JVO システムと世界における Virtual Observatory 開発の現状

国立天文台　天文データセンター　白崎裕治

JVO 人員

- 白崎裕治 (助教)
  - JVO portal 機能の開発・運用
  - VOサービスの開発・運用
- Christopher Zapart (特任専門員)
  - FITS WebQL の開発
  - Gaia データビューアの開発
- 大石雅寿 (天文情報センター 特任教授)
  - アドバイザー
  - IVOA における JVO グループ代表者

Services provided by the JVO system

- **JVO Portal service**
  - Portal service for accessing VO services
- **VO data services**
  - VO interface for ALMA, Subaru, Nobeyama data.
- **Data service for major datasets with dedicated GUI**
  - ALMA
  - Subaru (Suprime-Cam, MOIRCS, HDS)
  - Nobeyama Legacy Survey
  - Gaia DR1, DR2 (ADC is an affiliate data center of Gaia)
- **FITS WebQL service**
  - FITS Viewer working on a Web browser

ADC computer system

Multi-wavelength Data Analysis System

    Servers   : FUJITSU PRIMERGY RX2530 M2 x48 (CPU Core 696, Total memory 9TB)
    Storage : FUJITSU ETERNUS DX100 S4 (Total 2.4PB, SAN)

Data Archive System

    Servers   : FUJITSU PRIMERGY etc x81 (CPU Core 1036, Total memory 8TB)
    Storage : FUJITSU ETERNUS DX100 S4 (Total 9PB, SAN)
              FUJITSU ETERNUS LT270 S2 (Total 3.4PB, tape)

Virtual Observatory System

    Servers   : FUJITSU PRIMERGY x13 (CPU Core 208, Total Memory 1.6TB)
    Storage : FUJITSU ETERNUS (Total 476 TB, SAN)
              Newtech SuprimacyIII (Total 500 TB, SAN) (purchased)

The other Systems

   …

Total CPU Core 2,200, Memory 21TB, Sotrage 12.8PB

Each system has its own purchased hardware not shown here.

How to reduce the cost of these facilities and operation service ?

Hardware

Characteristics of hardware

FUJITSU lease

Server
  CPU: Xeon Gold
  Core: 208
  Mem: 1.6TB
  Network: 10G

Storage
  476 TB HDD
  1.6TBx10 SSD

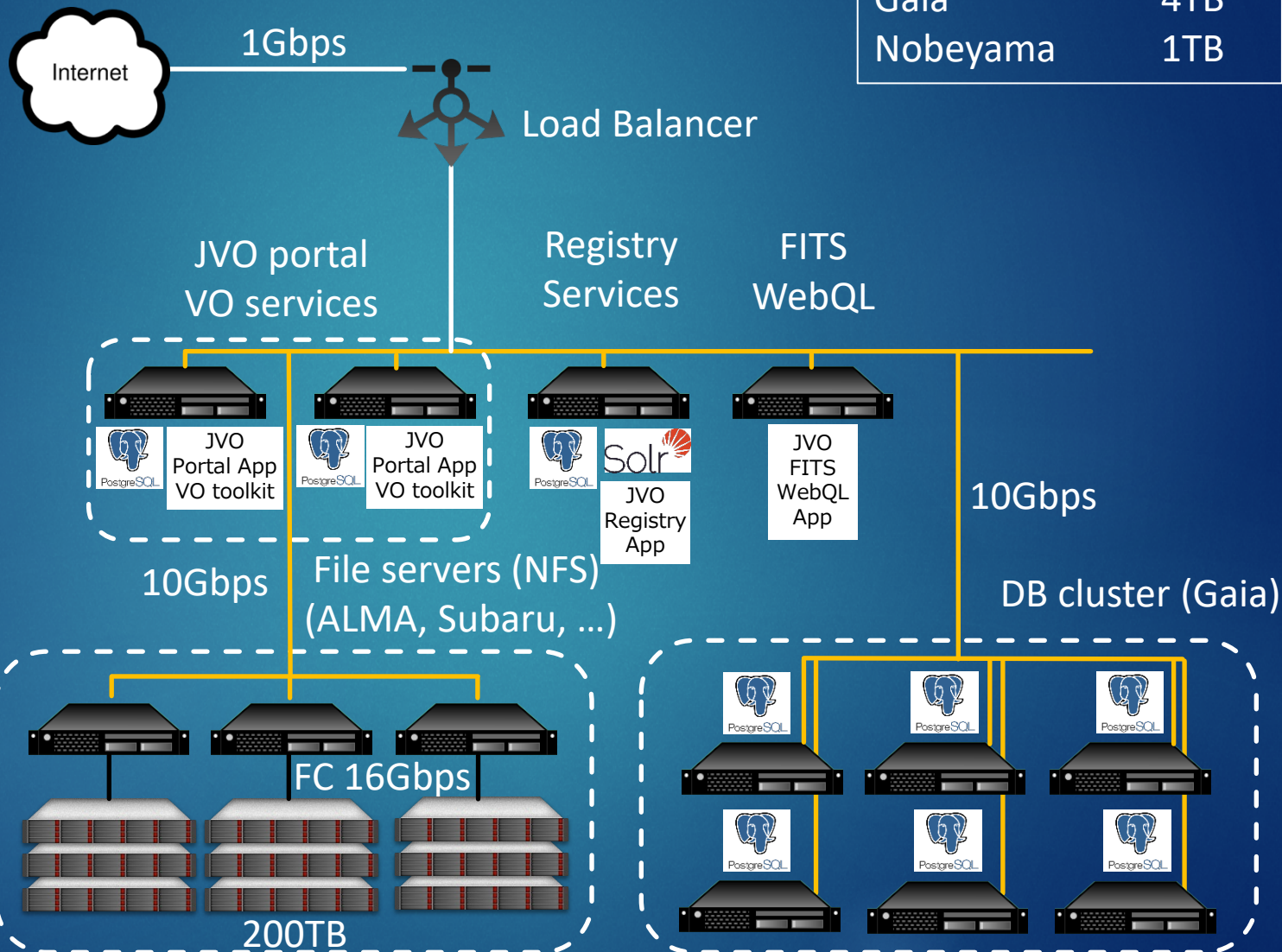Switch
  Catalyst 10G

Purchased

Server
  various

Storage
  500 TB HDD

Switch
  LoadMaster

Storage usage :

ALMA	400TB
Subaru	70TB
Gaia	4TB
Nobeyama	1TB

Internet

1Gbps

Load Balancer

JVO portal
VO services

Registry
Services

FITS
WebQL

JVO
Portal App
VO toolkit

JVO
Portal App
VO toolkit

JVO
Registry
App

JVO
FITS
WebQL
App

PostgreSQL

Solr

10Gbps

10Gbps

File servers (NFS)
(ALMA, Subaru, …)

DB cluster (Gaia)

FC 16Gbps

200TB

ALMA FITS Archive

ALMA FITS Archive

Using the data for publication

The following statement should be included in the acknowledgment of papers using the ALMA datasets obtained from the JVO portal:

"This paper makes use of the following ALMA data: ADS/JAO.ALMA#<Project code>. ALMA is a partnership of ESO (representing its member states), NSF (USA) and NINS (Japan), together with NRC (Canada) , MOST and ASIAA (Taiwan), and KASI (Republic of Korea), in cooperation with the Republic of Chile. The Joint ALMA Observatory is operated by ESO, AUI/NRAO and NAOJ."

