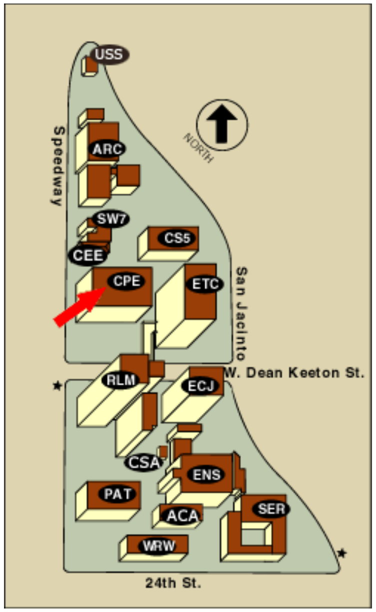
Monday, February 20, 2012



Exam 2 on Friday. Review sheet posted today.

Review session, Thursday, 5 – 6 pm, CPE 2.214

Second Sky Watch due Friday.

Reading: Sections 6.1 (Type Ib/c), 6.4, 6.5 (but not detail on polarization), 6.6, Betelgeuse, Section 1.2.1 (neutrinos), Sections 2.1, 2.2, 2.4, 2.5, Sections 3.1 – 3.5, 3.8, 4.1 – 4.4, 5.2, 5.4. [Evolution of 2 white dwarfs, end of Section 5.4 and Section 6.7 will be on Exam 3]

Astronomy in the news?

News:

50th anniversary of John Glenn orbiting the Earth, February 20, 1962.

Goal

To understand how stars, and Type Ia supernovae, evolve in binary systems.

One Minute Exam:

Two stars are born orbiting one another in a binary system. Which star will transfer matter first?

➡ The most massive star

⬅ The least massive star

⬆ The one with the smaller Roche lobe

⬇ The one with the smaller radius

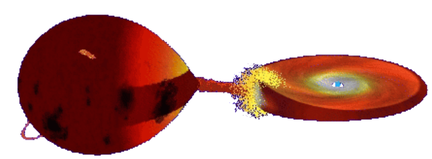
First star evolves, sheds its envelope, leaves behind a white dwarf.

Then the second star that was ***originally*** the less massive evolves, fills its Roche Lobe and sheds mass onto the white dwarf.

The white dwarf is a tiny moving target, the transfer stream misses the white dwarf, circles around it, collides with itself, forms a ring, and then settles inward to make a flat disk.

