Part II: Classification of galaxies using mid-IR colors

WISE The Wide-field Infrared Survey Explorer

at IPAC

NASA's Wide-field Infrared Survey Explorer (WISE; Wright et al. 2010) mapped the sky at 3.4, 4.6, 12, and 22 μm (W1, W2, W3, W4) in 2010 with an angular resolution of 6.1", 6.4", 6.5", & 12.0" in the four bands.

The WISE Source Catalog contains the attributes for 563,921,584 point-like and resolved objects detected on the Atlas Intensity images.

Catalog sources are required to have a measured SNR>5 in at least one band, and to meet other criteria to insure a high degree of reliability.

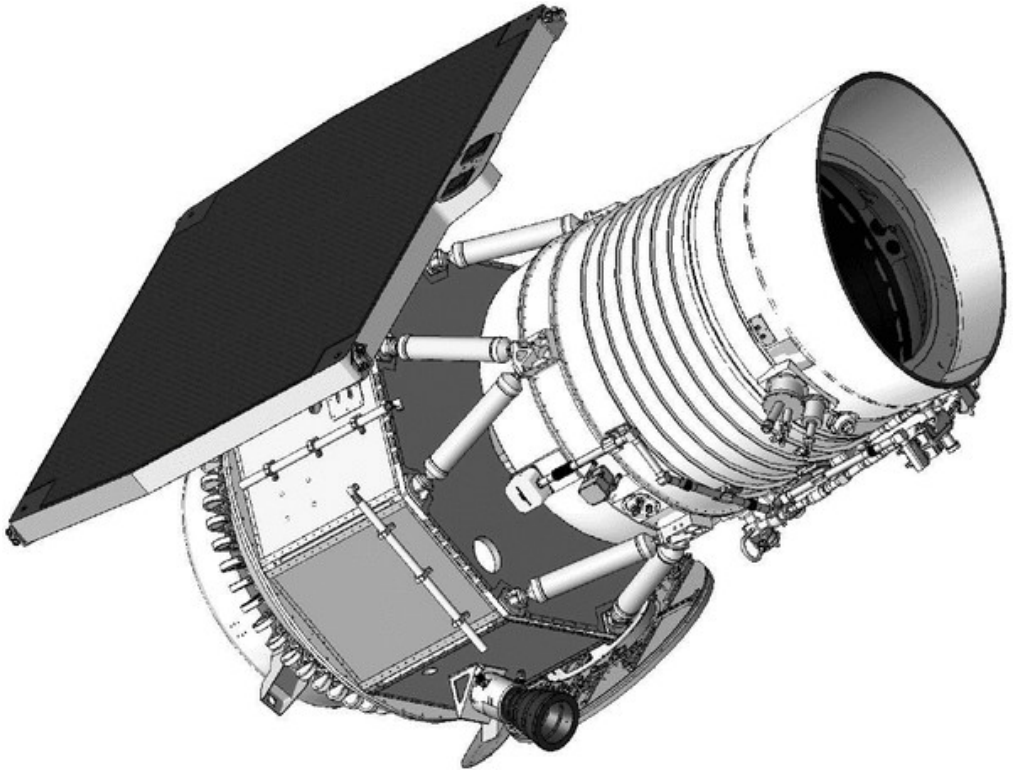
WISE Mission facts

The mission was planned to create infrared images of 99 percent of the sky, with at least eight images made of each position on the sky in order to increase accuracy.

The spacecraft was placed in a 525 km, circular, polar, Sun-synchronous orbit for its ten-month mission, during which it has taken 1.5 million images, one every 11 seconds.