You can find the project code (e.g. 2011.0.01234.S) on the dataset info page where you download the data.

Please also include the following sentence on the title page as a footnote to the title or in the acknowledgment of the paper.

"[Part of] the data are retrieved from the JVO portal (http://jvo.nao.ac.jp/portal) operated by the NAOJ"

- 2019-02-07: FITS WebQL v3 will end at the end of March 2019.
- 2018-10-17: FITS WebQL v4 was released: New feature 'FITS Cube Slicer' is available.

Target Name	Simbad Name	Project Code	Coords	Frequency	Advanced	Download

Numbre of Projects found : 2245   Clear all the filters

#	Project Code ?	# of Data	Title ?	Category --	Last Upate
1	2018.A.00047.S	221	Shock-induced chemistry in the CSEs of late-type stars: a pilot study	Stars and stellar evolution	2019-07-24
2	2017.1.00886.L	474	100,000 Molecular Clouds Across the Main Sequence: GMCs as the Drivers of Galaxy Evolution	Galaxy evolution	2019-07-24
3	2017.1.01158.S	569	ACA Study on the Driving Mechanisms of Starburst and Main-Sequence Star Formation in Local Galaxies	Active galaxies	2019-07-24
4	2017.1.00226.S	254	The W43 complex: a case study for high-mass star formation	ISM and star formation	2019-07-24
5	2017.1.00161.L	180	ALCHEMI: the ALMA Comprehensive High-resolution Extragalactic Molecular Inventory	Galaxy evolution	2019-07-24
6	2017.1.01687.S	48	Characterizing the solar nebula analog MP Mus	Disks and planet formation	2019-07-24
7	2017.1.01500.S	49	The diffuse molecular component in the nuclear bulge of the Milky Way	ISM and star formation	2019-07-24
8	2018.1.01538.S	6	Testing the gravitationally stability toward the innermost accretion system in high mass star-formation	ISM and star formation	2019-07-23
9	2017.1.00716.S	154	A survey of prestellar, high-mass clump candidates: constraining models of high-mass star formation	ISM and star formation	2019-07-23
10	2017.1.00009.S	22	Oscillations and waves contributing to coronal heating on the Sun	Sun	2019-07-23
11	2016.1.00187.S	14	Magnetic Fields and High-Mass Star Formation	ISM and star formation	2019-07-22
12	2016.2.00014.S	123	ALMA Observations of the Most Massive Galaxy Clusters at z > 1	Cosmology	2019-07-22
13	2017.1.01355.L	566	ALMA-IMF: ALMA transforms our view of the origin of stellar masses	ISM and star formation	2019-07-22
14	2015.1.00196.S	83	Zooming in on the parsec-scale structure of CO gas at low metallicity and its relation to star formation	ISM and star formation	2019-07-22
15	2017.1.01545.S	96	The first molecular line inventory in hybrid disks	Disks and planet formation	2019-07-21
16	2017.1.00019.S	5	Outflow structure of the young protostar Lupus 3 MMS	ISM and star formation	2019-07-21
17	2017.1.01053.S	341	SMORES: Shocked Molecular Outflows across a Range of Environments Survey	ISM and star formation	2019-07-21
18	2017.1.00239.S	82	What sets CO excitation in clumpy, turbulent disk galaxies?	Active galaxies	2019-07-21
19	2017.1.00428.L	970	ALPINE: The ALMA Large Program to INvestigate CII at Early times	Galaxy evolution	2019-07-21
20	2016.1.01272.T	8	Impact of a global dust storm on Martian atmosphere (retry)	Solar system	2019-07-21
21	2017.1.01584.S	11	The SIze and Albedo of New Horizons Distant Kuiper Belt Target (15810) Arawn	Solar system	2019-07-21
22	2017.1.00975.S	31	Searching for the Smoking Gun of Magnetar-Powered Super-Luminous Supernovae	Stars and stellar evolution	2019-07-21
23	2016.1.00071.S	6	Revealing the importance of magnetic fields in the earliest stages of the formation of high-mass stars	ISM and star formation	2019-07-21
24	2017.1.00767.S	27	An Unbiased Search for High Velocity Winds in local (U)LIRGs using the 7m Array	Galaxy evolution	2019-07-21
25	2017.1.00571.S	19	Toward the Baryon Census of z~0.3 Galaxy Groups	Cosmology	2019-07-21
26	2017.1.01347.S	20	Science with ALMA and JWST: Tracing the Heating and Cooling in Star Forming Regions in Galaxies at Cosmic Noon	Active galaxies	2019-07-21
27	2017.1.00916.S	67	Outflows and infalling profiles in compact clumps: high-mass star formation in the Southern Outer Galaxy	ISM and star formation	2019-07-21
28	2017.1.00765.S	37	Large-scale infalling envelopes through cold gas tracers	ISM and star formation	2019-07-20
29	2017.1.00527.S	172	The molecular gas and resolved star-formation law in low-redshift SMGs	Active galaxies	2019-07-20

