

Black Hole Cluster with Blender

June 12, 2025

1 Blender Code for BH Cluster

If you once want to use the Blender code for BH cluster in the GUI, here is what you should do. Here I assume you know the basic navigation on Blender.

1.1 Get the data

First, get the code directory on GitHub. Here, you should seen three files: find_BH_mergers.py, get_spin.py, run_this.sh. Make sure you put them in the same directory with punctures.dat and a directory named AH_data, which contains all stats_AH_xxx.dat files for the Spin data. Go the the run_this.sh and change the root directory. Now run run_this.sh. This code will generate a directory named Output. There will be three files named Position.csv, Size.csv, Spin.csv. These are the files you will need in Blender GUI.

Note: If certain python package not loading, you might need virtual environment.

1.2 Blender file

First, get the code file from Github, open the file and you will see this:

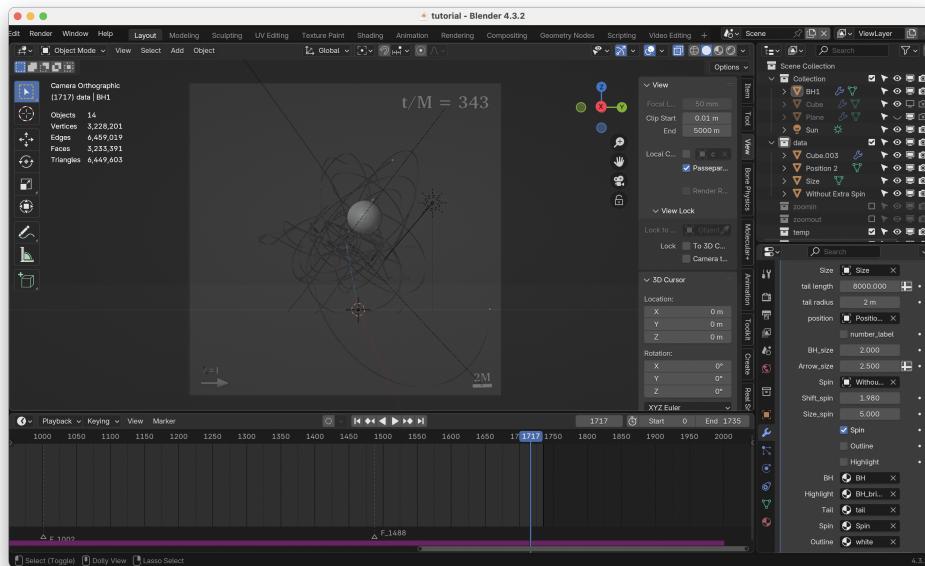


Figure 1: Blender file look like this

The first thing you want to do is run the script that came with the file. Go to top right and click "script". This script creates a way to read csv files.

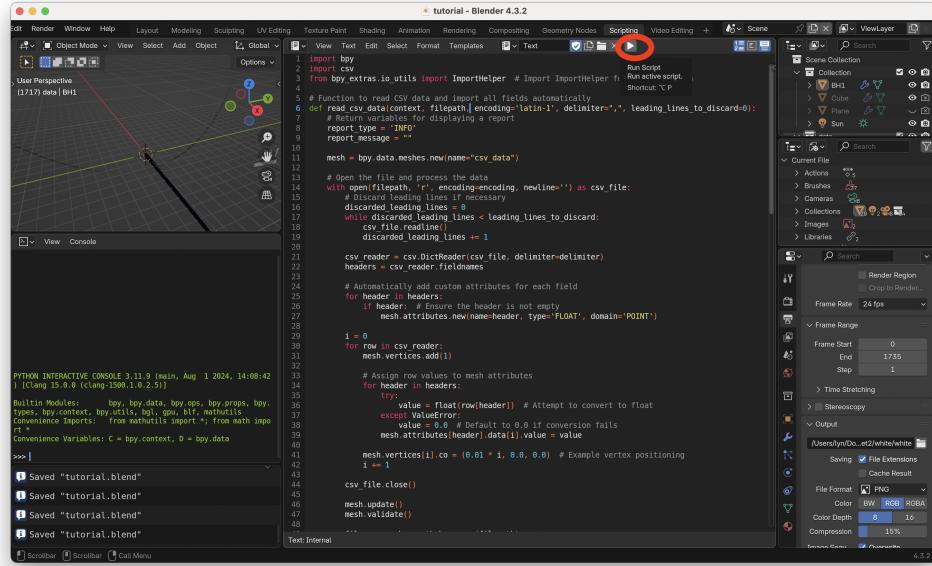


Figure 2: The script that reads CSV file

Now add the import the position.csv, size.csv, and spin.csv. If you don't have them, read previous section.

