# An introduction to the CDS services and tools

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### Introduction

The CDS harbours three major programs, accessible through the CDS Portal:



• **SIMBAD** The astronomical database SIMBAD contains more than 7 million objects. For each object it provides basic measurements (type, coordinates, proper motion, radial velocity, spectral type, distance, magnitude), cross-correlations and bibliography.

**VizieR** The VizieR catalogue service provides access to about 12 000 catalogues, being the most complete library of published astronomical data tables available online.

Aladin The interactive sky atlas Aladin allows to visualise astronomical images and to superimpose entries from different catalogues and databases. It allows to visualise SIMBAD and VizieR information and distributed archives and databases as well as to upload own tables or images. There are two versions of Aladin: Aladin desktop and Aladin lite which runs in the browser.

Besides these tools, the CDS has been providing a cross-match service (X-match) since November 2011.

### Goal of this tutorial

This tutorial shows how to use the CDS tools to gather information on specific astronomical objects. We will...

- Search for information on NGC 4039 in the CDS Portal
- Search for data on NGC 4039 in Aladin
- Compare the coverage of Sky Surveys and select interacting galaxies that have SDSS and GALEX data

# Search for information on NGC 4039 in the CDS Portal

Open the CDS Portal <u>http://cdsportal.u-strasbg.fr/</u> and make a query for NGC 4039. The result provides an overview of the information and data available for this object in the 3 CDS services: SIMBAD, Aladin and VizieR:

Target: NGC 4039 GO J2000 position for NGC 4039: 12 01 53.7 -18 53 08

### 1. SIMBAD - Identifiers, Basic Measurements and links to the Bibliography.



Click (with the right button of your mouse to open a new tab) on 'More SIMBAD data for NGC 4039' to see the full SIMBAD information on this object on a new tab.

لاھ	Portal S	imbad Viz	ieR Alad	in X-Match	n Othe	r⊤ Help					Grente
								N	IGC	39	
other query modes :	Identifier query	Coordinate query	Criteria query	Reference query	Basic query	Script submission	<u>TAP</u>	Output options	<u>Help</u>		
Query : NG	C 4039										C.D.S SIMBAD4 rel 1.3 - 2015.11.10CET11:23:30
Available data	z : <u>Basic da</u>	ta • Identif	ers • Plot	<u>&amp; images</u> •	Bibliog	raphy • Me	asureme	nts • Exte	ernal an	s • Notes • Annotations	
Basic data :											∑≊‴
NGC 40.	<b>39</b> G	alaxy in	Pair of	Galaxie	S					SIM	IBAD query around with radius 2 arcmin
Other object t	types:		GiP (),G	(ESO,LEDA,	MCG,SGC	,UGCA,[M980	]),IG	(VV), PaG	(RR95)	(WISH)	
ICRS coord.	(ep=J2000	Ŋ÷	12 01 53.	7 -18 53 0	8 ( Opt	ical ) [ ]	D 19891	SOLV.C.	01		Interactive AladinLite view
FK5 coord. (a FK4 coord. (a	ep=J2000 ep=B1950	eq=2000) : eq=1950) :	12 01 53. 11 59 19.	7 -18 53 0 9 -18 36 2	6 [ ] 8 [ ]						2 <sup>2</sup>
Gal coord. (e	p = J2000)	;	286.9685	+42.4453 [	1						10 M 10 M
Radial veloci	ity / Redshi	ft/cz:	V(km/s) 1 1989ESOLV	637 [9] / .COL	z(~) 0.	005474 [0.0	000030]	/ cz 164	1.00 [	)] (~) D	Contraction of the second second
Morphologica	al type:		Sc D 2004	ApJ602.	.231C						+
Angular size	(arcmin):		3.1 1.6 5	0 (~) (~)	D 2007A	pJS1731	L85G				
Fluxes (2) :			B 11.08 [ R 9.77 [~	[0.21] D <u>20</u> -] D <u>1989ES</u>	07ApJS.	.173185G					For: 3.09 2MASS ODS SOS 0
										@	VizieR photometry viewer Search within radius Max 30 3 arcsec

Note the list of object type codes. These classifications are drawn from the literature, and are stored in SIMBAD using an hierarchical classification scheme. The full list of Object Types can be found here: <u>http://simbad.u-strasbg.fr/simbad/sim-display?data=otypes</u>. The main Object Type of NGC 4039 is 'Galaxy in Pair of Galaxies' (GiP).

