Friday, February 28, 2014

Exam 2, Skywatch 2, Monday, 3/3.

Review sheet posted

Reading for Exam 2: Sections 6.1, 6.4, 6.5, 6.6, Betelgeuse interlude.

Background: Sections 1.2.1, 2.1, 2.2, 2.4, 2.5,

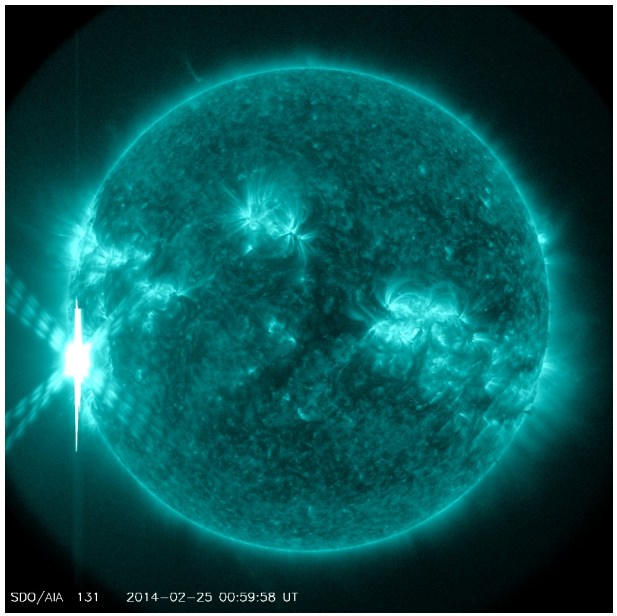
Wednesday, March 5, Wheeler on travel, we'll show a video of SN 1987A, topic of Chapter 7.

Astronomy in the news:

Neil De Grasse Tyson on NPR Fresh Air. Great anecdote about preparing to appear with Jon Stewart.

Biggest solar flare of the year on the Sun.

Magnetic phenomenon, coupled with rotation



Nova video *Death of a Star*, birth of SN 1987A on Wednesday

27 years ago. We were all younger! Things to look for:

Bob Kirshner mentions that Wheeler at Texas called him to tell him about the supernova.

Stirling Colgate, inventor of the multi-ball bouncing toy, who predicted the role of neutrinos in core-collapse supernovae.

Oscar Duhalde who saw it first.

Ian Shelton who recognized it first, credited with discovery.

Rob McNaught who took the first photo.

Neutrinos!!!

Update on new “nearby” supernova SN 2014J in M82

Searches for a classical nova or recurrent nova having exploded before the supernova have not detected anything, but lots of dust in the way.

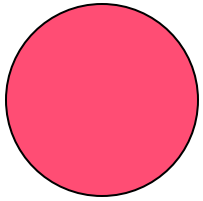
Goal

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

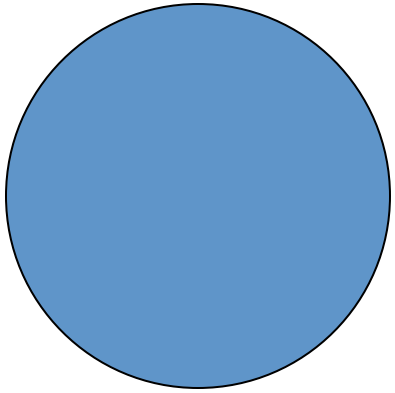
Fundamental property of stellar evolution:

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.

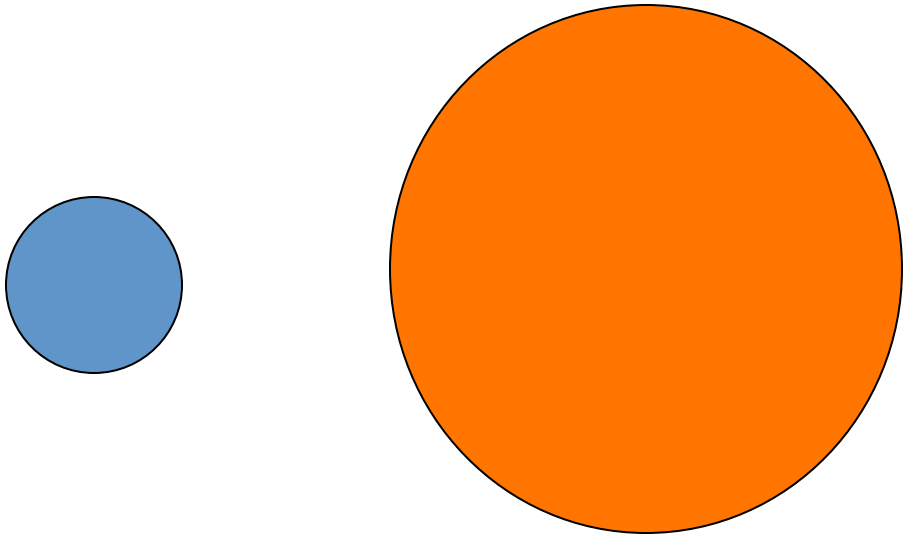


small mass, long life



high mass, short life

Algol paradox: Algol is a binary (actually triple) star system with a Red Giant orbiting a blue-white Main Sequence companion. The two stars were born at the same time.



