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A REVIEW ON VARIABILITY OF STARS IN UNIVERSE

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Abstract - *Unfortunately, astronomy is one of the few areas of knowledge in which the researcher cannot have a direct interaction with the object under study, given the enormous distances that separate it from it. In view of the above, the only information available about the celestial body consists of the electromagnetic radiation emitted by it, which after traveling great distances, it reaches the earth in the form of faint luminous rays or faint radio wave emissions. Thus, the present work contains the development of a graphical interface that allows to measure the changes presented in the luminosity of the variable stars, using digital image processing techniques. In addition, it introduces strategies of pre-processing of the astronomical photographs of the celestial body of interest, with the aim of reducing the defects caused by the noise associated with the process of capture. Finally, also enables the implementation of a higher-order interpolation technique that allows the construction of the light curve of the variable star, from which astronomers try to establish the causes of changes in the emitted luminous intensity, which range from processes of contraction and expansion of layers from the stellar atmosphere, to the presence of wandering bodies orbiting it.*

***Key Words*:** Astronomer, celestial bodies, radio-wave emission, *electromagnetic radiation, luminous intensity.*

1.INTRODUCTION

Without a doubt, astronomy stands out for being one of the most exciting branches of physics, since it allows the human being to satisfy his uncontrollable desire to know the environment that surrounds him. beyond imagined limits. Every time new images of distant discovered worlds appear in articles to this discipline, or galaxies so distant that they approach the maximum limit of the history of the universe that can be known; increasingly far-fetched questions arise whose proposed solutions can only be refined or discarded with new results obtained from observation.

This endless chain of observations and formulation of hypotheses, makes possible the constant renewal of the research that is advanced in this branch of physics, contributing not only to knowledge of the bodies that inhabit outer space, their nature and interactions; but also, to the same technological development of the human species. To cite any of these contributions, it is possible to mention the great influence that astronomical research has had in aviation, both military and commercial, after the trips from the Apollo missions to the Moon.

The fundamental objective of the study of variable stars is to determine the causes of the variations presented in the light emitted by the star, which range from ups and downs in the energy production of the star caused by the physico-chemical composition of the star, until the possible existence of planets orbiting the star, and that eclipse the light each time that these stand between the star and the earth. According to the above, the analysis of the data derived from the observation of the star is crucial to determine such causes, which can lead to important developments in astronomy, such as such as the discovery of planets beyond the boundaries of the solar system, black holes that expand or attenuate starlight, multiple star systems, neutron stars, pulsares, quasars,etc. However, the enormous distances that separate the star under study from the observer, make the celestial body is represented in the photographs by a weak point luminous, which is why the noise introduced in the image processing process is too loud.

Thus, in this research digital image processing was used with the aim of minimizing the effects caused by the noise introduced in the photographs, perform the quantification of the changes in the luminosity of the celestial bodies under study, and interpolating the magnitude data obtained by means of second-order polynomials; all this with the aim of constructing the light curve of variable stars, from which the acronyms will have the possibility of knowing in depth the phenomena that happen inside the stars, discover new planetary systems and star clusters, thus displacing the frontier of knowledge that is currently available. About the universe.

1.1 BACKGROUND

Studies of variable stars have developed in different ways, from the naked-eye records first made professionally by astronomer Henrietta Leavitt in 1912, to the trdowns achieved by modern photometry techniques with CCD cameras, published in the American Association of Variable Star Observers Journal [1]. Currently, these cameras allow to obtain high-resolution images of the star under study, in such a way that changes in the luminosity of the star, improving the possibilities of determining what the phenomenon is due to, with the purpose of obtaining its classification.

For the analysis of these images, processing systems similar to those used for time-domain signals are usually applied. These techniques are: the description by derivatives applied in the detection of maximums and minimums, changes of slope and concavity; the study by spectral decomposition or Fourier transformed with the end of identify the deferent wavelengths present in the photograph; the cosine transform for image compression; neural networks with the purpose of dividing the study of an entire large image, into subsections analyzed by independent processors; and the Transformed Wavelet used in noise removal and self-similarity detection [2]. This last property of the signals allows the detection of the nature of the variability, which subsequently makes possible the classification of the star.

Recently, researchers have focused on the search for variable stars within globular star clusters, which are considered stellar cradles, since there they are formed. Man much of the stars existing in the universe. The study of these celestial bodies allows astronomers to understand the behavior of stars in their initial stages, complementing the information that until today is held about the formation of new planetary systems. For example, S. Liu, Z. Wu and X. Zhang, made an identification and characterization of the variable stars existing in the cluster NGC 2126 in the constellation of Auriga [3], with the aim of estimating sus ages and determine the stages in which they are within the scale of stellar evolution. Similar work was done by David Weldrake, Penny D. Sackett and Terry J. Bridges, only for the globular cluster known as *Centauri,* in the southern constellation of Centaurus [4].

