Monday, February 13, 2017

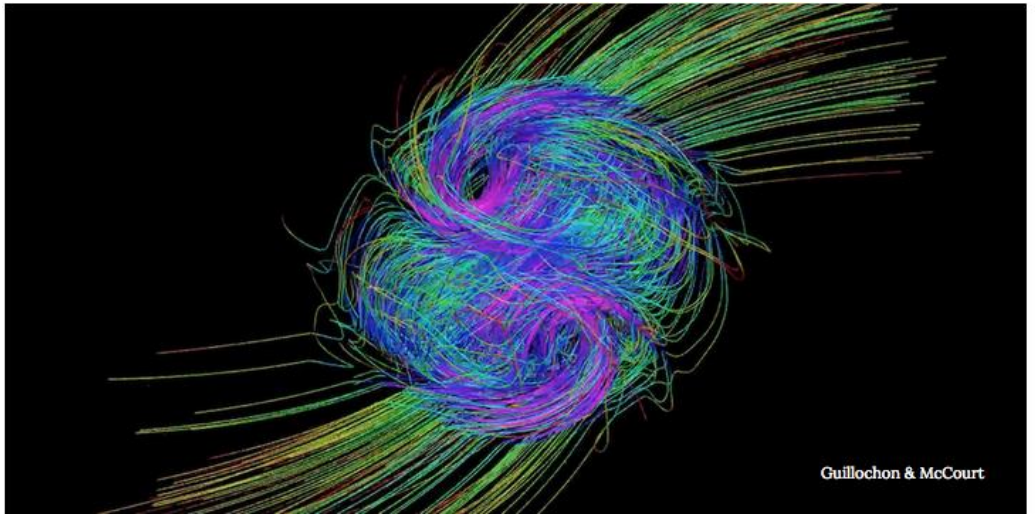
Second exam, Friday, February 24.

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

Astronomy in the news?

Simulation of the tidal disruption of a magnetic star by a black hole.

