Pyedra

Release 0.3.1

Milagros Colazo

Mar 29, 2021

CONTENTS:

Pyedra is a python library that allows you to fit three different models of asteroid phase functions to your observations.

CHAPTER

ONE

MOTIVATION

Phase curves of asteroids are very important for the scientific community as they can provide information needed for diameter and albedo estimates. Given the large amount of surveys currently being carried out and planned for the next few years, we believe it is necessary to have a tool capable of processing and providing useful information for such an amount of observational data.

Authors
Milagros Colazo (E-mail: milirita.colazovinovo@gmail.com)

CHAPTER

TWO

REPOSITORY AND ISSUES

https://github.com/milicolazo/Pyedra

2.1 Installation

This is the recommended way to install Pyedra.

2.1.1 Installing with pip

Make sure that the Python interpreter can load Pyedra code. The most convenient way to do this is to use virtualenv, virtualenvwrapper, and pip.

After setting up and activating the virtualenv, run the following command:

```
$ pip install Pyedra
...
```

That should be it all.

2.1.2 Installing the development version

If you'd like to be able to update your Pyedra code occasionally with the latest bug fixes and improvements, follow these instructions:

Make sure that you have Git installed and that you can run its commands from a shell. (Enter *git help* at a shell prompt to test this.)

Check out Pyedra main development branch like so:

```
$ git clone https://github.com/milicolazo/Pyedra.git
...
```

This will create a directory *Pyedra* in your current directory.

Then you can proceed to install with the commands

```
$ cd Pyedra
$ pip install -e .
...
```

2.2 Pyedra's Tutorial

This tutorial is intended to serve as a guide for using Pyedra to analyze asteroid phase curve data.

2.2.1 Imports

The first thing we will do is import the necessary libraries. In general you will need the following: - `pyedra` (*pyedra*) is the library that we present in this tutorial. - `pandas` (*pandas*) this library will allow you to import your data as a dataframe.

Note: In this tutorial we assume that you already have experience using these libraries.

[1]:
```
import pyedra
import pandas as pd
```

2.2.2 Load the data

The next thing we have to do is load our data. Pyedra should receive a dataframe with three columns: id (MPC number of the asteroid), alpha (α, phase angle) and v (reduced magnitude in Johnson's V filter). You must respect the order and names of the columns as they have been mentioned. In this step we recommend the use of pandas:

```
df = pd.read_csv('somefile.csv')
```

For this tutorial we will use a preloaded data set offered by Pyedra.

[2]:
```
df = pyedra.datasets.load_carbognani2019()
```

Here we show you the structure that your data file should have. Note that the file can contain information about many asteroids, which allows to obtain catalogs of the parameters of the phase function for large databases.

[3]:
```
df
```

[3]:

	id	alpha	v
0	85	0.89	7.62
1	85	1.18	7.67
2	85	2.07	7.82
3	85	5.11	8.01
4	85	16.24	8.48
5	85	17.49	8.53
6	85	21.24	8.66
7	208	0.64	9.20
8	208	1.01	9.24
9	208	1.74	9.39
10	208	3.75	9.69
11	208	11.85	9.73
12	208	17.28	9.97
13	208	19.18	9.99
14	236	0.86	8.28
15	236	1.27	8.17
16	236	1.95	8.22
17	236	6.39	8.82
18	236	9.77	8.73
19	236	10.69	8.78
20	236	22.14	9.12
21	236	24.72	9.16

(continues on next page)

(continued from previous page)

```
22  306   5.45  9.18
23  306   5.83  9.17
24  306   6.34  9.21
25  306   8.00  9.28
26  306  16.03  9.61
27  306  21.23  9.60
28  306  22.85  9.69
29  313   0.57  8.94
30  313   0.99  9.06
31  313   4.74  9.21
32  313   8.37  9.41
33  313  10.50  9.54
34  313  20.33  9.86
35  338   1.54  8.74
36  338   3.86  8.93
37  338  10.89  9.49
38  338  18.93  9.85
39  338  19.25  9.77
40  522   2.00  9.23
41  522   2.19  9.28
42  522   4.07  9.36
43  522   4.99  9.41
44  522   7.40  9.55
45  522  13.67  9.85
46  522  16.24  9.88
```

2.2.3 Fit your data

Pyedra's main objective is to fit a phase function model to our data. Currently the api offers three different models:

- `HG_fit` (H, G model): $V(\alpha) = H - 2.5log_{10}[(1-G)\Phi_1(\alpha) + G\Phi_2(\alpha)]$
- `Shev_fit` (Shevchenko model): $V(1,\alpha) = V(1,0) - \frac{a}{1+\alpha} + b \cdot \alpha$
- `HG1G2_fit` (H, G_1, G_2 model): $V(\alpha) = H - 2.5log_{10}[G_1\Phi_1(\alpha) + G_2\Phi_2(\alpha) + (1-G_1-G_2)\Phi_3(\alpha)]$

We will now explain how to apply each of them. At the end of this tutorial you will notice that they all work in an analogous way and that their implementation is very simple.

HG_fit

Let's assume that we want to fit the biparametric model H, G to our data set. What we will do is invoke Pyedra's `HG_fit` function:

[4]:
```
HG = pyedra.HG_fit(df)
```

We have already created our catalog of H, G parameters for our data set. Let's see what it looks like.

[5]:
```
HG
```

[5]:
```
    id         H   error_H         G   error_G         R
0   85  7.492423  0.070257  0.043400  0.035114  0.991422
1  208  9.153433  0.217270  0.219822  0.097057  0.899388
2  236  8.059719  0.202373  0.104392  0.094382  0.914150
3  306  8.816185  0.122374  0.306459  0.048506  0.970628
```

(continues on next page)

(continued from previous page)

```
4  313  8.860208  0.098102  0.170928  0.044624  0.982924
5  338  8.465495  0.087252 -0.121937  0.048183  0.992949
6  522  8.992164  0.063690  0.120200  0.028878  0.991757

PyedraFitDataFrame - 7 rows x 6 columns
```

R is the coefficient of determination of the fit

All pandas dataframe options are available. For example, you may be interested in knowing the mean H of your sample. To do so:

[6]:
```
HG.H.mean()
```

[6]:
```
8.54851801238607
```

Remeber that `HG.H` selects the H column.

