



How to Plot the H-R Diagram and Use its Applications

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ABSTRACT

In this study, we sought to explain how the stars who due to their physical features classified. In following, we explain more of what outcomes can be extracted category. However, we must consider that the physical characteristics of stars, clusters of stars in the universe will have an important role in finding distribution patternof stars.

Keywords: H-R diagram; Red shift; Luminosity

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1. INTRODUCTION

Stars, balls are big contain hot gases and stranding. Star properties such as color, temperature, size and luminosity by mass (amount of matter in it) are determined. Stellar-mass stars as varied characteristics are very different. It is also changeable characteristics of each individual star is having internal changes in its life cycle.

When you look at the sky at night, it seems that the stars flicker or their brightness varies from moment to moment. The flicker of movement of air in the atmosphere can be achieved. As the glass bends light, air starlight breaks. Regions disrupted air travel because

different size, different amounts of starlight is bent. Thus power stellar light that the eye eats, varies and it seems that flickers stars.

Stars according to their spectral characteristics to be classified. Decaying it would stellar spectrum of radiation of different wavelengths of radiation elements show, is obtained. With this information, temperature, color and chemical composition of stars is concluded. There are seven main spectral type each letter of the alphabet has become known. Each sub-spectra, which are numbered from 0 to 90.

Stars according to their spectral characteristics to be classified. Star from radiation spectrum analysis of the elements that show radiation of different wavelengths, can be achieved. With this information, temperature, color and chemical composition of stars is concluded. There are seven main spectral type each letter of the alphabet has become known. Each sub-spectra, which are numbered from 0 to 9. Why do stars shine? With the naked eye on a dark night with no moon and the stars in the sky, clear air can be detected around 2500. A camera or telescope will detect millions of stars.

In fact, some of them with an intensity ten thousand times our sun shine and some of them are much fainter than the central star of our solar system, but all the stars in one thing in common: they convert hydrogen into helium deep within themselves through nuclear energy Faithful and inexhaustible energy production. this will help to stars that are extremely long-lived. For example, the sun is the fuel that will last 10 billion years. Energy is transferred to the outside in the center of the star and the star-shaped particle Roentgen rays, ultraviolet light and radio waves emitted heat. Some of the stars at the end of his life destroyed by huge explosions. Then it's just small balls of material remains quite congested in astronomy, white dwarfs, neutron stars or black holes are called. One day the sun will become a white dwarf.

Conjugate stars: More than half of all stars are in binary or ternary groups that are held together by gravity. Star star married couples who are around their common mass. Often one of the stars are so faint it is not visible from Earth. If the brightness of the stars visible change, or if the couple himself apparently under the influence of gravitational field is adjacent bodies, astronomers can recognize it. Two stars in binary systems because of their attractive forces between the orbital motion affect each other. Astronomers observed the precise movements of the stars conjugate only way to determine the mass of the star directly.

Hipparchus (127 146 BC), the ancient Greek astronomer, 20, star of the most luminous stars that could see the faintest magnitude of the first and sixth magnitude described. Among those who had, median values ourselves. After the invention of the telescope, faint stars were observed more frequently and with improved power of the telescope, it was revealed sharp differences in brightness of the stars of the first magnitude. In the eighteenth century, so much the relation between approximately $5/2$ units (or more precisely $5/1188652$) was determined. The star has a certain magnitude star with a less 5.2 times brighter. Hipparchus system in describing the faintest stars visible to the naked eye as sixth magnitude astronomy equipment you need. With fresh and definite measure of value, now some of the stars that Hipparchus in the group had classified the first magnitude, with magnitude as zero or even negative. For those who think the appearance of the first magnitude stars in the night sky, you imagine that the distance of one kilometer (6/0 mile) you see a candle burning.

Sirius, the brightest star in the night sky, filled with celestial object in the night sky, full moon, with the magnitude of $5/12$. But in general, the brightest star, the sun is so $72/26$. Faintest stars ever observed by telescope, located in the constellation Vela. These pulsating stars known and appreciated sail is 26.