Matter gradually spirals inward, a process called ***accretion.***

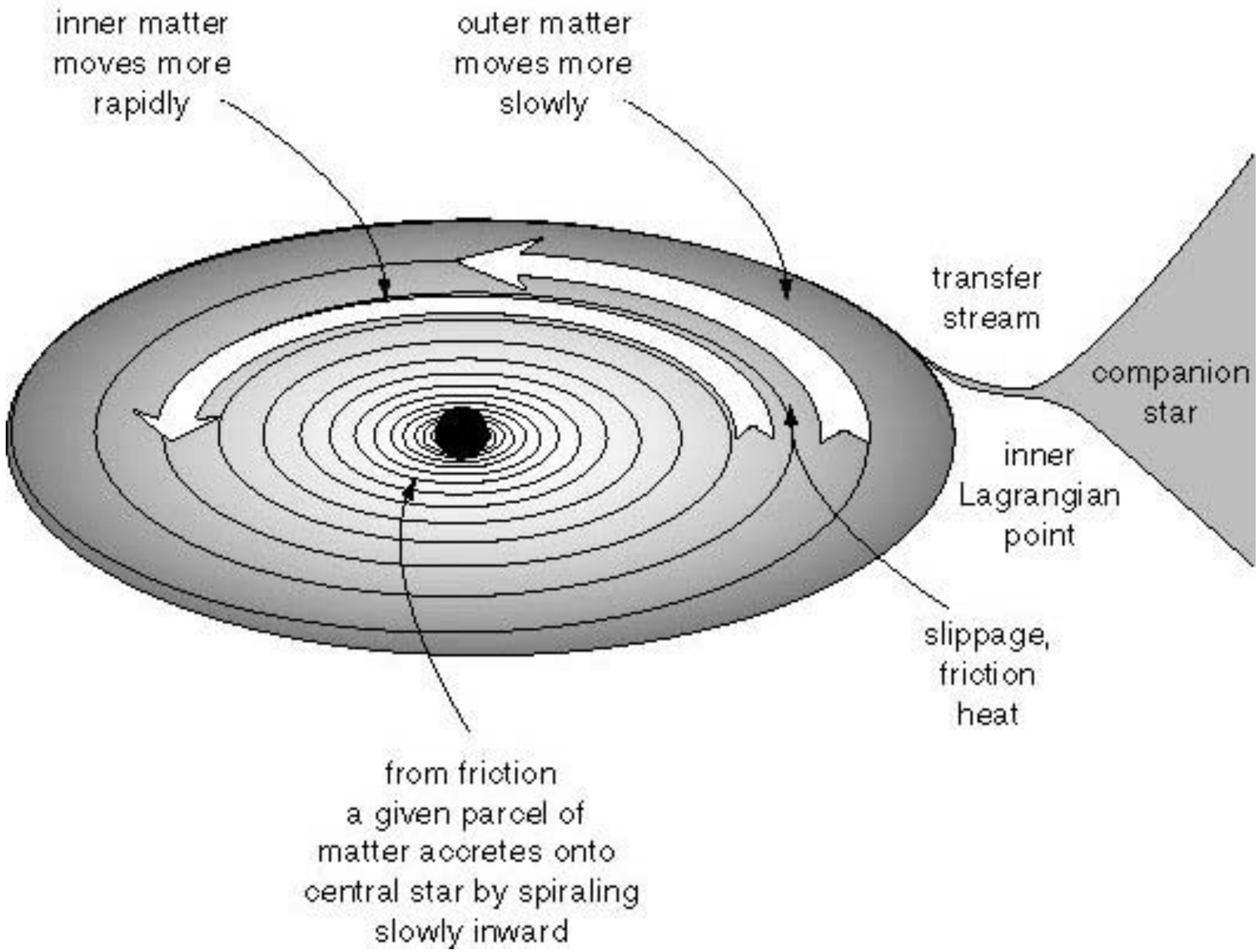
⇒ the result is an ***Accretion Disk*** (Chapter 4).



An accretion disk requires a transferring star for supply and a central star to give gravity, but it is essentially a separate entity with a structure and life of its own.

Goal – to understand how accretion disks work, what sort of radiation they emit.

Basic Disk Dynamics - Figure 4.1



Demonstration of Accretion Disk Dynamics

Need a volunteer

Goal

To understand how accretion disks shine and cause matter to accrete onto the central star.

Basic Disk Dynamics

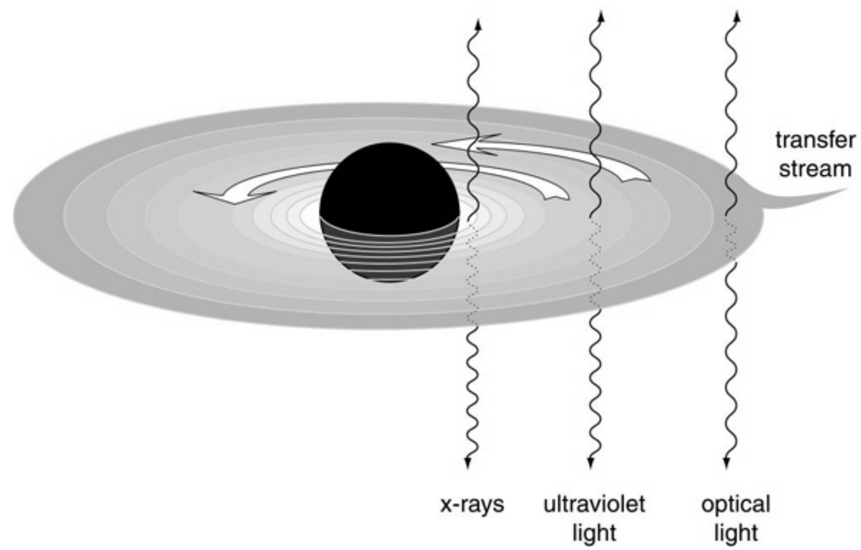
Orbits closer to the center are faster.
This creates rubbing and friction and heat, everywhere in the disk.

