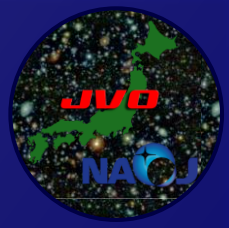


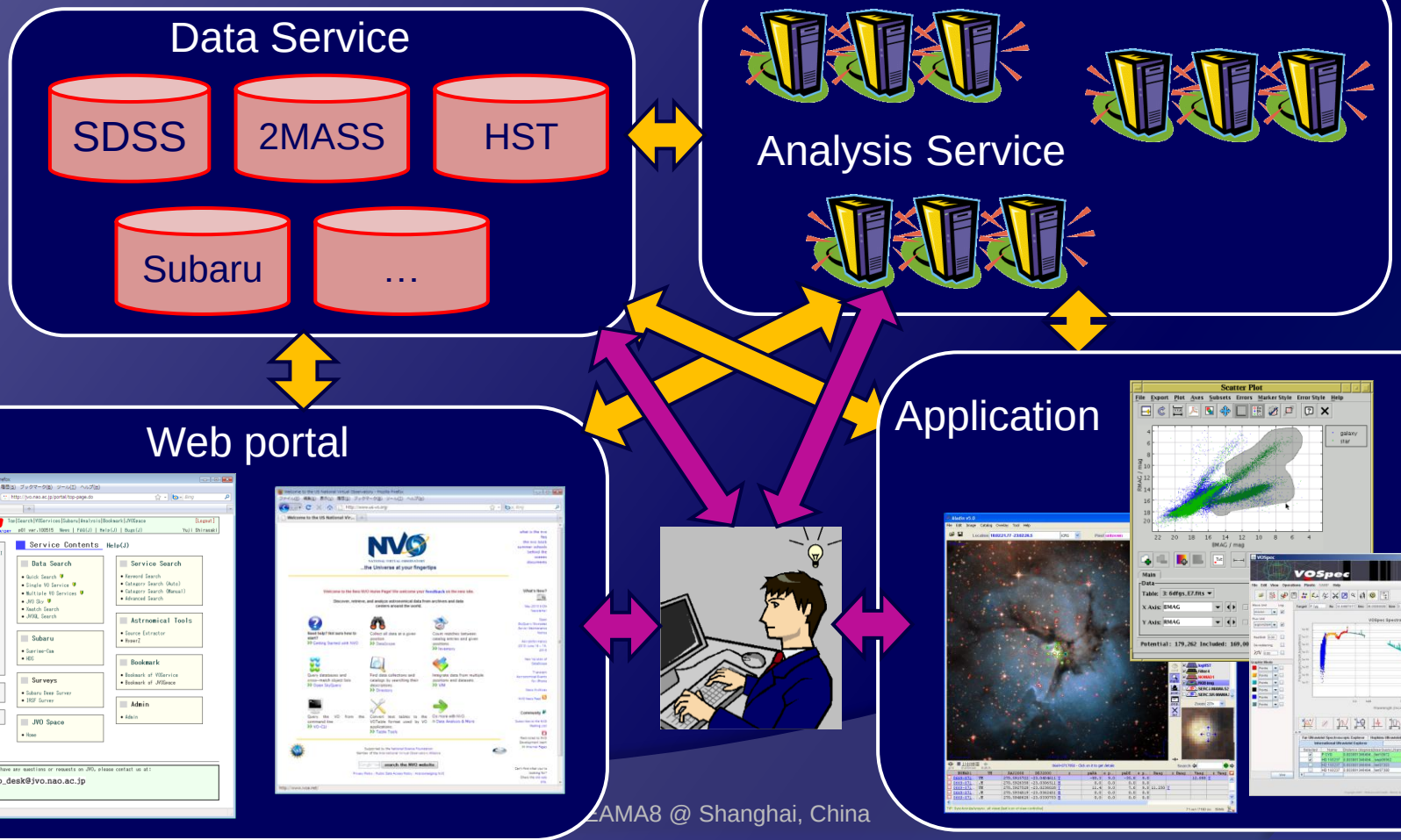
Study of QSO environment using the Japanese Virtual Observatory (JVO)

Yuji Shirasaki

National Astronomical Observatory of Japan

Virtual Observatory

- ✓ Infrastructure for efficient research environment
- ✓ International standard for data publication & access
- ✓ Sharing data worldwide, Maximize scientific return



VO Science

VO enables for a researcher

1) to find a small particular data subset from a large collection of catalog and observation data

