# AST 383C

## Stellar Atmospheres

### Spring 2009

**MWF 11:00 - 12:00**
**RLM 15.216B**
**Unique No. 48580**

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### LEVEL:

Böhm-Vitense, *Introduction to Stellar Astrophysics: Volume 2, Stellar Atmospheres*
Mihalas, *Stellar Atmospheres*
Gray, *Observations and Analysis of Stellar Photospheres*
Rybicki and Lightman, *Radiative Processes in Astrophysics*

### SYLLABUS

I. Summary of Observational Data: Motivations for studying stars. Spectral and luminosity classification. Relation of theory and observation.
II. Elements of Radiative Transfer Theory: Definitions. Emission, absorption, and scattering. Equation of transfer, radiative equilibrium.
III. Gray Atmospheres: Milne's equation. Two-stream and Eddington approximations. Emergent flux and limb darkening
IV. Local Thermodynamic equilibrium (LTE): Elements of statistical mechanics. Perfect gases and the Saha equation. Conditions for LTE. Depression of the adiabatic gradient in a partial ionization zone.
V. Non-LTE: Rate: Rate equations. Radiative and collisional rates; departure coefficients. Calculation of Einstein coefficients and collision cross-sections.
VI. Continuum Opacity: Opacity sources in high-, intermediate-, and low-temperature stellar atmospheres.
VII. LTE Continuum model Atmospheres: Basic equations. Numerical solution of transfer equation: (-iteration; Kurucz's and Feautrier's methods. Temperature-correction procedures.
VIII. Results and Comparison With Observations: Absolute energy distributions. The Balmer jump. Sample model atmosphere calculation. Flux distributions for sample model stars. Effect of absorption edges on atmospheric structure, line-blanketing, molecule formation.
IX. Mixing Length Theory: Convection and partial ionization zones. Simple phenomenological models.

X. Line Spectra: Line absorption profiles. Natural broadening and the Lorentz profile. Doppler broadening and the Voigt profile. Collisional broadening. Stark broadening, Inglis Teller formula.

XI. Line Transfer Problem.: Line transfer equation: pure scattering lines and pure absorption lines. Center-to-limb variations. Schuster mechanisms. Curve of growth and abundance determinations. Model atmosphere line calculations. Line blanketing theory, LTE line formation.

XII. Moving Atmospheres: Modeling stellar atmospheres with winds require hydrodynamic NLTE treatment. Development of a first-principles approach to the problem. Applications to Hot stars.