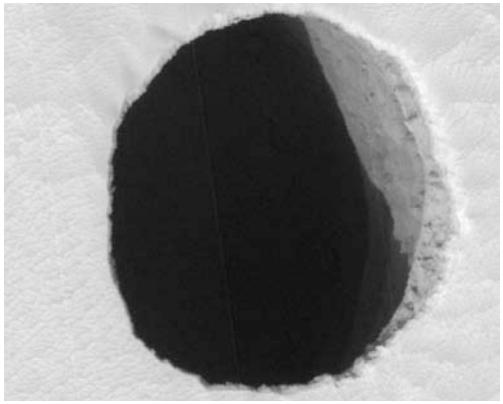
9/28/07

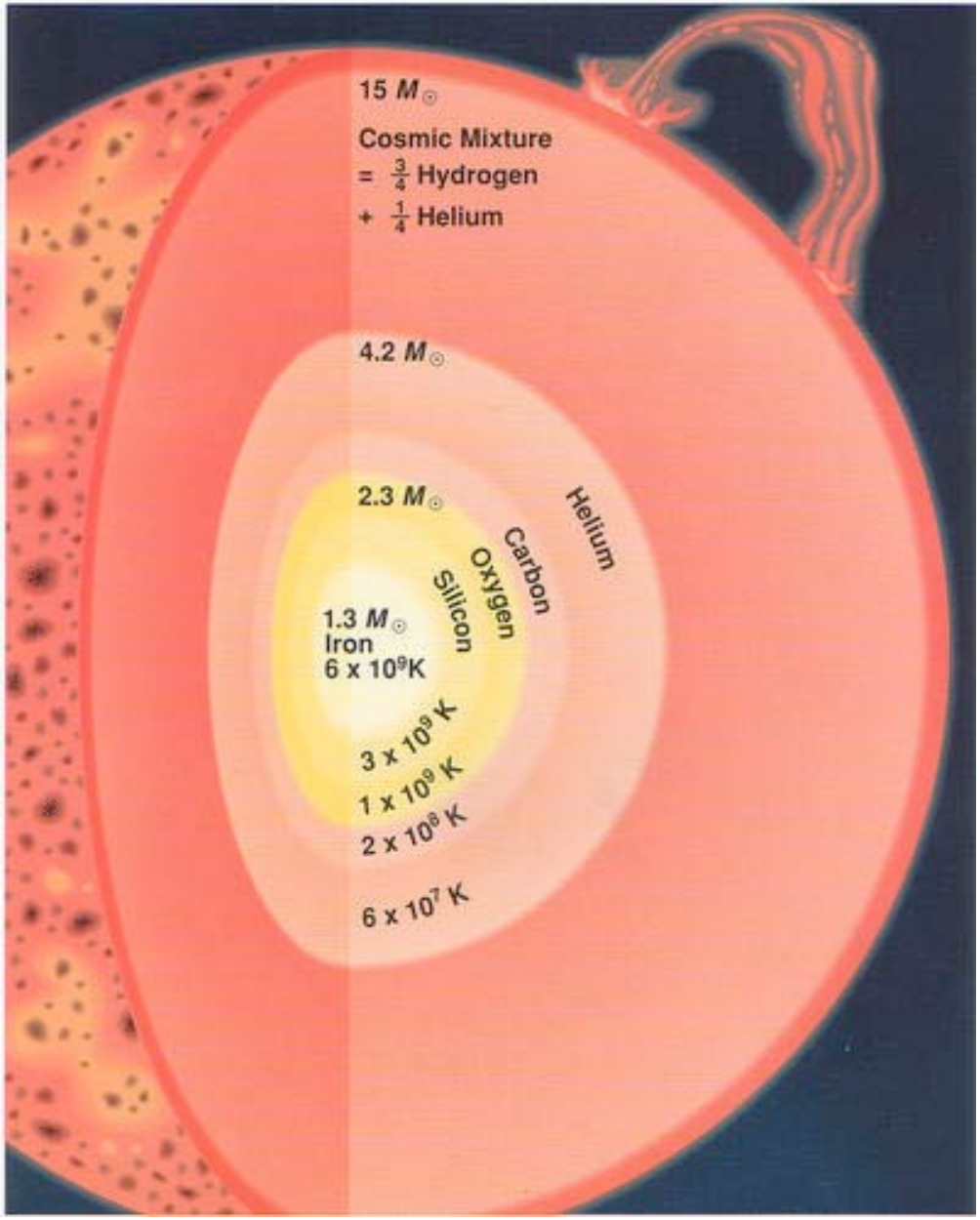
Sky Watch extra credit back Monday

Wheeler on travel Friday - Film or Review Session?

