Monday, February 6, 2017

Multiple Choice Grades and exam extra credit posted.

Exams, Sky Watch returned, exam key posted on Wednesday.

Astronomy in the news?

Same mass in all three cases

One Minute Exam: Where is gravity strongest?

A.

B.

C.

Insufficient information

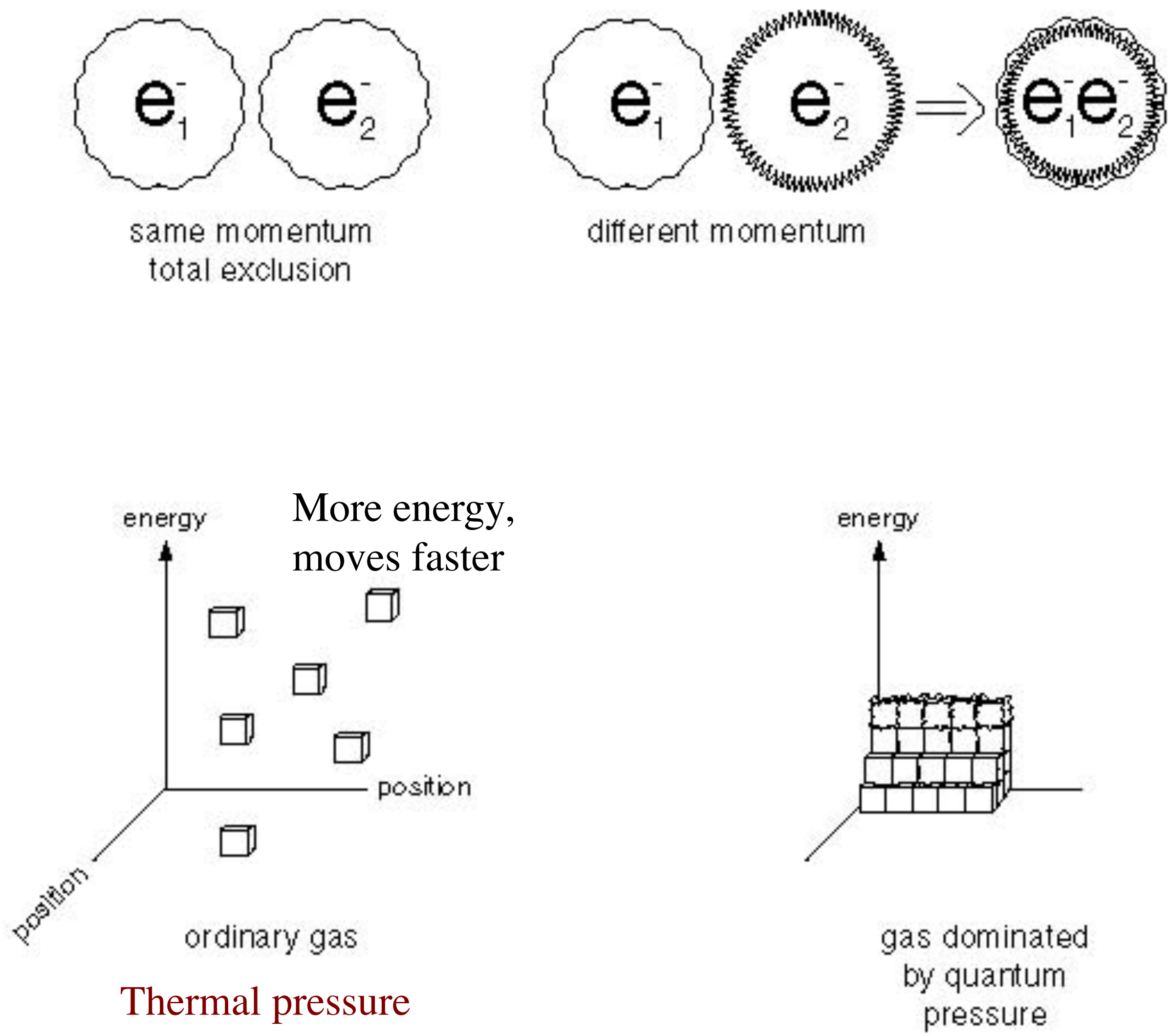
Goal:

To understand how pressure is created in stars, how thermal pressure controls the evolution of normal stars, and why quantum pressure makes white dwarfs liable to explode in some circumstances.

