Stellar Formation and Evolution --- Syllabus

Instructor: Professor Wen-Ping Chen

Office: 906

Class Time: Tuesday 3 to 6 pm

Classroom: Room 914

This course deals with the time variations of the structures of a star's interior (and atmosphere). We will discuss the important physical processes governing the life of a star --- from its birth out of a dense, cold molecular cloud core, to shining with the star's own thermonuclear fuels, to rapid changes in structures when these fuels are no longer available, to the end of a star's life, with matter in extremely compact states.

What it may take for a star billions of years, will take us one semester to cover the following subjects:

- Observational Properties of Stars
- Molecular Clouds and the Interstellar Medium
- Cloud Collapse and Fragmentation
- Stars and Statistical Physics
- Protostars and Jets
- Circumstellar Disks and Planet Formation
- Evolution onto the Main Sequence
- Binaries and Star Clusters
- On the Main Sequence --- Nuclear Reactions
- Effects of Rotation
- Instabilities --- Thermally, Dynamically and Convectively
- Post-MS Evolution of Low-Mass Stars --- RG, AGB, HB, PNe
- Post-MS Evolution of Massive Stars --- SN and SNR
- Mass Loss, Stellar Pulsation and Cepheid Variables
- Compact Objects --- White Dwarfs, Neutron Stars, and Black holes
- Violent End Products --- Supernovae and others

Text: "***An Introduction to the Theory of Stellar Structure and Evolution***", by Dina Prialnik, Cambridge, 2nd Ed. 2009

In addition to written midterm (30% grade) and final (30%) exams, there will be homework assignments, plus in-class exercises or projects (35%).

References

All the references you have found useful for the course ***Stellar Atmosphere and Structure*** will be also of use in this course. The following are the ones I refer to often.

- ✓ ***Physics of Stellar Evolution and Cosmology***, by H. Goldberg & Michael Scadron, 1982, Gordon and Breach
- ✓ ***Black Holes, White Dwarfs, and Neutron Stars,*** by Stuart L. Shapiro & Saul A. Teukolsky, 1983, Wiley
- ✓ ***Stellar Structure and Evolution***, by R. Kippenhahn & W. Weigert, 1990, Springer-Verlag
- ✓ ***Stellar Structure and Evolution***, by Huang, R.Q. 黃潤乾, Guoshin, 1990, originally published in Chinese (恆星物理).
- ✓ ***Introduction to Stellar Astrophysics***, Vol 3 --- Stellar Structure and Evolution, by Erika Bohm-Vitense, 1992, Cambridge
- ✓ ***The Physics of Stars***, by A.C. Phillips, 1994, John Wiley & Sons
- ✓ ***Stellar Evolution***, by Amos Harpaz, A K Peters, 1994
- ✓ ***The Stars*** --- Their Structure and Evolution, R. J. Tayler, 1994, Cambridge
- ✓ ***Supernovae and Nucleosynthesis,*** by David Arnett, 1996, Princeton
- ✓ ***Theoretical Astrophysics, Vol II*****: Stars and Stellar Systems** by Padmanabhan, T., a hefty, mathematical 3 volume set; comprehensive coverage of basic astrophysical processes in vol. 1, stars in vol. 2, and galaxies and cosmology in vol. 3, 2001, Cambridge
- ✓ ***The Formation of Stars,*** by Steven Stahler & Francesco Palla, 2004, Wiley-VCH
- ✓ ***Evolution of Stars and Stellar Populations***, by Maurizio Salaris & Santi, Cassisi, 2005, Wiley
- ✓ ***The Formation of Stars***, by Steven W. Stahler & Francesco Palla, 2004, Wiley
- ✓ ***From Dust to Stars,*** by Norbert S. Schulz, 2005, Springer
- ✓ ***Stellar Physics, 2: Stellar Evolution and Stability,*** by Bisnovatyi-Kogan, 2nd Ed., 2010, Springer (translated from Russian)
- ✓ ***Astrophysics of Planet Formation,*** by Philip J. Armitage, 2010, Cambridge
- ✓ ***Principles of Star Formation,*** by Peter Bodenheimer, 2011, Springer
- ✓ ***An Introduction to Star Formation,*** by Derek Ward-Thompson & Anthony P. Whitworth, 2011, Cambridge
- ✓ ***Stellar Evolution Physics,*** by Icko Iben, 2013 (two volumes), Cambridge
- ✓ ***Star Formation,*** by Mark R. Krumholz, 2017, World Scientific

For star formation, the book "***Molecular Clouds and Star Formation***", edited by Chi Yuan（袁祈）& Junhan You（尤峻汉）and published by World Scientific in 1993, should be a good reference. Unfortunately this book is currently out of print, but Prof Yuan kindly donated his editor copy.