Astronomy in the news? A new and intense type of radio burst has been discovered in archived views of the cosmos, astronomers revealed today.The single, short-lived blast (5 milliseconds) of radio waves likely occurred some 3 billion light-years from Earth, and it may signal a cosmic car crash of two neutron stars, the death throes of a black hole, or something else.

Pic of the Day - crater on Mars
from Mars Reconnaissance
Orbiter






Origin of Type II, Ib. Ic

How does a massive star get from hydrogen to iron, and why iron, and what then?

Evolution - gravity vs. charge repulsion
§ 2.1

Why do you have to heat a fuel to burn it?

H → He → C → O
more protons, more charge repulsion, must get ever hotter to burn ever "heavier" fuel

Just what massive stars do!
Support by thermal pressure.
When fuel runs out, core tries to cool but gravity squeezes, core contracts and HEATS UP
overcomes higher charge repulsion, burns new, heavier fuel, ***until get to iron***

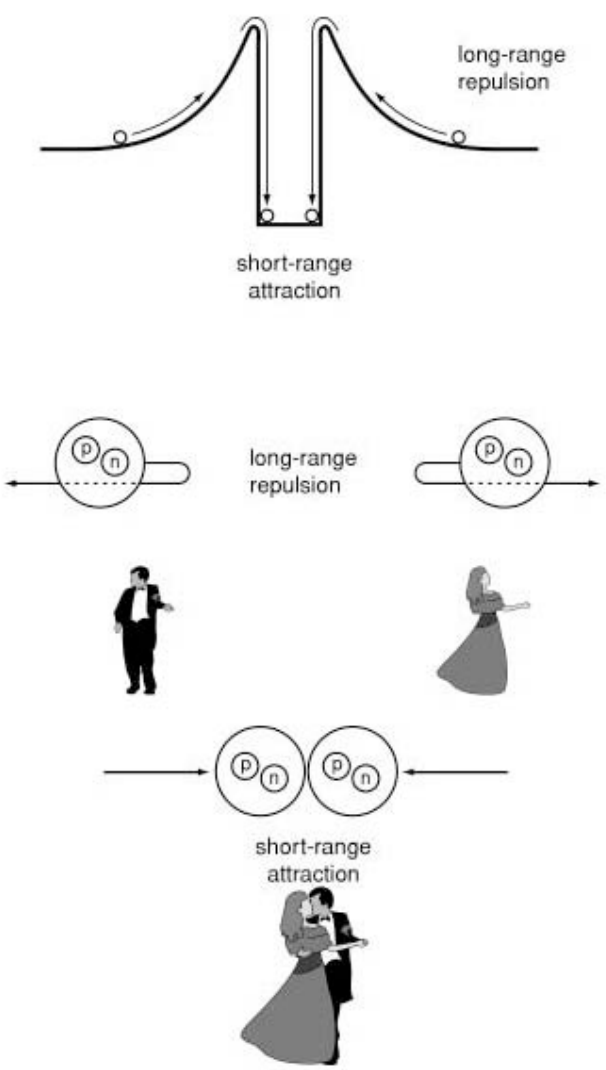



Figure 2.1

Make succession of heavier elements

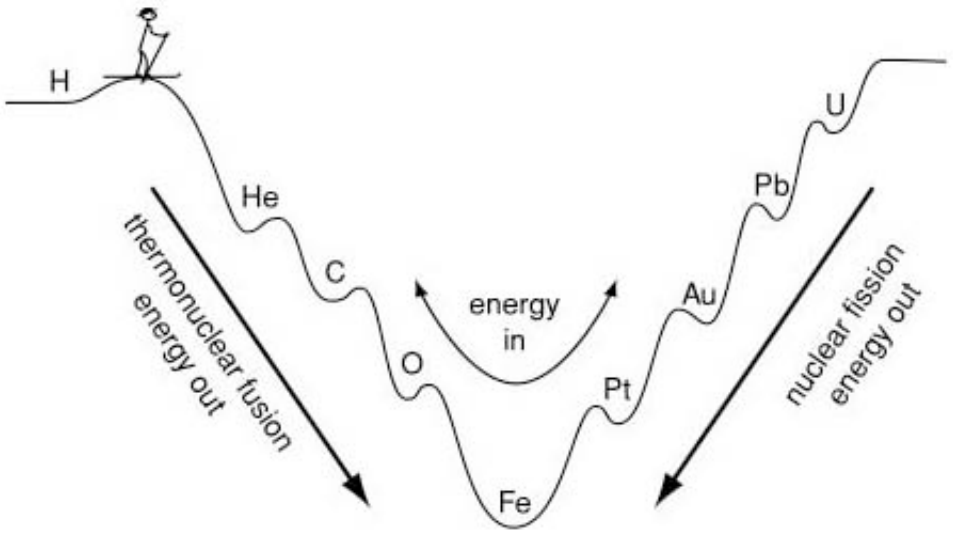



Figure 2.3

Special role of Iron - 26p, 30n

***Endothermic*** - must put energy in to break iron apart into lighter elements or to forge heavier elements, absorb energy, lower pressure, core contracts, absorb more energy, more contraction…

=> The iron core quickly collapses! Catastrophic death of the star.

When iron core forms - star is doomed to collapse, form a neutron star (or maybe a black hole), composed essentially of all neutrons.

$p + e \rightarrow n + \nu$ ***neutrino***,

Action of Weak Nuclear Force (Chapter 1.2)

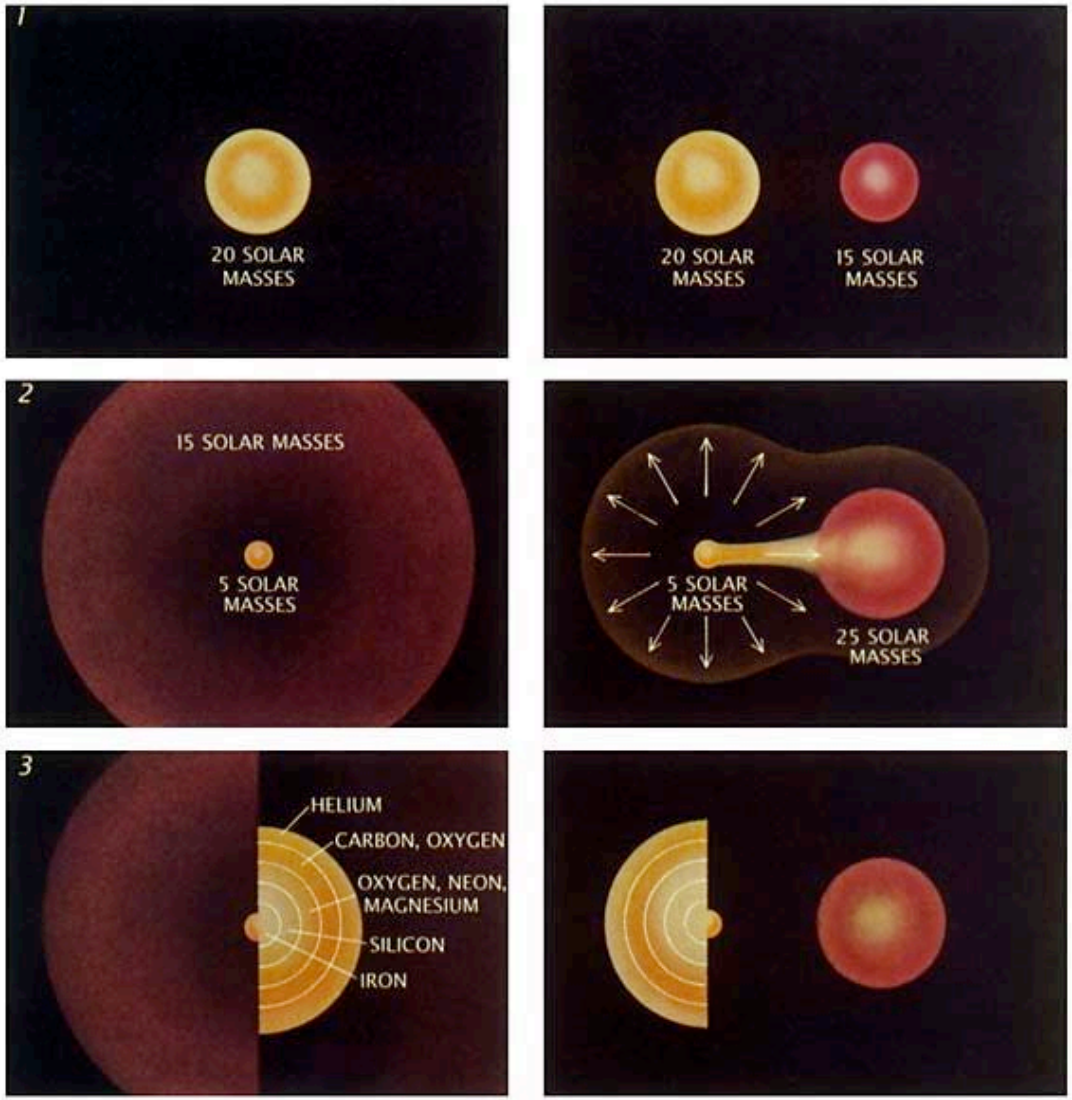
One $\nu$ is generated for every p that is converted