Another area of research in which variable stars are involved, consists of the search and characterization of extrasolar planets, that is, objects that are orbiting stars. distant located beyond the solar system. By analyzing the light curve of variable stars, it is possible to determine whether the observed changes in the apparent brightness of these celestial bodies are caused by transit. of a small planet, which generates an eclipse when it passes between the star and the earth. Thanks to this methodology, known as the transit technique, it has been possible to discover a large number of extrasolar planets. For example, in the work of K Szatmary,J Gal and L. Kiss, the recent discovery (August 2010) of the celestial body identified as WASP-37b, an exoplanet very hot that orbits the star WASP-37, of characteristics similar to those of the so-called Hot Jupiter, with a period of 3.577471 days, and que generates an increase in the apparent magnitude of the star of 0.02 magnitudes, as can be seen in figure 1.1 [5].

As for the pre-processing of the images is refers, carried out with the aim of minimizing the effects of noise, the vast majority of research works point to towards the calibration of the photographs by means of three auxiliary frames known as Darks, Flats and Bias. For example, in the thesis called Photometric Analysis of the Open Cluster NGC 6611, presented by the researcher Johanna Suárez Núñez, as a partial requirement to opt for the Master's degree in Physics from the University of Puerto Rico; a methodology is presented by which the auxiliary frames are combined through the promedio, with the objective of subtracting them from the original image, and thus reduce the consequences generated by the existence of additive noises [6]. However, no work has been found in which the possibility of combining auxiliary photograms by

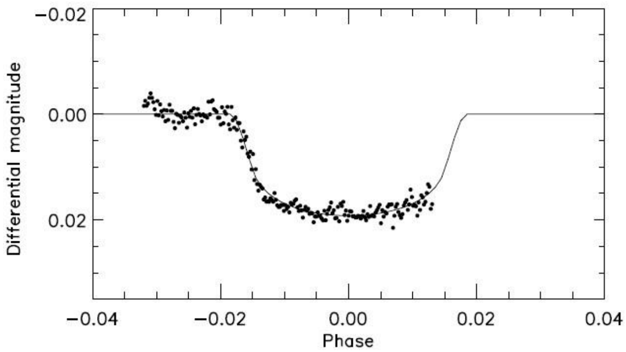

Figure 1.1. Light curve of the star WASP-37b.

other statistical operations such as median or fashion, so additional options were added to the graphical interface built in this work in order to offer this possibility.

For the measurement of changes in the luminosity of variable stars, it has been detected that the investigations carried out to date use two techniques fundamentally: aperture photometry and photometry differential, being this last one the most used, since the instrumental difficulted is considerably reduced. This technique contemplates the identification of the three-dimensional geometric shape that forms the image of the star in photography, known as PSF, from which it is made. the calculation of the effective width occupied by the star in the matrix, known as FWHM, to later measure the changes presented in the brightness of the celestial object. For example, in the monograph work presented by Tomás Tecce for the Faculty of Basic Sciences of the University of Buenos Aires in 2004, a methodology for the measurement of the changes in the luminosity of the variable stars, by obtaining the FWHM, considering the PSF as circular base [7]. However, since when capturing the image the atmospheric extinction can generate the distortion of the circular images that form the stars, and because the shape of the pixels of the CCD cameras is not exactly square, if not slightly rectangular; the graphical interface developed in this research proposes the creation of an algorithm that calculates two FWHM, one for the x-axis and one for the y-axis, considering the basis of the PSF as elliptical, but not circular, something much more adjusted to reality.

Once the values of apparent magnitude of the celestial body of interest for each of the frames taken throughout the observation day are obtained, itis necessary to perform an interpolation of the data in order to proceed with the construction of the light curve, from which astronomers can identify the main characteristics of the star to variable in study. More recent works perform this reconstruction from nonlinear regressions that usually cause discontinuities in the curve, which contradicts the character of softness inherent in any physical variable. In view of the above, this research suggests the use of an interpolation algorithm based on Cubic Splines, which constructs higher-order polynomials, but which respect the continuity of the whole phenomenon, offering light curves with reliable observations in which it is impossible to count on many samples given the climatic conditions, something very common in the country's observatories.

Although numerous studies of variable stars have been carried out worldwide applying various methods of signal processing, a large number are still found in the world. of stars pending by identificar and clasificar, since the number of research groups dedicated to this topic is in clear comparison with the number of stars que present variability (it is estimated that all stars are variable at some stage of their existence). Thus, the implementation of an effective method of processing astronomical images, will facilitate the classification of the stars that are pending study. [8].

2. LITERATURE REVIEW

2.1 Variable Stars

Variable stars are all celestial bodies of stellar characteristic that present changes in the intensity or color of the light perceived by an observer located in the super Theend of the earth, but whose causes are unrelated to the interaction of light rays with the layers of the atmosphere[9]. It is possible totrust that all stars exhibit some variability during their existence, as they pass through the stages ofevolution. stellar [10]. The origins of this phenomenon can be located inside the star, that is, explained from its expansion, eruption,etc.; or on the outside of it, in which case the explanation may be found in multiple star systems or in the presence of planetary bodies orbiting around them, which they hide the light from it every time they stand between the star and the earth. This feature makes it possibleto classifyvariablethese categories into two main categories: intrinsic and extrinsic.

For the study of variable stars, astronomers make observations throughout the period of variability by recording the apparent magnitude presented by the celeste body on each day of observation. By constructing a figure of luminosity against time, known as a light curve, it is possible to identifythe main characteristics of the object,such as, the period, amplitude, color index, special class, temperature, distance,etc. Given the above, the whole process is carried out with the aim of measuring The changes presented in the luminous intensity of a star from its photograph,is of utmost importance in the investigation of this type of celestial bodies.