- Use the **siblings button siblings** to identify the name of the other galaxy in this interacting pair. Sorting by the number of references (#ref) can help bring out the most important ones. What is the separation in arcseconds?
- Use the **References section** to find the earliest listed reference in the literature to this object.

Return to the CDS Portal page.

### 2. Aladin - Images.

ladin image	s					
Survey	Band	λ (µm)	Size	Epoch	Resolution	Download
SERC	J	0.46	14.1' x 14.1'	1983-02-15	1.6" / pixel	JPEG FITS 💿
SERC	J	0.46	1.6° x 1.6°	1983-02-15	6.7" / pixel	JPEG FITS 🛞
SERC	J	0.46	7.7° x 7.7°	1983-02-15	27.1" / pixel	
SERC	J	0.46	7.7° x 7.7°	1982-04-20	27.1" / pixel	JPEG FITS 🛞
MO	R	0.63	12.9' x 12.9'	1996-02-26	1.0" / pixel	
SERC	I.	0.80	12.9' x 12.9'	1996-05-25	1.0" / pixel	
MO	R	0.63	6.4° x 6.4°	1996-02-26	24.2" / pixel	
SERC	1	0.80	6.4° x 6.4°	1996-05-25	24.2" / pixel	

A DSS (Digitized Sky Survey) image is shown. Click below the image to obtain a colour version.

### 3. VizieR - Catalogues.

10 21	) catalog 0 catalog	ues with 'NGC 4039' keyword ogues around NGC 4039:				
Vizi	er catalogue	5				
Filte	r:	×				
	Name	Description	Local density	Wavelength	Popularity	Coverage map
	B/eso Query	ESO Science Archive Catalog (ESO, 1991-2015) [ReadMe]	78	optical	80	
	l/324 <u>Query</u>	The Initial Gaia Source List (IGSL) (Smart, 2013) [ReadMe]	55	optical	87	
	l/297 Query	NOMAD Catalog (Zacharias+ 2005) [ReadMe]	53	optical,IR	90	
	J/ApJS /192/10 <u>Query</u>	Chandra ACIS survey in 383 nearby galaxies. I. (Liu, 2011) [ReadMe]	52	X-ray	61	

The list of catalogues is sorted by Local Density, but can also be sorted by Name, Wavelength or Popularity. Note the sky coverage maps for each catalogue on the right.

The Antennae is listed in the Arp Atlas of Peculiar Galaxies, filter the Vizier catalogues returned for NGC 4039, by typing 'Arp' into the Filter box in the Vizier part of the CDS Portal:

١	Vizie	r catalogues					
F	liter:	Arp	×				
Γ		Name	Description	Local densit	Wavelength	Popularity	Coverage map
		VII/192 Query	Arp's Peculiar Galaxies (Webb 1996) [ReadMe]	2	optical	55	
		VII/74A Query	Atlas of Peculiar Galaxies (Arp 1966) [ReadMe]	1	optical	56	

Click on "Query" of the Webb 1996 catalogue to take you to the VizieR detailed query page.