$\Rightarrow$***<u>lots of neutrinos</u>***

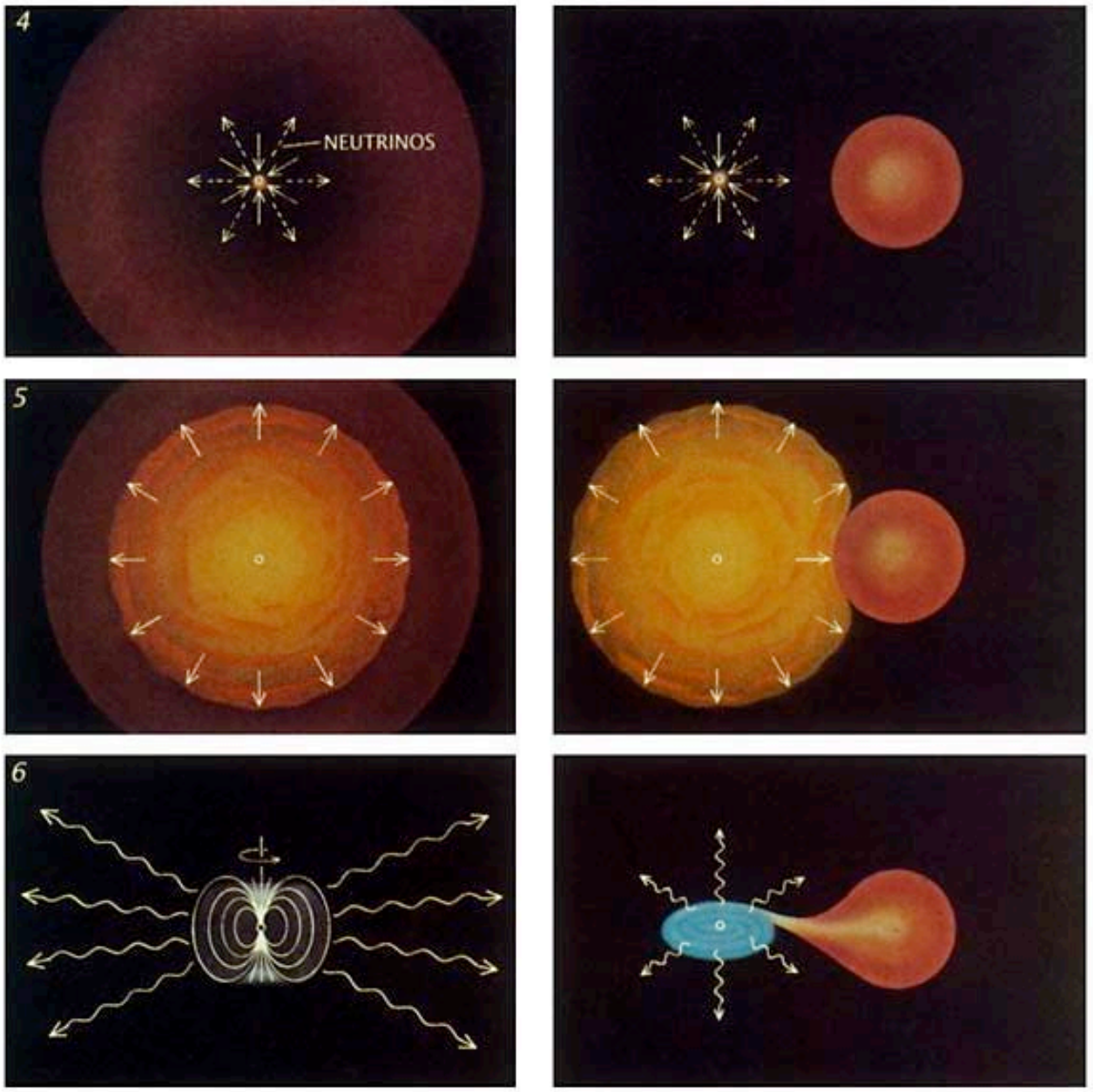
$\Rightarrow$99% of energy of collapse is carried off by neutrinos (Ch 1 2.1, 2.2)