There are currently two information systems that catalog the variable stars discovered. The first is known as the General Catalogue of Variable Star (GCVS), which contains more than 40,000 stars suspected of presenting some variability [11]. On the other hand, the American Association of Variable Star Observers created the catalog known as AAVSO, in which it is possible to observe the main characteristics of variable stars of interest. , including acelestialchart in which the location of the celestial body in the sky is presented [12]. These stellar identification systems are of great importance to the variable star researcher, as they allow him to identify the object under study and toestablish the state of the art from the works done by other observers.

Below is a brief description about the different types of variable stars discovered so far,and some light curves that allow to visualize the behavior of variability luminous presented by these celestial bodies.

2.1.1 Intrinsic Variables

As stated above, in some cases the cause of the variability lies in physico-chemical processes that take place inside stars. In this case the variable star is said to be intrinsic. Since the phenomena occurring in the layers of stellar atmospheres are extremely complex,itis necessary to divide this classification into subcategories, in such a way that it is it is easier to identify the origin of variability from the analysis of light curves.

PulsatingVariables: The variations in luminosity presented by this type of stars are due to the continuous contraction and expansion of the layers of the atmosphere, thus producing a displacement of spectral lines, which is explainable by doppler effect theory. Changes in the size of the star generate pressure variations that translate into temperature ups and downs, which in turn, due to the close relationship between temperature and luminosity ($L\alpha\, T_{and}{}^{4)}$,theytranslate into large variations in the luminous intensity emitted by the star [13]. Below are some types of pulsating variables.

- Cepheids: They are extremely important celestial bodies in astronomy since they serve as a beacon to calculate the distances in the universe. This is due to the existence of a direct relationship between the period and the absolute magnitude of the star, which allows measuring the space that separates it from the earth once its apparent magnitude from a light curve. Generally these are giant or supergiantstars, supremely massive,5 to 15 times the mass of the Sun, very young and bright, belonging to open clusters located close to the galactic plane [10]. Its light curves present periods of variation of between 1 and 100 days, with amplitudes ranging between 0.1 and 3 stellar magnitudes. One of the most representative stars of this classification is *CK Cam,* located in the constellation of Camelopardalis, with an apparent magnitude of +7.9 and a period of 90 days. In Table 2.1 the light curve of this celestial body, built by the Konkoly River Observatory in Budapest, Hungary, is presented.

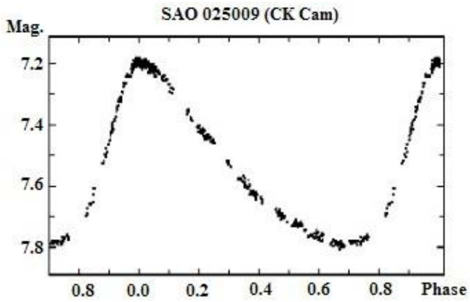

Figure 2.1. CK Cam light curve.

▪Type Mira: In this type of variables are the stars of long period, between 100 and 500 days, supergiants, ofthe spectral class M, with emission lines in their spectrum, and variations of luminosity that reach up to 6 magnitudes [13]. The most representative star of this group is *omicron cetus,* better known as Mira, with a period of 335 days and with a magnitude ranging between +4.89 and +9.16. In Guide 2.2 it is possible to observe the light curve of this star, supplied by the All Sky Automated Survey (ASAS).

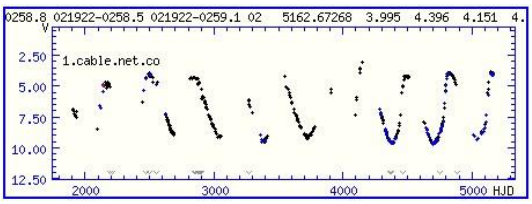

Figure 2.2. Omicron Ceti light curve.

W Virginis: These are giant stars, of absolutemagnitudes between 0.7 and 2, with periods ranging from 0.8 to 35 days, and changes in the luminosity of 0.3 to 1.2 magnitudes. Although they are somewhat similar to cepheids, they differ from the latter in their mass, which is usually between 0.4 and 0.6 solar masses [13]. An mplo axis of such stars is *HD*6286, in the constellation Pisces. This celestial body has a period of 35 days, with an increase in the apparent magnitude of +0.28. In Article 2.3 the light curve of this staris presented, built by the Astrophysical Institute Potsdam, in Germany [14].

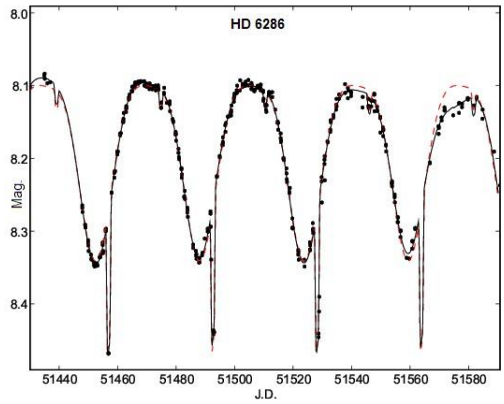

Figure 2.3. BE Psc light curve.

