TOWARDS A SIMPLE PHYSICAL MODEL OF LINE EMISSIONS FROM GALAXIES

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Abstract

Line intensity mapping (LIM) is a promising approach to study the star formation and interstellar medium (ISM) in galaxies through the measurements of aggregated line emissions from the entire galaxy population. While much previous work has exploited either simple scaling relations or sophisticated, galaxy-scale simulations to investigate the prospects of intensity mapping with different line tracers, a generic analytic framework that simultaneously favors details of ISM physics and the convenience of forecasts and physical interpretation is still lacking. Here, on the basis of analytic models connecting total infrared luminosity of galaxies to their hosting dark matter halos and redshifts, we develop a simple yet physically-motivated model that can self-consistently determine the integrated line intensities (e.g., HI, [CII], [NII] and CO) of galaxies. The model predictions are checked against various constraints on the line emissions from existing observations. We then apply the model to demonstrate the potential for reliably extracting physical properties of the ISM, such as the temperature and density, from cross-correlation analysis of future line intensity mapping experiments with multiple tracers probing different ISM phases.

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