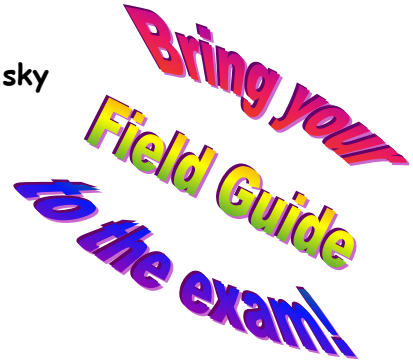
INTRODUCTION TO ASTRONOMY
FALL 2007
REVIEW FOR FINAL EXAM

MAJOR TOPICS :



I. The Celestial Sphere -- appearance and motions in the sky
- Constellations
- Coordinate Systems (horizon, RA & Dec, etc.)
- Daily motion
- Annual motion of the Sun & Stars
- Motion and pjases of the moon

II. Stars
- The nature of light and structure of matter
- The properties of the stars
- Stellar evolution

Sky Stuff to Know:
Constellations: UMa, UMi (*NIGHTS* May), Boö , CBr (*NIGHTS* June), Her, Sag (*NIGHTS* July), Lyr, Cyg, Aql (*NIGHTS* August), Cas, Cep, Per, And, Peg (*NIGHTS* see assignment)
(motions!) … (*NIGHTS:* May)
Solstices & Equinoxes
Know their definitions!
Know their α, δ, date, & constellation

I. THE CELESTIAL SPHERE (YOU CAN'T FORGET STUFF!)

A. Constellations: ***FIELD GUIDE*** Ch. 4
- Origin and organization, asterisms
- Constellation names, abbreviations, genitives (***FG*** pp. 440-441)
- Star names ("other" and Bayer designation)
  Know how to find them!

B. Coordinate systems: ***NIGHTS***, Oct. 8-24, ***FIELD GUIDE*** Ch. 15
- horizon – horizon, zenith, nadir, meridian, etc.
- celestial – RA, Dec, NCP, SCP, Celestial Equator

C. Motions in the sky
- daily motion ***CYCLES***[1] pp. 1-10
  stars, sun, moon, planets, comets, etc. circle NCP once per day
- annual motion ***CYCLES*** pp. 20-32
  equinoxes and solstices: right ascension, declination, constellation, date
  Review the Celestial Coordinates Lab!
  Review ***NIGHTS***, Jan. 19-20, Feb. 25-26, Mar. 6-10,21,22, April 2-4, 7, 8, May 22-25, June 21-26, July 20-24, Sep. 27-28, Nov. 23-24, Dec. 20-22
  the sun's motion along the ecliptic, and in declination (the analemma), the Zodiac
  sidereal and solar day and the analemma
- motion and phases of the moon ***CYCLES*** pp. 11-19
  phases, elongations, times of rising, transit, and setting (MOON WORKSHEET!!)
- motion and positions of the planets ***SKY GAZER'S ALMANAC***
  planetary longitudes, elongations, times of rising, transit, and setting (PLANETS WORKSHEET!!)

Review All the Worksheets
(ALL the calculations)

[1] Copies of 365 Starry Nights and Cycles is available in the Madill Science Library. Ask at the circulation desk.

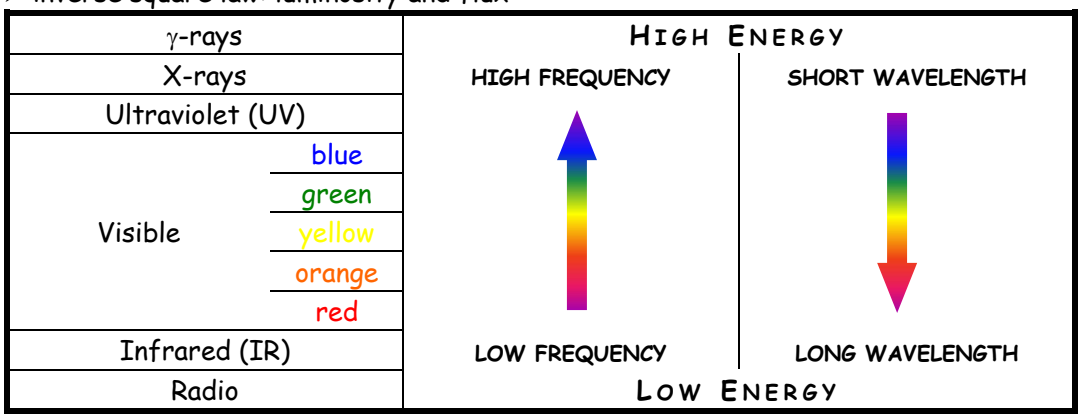
II. STARS

A. Spectroscopy

- The nature of light:

$$c = \lambda f, \qquad E = hf = [hc/\lambda]$$

- inverse square law: luminosity and flux
- inverse square law: luminosity and flux



