2/2/05

First Test, Chapters 1 - 5, Friday, February 11

Review sheet posted on web site

Help Session with Jen Sobeck ***tomorrow*** at 5 PM, RLM 15.216B

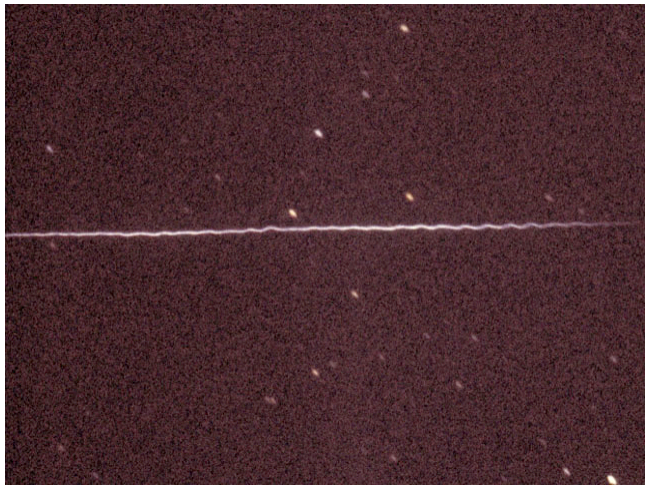
Wheeler on travel next week. Film Monday on Supernovae (topic of second exam).

Review session in class Wednesday, also Thursday 5 PM RLM 15.216B.

Astronomy in the news?

