Cosmology with the one dimensional power spectrum of the Lyman-alpha forest

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Abstract

Neutral hydrogen in the IGM scatters light at 1216A producing an absorption spectrum that is observed on any background sources known as the Lyman-alpha forest. The fluctuations in the Lyman-alpha forest absorption can be used as a tracer of the varying density of intergalactic gas expected from the growth of structures from primordial fluctuations in the Universe. They can be accurately described by the flux auto-correlation along a line of sight, which has been shown to be a powerful tool in astrophysics and cosmology.
We use the complete Baryon Oscillation Spectroscopic Survey (BOSS) and first extended-BOSS (eBOSS) spectra datasets which cover thirteen redshift bins, from z = 2.1 to z = 4.7 to compute the 1D flux power spectrum in the Lyman-alpha forest. We performed an extensive investigation of the systematic uncertainties affecting the measurement, and cosmological impacts as well.
The current constraints are at the percent level, and will even shrink further in the DESI era. The P1D measurement becomes sensitive to the complex mechanical effects of quasar outflows, known as AGN feedback. We use Adaptative Mesh Refinement (AMR) hydrodynamical simulations performing AGN feedback as a sub-grid model, the Horizon-AGN and Horizon-noAGN simulations, to evaluate its effect on the P1D of the Lyman-alpha forest. We observe two antagonist effects; the strong outflows regulate baryonic content at small scales by redistributing it at larger scales and suppress power on the largest scales of the Lyman-alpha P1D. We study the hypothesis of an ionization of the reinjected gas at large scales, heated by the AGN, to understand the decrease of power.

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