Questions about Test 2?

Final will be 20 Questions

50% on stuff since Test 2

50% old stuff (Chapters 2-5: problem solving, projectile motion, forces and free body diagrams, conservation of energy)

Final = Thursday, December 19 @ **8**pm

Room not yet assigned

Main Ideas Today:
States of Matter
Density
Pressure

For most of this course, we've talked about physics we've known about for > 100 years.

Today, we'll discuss some physics we are still trying to figure out!

The States of Matter You Know

https://www.youtube.com/watch?v=PcoiLAsUvqc

Temperature

Solid

Holds Shape

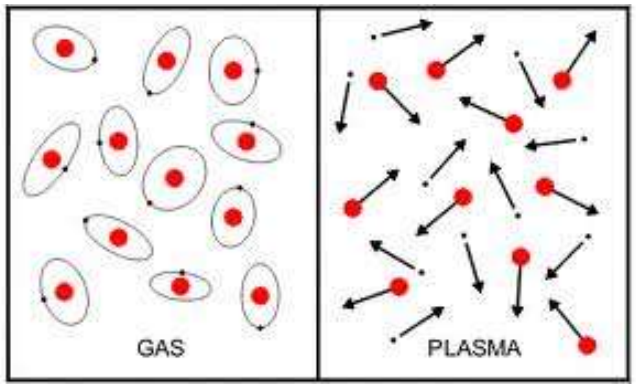
Fixed Volume

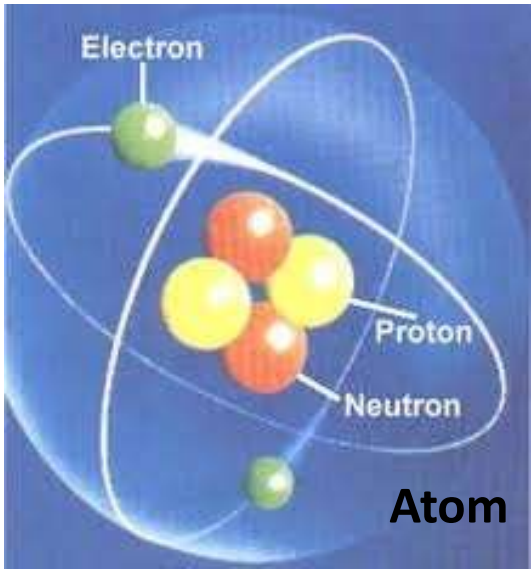
For a given temperature

Example

H_2O: Ice

The 4th State of Matter: Plasma





An ionized gas meaning:

Some of the atom's electrons have been stripped, resulting in a collection of ionized atoms and electrons, are no longer bound

– Unlike gases, solids, or liquids, it does not contain molecules

– Behaves differently from gases, such as in the presence of a field

More than 99% of the **known visible** universe

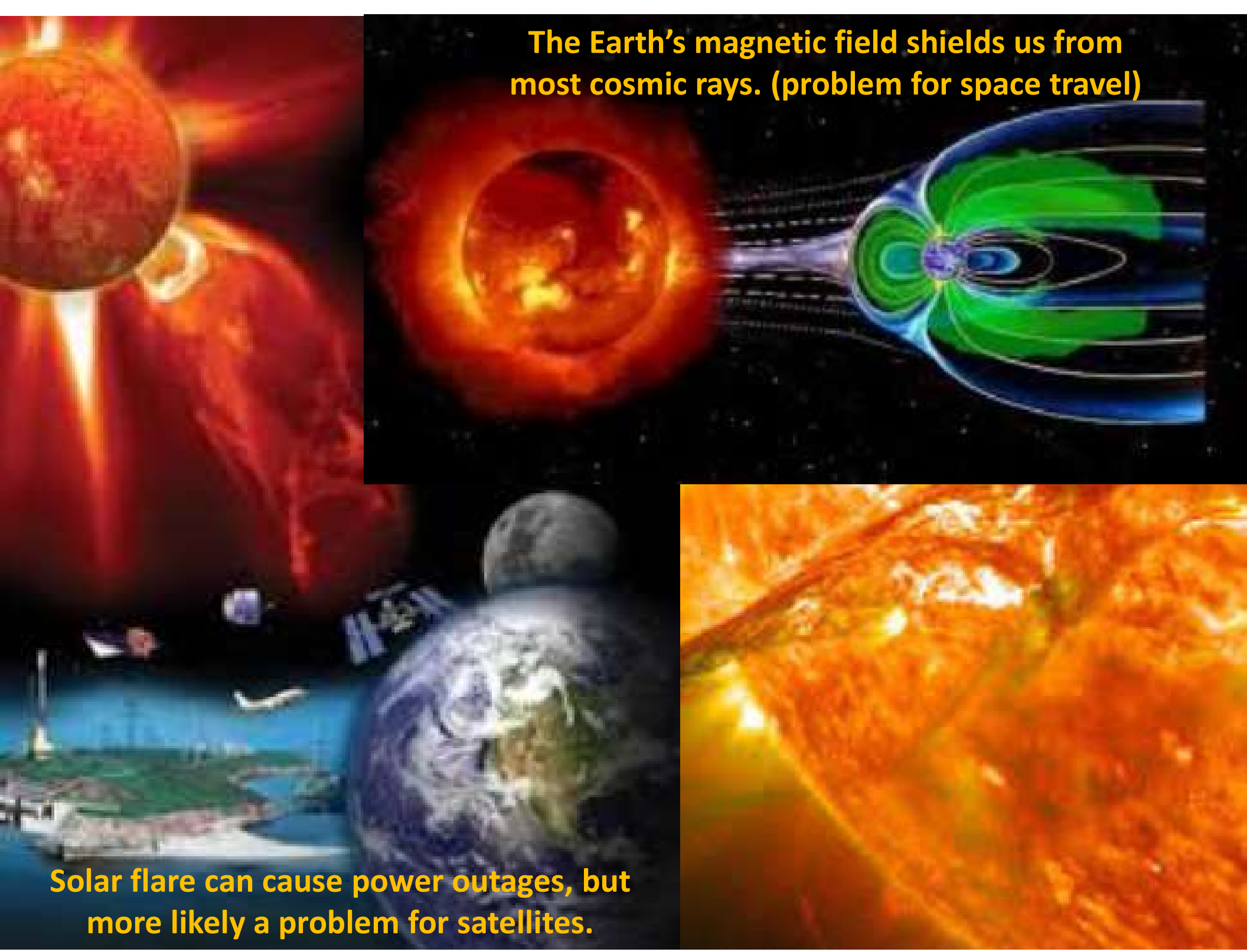
Where Can I Find Plasma?

