

September 17, 2010

Reading, Sections 6.4, 6.5, 6.6. Chapter 7.

Sections 1.2, 2.1, 2.4, 2.5 for background.

Astronomy in the News? Wheeler gave a colloquium on extremely bright supernovae at OU yesterday.

What did the Moon look like last night?

Pic of the Day – Northern Lights.
The Earth is rotating and magnetic



Goal

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

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

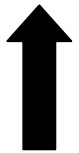
What happens to the *shock wave* produced when an iron core collapses to form a neutron star and bounces?



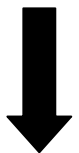
It fades away



It propagates out through the star and causes an explosion



It stalls at some distance from the neutron star

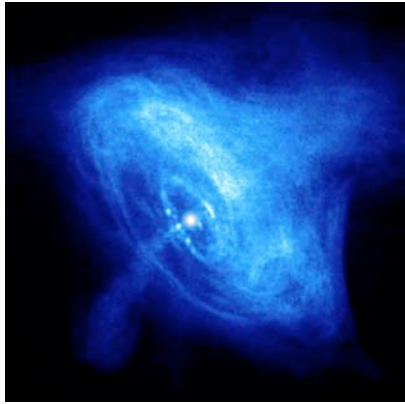


It traps neutrinos

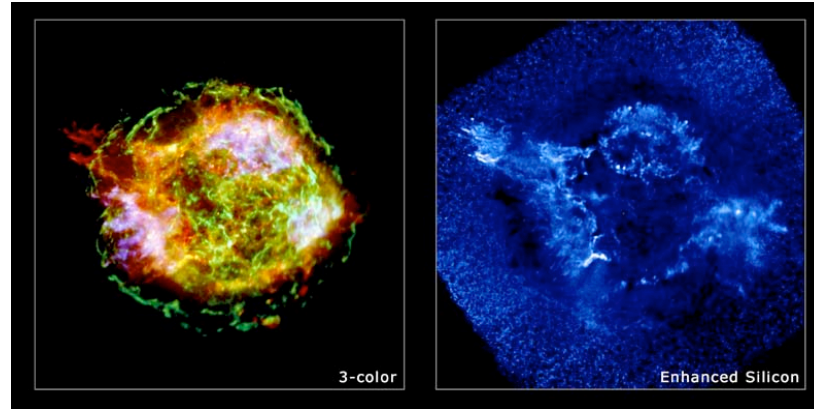
Goal

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 10 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.

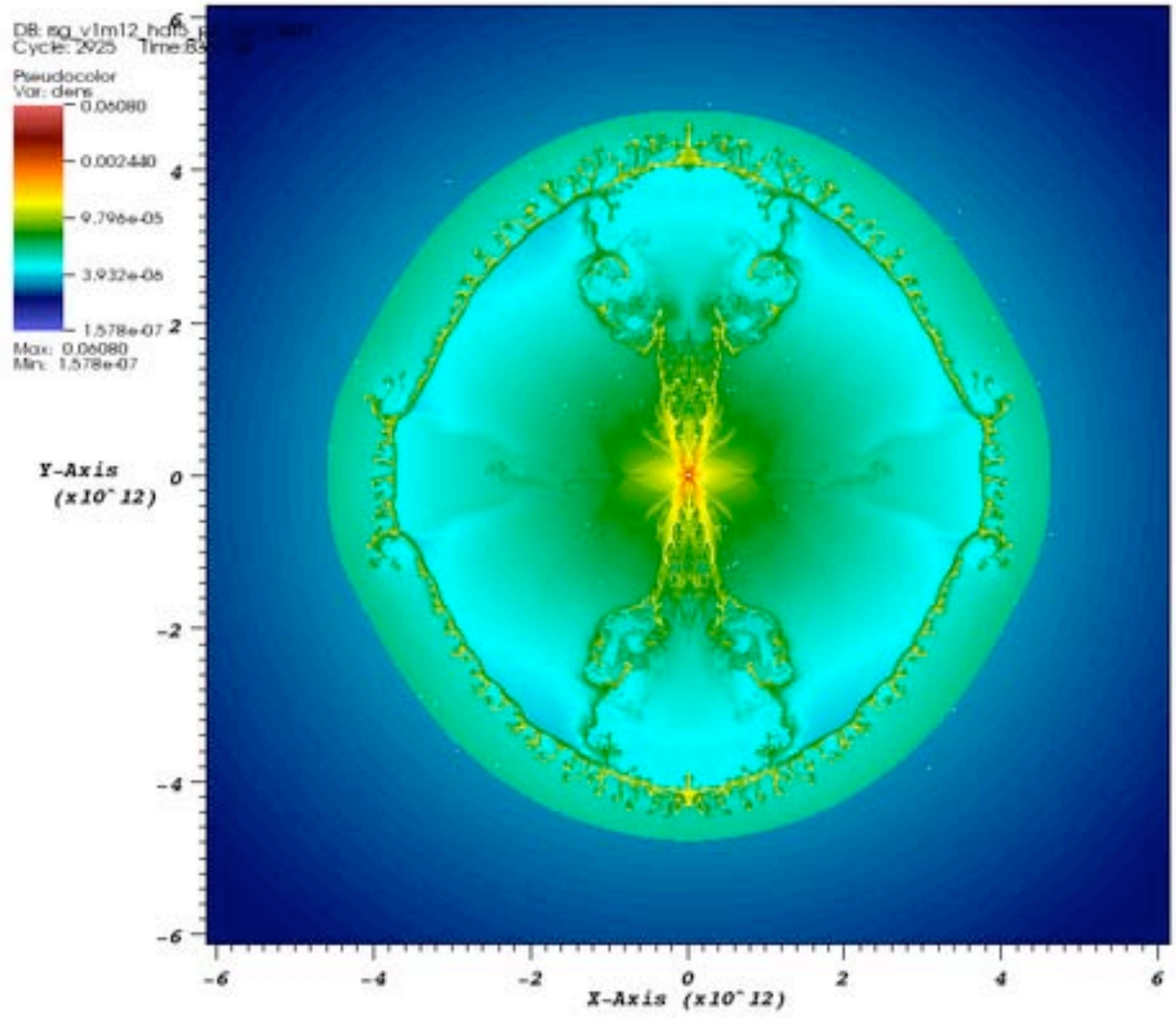
Calculations show jets emerging from newborn neutron star can explode the star, make it out-of-round.

