AST 301

Introduction to Astronomy

AST 301

INTRODUCTION TO ASTRONOMY

David L. Lambert
RLM 16.316, 471-7438, 502-9804
Office Hours: T W Th 10am – 3pm
M & F by appointment

TA
N. Vutisalchavakul
Office Hours: T Th 4 – 5 pm
RLM 15.310E

TA
Jinsong Liu
Office Hours: T 5 – 7 pm
ECJ 3.402

Text: Stars and Galaxies by Seeds and Backman, 9th Edition at Co-op

Notes:
http://www.as.utexas.edu/astronomy/education/fall15/lambert/301.html

Grades: see Class Notes I
3 quizzes, 6 homeworks and a final

Monday, December 14
9am - noon

Goal

- To present a contemporary view of the origin and evolution of the Universe and its principal components.
- To illustrate how a science works and matures.
  - Not just facts but indications of how we acquire and interpret facts.
  - Astronomy is a science.

    Astrology is not.
- A complete survey except the solar system.

The Scale of The Cosmos

- Solar System
- Our Galaxy
- Local Group of Galaxies
- Local Supercluster of Galaxies
- Beyond to the Observable Limit

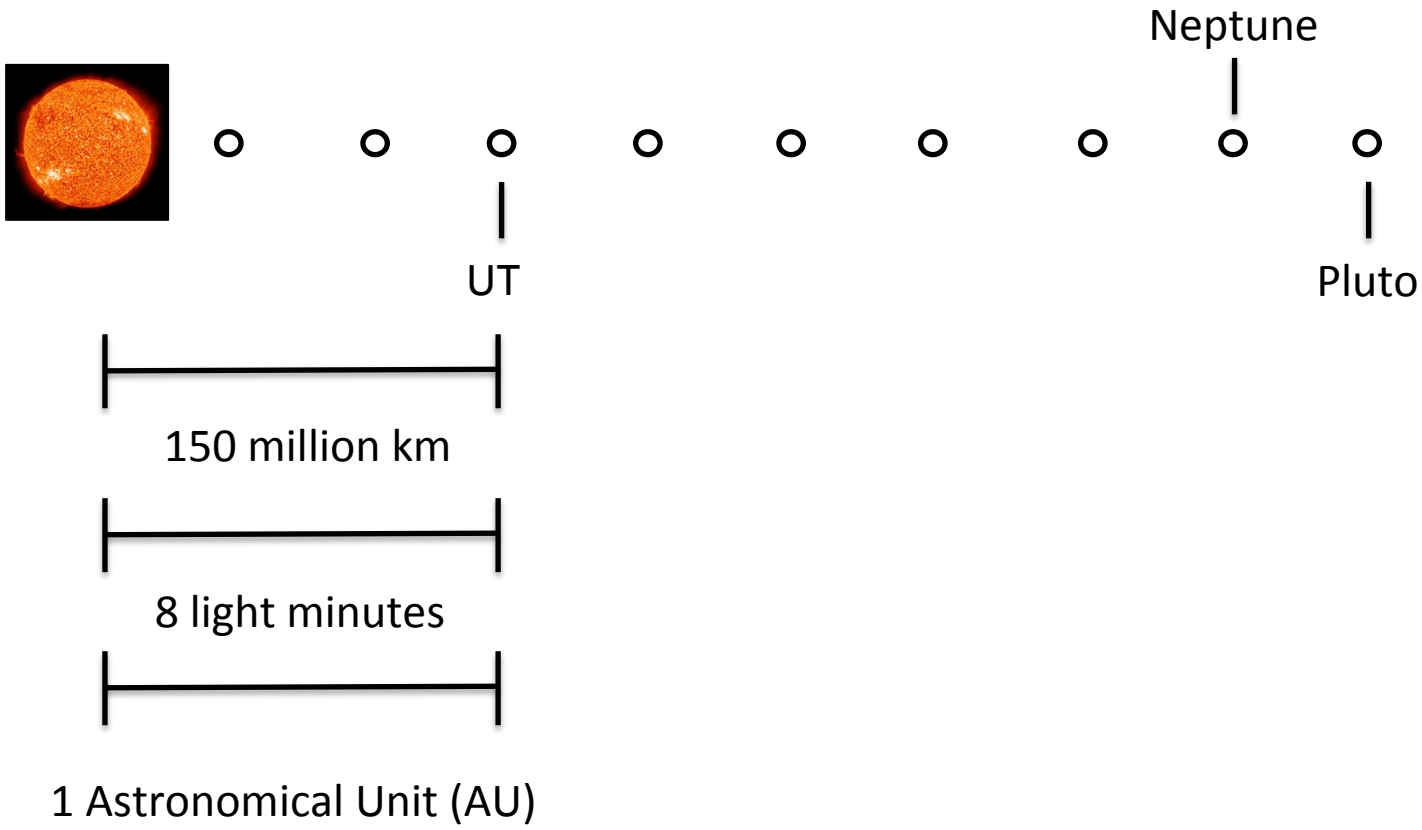
The solar System

Earth

Diameter = 13,000 km

Solar System

Sun + 8 Planets + Pluto and friends



Sun

Hot gas, mostly hydrogen and helium

Diameter

= 1,400,000 km

= 110 Earth diameters

Mass

= 2×10^{30} kg

= 330,000 Earth masses

Temperature

= 6,000 k at surface

= 15 million k at center

Stars

- Sun is a typical star but…
- Masses from 0.1 to 100 M_{sun}
- Radii from a few kms to size of Earth's orbit
- Surface temperature from 1,000 K and down to 100,000 K and up

The Galaxy

- ~ 100 trillion stars + gas/dust
- Star-to-star separations ≈ few light years (mostly)
- Stars DO NOT collide
- Stars may be double, triple, …in clusters
- Gas between stars

Our Galaxy and the Universe

- We are in the LOCAL GROUP of ~ 30 galaxies spread over a few million light years
- The Local Group is in the local SUPERCLUSTER of ~ 100 groups spread over 100 million light years
- Universe is made up of many superclusters out to about 10 billion light years, all expanding away from each other
