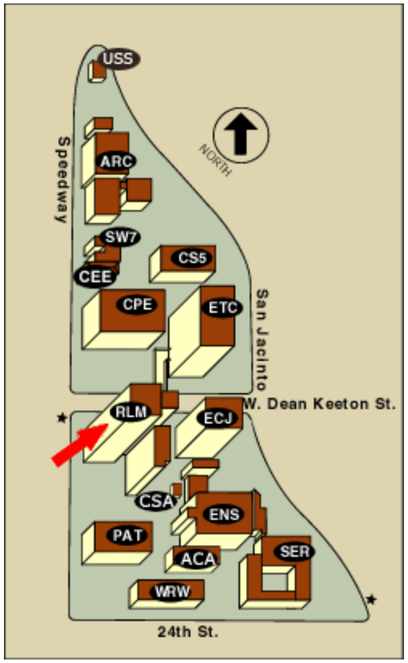
Wednesday, September 28, 2011



Exam 2 on Friday. Review sheet posted.

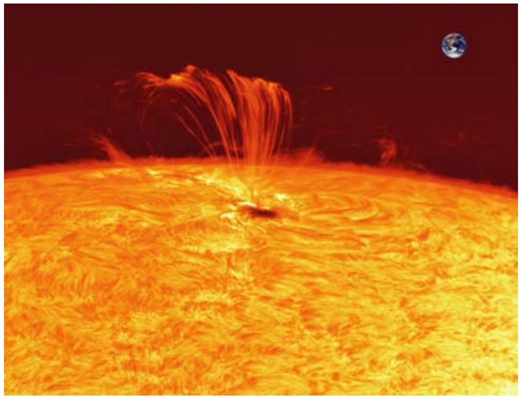
Review session, Thursday, 5 – 6 pm, RLM 4.102 (ground floor)

Second Sky Watch due.

Reading: Sections 6.4 - 6.7, Betelgeuse, Section 1.2.1, Sections 2.1, 2.2, 2.4, 2.5, Sections 3.1 – 3.5, 4.1 – 4.4.

Astronomy in the news?

Pic of the day: huge sunspots, flares, magnetic streams on Sun



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

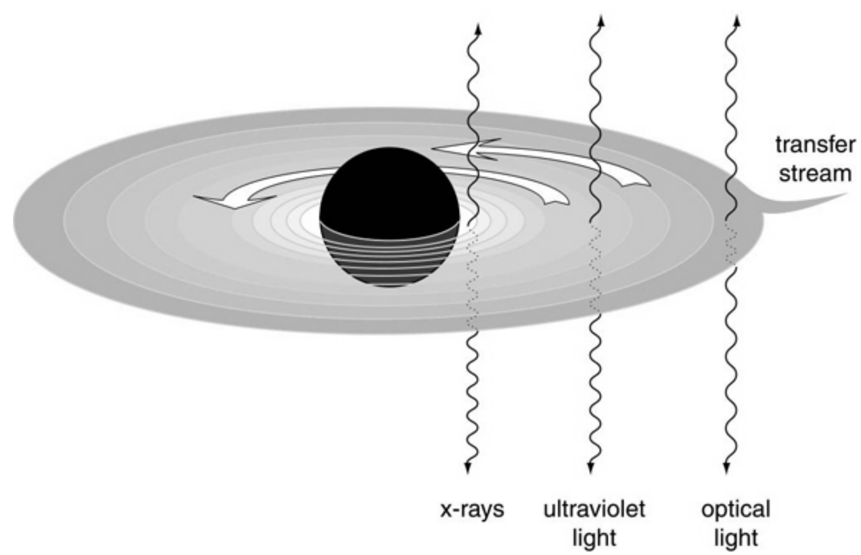
Orbits closer to the center are faster.
This creates rubbing and friction and heat, everywhere in the disk.