Simple Target List Of Targets			Fast Xm	atch with large	catalogs or Simbad
Target Name (resolved by Sesame) or Po	sition: Target dimension:				
Clear NGC 4039	J2000 ᅌ 2 arcmin ᅌ				
	• Radius OBox size				
Radmm R Opt UV X Y	Arp's Peculiar Galaxies (Webb 1996)	Similar Catalogs	1996S&T9292W	ReadMe+ftp	
<u>VII/192</u>	Post annotation				
1.VII/192/arpord	<sup>(c)</sup> list of Arp views with imaging data (338 rows)				
2. <u>VII/192/arplist</u>	<sup>(c)</sup> list and info for involved galaxies (592 rows)				
2 Xmatch is off					

Note that this catalogue contains two tables. Select the VII/192/arplist table by clicking on it and make a first query on this table by clicking on "submit", and examine the output as html.



Modify the query preferences to add extra coordinate columns in J2000 decimal degrees, and to obtain the whole catalogue:

- Remove the restriction on searching only around NGC 4039 by clearing the target name at the top of the form.
- In the "Preferences" window on the left, add extra coordinate columns in decimal degrees by checking the J2000 and decimal boxes, change the maximum number of rows returned to "unlimited" and check "All columns" in order to get the whole catalogue.

Then submit again.

When you are satisfied with the changes, select to save to "CDS portal" instead of HTML Table in the "Preferences" window and submit again. The save file is now shown in your personal user space on the CDS Portal.

Save a copy **from the portal to your desktop** in VOTable format, it will be used later in the tutorial.

### VizieR Search Page

# Search for data on NGC 4039 in Aladin

Open Aladin with at least 1GB of memory allocated to the save virtual machine:

java -jar -Xmx=1024m Aladin.jar

Open the Server Selector window via File  $\rightarrow$  Open, or by clicking the File icon in the top left of the Aladin window. The Server Selector provides access to Image servers on the left, catalogue servers on the right, and to a range of services including "all VO" along the top.

		Server selector		
	Others 🥢	File Sallvo 🎉	Natch	ols
Image servers	• A	ladin image server (	0	Catalog servers
Aladin	Step 1: Speci	fy a target/radius and pr	ress SUBMIT	All
images	Target (ICRS, name)	NGC 4039	Grab	coord
	Search cone	0 arcmin		
Skyview	>>> Step 2: load one o	r several images	Hierarchical vie	w Sulveys
	SURVEY COLO	R SIZE	OBS ID	RES Missions
	2MASS K(IR	K) 8.6' x 17.1	1' 9903205_KI0690221	1.1
Sloan	2MASS H(IR	H) 8.6' x 17.1	1' 9903205_HI0690221	. 1. 1
1	2MASS J(IR	J) 8.6' x 17.1	1' 9903205_JI0690221	. 1.1
DSS	SERC I-DSS	2(0.807um) 13.0' x 13.	.0' S572	1.1 WNED
	AAO R-DSS	2(0.64um) 13.0' x 13.	.0' 572	1.1
VLA	SERC J-DSS	1(0.468um) 14.2' x 14.	.2' 572	1.7 MOC
	SERC J-DSS	1(0.468um) 1.7° x 1.7°	° 572-LOW	6.6
Archives	SERC I-DSS	2(0.807um) 6.5° x 6.5°	° 572–PLATE	24. KyRot
<u>&gt;</u> *	AAO R-DSS	2(0.64um) 6.5° x 6.5°	° 572–PLATE	24. <b>Skybo</b>
Others	SERC J-DSS	1(0.468um) 6.7° x 6.7°	° 643–PLATE	27. Others.
1 <u>&gt;</u>	IRAS-IRIS 25MU(	25.0um) 12.5° x 12.	.5° I144B2H0	1.5
	Default	format: 💿 JPEG 🔵 F	ITS	
	Reset Cle	subm	IT Close	)

