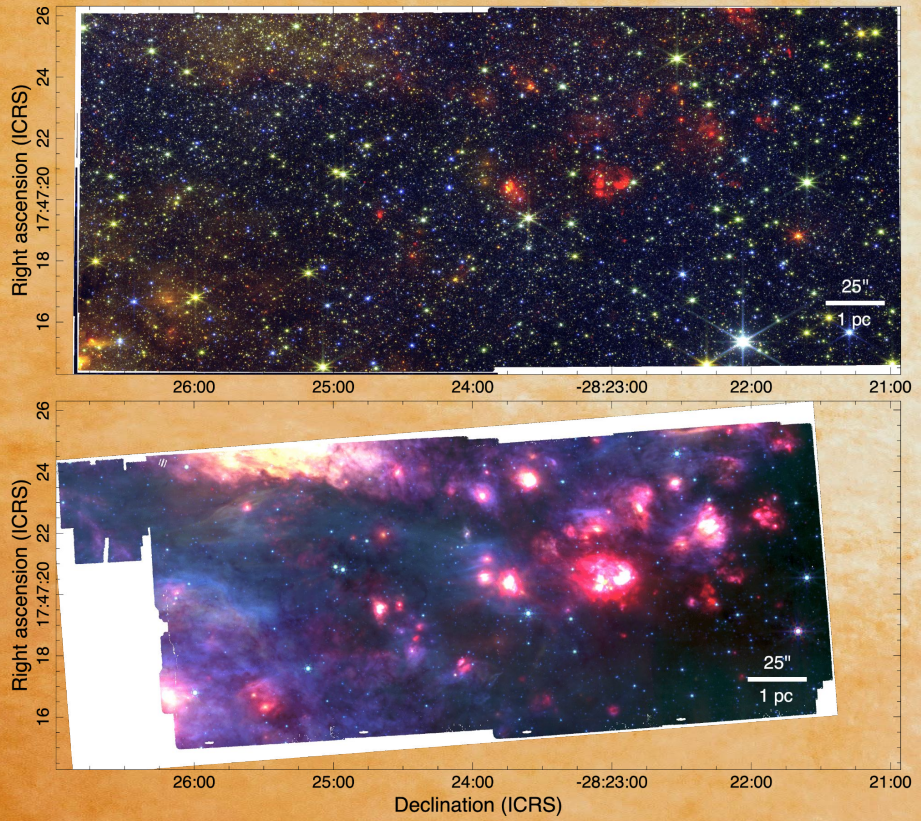


# Data from JWST Allows Mapping of Likely Stars



Since redder light is absorbed more slowly by CO ice, IR observations from JWST were used to create a map of likely stars in The Brick. Observations around the edge are more numerous because of gas thickness near the center. Foreground stars have been removed and background filled in by computation.

