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STELLAR SPECTRAL CLASSIFICATION ALONG WITH HERTZSPRUNG- RUSSELL DIAGRAM

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ABSTRACT: The HR diagram is a useful shorthand for locating a star in a two co-ordinates space. For astrophysicists, the Y-co-ordinates is bolometric luminosity, and the X-co-ordinate is effective temperature.
Two main fundamental quantities describing a star are luminosity and temperature. A hertz sprung-Russell diagram(HR diagram) is a graphical representation of a group of stars that use their absolute magnitudes and spectral types as coordinates. Spectral type can be explained primarily on the basis of the temperature of stars. To show how the temperatures and luminosity of stars are related H-R diagram uses the observable characteristics of relative apparent magnitude and spectral type.

KEYWORDS:_ Stellar Spectra; Spectral types and their temperature dependence; H-R diagram – bolometers, main sequence, giants, super-giants and white dwarfs.

INTRODUCTION:

One of the earliest uses of stellar spectra was to classify stars on the basis of strength spectral lines, particularly Balmer lines, In Stellar Spectra stars were classified into seven main spectral types namely O, B, A, F, G, K and M. Later on, it was discovered by M N Saha the relative strengths of spectral lines depend mainly on the star's temperature. On the basis of the co-relation between observable parameters of stars i.e., luminosities and temperature the most comprehensive classification of stars was done. This was attempted by Ejnar Hertzsprung and Henry Norris Russell in 1911 and gave rise to a diagram known as the HERTZSPRUNG-RUSSELL DIAGRAM.

H-R DIAGRAM -an important astronomical tool that represented a major step towards understanding how stars evolve over time. H-R diagram involves parameters such as temperature, luminosity and radius.

The majority of stars, including our Sun, are found in the Main sequence. Other major groups of stars found on the H-R diagram are giants and super-giants. Later on these types are discussed.

H-R DIAGRAM is one of the most useful and powerful plots in Astrophysics.

STELLAR SPECTRA:

A spectrum that contains information about a star's temperature, chemical composition and intrinsic luminosity is called stellar spectra.

The spectra showed that individual star differ widely from one another in brightness and detail. Spectra of some stars contains lines due to gas like hydrogen and helium, while other show lines produced by metals.

Example:' Solar spectrum' is a typical example of a Stellar Spectrum. It can be easily obtained by passing a narrow beam of Sunlight through a prism.

It consists of a continuum background superposed by dark lines. The dark lines in the Solar spectrum are called **Fraunhofer Lines.**

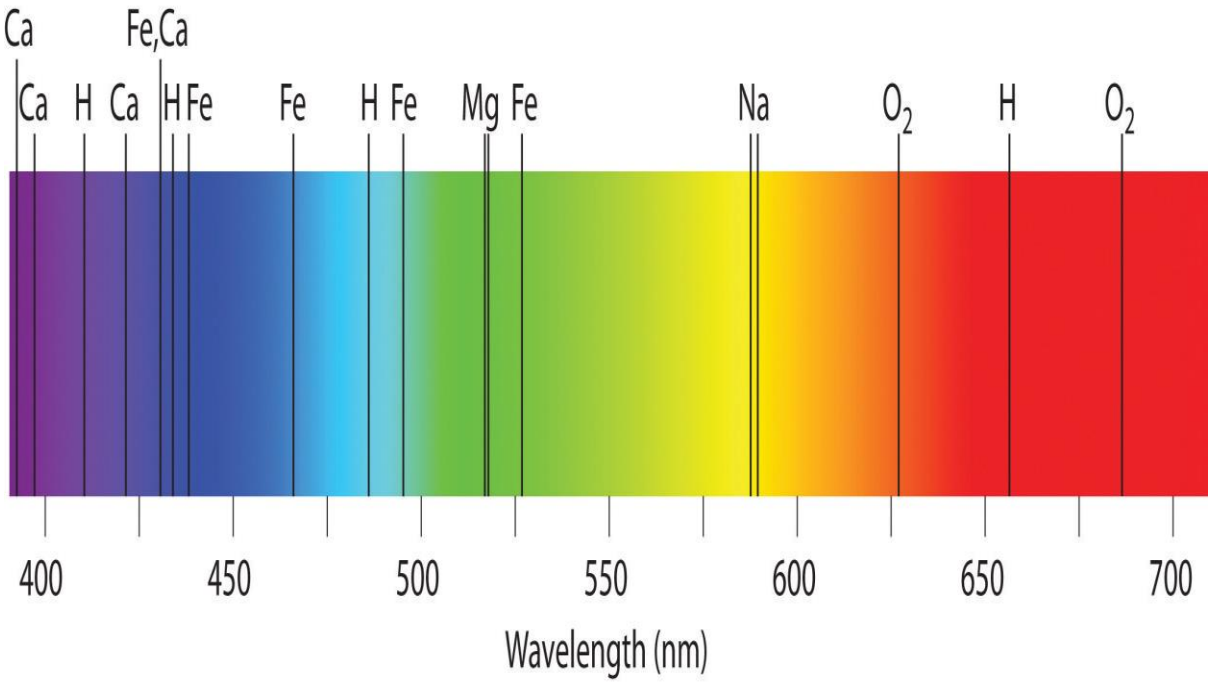


FIG. SOLAR SPECTRUM

The important lines in Stellar Spectra are due to H, HE, C, O neutral ionised atoms.

