9/14/06

*First Test, Chapters 1 - 5, next Friday, September 21*

No math, but you will have to think. Concentrate on lectures

Astronomy in the news? Anyone see the partial eclipse?

Two religious holidays with connections to astronomy started on Wednesday. Ramadan and Rosh Hoshana

Google Prize - $20 million for a private group to land a rover on the Moon. Bonus for finding Apollo artifacts. [Extra bonus for finding a large black stone monolith?]

Pic of the Day - Iapetus, Saturn's 3rd largest moon, black organic stuff and nearly snow white stuff.
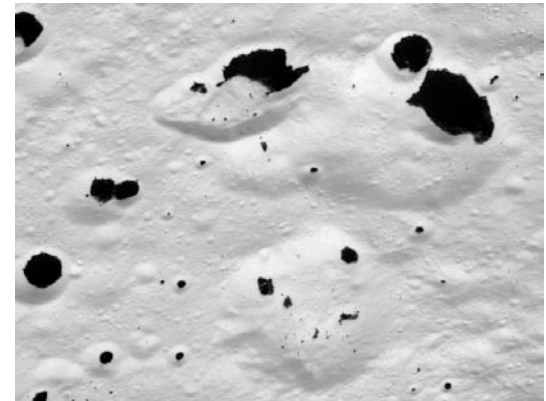
Sky Watch

Dwarf Novae:

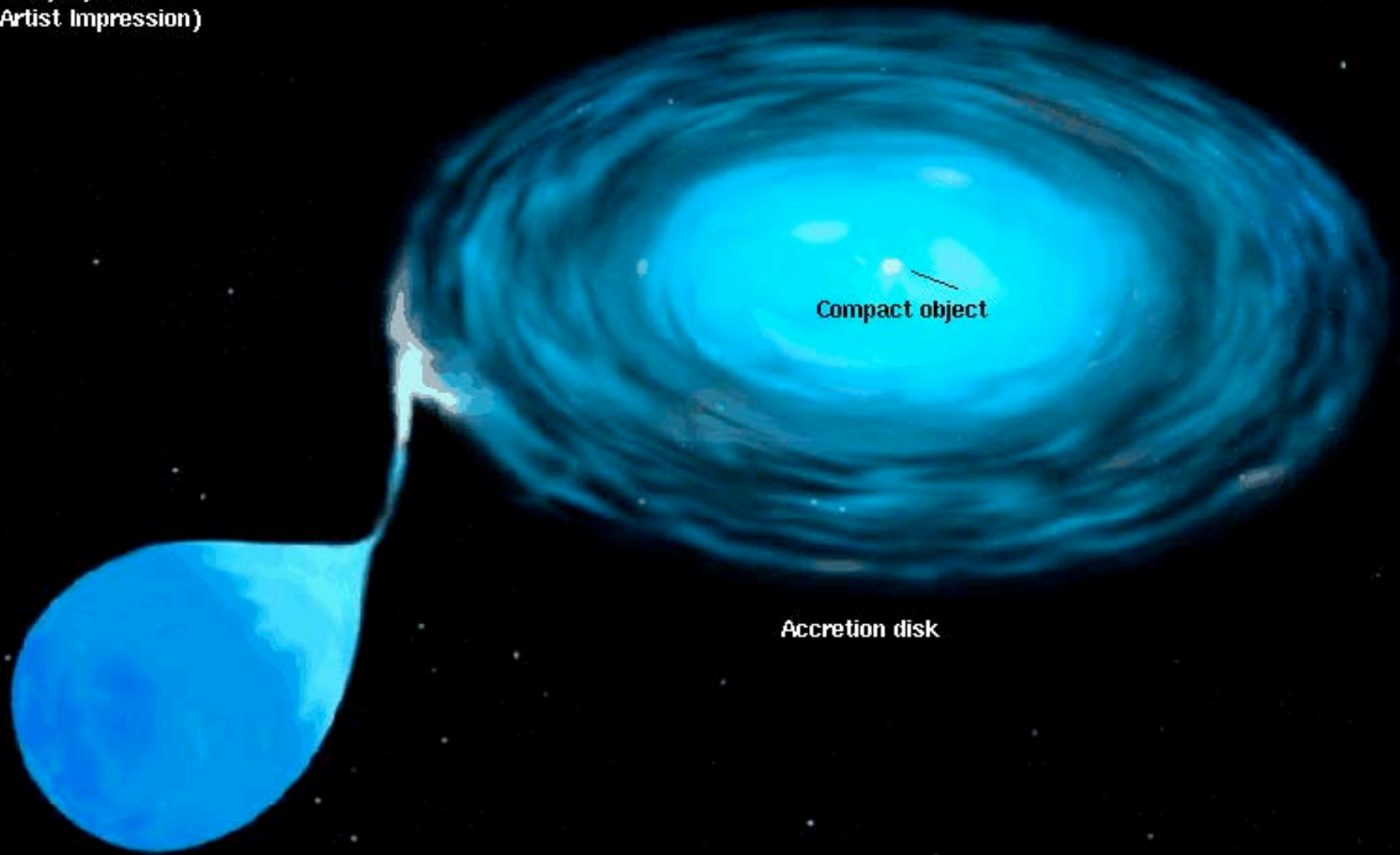SS Cygni - brightest dwarf novae in the sky, but a bit to dim for naked eye. In constellation Cygnus.

