reading_data

October 13, 2016

```
In [1]: %matplotlib inline
        print('-- ')
        print('-- Read data files in different formats (and save them) in python')
        print('-- ')
```

```
--
-- Read data files in different formats (and save them) in python
--
```

```
In [2]: print('\n ---- Ascii files! ----\n')
```

```
---- Ascii files! ----
```

```
In [ ]: # In test_data/ there is a text file called spectrum2.dat with
        # data that we want to import into python.
        # (spectrum2.dat is a model stellar spectrum from starburst99 for
        # a group of stars with 0.7 x solar metallicity,
        # 1e4 solar masses population, Kroupa IMF and a starburst 1e6 years ago)
```

```
In [3]: print('Read data into numpy array!')
        import numpy as np
        # http://docs.scipy.org/doc/numpy/reference/generated/numpy.loadtxt.html
        spec_nparray    =   np.loadtxt('test_data/spectrum2.dat',skiprows=6)
        print(type(spec_nparray))
```

```
Read data into numpy array!
<type 'numpy.ndarray'>
```

```
In [4]: spec_nparray.shape
```

```
Out[4]: (1221, 5)
```

```
In [5]: t_yr = spec_nparray[:,0]
```

```
In [7]: t_yr.dtype
```

```
Out[7]: dtype('float64')
```

```
In [ ]: # The genfromtxt function from numpy is a bit more flexible
        # http://docs.scipy.org/doc/numpy/reference/generated/numpy.genfromtxt.html
```

```
In [9]: spec_nparray2    =   np.genfromtxt('test_data/spectrum2.dat',skip_header=6,\
                            names=['time','wavelength','L_tot','L_stellar','L_nebular'])
        print(type(spec_nparray2))
        print(spec_nparray[0,0])
        print(spec_nparray2['time'][0])
```

```
<type 'numpy.ndarray'>
10010000.0
10010000.0
```

```
In [12]: # and if some values are missing:
         spec_nparray2    =   np.genfromtxt('test_data/spectrum2.dat',skip_header=6,\
                            names=['time','wavelength','L_tot','L_stellar','L_nebular'],\
                            missing_values='%%%',filling_values=-1)
         print(spec_nparray2['time'][0])
         # print(spec_nparray2[0][0])
```

```
nan
```

```
In [13]: spec_nparray    =   np.loadtxt('test_data/spectrum2.dat',skiprows=6)
         print(type(spec_nparray2))
```

```
        ---------------------------------------------------------------------------

        ValueError                                Traceback (most recent call last)

        <ipython-input-13-8d1e4c47eaff> in <module>()
          1
