Friday, February 21, 2014

Exam 2, a week from MONDAY, 3/3. Review sheet Monday

MODIFIED READING

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,

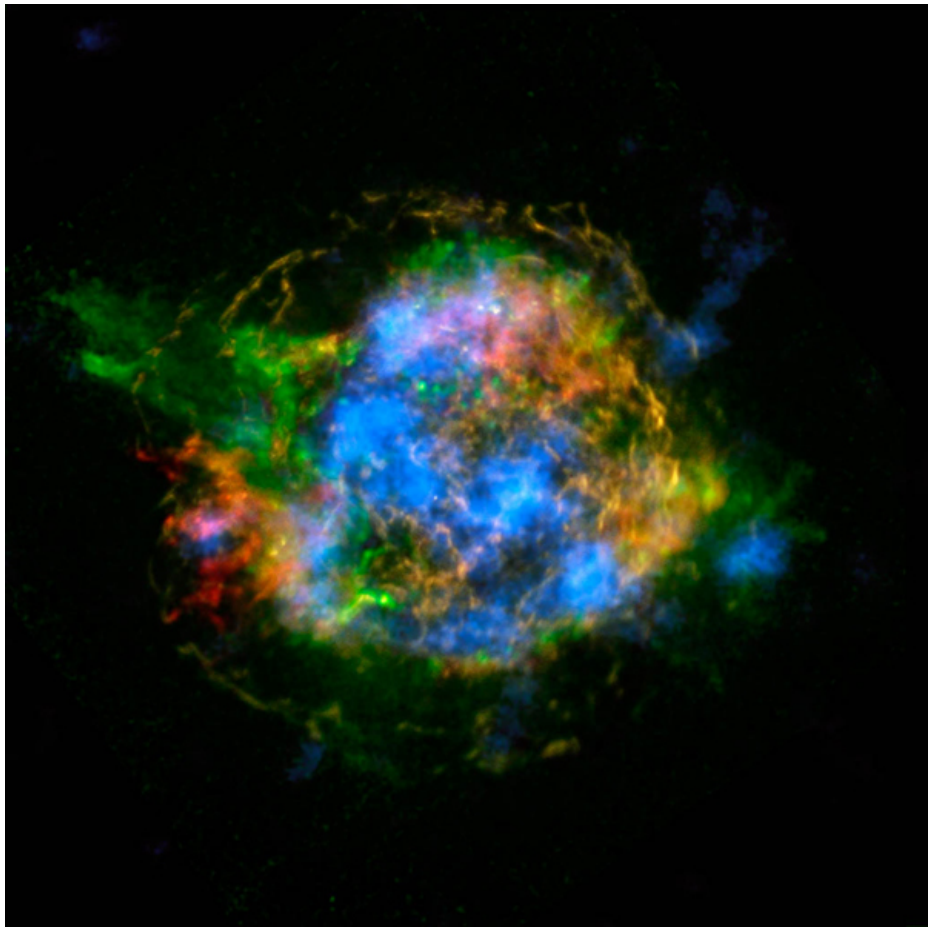
Astronomy in the news:

Thanks to Madi Glemser, Alicia Perry

Asymmetric supernova remnant and a runaway pulsar, a rotating, magnetic neutron star, with a trailing nebula and corkscrew jet.

More Astronomy in the News

Recently launched X-ray satellite NuStar has detected the distribution of radioactive elements in Cas A.



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

My Texas colleague, Howie Marion, is making very long wavelength infrared observations with NASA’s flying observatory, SOFIA, a 747 with a hole cut in its side to allow the telescope to see out.

How to define a particular direction in space?

Rotation - rotation axis.

