

September 7, 2007

Wheeler on travel next Wednesday, colloquium at Arizona State University - review session in class

Astronomy in the news? Asteroid collision in the asteroid belt 160 million years ago led to the asteroid that killed the dinosaurs 65 million years ago.

Pic of the day:

Eclipse of the Moon from the South Pole



Sky Watch

Objects mentioned so far:

Lyra - Ring Nebula, planetary nebula in Lyra

Sirius - massive blue main sequence star with white dwarf companion

TODAY: Algol - in Perseus

Other suggestions:

Vega - massive blue main sequence star in Lyra

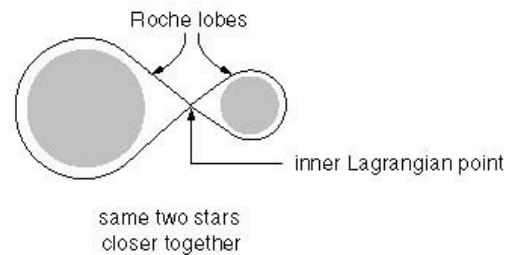
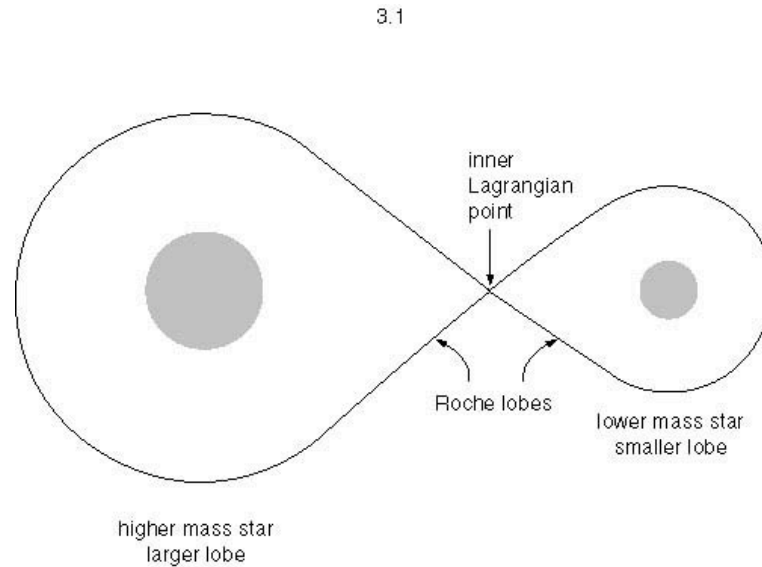
Antares - red giant in Scorpius

Other examples of these sorts of objects...

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.

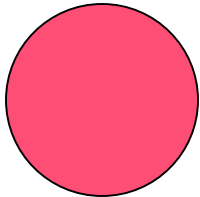


Caution:
the most massive star may not have the largest radius!

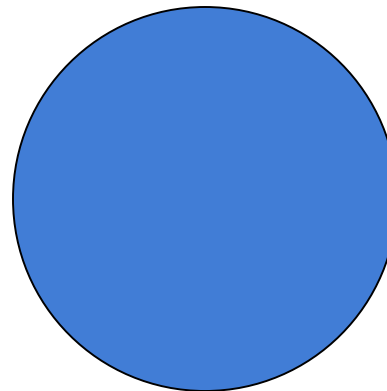
Fundamental property of stellar evolution:

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

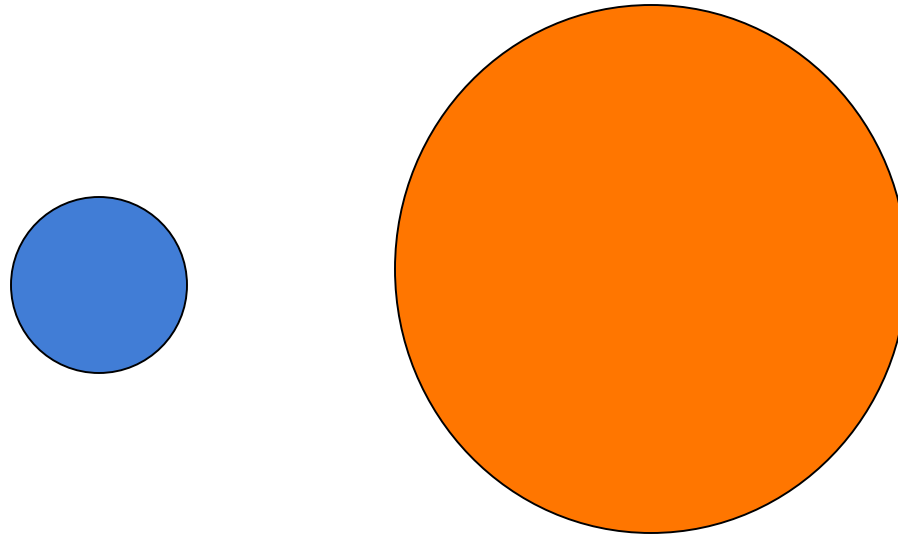
The Hebrews knew Algol as **Rosh ha Sitan**, Satan's Head

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 $\sim 0.5 M_{\odot}$ - but more evolved