# Sagittarius S2 Has a High Star-Formation Rate

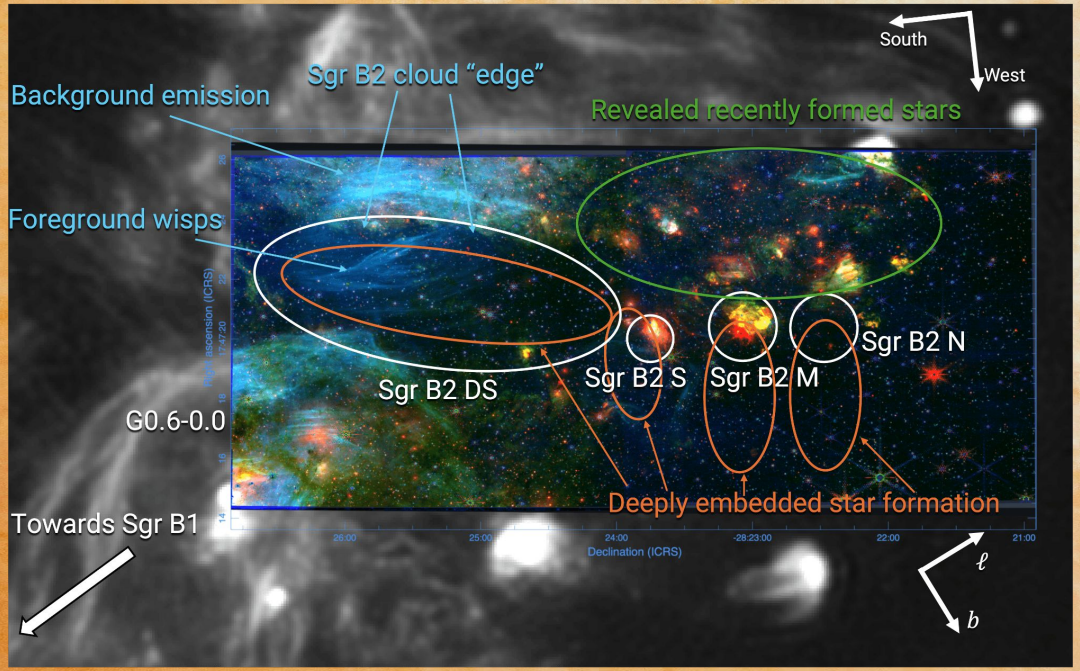


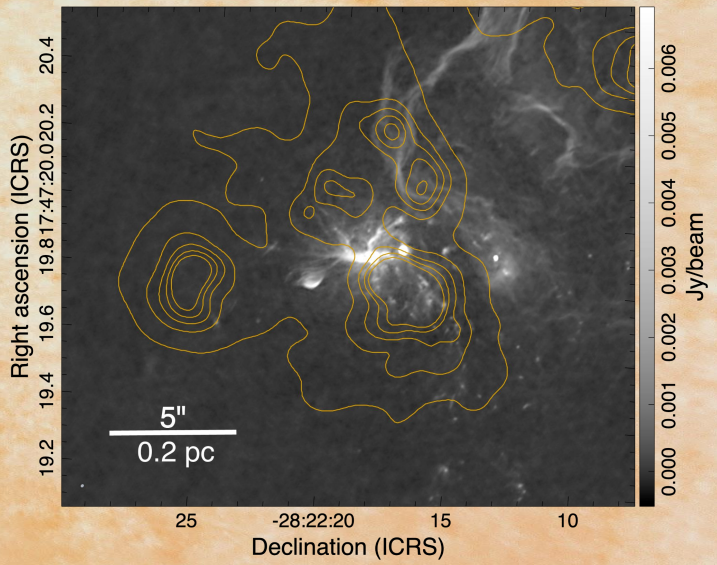

Sagittarius S2 has one of the highest star formation rates of any structure within our galaxy. It's star formation accounts for half of the star formation in the CMZ. It contains:

- Young Stars
- HII regions
- Hot Cores (protostars)
- Masers

# Sagittarius S2's Map of Stars and Dust

In the left image, less extinction is blue, more is in green, and red represents high-extinction dust clouds. The image on the right shows that IR light also finds places to escape dust and heavy gas structures in high-metallicity outflows.

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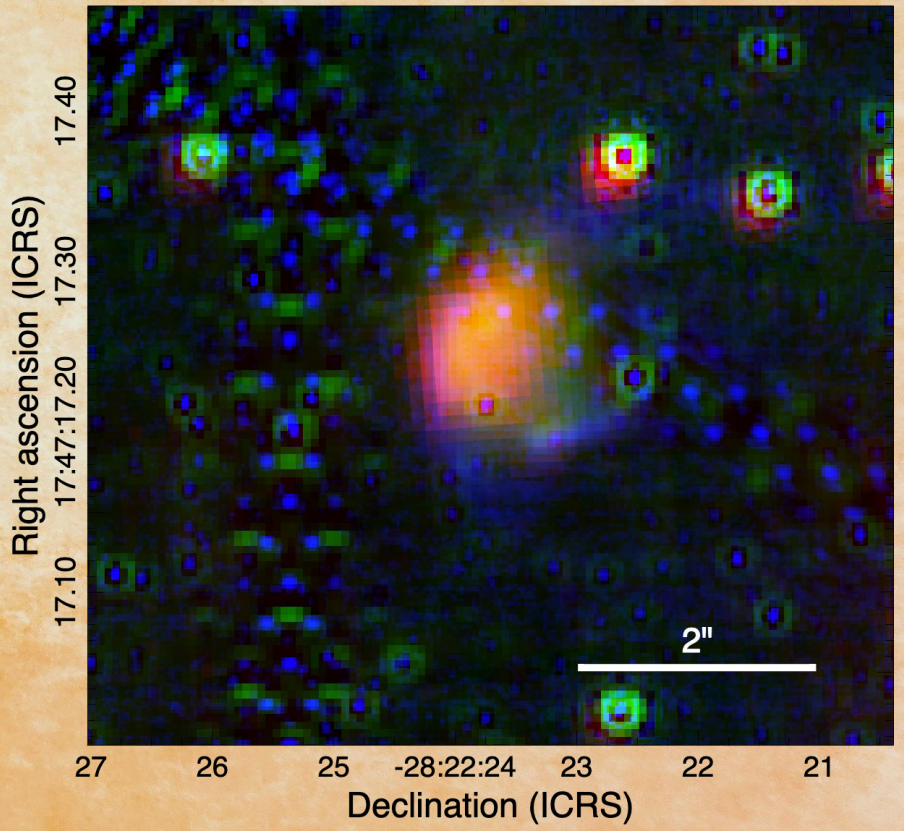
# Potential Planetary Nebulae in Sagittarius S2

A planetary nebula is the remains of an exploded star. Known nebulae are below. A candidate from SS2 is on the right.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