- Insert the target name NGC 4039 in the "Aladin images" server tab and press submit.
- Select a 13'x13' DSS image from the list and load it. Note that it loads as a plane into 'stack' on the right panel of the Aladin window.
- Make a contour map of the image using the "cont" icon button cont next to the stack. Increase the number of contours to better represent the image.
- Overlay a SIMBAD plane showing only the galaxies by selecting the 'SIMBAD Catalogue' server tab and choosing the 'Galaxy' as the Display filter.
- Change the colour of the SIMBAD plane using the plane Properties
- Using the select tool select , select some of the SIMBAD points and note that these are displayed as a table below the image. Note that this window can be detached with the icon .
- Select 2MASS J, H and K band images from the Aladin images tab in the server selector
- window, and construct a colour image with the 'rgb' tool
  - Select an image from the Hubble Press Release images:
    - File -> Load Astronomical Image -> Others -> Hubble Press Release Images
    - or via the 'Other' image servers in the Server Selector Window)
- Compare the images in a number of different ways:
  - Multi-view: View —> Create one view per image, or via the multi-view icons at the bottom left of the Aladin image window
  - Align and scale all images by using the match icon below the image window match.

- Transparency overlays: return to single view mode. Change the transparency of planes in the stack with opacity slider at the bottom of the stack. Note that you can move the location of planes in the stack.
- Search the VO for data on NGC 4039:
  - Use the "All VO" tab in the server selector to search for more images, catalogues and spectra. Make a general query for data from all the VO services accessible via Aladin, by clicking "Submit". When a number of results have returned, press "stop".
  - Expand some of the nodes of the tree. Note how the Field of View outlines of the data from some services is displayed over the images in the Aladin image window.



- To make a restricted search from data from selected services use the "Detailed List". To do this, first "unselect all", then choose the services you want to query (note that the 'Filter' text box can be used to search the list), e.g:
  - Hubble Legacy Archive
  - Skyview Virtual Observatory
  - Chandra X-ray Observatory Data Archive
  - ST-ECF Hubble Legacy Archive Images
- Submit to load the selected images
- Display the images in multi-view mode, and note that you can align all the images to the same orientation and scale using the match icon below the image window

# Compare the coverage of Sky Surveys and select interacting galaxies that have SDSS and GALEX data

- Browse the available surveys by clicking the "HiPS" (Hierarchical Progressive Survey, see <a href="http://aladin.u-strasbg.fr/hips/">http://aladin.u-strasbg.fr/hips/</a> for more info) in the Server Selector window.
- Select the SDSS 9 colored (Image -> Optical -> SDSS) and GALEX All Sky Imaging Survey colored (Image -> UV -> GALEX) surveys, and submit.

		Server selector	
	Others	🛇 File 🗲 🕬 🖉 V	Tools
Image servers	○ Prog	ressive surveys (HiPS) 🕜	Catalog servers
Aladin	Target (ICRS, name)	12 01 53.70 -18 53 08.0 G	ab coord
images	Radius	14'	
<sup>⊿</sup> SkyView	V 📄 UV		Surveys
UKIDSS	GALEX	c .	<b>Missions</b>
Sloan	<ul> <li>Optical</li> <li>DSS</li> </ul>		SITISAD
DSS	▼ 📄 SDSS	) colored SLOAN Digitized Sky Survey – Hea	pixed by CDS
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Others		z SLOAN Digitized Sky Survey – Healpixed colored SLOAN Digitized Sky Survey – Hea	by CDS (get M pixed by CDS
	Mellinger	colored (c) Axel Mellinger. Permission is gr	anted for use in
	CFHTLS		
	Default format: 💽	Preview (jpg png) 🛛 Full pixel dynamic (fi	ts)
	Reset	Clear SUBMIT Close	0

- Turn on the coordinate grid  $\frac{grid}{grid}$ , zoom out and use the pan tool  $\frac{grid}{grid}$  to explore the whole sky.
- Go into multi-view mode and lock the views so that they can be panned and zoomed together.
- Load the coverage map (MOC Multi-Order Coverage map) of both the SDSS and GALEX surveys, from the 'properties' panel for each plane, and clicking on "Coverage".