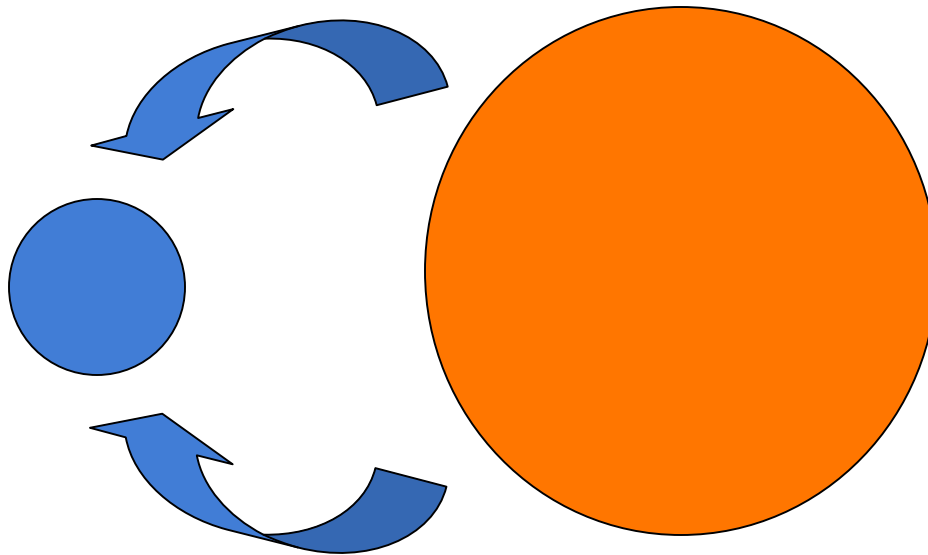
Blue-white Main Sequence star $\sim 2-3 M_{\odot}$ - but less evolved

Solution

Mass Transfer

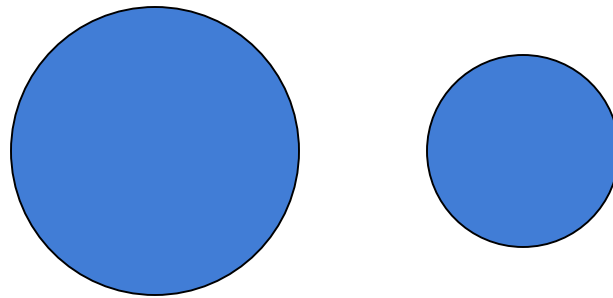
The red giant swells up, fills then overfills its Roche lobe and transfers mass to the companion.

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



One Minute Quiz

Two stars orbit one another in a binary system



Which star has the largest Roche lobe?

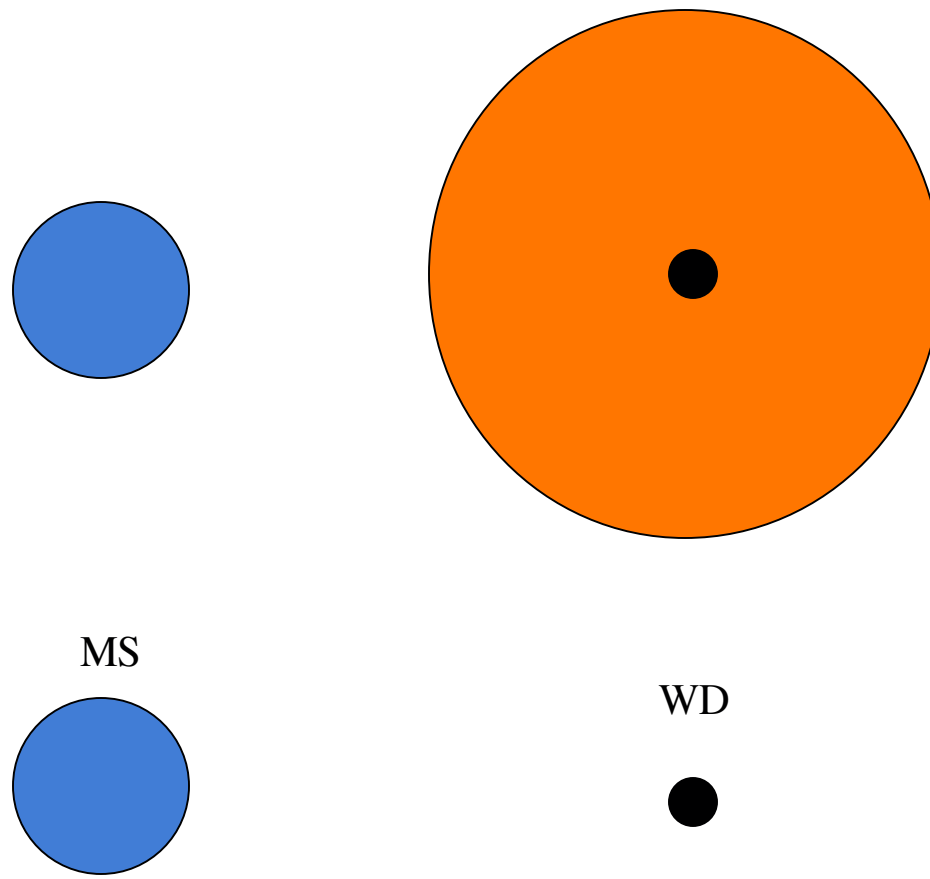
A the one on the left

B the one on the right

C insufficient information to answer the question

Solution to the *Algol Paradox*, how the evolved star can be the least massive - *Mass Transfer* through the *Roche Lobe* of the initially more massive, evolving star.

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



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*.

⇒ 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?

A The most massive star

B The least massive star

C The one with the smaller Roche lobe

D The one with the smaller radius