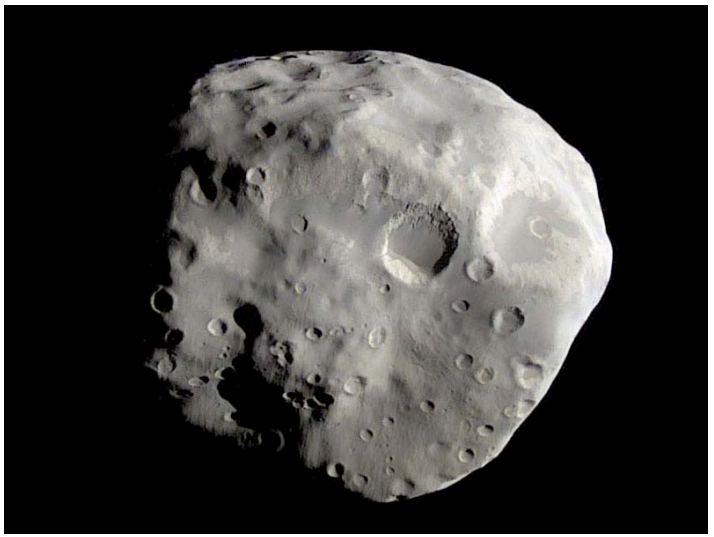
2/11/08

Sky Watch extra credit due today [Note Scorpius, U Sco is visible now if you look at the right time.]

Astronomy in the news? Supernovas on the History Channel tomorrow night, 8:00 PM

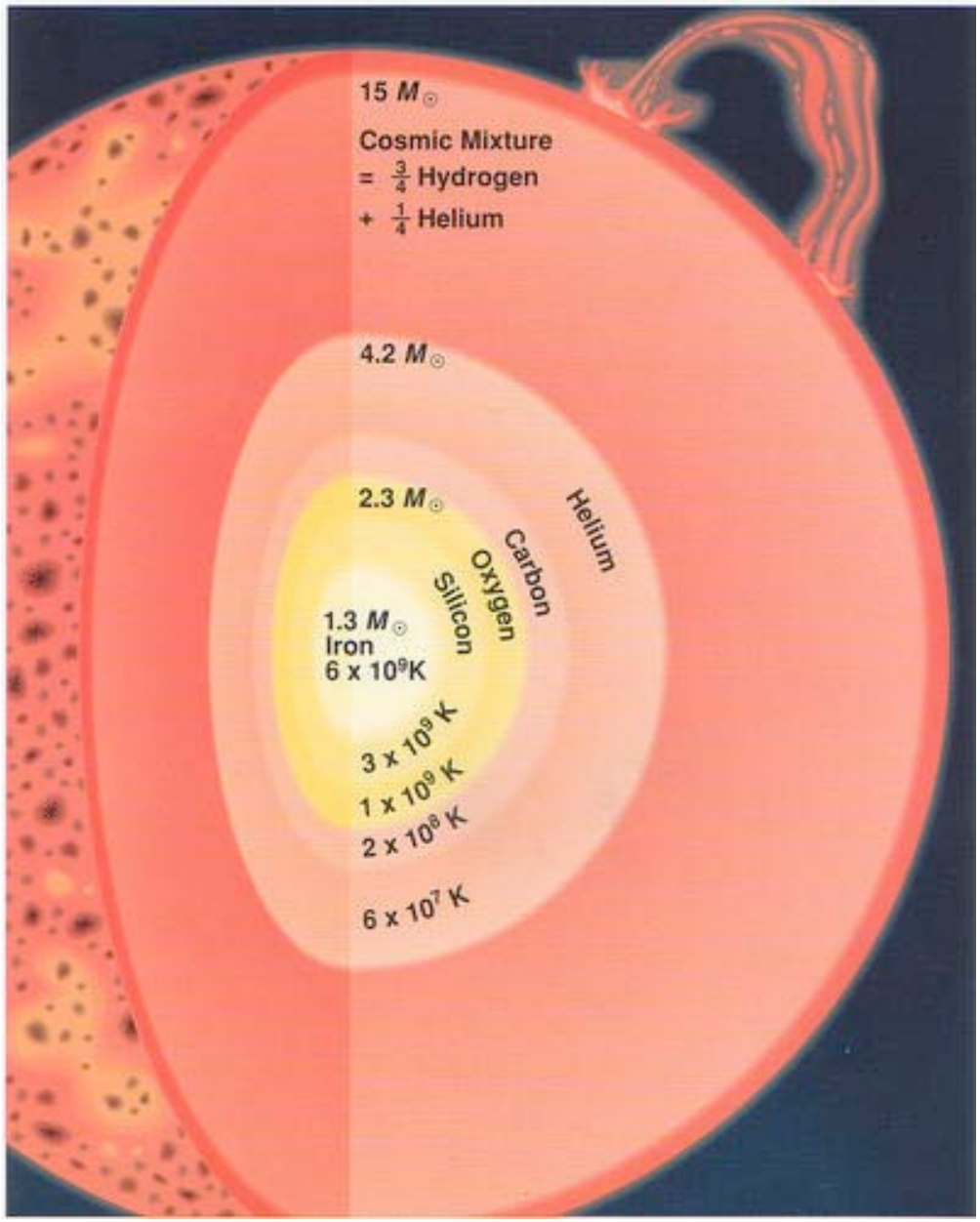
Special lecture, “The Possibility of Life Elsewhere in the Universe” next Wednesday, Feb 20, 7:30 PM - extra credit for attendance.

