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Presentation Requested: oral
Category: Cosmic Star Formation History
Question: How does the star formation rate density evolve over all redshifts, especially at z > 2? Is there agreement between the measurements from ALMA, JVLA, Herschel, HST, and other instruments? Can the SFR density be dissected showing what is contributing to it at different redshifts or how might we go beyond measuring this relationship. What are the state of the art simulations and how do the observations compare to them?

What drives the evolution of the cosmic star formation history

The cosmic star formation history (CSFH) increased from early epochs (z 6), peaked around z=1-3 (the 'epoch of galaxy assembly'), then decreased by an order of magnitude until present age. What drives this evolution? We investigate whether the trend in CSFH is driven by the evolution of the molecular gas content in galaxies. We performed the first molecular scan in a region of the Hubble Deep Field North (HDF-N), by scanning the 3mm window (79-115 GHz) using the IRAM Plateu de Bure Interferometer. Our goal was to put first direct constraints on the molecular gas functions, as traced by carbon monoxide (CO), at high redshift. We found 17 line candidates, and estimated that only up to 4 of them are spurious. By cross-matching with available multi-wavelength photometric and spectroscopic information in the HDF-N, and with dedicated follow-up observations at 2mm, we could pin down the line identification (thus, the redshift of the associated galaxies), and estimate physical quantities (e.g., location in the global star-formation law; molecular gas fraction; depletion time). More importantly, we could set first observational constraints on the CO luminosity functions up to z 3. Our results are in broad agreement with available models showing an enhanced cosmic abundance of molecular gas at high z. Such evolution could be even steeper than what predicted by current models, if all the line candidates discovered in our study were to be confirmed. More constraints will come from our follow-up observations (including a parallel 30-38 GHz scan of the GOODS-North area using the Jansky Very Large Array) and from a recently approved ALMA cycle 2 3mm project aim at repeating our 3mm scan experiment in a region of the Hubble Ultra Deep Field.