

# STELLAR ATMOSPHERES and the ISM

## Astronomy 3550

### Class meets:

M, W 1:15 to 2:30 pm

### Instructor:

Dr. D. John Hillier  
318 Allen Hall  
Phone 624-9213 (Department: 624-9000)  
Email [hillier@pitt.edu](mailto:hillier@pitt.edu)

### Office Hours:

F 1:15-2:30  
Any time I'm available (not before a class)  
By appointment

### Grades:

Final Assignment: Due: Fri, 34-Dec	20%
Homework:	80%

I reserve the right to adjust the grade allocations slightly.

## Other important dates (2020)

Date	Event
19 <sup>th</sup> Aug	Classes begin (Wednesday)
4 <sup>th</sup> Sep	End add/drop period (Friday)
7 <sup>th</sup> Sep	Labor day – classes as usual (Monday)
14 <sup>th</sup> Oct	Self care day (no classes – Wednesday)
25 <sup>th</sup> – 29 <sup>th</sup> Oct	Self care day (no classes – Wed-Sun)
4 <sup>th</sup> Dec	End of fall term (Friday)

## General references:

The Fundamentals of Stellar Astrophysics,  
Collins II (1989)

<http://bifrost.cwru.edu/personal/collins/astrobook/>

Introduction to Stellar Astrophysics (Vols 1, II, III)  
E. Bohm-Vietense

Modern Astrophysics,  
B.W. Carroll, D.A. Ostlie, (Addison-Weseley)

[Carroll-Introduction-to-Modern-Astrophysics-An-2nd-Edition](#)

Astrophysics of Gaseous Nebulae and Active Galactic Nuclei,  
Osterbrock (1984, University Science Books)

Astrophysics of Gaseous Nebulae and Active Galactic Nuclei,  
Osterbrock & Ferland (2006, University Science Books)

Atomic Astrophysics and Spectroscopy  
Pradhan and Nahar (2011, Cambridge University Press)

Advanced Stellar Astrophysics  
Rose (Cambridge)

# Stellar Atmospheres

Stellar Atmospheres,

Mihalas (1978, 2nd ed) (out of print).

Theory of Stellar Atmospheres

Hubeny and Mihalas (2014, Princeton University Press)

The Observations and Analysis of Stellar Photospheres,

D.F. Gray (1976, John Wiley and sons).

Interpreting Astronomical Spectra,

Emerson (1996, Wiley and sons)

Radiative Transfer and Spectral Line formation in Stellar Atmospheres

Rutten ([Rutten radiative transfer notes](#))

## **Stellar Interiors**

Principals of Stellar Evolution and Nucleosynthesis,  
Clayton (1983)

Stellar Interiors: Physical principles, Structure, and Evolution  
C.J. Hansen, S.D. Kawaler (1994, Springer-Verlag)

Stellar Structure and Evolution  
Kippenhann, Weigert (1990, Springer-Verlag)

An Introduction to the Theory of Stellar Structure and Evolution  
Diana Prialnik (2000, University Press).

Understanding stellar evolution  
Henny J.G.L.M. Lamers and Emily M. Levesque (IOP, 2017)

## **Advanced undergraduate level**

The Stars: Their Structure and Evolution  
R.J. Tayler (1994, Cambridge University press, 2nd ed)

The Physics of Stars  
A.C. Phillips (1999, Wiley, 2n ed.)

Stellar Evolution and Nucleosynthesis  
S.G. Ryan & A. J.Norton (2010, Cambridge)

# Course Outline

## 1. Fundamentals of Stellar Astronomy (Class & assigned reading)

Observables, Stellar Classification  
Magnitudes, Photometric systems  
Interstellar Extinction  
Measurement of stellar parameters:  
    Distances, masses, radii  
H-R diagram  
Atomic spectra

## 2. Stellar Atmospheres

Equation of Radiative Transfer  
Diffusion, Grey Atmosphere  
Convection  
Radiative and Atomic processes  
Local Thermodynamic Equilibrium (LTE)  
LTE line formation  
Non-LTE  
Statistical equilibrium equations

### **3. Interstellar medium and H II regions**

Thermal equilibrium

Cooling function

Structure of ISM

Interstellar shocks

Dust

### **4. Stellar Interiors**

Equation of state

Polytropes (briefly)

Hydrostatic and thermodynamic equilibrium

Energy transport

Energy generation and nucleosynthesis

Stellar Evolution

**Note:** The concepts of non-LTE, the statistical equilibrium equations, and atomic and radiative processes are relevant for both stellar atmospheres and the ISM/HII regions.