Friday, March 7, 2014

Exam 2, Skywatch 2, back

Reading for Exam 3: End of Section 6.6, Chapter 7

Background: Sections 3.3, 3.4, 3.5, 3.10, 4.1, 4.2, 4.3, 4.4, 5.2, 5.4, binary stars and accretion disks.

Astronomy in the news:

Kepler satellite team announced last week 715 more exoplanets around 305 stars. Total number of exoplanets known now about 1,700. Most have masses between that of gassy Neptune (17 Earth masses) and rocky Earth. Four are in the habitable zone of their stars, so might have liquid water and harbor life.

Wheeler's meeting in Washington, DC: how best for NASA and the National Science Foundation to do astronomy with limited budgets, including the origin of the Universe, the search for life elsewhere, and everything in between.

Update on new "nearby" supernova SN 2014J in M82

Wheeler is co-author on a paper led by Howie Marion on the infrared spectra and specifically on evidence that there is a smidgen of unburned carbon in the explosion. The explosion needs to burn most, but not quite all the original carbon in the white dwarf.

The President's new budget for 2015 proposes to put the SOFIA flying observatory into storage. Expensive to operate, not enough "bang for the buck."

Goal

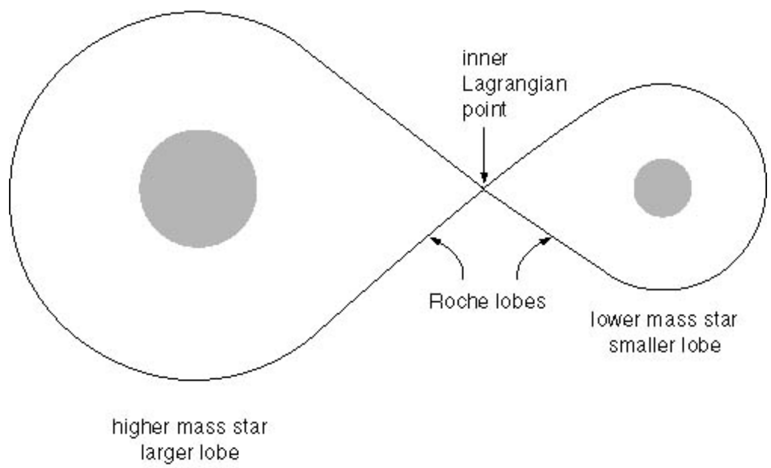
To understand how stars, and Type Ia supernovae, evolve in binary systems.

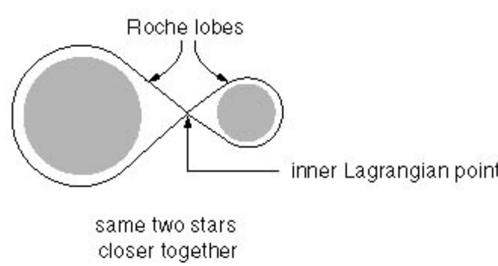
Binary Stars - Chapter 3

Roche Lobes Fig 3.1

Roche lobe is the gravitational domain of each star. Depends on size of orbit, but more massive star always has the largest Roche lobe.

3.1





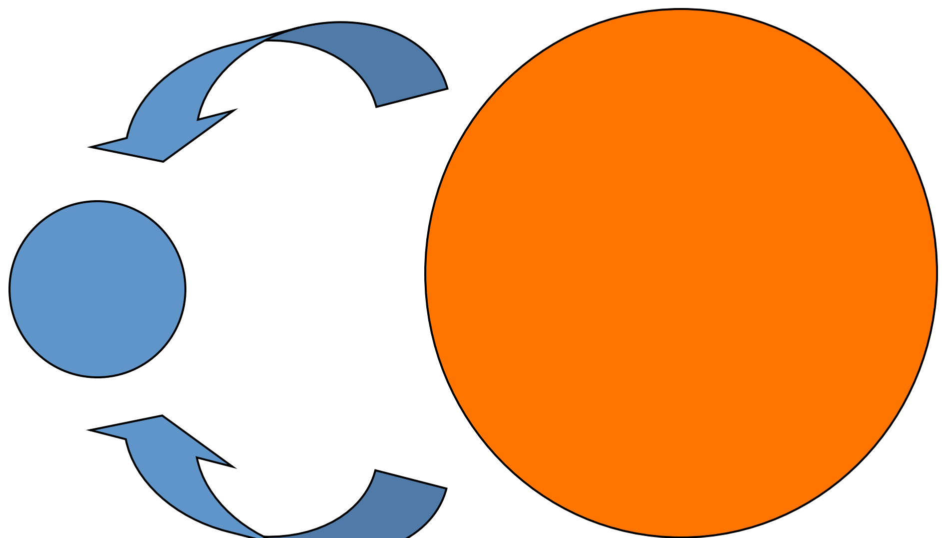
Caution: the most massive star may not have the largest radius!

