Intensity Mapping Spectral Line de-confusion in Map Space

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Abstract

Line intensity mapping (LIM) has emerged as a promising tool to probe the cosmic reionization and the large-scale structure. One particular challenge of LIM is the separation of blended spectral lines from different redshifts that fall in the same observed frequency channel. Previously proposed approaches for de-blending the lines, e.g. cross-correlation and power spectrum anisotropy techniques, aim at extracting the power spectrum of individual lines and are not able to provide information other than two-point statistics. In this work, we develop a line de-confusion technique in map space, making use of the fact that at a given source redshift multiple emission lines are observable in a LIM survey. We build a set of spectral templates to extract this information, using the matching pursuit algorithm in the sparse approximation. As an example, we consider an intensity mapping experiment targeting [C II] at the epoch of reionization which will have multiple low-redshift CO interlopers. We show that with a survey parameter similar to the two ongoing [C II] LIM experiments (TIME and CONCERTO), the one-point statistics VID (voxel intensity distribution) of our reconstructed 3D maps are consistent with that of the input map. Additionally, the reconstructed and input maps reach _˜80% map-space correlation.

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