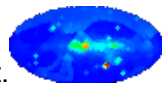
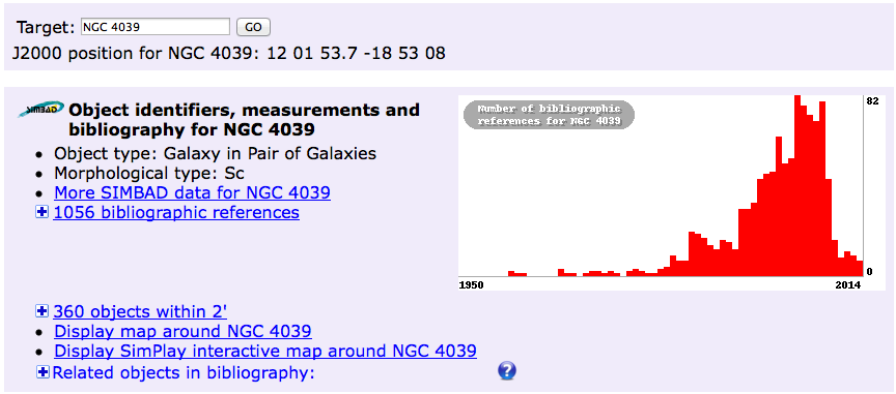
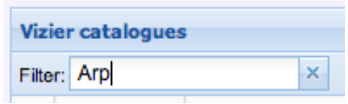
Search for information on NGC 4039 in the CDS Portal

- **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 - Identifiers, Basic Measurements and links to the Bibliography
  - Aladin - Images. A DSS (Digitized Sky Survey) image is shown, **click below the image to obtain a colour version**
  - Vizier - Catalogues. 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. 

- **Click on 'More SIMBAD data...'** to see the full SIMBAD information on this object**.** 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: Object classification in SIMBAD
  - 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

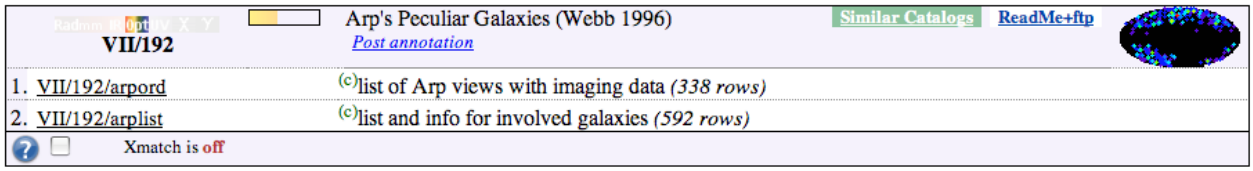


- **Return to the CDS Portal page, and go to the Vizier catalogues section**
  - The Antennae is listed in the Arp Atlas of Peculiar Galaxies.
  - Filter the Vizier catalogues returned for NGC 4039, **by typing 'Arp' into the Filter box** in the Vizier part of the CDS Portal.



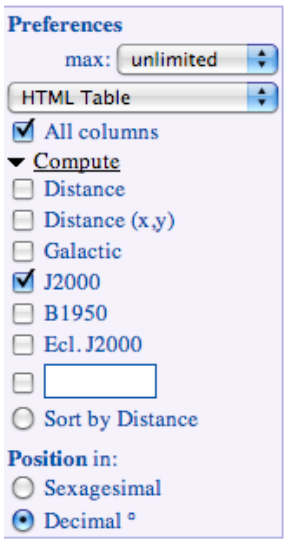
  - **Click on 'Query' of the Webb 1996 catalogue** to take you to the Vizier detailed query page

  - Note that this catalogue contains two tables. **Select the VII/192/arplist table by clicking on it**