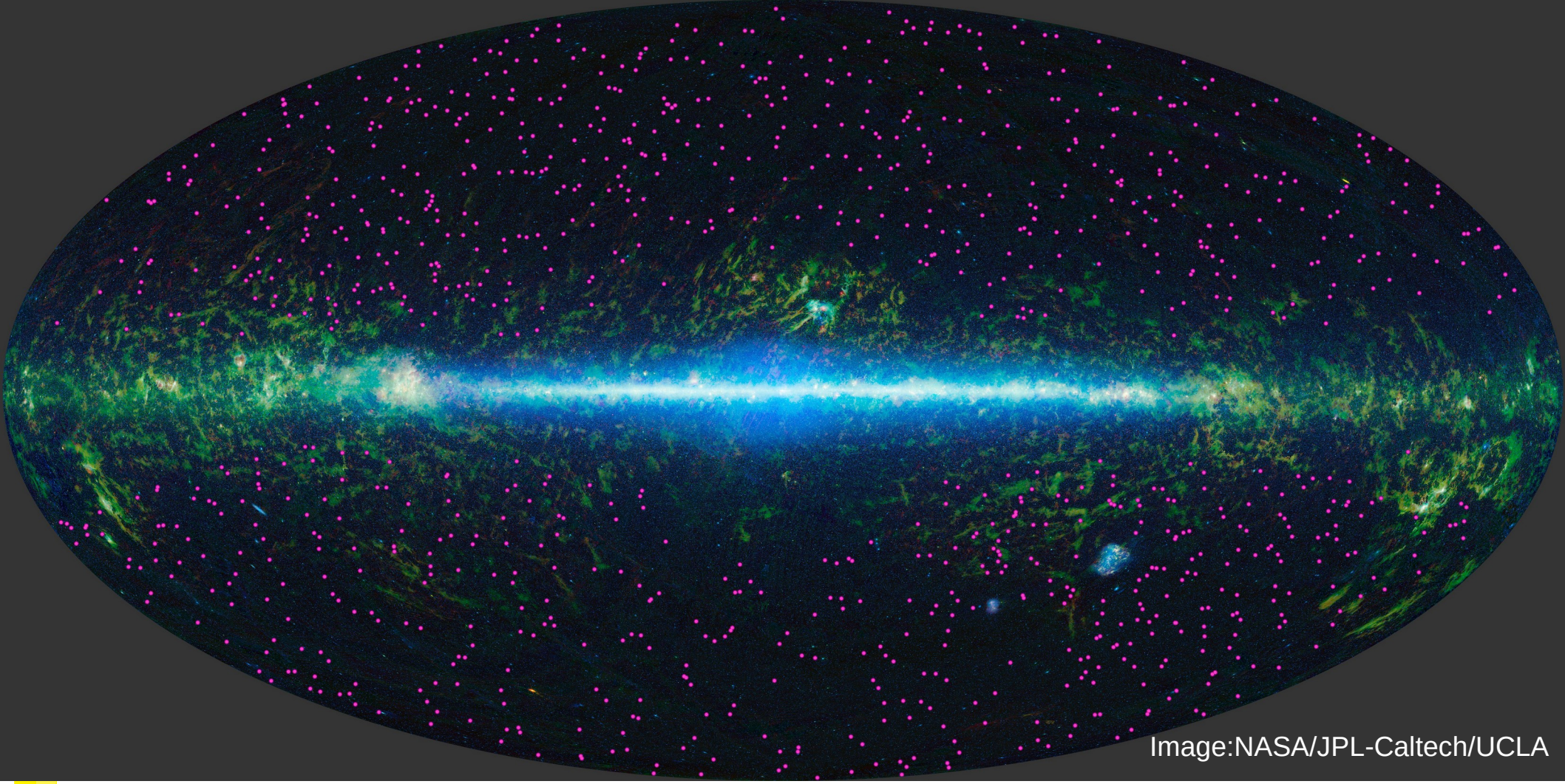
The produced image library contains data on the local Solar System, the Milky Way, and the more distant universe. Among the objects WISE studied are asteroids, cool, dim stars such as brown dwarfs, and the most luminous infrared galaxies.

WISE satellite



The WISE flight system in survey configuration with cover off.

NASA's Wide-field Infrared Survey Explorer, or WISE, spacecraft is situated on a work stand before launch



