PHY305: Stellar Atmospheres

Synopsis

This module describes how astronomers obtain information about the properties of stars from their atmospheres. On completion, you should be able to appreciate differences between the main spectral types, understand how the interaction of radiation with matter affects the appearance of a stellar atmosphere, including the major sources of opacity. You will have a knowledge of the formation of spectral lines, line broadening mechanisms, plus an appreciation of the use of stellar continua and lines as atmospheric diagnostics. The outer solar atmosphere will also be discussed, together with outflows from late and early type stars.

Syllabus

1. **Introduction to stellar atmospheres** What is a stellar atmosphere? History of stellar spectroscopy, brief discussion of major spectral types, and reminder of Luminosity Classes, Magnitudes, Bolometric Flux and Correction. [2 lectures]
2. **Local Thermodynamic Equilibrium**, Saha-Boltzmann Equations. [1 lecture]
3. **Radiation terms** Black body radiation, Effective Temperature, Specific Intensity, Flux, Optical depth, source function. [1 lecture]
4. **Radiative Transfer** Parallel ray and plane-parallel transfer equation, surface intensity, limb darkening, Eddington-Barbier relation, Eddington approximation, grey atmosphere [2 lectures]
5. **Continuous absorption** Line, bound-free, free-free opacity, atomic hydrogen, H^- ion, He, metals, molecules, Thompson and Rayleigh scattering [2 lectures]
6. **Temperatures and pressures of stars**, direct determinations of radii, temperatures and pressures from discontinuities, hydrostatic equilibrium, determination of electron pressure from gas pressure using Saha equation, radiation pressure, Eddington limit [2 lectures]
7. **Line absorption** Equivalent widths, natural line broadening, pressure broadening, thermal broadening, other broadening mechanisms, spectroscopic notation, allowed and forbidden lines, optically thin and thick lines, curve of growth, abundance determinations, departures from LTE [4 lectures]
8. **Solar atmosphere** Granulation, properties and observed features of chromosphere and corona, origin of coronal wind [1 lecture]
9. **Stellar winds**, Diagnostics and mechanisms of mass-loss from late-type stars; diagnostics and mechanisms of mass-loss from early-type stars [2 lectures]
10. **Current developments** Spectroscopic observations and models for supernovae, observations of brown dwarfs and properties of their atmospheres [1 lecture]