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Simulating line intensity mapping observations with TIFUUN on ASTE

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Recent observations by the James Webb Space Telescope have discovered numerous high-redshift galaxies, suggesting that galaxies may have evolved from an earlier stage of the Universe than expected. Exploring when heavy elements like carbon began to accumulate in the universe is an essential question in astronomy. Line intensity mapping (LIM) at millimeter to sub-millimeter wavelengths provides a comprehensive understanding of high-redshift galaxies, including both bright and faint ones, and their carbon contents by detecting signals from C+, C0, and CO. The Terahertz Integral Field Unit with Universal Nanotechnology (TIFUUN)[1], which leverages the integrated superconducting spectrograph technology demonstrated by DESHIMA [2][3][4], will provide a new capability for the sub/mm-LIM when deployed at the Atacama Submillimeter Telescope Experiment (ASTE).

In this research, we investigate the constraining power of TIFUUN on ASTE, when TIFUUN is equipped with two integral field units (IFUs) optimized for LIM. We assume provisional survey specifications of $\sigma \approx$ 1 mJy/beam and R = 500 at Band 1 (124-180 GHz with the angular resolution of 48 arcsec) and Band 2 (248-301 GHz with the angular resolution of 27 arcsec) over an area of 1 deg^2, and use mock observational data generated from the Illustris-TNG simulation. We find that more than 100 individual sources of [CII] at z ~6 could be detected at a significance of 5σ or greater, allowing us to constrain the [CII] luminosity function at the brightest end. Contributions from faint galaxies will be detected through power spectrum; however, it is necessary to remove bright foreground CO line galaxies. In this presentation, I will discuss foreground removal and its implications for the detectability of the [CII] power spectrum at z~6 using TIFUUN on ASTE. Specifically, I will explore an approach that combines multiple techniques, including a masking method based on a galaxy catalog and a cross-correlation analysis leveraging the detection of multiple emission lines, to effectively mitigate foreground contamination.

[1] Nishimura, Y., et al. 2025, LTD2025
[2] Endo, A., et al. 2019, Nature Astronomy, **3**, 989
[3] Taniguchi, A., et al. 2022, Journal of Low Temperature Physics, **209**, 278
[4] Endo, A., et al. 2025, LTD2025

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