Pic of the Day - Epimetheus, moon of Saturn, from Cassini mission fly by.



Texas team discovered SN 2008 aa, ab, ac late last week.

Latest was SN 2008ag discovered Sunday evening, #33 of the year.



Origin of Type II, Ib. Ic

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

Evolution - gravity vs. charge repulsion
§ 2.1

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 tries to cool but gravity squeezes, core contracts and HEATS UP
overcomes higher charge repulsion, burns new, heavier fuel, ***until get to iron***

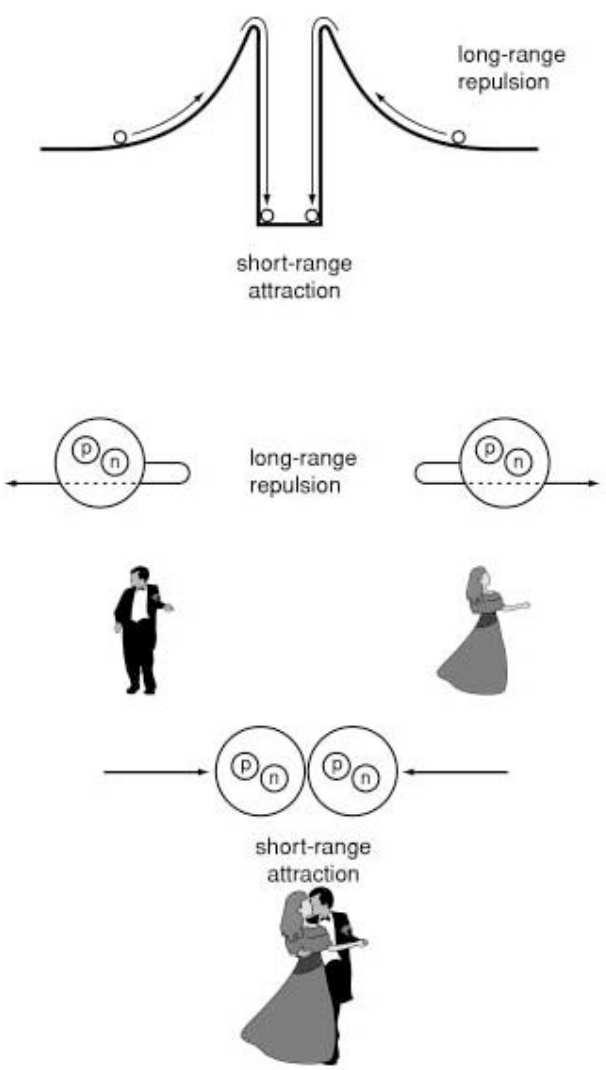


Figure 2.1

Make succession of heavier elements

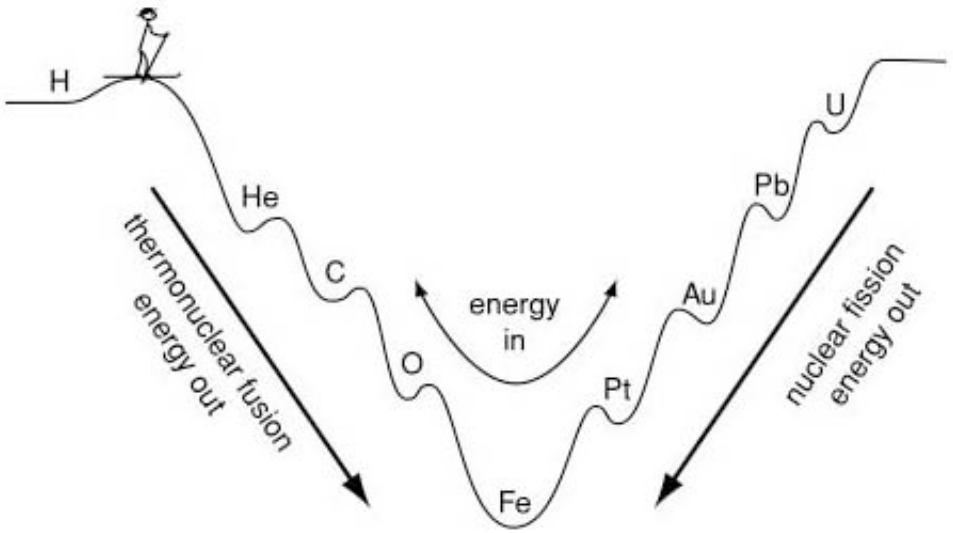


Figure 2.3

Special role of Iron - 26p, 30n

Endothermic - must put energy in to break iron apart into lighter elements or to forge heavier elements, absorb energy, lower pressure, core contracts, absorb more energy, more contraction…

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

When iron core forms - star is doomed to collapse, form a neutron star (or maybe a black hole), composed essentially of all neutrons.

$p + e \rightarrow n + \nu$ ***neutrino***,

Action of Weak Nuclear Force (Chapter 1.2)

