

LAW OF THE USE OF LIGHT CONTRAST PHOTOMETRY OF HILAL VISIBILITY TO DETERMINING THE EARLY MONTH

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Abstract - In making observations (*rukyat al-hilal*) humans use their eyes as detectors. However, the human eye has limitations, where the human eye is not able to capture the very dim light at both ends of the crescent curvature. In addition, the visibility of the hilal (the appearance of the hilal) is also influenced by the twilight light emitted from the sun which has been below the horizon and must know the value of the hilal illumination. Therefore, in this case, humans can take pictures of the new moon using a detector which can be considered as an "extension of the hand" of the eye. Because physically, the appearance of the new moon can be analyzed using various reliable and precise technological devices. One of them is by using photometry. The law on the use of tools to perform *rukyah*, the scholars are divided into two opinions. On this issue, Imam Ibn Hajar did not allow *merukyah* with technological tools, or *merukyah* using water reflections or glass surfaces. telescope, water, ballur (white object like glass) can still be considered as *rukyah*. Al-Mu'thi asserted that the use of optics is a helper because it is the eyes of the *perukyah* themselves who make the assessment of the new moon. As explained above, light contrast photometry also plays a role in the *rukyatul hilal* procession where the program is able to detect the dynamic presence of the new moon. The simple procedure of recording the presence of the new moon captured by the lens can be processed so that the image of the new moon can be seen.

Keywords: Law, Photometry, Beginning of the Month.

1. Introduction

Hilal is a very important phenomenon to know as a marker of the entry of a new month on the hijri calendar. One of them is by making observations (*rukyat*), which is an attempt to see the first crescent or crescent moon in the western sky (horizon) shortly after sunset before the turn of the new moon. *Rukyat* that can be used as the basis for determining the beginning of a new month on the hijri calendar is *rukyat al-mu'tabar* (scientific observation), namely *rukyat* that can be legally and scientifically accountable.

As in the report on the results of the *rukyat al-hilal* from Cakung, Jepara, and Gresik, the determination of 1 Shawwal 1432 hijriyah was controversial because the three reports were rejected by the MUI and the Isbat team conducted by the Ministry of Religion of the Republic of Indonesia, on the grounds that the hilal report from the three places This is not based on scientific observations or actual *rukyat al-hilal*, because the real possibility of the new moon cannot be seen. This was reinforced by a report

submitted by the Head of the Hisab Rukyat Agency of the Ministry of Religion that the results of observations of rukyat in 96 locations stated that the new moon was not visible.

In witnessing the new moon, it does not necessarily have to be accepted just because the witness is willing to take an oath. This is because the new moon is not an unseen object, but the new moon is a real object that can be observed, analyzed and predicted its position scientifically. Irrational testimony should be rejected.

In making observations (rukya al-hilal) humans use their eyes as detectors. However, the human eye has limitations, where the human eye is not able to capture the very dim light at both ends of the crescent curvature. In addition, the visibility of the hilal (the appearance of the hilal) is also influenced by the twilight light emitted from the sun which has been below the horizon and must know the value of the hilal illumination. The human eye is a natural detector that can record light. However, the ability of the human eye is very limited because it can only store observations in the memory of the observer so that quantitative analysis efforts cannot be carried out.

Therefore, in this case, humans can take pictures of the new moon using a detector which can be considered as an "extension of the hand" of the eye. Because physically, the appearance of the new moon can be analyzed using various reliable and precise technological devices. One of them is by using photometry.

