Simplifying Usability of Galaxy Rotation Curve Model

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Abstract

The focus of this project is not on data acquisition but rather on enhancing the usability of a model from previous research for future data collection. Previous data collection proved tedious when having Mathematica manually evaluate each data point. Thus, the use ability and efficiency for data collection was increased through the creation of an interface that relies on Mathematica's dynamic functions.

Introduction:

Originally data was collected via numerical integration using Mathematica to evaluate the mass density function (the rotation curve model) of which, required the user to manually enter values for the area of integration and re-evaluate numerous times. Other attempts were made using functions such as manipulate, which behaves like the created interface, but does not allow for the use of the computed value in later calculation. This problem arises from the 'manipulate' interface its-self being the output instead of just the computed numerical value. The lack of efficient data collection then led to the need to create a new interface in order to continue with the project, of which the goal is to compare multiple galaxies' rotation data to see if there is a link between dark matter and the measured/ theorized rotation velocities.[1]

Methods:

Creating an Interface:

The interface was constructed with the use of 4 operations: dynamic, slider, input field, and plot. The plot function was used to create a plot that would show what the plotted velocities should look like. The input field and slider were used in tandem, meaning that the position of the slider represented the number in the input box. The slider was added to see how changing variables in the model would affect the plot, while the input box was vital for easily entering data points. The dynamic function was used to create a system with dynamic updating; this means the system only needs to be evaluated once and anything associated with the dynamic operation will be updated as variables change.

Results:

The results of the project were a working interface that consisted of 6 manipulatable variables controlled by either slider or input box, an estimated mass of the integrated area, the velocity of stelar bodies at said radius, and a relative visual of what the ploted velocities should look like. (figure 1)

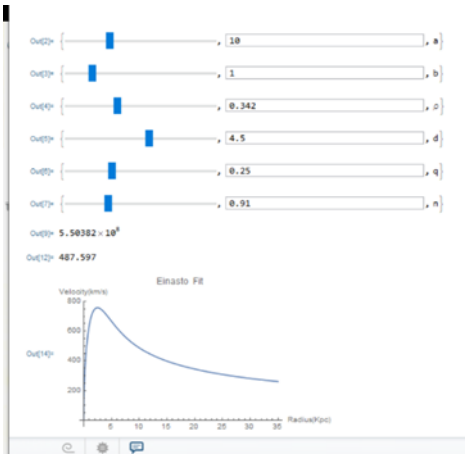

Figure1: The finished interface with Out 2 through 7 being the manipulatable variables, out 9 being the mass of the integrated area of the system in kilograms, out 12 is the velocity of stelar bodies orbiting at said radius in km/sec, and out14 is the projected graph for the collected data points.

Discussion:

With the completion of the model the next steps are to start collecting rotation curve data on different galaxies. As it stands, the interface works and does what it needs to and while the code can be made more efficient future updates could include data tables and charts that would get rid of the need of an excel sheet.

Reference

[1] Foxwell, E. “Modeling Dark Matter Rotation Curves of Spiral Galaxies.”