**ASTR 1120 General Astronomy: Stars & Galaxies**

Prof. Juri Toomre  TA: Ben Brown
Lecture 2  Wed 12 Jan 05
zeus.colorado.edu/astr1120-toomre

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**For next two classes, read:**

How to Succeed in this course, p. xxvi
• Chapter 1, all (Our Place in Universe)
• Review Basic Astronomical terms, p. 4
• Chapter 2, review all (Motion of Stars, Seasons)
• Chap 3, sec 3.5 (Nature of Science)
• First read of Chap 4, all (Matter and Energy)
• First read of Chap 6 (Light)

• Register your clickers by next class
• You can get a copy of lecture slides after class from course website (can be helpful)

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**How to succeed in this course**

• **GOT TO PUT IN THE TIME:**
  3 credits at CU →
  6 to 9 hours outside of the classroom (no kidding)

• Read the textbook sections BEFORE discussion in class (secrets of memory)

• Come see us during office hours!

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**Come talk with us**

• Juri Toomre’s office hours: Mon, Wed after class 11:15a-noon; Thur 2:00-3:45p in JILA Tower A-606 (phone: 303-492-7874)
jtoomre@solarz.colorado.edu

• Ben Brown’s office hours: Wed 1:00-3:00pm; Thur noon-2:00pm, in TA office, Duane E-122 (phone: 303-492-7851 or -5010)
bpbrown@colorado.edu

• Or call or email us to make an appointment!

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**Planetarium sessions**

• Three class meetings will be at Fiske Planetarium on campus

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**Observatory Nights**

• Starting this Thur 13 Jan at 7pm, then about every 2 weeks (6 in all) – by signup

• Sommers-Bausch Observatory (next to Fiske): 16” and 18” telescopes

• Not mandatory, but you can get extra credit toward your homework grade
Topics for Today

- Nature of astronomy as a science
- Scientific method: we observe, hypothesize, test its predictions, maybe fix it and try again
- Light as waves
- Special colors of light associated with each element
- Homework 1 passed out today

homework set 1

- Part A involves going to book website, after login 'joining our class' (cm228574 as in syllabus), doing the 'Light & Spectroscopy tutorial in Chap 6 while having your performance e-recorded (can repeat as often as wish). Complete by classtime Fri 21 Jan.

- Part B involves completing the 'Energy Level Diagrams & Spectral Lines' problem sheet passed out in class today. Due next Friday in class, no lates. Show how you got answers for Q 6-8 by staple-attaching worksheet.

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

Elements of astronomy

- Fundamental assumptions (always being tested)

  1. The Copernican principle
  2. Universality of laws of nature
COPERNICAN PRINCIPLE

Copernicus (1473-1543)

Simplified Form:
Earth not at center of solar system
Moon orbits:
Nothing special about location of...
...Earth in solar system (1.3°-1.5°)...
...Sun in solar system (15°-130°)
...M.N. Galileo in Parmenide (1609-1613)

Practical Implications for Astronomy:
Anytime observed solar problem occurs everywhere in Universe
That, please to note...
...other stars (2000s)
...other solar system (gravitation)
...other planetary systems (1)
...other like planet (2)

SCIENTIFIC LAWS are constantly being tested

ATOMS BEHAVE THE SAME EVERYWHERE

(were, we hope, and keep testing)

GRAVITY ACTS EVERYWHERE

SCIENTIFIC LAWS are constantly being tested

FOUR FUNDAMENTAL FORCES

(at work everywhere, we assume and test)

ELECTROMAGNETIC RADIATION

(used for most deductions)

PHOTONS

(quanta – particles of light)

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WAVES

PROPERTIES OF WAVES

FOUR TYPES OF FORCES IN NATURE

1. GRAVITY

2. ELECTROMAGNETIC

3. STRONG NUCLEAR

4. WEAK NUCLEAR
E-M (LIGHT) AS WAVES

Speed of light SAME for all wavelengths

$\lambda \times f = c$

WAVELENGTH x FREQUENCY = SPEED OF LIGHT

$\lambda = c/f$  \hspace{1cm}  $f = c/\lambda$

PROPERTIES (SPEED) OF ALL E-M WAVES:
- SAME!
- $c$, a constant ≈ 3 x 10^8 m/s

Quantum Mechanics

(energy of photons varies)

$E = h \times f$

PHOTON ENERGY = PLANCK'S CONSTANT x FREQUENCY

UV, X-RAYS MORE BRIGHT!