Book -1 copy on 2 hour reserve in Physics/Math/Astronomy.

Handouts from first class

Astronomy in the News?

Pluto

Lockheed Martin gets contract for Shuttle replacement

Pic of the Day - Gemini South

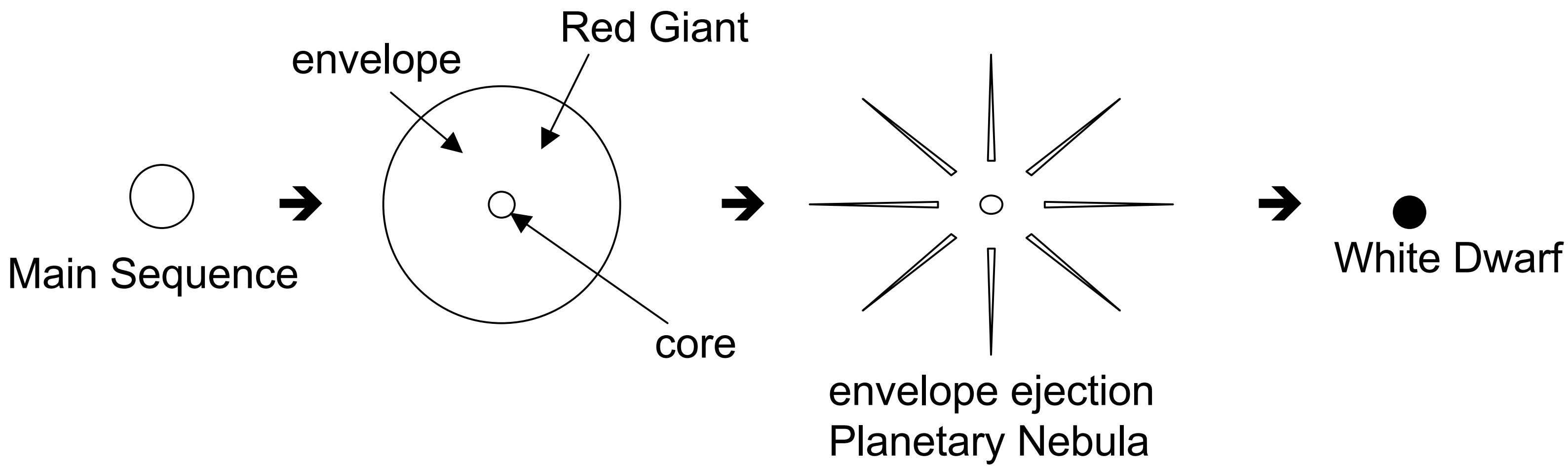
Background check

What is a main sequence star?

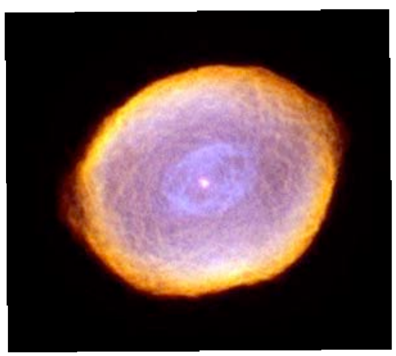
What is a red giant star?

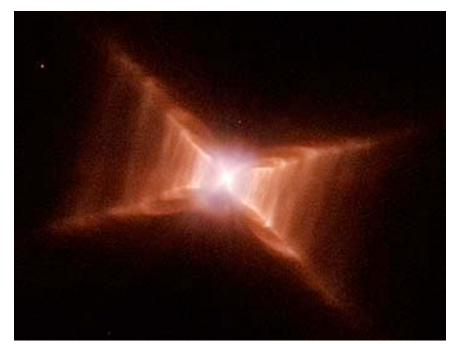
Write a few sentences, talk with your neighbors.

White Dwarfs (Chapter5)



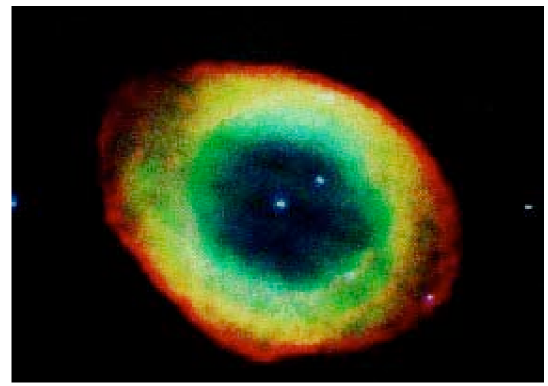
Most common stellar “corpse.” Come from low mass stars $\rightarrow$ plentiful.





Sky Watch Extra Credit:

Try to find the constellation Lyra, location of the Ring Nebula, Messier 57.



Other planetary nebulae.

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

White Dwarfs

Essentially every white dwarf formed since beginning of Galaxy is still here 10-100 billion of them (~ 100 billion stars total)

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

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

What do we know about white dwarfs?

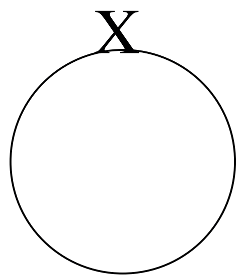
Mass ~ Sun
Most are single, 0.6 $M_\odot$ (solar masses)
Some in binary systems, higher mass

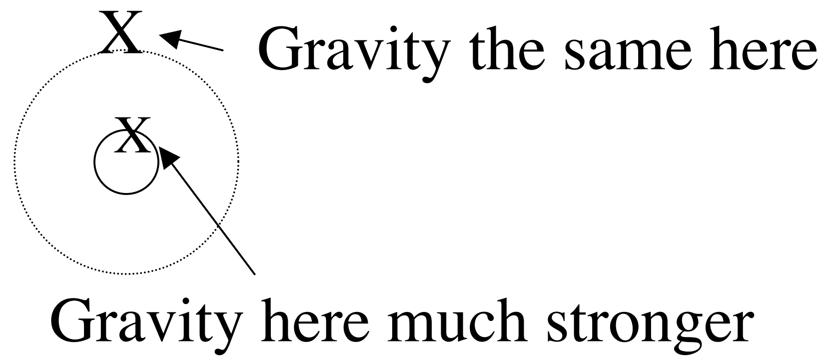
Size ~ Earth ~1% radius of Sun

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

OR MORE!

