

An introduction to the CDS services and tools

Ada Nebot Gomez-Moran, Mark Allen, and the CDS team

Centre de Données astronomiques de Strasbourg, France

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 <http://cdsportal.u-strasbg.fr/> and make a query for NGC 4039.

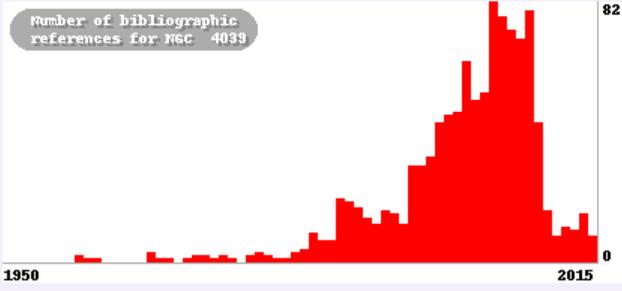
The result provides an overview of the information and data available for this object in the 3 CDS services: SIMBAD, Aladin and VizieR:

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

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

Object identifiers, measurements and bibliography for NGC 4039

- Object type: Galaxy in Pair of Galaxies
- Morphological type: Sc
- [More SIMBAD data for NGC 4039](#)
- [+ 1073 bibliographic references](#)



[+ 464 objects within 2'](#)

- [Display map around NGC 4039](#)
- [Display SimPlay interactive map around NGC 4039](#)
- [+ Related objects in 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.

Portal **Simbad** VizieR Aladin X-Match Other - Help

NGC 4039

other query modes: [Identifier query](#) [Coordinate query](#) [Criteria query](#) [Reference query](#) [Basic query](#) [Script submission](#) [TAP](#) [Output options](#) [Help](#)

Query : NGC 4039 C.D.S. - SIMBAD4 rel 1.3 - 2015.11.10CET11:23:30

Available data : [Basic data](#) • [Identifiers](#) • [Plot & images](#) • [Bibliography](#) • [Measurements](#) • [External archives](#) • [Notes](#) • [Annotations](#)

Basic data :

NGC 4039 -- Galaxy in Pair of Galaxies

Other object types: [GIP \(\), G \(ESO,LEDA,MCG,SGC,UGCA,\[M98c\]\), IG \(VV\), PaG \(RR95\), Rad \(WISH\)](#)

ICRS coord. (ep=J2000) : [12 01 53.7 -18 53 08 \(Optical \) \[\] D 1989ESOLV.C.....OL](#)

FK5 coord. (ep=J2000 eq=2000) : [12 01 53.7 -18 53 08 \[\]](#)

FK4 coord. (ep=B1950 eq=1950) : [11 59 19.9 -18 36 26 \[\]](#)

Gal coord. (ep=J2000) : [286.9685 +42.4453 \[\]](#)

Radial velocity / Redshift / cz : [V \(km/s\) 1637 \[9\] / z \(-\) 0.005474 \[0.000030\] / cz 1641.00 \[9.00\] \(-\) D 1989ESOLV.C.....OL](#)

Morphological type: [Sc D 2004ApJ...602..231C](#)

Angular size (arcmin): [3.1 1.6 50 \(-\) \(-\) D 2007ApJS...173..185G](#)

Fluxes (2) : [B 11.08 \[0.21\] D 2007ApJS...173..185G](#)
[R 9.77 \[-\] D 1989ESOLV.C.....OL](#)

SIMBAD with radius arcmin

Interactive [AladinLite](#) view



[VizieR photometry viewer](#)

Search within radius 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: <http://simbad.u-strasbg.fr/simbad/sim-display?data=otypes>. The main Object Type of NGC 4039 is 'Galaxy in Pair of Galaxies' (GiP).

- Use the **siblings button** 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.

Images for NGC 4039

- [Display region in Aladin \(Web Start\)](#)

| Aladin images | | | | | | |
|---------------|------|-----------------------------|---------------|------------|---------------|---|
| 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 | JPEG FITS |
| SERC | J | 0.46 | 7.7° x 7.7° | 1982-04-20 | 27.1" / pixel | JPEG FITS |
| AAO | R | 0.63 | 12.9' x 12.9' | 1996-02-26 | 1.0" / pixel | JPEG FITS |
| SERC | I | 0.80 | 12.9' x 12.9' | 1996-05-25 | 1.0" / pixel | JPEG FITS |
| AAO | R | 0.63 | 6.4° x 6.4° | 1996-02-26 | 24.2" / pixel | JPEG FITS |
| SERC | I | 0.80 | 6.4° x 6.4° | 1996-05-25 | 24.2" / pixel | JPEG FITS |



