Seeing the Spiral from the Arms: Modeling the Interstellar Medium of the Milky Way

A look at how computer models may be used to better interpret radio telescope observations, for the purpose of better understanding how stars are born.

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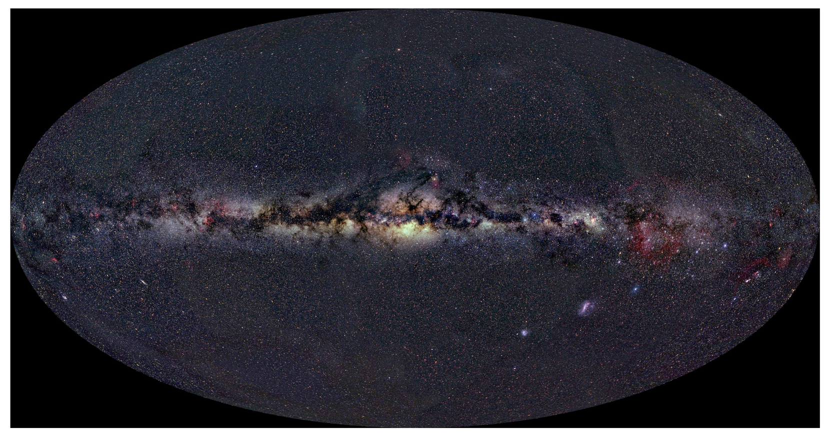
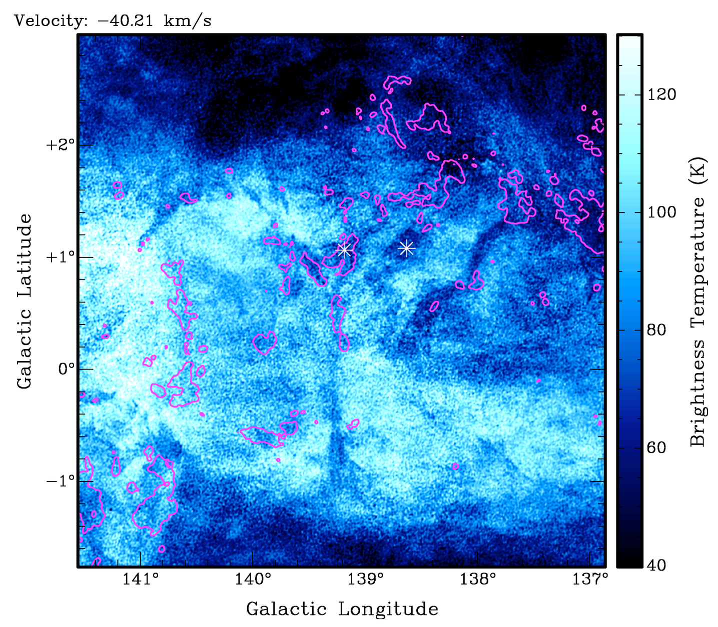


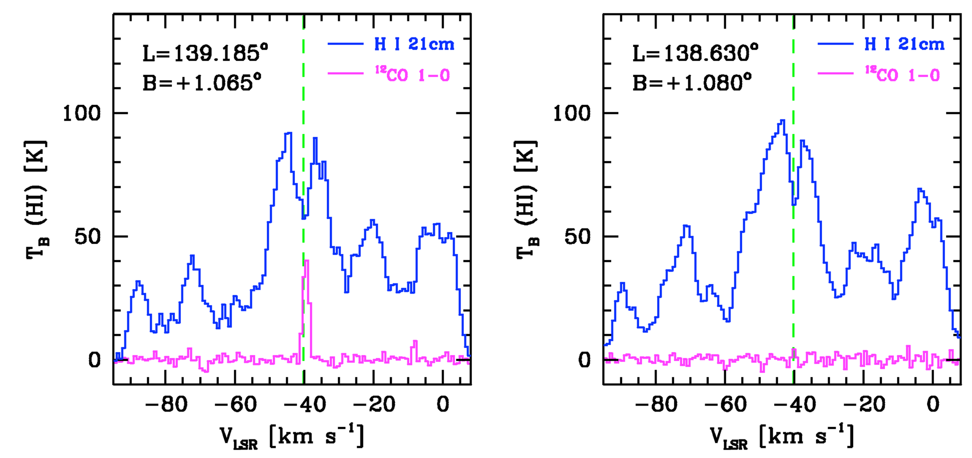
A Matter of Perspective

This image demonstrates the trouble with trying to get a good look at the Milky Way, while inside of it. The best we can get is an "edge-on view", like that shown above, by Axel Mellinger.



