

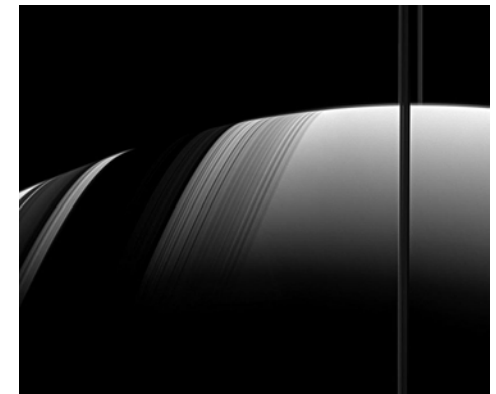
Wednesday, October 12, 2011

Reading: Section 6.7, Chapter 7, Chapter 8 - Sections 8.1, 8.2, 8.5, 8.6, 8.10

Manos new office RLM 16.308, starting Thursday

Astronomy in the news?

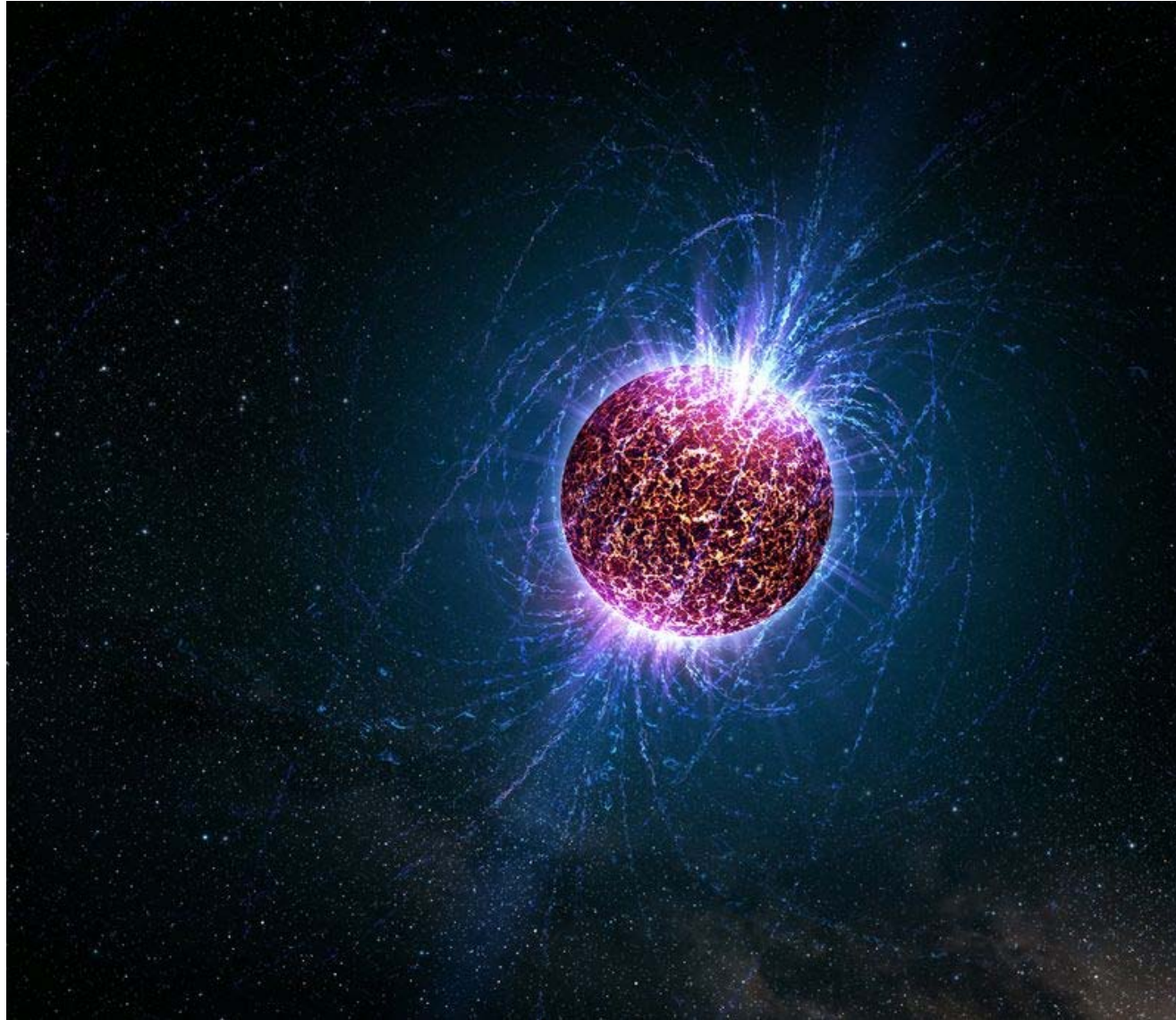
Pic of the day: ring shadows on Saturn from spacecraft Cassini.



