Spectral Observations of Star Formation with ALMA

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The Atacama Large Millimeter/submillimeter Array (ALMA) is the premier instrument for observing the rotational transitions of molecules in the universe. Such lines are the key to understanding the dynamics and chemistry of the molecular clouds from which stars form. In this presentation, we describe recent insights into the earliest phases of star formation from the ALMA Early Science period. For example, ALMA enabled the very first interferometric detection of the H_2D^+ 1_{10}-1_{11} line at 372.2 GHz, a tracer of the innermost regions of dense gas cores. Also, ALMA has detected inverse P-Cygni profiles, the unambiguous tracer of infall motions, in HCO^+ 4-3 and HCN 4-3 emission at 356.7 GHz and 354.5 GHz, respectively, towards protostars. Finally, ALMA has detected the Keplerian rotations of accretion disks, also in HCO^+ 4-3 and HCN 4-3 emission, around distant young stars, enabling estimates of the protostellar mass. In particular, we highlight how ALMA's wide frequency range, flexible correlator, and high sensitivity are making these and future breakthroughs possible.