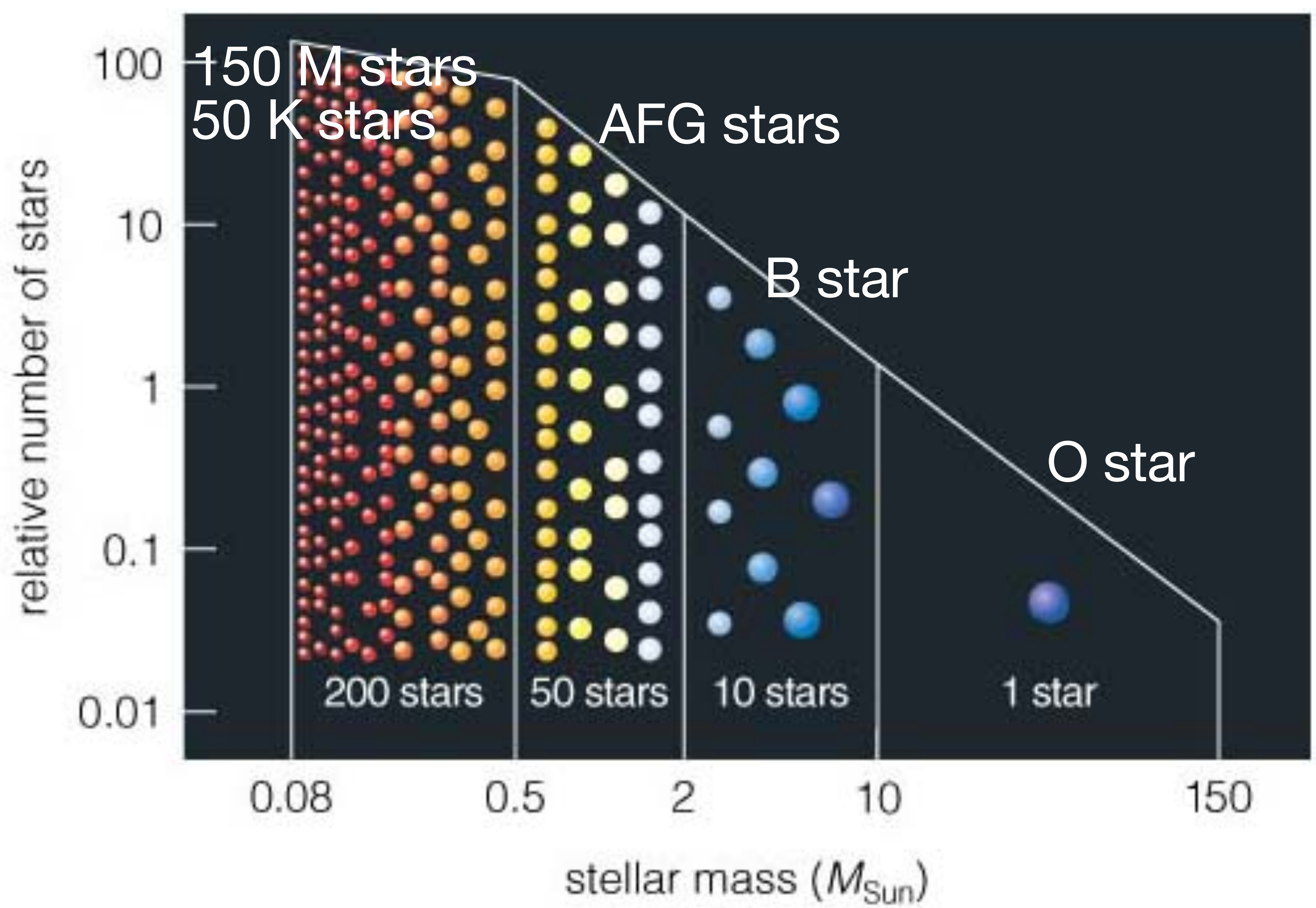
Building your own galaxy spectra

1. You have ascii files of different spectra for different stellar types (wavelength [A], flux density [erg/s/cm^2/A], arbitrary distance, solar Z). Plot the spectra in one figure (scale flux if needed). Recap the difference of the star spectra.