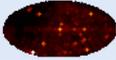
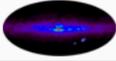
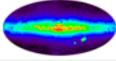
[Display color image](#)

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

3. VizieR - Catalogues.

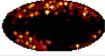
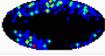
Catalogues for NGC 4039

- [10 catalogues with 'NGC 4039' keyword](#)
- [210 catalogues around NGC 4039:](#)

| VizieR catalogues | | | | | | |
|--|---|---------------|------------|------------|---|--|
| Filter: <input type="text" value=""/> | | | | | | |
| Name | Description | Local density | Wavelength | Popularity | Coverage map | |
| ★ B/eso Query | ESO Science Archive Catalog (ESO, 1991-2015) [ReadMe] | 78 | optical | 80 |  | |
| ★ I/324 Query | The Initial Gaia Source List (IGSL) (Smart, 2013) [ReadMe] | 55 | optical | 87 |  | |
| ★ I/297 Query | NOMAD Catalog (Zacharias+ 2005) [ReadMe] | 53 | optical,IR | 90 |  | |
| ★ J/ApJS/192/10 Query | 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:

| Vizier catalogues | | | | | | |
|--|----------------------------------|--|-----------------|------------|------------|---|
| Filter: <input type="text" value="Arp"/> | | | | | | |
| | 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.

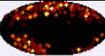
VizieR Search Page

[Simple Target](#) [List Of Targets](#) [Fast Xmatch with large catalogs or Simbad](#)

Target Name (resolved by [Sesame](#)) or Position: Target dimension:

Radius Box size

Random Int XY [Similar Catalogs](#) [1996S&T...92...92W](#) [ReadMe+ftp](#)

VII/192 

[1.VII/192/arporid](#) (c)list of Arp views with imaging data (338 rows)

[2.VII/192/arplist](#) (c)list and info for involved galaxies (592 rows)

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.

Preferences

max:

All columns

Compute

Distance ϱ

Position angle θ

Distance (x,y)

Galactic

J2000

B1950

Ecl. J2000

Sort by Distance

+ order -

No sort

Position in:

Sexagesimal

Decimal $^{\circ}$

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.

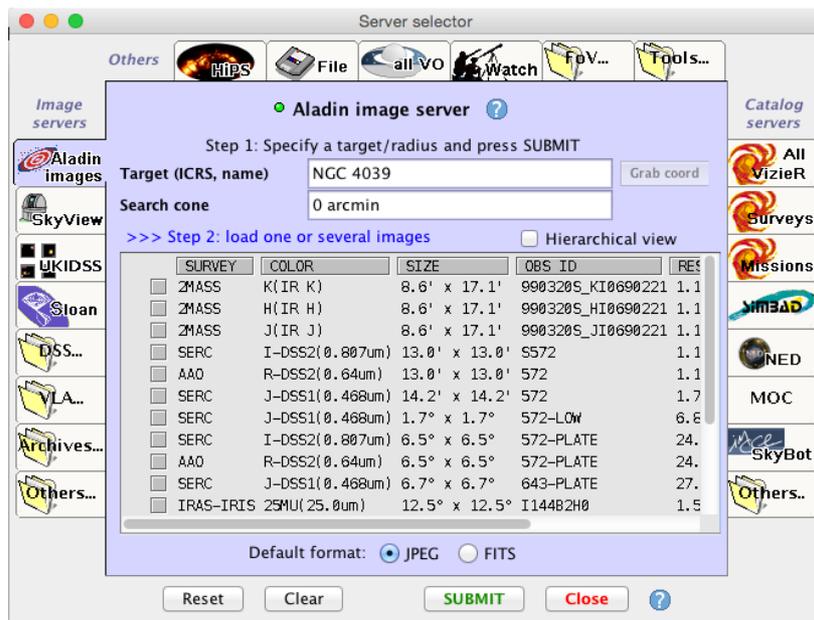
Save a copy **from the portal to your desktop** in VOTable format, it will be used later in the tutorial.