▪RR Lyrae: The stars belonging to this classification are in an evolutionary state in which the fusion of helium existing in the nucleus of the star. The periods are usually much smaller than those presented by the three previous types (around a day), although the depth of the variation only reaches tenths of a magnitude. They are generally found in globular clusters immersed within the galactic plane, so they are very useful when determining the distance between the earth and these groupings of stars. [13]. A typical example of this classification is *RR* Gem, in the constellation Gemini, whose lu z curve is observed in 2.4 [15].

▪Delta Scuti: They are stars that present variations in the luminosity emitted, due to radial and non-radial pulsations of the upper layers of the atmosphere. They are also known as dwarf Cepheids, as they possessn lower masses.

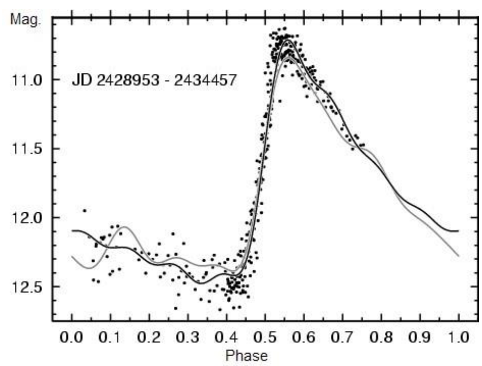

Figure 2.4. RR Gem light curve.

to those of that classification. A characteristic celestial body of this classificationis the star Y Z *Boo,* in the constellation of Bootes, which presents variations of 0.5 magnitudes with a period of 0.1040 days. In Table 2.5 the light curve of the star in question is presented [16].

▪IrregularVariables: This group is made up of supergiant stars, too massive and extremely young. The way in which pulsations are performed remains a mystery to astronomers;however, a special type of irregular variables, known as *T Tauri,*is thought to be in reality protoplanetary disks like the one that gave rise to the solar system. Being an irregular cloud of gas in rotation,the curve of light obtained presents a behavior devoid of periodicity. Table 2.6 presents the light curve of *RX J*1608,6−3922,a clear example of T *Tauri* stars [17].

EruptiveVariables: These types of stars usually present sudden increases in the luminosity emitted, due to explosions that occurred inside it, and in which it is not possible identificar periodicity any. These unexpected increases in brightness can occur in small amounts, as in the case of flare stars;or at immeasurable intensities, in which case they are it presents the explosion of the entire star, that is, in supernovae [13]. This category includes the types presented below.

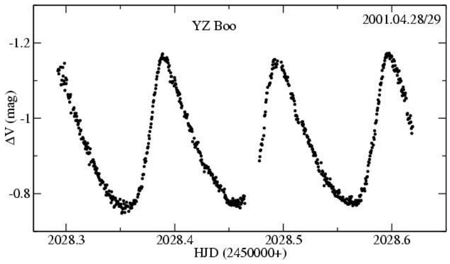

Figure 2.5. YZ Boo light curve.

▪UV Ceti: They are also known as flare stars. These are very small, young stars, usually of spectral class M. In them it is possible to appreciate superphysical states similar to those that occur in the Sun,and due to disturbances in the superphysical magnetic fields. Being stars of reduced size and low luminosity,the explosions generate increases in brightness of up to 5 magnitudes, reaching the maximum in a few seconds,and then decay to normal in a few minutes [10]. A representative of this classification is YZ CMi. In Table 2.7 the light curve of this staris presented, forthe ultraviolet and infrared bands. Note the abrupt peaks without periodicity offinida [18].

▪R Conora Borealis: These celestial bodies are characterized by suddenly passing from their normal brightness, to a magnitude 10 times weaker, a state in which they remain for several years. To recover its original intensity. This phenomenon is due to the existence of dust clouds in the upper layers of the atmosphere, which sometimes condense causing drastic decreases in their luminosity. The star that gave rise to this classification is AAVSO 1544+28A, better known as R Corona Borealis,or R CrB, whose light curve is presented in the 2.8, in which it is possible to observe drastic decreases in its brightness of up to 9 magnitudes [12].

▪Novas: They are the stars that vary their luminosity the most. It is clasifican in turn into ordinary novae, recurrent novae, dwarf novae and supernovae. The latter

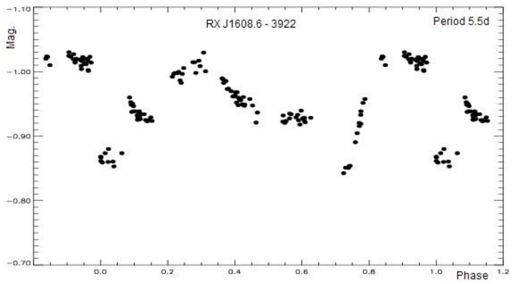

Figure 2.6. Light curve of RX J1608.6 - 3922.

they even experience brightness increases of 20 magnitudes in a few days, taking years to decay to the minimum, which is much lower than the original magnitude. On July 4, 1054, the star PSR B0531+21 exploded, leaving it to be visible for 23 days in broad daylight, a phenomenon that was reported by Chinese and Arabs. The supernova remnant, made up of debris spewed out by the phenomenon,isobserved today as a faint spot known as the Crab Nebula, in the constellation of Taurus [19]. Figure 2.9 presents a photograph of this celestial body taken by the author from the Astronomical Observatory of the Technological University of Pereira. Note the irregular shape of the gas cloud.

