

Stellar Atmosphere and Structure --- 2023 Fall Syllabus

Instructor: Professor Wen-Ping Chen

Class Time: Thursday 2 to 4:50 pm

Classroom: Room 914

Office: S4, Room 906

Office Hours: Please check my schedule posted on my door to sign up a slot.

This course covers the interior structures and atmospheres of stars. We will discuss the important physical processes governing the stability of a star (“stellar structure”) and how emerging photons interact with the stellar atmosphere that we observe to derive the stellar parameters. We will deal with the “static” stellar properties, but not the formation processes or how these properties evolve with time, i.e., stellar evolution, which will be the subjects of a subsequent course in the next semester.

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

In addition to the midterm (30% grade) and final (30%) exams, there will be homework assignments, plus in-class exercises and perhaps projects (40%).

For numerical modeling of atmospheres or interiors --- at least for some of the homework problems --- simple computer coding is required.

. Stellar Observational Properties; Gas Properties

. Radiative Transfer

Blackbody Radiation

Emission, Absorption, and Source Function

Equation of Transfer and its Solutions/Approximations

. Stellar Atmospheres

Opacities (Kramers, Rosseland)

Equations of State

Absorption and Spectral Lines

Line Formation

. Stellar Interiors

Hydrostatic Equilibrium

Mass Distribution

Lane-Emden Equation

Radiative, Thermal, and Convective Equilibrium

Energy Generation; Thermonuclear Reactions

(Degenerate Matter)

References

- ✓ *The Internal Constitution of the Stars*, Arthur S. Eddington, 1926, 1988 reprint, Cambridge U Press
- ✓ *An Introduction to the Study of Stellar Structure*, S. Chandrasekhar, 1939, 1967, Dover
- ✓ *Principles of Stellar Evolution and Nucleosynthesis*, Donald Clayton, 1968, 1983, U. Chicago Press
- ✓ *Introduction to Stellar Atmospheres and Interiors*, Eva Novotny, 1973, Oxford U Press, old but very comprehensive coverage
- ✓ *Stellar Atmospheres*, Dimitri Mihalas, 1978, W. H. Freeman & Company
- ✓ *The Fundamentals of Stellar Astrophysics*, George W. Collins, 1989, Freeman
- ✓ *Stellar Structure and Evolution*, R. Kippenhahn & W. Weigert, 1990, Springer-Verlag
- ✓ *Stellar Structure and Evolution*, 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*, Erika Bohm-Vitense, 1992, Cambridge
- ✓ *The Observation and Analysis of Stellar Photospheres*, David Gray, 1992, Cambridge U Press
- ✓ *The Stars*, Evry Scharzman and Françoise Praderie, 1993, Springer-Verlag, translated by A. R. King
- ✓ *Compendium of Practical Astronomy, Vol 2, Stars and Stellar Systems*, G. D. Roth (ed), 1993, Springer-Verlag
- ✓ *恆星大氣物理*, 汪珍如、區欽岳, 1993, 高等教育出版社
- ✓ *The Physics of Stars*, A. C. Phillips, 1994, John Wiley & Sons
- ✓ *The Stars: Their Structure and Evolution*, R. J. Tayler, 1994, Cambridge
- ✓ *Supernovae and Nucleosynthesis*, David Arnett, 1996, Princeton
- ✓ *Advanced Stellar Astrophysics*, William K. Rose, 1998, Cambridge
- ✓ *Theoretical Astrophysics, Vol II: Stars and Stellar Systems*, Padmanabhan, T., a hefty, mathematical 3 volume set; a comprehensive coverage of basic astrophysical processes in vol. 1, stars in vol. 2, and galaxies and cosmology in vol. 3, 2001, Cambridge
- ✓ *Stars and Stellar Evolution*, K. S. De Boer & W. Seggewiss, Ed., 2008, EDP Science
- ✓ *Stellar Physics, 2: Stellar Evolution and Stability*, Bisnovaty-Kogan, 2nd Ed., 2010, Springer (translated from Russian)
- ✓ *Theory of stellar Atmospheres*, Ivan Hubeny & Dimitri Mihalas, 2015, Princeton U Press
- ✓ *The Structure and Evolution of Stars*, J. J. Eldridge & Christopher A. Tout, 2019, World Scientific
- ✓ *Stars and Stellar Processes*, Mike Guidry, 2019, Cambridge

Class Schedule

#	Date		#	Date	
01	09/14		10	11/16	U. Sports Days
02	09/21		11	11/23	
03	09/28	Holiday eve	12	11/30	
04	10/05		13	12/07	
05	10/12		14	12/14	
06	10/19		15	12/21	
07	10/26	Midterm Exam	16	12/28	Final Exam
08	11/02		17	01/04	Exam review
09	11/09		18	01/11	Supple. materials