

Environment Study of AGNs at z = 0.3 to 3.0 using the Japanese Virtual Observatory

Y. Shirasaki, M. Ohishi, Y. Mizumoto, T. Takata, Y. Komiya (NAOJ). M. Tanaka (University of Tsukuba), N. Yasuda (University of Tokyo, ICRR) 💒

submitted to PASJ (arXiv:0907.5380)

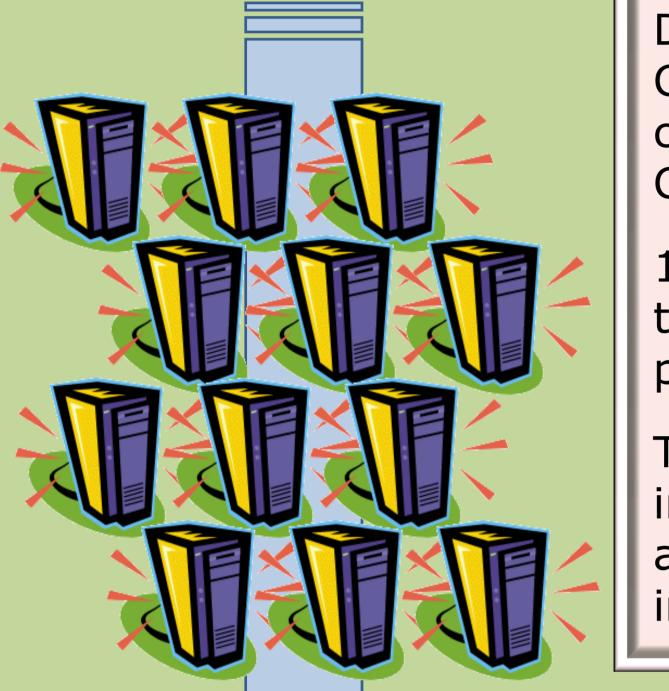
Abstract:

We present a science use case of Virtual Observatory, which is actually achieved to examine environment of AGN up to redshift of 3.0. We used the Japanese Virtual Observatory (JVO) to obtain the Subaru Suprime-Cam images around known AGNs. According to the hierarchical galaxy formation model, AGNs are expected to be found in environment of higher galaxy density than that of typical galaxies. The current observations, however, indicate that AGNs do not reside in particularly high density environment. We investigated $\sim 1,000$ AGNs, which is about ten times larger samples than previous studies covering redshifts larger than 0.6. We successfully found significant excess of galaxies around AGNs at redshifts of 0.3 through 1.8.

If this work was done in a classical manner, that is, raw data were retrieved from the archive through a web interface in an interactive way and the data were reduced in a local poor machine, it might have taken several years to finish it. Since the Virtual Observatory system is accessible through the standard interfaces, it would be easy to query and retrieve observed data in an automatic way. We have constructed a pipeline for retrieving the data and calculating the galaxy number density around a given coordinate. This procedure was executed in parallel on ~ 10 quad core PCs, and it took only one day for obtaining the final result.

Our result implies that the Virtual Observatory provides astronomers with a powerful tool to conduct a data-incentive astronomical research.

Subaru Data Archive (raw)



Step 0 (Admin) Parallel processing of large amount of data

Data reduction of all the Suprime-Cam data on the JVO grid computing system (12 servers, 48 CPU cores)

10 TB of RAW data are reduced through the JVO web interface. The processing time is ~ 10 days.

The metadata of the processed images are registered to a database and exposed through the VO interface.

Step 1

Multiple database query

Suprime-Cam images and UKIDSS catalog data are searched for around known AGNs.

