Monday, September 16

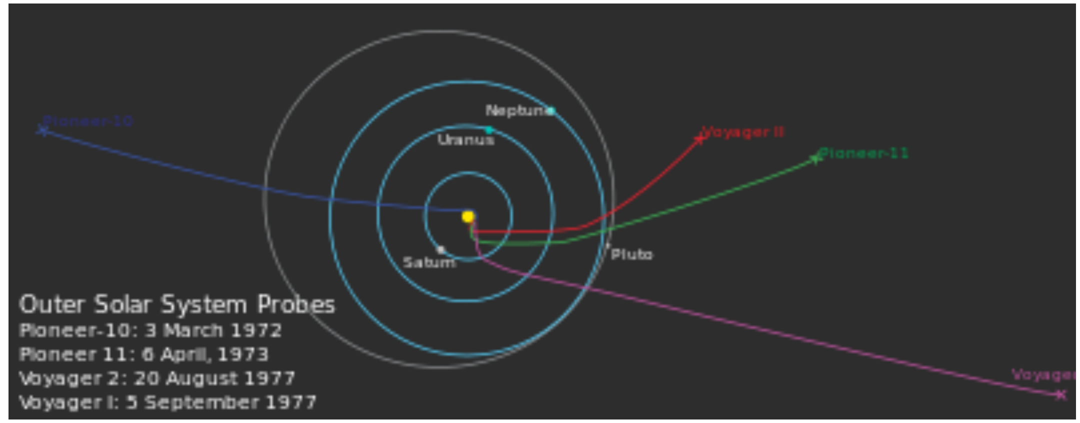
Exams returned Wednesday

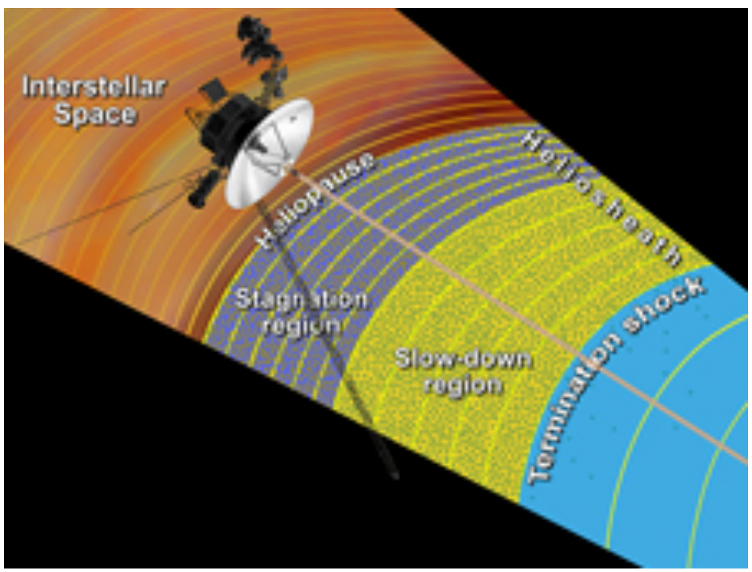
Astronomy in the news?