2. Now assume you have a stellar population of age 0 Gyr and solar metallicity. Compute the composite stellar spectrum by following the distribution of individual stars in the graph below (IMF-like):



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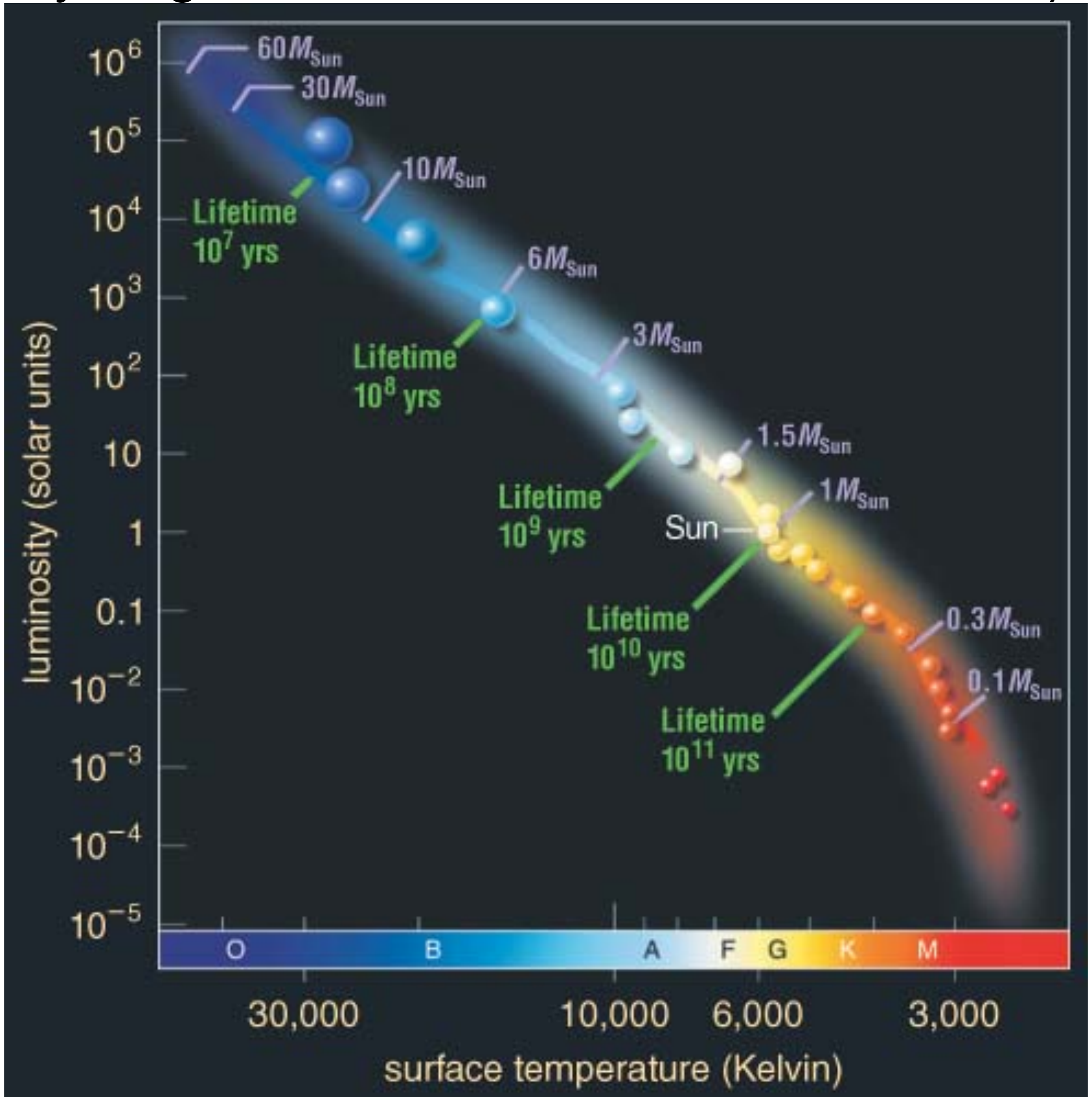
3. Continue to consider the life time of stars on the MS (as schematically visualised below), and compute the spectra for an SSP of 0.1 Gyr, 1 Gyr and of 10 Gyr (for simplicity, neglect emission from stars off the MS)