Similarities in Stellar Spectra provided the basis for the classification of stars into certain categories. The earliest classification was done by Annie J. Cannon. She classified more than 2,50,000 stars by observing the strength of absorption lines, particularly, The Hydrogen Balmar Lines.

Stars have been classified into seven major spectral lines namely O,B,A,F,G,K and M.

For great precision, Astronomers have divided each of the main spectral types into 10 sub – spectral types.

Eg: A-A0,A1,A2 …….. A9(sub spectral type)

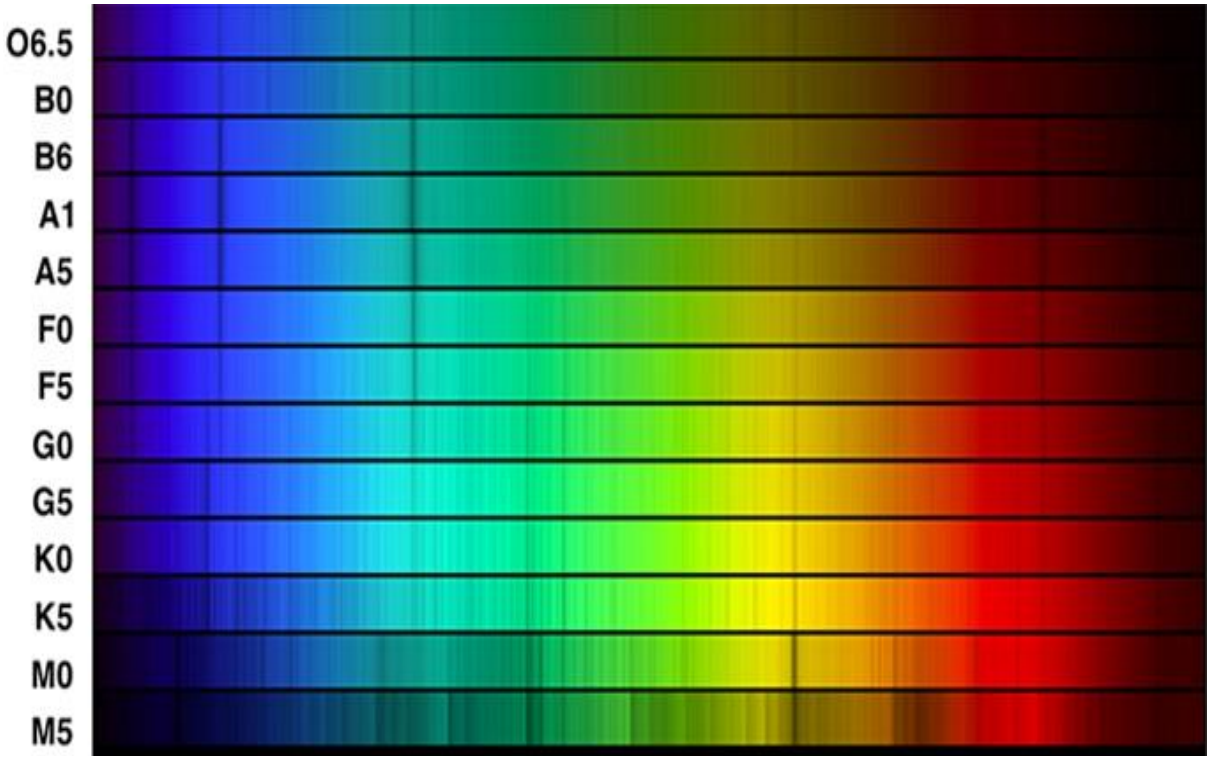
Next come F-F0,F1,F2…..F9(sub spectral type)

Thus there are 70 sub spectral types are possible .

SPECTRAL TYPE AND THEIR TEMPRATURE DEPENDENCE:

It was shown by M N Saha that Cannon's Spectral classification can be explained primarily explained on the basis of stars because the intensities of Spectral line depends on the surface temperature of stars.

