Recent and Future Topics in class

-- Recap: Course Overview and Basic Math Skills

-- Natural units in Astronomy

-- Overview of Astronomical Objects
  Building blocks of matter: protons, electron, neutrons, and atoms
  Stars
  Brown Dwarfs, Planets, and Moons
  Death of Stars: Planetary Nebulae, White Dwarfs, Supernovae remnants
  Why is human life `star stuff’?
  Different Type of Nebulae: Star-forming nebulae vs Planetary nebulae
  Galaxies and the Milky Way

-- Scales and Distances: From the infinitesimal to the grandest
-- Angular scales and sizes

-- Timescales: From the earliest epochs to the present day
Timescales From the Earliest Epochs to the Present Day
See in-class notes

In a mock-calendar where the age of the Universe (13.7 Gyr) is represented by one year, from Jan 1 to Dec 31

the time where evolved Homo Sapiens appear (600,000 yrs ago) would be in the last 23 min of Dec 31.

the time when agriculture/civilization developed (11,000 yrs ago) would be in the last 25 seconds of Dec 31, a mere blink of an eye away.

the epoch of major cultural and scientific development (400 yrs) would be in the last second of Dec 31.
The Last 400 years: A Privileged Era

The last century: tremendous progress in astronomy and astrophysics mapping the origin and evolution of the Universe

Kepler and Galileo, Newton’s law of Gravity; Einstein’s theory of relativity; Hubble shows the Universe is expanding; Cosmic Microwave background discovered and COBE launched. Dark matter and dark energy discovered; Hubble and other NASA Great Observatories launched, Cutting edge galaxy surveys to look back in time at the first galaxies
NASA’s Three Great Observatories

- Hubble Space Telescope (HST) launched in 1990
  Works at ultraviolet, optical and infrared wavelengths

- Chandra X-ray Observatory (CXO) launched in 1999: Works at X-ray wavelengths

- Spitzer Space Telescope (SST) launched in 2004: Works at mid to far infrared wavelengths: penetrates the dust
The Hubble Ultra Deep Field (HUDF) Survey in 2004

HUDF is the deepest visible-light image of the Universe.

In 2004, the HUDF team proposed the HUDF legacy project and carried the technical planning and observations of the HUDF.

Exposures totaling a million seconds were taken with the Advanced camera for Surveys (ACS) on the Hubble Space Telescope.

HUDF team

- Steve Beckwith
- John Caldwell
- Mark Clampin
- Michael Corbin
- Mark Dickinson
- Harry Ferguson
- Andy Fruchter
- Richard Hook
- Sharda Jogee
- Anton Koekemoer
- Ray Lucas
- Sangeeta Malhotra
- Mauro Giavalisco
- Nino Panagia
- James Rhoads
- Massimo Stiavelli
- Rachel Somerville
- Stefano Casertano
- Bruce Margon
- Chris Blades
- Massimo Robberto
- Megan Sosey
- Eddie Bergeron
HUDF allows us to look back about 12 Gyr in time....out to epochs when the Universe was merely 5% of its present age.
Astro 301/ Fall 2006
(50405)

Introduction to Astronomy
http://www.as.utexas.edu/~sj/a301-fa06

Instructor: Professor Shardha Jogee
TAs: Biqing For, Candace Gray, Irina Marinova

Lecture 7: Th Sep 21
Announcements (Lec 7)

See current Announcements on class website
http://www.as.utexas.edu/~sj/a301-fa06/

Hwk1 and quiz 2
Recent and upcoming topics in class

--- The QEDEx tips for understanding and applying laws or formulae

--- The Four Fundamental Forces
- The Force of Gravity: Newton’s Universal Law of Gravitation
  Einstein’s theory of general relativity vs Newton’s law of gravity

- Electromagnetic Forces
- The Strong force
- The Weak force
- Relative importance of the 4 forces: when and where do they matter?
  - attractive vs repulsive
  - long range vs short range
Four Fundamental Forces
Newtons’ Universal Law of Gravitation

\[ F_g = G \frac{M_1 M_2}{d^2} \]

See in class notes: the QEDEEx tips for understanding and applying laws or formulae
Newton’s Law of Gravity and Laws of Motion

Sir Isaac Newton (1642-1727)
Born in England

- Student (1661); Lucasian Professor of Mathematics (1669) at Trinity College, Cambridge Univ
- Unified “the Earth and the Heavens” with his laws of gravity and motion (1665-1666)
- Published “Principia” (Mathematical Principles of Natural Philosophy) in 1687
Einstein’s theory of General Relativity

Abell 2218 cluster of galaxies  (Region shown = 1.4  x 10^6 lyr )

Gravitational lenses observed  explained by Einstein’s theory of General Relativity, but not by Newton’s law of gravity
Albert Einstein
- Theory of Special Relativity 1905
- Theory of General Relativity 1916
- The Nobel Prize in Physics 1921
**Forces within the nucleus of an atom**

The nucleus is nearly 100,000 times smaller than the atom but contains nearly all of its mass.

Nucleus: Contains positively charged protons (red) and neutral neutrons (gray).

A carbon nucleus = 6p+ and 6n

A carbon atom is made of 6 e-orbiting a tiny carbon nucleus

--- See in-class notes: Forces acting are gravity, EM between e- p+, EM between p+ p+, Strong Forces, Weak Forces
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