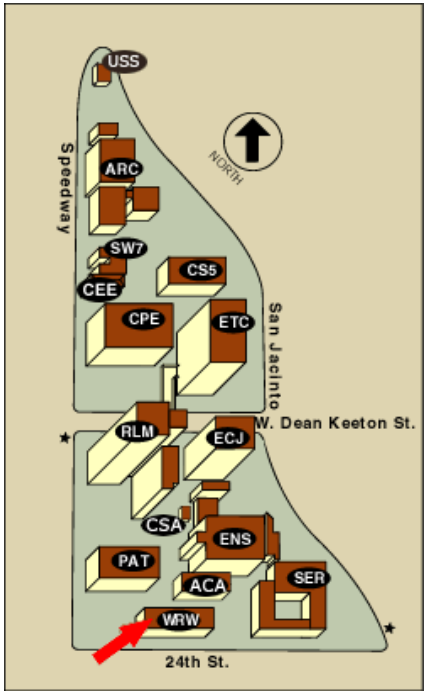
Wednesday, October 2, 2013

Exam 2 Friday. Review sheet posted.

Review session Tomorrow, 5 – 6 PM, WRW 102

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?

Government shut down. No astronomy picture of the day

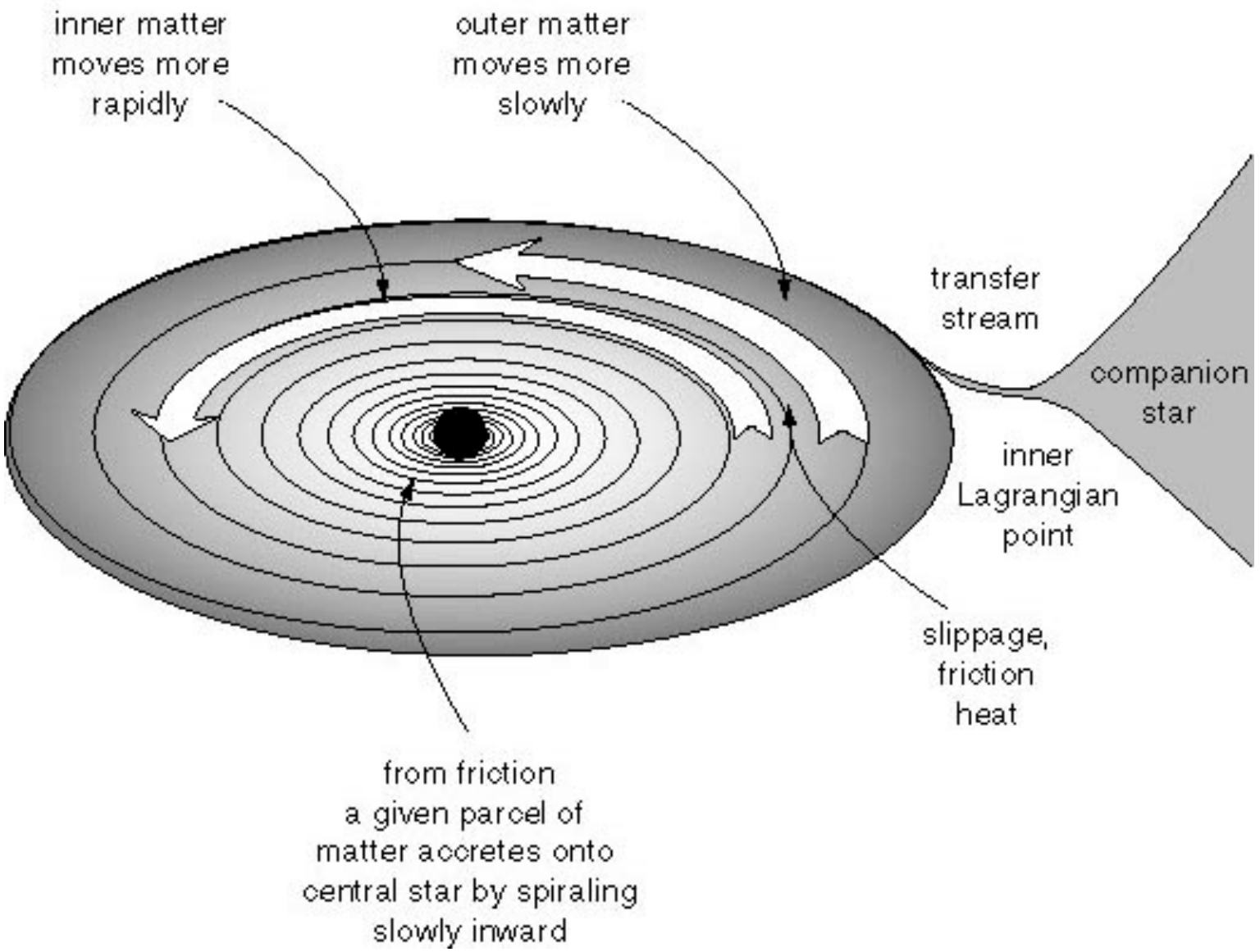
Goal

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