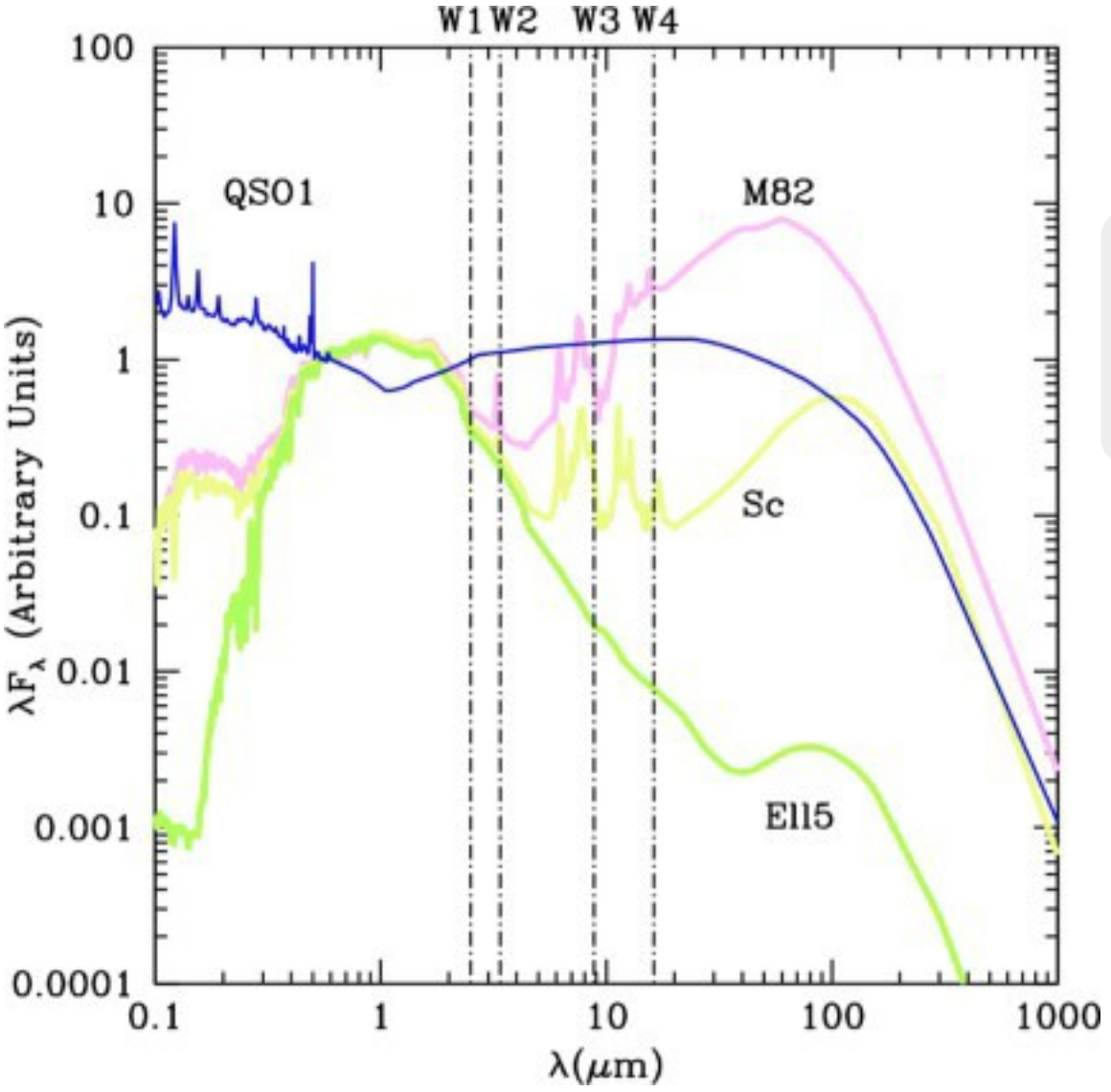
NASA's Wide-field Infrared Survey Explorer (WISE) has identified about 1,000 extremely obscured objects over the sky, as marked by the magenta symbols. These hot dust-obscured galaxies, or "hot DOGs," are turning out to be among the most luminous, or intrinsically bright objects known, in some cases putting out over 1,000 times more energy than our Milky Way galaxy.

One example image

Wolf-Rayet wind bubble NGC 2359 in the infrared using W1 as blue, W2 as cyan, W3 as green, and W4 as red.

