

Discover Dark Matter

Questionnaire pre and post activity

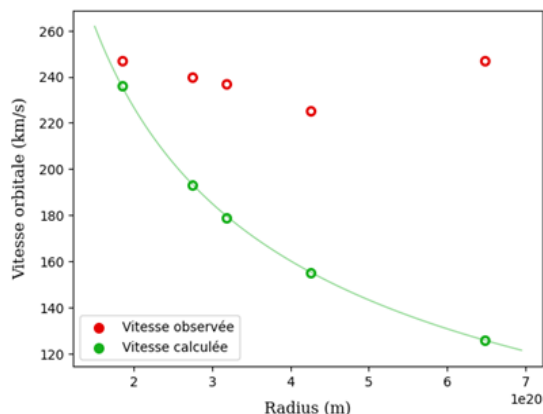
Answer these questions after completing the VR activity.

1. Choose the three words from the list below which best describe your experience during the activity: :

- Engaging
- Boring
- Instructive
- Motivating
- Nauseating
- Fantastic
- Fun
- Collaborative
- Interesting
- Useful
- Useless
- Realistic
- Pleasant
- Enjoyable
- Inviting
- Addictive
- Confusing
- Other: _____

2. Are the observed speeds greater than or smaller than the speeds calculated from the model?

The most important part of the game (exception made for the balloons at the end!) is the display of the graph showing the orbital speed of five stars from the UGC 11748 galaxy as a function of their distance from the galactic center.



3. The model gave you that $v = \sqrt{GM/r}$. Which of these variables is the most likely to be incorrect in the model?

4. If you had to choose a trendline for the observed speeds, what function would you choose? (linear, parabolic, cubic, exponential, other...)

5. We assumed the stars were orbiting a mass of 1.54×10^{41} kg. Estimate how much additional mass would be needed to account for the observed speed for each star? Plot the missing mass as a function of the radius.

6. When is the mechanical energy of the rocket the greatest?

- a) At lift off
- b) When the rocket reaches the space station
- c) The mechanical energy of the rocket does not change during the transfer.

Explain your answer.

Consult the web to answer the following questions to the best of your abilities.

7 : Who is Vera Rubin?

8 : As of today, which hypotheses best explain what dark matter is made of?

**9 : Try to explain the difference between dark matter and dark energy.
(This one is a bit harder!)**