Voyager 1: into interstellar space 36 years years after launch

Voyager 1: into interstellar space at 36 years

http://www.jpl.nasa.gov/news/news.php?release=2013-278





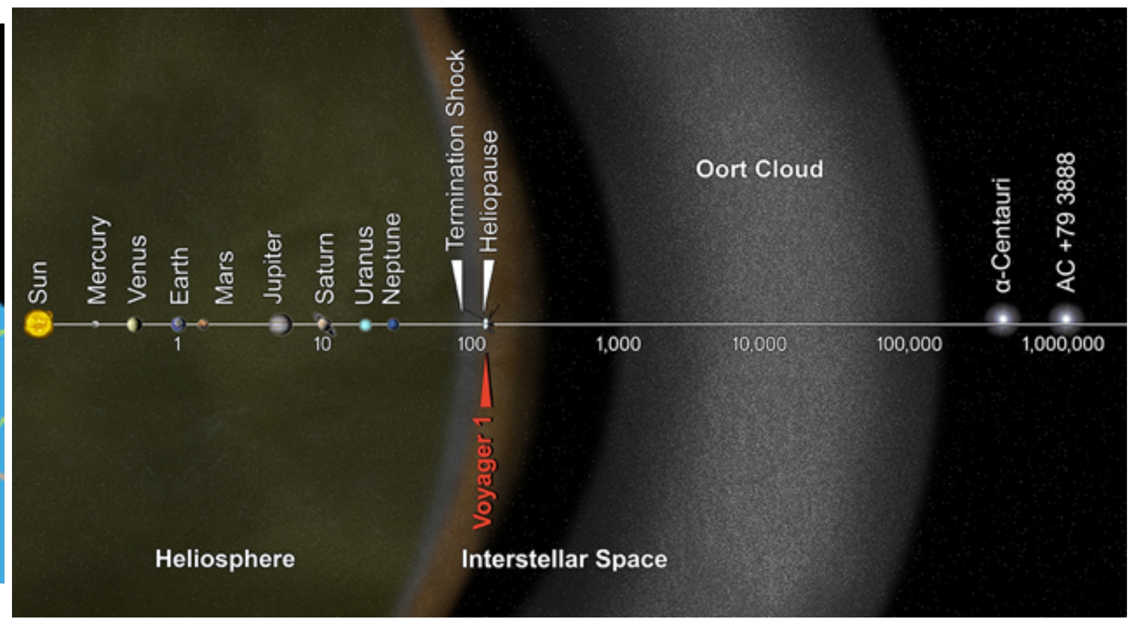


Photo by Raymond Gilford, 36 second exposure, 9/14/13

Goal:

To understand what we have learned from the study of “live” supernova explosions in other galaxies.

Another type of supernova

Ask me about its properties, vote about type of explosion.
Analogous to astronomers querying nature with their telescopes

➡ Massive star, core collapse, neutron star

⬅ Exploding white dwarf

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

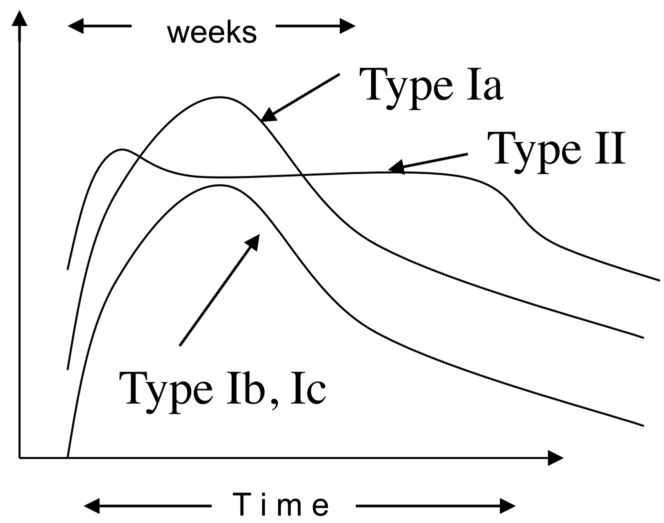
Explode in the spiral arms of spiral galaxies
Never in elliptical galaxies

$\Rightarrow$ massive stars, expect neutron star or black hole

Like Type II, but have somehow lost their outer layers of Hydrogen or even Helium $\Rightarrow$ wind (§2.2) or binary mass transfer (Chapter 3).

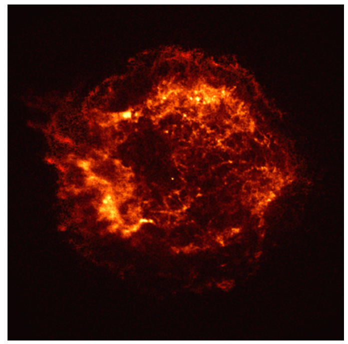
Type Ib, Type Ic Light Curve

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.



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 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, later.

