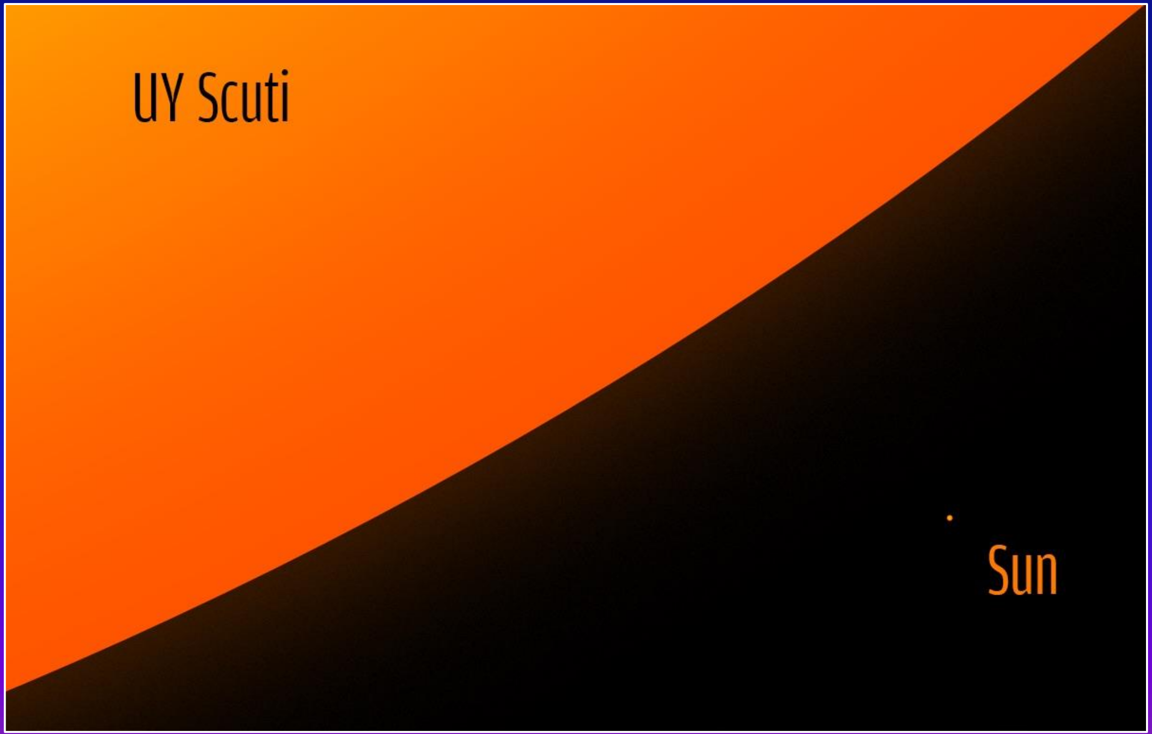
Stellar classification

UY Scuti a giant which is 1,700 times larger than the sun and is nearly eight astronomical units across . With a diameter of 2.3765 billion km, this star would engulf all planets up to Jupiter's orbit if placed in place of sun. Situated at 5,219 light years from earth. This beast is called a '**Red Hypergiant**'.
-image credit : Philip Park

The heaviest star known at present is the 'r136a1' which is 265 times heavier than sun . An '**O class'** star with a diameter of 42 million km.
Distance from Earth: 163,000 light years.
-image credit : nineplanets.org



There are stars of various sizes and masses. To know more about stellar classification, read on.