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, particles as waves
  - Uncertainty Principle -- Cannot specifythe 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 the 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



e$^-_1$
e$^-_2$
same momentum
total exclusion
e$^-_1$
e$^-_2$
e$^-_1$e$^-_2$
different momentum
energy
More energy,
moves faster
position
position
ordinary gas
Thermal pressure
energy
gas dominated
by quantum
pressure

Demonstration thermal pressure, quantum pressure - 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?

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 excess energy, pressure tries to drop, star contracts under gravity, and gets **hotter** (and higher pressure)

White Dwarf Radiate energy, *temperature does not matter*, pressure, size, remain constant, star gets **cooler**

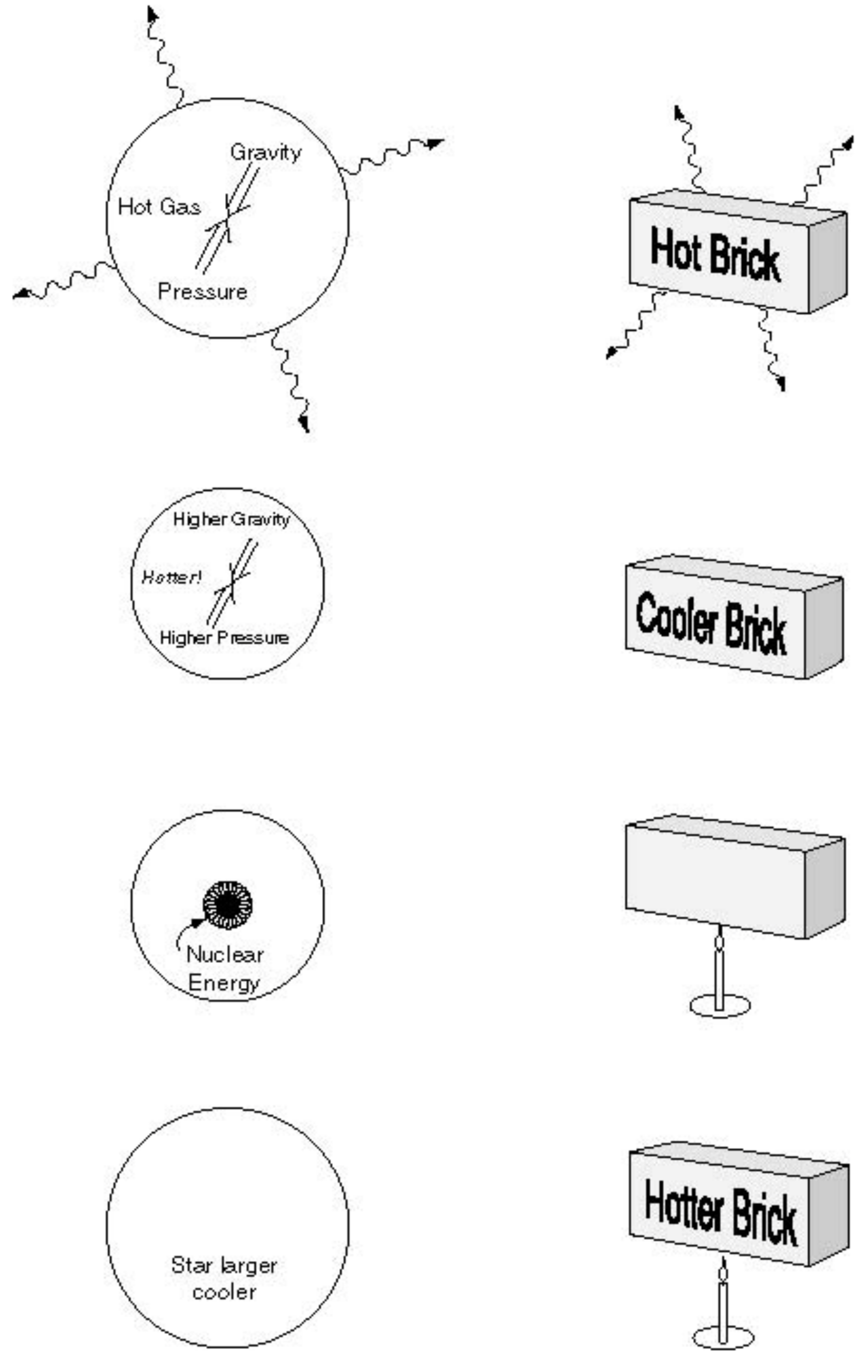
Opposite behavior	Normal Star - *Regulated*	put in energy, star expands, cools
	White Dwarf - *Unregulated*	put in energy, hotter, more nuclear burning -- explosion!

