ASTP-720 Homework 4

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Github Link: `https://github.com/zrd7527/ASTP720.git`

1 Problem 1

For this problem I used the 2 variable RK4 function created in homework 3 and created a function like the damped pendulum function, also in homework 3, which would solve both of the hydrostatic equilibrium equations simultaneously. The y input is a tuple of the mass and pressure determined from the previous iteration of the RK4 solver. The second input is the radius of the current iteration. Both inputs are used to solve the hydrostatic equilibrium equations and then both of the solutions are returned to the RK4 solver for the next iteration. The plot of mass versus radius for the central densities given for white dwarf stars is shown in Figure 1. The pressure is not found correctly because it does not decrease very much along the radius of the star. It only decreases by a few percent.

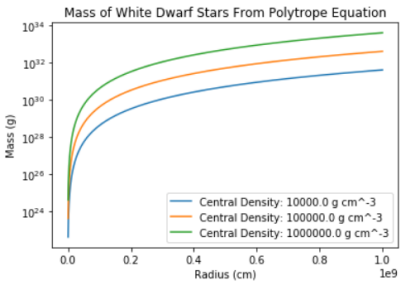

Figure 1

2 Problem 2

This problem was very similar to the first problem but with a relativistic equation for the pressure. I used the same method as in problem 1 but changed the pressure equation. The mass was found with the hydrostatic equilibrium equation. For this problem I did not find the mass radius relationship for neutron stars. This is likely due to the pressure problem also from problem 1. The plot of mass versus radius for this problem is shown in Figure 2.

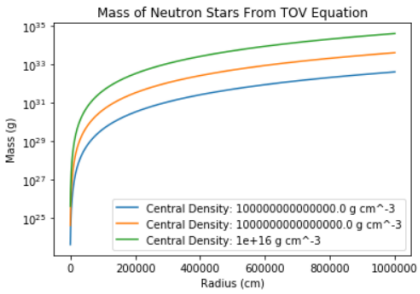

Figure 2

3 Problem 3

I used the solution from problem 2 to find the total mass of the neutron star J0030+0451. The total masses I find are between 46 and 460 solar masses, depending on the input central density of the neutron star. This problem also suffers from the same issues as before so I did not find the correct mass.