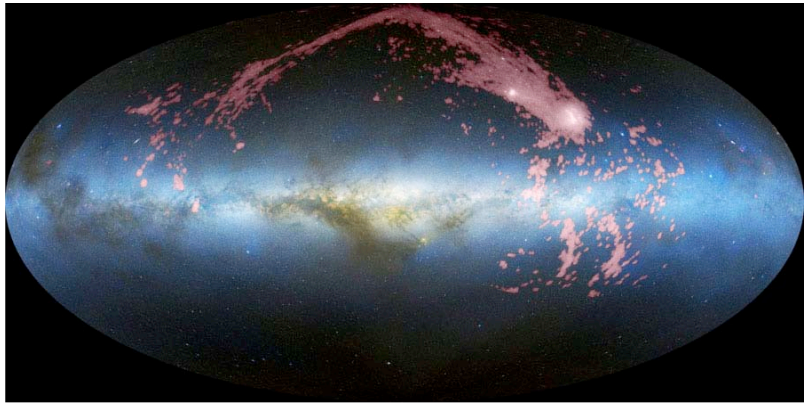
January 25, 2010

Reading assignment, Cosmic Catastrophes, Chapter 6 plus Section 5.1, Section 1.2.4 and Section 2.3 for background

Astronomy in the News? 1/2 pound meteorite, size of a tennis ball hit a doctor's office about 20 miles from Washington DC last Monday.

Steve Weinberg, Texas physics professor, winner of Nobel Prize in physics, has a new book of essays on topics related to this class: *Lake View: This World and the Universe*. Book signing at Book People yesterday.

Pic of the Day - stream of hydrogen gas from Milky Way neighbor galaxies, the Magellanic Clouds.



Discussion Point:

White dwarfs have about the same mass as the Sun and about the same radius as the Earth.

How does the gravity of a white dwarf compare to the Sun and the Earth, and why?

What do we know about white dwarfs?

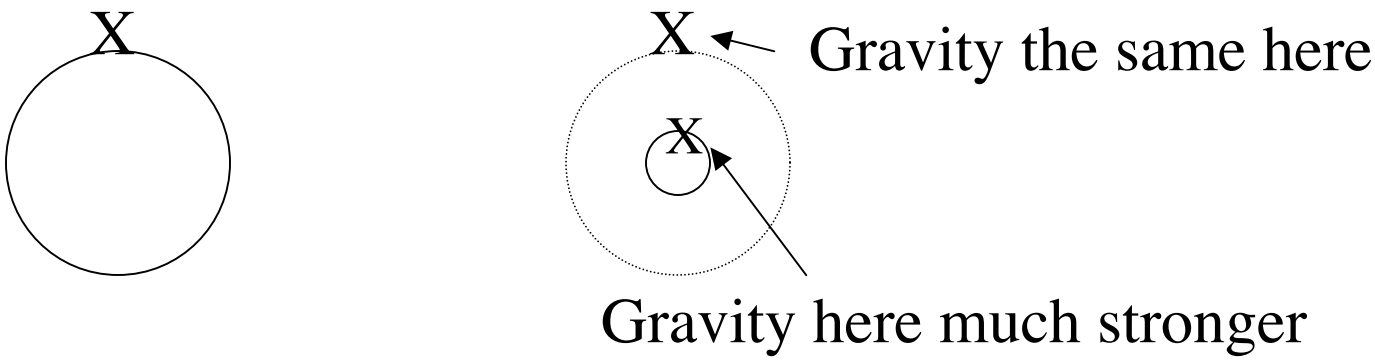
Mass ~ Sun
Most are single, 0.6 $M_\odot$ (solar masses)
Some in binary systems, higher mass

Size ~ Earth ~1% radius of Sun

$$\text{Density} = \frac{\text{mass}}{\text{volume}} \rightarrow \frac{10^6 \text{ grams}}{\text{c. c.}} \sim \frac{\text{tons}}{\text{cubic centimeter}}$$

OR MORE!

HUGE GRAVITY!



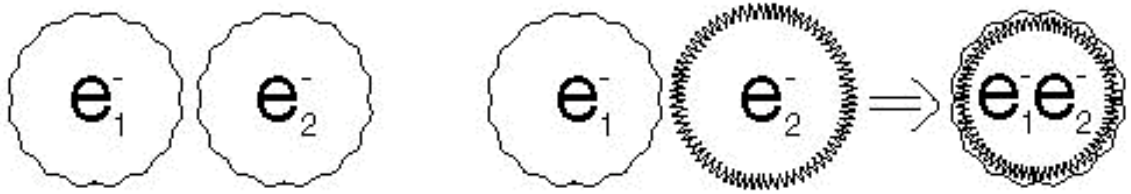
Same mass, smaller size, gravity on *surface* is larger because you are closer to the *center*.

Gravity on surface acts *as if* all mass beneath were concentrated at a point in the center -- Newton/Calculus

Huge gravity compresses a white dwarf --
requires special pressure to support it
(Section 1.2.4, Section 2.3)

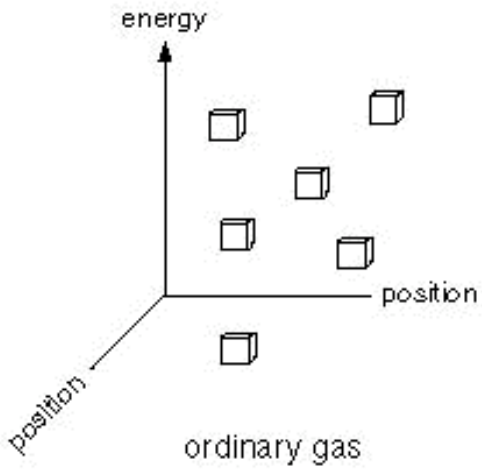
- ***Normal pressure*** -- thermal pressure
- Motion of hot particles -- Pressure depends on Temperature
- ***Quantum Pressure*** -- Quantum Theory
- Uncertainty Principle -- Can't specify position of any particle exactly
- Exclusion Principle -- No two identical particles (electrons, protons, neutrons) can occupy same place with same energy

Figure 1.4

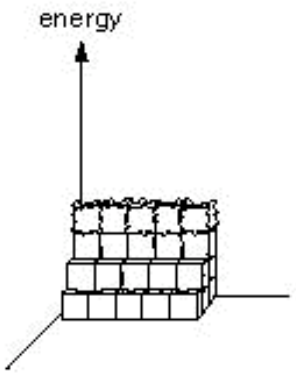


same momentum
total exclusion

different momentum



ordinary gas



gas dominated
by quantum
pressure

Demonstration - need volunteers.

Discussion point:

How does the different form of the pressure, thermal or quantum, affect the behavior of stars?

What happens if the star puts in excess nuclear energy?

What happens if the star loses excess energy to space?