Goal

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

Basic Disk Dynamics - Figure 4.1



Demonstration of Accretion Disk Dynamics

Need a volunteer

Basic Disk Dynamics

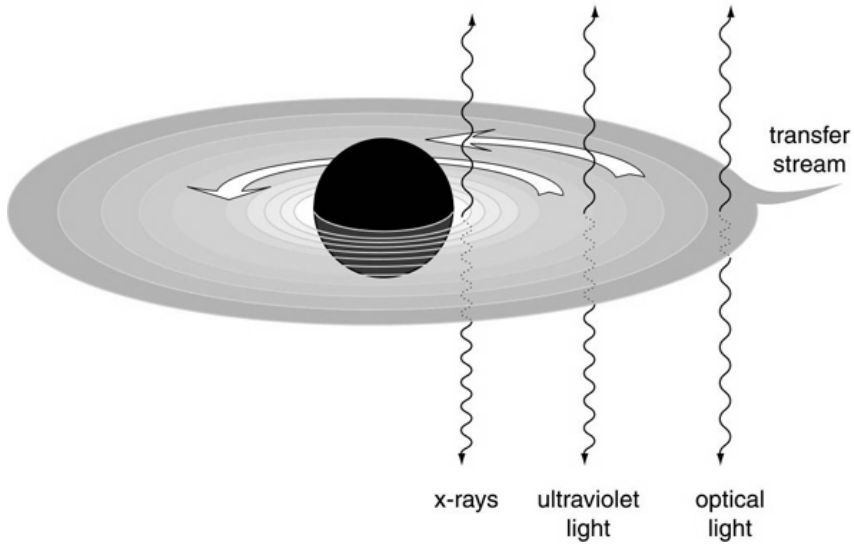
Orbits closer to the center are faster.
This creates rubbing and friction and heat, everywhere in the disk.

