

Monday, February 13, 2012

Reading Chapter 6 (continued) Sections 6.4, 6.5, 6.6, 6.7
(background: Sections 1.2, 2.1, 2.4, 2.5, 3.3, 3.4, 3.5, 3.10,
4.1, 4.2, 4.3, 4.4, 5.2, 5.4)

Astronomy in the news?

News:

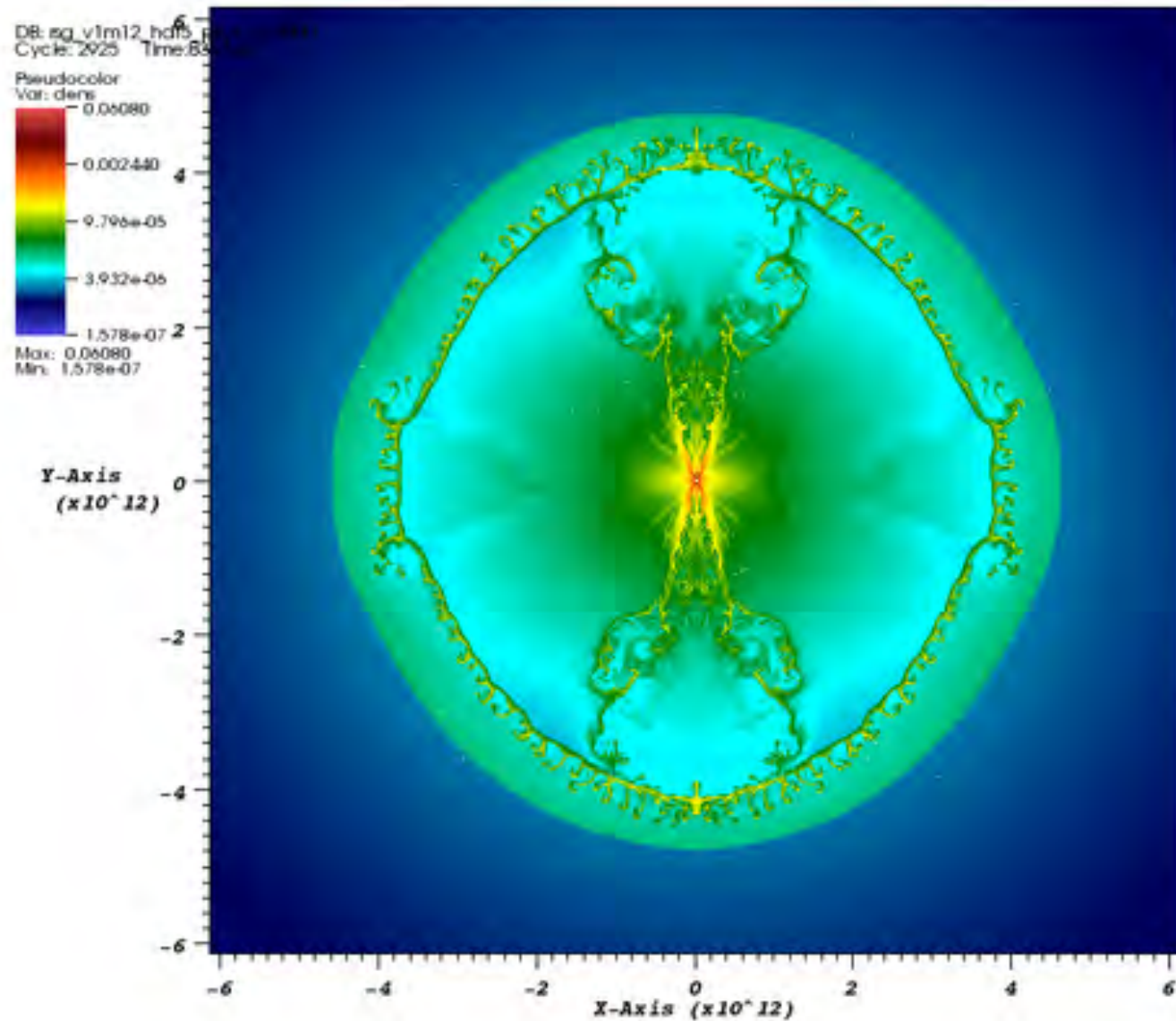
Goal

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

What jets do -

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

