Astronomy II - Stars and Galaxies (ASTR 1020)
Fall 2009
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REVIEW FOR SECOND EXAM

- Stellar brightnesses, apparent and absolute magnitudes
- H-R Diagram (HRD) - know what the HRD is a plot of (luminosity and temperature), Main Sequence, spectral types and meaning and their sequence (OBAFGKM), luminosity classes, know why some stars have strong hydrogen absorption lines and others do not, know the 'anatomy' of the HRD (main seq, giant, supergiants, WD stars)
- Stellar properties - how are mass, luminosity, radius, and temperature measured or deduced?
- General trends - mass-luminosity relation; stellar census, what kinds of stars are common/rare: hot O stars rare, and cool M stars common
- Distances - stellar parallax, spectroscopic parallax and related issues (such as extinction and reddening), proper motion
- Binaries - types (eclipsing, visual, spectroscopic), deriving masses, know about eclipsing binary lightcurves (getting relative luminosities, radii, temperatures)
- Nature of stars - what is hydrostatic equilibrium (gas pressure balances gravity)? what is the Eddington Limit (cap for star luminosity)? what are brown dwarfs? what does it mean to be a star?
- Star Formation - sequence of formation, cloud collapse, phases, and the timescales (see next)
- Important timescales - the Kelvin-Helmholtz timescale, cloud collapse timescale (or "free-fall" timescale); you show know characteristic numbers for these; Main Sequence timescale (fuel over consumption rate); you show know characteristic numbers for these (such as, the sun can live for 10 billion years, massive stars are more like tens and hundreds of millions of years, and lower mass stars are 100 billion years and longer)
- *Stellar Evolution*
  - know that the mass of a star is all-important for determining the type of star and its evolution
  - low mass stars have nuclear fusion of H in their cores ala the proton-proton chain, but high mass stars fuse H via the carbon cycle
  - know how convection can influence the lifetime of a star
  - know about the idea of evolutionary tracks in the HRD
  - know that mass loss (stellar winds) affects the lifetime of stars because it alters their mass
  - know about the period-luminosity relation for Cepheids
  - know about star clusters and the main sequence turn-off point, and how star clusters are relevant to understanding stellar evolution; know cluster types (globular vs galactic or open)

- Termination of stars - why this happens and what stars become as a function of initial star mass: supernovae, planetary nebulae, white dwarfs, neutron stars, black holes
- Pauli exclusion principle and degeneracy pressure (pressure that depends on density but not temperature)
- White Dwarfs - electron degeneracy pressure, know typical size, know Chandrasekhar mass limit, connection with novae and cataclysmic variables
- supernova events, why they happen, extremely bright, Type Ia versus Type II and their progenitors
- Neutron Stars - neutron degeneracy pressure, typical size, mass limit, discovery, pulsars, rotation and magnetic field
- Black Holes - properties, common misconceptions, Schwarzschild radius, event horizon, how they are found, example of Cygnus X-1

Expressions to be familiar with.

Remember, "$\propto$" below means "goes like this"

Geometric Stellar Parallax $d(\mathrm{pcs}) = 1/\theta(\mathrm{arcsec})$

Newton's version of Kepler's 3rd Law $(M_1 + M_2) \propto a^3/P^2$

flux $F \propto L/d^2$

$L_{\mathrm{MS}} \propto M^3$

$L \propto R^2 T^4$

$t_{\mathrm{ff}} = 50 \text{ Myr} \sqrt{\frac{1}{n_{\mathrm{cloud}}}}$

$t_{\mathrm{KH}} = 30 \text{ Myr} \frac{M^2}{RL}$

$t_{\mathrm{MS}} \propto \frac{M}{L}$

$t_{\mathrm{MS}} = 10^{10} \text{ Gyr} \frac{1}{M^2}$

$\text{Period} - \text{Luminosity Relation}, \ P \propto L$

Schwarzschild Radius, $R_S = \frac{2GM}{c^2}$

for binary stars, $(M_1 + M_2) \propto a^3/P^2$

Mean density, $\rho = 3M/4\pi R^3$