

Shari'ah Standardization of Astrophotography for Rukyatul Hilal

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Abstract

The development of rukyatul hilal technology is growing very fast, one of them is the astrophotography technique used to take an image of the hilal so that it becomes a photo that can be seen many times. However, we need to know that the determination of the beginning of the *qamariyah* month is not entirely dependent on science, but what determines whether or not an image is accepted as the basis for changing the *qamariyah* month is in the realm of shari'a (fiqh). Problems arise related to the acceptance of astrophotography images as a basis for determining the change of *qamariyah* months in fiqh, and if it is allowed whether there are certain conditions in it. This research was written using the literature study method by tracing the rules of fiqh in classical and contemporary Islamic sources, which were then analyzed deductively in order to formulate a regulation. With this method, it was found that the use of astrophotography in rukyatul hilal is allowed. However, in order for the image to be accepted as the basis for proof, three (3) conditions must be fulfilled.

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A. Introduction

The development of rukyatul hilal technology in Indonesia has undergone significant transformation in line with technological advances and social changes in society.[1] Rukyatul hilal, which is a method of observing the crescent moon to determine the beginning of the month in the Hijri calendar, has become an important part of determining the time of worship, especially Ramadan and Eid al-Fitr. In the modern era, people are increasingly aware of the importance of accuracy in this timekeeping, which encourages the use of advanced technologies such as telescopes and astronomical software to aid in observations. [2]

In recent years, collaboration between government agencies and religious organizations and other astronomical communities has increased. For example, BMKG

(meteorology, climatology, and geophysics agency) as well as organizations such as NU (Nahdatul ulama') and Muhammadiyah which often coordinate in carrying out rukyatul hilal. This not only increases the accuracy of observations, but also strengthens unity among different groups of people in celebrating important religious moments.[3]

On the other hand, challenges arise in the implementation of rukyatul hilal in Indonesia, such as differences of views between the mass organizations, unstable weather conditions and limited resources in several other regions. So there were efforts to improve the process and introduce scientific methods in rukyatul hilal. The development of rukyatul hilal in the modern era not only emphasizes on spiritual aspects, but also on the integration of science and technology such as image processing recently.[4]

However, the debate among scholars on the application of technology, including image processing In rukyatul hilal, it reflects the dynamics between tradition and modernity in religious practice.[1] In this context, rukyatul hilal as a method of crescent moon observation that has been carried out for generations is now faced with technological advances that allow for more accurate observations. Some scholars argue that the use of modern technology can improve the accuracy and efficiency of determining the beginning of the month, thereby reducing errors that may occur in manual observations. However, not all scholars agree with the application image processing In the rukyatul hilal, in the midst of this debate, it is important to find a common point between the opinions of scholars who are pro and con against image processing.

B. Method

This research was prepared using a qualitative approach, with a literature review method.[5] The data results from the arguments of the fiqh scholars collected will be analyzed in a deceptive-deductive manner which is then formulated into the forms of a concise shari'i prerequisite formulation.[6] The analysis is carried out with a deductive approach, namely from the discussion of the broad provisions of fiqh will be linked to the opinions of scholars, as well as astronomers and astronomers. After several provisions are collected, they will be formulated and grouped according to the similarity of characteristics and 'illat that he has. That way, it can be formulated then that the provisions of sharia are contextual with existing technological advances related to the use of astrophotography in rukyatul hilal.[7]

C. Results and Discussion

Research Results

To get a comprehensive discussion, the data taken must *cover anyside*, meaning that all variables that are the focus of the study as summarized in the title must have the same portion in the discussion. For this reason, the data taken using the following analysis method:

A. Sharia Standards for Hilal Testimony

The sharia standards referred to in this discussion are the basic provisions that are a prerequisite for receiving the testimony of the new moon to be used as a basis in determining the entry of the new moon. Sharia as a whole does not only regulate the subject who makes his observations, but there are also provisions related to the object observed, namely the hilal (young crescent) and the process of how the hilal process is observed. The depiction of the process needs to be considered, considering that there are many ways that can be done to observe the new moon, especially in this modern era. The hilal can then not only be observed using the naked eye, but can also be observed through aids such as telescopes, teopongs, etc.[1], [8]

a. Legal Basis

The determination of the beginning of the month of kamariah in Islam begins with the appearance of the hilal, the hilal is the first young crescent or crescent moon that is seen which continues to grow into a full moon, thins back and finally disappears from the sky.[9] As hinted at in QS. Al-Baqarah verse 189:[10]

