9/26/07

Exam 1: answer key posted

Astronomy in the news? Harvest Moon tonight, nearest Full Moon to Autumnal Equinox

Pic of the Day -

Type Ia

no Hydrogen or Helium

intermediate mass elements early on, iron later

avoid spiral arms, occur in elliptical galaxies

peaked light curve

all consistent with explosion in white dwarf, total disruption

Type II

Hydrogen early on, Oxygen, Magnesium, Calcium later

explode in spiral arms, never in elliptical galaxies

“plateau” light curve

consistent with massive, short-lived star that has an explosion deep within a Hydrogen Red Giant envelope by core collapse to leave behind a neutron star (or maybe a black hole).

One minute exam

A supernova explodes in an elliptical galaxy. Near peak light what element do you expect to see in the spectrum?

A) Hydrogen

B) Helium

C) Silicon

D) Iron

New Types, blurring the old categories, identified in the 1980's, defined by elements observed in the ***spectrum***.

Type Ib: no Hydrogen, but Helium early, near maximum brightness; Oxygen, Magnesium, Calcium later on

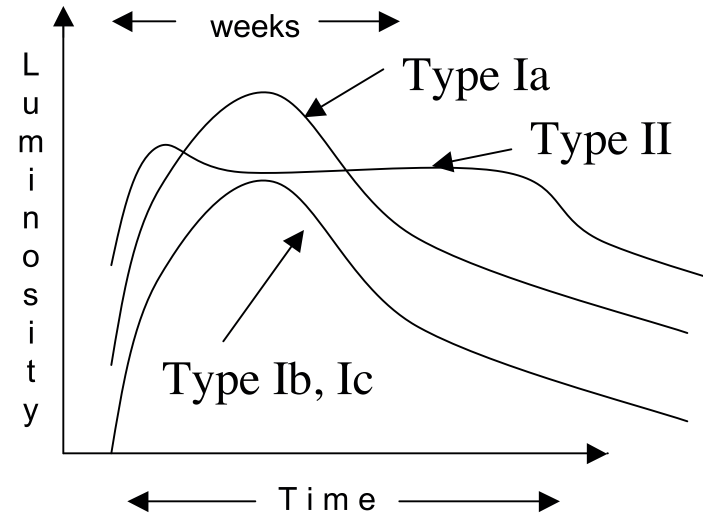
Type Ic: no Hydrogen no (or *very* little) Helium early, near maximum brightness;
Oxygen, Magnesium, Calcium later on

Explode in the spiral arms of spiral galaxies
Never in elliptical galaxies

⇒ massive stars, expect neutron star or black hole

Like Type II, but have somehow lost their outer layers of Hydrogen or even Helium ⇒ wind (§2.2) or binary mass transfer

Type Ib, Type Ic Light Curve
Similar to a Type Ia, usually, but not always, dimmer, consistent with a star that has lost its outer, Hydrogen envelope (or even Helium for a Type Ic) [will explain why dimmer later]



Crab might have had a light curve like this, but probably too much Hydrogen to qualify as a Type Ib

Cas A seems to have been dim at explosion, might have been a Type Ib, despite some evidence for a little Hydrogen in the remnant now

Kepler light curve not a “Type II,” could be consistent with Type Ia, b, c [most like Type Ia. Is there a compact object, or not??!!]