Wheeler elected President of the American Astronomical Society

Pic of Day - rotating meteor



§5.3 Origin of Cataclysmic Variables

Cataclysmic variables often have a ***main sequence companion transferring mass*** -- how can this be?

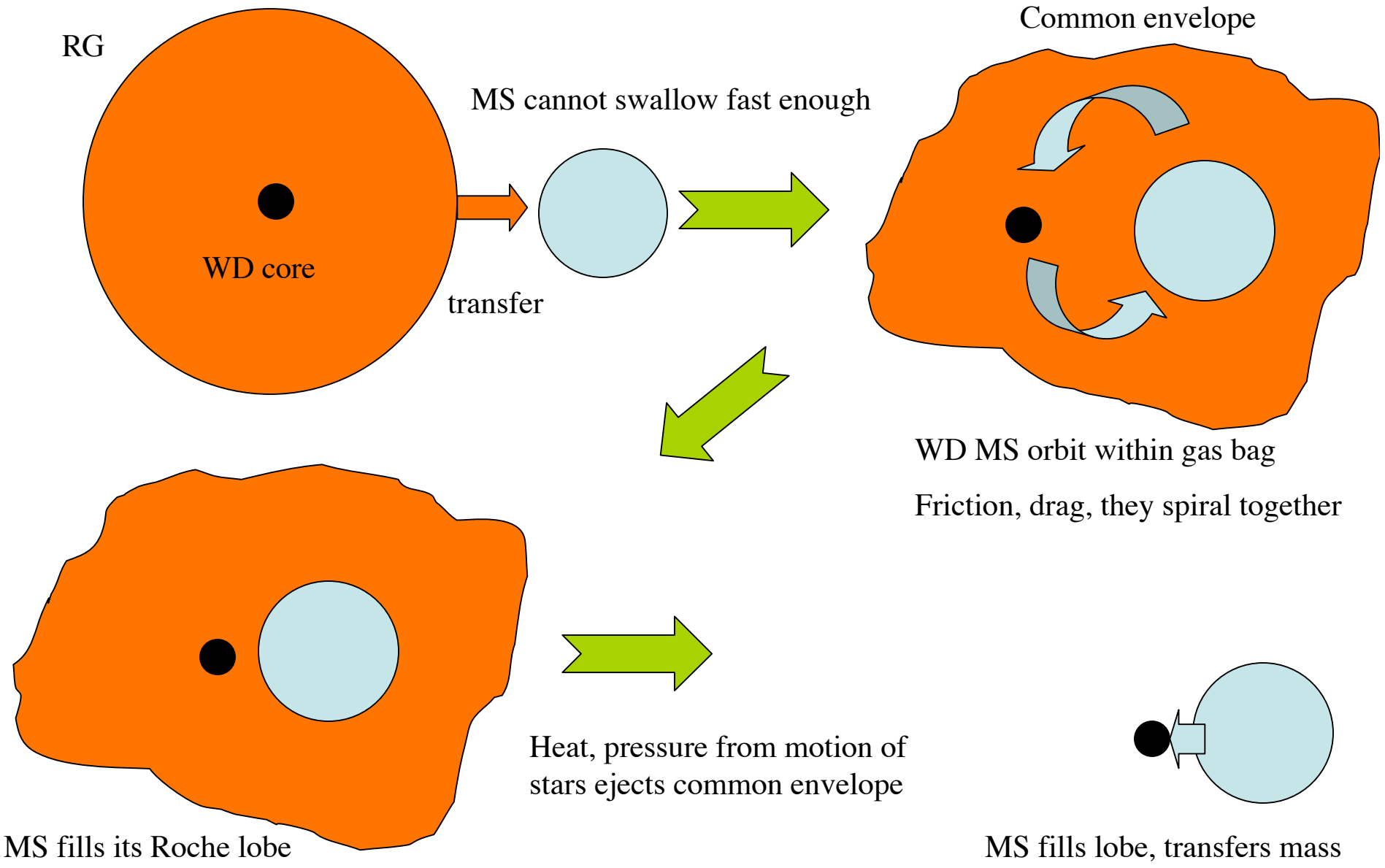
The two stars must once have been far apart to allow the originally more massive star to make a red giant with a white dwarf core.