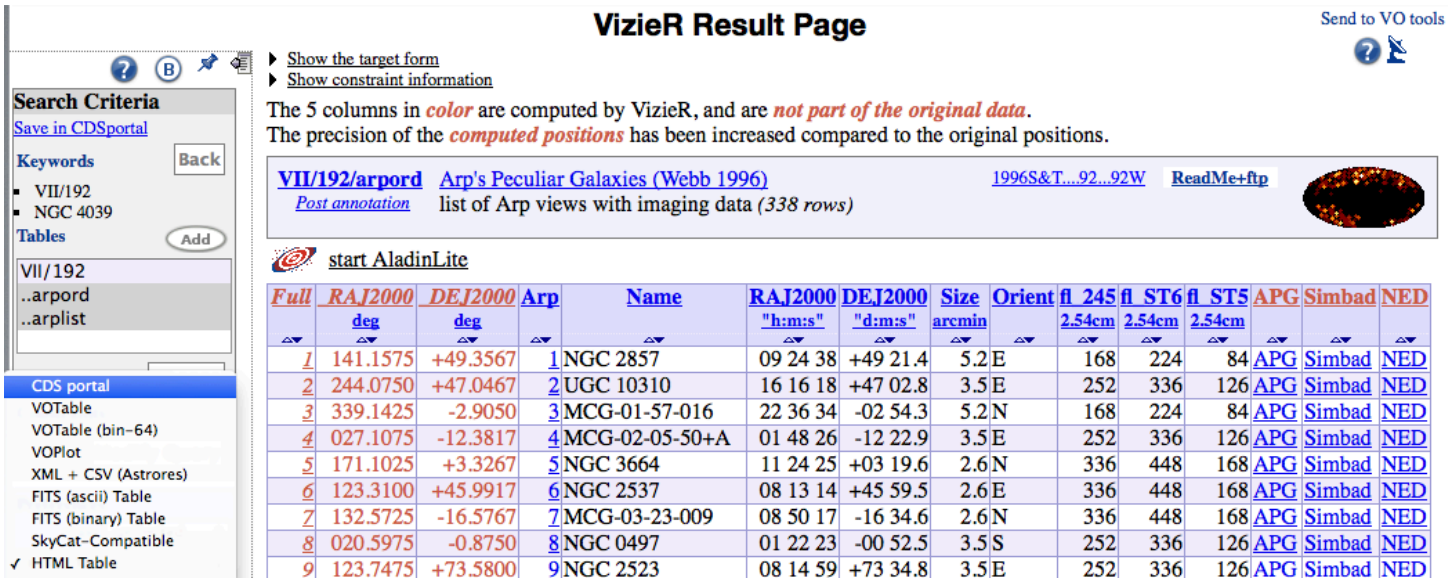
  - **Make a first query on this table by clicking 'submit',** and examine the output as html
  - **Modify the query preferences** to add extra coordinate columns in J2000 decimal degrees, and to obtain the whole catalogue
    - remove the restriction on searching only around NGC 4039 by **clearing the target name** at the top of the form
    - **add extra coordinate columns** in decimal degrees by **checking the J2000 and decimal boxes** in the Preferences window on the left

- **change the maximum number of rows returned** to 'Unlimited' in order to get the whole catalogue



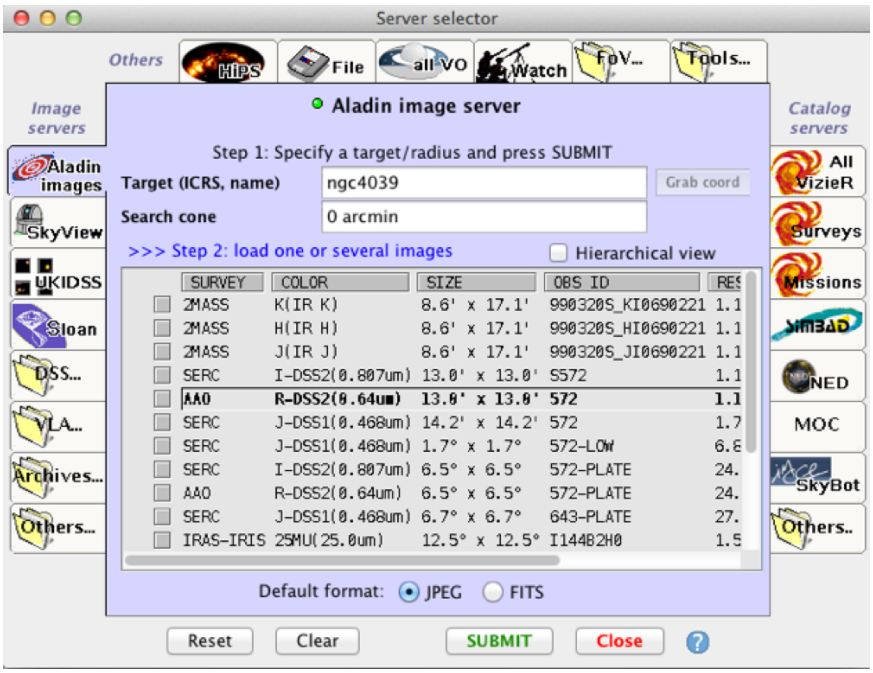
- then **'submit'** again
- When you are satisfied with the changes, select **save to 'CDS Portal'** in the Preferences window and submit again.
- The saved file is now shown in your personal user space on the CDS Portal.