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

A Type II supernova

B Type Ia supernova

C Type Ib supernova

D Type Ic supernova

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.***

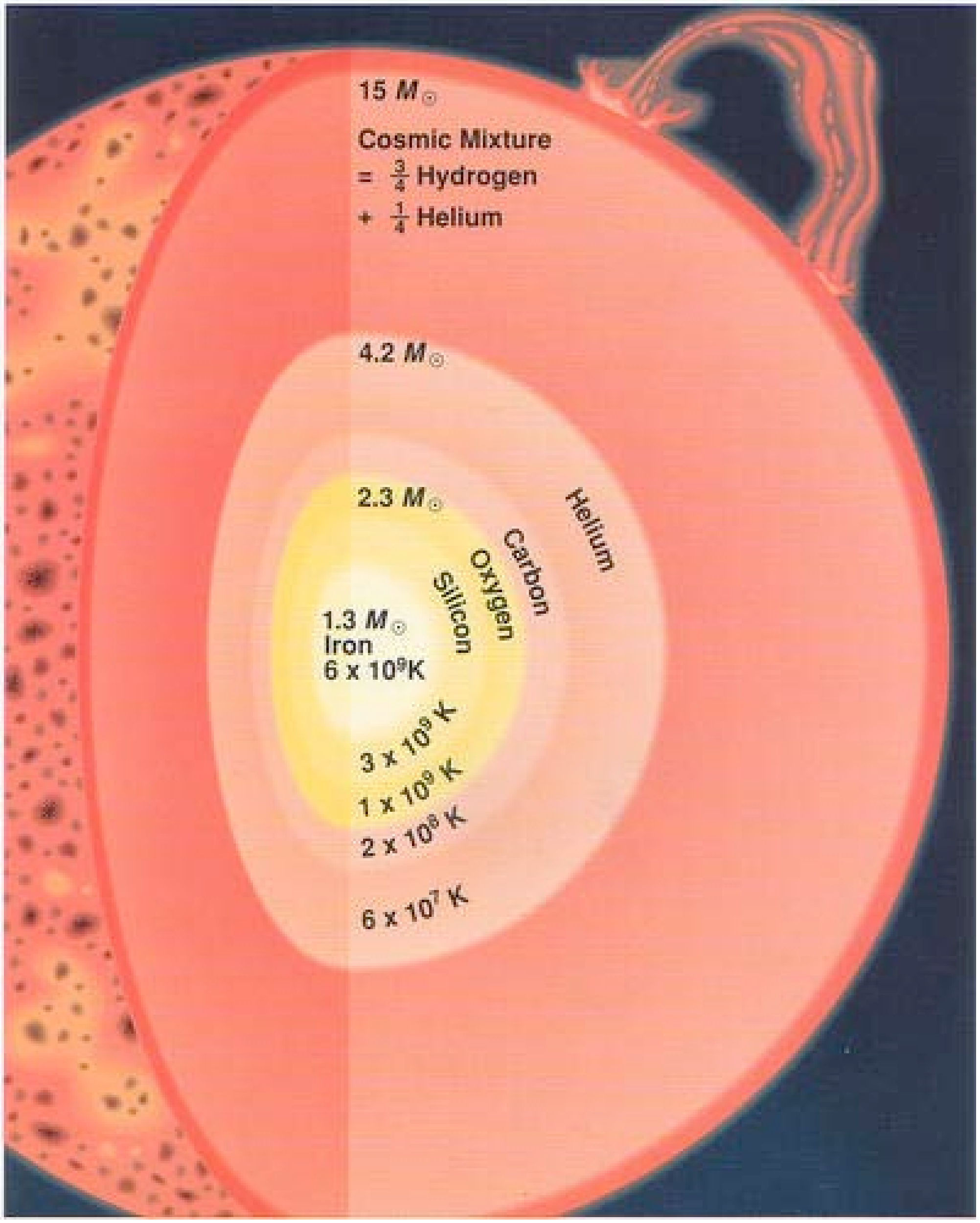
In spiral arms, never in elliptical galaxies -> short lived -> massive star -> expect core collapse, neutron star or black hole.
Original mass on the main sequence M > 8 solar masses

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).



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***

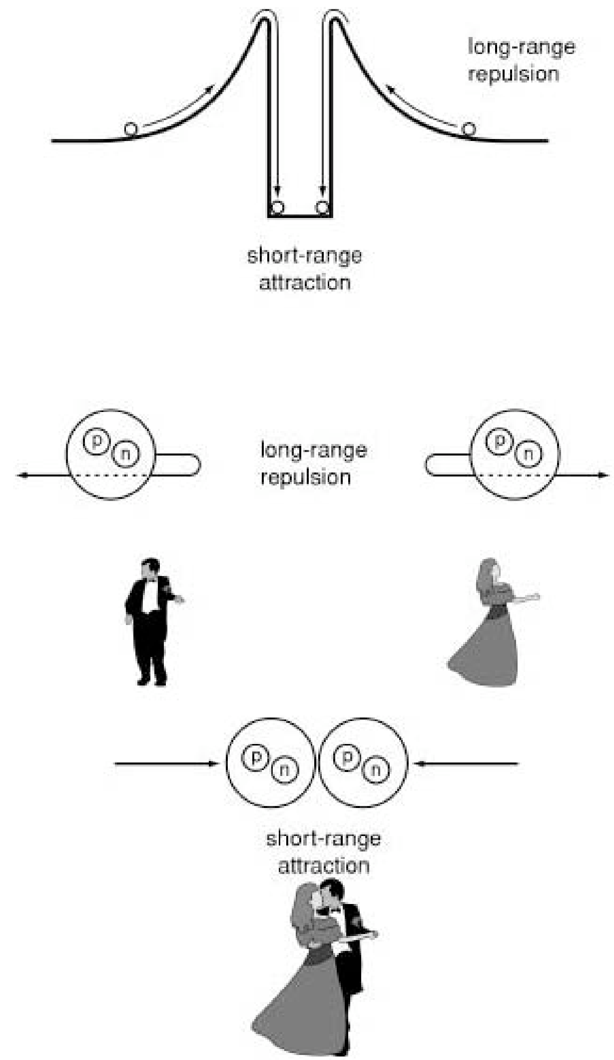


Figure 2.1