يَسْأَلُونَكَ عَنِ الْأَهِلَّةِ ۚ قُلْ هِيَ مَوَاقِيتُ لِلنَّاسِ وَالْحَجِّ ۚ وَلَيْسَ الْبُرْجُ بِأَنْ تَأْتُوا الْبُيُوتَ مِنْ ظُهُورِهَا وَلَكِنَّ الْبُرْجَ مِنَ الْأَنْقَىٰ ۗ وَأْتُوا
الْبُيُوتَ مِنْ أَبْوَابِهَا ۗ وَاتَّقُوا اللَّهَ لَعَلَّكُمْ تُفْلِحُونَ

"It is He Who makes the sun shine and the moon shine and He appoints manzilahs (places) for the passage of the moon, so that you may know the number of years and the reckoning (of time). God did not create such things but by right. He explains the signs (of His greatness) to those who know" (QS Yunus: 5)

b. Overview of the Shahadah

Root *Shahadah* Derived from *Shahada–Yashhadu–Syahādah*, which relates to the word *martyrdom*, which means someone who gives an explanation or testimony based on the knowledge he has. This term contains the meaning that the testimony or statement conveyed is based on a clear understanding and direct experience.[11] In the book *Mu'jam As-Safi*,

Shahadah defined as *Yamin* (oath), while *martyrdom* interpreted as *Oral* (speech) or *Al-Malah*, that is, the king. As for the *Al-Mu'jam Al-Wasith*, *Shahadah* means definite information about a testimony, whether directly related to a martyr or obtained indirectly through information, stories, or hearing.[12]

Based on the description of the word *syahida*, it can be concluded that *shahadah* is information obtained through clear and definite knowledge, accompanied by oaths, proofs, and explanations of the position of the hilal that are known directly through eye vision and careful observation. In the book *Fath al-Mu'in* by Zain ad-Din bin 'Abd al 'Aziz explains the *shahadah* in rukyatul hilal.

اخبار الشخص بحق على غيره بلفظ خاص الشهادة لرمضان لثبوتة بالنسبة للصوم فقط

Meaning: *A person's information to establish the truth for others with certain utterances for the purpose of determining the commencement of the obligation to fast in the month of Ramadan.*[10]

Each explained that the *shahadah* is to provide information about the results of his vision when he sees the hilal. Without witnessing any vision, it is meaningless. Although the hilal is seen as a need for Muslims, it cannot be accepted just like that. This means that the provisions that have existed since the time of the Prophet must certainly apply.

In his book of tafsir, Quraish Shihab interprets the meaning of the word *syahida* as knowing. Knowing that he means knowing his presence by seeing through the eyes of the head or by knowing by calculations, that he can be seen with the eyes of the head – even though he is factually invisible for one reason or another, such as clouds – then he should fast. Those who do not see it in the above sense are also obliged to fast if they know of its presence through a trusted person.[13]

c. The Meaning of *Shahadah* in Rukyatul Hilal

According to the rukyat group, the recitation of *syahida* in QS. al-Baqarah: 185 is interpreted as "to witness".[14] Thus, knowledge of the beginning and end of the month *Qamariyah* For them, it is taken based on rukyat or seeing the moon which is done on the 29th day. If the rukyat is not successful, either because of the position of the hilal which cannot be seen, or because there is cloud. Therefore, the determination of the beginning of the month must be based on *istikmal* (refinement of the number of months to 30).