By way of summary, Tables 2.1 and 2.2 present the main characteristics of the different types of intrinsic variables mentioned above.

2.1.2 Extrinsic Variables

Unlike intrinsic ones, extrinsic variable stars present changes in the perceived luminous intensity due to factors external to it, which range from the rotation of the solar mass. , through the existence of a multiple static system (eclipsing variables), and byanalyzing the presence of a planetary body orbiting around it (variables by transit of exoplanet). Each of these categoriesis described below.

Variable Type	Period in days	Spectral Class	Increase in Magnitudes
Cepheids	1 to 50	F - K_1	< 2

W Virginis	1 to 50	F - K_1	< 2
RR Lyrae	< 1	B_8 - F_2 III	< 0.7
Scuti δ	0.05 - 0.2	F III	< 1
β Cephei	0.1 - 0.25	B_1 - B_3 III	< 0.1
Scope	80 - 100	M III	> 2.5
RV Tauri	30 - 150	G - K_1 I	< 3
Semi-regular	300 - 1000	K - M I	< 2.5
Irregular	----	K - M I	< 2

Table 2.1: Main characteristics of pulsating variable stars.

Type of Variable	Increase in Apparent Magnitude
Supernova	>20
Ordinary nova	7-18
Recurrent nova	<10
Dwarf nova	2-6
R crown of borealis	1-9
Irregular	<4
Flare stars	<6

Table 2.2: Variation of luminosity in explosive variable stars.

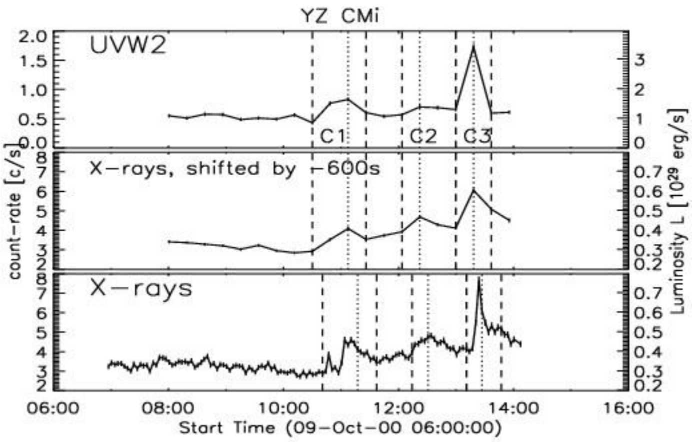

Figure 2.7. Light curve of YZ CMi.

Eclipsing Variables: More than half of the stars studied today are part of a rotating multiple star system. According to the orientation of the line of sight with respect to the orbital plane of the system,the stars can eclipse each other, whichresults in a variability of the brightness presented. According to the shape of the light curve, the eclipsing stars are classifiedas EA, EB and EW.

- EA-type eclipsants: These are eclipsing binary systems in which the components are completely spherical [13]. A representative of this category is Algol or β Persei, whose light curve for different bands within the visible spectrum is presented in figure 2.10 [20].

- Eclipsant type EB: These are systems in which the componentsare elliptical shapes, which givesthe determination of the onset and endof the eclipse from of the light curve. Generally,the stars involved in the phenomenon are of spectral class *B, A* or *F.* The most representative eclipsing variable star type EB is β *Lyrae,* in the constellation of the Lyre, also known as *Sheliak,* whose light curve is presented in 2.11 [21].

- Eclipsing type EW: As in the previous category, stars of the type

EW have apsoidal eli shape, but with the difference that they are found in

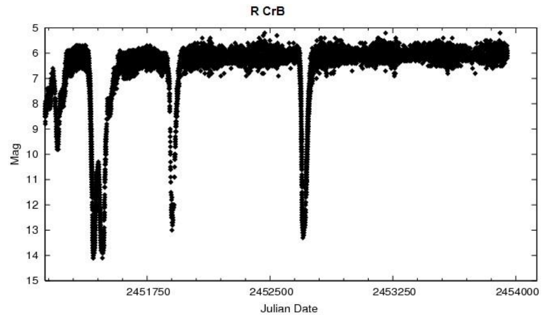

Figure 2.8. Light curve of R CrB.

contact,so the determination of the onset and endof the eclipse is greatlydetermined. A clear example of this classification is Y *Sex,* in the constellationof the Sextant,a rotating binary system in which stars share layers. Outside the atmosphere, generating changes in the apparent magnitude ranging from 9.8 to 10.2 magnitudes. In Article 2.12 itis possible to observe the light curve of this celestial body [22].