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



Full	RAJ2000 deg	DEJ2000 deg	Arp	Name	RAJ2000 "h:m:s"	DEJ2000 "d:m:s"	Size arcmin	Orient	fl_245 2.54cm	fl_ST6 2.54cm	fl_ST5 2.54cm	APG	Simbad	NED
1	141.1575	+49.3567	1	NGC 2857	09 24 38	+49 21.4	5.2	E	168	224	84	APG	Simbad	NED
2	244.0750	+47.0467	2	UGC 10310	16 16 18	+47 02.8	3.5	E	252	336	126	APG	Simbad	NED
3	339.1425	-2.9050	3	MCG-01-57-016	22 36 34	-02 54.3	5.2	N	168	224	84	APG	Simbad	NED
4	027.1075	-12.3817	4	MCG-02-05-50+A	01 48 26	-12 22.9	3.5	E	252	336	126	APG	Simbad	NED
5	171.1025	+3.3267	5	NGC 3664	11 24 25	+03 19.6	2.6	N	336	448	168	APG	Simbad	NED
6	123.3100	+45.9917	6	NGC 2537	08 13 14	+45 59.5	2.6	E	336	448	168	APG	Simbad	NED
7	132.5725	-16.5767	7	MCG-03-23-009	08 50 17	-16 34.6	2.6	N	336	448	168	APG	Simbad	NED
8	020.5975	-0.8750	8	NGC 0497	01 22 23	-00 52.5	3.5	S	252	336	126	APG	Simbad	NED
9	123.7475	+73.5800	9	NGC 2523	08 14 59	+73 34.8	3.5	E	252	336	126	APG	Simbad	NED

Search for data on NGC 4039 in Aladin

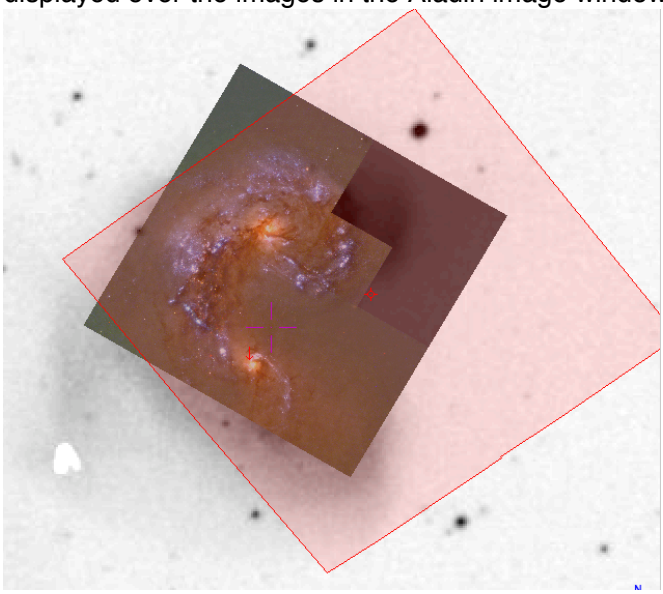
- **Open Aladin** with 1GB of memory allocated to the java virtual machine **java -Xmx1024m -jar Aladin.jar**
- Open the Server Selector window **via File>Open, or by clicking the File icon** in the top left of the Aladin window
  - The Server Selector provides access to Image servers on the left, catalogue 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 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 SIMBAD and choosing the 'Galaxy' as the Display filter.
- Change the colour of the SIMBAD plane using the plane Properties prop
- 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 rgb
- 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:**
  - **Multiview :** View>Create one view per image , or via the multiview icons at the bottom left of the Aladin image window multiview
  - Align and scale all images by using the match icon match 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 **resricted search** from data from selected services use the **'Detailed List**'. To do this, first 'unselect all', then choose the services you want to query,
e.g:

