Using_pyCloudy_2

June 14, 2017

In [1]:
```
%matplotlib inline
import numpy as np
import matplotlib.pyplot as plt
```

In [2]:
```
import pyCloudy as pc
```

In [3]:
```
# Changing the location and version of the cloudy executable.
pc.config.cloudy_exe = '/usr/local/Cloudy/c17.00/source/cloudy.exe'
```

In [4]:
```
# We define a function that will manage the input files of Cloudy.
# This allow to easily change some parameters, very usefull to do a grid.
def make_model(dir_, model_name, dens, ab_O):
    full_model_name = '{0}_{1:.0f}_{2:.2f}'.format(model_name, dens, ab_O)
    r_min = 5e16
    dist = 1.26
    Teff = 45000
    qH = 47.
    options = ('no molecules',
               'no level2 lines',
               'no fine opacities',
               'atom h-like levels small',
               'atom he-like levels small',
               'COSMIC RAY BACKGROUND',
               'element limit off -8',
               )
    emis_tab = ['H  1  4861.36A',
            'H  1  6562.85A',
            'Ca B  5875.64A',
            'N  2  6583.45A',
            'O  1  6300.30A',
            'O  2  3726.03A',
            'O  2  3728.81A',
            'O  3  5006.84A',
            'BLND  4363.00A',
            'S  2  6716.44A',
            'S  2  6730.82A',
            'Cl 3  5517.71A',
            'Cl 3  5537.87A',
            'O  1  63.1679m',
            'O  1  145.495m',
            'C  2  157.636m']
    abund = {'He' : -0.92, 'C' : -3.15, 'N' : -4.0, 'Ne' : -4.00,
             'S' : -5.35, 'Ar' : -5.80, 'Fe' : -7.4, 'Cl' : -7.00}
    abund['O'] = ab_O
```

```
    # Defining the object that will manage the input file for Cloudy
    c_input = pc.CloudyInput('{0}{1}'.format(dir_, full_model_name))
    # Filling the object with the parameters
    # Defining the ionizing SED: Effective temperature and luminosity.
    # The lumi_unit is one of the Cloudy options, like "luminosity solar", "q(H)", "ionization f
    c_input.set_BB(Teff = Teff, lumi_unit = 'q(h)', lumi_value = qH)
    # Defining the density. You may also use set_dlaw(parameters) if you have a density law def
    c_input.set_cste_density(dens)
    # Defining the inner radius. A second parameter would be the outer radius (matter-bounded n
    c_input.set_radius(np.log10(r_min))
    c_input.set_abund(ab_dict = abund, nograins = True)
    c_input.set_other(options)
    c_input.set_iterate() # (0) for no iteration, () for one iteration, (N) for N iterations.
    c_input.set_sphere() # () or (True) : sphere, or (False): open geometry.
    c_input.set_emis_tab(emis_tab)
    c_input.set_distance(dist, 'kpc')
    c_input.print_input(to_file = True, verbose = False)
```

```
In [5]: # The directory in which we will have the model
        # You may want to change this to a different place so that the current directory
        # will not receive all the Cloudy files.
        dir_ = '/tmp/'
```

```
In [6]: #writing the makefile in the directory dir_
        pc.print_make_file(dir_ = dir_)
```

```
In [7]: # setting verbosity to medium level, change to 3 for high verbosity
        pc.log_.level = 2
```

```
In [8]: # Generic name of the models
        model_name = 'model_2'
```

```
In [9]: # tables for the values of the density and the log(O/H)
        tab_dens = [3, 4, 5, 6]
        tab_ab_O = [-3.1, -3.25, -3.4, -3.55, -3.7]
```

```
In [10]: # defining the models and writing 20 input files
         for dens in tab_dens:
             for ab_O in tab_ab_O:
                 make_model(dir_, model_name, dens, ab_O)
```

```
In [11]: # Running the models using the makefile and n_proc processors
         n_proc = 8
         # Take, care, this will run 20 cloudy models on 3 processors! May take some time.
         # If you run all the models togeter (n_proc = 20), you will need 10 Go RAM.
         pc.run_cloudy(dir_ = dir_, n_proc = n_proc, model_name = model_name, use_make = True)
```

```
In [12]: # reading the Cloudy outputs and putting them in a list of CloudyModel objects
         Ms = pc.load_models('{0}{1}'.format(dir_, model_name), read_grains = False)
```

