Using_pyCloudy_MdB

June 2, 2020

1 In this example we use the MdB class to access a database of models.

The dabase is 3MdB, described here: https://sites.google.com/site/mexicanmillionmodels/the-different-projects/hii_chim

[4]:
```
%matplotlib inline
import numpy as np
import matplotlib.pyplot as plt
import pyCloudy as pc
import pandas as pd
import pymysql
```

[5]:
```
# Defining the connection parameters.
import os
host = os.environ['MdB_HOST']
user = os.environ['MdB_USER']
passwd = os.environ['MdB_PASSWD']
db=os.environ['MdB_DB_17']
```

[8]:
```
co = pymysql.connect(host=host, db=db, user=user, passwd=passwd)
res = pd.read_sql("""SELECT
    12+oxygen AS OH,
    nitrogen-oxygen AS NO,
    lumi AS logU,
    BLND_372700A/H__1_486133A AS O2,
    BLND_436300A/H__1_486133A AS O3_4363,
    O__3_500684A/H__1_486133A AS O3,
    N__2_658345A/H__1_486133A AS N2,
    (S__2_671644A + S__2_673082A)/H__1_486133A AS S2
FROM tab_17
WHERE ref = 'BOND'
""", con=co)
```

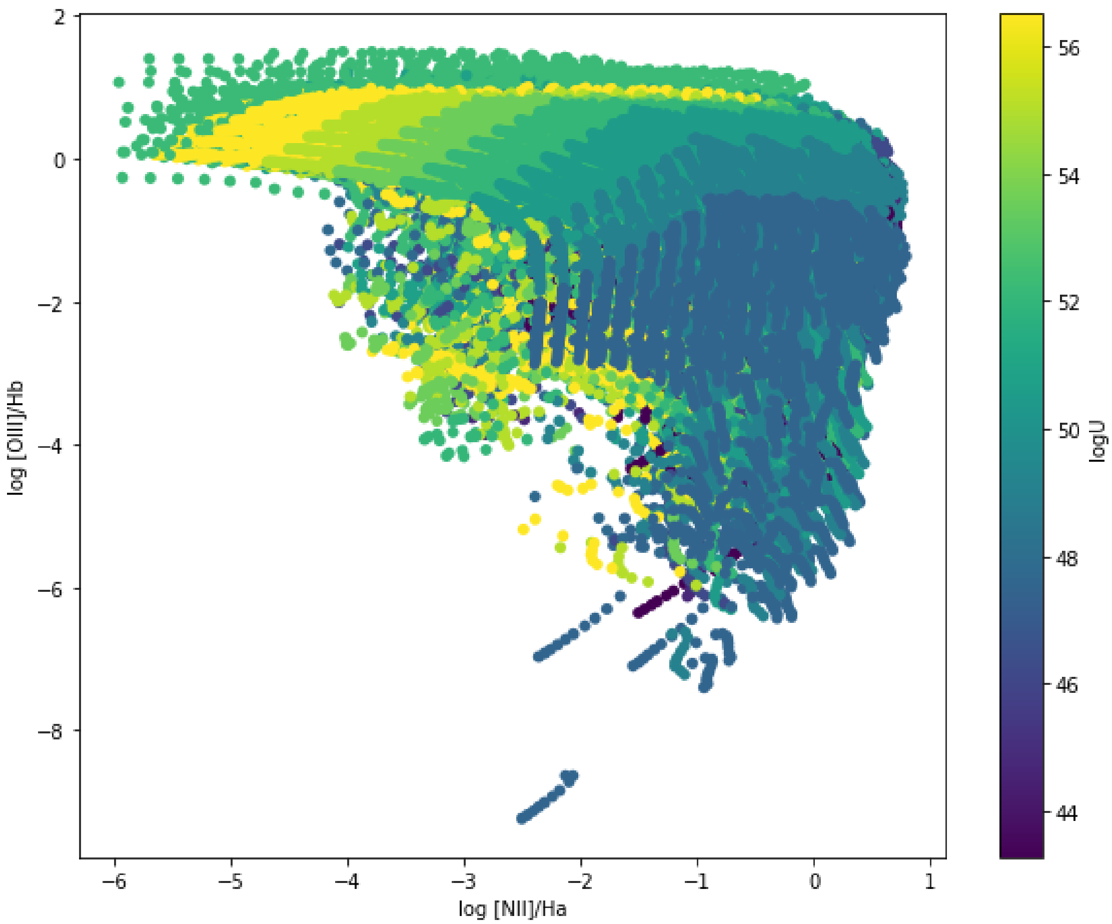
[9]:
```
print(len(res))
```

```
113420
```

