X22a Revealing the cosmic reionization history with fast radio bursts in the era of Square Kilometre Array

橋本哲也, 後藤友嗣, Ting-Yi Lu, Alvina Y. L. On, Daryl Joe D. Santos, Seong Jin Kim (NTHU), Ece Kilerci-Eser (Sabanci U.), Simon C.-C. Ho, Tiger Y.-Y. Hsiao, and Leo Y.-W. Lin (NTHU)

Revealing the cosmic reionization history is at the frontier of extragalactic astronomy. The power spectrum of the cosmic microwave background (CMB) polarization can be used to constrain the reionization history. Here, we propose a CMB-independent method using fast radio bursts (FRBs) to directly measure the ionization fraction of the intergalactic medium (IGM) as a function of redshift. FRBs are new astronomical transients with millisecond time-scales. Their dispersion measure ($\mathrm{DM_{IGM}}$) is an indicator of the amount of ionized material in the IGM. Since the differential of $\mathrm{DM_{IGM}}$ against redshift is proportional to the ionization fraction, our method allows us to directly measure the reionization history without any assumption on its functional shape. As a proof of concept, we constructed mock non-repeating FRB sources to be detected with the Square Kilometre Array, assuming three different reionization histories with the same optical depth of Thomson scattering. We considered three cases of redshift measurements: (A) spectroscopic redshift for all mock data, (B) spectroscopic redshift for 10 per cent of mock data, and (C) redshift estimated from an empirical relation of FRBs between their time-integrated luminosity and rest-frame intrinsic duration. In all cases, the reionization histories are consistently reconstructed from the mock FRB data using our method. Our results demonstrate the capability of future FRBs in constraining the reionization history.