AST 383C

Stellar Atmospheres

Fall 2016

TuTh 12:30 - 2:00 RLM 15.216B; Unique No. 47610

LEVEL:

Hubeny & Mihalas, The Theory of Stellar Atmospheres 2015

Böhm-Vitense, Introduction to Stellar Astrophysics: Volume 2

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. An approach to Flat stars: *accretion disks*.

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

X. 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.

XI. Experimental Astrophysics: Line broadening and continuum lowering. New empirically validated approaches.

XII. Convective Energy Transport: Partial ionization zones. Mixing Length Theory. Simple phenomenological models. But what about the kinetic energy of turbulence? Modern approaches through 3D simulations.