9/20/04

Exam 1 Grades on web - utdirect

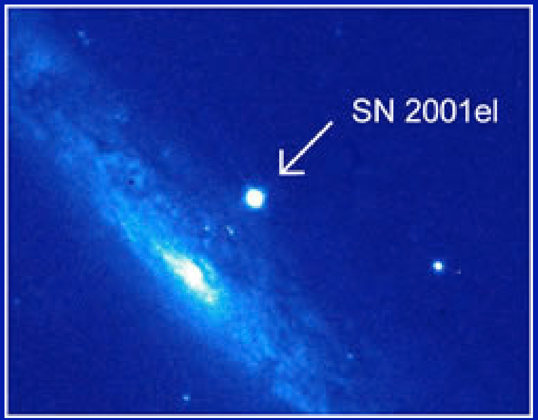
Key will be posted, probably Tuesday, exams back Wednesday

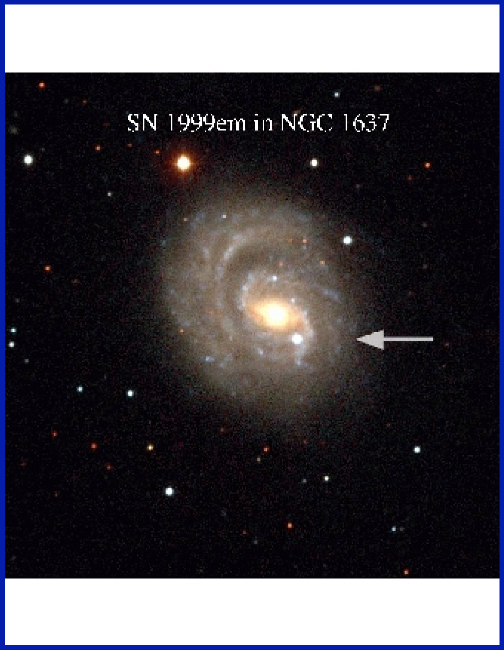
Histogram - average 80, B/C dividing line

News? Patches of water vapor on Mars are correlated with patches of methane. How is methane made on Earth?

Pic of the day - Saturn C-ring from Cassini Mission, like accretion disk, but no friction.

All SN since 1680, since invention of telescope, modern astronomy, have been discovered in other galaxies.




# Categories of Supernovae

1st discovered

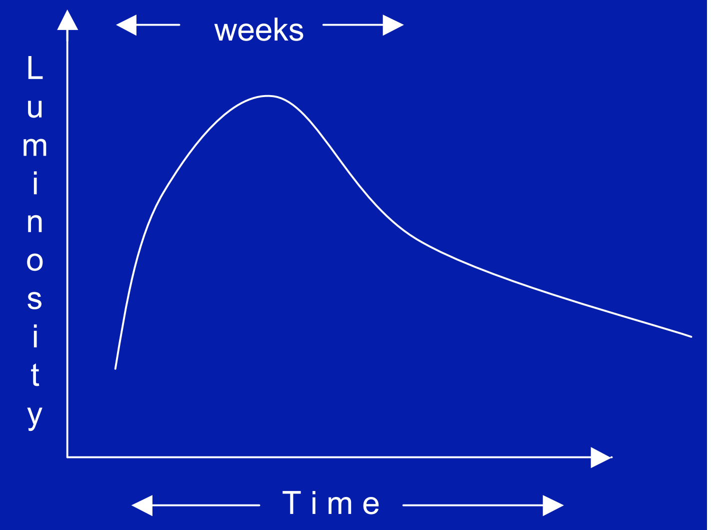
***Type Ia*** - no detectable Hydrogen in the spectrum, rather "intermediate mass elements" like oxygen, magnesium, silicon, sulfur, calcium. Iron appears later as the light fades.

SN 1994D

These occur in all galaxy types:
In spiral galaxies they tend to avoid the spiral arms, they have had time to drift away from the birth site → ***the star that explodes is old***
In irregular galaxies
In elliptical galaxies where star formation is thought to have ceased long ago → ***the star that explodes is old***

⇨***the progenitor that explodes must be long-lived, not very massive, suggesting a white dwarf***. Sun is long-lived, but won't explode

***Type Ia Light Curve***
brightness vs. time
consistent with an
exploding C/O white dwarf
***expect total disruption***,
no neutron star




If U Sco becomes a supernova it will probably be a Type Ia

SN 1006, almost definitely

Tycho, SN 1572 almost definitely

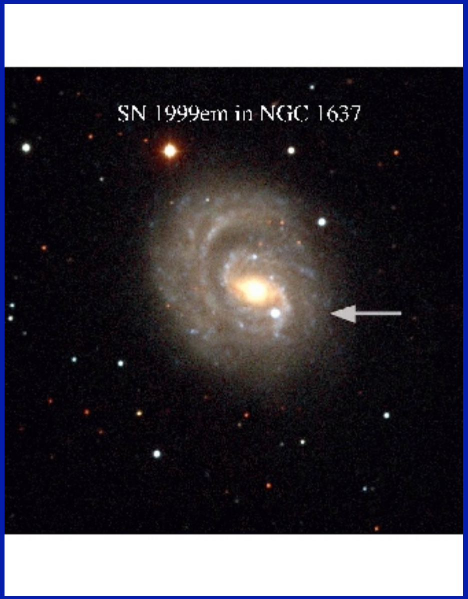
Kepler, 1604, some argue yes (no sign of neutron star), but some ambiguities suggesting a massive star progenitor

***Type II Supernovae*** - “other” type discovered early, show Hydrogen in the spectrum early, Oxygen, Magnesium, Calcium, later