	Properties
Properti	es of the plane "SDSS9 colored"
PlaneID:	SDSS9 colored
Description:	SDSS 9 color
Id:	ivo://CDS/P/SDSS9/color
HiPS publisher	CDS (T.Boch)
Release date	2014-10-24T15:12Z
Format:	HiPS
Url:	http://alaskybis.u-strasbg.fr/SDSS/DR9/color
HiPS properties	
Best pixel resolution	402.6mas
HEALPix NSide:	524288 (2^19)
Coord.sys.:	ICRS
Tile format	JPEG color
Tile width:	512 pix (2^9)
Coverage	
Space	36.19 % of sky Coverage
Original data	
Copyright	<u>SLOAN Digitized Sky Survey – Healpixed by</u> <u>CDS</u>
Used projection	
.projection center	12 01 53.70 -18 53 08.0
.method	SINUS ‡
.frame	Default ‡
Apply	Bookmark Close

Zoom into the edges of the surveys and note the way the MOC represents the coverage of the surveys.

- Calculate the intersection of the coverage maps of the SDSS and GALEX surveys using menu item Coverage —> Logical operations
- Load the full Webb 1996 Arp catalogue that you saved earlier. You can do this in one of the two following ways:
  - file —> load
  - drag and drop.

Alternatively you can download again the catalogue via the Vizier interface in the Catalogue Servers in Aladin.

- Filter the catalogue to select only the sources that fall within the SDSS+GALEX MOC:
  - Coverage —> Filter a table by MOC (This should select 426 sources)

•••	Filtering by MOC
	Specify a MOC and one or several catalog press the CREATE button to generate a new catalogue with sources inside (resp. outside) the MOC.
MOC plane	Int GALEX Allsky Imaging Survey (AIS) colored MOCSDSS9 colored MOC - "12 01 5
Catalog plane	Filter VII_192_arplist-151110.vot - "12 01 53.70 -18 53 08.0"
Catalog plane	none
Catalog plane	none
Catalog plane	none
	💿 inside  🔾 outside
	CREATE Reset Close

Visualise the brightest (< 9 mag) galaxies of the selected sources by extracting small images from the SDSS survey ("thumbnails"):

• Select the brightest galaxies by using the filter tool and the "Show brightest stars" predefined filter, and edit it by going into "Advanced mode" and modify it to select objects with magnitude < 9. (Note that the VT column is automatically identified with the Unified Content Descriptor "phot.mag\*"). Make sure that only the MOC filtered catalogue is active (otherwise sources in other planes may also be filtered). Click on "Apply" and then "export" to create a new plane consisting only of the sources selected by the filter.

There should be 7 sources brighter than 9 magnitudes.

operties of the filter	Filter1
	Beginner mode Advanced mode
Choose a predefined	filter
Predefined filters	<b>\$</b>
Or enter your own fi	Iter definition
eg: \${Bmag}<10 {dra	w red square)
Pick: Columns Þ	UCDs D Actions D Maths Units D
\$	[phot.mag*]<9 { draw }
Help	
neip	
Examples	
	Save filter Load filter
Export Create	a new plane with all filtered sources
export create	a new plane with an intered sources

• Make thumbnails of the selected brightest sources: Tools—>Thumbnail view generator. This makes a view for each source in the catalogue, and note that the views can be scrolled via the scroll bar on the left side of the main window.

## **Collect information on a sample of galaxies using Aladin [Optional]**

Use an Aladin script to obtain DSS and SDSS images with HST, Chandra, ESO observation log overlays for each of the selected bright galaxies.