According to this group, the term rukyah in the hadiths of *hisab rukyat* is *ta'abbudi-ghair ma'qul al-ma'na*. Meaning: the meaning cannot be rationalized. So, it cannot

be expanded and cannot be developed. Thus, rukyat is only interpreted as seeing with the eyes of the head (naked eyes—without tools)[15] From the paradigm of thinking of the rukyat group of experts above, the term rukyah bil fi'li emerged. Rukyah bil fi'li is an effort to see the new moon with the eyes (without using tools) which is done directly or by using tools at the end of the month *Qamariyah* (29th) at sunset.[16]

Here are some requirements as a martyr or witness in rukyatul hilal.

1) Formal Requirements:

- a) Aqil puberty or adulthood
- b) Muslim
- c) Male or Female
- d) Common sense
- e) Able to perform rukyatul hilal
- f) Honest, fair, and trustworthy
- g) The number of perukyat is more than one person
- h) Taking the Oath of Allegiance to the Prophet Muhammad (peace be upon him)
- i) The oath of testimony of rukyatul hilal in front of the Religious Court or Syar'ah Court and attended by two witnesses.[17]

2) Material Requirements:

- a) The people explained themselves and saw themselves with their eyes and using tools, that they saw the hilal.
- b) The people know exactly how the process of seeing the hilal is, namely when the time, place, how long to see it, the location, the direction of the position, and the state of the hilal being observed, as well as how the brightness of the sky or horizon of the hilal can be seen.
- c) The information on the results of rukyat reported by the perukyat does not contradict common sense, the calculation of science of hisab, the rules of science and the rules of sharia.[17]

d. Fiqh Scholars' Views on the Use of Astrophotography

The law of rukyat is mandatory, so the equipment and devices in rukyatulhilal are mandatory. This is in line with the rules of fiqh:[18] **لوسائل حكم المقاص**

The opinion of Imam Muhammad Bakhit al-Muṭi'i is often used as a reference (hujjah) in the discussion of the ability to use aids such as telescopes in the implementation of rukyat

al-hilal. His views are expressed in his work entitled *Irsyad Ahl al-Millah ila Itsbat al-Ahillah*: [19]

فَأَنذَرْتُ تَقْبُلَ شَهَادَةَ الرَّائِي لِلْهَيْلِ وَلَوْ رَأَى بِالنَّظَارَةِ الْمَعْظَمَةِ مَتَى كَانَ الْهَيْلُ مِنْ شَأْنِهِ أَنْ يَرَى لِغَيْرِ حَدِيدِ الْبَصْرِ جَدًّا
عِنْدَنَا لِنِ الْمَرْنِيِّ بِوَسْطَتِهَا هُوَ عَيْنُ الْهَيْلِ وَأَنْ مَا وَظَيْفَتِهَا أَنْ هَا تَسَاعِدُ الْبَصَرَ عَلَى رُؤْيَةِ الشَّيْءِ الْبَعِيدَةِ أَوْ الصَّغِيرَةِ مِمَّا
أَلْ تَمَكَّنَ رُؤْيَتَهُ بِدُونِهَا قُلْ مَاتَعَ حِينُنْذُ مِنْ تَرَائِي الْهَيْلِ النَّ مِنْ الرِّصْدِ خَانَةِ الْمَصْرِيِّ ةٍ وَغَيْرِهَا بِوَسْطَةِ مَا فِيهَا مِنْ
الظَّارَاتِ الْمَجْسَمَةِ. وَأَمَّا مَا قَالَهُ مَشَايخُنَا مِنْ عَدَمِ التَّعْوِيلِ عَلَى رُؤْيَتِهِ فِي الْمَاءِ أَوْ مِنْ وَرَاءِ زَجَاجٍ فَمَحْمُولٌ عَلَى أَنْ
الْمَرْنِيِّ مِثَالِ الْهَيْلِ أَلْ عَيْنُ الْهَيْلِ النَّ رُؤْيَةَ الْهَيْلِ فِي الْمَاءِ أَوْ مِنْ وَرَاءِ الزَّجَاجِ مَا هِيَ بِطَرِيقِ النِّعْكَاسِ قُلْ يَكُونُ الْمَرْنِيُّ
حِينُنْذُ عَيْنُ الْهَيْلِ بَلِ الْمَرْنِيُّ قَدْ أَنْ يَكُونُ صُورَةُ كَوْكَبٍ انْعَكَسَتْ إِلَى الْمَاءِ أَوْ أَدَى يَكُونُ عَلَيْهِ لَزْجَاجٍ فَيَأْخُذُ الشَّكْلَ أَلْ فِيهِمَا
وَأَلْ يَكُونُ عَلَى شَكْلِهِ الْحَقِيقِيِّ.