Solution to Algol Paradox

Mass Transfer

The red giant swells up, fills then overfills its Roche lobe and transfers mass to the companion.

The star that will become the red giant starts as the more massive star, but ends up the less massive.

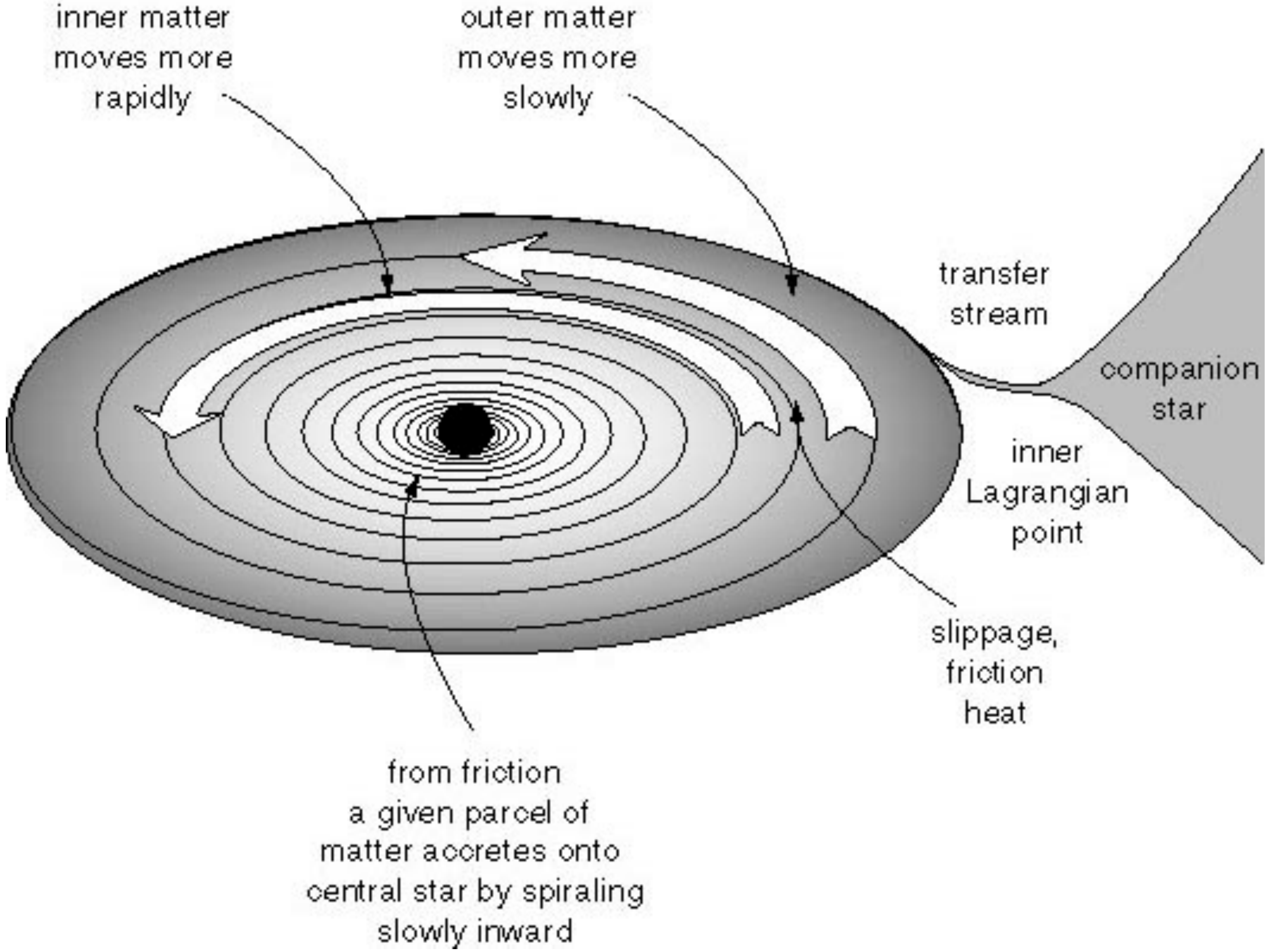


Which star is the most massive?