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

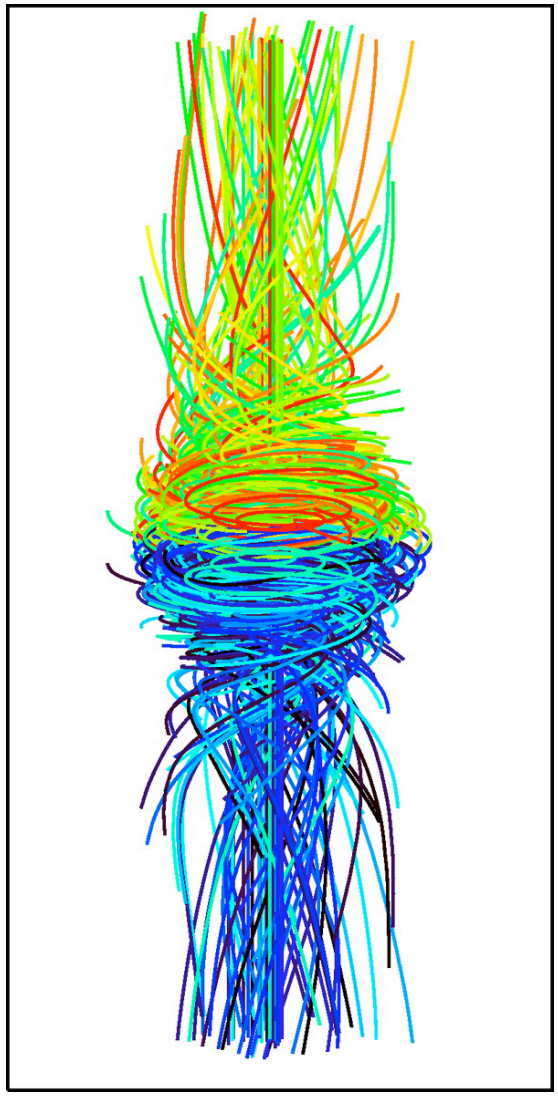
Rotate magnetic neutron star, amplify the magnetic field, eject mass if field is strong enough.

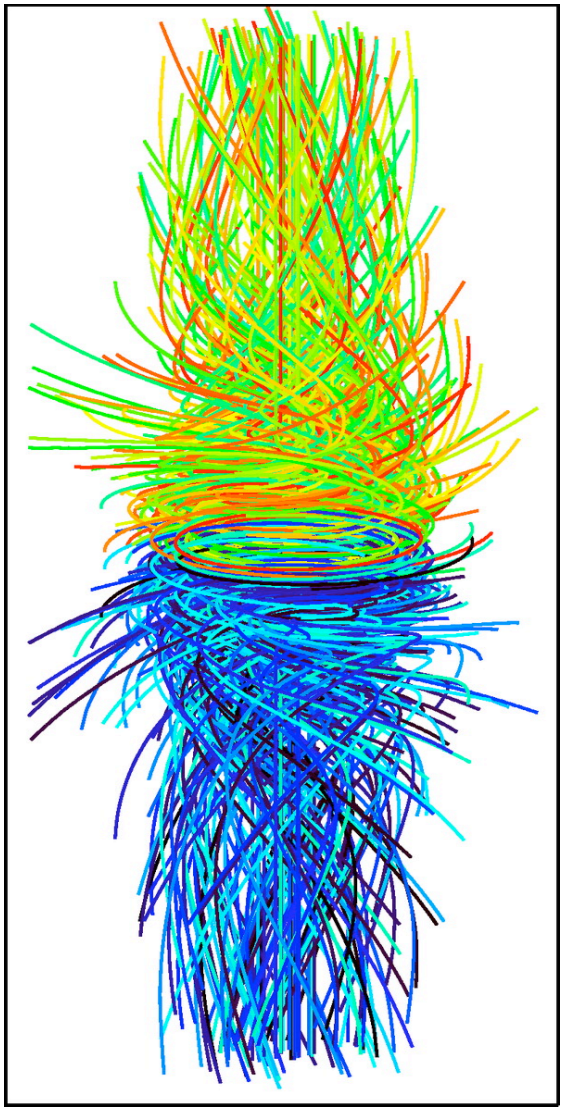
Magnetic lines of force, locus of equal field strength, act somewhat like rubber bands, they are elastic and tend to rebound if deformed and can be twisted and coiled.

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.

Twisted magnetic field lines of force making a magnetic jet during core collapse – A. Burrows et al.





