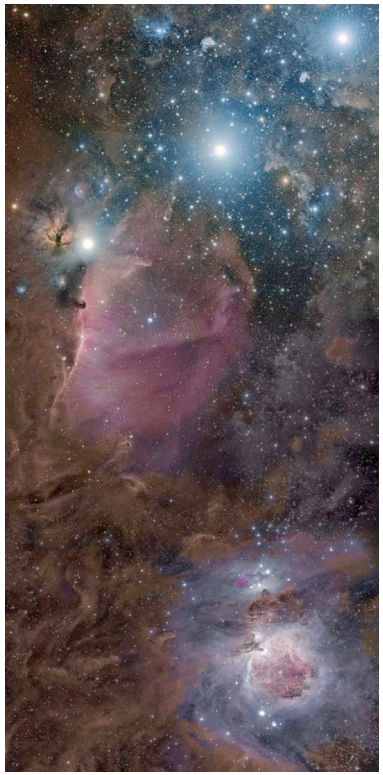
Tuesday, September 29, 2009

Exam, Sky Watch #1, IYA reports back, Exam Key posted on class web page. Histogram of grade distribution.

Wheeler on travel Thursday: colloquium at Wayne State University in Detroit. We'll show a program on Supernovae from the History Channel Universe Series (with JCW among others. Watch for ex-Texan Robert Quimby).

Astronomy in the news -

Pic of the Day - Orion
gas, dust, and stars.



IYA Activities

Steve Weinberg talk last Friday - apology for overcrowding, turning people away. Gnomen, Human Space Flight.

Asian Sky Stories gathering sky myths from Asian cultures September 2009 issue of Physics Today: http://www-irc.mtk.nao.ac.jp/~webadm/StarsofAsia_E/index.php?Book

Lecture by MacArthur "Genius" Award winner Jeff Weeks "The Shape of Space," 7:00 - 8:00 PM, Thursday, October 1, Thompson Conference Center. Not directly related to IYA, but potentially related to class, so will count report as equivalent to an IYA activity.

Type Ia
no Hydrogen or Helium
intermediate mass elements (oxygen, magnesium, silicon, sulfur, calcium) early on, iron later
avoid spiral arms, occur in elliptical galaxies
peaked light curve
all consistent with thermonuclear explosion in white dwarf that has waited for a long time to explode, 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).

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

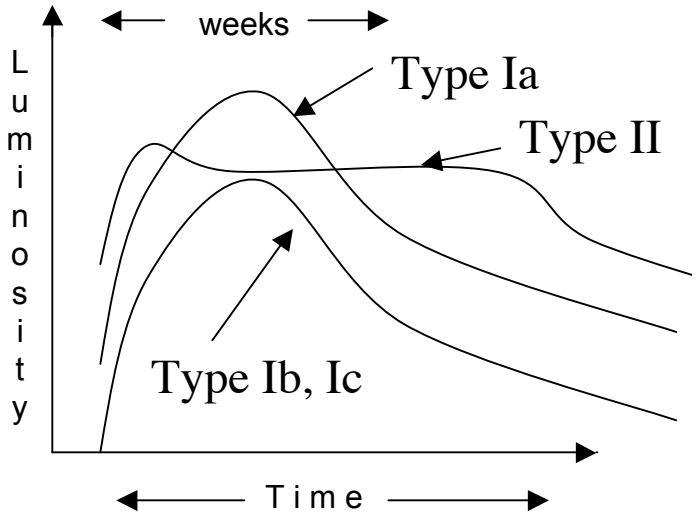
Type Ic: no Hydrogen no (or *very* little) Helium early, near maximum brightness;
Oxygen, Magnesium, Calcium later on

Explode in the spiral arms of spiral galaxies ⇒ massive stars,
Never in elliptical galaxies 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

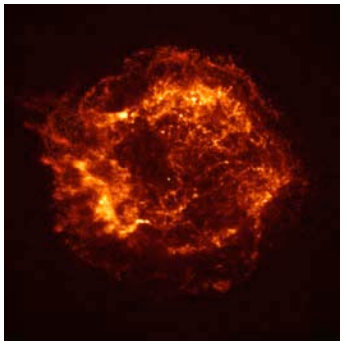
Type Ib, Type Ic Light Curve

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, some evidence for a little Hydrogen in the remnant now. Recent spectrum of light from peak reflected from dust, arriving "now" shows it was closely related to a Type Ib.



