Measuring the Reionization History with Quasar Damping Wings

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Abstract

The Lyman-alpha damping wing from neutral hydrogen in the intergalactic medium is predicted to be a key signature of the reionization epoch in the spectra of high-redshift quasars. There are substantial challenges in measuring and interpreting this signal, however: the intrinsic spectrum of a quasar near its Lyman-alpha line is highly uncertain, and the strength of the damping wing depends on the patchy structure of reionization and the age of the quasar. We have developed a Principal Component Analysis-based machine-learning approach to predict the intrinsic quasar spectrum, and have combined semi-numerical simulations of reionization topology with 1D radiative transfer through hydrodynamical simulations to predict the range of possible damping wing morphologies. Using a Bayesian statistical formalism calibrated with forward-modeled mock spectra we can then translate an observed quasar spectrum into constraints on the global neutral fraction and the length of the luminous quasar phase. I will discuss the application of these methods to spectra of the highest redshift quasars known to date.

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