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

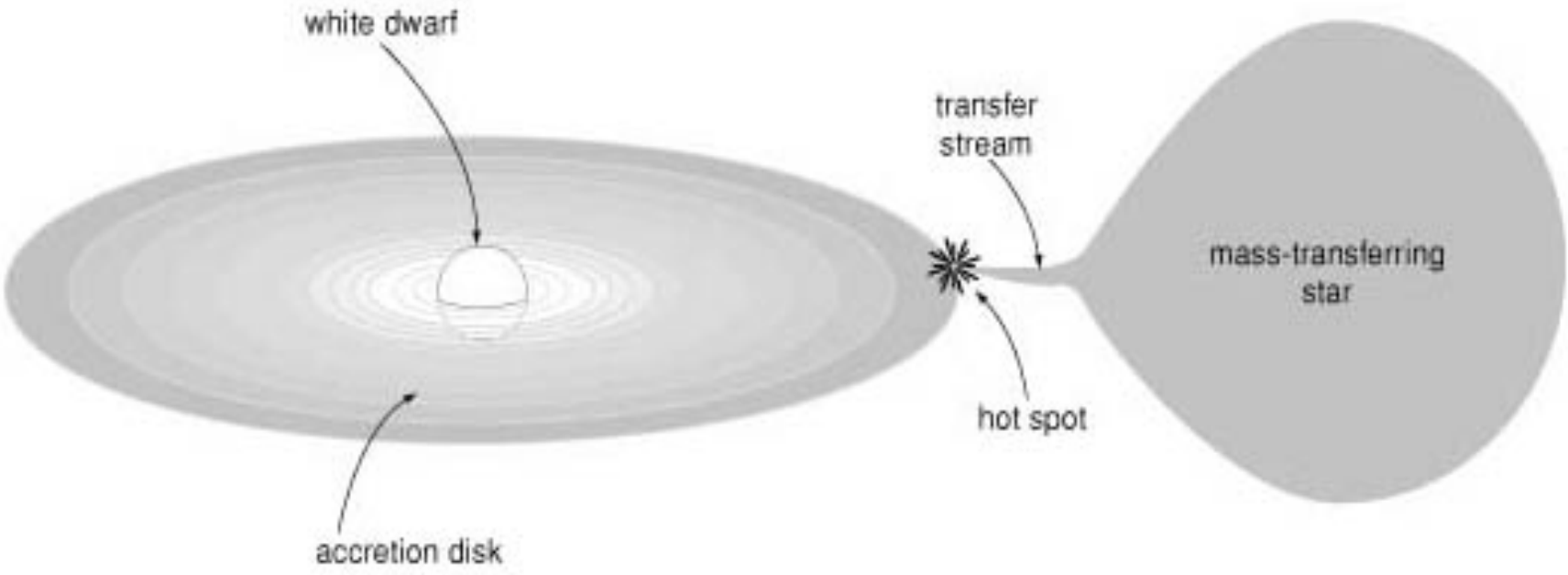


Goal – to understand how white dwarfs in binary star systems can, and cannot, grow to the Chandrasekar mass and explode.

Cataclysmic Variables

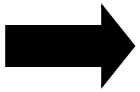
Second stage of mass transfer (Section 5.2)
General Category "Novae"
"New" stars flare up, see where none had been seen before.

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

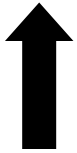


One Minute Exam:

In an accretion disk, friction causes moving matter to

 Slow down

 Speed up

 Move outward

 Pass from one Roche lobe to another

§ 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, RS Oph

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}?

Classical Novae:

Infrequent outbursts, powerful explosions on the surface of a white dwarf.

Not a supernova, the white dwarf survives.
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 growing to the Chandrasekhar Limit.

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

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

Eventually, the other star will make a white dwarf, so will have two white dwarfs orbiting one another (details to follow, and to be on third exam).

Recurrent Novae like U Sco, RS Oph:

More frequent outbursts, less disruptive explosions on the surface of a white dwarf.

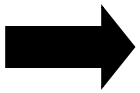
Recurrent nova systems do seem to have large mass white dwarfs that are gaining mass.

Encouraging, but maybe not enough of them to account for the rate of explosions of Type Ia supernovae.

Exactly what kind of binary system gives rise to Type Ia supernovae is not yet known.

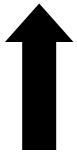
One Minute Exam

We expect classical nova systems to end up making two white dwarfs orbiting one another because:



The first white dwarf loses mass and hence cannot grow and explode

The first white dwarf will accrete mass until it reaches the Chandrasekhar limit



The main sequence star transferring mass must eventually make a white dwarf

The second white dwarf has the Chandrasekhar mass

Sky Watch

Algol

Classical Novae:

CP Pup, toward constellation Puppis in 1942

Pup 91, another toward Puppis in 1991 (not same place in our Galaxy, just accidently off in the same approximate direction)

QU Vul, toward constellation Vulpecula, white dwarf composed of Oxygen, Neon, and Magnesium rather than Carbon and Oxygen.

GK Per toward constellation Perseus - has had both a classical nova eruption in 1901 and dwarf nova eruptions.

Sky Watch

Recurrent Novae:

U Sco in the constellation Scorpius is a Recurrent Nova,
It may be a candidate to explode as a supernova!

Might see Scorpius. Also has neutron stars and black holes.

T Pyx in constellation Pyxis.

RS Oph in constellation Ophiucus

End of Material for Exam 2