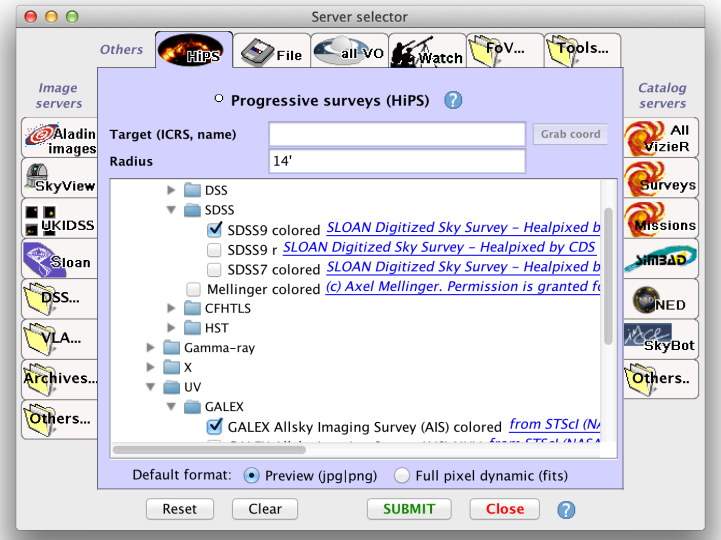
- Hubble Legacy Archive
- Skyview Virtual Observatory
- Chandra X-ray Observatory Data Archive
- ST-ECF Hubble Legacy Archive Images
  (note that the 'Filter' text box can be used to search the list).

- **Submit** to load the selected images
- Display the images in multiview 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) in the Server Selector window
- Select the **SDSS 9 colored** and **GALEX** *All Sky Imaging Survey coloured* surveys, and **submit**
-



- Turn on the coordinate grid 

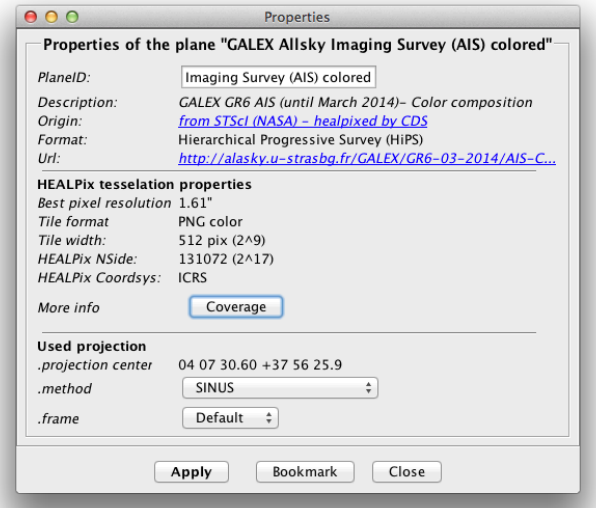
, **Zoom out** and **use the pan tool** 

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 

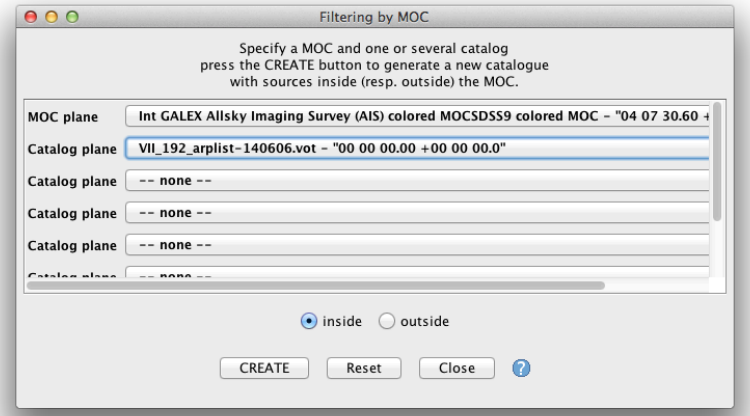
for each plane, and clicking on **'Coverage'**



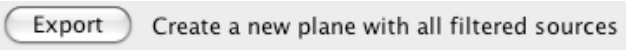
- Zoom into the edges of the surveys and note the way the MOC represents the coverage of the surveys
- **Calculate the intersection** of the coverage maps of the SDSS and GALEX surveys using menu item **Coverage > Logical operations**
- **Load the full Webb 1996 Arp catalogue** that you saved earlier (by file>load, or by drag and drop, or download again via the Vizier interface in the Catalogue Servers in Aladin)

