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Presentation Requested: oral
Category: Evolution of the Interstellar Medium and Star formation over Cosmic Time
Question: Is there a common Schmidt-Kennicutt law at all redshifts and all scales? How is this "law" affected by different measurement limitations or conversion factors from tracer molecules or emission / absorption lines to amounts of gas and SFR?

Far-IR fine-structure line studies of early galaxies: Where are we and where do we need to go?

The far-IR fine-structure lines are powerful probes of the physical conditions in the interstellar medium (ISM). They arise in the ionized, atomic, and molecular phases of the ISM from the fine-structure levels of carbon, oxygen, nitrogen and their various ions. Typically the lines are collisionally excited, optically thin and weakly affected by extinction due to dust. As such, the lines serve as important, if not dominant, coolants of their respective phases of the ISM and makes them excellent probes of both the density of the gas and source of gas heating. While inaccessible from ground at their rest wavelengths, they begin falling into the short submillimeter telluric-windows ($\sim$ 200 to 500 μm) from high-z systems at z $\sim$ 1. Over the past half-decade or so many of the important lines have been detected (i.e. [CII] 158 μm, [OIII] 88 μm, [NII] 122 μm etc.) from galaxies in the early universe. This pioneering work has demonstrated their utility for understanding high redshift systems including providing constraints on the size of the star forming region, quantity of ionized gas, age of the starburst, and gas phase abundances to name a few. Now in the ALMA era of studies using the fine-structure lines have the potential to dramatically increase our understanding of early galaxies, both in their formation and evolution. Much work is required, however, to fully realize this potential. Here I will summarize the current state of fine-structure line studies of high-z galaxies including our work using the ZEUS-1 and ZEUS-2 spectrometers as well as Herschel and ALMA. Lastly, I will discuss the additional multi-wavelength studies necessary for realizing the full scientific potential of the FIR fine-structure lines for studying the early universe.