(Note) can be accepted by the testimony of a person who sees the hilal even though he sees with magnifying binoculars along the length of the hilal can be seen by other than a person whose vision is very sharp in our opinion, because what is seen through the medium of the tool is the hilal itself and its function is only to help the eyesight to see distant or small objects that are impossible to see without the tool. Therefore, there is no obstacle to the effort to see the new moon today from Egyptian moon binoculars and others with their magnifying devices. As for what our Shaykhs said about the impossibility of holding to the rukyat alhilal in the water or from behind the glass, then it is because what is seen is the image of the hilal, not the hilal itself, because seeing the hilal in the water or from behind the glass is only by means of reflection, so what is seen at that time is not the hilal itself but that is sometimes the image of the star reflected in the water or glass. Then it takes the form of the hilal in water or glass, and not according to the actual form of the hilal.

Imam Muhammad Bakhit al-Muṭi'i in his works *Irsyād Ahl al-Millah ilā Itsbāt al-Ahillah* stating that the testimony of a person who sees the new moon with the help of an optical device such as a telescope is still acceptable, as long as it is logically possible to see the ordinary human eye, even without the extraordinary visual acuity. He emphasized that tools such as telescopes only serve to clarify distant or small objects, and that the object seen through the instrument is the hilal itself, not its shadow. [19]

Furthermore, he differentiated between seeing the hilal directly with the help of optical devices and seeing it through reflections, such as on the surface of water or glass. According to him, the view of some scholars who reject the sight through water or glass is due to the nature of the reflection, because what is seen is not a direct hilal, but only a shadow or

reflection that resembles the shape of the hilal, which can be deceiving or not in accordance with its original form.

This opinion gives legitimacy to the use of modern technology in rukyat al-hilal, as long as it fulfills the basic principle of direct vision of the hilal and does not rely on inauthentic reflections or images. The decision of Lajnah Falakiyah of the Executive Board of Nahdlatul Ulama states that rukyat using a telescope or optical aids is allowed and considered legal, both in clear and cloudy conditions. However, the use of such tools should aim to clarify the object being seen directly, not through reflections. In addition, rukyat is only considered valid as long as the hisab experts do not agree that the position of the hilal is still below the horizon.[20]

Ibn Hajar stated in his book that it is not permissible to use the tools of a glass countryman (nahwi mir'atin).[21] Then as-Syarwani explained that what is meant by a glass compatriot is water, a ballur (a white object like glass) that brings the distant closer or enlarges the small. However, then as-Syarwani expressed his own opinion that even if he uses tools, it can still be called rukyat al-Hilal. [22]

B. The Use of Astrophotography in Rukyatul Hilal

Astrofootography is a tool to accurately measure the brightness (photometry) and position (astrometry) of stars, comets, minor planets, supernovae, and others. The process of astrophotography is the same as observing certain phenomena such as Eclipses, Meteors, and Crescent Moons is a satisfaction in itself for Astrophotography enthusiasts. For Legault, astrophotography is the observation of celestial bodies and capturing them through photos, and can be done simply through a Digital Single Lens Reflex (DSLR) camera to through sophisticated binoculars such as the LOSMANDI GM8.[23]

Astrophotography is a combination of two sciences that both require special skills and tools to implement it, in contrast to traditional photography techniques, astrophotography requires special instruments related to astronomy and photography.[24] In essence, astrophotography is not only one of the branches of astronomy but also an art or technique in photography activities. Astrophotography is the art and science of taking pictures of astronomical objects, celestial phenomena, and large areas of the sky. This practice combines the principles of astronomy with advanced photography techniques to capture images of the night sky that are often invisible to the naked eye. Astrophotography can cover a wide range of

subjects, from celestial bodies in our solar system, such as planets and moons, to objects far away in space, such as stars, nebulae, and galaxies.

a. Basic Techniques of Astrophotography

Astrophotography has its own techniques in its implementation, but there are several things that need to be prepared and done properly and carefully, namely:[24]

1. Equipment prepared

- a) Cameras with sensitive sensors and high-quality lenses are key to producing sharp, detailed images.
- b) A stable tripod and remote control are essential to avoid camera shake that can ruin the results.

