Using_pyCloudy_MdB

August 6, 2025

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

[ ]:

```
import numpy as np
import matplotlib.pyplot as plt
import pyCloudy as pc
import pandas as pd
from sqlalchemy import create_engine
```

[2]:

```
# 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']
```

[4]:

```
request = """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'
"""
sqlEngine = create_engine(f'mysql+pymysql://{user}:{passwd}@{host}:{3306}/{db}')

with sqlEngine.connect() as db_con:
    res = pd.read_sql(request, con=db_con)
```

[5]:

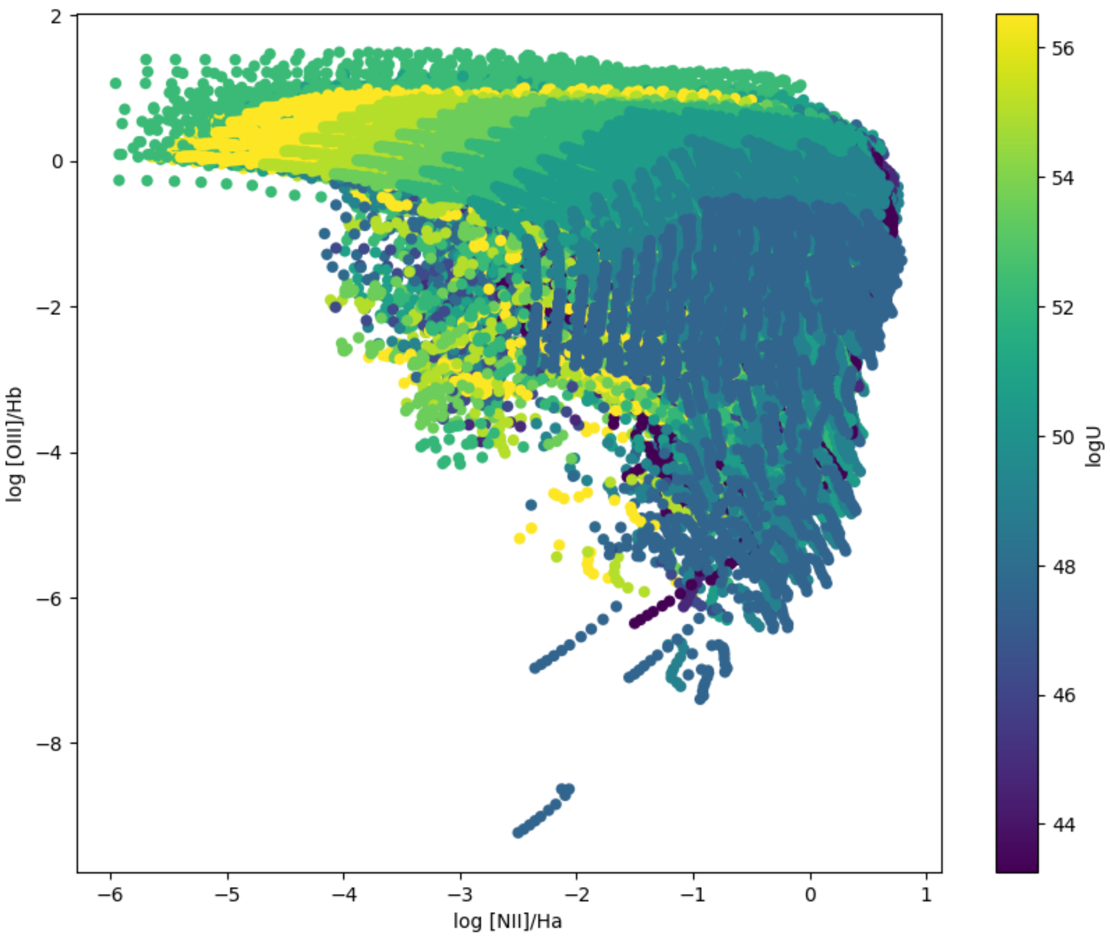
```
print(len(res))
```

```
113420
```

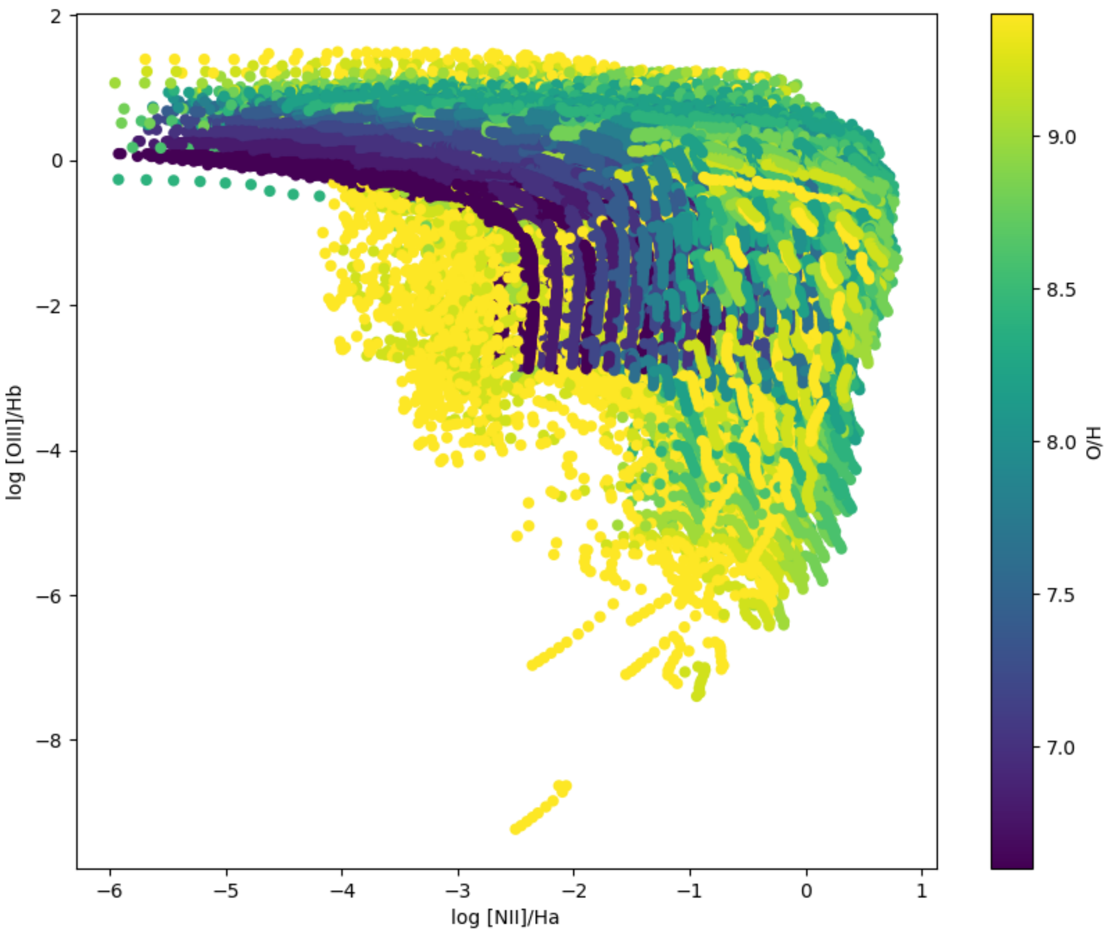
[6]:
```
res
```

[6]:
```
         OH    NO       logU        O2       O3_4363        O3        N2  \
0       8.2 -1.00  52.262277  0.443831  4.624517e-02  5.087498  0.036771
1       8.2 -1.00  52.262277  0.008498  1.901961e-02  2.643664  0.000310
2       8.2 -1.00  52.262277  0.015441  2.126387e-02  3.163863  0.000741
3       8.2 -1.00  52.262277  0.023099  2.288621e-02  3.464117  0.001255
4       8.2 -1.00  52.262277  0.032308  2.443923e-02  3.692262  0.001887
…      …    …        …       …            …        …       …
113415  9.4 -0.25  47.532553  0.029679  4.341928e-11  0.000002  0.354148
113416  9.2 -0.25  47.532553  0.104207  9.519672e-10  0.000018  1.095120
113417  9.2 -0.25  47.532553  0.948997  1.291271e-05  0.042813  4.489167
113418  9.2 -0.25  47.532553  0.435569  1.489141e-06  0.009202  2.744305
113419  9.2 -0.25  47.532553  0.293898  6.299614e-08  0.000529  2.152770

              S2
0       0.032356
1       0.000058
2       0.000250
3       0.000568
4       0.001034
…          …
113415  0.142798
113416  0.418765
113417  1.296916
113418  0.869078
113419  0.738143

[113420 rows x 8 columns]
```