Stellar Classification

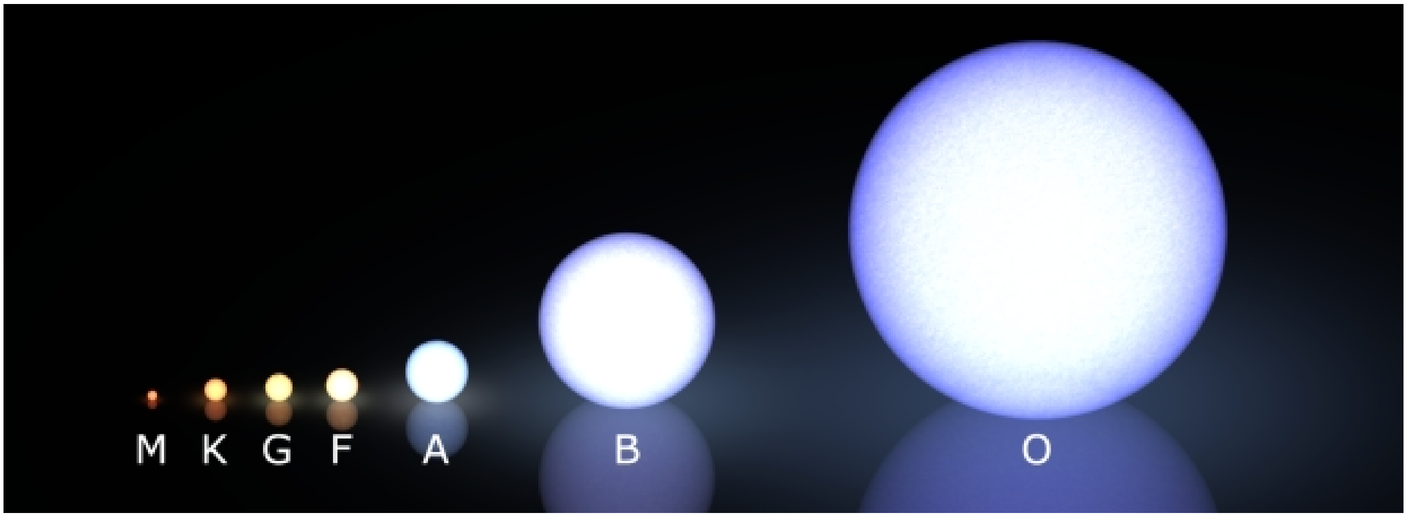


Figure 1 Stars according to the MK table

Image Credit: [Wikipedia]

Stellar classification is the classification of stars according to their size, temperature and spectral characteristics. According to the much used Morgan-Keenan table, the classification of stars has evolved into seven different classes or groups. This system was created by ***Annie Jump Cannon***, an American Astronomer. ***Cannon*** developed this system on the basis of Balmer spectral lines, later characterization according to size and temperature were approached. The seven groups are O, B, A, F, G, K and M.

Stars classified in the 'O' group are the most massive and hottest, with temperatures exceeding 30,000°C, while[i] those in the 'M' group are the smallest and coolest, with temperatures less than 3,000°C.

A star with a really high temperature is a Blue star while those quite the smallest ones are Red stars. Hence colour of the star is dependent on its Size and Temperature. This is similar to what we observe with the black bodies at very high temperatures. Usually most blue stars are very hot and are therefore classed as 'O' stars, while the coolest are red stars, and are classified into the 'M' class.

Class	Temperature (deg. Celsius)	Colour
O	>30,000	Blue
B	20,000	Blue-white
A	10,000	White
F	7,000	Yellow-white
G	6,000	Yellow
K	5,000	Orange
M	<3,000	Red

The above divisions are according the MK Table with approx values of star temperatures.

There are several different observable stars in the night sky, some are small, some quite larger and brighter. Disparity in their sizes also brings about difference in their lifetimes. Let us take for instance our star which is classified as a G class star with a temperature of about 5,500 deg. Celsius. Our sun is about 4.6 billion years old and has a total lifetime of about 10 Billion years. Over the course of time our sun would undergo changes which will make it a 'Red Giant', a large red star expanding beyond Venus before it consumes its fuel and turns into a dense, less luminescent star called a 'White dwarf'.

Hertzsprung-Russel Diagram

You may know over the course of time every star will change it's size and temperature. Hence we need a tool to classify the evolutionary stage of the stars too, the Hertzsprung- Russel diagram is one such tool, which we refer to as HR diagram, used by astronomers to estimate the size, mass, age and evolutionary stage of a star. Below is a pictorial representation of how an HR diagram may look.

