

The Sloan Digital Sky Survey Reverberation Mapping Project: Post-Starburst Signatures in Quasar Host Galaxies at $z < 1$

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Quasar host galaxies are key for understanding the relation between galaxies and the supermassive black holes (SMBHs) at their centers. We present a study of 191 broad-line quasars and their host galaxies at $z < 1$, using high signal-to-noise ratio (SNR) spectra produced by the Sloan Digital Sky Survey Reverberation Mapping project [1]. Clear detection of stellar absorption lines allows a reliable decomposition of the observed spectra into nuclear and host components, using spectral models of quasar and stellar radiations as well as emission lines from the interstellar medium. We estimate age, mass M_* , and velocity dispersion σ_* of the host stars, the star formation rate (SFR), quasar luminosity, and SMBH mass M_\bullet , for each object. The quasars are preferentially hosted by massive galaxies with $M_* \sim 10^{11} M_\odot$ characterized by stellar ages around a billion years, which coincides with the transition phase of normal galaxies from the blue cloud to the red sequence (Figure 1). The host galaxies have relatively low SFRs and fall below the main sequence of star-forming galaxies at similar redshifts. These facts suggest that the hosts have experienced an episode of major star formation sometime in the past billion years, which was subsequently quenched or suppressed. The derived $M_\bullet - \sigma_*$ and $M_\bullet - M_*$ relations agree with our past measurements and are consistent with no evolution from the local Universe. The present analysis demonstrates that reliable measurements of stellar properties of quasar host galaxies are possible with high-SNR fiber spectra, which will be acquired in large numbers with future powerful instruments such as the Subaru Prime Focus Spectrograph.

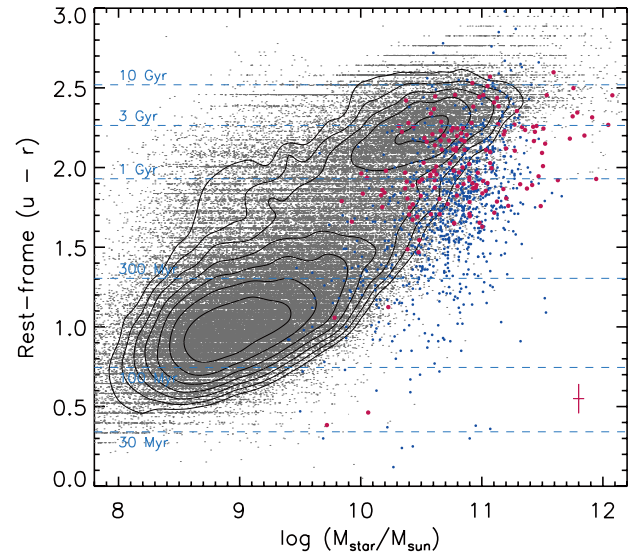


Figure 1: Rest-frame $(u-r)$ colors and stellar masses of the quasar host galaxies in this work (red dots) and in [2] (blue dots). The typical error for the present sample is shown by the error bar at the bottom right corner. The small gray dots and contours, drawn at logarithmically stepped levels of number density, represent non-AGN galaxies at $0.5 < z < 1.0$ taken from the COSMOS/UltraVISTA K -band selected catalog. The dots are given small random offsets to improve visibility. The dashed lines mark the SSP colors with $t_* = 0.03, 0.1, 0.3, 1, 3,$ and 10 Gyr, as labelled. The quasar hosts are preferentially hosted by massive galaxies distributed from the massive tip of the blue cloud to the red sequence. Their mean stellar age ($t_* \sim 1$ Gyr) corresponds to the gap of the bimodal distribution of inactive galaxies, where blue star-forming galaxies may be rapidly transitioning to the red sequence.

References

- [1] Matsuoka, Y., Strauss, M. A., Shen, Y., et al.: 2015, *ApJ*, **811**, 91.
- [2] Matsuoka, Y., Strauss, M. A., Price, T. N., III, DiDonato, M. S.: 2014, *ApJ*, **780**, 162.