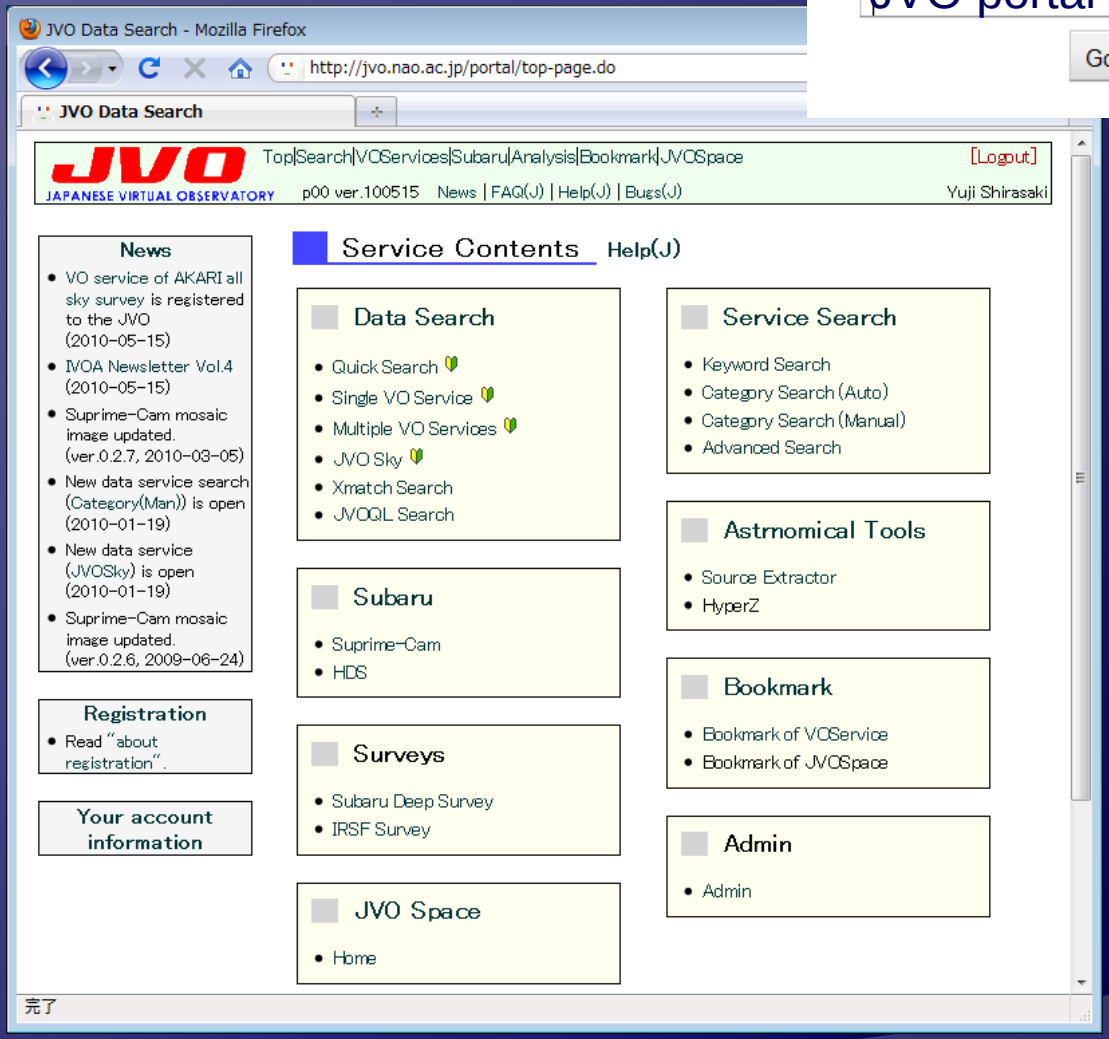
2) to retrieve and use large amount data in automated way

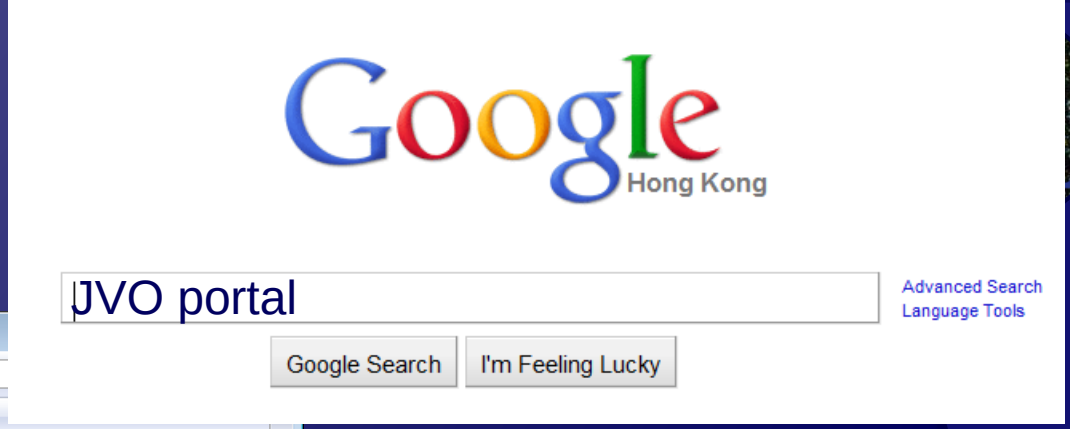
VO science papers

- ✓ http://www.euro-vo.org/pub/fc/papers.html 43 papers
- ✓ More and more VO science papers are appearing
- ✓ However, most of them are type-1 science case
- ✓ We demonstrated type-2 science case