U Geminorum - in the constellation Gemini

Self-graded pop quiz

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

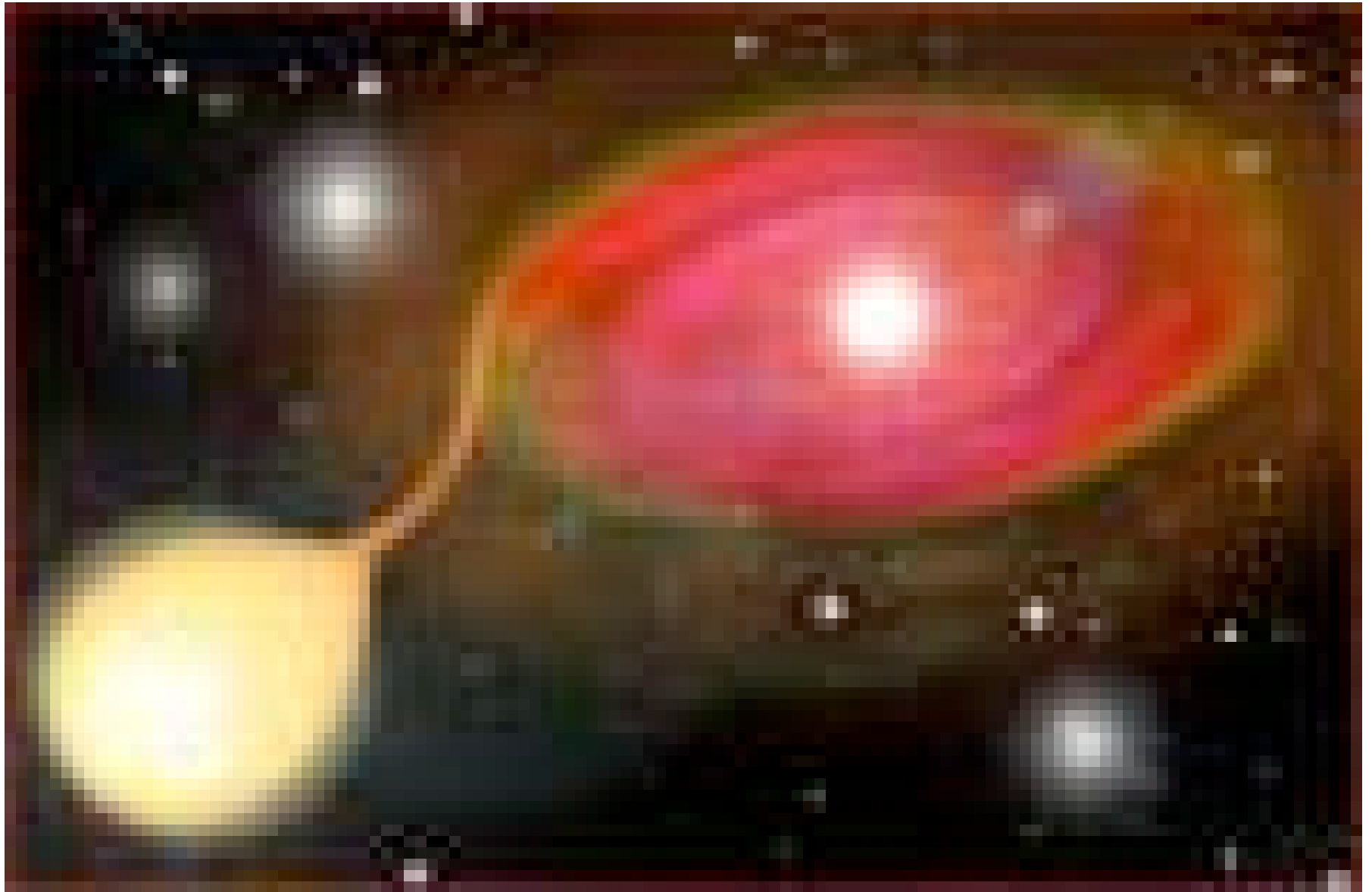Draw a picture of a Cataclysmic Variable and label all the key parts.
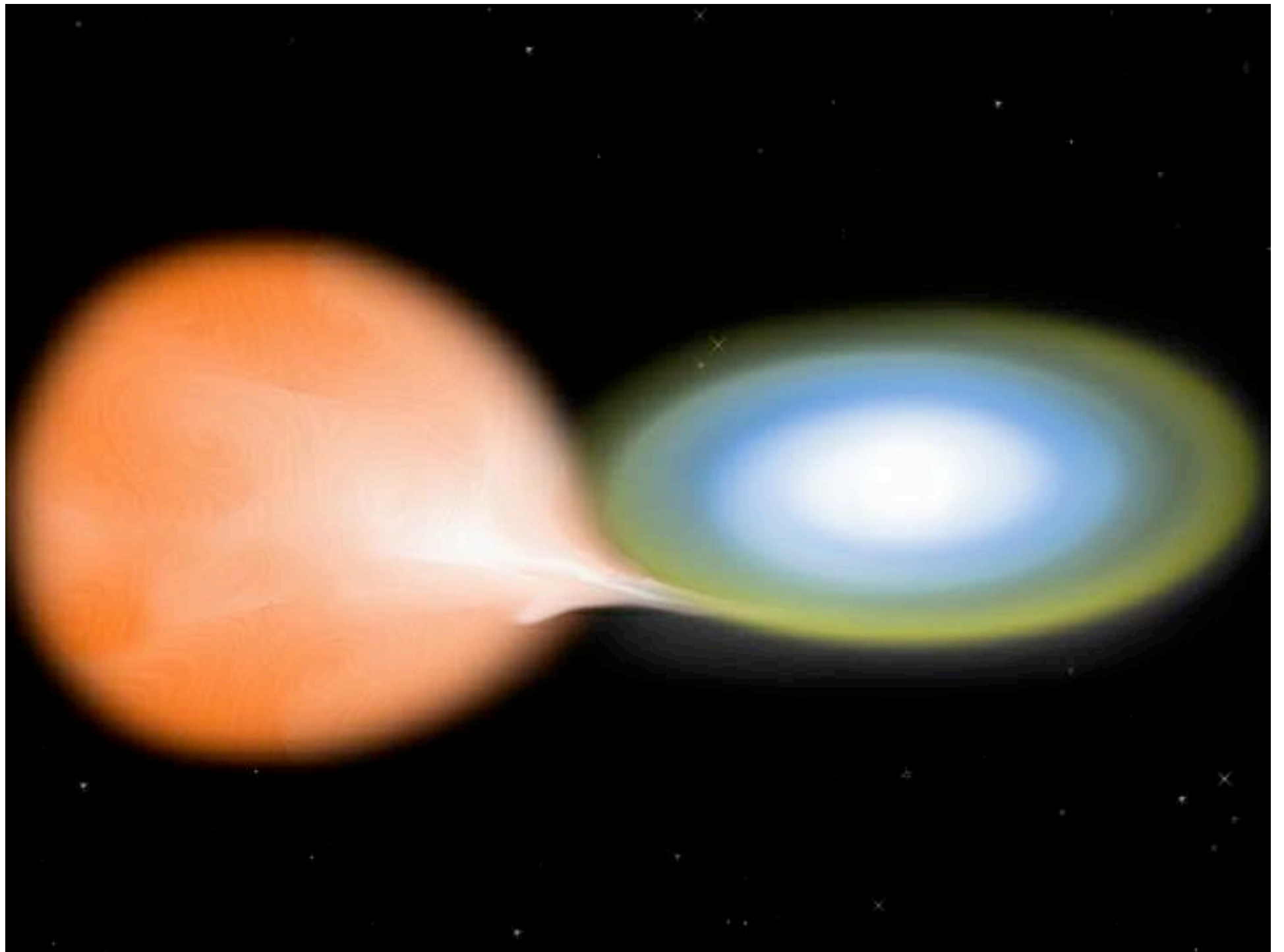