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:

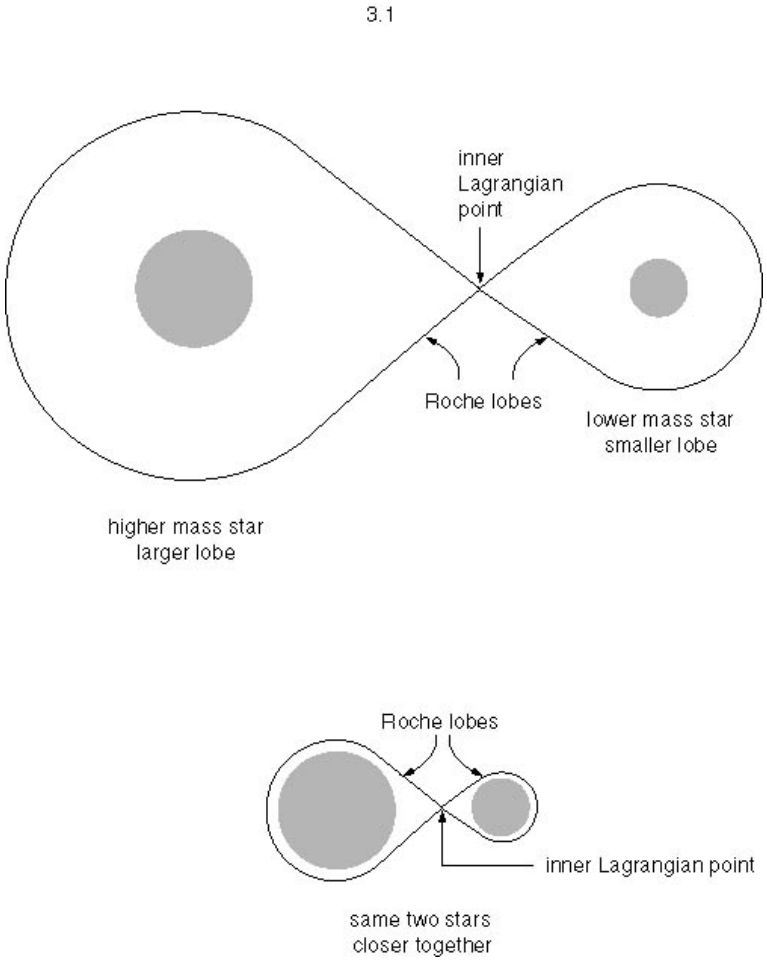
Explain to your neighbor why this is a dilemma.

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

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.



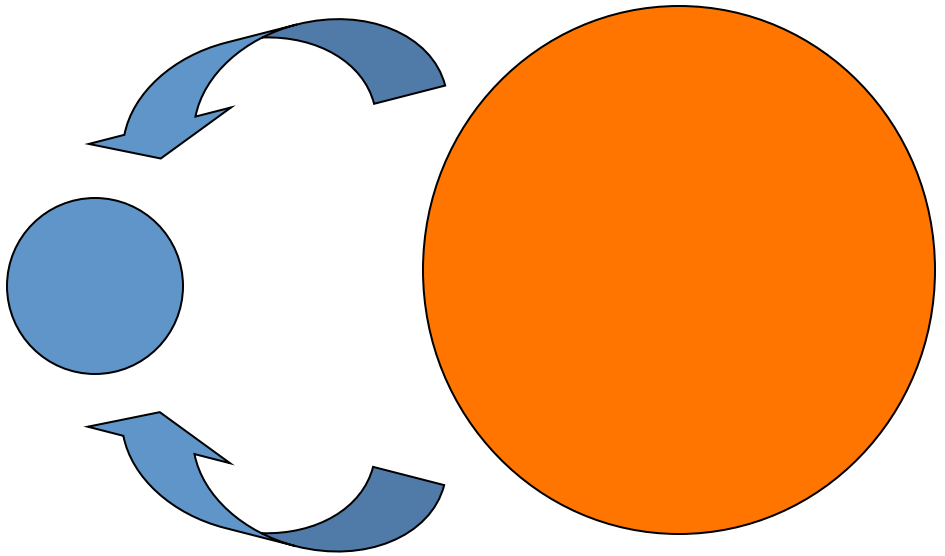
Caution: the most massive star may not have the largest radius!