Process Stack

Search Stack   Download Stack

Process Name	Date	Process
jvoscope_20190724144312990_108_878	2019-07-24	complete

searching=0 finished=400 waiting=0 found=132 nodata=264 faile
finished

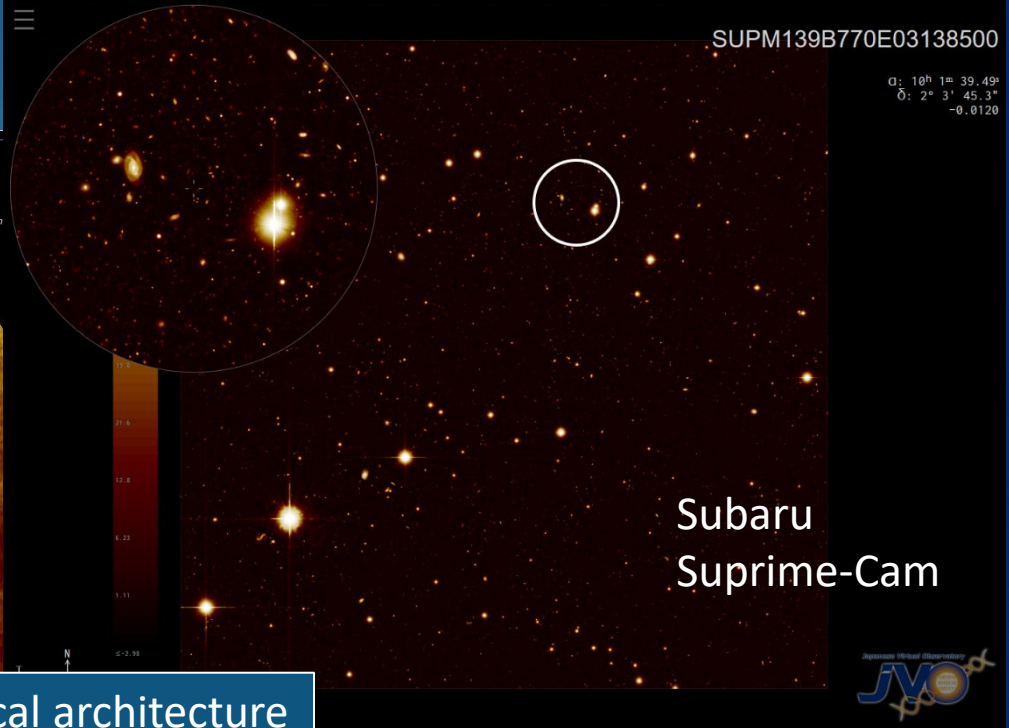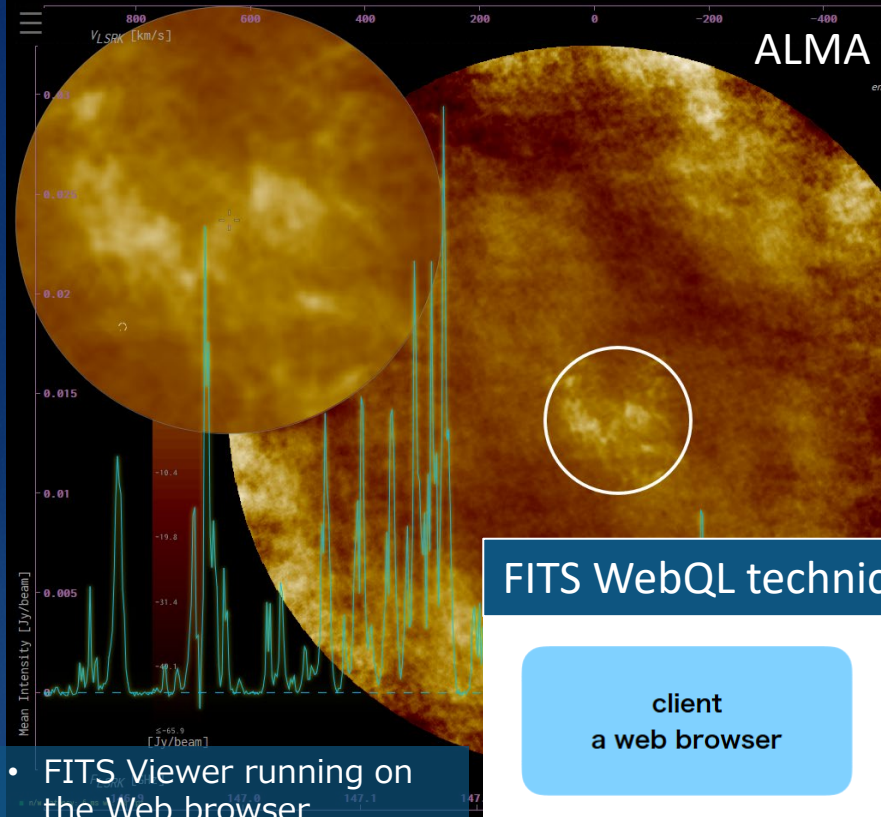| Summary	Summary	Summary	Summary	Summary	Summary
JVO portal VO search page version 2. Older version of JVO portal (version 1) is linked from here.	Download the reduced Subaru data. Suprime-Cam, MOIRCS, HDS.	Search, View, and Download the ALMA data cube in FITS format. SV data, Archive, WebQL demo.	Search, View, and Download the Nobeyama data cube in FITS format. FUGIN, COMING, StarFormation.	Gaia related source catalogs. Gaia DR1, Gaia DR1 TGAS, Gaia DR2	AKARI FIS image	Subaru Deep Survey Catalog	IRSF LMC/SMC/BMC Survey

