Tracing the Molecular Gas in Star-forming Dwarf Galaxies: The Need for CII Observations

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CO emission proves to be an unreliable tracer for H_2, especially in the hostile environment of star-forming, low-metallicity dwarf galaxies. The X_{CO} conversion factor is far from being a (metallicity-scaled) constant for a galaxy but a truly local property and a sensitive diagnostic of the physical conditions of the studied regions. However, investigating X_{CO} in detail partly overcomes the feebleness of CO observations. We present results of an in-depth study of the molecular gas in the prototypical blue compact dwarf galaxy Haro 2. Virial mass estimates based on interferometric CO(1-0) & CO(2-1) data and radiative transfer analysis that includes the CO(3-2) and ^{13}CO lines, yield both low X_{CO} factors for (apparently undisturbed) molecular cloud complexes despite the low metallicity of Haro 2. This indicates that the shielding against CO photo-dissociation in low-mass galaxies is indeed not only correlated with metallicity but might more strongly depend on parameters like the structure of molecular cloud complexes. Such cloud characteristics may differ in dwarf galaxies. Preliminary results of our line ratio studies from mapping of the higher CO transitions in other dwarf galaxies (IC10, NGC 1569, NGC 5264, NGC 3077) also reveal very complex molecular phases - surprisingly in the more quiescent outer regions of some of these dwarfs. Obviously is our understanding of the distribution and energy balance of the dense ISM in low-mass galaxies very incomplete without the study of major coolants like CI and CII. While CI emission is directly associated with the CO emitting cloud cores, is CII more extended and probably better tracing the molecular complexes. The high spectral resolution of HIFI, the sensitivity and the small beam of FIRST at 158{SYMBOL 109 \f "Symbol"}m will allow detailed studies of the structure and energy balance of the ISM and its relation to star formation in a variety of dwarf galaxies beyond the local group. CII observations of dwarf galaxies will help to clarify the sometimes contradictory results on the state of the dense ISM in these extreme environments and provide valuable input for refined PDR models.