February 19, 2010

Second exam, Friday, February 26. Review Sheet Monday.

Reading, Sections 6.4, 6.5, 6.6, 6.7

Sections 1.2, 2.1, 2.4, 2.5, Sections 3.3, 3.4, 3.5, 3.10, Sections 4.1, 4.2, 4.3, 4.4, Sections 5.2, 5.4 for background

Astronomy in the News? Study of -rays from elliptical galaxies put limits on the origin of Type Ia supernovae. Subject of next two lectures!

Pic of the Day - Infrared view of dust lanes in Andromeda Galaxy from newly launched Wide-Field Infrared Survey Explorer, WISE, satellite.
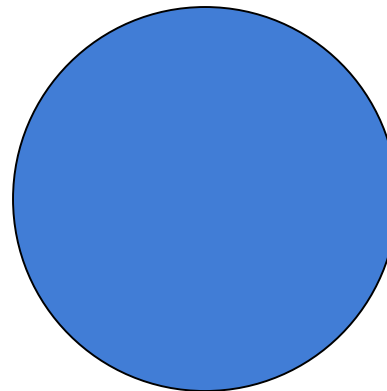
Fundamental property of stellar evolution:

A more massive star has more fuel, but is also *hotter to give the pressure to support the higher mass against gravity*, brighter, burns that fuel faster.

=> stars with higher mass on the main sequence evolve more quickly than stars with lower mass.
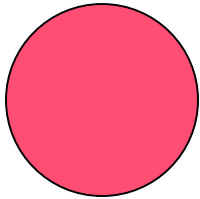
small mass, long life

high mass, short life

Algol, Beta Perseus, second brightest star in the constellation Perseus

Ancient Arabs called the star **Al-Ghul**, the Ghoul

The Hebrews knew Algol as **Rosh Ha'Satan**, Satan's Head, or perhaps **Rosh Ha'Shed**, head of the devil or of a genie.

The Chinese called it **Tseih She**, the Piled-up Corpses

In Greek mythology, Algol is the head of the Gorgon Medusa that Perseus carries under his left arm.

Find Algol for your Sky Watch Project.

Algol paradox: Algol is a binary star system with a Red Giant orbiting a blue-white Main Sequence companion.
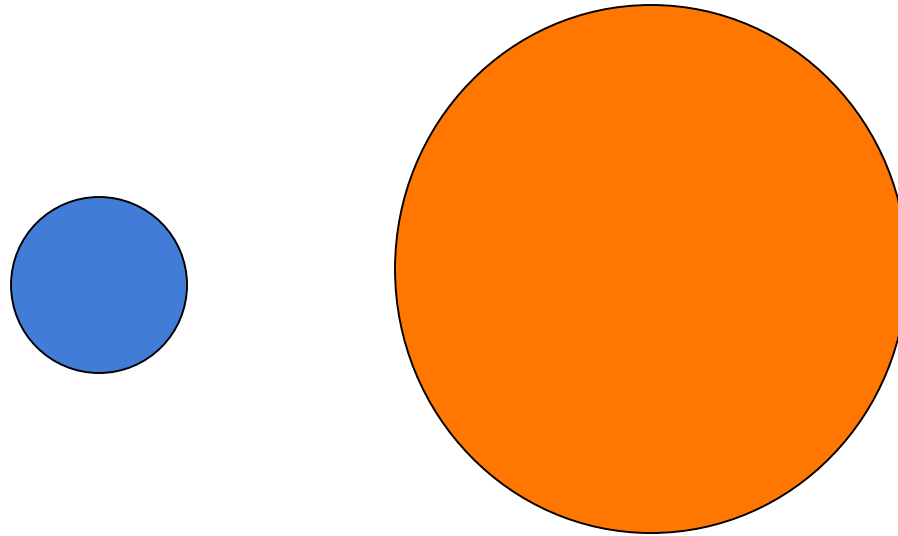
Which is most massive?

Use Kepler's law to measure total mass, then other astronomy (luminosity of main sequence star tells the mass) to determine the individual masses.

Answer: the unevolved main sequence star!

Red Giant ~ 0.5 $M_\odot$ - but more evolved

Blue-white Main Sequence star ~ 2-3 $M_\odot$ - but less evolved

Discussion Point:

Explain to your neighbor why this is a dilemma.