Brown dwarfs, stars are not real, but the stars are incomplete heat and little light shine and at the same time, their attractions to the contracting party. But a brown dwarf contains less than 8% of the mass of the Sun's mass and gravitational contraction to continue until the outbreak of a nuclear reactor is not enough. No nuclear reactor, can not brown dwarfs shine as bright as the stars. Brown dwarfs are dim because only in 1995 that the first one of them was discovered.

Drawing stars: Hertzsprung–Russell graph is a very important tool for astronomers. To draw an absolute magnitudes of the stars relative to their range of (their color) or relative to their surface temperatures, which is a determinant of their spectrum, are used. In this diagram, the stars of the different groups that represent the stages of its life cycle is fit. This chart will help astronomers to understand how stellar evolution and star formation to understand the relationship between properties.

The colors of the stars: he color depends on the star's surface temperature. If you know the value of these properties. You may be able to assess additional value. Blue stars and hottest stars, white stars, cooler. After that yellow and orange stars, and the coolest stars are red. Perhaps the blue color temperature to 50 million degrees Celsius (90 million F), while the red stars, surface temperature up to 2 thousand C (600/3 F) is low.

The term refers to the brightness of the irradiation stars at any wavelength. For example, by increasing the luminosity of the star, the star may, in addition to the more visible light, infrared and ultraviolet light emit more, but the absolute magnitudes and appearance, standard visible light shining stars.

Basically brightness of the stars by mass and stage of the life cycle of stars is determined. The mass of the star is more, compared with less mass star and at the same stage of the life cycle of denser, hotter and more luminous. 2 stars with surface temperatures of the area and have the same brightness and color. If the star expands, its surface temperature decreases. For example, when the main chain of a yellow star like the sun to cool red giant. Although a certain level of Dark Star (such as a square kilometer or square mile) Lower radiation emitted. Bright increases, because the area has increased stubble and rays are more likely to leave their stars. The increase in apparent magnitudes and absolute brightness means that they are also high.

Mass of the star: the mass of stars indicates the amount of matter in it. Units of measure the mass of a star, the Sun's mass. Each solar mass equal to the mass of the sun. Most stars between the mass of 0.8 to 60 solar masses, though the mass of 120 solar masses of stars is limited. If the stellar mass of other stars, the more is not necessarily larger diameter because the density of matter depends on the size of the star.

Many stars, astma. Most of these names have Arabic roots, that is the heritage of Muslim astronomers Ages 8 and 9th. But the majority of known stars. Instead of the Latin name of the constellation and the letter of the Greek alphabet are identified. This naming system to Johann Bayer (1625 1572) non-professional astronomer Germany, which in 1603 published atlas of the stars, be provided.

According to Bayer system, generally the most luminous stars in each constellation alpha (equivalent Greek letter a) to the next bright star beta (B = b) will be allocated and so on. When referring to a specific star, constellation genitive Latin name is used. For example, shiniest stars in the constellation. Because the Greek alphabet has only 24 letters, Bayer system is limited. Sometimes the Greek letter written on the numbers used to identify the stars are close to each other. For example, Orion and Orion a5 a6 of Roman letters (a, b, c, A, B, C)

and Arabic numerals (1,2,3) used in the stars.

Brightness of the stars: radiation intensity of the luminosity of the star. The brightness of visible light is measured based on the value: The lower the magnitude number, the brighter the star. An apparent magnitude measures the brightness of celestial object from the perspective of an observer on Earth: no matter how distant celestial object, the more light sails, more dispersed, and the fainter it seems. The absolute brightness of celestial object in case measures were light-years away, if at a certain distance $6/32$, with its light intensity was observed.

Life cycles of stars: stars are born, millions or billions of years shine and then die. Each star has a multi-stage life cycle during which the size and its temperature varies greatly. The mass of each star (the amount of matter in the star) main determinant of long-lived stars, and how it is evolving. The greater the mass of the star, in a nuclear reactor gases burn quickly and die sooner. Jrmtryn full of stars for several million years bring. Those with less mass, they can shine up to tens of billion years.

Interstellar matter: the distance between stars in each galaxy, interstellar medium is filled with a gas containing mainly hydrogen and helium, a small amount of other gases and dust. This material is unequal distribution of temperature and density billion times less than air. Most of the interstellar medium clouds that some of them can release or to reflect the starlight in or around them, or obstruction light nebula celestial bodies far as we identify. The interstellar medium by stellar winds and material particles ejected by the dying star becomes rich. About 10 percent of the mass of the interstellar medium of the Milky Way formed and this figure is characteristic of spiral galaxies. Most of the interstellar material in galaxies spiral arms, where star formation.

