Galaxy Evolution and Feedback across Different Environments
Proceedings IAU Symposium No. 359, 2020
T. Storchi-Bergmann, W. Forman, R. Overzier & R. Riffel, eds.
doi:10.1017/S1743921320002094

POSTERS

The relation between the environment and nuclear activity in nearby QSOs: Defining a control sample

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Abstract. In this study, we aim to investigate the relation between nuclear activity and the environment for luminous (L[O III] $> 7.63 \times 10^{41}$ erg s^{-1}) Active Galactic Nuclei (AGN) - that, at these luminosities are classified as quasi-stellar objects (QSOs) - using a sample of 436 type 2 QSOs. Recent studies suggest that there is an excess of interacting hosts in luminous AGN, indicating that interactions trigger the nuclear activity. In order to examine this, it is necessary to select a control sample of non-active galaxies, matched to the active ones by the properties of the host galaxies, such as distance and stellar mass. We present here the results of the search for such a control sample.

Keywords. galaxies: active, galaxies: interactions; quasars

1. Introduction

The QSO 2 sample we used is a subset of that of Reyes *et al.* (2008), selected according to their spectra in the Sloan Digital Sky Survey (SDSS) for being luminous but sufficiently nearby ($z < 0.3$) for resolving the morphology of their host galaxies, as done previously in Storchi-Bergmann *et al.* (2018). The small sample of Storchi-Bergmann *et al.* (2018) indicated an excess of interacting galaxies. Our goal is to investigate the incidence of companions in a larger, statistically significant sample.

To achieve this objective, we needed to define a control sample. The first strategy to build the control sample was to use SDSS images to match the continuum luminosity of the QSOs with that of non-active galaxies at similar distances. The goal was to find a continuum band that was free of emission lines in the QSOs, so that we could select a control based on the luminosity of that particular band.

The second strategy was to define the control sample based on the stellar mass of the galaxy and its redshift. For this we needed to derive the stellar mass of the QSO host galaxies, which we did through synthesis of their stellar populations. As the stellar continuum flux is weak in the QSO spectra, in order to have enough signal-to-noise ratio in the continuum we separated our sample in 10 redshift bins, with 43 or 44 QSOs each. We then obtained the median spectra of the QSOs in each bin, after correcting the individual

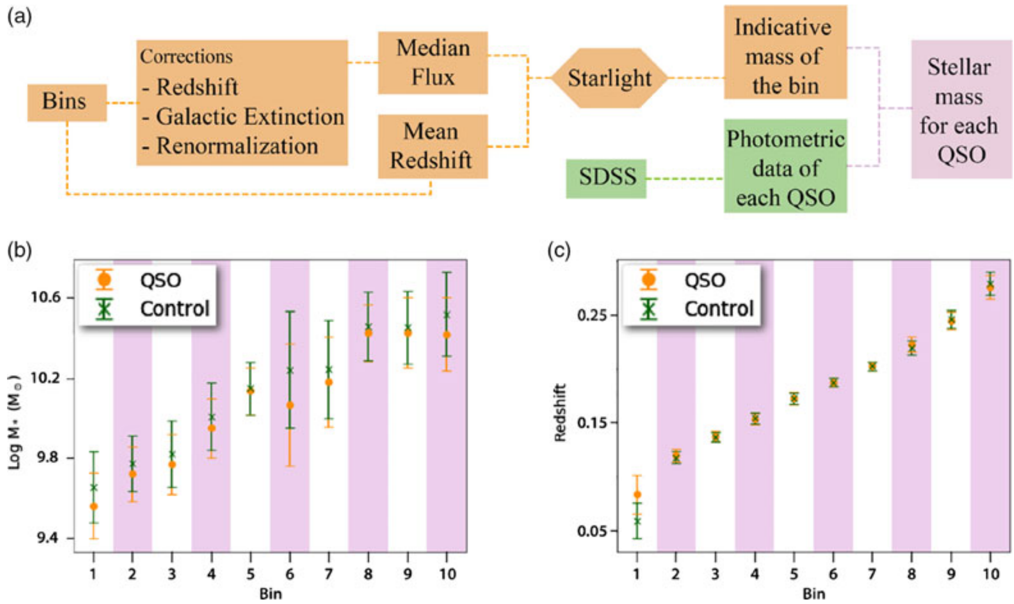

Figure 1. (a) Summary of the process to obtain the stellar mass of the QSOs. The bottom panels show the comparison between the QSOs (orange) and possible control galaxies (green) in terms of (b) mean stellar masses and (c) mean redshifts. The error bars are the standard deviation of the mean.

spectra for redshift and galactic extinction and renormalizing them. We were able to obtain the corresponding stellar masses for each bin from stellar population synthesis of the continuum spectrum using the program STARLIGHT (Cid Fernandes *et al.* 2014; Mateus *et al.* 2006). Then, we calculated the approximate mass for all QSOs using the indicative mass for each bin and photometric data for each QSO. Figure 1a shows a diagram summarizing this process.

2. Results

When inspecting the spectra of the 436 QSOs, we noticed that the majority did not have any SDSS band (u, g, r, i, z) free from emission lines. None of the spectra possess a full coverage of the u-band, and only a few extend to the end of z-band, thus, only the bands g, r, and i could be used. For the majority of the objects, these bands were contaminated by the emission lines: [O III]λ5007, [O II]λ3727, [N III]λ3868, Hα, [O I]λ6300, [N II]λ6583 and [S II]$\lambda 6716 + \lambda 6731$. Therefore, we were unable to select a control sample via the continuum luminosity in the SDSS image bands.

Our next strategy was to match the control galaxies to each QSO via stellar masses. After obtaining an estimate for the stellar mass of each QSO we calculated the mean and standard deviation of the stellar masses for each bin. We thus selected 150 control galaxies that matched the redshift range and with stellar masses within two standard deviations of the mean value. Figure 1b shows the mean stellar mass of each bin for the QSOs as compared to the mean stellar mass of the 150 possible control galaxies. Figure 1c compares the mean redshifts.

We have now shown that we are able to create an appropriate control sample. The next step in our program is to select the best galaxies among the 150 of each bin to be the controls for each QSO of our sample, according to the stellar mass and redshift.

https://doi.org/10.1017/S1743921320002094 Published online by Cambridge University Press

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