NEWS

- 2018-10-17 FITS WebQLv4 (Beta) was released. New feature "FITS Cube slicer" is available.
- 2018-06-07 Gaia DR2 is now available at JVO portal.
- 2018-06-07 The data of Nobeyama 45-m Legacy projects was released.
- 2017-10-19 VO Search update: new VO search interface named JVOIndex and JVOExplorer are open to the public.
- 2017-09-05 JVO ALMA FITS archive update: the BETA version 3 (renamed FITSWebQL) of the interactive ALMA WebQL is now avaialble.
- 2017-06-26 JVO ALMA FITS archive update: Advanced Search GUI was implemented. You can search the data by specifying various criteria.
- 2017-06-26 JVO ALMA FITS archive update: Functionality for filtering the projects list by their science category was implemented.
- 2017-06-12 Subaru Suprim-Cam mosaic images were reprocessed with the most recent reduction pipeline for which mosaic success rate was improved. They are avaiable at: JVO Suprime-Cam mosaic image archive.
- 2017-03-13 JVO portal top page and the VO search GUI was updated.
- 2017-03-08 Subaru WebQL experimental version is available at data download page of JVO Suprime-Cam mosaic image archive. Try it with a sample image
- 2016-10-15 ALMA WebQL v2 was updated.
- 2016-10-15 Gaia source catalog is now availabe at JVO portal.
- 2016-04-10 Subaru Suprime-Cam Archive was updated. All the data were reprocessed with the most recent data reduction pipeline.
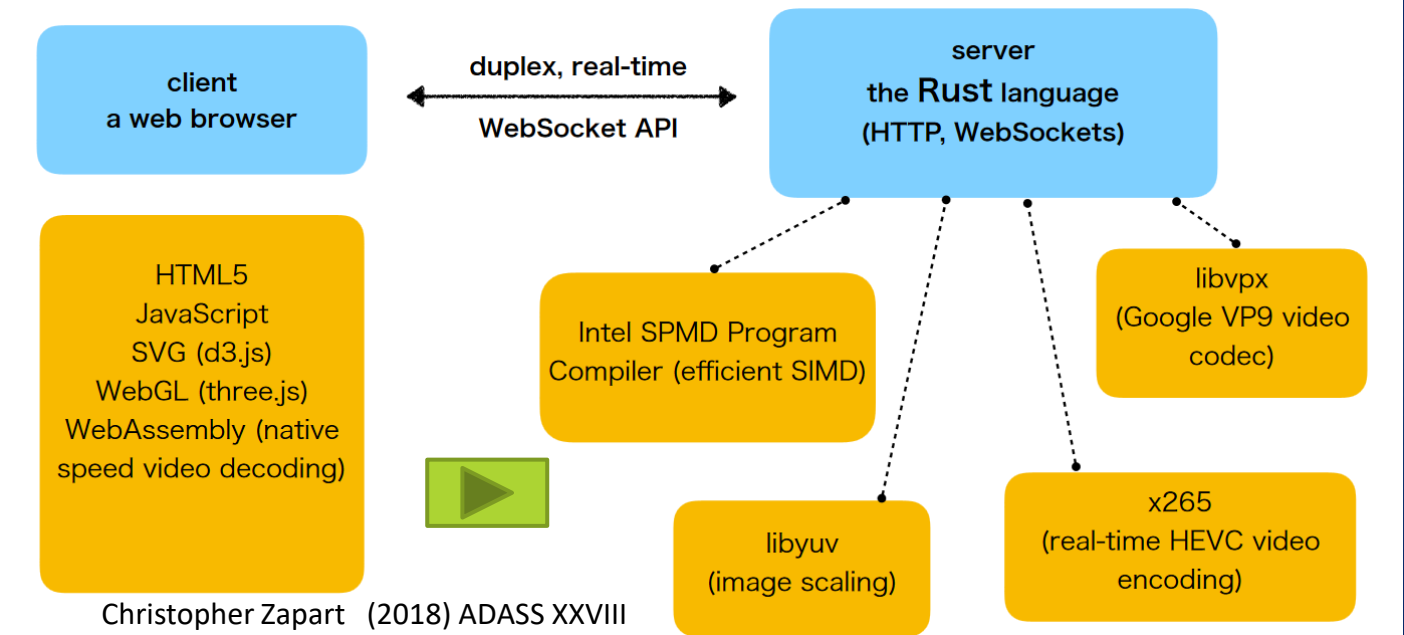
JVO Help Desk

help_desk@jvo.nao.ac.jp

FITS WebQL

ALMA

SUPM139B770E03138500

Subaru
Suprime-Cam

- FITS Viewer running on the Web browser
- No need to download FITS
- Pixel data are received from the server and they are rendered in the browser using JavaScript library.
- Enable to cut-out sub-image to reduced data size to download

FITS WebQL technical architecture

client
a web browser

duplex, real-time
WebSocket API

server
the Rust language
(HTTP, WebSockets)

HTML5
JavaScript
SVG (d3.js)
WebGL (three.js)
WebAssembly (native speed video decoding)

Intel SPMD Program Compiler (efficient SIMD)

libyuv
(image scaling)

x265
(real-time HEVC video encoding)

libvpx
(Google VP9 video codec)

Christopher Zapart   (2018) ADASS XXVIII

Distributed database

Gaia Source Catalog (DR2)

Description:

This table has an entry for every Gaia observed source as listed in the Main Database accumulating catalogue version from which the current release has been generated. Total number of records is 1,692,919,135.

It contains the basic source parameters, that is only final data (no epoch data) and no spectra (neither final nor epoch).

Please refer to the Gaia project page for Gaia itself.

Download:

- Gaia main source catalog : Gaia source catalog in gzipped CSV format.
- Gaia misc catalog : The other miscellaneous catalogs can be retrieved from this page.
- Gaia XMatch catalog : The crossmatches between the Gaia DR2 catalogue and several other catalogues can also be found at this page.

Acknowledgement Information:

- If you use public Gaia data in your paper, please take note of the guide on how to acknowledge and cite Gaia DR1/DR2.
- An acknowledgment of the usage of JVO portal, as described in the "How to acknowledge" page, would be appreciated.

Search result:

Previous query result may be found in the JVOSpace if you have logged in as a registered user and have executed a query.

Other resources:

Gaia DR1

Recomended browser:

Mozilla Firefox.

Chrome, Safari may work.

Hertzsprung-Russell diagram

To enable large query, distributed DB system was developed. The data are registered to the multiple DBs which are stored in different disk to achieve fast parallel I/O.

Currently Gaia source catalog and image metadata collected by VO Crawler from the various VO services are registered in this system.

Creating a plot for billions of data is a time-consuming process too.