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

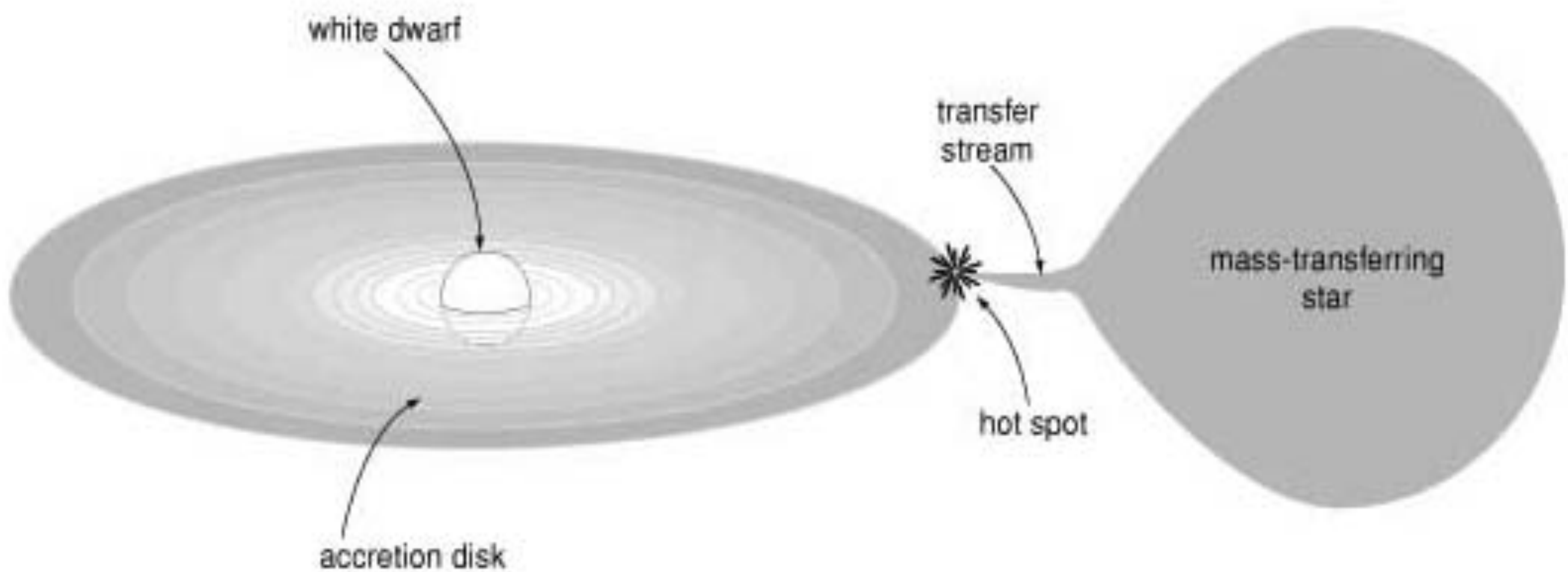
↓ Pass from one Roche lobe to another

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
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 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!***

Classical Novae:

Infrequent outbursts, powerful explosions on surface of white dwarf.

Problem with losing mass from white dwarf during surface explosions.

Recurrent Novae like USco:

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

Do seem to have large mass white dwarfs, 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.

Sky Watch

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.

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

End of Material for Exam 2

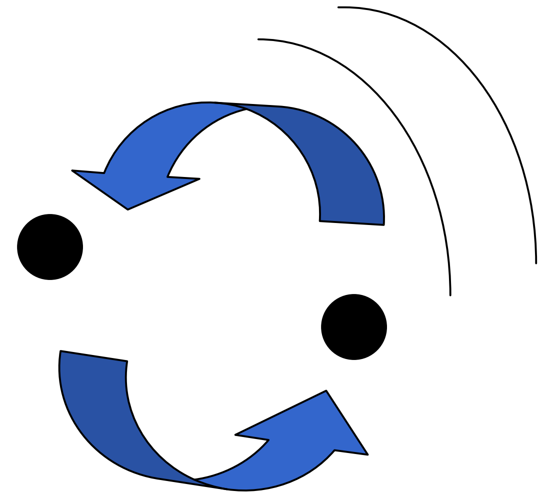
Goal – to understand what happens to two white dwarfs in a binary system.

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!