Ay 190 Worksheet 4

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1. Description of the Network Code

At the top of the code, several constants are defined as well as parameters for the EOS of a white dwarf (i.e. Γ and K in the polytrope euqation). Central and minimum densities are also defined here. The main routine is called tov_integrate, which takes in the maximum radius for the grid and the number of zones. It calls set_grid, which simply creates an array of radial zones which each have a thickness dr. tov_integrate then defines the central pressure (based on the polytrope equation) and sets the central $M(r)$ to zero, then iterates outward through the zones. In this iteration, it first uses one of the Runge-Kutta methods (e.g. in tov_RK2) to calculate values of pressure and interior mass for the $i+1$ zone. It also defines a surface at the minimum density above which the mass will not increase. Then it calculates the density and energy density based on the pressure. The outputs of this routine are: a $4 \times n_z$ array (where n_z is the number of zones) containing $\rho(r)$, $P(r)$, $\epsilon(r)$,, and $M(r)$; the surface radius; and the width of the zones.

2. First Convergence Test and Profile Plots

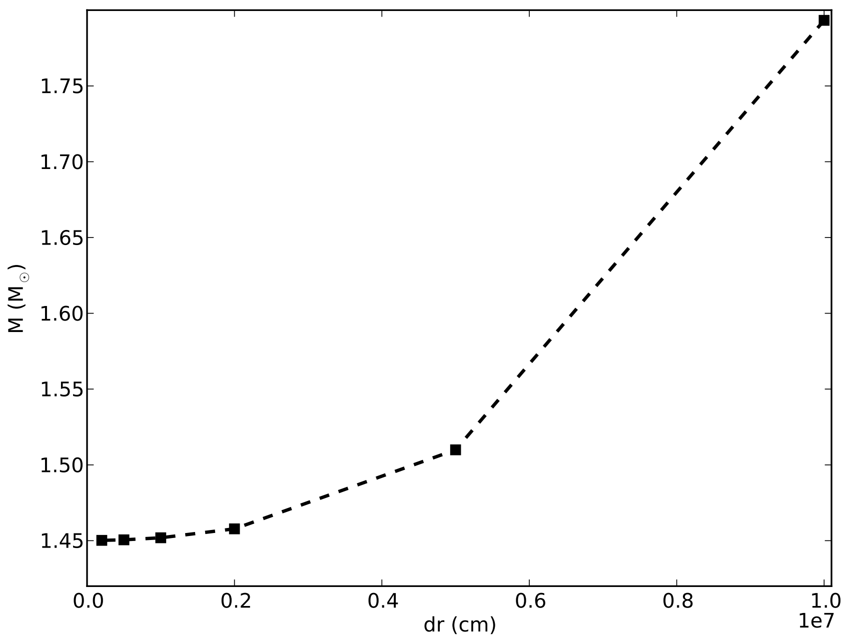

Fig. 1.— Mass calculated by RK2 as a function of the zone size dr. The calculation converges on the correct value for high numbers of zones. The highest number of zones used is 5000.

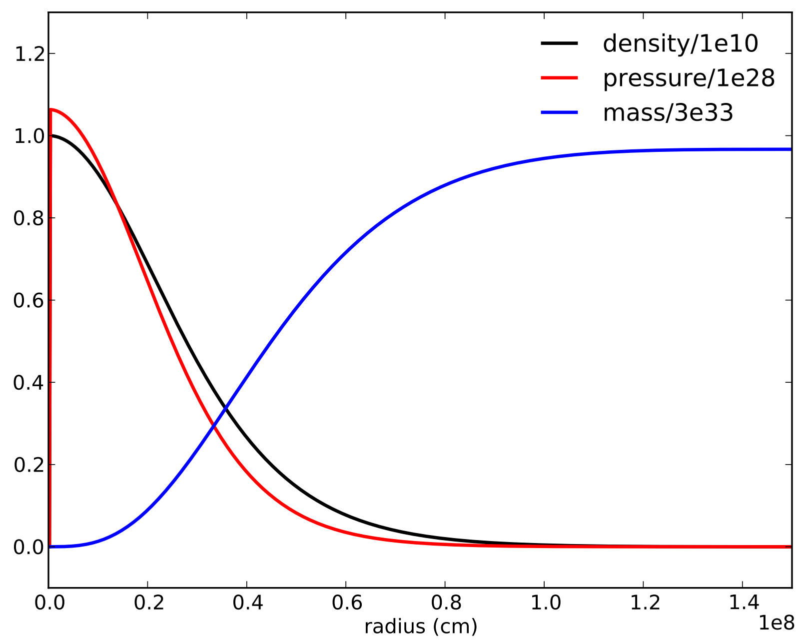

Fig. 2.— Density, pressure, and mass as a function of radius using 5000 zones and RK2.

