Friday, March 25, 2017

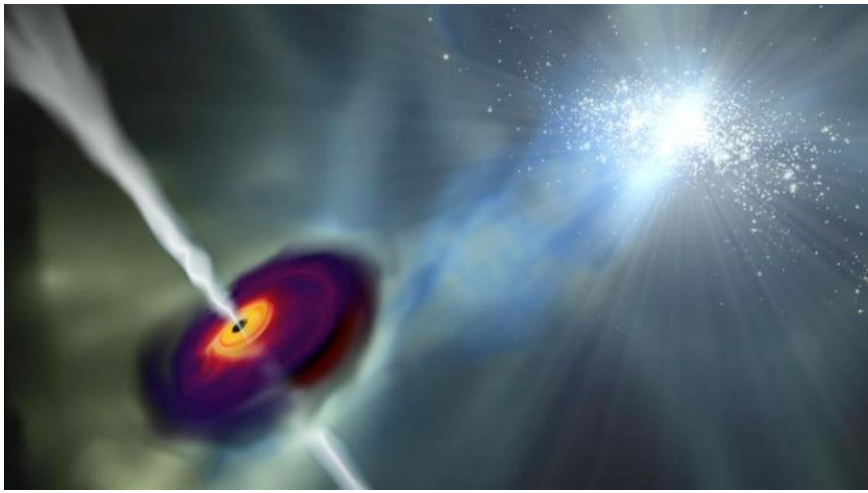
Reading for Exam 3:

Chapter 6, end of Section 6 (binary evolution), Section 6.7 (radioactive decay), Chapter 7 (SN 1987A), Background: Sections 3.1, 3.2, 3.3, 3.4, 3.5, 3.8, 3.10, 4.1, 4.2, 4.3, 4.4, 5.2, 5.4 (binary stars and accretion disks). Plus superluminous supernovae, **not in the book**.

Review Sheet posted on web site and Canvas

Astronomy in the news?

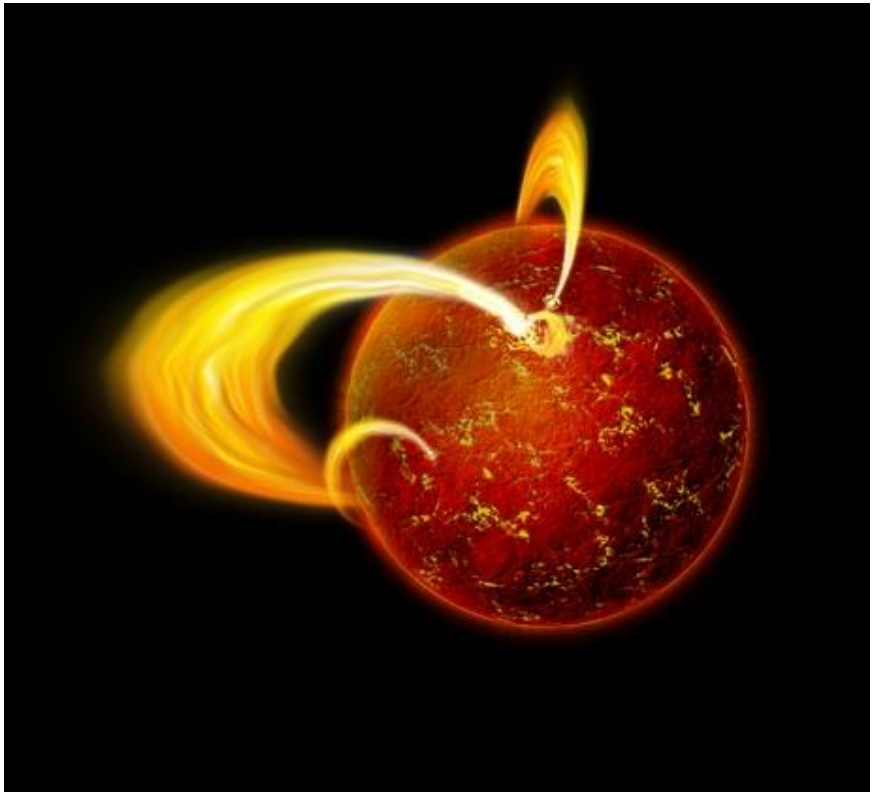
Bright radiation emitted by neighboring galaxies likely fueled the rapid growth of supermassive black holes in the early universe, a new study shows.