Search for data on NGC 4039 in Aladin

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

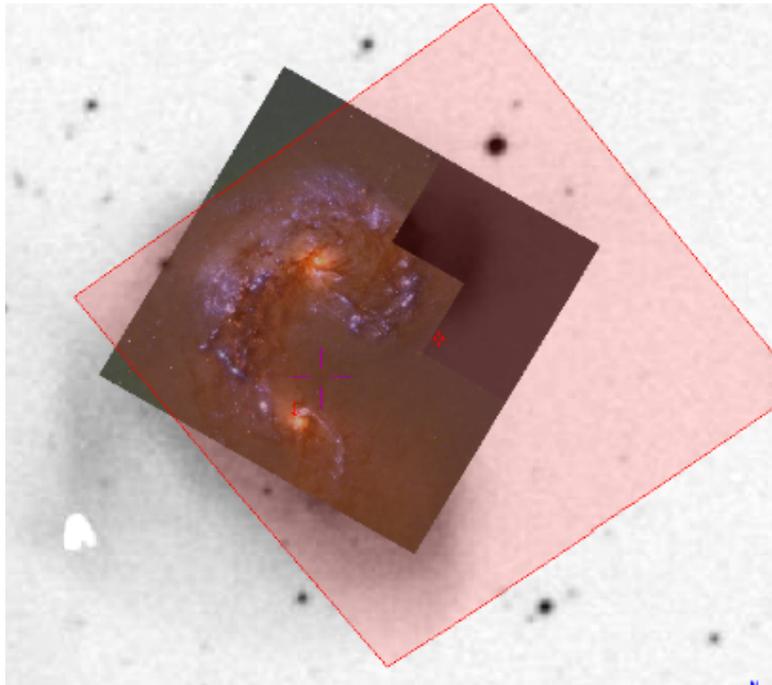
```
java -jar -Xmx=1024m Aladin.jar
```

Open the Server Selector window via File → 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.



- 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  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 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 .

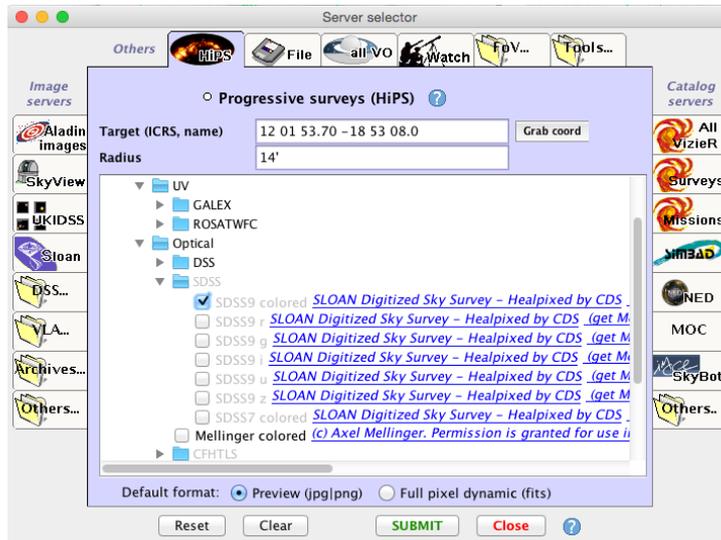
- Transparency overlays: return to single view mode. Change the transparency of planes in the stack with opacity slider at the bottom of the stack. Note that you can move the location of planes in the stack.
- Search the VO for data on NGC 4039:
 - Use the “All VO” tab  in the server selector to search 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.



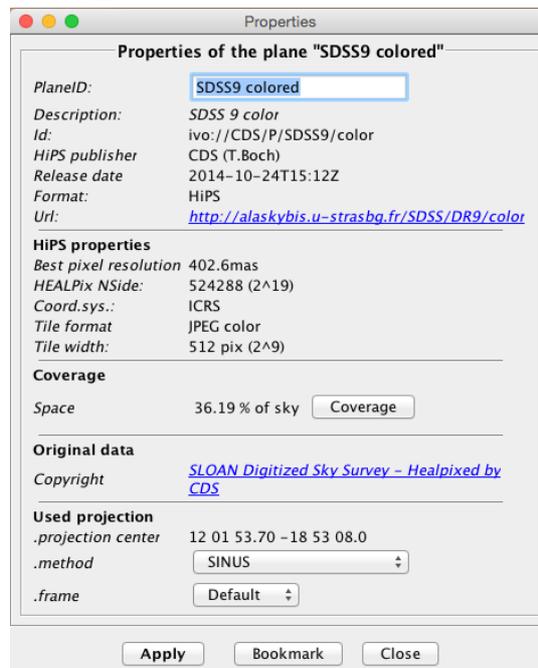
- To make a restricted search from data from selected services use the “Detailed List”. To do this, first “unselect all”, then choose the services you want to query (note that the 'Filter' text box can be used to search the list), e.g:
 - ▶ Hubble Legacy Archive
 - ▶ Skyview Virtual Observatory
 - ▶ 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 <http://aladin.u-strasbg.fr/hips/> 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.