JVO portal

http://jvo.nao.ac.jp/portal





- ✓ 10,551 Data Resources
  - 7,397 Catalogs
  - 208 Image Services
  - 84 Spectrum Services
  - …
- ✓ Reduced Subaru Data
  - Suprime-Cam
  - HDS

JVO Subaru archive

- ✓ Suprime-Cam data reduction system
  - Data archive and parallel computing system are connected with a dedicated network (128Gps)
  - The whole data can be processed in two weeks (using 48 CPU cores)
- ✓ VO access as well as a dedicated GUI
  - Data retrieval is “programmable”
  - Possible to retrieve cutout image for specified region
  - Don’t need to download all the data (~10TB), data can be retrieved on demand

GUI for Suprime-Cam archive

Suprime-Cam Help(J)

Object Name | Date | Coord. | Reduction | Job Status | Command Queue

Alphabetic: A B C D E F G H I J K L M N O P Q R S T U V W X Y Z O

20 Update

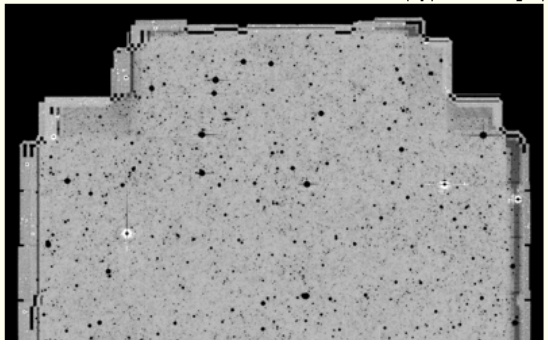
Total Number 71 Back Next

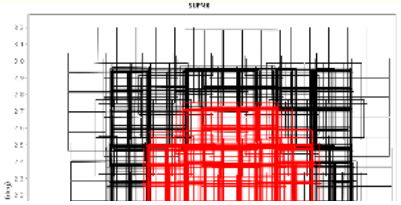
#	ObjectName	W-J-B	W-J-V	W-C-RC	W-C-IC	W-S-I+	W-S-Z+	W-J-U
21	CL1604_8	1 (1)	0	3 (1)	5 (1)	0	0	0
22	CLJ1226.9	0	6 (1)	0	0	0	0	0
23	CLJ1350.8	0	3 (1)	3 (1)	0	0	0	0
24	COSMOS	111 (1)	120 (1)	0	0			
25	COSMOS_CALIB1	1 (1)	1 (1)	0	0			
26	CVN1	0	8 (1)	0	18 (1)			
27	CVN1_F	0	8 (1)	0	18 (1)			
28	CVN2	0	13 (1)	0	18 (1)			
29	CVN2_F	0	8 (1)	0	18 (1)			
30	CVn	0	0	0	0			
31	CVnE	0	0	0	0			
32	Cal Off	0	0	0	1			
33	Cal On	0	0	0	2			
34	CasA	0	0	5 (1)	0			
35	Cetus	0	5 (1)	0	0			
36	Chandra deep	0	4 (1)	3 (1)	8 (1)			
37	CIJ1226	6 (1)	0	0	0			
38	CIJ1415	6 (1)	0	0	0			
39	CL_1137_3000_I	0	0	0	0			
40	CL_1137_3000_Z	0	0	0	0			

Check All Uncheck All Register

Goto TOP

Mosaic frame: SUPM550826F900000 (field=0,type=coadd_all,subtype=all,totalExposureTime=28620[sec],totalNum





JVO Sky Help(J)

Object Name | Suprime-Cam/Subaru | HDS/Subaru | Suzaku

Coodirnate or ObjectName : Go (ra, dec)=(184.326, 12.899)=(12h17m18.21s, 12d53m54.82s)

OK

suzaku:9/9, hds:3/3, spcam:36/36, searchtime:40ms

suzaku

spcam

hds

"Early Science Result from the Japanese Virtual Observatory: AGN and Galaxy Clustering at z = 0.3 to 3.0"

Y.Shirasaki et al. 2010 submitted to PASJ (arXiv:0907.5380v2)

- ✓ Measurement of AGN-Galaxy cross-correlation
  - Fueling mechanism of AGN
  - Co-evolution of galaxy and black hole
  - Use all the data of Suprime-Cam archive (nobody have done !)
- ✓ Existing works
  - Redshift measurement → 3D cross-correlation
  - z < 0.6 : Good statistic using SDSS data
  - z > 0.6 : Relatively poor stat. (several tens).
    - Hard to increase statistics:
    - Statistic at small scale (~1Mpc) is extremely poor
    - Affected by Cosmic Variance
    - Biased to red galaxy in the spectroscopic target selection