Cosmic rays, energetic atomic particles that are almost the speed of light in space travel. The primary cosmic rays, energetic particles outside the Earth's atmosphere that may be imported into Earth's atmosphere to produce secondary Cosmic rays collide with other particles. The origin of the highest energy cosmic rays that are outside our galaxy and galaxies and quasars from their roots activist. The origin of cosmic rays and low-energy, explosion, and supernova remnants within our galaxy and Palsarhay. The origin of cosmic rays that have the lowest energy, the solar system and solar flares occur.

However, our massive universe contains an infinite number of stars each with their own age, size, luminosity, temperature, and composition. Danish astronomer Ejnar Hertzsprung and American astronomer Henry Norris Russell found patterns while relating all of these characteristics so they came up with a simple diagram that drastically changed the way that astronomers classified stars.

The H-R diagram is used for classifying stars based on its characteristics; age, composition, size, luminosity, temperature, and mass. Temperature, star classification, or color can be placed on the X-axis of the H-R diagram however unlike many graphs the X-axis in higher toward the left, this means that the higher the temperature of the star the closer it is the origin.

Temperature directly affects the color that stars emit their light in; if stars are 3,000 K or below then they are red, if they have temperatures of about 7,500 K then they emit more green light than anything else, if they are above 30,000 K then stars emit blue light. We can come to conclusion that if the stars are hot and bright they are shifted to the blue side of spectrum and if they are cooler and dimmer they are shifted to the red side [1].