What jets do -

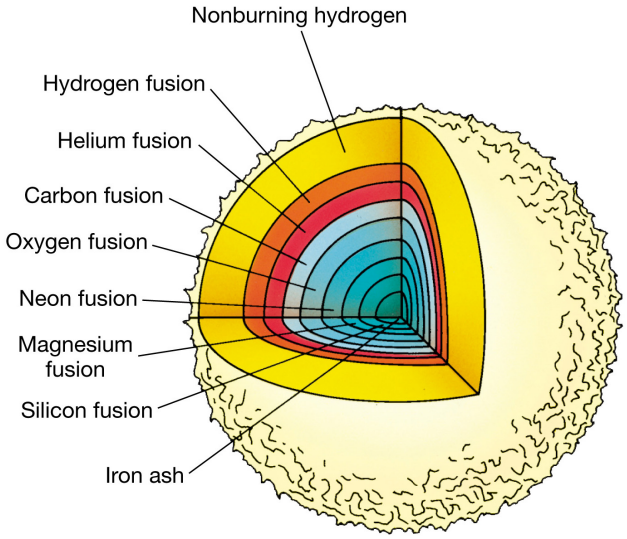
Bagel and breadstick, jet/torus shape "natural."

Strong enough jet can explode the star, but neutrinos also play a role - complicated problem!

Account qualitatively for out-of-round shapes.

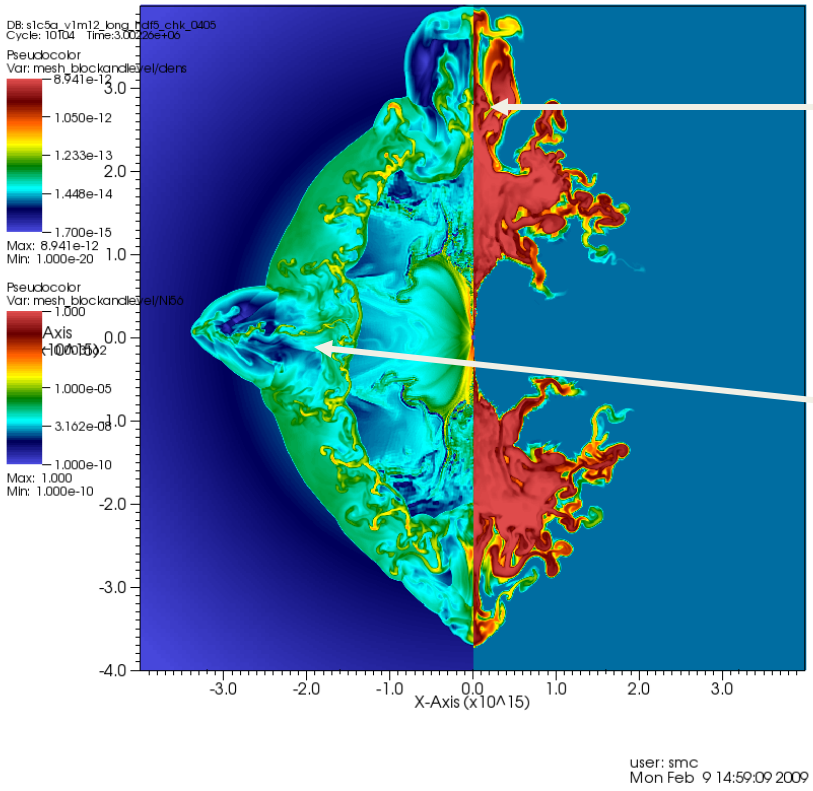
Test for shape (jet/torus), prediction of different elements exploded in different directions.

Initially spherical model,



Spherical Explosion
hydrogen, helium, oxygen, silicon, calcium, and iron would be exploded in all directions

