October 13, 2010

Reading Chapter 7, Chapter 8 - Sections 8.1, 8.2, 8.5, 8.6, 8.10

Astronomy in the News? Chilean mine rescue in Atacama desert, site of new telescopes.

Pic of the Day – Hubble, Escher, Venice

Goal:

To understand how isolated neutron stars are observed as “pulsars.”

New results from NASA ***Fermi Observatory***, launched June 2008, that detects high-energy Gamma Rays

Radio may come from magnetic poles, but most of the power is in high-energy gamma rays and occurs in regions beyond the neutron star, near the speed of light circle.

Goal:

To understand how neutron stars behave in accreting binary systems.

Radio pulsars are alone in space or in non-transferring binary system

Vast majority of known radio (and gamma-ray) pulsars are alone in space

~ two dozen have binary companions

Binaries special - use Kepler's laws to measure mass

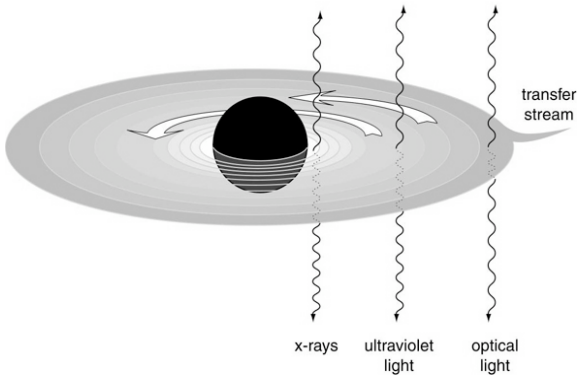
Orbital decay $\Rightarrow$ Gravitational Radiation - Nobel Prize 1993

Some neutron stars are in binaries with mass transfer

Mass transfer floods the magnetic field/poles with gas/plasma, short circuits, kills the radio (and gamma-ray) mechanism.

With mass transfer ⇒ X-rays, another story

High gravity of NS, rapid motion in inner disk, great friction, heat
=> X-rays



Matter lands on, collides with NS Surface => X-rays

Uhuru satellite launched from Kenya 1972 found sky ablaze in X-rays: Neutron stars and black holes in binary systems. Many satellites launched since then, including *Chandra Observatory* and the *Fermi Observatory*.

Nobel prize in 2002 to for this and related discoveries.

For strong magnetic field matter connects to, flows *along* magnetic lines of force (can't flow across field lines of force)

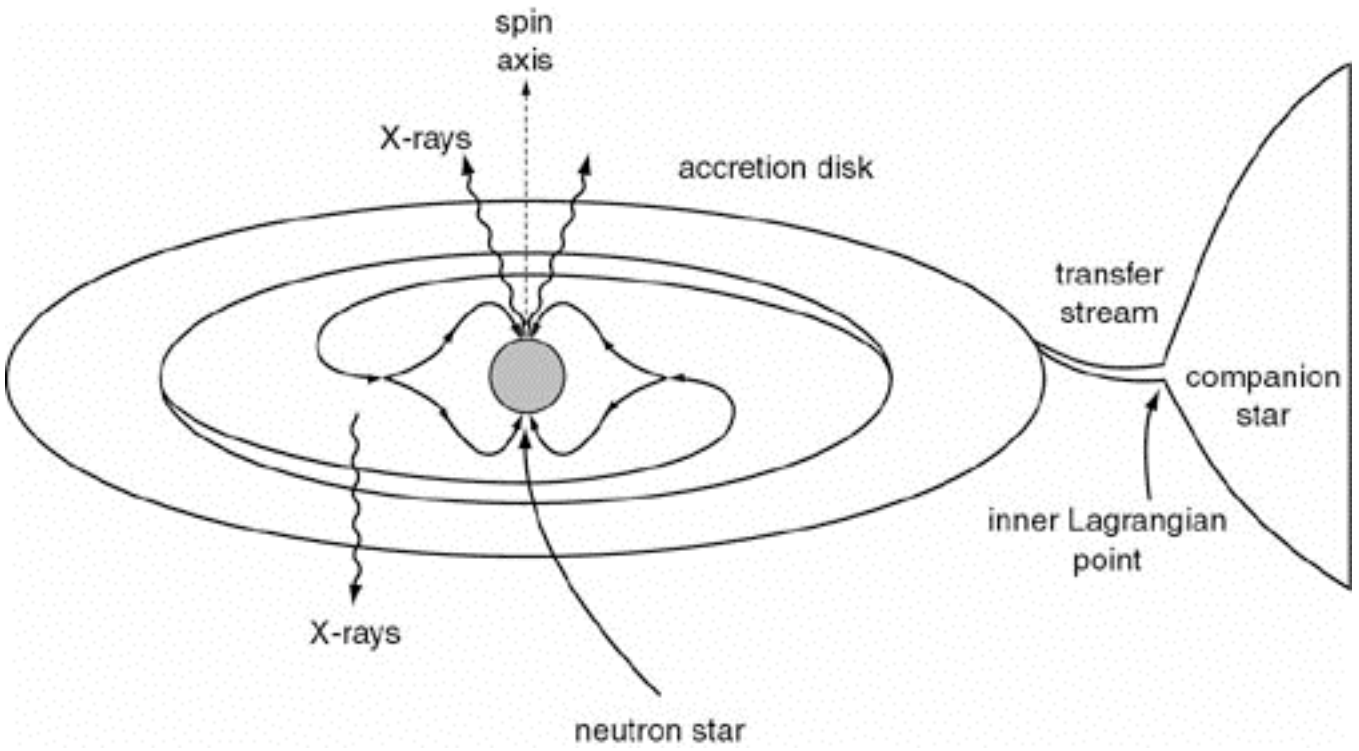
This process automatically channels matter to *magnetic* poles

Matter slams into neutron star at the poles, gets hot, emits X-rays (but kills radio, gamma rays)

Rotation with tilted magnetic field can give X-ray "pulses" by the light house mechanism.

