Wednesday, September 4, 2103

Facebook; Twitter posts (not classroom related).

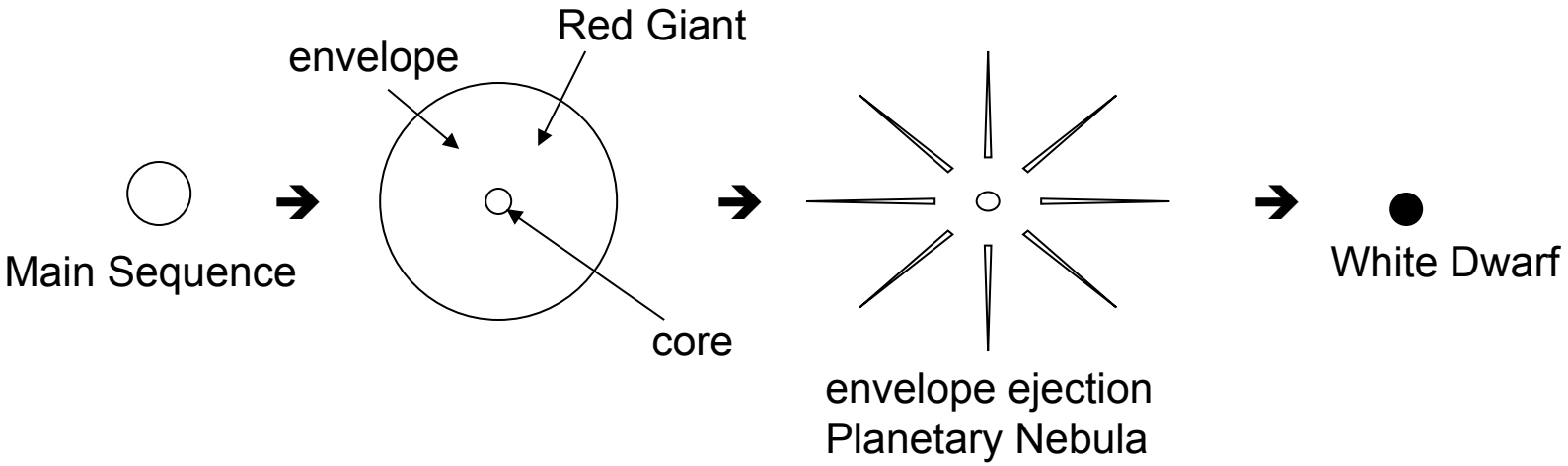
Astronomy in the news?

LADEE US Moon probe to be launched this week. Looking for water, studying lunar dust.

Discussion Point:

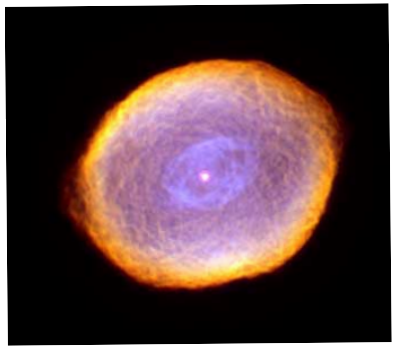
Why are white dwarfs called white dwarfs?

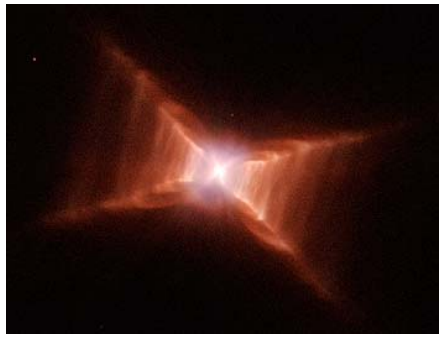
White Dwarfs (Section 5.1)



White dwarfs are the most common stellar "corpse."
They come from low mass stars → plentiful.

Examples of planetary nebulae surrounding new-born white dwarfs

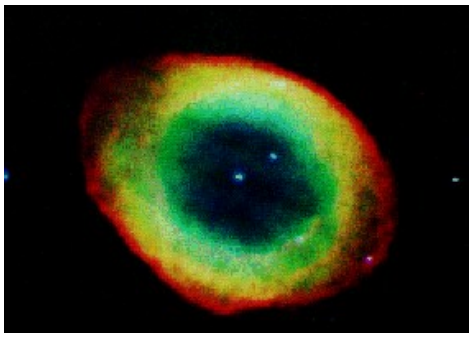




Sky Watch Extra Credit:.

