Co-Evolution of Central Black Holes and Galaxies
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AGN and Galaxy Clustering at z = 0.3 − 3.0 using the Japanese Virtual Observatory

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Abstract. We present the result of the projected cross correlation analysis of the AGNs and galaxies at redshifts from 0.3 to 3.0. It has been believed that the origin of AGN activity is accretion of matters into a massive black hole at the center of a galaxy (e.g. Lynden-Bell(1969)). To explain the activity of the AGNs, a large fraction of matters in the galaxy must be delivered to the inner region on a short timescale (Hopkins *et al.*(2008)). One possible mechanism for causing rapid gas inflows into the central region is a major galaxy merger between gas-rich galaxies (e.g. Kauffmann and Haehnelt (2000)). If this is the case, AGNs are expected to be found in an environment with higher galaxy density than that of typical galaxies. We investigated environments of ~ 750 AGNs, which was about ten times larger sample than those of previous observations, and found significant excess of galaxies around the AGNs at redshift range of 0.3 to 1.8. We used the Japanese Virtual Observatory (JVO) to obtain the Subaru Suprime-Cam images and UKIDSS data around known AGNs. The dataset accessed through the JVO are: Catalog of Quasars and Active Galactic Nuclei by Veron-Cetty *et al.*(2006), SDSS DR-5 Quasar Catalog by Schneider *et al.*(2007), Subaru Suprime-Cam Reduced Image Archive of JVO, and UKIDSS DR2 catalog by Warren *et al.*(2007). We divided all the AGN samples into four redshift groups, $z = 0.3$–0.8, 0.8–1.5, 1.5–1.8, and 1.8–3.0. For each redshift group, the dataset was further divided into a dimmer group ($M_V \geqslant -25$) and a brighter group ($M_V < -25$). We found that the correlation length of the high redshift bright sample ($z = 1.5$–1.8) was larger than that of the low redshift dim sample ($z = 0.3$–0.8). We also found that the correlation length was larger for the dim group at redshift range 0.8–1.5. These results can be explained by considering the downsizing of mass assembly. More details can be found in Shirasaki *et al.* (2009). Our result implies that the Japanese Virtual Observatory can be a powerful tool to investigate the co-evolution of central black holes and galaxies at the intermediate redshift universe.

Keywords. large-scale structure of universe, quasars: general, galaxies: evolution, galaxies: formation, astronomical data bases: miscellaneous

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