

Measuring the Brightnesses of Stars

Luminosity vs. flux. Inverse square law. **The magnitude system** – absolute magnitude vs. apparent magnitude. Properties of light: **wavelength, frequency, energy.** The electromagnetic spectrum. Atmospheric absorption of light. **The Doppler effect. Blackbody radiation.** Measuring the brightness of stars at different wavelengths of visual light. Color index of stars.

Understanding the Spectra of Stars

Concept of spectral lines in a spectrum (absorption, emission). The structure of atoms (nucleus with protons & neutrons, electrons “orbiting” the nucleus). The relationship between electron orbits and the energy stored in an atom. Radiative and collisional excitation and deexcitation. Ionization. Spectral lines from ions and molecules. Strength of spectral lines, equivalent width. **The relationship between gas temperature and energy level of atoms. The relationship between gas temperature and the ionization state of atoms.**

Understanding the Spectra of Stars *(continued)*

Kirchhoff's laws for the formation of spectra of different types. Stellar spectra -- their features and how they are classified (**OBAFGKM**). Spectral classification and temperature.

The Sun

The structure of the Sun, internal and external. **Hydrostatic equilibrium**. Pressure, temperature, density in the core: nuclear fusion. Proton-proton chain and **energy generation**. Transportation of energy from the core to the Sun's surface. The solar neutrino “problem”. Magnetic fields in the Sun and solar activity (sunspots, solar flares, prominences, CMEs).

Binary Stars and Stellar Masses

Types of binary stars: apparent, visual, spectroscopic, eclipsing. Method to measure **stellar masses** using binary stars. Light curves. **Parallax** as a method to measure stellar distances.

The Hertzsprung-Russell Diagram

H-R Diagram: axes, regions in the diagram, luminosity classes. Stellar radii and the H-R diagram. $L = 4\pi R^2 \sigma T^4$. Using the H-R diagram to understand stellar evolution. H-R diagram and the ages of star clusters. Isocrones. Spectroscopic parallax as a method to measure distances.