In the Neighbourhood of Tame Monsters I

A study of galaxies near low-redshift quasars.

Beatriz Villarroel, Nils Bergvall and Michael J. Way

UPPSALA UNIVERSITET

Unsolved problems

How did the quasars form

- Via mergers? 50% of quasar host galaxies show signs of interaction (Canalizo & Stockton 1997).
- Via monolithic collapse?
- Via accretion on primordial black holes (Haiman & Loeb 2001)?
- Via...?

Could quasars trigger or quench star formation in nearby galaxies?
E.g. AGN feedback models (e.g. Tabor & Binney 1993; Hopkins 2006)

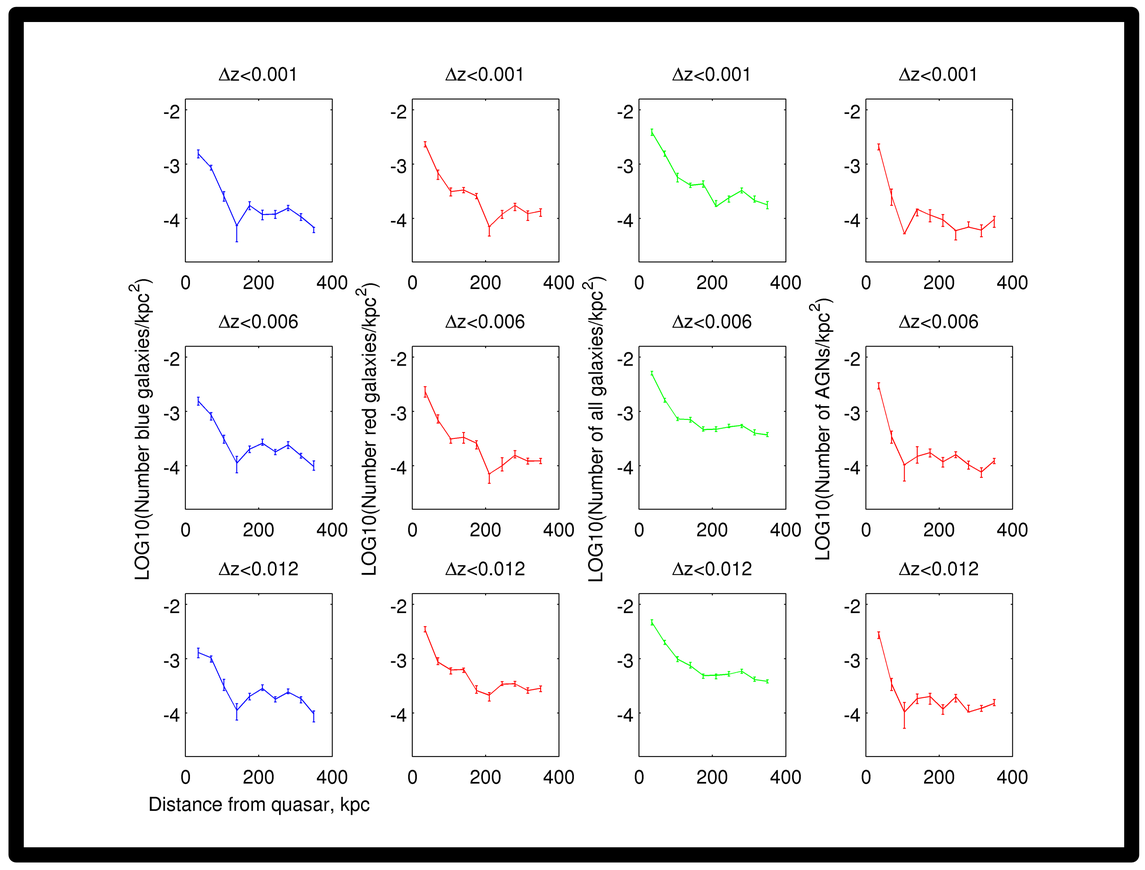

Fig. 3. The surface densities of the neighbour galaxies around the quasar have been calculated as a function of distance from the quasar. Left panel shows blue (U-R<2.2) non-AGN galaxies, second panel shows red galaxies (U-R>2.2) third all non-AGN galaxies, the right panel shows the AGN. Three redshift difference cuts between quasar and galaxy, |Δz|<0.001, |Δz|<0.006 and |Δz|<0.012 have been used.

Sample

We want to understand quasar formation and how quasars influence surrounding galaxies. We therefore study the properties of the close neighbourhood of quasars. We use 305 quasar-galaxy pairs with spectroscopic redshifts at $0.03 < z < 0.2$ from the Sloan Digital Sky Survey (SDSS). The objects in the pairs are situated within a projected distance of 350 kpc and $|\Delta z| < 0.012$. Figure 1 shows our sample. Since our sample is non-volume limited, we will use colors when analyzing.