We are now developing a Gaia data quick viewer which enables user to visualize the distribution of Gaia source parameters without downloading all the data.
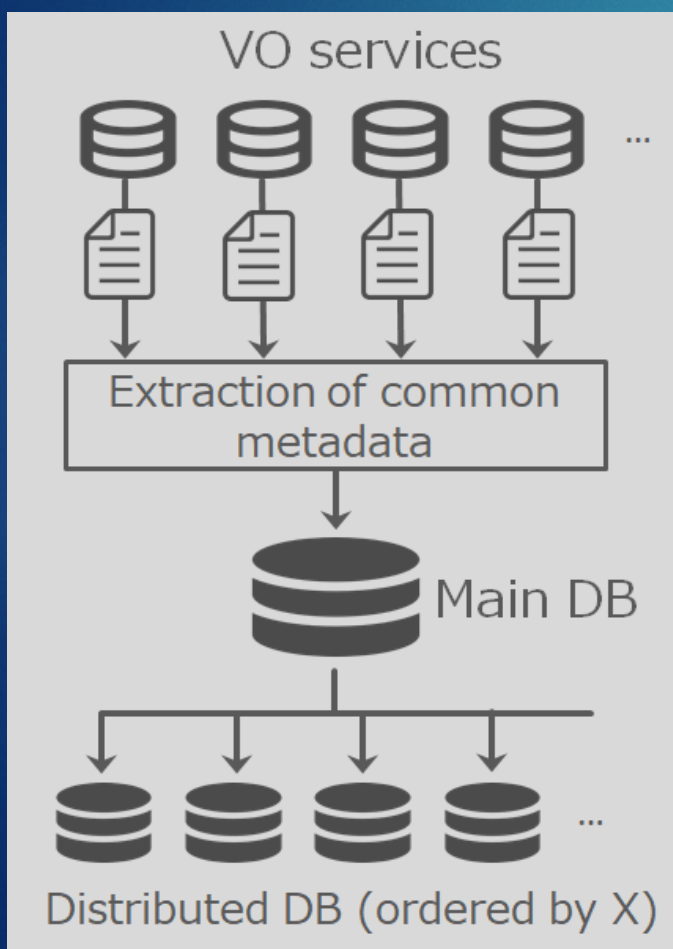
Data are read and binned into a histogram in parallel using the distributed query system. Currently it takes a few tens minutes to read all the data and create a plot.
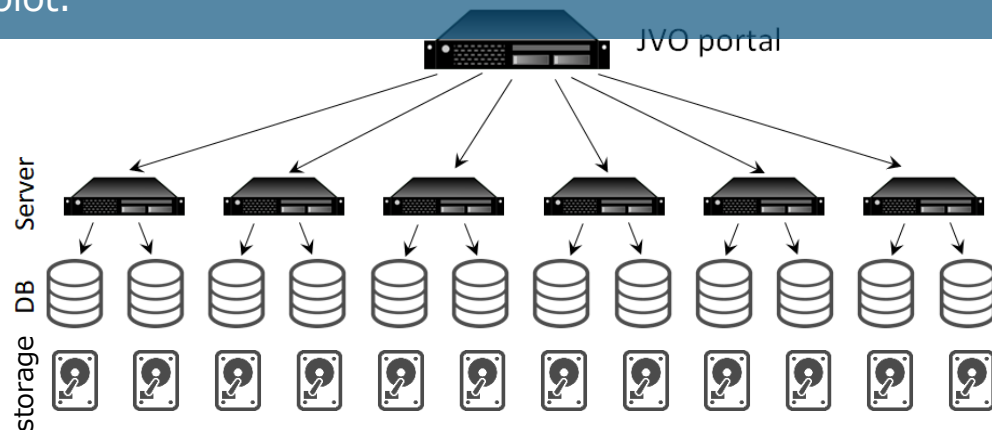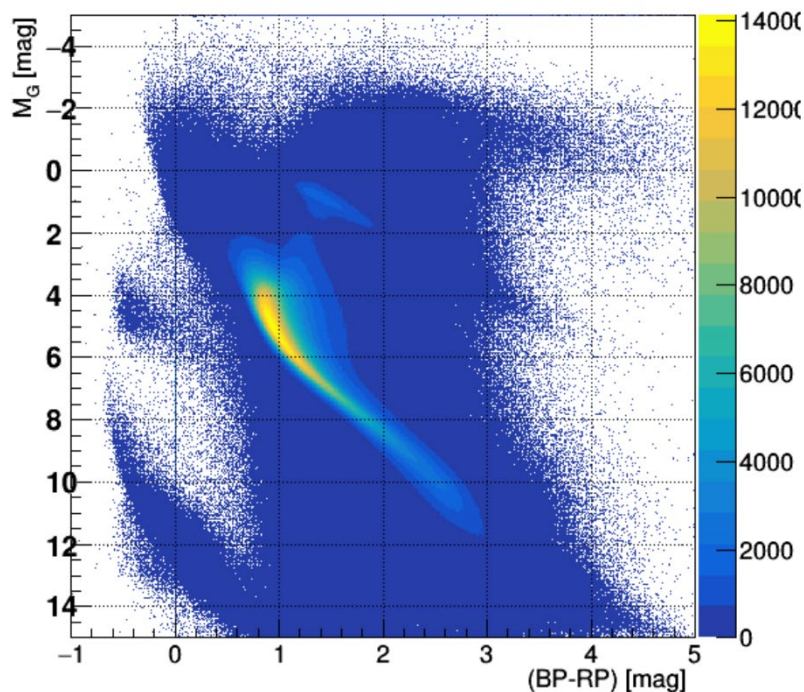
VO Crawling system

- Image metadata are collected by crawling the major VO services, and they are registered to the distributed database system.
- This allows users to browse and find multi-λ dataset very quickly.
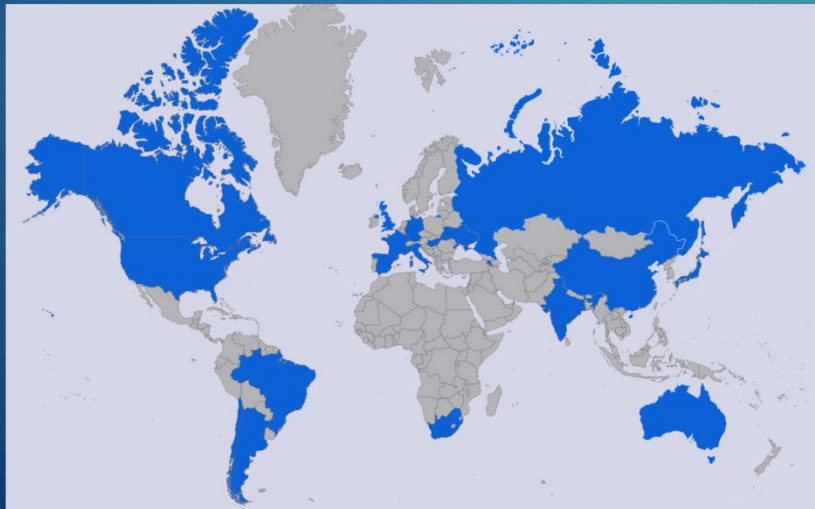
International Virtual Observatory Alliance

VO 標準仕様の作成。21 カ国・地域が加盟
http://www.ivoa.net/

- 欧州は地域組織としての EuroVO の他、各国毎にも VO グループを組織
- 米国は国内各組織をまとめた USVOA の他、NASA 系データセンターで組織される NAVO が組織されている。
- 予算は外部資金によるところが多い。