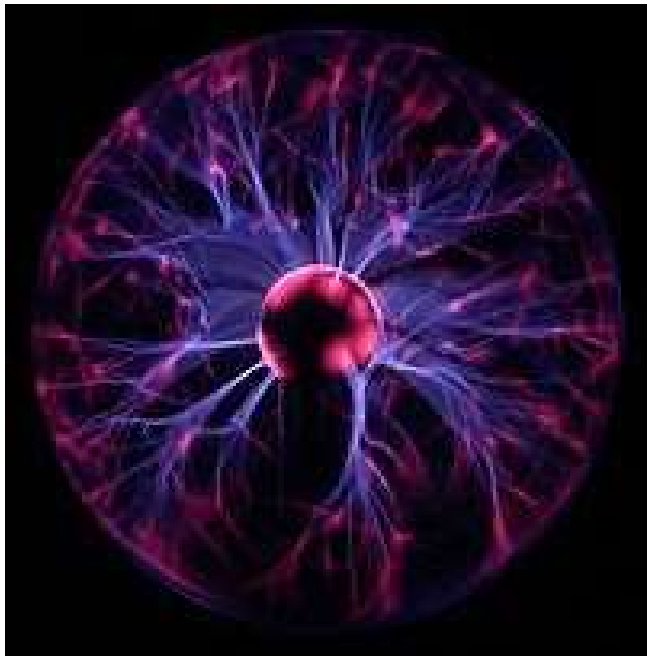
- Fluorescent Lights
- Strobe Lights
- Experimental Fusion Research Devices
- West Virginia University (Third Floor)

In nature:

The Sun and other **stars**

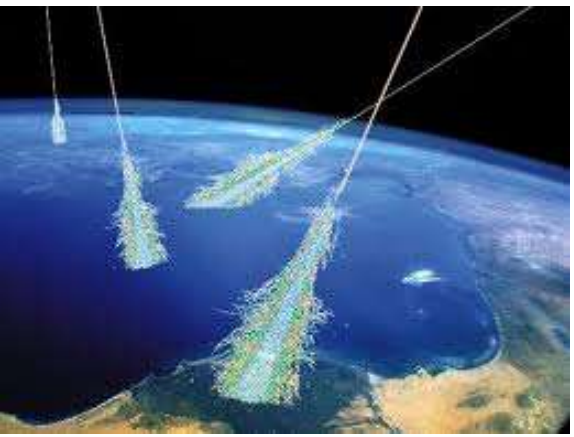
The Aurora Borealis (aka The Northern Lights)


The Earth's magnetic field shields us from most cosmic rays. (problem for space travel)
Solar flare can cause power outages, but more likely a problem for satellites.