[7]:
```
HG.H
```

[7]:
```
0    7.492423
1    9.153433
2    8.059719
3    8.816185
4    8.860208
5    8.465495
6    8.992164
Name: H, dtype: float64
```

The `PyedraFitDataFrame` can also be filtered, like a canonical pandas dataframe. Let's assume that we want to save the created catalog, but only for those asteroids whose id is less than t300. All we have to do is:

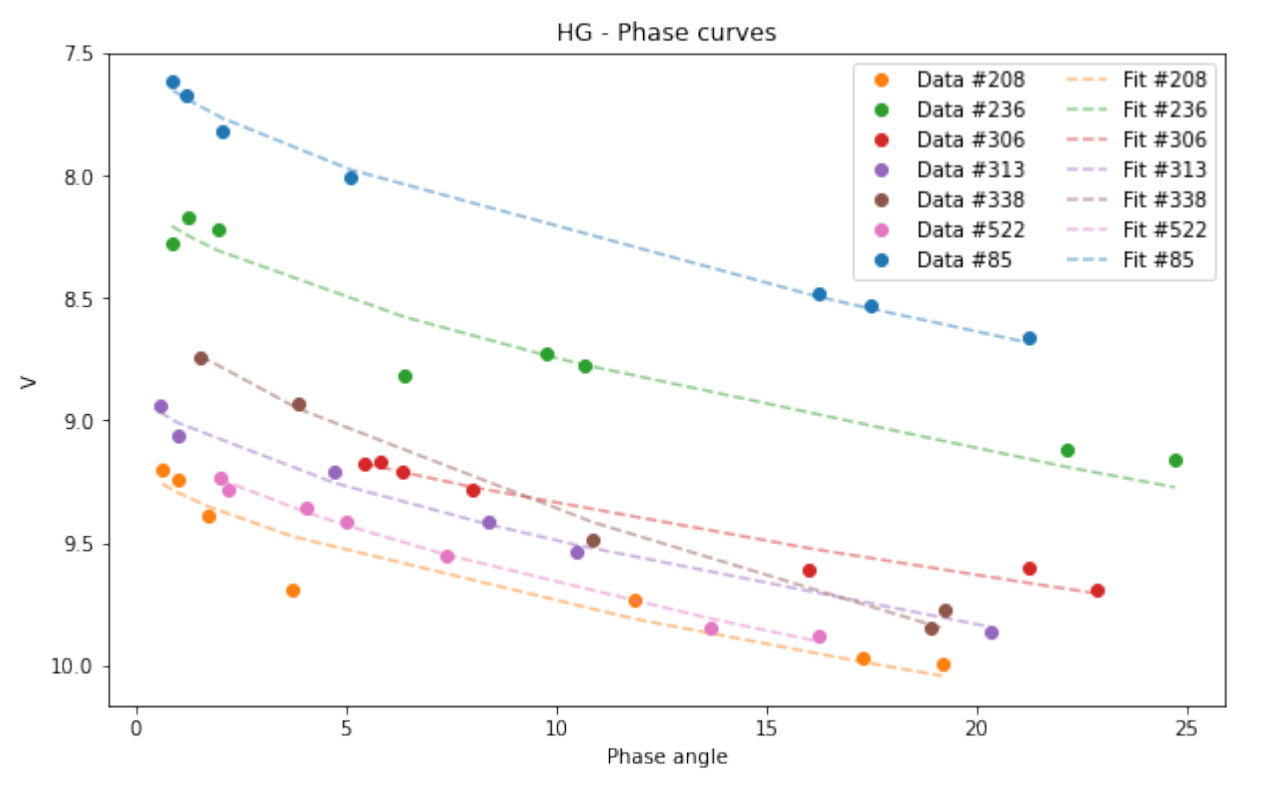
[8]:
```
filtered = HG.model_df[HG.model_df['id'] < 300]
filtered
```

[8]:
```
    id         H   error_H         G   error_G         R
0   85  7.492423  0.070257  0.043400  0.035114  0.991422
1  208  9.153433  0.217270  0.219822  0.097057  0.899388
2  236  8.059719  0.202373  0.104392  0.094382  0.914150
```

Finally we want to see our data plotted together with their respective fits. To do this we will use the `.plot` function provided by Pyedra. To obtain the graph with the adjustments of the phase function model we only have to pass to `.plot` the dataframe that contains our data in the following way:

[9]:
```
HG.plot(df=df)
```

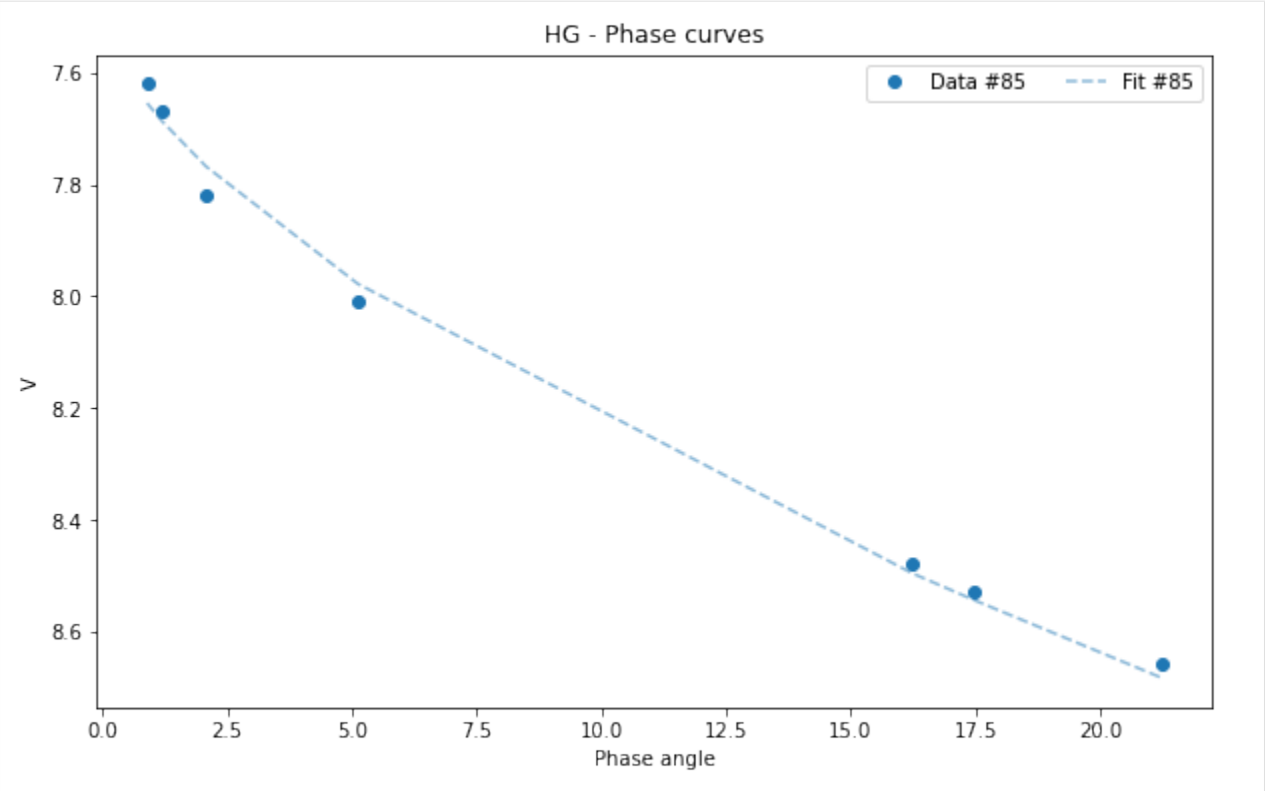
[9]:
```
<AxesSubplot:title={'center':'HG - Phase curves'}, xlabel='Phase angle', ylabel='V'>
```



If your database is very large and you want a clearer graph, or if you only want to see the fit of one of the asteroids you can filter your initial dataframe.

