

Homework Assignment

1. Extract the sample of Green Pea galaxies from Cardamone et al., 2009 (both star forming and NLS1s) and classify them using the BPT diagram, WISE colour-colour plot.
2. In brief, describe the common AGN/star forming galaxy classification methods used here (BPT diagram and WISE colour-colour plot) and their limitations when dealing with low-metallicity dwarf galaxies (or the high-z counterparts).

The primary aim of this assignment is to familiarize with the galaxy classification methodology, both from the theoretical point, but also practically. The assignment will give a taste of working with python packages designed for astronomical purpose. Students will also learn how to access large datasets, match catalogues and clean data tables.

Step by step guide

Necessary software:

Python, numpy, matplotlib.

TopCat <https://www.star.bris.ac.uk/~mbt/topcat/>

Astropy <https://docs.astropy.org/en/stable/install.html#installing-astropy>

Familiarize yourself with reading FITS tables, joining/modifying tables, and matching datasets by RA-DEC.

Astroquery <https://astroquery.readthedocs.io/en/latest/index.html>

Obtaining the sample:

On <https://ui.adsabs.harvard.edu>, search for the paper by Cardamone et al., 2009, go to the publisher webpage, find the appropriate data tables and save them as .csv files. The important columns are RA, DEC and redshift (z). If necessary, you can delete all other columns.

Obtaining line luminosities:

Download the following two tables from SDSS DR8
(https://www.sdss4.org/dr17/spectro/galaxy_mpajhu/):

1. galspecinfo
2. galspecline

The first table galspecinfo contains the basic information of observed sources. The important columns of interest for us are SPECOBJID and RA and DEC. As you will notice, the second table, galspecline, does not contain RA and DEC columns. The two datasets are organized such that the sources are matched, line by line, by their SPECOBJID. So, in order for the tables to be useful for

us, we want to join them together.

Using astropy tables, join the two tables (you can save this table as a separate csv or fits file on your computer for future access). Inspect the tables and remove sources/lines which have unphysical data (values -1 or -9999 etc).

After this, you can cross-match the Cardamone+09 table with the table above. Use the catalog matching functionality within astropy to match the catalogs. Alternatively, you can load the Cardamone+09 and the combined SDSS galspec tables in TOPCAT and match the two catalogs there and save the result to your computer. This will give you the SDSS line parameters for all the sources, which you can use to plot the BPT diagram.

Obtaining WISE colours:

Similar to the catalog matching mentioned above, you can obtain the WISE data by matching the sources in the Cardamone+09 table to the WISE catalog, using the astroquery function. The details of the matching procedure are mentioned here <https://astroquery.readthedocs.io/en/latest/ipac/irsa/irsa.html>. Using the WISE magnitudes in the four bands (W1, W2, W3, and W4), construct the WISE colour-colour diagram.

If, at any point during the assignment, you have any problems, or if you do not know how to perform certain steps, do not hesitate to contact me. I will be happy to provide all the assistance. If needed, we can have an in-person meeting in 2026 to work on the assignment together.