2. Research Method

Adapun jenis penelitian yang digunakan adalah penelitian pustaka (library research) yang bersifat deskriptif kualitatif. Adapun teknik analisis data dalam penelitian ini adalah analisis deskriptif yaitu melukiskan secara sistematis, faktual dan akurat mengenai fakta-fakta yang diperoleh di lapangan. Untuk proses analisis dimulai dengan menelaah seluruh data yang tersedia dari berbagai sumber. Analisis Data penulisan karya tulis ilmiah ini diawali dengan pengumpulan data, kemudian memilih informasi yang sesuai dengan masalah yang dikaji kemudian di analisis. Penyajian karya tulis ilmiah ini dilakukan secara deskriptif

3. Discussion

A. Photometry and Light Intensity

Photometry is a branch of astronomy that studies light information sent from outer space, either in the form of stars or other celestial bodies. Where photometry is also part of optical physics which studies the intensity of light (intensity) and degree of illumination (brightness).

Photometric geneology is derived from the epistemological building of astrophysics science which studies light information sent from outer space, either in the form of starlight or the light of other celestial bodies. Light, in the study of photometry is not limited to light sources, but can also be electromagnetic waves, such as infrared, ultraviolet light, gamma rays, X rays or radio waves.

In the dictionary of Physics, the term photometry is the study of visible radiation, especially the calculation and measurement of the intensity and flux of light.

There are two types of measurements used in photometry. First, measuring the amount of light (luminous) by relying on the use of the human eye. Second, measuring the amount of radiation (radiant) which relies on photoelectric devices to measure electromagnetic energy.

Photometry focuses more on the study of light intensity (intensity) and degree of illumination (brightness). Even photometry also learns about the size of the amount of light. Measurement of light intensity is done by comparing the intensity of a standard light source with the intensity of other light.

In doing photometry nothing but comparing the intensity of a standard light source with the intensity of other light. Where the light intensity itself is the principal physical quantity to measure the power emitted by a light source in a certain direction per unit angle. In the field of optics and photography, the ability of the human eye is sensitive and is only able to capture light of a certain wavelength which is measured in basic quantities.

B. Criteria for the Visibility of the Hilal in Determining the Beginning of the Hijriyah Month

The criteria for the visibility of the new moon is an astronomical study that continues to develop. However, this criterion is not only for the purposes of determining the beginning of the qamariyah month for Muslims alone, but also a scientific challenge for new moon observers to find out how strong the light of the new moon is when the new moon phenomenon occurs.

According to Thomas Djamaluddin, in determining the criteria for the visibility of the new moon, there are two important aspects that influence: the physical condition of the new moon due to illumination on the moon and the condition of the foreground light due to scattering of sunlight by the atmosphere on the horizon (horizon). The condition of lunar illumination as a prerequisite for the sight of the new moon was first obtained by Danjon who based on extrapolation of observational data stated that at a distance of the moon-sun $< 7^\circ$ the new moon could not be seen. The 7° limit is known as the Danjon limit. The Danjon limit is caused by the sensitivity limit of the human eye, which cannot see the very thin hilal light.

C. Photometric Formula of Light Contrast Visibility of the Hilal to Twilight Light

One of the tools or applications that can be used to formulate and perform photometric analysis of observations is IRIS Software. This software became known in the technological era in the mid-1980s, when CCD cameras began to be used by amateur practitioners. This software was created for Apple III type computers in assembly language that has the ability to process images up to 128×128 mega pixels or more.

In line with technological developments and the increasing need for image processing power. Then the IRIS software continues to be developed in the form of a windows platform that can process several thousand pixel images. IRIS software can be downloaded for free (freeware) via: <http://www.astrosurf.com/buil/iris/iris.htm>.