Friction tries to slow the orbiting matter, but it falls ***inward*** and ends up moving ***faster***.
(Just as removing heat from a normal star causes it to get hotter)
Slow settling inward by friction -- ***accretion***

Friction also causes ***heat.***

Hotter on inside, cooler on outside

Optical	→	UV	→	X-rays
		WD		NS, BH



One Minute Exam:

In an accretion disk, friction causes moving matter to

➡ Slow down

⬅ Speed up

⬆ Move outward

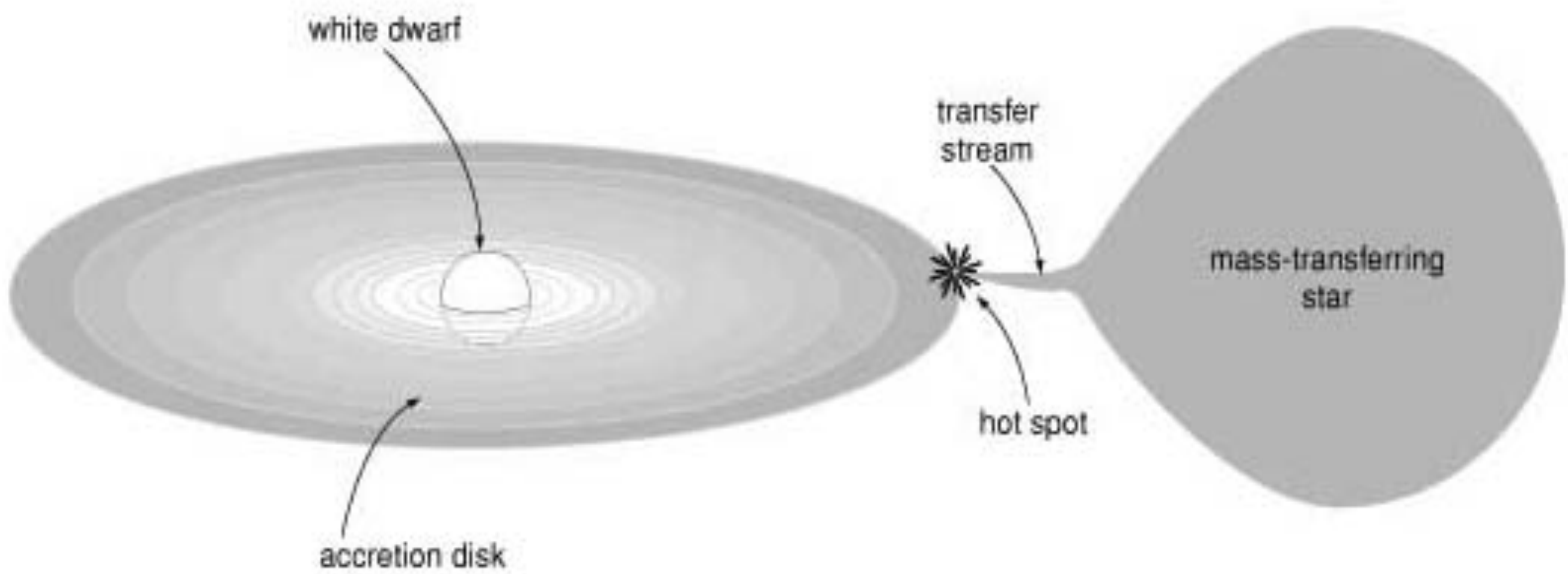
⬇ Pass from one Roche lobe to another

Goal – to understand how white dwarfs in binary star systems can, and cannot, grow to the Chandrasekar mass and explode.

Cataclysmic Variables

Second stage of mass transfer (Section 5.2)
General Category “Novae”
“New” stars flare up, see where none had been seen before.

All CVs share same general features: ***transferring star***, ***transfer stream***, ***hot spot***, ***accretion disk***, and ***white dwarf***.



§ 5.4 Final Evolution of Cataclysmic Variables

Some CVs have managed to reach large white dwarf masses
$M_{wd} \sim M_{ch}$ Chandrasekhar mass, 1.4 solar masses, like U Sco

If get close enough to M_{ch}, attain high density,
ignite carbon in center
Quantum Deregulated → violent explosion
Type Ia Supernova?!

What CVs have white dwarfs that reach M_{ch}?
Not classical novae
explosion of surface H shell also rips off a bit of the white dwarf mass - we see excess carbon & oxygen in ejected matter
white dwarf shrinks in mass rather than grows.

Likely outcome in this case - 2nd star finally burns out H, tries to form red giant, mass transfer => ***Two WDs!***