AST 111
Fall 2008
Hour Exam #2 Review

Format: Short answer, some calculations required; bring your calculator.

Material and concepts from class, homework, and from Bennett et al. *The Cosmic Perspective* (4th Ed.) chapters 5, 7, 8, 9, 10, and 14 will be included

You should be familiar with the following material and concepts:

1. **Light and Spectra**

   - light = electromagnetic radiation: radio, infrared, optical, ultraviolet, x-rays, gamma rays
   - emission, reflection, absorption, scattering
   - waves vs. particles
   - $\lambda\nu = c$
   - $E = h\nu$
   - thermal radiation
   - Wien's Law: $\lambda_{\rm peak}({\rm nm}) = 2.9 \times 10^6({\rm nm/K})/T({\rm K})$
   - Stefan-Boltzmann Law: power = luminosity = energy/time = $P = L = A_{\rm surf}\sigma T^4$ J/s = Watts
   - inverse square law: Intensity $I = L/4\pi d^2 {\rm Watts/m^2}$
   - spectral emission and absorption lines
   - Doppler (blue- and red-) shift: $\frac{\Delta\lambda}{\lambda_{\rm lab}} = \frac{\lambda_{\rm obs}-\lambda_{\rm lab}}{\lambda_{\rm lab}} = \frac{\Delta v}{c}$
   - quantized energy levels of atoms
   - spectral emission and absorption lines
   - Kirchoff's Law: thermal emission, or absorption lines, or emission lines
   - light and spectra give direct info on brightness, composition, gas density, temperature, and velocity

2. **Solar System**

   - 8 planets (M,V,E,M,J,S,U,N)

- orbits are all almost in one plane, like a disk
- 0.4 AU $< a <$ 30 AU, but comets out to 50,000 AU - 1/4 of way to Proxima Centauri
- counterclockwise orbits and spins (except V,U)
- composition, structure, size, atmosphere, location of planets
- terrestrial planets (M,V,E,M)
- coalescence, differentiation
- bombardment (including Moon formation)
- volcanism and plate tectonics
- erosion
- differentiation, core, mantle, crust
- greenhouse effect
- magnetosphere
- some cratered surfaces, some smooth
- radioactive dating (rocks from Earth, Moon, Mars, meteorites) $\rightarrow$ age of solar system at least 4.6 Gyr.

$$\frac{N_{\text{now}}}{N_{\text{orig}}} = (\frac{1}{2})^{t/\tau_{1/2}}$$

so

$$t = \frac{log(N_{\text{now}}/N_{\text{orig}})}{log(1/2)}\tau_{1/2}$$

- scale model of solar system
- solar nebula theory
- condensation; frost line; hydrogen compounds; planetesimals
- heavy bombardment
- solar wind
- extrasolar planets observed via Doppler shift of parent star; IR excess; protoplanetary disks

3. **Sun**

- photosphere
- chromosphere
- corona
- prominence

- sunspot
- flare
- granules
- solar wind
- 11-year solar cycle
- magnetic field
- fission
- fusion
- proton-proton chain
- CNO cycle
- $E = mc^2$
- neutrino
- convection
- hydrodynamic equilibrium + nuclear thermostat
- Lifetime of Sun
  τ_{Sun} = (total mass lost in H $\rightarrow$ He fusion)/(rate of mass consumption) = 13% $\times$ $M_{sun} \times 0.7\%/(L/c^2) = 10^{10}$yrs for Sun