Filter the catalogue to select only the souces that fall within the SDSS+GALEX MOC

- **Coverage > Filter a table by MOC** *(which should select about 426 sources)*



- **Visualise the selected sources** by extracting small images from the SDSS survey ('thumbnails')
  - **First select the brightest galaxies by using a filter:**
    - Add a filter to the stack using the filter tool 

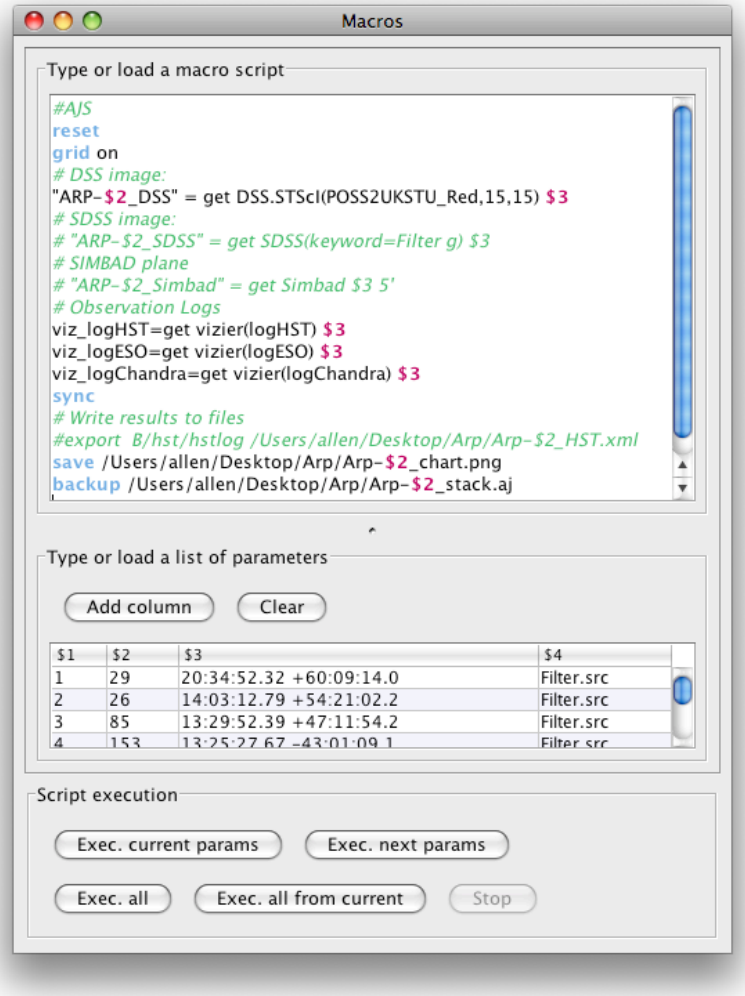
    - **Choose the 'Show brightest stars' pre-defined filter**, and edit it by going into 'Advanced mode' and modify it to select objects with magnitude **< 9**. (Note that the VT column is automatically identified with the Unified Content Descriptor 'phot.mag*')
    - Make sure that only the MOC filtered catalogue is active (otherwise sources in other planes may also be filtered)
    - In the filter Properties (click on the 'prop' icon next to the stack), create a new plane consisting only of the sources selected by the filter by clicking the 'export' button
    - 

  - Optional - **Alternative ways to select objects from the catalogue using constraints**
    - **Alternative 1:** Select all the sources in the catalogue, and sort them based on the VT column by clicking on the column name at the top of the table in the measurements window. Tag the brightest sources by checking the boxes, and save the tagged sources as a new plane
    - **Alternative 2:** Open TOPCAT and send the catalogue plane to TOPCAT by right-clicking the catalogue plane and selecting 'Broadcast selected tables to > TOPCAT'. Use TOPCAT to make a subset of the brightest sources and send the result back to Aladin

- **Make thumbnails of the 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**
  - **Open the Aladin macro controller** Tool>Macro controller
  - **Load the script** ( Arp_script.ajs) into the macro controller (Tools>Macro Controler then File>Load script, or cut and paste the script into the top panel of the Macros window)
  - **Create a folder called 'Arp'** and edit the script to insert a sensible path for saving the output files, e.g. ~/Desktop/Arp
  - **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