Physics 195 Problem Set 3

Problem 7

(a) Plot the density structure of polytropic stars with $n = 0, 1, 5$. (Make sure you plot ρ/ρ_c vs r/λ_n).

Solution:

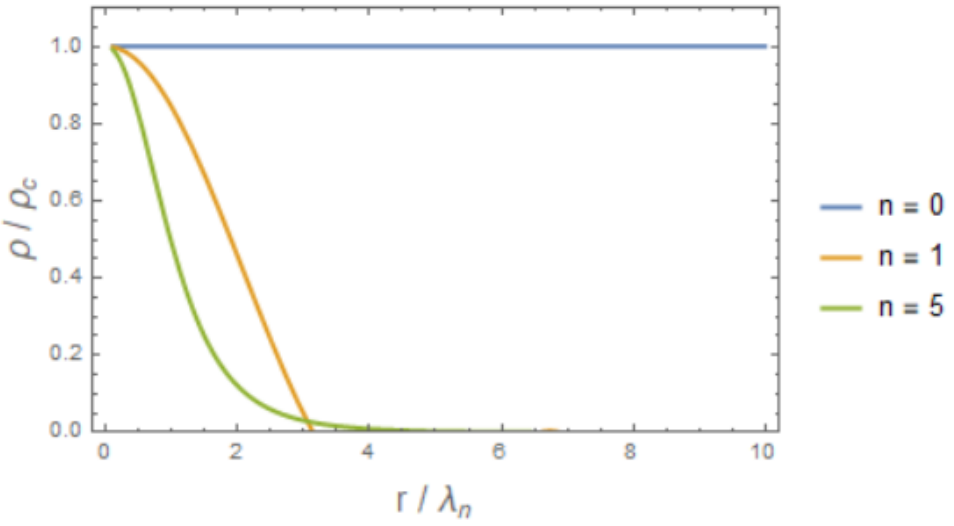

Figure 1: Density structure of polytropic stars with $n = 0, 1, 5$

(b) Numerically compute the density structure of $n = 1.5$ and $n = 3$ polytropes. Plot these alongside the exact solutions for $n = 0, 1, 5$. What can you conclude about the concentration of density with radius for increasing n?

Solution:

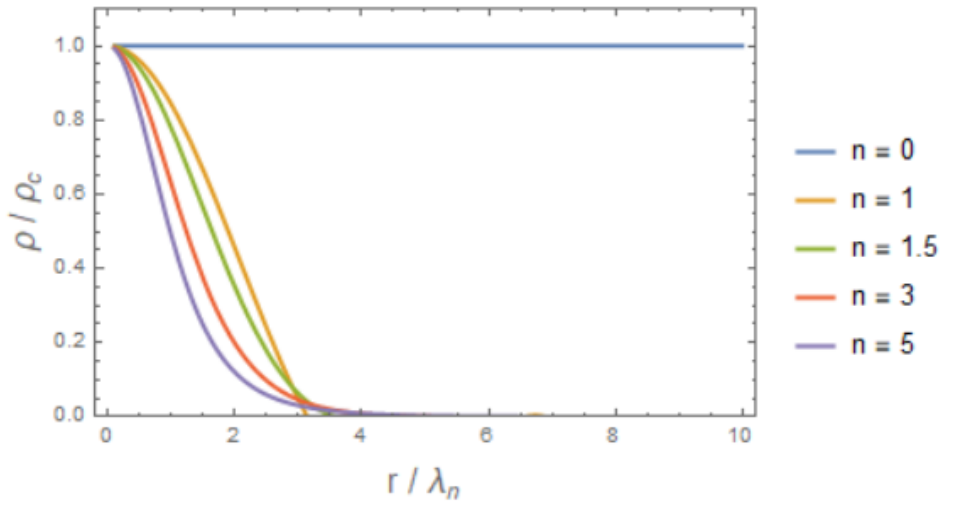

Figure 2: Density structure of polytropic stars with $n = 0, 1, 1.5, 3, 5$

As shown in the figure above, polytropic stars of index $n = 0$ have a constant density all throughout the star. Starting from $n = 1$, the density drops as we go from the center of the star to its surface. We can also see from the plot that as n increases, the density curves get steeper. This means that the density in polytropic stars gets more concentrated in the center with increasing n.