- Copy the script Arp\_script.ajs from the USB stick we will circulate to your computer. The content of this script is shown below.
- Create a folder called 'Arp' and edit the script Arp\_script.ajs to insert a sensible path for saving the output files, e.g. ~/*Desktop/Arp*.
- Open the Aladin macro controller and load the script:
  - Tools -> Macro Controler then File-> Load script
  - or cut and paste the script into the top panel of the Macros window.
- Select all the sources in the bright galaxies catalogue:
  - right click on the plane, and "Select all objects in selected planes")
  - In the Macros window: File—> Use selected plane sources as params.
  - Note how the catalogue columns are shown as parameters which can be referred to as \$1, \$2, etc. within the script.
- Click on the first row of the parameters table and execute the script for this row "Exec current params".
- Optional add SDSS image: remove the # to enable download of a SDSS g-band image for each source. Note that this results in an 'Data not available' message for objects not covered by SDSS.
- Inspect the output in the Aladin window, and also the files written in the Arp folder
- Execute the script for all sources by "Exec all from current"

Note that the saved "stack" files, can simply be dragged and dropped into Aladin for inspection.

		maoroo	
pe or load a	a macro script		
AJS			1
eset			
rid on			
DSS image:			
ARP-\$2_DSS	5" = get DSS.STScI(P0	OSS2UKSTU_Red,15,15) <b>\$3</b>	
SDSS image	2		
AKP-\$2_SL	$DSS^{*} = get SDSS(key)$	word=Filter g) \$3	
SINBAD PIA	ne imbad" – get Simbag	1 62 5'	
Observation	n Loas	222	
iz logHST=0	aet vizier(logHST) \$3		
iz_logESO=c	get vizier(logESO) \$3		
iz_logChand	lra=get vizier(logCha	andra) \$3	
ync			
ause 1			
Write result	ts to files		
export B/h	st/hstlog /Users/ar	igm/Desktop/Arp/Arp-\$2_HST.x	ml
ave /Users/	angm/Desktop/Arp	/Arp- <mark>\$2_c</mark> hart.png	
acking /lico	rs/angm/Deskton//		
me es land a	list of normators	Arp/Arp-\$2_stack.aj	
/pe or load a	a list of parameters -	Arp/Arp-32_stack.aj	
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pe or load a	I list of parameters	xfp/Arp-3∠_stack.aj	SIC
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ype or load a Add colui	k list of parameters	xfp/Arp-3∠_stack.a)          \$3       \$4         14:03:12.70 + 54:       Filte         13:29:52.30 + 47:       Filte         12:43:39.60 + 11:       Filte         12:29:46.40 + 07:       Filte         11:20:14.90 + 12:       Filte         10:242:40.70 - 00:0       Filte	-src -src -src -src -src -src -src -src
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/pe or load a	I list of parameters	\$3     \$3     \$4     \$3     \$4     \$3     \$4     \$3     \$4     \$3     \$6	SFC SFC SFC SFC SFC SFC SFC SFC
pe or load a Add colui	I list of parameters	\$3         \$4           \$14:03:12:70 + 54:         Filter           13:29:52:30 + 47:         Filter           12:43:39:60 + 11:         Filter           12:29:46:40 + 07:         Filter           12:29:46:40 + 07:         Filter           02:42:40.70 - 00:0         Filter	SFC SFC SFC SFC SFC SFC SFC SFC SFC
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Content of the script Arp\_script.ajs:

```
#AJS
reset
grid on
# DSS image:
"ARP-$2_DSS" = get DSS.STScI(POSS2UKSTU_Red,15,15) $3
# SDSS image:
# "ARP-$2_SDSS" = get SDSS(keyword=Filter g) $3
# SIMBAD plane
# "ARP-$2_Simbad" = get Simbad $3 5'
# Observation Logs
viz_logHST=get vizier(logHST) $3
viz_logESO=get vizier(logESO) $3
viz_logChandra=get vizier(logChandra) $3
sync
pause 1
# Write results to files
# export B/hst/hstlog /Users/angm/Desktop/Arp/Arp-$2_HST.xml
save /Users/angm/Desktop/Arp/Arp-$2_chart.png
backup /Users/angm/Desktop/Arp/Arp-$2_stack.aj
```

Change "/Users/angm/" for your own location!