[10]:
```
asteroid_85 = df[df['id'] == 85]
HG_85 = pyedra.HG_fit(asteroid_85)
HG_85.plot(df = asteroid_85)
```

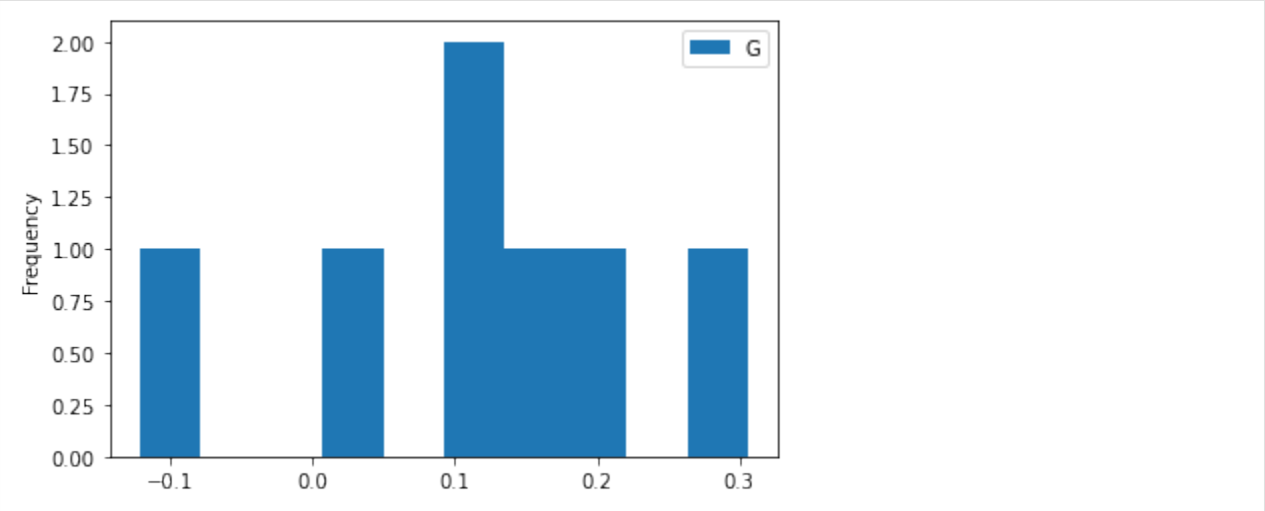
[10]:
```
<AxesSubplot:title={'center':'HG - Phase curves'}, xlabel='Phase angle', ylabel='V'>
```



All pandas plots are available if you want to use any of them. For example, we may want to visualize the histogram of one of the parameters:

[11]:
```
HG.plot(y='G', kind='hist')
```

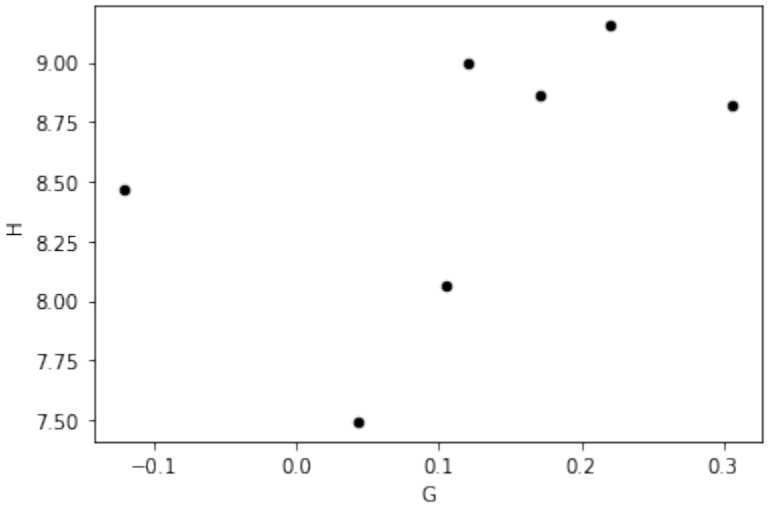
[11]:
```
<AxesSubplot:ylabel='Frequency'>
```



Or we may want to find out if there is a correlation between parameters:

[12]:
```
HG.plot(x='G', y='H', kind='scatter', marker='o', color='black')
```

[12]:
```
<AxesSubplot:xlabel='G', ylabel='H'>
```



Everything we have done in this section can be extended in an analogous way to the rest of the models, as we will see below.

HG1G2_fit

Now we want to adjust the H, G_1, G_2 model to our data. Use the function `HG1G2_fit` in the following way.

[13]:
```
HG1G2 = pyedra.HG1G2_fit(df)
HG1G2
```

[13]:

	id	H12	error_H12	G1	error_G1	G2	error_G2	R
0	85	7.398776	0.162316	0.303790	0.081963	0.236331	0.062360	0.996285
1	208	8.904819	0.326344	-0.393842	0.320769	0.709746	0.190495	0.976405
2	236	7.901036	0.558052	0.043248	0.361217	0.413350	0.237267	0.934118
3	306	8.224509	1.238547	-0.041959	0.529741	0.367042	0.443392	0.968671
4	313	8.883195	0.347260	0.661550	0.161242	0.127482	0.154199	0.984322
5	338	8.450968	0.391477	0.691141	0.194887	-0.070232	0.173648	0.991939
6	522	9.046202	0.213791	0.705920	0.107933	0.088499	0.087300	0.992124

PyedraFitDataFrame - 7 rows x 8 columns

R is the coefficient of determination of the fit.

We can calculate, for example, the median of each of the columns:

[14]:
```
HG1G2.median()
```

[14]:
```
id           306.000000
H12            8.450968
error_H12      0.347260
G1             0.303790
error_G1       0.194887
G2             0.236331
error_G2       0.173648
R              0.984322
dtype: float64
```

Again, we can filter our catalog. We are keeping the best settings, that is, those whose R is greater than 0.98.