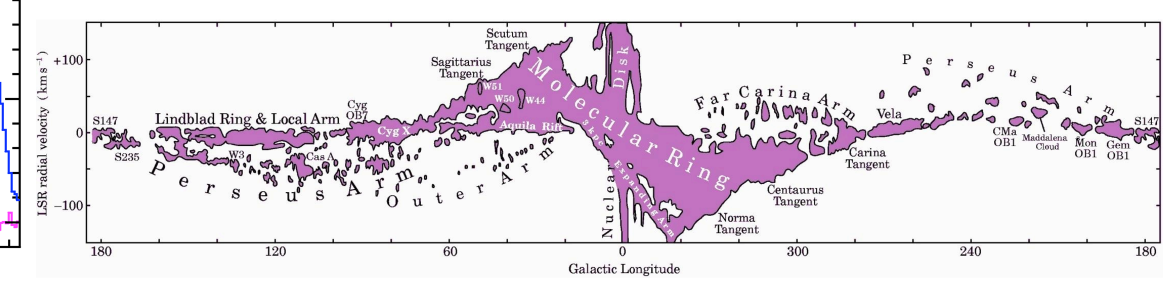
Radio Imagery

Above is an image obtained by a radio telescope. This is a good example of the observational data which the models are based on. One should note that coloring in these images is artificial.



What Interstellar Clouds are Made of

Spectra taken from the points marked with an asterisk, in the image at left – also a very important source of observational data. A spectrograph takes the emission spectrum at a given point on an image. The spectrum is used to determine which atomic and molecular components of the inter-stellar medium are present at a specified location in the celestial sphere. Changes in apparent wavelength will also be caused by a Doppler shift (the same effect which causes us to hear a higher frequency from a siren when it is moving toward us).

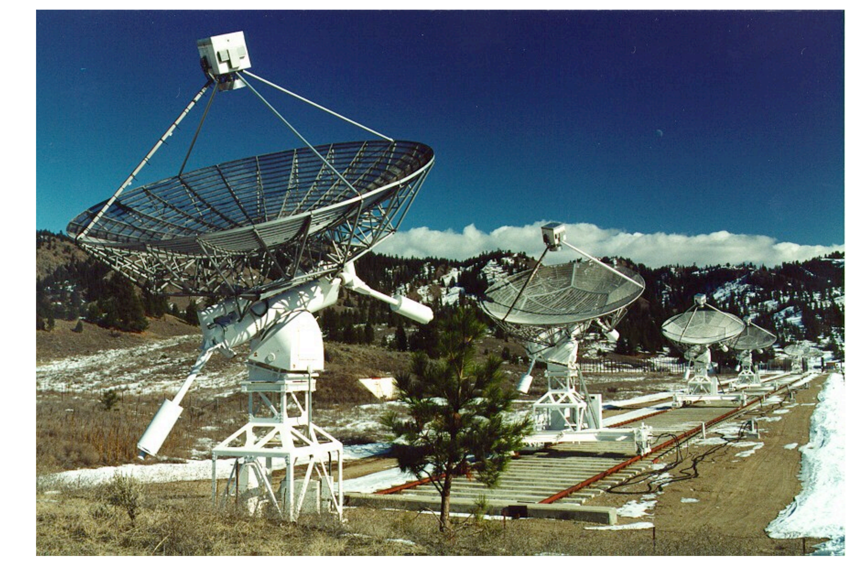


Map of the Galaxy

The map, above, from Dame et. al (2001), provides a brief description of how to read the model images. Changes in apparent velocities are due to the motion of the galactic components around the galactic center (possibly a monstrous black hole).

"Where do these pictures come from?"

Not all telescopes are created equally. An observer must use the proper telescope for the ***wavelength*** of the electromagnetic spectrum which he or she wishes to inspect(i.e. radio waves, infrared, visible light, ultraviolet, and microwaves).