- electromagnetic spectrum
- atomic structure, source of emission and absorption lines
- Hydrogen Balmer spectrum
- Spectral Classes: **O B A F G K M**

  order (A – N): Willamina Fleming
  order (O – M): Antonia Maury
  subclsses & classification: Annie Jump Cannon
  temperature association: Cecillia Payne Gaposchkin

B. Star Properties (how do we measure or calculate … any needed equations will be given)

- temperature
- distance
- size
- flux and luminosity

Review "Magnitudes, Luminosities and Sizes" worksheets

C. HR diagram *NIGHTS*, March 15-21, *FIELD GUIDE* Appendix 3

- axes (what's plotted against what? What are the scales)
- regions (Main Sequence, Giants (red & blue) Dwarfs (red & white), Luminosity Classes)
- be able to plot positions of stars (given M_v and Spectral Type)!

D. Stellar evolution (be able to explain each process and give examples of objects in each stage)

- Star Birth (*e.g.* Great Nebula in Orion, Eagle Nebula: Pillars of Creation)
- Main Sequence Stars
  - What process defines a STAR?
  - What is a star's source of energy?
  - Sunspots & Solar Max
- Red Giant Stage
  - what starts and ends this stage in low-mass stars (Sol)
- Star Death
  - Planetary Nebula and White Dwarf
  - Supernova and Neutron Stars
  - Supernova and Black Hole

$E=mc^2$

Know name, position & constellation of examples of each stage

Study the Astronomy Notes at
http://www.astronomynotes.com/
"The Life Cycle of Stars"
http://suhep.phy.syr.edu/courses/PHY106.97Spring/Termprojects/Projects/Stars/
and
IMAGINE: The Life Cycles of Stars
http://imagine.gsfc.nasa.gov/docs/teachers/lifecycles/LC_title.html

III. The Solar System

- worlds (expect images)

  Be able to describe the basic nature (rocky, icy, gas, atmosphere, craters, volcanoes, etc.) of the inner eight planets, the Galilean Moons, Titan, and Triton, and Luna.

- arrangement, size, and formation of the solar system

  Handy Websites: http://www.spaceart.com/solar/
  http://www.seds.org/billa/tnp/
  http://www.athena.ivv.nasa.gov/curric/space/planets/
  http://stardate.utexas.edu/resources/ssguide/intro.html
  http://www.novaspace.com/

  The Astronomical Unit (AU)

  1 *AU* = mean Earth-Sun distance
  = 150,000,000 km (150 million km)
  = 93,000,000 mi (≈ 100 million miles is close enough)

NAME	SYMBOL	SIZE	DISTANCE FROM SOL	LENGTH OF DAY	LENGTH OF YEAR
MERCURY	☿	0.4 $R_\oplus$	0.4 AU	60 $d_\oplus$	$\frac{1}{4}$ $y_\oplus$
VENUS	♀	0.95 $R_\oplus$	0.7 AU	243 $d_\oplus$ (R)	0.6 $y_\oplus$
EARTH	⊕	1.0 $R_\oplus$	1.0 AU	1$d_\oplus$	1 $y_\oplus$
MARS	♂	0.5 $R_\oplus$	1.5 AU	1.03 $d_\oplus$	2 $y_\oplus$
JUPITER	♃	11 $R_\oplus$	5 AU	10 $h_\oplus$	12 $y_\oplus$ (≈ ONE CONSTELLATION OF THE ZODIAC PER YEAR)
SATURN	♄	9.5 $R_\oplus$	10 AU	10.25 $h_\oplus$	30 $y_\oplus$
URANUS	♅	4.1 $R_\oplus$	20 AU	17 $h_\oplus$ (R)	85 $y_\oplus$
NEPTUNE	♆	3.9 $R_\oplus$	30 AU	16 $h_\oplus$	165 $y_\oplus$
PLUTO	♇	0.2 $R_\oplus$	40 AU	6 $d_\oplus$ (R)	250 $y_\oplus$

See details on Solar System review sheet!

- current positions of the planets in the sky (http://www.fourmilab.ch/solar/solar.html)
  understand how to use Appendix 11 and the planetary longitudes to find the positions of the planets (and the sun … and the moon using the phases listed on *FG* pp. 350-1) in the sky
- Earth as a planet
  -- interior (http://pubs.usgs.gov/publications/text/dynamic.html)
  interior layers: names, composition, phase (solid, liquid, plastic)
  be able to explain the driving force of plate tectonics
  -- surface
  geology: cratering,
  volcanism (http://volcano.und.nodak.edu/)
  plate tectonics (http://volcano.und.nodak.edu/vwdocs/vwlessons/plate_tectonics/introduction.html)
  oceans: the importance of water in the evolution of the atmosphere & life
  -- atmosphere
  composition, evolution, circulation (Hadley Cells), weather