Plasma Globe

- A globe with a small amount of **gas** (type of gas affects color)
- The plasma extends from the inner electrode to the outer glass, giving the appearance of beams of colored light



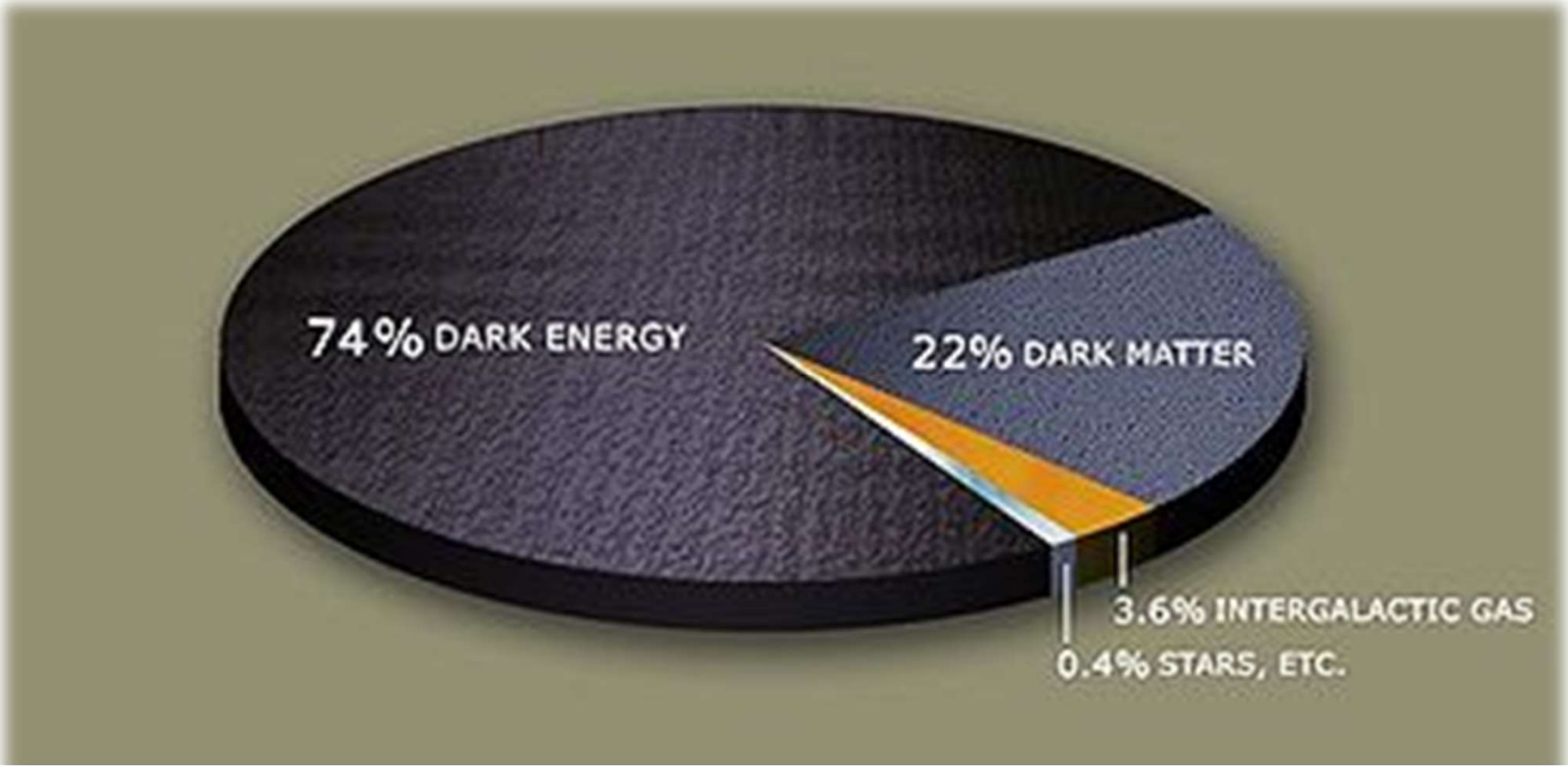
How it Works

- Cosmic rays (that are constantly bombarding the Earth) ionize some of the gas particles
- The power supply accelerates these particles
- As they move around, they ionize other particles, creating more plasma