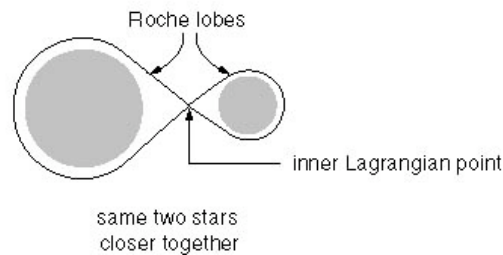Do you remember how Kepler's 3rd law can be used to measure the total mass of the binary system?

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.

inner
Lagrangian
point

Roche lobes

lower mass star
smaller lobe

higher mass star
larger lobe
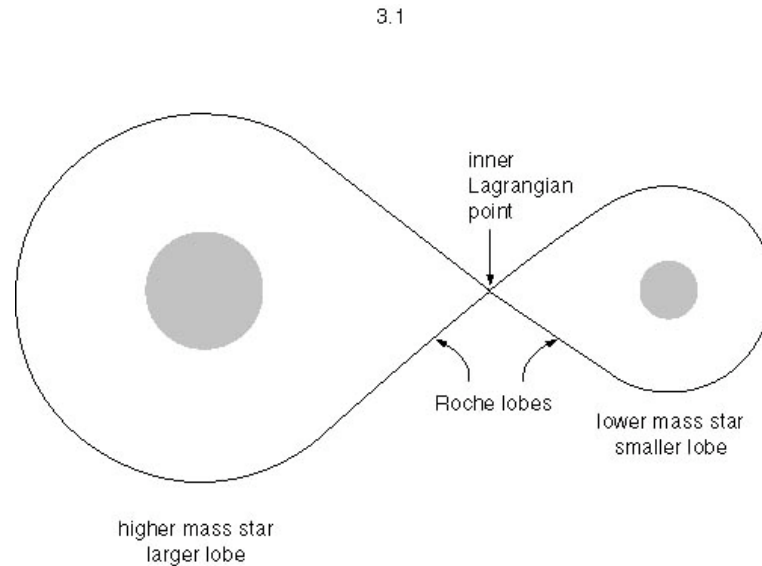
Caution: the most massive star may not have the largest radius!

Roche lobes

inner Lagrangian point

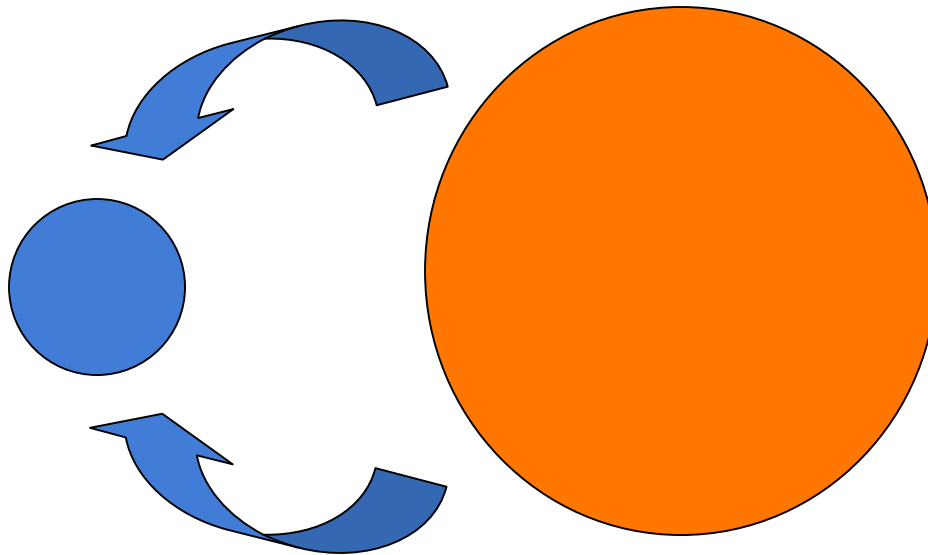same two stars
closer together
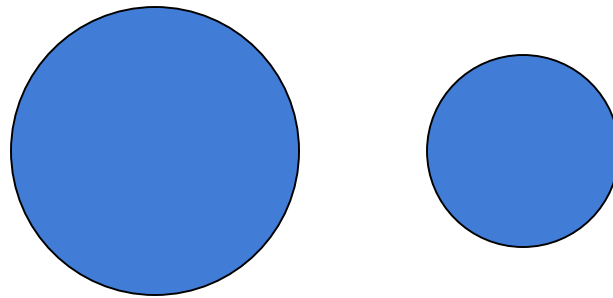
Solution to Algol Paradox

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.