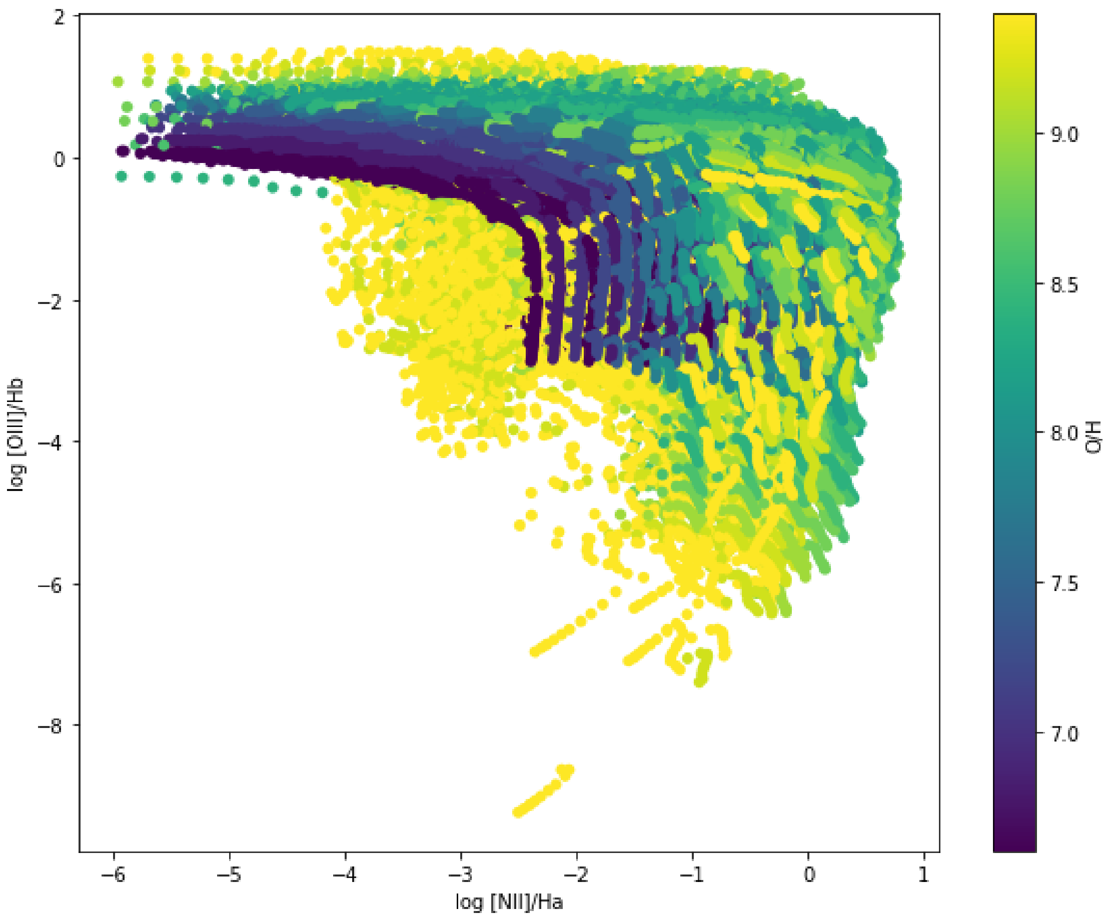
[10]:
```
res
```

[10]:
```
         OH    NO       logU        O2       O3_4363            O3        N2  \
0       9.4 -1.00  47.532553  1.996031  6.364626e-05  1.447794e-01  1.426077
1       9.2 -0.50  43.262277  0.272503  1.871795e-07  8.125187e-04  1.117005
2       9.4  0.00  47.532553  0.009758  1.062763e-09  5.001466e-07  0.016908
3       9.2  0.00  47.532553  0.137288  2.965965e-07  4.720362e-03  2.256497
4       9.4 -1.00  47.532553  0.293409  2.423485e-08  2.649722e-04  0.438272
…      …    …        …        …             …              …          …
113415  9.4 -0.25  47.532553  0.029679  4.341928e-11  2.225320e-06  0.354148
113416  9.2 -0.25  47.532553  0.104207  9.519672e-10  1.782989e-05  1.095120
113417  9.2 -0.25  47.532553  0.948997  1.291271e-05  4.281305e-02  4.489167
113418  9.2 -0.25  47.532553  0.435569  1.489141e-06  9.202054e-03  2.744305
113419  9.2 -0.25  47.532553  0.293898  6.299614e-08  5.288504e-04  2.152770

              S2
0       1.922521
1       0.677754
2       0.004035
3       0.385450
4       0.957386
…          …
113415  0.142798
113416  0.418765
113417  1.296916
113418  0.869078
113419  0.738143

[113420 rows x 8 columns]
```

[11]:
```
plt.figure(figsize=(10, 8))
plt.scatter(np.log10(res['N2']), np.log10(res['O3']), c=res['logU'], edgecolor␣
 ↪= 'none')
plt.xlabel('log [NII]/Ha')
plt.ylabel('log [OIII]/Hb')
cb = plt.colorbar()
cb.set_label('logU');
```



[12]:
```
plt.figure(figsize=(10, 8))
plt.scatter(np.log10(res['N2']), np.log10(res['O3']), c=res['OH'], edgecolor =␣
 ↪'none')
plt.xlabel('log [NII]/Ha')
plt.ylabel('log [OIII]/Hb')
cb = plt.colorbar()
cb.set_label('O/H');
```




```
[13]: res = pd.read_sql("SELECT count(*) as N FROM tab_17 WHERE ref like 'PNe_2020'",␣
       ↪con=co)
      print("Total number of models with ref='PNe_2020': {}".format(res.N.values[0]))
```

```
Total number of models with ref='PNe_2020': 724386
```

