Highlights of Spanish Astrophysics XII, Proceedings of the XVI Scientific Meeting of the Spanish Astronomical Society held on July 15 - 19, 2024, in Granada, Spain. M. Manteiga, F. González Galindo, A. Labiano Ortega, M. Martínez González, N. Rea, M. Romero Gómez, A. Ulla Miguel, G. Yepes, C. Rodríguez López, A. Gómez García and C. Dafonte (eds.), 2025

Can we detect the cosmic web in Ly α emission? Ly α Intensity Mapping forecast for DECaLS/BASS-DESI

Pablo Renard¹, Daniele Spinoso¹, Zechang Sun¹, Hu Zou², Paulo Montero-Camacho³ and Zheng Cai¹

¹ Department of Astronomy, Tsinghua University, Beijing 100084, China

² Department of Mathematics and Theory, Peng Cheng Laboratory, Shenzhen, Guangdong 518066, China

³ National Astronomical Observatories, Chinese Academy of Sciences, Beijing 100012, China

Abstract

Intensity Mapping is a promising observational technique, consisting in the tracing of emission lines on large angular scales, without resolving any particular objects. Here, I will present a new method to perform $Ly\alpha$ intensity mapping with the background of broadband images, readily available from current and upcoming photometric surveys, and the $Ly\alpha$ forest of QSO spectra, in order to trace the unresolved $Ly\alpha$ emission that permeates the inter-galactic medium (IGM). We perform a forecast for currently existing/ongoing surveys (DESI and the g-band data of its Legacy Imaging Surveys) and show that even the absence of any detection may place competitive upper limits in the total $Ly\alpha$ luminosity at $z\sim3$. We fully expect this signal to be detectable in the $z\sim3$ range with imaging data from already planned space missions (CSST) and ground surveys (LSST), and maybe even at z > 3.5 (Euclid). Such detection would be the first imaging observation of the large-scale structure (>10 cMpc/h) in diffuse Ly α emission, and would contribute to understanding the distribution and physical properties of baryons in the cosmic web. For example, it would place constraints on total $Ly\alpha$ luminosity (both from diffuse IGM emission and unresolved $Ly\alpha$ emitters), as well as on the bias of this diffuse $Ly\alpha$ emission as a tracer of large-scale structure.

My poster in zenodo.org can be found here