

FASMA tutorial

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1 The configuration file

To use FASMA in an automatic way, configure the “StarMe_synth.cfg”. There are 4 acceptable configurations. For more options, the synthDriver has to be adapted.

- To create a synthetic spectrum with solar values, only the line list file is required, e.g.:

```
#linelist
giraffe_sun_arcturus_calib.lst
```

The line list file should be in the rawLinelist folder. A line list is given already with FASMA.

- For a given line list select your options. The options are space separated from the line list file and the options are comma separated, e.g.:

```
#linelist options
giraffe_sun_arcturus_calib.lst observations:Sun_HARPS.fits , resolution:115000 , minimize , refine
```

This example means that for the observed spectrum ‘Sun_HARPS.fits’ with resolution 115000, FASMA will minimize it starting from solar values using the refine option. For the not listed options, FASMA uses the default ones.

- For a given line list and a set of initial values, create a synthetic spectrum. The initial parameters are space separated from the line list file, e.g.:

```
#linelist tefflogg [M/H] vt vmac vsini
giraffe_sun_arcturus_calib.lst 5777 4.44 0.0 1.0 3.21 1.9
```

- For a given line list and a set of initial values select your options. The initial parameters are space separated from the line list file and the options are comma separated, e.g.:

```
#linelist tefflogg [M/H] vt vmac vsini options
giraffe_sun_arcturus_calib.lst 5777 4.44 0.0 1.0 3.21 1.9 observations:Sun_HARPS.fits , resolution:115000 , minimize , vt , vmac , refine
```

The latter configuration is the suggested methodology.

Once the configuration file is set, run FASMA:

```
python synthDriver.py
```

1.1 Default options

The default options of FASMA can be changed in the configuration file ‘StarMe_synth.cfg’.

1. spt : False

In case the initial parameters of the stars are not known, the user can input the spectral type and luminosity class as shown in the SpectralTypes.yml file, e.g. spt:G2V.

2. model : ‘kurucz95’

The model atmospheres included in FASMA are: kurucz95, apogee_kurucz, and marcs.

3. MOOGv: 2014

The version of MOOG currently is 2014 but can easily be updated to newer versions.

4. save: False

If save = True, the output synthetic spectrum is saved in results.

5. teff: False
logg: False
feh: False
vt: False
vmac: False
vsini: False

If any of these options is set, then they are fixed in the minimization process.

6. flag_vt: False
flag_vmac: False

If any of these flags is on, the microturbulence or macroturbulence are set fixed to the values of empirical calibrations during the minimization process.

7. plot: False
plot_res: False

These are plotting options of the synthetic/observed spectra (plot) and of their residuals in case of minimization (plot_res).

8. damping: 1

The damping option of MOOG to deal with the van der Waals broadening. The acceptable values are: 0, 1, 2.

9. step_wave: 0.01
step_flux: 3.0

The wavelength step for the synthetic spectrum to be created and the flux limit to consider opacity distributions from the neighboring lines measured in Å. These are the same options of MOOG.

10. minimize: False

The minimization option is on/off.

11. refine: False

The refine option performs corrections on the derived parameters after the minimization for a more detailed analysis. After a first run, a second minimization starts with optimized microturbulence and macroturbulence values according to the parameters of the first run.

12. errors: False

The errors are calculated by shifting the free parameters by a certain value. If this option is of the errors correspond to the covariance matrix of the fit.

13. observations: False

The name of the spectrum is given here. If the spectrum is at the spectra folder there is no need to give the full path.

14. `inter_file :` `'intervals_hr10_15n.lst'`

This is the file which contains the intervals of the synthesis. FASMA already has specific intervals which correspond to the given line list. This file should be inside the `rawLinelist` folder.

15. `snr :` `None`

The signal-to-noise (SNR) values of the observed spectra can be given by the user. They are used in the normalization process. Otherwise the SNR is calculated by the `PyAstronomy` function.

16. `resolution :` `None`

The resolution of the synthetic spectrum or the resolution of the observed spectrum. This value is necessary when minimization is on.

17. `limb :` `0.6`

The limb darkening coefficient for the vsini calculations. It is set fixed to 0.6 but can have different values depending on luminosity class.