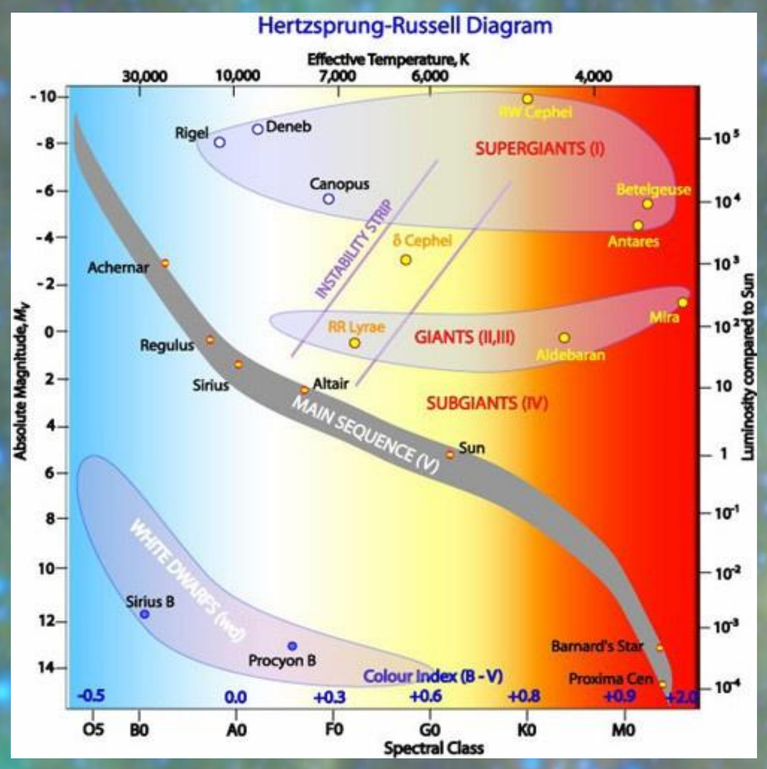
Types of Stars

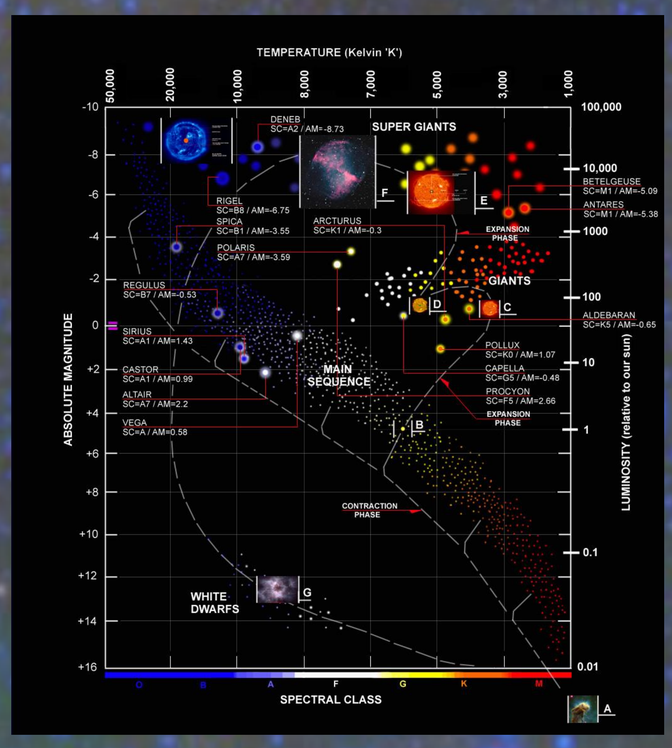
Spectral Classifications: Based on the luminosity and effective temperature , the stars are categorized depending upon their positions in the HR diagram.