Most occur in spiral galaxies, *in the spiral arms*, ***they have no time to drift from the birth site*** sometimes in irregular galaxies ***never in elliptical galaxies***

***→The progenitor stars are young, short-lived massive stars***

***We expect such stars to evolve to form iron cores and collapse to a neutron star or black hole*** (physics to come)



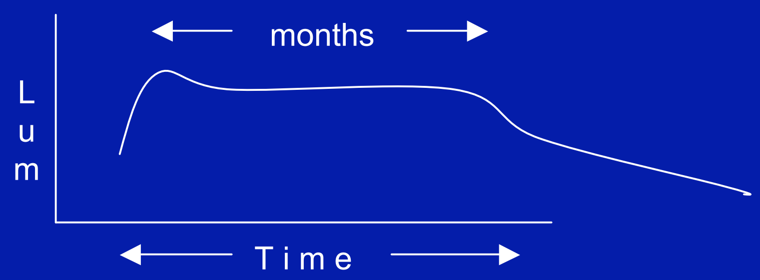

SN 1999em

Light curves of Type II supernovae are consistent with explosion in Red Giant

Betelgeuse is a massive red giant, 15 solar masses: we expect it to become a Type II supernova. ***Maybe tonight!***

SN 386, 1181 records are sparse, might have been Type II
Crab was a "peculiar" Type II (high helium abundance, slow explosion)
Cas A was probably something else (next topic),
SN1987A was a "peculiar" Type II.

Not obvious that any of the historical supernovae were a "normal" Type II, although Type II are common in other galaxies



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

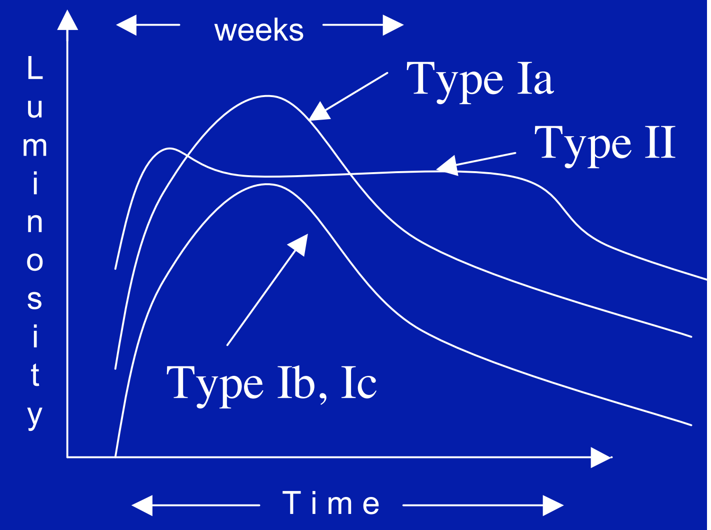
Type Ic: no Hydrogen no (or *very* little) Helium early, near maximum brightness;
Oxygen, Magnesium, Calcium later on

Explode in the spiral arms of spiral galaxies $\Rightarrow$ 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

***Type Ib, Type Ic Light Curve***

Similar to a Type Ia, but 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

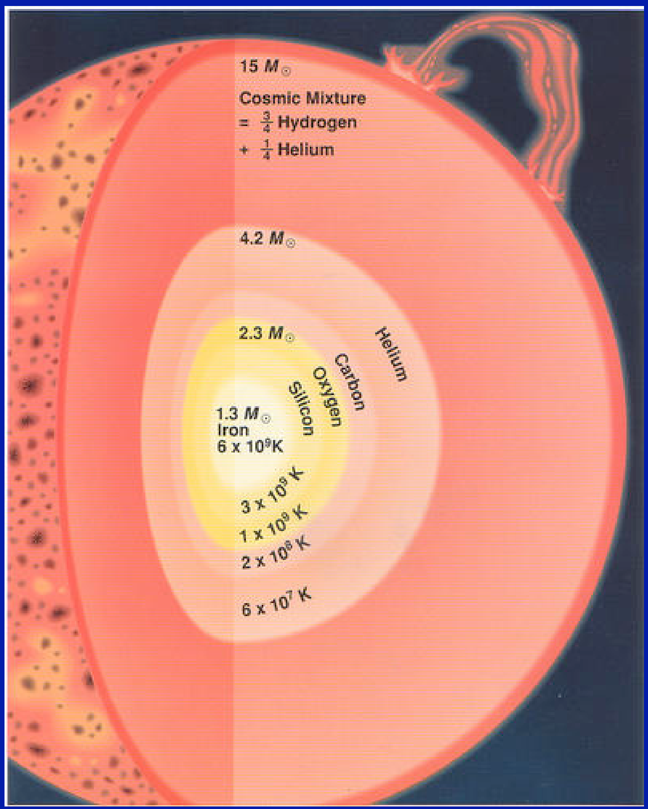
Cas A seems to have been dim at explosion, might have been a Type Ib, despite some evidence for a little Hydrogen in the remnant now

Kepler light curve not a "Type II," could be consistent with Type Ia, b, c.

Physics: core of Helium or heavier elements, Carbon, Oxygen, Magnesium, Silicon, Calcium, finally Iron, continues to be hot even as it gets dense,

⇒ always supported by thermal pressure

⇒ continues to evolve, whether the Hydrogen envelope is there (Type II) or not (Type Ib, Type Ic).




H -> He (2 protons, 2 neutrons)

2 Helium -> unstable, no such element

3 Helium -> Carbon (6 protons, 6 neutrons)

4 Helium -> Oxygen (8 protons, 8 neutrons)

6 Helium -> Magnesium (12 protons, 12 neutrons)

7 Helium -> Silicon (14 protons, 14 neutrons)

Common elements forged in stars are built on building blocks of helium nuclei