*Molecular Gas, Dust, and Star Formation in Galaxies*
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# Spatial Variation of CO Excitation in High-z Galaxies

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**Abstract.** Previous studies of the molecular gas excitation in high-redshift galaxies have focused on galaxy-wide averages of CO line ratios. However, it is possible that these averages hide spatial variation on sub-galactic scales, disguising the true distribution and conditions of the molecular gas within star-forming galaxies. Even in the pre-ALMA era we have begun to see evidence for spatial variation of CO excitation in both rest-UV selected and submillimeter-selected galaxies at $z > 2$, aided both by the increased frequency coverage of the Jansky Very Large Array (allowing high-resolution observations of the CO(1–0) line, the best tracer for the coldest molecular gas) and by the benefits of gravitational lensing for spatially extended sources. We show new results for multiple high-redshift systems that reveal spatial and/or spectral variations in CO excitation, including an early-stage merger that has different conditions in its two components, thereby illustrating the need for high spatial and spectral resolution mapping in order to accurately characterize the molecular ISM in high-$z$ galaxies.

**Keywords.** galaxies: high-redshift — galaxies: ISM — ISM: molecules

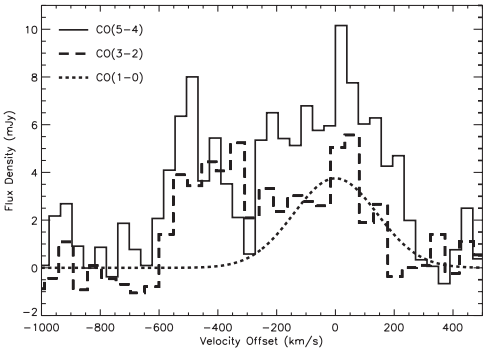


**Figure 1.** The CO(5–4) (solid) and CO(3–2) (dashed) spectral lines of SMM J00266+1708 ($z = 2.742$), shifted to match the rest frame velocity of the CO(1–0) line (Gaussian fit shown in dotted line; amplitude multiplied by a factor of five for clarity). A second component that was undetected in the original CO(1–0) observation indicates that SMM J00266+1708 is likely comprised of two merging galaxies: a blue component with dispersion-dominated kinematics and a single-phase molecular ISM, and a red component with a velocity gradient and a multi-phase molecular ISM (Sharon *et al.* in prep.).

## Reference

Sharon, C. E., *et al. in preparation*