

Creating Flight Paths through the Universe

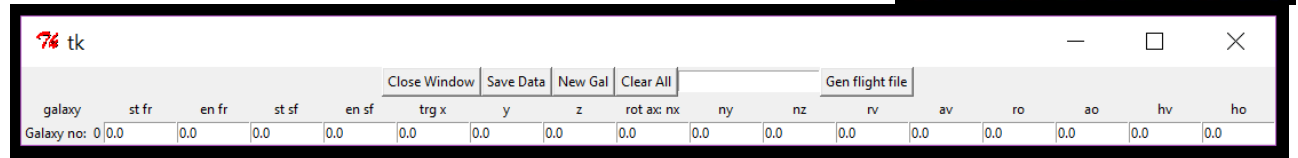
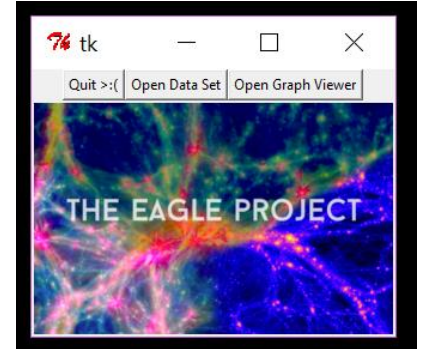
Part One : Use of the GUI

Opening window:

To run the GUI simply run the python script *gui.py* in the command widow. The first thing that should appear is the opening window:

In order to create a new flight path, you first need to add the positions of the objects you are interested in by clicking **Open Data Set**.

You should see a window appear. By then clicking **New Gal** button this should look like below. Every time you click the **New Gal** button an extra row should appear with all the parameters of the galaxy you wish to add to the flight plan.



Each entry box is a different variable that you can enter to define the flight past a specific point, variable defined in the table below: (NOTE: The radial, angular and helix coordinates are identical to cylindrical coordinates in the targets reference frame)

st fr	The starting frame of the orbit of the galaxy in question. This should be -1 for the first row
en fr	The end frame of the orbit of the galaxy in question. This should be one greater or the final row
st sf	The scale factor at which the orbit of this galaxy will start
en sf	The scale factor at which the orbit of this galaxy will end
trg : x	The x position in real coordinates at which to centre the orbit. Units of cMpc
trg : y	The y position in real coordinates at which to centre the orbit. Units of cMpc
trg : z	The z position in real coordinates at which to centre the orbit. Units of cMpc
rot ax: nx	The basis to define the rational axis, eg 1 0 0 to rotate about the x axis
rot ax: ny	
rot ax: nz	
rv	The radial velocity, used if you want to spiral out/in to a galaxy. Positive is outwards in units of cMpc frame ⁻¹
av	The angular velocity in units of orbits frame ⁻¹ as a decimal
ro	Radial offset, the initial radius of the orbit. Units of cMpc
ao	Angular offset, used to shift the orbit, delays the start of by a fraction specified. Units of orbits, enter as a decimal.
hv	Helix velocity, the velocity normal to the plane of the orbit to create a helix. Units of cMpc frame ⁻¹
ho	Helix offset, the initial height above the orbital plane. Units of cMpc