HOTTEST-(O,B,A,F,G,K,M)-COOLEST



EXAMPLE OF SPECTRA OF VARIOUS TYPES OF STARS (O to M)

TABLE 17.2 Stellar Spectral Classes

Spectral Class	Approximate Surface Temperature (K)	Noteworthy Absorption Lines	Familiar Examples
O	30,000	Ionized helium strong; multiply ionized heavy elements; hydrogen faint	Mintaka (O9)
B	20,000	Neutral helium moderate; singly ionized heavy elements; hydrogen moderate	Rigel (B8)
A	10,000	Neutral helium very faint; singly ionized heavy elements; hydrogen strong	Vega (A0), Sirius (A1)
F	7000	Singly ionized heavy elements; neutral metals; hydrogen moderate	Canopus (F0)
G	6000	Singly ionized heavy elements; neutral metals; hydrogen relatively faint	Sun (G2), Alpha Centauri (G2)
K	4000	Singly ionized heavy elements; neutral metals strong; hydrogen faint	Arcturus (K2), Aldebaran (K5)
M	3000	Neutral atoms strong; molecules moderate; hydrogen very faint	Betelgeuse (M2), Barnard's Star (M5)

SPECTRAL TYPES AND THEIR PARAMETERS

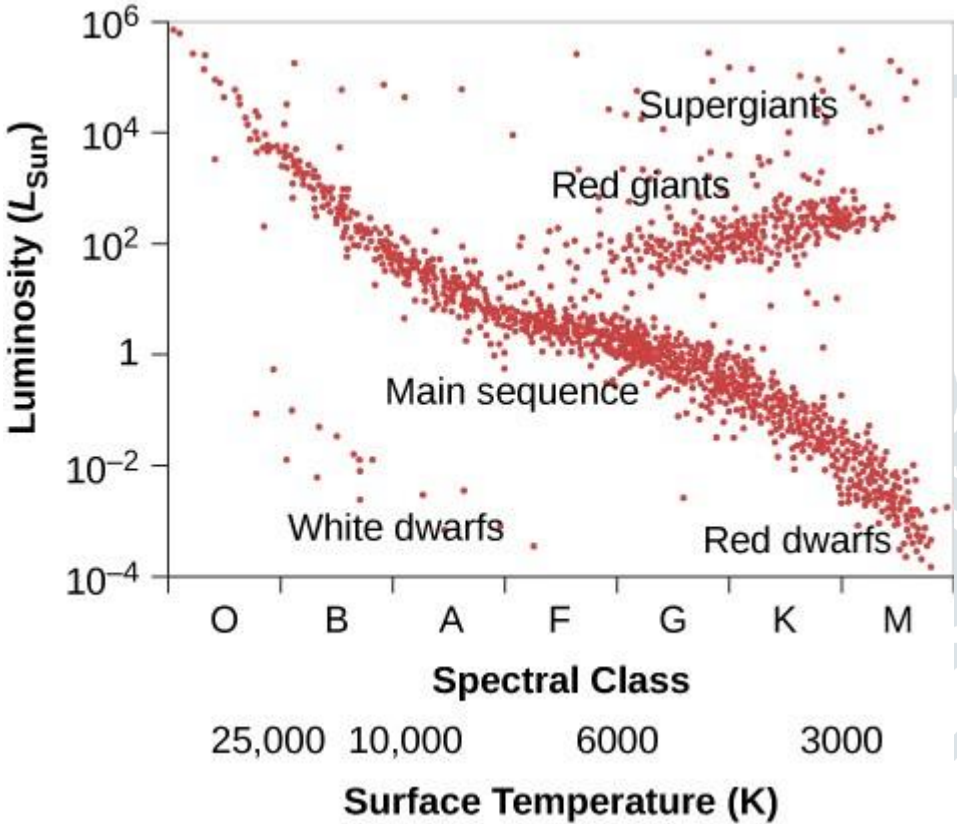
H-R

DIAGRAM:

The diagram is a graph that enables us to classify stars on the basis of temperature and their luminosity. H-R diagram involves parameters such as temperature, luminosity and radius.

The luminosity of a star: It is defined as the total energy radiated by it in 1 second consisting of radiation of all wavelengths.

H-R **DIAGRAM is a plot between absolute magnitude or luminosity (Y-axis) and temperature along X-axis.**



