ABSTRACT

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The ISM properties in Low Metallicity Galaxies from Herschel to Alma

Many studies suggest that CO is not a reliable tracer of the molecular reservoir in all galaxies. This is a particularly glaring problem in low metallicity dwarf galaxies, where attempts to get at the molecular reservoir via CO lines have not proven to be fruitful experiments in most cases. How galaxies convert gas into stars is indeed an essential key in understanding how primodial galaxies have evolved from the large scale structures to the objects we see today. The energy balance in the ISM requires a detailed study of the gas reservoir and dust properties.Toward this goal, the Herschel Dwarf Galaxy Survey is a Guaranteed Time Key program targeting 55 widely-varying low metallicity galaxies in the Local Universe being observed in the FIR fine structure lines (63 and 145 mu OI, 158 mu CII, 122 and 205 mu NII, 88 mu OIII, 57 mu NIII), as well as the 60 to 550 mu dust continuum. SPIRE observations confirm large dust masses and the dust-to-gas mass ratios we find in low metallicity galaxies are difficult to reconcile with chemical evolution models. We find dramatic variations in the FIR line ratios throughout the galaxies, giving us, for the first time, probes of the low density ionised gas, the HII regions and photodissociation regions in dwarf galaxies. We find line ratios in the metal-poor ISM which are characteristically different than those in the metal-rich environments, highlighting the different filling factors of neutral versus ionised gas and suggesting a very clumpy ISM structure . The [CII]/CO ratios are higher in the dwarfs than in the more metal-rich galaxies and we interprete this as a signature of 'hidden', self-shielded molecular gas residing in the C+ - emitting regions, which are not traced by CO. We will use the [CII] line along with the observed CO to recalibrate the tracers for molecular gas, especially in low-metallicity regions. ALMA observations will be essential to peer into the molecular cloud structure of the low metallicity ISM, which appears to be very clumpy, and resolve the controversy surrounding the star formation law applied to these low mass systems. Only with an ALMA survey of the CO ladder and a density tracer, such as HCN, as well as mapping out the cold dust in these galaxies, can we obtain a total inventory of the molecular gas and characterise the warm and cool gas phases, thus resolving the state of the enigmatic star formation in low metallicity galaxies.