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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?

The Cosmic Evolution of the Physical Properties of the Molecular ISM in Star Forming Galaxies

The JVLA, PdBI and ALMA are revolutionizing our view of star formation in both local and high-redshift galaxies. Galaxies at high-z are seen to be exceptionally gas rich (compared to local analogues), with a Kennicutt-Schmidt star formation law with strongly varying star formation efficiencies. These observations rely critically on inferences made from the star forming molecular gas, whose emission is determined by small scale physics: radiative feedback from massive stars, supersonic turbulence and global gravitational collapse. I will present a model for the life cycle of giant molecular clouds in star forming galaxies as dictated by momentum input from massive stars, and global galaxy dynamical processes which informs direct observables such as CO and HCN emission. From this model, I describe the origin of the structure of the molecular ISM in galaxies from high-z to present epoch, as well as the normalization of the Kennicutt-Schmidt law. I will similarly utilize these results to present a general form for both the CO-H2 conversion factor in star forming galaxies, as well as the origin of CO excitation ladders (SLEDs). This will have a critical impact on our understanding of galaxy gas fractions across cosmic time, the star formation law, and the results from CO deep fields.