ORIGINS Space Telescope

From the first stars to life

National Aeronautics and Space Administration

NASA

Origins Space Telescope: Tracing Dark Molecular Gas in the Milky Way

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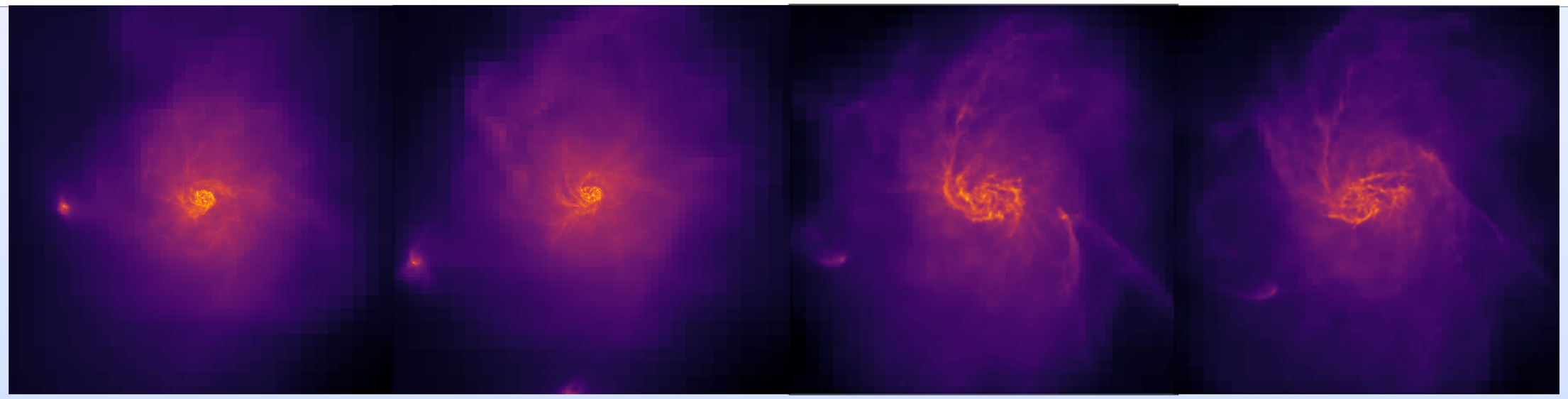
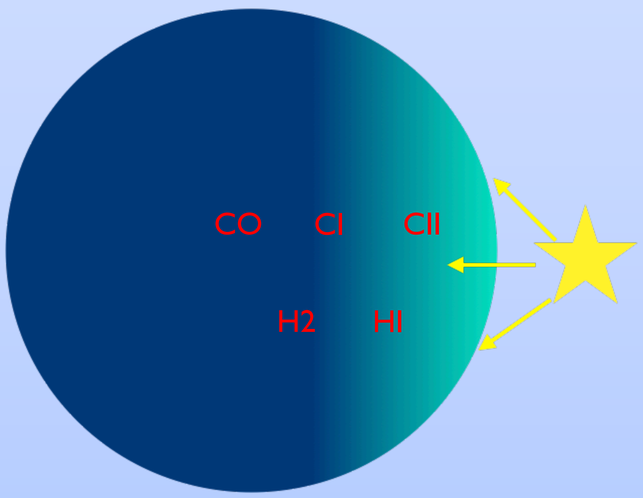


Dark Molecular Gas in Galaxies

The traditional tracer molecule of molecular H_2 gas in galaxies is CO. CO typically requires large columns of dust to protect itself from both the Interstellar UV Radiation Field, as well as the metagalactic cosmic ray flux.