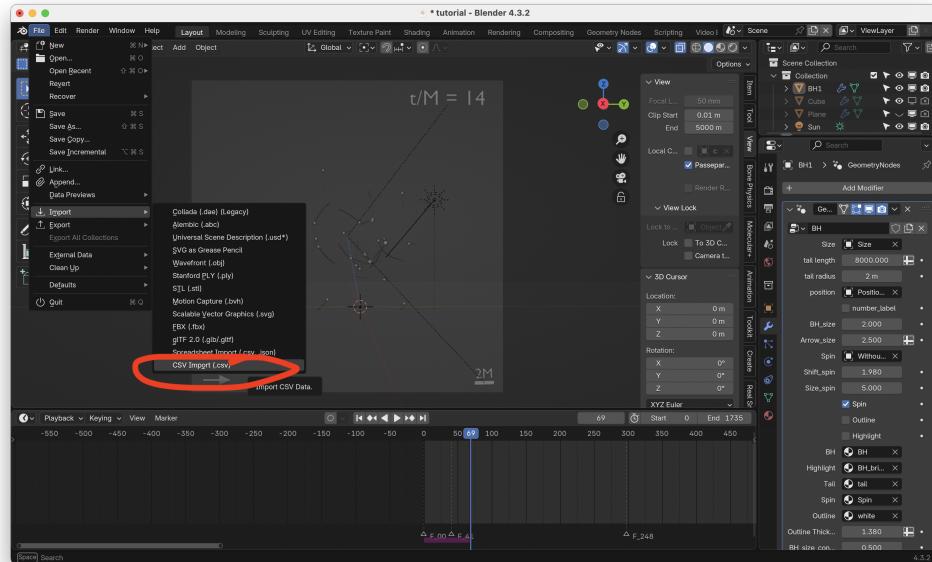


Figure 3: Import the csv file

The right modifier has all the parameter of the black hole cluster.