If plasma is > 99% of the **known visible** universe,

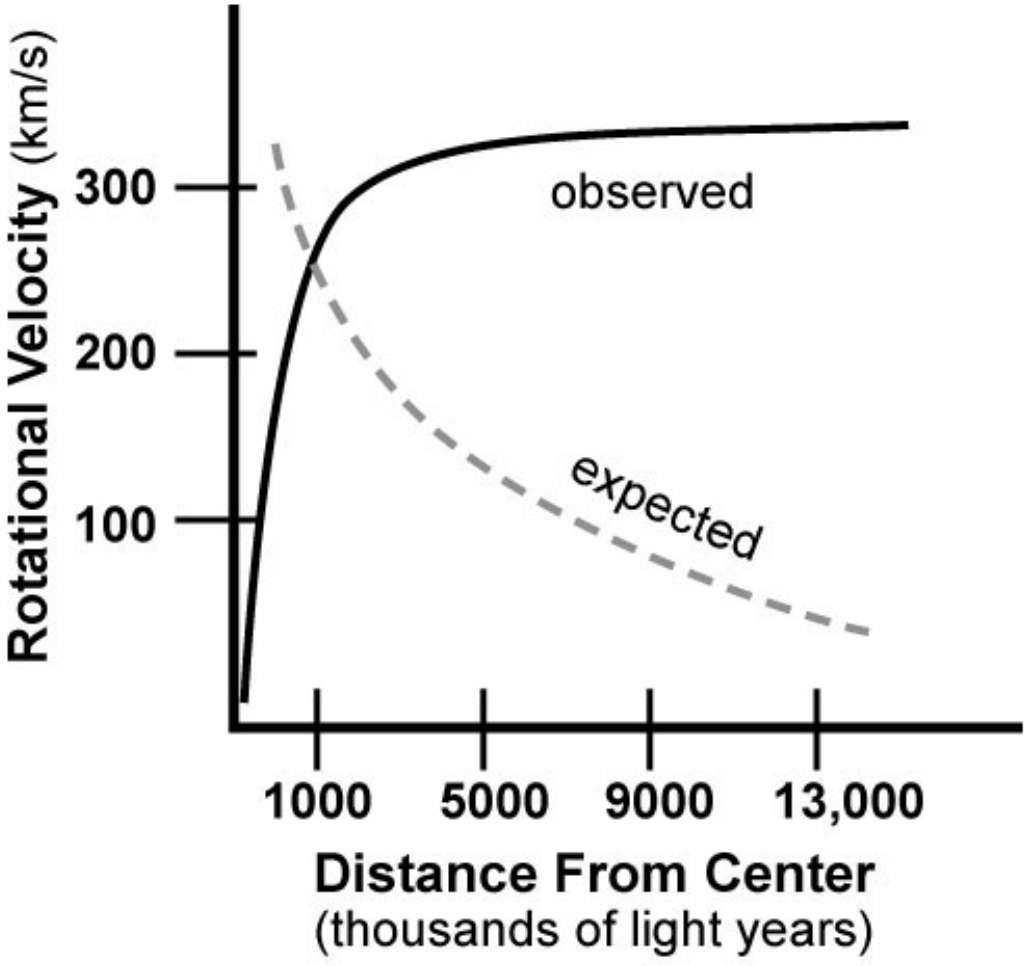
what don't we know?

These four states of matter (solid, liquid, gas, plasma) **may** constitute <5% of all matter in our Universe!



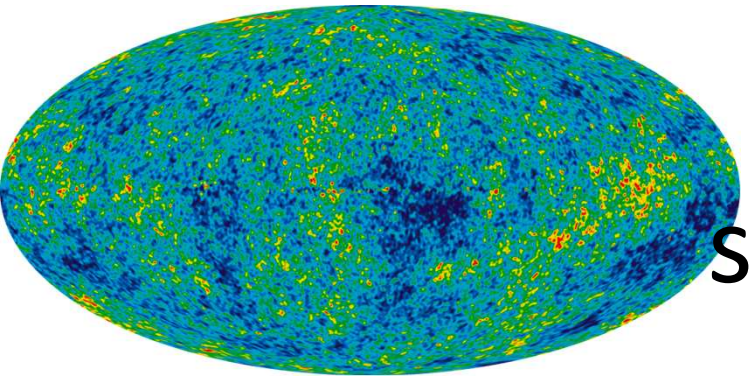
First “Evidence” of Dark Matter

Rotation Curves in Galaxy Spirals



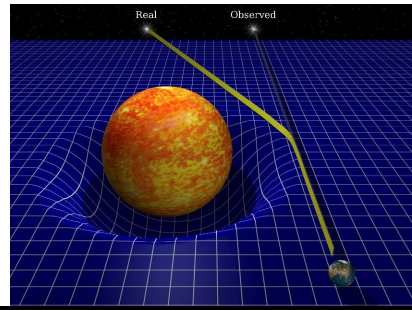
Thousands of rotation curves have been measured

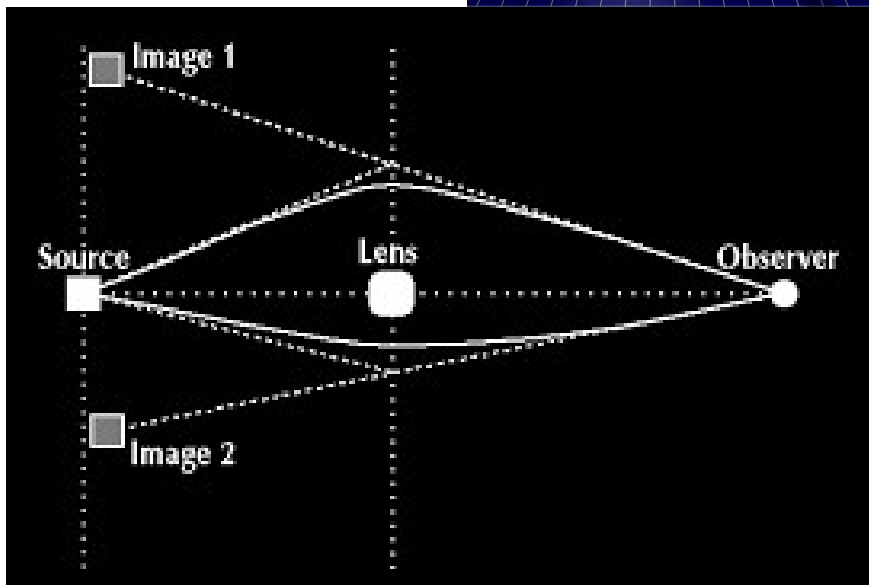
Mass of a galaxy grows with radius=Requires dark matter halo



Other observations suggesting dark matter is real

- gravitational lensing of background objects by galaxy clusters (shift amount depends on mass)
- the temperature distribution of hot gas in galaxies and clusters of galaxies
- anisotropies in the cosmic microwave background
- Colliding dark matter!