[7]:
```
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');
```



[8]:
```
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
```

[19]:
```
# Query the database
com1 = 'BB' # Blackbody
com2 = 'C' # Constant density
com4 = 'S' # Solar metallicity
com5 = 'N' # No dust
com6 = 1 # selected models
request = f"""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 = '{com1}'
    AND com2 = '{com2}'
    AND com4 = '{com4}'
    AND com5 = '{com5}'
    AND com6 = {com6}
    """
with sqlEngine.connect() as db_con:
    res = pd.read_sql(request, con=db_con)
```

[17]:

```
print(request)
```

```
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 'B_'
    AND com2 like 'C_'
    AND com4 = 'S'
    AND com5 = 'N'
    AND com6 = 1
```

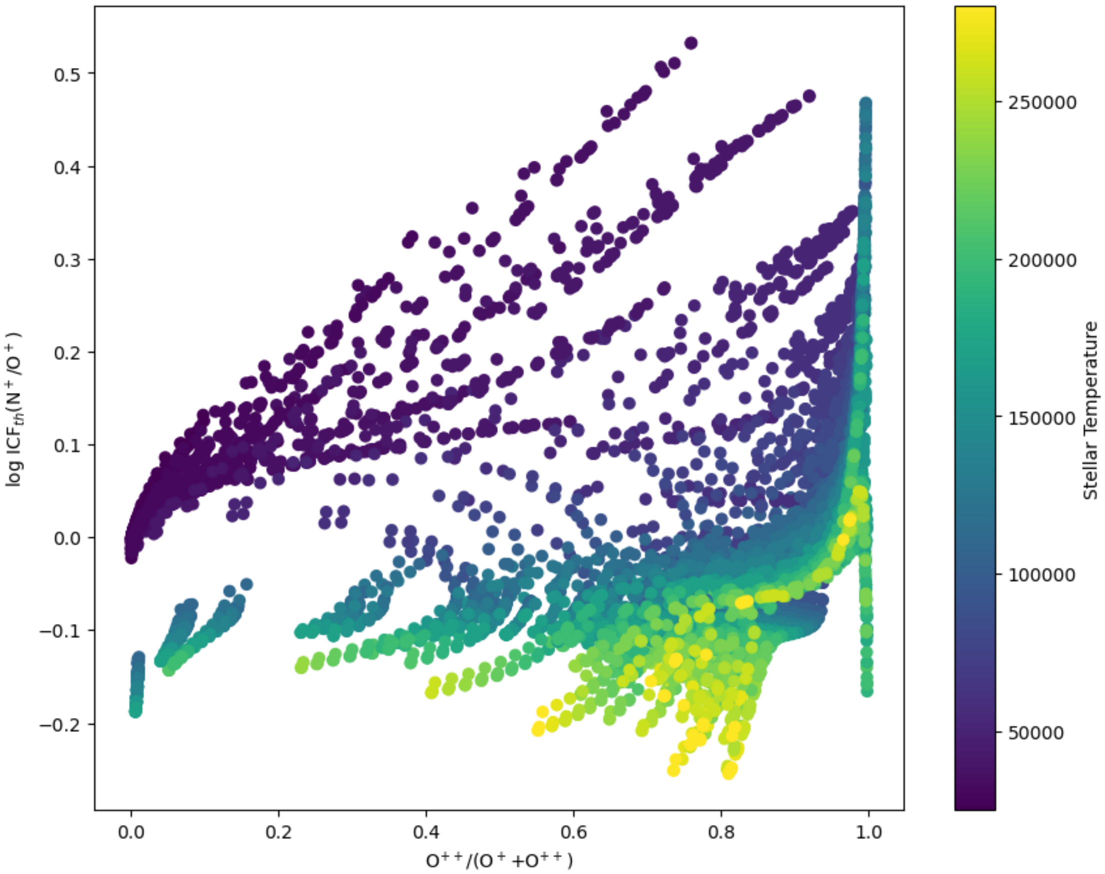
[20]:

```
print(len(res))
```

```
8380
```

[21]:

```
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')
```


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