海外における VO の活動

- 主要な衛星観測データはほぼ全てが VO による検索が可能。
- 地上観測データは、サーベイ観測結果については大部分が VO による検索が可能となってきている。
- 今後観測が開始される大型プロジェクトについては、ほぼ全て VO 対応を予定している。(LSST, WFIRST, Euclid …)
- Astropy project との協力による python VO ライブラリの開発も進行している。

VO サイト	リソース数	主なデータセット
CDS.VizieR	19378	カタログデータ
nasa.heasarc	1077	X線データカタログなど
irsa.ipac	490	2MASS,AKARI,DSS,Gaia,Herschel,IRAS,Planck,Spitzer,WISE　COSMOS,DENIS,USNO
org.gavo.dc	165	2MASS,AMANDA,ANTARES,GAIA,LAMOST.HIPPARCOS,ROSAT,SDSS,WISE, CALIFA,COSMOS,zCOSMOS
wfau.roe.ac.uk	128	GALEX,IRAS,ROSAT,SDSS,2MASS,VISTA,WISE,XMM 6dF,ATLAS,DENIS,FIRST,GLIMPSE,MGC,SuperCOSMOS,2MPZ,UKIDSS,VHS VIDEO,VIKING,VMC,VVV
archive.stsci.edu	91	2MASS,GAIA,GALEX,PanSTARRS,SDSS,TESS,WISE,FUSE,HST,Kepler,ATLAS,FIRST,GSPC,HLA,UltraVISTA,USNO,VIKING,VHS,GOODS,GSC,HDFN,HDFS,HubbleSC
svo.cab	84	COROT,GAIA,CALAR ALTO　ALHAMBRA
uk.ac.le.star.tmpledas	56	LEDAS
mssl.ucl.ac.uk	54	HINODE,GOES,Polar,Ulysses,Voyager,Wind,SOHO,RHESSI,XMM
mast.stsci	50	HST,GALEX,CANDELS,CLASH,HUDF,GOODS,HDF,COSMOC,HDFS,XMM,FUSE,GALEX, FIRST

| VO サイト	リソース数	主なデータセット
sdss.jhu	48	SDSS,ROSAT,2dF,USNOB,FIRST
ia2.inaf.it	47	VIPERS,WINGS,PLANCK,TNG
vopdc.obspm	45	GAIA,HESS
helio-vo.eu	34	Heliophysics
cadc.nrc.ca	34	GEMINI,CFHT,HST,JCMT,UKIRT
edu.gavo.org	33	For education
esavo	31	HST,Herschel,ISO,XMM
astronet.ru	31	DENIS,Gaia,SDSS,TWOMASS,2XMM,USNO
ivoa.net	29	VOStandard
ned.ipac	21	NED
uk.ac.cam.ast	20	2dF,INT,Hipparcos
asu.cas.cz	19	LAMOST
jvo	17	Subaru, ALMA, Nobeyama
China-VO	17	LAMOST
xcatdb	14	XMM
…		

HiPS

"DM flux-color-Rp-G-Bp I 345 gaia2" progressive survey

This Web resource contains HiPS(*) components for **DM flux-color-Rp-G-Bp I 345 gaia2** progressive survey.
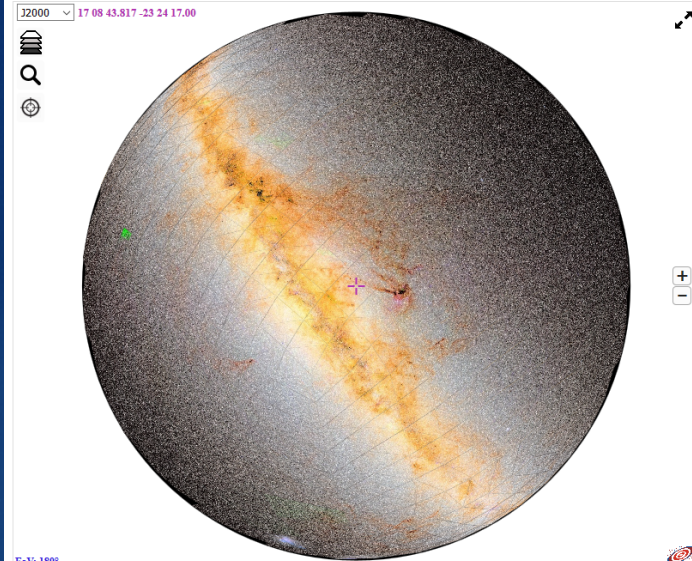
- **Label:** DM flux-color-Rp-G-Bp I 345 gaia2
- **Type:** colored HiPS image
- **Best pixel angular resolution:** 25.77"
- **Max tile order:** 4 (NSIDE=16)
- **Available encoding tiles:** jpeg
- **Tile size:** 512x512
- **Processing date:** 2019-05-21T08:57Z
- **HiPS builder:** Aladin/HipsGen v10.125
- **Coordinate frame:** equatorial
- **Sky area:** 100.0% of sky => 41253Â°^2
- **Associated coverage map:** MOC
- **Property file:** properties
- **Base URL:**

  http://alasky.u-strasbg.fr/ancillary/GaiaDR2/color-Rp-G-Bp-flux-map

FoV: 180°

This survey can be displayed by Aladin Lite (see above), by Aladin Desktop client (just open the base URL) or any other HiPS aware clients.

(*) HiPS is a recommended International Virtual Observatory Alliance standard:HiPS REC. The HiPS technology allows a dedi... at any location and at any scale. HiPS has been invented by CDS-Université de Strasbourg/CNRS (2015A&A...578A.114F). It is designed for astronomical scientifical usages (low distorsion, true pixel values...).