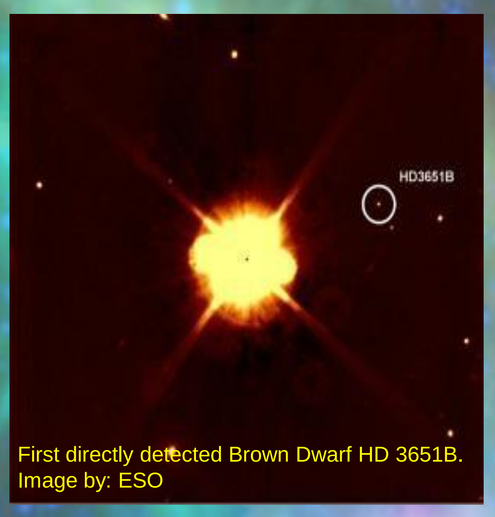
Hertzsprung -Russell Diagram

(H-R Diagram) :

1. The H-R Diagram is a graphical tool that astronomers use to classify stars according to their luminosity (i.e. brightness), spectral type, color, temperature and evolutionary stage.
2. HR diagram is a plot of luminosity of stars versus its effective temperature.
3. Most of the stars occupy the region in the diagram along the line called the main sequence. During that stage stars are fusing hydrogen in their cores.



Various Types of Stars



First directly detected Brown Dwarf HD 3651B.
Image by: ESO

Brown Dwarf:

Brown dwarfs are sub-stellar objects that are not massive enough to sustain nuclear fusion processes.
Since, comparatively they are very cold objects, it is difficult to detect them.
Now there are ongoing efforts to study them in infrared wavelengths.
This picture shows a brown dwarf around a star HD3651 located 36Ly away in constellation of Pisces.

White Dwarf:

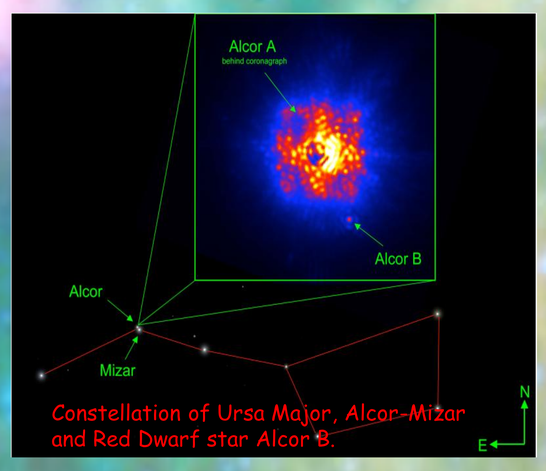
After a star like the sun exhausts its nuclear fuel, it loses its outer layer as a "planetary nebula" and leaves behind the remnant "white dwarf" core.
Stars with initial masses
M < 8Msun will end as white dwarfs.
A typical white dwarf is about the size of the Earth.
It is very dense and hot. A spoonful of white dwarf material on Earth would weigh as much as few tons.
The image is of Helix nebula towards constellation of Aquarius hosts a White Dwarf star at the centre.



Helix Nebula 6500Ly away. Green arrow points the White Dwarf

Red Dwarf:

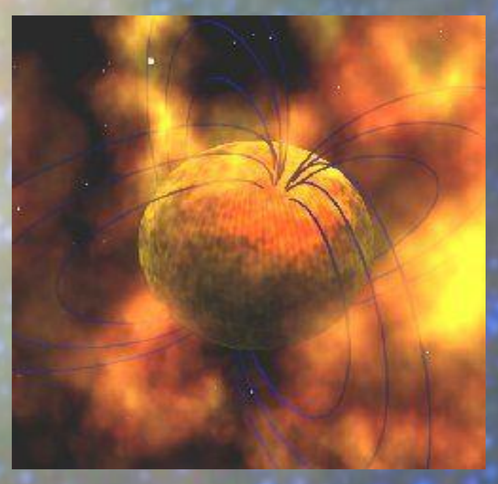
Red dwarfs are stars that are small, cooler and dimmer than our Sun. They are much less massive than the Sun. The very first Red dwarfs formed in our Galaxy should be still in their main sequence stage and they retain their initial composition. The image along side shows the famous double star Alcor-Mizar from constellation of Ursa Major. Alcor has a companion red dwarf star Alcor-B marked with green arrow.



