Astronomy II - Stars and Galaxies (ASTR 1020)
Fall 2013
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REVIEW FOR SECOND EXAM

- *Sun*
  - be familiar with general properties of the Sun – composition, different sections (core and convective zone), etc
  - interior – fusion, p-p chain (hydrogen to helium), neutrinos, the neutrino problem and resolution, how long the Sun can live, how long it takes energy in the Sun to leak out at the photosphere (about 10^5 years)
  - atmosphere – the three components (photosphere, chromosphere, corona) and general properties, activity (sunspots, solar flares), solar wind
  - the solar cycle for sunspots, that it is associated with magnetic fields, and that the cycle is 11 years
  - be familiar with the concepts of the solar wind and mass loss from the Sun
- *Stars*
  - Stellar properties - how are mass, luminosity, radius, and temperature measured or deduced?
  - 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)
  - 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
  - Know about the magnitude brightness system
  - Binaries - types (eclipsing, visual, spectroscopic), deriving masses, know about eclipsing binary lightcurves (getting relative luminosities, radii, temperatures)
- *Stellar Evolution*
  - know that the mass of a star is all-important for determining the type of star and its evolution
  - Star Formation - sequence of formation (collapse, fragment, flatten, protostar)

- Important timescales - cloud collapse (or "free-fall") timescale about 1 Myr; the Kelvin-Helmholtz timescale for protostars about 10 Myr; Main Sequence timescale about 1 Gyr and longer (know that the sun can live for 10 Gyrs, massive stars are more like tens of millions of years)
- 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 that close binaries can transfer mass, which affects their evolution

Expressions to be familiar with:

- Remember, "$\propto$" below means "goes like this"
- Geometric Stellar Parallax:
  $d(\mathrm{pc}) = 1/\theta(\mathrm{arcsec})$
- Newton's version of Kepler's 3rd Law:
  $(M_1 + M_2) \propto a^3/P^2$
- Mass Luminosity Relation:
  $L_{\mathrm{MS}} \propto M^3$
- Relation between stellar parameters
  $L \propto R^2\, T^4$
- Cloud collapse
  $t_{\mathrm{ff}} = 50 \times \mathrm{Myr}\, \sqrt{\frac{1}{n_{\mathrm{cloud}}}}$
- Protostar (mass, radius, luminosity in solar units)
  $t_{\mathrm{KH}} = 30\ \mathrm{Myr}\, \frac{M^2}{RL}$
- Main Sequence
  $t_{\mathrm{MS}} \propto \frac{M}{L}$
  $t_{\mathrm{MS}} = 10^{10}\ \mathrm{Gyr} \times \frac{M_\odot^2}{M^2}$