- Galaxy – Galaxy separations are often such that Galaxy collisions occur

Time Scales

- Age of Universe
  - ≃ 14 billion years
- Age of Sun
  - ≃ 4.5 billion years
- Age of Earth
  - ≃ 4.5 billion years

IF 1 COSMIC YEAR ≡ 14 BILLION YEARS

AUG 13			:	EARTH FORMS
DEC 13			:	INVERTEBRATE LIFE
DEC 25			:	DINOSAURS
DEC 30			:	DINSOAURS DIED
DEC 31, 9pm			:	EARLIEST HUMANS
	11pm	59m 30s	:	AGRICULTURE
		47s	:	PYRAMIDS
		59s	:	KEPLER/GALILEO/NEWTON
		59.9s	:	ASTRONOMY 301

Scientific Notation

HOW DO WE HANDLE VERY LARGE AND VERY SMALL NUMBERS?

$10^0 \equiv 1$	
$10^1 \equiv 10$	$10^{-1} \equiv 1/10$
$10^2 \equiv 100$	$10^{-2} \equiv 1/100$
$10^3 \equiv 1000$	$10^{-3} \equiv 1/1000$
$10^4 \equiv 10000$	$10^{-4} \equiv 1/10000$
…	…

$10^2 \times 10^3 = 10^5$

$100 \times 1000 = 100{,}000$

ADD EXPONENTS

$10^2 \times 10^{-1} = 10^1 \equiv 10$

$100 \times 1/10 = 10$

ADD EXPONENTS

SUBTRACT EXPONENTS

$21.4 \equiv 2.14 \times 10$

$214 \equiv 2.14 \times 10^{2}$

…

$0.214 \equiv 2.14 \div 10 \equiv 2.14 \times 10^{-1}$

$0.0214 \equiv 2.14 \div 10^{2} \equiv 2.14 \times 10^{-2}$

$$\frac{6240}{3.12} = \frac{6.24 \times 10^{3}}{3.12} = 2 \times 10^{3} \equiv 2000$$

$$\frac{6240}{0.031} = \frac{6.240 \times 10^{3}}{3.12 \times 10^{-2}} = 2 \times 10^{5}$$

$3 - (-2) = 3 + 2 = 5$

$$= \frac{6.240 \times 10^{3}}{3.12 \div 10^{2}} = 2 \times 10^{5}$$

OR USE A CALCULATOR!

BASIC POINT!

- $6 \times 10^{+20}$ is a large number

  6 followed by 20 zeros

- 6×10^{-30} is a very small number

  0.0 ……. 06

  29 zeros

$$\frac{6}{10^{30}}$$

SCIENTIFIC NOTATION – PREFIXES

Prefix	**Symbol**	**Factor**
giga	G	10^{9}
mega	M	10^{6}
kilo	k	10^{3}
centi	c	10^{-2}
milli	m	10^{-3}
micro	μ	10^{-6}
nano	n	10^{-9}

ASTRONOMICAL DISTANCES

- Astronomical unit (AU) is the radius of the Earth's orbit around the sun
  1 AU ≃ 150 x 10^6 km
  =8 light minutes

- Light year (ly) is the DISTANCE light travels in one year
  1 ly ≃ 10^{13} km
  ≃ 63,000 AU

- Parsec (pc) is the distance at which 1 AU subtends 1 arsec
  1 pc ≃ 3.3 ly
  ≃ 200,000 AU