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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?

### **Multi-wavelength ISM diagnostics in high redshift galaxies**

The prominent peak in the history of star formation and black hole accretion at  $z \sim 1-3$  suggests strong evolution in the mechanisms that grow stars and black holes in galaxies. Multi-wavelength observations of the interstellar medium can quantify both the energy balance between star formation and AGN activity, and constrain the composition and conditions of the gas and dust available to form new stars. In order to measure and understand the evolution of the ISM in high redshift galaxies, we combine diagnostics from mid-IR spectroscopy, far-IR fine structure lines, far-IR/(sub)mm continuum and CO molecular lines. We quantify the evolution in the ISM with redshift and as an AGN grows more luminous within a star forming galaxy. We present new observations from the Large Millimeter Telescope which enable us to dissect scatter in the integrated Schmidt-Kennicutt relation due to the balance between star formation and AGN activity in galaxies. We emphasize the importance of carefully accounting for composite sources which appear to be star-forming galaxies but where low levels of AGN emission present are sufficient to affect the observed ISM conditions. The co-evolution of AGN and star formation activity in galaxies insists that these composite sources are crucial for understanding galaxy evolution. We place our results in the context of popular evolutionary scenarios proposed for massive galaxies and discuss how future observations of the ISM with ALMA, LMT and JWST will allow us to exploit these multi-wavelength diagnostics in larger samples of galaxies.