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Study on the environment around QSOs with redshift of 1–3 using the JVO System

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Virtual Observatory (VO) is an emerging astronomical infrastructure for sharing the astronomical data set in the world. National Astronomical Observatory of Japan (NAOJ) started its VO project (Japanese Virtual Observatory – JVO) in 2002, and developed JVO portal prototypes. We have carried out several science use cases, such as cosmic string searches and QSO environment studies, by using the prototype system to examine the functionality of the system. This paper describes a preliminary result of the latter science use case.

QSOs trace the most massive structures, so they can be used as a probe of clusters of galaxies. Since a survey using the QSOs as a lighthouse is not biased by galaxy types, it provides averaged feature of galaxy structure than that conducted by a survey that utilizes a narrow band filter to pick up an emission line for a specific redshift. In addition, it is also possible to explore the redshift desert around $z = 1.5 - 3.0$ by taking multi-color images between optical and near-infrared region.

We have constructed databases of QSOs and of Subaru SuprimeCam, and put a SkyNode interface on them. SkyNode is a VO standard data access interface based on SQL. JVO portal can federate the distributed SkyNode services, so it is possible to execute queries which associate the two different databases.

Using the JVO portal, we searched for SuprimeCam images which contains catalogued QSOs, then found 700 QSOs were observered by the SuprimCam with at least three filters and total exposure of longer than 1000 sec.

From these images, we created catalogues of detected objects around QSOs, estimated redshifts, and calculated a correlation between a QSO and the objects. We analyzed 100 out of the 700 QSOs. We calculated spatial QSO-Galaxy cross-correlation amplitude $B_{\rm QG}$ for each redshift interval. The result is: $\rm B_{QG} = 53.6 \pm 13.3$, 122.2 ± 29.3, 164.0 ± 80.9, 185.8 ± 108.2, and 538.5 ± 1072.1 for redshift ranges of, respectively, $z = 0.5 - 1.0$, $1.0 - 1.5$, $1.5 - 2.0$, $2.0 - 3.0$, and $3.0 - 4.0$, respectively.

Although the result still has large statistical errors, there can be seen a marginal clustering around QSOs. We expect that this study will be improved by addition of available data in the VO and by follow-up observations in the near-infrared bands.