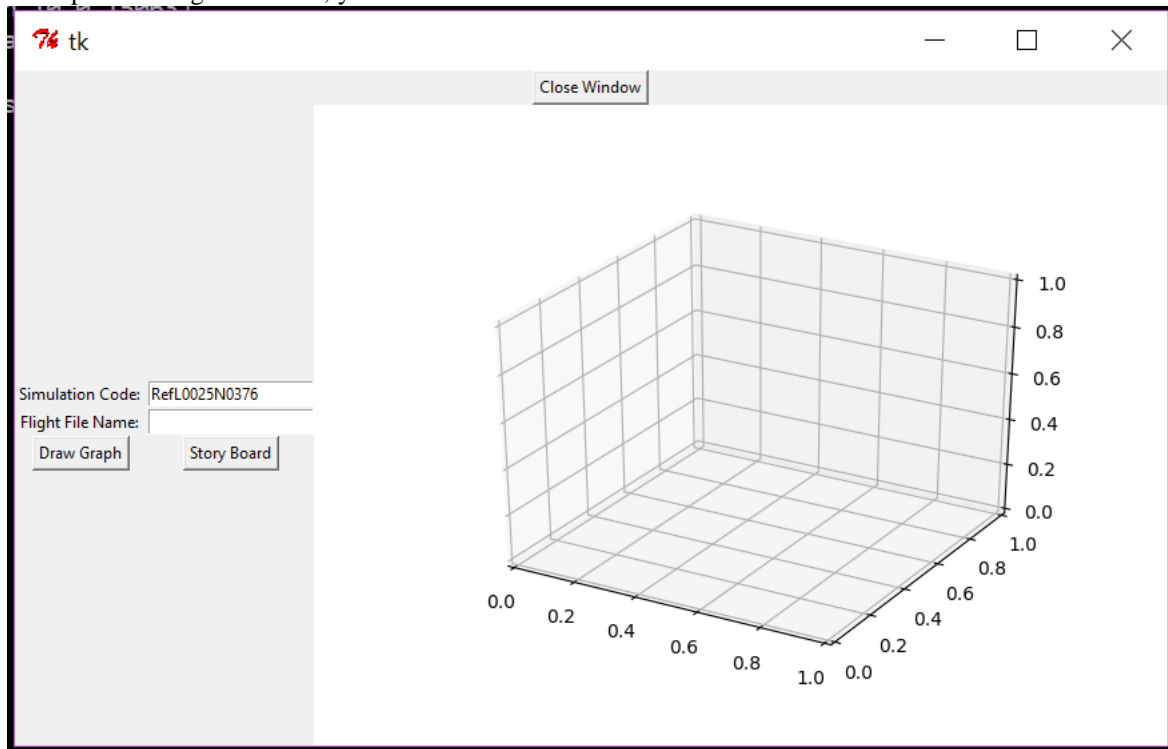
NOTE: You do not need to have a continuum of frames specified apart from the start which must always be -1, any gaps in frames between galaxies will be used to spline a path between them as such you can decide on the time travelling to each galaxy by choosing the gaps in the frame.

Saving the data

Once you have input all the desired galaxies, to save the data to a text file which can be later used to create a movie form click the **Save Data** button then (after entering a name for the text file in the box adjacent) the **Gen Flight File** button. The file is now save with the name you gave it.

Plotting the Flight Path & Story Board

Once you have generated a text file of the flight path you can use the **Open Graph Viewer** to visualise this in 3D. Upon clicking this button, you will see this:



First you need to input the txt file name (including the .txt part) into the entry for flight file name. Click **Draw Graph** and a 3D moveable plot of the flight plan will appear. The blue arrows shows the basis vector which the camera is looking down, the other arrows the remaining basis vectors of the camera.

NOTE: The 'Draw Graph' feature can be use for any txt file in the correct format and is not restricted to files generated using the method above if the text file is in the same directory as the *gui.py* file.

If the flight path is satisfactory you can create a story board of the images by clicking the **Story Board** button. This will output all the frames in the text file to a directory of the same name as the text file. You will need to change the **Simulation Code** if you are not working in the default box named above, this will change the SQL in the code to pull the data for the correct box. This needs to be changed **before** clicking the story board button.

Example: If we want to travel through the universe passing two galaxies of known position at a known scale factor starting from a specified point and ending at a point.

- 1: Open up the data set and input the staring point as one frame, eg form -1 to 0 with all entries filled in.
- 2: At the details of the galaxies you wish to pass by, gaps in the frame numbers will be splined as you travel between the points. An example of what this could look like is below:

		Close Window Save Data New Gal Clear All int.txt Gen flight file														
galaxy	st fr	en fr	st sf	en sf	trg x	y	z	rot ax: nx	ny	nz	rv	av	ro	ao	hv	ho
Galaxy no: 0	-1	0.0	0.5	0.5	3.45	5.72	11.0	1	0	0	0	0.0	0.0	0.0	0.0	0.0
Galaxy no: 1	50	100	0.5	0.6	2	8	19	1	0	0	0.02	0.01	5	0.0	0.0	0.0
Galaxy no: 2	150	250	0.8	0.8	1	6	7	0	1	0	0.05	0.05	3	0.0	0.02	0.5
Galaxy no: 3	300	301	1	1	20	20	20	1	0	0	0	0	0	0	0.0	0.0

- 3: Click **Save Data** then **Gen flight file** (with a name) to create the file.

4: open the graph viewer and input the text file that you have created and you should see the path as below:

