Wednesday, February 5, 2014

No office hours at 5PM today, but I'll be in my office all afternoon until 4PM.

First Exam, Skywatch, Friday February 7.

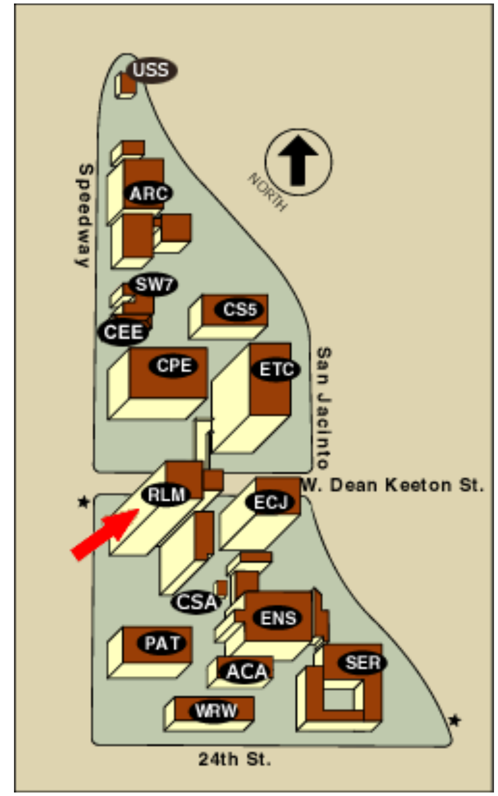
Review sheet posted.

Review session Thursday, 5 – 6 PM, RLM 7.104

Reading for Exam 1: Section 5.1 (white dwarfs), 1.2.4 (quantum theory), Section 2.3 (quantum deregulation), Section 6.1 (supernovae; *not* Type Ib, Type Ic, next exam).

Reading for Exam 2: Chapter 6, Sections 6.1 (end, Type Ib/c) 6.4 – 6.6 (background: Sections 1.2, 2.1, 2.4, 2.5, 3.3, 3.4, 3.5, 3.10, 4.1, 4.2, 4.3, 4.4, 5.2, 5.4)

Astronomy in the news?



Update on new “nearby” supernova SN 2014J in M82

Nothing worth reporting

Type Ia:

No Hydrogen or helium, intermediate mass elements (oxygen, magnesium, silicon, sulfur, calcium; *made in the explosion*) early on, Iron later.

Not in spiral arms, do occur in elliptical galaxies -> old when blow

Characteristic peaked light curve

All consistent with explosion in Chandrasekhar mass carbon/ oxygen white dwarf in binary system, total disruption

Original mass on the main sequence M < 8 solar masses so that quantum pressure takes over from thermal pressure in the carbon/ oxygen core that forms after the helium-burning phase.

Type II: Hydrogen early, Oxygen, Magnesium, Calcium (*made in the star before the explosion, then ejected*), later.

Type Ib: no Hydrogen, but Helium early, Oxygen, Magnesium, Calcium later. ***H envelope lost, by stellar wind or binary star transfer.***

Type Ic: no Hydrogen no Helium early, Oxygen, Magnesium, Calcium later. ***Even more mass loss, by stellar wind or binary star transfer.***

