Co-Evolution of Central Black Holes and Galaxies
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Environmental Effects on Properties of Type 2 QSOs

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Type 2 QSOs (QSO2s) are intrinsically luminous QSOs embedded in dusty environments. In this work, we study the radio, optical, and soft X-ray properties of 887 optically selected [O III]-based QSO2s (Reyes *et al.* 2008) at $z < 0.83$ to investigate the connection between QSO2s and their environments. We use SDSS data to measure the luminosity-limited galaxy counts in a volume centered on each QSO2 and defined by $\Delta z < 0.1$ (based on photometric redshifts) and within a projected distance of 1.5 Mpc of the QSO2 ($\sigma_{1.5\mathrm{Mpc}}$). We used *ROSAT* All Sky Survey (RASS) data to estimate the X-ray excess. Hsu & Chen (2010), after correcting for Galactic absorption, obtain a lower limit for the intrinsic neutral hydrogen column density (N_{H}) toward each of the QSO2s. About 50% of these sources have $N_{\mathrm{H}} > 10^{22}$ cm^{-2}. We take this value as a threshold to subdivide QSO2s into high- and low-N_{H} groups, and compare their environments. The distributions $\sigma_{1.5\mathrm{Mpc}}$ of the two populations show that, in regions of higher galaxy density, QSO2s are dominated by the high-N_{H} population (Figure 1), suggesting a closer connection between more obscured QSO2s and surrounding galaxies.

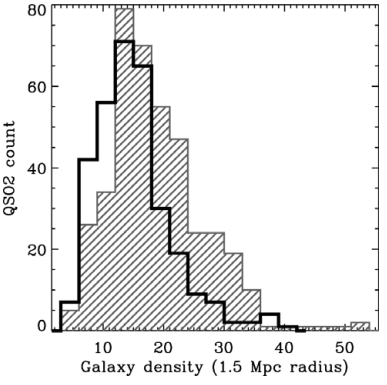

Figure 1. Galaxy number density distribution functions $\sigma_{1.5\mathrm{Mpc}}$ of high-N_{H} (shaded region) and low-N_{H} (thick solid line) QSO2.

We also detect X-ray excess (in the *ROSAT* 0.4–2.4 keV band) at 2σ confidence regions centered on most high-N_{H} QSO2s. However, a further analysis of these high-N_{H} QSO2s in X-ray excess regions does not show evidence of a correlation between the excess X-ray brightness and galaxy richness. This may imply that the more important external factors on fueling QSO2s and producing obscuring material are the nearby galaxies and their interaction with the QSO2 host galaxies; such an environment could also provide heating sources to the intergalactic medium.

References

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