Variablesby Exoplanet Transit: If the orbital plane of an extrasolar planetary system is parallel to the line of sight, each time the planet transits between the star and the earth it will generate a eclipse, which translates into a small increase in the apparent magnitude of the observable star in the light curve of the same. In this way it has been possible to discover a large number of exoplanets, thus finding an important application for the study of the light curves of variable stars, which motivated the realization of this project. It is for this reason that the light curves constructed by the developed graphical interface correspond to two stars with occultation due to exoplanets. In this way, future research carried out at the Astronomical Observatory of the Technological University of Pereira could focus on the discovery of planets beyond the solar system, processing the photographs captured in the application construida in this work. Table 2.13 presents the light curve of the star GJ346, which has an exoplanet orbiting around it that generates decreases in brightness. of just +0.02 magnitudes, obtained through the graphical interface developed by the author. Note

Figure 2.9. Crab Nebula (M 1). 5x20s. Meade LX 200 16", CCD Meade DSI Pro II. AstroDiff Software. Edwin Andres Quintero Salazar°c .

that being such small changes in luminosity, digital image processing plays a crucial role in achieving their detection above noise. A more detailed description of the advance practice for obtaining this light curve is presented in the results chapter.

2.2 Stellar Magnitude

Stellar magnitude is an indicator of the luminous intensity emitted by a celestial body. Since this quantity depends directly on the distance separating the objector observer, and the temperature of the observer, itis possible to consider two types of stellar magnitudes. closely related to the relative position of the star, which are described below.

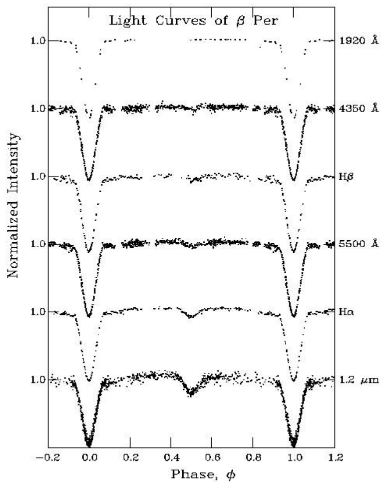

Figure 2.10. *Persei β* light curve.

2.2.1 Apparent Magnitude

The apparent magnitude is a scalar quantity that provides an estimate of the obvious brightness of a star,and is measured from the amount of light perceived by an observer located in the earth. This measurement does not consider the actual distance at which the celestial body is located, so distant objects that are actually very intense, could possess a magnitude. apparent that the clasifica as less bright than other stars located much closer. This measurement system has its origin in an ancient technique devised by Hipparchus, which consisted of dividing the luminous intensity of visible stars into six magnitudes, being m = +1 for the brightest, and m = +6 for the faintest. Since the sensitivity of the human eye to light intensity has a logarithmic behavior, the scale of magnitudes also presents this characteristic, in addition to being denied, because bright stars have numerically lower magnitudes than those of the darker ones. The apparent magnitude of a star isfixed from equation 2.1.

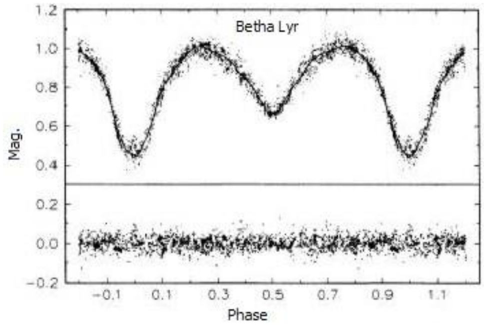

Figure 2.11. *Lyr β* light curve.

$$m = -2{,}5\log(I_{to}) \qquad (2.1)$$

Where m represents the apparent magnitude of the star,and I_{to} the perceived brightness[23].

However, the Earth's atmosphere scatters light from outer space, so the apparent magnitude of a celestial body, perceived from the surfaceof the earth, is increased in some magnitudes, since a decrease in brightness implies a numerical increase in magnitude. This phenomenon is known as atmospheric extinction. In addition,the instruments through which observations are made from different points of the planet do not have the same characteristics, which also affects the measurement. As if that were not enough, these perturbations do not remain constant, but depend on the frequency band in which the observationis made, that is, on the color . Thus, itis necessary to rewrite equation 2.1 in order to introduce the defects caused by the phenomena described above, resulting in the equation 2.2.

$$m\lambda Obs = m\lambda + K\lambda XZ + C \qquad (2.2)$$

Where $m_{\lambda Obs}$ is the apparent magnitude measured by an observer in a frequency band λ, m_{λ} is the actual apparent magnitude of the object in that band (measured outside the atmosphere and through ideal detectors), K_λ is the atmospheric extinction ratio in the band λ, X_Z is the mass of air present at an angle zenith z,

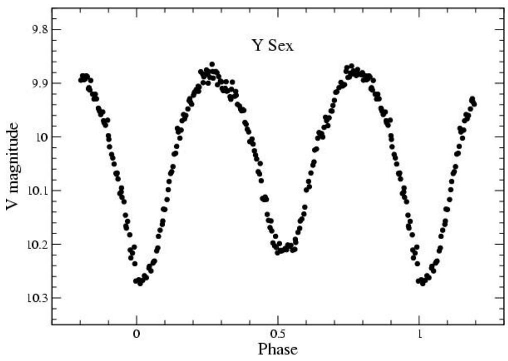

Figure 2.12. Light curve of Y *Sex.*

Y C is the instrumental constant given by the equipment involved in the measurement process.