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

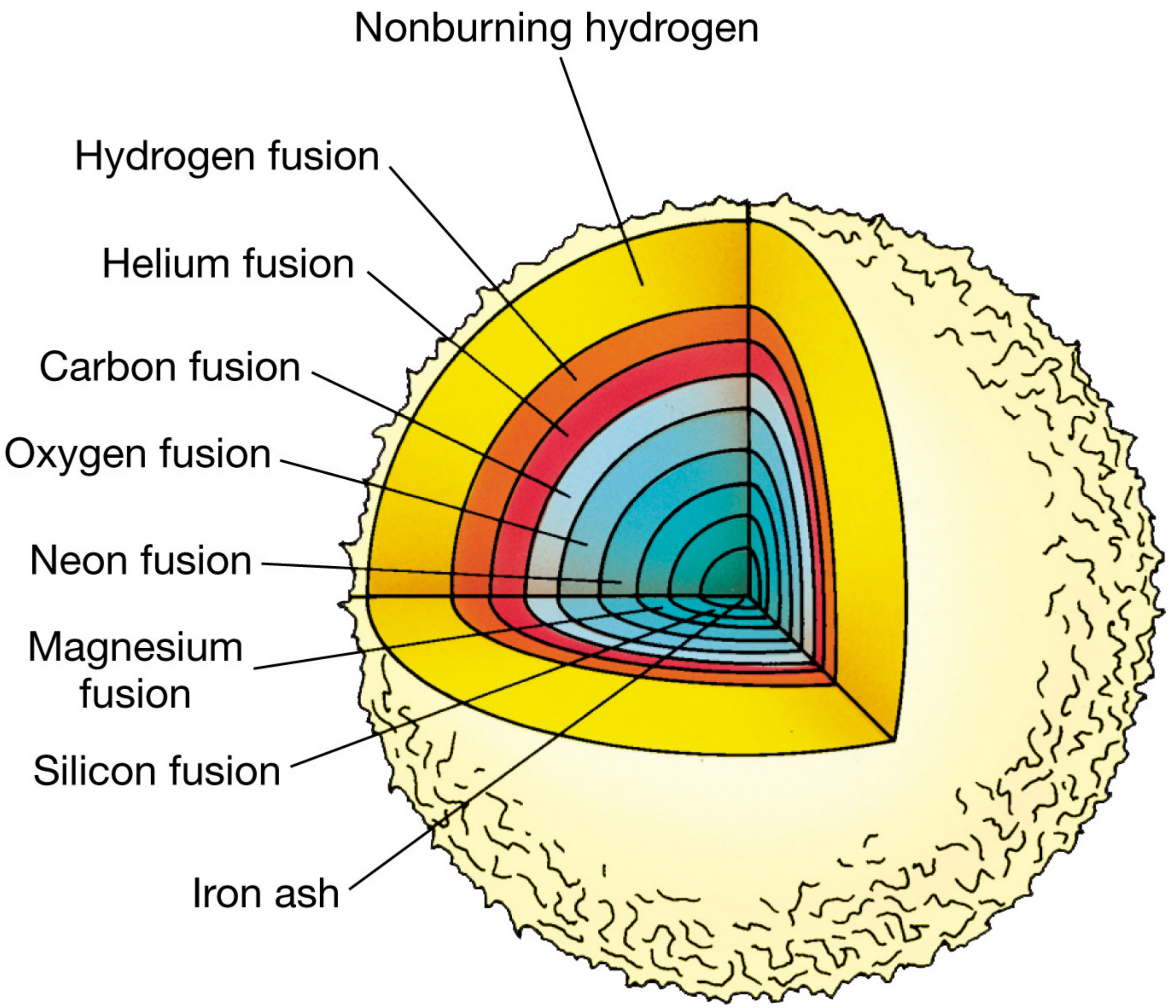
Type Ic: no Hydrogen no (or *very* little) Helium early, Oxygen, Magnesium, Calcium later. ***Even more mass loss, by stellar wind or binary star transfer.***

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 > 12 solar masses, so that thermal pressure always dominates.