[15]:
```
best_fits = HG1G2.model_df[HG1G2.model_df['R'] > 0.98]
best_fits
```

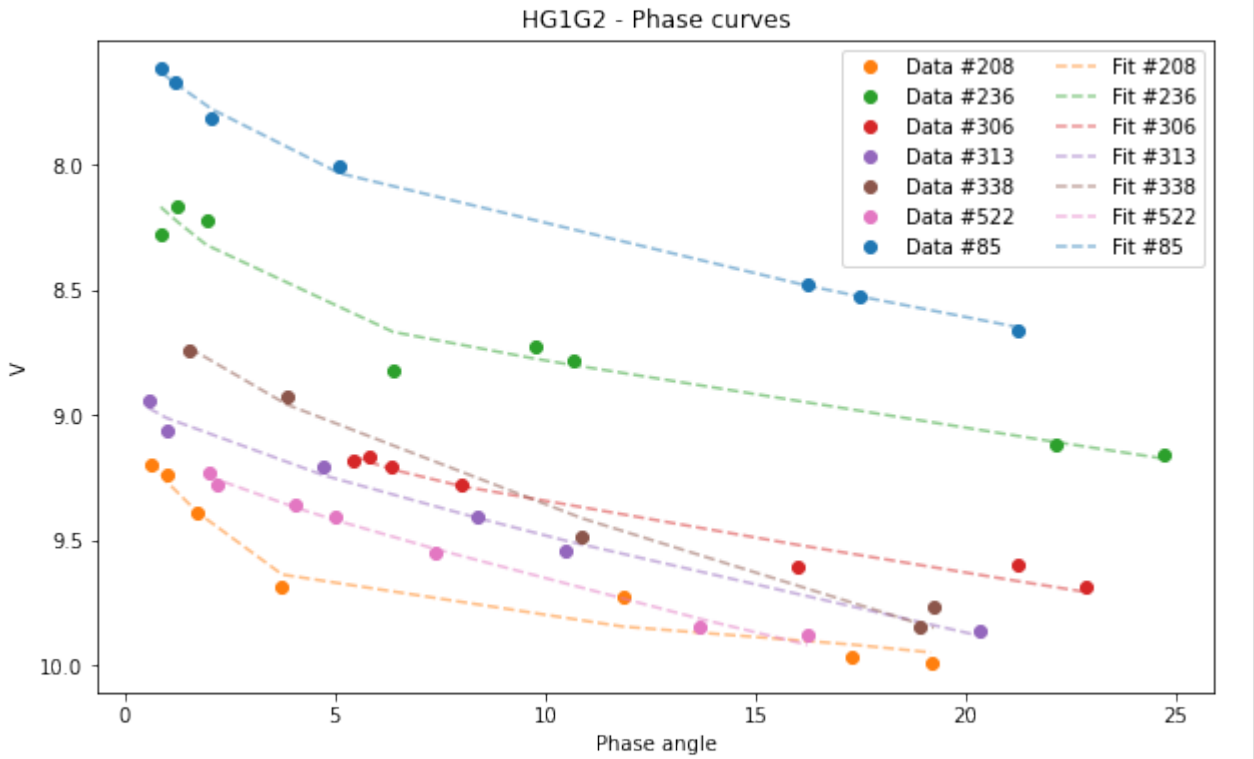
[15]:

	id	H12	error_H12	G1	error_G1	G2	error_G2	R
0	85	7.398776	0.162316	0.303790	0.081963	0.236331	0.062360	0.996285
4	313	8.883195	0.347260	0.661550	0.161242	0.127482	0.154199	0.984322
5	338	8.450968	0.391477	0.691141	0.194887	-0.070232	0.173648	0.991939
6	522	9.046202	0.213791	0.705920	0.107933	0.088499	0.087300	0.992124

We will now look at the graphics.

[16]:
```
HG1G2.plot(df=df)
```

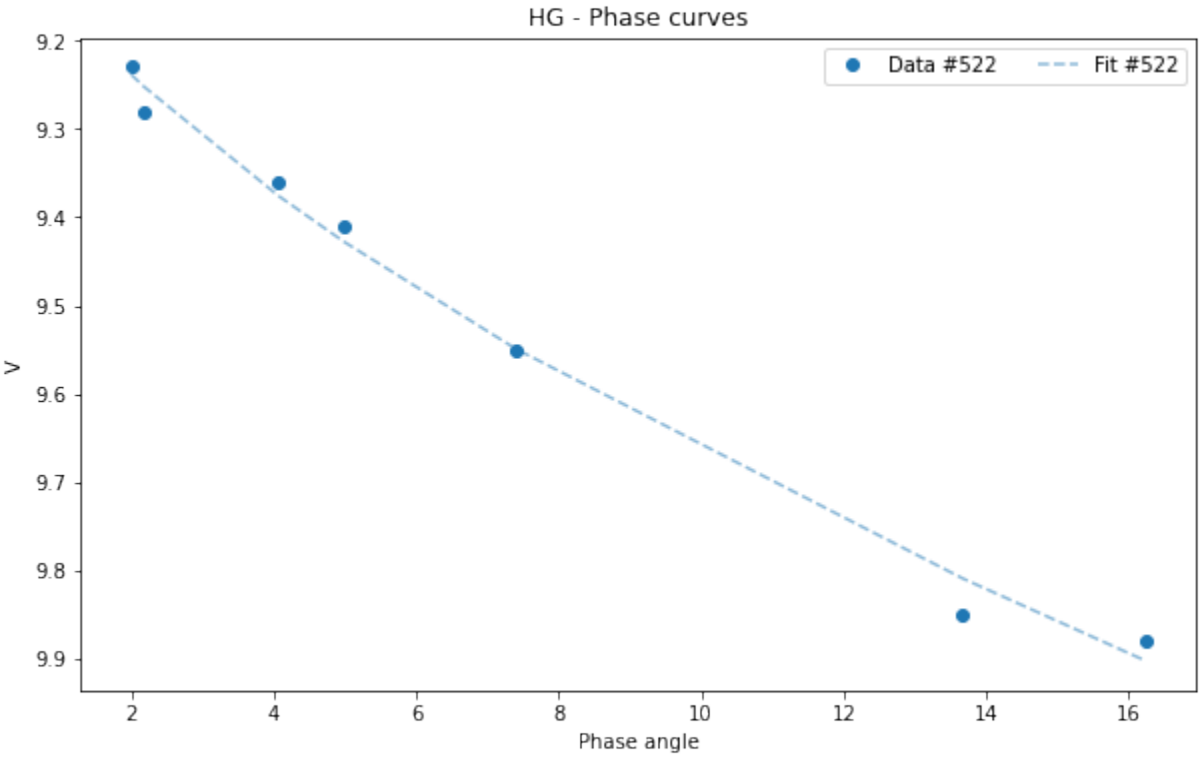
[16]:
```
<AxesSubplot:title={'center':'HG1G2 - Phase curves'}, xlabel='Phase angle', ylabel='V
↪'>
```



If we want to visualize the graph only of the asteroid (522):

[17]:
```
asteroid_522 = df[df['id'] == 522]
HG1G2_522 = pyedra.HG_fit(asteroid_522)
HG1G2_522.plot(df=asteroid_522)
```

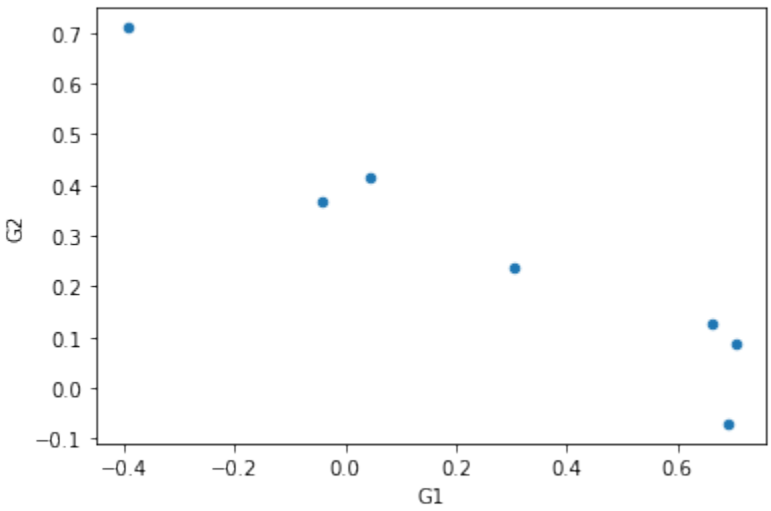
[17]:
```
<AxesSubplot:title={'center':'HG - Phase curves'}, xlabel='Phase angle', ylabel='V'>
```



To see the correlation between the parameters G_1 and G_2 we can use the "scatter" graph of pandas:

[18]:
```
HG1G2.plot(x='G1', y='G2', kind='scatter')
```

[18]:
```
<AxesSubplot:xlabel='G1', ylabel='G2'>
```



Shev_fit

If we want to adjust the Shevchenko model to our data, we must use `Shev_fit`.