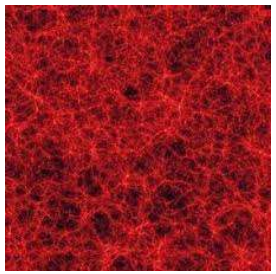


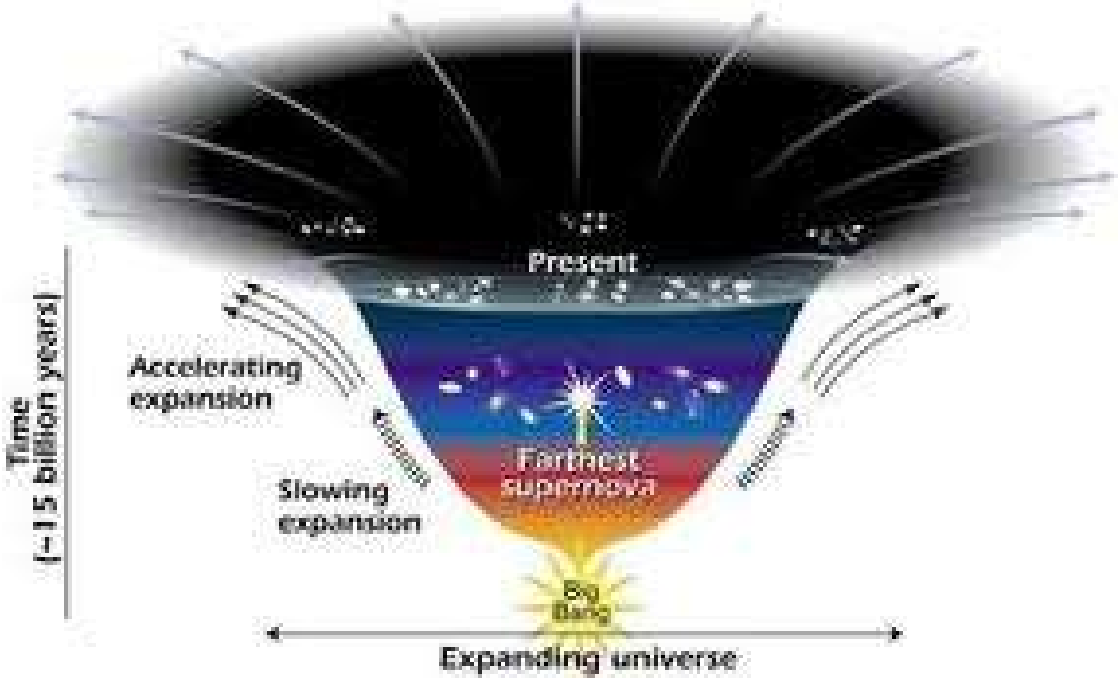


According to cosmologists, dark matter is composed primarily of a not yet discovered type of particle that does not interact with light.

Dark Energy—Even More Mysterious!

- Several cosmological observations demonstrated that the expansion of the universe is accelerating (all stars moving away)
- What is causing this acceleration? It is called Dark Energy, but what is it?