Goal:

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

Artist's conception of neutron star with tilted magnetic field.



Courtesy
Casey Reed,
Penn State
University.

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Radio emission from “sparks” “thunderstorms,” blobs of plasma, perhaps at tilted poles or “speed of light” cylinder

Tilted Poles: whip magnetic field around \Rightarrow huge electric fields create huge currents, “thunderstorms” \Rightarrow radio “static”

Speed of light cylinder - distance from rotation axis at which plasma whipped around by “stiff” magnetic field would be moving at the speed of light. The field and plasma must be disrupted there.

Radiation is produced steadily from off-center blobs of plasma, see “pulses” by “lighthouse” mechanism

Flashlights

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

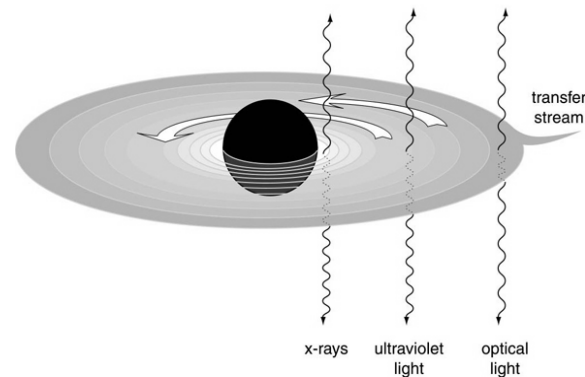
Orbital decay \Rightarrow Gravitational Radiation - Nobel Prize 1993

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 \Rightarrow X-rays, another story

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



Matter lands on, collides with NS Surface \Rightarrow 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 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)

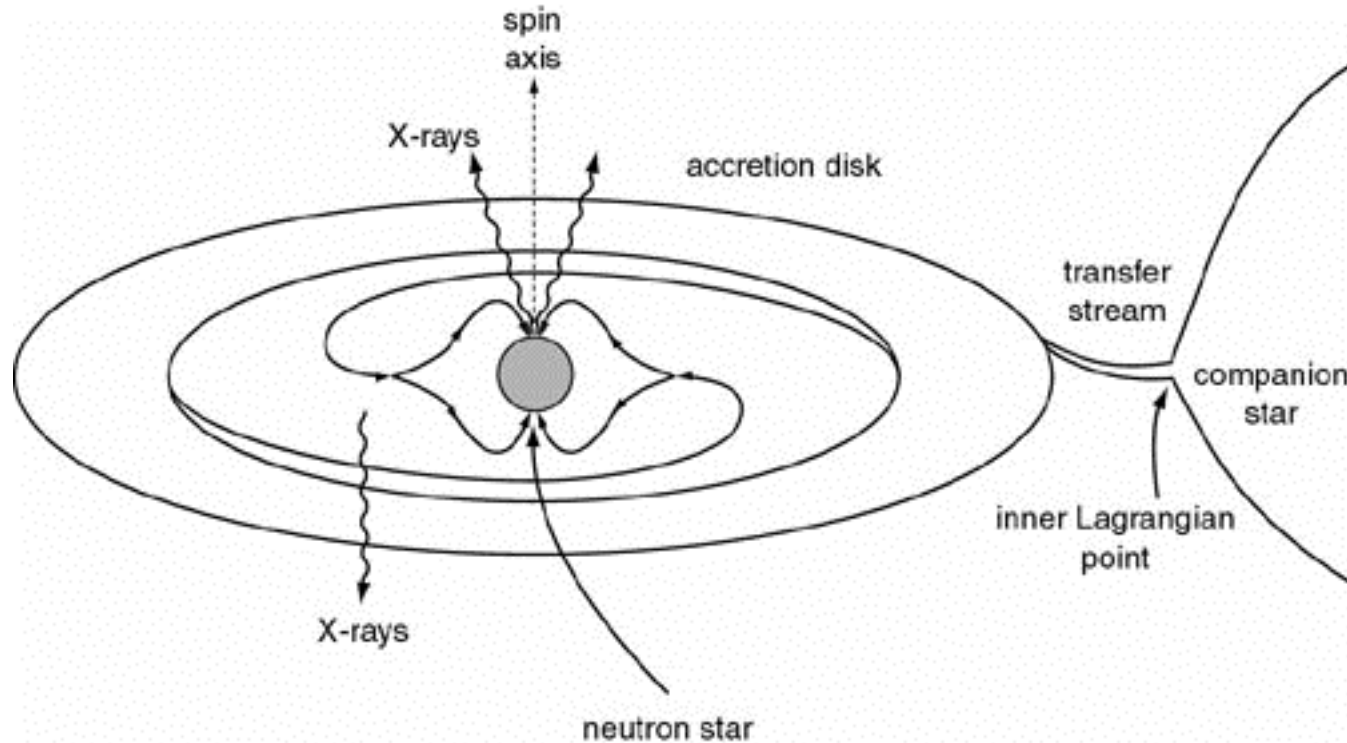
This process automatically channels matter to *magnetic* poles