[19]:
```
Shev = pyedra.Shev_fit(df)
Shev
```

[19]:
```
    id     V_lin  error_V_lin         b   error_b         c   error_c  \
0   85  7.957775     0.022576  0.696826  0.051010  0.034637  0.001184
1  208  9.738767     0.146121  0.945126  0.300105  0.014448  0.008524
2  236  8.626281     0.166623  0.916350  0.402758  0.023646  0.008515
3  306  9.600553     0.275835  3.231009  1.549868  0.009097  0.010083
4  313  9.132444     0.071010  0.297612  0.140332  0.037097  0.004712
5  338  9.003280     0.216194  0.900765  0.623240  0.045328  0.011141
6  522  9.292723     0.084461  0.392058  0.267625  0.039625  0.005236

          R
0  0.999542
1  0.960483
2  0.932592
3  0.975662
4  0.988686
5  0.985846
6  0.989935

PyedraFitDataFrame - 7 rows x 8 columns
```

R is the coefficient of determination of the fit.

We can select a particular column and calculate, for example, its minimum:

[20]:
```
Shev.V_lin
```

[20]:
```
0    7.957775
1    9.738767
2    8.626281
3    9.600553
4    9.132444
5    9.003280
6    9.292723
Name: V_lin, dtype: float64
```

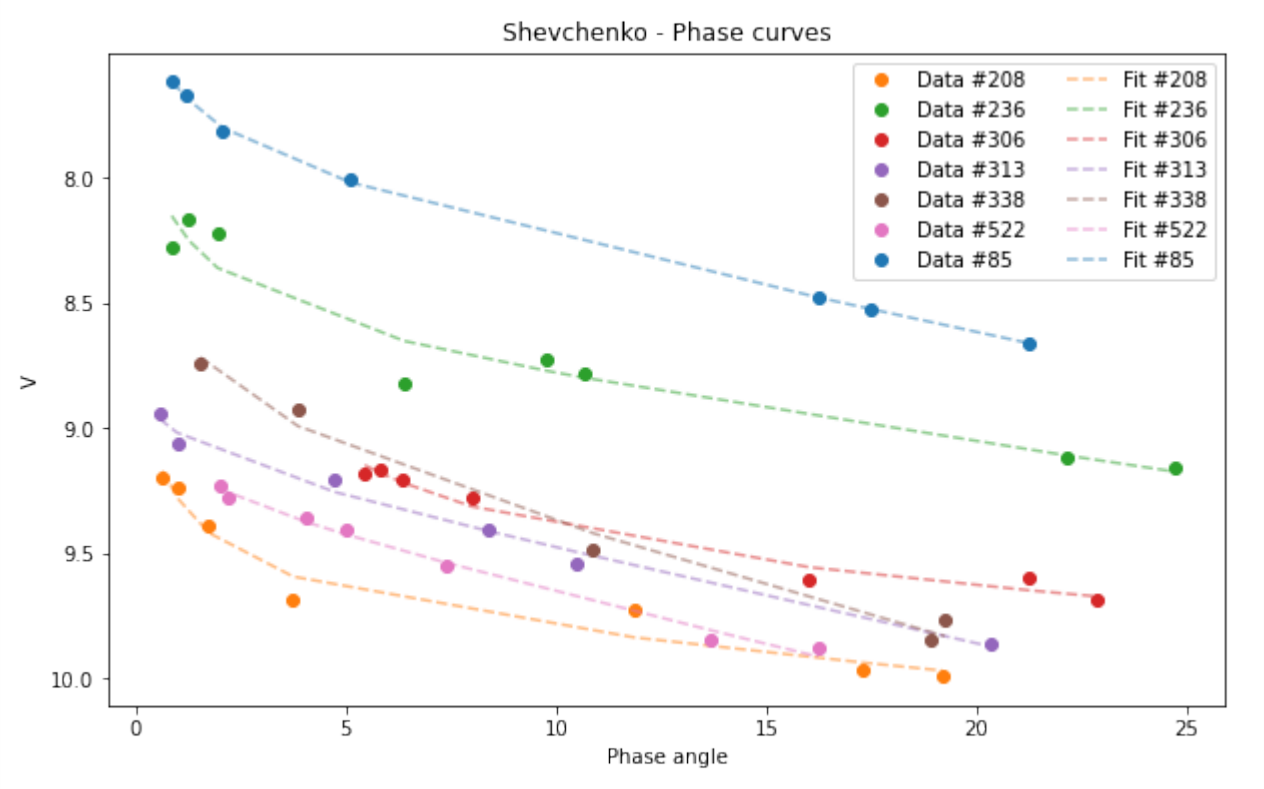
[21]:
```
Shev.V_lin.min()
```

[21]:
```
7.9577754899895226
```

And obviously we can graph the resulting fit:

[22]:
```
Shev.plot(df=df)
```

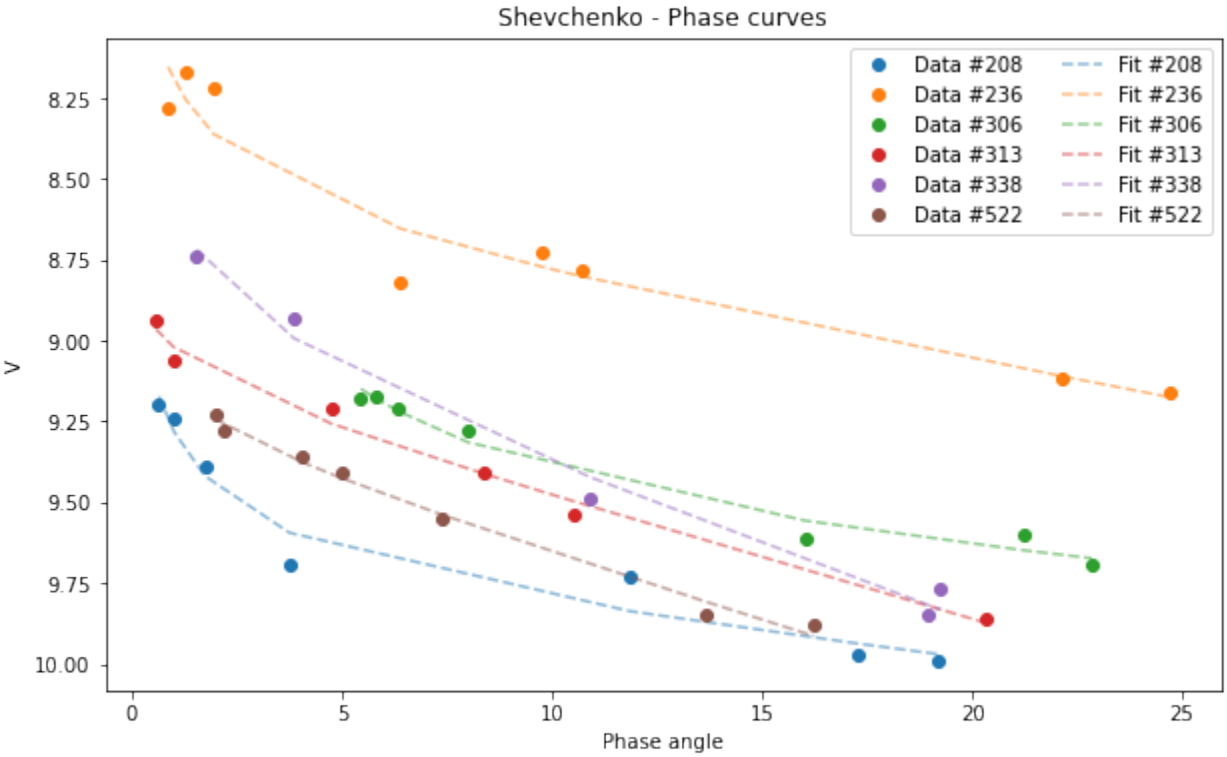
[22]:
```
<AxesSubplot:title={'center':'Shevchenko - Phase curves'}, xlabel='Phase angle',␣
↪ylabel='V'>
```



Selecting a subsample:

[23]:
```
subsample = df[df['id'] > 100 ]
Shev_subsample = pyedra.Shev_fit(subsample)
Shev_subsample.plot(df=subsample)
```

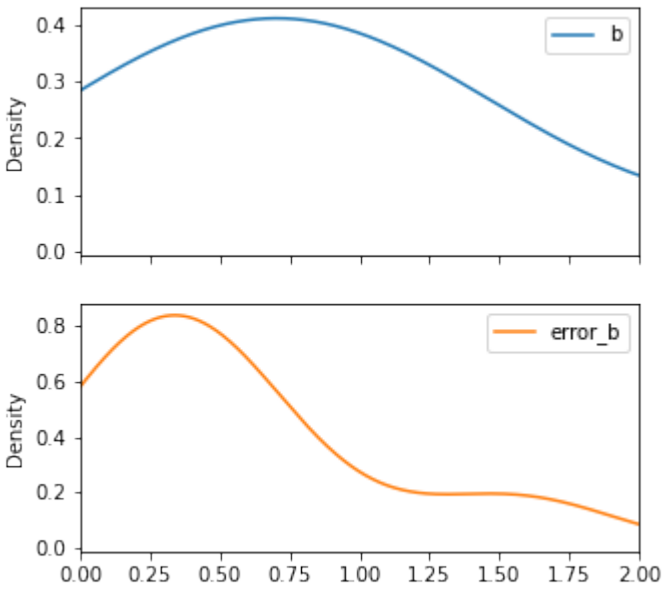
[23]:
```
<AxesSubplot:title={'center':'Shevchenko - Phase curves'}, xlabel='Phase angle',␣
↪ylabel='V'>
```



We can use some of the pandas plot.

[24]:
```
Shev_subsample.plot(y=['b', 'error_b'], kind='density', subplots=True, figsize=(5,5),␣
↪xlim=(0,2))
```

[24]:
```
array([<AxesSubplot:ylabel='Density'>, <AxesSubplot:ylabel='Density'>],
      dtype=object)
```



2.2.4 Gaia Data

Below we show the procedure to combine some observation dataset with Gaia DR2 observations.

We import the gaia data with `load_gaia()`

[33]:
```
gaia = pyedra.datasets.load_gaia()
```

We then join both datasets (ours and gaia) with `merge_obs`

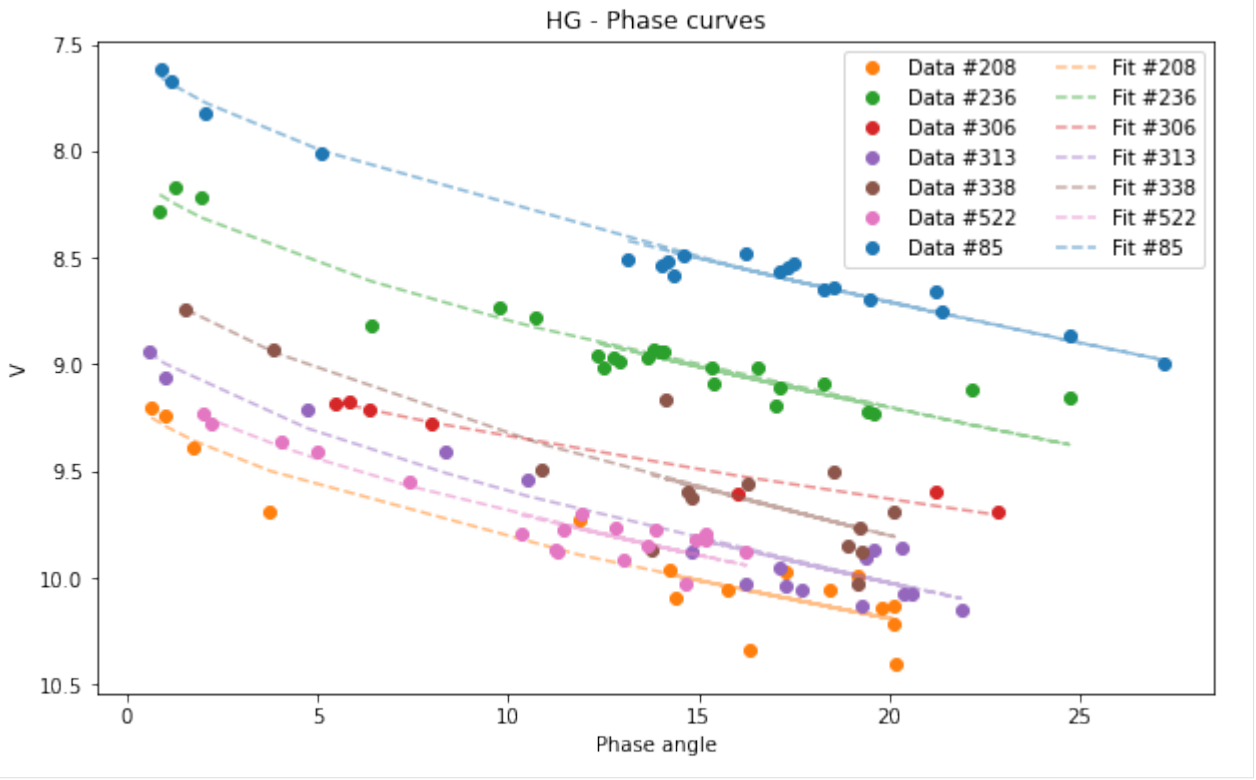
[34]:
```
merge = pyedra.merge_obs(df, gaia)
merge = merge[['id', 'alpha', 'v']]
```

We apply to the new dataframe all the functionalities as we did before

[35]:
```
catalog = pyedra.HG_fit(merge)
```

[37]:
```
catalog.plot(df=merge)
```

[37]:
```
<AxesSubplot:title={'center':'HG - Phase curves'}, xlabel='Phase angle', ylabel='V'>
```



[ ]:
```
```

2.3 Licence

2.4 pyedra API

Pyedra currently has three functions, each of which adjusts a different phase function model.

The input file must be a .csv file with three columns: id (mpc number), alpha (phase angle) and v (reduced magnitude in Johnson's V filter).

The modules are:

- **HG_fit**: adjusts the H-G biparametric function to the data set.
- **Shev_fit**: adjusts the Shevchenko triparametric function to the data set.
- **HG1G2_fit**: adjusts the triparametric function H-G1-G2 to the data set.

In addition, the data input can be plotted with the chosen fit.

2.4.1 Module `pyedra.core`

Implementation of phase function for asteroids.

class `pyedra.core.`**MetaData**(*data=NOTHING*)

Bases: `collections.abc.Mapping`

Implements an inmutable dict-like to store the metadata.

Also provides attribute like access to the keys.

Example

```
>>> metadata = MetaData({"a": 1, "b": 2})
>>> metadata.a
1
```

```
>>> metadata["a"]
1
```

class pyedra.core.**PyedraFitDataFrame**(*model*, *model_df*, *plot_cls*, *metadata=NOTHING*)
Bases: object

Initialize a dataframe model_df to which we can apply function a.

class pyedra.core.**BasePlot**(*pdf*)
Bases: abc.ABC

Plots for HG fit.

abstract property default_plot_kind
Return the default plot to be rendered.

pyedra.core.**obs_counter**(*df*, *obs*, *idc='id'*, *alphac='alpha'*)
Count the observations. A minimum is needed to the fits.

Parameters

- **df** (pandas.DataFrame) – The dataframe must with the values
- **idc** (str, optional (default=id)) – Column with the mpc number of the asteroids.
- **alphac** (str, optional (default=alpha)) – Column with the phase angle of the asteroids.
- **obs** (int) – Minimum number of observations needed to perform the fit.

Returns **out** – Numpy array containing the asteroids whose number of observations is less than obs.

Return type ndarray

pyedra.core.**merge_obs**(*obs_a*, *obs_b*, *idc_a='id'*, *idc_b='id'*, *alphac_a='alpha'*, *alphac_b='alpha'*, *magc_a='v'*, *magc_b='v'*, ***kwargs*)
Merge two dataframes with observations.

Sources whose id is not present in *obs_a* are discarded.

The function concantenates two dataframes (obs_a and obs_b), and assumes that the columns idc_a, alphac_a and magc_a from obs_a are equivalent to idc_b, alphac_b and magc_b from a dataframe obs_b. The resulting dataframe uses the names of obs_a for those three columns and places them at the start, and all other columns of both dataframes combined with the same behavior of pandas.concat.

Parameters

- **obs_a** (pandas.DataFrame) – The dataframe must with the observations.
- **obs_b** (pandas.DataFrame) – The dataframe must with the observations to be concatenated to obs_a.
- **idc_a** (str, optional (default=id)) – Column with the mpc number of the asteroids of the obs_a dataframe.
- **idc_b** (str, optional (default=id)) – Column with the mpc number of the asteroids of the obs_b dataframe.

- **alphac_a** (str, optional (default=alpha)) – Column with the phase angle of the asteroids of the obs_a dataframe.
- **alphac_b** (str, optional (default=alpha)) – Column with the phase angle of the asteroids of the obs_b dataframe.
- **magc_a** (str, optional (default=v)) – Column with the magnitude of the obs_a dataframe. The default 'v' value is reference to the reduced magnitude in Johnson's V filter.
- **magc_b** (str, optional (default=v)) – Column with the magnitude of the obs_b dataframe. The default 'v' value is reference to the reduced magnitude in Johnson's V filter.
- **kwargs** (dict or None (optional)) – The parameters to send to the subjacent pandas.concat function.

Returns Merged dataframes.

Return type pd.DataFrame

2.4.2 Module pyedra.hg1g2_model

Implementation of phase function for asteroids.

class pyedra.hg1g2_model.**HG1G2Plot**(*pdf*)

Bases: *pyedra.core.BasePlot*

Plots for HG1G2 fit.

curvefit(*df*, *idc='id'*, *alphac='alpha'*, *magc='v'*, *ax=None*, *cmap=None*, *fit_kwargs=None*, *data_kwargs=None*)

Plot the phase function using the HG1G2 model.

Parameters

- **df** (pandas.DataFrame) – The dataframe must with the values
- **idc** (str, optional (default=id)) – Column with the mpc number of the asteroids.
- **alphac** (str, optional (default=alpha)) – Column with the phase angle of the asteroids.
- **magc** (str, optional (default=v)) – Column with the magnitude. The default 'v' value is reference to the reduced magnitude in Johnson's V filter.
- **ax** (matplotlib.pyplot.Axis, (optional)) – Matplotlib axis
- **cmap** (None, str or calable (optional)) – Name of the color map to be used (https://matplotlib.org/users/colormaps.html). If is None, the default colors of the matplotlib.pyplot.plot function is used, and if, and is a callable is used as colormap generator.
- **fit_kwargs** (dict or None (optional)) – The parameters to send to the fit curve plot. Only label and color can't be provided.
- **data_kwargs** (dict or None (optional)) – The parameters to send to the data plot. Only label and color can't be provided.

Returns The axis where the method draws.

Return type matplotlib.pyplot.Axis

pyedra.hg1g2_model.**HG1G2_fit**(*df*, *idc='id'*, *alphac='alpha'*, *magc='v'*)

Fit (H-G1-G2) system to data from table.

HG1G2_fit calculates the H,G1 and G2 parameters of the phase function following the procedure described in[5] .

Parameters

- **df** (`pandas.DataFrame`) – The dataframe must with the values
- **idc** (`str`, optional (default=id)) – Column with the mpc number of the asteroids.
- **alphac** (`str`, optional (default=alpha)) – Column with the phase angle of the asteroids.
- **magc** (`str`, optional (default=v)) – Column with the magnitude. The default 'v' value is reference to the reduced magnitude in Johnson's V filter.

Returns The output contains eight columns: id (mpc number of the asteroid), H (absolute magnitude returned by the fit), H error (fit H parameter error), G1 (G1 parameter returned by the fit), G1 error (fit G1 parameter error), G2 (G2 parameter returned bythe fit), G2 error (fit G2 parameter error), and R (fit determination coefficient).

Return type `PyedraFitDataFrame`

References

2.4.3 Module `pyedra.hg_model`

H,G model for Pyedra.

class pyedra.hg_model.**HGPlot**(*pdf*)

Bases: *pyedra.core.BasePlot*

Plots for HG fit.

curvefit(*df*, *idc='id'*, *alphac='alpha'*, *magc='v'*, *ax=None*, *cmap=None*, *fit_kwargs=None*, *data_kwargs=None*)

Plot the phase function using the HG model.

Parameters

- **df** (`pandas.DataFrame`) – The dataframe must with the values
- **idc** (`str`, optional (default=id)) – Column with the mpc number of the asteroids.
- **alphac** (`str`, optional (default=alpha)) – Column with the phase angle of the asteroids.
- **magc** (`str`, optional (default=v)) – Column with the magnitude. The default 'v' value is reference to the reduced magnitude in Johnson's V filter.
- **ax** (`matplotlib.pyplot.Axis`, (optional)) – Matplotlib axis
- **cmap** (`None`, `str` or calable (optional)) – Name of the color map to be used (https://matplotlib.org/users/colormaps.html). If is None, the default colors of the matplotlib.pyplot.plot function is used, and if, and is a callable is used as colormap generator.
- **fit_kwargs** (`dict` or `None` (optional)) – The parameters to send to the fit curve plot. Only `label` and `color` can't be provided.
- **data_kwargs** (`dict` or `None` (optional)) – The parameters to send to the data plot. Only `label` and `color` can't be provided.

Returns The axis where the method draws.

Return type `matplotlib.pyplot.Axis`

[5] Muinonen K., Belskaya I. N., Cellino A., Delbò M., Levasseur-Regourd A.-C.,Penttilä A., Tedesco E. F., 2010, Icarus, 209, 542.

pyedra.hg_model.**HG_fit**(*df*, *idc='id'*, *alphac='alpha'*, *magc='v'*)

Fit (H-G) system to data from table.

HG_fit calculates the H and G parameters of the phase function following the procedure described in[1] .

Parameters

- **df** (pandas.DataFrame) – The dataframe must with the values
- **idc** (str, optional (default=id)) – Column with the mpc number of the asteroids.
- **alphac** (str, optional (default=alpha)) – Column with the phase angle of the asteroids.
- **magc** (str, optional (default=v)) – Column with the magnitude. The default 'v' value is reference to the reduced magnitude in Johnson's V filter.

Returns The output contains 7 columns: id (mpc number of the asteroid), H (absolute magnitude returned by the fit), H error (fit H parameter error), G (slope parameter returned by the fit), G error (fit G parameter error), R (fit determination coefficient) and observations (number of observation of the given asteroid).

Return type PyedraFitDataFrame

References

2.4.4 Module pyedra.shevchenko_model

Shevchenko model for Pyedra.

class pyedra.shevchenko_model.**ShevPlot**(*pdf*)

Bases: *pyedra.core.BasePlot*

Plots for Shevchenko fit.

curvefit(*df*, *idc='id'*, *alphac='alpha'*, *magc='v'*, *ax=None*, *cmap=None*, *fit_kwargs=None*, *data_kwargs=None*)

Plot the phase function using the Shev model.

Parameters

- **df** (pandas.DataFrame) – The dataframe must with the values
- **idc** (str, optional (default=id)) – Column with the mpc number of the asteroids.
- **alphac** (str, optional (default=alpha)) – Column with the phase angle of the asteroids.
- **magc** (str, optional (default=v)) – Column with the magnitude. The default 'v' value is reference to the reduced magnitude in Johnson's V filter.
- **ax** (matplotlib.pyplot.Axis, (optional)) – Matplotlib axis
- **cmap** (None, str or calable (optional)) – Name of the color map to be used (https://matplotlib.org/users/colormaps.html). If is None, the default colors of the matplotlib.pyplot.plot function is used, and if, and is a callable is used as colormap generator.
- **fit_kwargs** (dict or None (optional)) – The parameters to send to the fit curve plot. Only label and color can't be provided.
- **data_kwargs** (dict or None (optional)) – The parameters to send to the data plot. Only label and color can't be provided.

Returns The axis where the method draws.

[1] Muinonen K., Belskaya I. N., Cellino A., Delbò M., Levasseur-Regourd A.-C.,Penttilä A., Tedesco E. F., 2010, Icarus, 209, 542.

Return type `matplotlib.pyplot.Axis`

`pyedra.shevchenko_model.`**`Shev_fit`**(*df*, *idc='id'*, *alphac='alpha'*, *magc='v'*)

Fit Shevchenko equation to data from table.

Shev_fit calculates parameters of the three-parameter empirical function proposed by Schevchenko[2],[3] .

Parameters

- **`df`** (`pandas.DataFrame`) – The dataframe must with the values
- **`idc`** (`str`, optional (default=id)) – Column with the mpc number of the asteroids.
- **`alphac`** (`str`, optional (default=alpha)) – Column with the phase angle of the asteroids.
- **`magc`** (`str`, optional (default=v)) – Column with the magnitude. The default 'v' value is reference to the reduced magnitude in Johnson's V filter.

Returns The output contains six columns: id (mpc number of the asteroid), V_lin (magnitude calculated by linear extrapolation to zero), V_lin error (fit V_lin parameter error), b (fit parameter characterizing the opposition efect amplitude), b error (fit b parameter error), c (fit parameter describing the linear part of the magnitude phase dependence), c error (fit c parameter error)[4] and R (fit determination coefficient).

Return type `PyedraFitDataFrame`

References

2.4.5 Module `pyedra.datasets`

The pyedra.datasets module includes utilities to load datasets.

It also features some artificial data generators.

`pyedra.datasets.`**`load_carbognani2019`**()

Input for use with the phase functions.

This dataset contains the first and second columns of Table 2 of[6] . These columns correspond to: phase angle (°) and V_max (mag). V_max is the reduced magnitude of the lightcurve maximum.

References

`pyedra.datasets.`**`load_penttila2016`**()

Tabulated values of the base functions for H-G1-G2 system.

This dataset corresponds to Table B.4 of[7] .

[2] Shevchenko, V. G. 1996. Analysis of the asteroid phase dependences of brightness. Lunar Planet Sci. XXVII, 1086.

[3] Shevchenko, V. G. 1997. Analysis of asteroid brightness phase relations. Solar System Res. 31, 219-224.

[4] Belskaya, I. N., Shevchenko, V. G., 2000. Opposition effect of asteroids. Icarus 147, 94-105.

[6] Carbognani, A., Cellino, A., & Caminiti, S. (2019). New phase-magnitude curves for some main belt asteroids, fit of different photometric systems and calibration of the albedo-Photometry relation. Planetary and Space Science, 169, 15-34.

[7] A. Penttilä, V. G. Shevchenko, O. Wilkman, & K. Muinonen (2016). H,G1, G2 photometric phase function extended to low-accuracy data. 123:117–125.

References

pyedra.datasets.**load_gaia**()
Gaia observations.

The data used to obtain these quantities were downloaded from the Gaia Archive (https://gea.esac.esa.int/archive/)[8] .

References

[8] Gaia Collaboration et al., 2018, A&A, 616, A13

CHAPTER

THREE

INDICES AND TABLES

- genindex
- modindex
- search

PYTHON MODULE INDEX

p

INDEX