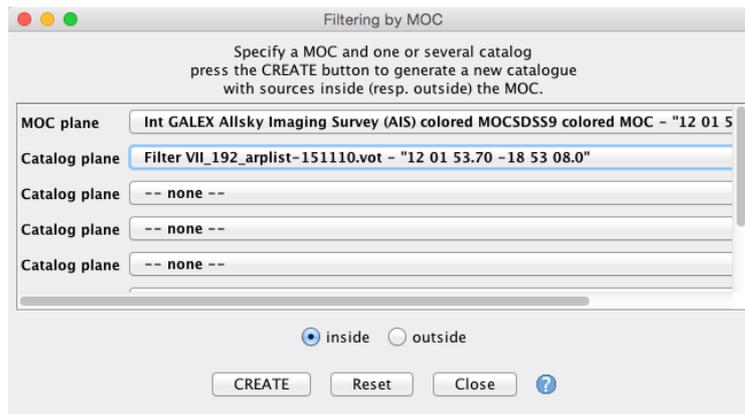


- Turn on the coordinate grid , zoom out and use the pan tool  to explore the whole sky.
- Go into multi-view mode and lock the views so that they can be panned and zoomed together.
- Load the coverage map (MOC - Multi-Order Coverage map) of both the SDSS and GALEX surveys, from the ‘properties’ panel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



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

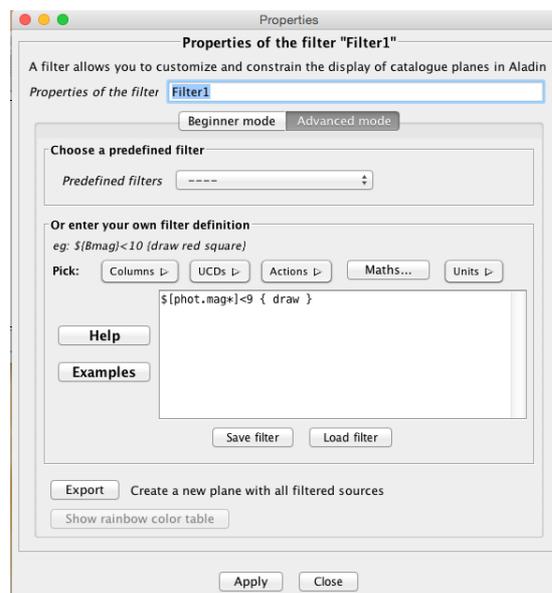
- Calculate the intersection of the coverage maps of the SDSS and GALEX surveys using menu item Coverage → Logical operations
- Load the full Webb 1996 Arp catalogue that you saved earlier. You can do this in one of the two following ways:
 - file → load
 - drag and drop.
 Alternatively you can download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



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 : Choose the “Show brightest stars” pre-defined 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.



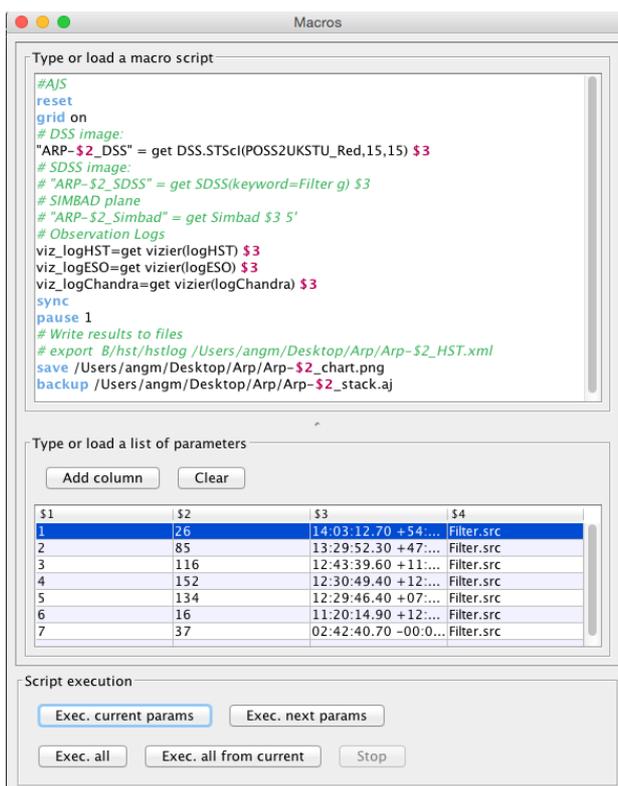
- Make thumbnails of the selected brightest sources: Tools—>Thumbnail view generator. This makes a view for each source in the catalogue, and note that the views can be scrolled via the scroll bar on the left side of the main window.

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 Controller 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.



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!