The zenith angle z is the angle between the star and the zenith. In paragraph 2.14, if h is the angle that forms the line of sight of the star with the horizon, then the zenith angle is given by equation 2.3.

$$Z = 90^o - h \quad (2.3)$$

For the calculation of the air mass it is necessary to know the height of the star above the horizon,the time at which the observation was made, and the geographical coordinates of thesite. in which the observatory is located (see equation 2.4).

$$X_Z = [\text{without}\varphi\text{without}\delta + \cos\varphi\cos\delta\ \cos(HA)]^{-1} (2.4)$$

Where φ is the latitude of the place of observation, δ is the declination of the star,and HA is the hourly angle, thatis, the difference between sidereal time in the moment of study and the right ascension of the star.

For the calculation of the atmospheric extinction ratio K_λ and the instrumental constant C,it is necessary to take several photographs of the star of interest during

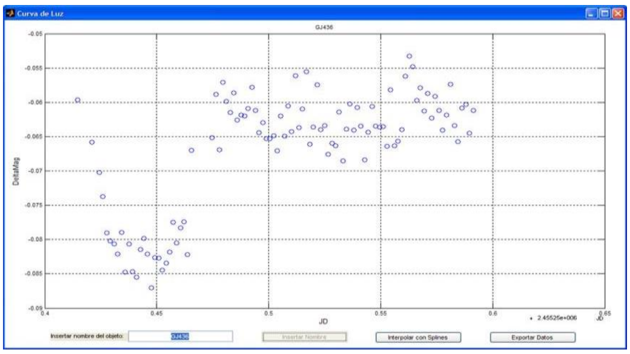

Figure 2.13. Light curve of GJ436. AstroDiff Software. Edwin Andres Quintero Salazar°c.

several nights, so that the height of it varies. Subsequently,it is graphed $m_\lambda - m_{\lambda 0}$ (where $m_{\lambda 0}$ is taken from the standard calibration stars), versus X_Z (the air mass), and is performed. a linear regression. The slope of this line correspondsto the atmospheric extinction ratio and the interception with the ordered to the instrumental constant.

2.2.2 Absolute Magnitude

As stated above, many stars have a very high apparent magnitude because they are at greatdistances, which does not imply that they are actually not very bright.. In order to determine the actual luminous intensity of two or more stars,itis necessary to establish what their magnitude would be if they were all at the same distance from the earth. Thus,the absolute magnitude is as fixed as the apparent magnitude presented by a star if it were 32.6 light years away, that is, 10 parsecs away [24].

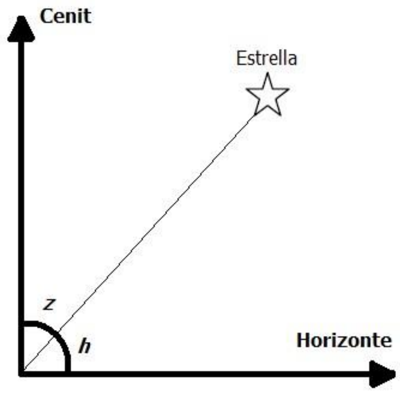

Figure 2.14. Overhead angle.

Equation 2.5 presents the mathematical definition of absolute magnitude.

$$M = -2{,}5\log(I_{abs}) \quad (2.5)$$

Where M is the absolute magnitude and I_{abs} its total luminous intensity.

As is known, the luminous intensity obeys the law of the inverse square of the distance. Thus, the relationship between the apparent luminous intensity and the absolute luminous intensity mustbe equal to that present between the distance used for the measurement of the absolute (10 parsecs)andthe distance separating the star from the tierra:

$$\frac{I_{apa}}{I_{abs}} = \left(\frac{10}{d}\right)^2$$

$$\log\left(\frac{I_{apa}}{I_{abs}}\right)^2 = 2\log\left(\frac{I_{apa}}{I_{abs}}\right) = 2\log 10 - 2\log d$$

$$\log\left(\frac{I_{apa}}{I_{abs}}\right) = 2 - 2\log d \qquad (2.6)$$

If m is the apparent magnitude corresponding to brightness I_{apa},and M is the absolute magnitude , which isobtained by finition from I_{abs}, byapplying equation 2.1 has:

$$M - m = -2,5\log(I_{abs}) - [-2,5\log(I_{apa})]$$

$$M - m = 2,5\log(I_{apa}) - 2,5\log(I_{abs})$$

$$M - m = 2,5\log\left(\frac{I_{apa}}{I_{abs}}\right) \qquad (2.7)$$

Substituting the value of $\log\left(\frac{I_{apa}}{I_{abs}}\right)$obtained in equation 2.6, in the previous expression, one obtains:

$$M - m = 5 - 5\log d$$

$$M = m + 5 - 5\log d \qquad (2.8)$$

Where M is the absolute magnitude of the star, m its apparent magnitude, and d the distance in parsecs separating the star from the earth.

3. CONCLUSIONS

The graphical interface developed in this paper contemplates the possibility of choosing the statistical operation by which it is intended to estimate the value of the background of the sky , as for the combination of the Darks, Flats and Bias frames, used in the production of colour images. This allows the user to determine if the calculation with mean, median or fashion,fits more accurately to the type of images obtained through mounting. instrumental implemented for the capture of the series of photographs of the variable star of interest.