Dataset

AGN samples

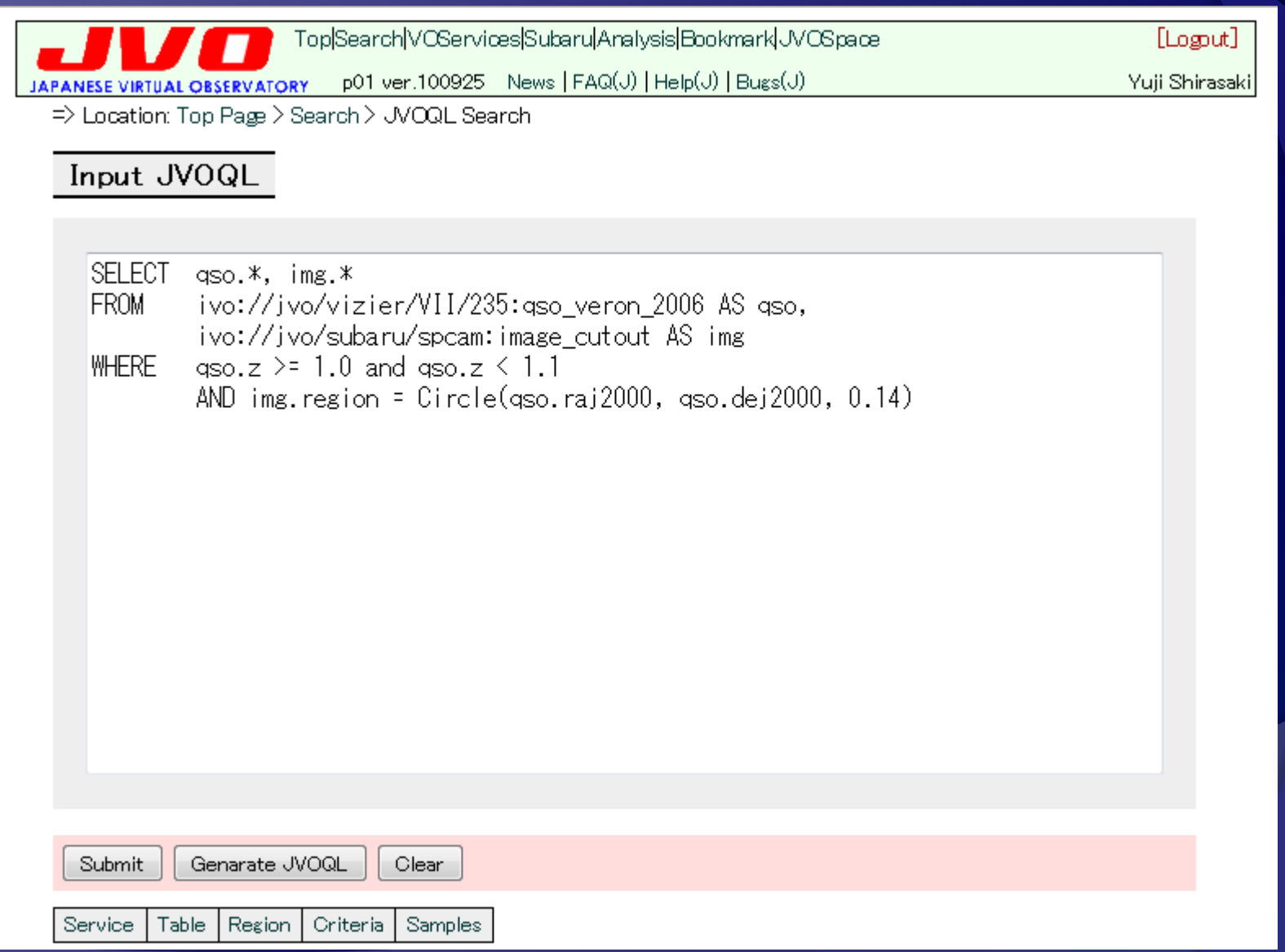
- ✓Veron QSO/AGN Catalog (12th ed)
- ✓SDSS DR-5 QSO Catalog (4th ed)