HUGE GRAVITY!





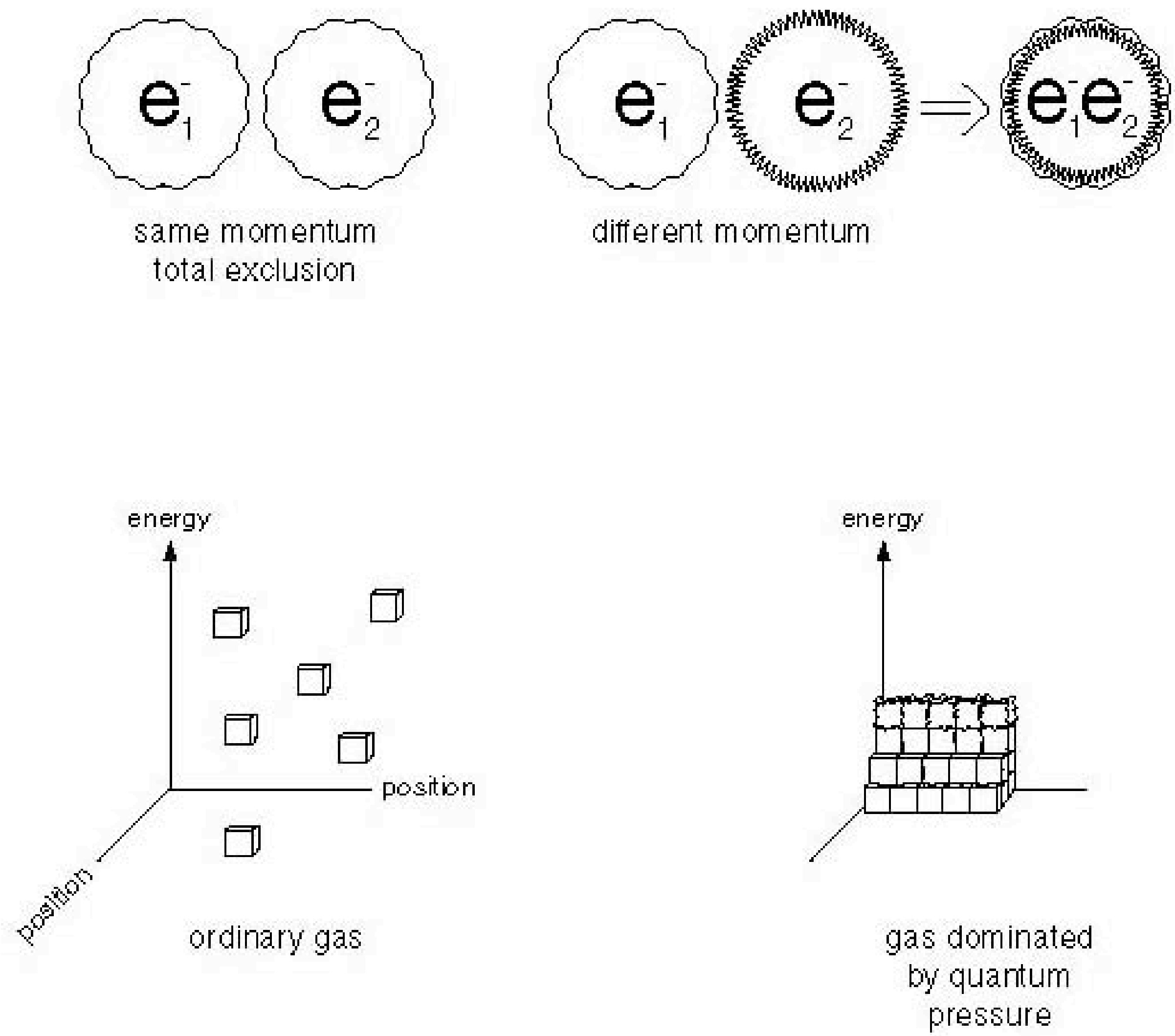
Same mass, smaller size, gravity on *surface* is larger because you are closer to the *center*.

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

Huge gravity compresses star --
requires special pressure to support it (Chapter 1)

- 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 can occupy same place with same energy

Figure 1.4



e_1^-
e_2^-
same momentum
total exclusion
e_1^-
e_2^-
$e_1^- e_2^-$
different momentum
energy
position
position
ordinary gas
energy
gas dominated
by quantum
pressure

Same
mass in
all three
cases

One Minute Exam:

Where is gravity strongest, A, B, or C?

Talk to your neighbors.

Quantum Pressure -- just depends on squeezing particles,
electrons for white dwarf, to very high density
-- depends on density only
-- *does not* depend on temperature

Important Implication:

Normal ★	Radiate energy, temperature/pressure try to drop, star compresses, gets **hotter** (and higher pressure)
White Dwarf	Radiate energy, *temperature does not matter*, pressure remains constant, star gets **cooler**

Opposite behavior	Normal Star - *Regulated*	put in energy, star expands, cools
	White Dwarf - *Unregulated*	put in energy, hotter, more nuclear burning -- explosion!