The photometric data obtained for the variable stars GJ436 and TrES3, show how the variation introduced to the aperture photometry procedure, consisting of the determination of 2 FWHM,one for x and one for y; presents results much closer to those established for these two celestial bodies, than those thrown by other computer applications. This is explained by the impossibility of generating completely circular geometric shapes that representthe star in photography, mainly due to imperfections in the CCD sensor and the noise associated with the process of capturing the frames. Thus, it is possible to conclude that AstroDiff introduces substantial improvements to the image photometry traditionally implemented by curve construction programs. of light most used by the world astronomical community.

REFERENCES

1. FERNANDEZ Monica. Variable Starlight Curves. Complutense University of Madrid. 2002.
2. BERRY Richard, BURNELL James. The Handbook of Astronomical Image Processing. Willmann-Bell. 2005.
3. LIU S. F., WU Z. Y., ZHANG X.B., WU J. H., MA J., JIANG Z.J., CHEN J. S., ZHOU X. Variable Stars in the Field of Open Cluster NGC 2126. Research in Astronomy and Astrophysics. Page. 791-802. Vol 9. No. 7. 2009.
4. WELDRAKE D., SACKETT P., BRIDGES T. A Deep Wide-Field Variable Star Catalog of *ω Centauri*. The Astronomical Journal. Page. 1447-1469. Vol 133. April 2007.
5. SIMPSON E. K., FAEDI F., BARROS S.C.C., BRAWN D. J. A. WASP-37b: a 1.7 MJ Exoplanet Transiting a Metal-Poor Star. The Astrophysical Journal. Page. 1-12. August 18, 2010.
6. SUAREZ Johanna. Metric photoanalysis of the Open Cluster NGC 6611. University of Puerto Rico. 2006.
7. TECCE Thomas. Astronomical Image Analysis: Algorithms for Automatic StarIdentification and Photometry. Faculty of Basic Sciences. University of Buenos Aires. 2004.
8. SZATMARY K., GAL J., KISS L.L. Application of Wavelet Analysis in Variable Star Research. Astronomy and Astrophysics Journal. No. 308. Page. 791-798. 1996.
9. Decree 2442 of 2006 of the Presidency of the Republic of Colombia. Creation of the Colombian Space Commission. Available in:

   http://www.cce.gov.co/c/document_library/get_file?uuid=ad089e8f-bf35-

   491d-9266-ae1d651b9af9&groupId=10711
10. PERCY John. Understanding Variable Stars. First Edition. Cambridge University Press. 2007.
11. General Catalogue of Variable Stars (GCVS). Availablein:http://www.sai.msu.su/gcvs/gcvs/index.htm

12. American Association of Variable Star Observers Catalogue. Available in: http://www.aavso.org

13. STERKEN Christiaan, AERTS Conny. Astrophysics of Variable Stars. Astronomical Society of the Pacific. 2006.

14. STRASSMEIER K. G., BARTUS J., FELKEL F.C., HENRY G. W. The Chromospherically Active, Triple, Ellipsoidal, and Eclipsing Binary HD 6286 = BE Piscium: a Laboratory for Binary Evolution. Astronomy and Astrophysics Journal. Vol. 485. No. 1. Page. 233-243. July 2008.

15. SÓDOR Á., SZEIDL B., JURCSIK J. The Blazhko Behaviour of RR Geminorum II. Astronomy and Astrophysics Journal. Vol. 469. No. 3. Page. 1033-1043. July 2007.

16. DEREKAS A., KISS L. L., SZÉKELY E. J. A Photometric Monitoring of Bright High-Amplitude δ Scuti Stars. Astronomy and Astrophysics Journal. Vol. 402. No. 2. Page. 733-743. May 2003.

17. JOERGENS V., GUENTHER E., FERNÁNDEZ M. The T Tauri Star RX J1608.6-3922 -not an Eclipsing Binary but a Spotted Single Star. Astronomy and Astrophysics Journal. Vol. 373. No. 3. Page. 966-973. July 2001.

18. HARRAL. K., AUDARD M., MEWE R. Relationship between X-Ray and Ultraviolet Emission of Flares from dMe Stars Observed by XMM-Newton. Astronomy and Astrophysics Journal. Vol. 431. No. 2. Page. 679-686. February 2005.

19. KARTTUNEN H., POUTANEN M. Fundamental Astronomy. Fourth Edition. Springer Verlag. 2003.

20. RICHARDS M. The Journal to Algol. Mercury. Vol. 29. No. 4. Page 34. February 2002.

21. HARMENEC P., MORAND F., BONNEAU D. Jet-Like Structures in β Lyrae. Results of Optical Interferometry, Spectroscopy and Photometry. Astronomy and Astrophysics Journal. Vol. 312. Page. 879-896. August 1996.

22. GIMÉNEZ A., JAMAR C., TORRA T. OMC: An Optical Monitoring Camera for INTEGRAL. Astronomy and Astrophysics Journal. Vol. 411. No. 1. Page. L261L268. November 2003.

23. RODRIGUEZ L. F. Star Formation . First Edition. Ediciones Científicas Universitarias. Universidad Nacional Autónoma de México. 1996.

24. ROTH G. D. Handbook of Practical Astronomy. Springer Verlag Berlin Heidelberg. 2009.