Single star: Type II

Same star in binary: Type Ib/c




Same evolution inside star, thermal pressure, regulated burning, shells of heavier elements, whether envelope there or not




Rotating, magnetic radio pulsar.

Neutron star in binary system, X-ray source

One minute exam

Why do you have to heat a nuclear fuel to make it burn?

A) Charge repulsion keeps nuclei apart

B) The strong nuclear force keeps nuclei apart

C) To overcome the loss of neutrinos

D) To make protons

***Iron core*** of massive star absorbs energy, collapses in about 1 second to form ***neutron star***.

Essentially all protons and electrons are converted to neutrons with the emission of a ***neutrino***, tiny mass, no electrical charge, interacts little with normal matter, only through weak nuclear force (Chapter 1)

***Neutron Star*** - mass of Sun, but size of small city, ~ 10 kilometers in radius, density of atomic nucleus.

***Huge gravity*** - surface is now ***much closer*** to the center!

One minute exam

What is the importance of iron in massive stars?

A) It produces a great deal of energy

B) It absorbs energy

C) It produces neutrinos

D) It combines with oxygen and produces rust

When 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!

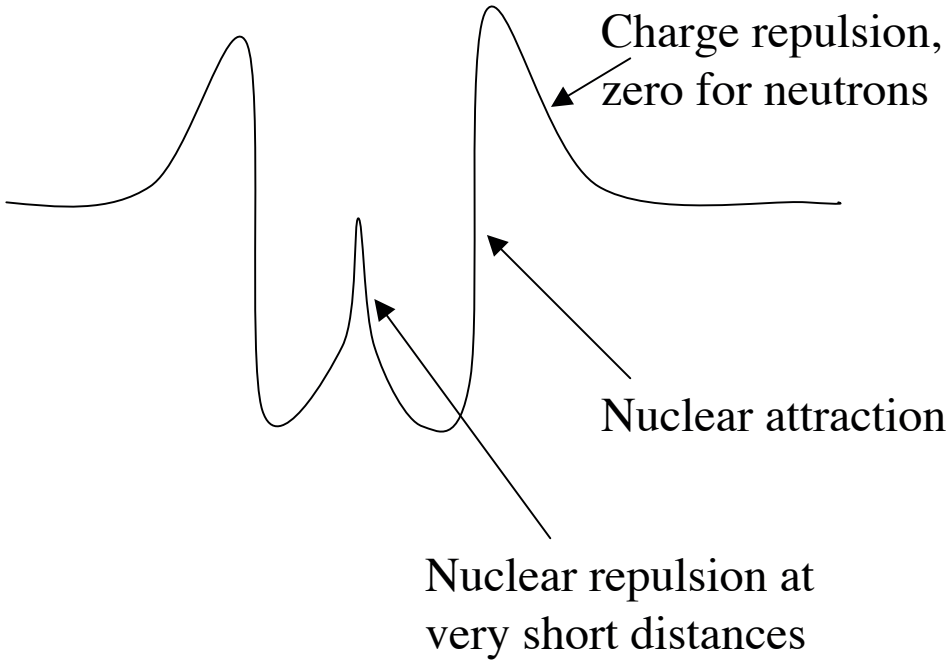
The outer parts of the star, beyond the neutron star, are ***transparent to the neutrinos***, the neutrinos flood out freely and carry off most of the energy.