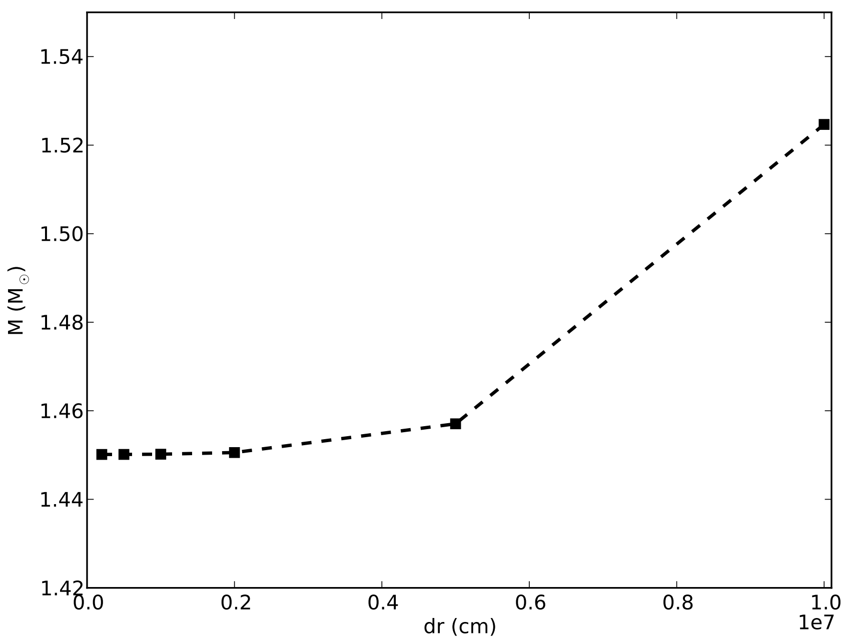

Fig. 3.—

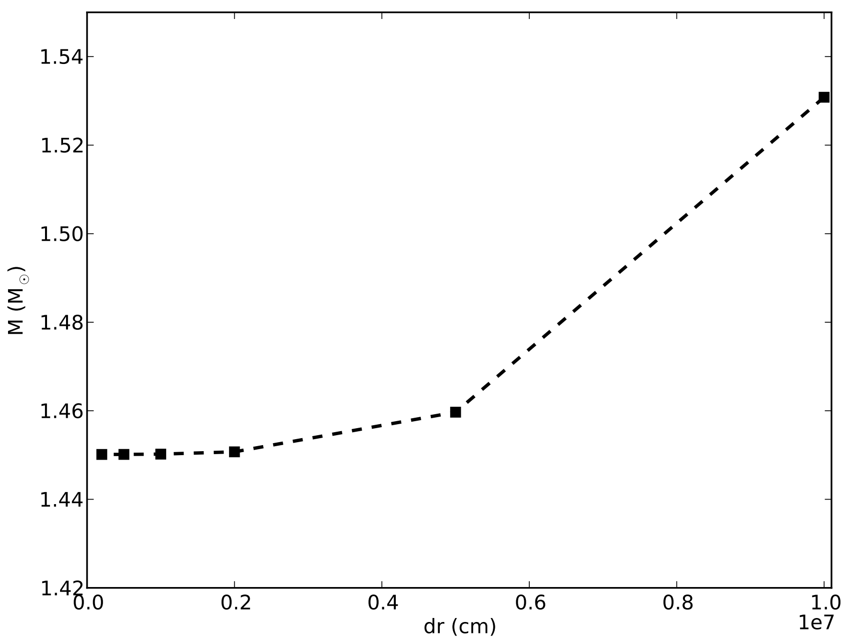

Fig. 4.—