AS730 - Galaxies 2024B
Homework 2

Problem 1.
In this problem you will reproduce the mass-metallicity relation for local galaxies. We will again use the SDSS "value added" catalogs from HW1: https://www.sdss.org/dr12/spectro/galaxy_mpajhu/. Identify the catalogs that contain stellar mass, star formation rate, and Oxygen abundance estimates. Use these catalogs to select a large sample of galaxies at **low redshift** with **robust** determinations of these quantities (How did you make sure these are robust?).

- Reproduce the stellar mass-metallicity plot (Figure 6, Tremonti et al. 2004). *Note that if you plot the points, the figure becomes almost illegible, so consider making a 2D histogram or giving transparency to very small points.*
- Now color code the points by SFR (or the bins, depending on what you decided to do in the previous step. If you used bins, you need to estimate the average per bin).

Problem 2.
Use the same "value added" catalogs. Select a small random sample (~100 galaxies) with reliable and robust Hα and Hβ flux measurements. Use them to estimate "extinction corrected" SFRs for these galaxies. Explain your steps, assumptions, etc. (e.g., what reddening law did you use and why?).
Compare them to the SFR estimates from the same catalogs. Are they similar or different? What could explain the differences?

Problem 3.
In this problem you will create a synthetic SED using stellar population models (we will ignore nebular emission but we will include dust attenuation).

a. Go to the BPASS website (https://bpass.auckland.ac.nz/) and download their default simple stellar population with Solar metallicity (take a look at the manual to figure out which one is the default for the latest version: https://bpass.auckland.ac.nz/14.html).
b. The homework includes a SFH file (sfh.dat) which contains two columns. The first one is time in Myr since the Big Bang, the second is SFR in Msun/yr (it is one of the SFHs from the simulation by Tacchella et al. 2018). You must use this SFH to create a composite SED.
c. Now apply a Calzetti et al. (2000) extinction law with Av=1.
d. For comparison, you must now install FSPS and python FSPS on your computer (https://dfm.io/python-fsps/current/ and follow the instructions there). We will use it to re-create the composite SED with the same SFH and extinction but notice that FSPS uses a different set of stellar templates and evolutionary tracks.
e. What about the IMF?

f. Compare the results. Can you explain the differences that you see based on your understanding of the two different codes?

You must provide the codes used to create the synthetic SED and a plot of the SEDs in the UV-NIR range. You can do it in a jupyter notebook, for example, but you can use whatever language you are comfortable with.