ASTR 1020: Stars & Galaxies

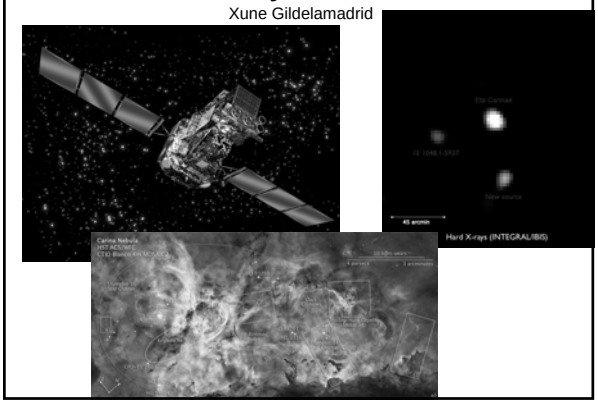
February 29, 2008

• Reading: Chapter 18, section 18.1 in textbook; summary of key concepts.

• *MasteringAstronomy* Homework on Stellar Evolution is due March 3rd.

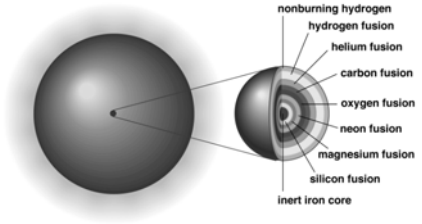
Astronomy in the News

Xune Gildelamadrid

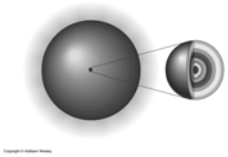


High Mass Star

- Core structure keeps on building successive shells—
- Lesser elements on the outside, heavier ones on the inside



- The core of a high mass star accumulates iron as the layers above it burn
- Degeneracy pressure supports the core for awhile until the mass of iron gets too heavy



Clicker Question: Basketball & Super ball Demo

What do you think will happen?

a) The two balls will bounce up together
b) The little ball will bounce higher than the basketball
c) Nothing interesting the first time: he'll have to do this three or four times to get it to "work"

Supernova!

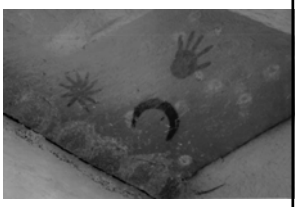
- The lightweight atmosphere impacts on the heavy core and is "bounced" off in a huge explosion
- Huge energy release from neutrinos!

Supernovae

- Exploding remnant of a massive star, disperses and spreads heavy element through the galaxy
- Inside is a neutron star– a remnant core of pure neutrons

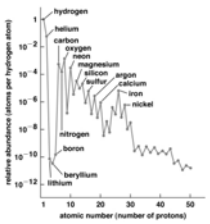
"The Crab", aka Messier 1, went off July 4th, 1054 A.D. ;
visible in the daytime!

- Petroglyph from Chaco Canyon:
- Correct configuration relative to the new moon for the Crab Supernovae
- You can check this on your SkyGazer planetarium software….



Creation of the Elements

- Should (and mostly DO) follow the pattern of fusion reactions
- Heavier elements are made during the explosion, as helium nuclei are slammed into heavier elements

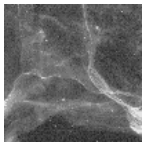


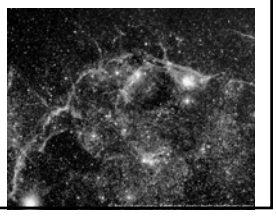
This is Deep

- All heavy elements are created and dispersed through the galaxy by stars
- Without supernovae, nothing heavier than carbon
- WE ARE STAR STUFF
- Our atoms were once parts of stars that died more than 4.6 billion years ago, whose remains were swept up into the solar system when the Sun formed

Observing Supernovae

- About 1 per century per galaxy (none in Milky Way since 1604) ☹
- Bright explosion visible for weeks/months- some visible in daytime!
- Remnant visible for 100's of thousands of years as huge bubbles and "veils"

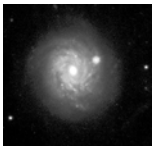




Supernovae in Other Galaxies

- Bright enough to be seen as a sudden, bright point in other galaxies
- Scores of amateur and pro astronomers monitor nearby galaxies nightly to catch them

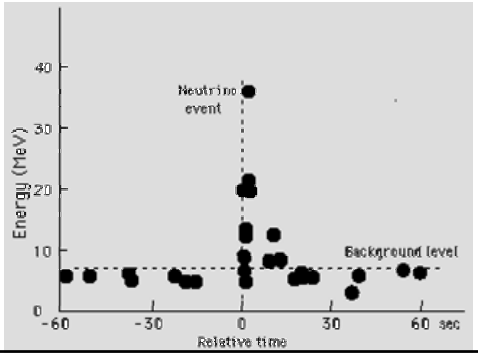
(1 per 100 years per galaxy means that monitoring 100 galaxies will get you 1 supernova per year)



SN 1987 A: nearest one since 1604

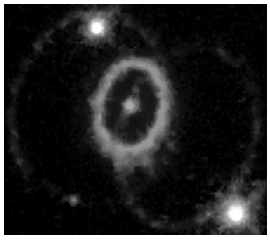
- Exploded in Large Magellanic Cloud (companion dwarf galaxy to Milky Way)
- Seen only from southern hemisphere

Possible neutrino burst? SIX extra neutrinos were detected when SN1987A went off



SN 1987 A

- Precursor: massive blue star (!?)
- Ring structure: illuminated remnants of an earlier stellar wind?
- Ejecta are now starting to hit this region- brightening
- Double ring- traced by energy jet from unseen companion????

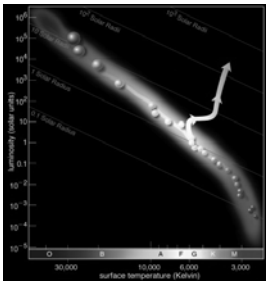


Clicker Question: Binary Systems: The Algol Paradox

Algol is a binary system consisting of a 3.7 solar mass main sequence star and a 0.8 solar mass red giant. Why is this strange?

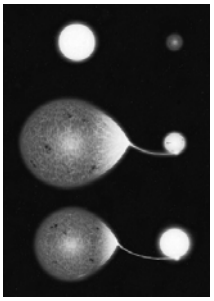
a) A 3.7 star should have become a red giant before a 0.8 solar mass star
b) Binary stars usually have the same mass
c) 0.8 solar mass stars usually never become red giants

- (a) Binary stars can have different masses but usually ARE formed at the same time. The more massive star should have had a shorter main sequence lifetime



What probably happened

- The 0.8 solar mass star once was more massive
- As it became a red giant, it swelled and poured material onto its companion
- The red giant is now less massive than its companion
- Future: when the other star goes red giant, it may pour gas back…?



Moral of the story: choose your companions wisely, as they may determine your fate