Predict a jet/torus “bagel and breadstick” shape

What jets do -

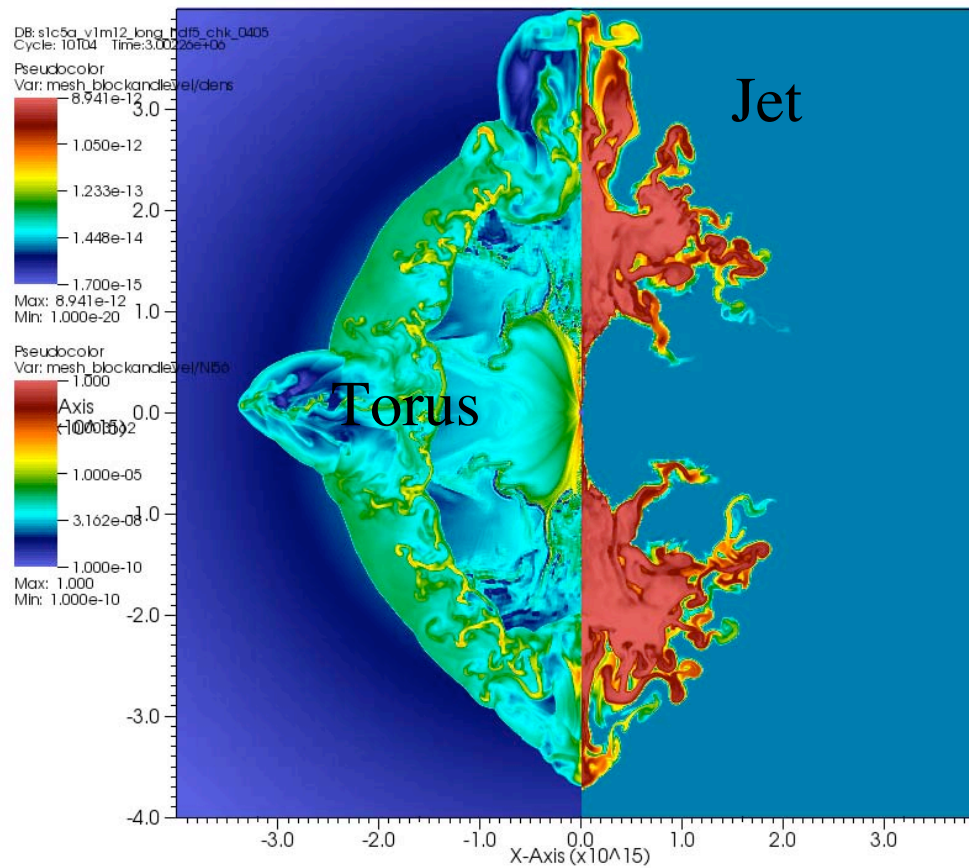
Bagel and breadstick, jet/torus shape “natural.”





Iteration
by
Explosion
of two
identical
jets in a red
giant star
like
Betelgeuse

Couch et al.
2009



user: smc
 Mon Feb 9 14:59:09 2009

Computer models predict a jet/torus, “bagel and breadstick” structure

Couch et al. 2009

This is the first new idea to understand these supernovae in thirty years.

Bagel and
Breadstick
Halloween
costume, 2008,
Marquette
University,
Milwaukee



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.