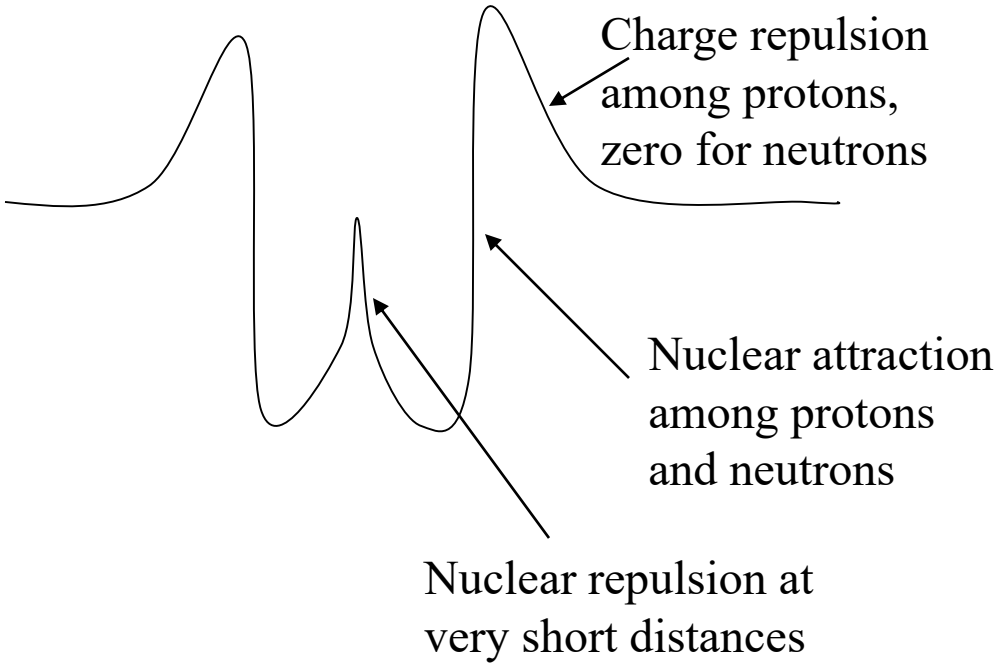


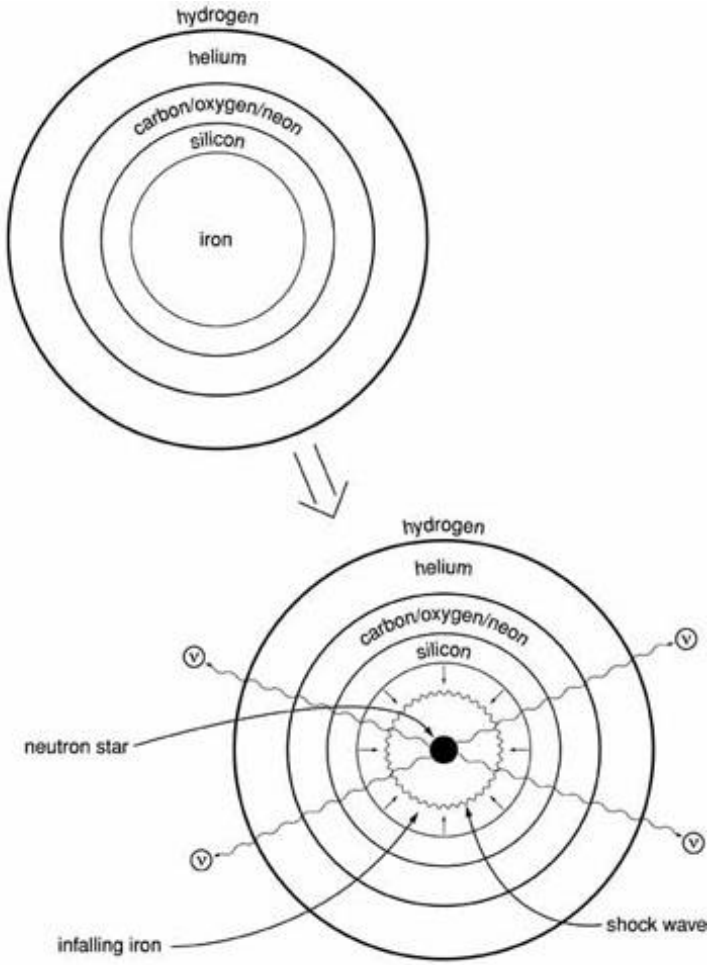
Goal

To understand how the collapse of an iron core can trigger a supernova explosion

Collapse of iron core to form neutron star is halted by the repulsive strong nuclear force at very close distances, high compaction of neutrons (somewhat uncertain)
+ quantum pressure of neutrons

Fig 6.1





Maximum mass of a neutron star is 1.5 to 2 solar masses

When a neutron star forms, get huge energy from dropping from size of Earth or White Dwarf to size of Austin.

100 times more energy than is needed to explode off the outer layers of the massive star.

That does not guarantee an explosion!

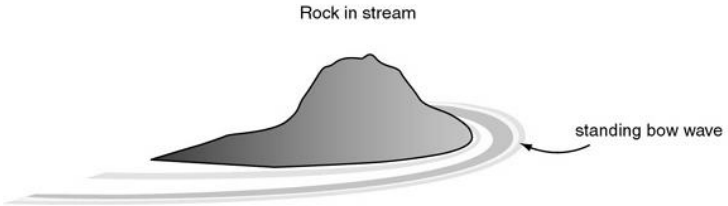
The outer parts of the star, beyond the neutron star, are ***transparent to the neutrinos***, the neutrinos flood out freely and carry off most of the energy, about 99%.

Is 1% of the neutrino energy left behind to cause the explosion?

