3/24/06

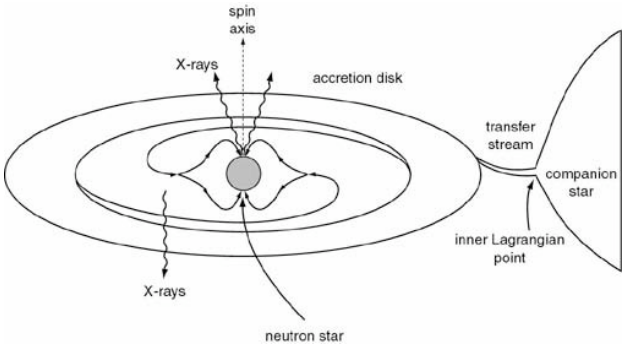
Reading - Chapter 8, Sections 7, 10, (skip 11) neutron stars

Chapter 9 - Black Holes

News: Earthquakes from sliding glaciers in Greenland

Pic of the day; Rosette Nebula: star formation

Figure 8.2



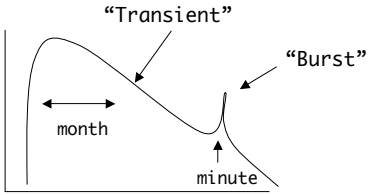
Some neutron stars are in binary systems, they accrete mass through an accretion disk and produce ***X-rays***.

Accretion onto tilted magnetic poles can give pulses of X-rays by "lighthouse" mechanism

X-ray Transients - flare every few years for a month or so: suspect ***disk instability*** like ***dwarf novae***, but neutron star, not white dwarf.

X-ray Bursters - rise in about a second, decay in a minute, no "pulses," suspect low magnetic fields,
Analog of ***classical novae***, thermonuclear burning on surface of neutron star not white dwarf
H is *thermally supported* - regulated burning H → He
He, high density, *quantum pressure* - unregulated → ***flash!***
little matter expelled because of high gravity

One Case
Both Phenomena



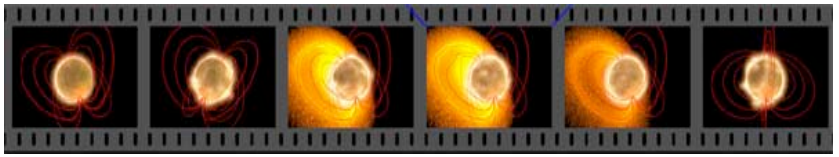
Soft Gamma Ray Repeaters - 4 known

One flared in the Large Magellanic Cloud galaxy, energy arrived in March 5, 1979.

Another flared in our Galaxy, energy arrived August 27, 1998, caused aurorae from 1000's of light years away.

Yet another flared in our Galaxy with energy arriving December 27, 2004, on the far side of the Galactic center, perhaps 10's of 1000's of light years away, brightest release of energy ever seen in the Galaxy, 100 times more powerful than August 1998 burst.

Magnetic eruption in neutron star [not necessarily in binary system.]



Theory - break patch of iron-like "crust" of neutron star, convert magnetic energy to heat (1998 burst) or completely rearrange magnetic field configuration (2004 burst).

Require "wiggling" of very strong magnetic fields, 100 × Crab pulsar

⇒ ***Magnetar*** - very highly magnetic pulsar.

Origin of magnetars compared to normal pulsars not yet known.

Formation might be related to hypernovae or Gamma-ray bursts (Chapter 11).

New X-ray, Gamma-ray satellites (Swift) should see many of these brightest bursts (December 27) in distant galaxies.

One Minute Exam

Which statement is most relevant to making an X-ray pulsar?

A) A solitary neutron star rotates with a tilted magnetic field.

B) A neutron star with an unstable accretion disk accretes matter from a binary companion.

C) A neutron star with a tilted magnetic field accretes matter from a binary companion.

C) A neutron star has a magnetic field 100 times stronger than the pulsar in the Crab nebula.

New Topic: Black Holes

Chapters 9

What do you know about them -- What did you learn?

Black Hole comic,

Black Holes

Mitchell, Laplace, late 18th Century: with Newton's Gravity could have escape velocity greater than the speed of light => light could not get out, completely dark, *corps obscurs*.

Now know Newton was wrong.

Excellent approximation for weak gravity - "true" in that case

Conceptual problems $F = \frac{G M_1 M_2}{r^2}$

infinite force for zero separation (in physics infinity ⇒ problem)

instantaneous reaction => infinite speed of gravity

Experiment - wrong deflection of light.

Need Einstein and more!