ve the answer to this

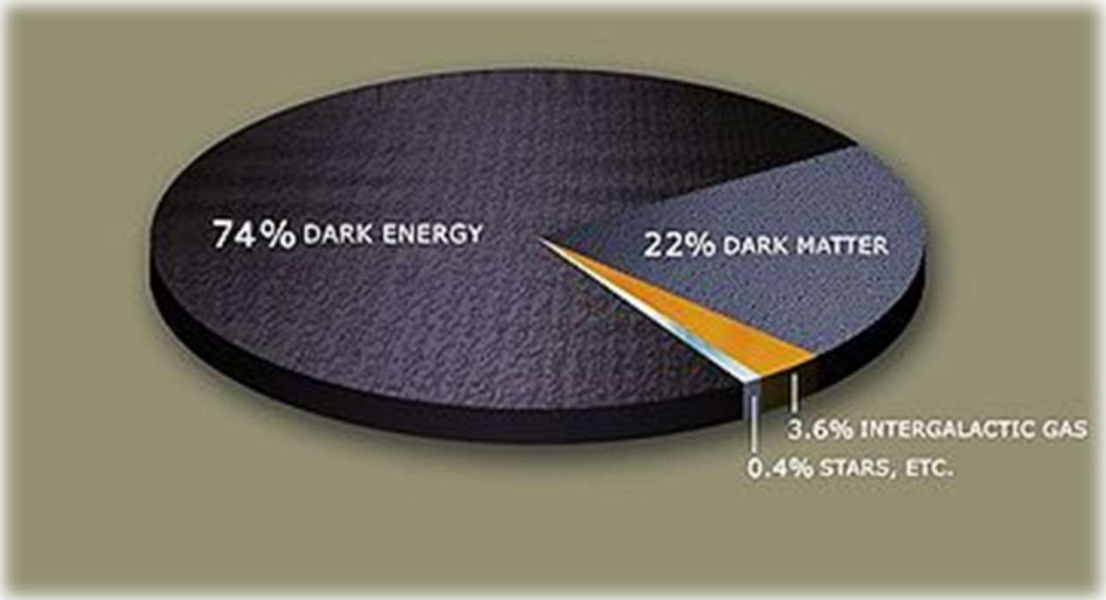
ılsive force, or anti-

0% of Matter!

I just want you to know that we think dark matter and dark energy exist and they may have important implications for space travel and understanding our universe.

Just a fun example of what physicists study today.

Let's focus on what we do understand.



You don't need to know any more about them for the test.

Why does ice float?

Density is $\rho = \frac{M}{V} = \frac{mass}{volume}$

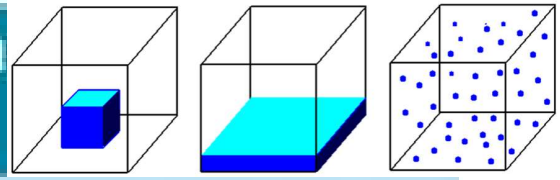
Warning: ρ is not p = m v ! .

- The values of density for a substance vary slightly with temperature since volume is temperature dependent Otherwise ice would not float in water

Density is $\rho = \frac{M}{V} = \frac{mass}{volume}$

Warning: ρ is not p = m v ! .

- The values of density for a substance vary slightly with temperature since volume is temperature dependent Otherwise ice would not float in water
- The various densities indicate the average molecular spacing in a gas is much greater than that in a solid or liquid

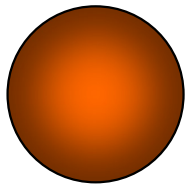


Densities of Some Common Substances at Standard Temperature (0°C) and Pressure (Atmospheric)

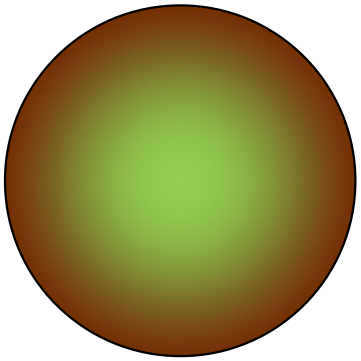
Substance	ρ (kg/m^3)	Substance	ρ (kg/m^3)
Air	1.29	Ice	0.917×10^3
Aluminum	2.70×10^3	Iron	7.86×10^3
Benzene	0.879×10^3	Lead	11.3×10^3
Copper	8.92×10^3	Mercury	13.6×10^3
Ethyl alcohol	0.806×10^3	Oak	0.710×10^3
Fresh water	1.00×10^3	Oxygen gas	1.43
Glycerin	1.26×10^3	Pine	0.373×10^3
Gold	19.3×10^3	Platinum	21.4×10^3
Helium gas	1.79×10^{-1}	Seawater	1.03×10^3
Hydrogen gas	8.99×10^{-2}	Silver	10.5×10^3

Not necessarily made of same material.

The sphere on the right has **twice the mass** and **twice the radius** of the sphere on the left.