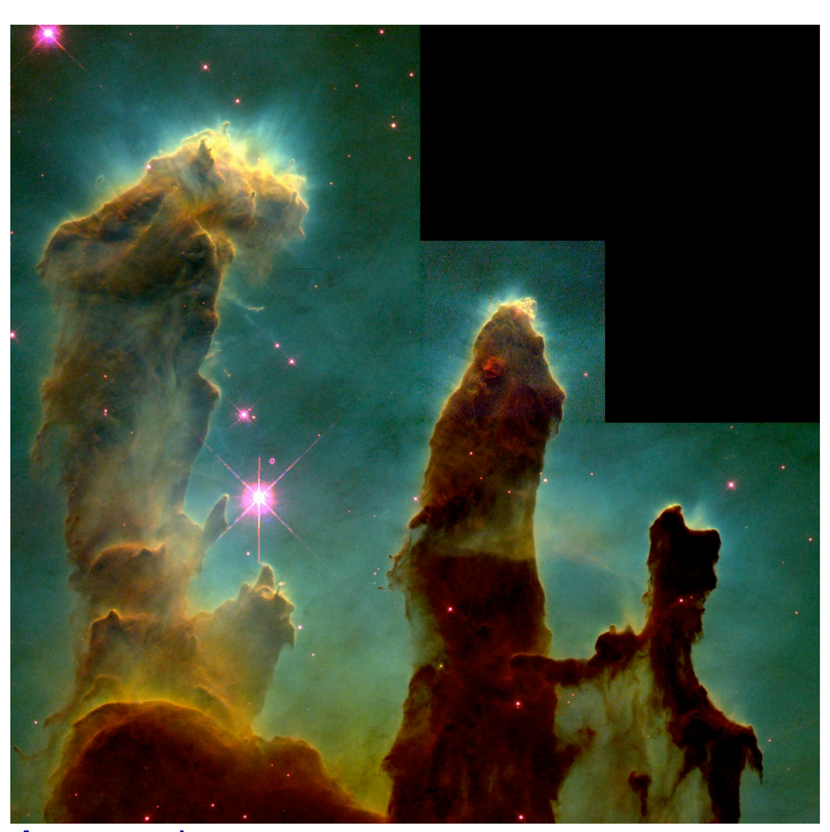


Radio Telescope

This is where most of our observational data comes from. Without surveys such as the one completed by the Dominion Radio Astrophysical Observatory's Synthesis Telescope , above, our model would have nothing to interpret. Radio telescopes reveal electromagnetic radiation sources which are missed by the light gathering mirrors in optical telescopes.

Galactic Arms

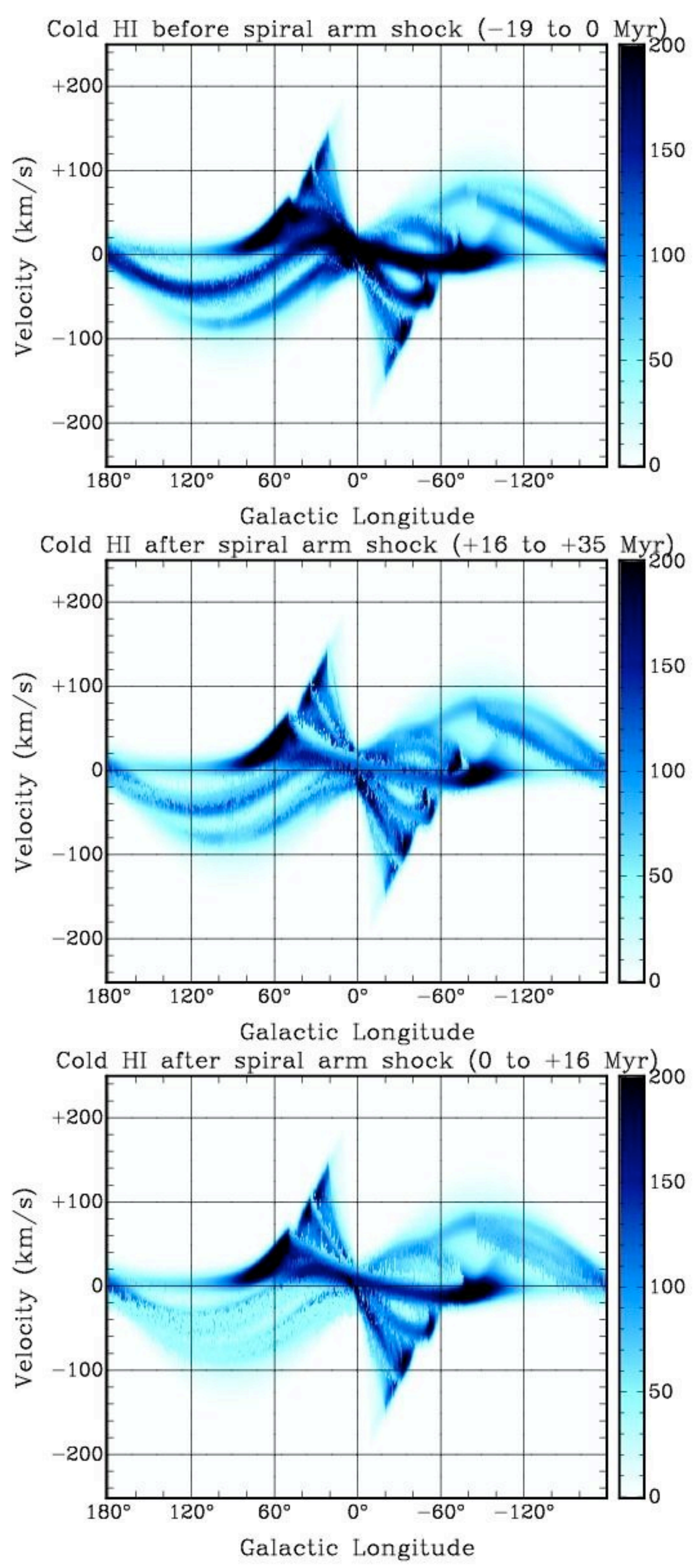
The general shape of the M74 spiral galaxy, in the image above from the Hubble Space Telescope, is similar to that of our own galaxy.