- 観測データ（画像）取得領域の確認や、取得されたデータのクイックルック等が可能な VO インターフェイス。

- 現在 800 種以上の画像データセットなどが公開されている。

HiPS servers (list of HiPS HTTP servers - required a VO registration)

http://aladin.unistra.fr/hips/registry

#	Origin	Type	HiPS list URL
1	CEFCA	*image,catalog*	https://archive.cefca.es/catalogues/hips_list.html
2	cfa.harvard.edu	*image*	https://cdaftp.cfa.harvard.edu/hipslist
3	wfau.roe.ac.uk	*image,catalog*	http://surveys.roe.ac.uk/hips71/hipslist
4	CASDA	*image*	https://casda.csiro.au/hips/hipslist
5	PADC	*image*	http://voparis-srv-paris.obspm.fr/vo/planeto/hips/perl_hipslist.pl
6	IPAC	*image*	http://irsa.ipac.caltech.edu/data/hips/list
7	ANU	*image*	http://skymapper.anu.edu.au/_HiPS/hipslist.txt
8	Leiden	*image,catalog*	http://tgssadr.strw.leidenuniv.nl/hips_list
9	IRAP	*image*	http://cade.irap.omp.eu/documents/Ancillary/4Aladin/hipslist-IRAP.txt
10	SSC	*image*	http://saada.unistra.fr/cgi-bin/hipslist
11	CDS	*image,cube*	http://alasky.unistra.fr/hipslist
12	CDS	*image,cube*	http://alaskybis.unistra.fr/hipslist
13	CDS	*image,cube*	https://alaskybis.unistra.fr/hipslist
14	CDS	*catalog*	http://axel.u-strasbg.fr/HiPSCatService/hiplist
15	AMIGA		http://amiga.iaa.es/hipslist
16	svo.cab	*image*	http://gtc.sdc.cab.inta-csic.es/hips/hipslist
17	IAS	*image*	http://healpix.ias.u-psud.fr/hipslist
18	ESAC	*image*	http://skies.esac.esa.int/hipslist
19	JAXA	*image,catalog*	http://darts.isas.jaxa.jp/pub/judo2/HiPS/hipslist.txt
20	CADC	*image*	http://hips.canfar.net/hipslist.txt
21	HEASARC	*image*	https://skyview.gsfc.nasa.gov/hips/skyview.hips
22	China-VO	*image*	http://hips.china-vo.org/hipslist

ESASky & pyESASky

ESASky : Web portal for discovering multi-λ observations
pyESASky : interactive widget used within Jupyter notebook and
JupyterLAB

https://sky.esa.int/

Topcat

http://www.starlink.ac.uk/topcat/

➢ Mark Taylor

➢ 様々な種類のプロット

➢ データはローカルファイルからロードする他、VOサービスからも取得可能。

➢ 複数カタログのクロスマッチ機能など。
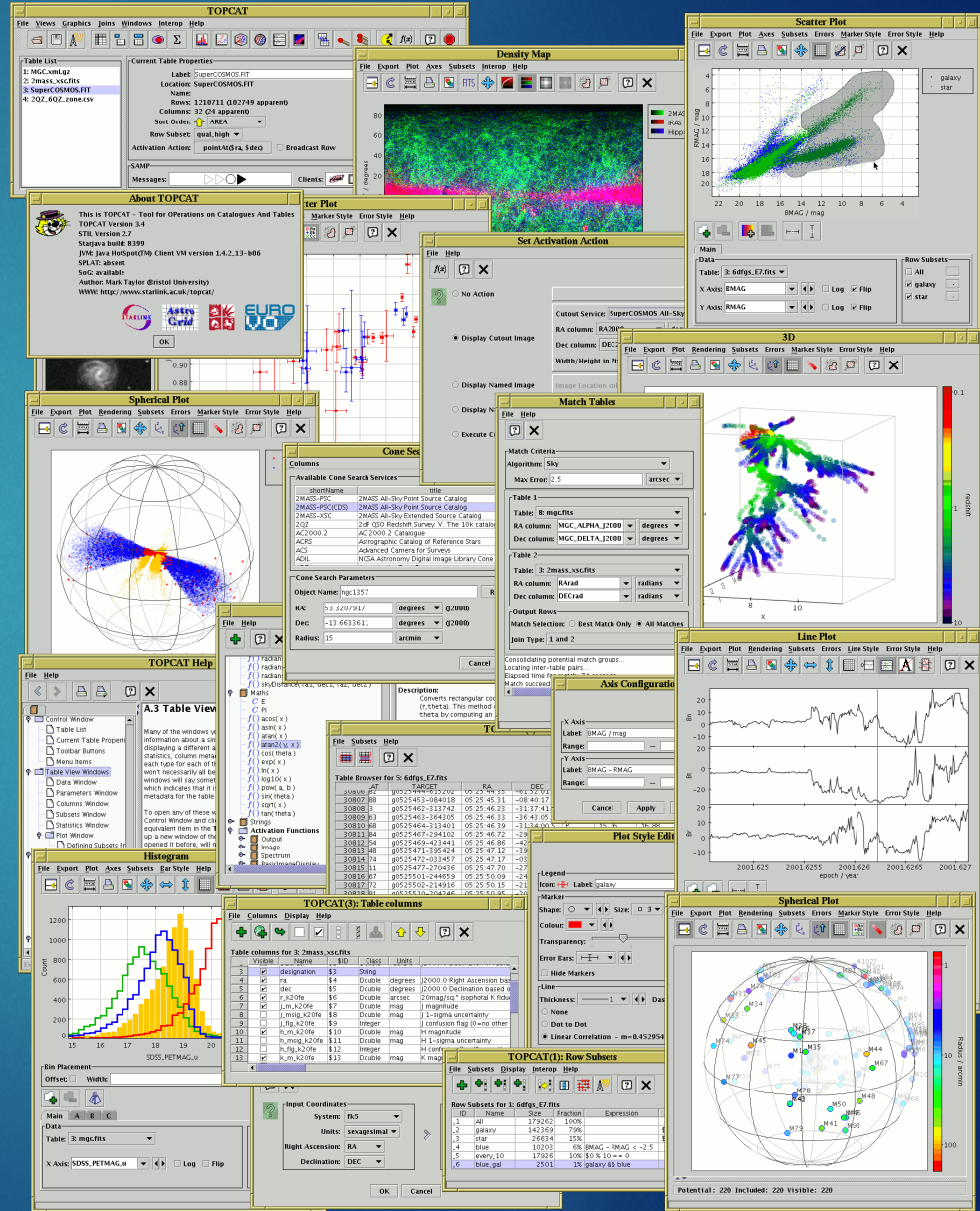
Aladin

- フランス ストラスブルグ天文データセンター (CDS)
- 画像データ、カタログデータを取得し表示。

ローカルファイル

Aladin 画像・カタログサーバー

VO サービス

研究成果

本文に "JVO" を利用したことが明示されている査読論文

年	論文数
合計	31
2019	8
2018	3
2017	5
2016	9
2015	1
2014	1
2013	2
2012	0
2011	1
2010	1