Galaxy samples

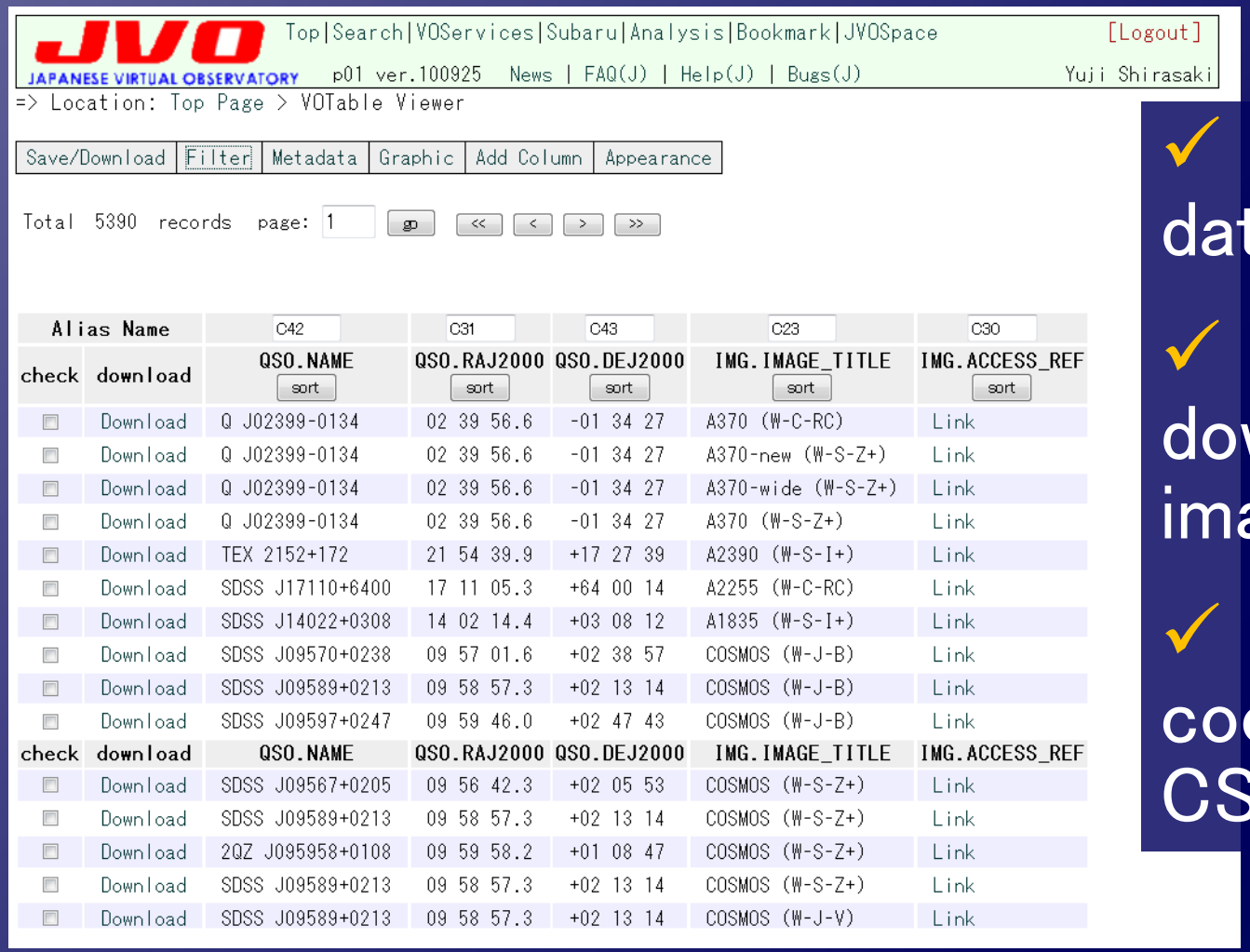
- ✓JVO Suprime-Cam Archive (B,V,R,I,i',z' band)
- ✓UKIDSS DR-2 Catalog (K band)
- ✓Deepest observation data was used for each AGN

Suprime-Cam	484
UKIDSS	1325
Total	1809

Search Suprime-Cam image around AGN



Search Result



JVO JAPANESE VIRTUAL OBSERVATORY

Top | Search | VOServices | Subaru | Analysis | Bookmark | JVOSpace [Logout]