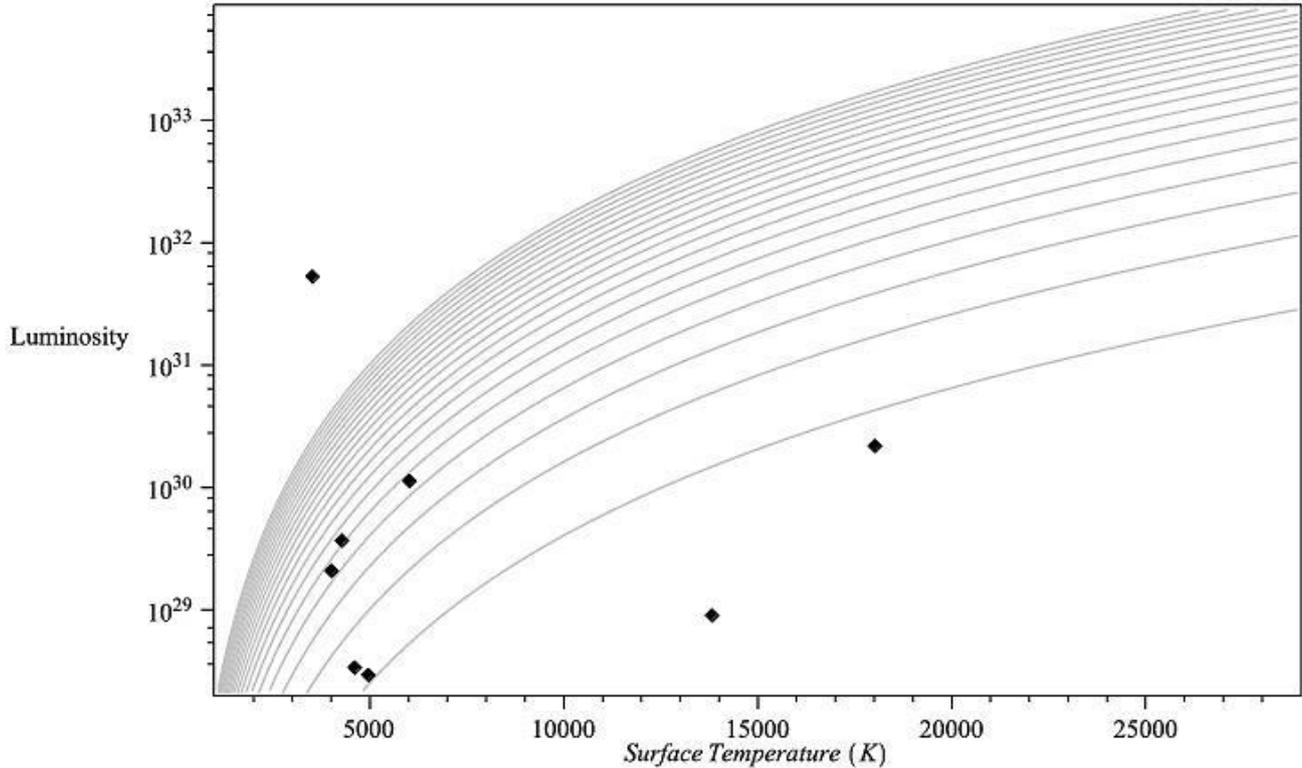


Figure 1. The H-R diagram when the vertical axis has a logarithmic division.

The y-axis of the H-R diagram can be represented by luminosity, which is a measurement of brightness in comparison to the sun or apparent magnitude. Luminosity of a star relates to the mass of the star. If all of the stars in the main sequence acquired the same mass then the main sequence would be represented by a single point. This diagram can also lead to learning about the life of a star. It can also show the roadmap of star's life.

2. HOW WE USE MAPALE TO PLOT THE H-R DIAGRAM

In order to plot the H-R diagram in maple we'll use a function related the luminosity of star with the surface temperature. The energy radiated from a star with the radius R and the surface temperature T per second is called the luminosity:

$$L = 4\pi\sigma R^2 T^4$$

where σ the Stephen-boltzman constant witch has the value of 6.67×10^{-8} j/s.

The H-R diagram will appear by plotting the luminosity versus the surface temperature for different values of radius. the radius differs from 1 to 10 times of the sun radius. bye using a "for circle" we can ask maple to calculate the value of L for different radius and temperature

and plot the diagram for it. the luminosity and the radius of stars are calculated in comparison to the sun. the vertical axis has been calculated as log plot. Another way to plot the diagram is to use "pointplot" by having the luminosity and the temperature of different stars. the last step is to gather all these diagram into one by using "display" operator. the diagram has been shown at below.

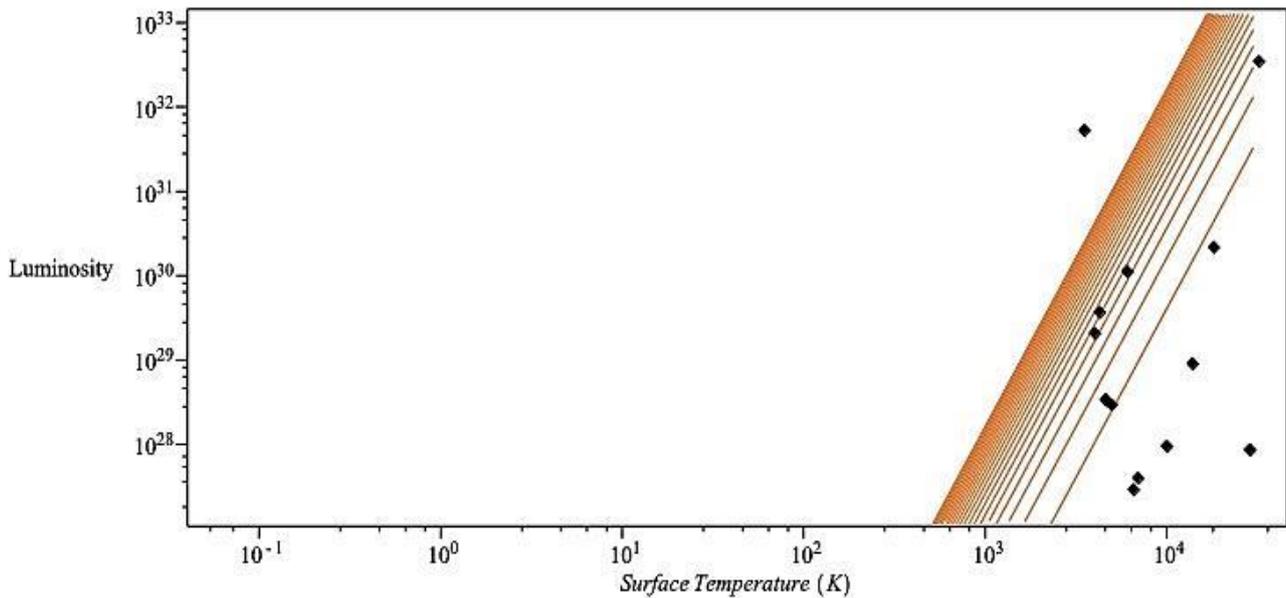


Figure 2. The H-R diagram when the vertical axis has a logarithmic division.

