

Monday, January 23, 2012

Facebook; Twitter posts (not classroom related).

Astronomy in the news?

Conference in Tucson about the Event Horizon Telescope, plans to see the “dark spot” of the black hole in the center of our Galaxy with radio telescopes. Size of the orbit of Mercury 26,000 light year away.

Equivalent to seeing a grapefruit on the Moon.

## White Dwarfs (Section 5.1)

White Dwarf – dense core left behind by low mass stars (less than 8 solar masses) after red giant and planetary nebular phase.

Essentially every white dwarf formed since beginning of the Galaxy is still here 10-100 billion of them (~ 100 billion stars total), but a few white dwarfs have blown up.

Most white dwarfs are dim, undiscovered, we see only those nearby, none naked eye

Sirius, brightest star in the sky, has a white dwarf companion. Can't see the white dwarf with the naked eye, too small, dim, but Sirius is easy if you look for it at the right time.

*Find Sirius for the extra credit sky watch project.*

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  $\sim$  Sun

Most are single,  $0.6 M_{\odot}$  (solar masses)

Some in binary systems, higher mass

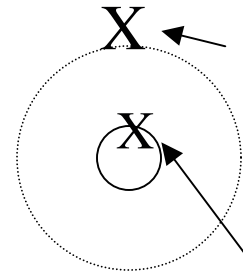
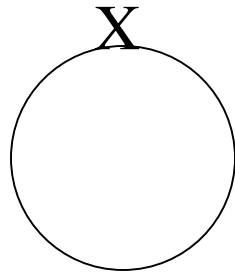
Size  $\sim$  Earth

$\sim 1\%$  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!



Gravity the same here

Gravity here much stronger

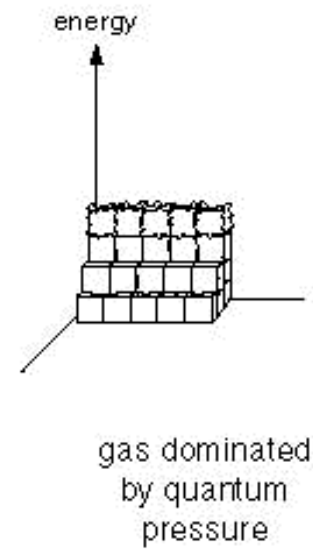
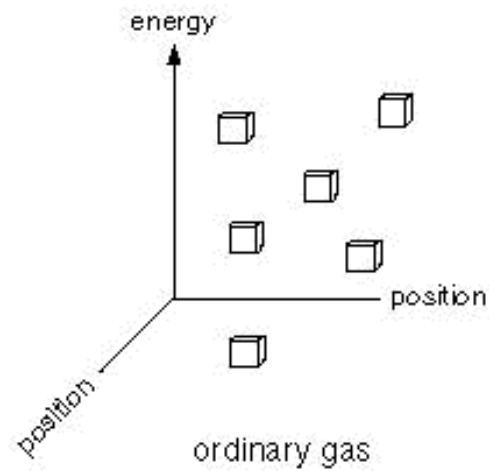
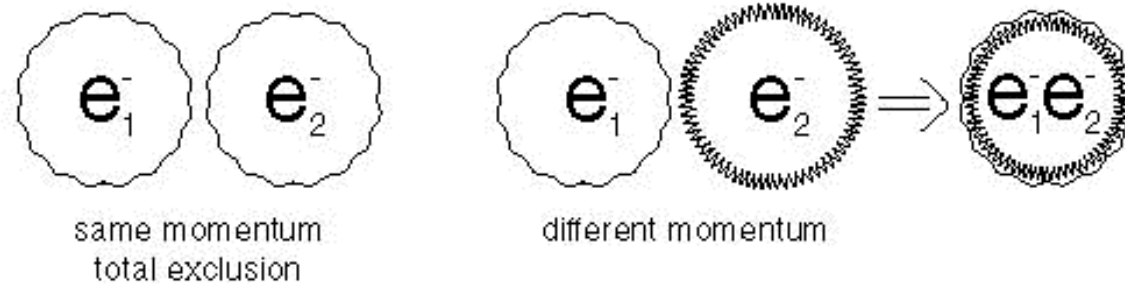
Same mass, smaller size, gravity on *surface* is larger because you are closer to the *center*.

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)

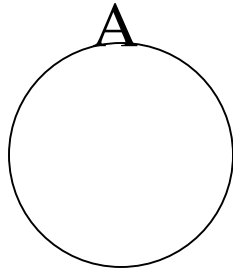
- *Normal pressure* -- thermal pressure
- Motion of hot particles -- *Pressure depends on Temperature*
- *Quantum Pressure* -- Quantum Theory
- Uncertainty Principle -- Can't specify position of any particle exactly. If you squeeze and “locate” a particle more precisely, its energy gets more uncertain, and larger on average.
- Exclusion Principle -- No two identical particles (electrons, protons, neutrons) can occupy same place with same energy, but they can if one has more “uncertainty” energy.
- *Pressure depends only on density, not on temperature*

# Figure 1.4

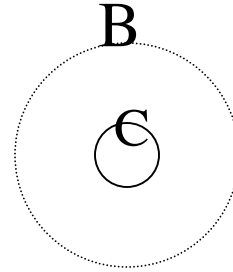


Demonstration thermal pressure, quantum pressure - need volunteers.





A



B

Same  
mass in  
all three  
cases

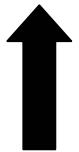
One Minute Exam: Where is gravity strongest?



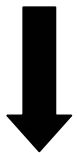
A.



B.



C.



Insufficient information