ASTR 1040 Accel Intro Astronomy 2: Stars & Galaxies

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Lecture 2      Thur 19 Jan 06
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Topics for Today
• Nature of astronomy as a science
• Light as waves
• Coupling of atoms and light
• Yields "spectral lines" that are fingerprints unique to each atom
• "Kirchoff’s Laws" about emission and absorption features in spectra
• Observatory Night 1 tonight (snowy?)

Reading (overlap with 1030)

How to Succeed in this course, p. xxvi
• Chapter 1, all (Our Place in Universe)
• Review Basic Astronomical terms, p. 4
• Review Chap 2, (Motion of Stars, Seasons)
• Chap 3, sec 3.5 (Nature of Science)
• Review all of Chap 4 (Matter and Energy)
• Read in detail Chap 6 (Light)
• Begin reading Chap 7 (Telescopes) for Tues class
• You can get copy of all slides after class from course website (can be helpful)

Changes to Syllabus

• Adjustment to textbook website: or how you complete Part A in Homework 1
• All have access to masteringastronomy.com without charge using special code (!)
• Establish your login (see handout sheet), join our class ASTR1040TOOMRE

ELEMENTS OF ASTRONOMY

FUNDAMENTAL ASSUMPTIONS
(always being tested)
What does a lecture `cost you’?
(also a clicker tryout)

- A. About $6 each, great buy
- B. About $24 each, kind of expensive
- C. Close to $100 each, ouch!
- D. Nearly $200 each, but what a steal!
- E. Priceless, but hopefully a pleasure

So how can we estimate the cost?

Real cost of lectures -- so use them well

Breaking a problem down to simple elements

\[ \lambda \times f = c \]

Speed of light same for all wavelengths

E-M (Light) as Waves

Electromagnetic Spectrum

Quantum Mechanics (energy of photons varies)

\[ E = hf \]

Gamma-rays x-rays ultraviolet visible infrared radio
**ATOMS**
protons, neutrons, electrons
(and quarks ..)
Building blocks for everything

**Nucleus and its electron cloud ....**

atomic number = number of protons
atomic mass = number of protons + neutrons

<table>
<thead>
<tr>
<th>Atom</th>
<th>Atomic Number</th>
<th>Atomic Mass</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydrogen (H)</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Helium (He)</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Carbon (C)</td>
<td>6</td>
<td>12</td>
</tr>
</tbody>
</table>

Isotopes of Carbon
- Carbon-12
- Carbon-13
- Carbon-14

Different isotopes of a given element contain the same number of protons but different numbers of neutrons.

**Atoms Involve Big Empty Spaces**

Ten million atoms could fit end to end across this dot.

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).

Atom: Electrons are "removed out" in a cloud around the nucleus.

**ORBITS OF ELECTRONS**
Popping from one orbit to another involves particular PHOTONS
(like DNA prints)

**ENERGY LEVELS**
(of electrons)
in Hydrogen

Each transition involves photons of specific color
(like fingerprints)

**Hydrogen’s Energy Diagram**

Emission
Absorption
Discussion Clicker Q

Is Extra-Sensory Perception (ESP), or telepathy, possible ... or is it nutty?

A. Pretty unlikely (No)
B. Sure, I believe it (Yes)
C. Darned if I know (and why ask this in astronomy)
D. How could such “communication” be carried out? (Interested)
E. I prefer to sleep, wake me when its over

Advice: Read Appendix C.3 “Working with Units”