    ----> 2 spec_nparray    =   np.loadtxt('test_data/spectrum2.dat',skiprows=6)
          3 print(type(spec_nparray2))


        /Users/Karen/anaconda2/lib/python2.7/site-packages/numpy/lib/npyio.pyc in loadtxt(fname, dtype,
        928
        929             # Convert each value according to its column and store
    --> 930             items = [conv(val) for (conv, val) in zip(converters, vals)]
        931             # Then pack it according to the dtype's nesting
        932             items = pack_items(items, packing)


        /Users/Karen/anaconda2/lib/python2.7/site-packages/numpy/lib/npyio.pyc in floatconv(x)
        657         if b'0x' in x:
        658             return float.fromhex(asstr(x))
    --> 659         return float(x)
        660
        661     typ = dtype.type


        ValueError: could not convert string to float: %%%
```

```
In [ ]: # Typically, a smarter way is to load the data directly into a pandas dataframe
        # http://pandas.pydata.org/pandas-docs/stable/dsintro.html
```

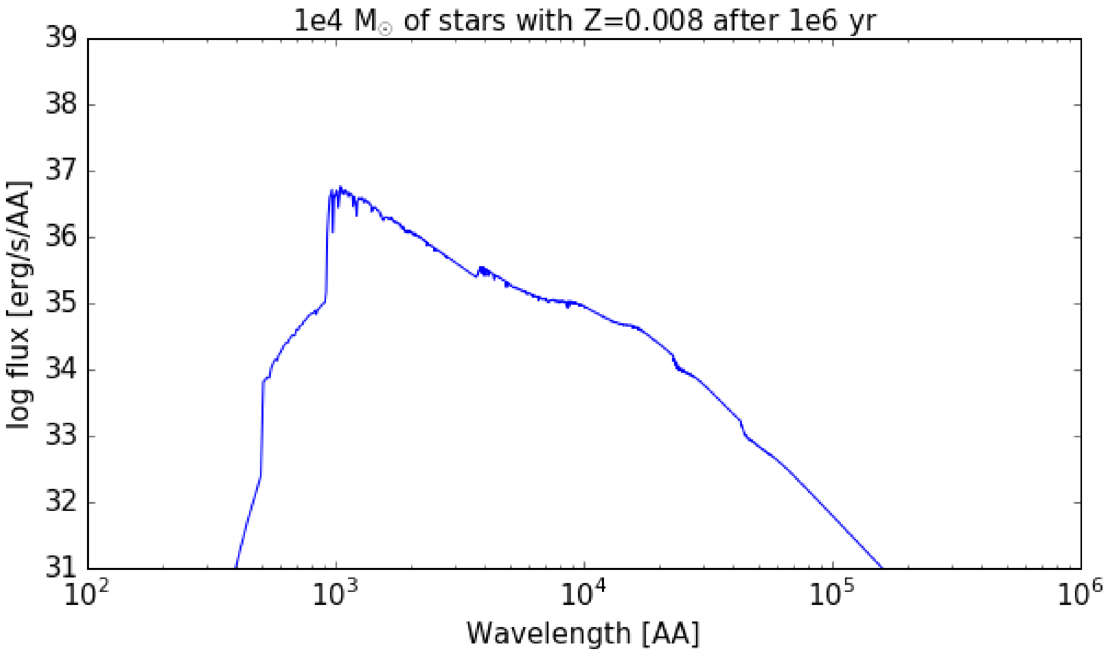
```
In [26]: print('Read data into pandas dataframe!')
         import pandas as pd
         names=['time','wavelength','L_tot','L_stellar','L_nebular']
         spec_dataframe    =   pd.read_table('test_data/spectrum2.dat',\
                         names=names,\
                         skiprows=6,sep=r"\s*",engine='python')
         print(type(spec_dataframe))
```

```
Read data into pandas dataframe!
<class 'pandas.core.frame.DataFrame'>
```

```
In [18]: spec_dataframe['time'][1]
```

```
Out[18]: 10010000.0
```

```
In [22]: # Plot spectrum
         import matplotlib.pyplot as plt
         import matplotlib as mpl
         mpl.rcParams['xtick.labelsize'] = 15
         mpl.rcParams['ytick.labelsize'] = 15
         fig          =   plt.figure(0,figsize=(10,5))
         ax1          =   fig.add_axes([0.15,0.1,0.75,0.8])
         ax1.set_ylim(31,39)
         ax1.set_xlim(1e2,1e6)
         ax1.set_xscale('log')
         ax1.set_xlabel('Wavelength [AA]',fontsize=15)
         ax1.set_ylabel('log flux [erg/s/AA]',fontsize=15)
         ax1.set_title('1e4 M$_{\odot}$ of stars with Z=0.008 after 1e6 yr',fontsize=15)#+str(t1)+' yr'
         #ax1.plot(spec_nparray[:,1],spec_nparray[:,2],'b')
         #ax1.plot(spec_nparray2['wavelength'],spec_nparray2['L_tot'],'b')
         ax1.plot(spec_dataframe['wavelength'],spec_dataframe['L_tot'],'b')
         plt.show()
```



```
In [27]: print('\n ---- Fits files! ----\n')
```

```
---- Fits files! ----
```

