Title:

ALMA DenseGAS Survey: Testing the (non-)universality of the dense gas star formation scaling relation

Summary:

In the stellar mass–star formation rate plane, galaxies are broadly divided into actively star-forming galaxies on the "star-forming main sequence" and red galaxies that have ceased forming stars. "Green valley" galaxies, lying between the two, are thought to be in a transitional phase in which star formation is shutting down. Large CO surveys of nearby galaxies such as xCOLDGASS have shown that the molecular star formation efficiency (star formation rate / molecular gas mass) depends on the specific star formation rate (star formation rate / stellar mass), varying systematically once galaxies below the main sequence are included. Understanding the origin of this variation requires measurements of the dense molecular gas (traced by HCN and other lines) directly responsible for star formation. However, existing dense gas observations are concentrated above the main sequence, and observations of green-valley galaxies remain very scarce. In this project, we will systematically analyze ALMA dense gas data for green-valley and main-sequence galaxies to reveal how the dense gas fraction (dense gas mass / molecular gas mass) and the dense gas star formation efficiency (star formation rate / dense gas mass) change with star formation activity. We will thereby determine whether star formation suppression is driven by a deficit of dense gas or by a reduced dense gas star formation efficiency, and test the universality of the dense gas star formation law. Building on this work, we further aim to realize the ALMA DenseGAS Survey, an ALMA Large Program that extends this study to a substantially larger sample.