Strong C^+ emission in galaxies at z$\sim$1-2: Evidence for cold flow accretion powered star formation in the early Universe

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Abstract: The nature of star formation in high redshift ULIRGs, whether they are fueled by major mergers between gas rich systems or accretion of gas from the IGM, remains a matter of debate. To explore this issue, we have observed the [CII] 157.7 μm line in eight star forming galaxies at redshifts 1 to 2 using the redshift(z) Early Universe Spectrometer (ZEUS). This represents a significant addition to [CII] observations during the epoch of peak star formation. We have augmented this survey with observations of the [OI]63 μm line and far infrared photometry from the PACS and SPIRE Herschel instruments as well as Spitzer IRS spectra from the literature showing PAH features. Our sources exhibit above average gas heating efficiency, many with $L_{[CII]}/L_{FIR} > 10^{-2}$. The relatively strong [CII] emission is consistent with our sources being dominated by star formation powered PDRs, extending to kpc scales. In at least one source we also see very high [CII]/PAH ratios and a cool dust temperature, suggesting another mode of gas heating in addition to normal photoelectric heating may be contributing to the observed [CII] emission. Further investigation with high resolution instruments such as ALMA and HST will resolve the nature of these sources and provide means to effectively survey large samples of star forming galaxies in the early Universe.