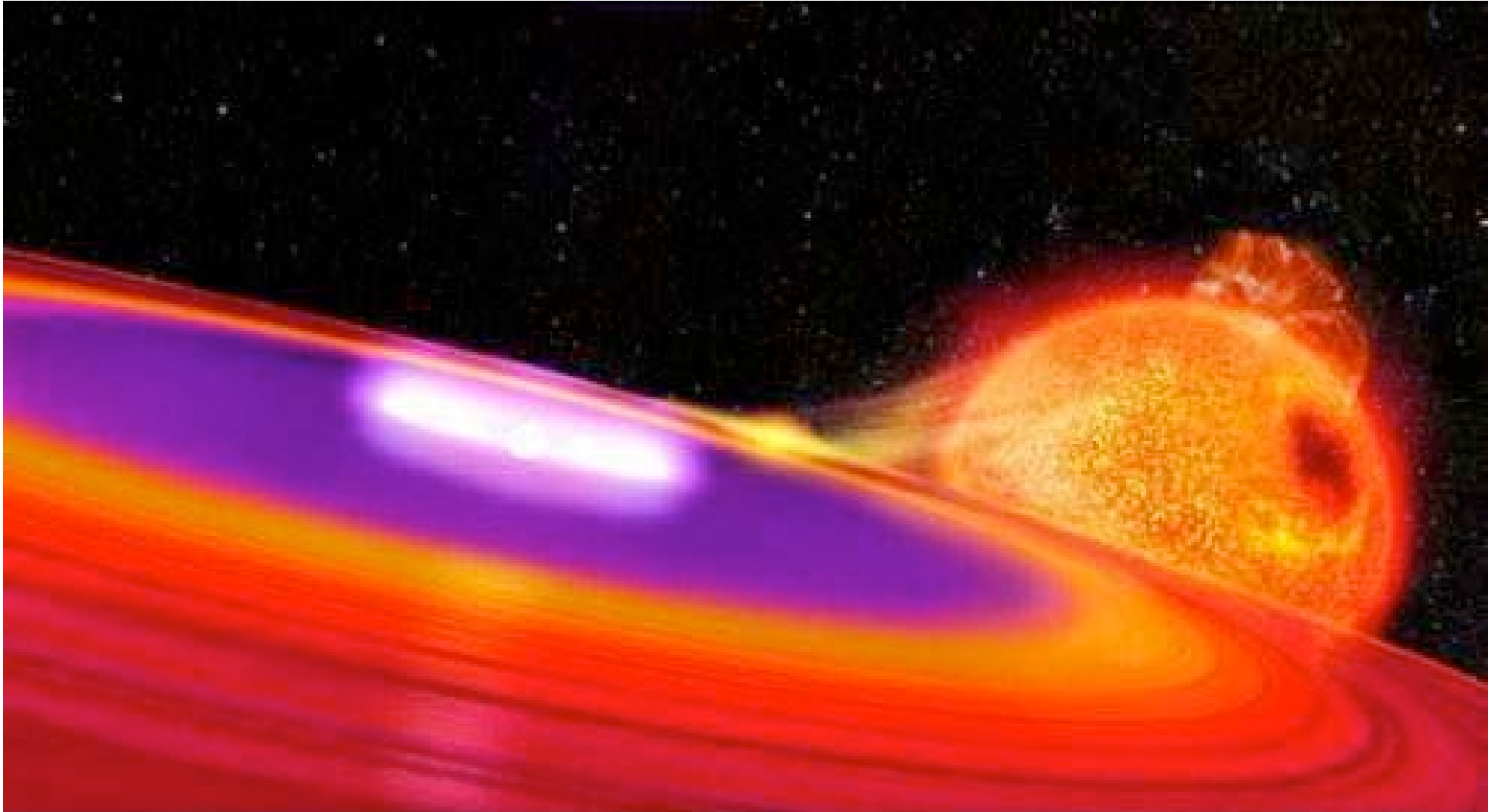
Binary system
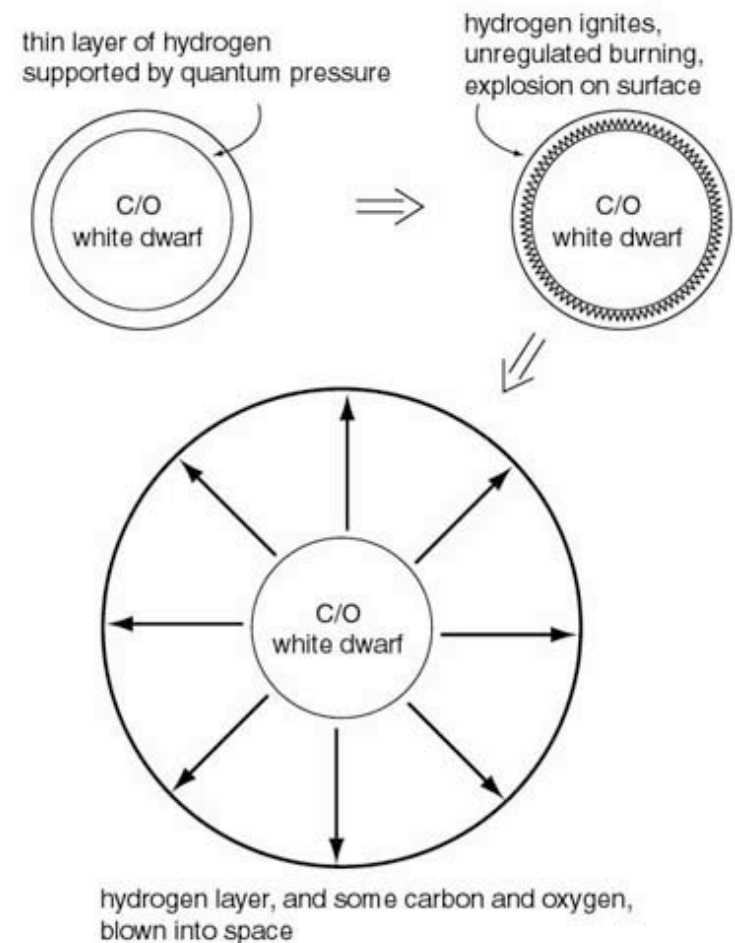(Artist Impression)