In this paper, as an example of doing photometry using IRIS Version 5.59 software. the basic principle is not much different, but the details of the software facilities are always changing depending on the version. The technique for measuring the intensity of the hilal light and Syafaq with IRIS Version 5.59 software, namely when measuring the intensity of the hilal light, what must be prepared includes the image of the new moon. The steps taken to display the image of the new moon in the IRIS Version 5.59 software are:

1. By clicking the File dialog box (the leftmost dialog box), then selecting and clicking load for data entry.
2. After that the Open dialog box will appear. Select files of type then select graphics (*bmp, *jpeg, *tif, *tiff, *png).
3. Select the folder containing the hilal image for which the light intensity value will be determined, then click the hilal image and then Open.
4. After that a dialog box will appear at the top that says Look In, then look for the image of the new moon that has been crossed on the computer, then click Open. After that, the new moon image will appear.
5. The next step that must be taken according to romanishin is how far the radius will be used in making measurements? Or how big is the circle (eparture) in pixels or arcsec? The larger the sphere (eparture) used to get all the light from the star, the larger the radius selected. To find the photometric aperture menu, it can be opened in the analysis box and then the photometric aperture will be obtained, then click the circle aperture, what radius we want and adjust to the new moon to be measured.
6. After determining what radius size to use, a round cursor will appear. Then shoot for the hilal to get the value of the intensity of the hilal light.
7. After shooting at the light intensity of the new moon which is used as a substitute for the standard star, then the next step is to shoot at the light intensity of the syafaq by alternating the cursor circle not far from the new moon position. When the cursor has been directed to the target object, the value is determined to get the intensity value. The results are displayed in the output window. The first line gives the photometric line then the coordinates of the center of the circle. The second line is the number of pixels that lie inside the circle. The last line is the sum of the intensities of all pixels that lie in the circle. It is the value of the intensity of the new moon and twilight that will be used in this paper.
8. The measurement of the intensity of the new moon light can be done using five samples of the focal point of the twilight light around the new moon for each new moon image, after that the measurement will be calibrated by dividing the intensity of the shafaq light in each sample by the intensity of the new moon light which is used as a standard star.

The intensity of the hilal and twilight light can be determined by analyzing the contrast of the new moon against the twilight light using IRIS 5.59 software. The analytical techniques used are as follows:

- a. Before shooting the hilal and syafaq, the camera is mounted on a sturdy tripod so that the three shifts in direction, so that the shots can focus on the intended object, namely the hilal and syafaq.
- b. The measurement of the intensity of the hilal light is carried out right on the crescent, this is done to determine the intensity value of the hilal light. Then for the measurement of the value of the light intensity of the syafaq, shooting was carried out around the hilal of as many as five sample points at different locations, this was done to determine the strength of the intensity value of the syafaq from each point, carried out at different places because from each point of view, the value Syafaq light intensity obtained is not the same.
- c. Hilal is used as a standard star, namely as the main reference point for the sample position and as a calibrator. The main reference point serves to overcome the possibility of the camera shifting slightly during the shoot.
- d. The intensity of the hilal and syafaq light can be obtained by processing each image from the photo shoot using the IRIS-5.59 software. By taking one hilal sample point as a standard star and five different sample points of shafaq light from each image as shown in the following illustration:

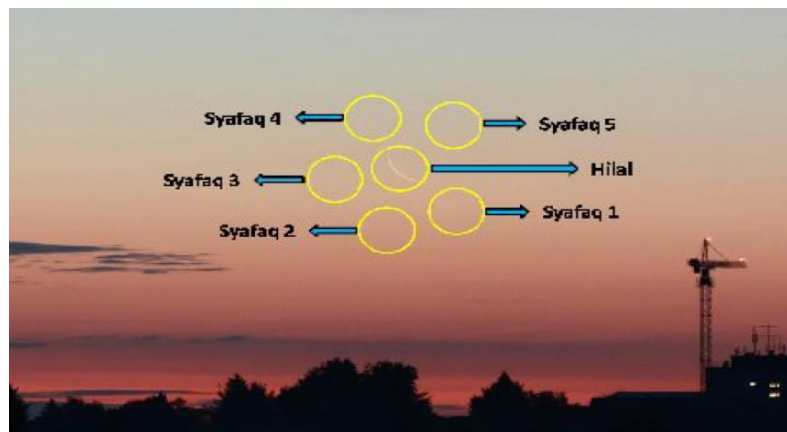


Figure 1: Illustration of light image processing using IRIS 5.59 . software

In the application of this photometry, as has been done by Sukirman (2012) in analyzing the new moon image taken on September 28, 2011 AD coinciding with 29 Shawwal 1432 H for the determination of the beginning of the month of Dzulqa'dah 1432 H. However, in his research the new moon was already visible when captured by camera. However, the sighting of the new moon can be clarified with the IRIS.5.59 software and the intensity of the light between the new moon and the evening light can be known.

