Wednesday, February 4, 2015

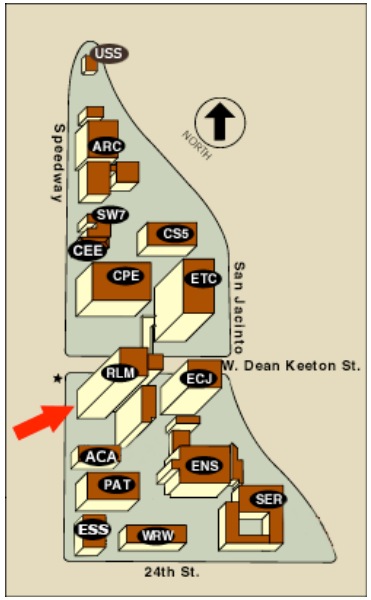
First exam Friday. First Sky Watch Due.

Review sheet posted.

Review session Thursday, 5 – 6 PM, RLM 6.104

Reading:

Chapter 6 Supernovae, Sections § 6.1, 6.2, 6.3
Chapter 1 Introduction, §1.1, 1.2.1, 1.3.1, 1.3.2
Chapter 5 White Dwarfs, § 5.1



Astronomy in the news?

Local NPR blurb on Black Hole Swallowing Star yesterday morning.

Goal:

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

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-rich Red Giant envelope by core collapse to leave behind a neutron star (or maybe a black hole).

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 (or *very* little) 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

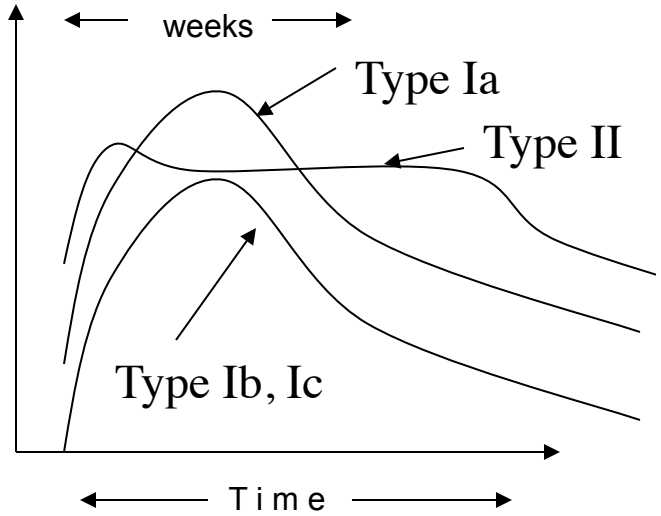
Explode in the spiral arms of spiral galaxies
Never in elliptical galaxies

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

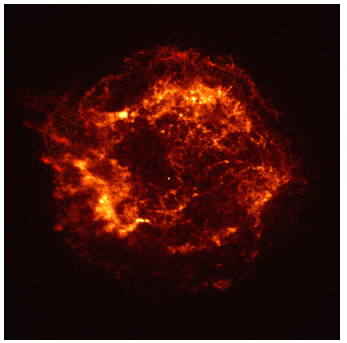
Like Type II, but have somehow lost their outer layers of Hydrogen or even Helium $\Rightarrow$ wind (§2.2) or binary mass transfer (Chapter 3). [Will discuss later]

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]



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; *made in the explosion*) early on, Iron later.

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

Characteristic 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.
[Explain why next, but for second exam]

Type II: Hydrogen early, Oxygen, Magnesium, Calcium (*made in the star before the explosion, then ejected*), later.

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

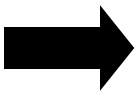
Type Ic: no Hydrogen no Helium early, Oxygen, Magnesium, Calcium later. ***Even more mass loss, by stellar wind or binary star transfer.***

Occur in spiral arms, never in elliptical galaxies -> short lived -> massive star -> expect core collapse, neutron star or black hole (but can't see in distant galaxies).

Original mass on the main sequence M > 12 solar masses

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

End of Material for Test 1

Material for Second Exam

Reading:
Chapter 6 Supernovae §6.4, 6.5
Background:
Chapter 1 Introduction §1.2.1, 1.2.3, 1.2.4
Chapter 2 Stellar Death §2.1, 2.3, 2.4, 2.5

Issues to look for in background:

What are thermal and quantum pressure and how do they work?
Chapter 1 §1.2.3, 1.2.4, Chapter 2 §2.3

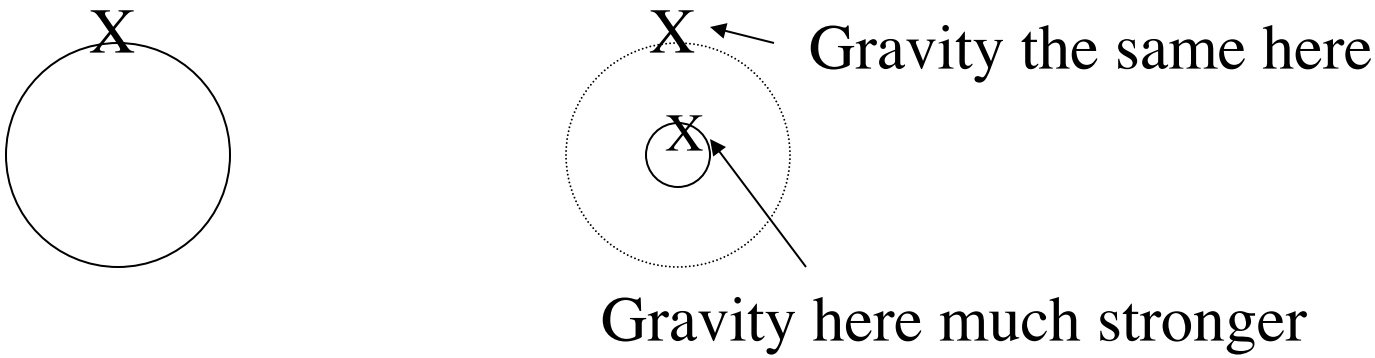
Why is it necessary for a thermonuclear fuel to get hot to burn? - charge repulsion Chapter 2 §2.1, 3

Why is iron important? Chapter 2, §2.4, 2.5

Discussion Points:

White dwarfs have about the same mass as the Sun and about the same radius as the Earth.

How does the gravity of a white dwarf compare to the Sun and the Earth, and why?



Same mass, smaller size, gravity on *surface* is larger because you are closer to the *center*.

Gravity on surface acts *as if* all mass beneath were concentrated at a point in the center -- Newton/Calculus

Goal:

To understand how pressure is created in stars, how thermal pressure controls the evolution of normal stars, and why quantum pressure makes white dwarfs liable to explode in some circumstances.