Compact object

Accretion disk

Companion star

Classical Nova

Hydrogen from transfer accumulates on surface of white dwarf composed (usually) of Carbon/Oxygen (burning He → C/O in core of red giant before envelope is ejected as a planetary nebula)

H is supported by **Quantum Pressure**
H gets denser, hotter begins to burn (to make He)
Burning is **unregulated** - explode surface layer of H

C/O core essentially undisturbed, although a little mass is ripped from the surface of the core

thin layer of hydrogen supported by quantum pressure

C/O white dwarf

hydrogen ignites, unregulated burning, explosion on surface

C/O white dwarf

C/O white dwarf

hydrogen layer, and some carbon and oxygen, blown into space

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 1901 and dwarf nova eruptions.

Recurrent Nova

Mechanism uncertain

Probably variation of Classical Nova with mass of white dwarf especially near *Chandrasekhar mass*

At *Chandrasekhar mass*, may get a Supernova (will discuss specific mechanism later, Chapter 6)

U Sco in the constellation Scorpius is a Recurrent Nova,

It may be a candidate to explode as a supernova!

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

One Minute Exam

In dwarf nova systems, the activity causing the outburst occurs

A In the mass transferring star

B In the accretion disk

C On the surface of the white dwarf

D At the inner Lagrangian point

§5.3 Origin of Cataclysmic Variables

Cataclysmic variables often have a ***main sequence companion transferring mass*** -- how can this be?
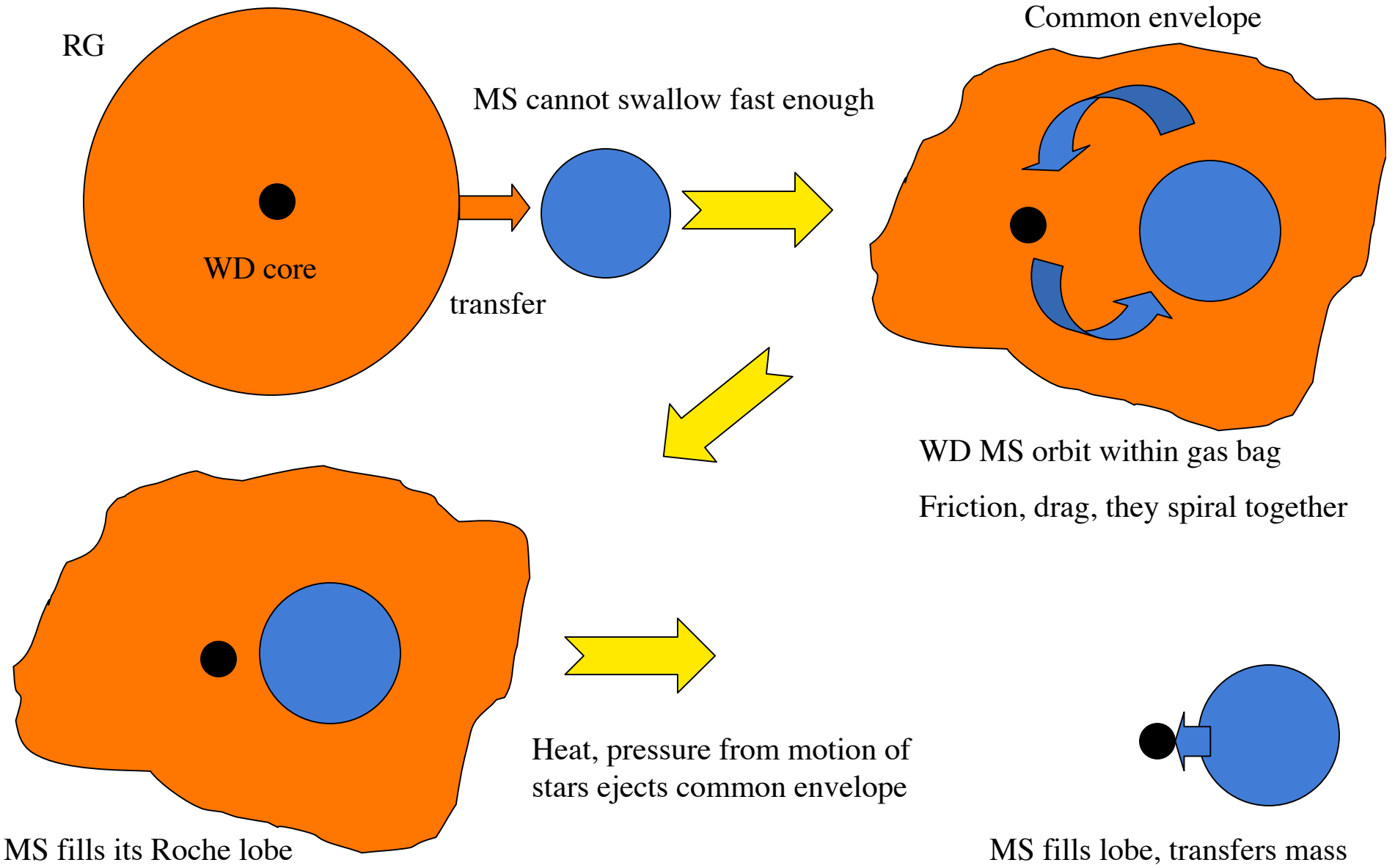
The two stars must once have been far apart to allow the originally more massive star to make a red giant with a white dwarf core.

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

RG

Common envelope

WD core

MS cannot swallow fast enough

transfer

WD MS orbit within gas bag

Friction, drag, they spiral together

MS fills its Roche lobe

Heat, pressure from motion of
stars ejects common envelope

MS fills lobe, transfers mass

One Minute Exam

In most dwarf nova systems, the star transferring mass is a main sequence star. This means:

A The main sequence star was once a red giant, but lost mass

B The main sequence star used to be further away from the white dwarf

C The main sequence star and the star that made the white dwarf were born close together.

D The main sequence star has more mass than the 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 $\rightarrow$ violent explosion
Supernova (Chapter 6)

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