ISM conditions in gas mass-selected galaxies at z=1-3 from ASPECS

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Understanding the physical conditions inside the cold ISM of distant galaxies and their relation to the global galaxy properties are essential to the theory of galaxy formation because (i) they determine the boundary conditions for star formation to take place in the cold gas, and (ii) they are key to determine cold gas masses from single-tracer surveys of the cosmic molecular gas densities. We present the results [1] on the physical conditions in a gas mass-selected sample of star-forming galaxies at cosmic noon (z=1-3) from the ALMA Spectroscopic Survey in the Hubble Ultra Deep Field (ASPECS) [2,3]. Using state-of-the-art Turbulent Large Velocity Gradient models, we self-consistently model the CO, [CI] and dust continuum emission of the galaxies, that lie on, above, and below the galaxy main sequence at z=1-3. The galaxies show moderate CO excitation that (on-average) is above that of the Milky Way, but lower than that of color- and submm-selected galaxies, indicating that a warm component is present but not omniprevalent at z=1-2. Interestingly, we find that the galaxies at z=2-3 have intrinsically higher CO excitation than those at z=1-2, potentially linked to their higher surface densities of star formation and gas. Our results show that our understanding of the ISM conditions remains incomplete and future surveys should focus on mapping the multi-line diagnostics of the ISM in distant star-forming galaxies.

References

[1] Boogaard, L.A., et al, ApJ, 902, 109 (2020)
[2] Walter, F., et al., ApJ, 833, 67 (2016)
[3] Decarli, R., et al. ApJ, 902, 110 (2020)