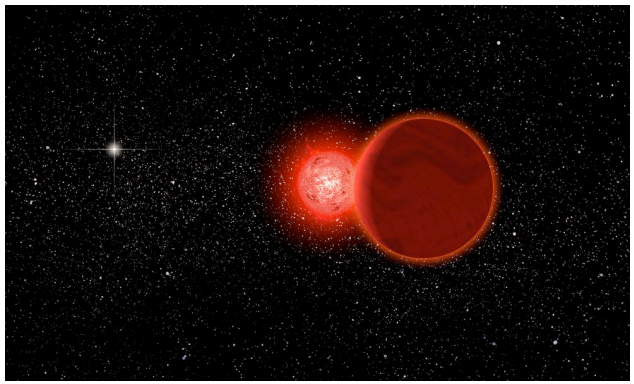
Friday, February 20, 2015

Exam 2, Skywatch 2, a week from Today, 2/27. Review sheet posted Monday.

Reading for Exam 2:

Chapter 6 Supernovae §6.4, 6.5, 6.6 (most of section, binary star evolution for Exam 3), Betelgeuse interlude.
Background:
Chapter 1 Introduction §1.2.1, 1.2.3, 1.2.4
Chapter 2 Stellar Death §2.1, 2.3, 2.4, 2.5



Astronomy in the news?

Star (red dwarf/brown dwarf binary) buzzed solar system during time of Neanderthals, 70,000 year ago, now 20 light years away.

Two new moons for Pluto, Nix and Hydra, New Horizons Mission.

UT grad one of 100 finalists for Mars colony.

Goal

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

How to define a particular direction in space?
Rotation - rotation axis.

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

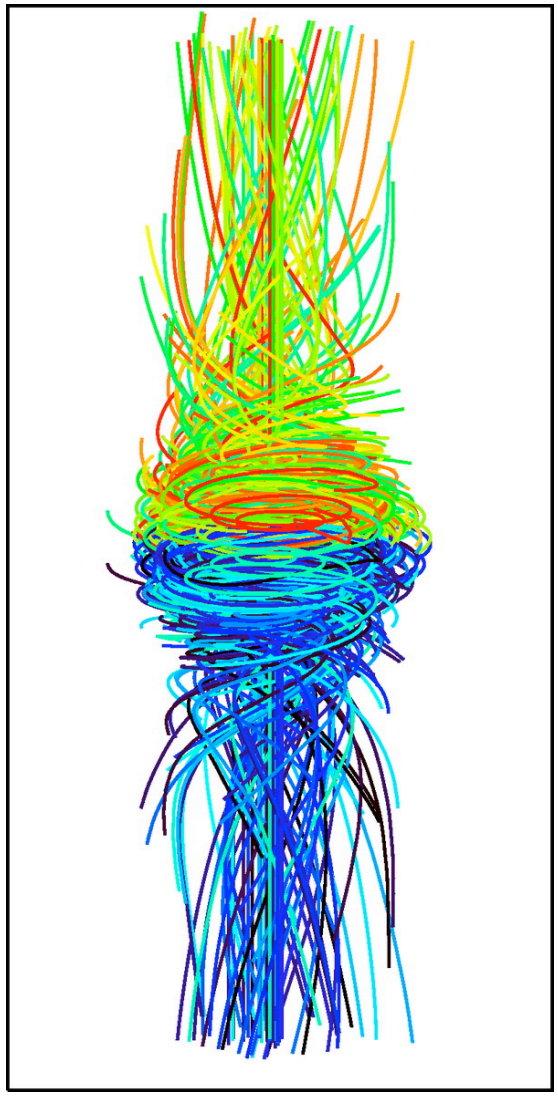
Magnetic lines of force, locus of equal field strength, act somewhat like rubber bands, they are elastic and tend to rebound if deformed and can be twisted and coiled.