Note that will get X-rays from poles when accreting even if the magnetic poles are aligned with the rotation axis, just not lighthouses "pulses" (unlike radio mechanism that requires tilted poles to radiate at all).

Figure 8.2

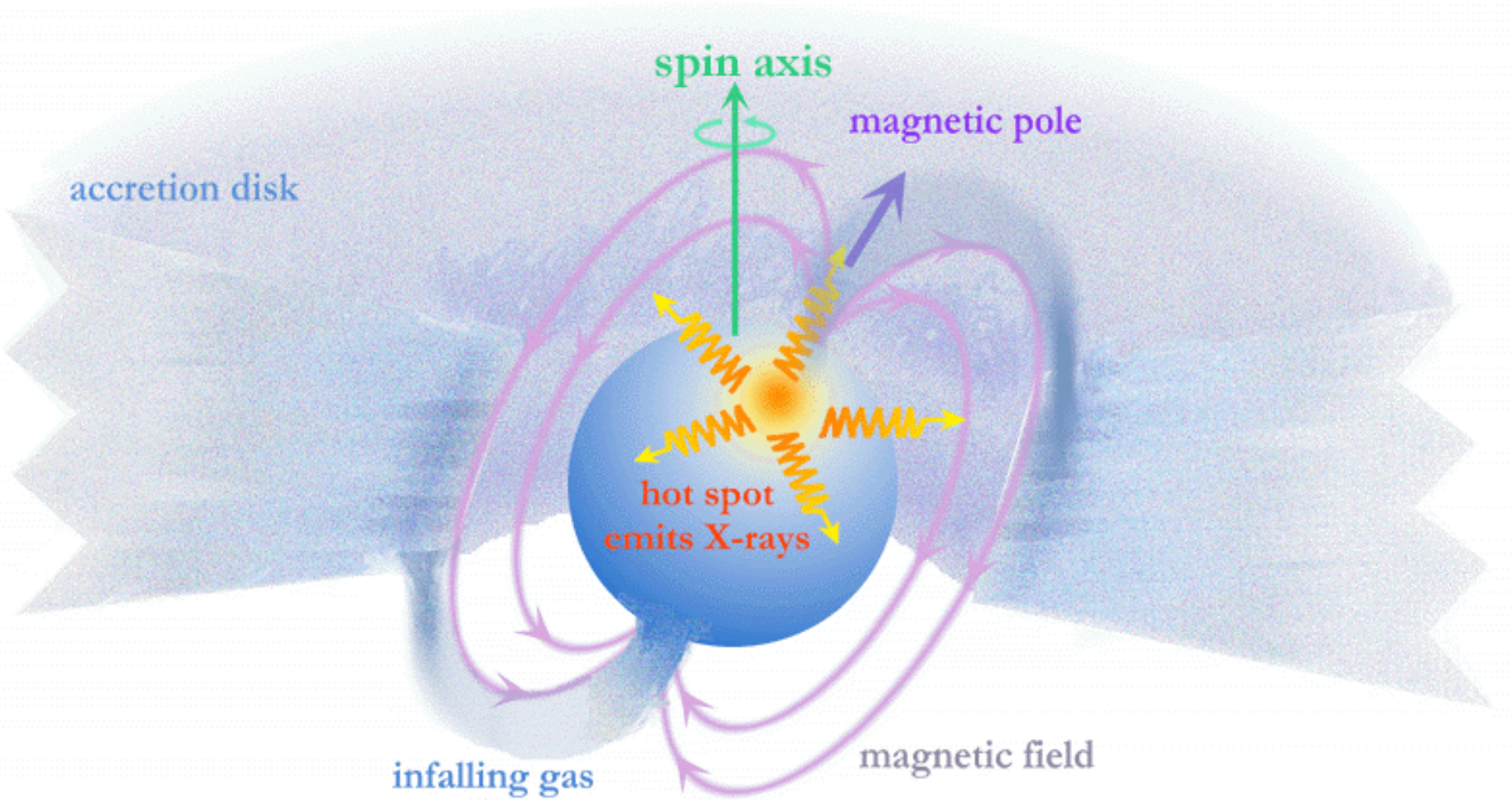


Some neutron stars are in binary systems, they accrete mass through an accretion disk and produce ***X-rays***. X-rays are produced even if the magnetic poles are aligned with the rotation axis, but will not get "pulses" from the light house effect.

Goal:

To understand how neutron stars are observed as X-ray "pulsars."

Accretion onto *tilted* magnetic poles can give pulses of X-rays by “lighthouse” mechanism



Neutron stars for Sky Watch

Single neutron stars Geminga (Section 8.11) in Gemini

Gravitational radiation from pulsar in binary system - Aquila

X-ray pulsars, Her X-1 in Hercules, Cen X-4 in Centaurus

Goal:

To understand the nature of neutron stars with exceptionally large magnetic fields.

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, from 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.]