One Minute Exam

Two stars orbit one another in a binary system

Which star has the largest Roche lobe?

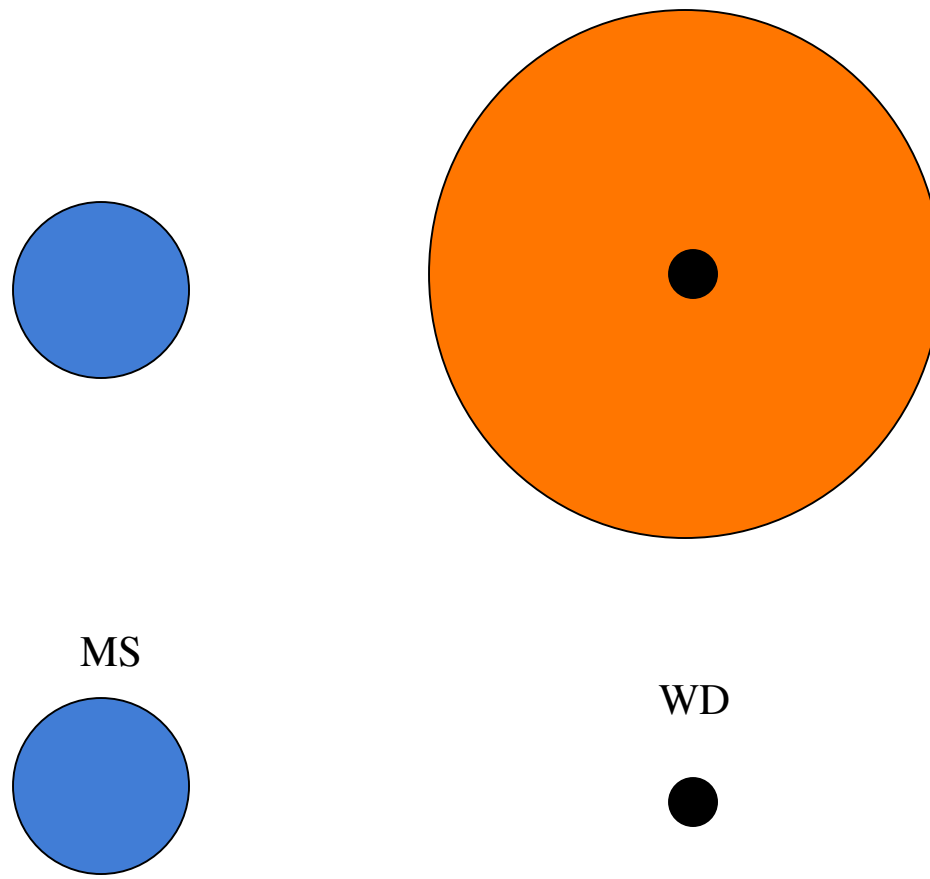→ the one on the left

← the one on the right

↑ insufficient information to answer the question

Which star is the most massive?

In common circumstances, all the hydrogen envelope is transferred to the companion (or ejected into space), leaving the core of the red giant as a white dwarf orbiting the remaining main sequence star

MS

WD

First star evolves, sheds its envelope, leaves behind a white dwarf.

Then the second star that was *originally* the less massive evolves, fills its Roche Lobe and sheds mass onto the white dwarf.

The white dwarf is a tiny moving target, the transfer stream misses the white dwarf, circles around it, collides with itself, forms a ring, and then settles inward to make a flat disk.

Matter gradually spirals inward, a process called *accretion.*

$\Rightarrow$ the result is an *Accretion Disk* (Chapter 4).
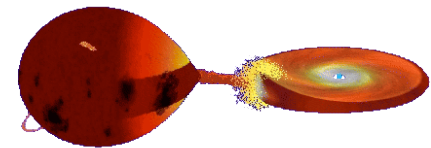
An accretion disk requires a transferring star for supply and a central star to give gravity, but it is essentially a separate entity with a structure and life of its own.
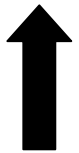
One Minute Exam:

Two stars are born orbiting one another in a binary system. Which star will transfer matter first?

➡ The most massive star

⬅ The least massive star

⬆ The one with the smaller Roche lobe

⬇ The one with the smaller radius

Demonstration of Accretion Disk Dynamics

Need a volunteer

Basic Disk Dynamics - Figure 4.1