2/15/06

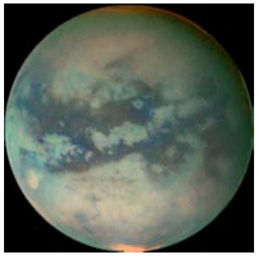
Exams back

Wheeler away Thursday, Friday - film on SN 1987A, neutrinos from core collapse, Bob Kirshner, Stan Woosley, Stirling Colgate.

Weinberg lecture tonight, Dark Energy, Cosmology Thompson 7:30 PM Conference Center Room 1.110

News? NASA Science budget a shambles, humans vs "robots"

Pic of the day - Titan moon of Saturn, recent lander



Type Ia: No Hydrogen, oxygen, magnesium, silicon, sulfur, calcium early, Iron later.

Not in spiral arms, do occur in elliptical galaxies -> old when blow -> white dwarfs, total disruption, no neutron star.
Original mass on the main sequence M < 8 solar masses

Type II: Hydrogen early, Oxygen, Magnesium, Calcium, later.

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

Type Ic: no Hydrogen no (or *very* little) Helium early, Oxygen, Magnesium, Calcium later. ***Even more mass loss, wind or transfer.***

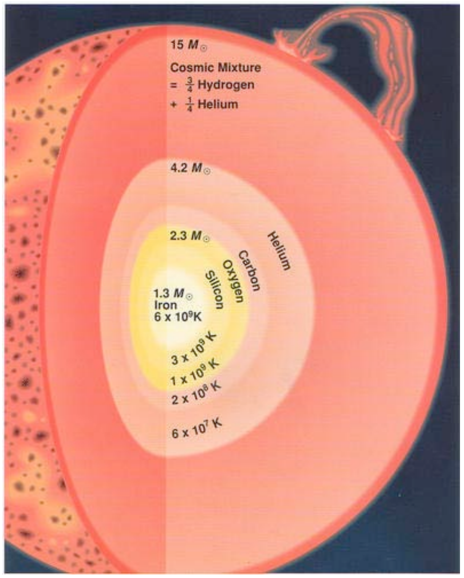
In spiral arms, never in elliptical galaxies -> short lived -> massive star -> expect core collapse, neutron star or black hole.
Original mass on the main sequence M > 8 solar masses

Even more recent (late 90's), possibility of "hypernovae."

For Types Ia, Ib, Ic, II the energy of explosion (motion energy, kinetic energy) is ~1% of the energy generated by collapse to form a neutron star.

Some explosions that otherwise resemble Type Ic (no Hydrogen, no Helium) have shown exceptionally high velocities. Some people have argued that this variation of Type Ic requires perhaps 10 × more explosion energy, thus coining the name "hypernovae" but ***asymmetries*** could play a role, brighter, faster in some directions than others. Nature, connection to "ordinary" Type Ic remains controversial.

These events represent a possible link to ***Gamma-Ray Bursts*** (Chapter 11), the formation of black holes (OR NOT).



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***

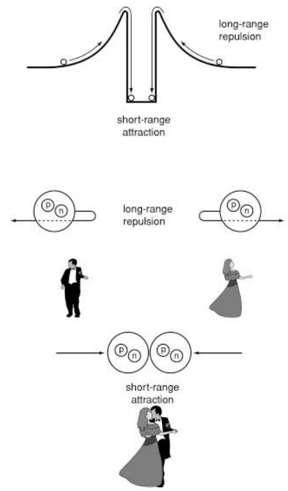


Figure 2.1

Make succession of heavier elements

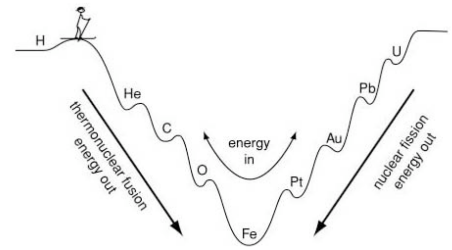


Figure 2.3

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***,

one ν is generated for every p that is converted

⇒***<u>lots of neutrinos</u>***

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

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