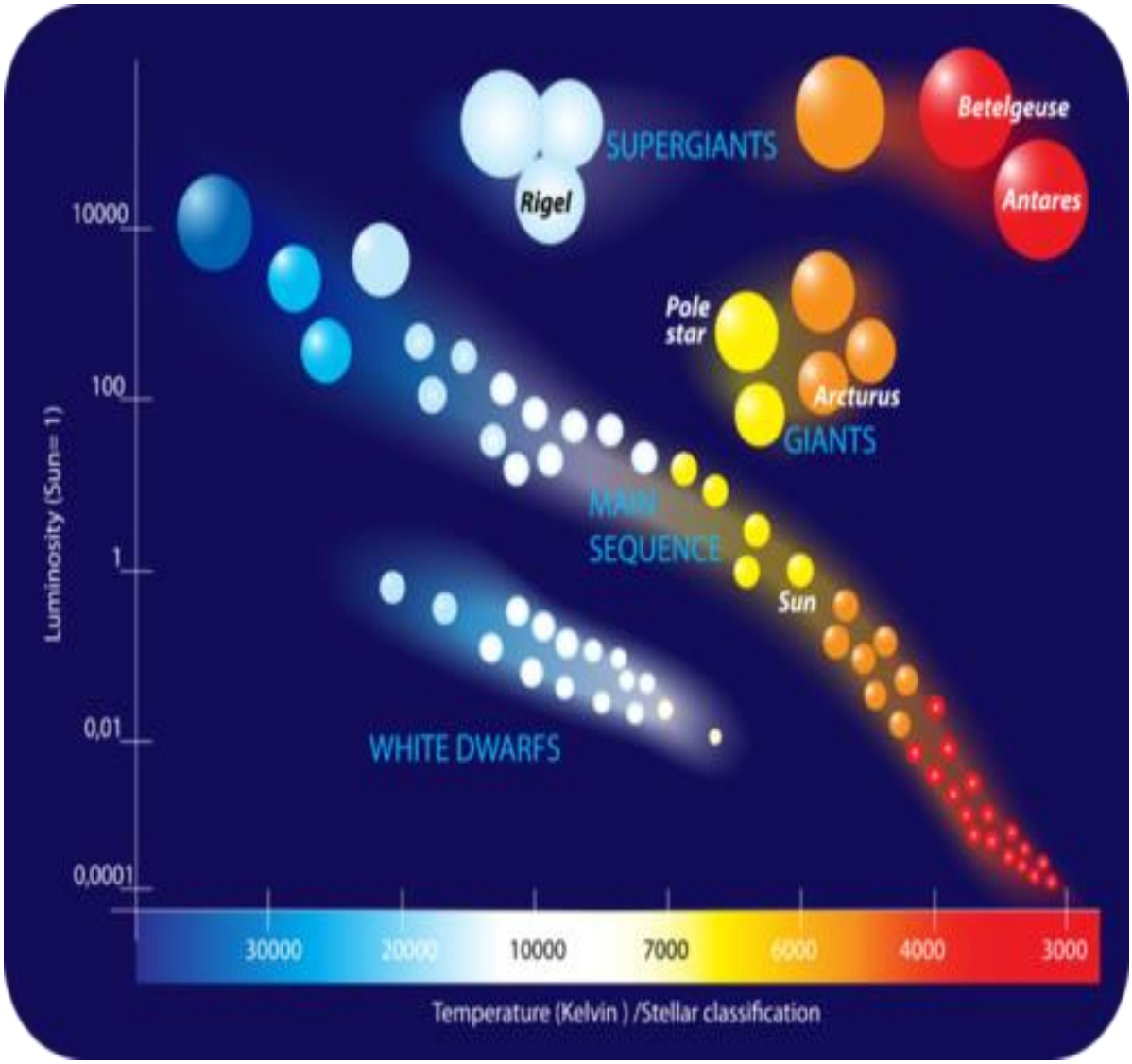


FIGURE: a) A Schematic H-R Diagram

b) Magnified version of H-R Diagram

On H-R DIAGRAM, the Star is located near the bottom of the diagram which means that its luminosity is low and similarly a star in the right indicates that it's temperature is low.

On the basis of H-R DIAGRAM, stars are grouped into four categories namely,

.Main sequence

.Giant

.super-giants

.white dwarf

Main sequence: The majority of stars fall along a central diagonal called t main sequence. The main sequence stars fall to account for nearly 90% of stars.

Gaints: Named so because of their big size, located at the top right of the H-R diagram have a low temperature but high luminosity.

Supergiants: They are extraordinarily big in size and have high luminosity and low temperature.

White dwarf: They are located below the main sequence. These stars are very hot but their luminosity is very low.

The H-R diagram provides information about the following parameters.

. Size

. Luminosity

. Mass

. Spectral type&

. Absolute magnitude

It is because of this reason H-R DIAGRAM is very important in astronomy.

CONCLUSION: So far as we have studied Stellar Spectra and the classification of stars on the basis of their temperature, it can be concluded that H-R DIAGRAM gives an idea about the size of a star. It also traces the evolutionary stage of a star. H-R DIAGRAM can tell us about the ages of star clusters. For instance, a cluster with a lot of blue giants is very young because those stars burn out very quickly. The main sequence stars fall to account for nearly 90% of stars. An older cluster has

most of the RED GIANTS. As the cluster ages even further, we see an increasing number of WHITE DWARF stars.

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