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 to be tedious while having Mathematica manually evaluate each data point. Thus, the usability and efficiency for data collection was improved by the creation of an interface that relies on Mathematica's dynamic functions instead.

Introduction

Originally the data was collected via numerical integration using Mathematica to evaluate the mass density function (the rotation curve model) for which the user was required to manually enter values for the area of integration. The area was reevaluated numerous times. Other attempts were made using functions such as manipulate, which behaves like the created interface, but it does not allow for the use of the computed value in later calculation. This problem arises from the 'manipulate' interface's being an output instead of a computed numerical value. The lack of efficient data collection then resulted in a need for the creation of a new interface to continue the project, where the goal was to compare multiple galaxies' rotation data to determine if a link exists between dark matter and the theorized rotation velocities.[1]

Methods

Creating an Interface:

The interface was constructed by 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 continually updated as other variables change.

Results

The result of the project was 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 stellar bodies at said radius, and a relative visual of what the plotted velocities should look like. (figure 1)

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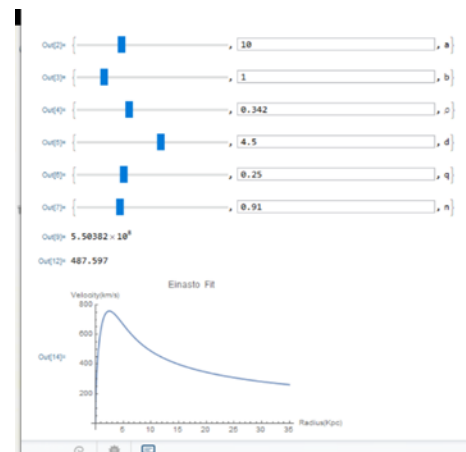
being the manipulatable variables, out 9 being the mass of the integrated area of the system in kilograms, out 12 is the velocity of stellar bodies orbiting at said radius in km/sec, and out14 is the projected graph for the collected data points.

Discussion

Following the completion of the model, the next step includes collecting rotation curve data on different galaxies. As it stands, the interface works and functions as it was intended to. While the code can be made more efficient, future updates could include data tables and charts that would rid the interface of the need for an excel data file.

REFERENCES

- [1] Foxwell, E. "Modeling Dark Matter Rotation Curves of Spiral Galaxies."