Caius: Synthetic Observations Using a Robust End-to-End Radiative Transfer Modeling Pipeline

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ABSTRACT: We present synthetic observations for the first generations of galaxies in the Universe and make predictions for future deep field observations for redshifts greater than 6. Due to the strong impact of nebular emission lines and the relatively compact scale of HII regions, high resolution cosmological simulations and a robust suite of analysis tools are required to properly simulate spectra. We created a software pipeline consisting of FSPS, Hyperion, Cloudy and our own tools to generate synthetic IR observations from a fully three-dimensional arrangement of gas, dust, and stars. Our prescription allows us to include emission lines for a complete chemical network and tackle the effect of dust extinction and scattering in the various lines of sight. We provide spectra, 2-D binned photon imagery for both HST and JWST IR filters, luminosity relationships, and emission line strengths for a large sample of high redshift galaxies in the Renaissance Simulations (Xu et al. 2013). We also pay special attention to contributions from Population III stars and high-mass X-ray binaries and explore a direct-collapse black hole simulation (Aykutalp et al. 2014). Our resulting synthetic spectra show high variability between galactic halos with a strong dependence on stellar mass, viewing angle, metallicity, gas mass fraction, and formation history. Population III clusters were found to exhibit characteristics that make them discernable when viewed near the end of the Reionization Epoch. Direct-collapse black holes were seen to be observable for a few million years after their formation when they trigger star formation by inducing the production of molecular hydrogen with ionizing radiation.