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

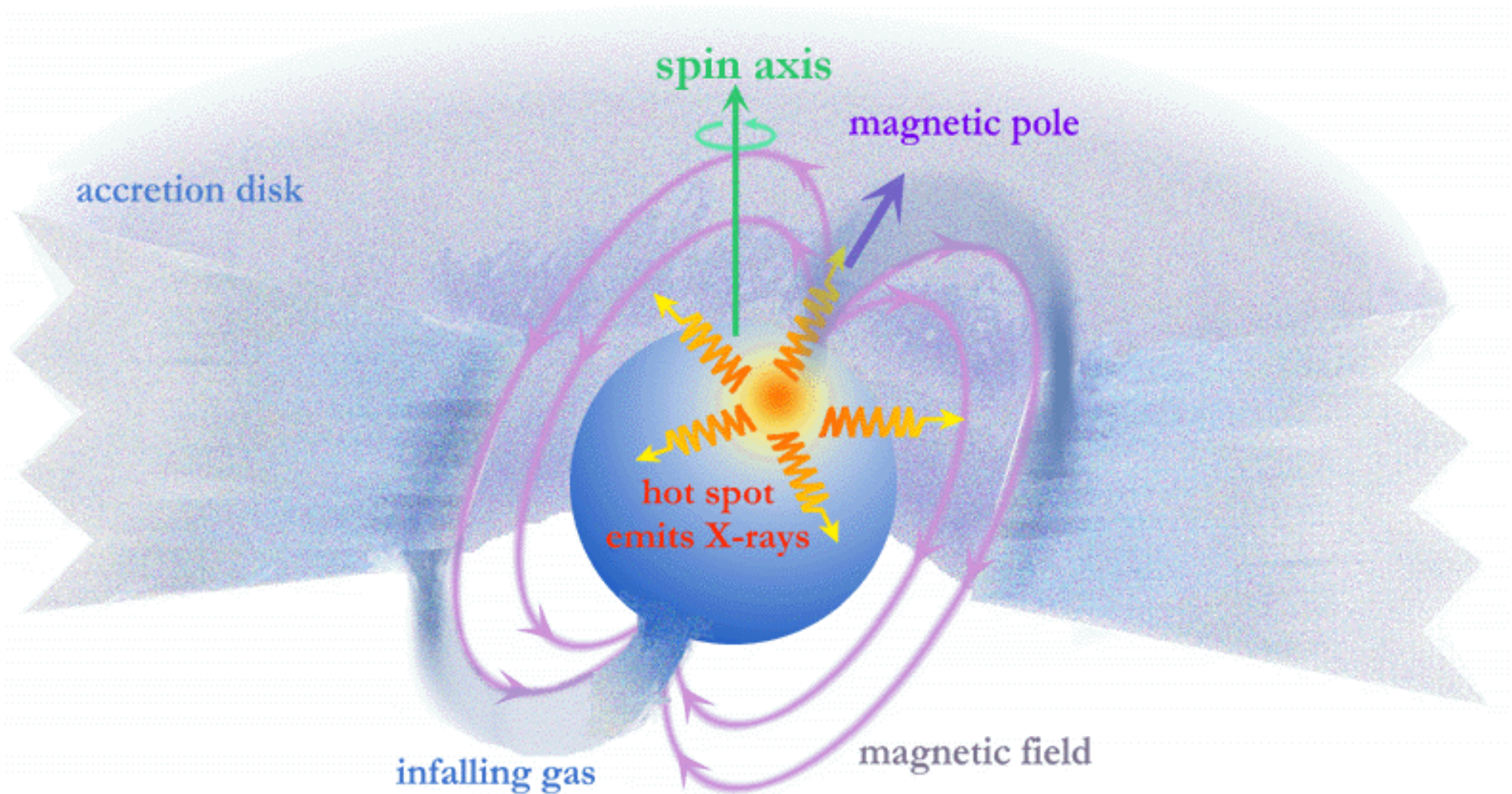


Some neutron stars are in binary systems, they accrete mass through an accretion disk and produce *X-rays*. X-rays are produced even if the magnetic poles are aligned with the rotation axis, but may not get “pulses” from the light house effect.

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 (or other “off-center” effect)



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