mass m
radius R



mass $2m$
radius $2R$

Compared to the sphere on the left, the larger sphere on the right has

A. twice the density.

B. the same density.

C. 1/2 the density.

D. 1/4 the density.

E. 1/8 the density.

$V_{sphere} \propto R^3$

$$\rho = \frac{M}{V} = \frac{mass}{volume}$$

Q123

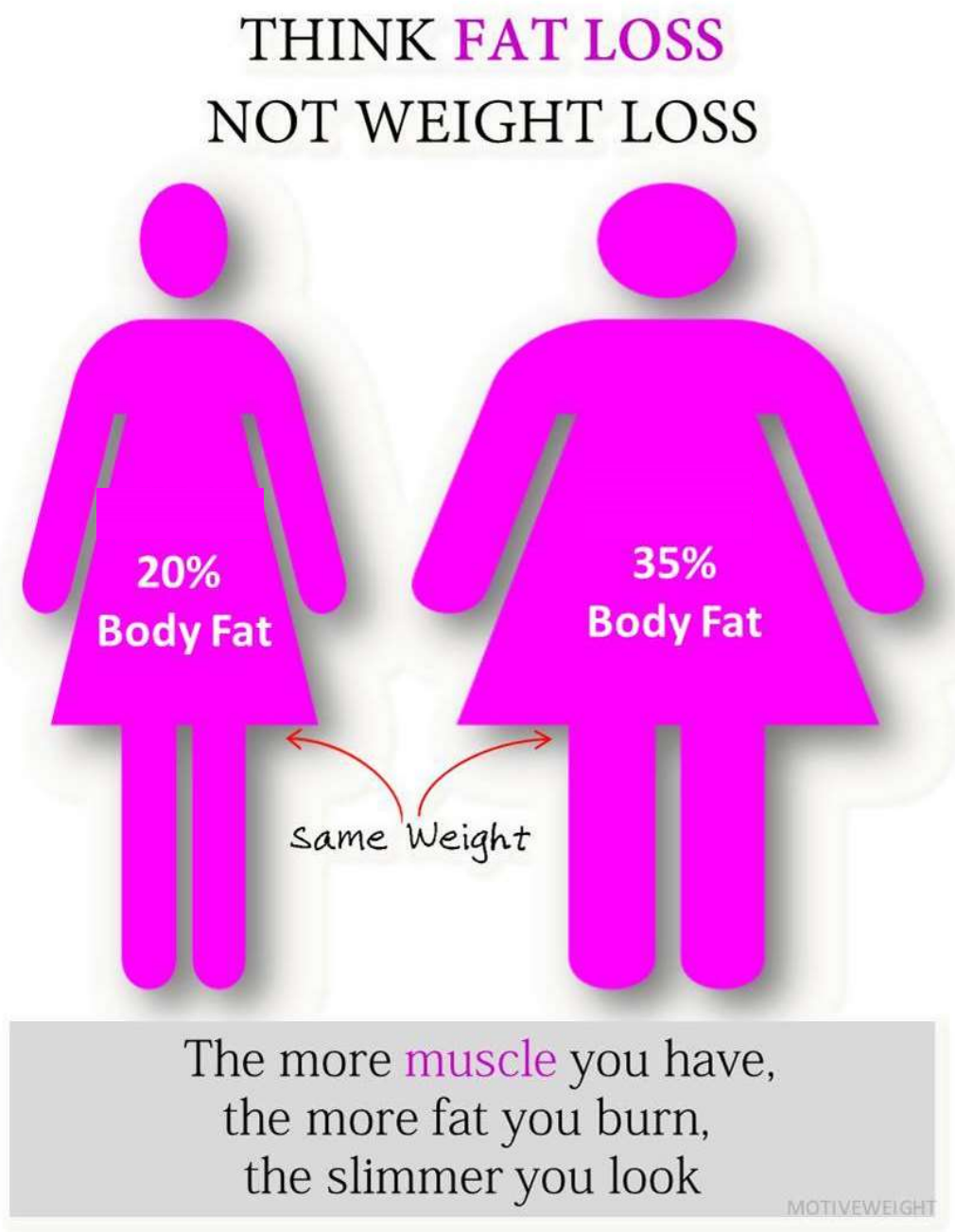
250 LB
2008

250 LB
2013

Older and fitter

Muscle is more dense than fat.
So while it sounds a little funny, your fitness goal might be to get more dense!

(Funny because of the other definition of *dense* in common language.)

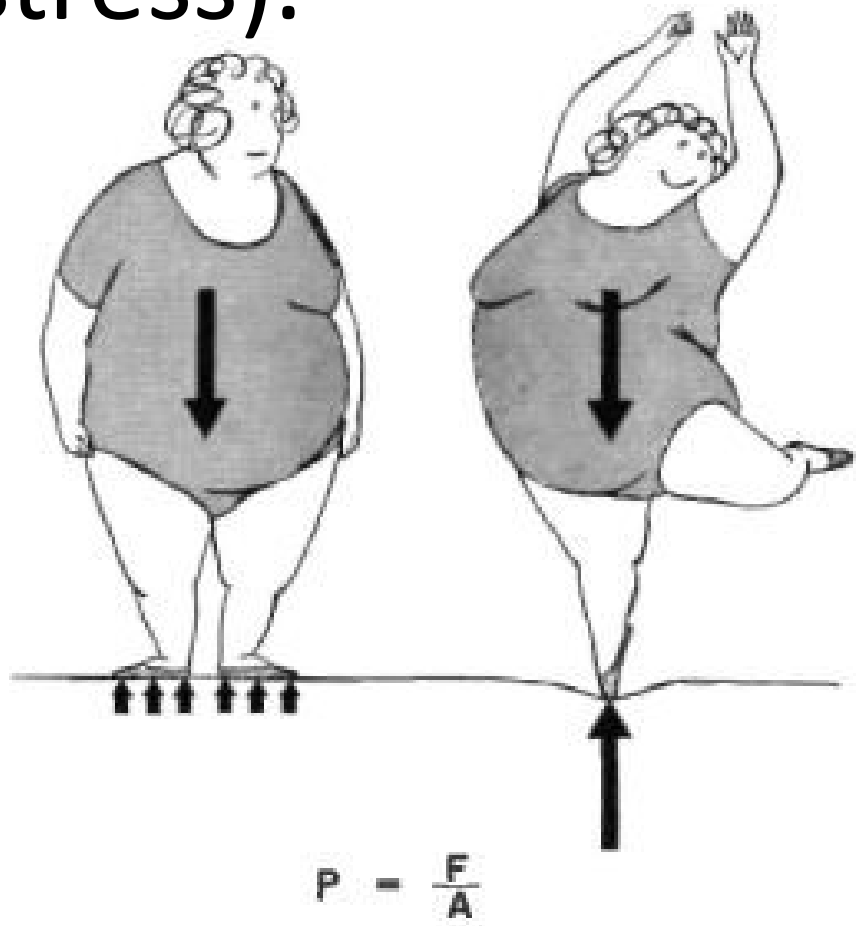


Muscle helps you burn slightly more calories and lessens the likelihood/severity of injuries.