Exercises — 2

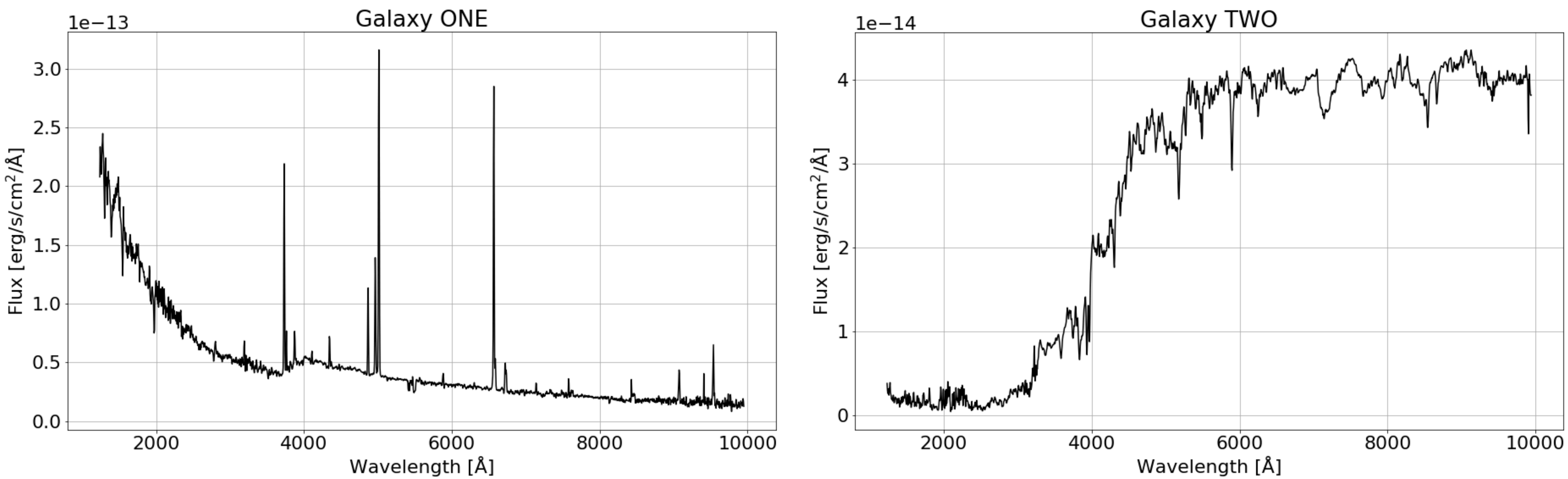
Building your own galaxy spectra

4. Assume a galaxy is mainly composed of SSPs of age 0 Gyr, of age 0.1, 1 Gyr and of age 10 Gyr, each with a relative contribution of 0.1, 0.1,0.3, and 0.5 to the total spectrum (to weight the flux when summing up). How does the spectrum look like?

5. How does the spectrum change if the galaxy consists only of SSPs older than 1Gyr?

6. Look at the two real galaxy spectra below. What can you conclude about their stellar populations and galaxy properties?

7. What are the “line features” in galaxy one? And which general simplifications have we made in points 1-4 compared to reality?



