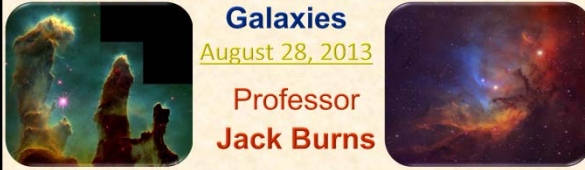



ASTR 1020
Introductory Astronomy 2: Stars & Galaxies
 August 28, 2013
 Professor
Jack Burns



Newcomers - All class info is at website:
<http://lunar.colorado.edu/~jaburns/astr1020>

- Notes from last class are now posted on the class website.
- Room available in Wednesday recitation sections!

Astronomy
Picture of the Day



Our Home World!

MasteringAstronomy


- All homework will be assigned via the online system *MasteringAstronomy*.
- Stay up with class assignments in conjunction with the reading.
- The course ID for Astr 1020 in *MasteringAstronomy* is **ASTR1020FALL2013**.
- Access to MasteringAstronomy comes with the purchase of your textbook. Alternatively, you can purchase access to MA separately.

Homework

- Reading:
 - Chapter 1.
 - Summary of Key Concepts, p. 20-21.
- *Intro to MasteringAstronomy* (complete by Sep. 4 at midnight). Located at website: <http://www.masteringastronomy.com>
 - Your grade will be based on completion of the tutorial and exercises.
 - Grades are tracked automatically online. Nothing to hand in!!!
 - Start this exercise now in case of technical problems.
- **Register your clickers!**

Nights for 1st Class Sky
Observation Exercise
(field near Leeds Business School)


September 10, 12, 16, 18, 24, 26



Today's Class: Brief Tour of the
Universe; Sizes and Scales

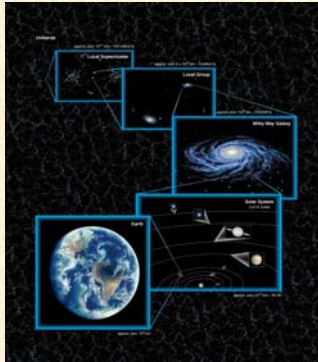
Reading: Chapter 1

- Scales in space



What we'll be studying: Our place in the Universe

- Sizes and scales: finding your way through the universe

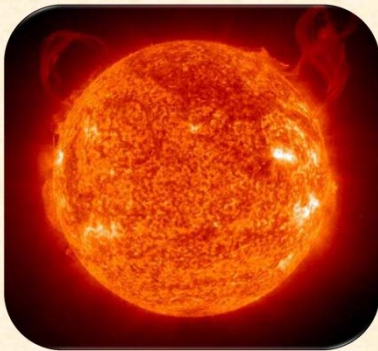


Review of Gravity & Light

- What are they?
- How do we use them to understand sizes, masses, and composition of stars & galaxies.

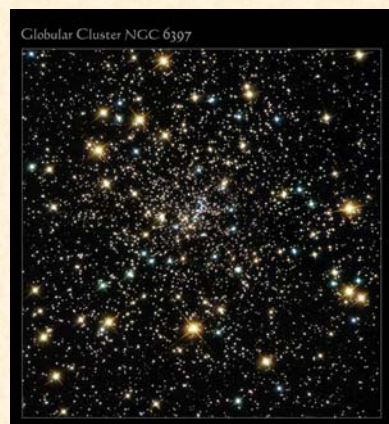


The Sun



The Sun is a star: a large, glowing ball of gas that generates heat and light through nuclear fusion

Stars of every size and color



Stellar Birth and Life



Nebula: an interstellar cloud of gas and/or dust

Star death: white dwarfs, neutron stars, and black holes



Our Galaxy: The Milky Way

Most of Milky Way's light comes from disk and bulge ...

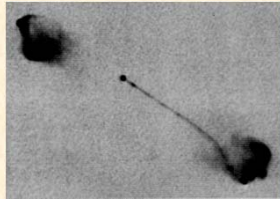


... but most of the mass is in its halo.

Exploring a universe of galaxies



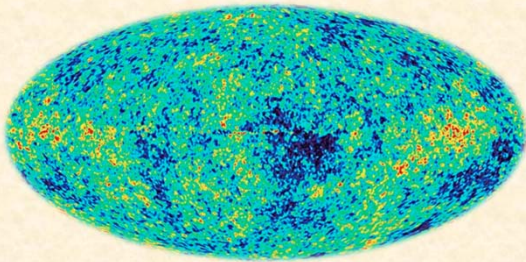
Galaxy Evolution & Central Engines



Dark Matter, Dark Energy and the Fate of the Universe



The Big Bang



Navigating the Universe: Sizes and Scales



"I don't pretend to understand the Universe. It's a great deal bigger than I am".

- Thomas Carlyle (1795-1881)

Our Cosmic Address

Earth

Sun/Solar System

Milky Way Galaxy

Local Group

Local Supercluster

Earth rotates around its axis once each day, carrying people in most parts of the world around the axis at more than 1000 km/hr.

Earth orbits the Sun once each year, moving at more than 100,000 km/hr.

The Solar System moves relative to nearby stars, typically at a speed of 10,000 km/hr.

The Milky Way Galaxy rotates, carrying our Sun around its center once every 200 million years, at a speed of about 200,000 km/hr.

Our galaxy moves relative to others in the Local Group, and our traveling band of 100,000 galaxies are receding from us at speeds close to the speed of light.

The universe expands. The more distant an object, the faster it moves away from us; the most distant galaxies are receding from us at speeds close to the speed of light.

Earth is part of the solar system, which is within the Milky Way Galaxy, which is a member of the Local Group of galaxies within the Local Supercluster.

Scale models of the Universe

- Scale Sun as a grapefruit (1:10,000,000,000,000=1:10¹³)

- Earth = pin, 15 meters from Sun.
- Mars = pin, 23 meters
- Jupiter = marble, 78 meters
- Pluto = tiny grain, ¼ mile away
- See model near the Fiske Planetarium!

- On this scale, the nearest stars (Alpha Centauri triple star system is 4.2 light years away) would be a system formed by a cantaloupe, a small apple and a kiwi fruit, located in Newfoundland, Canada
- There is essentially nothing in between!

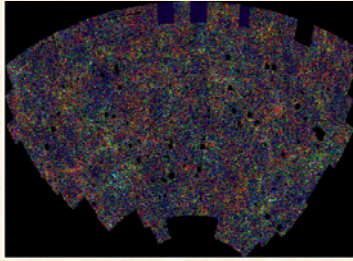
Try a New Scale for the Galaxy:

- Stars are microscopic located 2mm apart.
- Milky Way galaxy is 22 meters in diameter, contains 100,000,000,000's (100's of billions) of stars.

Yet Another Scale for Everything Else

- Galaxies are 10 inch paper plates.
- Milky Way and nearest neighbor (Andromeda) are 5 meters apart.
- Galaxy groups and clusters contain 10's to 1000's of galaxies.

- Superclusters 50 meters across (size of buildings in our scale model) are the largest structures we see.
- Observable universe is about size of Boulder county on this scale.



In this image, each dot is an entire galaxy

This is big stuff- how to grasp astronomical numbers?

- Powers of 10: count the number of zeros behind the digit (review Appendix C in textbook).
- 1000= 1 thousand = 10^3
- 1,000,000 = 1 million = 10^6
- 1,000,000,000 = 1 billion = 10^9
- 10,000,000,000,000,000,000,000 = 10^{22}
= approximately the number of stars in the observable universe- more than the grains of sand on all the beaches on Earth.