ASTR 1020
Introductory Astronomy 2: Stars & Galaxies

September 4, 2013

Professor
Jack Burns

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

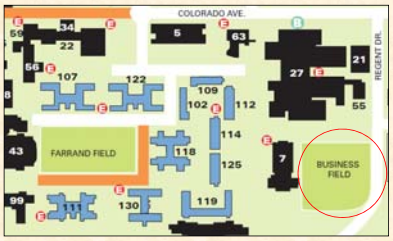
Notes from last week's classes are posted on the class website.

music

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

September 10, 12, 16, 18, 24, 25

(arrive at 8:30 pm for Sep. 10-12)



Homework

- **Reading**: Chapter 5, sections 5.1, 5.2; summary of key concepts.
- *MasteringAstronomy* Tutorials & Exercises – Scales of the Universe (complete by **Sep. 6th**). Located at website: http://www.masteringastronomy.com.
- Need volunteers for "Astronomy in the News" on Fridays (please E-mail me).
- Clicker questions count for points starting next Monday. Must register clickers!
- If you are in Monday recitation section, please go to Wednesday this week, if possible.

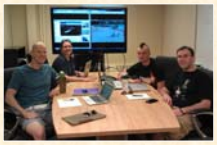
Astronomy Pictures of the Day

Surface Telerobotics from the International Space Station

Astronaut Chris Cassidy studies the "Surface Telerobotics Workbench" (2013-06-17).

ISS Mission Control during June Surface Telerobotics test.

K10 rover at NASA Ames under the command of ISS astronaut.



Remote Operations Center at U. Colorado: mission simulation science team.

Today's Class: Energy and Gravity

- Types of energy
- Conservation of Energy
- Gravity

Clicker Question from Reading

Which of the following energy types is also a form of kinetic energy (choose one)?

A.) $E=mc^2$
B.) Thermal (heat) energy
C.) Gravitational potential energy
D.) Sunlight

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Types of energy:

1) Kinetic Energy

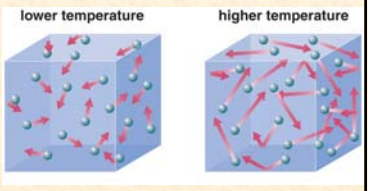
- Movement energy, greater for larger masses, faster movement

=>Examples: rolling, falling, zooming, swinging, etc.

1a.) Thermal energy

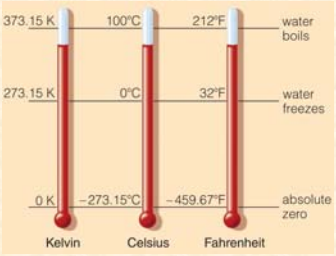
- The "heat energy" of things.

=>A form of kinetic energy, but with random motion. Increasing thermal energy causes atoms to move faster.



Thermal energy measured with an "absolute" temperature scale

- T (degrees Celsius) = [T (Fahrenheit) – 32]/1.8.
- T in "Kelvin" = Celsius + 273.15 degrees.



Examples:

Hot pizza oven
450F = (450- 32) / 1.8 = 232 C = 505 K

Room temp
70 F = (70-32)/1.8 = 21 C = 294 K ~ 300 K
(remember this number)

Surface of the Sun = 5000 K
Interstellar gas = 10 K
Absolute zero = no thermal energy in matter (all atomic motion stops) = 0 K

2.) Potential energy

- Energy which has the potential to become kinetic, thermal, or radiative energy. Think of it as stored energy.

- Examples:
  - rock on a high ledge (gravitational potential)
  - flashlight battery (electric potential)
  - candy bar (chemical potential)
  - rubber band stretched and held

Mass energy= a special form of potential energy

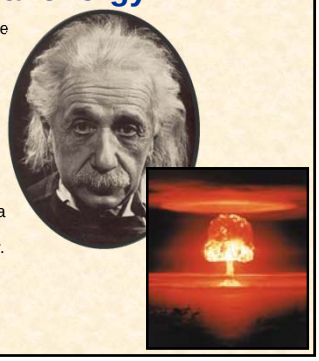
Matter can be thought of as a type of energy and be converted under special situations to energy

$E = mc^2$

m= mass converted to energy

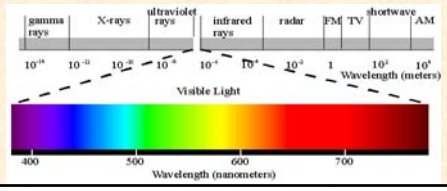
c = speed of light

Since c is large, this means that a tiny amount of matter can release a great deal of energy. Foundation for the Sun's energy, atom bomb.



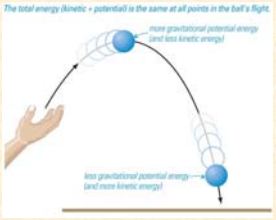
3) Radiative energy

- All types of light:
  - Sunlight, lamplight
  - Radio waves
  - X-rays
  - → MUCH more on this later!



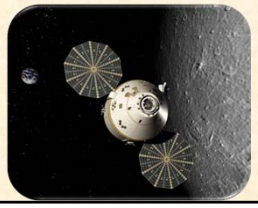
Conservation of Energy

- AN IMPORTANT CONCEPT!!!!!!!!!!
- Energy can be converted from one type of energy to another, but never created or destroyed
- Many actions in the universe represent the conversion of one form of energy to another. *Remembering conservation of energy is key to understanding how everything works.*
- The total energy content of the universe was determined in the Big Bang and remains the same today.



What are Newton's three laws of motion?

Newton's first law of motion: An object moves at constant velocity unless a net force acts to change its speed or direction.



Newton's second law of motion

Force = mass × acceleration

Newton's third law of motion:

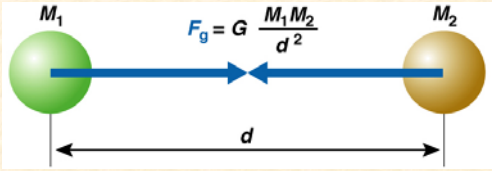
For every force, there is always an *equal and opposite* reaction force.

demo

What determines the strength of gravity?

The **Universal Law of Gravitation:**

1. Every mass attracts every other mass.
2. Attraction is *directly* proportional to the product of their masses.
3. Attraction is *inversely* proportional to the *square* of the distance between their centers.



Clicker Question

If Earth were *twice* as far from the Sun, the force of gravity attracting Earth to the Sun would be

a) Twice as strong
b) Half as strong
c) One-quarter as strong

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