By comparison between two diagram it can be resulted that most of the stars obey the luminosity rule. these stars are placed in a region named the main sequence and live their entire life there. they leave the main sequence as they became a red giant with the luminosity rule is not used for them. Betelgeuse $\alpha(Orion)$ is a red giant with is determined as a red point in the diagram, upper than the stars of main sequence [2-6].

Thought leadership charts astronomers to speculate that it may be of stellar evolution, the main proposal of red giant stars in dwarf fall show, then moving along the main sequence in the course of his life. The star was thought that by converting gravitational energy into radiation energy emitted by the Kelvin-Helmholtz mechanism.

This instrument at the age of only tens of millions of years for the sun, creating a conflict over the age of the solar system, astronomers, biologists and geologists and the evidence that the earth is older than it was. The conflict was settled in the 1930s that fusion as an energy source known stars. However, following the meeting of the Royal Astronomical Society Russell diagram. In 1912, Arthur Eddington to use it as a basis for the development of ideas in the physics of stars was inspired. In 1926, in his book to his inner constitution of physics, explain how the star on the right.

This is a significant development, especially since it was the main problem of the theory of stellar energy source of a star, was still unresolved.

Heat energy, and even the stars are largely composed of hydrogen (see metallicity), yet to be discovered. Eddington managed to escape from this problem with a focus on transport thermodynamic energy radiation inside stars.

3. HOW TO CALCULATE ASTRONOMICAL DISTANCES?

One of the most important parameters of a body in the world that is calculated to calculate other parameters, its distance from us. The distance of objects can be reached important and vital about them.

From ancient times to calculate the distance of celestial bodies techniques had been developed. But usually all about the planets Mars and Jupiter did not answer most distant objects because the accuracy was very low current measurement tools. But these new techniques developed and evolved over time. In this article, we refer to four of the most important methods of measurement.

4. THE DIFFERENCE IN APPEARANCE

Place your finger in front of you, close your left eye and right eye to look into the background of your finger is left to do this by eye. In each case, the background will change finger, because your eyes because of parallax apart and together different contexts to show you. In this way, we can calculate the distance between two eyes finger apart, this method called parallax. To calculate the distance of nearby objects is very good and simple (for measuring the army used this method.)

Now, using the following equation in terms of distance easily earn astronomical units (AU, as you know any (Au) or 150 million kilometers from Earth-Sun distance). By definition, any 206265 astronomical units to parsecs consider a relationship written as follows. By calculating P (apparent shift in seconds) d arc is obtained. ($P = 1 / d$ (pc)).

With this method, because of the inability of up to 100 parsecs can only measure that can be changed by removing the atmosphere to 1,000 parsecs. So not very useful and commonly used measure in our own Solar System.

Parallax range Surface temperature and the Tyfshan stars based on classification range that defines the classification of stellar spectra and by knowing the type of information, such as bright stars in the star's spectrum can be calculated. Graphing called Hertzsprung–Russell (H - R) globular that many bright stars based on classification specifies a range of experimental and statistical. Of the charts and the spectroscopy of the bright stars of each star can be identified. Having obtained an absolute luminosity (L) using a simple formula that looks at the bright and there are mass is calculated.

The apparent brightness of formula (b) also need to be determined by photometry from the ground. This method is based spectroscopy to determine the distance is called the parallax range. This is due to lack of sufficient accuracy and to dim and distant stars has limitations, but better than Parallax is apparent.