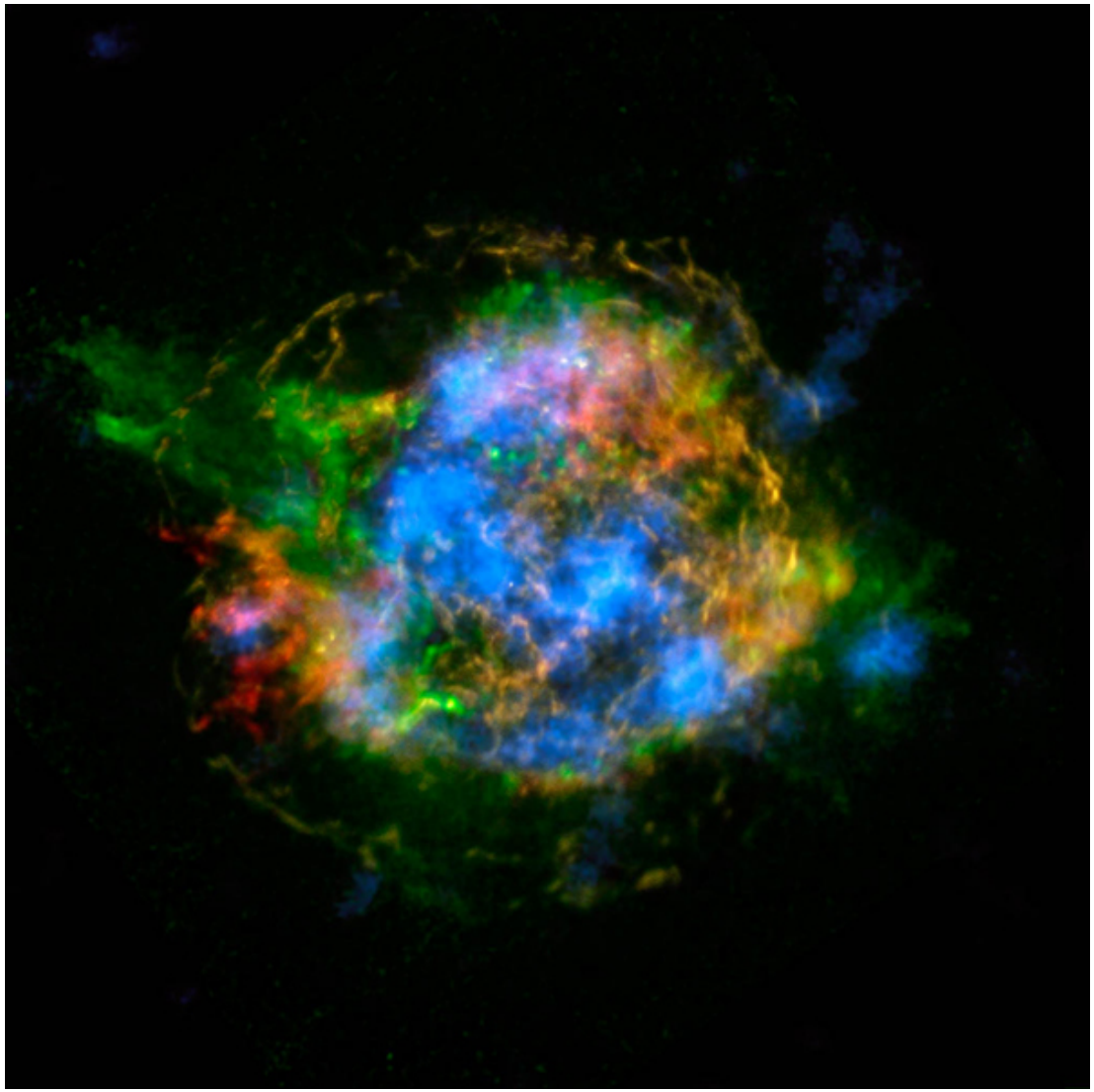
Jet-induced Explosion axis/torus structure



Jet
iron, O bread stick

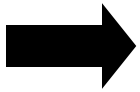
Torus
He bagel

Some radioactive material in the “counterjet,” some in the “bagel?”

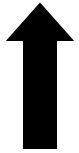


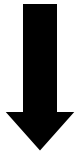
One Minute Exam

Why do astronomers think that jets may be involved in the core collapse explosion of massive stars?:

 Iron makes jets

 Jets make iron and oxygen

 Cassiopeia A has a collapsed object in the center of the explosion

 All core collapse supernovae are out of round

Bagel and Breadstick Halloween costume, 2008,

Marquette University, Milwaukee

Understanding how magnetic fields form and behave in core collapse is on the cutting edge of research.

There is yet no general agreement as to how *implosion* of the iron core is turned into the *explosion* of the supernova.

Rebounding, boiling neutron star, standing shock, neutrinos, rotation, and magnetic fields are all important ingredients.