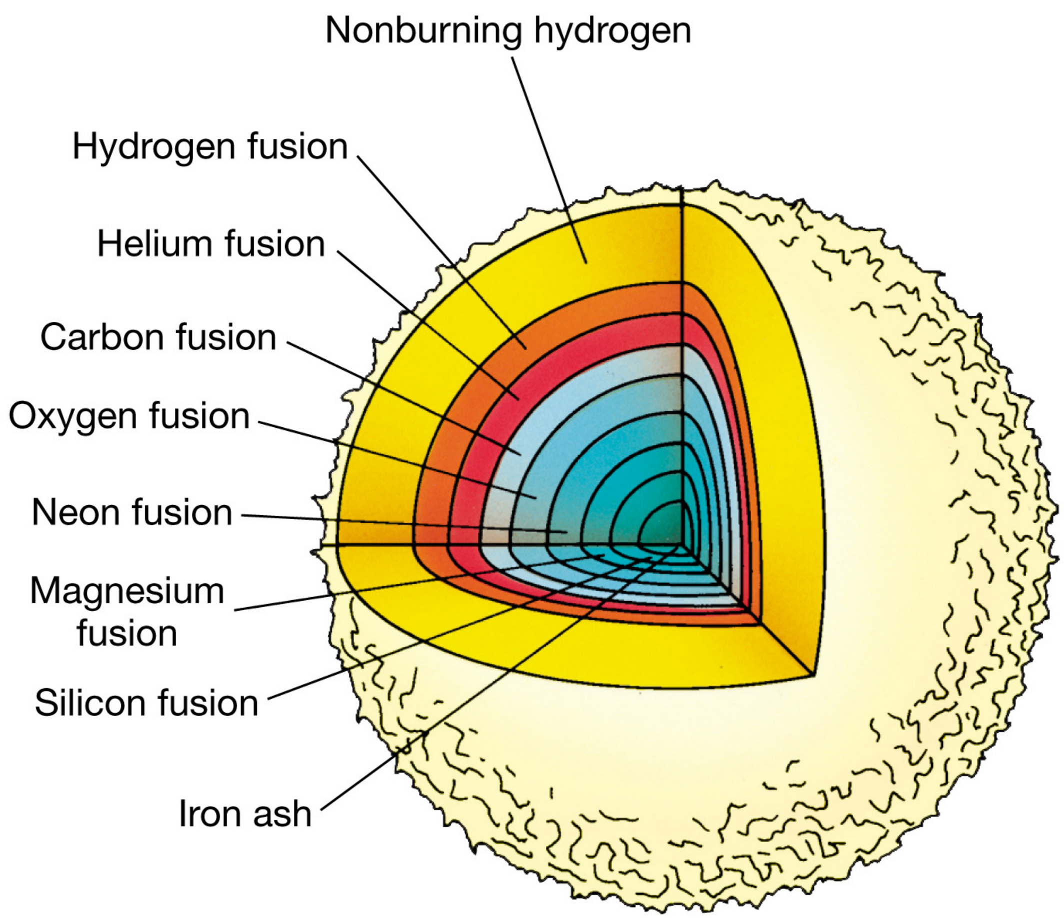
Occur in spiral arms, never in elliptical galaxies -> short lived -> massive star -> expect core collapse, neutron star or black hole.

Original mass on the main sequence M > 12 solar masses, so that thermal pressure always dominates.

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: Section 2.1, 2.4, 2.5, 6.4 – 6.5



One Minute Exam

A supernova that explodes within the spiral arm of a spiral galaxy and shows no evidence for hydrogen or helium in its spectrum is probably a

→ Type II supernova

← Type Ia supernova

↑ Type Ib supernova

↓ Type Ic supernova

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 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.

Evolution - gravity vs. charge repulsion
§ 2.1

Discussion point: Why do you have to heat a fuel to burn it?

H → He → C → O
more protons, more charge repulsion, must get ever hotter to burn ever "heavier" fuel

Just what massive stars do!
Support by thermal pressure.
When fuel runs out, **core loses energy**, but gravity squeezes, core contracts and HEATS UP
overcomes higher charge repulsion, burns new, heavier fuel, ***until get to iron***