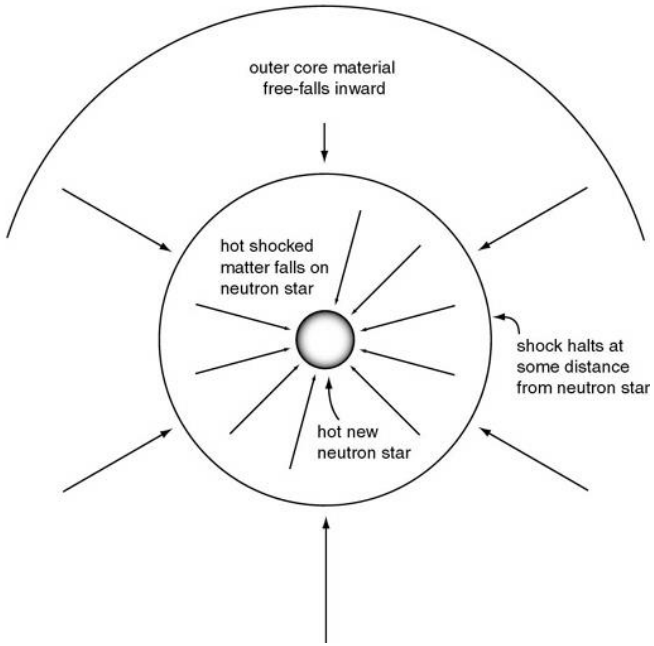
Tough problem! 1.5% is plenty, 0.5% is too little.

New-born neutron star over compresses and rebounds - potential mechanism for explosion,

DOES NOT WORK!



Form ***standing shock***, and outer material just continues to fall in, pass through shock front and settles onto the neutron star.

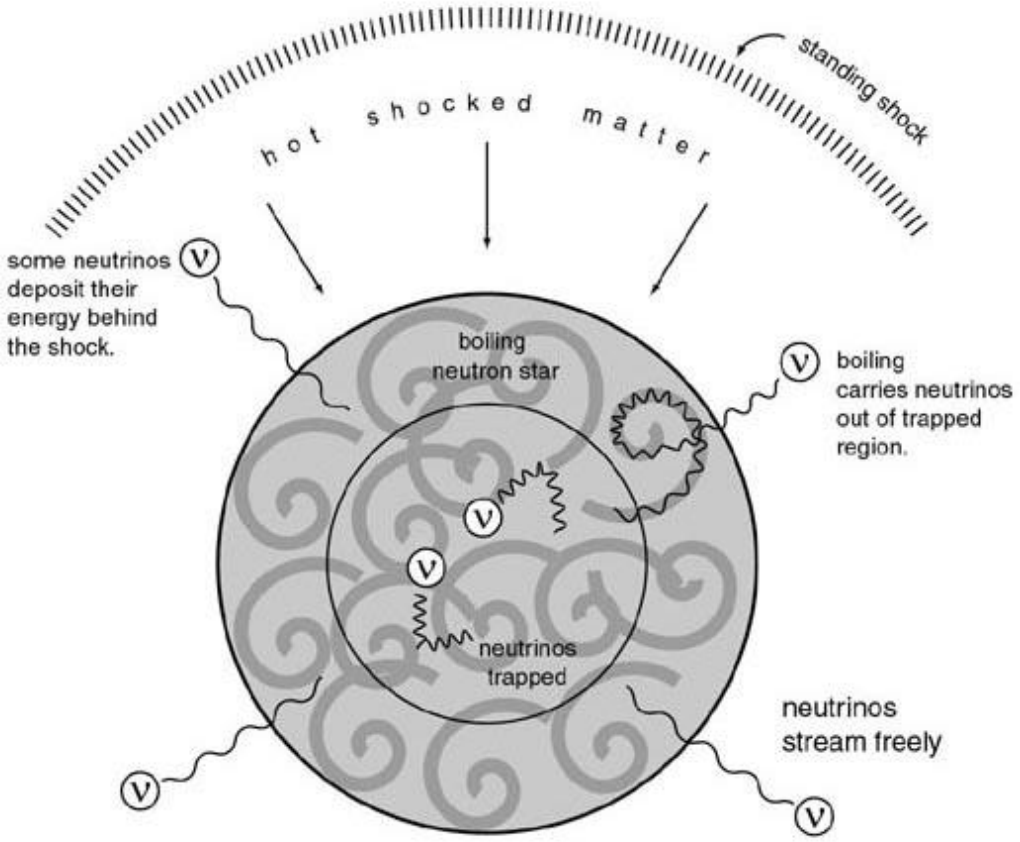


Neutron stars are dense enough to trap some of the neutrinos. Perhaps the neutron star can boil out neutrinos at a higher rate…