Constellation of Ursa Major, Alcor-Mizar and Red Dwarf star Alcor B.

Neutron Star

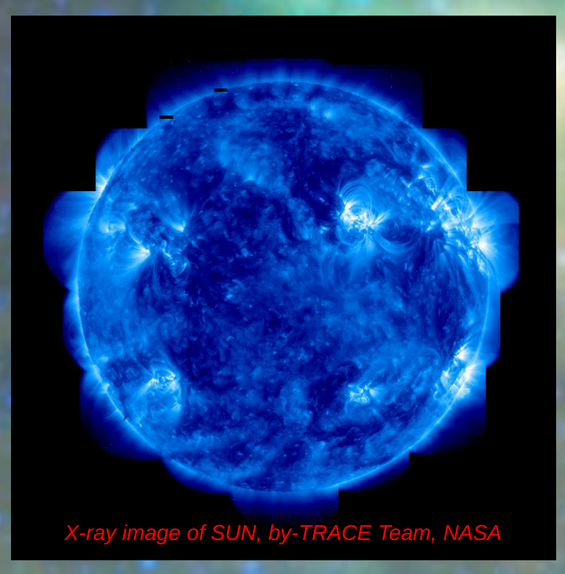
Neutron stars are formed when a massive star dies in a "supernova explosion". During this dramatic event, the core of the star suddenly collapses under its own weight and the outer parts are violently ejected into surrounding space.
A typical neutron star is the size of a small city.
A spoonful of material form such star on Earth would weigh as much as all the cars on Earth put together.



Magnetar:

Magnetars are a class of neutron stars, the surface magnetic field of which ranges around 10^{15} -10^{16} Gauss. This magnetic field is approximately thousand trillion times stronger than the Earth's magnetic field.

The picture on the left is an artistic view of a magnetar.