When a dense object (or any object) pushes against you, it applies pressure (or stress).

Pressure = Force / Area

Unit of pressure is **pascal** (Pa) $1\ \text{Pa} = 1\ \text{N/m}^2$



Pressure depends on the area over which the force is spread

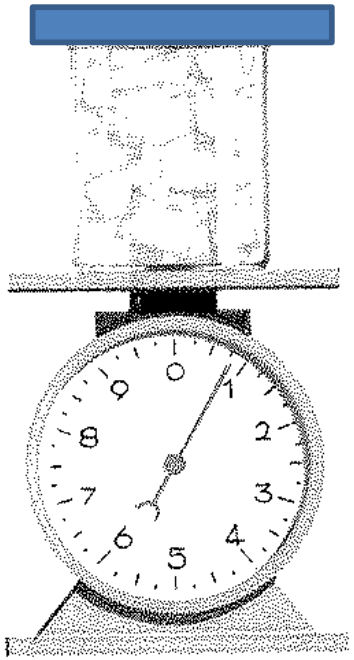
(Also known as stress in solid materials.)

Man on a Chair

Pressure always pushes perpendicular to the surface.

A man sits on a four-legged chair with his feet off the floor. The combined mass of the man and chair is 95 kg. If the chair legs are circular and have a radius of 0.50 cm at the bottom, what pressure does each leg exert on the floor?

What could you do to reduce pressure and chance of scratching?

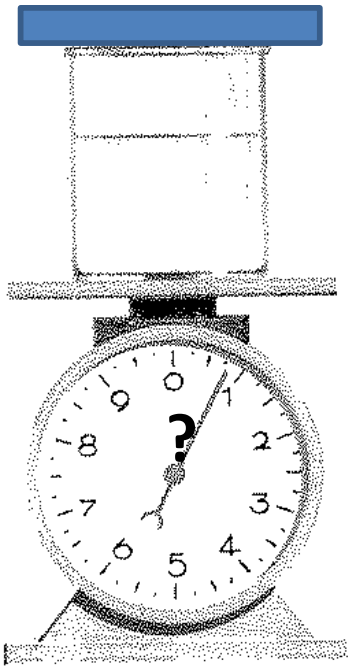


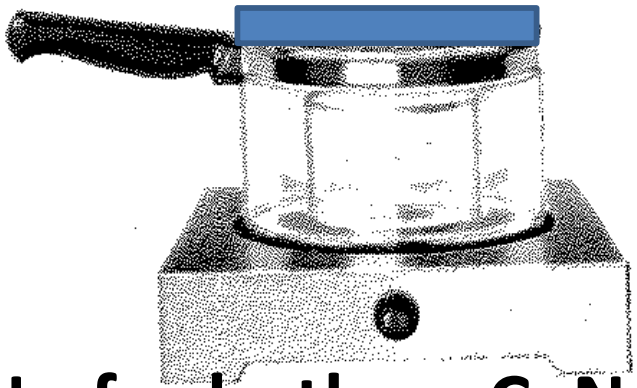
Changing Between States

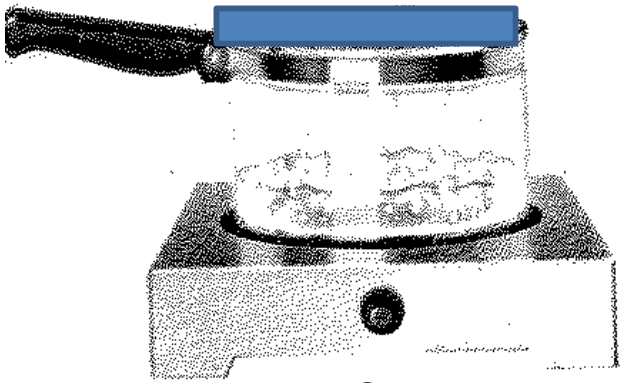
If you wait long enough **ice will melt to water**. And if you heat it, **water evaporates to water vapor** (gas).

Will the mass of the different states of water be **different** if the containers are sealed? **Q118**

Will the mass of the different states of water be different if the containers are **not** sealed? **Q119**







A. No for both
B. Yes for both
C. No for ice, yes for gas
D. Yes for ice, no for gas

Main Ideas in Class Today

After today, you should be able to:

- Briefly explain differences between the 3 well-known states of matter
- Be able to make small talk about dark matter/energy and plasma
- Calculate density and pressure

Extra Practice: 9.1, 9.3, 9.5