

Homework #8

Galactic Chemical Evolution

Assigned: April 28, 2021 Due: May 12, 2021

Please submit your answers to the questions below in writing. Please also submit a copy of the Jupyter notebook that contains your best case scenario, i.e., your optimized parameters (question f).

This homework set focuses on exploring a simple GCE model. As in homework #4, you will be using a Jupyter notebook that is available on AstroHub.¹

The Jupyter notebook you will be using can be found in the following folder on AstroHub: `/wendi-examples/Galactic_chemical_evolution_school/`. The file is named `HS_GCE_Step_1_Constrain_MW_model.ipynb`. You should execute this file on AstroHub in order to have all data available.

Attention: The notebook has a small error in it and won't produce plots in its current stage. Please put the following in a cell before the first plot: `%matplotlib inline`. Then delete all lines that say `%matplotlib nbagg`. Plotting should now work.

Please read through the whole notebook in order to understand the different assumptions, etc. You will be modifying the parameters for run 2, e.g., the following lines:

```
# Set of parameters for the second run
# !! Please modify whatever you want !!
sfe = 0.04
t_star = 1.0e8
in_mag = 1.0
```

Please work on the following questions:

- What do the parameters `sfe`, `t_star`, and `in_mag` represent?
- Set `t_star` and `in_mag` equal to the example and change `sfe`. How do the SFR, the ISM gas mass, and the $[\text{Fe}/\text{H}]$ vary over the age of the galaxy? Interpret these trends with respect to the change of `sfe`.

¹<https://astrohub.uvic.ca>, see homework #4 for details.

- c. Set `sfe` and `in_mag` equal to the example and change `t_star`. How do the SFR, the ISM gas mass, and the $[\text{Fe}/\text{H}]$ vary over the age of the galaxy? Interpret these trends with respect to the the change of `t_star`.
- d. Set `sfe` and `t_star` equal to the example and change `in_mag`. How do the SFR, the ISM gas mass, and the $[\text{Fe}/\text{H}]$ vary over the age of the galaxy? Interpret these trends with respect to the the change of `in_mag`.
- e. Can you find a parameter set that brings the integrated stellar mass, the SFR, ISM gas mass, and the $[\text{Fe}/\text{H}]$ into agreement with the Milky Way observations?

There are several more examples on AstroHub that show you more GCE details. Please feel free to look into them, be curious, play, and have fun!