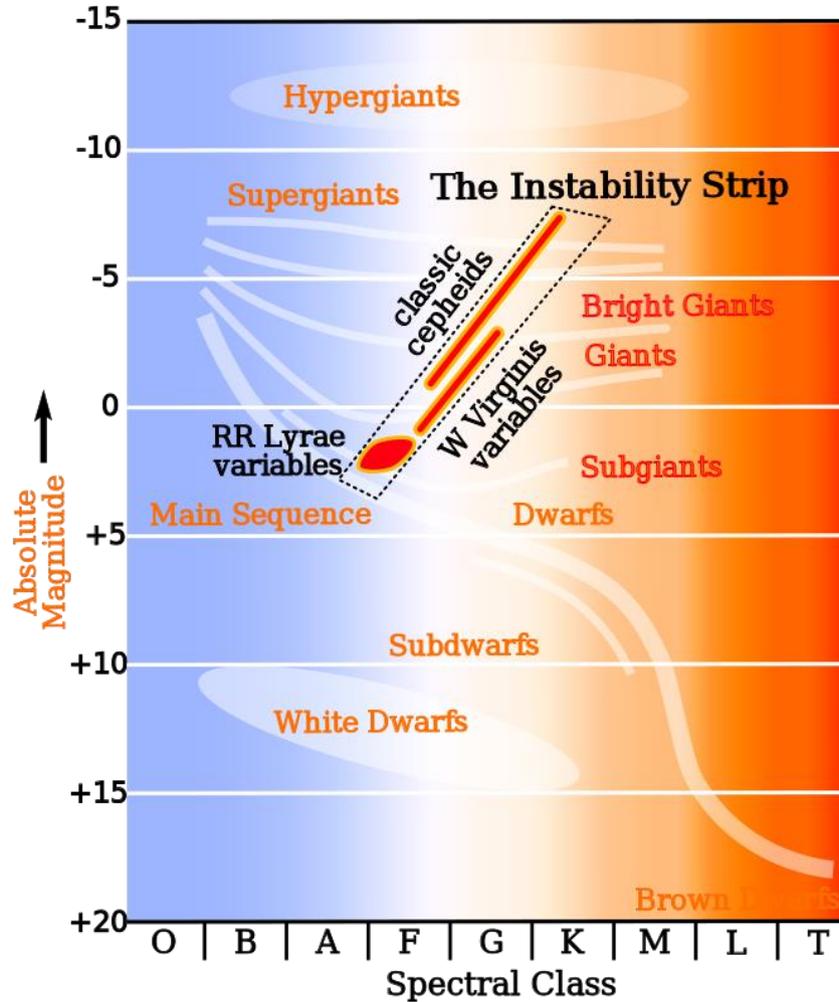


Figure 3. H-R with a bar graph instability and its components are highlighted.

The use of Cepheid variable stars and supernova

Cepheid variable stars and supernovae indicators measuring distance because they are frequently correlated directly with brilliance. Cepheid variables are the most important tool to calculate the distance of galaxies. Recently, astronomers using supernovae Group I) a) can also gain from objects very far away. Because the brightness of the supernova is so much that can be observed from a distance as well. For example, in 1992 a team of astronomers from Cepheid in a galaxy called IC 4182 Changes to determine its distance from Earth used.

They are meant benefited from the Hubble Space Telescope. On 20 separate occasions galaxy of stars that were shooting. By comparing the photos with each of the 27 variables identified in the photos. With continuous observations of its light curve variables could draw them, then spectroscopy, the spectra of stars variable examined, and of the whole of the amount of iron in variable identify. If the iron content is high, variable I) a) and type II is low.

It calculates the average magnitude of the light curve of the star and its orbital period will occur. As we have stated period is directly related with variable brightness. This follows

from the following diagram is a graph obtained experimentally. By putting the period in question and know what type of variable it whole (I) or (II) can be acquired absolute brilliance. Since, for the absolute luminosity increase logarithmically and (in Basic 2.54) changes. For knowing the absolute luminosity of the Sun's luminosity can calculate the absolute magnitude. However, knowing the magnitude and magnitude of the light curve graph using the modal distance relationship, are obtained:

$$m - M = \text{distance modulus} = 5 \log d - 5.$$

Using Hubble's law:

Another method used to calculate the distance of galaxies from Hubble's law is specific objects. In this way, the Hubble's law mathematically that we use are as follows:

$$V = d \times H$$

where v is the velocity of the object in line with our vision and H is the Hubble constant.