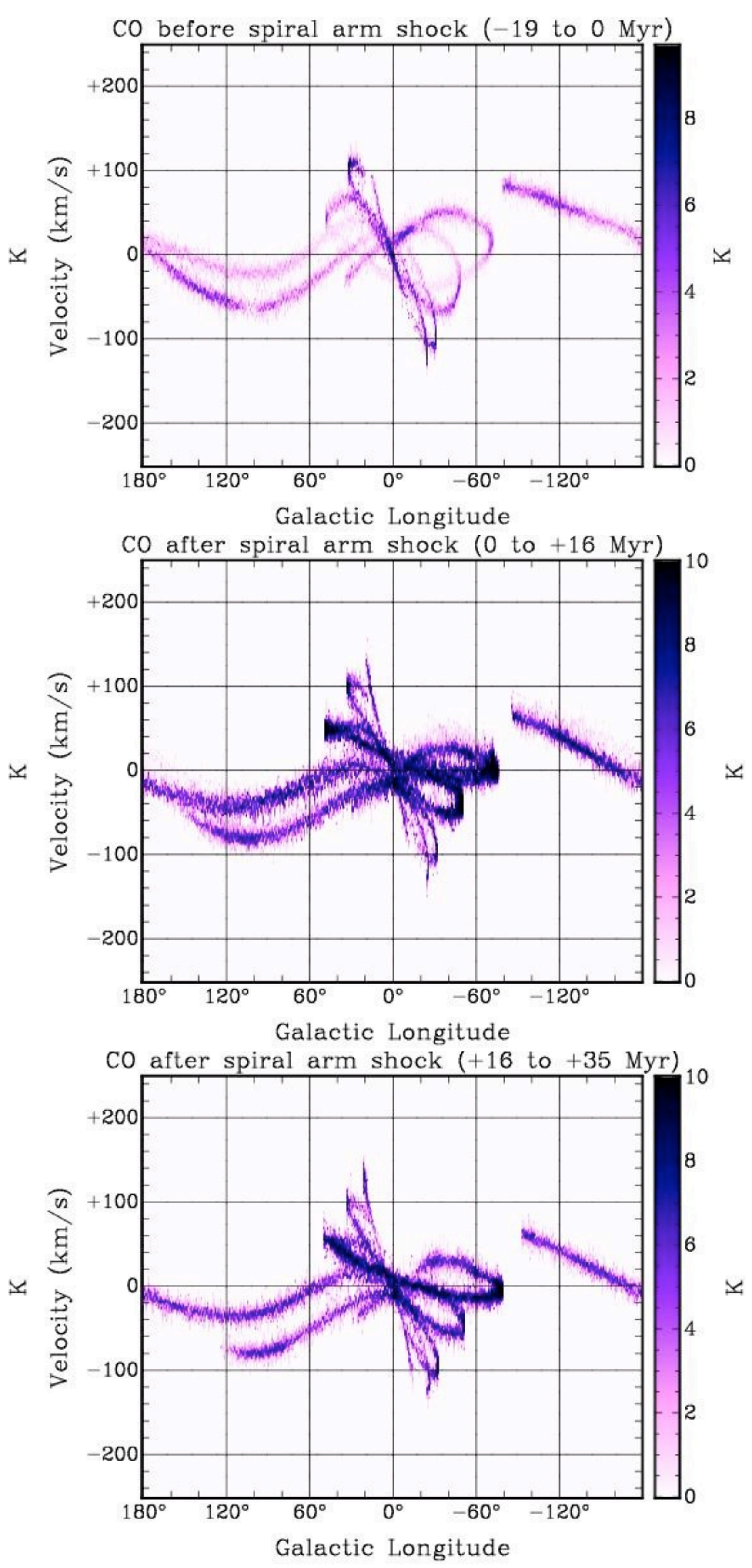
Astrogenesis

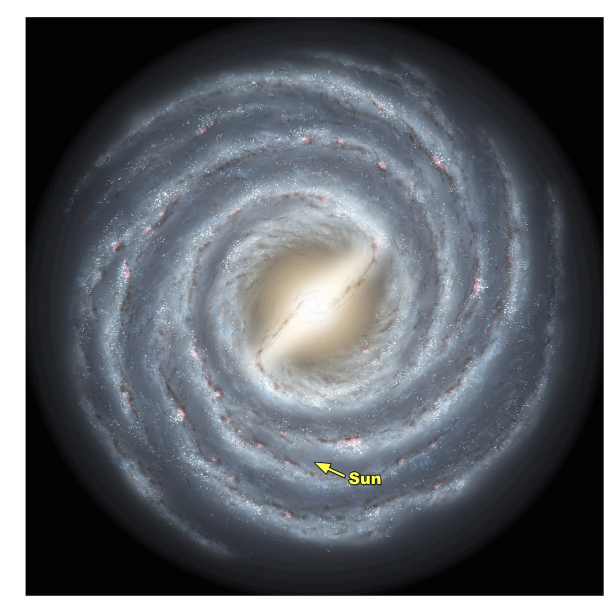
The "Pillars of Creation", or "The Eagle Nebula", is a famous example, from Hubble , of a star-forming cloud, not unlike those we are modeling.