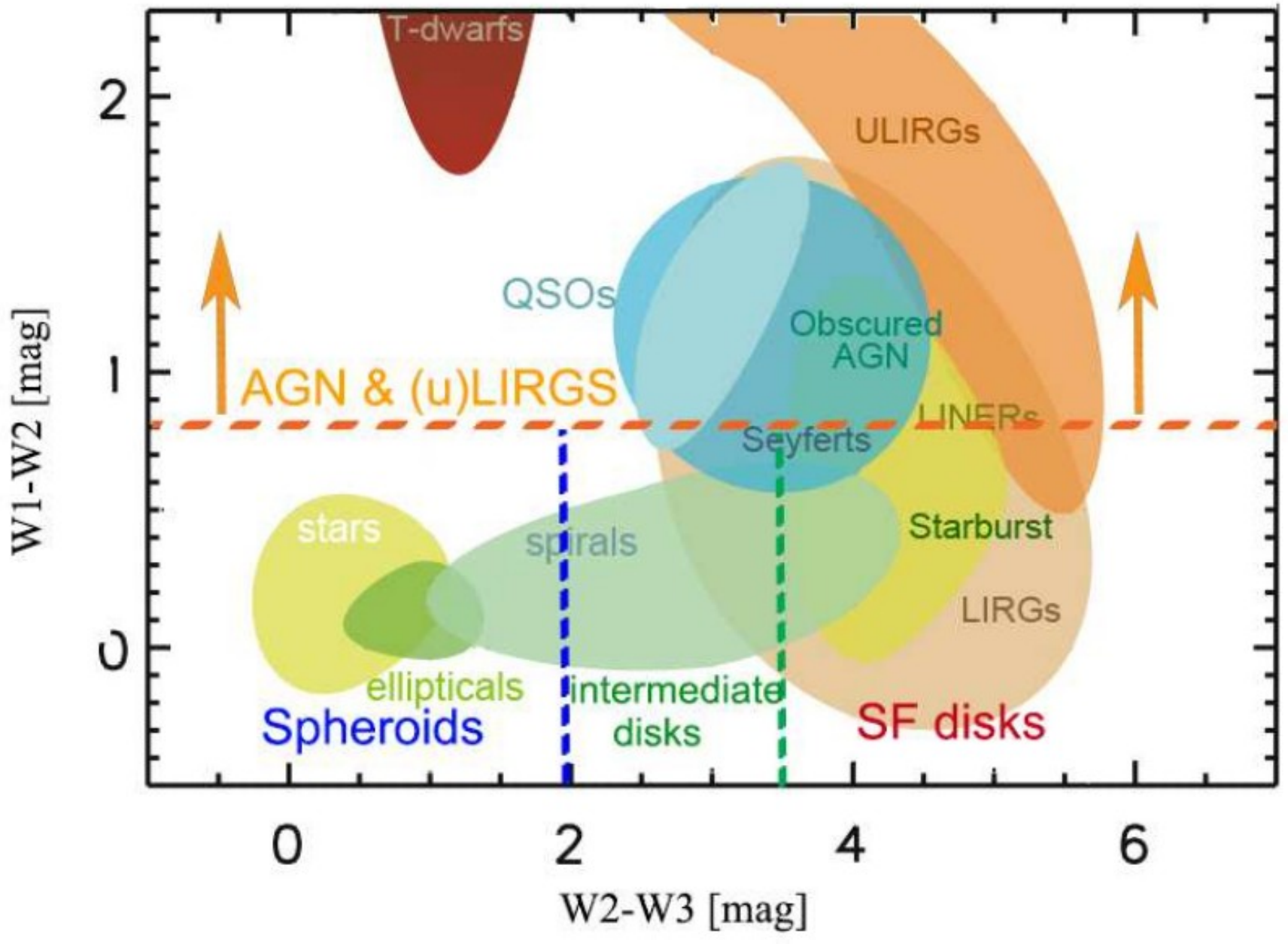
SED and W1,W2, W3 & W4

SEDs of typical galaxies, with the four WISE bands marked.