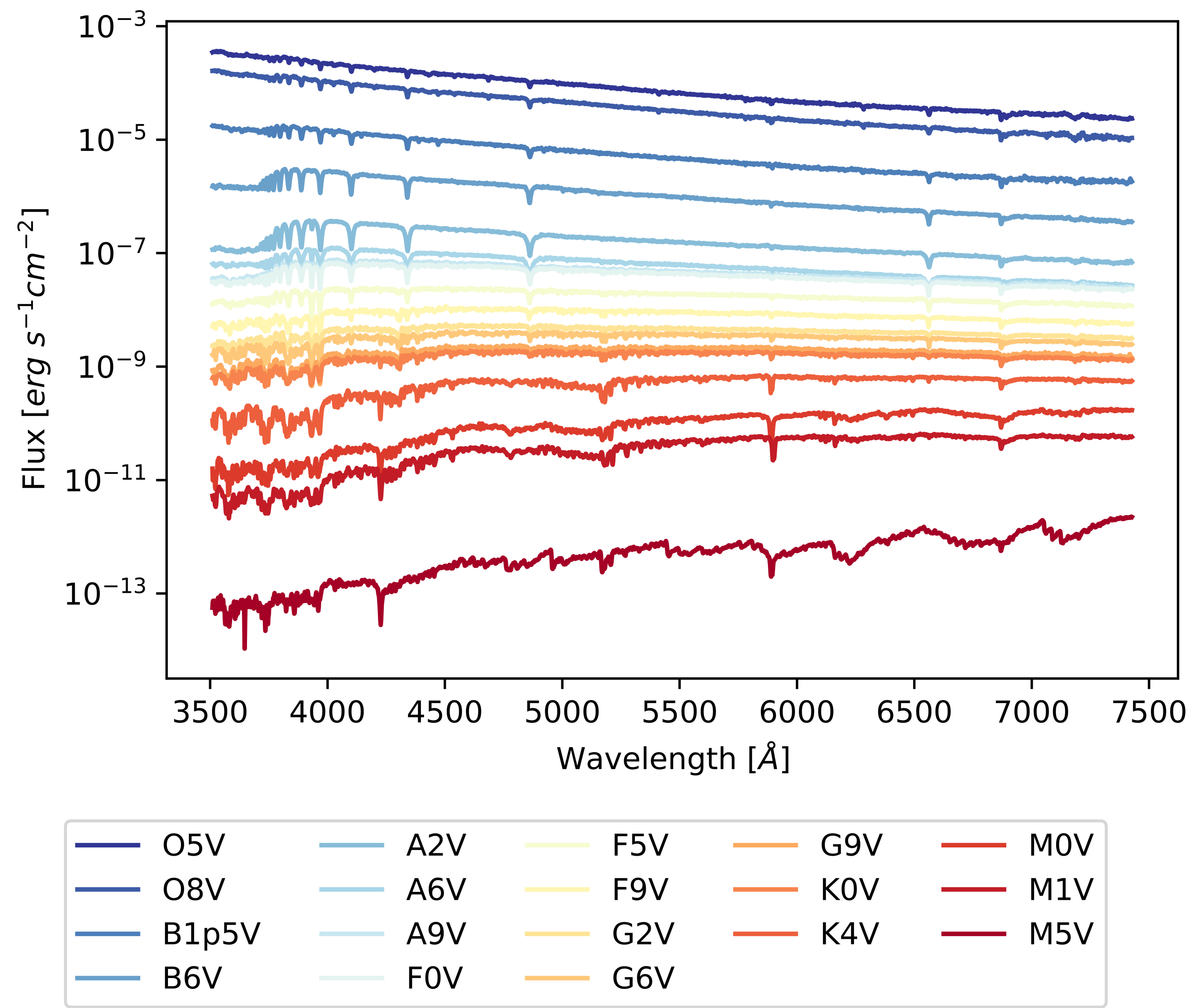
Solutions — 2

1. The spectra differ in three main ways:

a) More massive, hotter stars (O, A, B) produce an overall greater flux output.

b) More massive, hotter stars produce proportionally more intense UV continuum emission, whereas cooler stars have their peak at longer wavelengths.

c) Colder stars show progressively more absorption lines (metals and molecules), as in hot stars atoms more massive than hydrogen and helium are dissociated.



