Galaxies Assignment
Modelling Galaxy Spectra

In this assignment, you will learn to model spectra of galaxies (a sample of four) from the GAMA survey using the BAGPIPES package built using python. We will use photometric observations in different wavebands from the GAMA survey to model the galaxy spectra.

Galaxy and Mass Assembly, GAMA is an imaging and spectroscopic survey of about 300,000 galaxies spread over 290 square degrees of the sky, with a magnitude cut of sources brighter than r < 19.8 mag. The technical details of the survey are described in Driver et al. (2009).

Bayesian Analysis of Galaxies for Physical Inference and Parameter EStimation (BAGPIPES) is a state-of-the-art Python code for modeling galaxy spectra and fitting spectroscopic and photometric observations. More about BAGPIPES and its usage for fitting photometric observations can be found in Carnall et al. (2018). BAGPIPES can be installed by following the instructions from here.

You will be getting two ASCII files with photometric data. One of these contains photometric data of 2 galaxies in 21 wavebands, and the other has photometric data of two more galaxies in 5 bands (SDSS photometric bands). The 21 photometric bands are:

- GALEX: FUV, NUV
- SDSS: u,g,r, i,z
- VIKING: Z,Y,J,H,Ks
- WISE: W1,W2,W3,W4
- Herschel PACS: $100\,\mu m$,$160\,\mu m$
- Herschel SPIRE: $250\,\mu m$,$350\,\mu m$,$500\,\mu m$

To get started with BAGPIPES you can look at the iPython notebook examples given in their GitHub. For this assignment, we will mainly focus on the third example which is fitting photometric data.

You will need filter response curves for those 21 photometric bands, which you can get it from the SVO Filter Profile Service. In the above-given example, we can see that we need to define the model we want to fit the data, although the example provides only one example model, you can look at how to fit a complex model in the fourth example, and all the different parameters that you can define for your own custom model in section 3.1 of Carnall et al. (2018).

Your goal is to use BAGPIPES to generate a synthetic SED for each of the four galaxies using their respective photometric magnitudes in the different wavebands.

For each galaxy,

1. include a figure that shows the best-fit synthetic SED with the photometric magnitudes overlaid
2. list the values for the following quantities, along with uncertainty, derived from the posterior distribution (a) SFR (b) stellar mass (c) redshift of the galaxy, and (d) age of the underlying stellar population.
3. put forward your best guess-estimate on what morphological type(s) the galaxy could be.
4. Comment on whether 21-band photometry yields more exact results than 5-band photometry, or is it the other way, and the reason as to why?

The final submission should be a single PDF file with your name and student ID number listed on top.