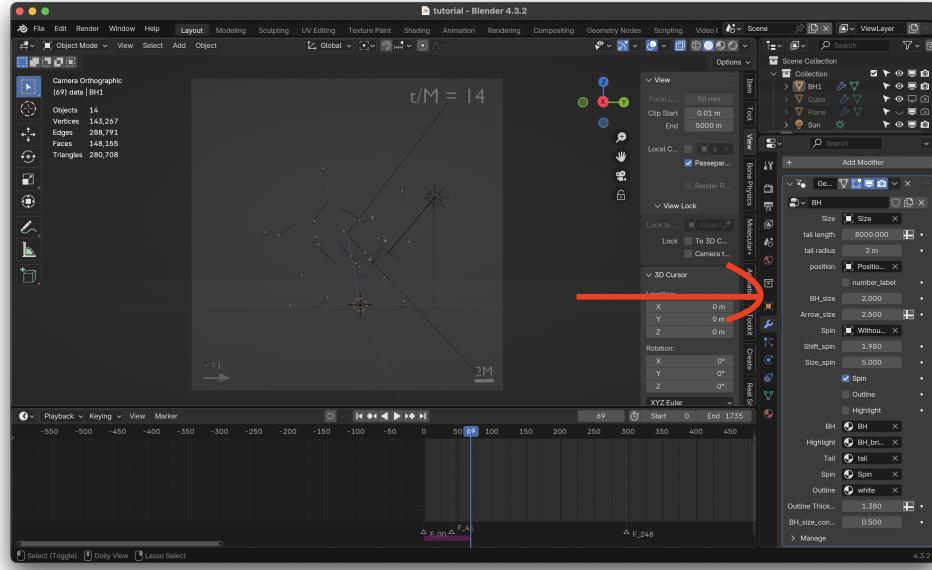


Figure 4: Parameter for BH cluster

- **Size:** Choose the size csv file
- **tail length:** the length of the trajectory in frames. i.e. making it 200 will show 200 frames of trajectory.
- **tail radius:** size of the tail
- **position:** Choose the position csv file.
- **BH_size:** controls how big the black holes are. This correspond to the mass of the black holes, and 1 is the exact size. To make the black holes visible, you might need to adjust size to be greater than 1.
- **Arrow_size:** Intent to control the cylinder size of the spin arrow. Currently under development and does nothing.
- **Spin:** Choose the spin csv file
- **Shift_spin:** How much do you want the spin to point away from the black holes.
- **Size_spin:** Size of spin arrow
- **Spin/Outline/Highlight:** If you want to show spin/outline/highlight. Outline is for the outline of the black hole, so they become more visible in certain background. Highlight is for change in color when merge.
- **BH/Highlight/Tail/Spin/Outline:** These are controls for the material
- **Outline Thickness:** Bigger number means thicker outline
- **BH_size_constant:** To make the black holes visible, we use the formula *actual size * BH size + BH size constant*

Now you are ready to render the video

1.3 If you want to modify the blender code

The blender code is based on geometry node, and if you want to understand the code, you might want to learn a little bit of geometry node.

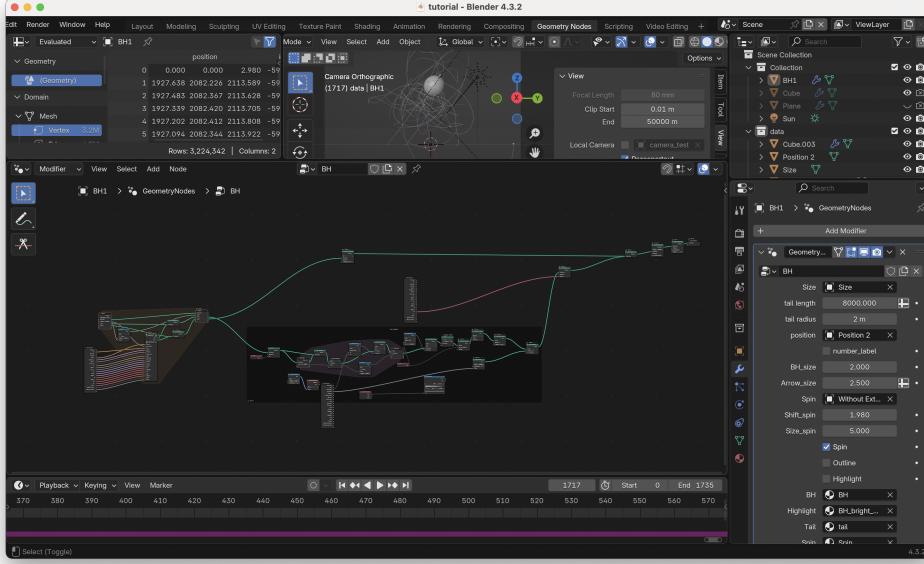


Figure 5: Geometry node setup for the BH cluster

For BH cluster, the code has two sections. The first one controls the black holes and it's spin, the second one gives the trajectory. There are subgroup in the part of the that plot the black holes, and if you don't understand it, ask Yinuan.

Also note the t/M, spin bar and the scale bar are also done with geometry node. These are easier to understand and modify. These are parent to the camera, so when the camera moves they will move with the camera. Also note that the scale for the scale bar automatically adjust itself when the camera moves.

