

ASTR 1020
Introductory Astronomy 2:
Stars & Galaxies
January 23, 2008

Professor **Jack Burns**

Newcomers - All class info is at website:
<http://solo.colorado.edu/~jaburns/Astr1020Sp08/index.html>

Fiske Planetarium Show: **Colorado Skies: Observational Astronomy**, Thursday, Jan. 24 at 8:00 pm. 1

Planetarium

- To receive extra credit for attending a Fiske Planetarium show (1 point), you will need to sign your name on a sheet at the end of the show.
 - Either the ticket-taker or the person doing the show will provide you with access to the sheet.
 - Fiske shows are free each Thursday night!
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Homework

- **Reading:** Chapter 5, sections 5.1, 5.2; summary of key concepts.
 - *MasteringAstronomy* Tutorials & Exercises – Scales of the Universe (complete by Jan. 28th). Located at website: <http://www.masteringastronomy.com>.
 - Need volunteers for Astronomy in the News on Fridays (please E-mail me).
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Astronomy Video of the Day

Monty Python's Scales of the Universe



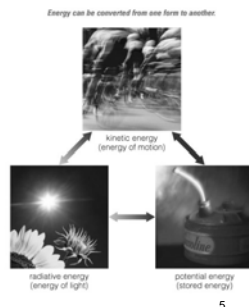
Today's Class: Energy and Matter

Types of energy

Conservation of Energy

Gravity

Matter: atoms, molecules



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

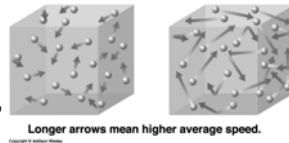
- Movement energy, greater for larger masses, faster movement

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

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1a.) Thermal energy

- The “heat energy” of things.

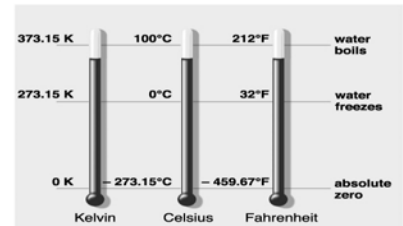


A form of kinetic energy, but with random motion. Increasing thermal energy causes atoms to move faster.

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Thermal energy measured with an “absolute” temperature scale

- T (degrees Celsius) = $[T$ (Fahrenheit) $- 32] / 1.8$.
- T in “degrees Kelvin” = Celsius + 273.15 degrees.



Examples:

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

Room temp
 $70 F = (70 - 32) / 1.8 = 21 C = 294 K \sim 300 K$
(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

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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

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Mass energy= a special form of potential energy

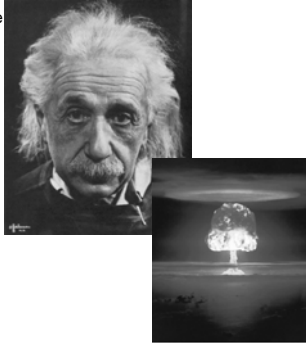
Matter can be thought of as a type of energy and be converted under special situations to energy

$$E = mc^2$$

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!

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Conservation of Energy

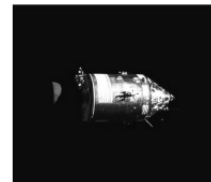
- AN IMPORTANT CONCEPT!!!!!!!!!!!!
- Energy can be converted from one type of energy to another, but never created or destroyed
- Many actions in the universe represent the conversion of one form of energy to another. Remembering conservation of energy is key to understanding how everything works.

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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.



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Newton's second law of motion

$$\text{Force} = \text{mass} \times \text{acceleration}$$



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Newton's third law of motion:

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

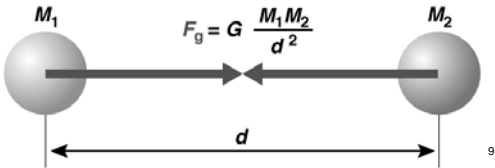


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What determines the strength of gravity?

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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