p01 ver.100925 News | FAQ(J) | Help(J) | Bugs(J) Yuji Shirasaki

=> Location: Top Page > VOTable Viewer

Save/Download | Filter | Metadata | Graphic | Add Column | Appearance

Total 5390 records page: 1 go << < > >>

Alias Name		C42	C31	C43	C23	C30
check	download	QSO.NAME sort	QSO.RAJ2000 sort	QSO.DEJ2000 sort	IMG.IMAGE_TITLE sort	IMG.ACCESS_REF sort
☐	Download	Q J02399-0134	02 39 56.6	-01 34 27	A370 (W-C-RC)	Link
☐	Download	Q J02399-0134	02 39 56.6	-01 34 27	A370-new (W-S-Z+)	Link
☐	Download	Q J02399-0134	02 39 56.6	-01 34 27	A370-wide (W-S-Z+)	Link
☐	Download	Q J02399-0134	02 39 56.6	-01 34 27	A370 (W-S-Z+)	Link
☐	Download	TEX 2152+172	21 54 39.9	+17 27 39	A2390 (W-S-I+)	Link
☐	Download	SDSS J17110+6400	17 11 05.3	+64 00 14	A2255 (W-C-RC)	Link
☐	Download	SDSS J14022+0308	14 02 14.4	+03 08 12	A1835 (W-S-I+)	Link
☐	Download	SDSS J09570+0238	09 57 01.6	+02 38 57	COSMOS (W-J-B)	Link
☐	Download	SDSS J09589+0213	09 58 57.3	+02 13 14	COSMOS (W-J-B)	Link
☐	Download	SDSS J09597+0247	09 59 46.0	+02 47 43	COSMOS (W-J-B)	Link
check	download	QSO.NAME	QSO.RAJ2000	QSO.DEJ2000	IMG.IMAGE_TITLE	IMG.ACCESS_REF
☐	Download	SDSS J09567+0205	09 56 42.3	+02 05 53	COSMOS (W-S-Z+)	Link
☐	Download	SDSS J09589+0213	09 58 57.3	+02 13 14	COSMOS (W-S-Z+)	Link
☐	Download	2QZ J095958+0108	09 59 58.2	+01 08 47	COSMOS (W-S-Z+)	Link
☐	Download	SDSS J09589+0213	09 58 57.3	+02 13 14	COSMOS (W-S-Z+)	Link
☐	Download	SDSS J09589+0213	09 58 57.3	+02 13 14	COSMOS (W-J-V)	Link

- ✓ Only a part of data is displayed
- ✓ No way to download all the image at one
- ✓ Download coordinates in CSV format

- ✓ Create a list of AGN which is observed with Suprime-Cam

Automate using a script

- ✓ Download and analysis for ~12,000 AGNs
  - hard or impossible to do by hand.
- ✓ Make a script (e.g. shell script)
  - Create a catalog from retrieved image data …
  - Execute this script for each AGN
  - 12,000 AGNs → 40 parallels. Completed in one day.
- ✓ Access to VO
  - Used command line access tool.
  - Convenient to repeat the same query by changing the query condition.