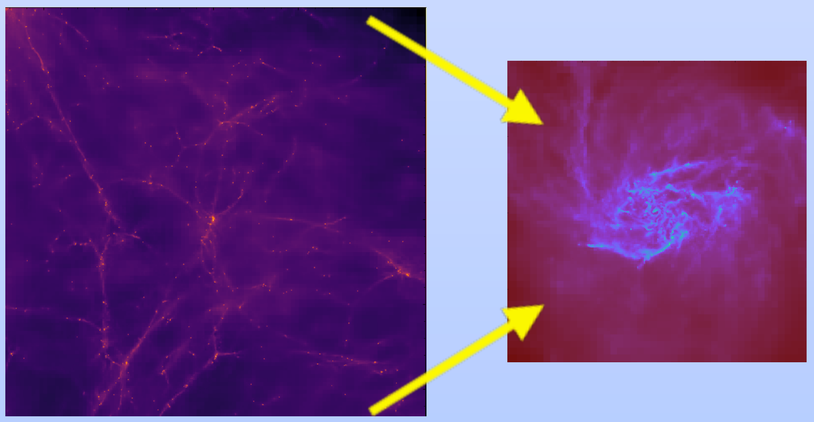
CO typically dissociates into CI (609 μm) and [CII] (158 μm). Due to the difficulty in observing these wavelengths from the ground, the quantity of this "CO-dark" molecular gas in the Milky Way and nearby Universe is relatively unconstrained. Quantifying the fraction of dark gas is essential to understanding the total star-forming molecular gas content in galaxies.

How can we Determine this?

The first thing we want to know is: do we expect there to be a ton of dark molecular gas in the Milky Way?

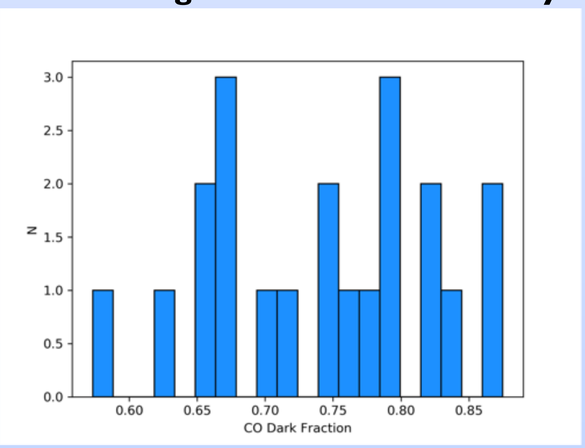
To theoretically determine this, we need two things:

1. A model for the Milky Way two
2. A model for the phase structure of the neutral gas

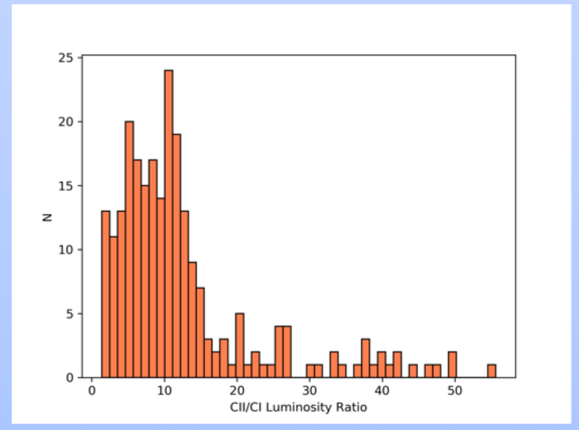


To generate models of the Milky Way, we run massive Cosmological zoom simulations using the MUFASA wind scheme (Dave et al. 2016). Like, a million CPU hours per galaxy. We then couple these with thermo-chemical-radiative equilibrium calculations (using DESPOTIC; Krumholz 2014) to calculate the neutral gas chemical structure. The chemical reactions follow the Glover & Clark networks, modeling pathways between CO, CI and CII, while balancing radiative cooling and thermal heating processes. If you want to read the math, check out Narayanan & Krumholz 2017, but we figured for a poster you'd probably rather look at pretty pictures than math.

How much dark gas is there in the Milky Way?



It turns out that if we look at all of our model Milky Way Simulations, about half the gas is dark (distribution is at the **Top),** and of that dark gas, the vast majority of it is in the [CII] phase (as opposed to CI; **Bottom**); (Li, Narayanan, Krumholz & Dave in prep.).



If only we had a telescope that could observe all this dark gas that will light up at [CII] (158 μm)….oh wait…OST to the rescue! OST is *uniquely* positioned to measure a census of the dark molecular gas content of the Milky Way and nearby Universe

The **Origins Space Telescope** is the mission concept for the **Far Infrared Surveyor**, a study in development by NASA in preparation for the *2020 Astronomy and Astrophysics Decadal Survey*.

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