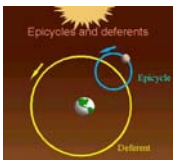
Midterm 1 Study Guide

- This page + 5 more pages available at course web site www.pa.msu.edu/courses/ISP205/sec-3
  - Print out and bring to review session.
- Midterm will have 45 multiple choice questions.
- Midterm *will cover* :
  - Things I have talked about in class. Use the textbook to help you understand the things I talked about in class
  - A few simple (multiple choice) problems requiring you to know and use the equations given in the study guide. Similar to the homework problems. If you could do the homework, you can do the midterm. Don't panic.
  - The study guide is meant to recap the most important points, but I will test you over *all* of the material I have presented in class, whether or not it is in the study guide.
- I will *not* test you about things in the book that I have *not* mentioned in class.

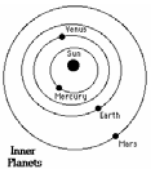
The Motions of the Planets



Ptolemy
140 AD

Copernicus
1543

Simpler model



Kepler
1609

More accurate description of data

Kepler's Laws

1. Each planet moves around orbit in ellipse, with sun at one focus.
2. The straight line joining the planet and the sun sweeps out equal areas of space in equal amounts of time.
3. $P^2 = a^3$

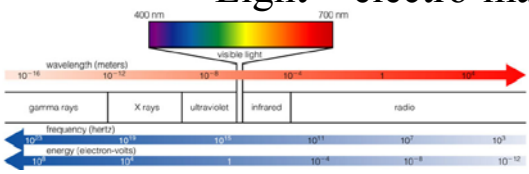
Some Important Concepts

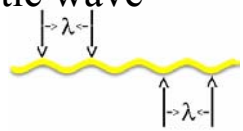
- Newton's 3 laws of motion
  - Object's *momentum* does not change unless acted on by a *force*.
  - F = ma
  - Conservation of total momentum of system (Action - Reaction).
- Gravitational force = $\frac{Gm_1m_2}{r^2}$ (universal attraction between all objects)

- Conservation of total *angular momentum* of system.
- Conservation of total *energy* of system.

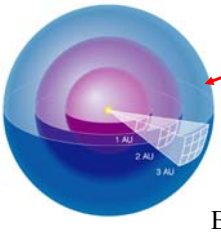
- Kepler's laws
- Escape velocity
- …
- And almost everything else concerning motions of objects

Light = electro-magnetic wave





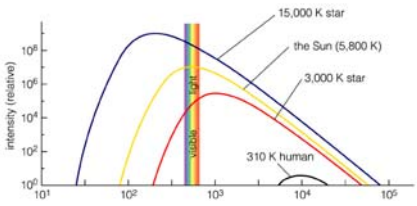
- *frequency* = rate at which crests pass a stationary observer.
  f = velocity/distance = c/λ (in cycles/second, or Hz)
- *Energy* of each photon:
  E = hf = hc/λ (h = Planck's constant)



Inverse square law: $F = L / 4\pi r^2$

Black Bodies:

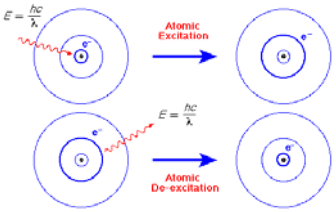
- Wien Displacement Law.
  - $\lambda_{max} = 3x10^6 / T$
- Total energy emitted *per unit surface area*:
  $E = \sigma T^4$ (Steffan-Boltzmann Law)



Wavelength → ← Energy

Emission & Absorption Lines

- Bohr Atom:
  - Electrons can only be in orbits at certain special radii.
  - Only one electron can be in a given orbit at one time.
  - Electron's energy stays constant while it is in orbit.
- Each Bohr orbit has its own distinct energy.
- For electron to move from inner orbit to one further out, it must gain exactly the energy difference between the orbits.
  - Can absorb photon with correct energy
  - Produces *absorption line* if it removes this photon from background continuous spectrum
- De-excitation
  - Electron falls to lower level
  - Can emit photon with energy = exact energy difference between levels.
  - Produces *emission lines* if no background light source.
- Also – *Ionization*: electron lost completely. *Recombination*: electron recaptured.



Formation of spectral lines

[see Fig 5.7]