Dynamically-regulated star formation in the strongly interacting Taffy galaxies.

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The Taffy system was formed from the head-on collision of the galaxy pair UGC 12914/5. This strong interaction has created a 20 kpc-long massive and turbulent bridge of atomic and molecular gas (Gao+03). Unlike in other interacting/merging systems like (U)LIRGs, the Star Formation (SF) in Taffy is not enhanced but rather inhibited. We have studied the effects of such extreme gas dynamics on the molecular ISM and how it affects its ability to form stars. In order to understand the connection between large-scale environment and molecular cloud properties, we carried out a multi-species survey of the molecular line emission across Taffy using the IRAM 30-m telescope. Our study included tracers of the bulk molecular gas (12,13CO), the dense star-forming phase (HCN, HCO+) and shock-driven chemistry (SiO, HNCO). Combining these tracers, we found out that not only the bulk of the molecular gas is inefficient at forming stars, but the efficiency of its dense phase is also abnormally low (1 dex below (U)LIRG typical values). Furthermore, the dense gas fraction in the bridge is considerably low (4%), suggesting that the gas density is lower than in other interacting/merging systems and comparable that of normal spiral galaxies. On the other hand, the first direct detection of shocks via SiO, together with the broad line profiles, supports the idea that enhanced shock-driven turbulence is inhibiting the SF in such clouds.

Finally, we combine our observations with literature data (Usero+15, García-Burillo+12) to place constraints on a set of well-known analytic models of SF (Federrath+12). The extreme conditions found in the Taffy system significantly expand the region of the parameter space covered by previous extragalactic observations, which cannot be easily accounted for by several of those models. We interpret this discrepancy as an oversimplification of the feedback effects so that these analytic theories cannot slow down the quick gas collapse produced by the multi free-fall time approach invoked in those models.

References:

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