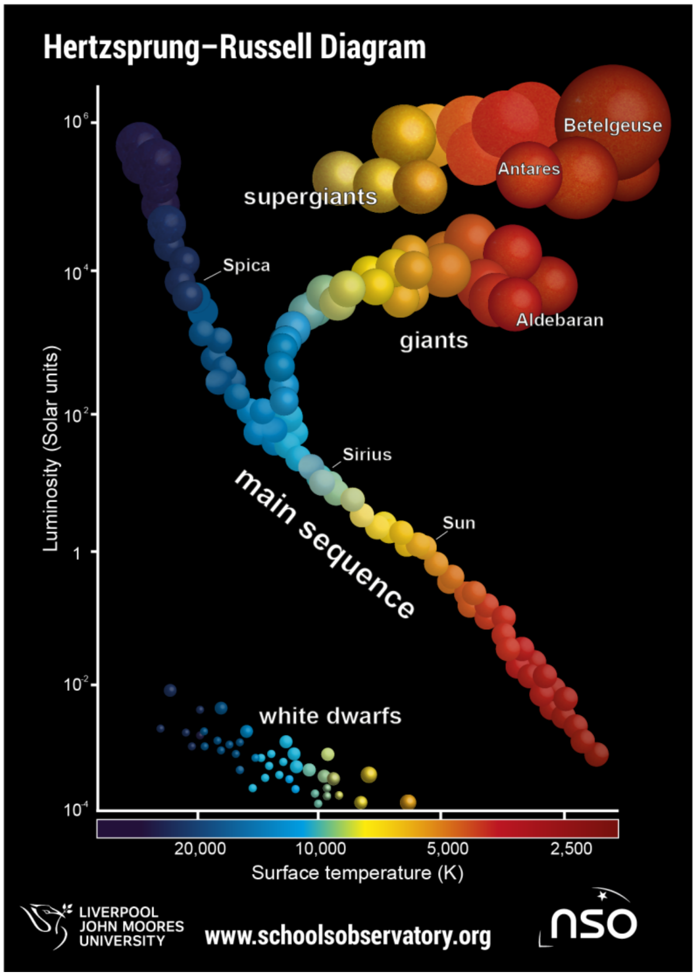


Figure 2 Image credits : [NSO]

The HR diagram is a plot between the Luminosity of a star and the surface temperature of the star. It was created by astronomers ***Ejnar Hertzsprung*** and ***Henry Norris Russell*** about 1910. It was earlier defined with the axis Luminosity against spectral characteristics. Hertzsprung's earlier diagrams had stars identified by the parallax method. Now several different scientifical variations are available for the diagram.

The diagram has a main sequence (a fairly straight line trend) of the plot which signifies that stars spend most of their life in being a star in the main sequence, later these stars will become either white or red dwarfs(below the main sequence) or Red giants(Above the main sequence) according to their size. The smaller stars primarily the G and K stars are the ones which usually undergo red giant phase and end up white or red dwarfs respectively. While those having sufficiently higher mass are the ones becoming Supergiants and Hypergiants (the Largest self luminous objects in the universe) and undergo 'Supernova' which further end up either a 'Neutron star' or a 'Blackhole'.

The spectral properties of these stars are analyzed by the property of Doppler shift. Another relationship is Wien's displacement law which is quite useful for determining the temperatures of hot radiant objects such as stars, and indeed for a determination of the temperature of any radiant object whose temperature is far above that of its surroundings.

Why Classify Stars?

Humans have always had this itch, of knowing “Are we truly alone in this Universe?” This very question is the reason we gaze night sky. Intelligent life evolved after the 4.54 billion year span of time on our Earth, this fact indicates that the lifetime of the large blue stars is too less for intelligent life to develop. Blue giants are usually stars classified as O class, these consume their fuel rapidly and live short lives. On the other hand the stars which are too small i.e. M class stars usually have a tendency to tidally lock the planets in the habitable region (also known as goldilocks region). Being ‘Tidally locked’ means that the one part of the planet will always face the sun becoming extremely hot, while the rest of it is frozen barren (much like a space eyeball), these situation won’t allow life to fruition. Currently the stars of class F, G and K are having best chances for habitable planets.

The night sky always reminds us the scale of the universe, and star classification gives us hope that far off there is a civilization, far off, waiting to be found.

References :

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