Cold and Warm Neutral Medium– Atomic Hydrogen Gas (cold gas in absorption), moving through the spiral arms.



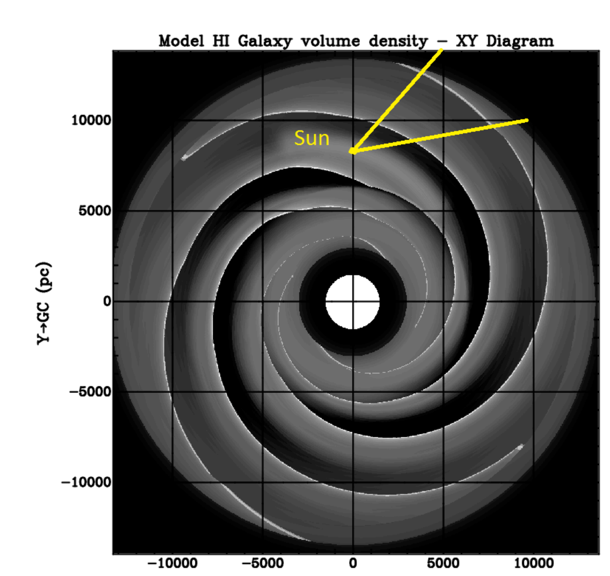
Colder (10-20K) Carbon Monoxide Molecular Gas progressing through the spiral arm shocks.



