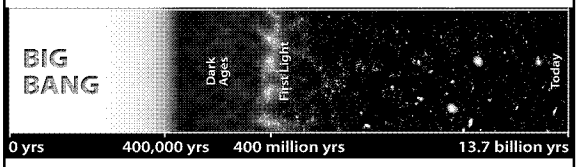
Astronomy 143:
The History of the Universe



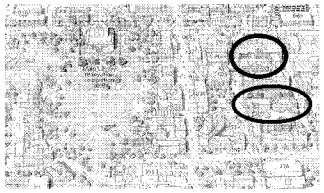
Wednesday, September 23

Professor Barbara Ryden

The Professor:

Barbara Ryden

Office: 4035 McPherson



North→

Office hours:

Mo Tu 1:30 – 3 pm, We Fr 3 - 5 pm,

or by appointment [292-4562]

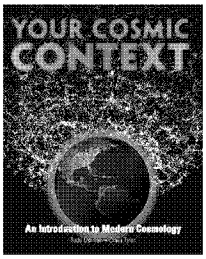
The Graduate Teaching Associate:

Rob Siverd

Office: 4061 McPherson

Office hours: Mo Tu 3 – 5 pm

The Textbook:



Your Cosmic Context,
by Duncan & Tyler

The Website:

www.astronomy.ohio-state.edu/~ryden/ast143/

Contains: Lecture PowerPoint printouts, syllabus, problem sets, & useful links.

The science that studies the history (& future) of the universe is called "**cosmology**".

"kosmos" = order, harmony

"logos" = word, law

What is Science?

Systematic study of the universe, using the scientific method.

Scientific Method

Gather facts

⇩

Guess an explanation
(guess = "hypothesis")

⇩

Test hypothesis ↺

⇩

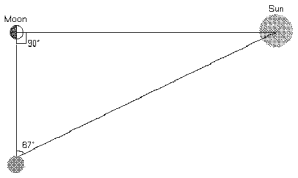
Modify hypothesis

A well-tested hypothesis = "theory"

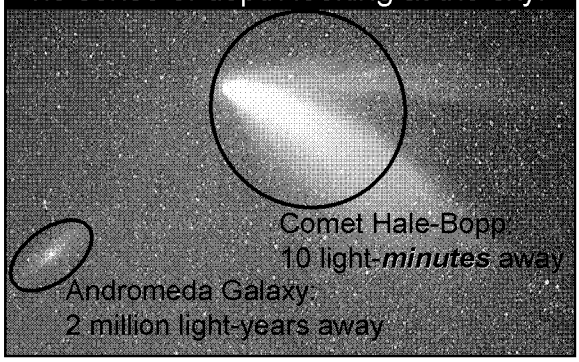
What math do you need?
A little algebra & geometry.

$$F = \frac{L}{4\pi d^2}$$

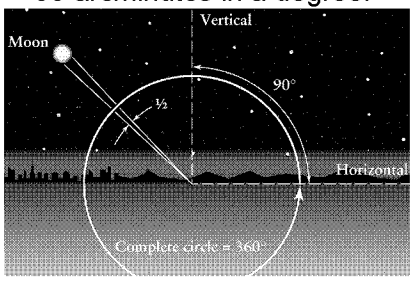
$$\frac{\lambda - \lambda_0}{\lambda_0} = \frac{V}{c}$$



Big Problem for Astronomers:
no sense of depth looking at the sky.



There are 360 degrees in a circle,
60 arcminutes in a degree.



Seen from Earth, both Sun and Moon
appear ½ degree across.

Practical matters: Astronomers use scientific notation to write large (& small) numbers.

$1000 = 10^3$

$1{,}000{,}000{,}000 = 10^9$

$0.001 = 10^{-3}$

$2{,}200{,}000 = 2.2 \times 10^6$

Number of people living on Earth =

6.79 billion =

6.79×10^9

(source: U.S. Census Bureau)

Number of stars in our galaxy =

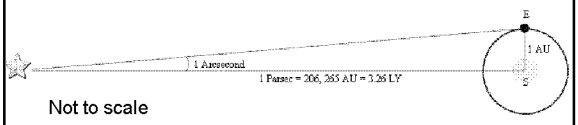
200 billion $\leftrightarrow$ 400 billion =

$(2 \leftrightarrow 4) \times 10^{11}$

Astronomers measure length in meters, astronomical units, and parsecs.

Distance from Earth to Sun =
150 billion meters =
1.5×10^{11} meters =
1 astronomical unit (AU)

1 parsec = distance at which a star has a parallax of 1 arcsecond.



Not to scale

1 arcsecond = 1/60 arcminute
= 1/3600 degree = a very small angle!

1 parsec = 206,000 astronomical units = 3.26 light-years = a very large distance!

Astronomers measure time in seconds and years.

Time for Earth to go around Sun =
1 year =
365 ¼ days =
3.2×10^7 seconds

Astronomers measure mass in kilograms.

NOTE: mass and weight are NOT the same thing!

MASS = amount of matter

WEIGHT = force with which gravity pulls on matter

Example:

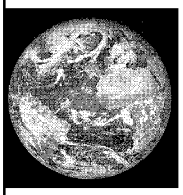
MASS = 1 kilogram = 1000 grams

WEIGHT = 35 ounces on Earth

WEIGHT = 6 ounces on Moon

WEIGHT = 13 ounces on Mars

Properties of the Earth (a planet)

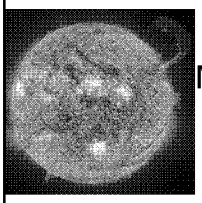


Diameter = 13,000 kilometers (7900 miles)

Mass = 6×10^{24} kilograms

Age = 4.6 billion years

Properties of the Sun (a star)



Diameter = 1.4 million kilometers = 100 × Earth diameter

Mass = 2×10^{30} kilograms = 330,000 × Earth mass

Age = 4.6 billion years