Friday, March 4, 2016

Reading for Exam 3, April 1:

Chapter 6, end of Section 6 (binary evolution), Section 6.7 (radioactive decay), Chapter 7 (SN 1987A)

Background in Chapters 3, 4, 5.

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).

Astronomy in the news?

Scott Kelly (not Mark (or Mike))

To Mars in 3 days. Directed Energy Propulsion, push with photons, near speed of light.

DOING SCIENCE!!

Not revealed wisdom. Ideally science is a self-correcting rough and tumble of ideas, observations, experiments, theory.

Fast Radio Bursts, only 17 known.

1. Exciting news, first location of an FRB, in an elliptical galaxy.

Hmmm, no? Prompt report that the elliptical galaxy has an “active nucleus” with “ordinary” variable radiation, so unrelated to the FRB.

2. FRBs never repeat (new, to me, factoid). A popular hypothesis is that they arise as neutron stars merge and collide (see next slides!)

Report yesterday, found a repeating FRB. If so, cannot be a destructive event that destroys the object like merging neutron stars.

Back to the drawing board, more observations, more ideas…

Classical Novae:

Binary systems that have nova explosions seem unable to proceed to Type Ia supernova explosions.

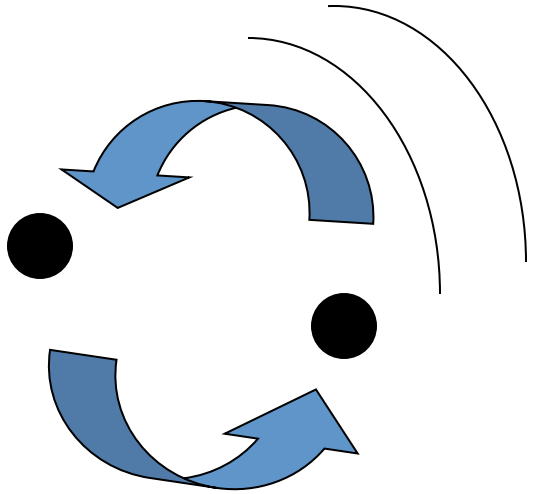
Eventually, the originally less massive star will make a white dwarf, so will have two white dwarfs orbiting one another.

We observe binary systems with two white dwarfs, so we know nature makes them somehow.

Goal – to understand what happens to two white dwarfs in a binary system.

We do observe 2 white dwarfs in orbit in some cases - is that the end?

No: ***gravitational radiation*** (§ 3.10)