2. Location Selection

The selection of the right location is very important in astrophotography. The criteria for a suitable location for astrophotography are:

- a) Dark skies and lack of artificial light
- b) Away from city lights and air pollution
- c) Weather conditions with clear skies and no clouds This is highly emphasized in order to produce perfect shots.

3. Instrument installation

If you are using a camera, then it is enough to prepare the camera and tripod, then set the camera in manual mode and adjust the ISO settings, shutter speed, and aperture to produce good quality images. Mount the camera on a tripod to maintain stability and avoid vibration when taking photos.

When photographing celestial bodies, astrophotographers must also pay attention to correct techniques and settings. The first step is to use the manual mode on the camera and select the ISO settings, then setting the focus carefully and using a large lens opening will help in taking bright and detailed images.

4. Observations

Taking pictures of the night sky takes a long time due to long exposures. Astrophotographers should be prepared to spend hours outdoors at night, observing and waiting for the right conditions. There are several stages in the implementation of astrophotography, including:

- a) *Focusing*, focusing the telescope by utilizing the help of celestial objects according to the observation time
- b) *Pointing*, positioning the object captured by the telescope in a specific position by adjusting the camera's viewing angle capabilities.

5. Image Processing

After getting a suitable image, the next process is image processing with other terms *Image Processing*. This process is the process of taking images or images of celestial objects with certain techniques, images are visual images of an object or several objects. The form of images varies, from photos of people, images of clouds, X-ray results, to satellite images.[25]

Images are divided into two types, namely analog images that are often found in paper form (e.g. photos or X-rays) and digital images, which are images that are expressed in a digital data set and can be processed by computers. Meanwhile, in principle, images are divided into three types, namely:[25]

- a) Binary image (monochrome image), a black and white image whose pixel value is in the form of a zero.
- b) Grayscale imagery, an image that uses a gray color gradation that is a combination of black and white.
- c) The color image is composed of three components, namely red, green and blue components. This image represents the visual state of the objects that we are used to seeing. This image is often converted to a grayish image which is then processed to obtain the texture of the object.

The images that are photographed often experience degradation (degradation), for example contain defects or noise (noise), colors are too contrasting, not sharp, blurring, and so on. Of course, this kind of image becomes more difficult to interpret because the information conveyed by the image becomes reduced.[26] In order for the image of the new moon that is disturbed or does not look easy to interpret (both by humans and machines), the image needs to be processed or processed to produce another image of the new moon with better quality.[27] This process is called *Image processing* which aims to improve the quality of the image image so that it is easily interpreted by humans or machines (in this case computers). Image processing techniques transform the image into another image. This means that the image and output are also images, but the output image has better quality than the input image.[26]

6. The Process of Taking and Processing Hilal Image

The science of astrophotography is very possible to be used as one of the techniques in the implementation of rukyat, by looking at the condition of the hilal whose light intensity is very weak, a special technique is needed that can describe the state of the hilal. The ability of astrophotography in capturing the process of observing the hilal in the form of images or images can be used as hilal data for a development related to the hilal.

Based on the results of BMKG's observations, they applied the *Image processing* In helping the success of the observation of the new moon, every month they actively observe the new moon. Based on data uploaded on the hilal.bmkg.go.id website, it is reported that since Ramadan 1443 H / March 2022 – Rajab 1445 / March 2024, it has been observed that 9 images of the new moon have been observed,[27] In the following months, the height of the hilal did not meet the criteria for the appearance of the hilal.