```
In [ ]: # In test_data/ there is a file called cloud.fits with data that we
        # want to import into python.
        # (cloud.fits is a simulated HCO+ data cube of a cloud, calculated
        # with RT code LIME)
```

```
In [33]: # Read fits file into list-like Python opject with the fits function from the astropy module
         from astropy.io import fits
         fits_file = fits.open(’test_data/cloud.fits’)
         print(type(fits_file))
         fits_file.info() # get basic info, like number of header cards and dimensions of data
```

```
<class ’astropy.io.fits.hdu.hdulist.HDUList’>
Filename: test_data/cloud.fits
No.    Name         Type      Cards   Dimensions   Format
0    PRIMARY     PrimaryHDU      34   (100, 100, 61)   float32
```

```
In [34]: print(fits_file[0].header) # display all header cards
```

```
SIMPLE  =                    T / file does conform to FITS standard             BITPIX  =
```

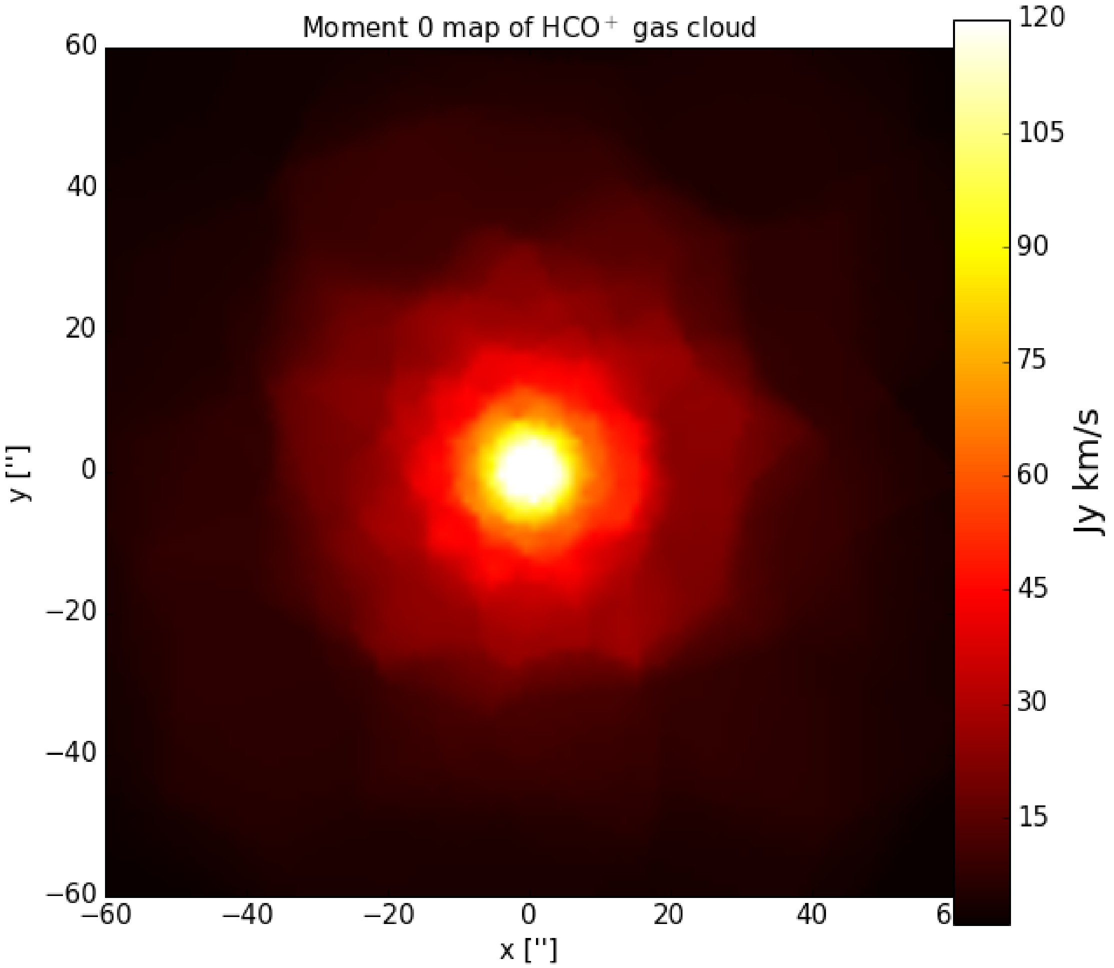
```
In [37]: # We can extract general info from the header cards like this:
         imgres = fits_file[0].header[’CDELT2’]
         print(’Image resolution: ’ + str(imgres) + ’ degrees’)
         npix = fits_file[0].header[’NAXIS3’]
         print(’Number of pixels on each side: ’ + str(npix))
         velres = fits_file[0].header[’CDELT3’]
         print(’Velocity resolution: ’ + str(velres) + ’m/s’)
         fits_file[0].header[’CDELT2’]=2.0
         print(’Image resolution: ’ + str(imgres) + ’ degrees’)
```

```
Image resolution: 2.0 degrees
Number of pixels on each side: 61
Velocity resolution: 500.0m/s
Image resolution: 2.0 degrees
```

```
In [39]: # And the actual data is an attribute of data[0]
         HCO_flux = fits_file[0].data # [velocity channels, x axis, y axis]
         print(HCO_flux[0,50,50])
         mom0 = HCO_flux.sum(axis=0)*velres/1000 # moment 0 map, Jy*km/s
```

```
0.463905
```

```
In [40]: # Contour plot of data cube
         import matplotlib.cm as cm
         fig         =   plt.figure(1,figsize=(9,9))
         ax1         =   fig.add_axes([0.15,0.1,0.75,0.8])
         ax1.set_xlabel("x [’’]",fontsize=15)
         ax1.set_ylabel("y [’’]",fontsize=15)
         ax1.set_title("Moment 0 map of HCO$^+$ gas cloud",fontsize=15)
