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Modeling the large-scale structure and the neutral hydrogen content of the universe.

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Studies on the rest frame 21 cm spectral emission line of neutral hydrogen (HI; from the hyperfine spin-flip state transition) provides an interesting and novel way of studying the large-scale structure (LLS), baryon acoustic oscillations (BAO), cosmological models and galaxy dynamics and evolution. By modelling the distribution function of HI within dark matter halos and, consequently, the correlation power spectrum from this HI distribution function, it is possible to derive the HI content within galaxies, halos and the universe, and also the LLS of the universe. To achieve this goal we used the HALOMOD python package to carefully model the halo occupation distribution (HOD) for discrete and continuous HI tracers, and also the total HI-galaxy cross-power spectrum. This HI-galaxy cross-power was then fitted with the EMCEE python package to HI-galaxy cross-correlation data from the literature with redshifts between $0.400<z<0.459$ and scales between $0.05<k<0.28$. The fit allowed to model the LLS of the universe, constrain the HOD parameters and derive several cosmological parameters, for e.g. the density fraction of HI and the average, minimum and maximum mass of HI per halo and galaxy. These results improve previous constraints on the structure and HI content of the universe, and also star and galaxy formation and evolution models.

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