ripples in curved space-time

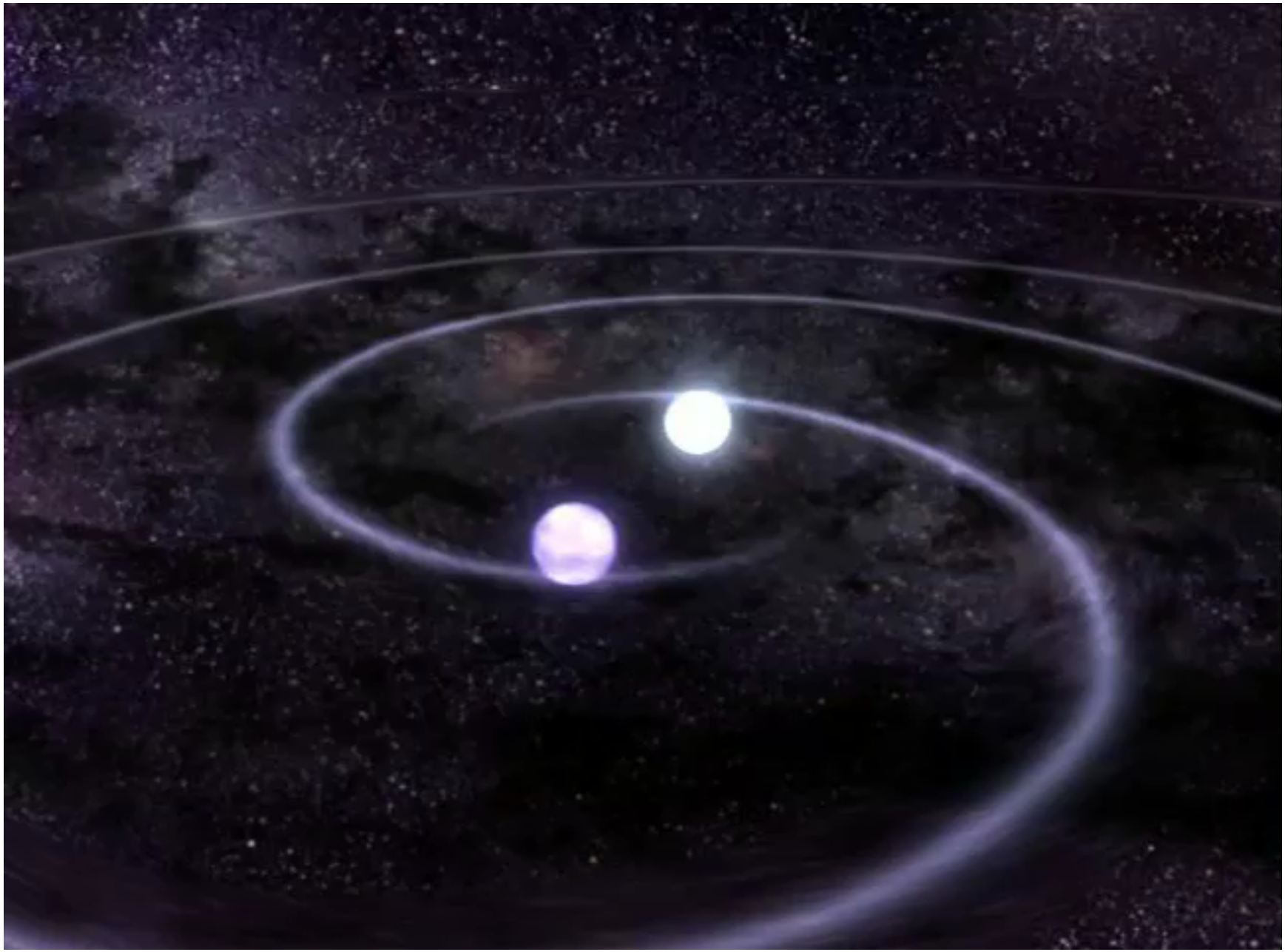
like paddle on surface of pond

remove energy from orbit - acts as drag

If you try to slow down an orbiting object what happens?

Falls inward, speeds up,
Get more gravitational radiation, more inspiral

Given enough time (billions of years) 2 white dwarfs must spiral together!

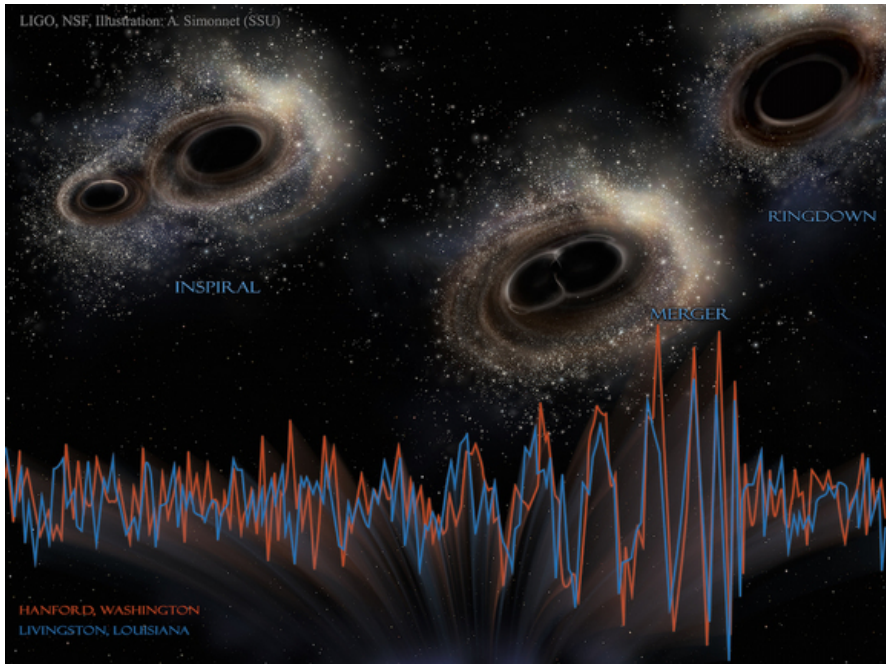


Inspiral by emission of gravitational waves:

Previously deduced indirectly by inspiral of orbit of two neutron stars.

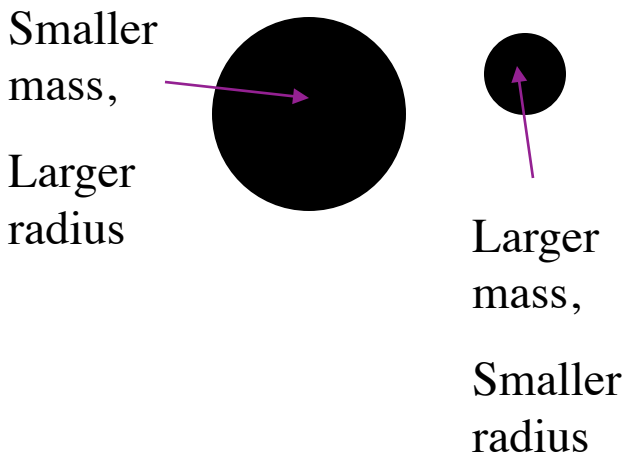
Last year inspiral of two orbiting white dwarfs detected for the first time by Texas astronomers, Don Winget and J. J. Hermes.

Now the actual detection by LIGO of the gravitational waves themselves for two inspiraling black holes.



What happens when two white dwarfs spiral together?

New physical fact:
Larger mass WD has smaller radius



Which WD has the smaller Roche lobe?

What happens to the size of the Roche lobes as the WDs spiral closer by gravitational radiation?

Which fills its Roche Lobe first?

When that WD fills its Roche lobe and transfers mass, what happens to its radius?

When that WD fills its Roche lobe and transfers mass, what happens to its Roche lobe?

What happens to the white dwarf?

What happens when two white dwarfs spiral together?

Which WD has the smaller Roche lobe?

The smaller mass

What happens to the Roche lobes as the WDs spiral closer by gravitational radiation?

They both get smaller

Which fills its Roche Lobe first?

Must be the smaller mass

As small mass WD loses mass, its ***radius gets larger***,
but its ***Roche Lobe gets smaller***! Runaway mass transfer.

Small mass WD transfers essentially all its mass to larger mass WD

Could end up with one larger mass WD

If larger mass hits M_{ch} → could get explosion => Supernova