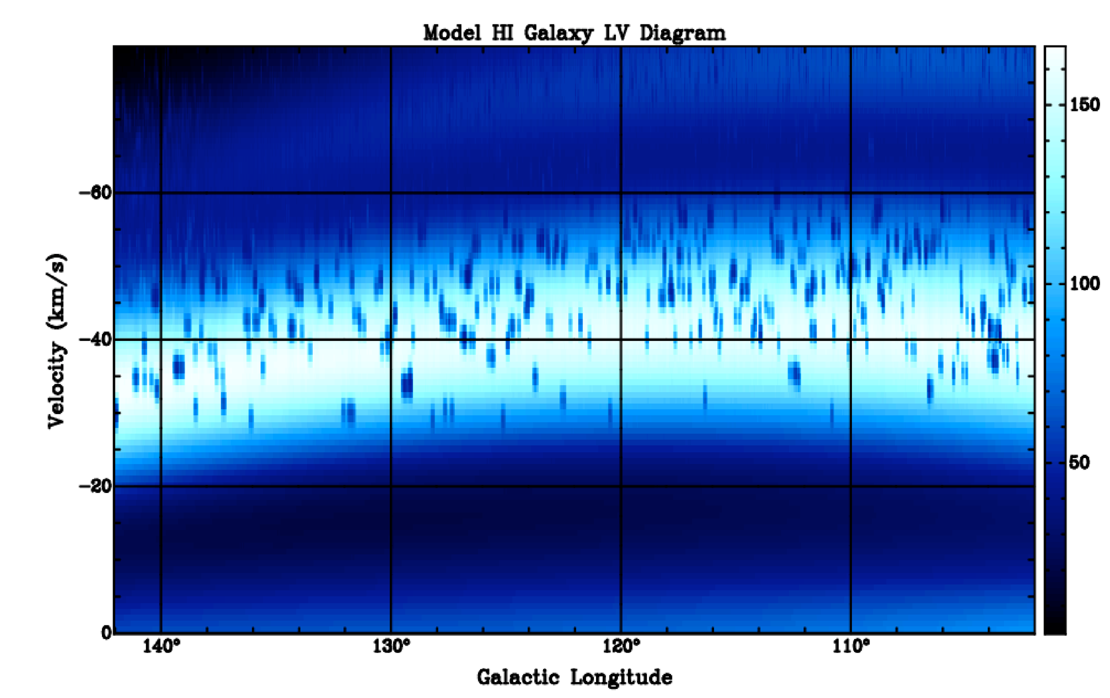


Relating to the Real Thing

This is not an actual photograph, but it does simulate what the Milky Way might look like, in the optical range, when viewed from afar. (*Churchwell et. al*).

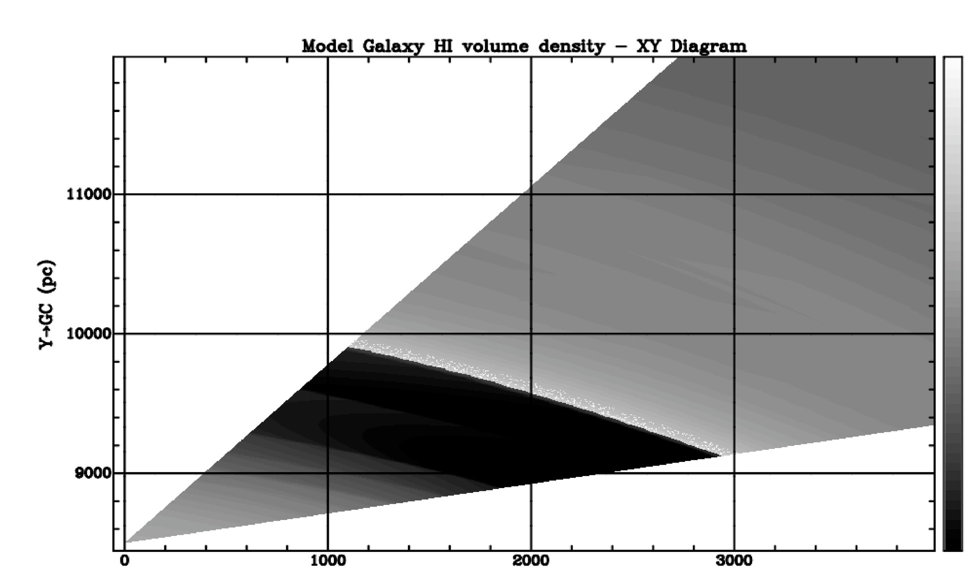


This is an image produced by our model and simulates what the Milky Way might look like in the radio range. The section taken for the high resolution images, at right, outlined in yellow.



Getting in Closer

This image shows a much higher resolution rendering (*one parsec per pixel*) of the galaxy, compared to those at center. However it only shows a limited portion of the Perseus arm, rather than the whole galaxy, Individual hydrogen clouds may be identified at this resolution. The images at center are at a 25 parsec per pixel resolution



A Small Slice

To illustrate the area-resolution compromise, this images shows the same portion of the galaxy as the image above, but the radial shape has been preserved. One could think of this as a small slice of the "galaxy pie".

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