Abstract:

Star formation in disk galaxies takes place in cold, dense clouds containing millions of solar masses of molecular gas. These giant molecular clouds (GMCs) are very dynamic, forming out of diffuse interstellar gas, undergoing local collapse to produce clusters of stars, and then dispersing due to energetic feedback from star formation. Recent numerical simulations have shown how self-gravitating ISM compression into GMCs results in strings of HII regions that light up spiral arms, and creates interarm spur structures seen in high-resolution HST and Spitzer images of grand design spirals. Simulations including a multiphase ISM have been able to reproduce observed relationships between large-scale gas properties and star formation rates in nearby disk galaxies, and have demonstrated how feedback-driven turbulence and environment (including the rotation rate and the stellar disk's gravity) are crucial in setting these rates on ~kpc scales. These results help to explain why observed molecular-to-atomic mass ratios and star formation rates correlate with the mean midplane pressure. In addition, they suggest that empirical Kennicutt-Schmidt relations between star formation rate and gas surface density arise in part as a result of long-term galactic evolution toward Toomre parameters near unity. In discussing these recent results, I will also highlight the importance of resolving disks' vertical structure in numerical models, in order to obtain reliable measures of the star formation rate.