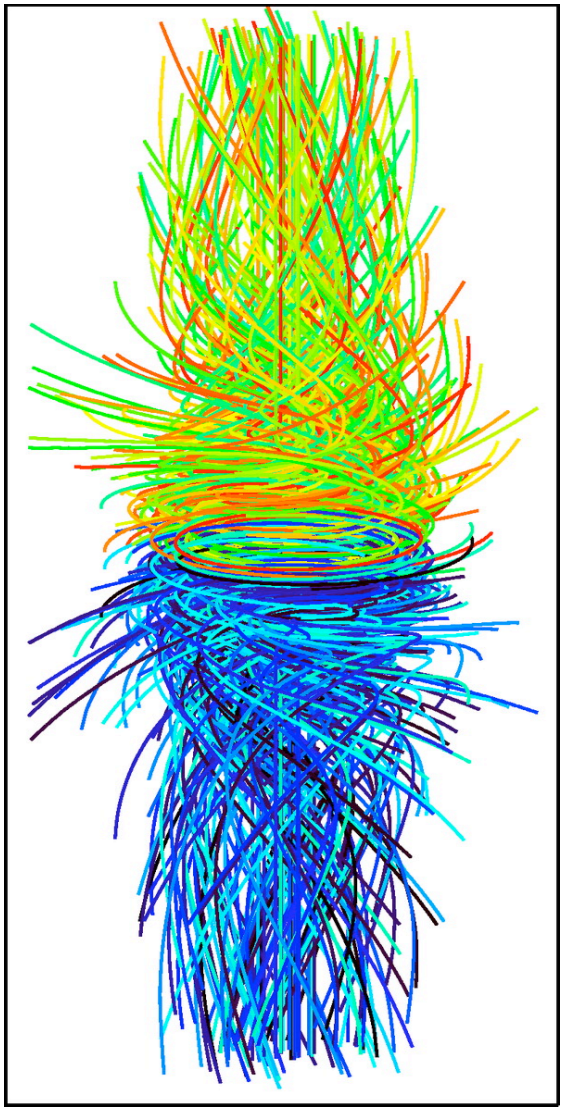
Twisted magnetic fields have tension along them and exert pressure sideways and along the lines of force.

Rubber band - twist moves along the rubber band.

Rotate magnetic neutron star, amplify the magnetic field, confine matter, eject mass along rotation axis if field is strong enough.

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





More recent 3-D magnetic jet simulation – S. Couch

What jets do -

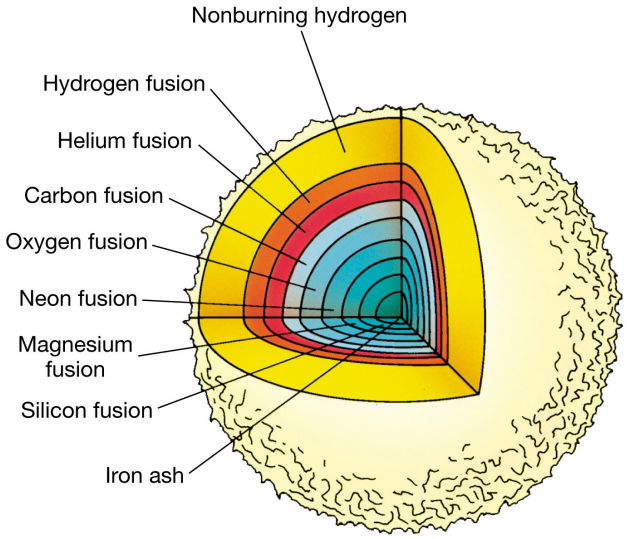
Bagel and breadstick, jet/torus shape "natural."

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

Account qualitatively for out-of-round shapes.

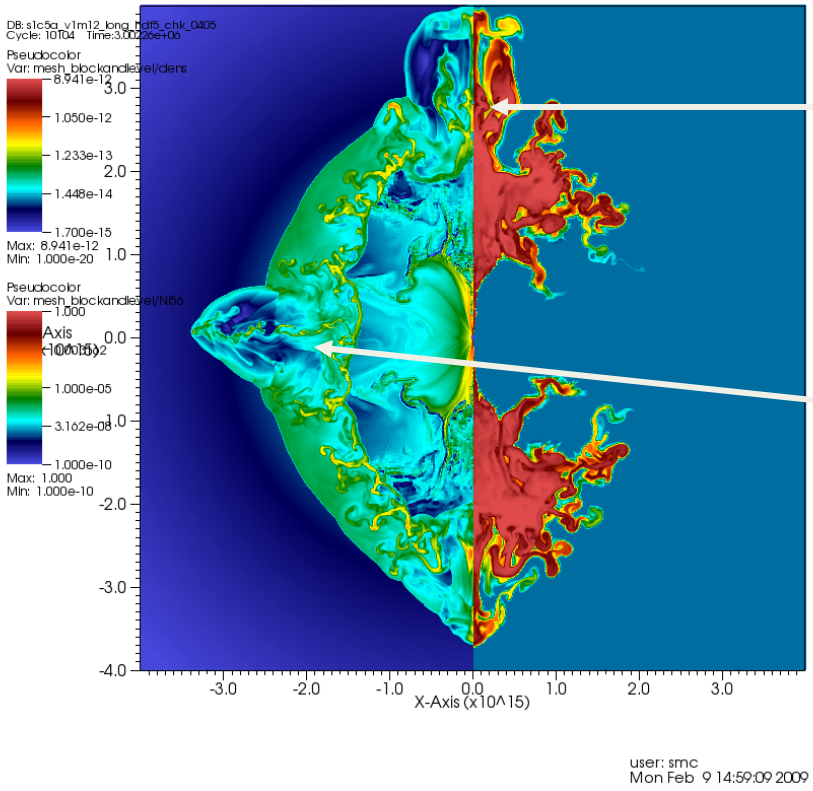
Test for shape (jet/torus), prediction of different elements exploded in different directions.