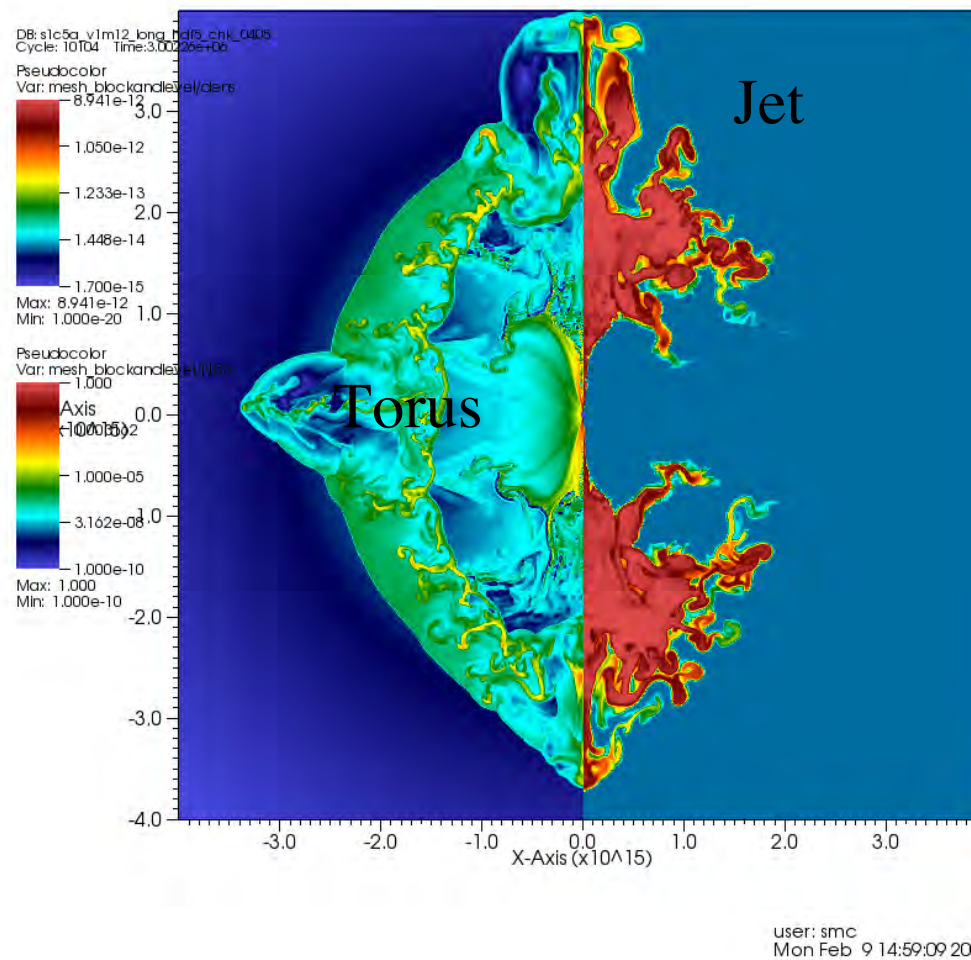




Explosion
of two
identical
jets in a red
giant star
like
Betelgeuse

Couch et al.
2009

user: smc
Wed Apr 9 12:20:47 2008



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.

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)

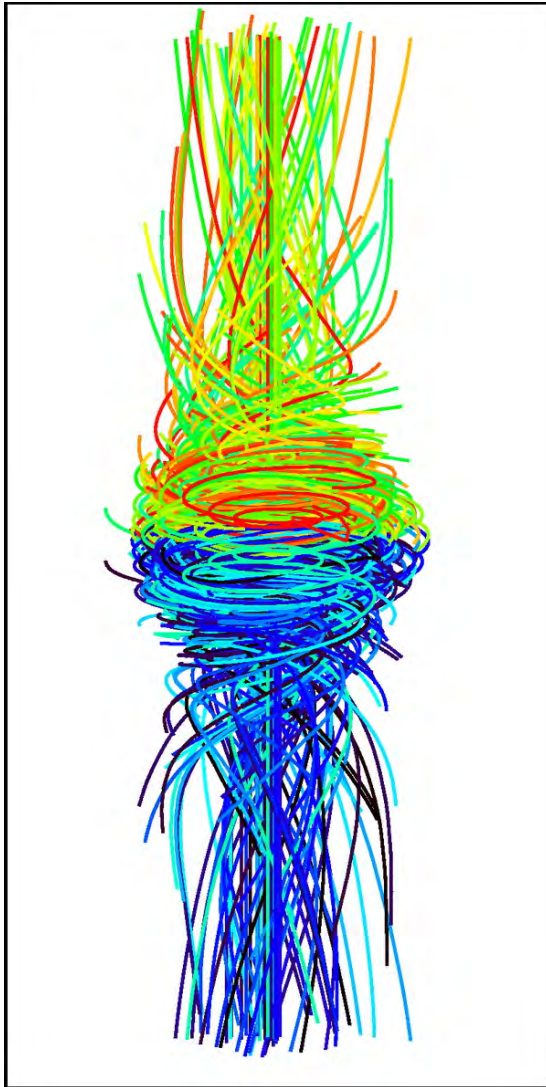
Rotate magnetic neutron star, amplify the magnetic field, eject mass if field is strong enough.