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 or helium, intermediate mass elements (oxygen, magnesium, silicon, sulfur, calcium) early on, Iron later.

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

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

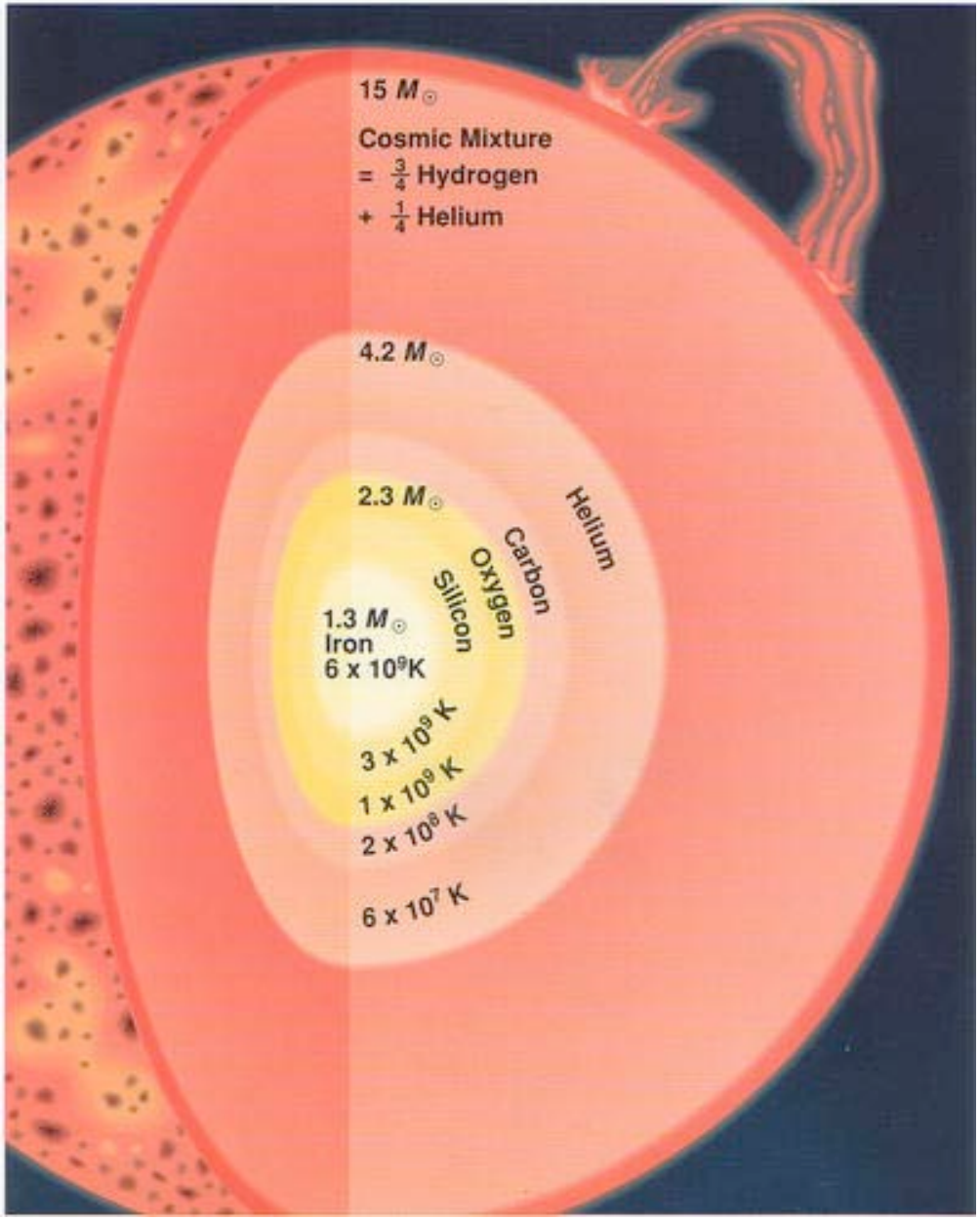
Type II: Hydrogen early, Oxygen, Magnesium, Calcium, later.