To calculate the distance of galaxies and distant objects radial velocity (to see) crime by Redshift (red shift) to calculate the star of the whole. By the following equation redshift velocity can be obtained from:

$$v = C \times Z$$

Now put the speed on the Hubble distance is obtained:

$$d = C \times Z / H$$

Of course, this method is not very accurate. The exact amount is not known why the Hubble constant. Because this relationship is consistent with the age of the universe and its amount varies according to different theories. This dependence also creates a long time in Mhasabt disorder. Now the best way to measure the distance of objects up to a distance of several tens of mega-parsecs Abrnvakhtrhast calculated with good accuracy.

5. H-R AND FORMATION OF STARS

In the mid-nineteenth century changed the focus of astronomy. Instead of paying attention to the position of celestial bodies in the sky, astronomers were curious about the nature of those bodies. Other stars were points of light moving mass and physical composition was important. Spectroscopy, which splits light to be invented by physics to astronomy and astrophysics link (astrophysics) began Spectroscopy instrument to analyze light from a celestial object and then used a whole. The spectra obtained and comparison with the spectrum of a substance known as similarity search, and therefore to identify substances in the body. The spectrometer is used for various scientific purposes and not used solely in astronomy research.

Astrophysics to study the composition and origin of the interaction (interaction) of the

heavenly bodies natural processes that take place in them and the physical forces that affect their pay. Astrophysics is the branch of astronomy.

Analysis sunlight

Astronomers use spectroscopy to analyze the sun's spectrum Formed when the radial wavelengths of electromagnetic radiation to be analyzed when it is composed. The whole radiation emitted by a celestial body can be recorded spectrogram. Information about the color temperature and chemical composition of the spectrum of a star, the star gives astronomers.

Each star has a unique spectrum that includes a pattern of lines that represent the chemical composition of stars. In the late nineteenth century America, a group of Harvard Observatory to study the whole hundreds of thousands of stars.

Magnitude stars

Spectroscopy milestone scientists understand the nature of the classified stars based on characteristics of birth and death ,how they discovered the energy source.

Harvard classification system

Harvard Observatory has classified his team began the spectra of stars of hydrogen lines. Their stars have strong hydrogen lines were in a class. Class B represents lines was weaker and so on. Later, one of member of the team found that at a given temperature hydrogen lines are stronger and hotter stars less hydrogen and re-arranged system based on temperature, as well as the system M, K, G, F, A, B, O.

H-R Diagram

In the early twentieth century Danish astronomer Einar Hertzsprung and Henry Russell 1873-1967, 1877-1957 American independent classification based on the spectra of stars were bright. Both soon realized that the results show that the stars are in class that life cycle of stars. Hertzsprung–Russell graph continues to characterize modern astronomy.

Understanding Energy Star

Almost from 1920, a group of Astrophysicists have attempted to identify the energy source of stars. English astronomer proof that stars are made mostly of hydrogen and a combination of most stars are the same. In 1929, Arthur Eddington from 1882 to 1944 showed that star power comes from converting hydrogen into helium. In the decades that followed, astronomers its work on the basis of this and other work he did on the relationship mass of the star and its brightness [1].

6. CONCLUSION

Many of the stars in the H-R graph occupies an area along the main sequence. During this stage, the stars combine hydrogen in its core. Next concentration of stars in the horizontal (fusion of helium in the core and hydrogen burning in a shell around the core) is shareware.

Another outstanding feature is located in the Hertzsprung–Russell gap between spectral type A5 and G0 and between 1 and 3 is the absolute value (for example between the majors and the Giants in the horizontal). Variable stars RR Lryae can be found on the left side of the slot. Cepheid variables live in the upper part of the instability strip. H-R with bar graph instability and its components are highlighted. H-R diagram can also be used by scientists to measure how far away a star cluster is around the earth. This can be compared with the absolute magnitude of the stars in the cluster are known star (or stars model) done. Groups are then moved in vertical direction, as long as the two main sequences overlap. The difference in magnitude to match the two groups was called bridge the gap and direct measurement module for (extinction ignoring) away. This method is known as the main sequence fitting and a spectral type of parallax.

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