

Wednesday, February 19, 2014

***Grades posted on Blackboard, Keys on Web site.***

***New exam schedule for 2, 3, 4 on MONDAYS, 3/3, 3/31, 4/14. 5<sup>th</sup> still on Friday, 5/2. Reviews will still be on previous Thursdays.***

Reading for Exam 2: Sections 6.1, 6.4, 6.5, 6.6, Betelgeuse interlude.

Background: Sections 1.2.1, 2.1, 2.2, 2.4, 2.5, 3.3, 3.4, 3.5, 3.10, 4.1, 4.2, 4.3, 4.4, 5.2, 5.4

Astronomy in the news:

Guest lectures:

Rob Kennicut, Professor, Cambridge University (with Hawking), expert on formation of stars (TODAY, Wednesday, 4:00 p.m., CPE 2.208)

Don Winget, Professor, UT, expert on White Dwarf stars, Saturday, 1 p.m., Peter O'Donnell Building, Room 2.302.

Update on new “nearby” supernova SN 2014J in M82

## Goal

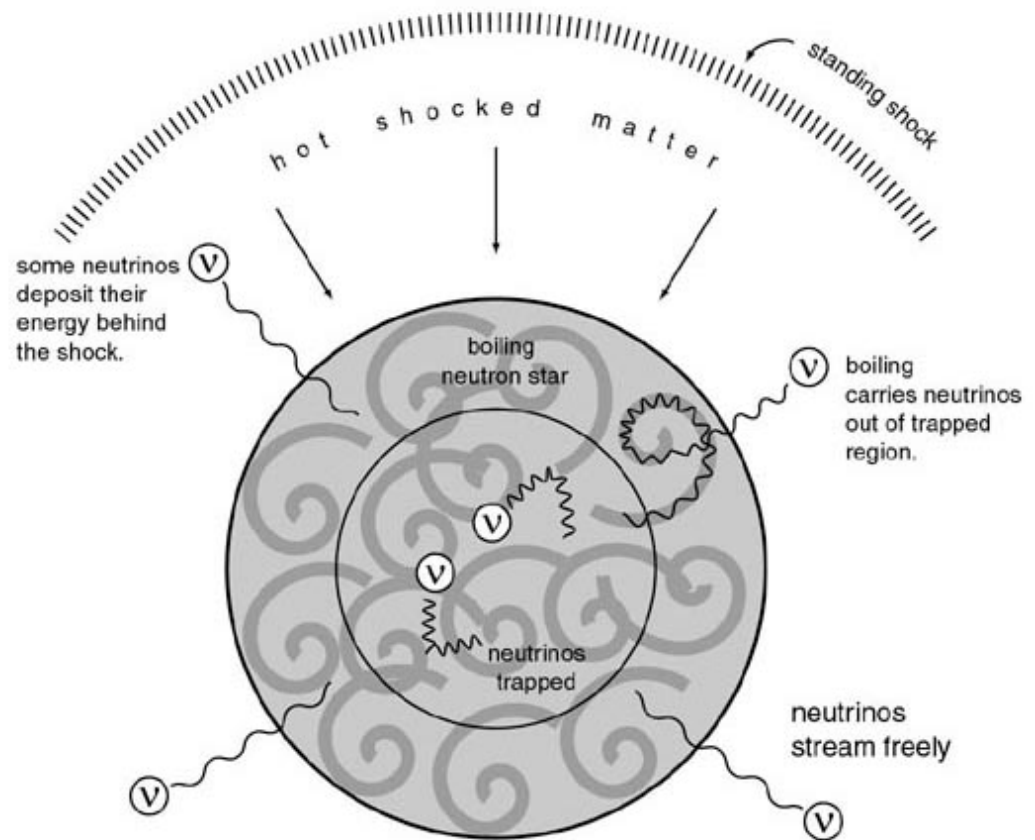
To understand what happens after a massive star forms an iron core

Neutron stars are dense enough to trap some of the neutrinos.  
Perhaps the neutron star can boil out neutrinos at a higher rate...

Possible, but still not proven,

A bit like boiling a pot on the stove, the steam comes out, but lid just rattles, it does not explode to the ceiling.

May need a new idea...