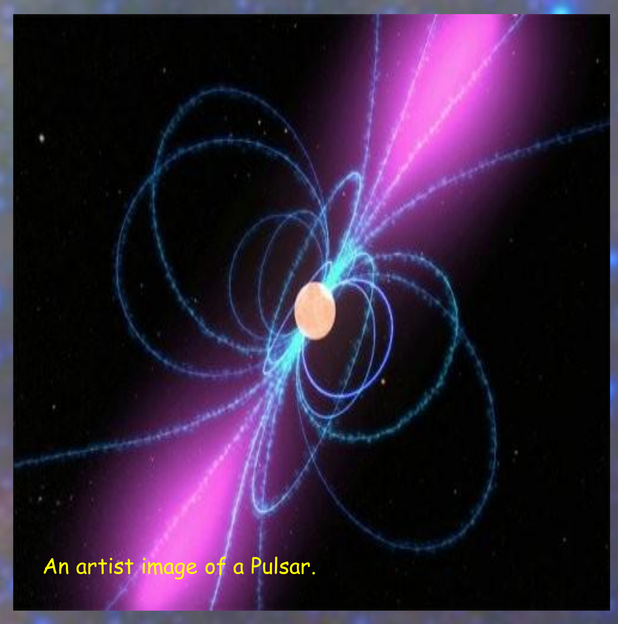
X-ray image of SUN, by-TRACE Team, NASA

SUN

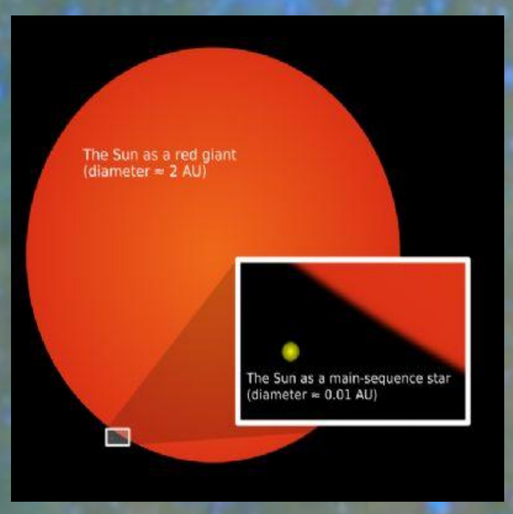
Our Sun is an ordinary, main sequence star which is fusing hydrogen into helium at its core. It is around 4.5 billion years old, and is around halfway through its lifetime.
It is expected to evolve into a red giant and subsequently into white dwarf.

Pulsar:

Pulsars are spinning neutron stars that have jets of particles, beamed along magnetic poles, moving almost at the speed of light.
This beam of light from the jets sweep around as the pulsar rotates, just as the spotlight in a lighthouse does, hence pulses of radiation are seen as the beam sweeps over the Earth.

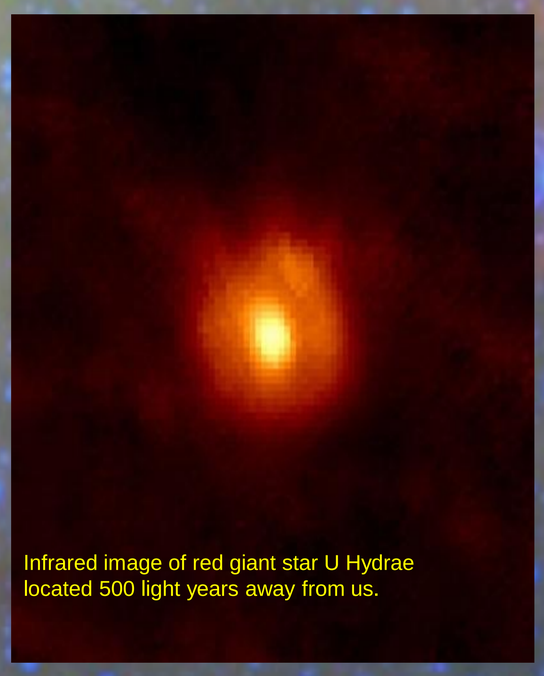


An artist image of a Pulsar.



Red giants:

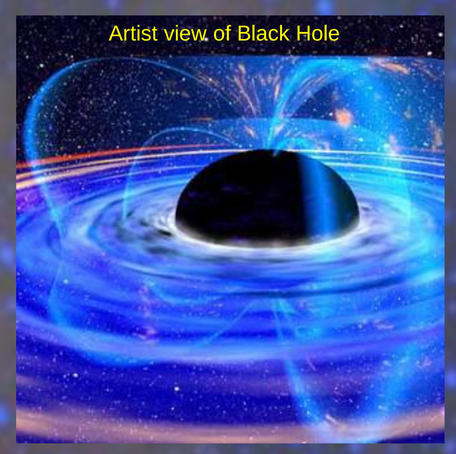
1. When stars like our Sun reach the end of their life by exhausting the supply of hydrogen at their cores, they enter one last phase of ballooning up to many times of the original size. Such objects are called red giant stars
2. Such stars have radii ten to hundreds of times larger than that of the Sun.
3. Our own Sun, for example will grow so large that it will engulf the orbits of Mercury, Venus and even Earth.



Infrared image of red giant star U Hydrae located 500 light years away from us.

Black Hole:

1. Black holes are the evolutionary endpoints of very massive stars that undergo a supernova explosion leaving behind a burnt out stellar remnant.
2. With no outward forces to oppose gravitational forces, the remnant collapses in on itself. The object left behind has such a strong gravity that its escape velocity is greater than the speed of light.
3. It means that not even light can escape from black hole.



Artist view of Black Hole