Solution to Algol Paradox

Mass Transfer

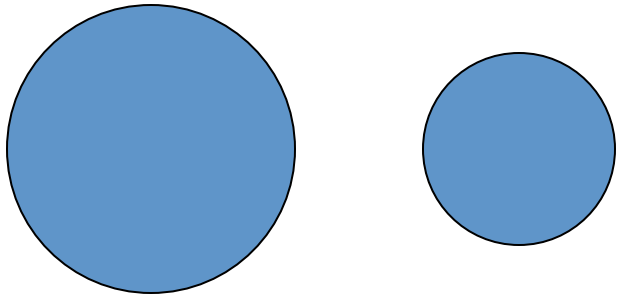
The red giant swells up, fills then overfills its Roche lobe and transfers mass to the companion.

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

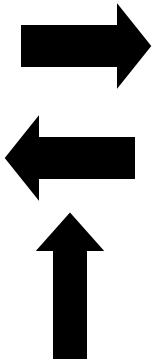


One Minute Exam

Two stars orbit one another in a binary system



Which star has the largest Roche lobe?



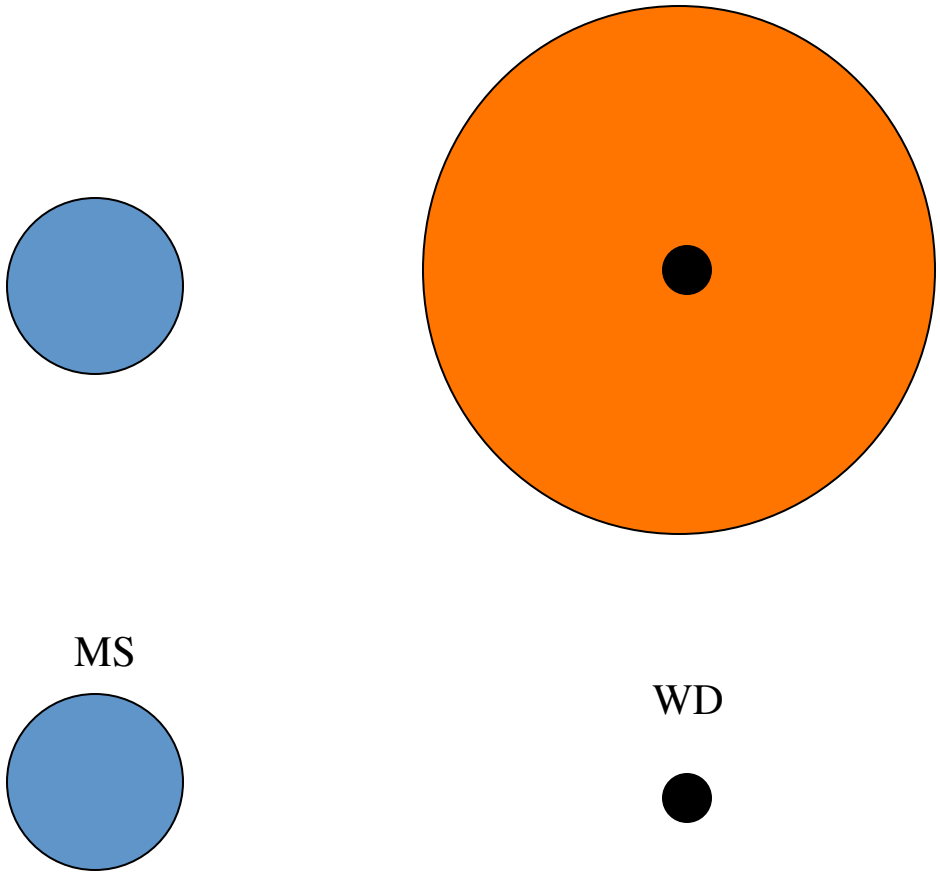
the one on the left

the one on the right

insufficient information to answer the question

Which star is the most massive?

In common circumstances for binary star systems, 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

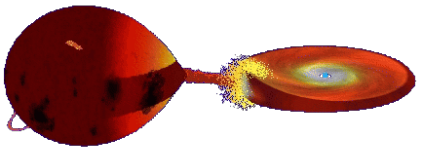


First star evolves, sheds its envelope, leaves behind a white dwarf.

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.

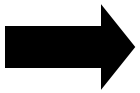
Matter gradually spirals inward, a process called ***accretion.***

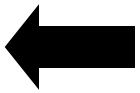
$\Rightarrow$ the result is an ***Accretion Disk*** (Chapter 4). 

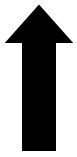
An accretion disk requires a transferring star for supply and a central star to give gravity, but it is essentially a separate entity with a structure and life of its own.

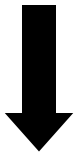
One Minute Exam:

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