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Proximity zone sizes of z > 6.5 quasars as probes of SMBHs and the IGM in the Epoch of Reionization

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The study of high-redshift (z>6) quasars is a fundamental key to the understanding of the formation and evolution of the first supermassive black holes (SMBHs) and the history of Reionization. We present the proximity zone size analysis performed on optical and near-infrared spectroscopic observations for a sample of 45 quasars at $6.50 < z \leq 7.64$. This represents the largest medium/moderate-resolution sample of quasars at z>6.5 from ground-based instruments, and its homogeneity and reproducibility make it ideally suited for several scientific goals, i.e., the study of the Ly-alpha forest, the intergalactic medium (IGM) metal content and temperature, as well as other properties such as the quasar luminosity function and the distribution of SMBH masses and Eddington ratios. Starting from this sample, a composite spectrum for evaluating the average rest-frame UV quasar spectral properties has already been produced and analyzed.
Here, we focus on the analysis of the proximity zone size distribution, which is fundamental to inferring information on the quasars' lifetime. Thanks to the reconstruction of the quasar intrinsic blue side from the observed red side (via PCA continuum modeling), we use these quantities to provide more stringent constraints on essential parameters such as the hydrogen neutral fraction at the epoch of Reionization and the radiative efficiency of the first SMBHs. In particular, in this work, we find smaller proximity zones than expected from model predictions. If we rule out the presence of metal absorbers, this evidence could be linked to a 'blinking lightbulb' scenario, in which the quasar periodically turns on and off with a certain duty cycle, and could represent an interesting observational case to study quasar variability on time-scales comparable to the equilibration time.

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