There are 4 methods that can be done in *Image processing* In the implementation of rukyatul hilal, including:[27]

1. Increase or decrease the contrast of a single image of the new moon

This is necessary to clarify the appearance of the hilal in one image, because it often happens that the image of the hilal is almost the same as the background or other objects such as clouds that are around the hilal, of course it is difficult to determine whether the object is hilal or not, so special arrangements are needed for the contrast of the hilal image.

2. Increase or decrease the contrast in some of the hilal images by paying attention to their consistency

The difference with the previous stage is the other image processing. This is done because the new moon cannot be seen or not, but there is a possibility of being seen. The meaning of consistency is that there is no difference between several images, either in terms of shape, position or location of the hilal in some visible images. If it shows the similarity of consistency, then the image that looks like the hilal can be ascertained that it is the hilal.

3. Accumulation of hilal images without calibration

At this stage the hilal is not visible at all in some images, the contrast enhancement process also does not produce the appearance of the hilal image. So the next stage is to combine several images into one or commonly called stacking. There is no limit in the accumulation of images, the image of the new moon will appear in the accumulation of the last image.

4. Accumulation of hilal images with calibration

There are stages that are carried out before accumulating images, namely first calibrating the image of the hilal. The calibration is carried out at the time of image taking with calibrator tools. To increase the *Signal to Noise* (S/N) Ratio, record bias *frames*, dark *frames*, and flat field images.

Bias Imagery is required to correct the irregularity of each pixel on the detector in recording data. Dark Imaging is required to correct the effects of heat and electronic noise on the detector. Flat Field Image is needed to correct problems related to the scattering of light from the front of the telescope, the lens, to the detector.

Discussion

A. *Fiqh Review of the Use of Astrophotography in Rukyatul Hilal*

According to Hadi Bashori, the use of technology in rukyatul hilal, such as telescopes equipped with *CCD Imaging* (cameras used in conjunction with telescopes to capture images), need to be studied further, both in terms of validity and application in combining traditional rukyat methods with the development of science and technology. It is hoped that the study of *Digital Image Processing* can be a solution or alternative for the government in uniting the differences in determining the beginning of the hijri month in Indonesia. However, it is still a question whether the criteria for the height of the hilal obtained through *Digital Image Processing* can be accepted in the provisions of fiqh and does not contradict the views of the scholars or the Indonesian Ulema Council (MUI). Another concern that arises is the possibility of digital data engineering that can cause the image of the hilal to not be recognized for its validity.[28]

The testimony of the hilal as described earlier is known as the term *Shahadah* in the study of fiqh. Testimony must be oral through a procession of oaths, where in the process of taking the oath the testimony must be based on certain, accurate, clear, and biased information accompanied by proof. Where, accurate information can come from eye vision or careful observations. In more detail, Mustafa Al Buga explained that the testimony of a witness (*martyrdom*) can be obtained through information, stories, or listening.[12]. In addition, Zain ad-Din bin 'Abd al-'Aziz defines the shahadah in rukyatul hilal as "*information of a person to establish the truth for others with a certain 'recitation' for the determination of the commencement of the obligation of fasting in the month of Ramadan*"[10]

From the basic understanding of the shahadah which is the key factor for the acceptance of the testimony of the hilal as the basis for determining the entry of the beginning of the month, we can see the common thread that becomes a gap so that the images produced from the astrophotography process can be accepted as the basis for the testimony. If we look in more detail, what is the key to the reception is the recitation of a person through an oath that he has seen the hilal. Meanwhile, the process of vision is required to be sourced from certain and accurate information, even though it is obtained through several ways as Mustafa Al Boga thinks.[12] This opinion is even strengthened by the explanation of the Quraish shihab who interprets the word *Syahida* as knowing the presence of the hilal through the eyes of the head directly or knowing through calculations.[13]

From this opinion, the meaning of *the shahadah* will be broader, which allows many methods to be included in it. Although, there will be restrictions as a form of prudence and safeguarding the legitimacy of the law that is certain, accurate, and clear. However, what we can underline here is that the key factor of testimony is the person who testifies and recites the testimony in the form of an oath. Where, the basis for the testimony he used can be sourced from various methods. It is possible that it comes from the astrophotography process.

