January 27, 2009

Book - OK? New? Used?

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

Handouts from first class

ABCD answer sheets for One Minute Exams - download

Star Parties - can be useful for extra credit - watch weather, Moon?

2 minute break after 50 minutes: 1:20

Astronomy in the News? Web, TV

Pic of the Day - Milky Way over Mauna Kea

Video Last Week

background

Background Check

What is a main sequence star?

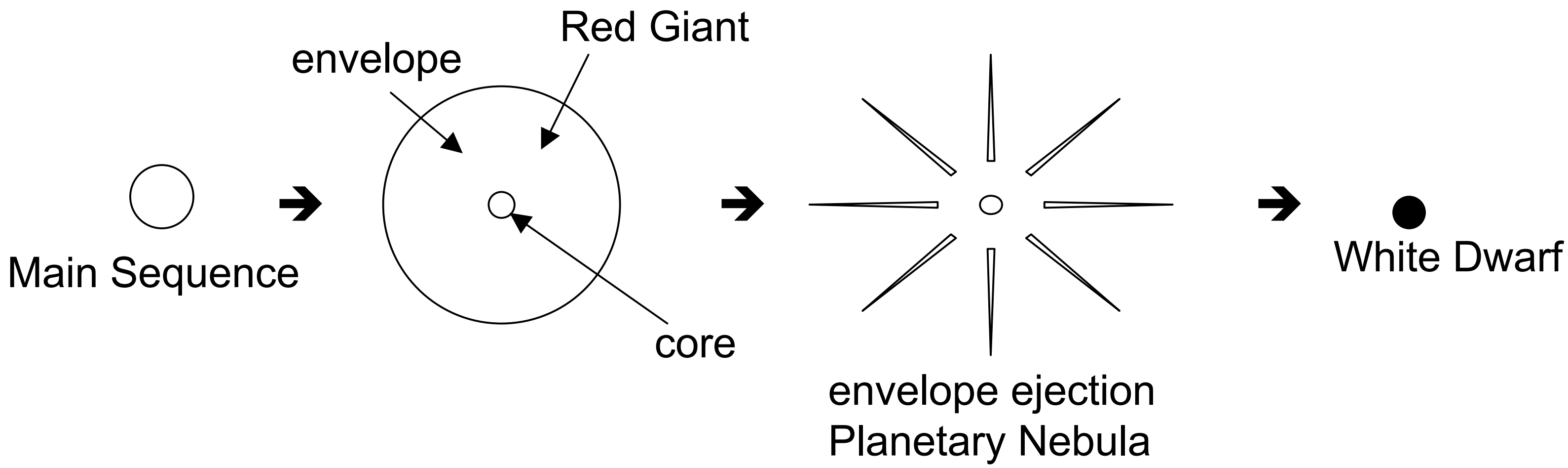
What is a red giant star?

Write a few sentences, talk with your neighbors.

Concept Check

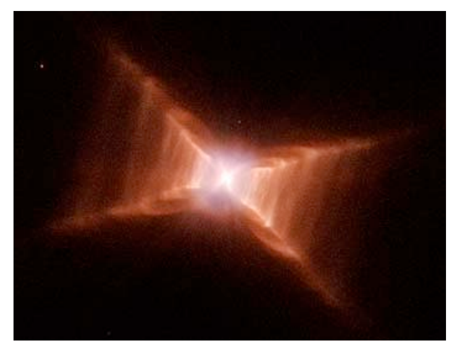
What’s on the cover of the book?

White Dwarfs (Chapter5)



Most common stellar “corpse.” Come from low mass stars → plentiful.

Examples of planetary nebulae surrounding new-born white dwarfs



Sky Watch Extra Credit:.

Constellation Draco site of the Cat’s Eye Nebula

Can’t see with naked eye, but can find Draco

Other planetary nebulae.

Also Moon, Venus, 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 Sirius for the extra credit project.

What do we know about white dwarfs?

Mass ~ Sun

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

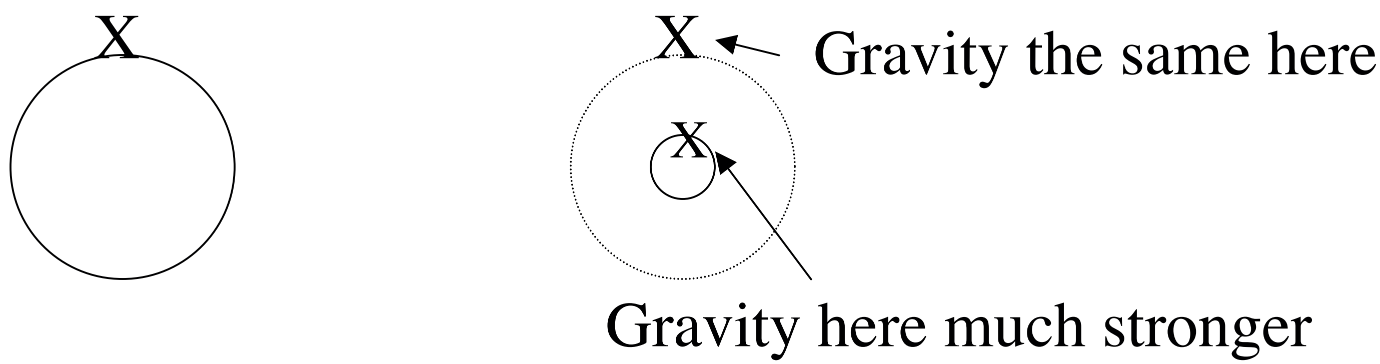
Some in binary systems, higher mass

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!



