Disentangling Galaxies During the Peak of Star Formation and Galaxies During the Epoch of Reionization Using Roman and TIME

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The specifics of the formation of large-scale structures such as galaxies in the Early Universe, together with conditions of peak stellar formation at later epochs remain largely unknown. The evolution of the Universe across this wide range of cosmic history can be understood by combining astrophysical signals from galaxies at the Epoch of Reionization (EoR), when starlight first emerged, and the Cosmic Noon, when galaxies were actively forming stars. This work lays the groundwork of a cross-correlation analysis between measurements of two instruments, TIME and Roman, that will investigate these two eras of cosmic evolution. TIME is a millimetre line-intensity mapping instrument that will directly probe the EoR by measuring CII fluctuations from the oldest galaxies between redshifts $5 < z < 9$, while also measuring the CO intensity fluctuations that trace molecular gas content around actively star-forming galaxies at cosmic noon i.e. $z \sim 2$. TIME's CO foreground will complement the High-latitude Imaging Survey (HLS) planned for the Roman Space Telescope, NASA's next-generation space observatory, that will provide high-resolution infrared photometry measurements of tens of millions of galaxies out to $z \sim 2$.

To emulate a Roman galaxy catalog, the multiwavelength photometry catalog of the deep infrared CANDELS survey of the COSMOS sky field was chosen (Nayyeri et al., 2016). After imposing a set of suitable selection criteria, the catalog consists of 32,721 H-band selected galaxies at $z_{phot} \leq 4.0$, with good photometry data available. BzK and VJL colour-colour selections were applied to identify the star-forming and quiescent/passively-evolving populations, their total infrared luminosities were estimated as a function of redshifts and stellar masses and utilized to model their CO emission. Considering galaxies in bins of stellar mass and redshift, akin to TIME's planned tomography, would make the CO modelling, presently found to be suitable, more robust.