http://jvo.nao.ac.jp/science.html

SVO による VO を利用した査読論文調査結果

VOpubs

1760 Results

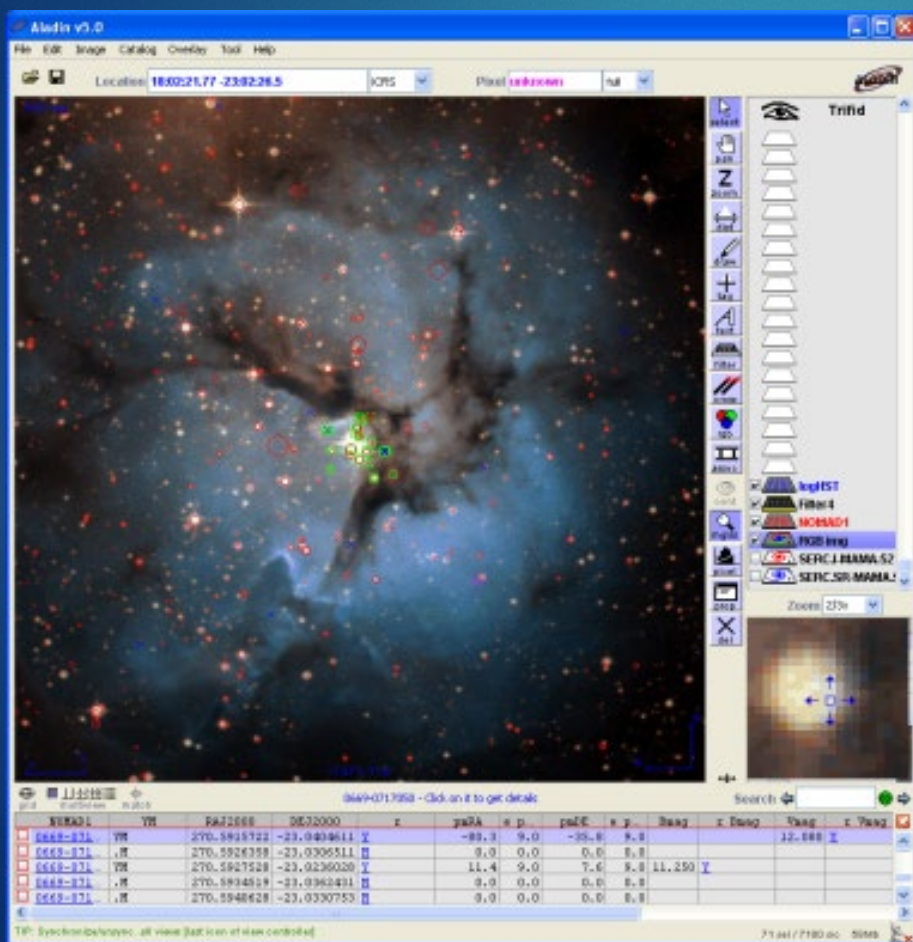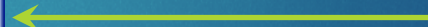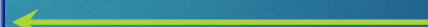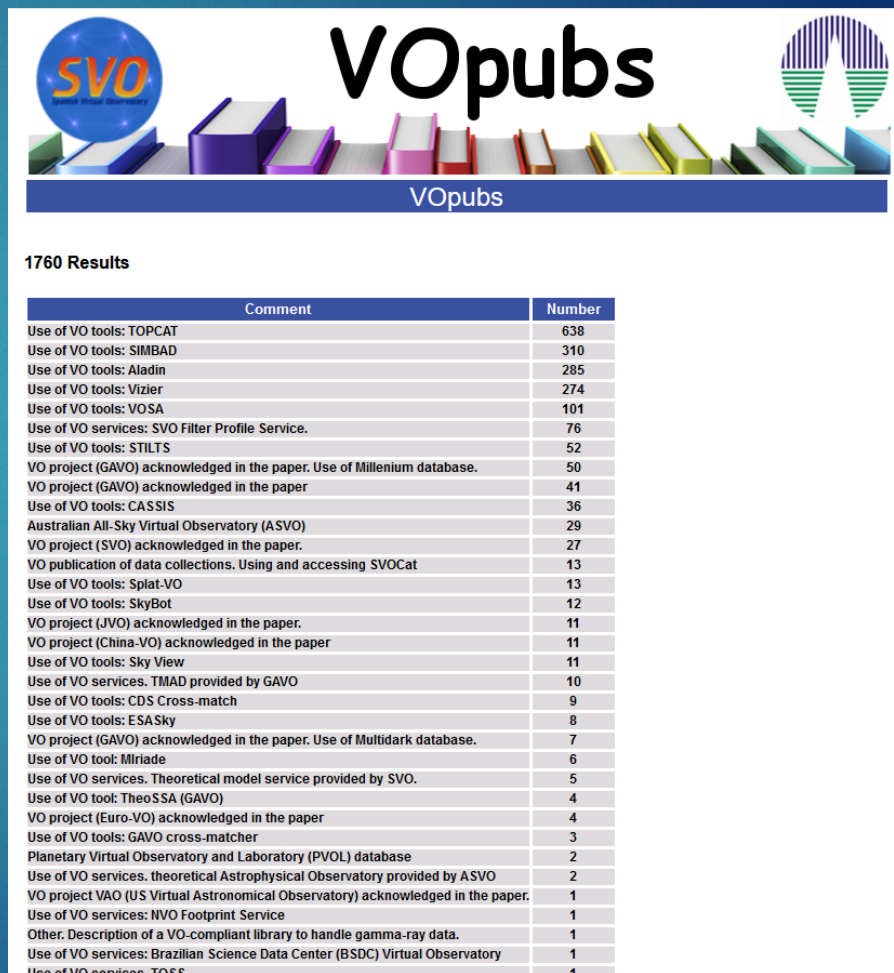| Comment	Number
Use of VO tools: TOPCAT	638
Use of VO tools: SIMBAD	310
Use of VO tools: Aladin	285
Use of VO tools: Vizier	274
Use of VO tools: VOSA	101
Use of VO services: SVO Filter Profile Service.	76
Use of VO tools: STILTS	52
VO project (GAVO) acknowledged in the paper. Use of Millenium database.	50
VO project (GAVO) acknowledged in the paper	41
Use of VO tools: CASSIS	36
Australian All-Sky Virtual Observatory (ASVO)	29
VO project (SVO) acknowledged in the paper.	27
VO publication of data collections. Using and accessing SVOCat	13
Use of VO tools: Splat-VO	13
Use of VO tools: SkyBot	12
VO project (JVO) acknowledged in the paper.	11
VO project (China-VO) acknowledged in the paper	11
Use of VO tools: Sky View	11
Use of VO services. TMAD provided by GAVO	10
Use of VO tools: CDS Cross-match	9
Use of VO tools: ESASky	8
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