## One Minute Exam:

Most of the energy liberated in the formation of a neutron star is emitted in the form of:

 Neutrons

 Protons

 Neutrinos

 Photons

## One Minute Exam

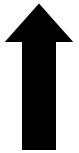
What happens to the initial *shock wave* produced when an iron core collapses to form a neutron star and bounces?



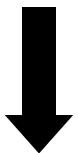
It fades away



It propagates out through the star and causes an explosion



It stalls at some distance from the neutron star

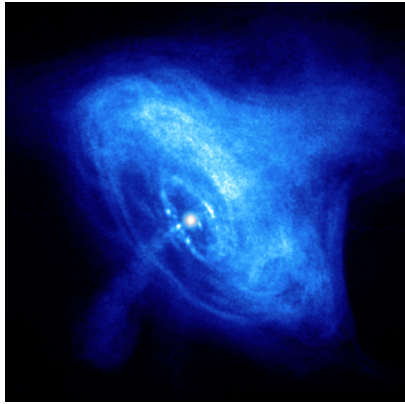


It traps neutrinos

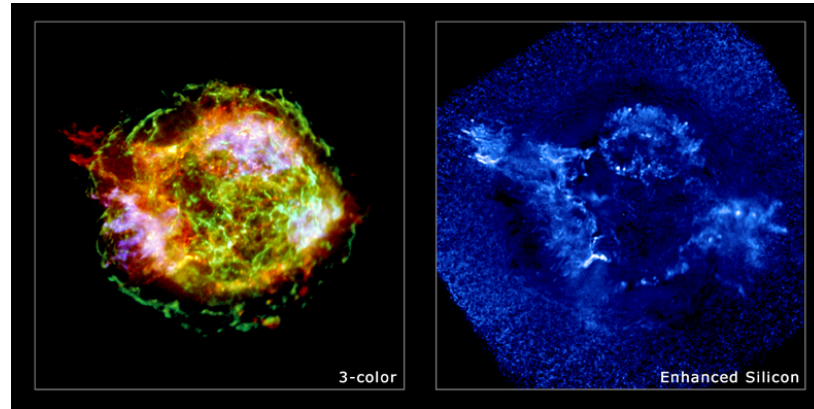
Goal

To understand how jets may trigger a core –collapse  
supernova explosion

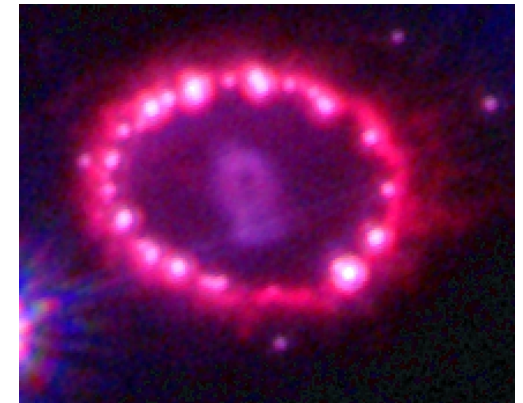
New possibility - Jet-induced supernova (Ch 6, p. 94)



Crab Nebula



Cassiopeiae A



SN 1987A

Are jet-like flows typical? Are they important?



Studies (last 20 years) show that all Core Collapse Supernovae (massive stars: Type II, Ib, Ic) are out-of-round.

Perhaps combination football, frisbee, or something else.

Death Star Explosion (YouTube)

Supernovae show shapes consistent with (but not necessarily proving) jet-like flow.

Computer calculations show that jets emerging from newborn neutron star can explode the star, make it out-of-round.

Predict a jet/torus “bagel and breadstick” shape

*What jets do -*

Bagel and breadstick, jet/torus shape “natural.”





## Discussion points

How does a supernova determine a direction in space?

How does a supernova produce a jet-like flow?

How to define a particular direction in space?

Rotation - rotation axis.

How to make a jet? Some variation on squeeze and squirt (toothpaste mechanism)

Rotate magnetic neutron star, amplify the magnetic field, eject mass if field is strong enough.

*Magnetic lines of force*, locus of equal field strength, act somewhat like rubber bands, they are elastic and tend to rebound if deformed and can be twisted and coiled.

Twisted magnetic fields have tension along them and exert pressure sideways and along the lines of force.

Rubber band - twist moves along the rubber band.