Still a huge challenge to simulate properly on supercomputers.

Nature does not care what astrophysicists do not understand.

Type II and Type Ib/c supernovae continue to explode!

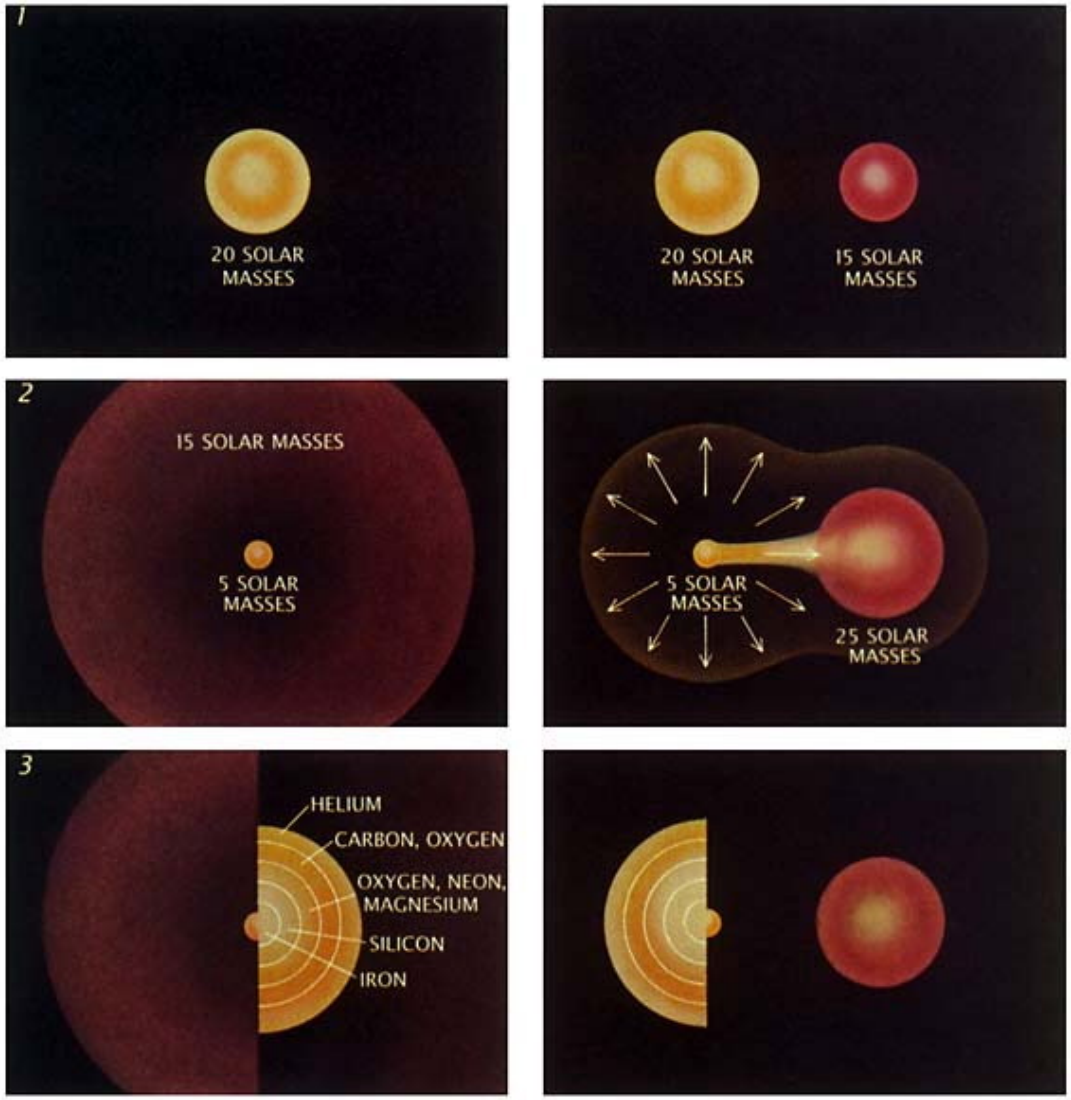
Goal

To understand how the iron core process works in Type II, Type Ib, and Type Ic supernovae.