         x1 = imgres*(np.arange(npix)-npix/2) # image axis
         xmax = max(x1)
         im = ax1.imshow(mom0,interpolation=’bilinear’,origin=’lower’,cmap=cm.hot,extent=(-xmax,xmax,-x
         cax = fig.add_axes([0.9,0.1,0.05,0.8])
         cbar = plt.colorbar(im,cax=cax)
         cbar.set_label(’Jy km/s’,size=20)
         plt.show(block=False)
```



```
In [41]: print('\n ---- Saving python data for later! ----\n')
```

```
---- Saving python data for later! ----
```

```
In [42]: print('Save a numpy array!')
         # Say you have a numpy array that you want to save to a file and load later.
         # One way to do so is with numpy:
         np.save('test_data/spec_nparray',spec_nparray) # will get a 'npy' extension
         load_spec_nparray = np.load('test_data/spec_nparray.npy')
         load_spec_nparray[0,0] # test
```

```
Save a numpy array!
```

```
Out[42]: 10010000.0
```

```
In [43]: # You can also use pickle! Or cPickle, which is pickle written in C,
         # with several advantages.
         import cPickle as pickle
         pickle.dump(spec_nparray,open('test_data/spec_nparray_pickle','wb')) # no extension
         # 'wb' is the protocol and means to write to binary format
         load_spec_nparray = pickle.load(open('test_data/spec_nparray_pickle','rb'))
         load_spec_nparray[0,0] # test
```

```
Out[43]: 10010000.0
```

```
In [44]: # You can also use pandas to save a dataframe with pickle:
         spec_dataframe.to_pickle('test_data/spec_dataframe_pickle') # no extension
         load_spec_dataframe_pickle = pd.read_pickle('test_data/spec_dataframe_pickle')
         load_spec_dataframe_pickle['time'][0] # test
```

```
Out[44]: 10010000.0
```

```
In [45]: spec_nparray.to_pickle('test_data/spec_dataframe_pickle')
```

```
        ---------------------------------------------------------------------------

        AttributeError                            Traceback (most recent call last)

        <ipython-input-45-2d44d668b928> in <module>()
    ----> 1 spec_nparray.to_pickle('test_data/spec_dataframe_pickle')


        AttributeError: 'numpy.ndarray' object has no attribute 'to_pickle'
```

```
In [ ]:
```