One ν is generated for every p that is convertedm star's worth of protons

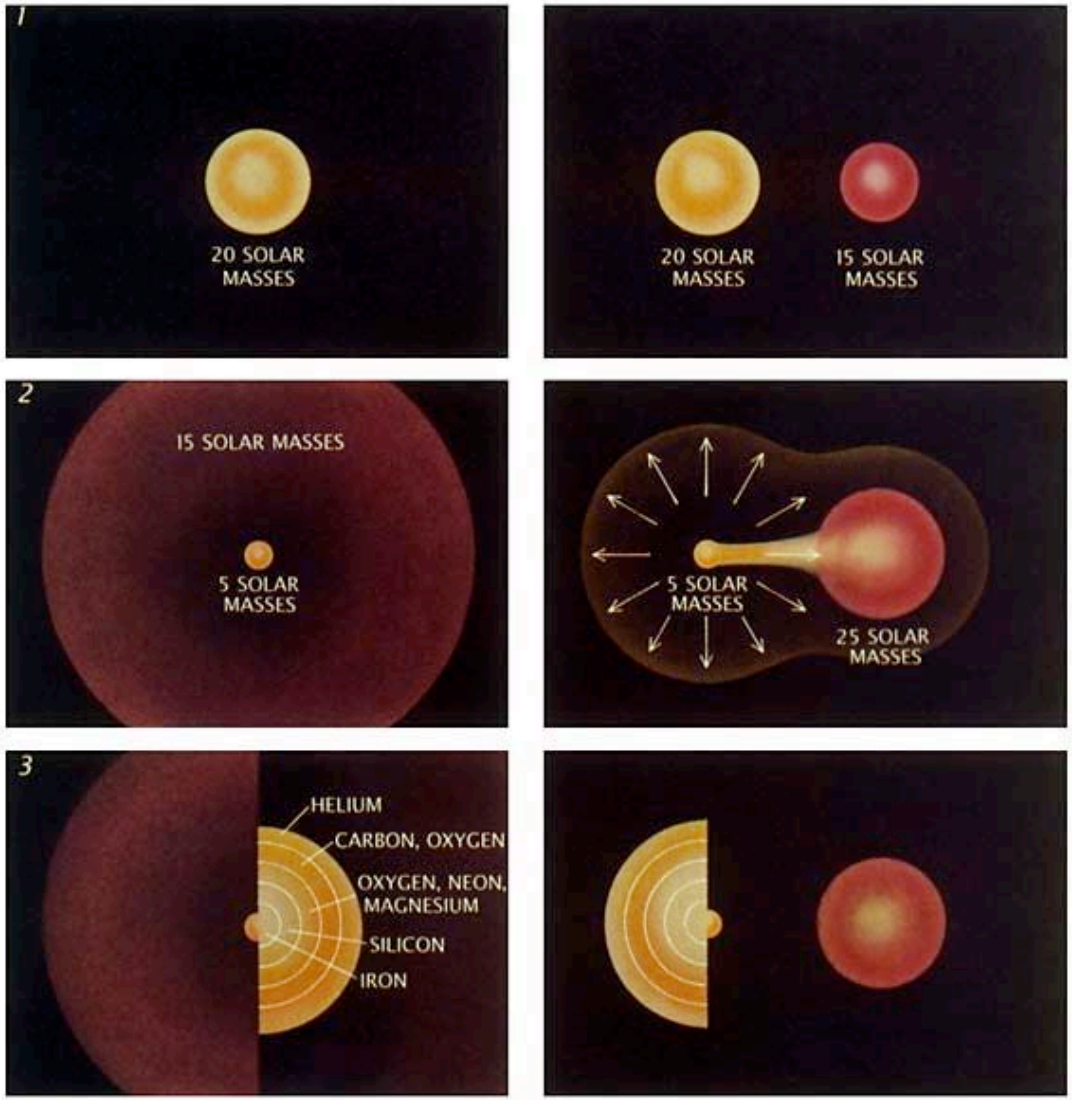
$\Rightarrow$***lots of neutrinos***

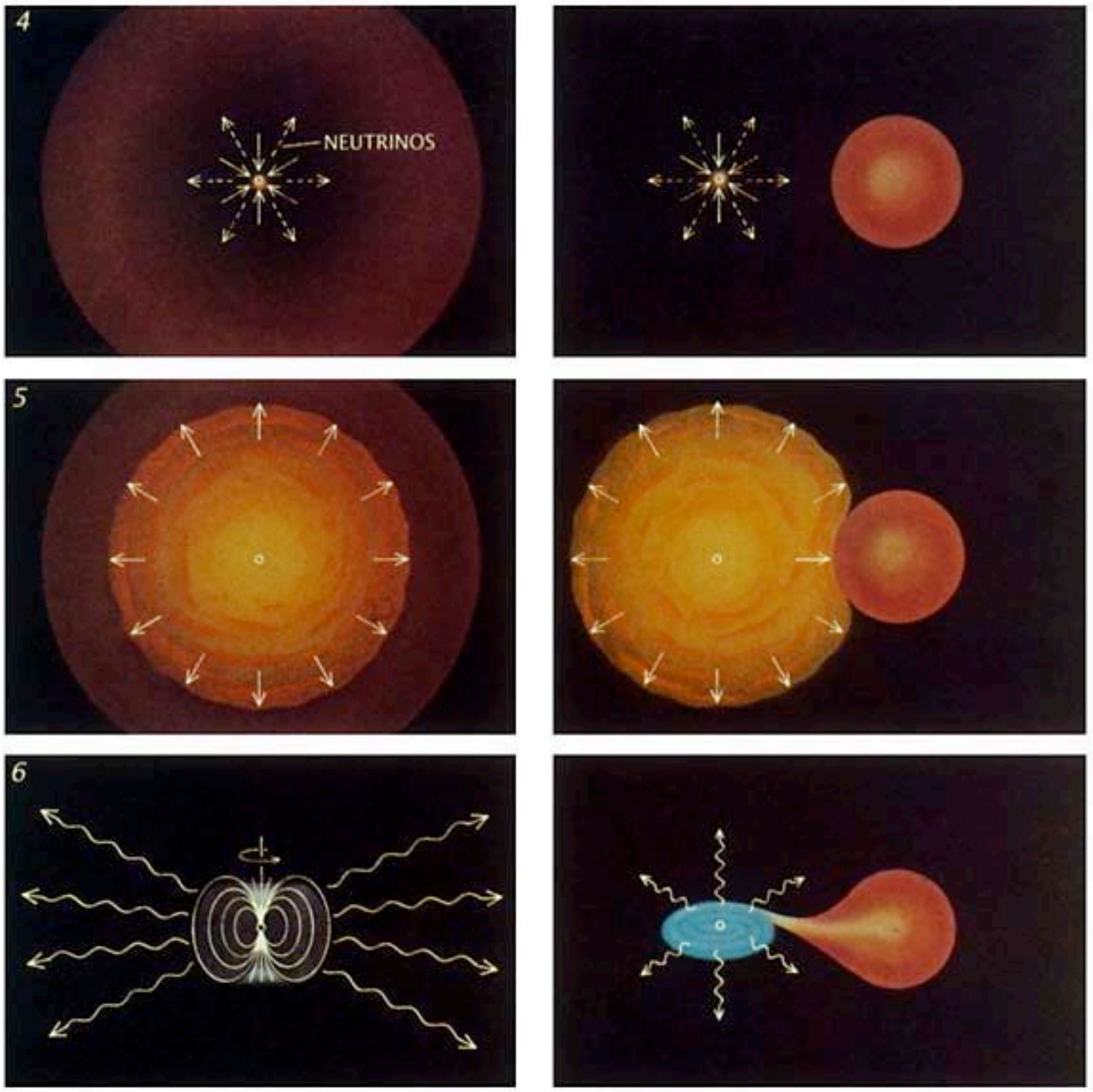
$\Rightarrow$99% of energy of collapse is carried off by neutrinos (Ch 1 2.1, 2.2)

Single star: Type II

Same star in binary: Type Ib/c

Same evolution inside star, thermal pressure, regulated burning, shells of heavier elements, whether envelope there or not





Rotating, magnetic radio pulsar.

Neutron star in binary system, X-ray source

One minute exam

Why do you have to heat a nuclear fuel to make it burn?

A) Charge repulsion keeps nuclei apart

B) The strong nuclear force keeps nuclei apart

C) To overcome the loss of neutrinos

D) To make protons

Iron core of massive star absorbs energy, collapses in about 1 second to form a ***neutron star***.

Essentially all protons and electrons are converted to neutrons with the emission of a ***neutrino***, tiny mass, no electrical charge, interacts little with normal matter, only through weak nuclear force (Chapter 1)

Neutron Star - mass of Sun, but size of small city, ~ 10 kilometers in radius, density of atomic nucleus.

Huge gravity - surface is now ***much closer*** to the center!

One minute exam

What is the importance of iron in massive stars?

A) It produces a great deal of energy

B) It absorbs energy

C) It produces neutrinos

D) It combines with oxygen and produces rust

When neutron star forms, get huge energy from dropping from size of Earth or White Dwarf to size of Austin.

100 times more energy than is needed to explode off the outer layers of the massive star.

That does not guarantee an explosion!

The outer parts of the star, beyond the neutron star, are ***transparent to the neutrinos***, the neutrinos flood out freely and carry off most of the energy.

Is 1% of the neutrino energy left behind to cause the explosion?

Tough problem! 1.5% is plenty, 0.5% is too little.