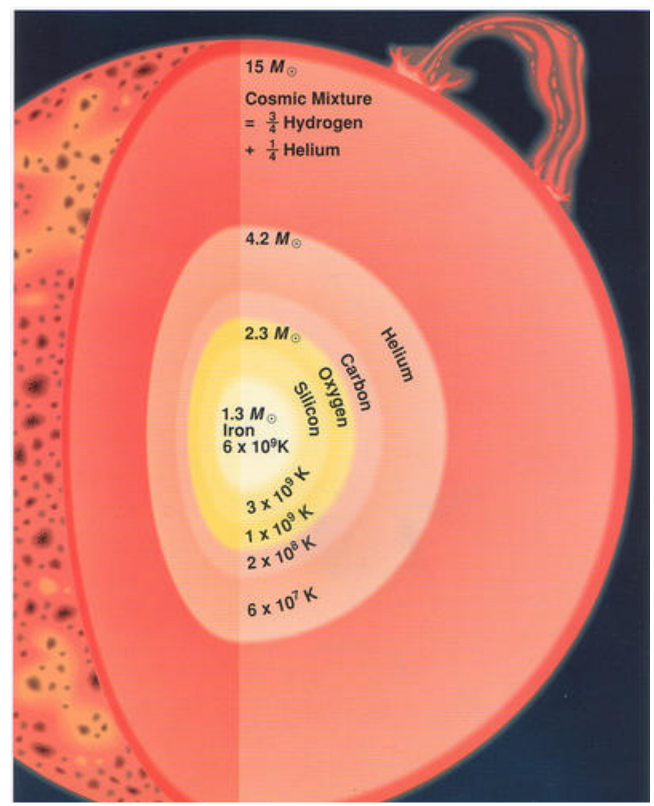
Goal

To understand how a massive star gets from hydrogen to iron, and why iron?



Origin of Type II, Ib, Ic

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



Discussion point:

What do you know about iron?

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

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***

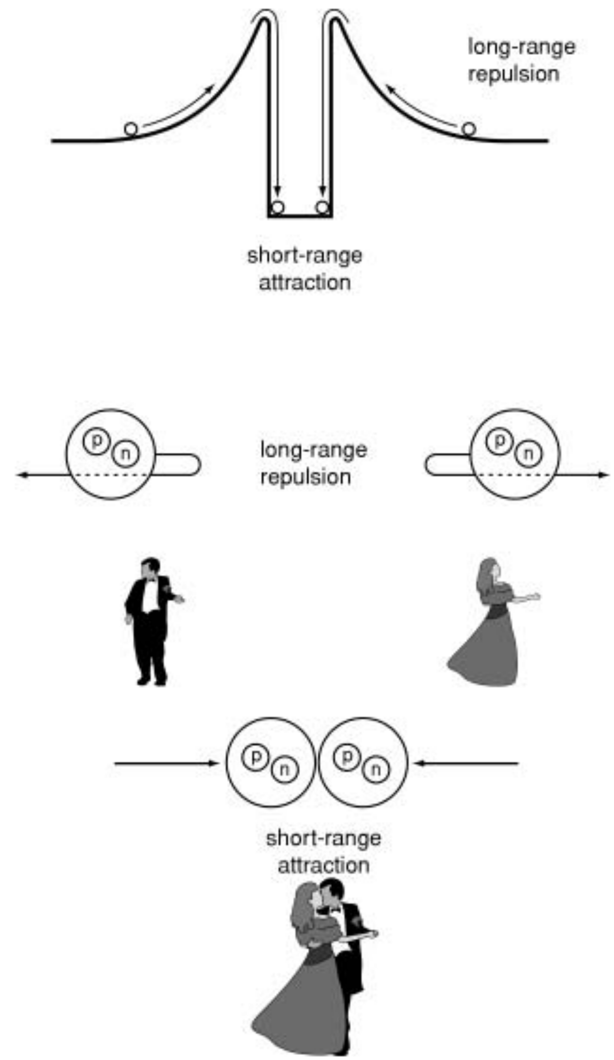


Figure 2.1