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.

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



What jets do -

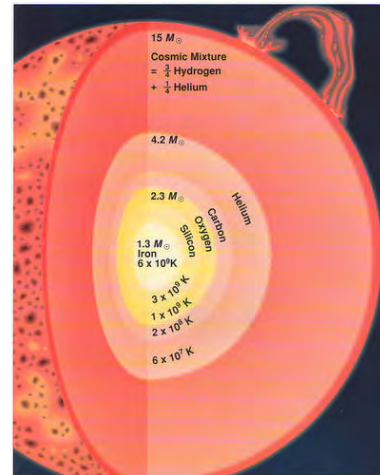
Bagel and breadstick, jet/torus shape “natural.”

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

Account qualitatively for out-of-round shapes.

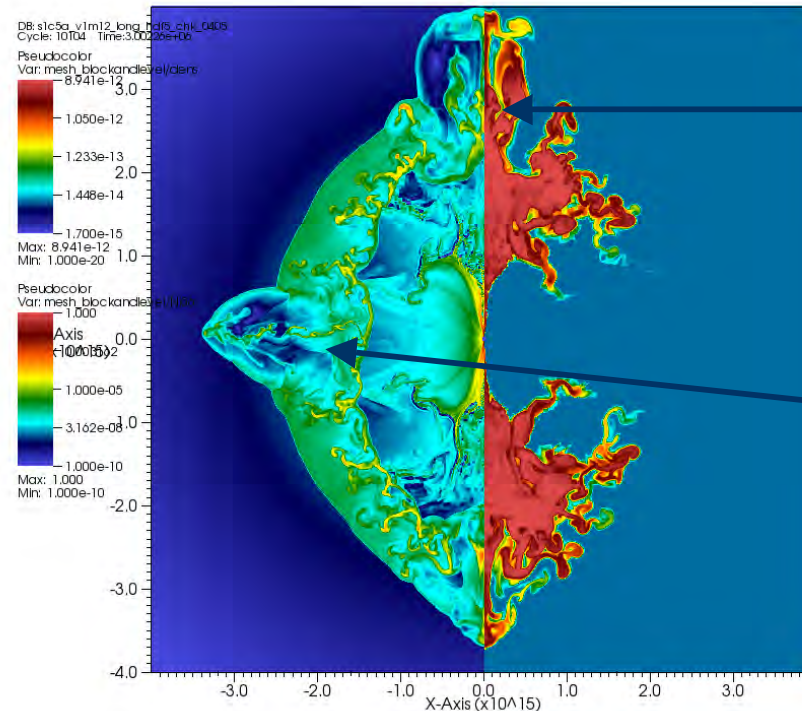
Test for shape (jet/torus), prediction of different elements exploded in different directions.

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

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



Back to physics of Type Ia Supernovae -
exploding white dwarfs

Chapter 6, Section 6 in Cosmic Catastrophes

Background in Chapters 3, 4, 5.

Goal

To understand the process of thermonuclear explosion in a white dwarf to make a Type Ia supernova.

Type II (Ib, Ic) energy from falling, gravity, Type Ia energy from thermonuclear explosion.

For core collapse, iron is produced BEFORE the explosion in the progenitor star and triggers collapse, for thermonuclear explosion of carbon and oxygen, iron is produced DURING the explosion.

Type Ia - see O, Mg, Si, S, Ca early on, iron later => *iron is inside*