Bonus:

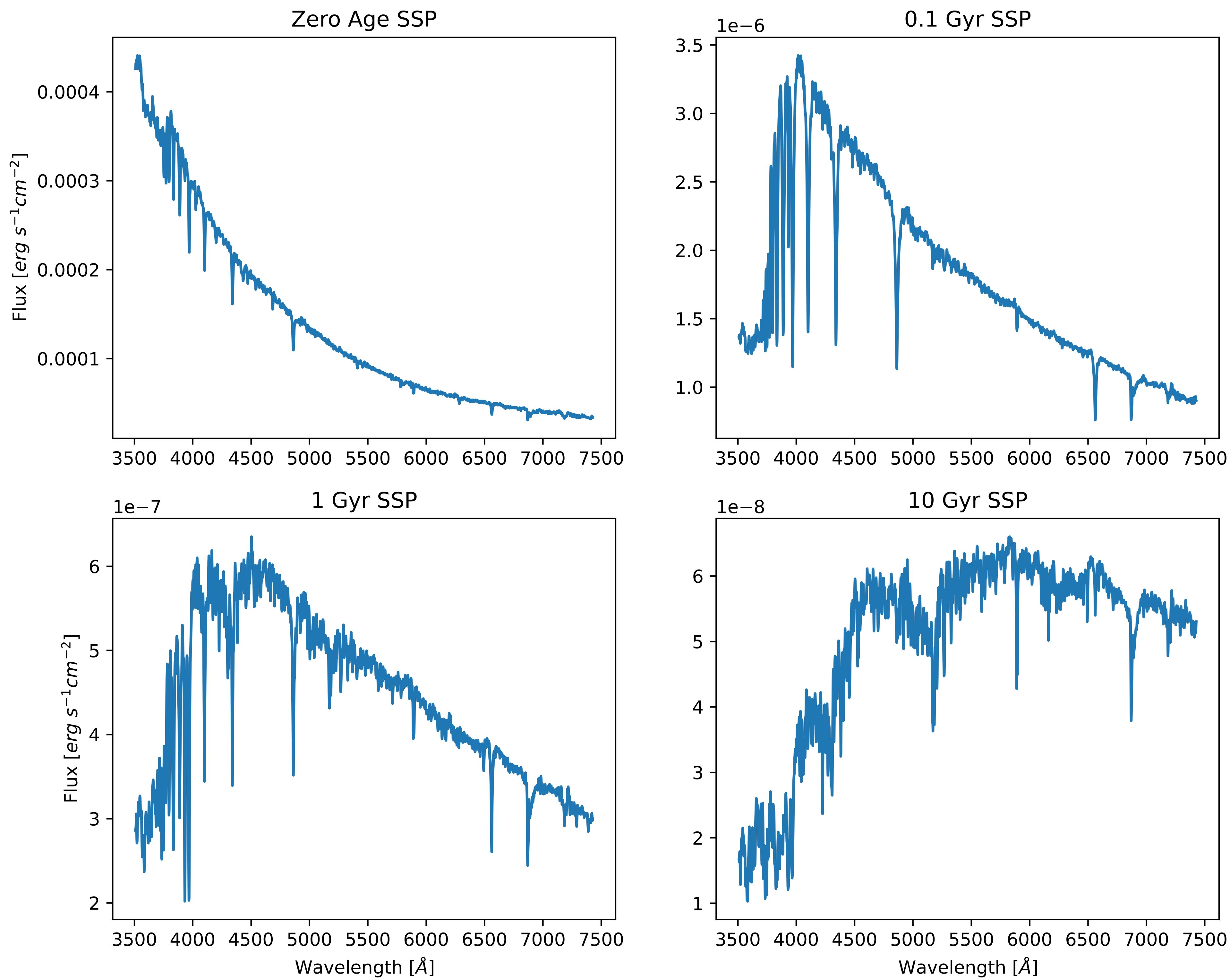
a) Balmer break appears for A and F stars

b) M stars show broad absorption features caused by the presence of molecules (TiO)

Solutions — 2

2&3.

Approach: adjust the remaining stellar population from the IMF according to the stellar lifetimes.



4-7.

Our galaxy containing all types of SSPs looks similar to galaxy ONE. We can therefore conclude that this is a galaxy with recent starbursts, which are likely young spiral galaxies. Galaxy TWO looks like our galaxy made up of older stellar populations, meaning it is old, without recent star formation. These galaxies are usually ellipticals.

The line features are a result of young stars ionising and exciting the interstellar gas, followed by de-excitations. This process has not been accounted for in our models. Other simplifications include assuming only single stars, a universal IMF made up of 260 stars and not modelling for dust absorption.