AGN redshift & absolute mag

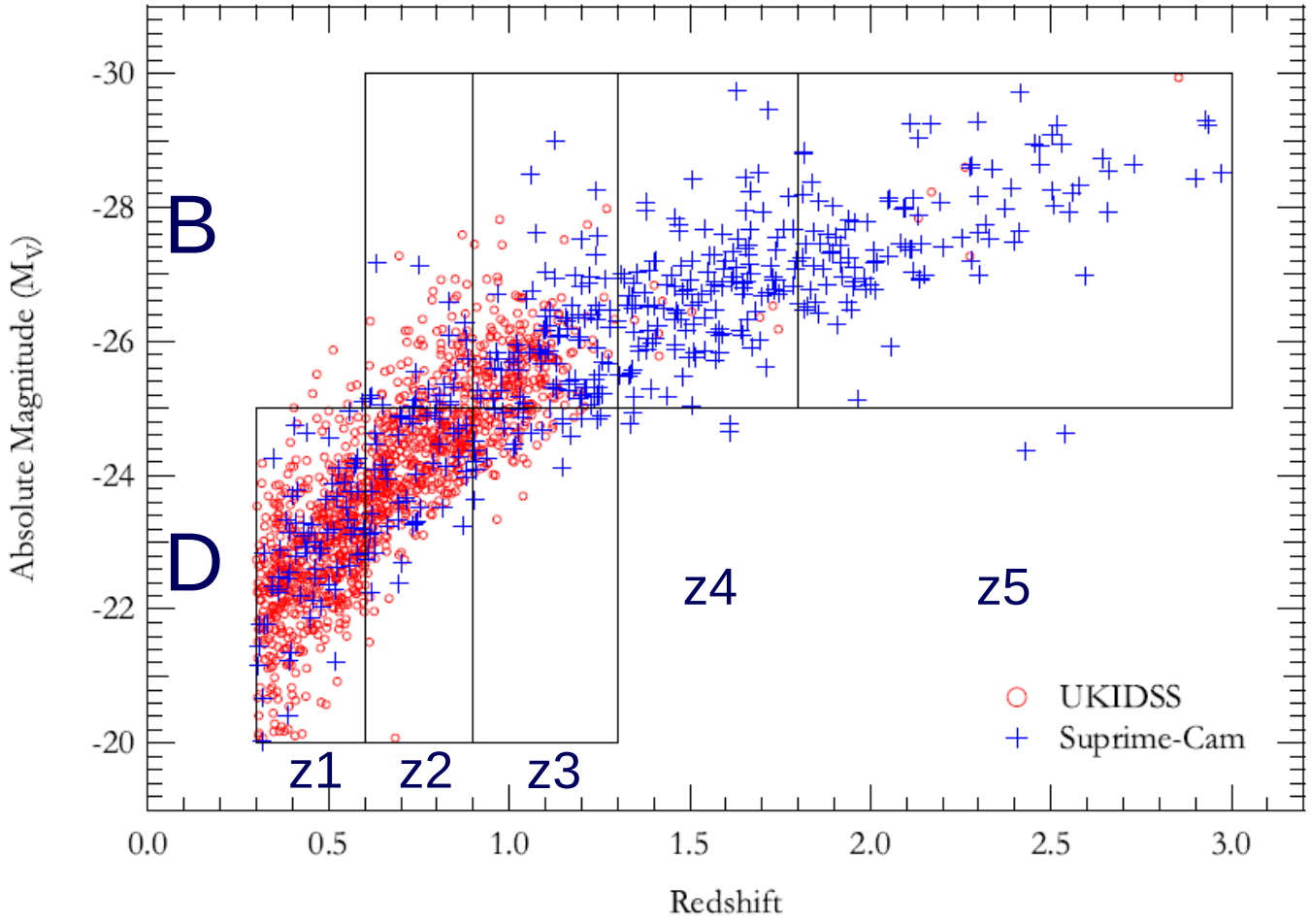


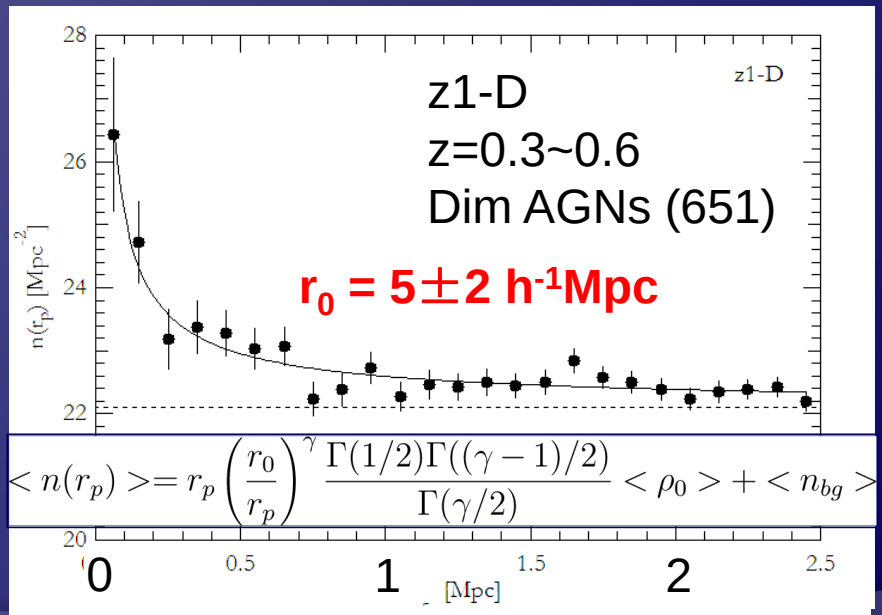
Fig. 5. K-corrected V band absolute magnitude vs redshift of the AGNs used in this work. Open circles represent AGN samples for which the galaxy sample is derived from the UKIDSS data, and the crosses represent AGN samples for which the galaxy sample is derived from the Suprime-Cam data.

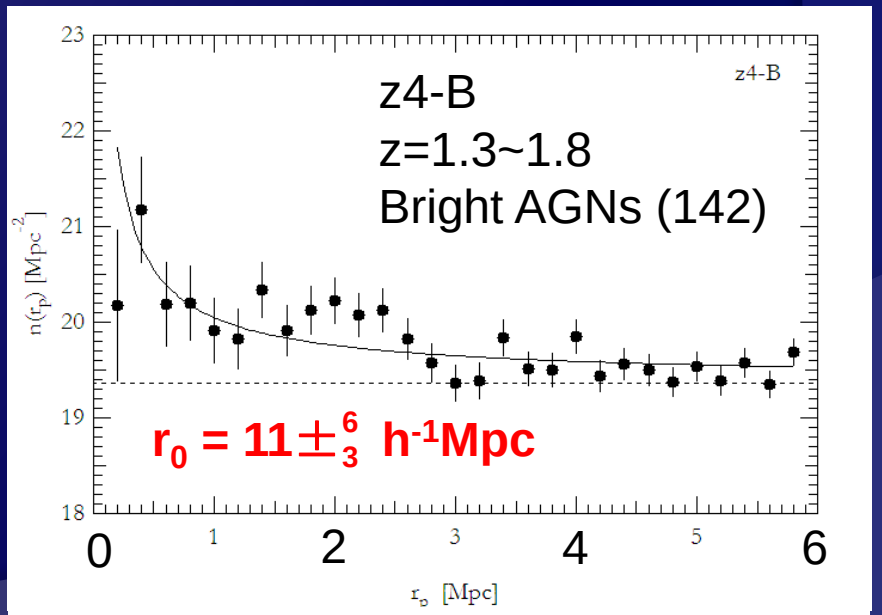
Analysis

- ✓ Projected correlation function : $\omega(r_p)$

$$\omega(r_p) = 2\int_0^\infty \xi(r_p,\pi)d\pi = r_p\left(\frac{r_0}{r_p}\right)^\gamma \frac{\Gamma(1/2)\Gamma((\gamma-1)/2)}{\Gamma(\gamma/2)}$$

