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Improved technique for quasar continuum prediction in the Lyα forest based on composite spectra

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The intergalactic medium is revealed by the numerous absorption lines of neutral Hydrogen H¯{\sc i} (the so-called Lyα forest) seen in the spectra of distant quasars ($z > 2$), which traces the thermal and radiative history of the Universe, as well as the evolution of underlying matter distribution over a wide range of scales and redshifts. It is possible due to the relation of the Lyα opacity of the intergalactic H¯{\sc i} to its density and other physical parameters. As a measure of opacity, the value of mean transmission is used, which is defined as a ratio of observed (transmitted) and emitted fluxes. One of the main problems in these studies is related to the determination of emitted flux, i. e. the continuum level in quasar spectra. Most of the currently available methods of continuum determination are based on interpolation of absorption-free regions within Lyα forest or continuum extrapolation from wavelengths longer than 1215\,\AA. However, both of these methods work poorly for strongly absorbed spectra at high redshifts and do not consider the spectral and physical properties of each individual quasar (e.g. luminosity, spectral index etc), which may also affect the shape of the intrinsic quasar continuum and spectral lines.

In this work, we present a new method for determination of the intrinsic continuum level based on the composite spectra of quasars. For this purpose, we selected 10096 medium-resolution quasar spectra from the Sloan Digital Sky Survey Data Release 10 without own quasar absorption lines (BAL) and DLA systems. To take into account the properties of individual quasars, we compiled 92 composite spectra from subsamples of quasars with similar monochromatic luminosity at 1450\,\AA and similar spectral index within the wavelength range 1215–1450\,\AA. The intrinsic continuum in the Lyα forest for each individual quasar spectrum was found by the selection of the most optimal composite spectrum. The resulting continuum for individual quasars was used to measure the mean transmission in the Lyα forest and its dependence on the redshift.

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