Figure 1.3

A normal star can and will radiate away thermal energy and hence structural energy.

A brick cannot radiate its structural energy,

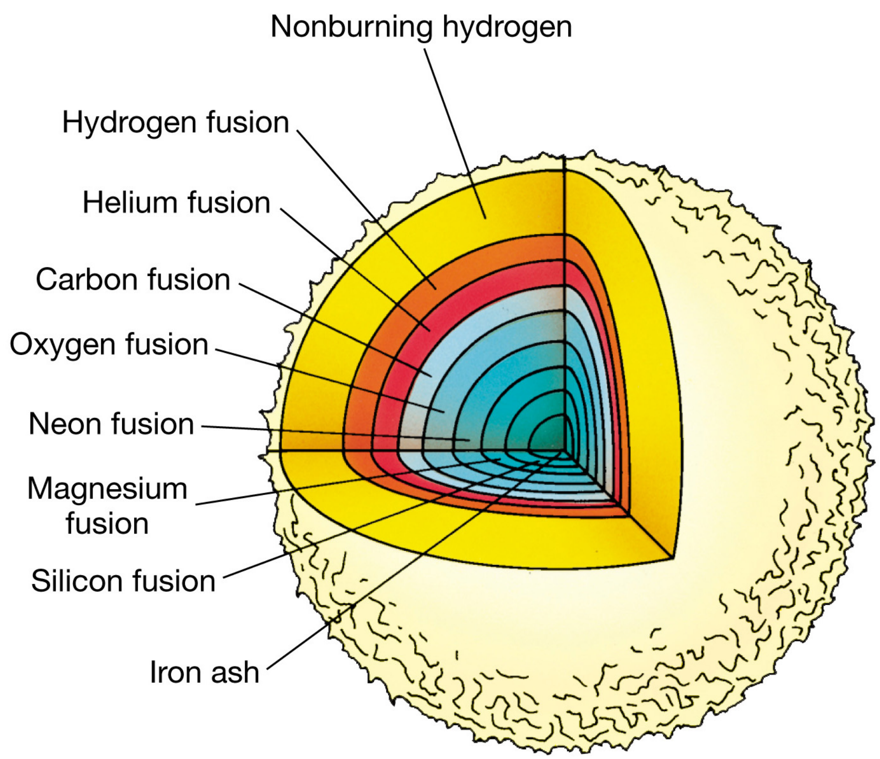
A white dwarf cannot radiate away its quantum energy.



Goal: to understand the origin of Type II, Ib, Ic

How does a massive star get from hydrogen to iron, and why iron, and what then?

Reading: Chapter 1, Section 2.1 (forces, neutrinos), Chapter 2, Section 2.1, 2.4, 2.5, Chapter 6, Sections 6.4, 6.5 (jets, but not polarization), Betelgeuse interlude, end of Chapter 6.



Sky Watch Targets

Binary Stars

Sirius, if you have not already done it.

Algol, Beta Persei in Perseus

Antares, Alpha Scorpii in Scorpius

Beta Lyrae in Lyra

Rigel, Beta Orionis in Orion (triple star system)

Spica in Virgo

Other binary star systems

Nuclear physics:

Protons and neutrons attract each other.

The **strong nuclear force** (Section 1.2.1) binds protons and neutrons together in atomic nuclei.

Short range force, acts only when protons and neutrons are nearly touching.

Protons have positive electrical charge. They repel one another at large distances.

The strong nuclear force can, and does overwhelm the charge repulsion if the protons and neutrons are close enough together.