Write the following text on the front cover of your homework assignment and sign it. If the text is missing, 20 points will be subtracted from your homework grade.

Honor Pledge for Graded Assignments

"I affirm that I have not given or received any unauthorized help on this assignment, and that this work is my own."

_____

_____

_____

Signature _____

In this assignment, we simulate the gravitational assist when a spacecraft flies by the Earth. The Earth has a mass of 5.97 x 10^{24} kg and its orbital speed is 108,000 km/h.

Consider a spacecraft that uses the gravitational assist of the Earth to change its direction and its speed, as shown in Fig. 1 (assume the Earth is located at B and the orbital velocity is pointing in the direction shown in Fig. 1). Ignore the rotation of the sun around the center of the Milky-Way galaxy.

a. Use glowscript.org to explore the gravitational assist of the spacecraft and show how its speed and direction changes as function of time as the spacecraft passes the Earth. Explore how the final velocity (magnitude and direction) changes as function of the initial velocity of the spacecraft.

b. Modify the simulation developed above to explore how the gravitational assist changes when the spacecraft passes the Earth on the right-hand side in Fig. 1) instead of on the left-hand side. Explore how the final velocity (magnitude and direction) changes as function of the initial velocity of the spacecraft.

Note: for each simulation, make sure you use the proper time step (verify that your results are not sensitive to the time step you used).

Submit the URL of your programs for part a) and b) via email to Professor Wolfs (wolfs@pas.rochester.edu). Make sure that your programs are in a public folder. In addition, submit a pdf file with your observations, addressing the questions raised in the problem. The name of the pdf file should be should be ExtraHW03Phy235XXYYYYYYYY.pdf where XX is your last name and YYYYYYYY is your student id number and the subject of your email should start with ExtraHW03Phy235XXYYYYYYYY where XX is your last name and YYYYYYYY is your student id number.

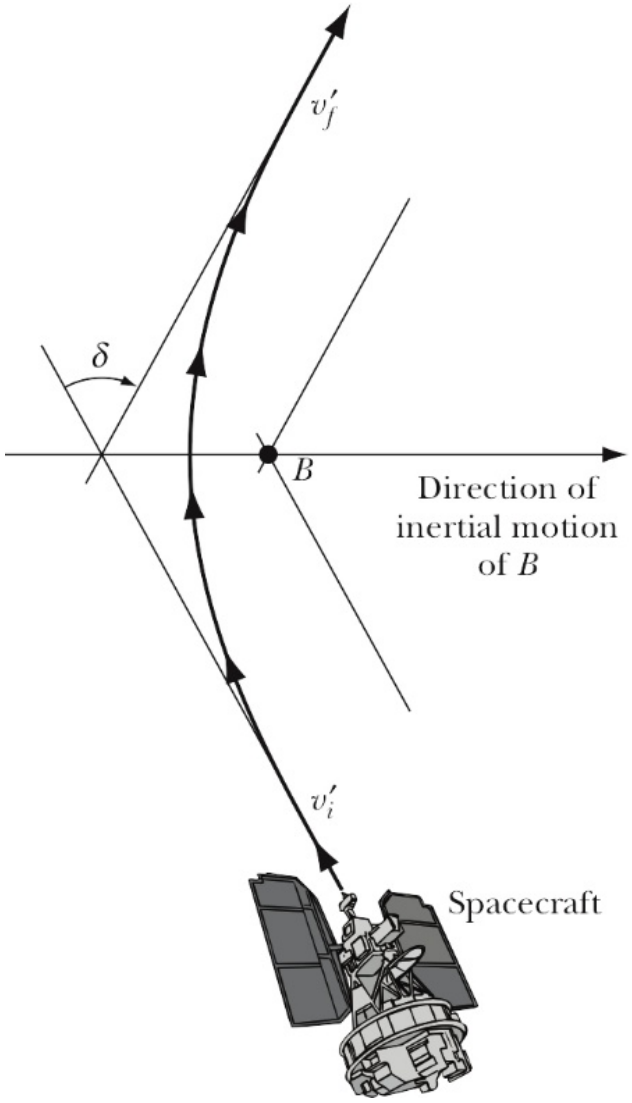

Figure 1: Gravitational assist of a space craft by the Earth.