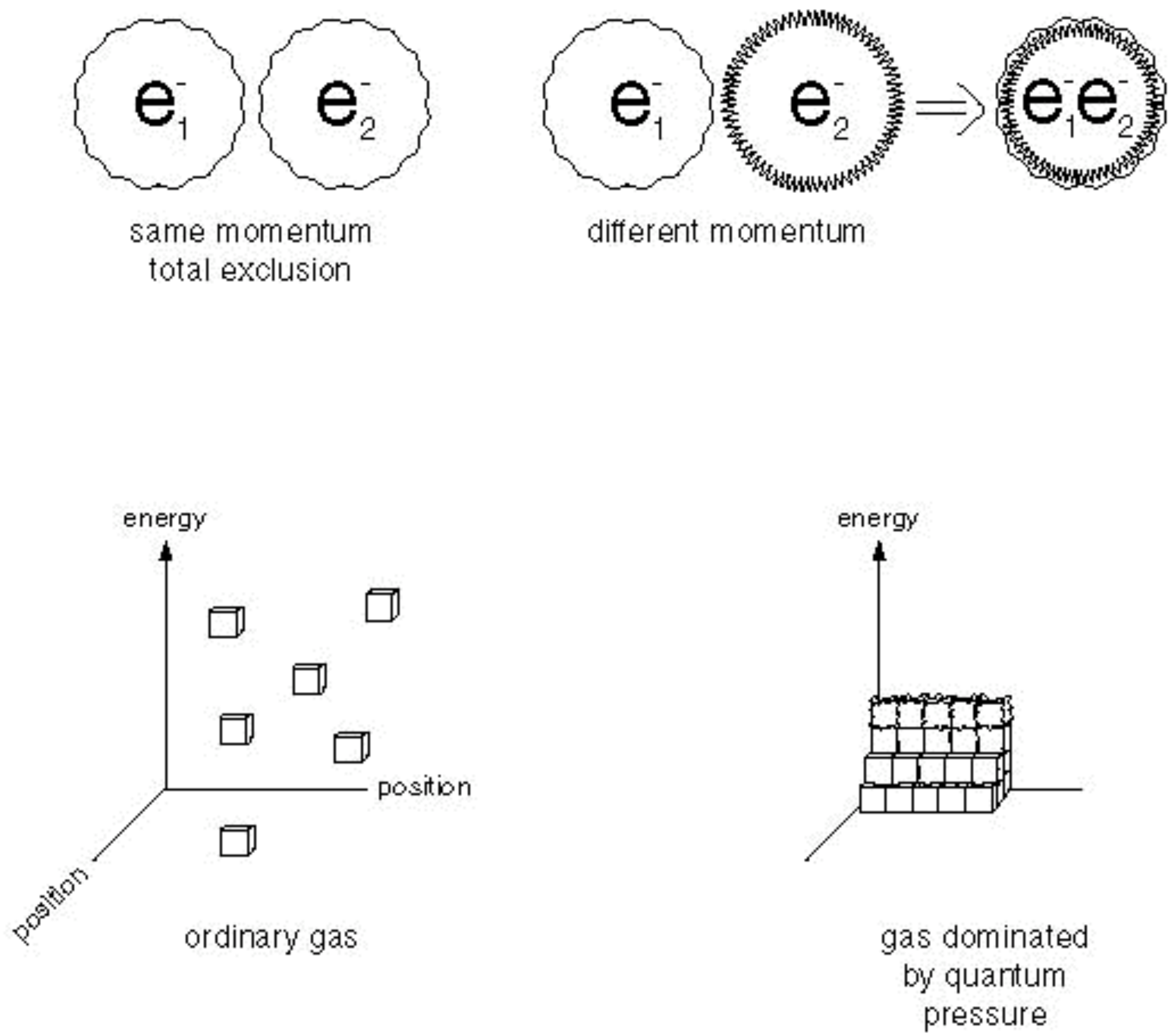
Same mass, smaller size, gravity on *surface* is larger because you are closer to the *center*.

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

Huge gravity compresses a white dwarf --
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 (electrons, protons, neutrons) 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

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, pressure tries to drop, star contracts and gets **hotter** (and higher pressure)

White Dwarf — Radiate energy, *temperature does not matter*, pressure, size, remain 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!