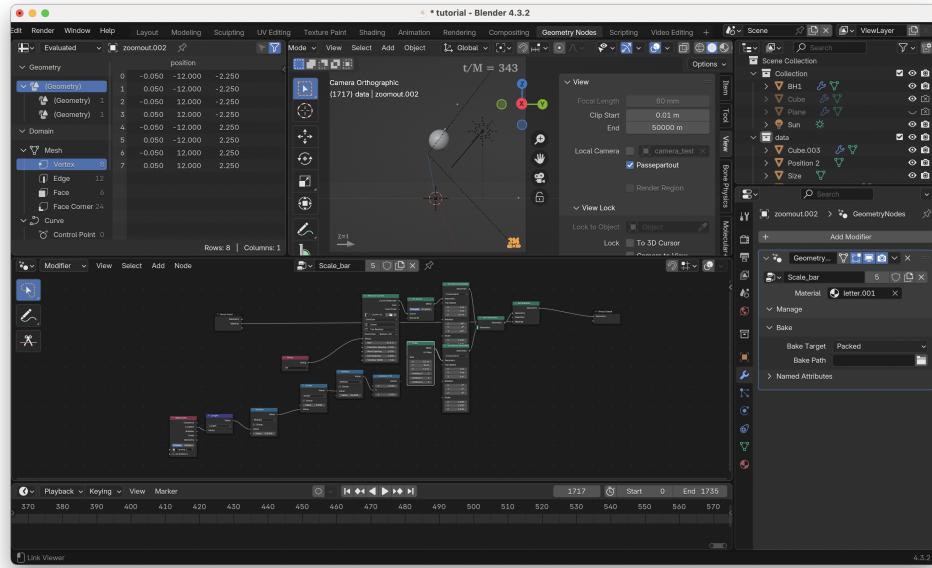


Figure 6: Scale bar

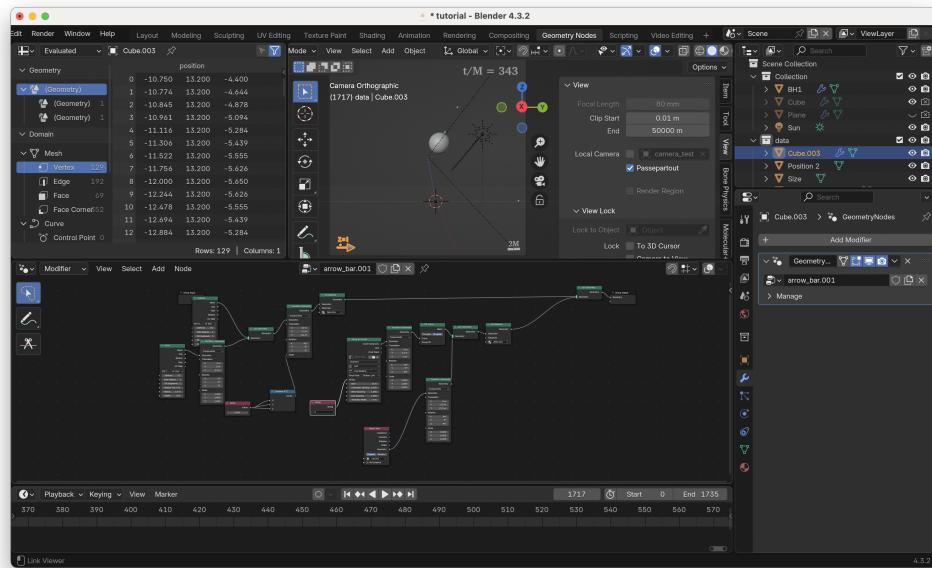


Figure 7: Spin arrow bar

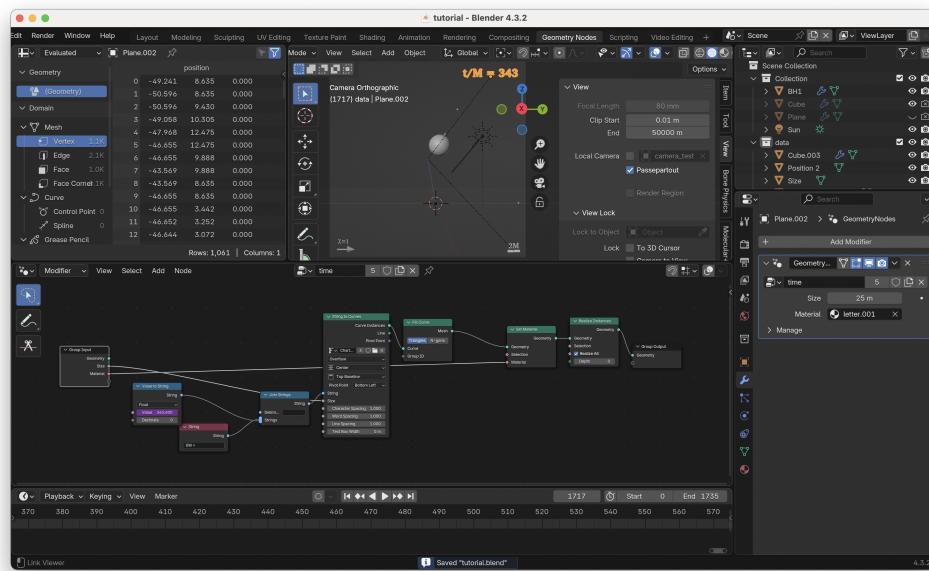


Figure 8: t/M bar