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Decoding the cosmological baryonic fluctuations using localized fast radio bursts

The enigma of the missing baryons poses a prominent and unresolved problem in astronomy. Dispersion measures (DM), serving as a distinctive observable of fast radio bursts (FRBs), quantify the electron column density along each line-of-sight, revealing the missing baryons described in the Macquart (DM-z) relation. The scatter of this relation is anticipated to be caused by the variation of cosmic structure. However, this is not yet statistically confirmed. Here, we present the statistical evidence of the cosmological baryonic fluctuations. We calculate the foreground galaxy number densities around 14 and 13 localized FRBs are measured with WISE-PS1-STRM and WISE × SCOS photometric redshift galaxy catalog, respectively. The foreground galaxy number densities are determined through a comparison with measuring random apertures with a radius of 1 Mpc. We found a positive correlation between the excess of DM contributed by the medium outside galaxies (DMcosmic) and the foreground galaxy number density. The correlation is strong and statistically significant with median Pearson coefficients of 0.6 and 0.6 and median p-values of 0.012 and 0.032 for the galaxy catalogs, respectively, calculated by Monte Carlo simulations. Our findings indicate that baryonic matter density outside galaxies exceed its cosmic average along the line-of-sight to regions of excess galaxy-density, whereas there is less amount of baryons along the line-of-sight to low-density regions, presenting statistical evidence for cosmological fluctuation of the ionised baryons on a characteristic scale of < 6 Mpc.

Section

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