E. The Law of Use of Light Contrast Photometry Hilal Visibility

These technological advances also played a role in implementing modern astronomy for reckoning and rukyat. For example, advances in the field of computers can be used to create computer programs to help people's problems.

The Qur'an gives a signal in the development of science as the word of Allah SWT QS. Ali Imran: 190.

إِنَّ فِي خَلْقِ السَّمَوَاتِ وَالْأَرْضِ وَاخْتِلَافِ اللَّيْلِ وَالنَّهَارِ لَآيَاتٍ لِأُولَى الْأَلْبَابِ

Translation:

Verily in the creation of the heavens and the earth, and the alternation of the night and the day, there are signs for people of understanding.

In the interpretation of Al Misbah (Shihab: 2012) Verily Allah's creation of the heavens and the earth with perfection and accuracy, the difference between day and night, light and darkness, the long and short span of time, are clear signs for those who have reason to know. the oneness and power of God. Indeed, in the creation of the heavens and the earth, the differences in the time span of day and night are signs of God's power for the Ulû al-Albâb (people of deep knowledge). The text of the verse hints at cosmic facts that point to the majesty of the Creator. In this case observing the color of the sky can be caught by our vision thanks to the solar radiation that hits the layer of air that envelops the earth so that it is visible to the eye.

Apart from the opinion of the command to develop knowledge and technology in terms of using tools to perform rukyah, the scholars are divided into two opinions. In this case, Imam Ibn Hajar did not allow merukyah with technological tools, or merukyah using water reflections or the surface of the glass that is seen is not the new moon but the image or shadow of the new moon or not even the new moon but another planet that resembles the new moon. (: 1983). On the other hand, the scholars who allow merukyah with technological tools, namely, al-Syarwani, he explained that the use of tools that bring closer or enlarge such as telescopes, water, ballur (objects that are white like glass) can still be considered as rukyah. Al-Mu'thi (1329 H) asserted that the use of optics as a helper because it was the eyes of the perukyah themselves who made the assessment of the new moon.

As explained above, the computer also plays a role in the rukyatul hilal procession where the program is able to detect the dynamic presence of the hilal. The simple procedure of recording the presence of the new moon captured by the lens can be processed so that the image of the new moon can be seen.

3. Conclusion

In making observations (rukya al-hilal) humans use their eyes as detectors. However, the human eye has limitations, where the human eye is not able to capture the very dim light at both ends of the crescent curvature. Therefore, in this case, humans can take pictures of the new moon using a detector which can be considered as an "extension of the hand" of the eye. Because physically, the appearance of the new moon can be analyzed using various reliable and precise technological devices. One of them is by using photometry.

Photometry focuses more on the study of light intensity (intensity) and degree of illumination (brightness). The use of this photometry can be used as an accuracy test

or verification test of the data on the criteria for the sighting of the new moon. Of course in this context the sighting of the new moon that can be seen using a tool. Because the power of the eye has a weakness. The existence of this tool as a tool for the eye to better be able to see the phenomenon of the new moon.

The law on the use of tools to perform rukyah, the scholars are divided into two opinions. On this issue, Imam Ibn Hajar did not allow merukyah with technological tools, or merukyah using water reflections or glass surfaces, telescope, water, ballur (white object like glass) can still be considered as rukyah. Al-Mu'thi asserted that the use of optics is a helper because it is the eyes of the perukyah themselves who make the assessment of the new moon.

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