Need room!!

The stars are observed now to be close together with the main sequence star filling its Roche lobe.

The main sequence star has not expanded to become a red giant, how come it is filling its Roche lobe?

Answer: § 3.9 Common Envelope Evolution



§ 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

Supernova (Chapter 6)

What CVs 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, likely makes a 2nd common envelope => ***Two WDs!***

Clearly some systems like U Sco escape this fate - How?

Recent work suggests that transfer of mass at just the right fast rate allows the H layer to stay hot, ***thermal pressure, regulated***

H burns to He, He to C and 0 that are added to white dwarf

M_{wd} grows in C/0 mass

A binary system could be a classical nova for some time
then accrete faster, grow to M_{ch}

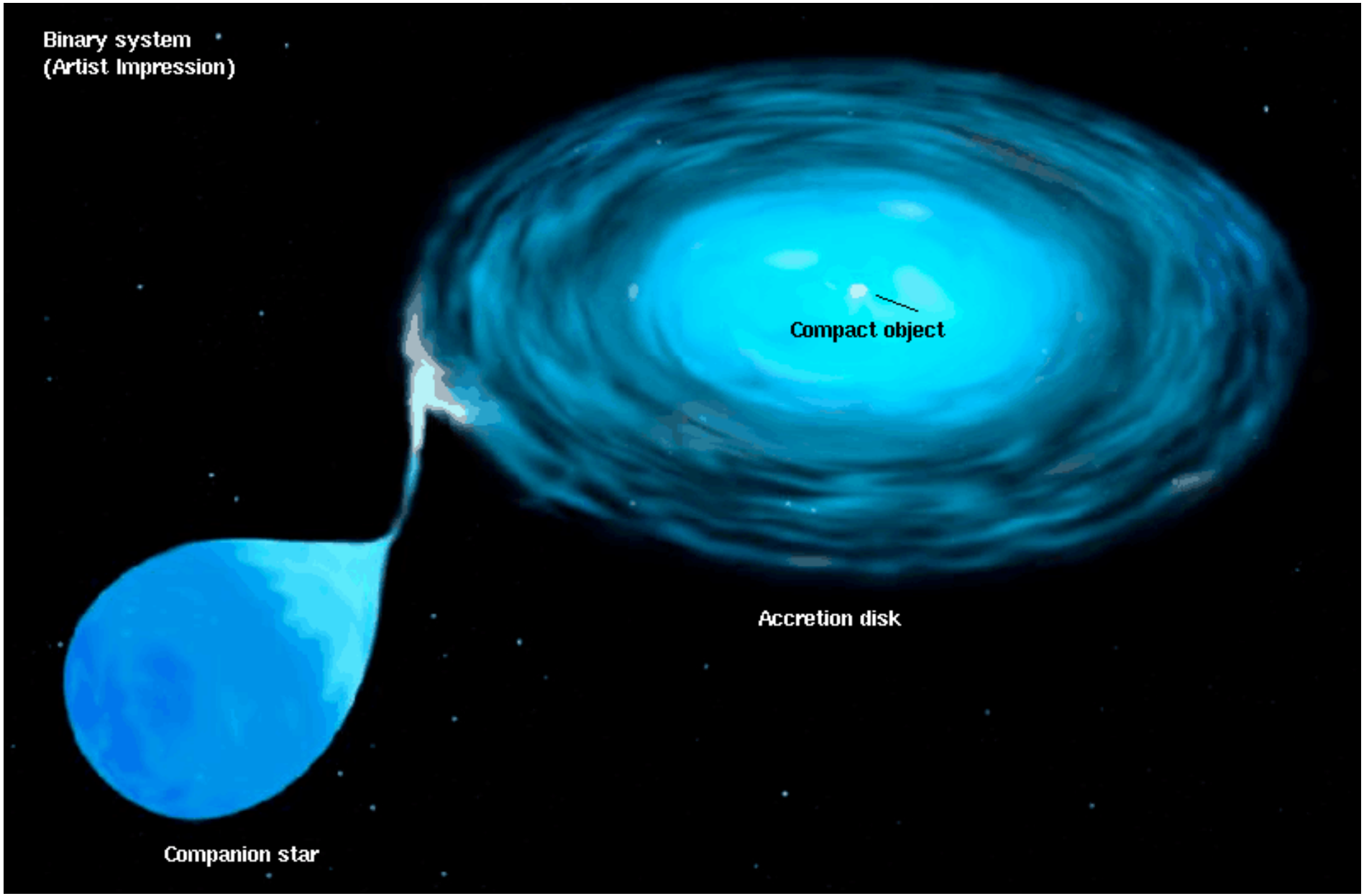
Some white dwarfs grow to near the Chandrasekhar mass and explode, some don't