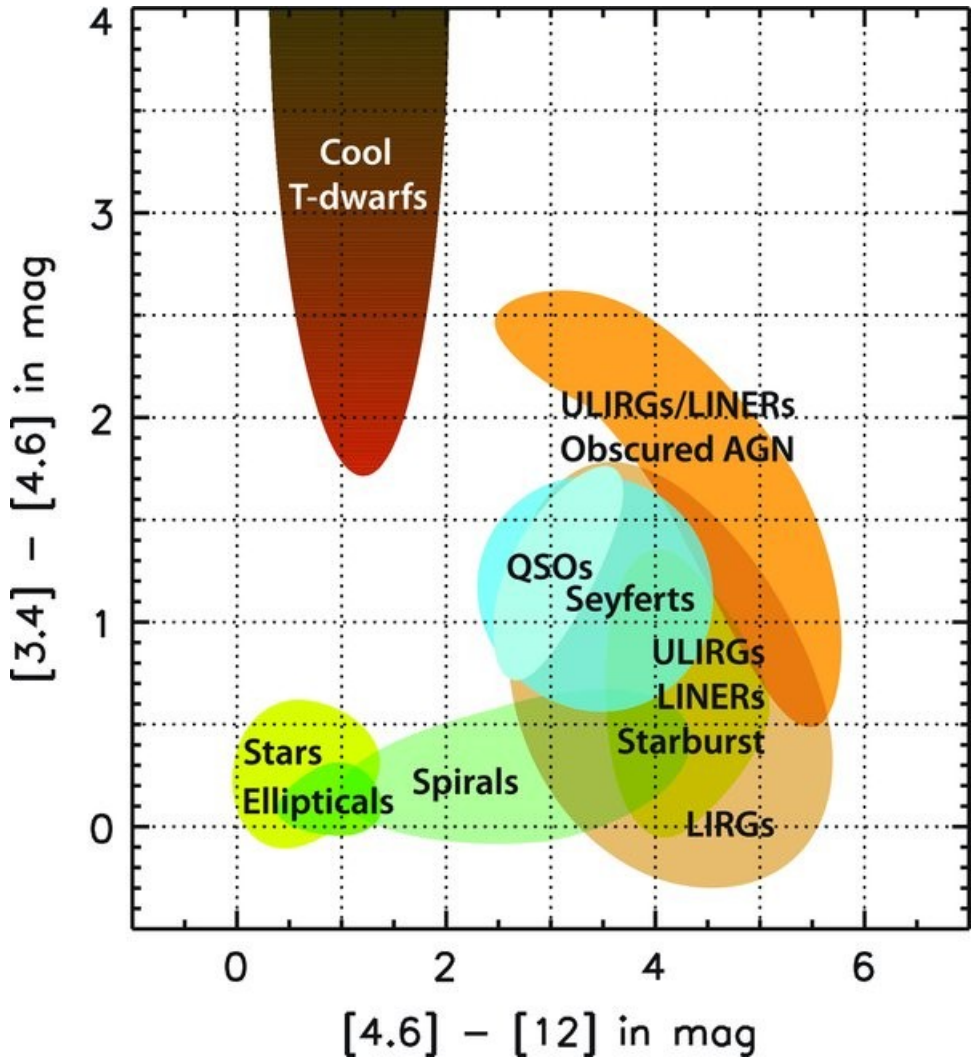


How can we use it?

WISE color-color diagram showing location of different galaxy types defined from Wright et al. 2010



WISE color-color diagram



Color–color diagram showing the locations of interesting classes of objects.

Stars and early-type galaxies have colors near zero, while brown dwarfs are very red in W1–W2.

Spiral galaxies are red in W2–W3, and ULIRGS tend to be red in both colors.

Assignment: **WISE color-color diagram**

Due for report: 28.04.2023. (Friday)

1. For the sample of galaxies selected from SDSS database in Part I, find the corresponding WISE colors using WISE fluxes from Cross-identifications link: https://skyserver.sdss.org/dr14/en/help/docs/realquery.aspx#wisexmatch

2. Assign classes (AGN & (u)LIRGS, Spheroids, Intermediate disks and SF disks) to all objects in the sample using the thresholds from the image on the bottom right (dashed lines). How do these classes compare to ones obtained using BPT diagram from Part I?

3. Locate one random object on the WISE color-color plot having W1–W2>=0.8 (Assef et al. 2013) and address the following:

   - Where is the object located in this plot? Mark it clearly on the graph.
   - Does it agree with the optical classification from BPT diagram?
   - Draw some conclusions about the type of AGN using the WISE color-color plot.

https://skyserver.sdss.org/dr14/en/help/docs/realquery.aspx#wisexmatch

This template SQL query can be your starting point.

Load this query and adopt it further.

Use Schema browser to explore WISE tables on SDSS

References

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Kewley et al. 2001, https://ui.adsabs.harvard.edu/abs/2001ApJ...556..121K

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http://wise2.ipac.caltech.edu/docs/release/allsky/

http://wise2.ipac.caltech.edu/docs/release/allwise/

http://wise.ssl.berkeley.edu/

Artist concept of WISE spacecraft
Image:NASA/JPL-Caltech