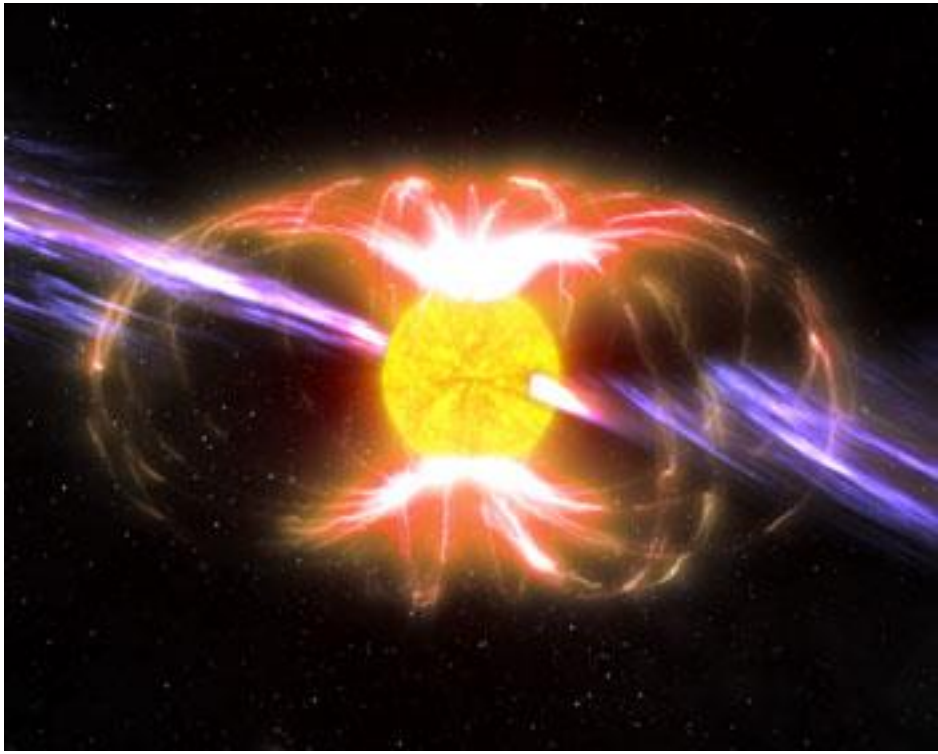


Goal:

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

Magnetars!

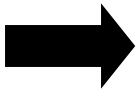




6th Soft Gamma-ray repeater outburst, March, 2010, SGR 1833-0832, in direction of Sagittarius, center of Milky Way, is a magnetar with a "pulsar" spin period of 7.56 seconds. Maybe 1 or 2 more.

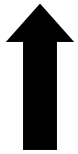
One Minute Exam

Which statement is most relevant to making a radio pulsar?



A solitary neutron star rotates with a tilted magnetic field.

A neutron star accretes matter from a binary companion.



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

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

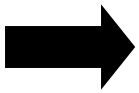
One Minute Exam

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

- A solitary neutron star rotates with a tilted magnetic field.
- A neutron star accretes matter from a binary companion.
- A neutron star with a tilted magnetic field accretes matter from a binary companion.
- A neutron star has a magnetic field 100 times stronger than the pulsar in the Crab nebula.

One Minute Exam

Which statement is most relevant to making a soft gamma-ray repeater outburst?



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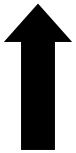

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New Topic: Black Holes

Chapter 9

Reading, Chapter 9: all except 9.6.3, 9.6.4

Goal:

To understand the historical roots and basic theoretical concepts behind black holes and the huge conceptual differences between Newton's and Einstein's view of gravity.

Black Holes

Mitchell, Laplace, late 18th Century: with Newton's Gravity
could have bodies with **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
instantaneous reaction => infinite speed of gravity

In physics infinity $\Rightarrow$ problem

Experiment – Newton's theory predicts the wrong deflection of light.

Need Einstein and more!

Great conceptual differences between Newton and Einstein on the Nature of Gravity

Newton - Force between two objects

Einstein - Mass curves space, objects move *with no force* in curved space

Need to explore curved space - use geometry in multiple dimensions

Goals:

To understand how Einstein taught us to think about space, time, and gravity.

To understand what we mean by space.

To understand how space can be curved.

SPACE - *The Final Frontier*

Dimensions - defined by the number of mutually perpendicular directions

0 D - point

1 D - line

2 D – area or surface

3 D - volume (secret hand sign)

4 D - ?

Hyperspace - space with more dimensions than the one under consideration