An Introduction to Dark Matter

Name: _____

Solar System

With your group, search the average orbital distance between each planet in our solar system and our sun. NASA has a factsheet that may be helpful here. https://nssdc.gsfc.nasa.gov/planetary/factsheet/

Make up a quick scatterplot graph comparing Distance from Sun and Orbital Velocity.

Quick tip: open Google Sheets and create 3 columns for the name of the planet, the distance from the sun (Diameter) and the orbital velocity. Select both columns and Insert - Chart - X Y (Scatter). Label your graph by clicking in your graph to see the Chart Design tab, far left option is Add Chart Element, add Axis Title to each axis with units and add Chart Title. Include the units in the labels for each axis.

1. Describe your graph: What is the shape? What is the slope? How does the velocity change as a planet gets further from the Sun?

2. Why does the velocity change this way? Discuss and come up with a reason, after you have discussed with your table and checked in with another table, summarize your reasons below.

Now think about what a similar graph for a galaxy might look like. Similar to our solar system, galaxies have stars at differing distances from the center mass.

3. What do you expect to see when you graph the distances of different stars against the velocity of those stars, similar to what you just graphed for our solar system?

4. Discuss what you expect and why with your group and explain your predictions below.

Galaxy Rotation Curve

Start out with one galaxy at a time and create a similar graph. The data we are using is from the University of Maryland astronomy program and is located here. http://astroweb.case.edu/ssm/data/RCsmooth.0701.dat

You are using two columns for each graph, start with: R (‘’) and V (km/s). The unit ‘’ is arcseconds.

This graph should look different.

5. Discuss the differences you see between the two graphs with your group and write your conclusions below.

6. What could cause this different shape? If you assume that Newton’s Laws are constant (this is not necessarily a good assumption) then what could be a possible explanation for what you see in the 2nd graph?

7. Have everyone at the table choose a different galaxy to plot so that no one is plotting the same one for their second graph. Plot the data for your second galaxy and share with your group. Compare everyone's second galaxy graph and discuss any differences.

8. How would the graphs look if you plotted only the star velocities (V_{disk}) or only the gas (V_{gas})? Try both options and compare to the smoothed velocity V.