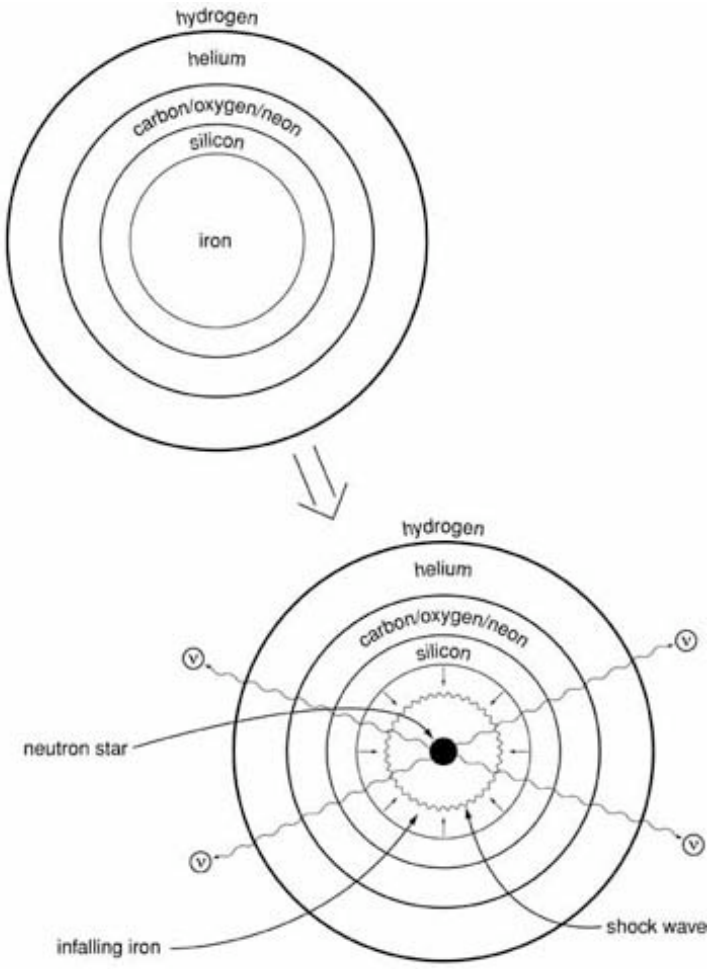
Is 1% of the neutrino energy left behind to cause the explosion?

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

Fig 6.1

Collapse is halted by the repulsive nuclear force (somewhat uncertain) + quantum pressure of neutrons

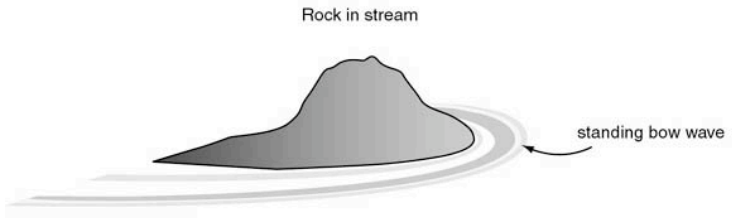



Maximum mass of a neutron star is 1.5 to 2 solar masses

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 settle onto the neutron star.