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

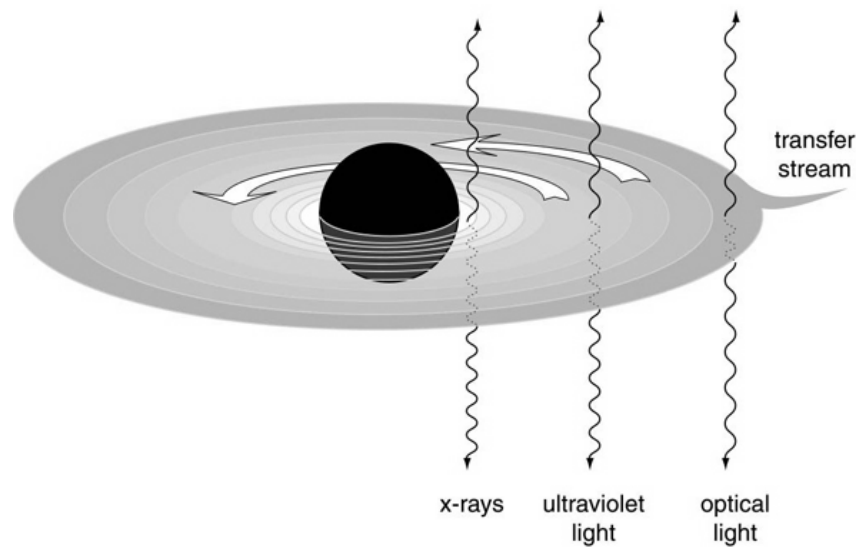
Orbits closer to the center are faster.
This creates rubbing and friction and heat, everywhere in the disk.

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 $\rightarrow$ UV $\rightarrow$ X-rays
WD NS, BH

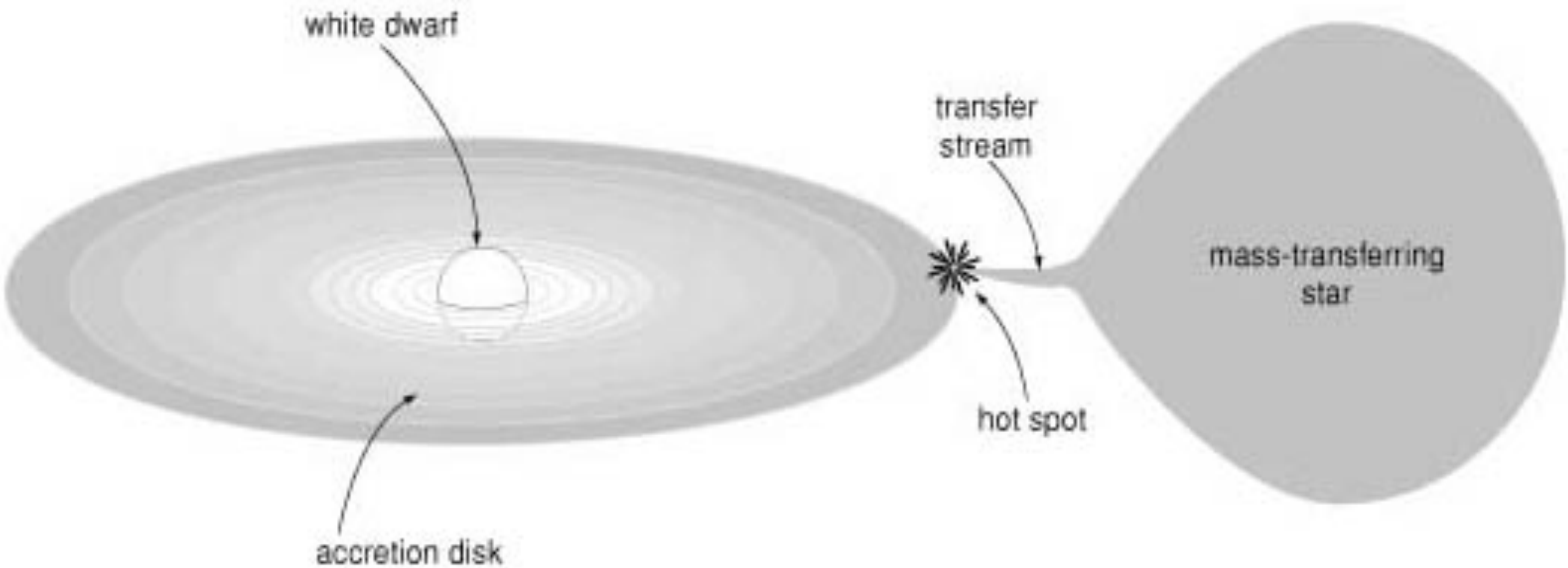


Goal – to understand how white dwarfs in binary star systems can, and cannot, grow to the Chandrasekar mass and explode.

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}?