The following JVO Query Language (JVOQL) is an example to execute a coordinate join between an AGN catalog table and a Suprime-Cam metadata table:



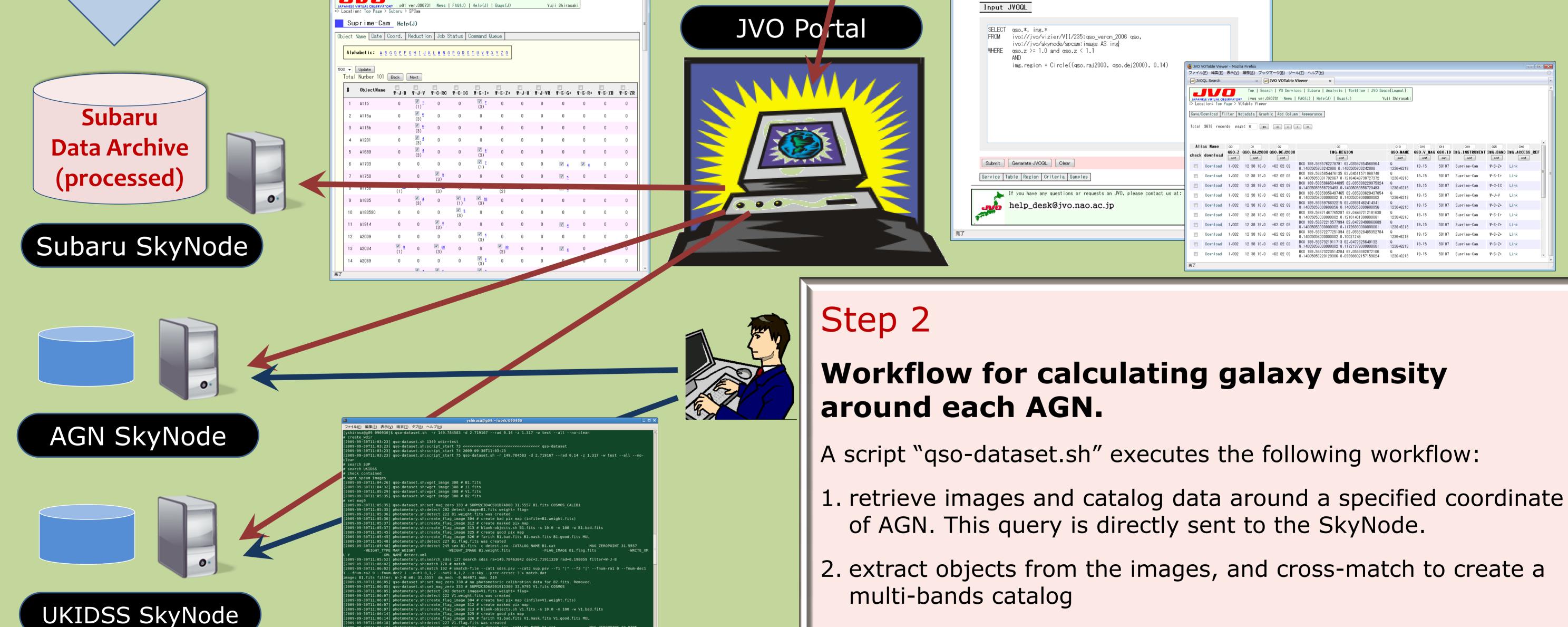
AND

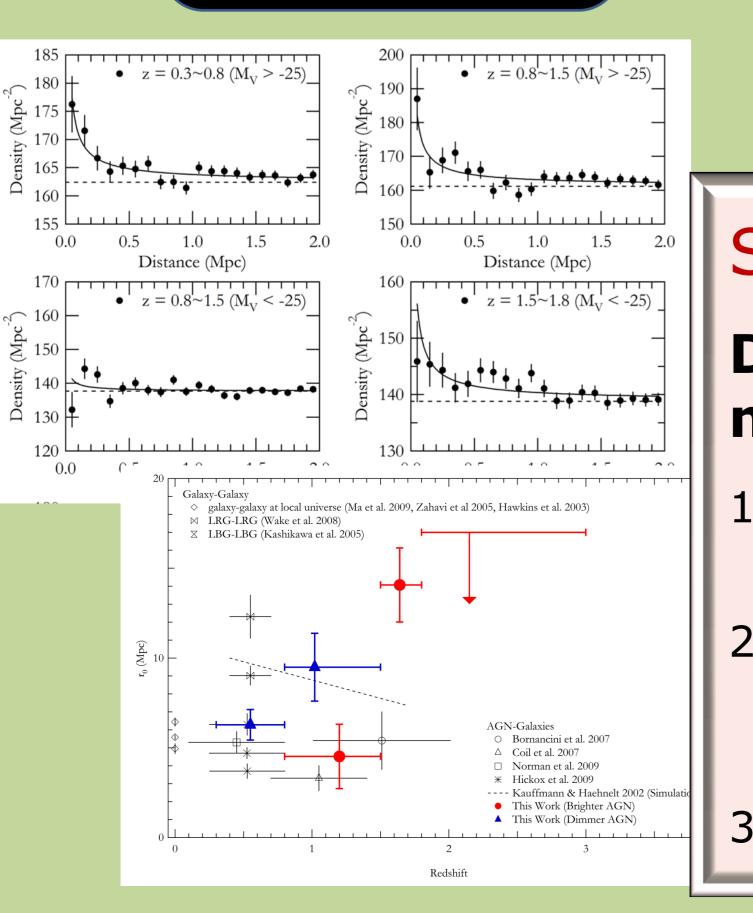
qso. *, img. * ivo://jvo/vizier/VII/235:qso_veron_2006 qso ivo://jvo/skynode/spcam:image AS img qso. $z \ge 1.0$ and qso. z < 1.1

img.region = Circle((qso.raj2000, qso.dej2000) 0.14)

months being

検索





[2009-09-30T11:06:29] photometory.sh:search_sdss 127 search sdss ra=149.78453284 dec=2.71909668 rad=0.19804 filter=W-J-V
[2009-09-30T11:06:38] photometory.sh:match 178 # match
[2009-09-30T11:06:38] photometory.sh:match 192 # xmatch-filecat1 sdss.psvcat2 sup.psvf1 " "f2 " "fnum-ra1 0fnum-dec1 1
2 0fnum-dec2 1out1 0,1,2out2 0,1,2x-skyprec-arcsec 3 > match.dat
image: V1.fits filter: W-J-V m0: 33.9795 dm med: -1.55306 num: 804
[2009-09-30T11:06:40] qso-dataset.sh:set_mag_zero_333 # SUPM2C3D69E956E0000_33.7305_i1.fits_COSMOS
[2009-09-30T11:06:41] photometory.sh:detect 202 detect image=i1.fits weight= flag=
[2009-09-30T11:06:42] photometory.sh:detect 222 i1.weight.fits was created
<pre>[2009-09-30T11:06:42] photometory.sh:create_flag_image_304 # create bad pix map (infile=i1.weight.fits)</pre>
[2009-09-30T11:06:43] photometory.sh:create flag_image 312 # create masked pix map
[2009-09-30T11:06:43] photometory.sh:create_flag_image 313 # blank-objects.sh i1.fits -s 10.0 -m 100 -w i1.bad.fits
[2009-09-30T11:06:54] photometory.sh:create_flag_image 325 # create good pix map
[2009-09-30T11:06:54] photometory.sh:create_flag_image 326 # farith i1.bad.fits i1.mask.fits i1.good.fits MUL



1. Stack the galaxy density profiles around each AGN

2. Calculate correlation length between AGN and galaxies for each redshift and luminosity range.

3. Write a paper...

3. Calculate galaxy number density around the AGN position

This script is executed for every AGN found in the step 1:

qso-dataset.sh --ra <qso_ra> --dec <qso_dec> --rad <img_radius> -z <qso_z>

Conclusion

Combination of all the Subaru archival data and the data obtained by medium-sized survey telescopes has successfully revealed AGN environment at intermediate redshift range with higher statistical significance than ever achieved. The feature of the VO service that enables automated queries is crucial for conducting data-incentive astronomical studies in the 21st century.