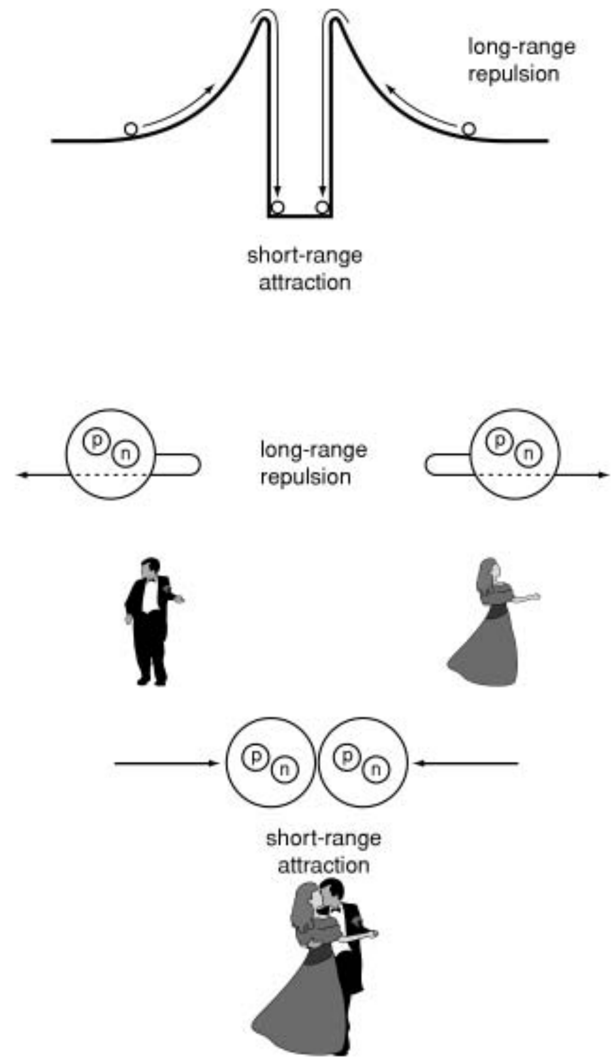


Figure 2.1

Make succession of heavier elements

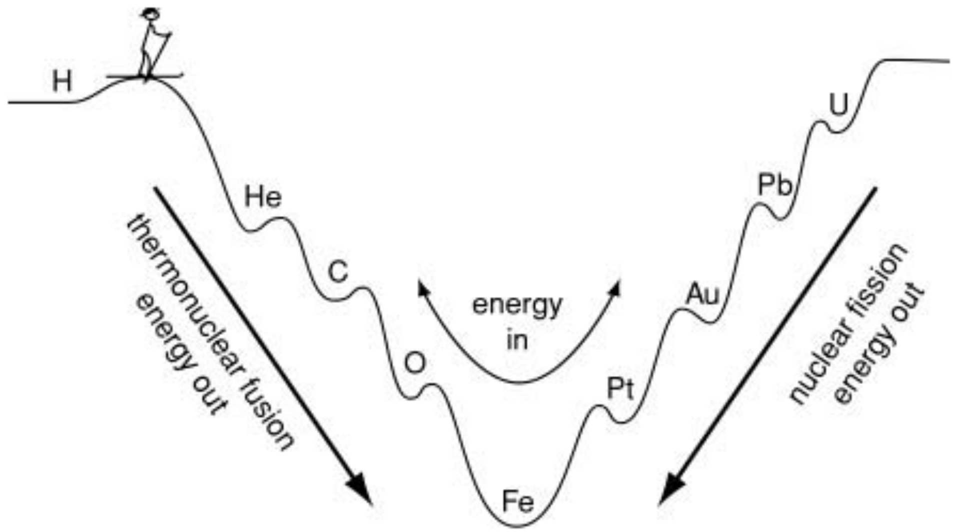


Figure 2.3 measure of binding energy of protons and neutrons in the atomic nucleus

Special role of Iron - 26p, 30n, most tightly bound arrangement of protons and neutrons.
Endothermic - must put energy in to break iron apart into lighter elements or to forge heavier elements. Irons absorbs energy, lowers pressure, core contracts, iron absorbs more energy, more contraction…

=> The iron core quickly collapses! Catastrophic death of the star.