Stony Brook University
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Doctoral Defense Announcement

Abstract

Evolution of Gas Across Spiral Arms in the Whirlpool Galaxy

By

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The textbook picture of the interstellar medium (ISM) is rapidly evolving. New evidence is reveling a new picture of the ISM. In this thesis, I seek to help develop this new picture by studying the evolution of molecular gas and the role of large-scale galactic dynamics in organizing the ISM in the Whirlpool Galaxy, M51. I begin by presenting measurements of the geometrical offsets between interstellar gas, HI and CO, with tracers of recent star formation, 24μm and Hα. These offsets can help determine the underlying large-scale galactic dynamics. Along the spiral arms in M51, offsets between CO and the star formation tracers suggest that gas is flowing through the spiral arms, as expected under the density wave theory, but the offsets do not show the expected signature of a single pattern speed and imply a more complicated underlying spiral pattern. Next, I will discuss an intermediate stage of gas evolution, by studying a denser component of the ISM with HCN and HCO+ emission. These molecules probe densities ~10^{4-5} cm^{-3}. I present new ~400 pc scale observations made with the GBT, and ~175 pc scale spiral arm observations made with CARMA. These observations reveal that the dense gas tracers are localized along the star forming spiral arms. In particular, there are regions where dense gas is present, but there is no evidence of massive star formation. This may imply that the local environment and small-scale physics are important for determining which gas will form stars. These new observations also help fill in the four-magnitude gap separating previous observations of galaxies and the star forming regions within the Milky Way. There is a deviation between these new observations and the previous correlation. Secondary processes caused by either the mass to light conversion or star formation efficiency may explain this deviation.

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