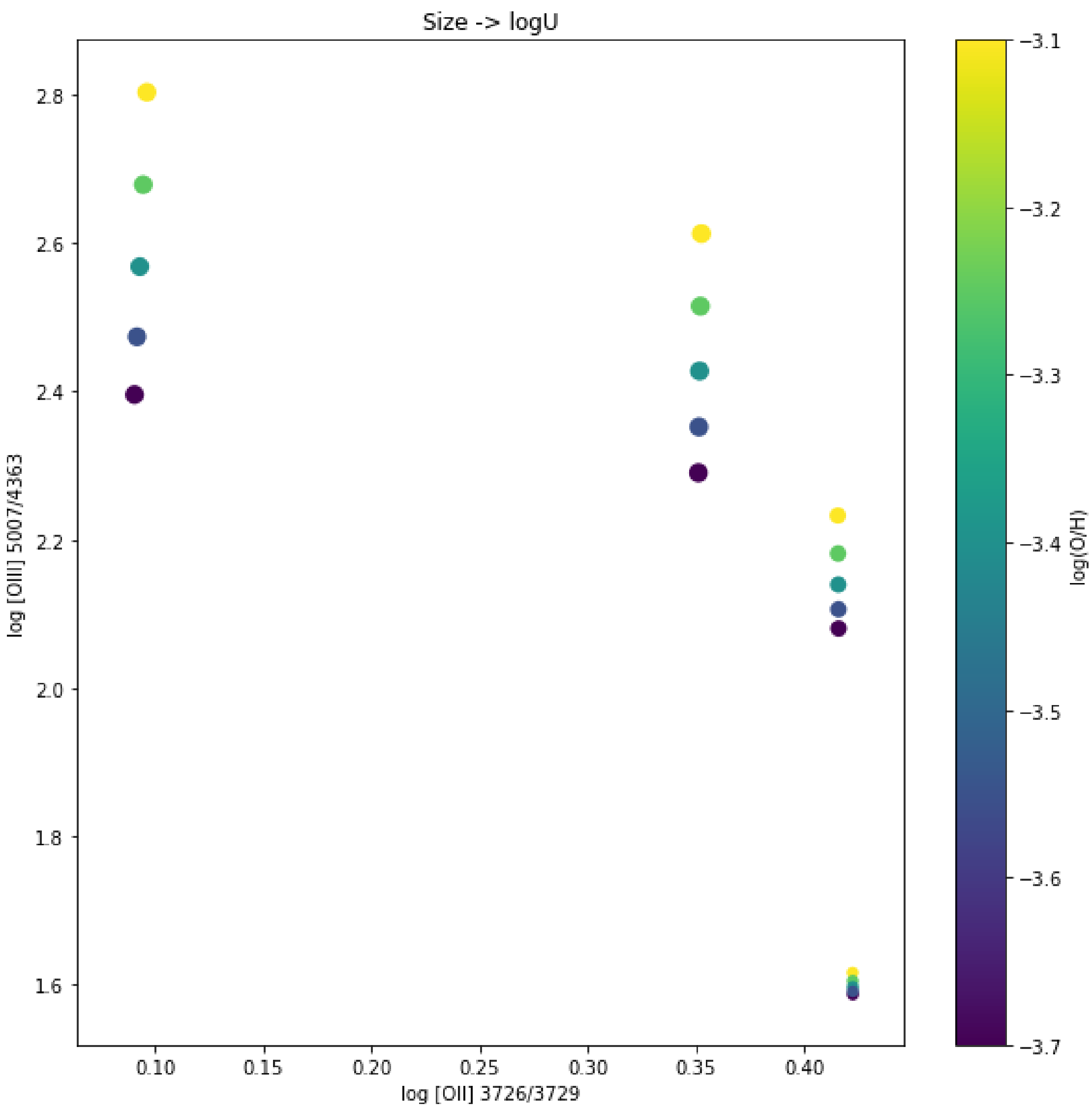
```
In [14]: #Computing line intensity ratios
         rO3 = [np.log10(M.get_emis_vol('O__3_500684A')/M.get_emis_vol('BLND_436300A')) for M in Ms]
         rO2 = [np.log10(M.get_emis_vol('O__2_372603A')/M.get_emis_vol('O__2_372881A')) for M in Ms]
```

```
In [15]: # defining the colors associated to the Oxygen abundances
         col = [M.abund['O'] for M in Ms]
```

In [16]:
```
# defining the size as the density (at the first step, but in these models it's constant)
#size = [np.log10(M.nH[0])*20 for M in Ms]
size = [40*(5+M.log_U_mean) for M in Ms]
```

In [17]:
```
plt.figure(figsize=(10,10))
plt.scatter(rO2, rO3, c=col, s=size, edgecolors = 'none')
plt.xlabel('log [OII] 3726/3729')
plt.ylabel('log [OIII] 5007/4363')
cb = plt.colorbar()
cb.set_label('log(O/H)')
plt.title('Size -> logU')
```

Out[17]: <matplotlib.text.Text at 0x7f8c3ab97748>



In [ ]: