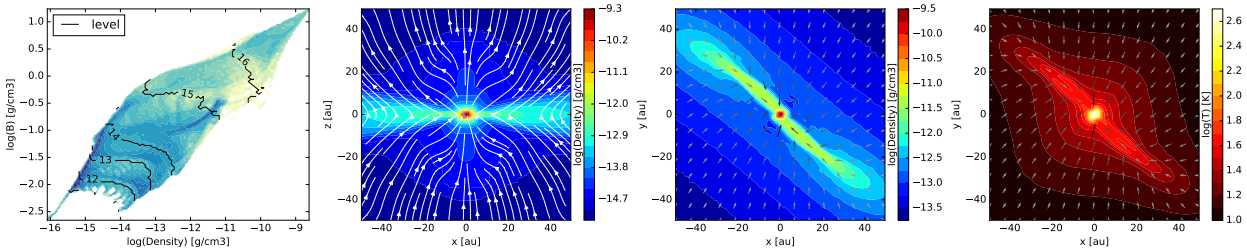
Plotting-Ramses
User Guide



Neil Vaytet

Centre for Star and Planet Formation
Niels Bohr Institute
University of Copenhagen
Denmark

neil.vaytet@nbi.ku.dk

Version 1.0 - 18/03/2017

Contents

1 Introduction

Plotting-Ramses was developed to provide a light-weight method to read and plot basic diagnostics on RAMSES simulation outputs. It currently only works with the native 'binary' data output format. It uses f2py to interface a fast Fortran90 file reader with a Python-matplotlib layer for data manipulation and visualization.

2 Getting started

2.1 Installation

Requirements: you will need matplotlib and f2py installed on your system.
Clone the repository from Bitbucket into your chosen directory. For this tutorial, the directory will be located at /home/user/software:

```
cd /home/user/software
git clone https://nvaytet@bitbucket.org/nvaytet/plotting-ramses.git
```

Before plotting, you must first run 'f2py' on the fortran subroutine which reads in the RAMSES data:

```
cd plotting-ramses
f2py -c read_ramses_data.f90 -m read_ramses_data
```

This will print out a few warnings but should still create a file read_ramses_data.so in the plotting-ramses directory. Finally, it would probably be a good idea to add the path to the plotting-ramses directory to you PYTHONPATH:

```
export PYTHONPATH=$PYTHONPATH:/home/user/software/plotting-ramses
```

To avoid having to do this every time you open a new terminal, you can of course add this to you .bashrc file.

2.2 Making your first plot

Navigate to the directory containing the data of your simulation and open an ipython console:

```
cd /path/to/my/ramses/data
ipython
```

Import the plotting_ramses class and load the output of your choice (this will be output number 71 in this example).[1]

```
In [1]: import plotting_ramses as pp
In [2]: mydata = pp.RamsesOutput(71,scale="au",verbose=True)
===========================================
```

[1] The data loader searches for a hydro_file_descriptor.txt inside the output directory to get the variable names, so make sure your version of RAMSES supports this. If it doesn't, you can edit the read_ramses_data.f90 subroutine so that it reads the data properly. By default it will try to guess by itself which are the variables to read, but this will almost certainly fail with editing it.

```
Processing    60 files
 10%
 20%
 30%
 40%
 50%
 60%
 70%
 80%
 90%
100%
Read   2458296 cells
Generating data structure... please wait
output_00071 successfully loaded
------------------------------------------
boxsize: 11034.1000058
center: None
levelmax: 29
levelmin: 6
ncells: 2458296
ncpu: 60
ndim: 3
nstep: 700
scale: au
time: 8.990163083e+11
ud: 3.8346e-24
ul: 3.08e+18
ut: 1.97732040947e+15
------------------------------------------
The variables are:
Name                Unit       Min                 Max
B                   [G      ] 7.05568663006e-06 18.1223463688
B_left_x            [G      ] -4.30285430461    4.30285430335
B_left_y            [G      ] -5.24127101488    5.24127101996
B_left_z            [G      ] -0.202153242353   18.1962401627
B_right_x           [G      ] -4.30285430461    4.30285430335
B_right_y           [G      ] -5.24127101488    5.24127101996
B_right_z           [G      ] -0.202153242353   18.1962401627
B_x                 [G      ] -4.29553104763    4.29553104622
B_y                 [G      ] -5.18964286611    5.18964287075
B_z                 [G      ] -0.200583478476   18.1221774265
density             [g/cm3  ] 1.53759058663e-20 2.62851267815e-09
dx                  [au     ] 0.0841835022417   172.407812591
level               [       ] 6.0               17.0
log_B               [g/cm3  ] -5.15146071612    1.25821442673
log_T               [K      ] 0.977980673125    2.84825249049
log_rho             [g/cm3  ] -19.8131592885    -8.5802899239
passive_scalar_1    [       ] 0.0               0.0
passive_scalar_2    [       ] 0.0               0.0
passive_scalar_3    [       ] 0.0               0.0
passive_scalar_4    [       ] 209.455501728     24103.1825934
radiative_energy_1 [erg/cm3] 6.24769168451e-11 0.0018699559894
```

```
temperature         [K      ] 9.50562490999     705.102883133
thermal_pressure    [g/cm/s2] 5.23633293194e-12 102.480387715
velocity_x          [cm/s   ] -267066.601808    267066.601866
velocity_y          [cm/s   ] -258785.071957    258785.071989
velocity_z          [cm/s   ] -174910.102931    174904.922142
x                   [au     ] -5430.84609661    5430.84609661
y                   [au     ] -5430.84609661    5430.84609661
z                   [au     ] -5430.84609661    5430.84609661
================================================
```

In the call to `RamsesOutput`, the first argument is the output number[2], while the second is the spatial scale you want to convert distances to. Possible choices are `"cm"`, `"au"` or `"pc"`. If you add `'verbose=True'` to the argument list, it will also print out some information about the data (the variables names, their minimum and maximum values, etc.). `plotting-ramses` tries to guess the units of each variable field according to its name. This is done by the `get_units()` function and can easily be modified if you have non-standard variables.

We now wish to plot a 2d histogram of the logarithm of density versus logarithm of magnetic field for all the cells inside the computational domain.

```
In [3]: mydata.plot_histogram("log_rho","log_B")
```

3 Support

Plotting-Ramses was developed by Neil Vaytet & Tommaso Grassi from the Centre for Star and Planet Formation at the University of Copenhagen, Denmark.
The software is free for anyone to use, but absolutely no warranty is provided. If you run into bugs or issues, you can contact the authors via email at neil.vaytet@nbi.ku.dk.

[2]Note that you can use `"-1"` to select the last output in the directory.