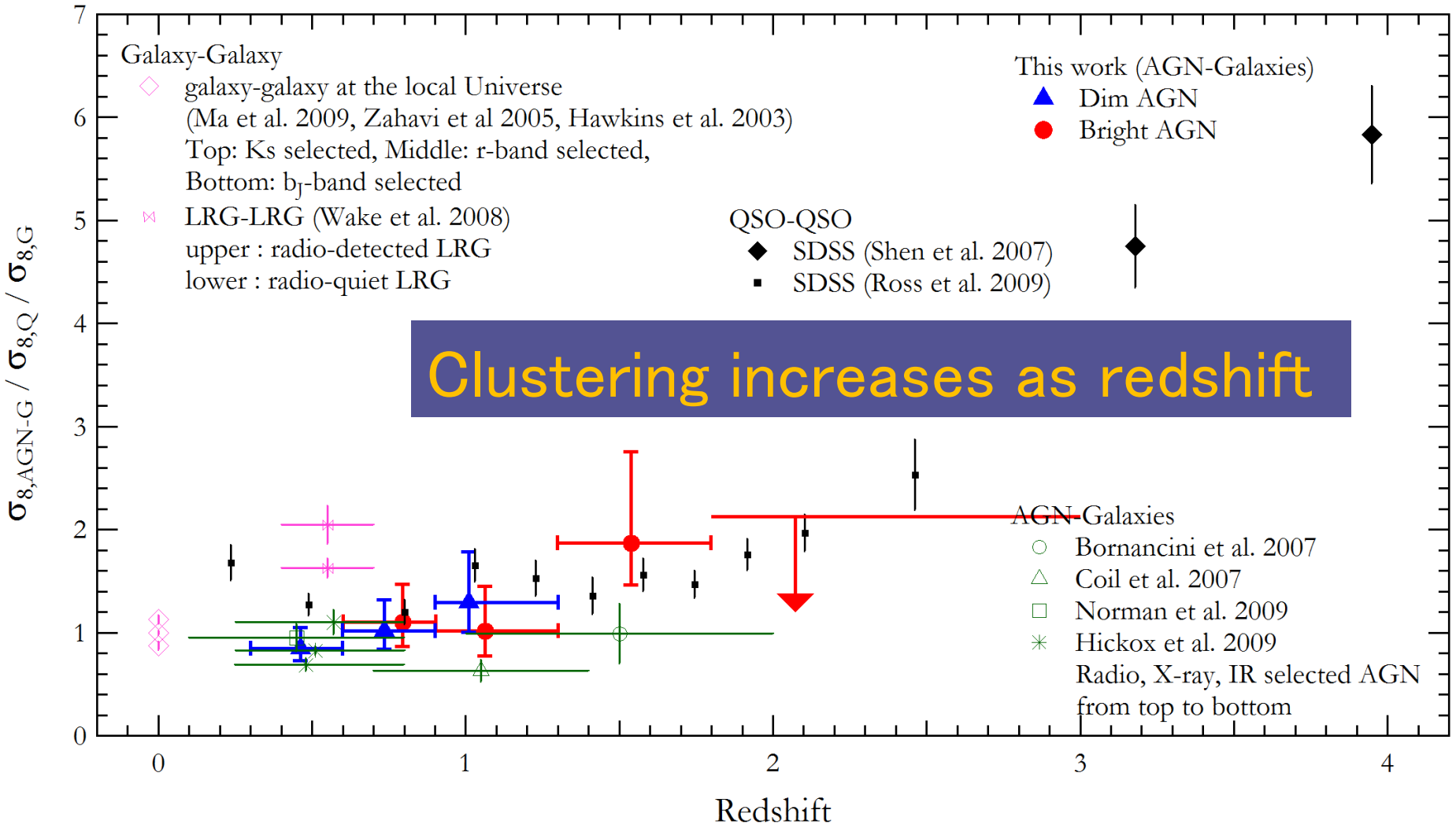
$$\xi(r) = (r_0/r)^\gamma. \qquad = \frac{1}{\rho_0}\int_{-\infty}^{\infty}(\rho(r)-\rho_0)d\pi = \frac{n(r_p)-n_{\rm bg}}{\rho_0}$$





Result

σ_8 : rms of correlation function at < 8 Mpc



Summary

- ✓ Complementary with existing study
  - Precise correlation function at small scale (~3 h^{-1}Mpc)
  - Free from cosmic variance
  - Sensitive to dim and blue star-forming galaxy
- ✓ Effectiveness of “reduced” Subaru data archive
  - Especially Suprime-Cam has high utility value; can be used in may other research fields
  - Make it possible to do a study not possible if begin from reduction of raw data
- ✓ Skill of writing a script for automation
  - GUI-based application is not helpful for utilizing large amount of data
  - JVO will provide command line access tools as well as on-line service accessible from the tool.