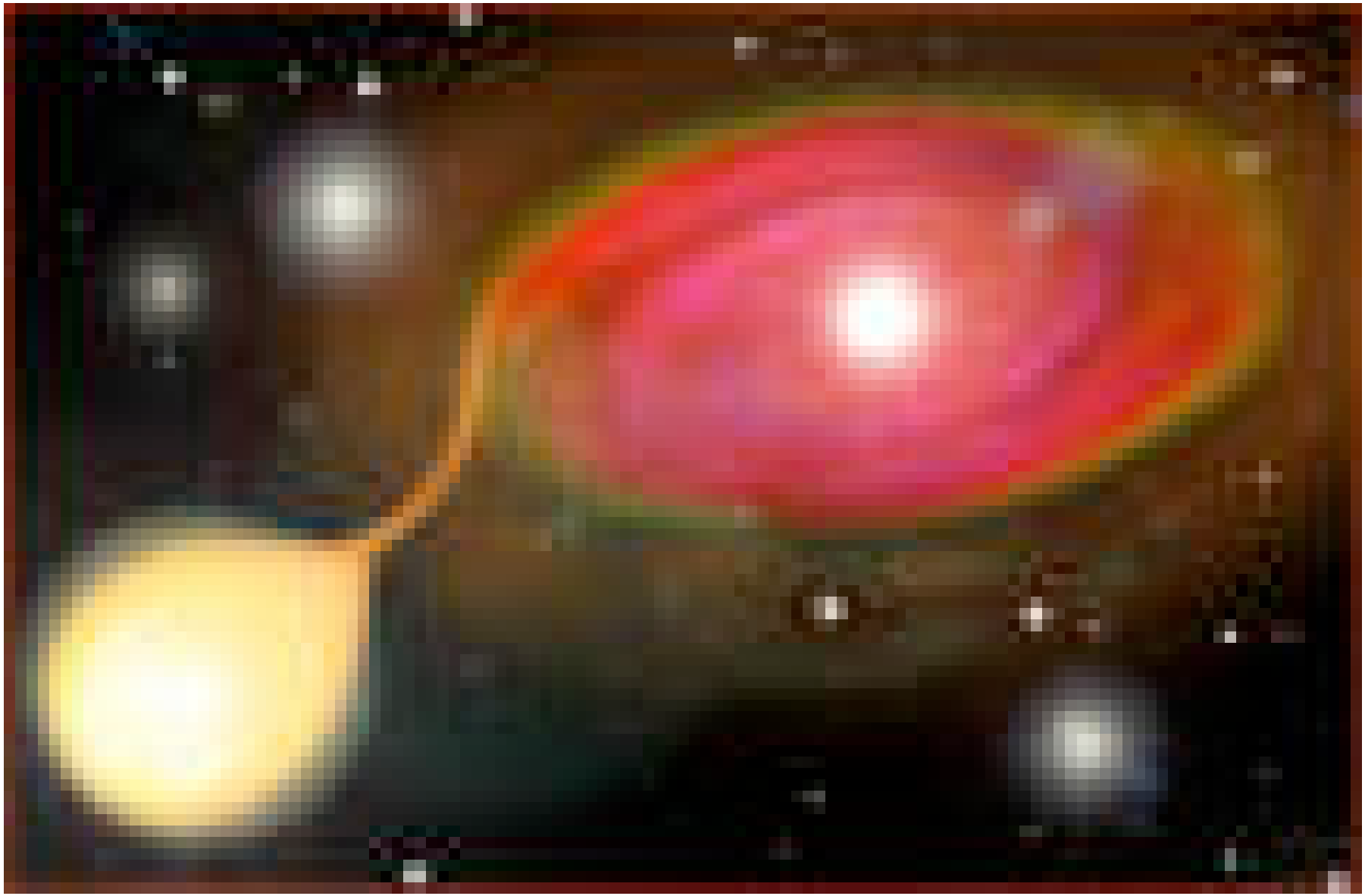
We still don't fully understand why…

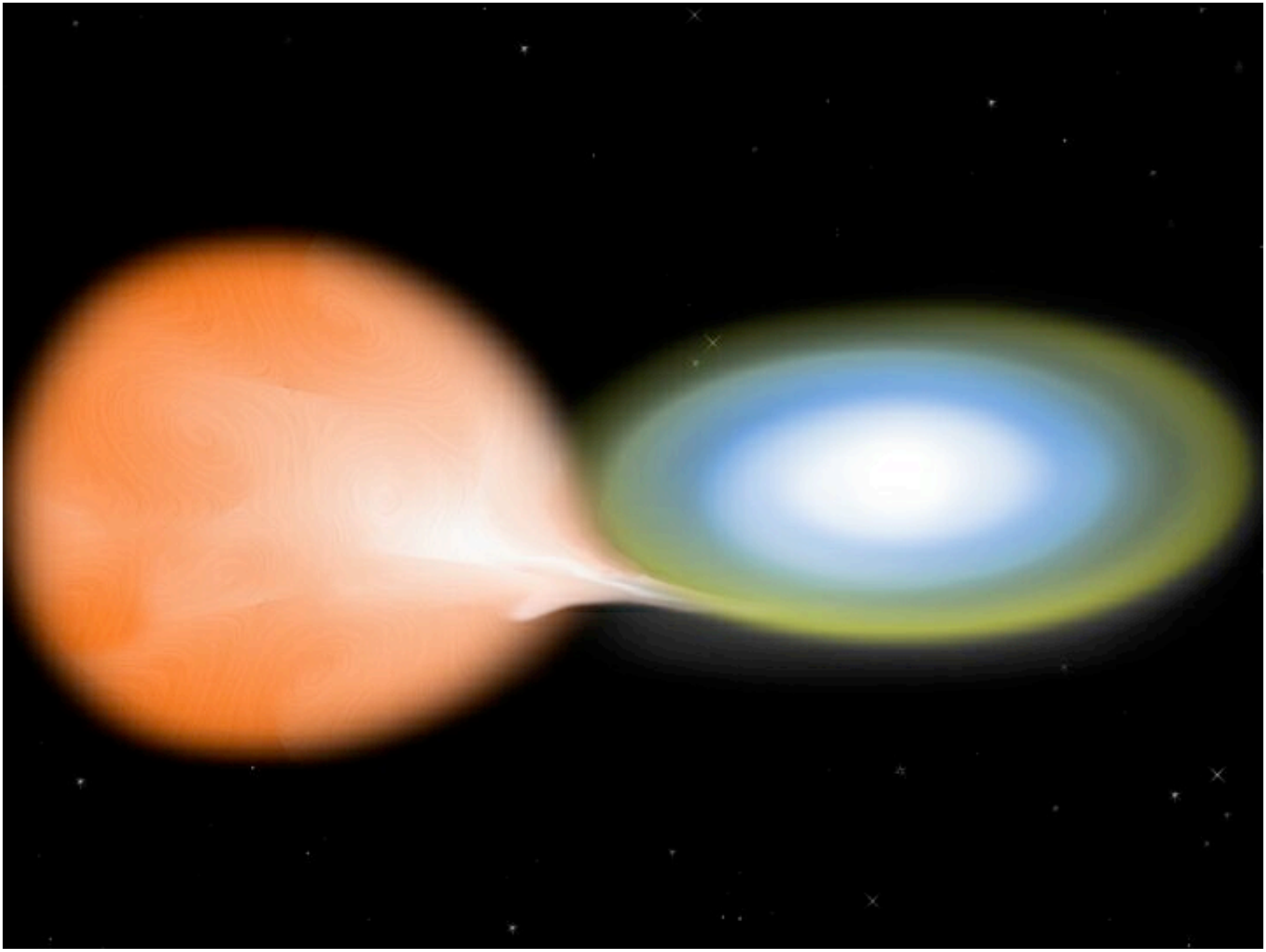
Self-graded pop quiz

Draw a picture of two stars with their Roche lobes and label which star has the largest mass.

Draw a picture of a Cataclysmic Variable and label all the key parts.

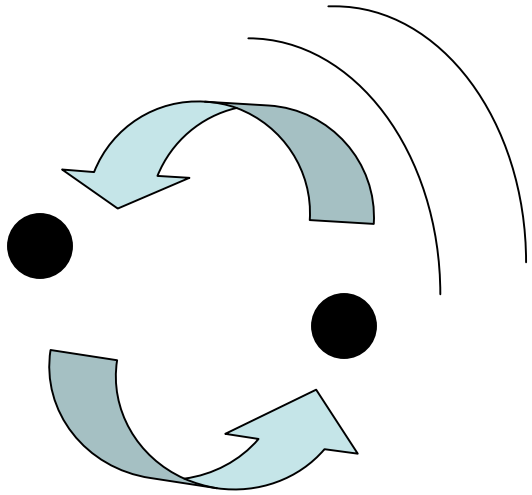

Binary system
(Artist Impression)
Compact object
Accretion disk
Companion star





We do observe 2 WDs 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) 2WD must spiral together!