A. survey of the cold molecular gas in gravitationally lensed star-forming galaxies at z - 2

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Abstract

Using the Australia Telescope Compact Array, we conducted a survey of CO J = 1 - 0 and J = 2 - 1 line emission towards strongly lensed high-redshift dusty star-forming galaxies (DSFGs) previously discovered with the South Pole Telescope (SPT). Our sample comprises 17 sources that had CO-based spectroscopic redshifts obtained with the Atacama Large Millimeter/submillimeter Array and the Atacama Pathfinder Experiment. We detect all sources with known redshifts in either CO J = 1 - 0 or J = 2 - 1. 12 sources are detected in the 7-mm continuum. The derived CO luminosities imply gas masses in the range (0.5–11) × 1010 M and gas depletion time-scales tdep < 200 Myr, using a CO to gas mass conversion factor aCO = 0.8 M (K km s-1 pc2) -1. Combining the CO luminosities and dust masses, along with a fixed gas-to-dust ratio, we derive aCO factors in the range 0.4–1.8 M (K km s-1 pc2) -1, similar to what is found in other starbursting systems. We find small scatter in aCO values within the sample, even though inherent variations in the spatial distribution of dust and gas in individual cases could bias the dust-based aCO estimates. We find that lensing magnification factors based on the CO linewidth to luminosity relation (μCO) are highly unreliable, but particularly when μ < 5. Finally, comparison of the gas and dynamical masses suggest that the average molecular gas fraction stays relatively constant at z = 2–5 in the SPT DSFG sample..

Keywords

Galaxies: evolution, Galaxies: formation, Galaxies: high-redshift, Galaxies: starburst, Cosmology: observations.