Find red giant Betelgeuse in Orion Constellation

Other red giants



Find the constellation Lyra, location of the Ring Nebula, Messier 57.

You can't see the planetary nebula with your naked eye, but you can find Lyra

Other planetary nebulae

Also Moon, Mars, Venus, Jupiter, Big Dipper for orientation, NSEW, learning to use a star chart

Check out links: Whole Sky Chart

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 Points:

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?

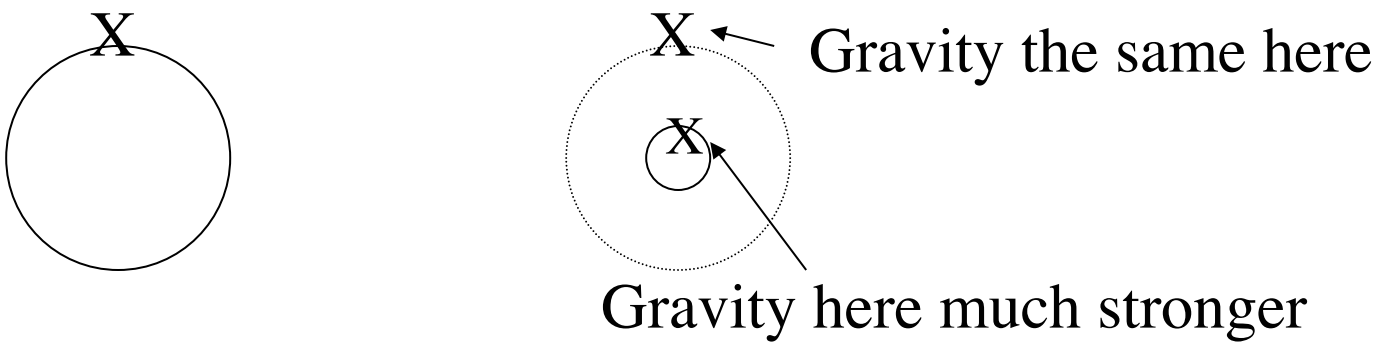
Mass ~ Sun
Most are single, $0.6\ M_{\odot}$ (solar masses)
Some in binary systems, higher mass

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!



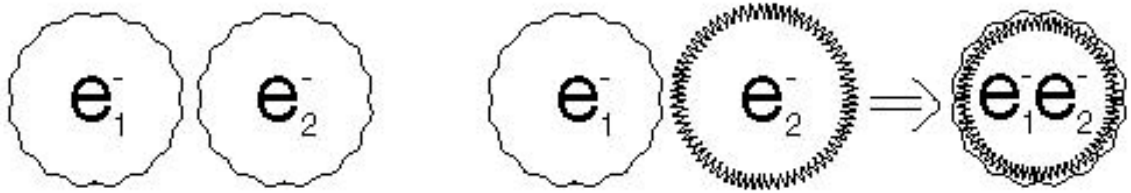
Same mass, smaller size, gravity on *surface* is larger because you are closer to the *center*.

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)

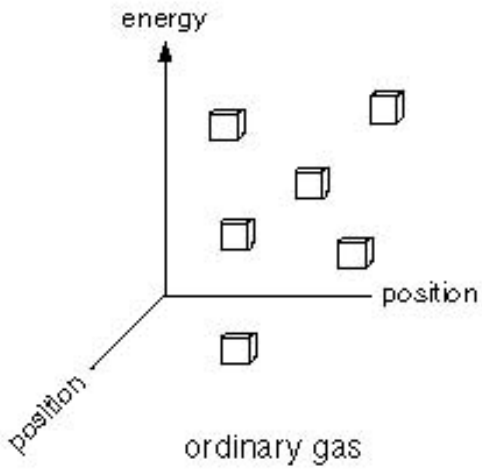
- ***Normal pressure*** -- thermal pressure
- Motion of hot particles -- ***Pressure depends on Temperature***
- ***Quantum Pressure*** -- Quantum Theory
- Uncertainty Principle -- Can't specify position of any particle exactly. If you squeeze and "locate" a particle more precisely, its energy gets more 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

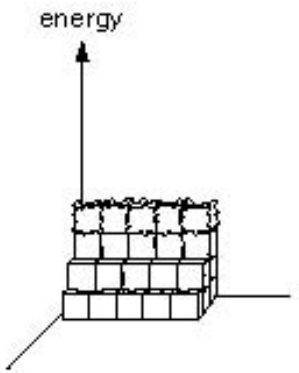


same momentum
total exclusion

different momentum



ordinary gas



gas dominated
by quantum
pressure