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 (or *very* little) Helium early, Oxygen, Magnesium, Calcium later. ***Even more mass loss, by stellar wind or binary star 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



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***

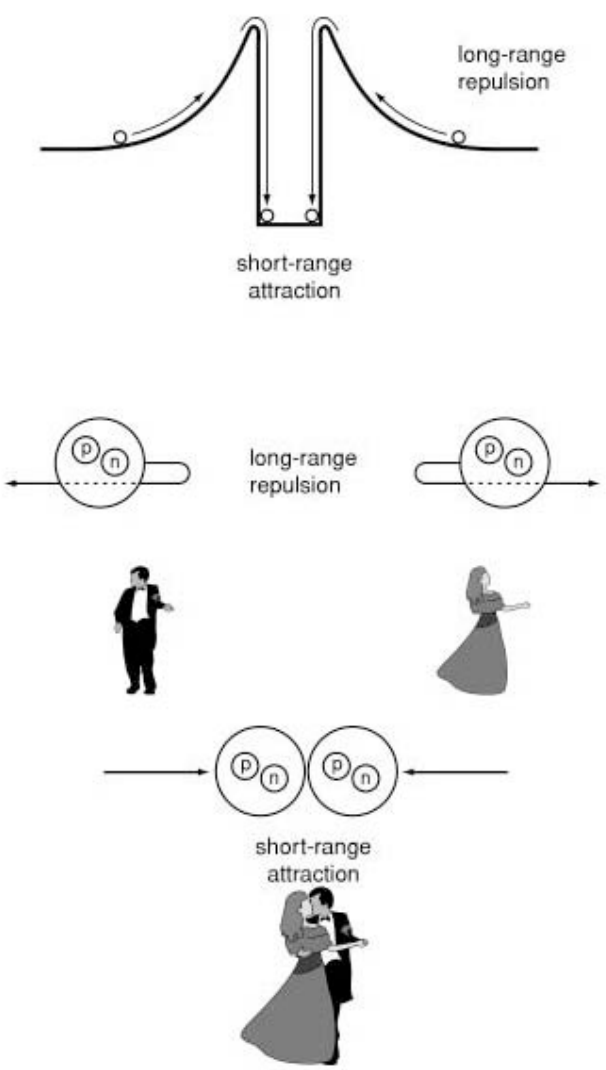


Figure 2.1

Make succession of heavier elements

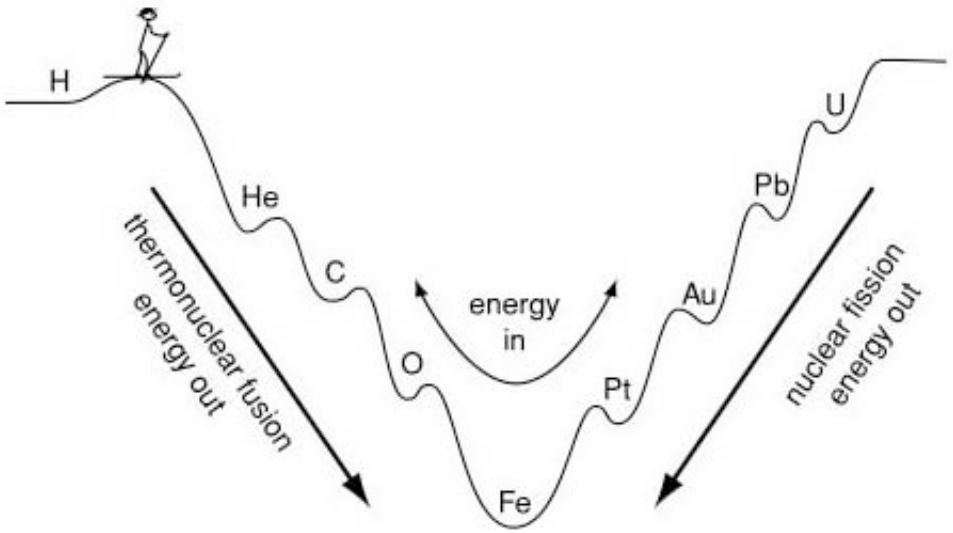


Figure 2.3

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.