Since we want to compare different types of neighbour galaxies, we first separate the narrow-line AGN from the other galaxies using the BPT criterion (Baldwin et al. 1981) as modified by Kauffmann (2003), see figure 2. To separate the broad-line AGN, we use $\sigma(H\alpha) > 15$ Å. Following the color classification by Strateva (2002), we define blue galaxies as those with u-r < 2.2 and others as red galaxies. For AGN, blue non-AGN, red non-AGN and all non-AGN neighbour galaxies, we calculate the surface densities as function of distance from the quasars, see figure 3.

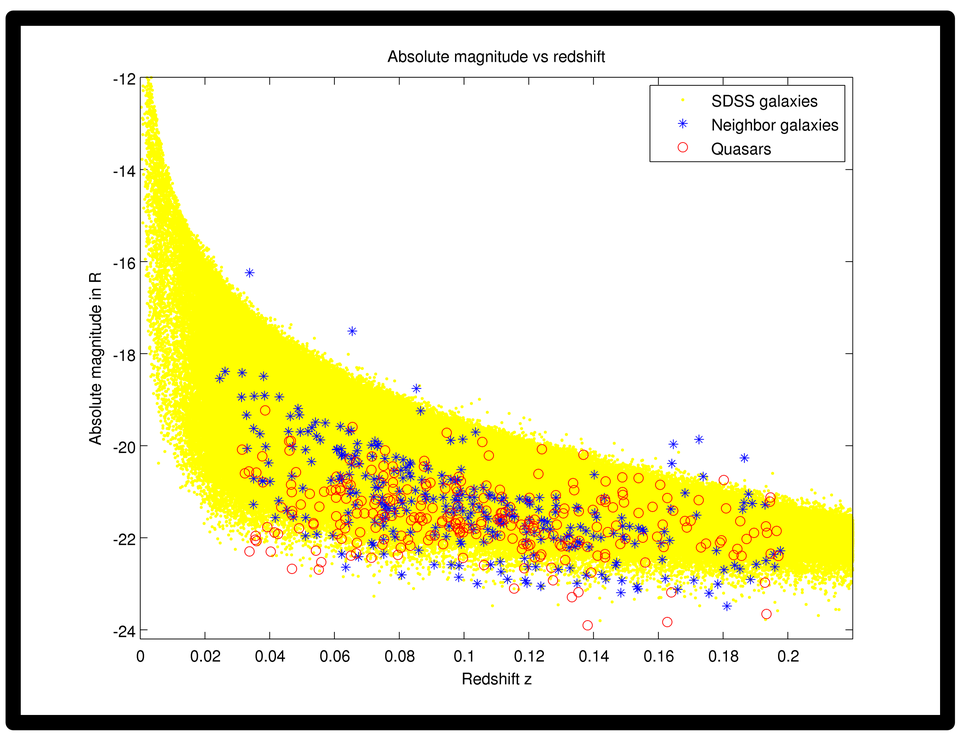

Fig. 1. A non-volume limited sample. Our quasars are represented by circles. The companion galaxies are marked with stars. The sea of dots represents all the SDSS galaxies in the database.

Methods

We apply k-corrections on apparent magnitudes after correction for galactic extinction. We correct the Balmer lines for underlying stellar absorption. All spectral lines are extinction corrected according to Whitford (1958). We finally apply inclination-dependent dust extinction corrections on the colors (Cho & Park 2001).

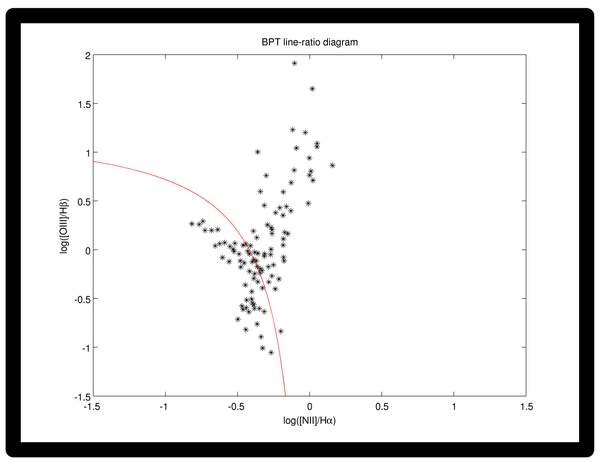

Fig.2. Separation of AGN using the BPT-diagram. The division line separates pure star-forming galaxies from AGN. Galaxies above the line are AGN.

Results

- There is an increase in the surface density of galaxies near quasars. Comparison to sample of field galaxies within same luminosity range shows that the clustering is stronger for quasar-galaxy pairs than for field-galaxy pairs.
- The number of galaxies is little affected by the $|\Delta z|$ cut for the quasar-galaxy sample, suggesting strong clustering.
- Could this be a support for a merger-driven scenario behind quasar formation? More studies needed!!