Physics B3: Astrophysics

Stellar Structure and Evolution

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GENERAL TEXTBOOKS

- An Introduction to Modern Astrophysics, Carroll & Ostlie
- Introductory Astronomy and Astrophysics, Zeilik & Gregory
- An Introduction to the Theory of Stellar Structure and Evolution, Prialnik

ADVANCED TEXTBOOKS on Stellar Structure and Evolution

- Stellar Structure and Evolution, Kippenhahn & Weigert (1994)
- Black Holes, White Dwarfs, and Neutron Stars, Shapiro & Teukolsky (1983)

The Astrophysicist's Approach

- the role of order-of-magnitude estimates
- astrophysicists' versions of standard physics equations
- the role of astronomical observations as substitute for laboratory experiments
  - ▷ search the sky for 'experiments' of interest, piece together time sequences (e.g. solar lifetime 10^{10} yr)
  - ▷ continue to develop instruments (telescopes) to search the sky to ever higher precision and in different wavebands.

LECTURE SCHEDULE: Podsiadlowski
(Supplementary material in italics)

- **Observable properties of stars: luminosity, surface temperature, radius, mass.**
- **Correlations between stellar properties. M – L relation. H-R diagram. Chemical composition of stars. *Brown dwarfs. Planets.***
- **Physical state of the stellar interior – hydrostatic equilibrium – distribution of mass – estimates of P_c, T_c – virial theorem – thermal and gravitational energy – energy generation equation – transport by radiation and convection.**
- **Equations of stellar structure. Equation of state for stellar interiors – perfect gas – degenerate gas – sources of opacity.**
- **Nuclear reaction – hydrogen burning – CNO cycle – helium burning.**
- **The Sun: *helioseismology, neutrino astrophysics, the solar neutrino problem, solar neutrino experiments.***
- **Structure of main-sequence stars. Qualitative account of star-formation**
- **Ages of stellar clusters. Advanced evolutionary stages. Planetary nebulae. Degenerate stars.**
- **Evolution of high-mass stars. Supernovae: core-collapse, thermonuclear explosions, classification, *SN 1987A***
- **Compact stars: neutron stars/pulsars, black holes, Schwarzschild radius, orbits around black holes, *gamma-ray bursts.***
- **Binary stars. Properties, mass function, Roche lobe, mass transfer, *eclipsing binaries, X-ray binaries, cataclysmic variables.***