IV. Galaxies and Cosmology

- Types of galaxies (be able to recognize the ones on the Power Points!)
  - details about the Milky Way (dimensions, contents, interactions)
  - details about dark matter (why do we believe it's there? what might it be?)
- The DATA of Big Bang Cosmology

all galaxies are redshifted

⇒ evidence that they are all moving away from us

more distant galaxies are more redshifted

⇒ evidence that more distant galaxies are moving away faster

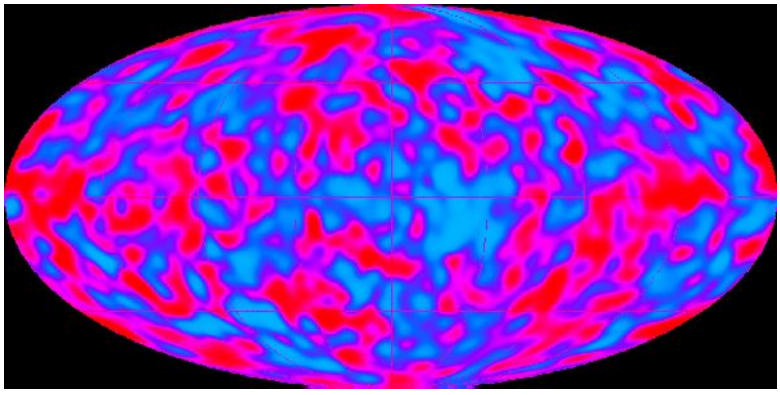
⇒ evidence that the universe is EXPANDING (Space, itself, is expanding!)

the observed cosmic background radiation (CBR) fits the model of the coolest opaque universe (just before atoms formed and it became non-transparent) at a redshift appropriate to the time when the universe was last opaque.

- The expansion of the universe
  - ⇒ how is the universe like a raisin bread?
  - ⇒ how is the universe like a gas?
- The four fundamental forces and what they do

	NAME	RELATIVE STRENGTH	RANGE	PHENOMENON	SUSCEPTIBLE PARTICLES	CARRIER PARTICLES	SEPARATION ABT
weakest	*GRAVITATIONAL FORCE*	1	∞	KEEPS US ON THE GROUND, MAKES STARS	all matter	gravitons	10^{-43}s
	WEAK NUCLEAR FORCE	10^{25}	10^{-17} m	RESPONSIBLE FOR RADIOACTIVE DECAY	nuclear particles	weak bosons	10^{-10}s
	ELECTROMAGNETIC FORCE	10^{36}	∞	MAKES CAT HAIR CLING TO ANYTHING EXPENSIVE	charged matter	photons	10^{-10}s
strongest	*STRONG NUCLEAR FORCE*	10^{38}	10^{-15} m	HOLDS QUARKS & BARYONS TOGETHER IN NUCLEUS	nuclear particles	gluons	10^{-38}s

- The history of the universe … after the moment of creation (t = 0 seconds) know what happened at about
  - 10^{-43} sec
  - 10^{-38} sec
  - 10^{-10} sec
  - 10^{-3} sec (1 millisecond)
  - 3 min
  - 500,000 years
  - ~1 Gy
  - ~9.1 Gy
  - ~13.6 Gy



- Think about the origin of the protons, neutrons, and electrons in your body and the elements made from them in the cores and explosions of stars, and think about the Desiderata:

Desiderata

Go placidly amid the noise and haste, and remember what peace there may be in silence. As far as possible, without surrender, be on good terms with all persons.

Speak your truth quietly and clearly, and listen to others, even the dull and ignorant; they too have their story. Avoid loud and aggressive persons; they are vexations to the spirit.

If you compare yourself with others, you may become vain and bitter, for always there will be greater and lesser persons than yourself.

Enjoy your achievements as well as your plans. Keep interested in your career, however humble; it is a real possession in the changing fortunes of time.

Exercise caution in your business affairs; the world is full of trickery. But let this not blind you to what virtue there is: many persons strive for high ideals, and everywhere life is full of heroism.

Be yourself. Especially do not feign affection. Neither be cynical about love, for in the face of all aridity and disenchantment it is perennial as the grass.

Take kindly the counsel of the years, gracefully surrendering the things of youth.

Nurture strength of spirit to shield you in sudden misfortune. But do not distress yourself with imaginings. Many fears are born of fatigue and loneliness. Beyond a wholesome discipline, be gentle with yourself.

You are a child of the universe, no less than the trees and the stars; you have a right to be here.

And whether or not it is clear to you, no doubt the universe is unfolding as it should. Therefore, be at peace with God, whatever you conceive God to be, and whatever your labors and aspirations, in the noisy confusion of life, keep peace with your soul.

With all its sham, drudgery and broken dreams, it is still a beautiful world. Be careful. Strive to be happy.

Max Erhmann, 1927.