

# Semester Project

## Due Friday December 5

**Homework is due by 5:00 pm on the due date. Late homework will not be accepted.**

This is a larger semester project, which will be worth 3 homework assignments. This is required extra work for graduate students. Undergraduates are welcome to do it for extra credit.

Choose *one* problem from any of the problems listed below.

### Numerical Questions

1. Write a Saha Solver for Helium. It should be able to calculate the ionization fractions for fixed density  $n$  or for fixed gas pressure  $P_g$ . Describe how you could generalize it to include more elements. Use partition functions from the Tables in Allen.
2. Write a solver for the Lane-Emden equation. Check that it gives the right results in the three analytic cases. Find the value of the Chandrasekhar mass for a white dwarf and for a “star” held up by the pressure of degenerate neutrons.
3. Write a Henyey solver as described in class. Test it on the analytic polytropes. I will give you a short writeup to guide you.
4. Write a Feautrier Solver for the Grey Transfer Problem. I will give you a short writeup to guide you.
5. Use [EZWEB](#) to follow the evolution of a  $5 M_{\odot}$  star in the HR Diagram. Plot and label the various stages. Now create a few models and show an Isochrone diagram for 700 Million years. Lower the metallicity, repeat the Isochrone diagram and discuss the results. If you are not familiar with IDL this might be a pretty difficult project.

### Qualitative Questions

6. Read the review article by Icko Iben, 1967, Annual Reviews of Astronomy and Astrophysics, Volume 5. Describe in detail the evolutionary track of a  $5 M_{\odot}$  star.
7. Read the review by Chabrier and describe how the mass function differs from the Salpeter mass function. That is, summarize the detailed mass function.
8. Read and summarize: *Observational Clues to the Progenitors of Type Ia Supernovae* Dan Maoz, Filippo Mannucci, and Gijs Nelemans Annual Review of Astronomy and Astrophysics Vol. 52: 107-170 DOI: 10.1146/annurev-astro-082812-141031

9. Read and summarize: *Solar Neutrinos: Status and Prospects*, W.C. Haxton, R.G. Hamish Robertson, and Aldo M. Serenelli, Annual Review of Astronomy and Astrophysics Vol. 51: 21-61 DOI: 10.1146/annurev-astro-081811-125539
10. Read and summarize: *The Formation and Early Evolution of Low-Mass Stars and Brown Dwarfs*, Kevin L. Luhman, Annual Review of Astronomy and Astrophysics Vol. 50: 65-106 DOI: 10.1146/annurev-astro-081811-125528
11. Read and summarize: *Presupernova Evolution of Massive Single and Binary Stars*, N. Langer, Annual Review of Astronomy and Astrophysics Vol. 50: 107-164 DOI: 10.1146/annurev-astro-081811-125534