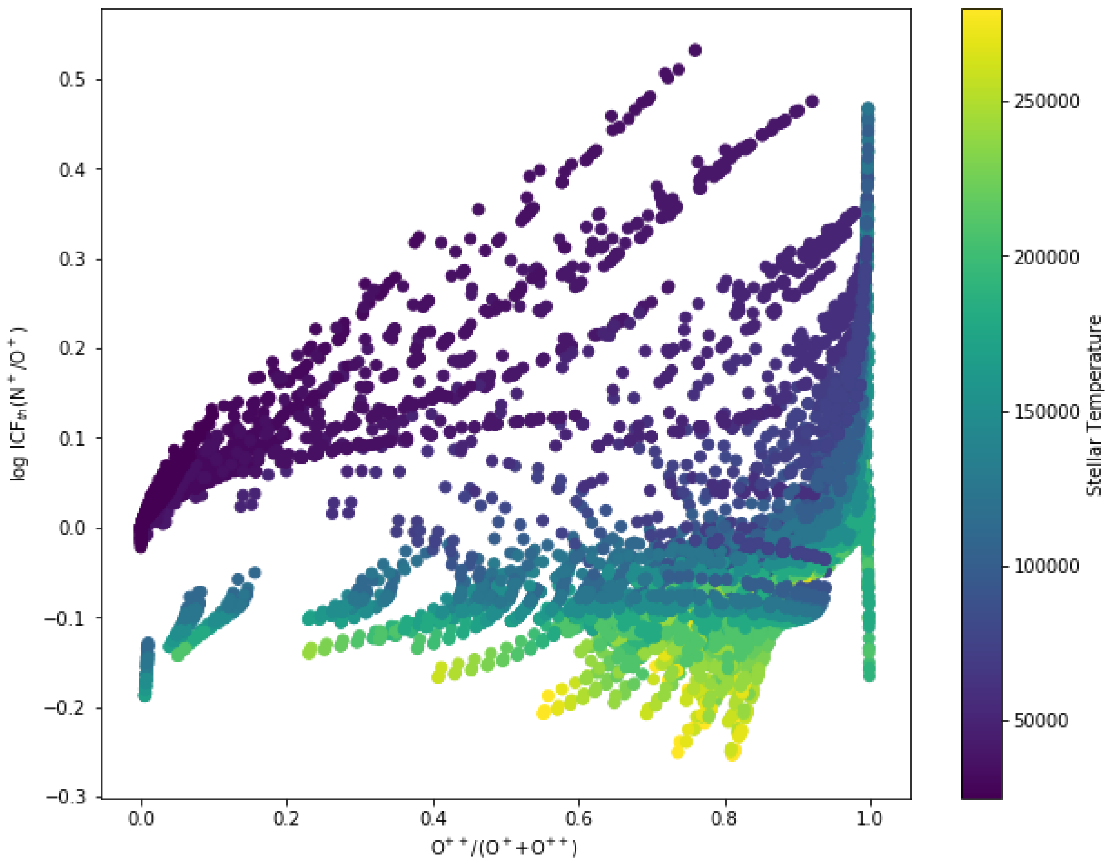
```
[16]: # Query the database
      com1 = 'B' # Blackbody
      com2 = 'C' # Constant density
      com4 = 'S' # Solar metallicity
      com5 = 'N' # No dust
      com6 = 1 # selected models
      res = pd.read_sql("""SELECT
          A_HYDROGEN_vol_1, A_HELIUM_vol_1, A_HELIUM_vol_2, A_CARBON_vol_2,␣
       ↪A_NITROGEN_vol_1, A_OXYGEN_vol_1,A_OXYGEN_vol_2,
          A_NEON_vol_2, A_NEON_vol_4, A_SULPHUR_vol_1, A_SULPHUR_vol_2,␣
       ↪A_CHLORINE_vol_1, A_CHLORINE_vol_2, A_CHLORINE_vol_3,
          A_ARGON_vol_2, A_ZINC_vol_3, A_IRON_vol_2, A_NICKEL_vol_2, MassFrac, atm1
```

```
FROM tab_17, abion_17
WHERE tab_17.ref like 'PNe_2020'
    AND tab_17.N = abion_17.N
    AND com1 like '{}%'
    AND com2 like '{}%'
    AND com4 = '{}'
    AND com5 = '{}'
    AND com6 = {}
    """.format(com1, com2, com4, com5, com6),
                  con=co)
```

[17]:
```
print(len(res))
```

8380

[18]:
```
plt.figure(figsize=(10, 8))
plt.scatter(res['A_OXYGEN_vol_2']/(res['A_OXYGEN_vol_1']+res['A_OXYGEN_vol_2']),
                np.log10(res['A_OXYGEN_vol_1']/res['A_NITROGEN_vol_1']),␣
 ↪c=res['atm1'])
plt.xlabel(r'O$^{++}$/(O$^+$+O$^{++}$)')
plt.ylabel(r'log ICF$_{th}$(N$^+$/O$^+$)')
cb = plt.colorbar()
cb.set_label('Stellar Temperature')
```



0.5
0.4
0.3
0.2
0.1
0.0
−0.1
−0.2
−0.3
log ICF$_{th}$(N$^+$/O$^+$)
0.0
0.2
0.4
0.6
0.8
1.0
O^{++}/(O$^+$+O^{++})
250000
200000
150000
100000
50000
Stellar Temperature