Initially spherical model,



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

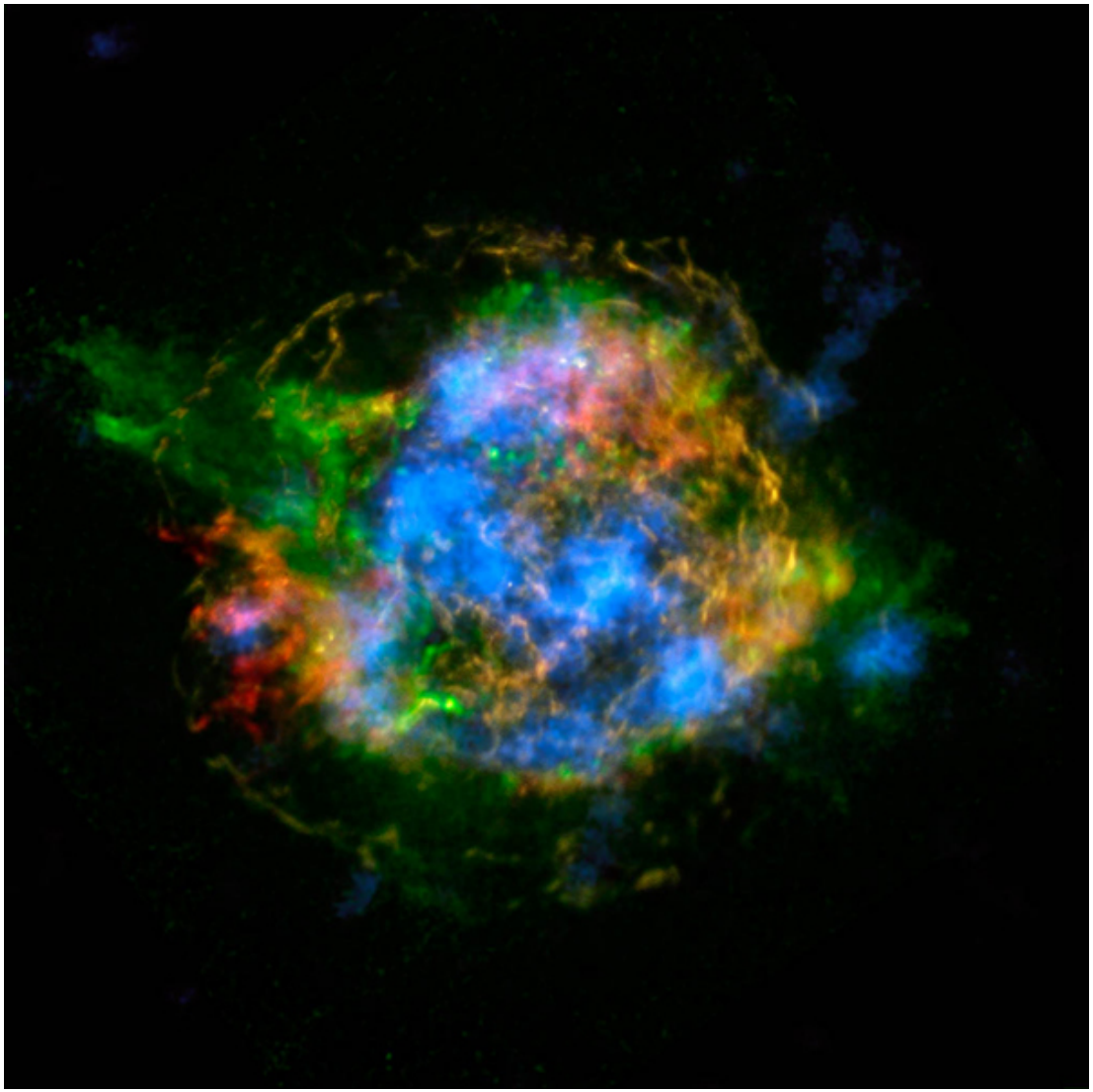
Jet-induced Explosion axis/torus structure



Jet
iron, O bread stick

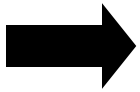
Torus
He bagel

Cas A: some radioactive material (blue) in the "counterjet," some in the "bagel?"



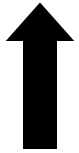
One Minute Exam

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

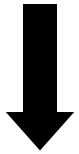


Iron makes jets

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

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!