Possible, but still not proven,

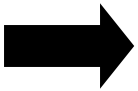
A bit like boiling a pot on the stove, the steam comes out, but lid just rattles, it does not explode to the ceiling.

May need a new idea…



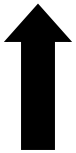
One Minute Exam:

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



Neutrons

Protons

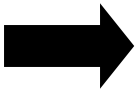


Neutrinos

Photons

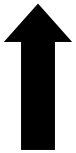
One Minute Exam

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



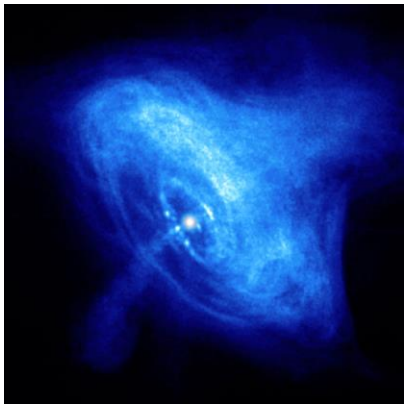
It stalls at some distance from the neutron star

It traps neutrinos

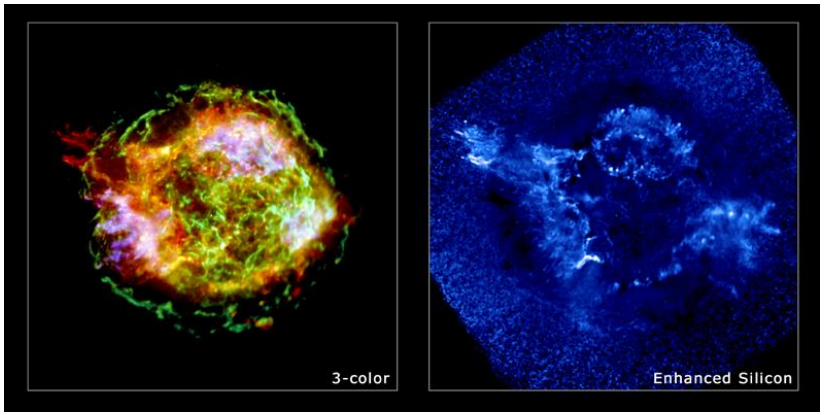
Goal

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

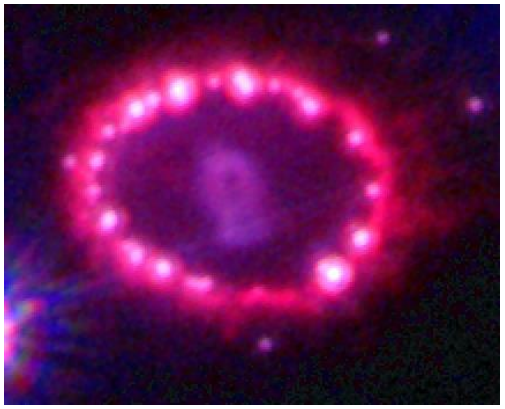
New possibility - Jet-induced supernova, Chapter 6, Section 6.5
(but not the discussion of polarization)



Crab Nebula



Cassiopeiae A



SN 1987A

Are jet-like flows typical? Are they important?

Studies (last 25 years) show that all Core Collapse Supernovae (massive stars: Type II, Ib, Ic) are out-of-round.

Perhaps combination football, frisbee, or something else.

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