To understand how they are alike and why and how are they different.

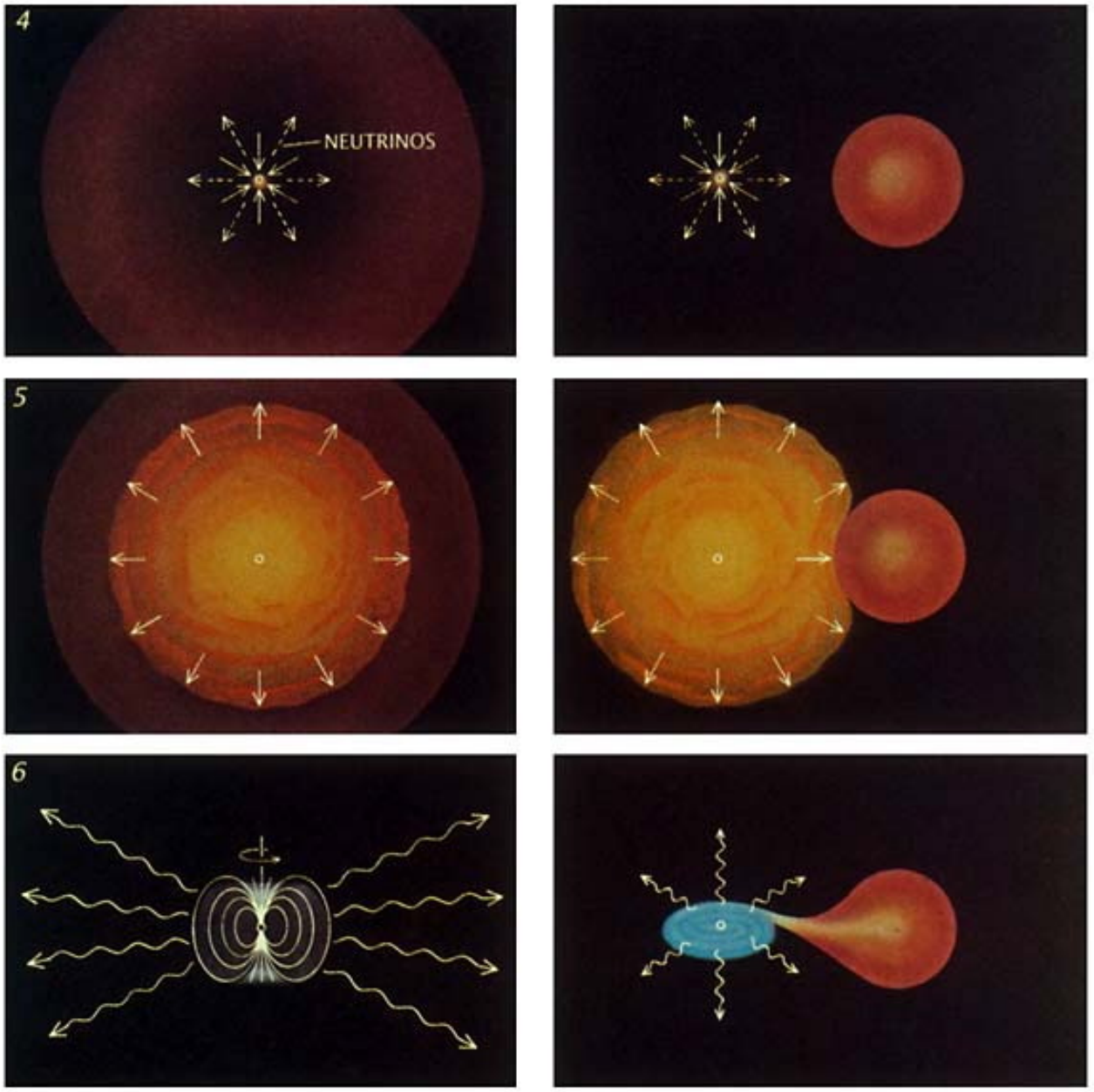
Single star: Type II Same star in binary: Type Ib/c

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



Single star: Type II

Same star in binary: Type Ib/c



Both types leave behind a neutron star

Rotating, magnetic radio pulsar.

Neutron star in binary system, X-ray source