The law of using astrophotography can be equated with the law on the use of aids in rukyatul hilal. The basic principle of astrophotography is reinforcement as well as Clarify the image of the Hilal that does exist and exists, even though in visible conditions there are many things that block the visibility of the Hilal clearly.[29]. This can be seen from the entire process applied to the hilal image in astrophotography, namely: Increasing or decreasing the contrast in one hilal image, the accumulation of the hilal image with calibration, where the calibration in question is the reduction of image disturbances such as *Noise*, or background light interference with certain Techniques. So, it can be said that astrophotography only clarifies images whose form of the new moon is real and can be observed.[27] It makes sense that later, astrophotography was equated with the use of telescopes that act as an aid so that the observed moon can be seen more clearly.

For the law of the use of aids is divided into two, for aids that point to the hilal directly, such as telescopes, are allowed. As for aids that reflect the hilal indirectly, they are not allowed. This impossibility is caused by the possibility that the reflection formed is not the hilal, it could come from the star or other objects whose shape changes due to the nature of the reflecting object. As said by Imam Muhammad Bakhit Al-Muti'i in his work *Irsyād Ahl al-*

Millah ilā Itsbāt al-Ahillah stating that the testimony of a person who sees the new moon with the help of an optical device such as a telescope is still acceptable, as long as it is logically possible to see the ordinary human eye, even without the extraordinary visual acuity. He emphasized that tools such as telescopes only serve to clarify distant or small objects, and that the object seen through the instrument is the hilal itself, not its shadow.[19]

However, as stated by Hadi Bashori above, the current concern is the engineering of digital data that can cause the image of the hilal to be manipulated and become false data used for certain purposes. This can then be overcome if we know the processes carried out in astrophotography to image processing to produce valid hilal images. With careful measures, factors that indicate the manipulation or creation of false data can be avoided, and prevented from the start. This is where it is necessary to standardize the sharia on the results of astrophotography images which will be used as basic information from a person's testimony.

B. Sharia Standards for the Acceptance of the Image of the Hilal as a Rukyat Witness

Although Image processing in rukyatul hilal serves to strengthen or enhance contrast by combining several recorded images. There are still doubts in its use, because photography technology is so sophisticated that it can form false data that is similar to the original shape of an object such as an image (*Synthetic Image*) produced by *Artificial Intelligence* (AI).[30] Simply put, the astrophotography process applied was initially carried out on videos that were broken down into many frames, then put together into one image that showed the new moon more clearly and firmly. Based on the rules of fiqh, the results of rukyatul hilal that utilize technology *Digital Imaging* For image processing, this is acceptable and justified. This is because the main purpose of using rukyat aids is to facilitate the rukyatul hilal process as a guideline in determining the beginning of the Hijri month.

As a solution to the concern of false images that can be formed automatically, there are opinions from several philosophers and Islamic law experts, namely: Huzaemah Tahido Yanggo, Ahmad Rofiq, and Slamet Hambali. In Huzaemah's view, astrophotography techniques in rukyatul hilal are considered a good thing (*São Paulo*) so that there is no reason to reject it. This goodness is contained in the ability of astrophotography to detect the new moon with the final result in the form of an image, so that it can be used as an empirical basis in the observation of the new moon. Through the *São Paulo* He argued that "*When technology can facilitate the implementation of a worship, then it is seen as good*". However, behind his permission for astrophotography, he also gave notes related to the process *image processing* or

image/image processing. As long as this process functions as a support to clarify or ensure the existence of the hilal, it is legal to apply. As long as the processing is carried out, it can be scientifically accounted for.[27]

To emphasize "accountability" for the image processing process, Ahmad Rofiq provided that when in the rukyatul hilal process a technological process that allows manipulation is used, the process must consider two things, namely calibration and validation. More emphatically, Slamet Hambali emphasized that in the implementation of *image processing* In the image of the hilal, the hilal must be seen first in essence (the embryo of the hilal is seen that it must be there) even though it is not clear or vague. The use of image processing is allowed within limits only to clarify the image of the new moon, not to process the new moon that cannot be observed at all and then engineered so that the new moon can be seen. If the image processing process is spiced with engineering then it is not allowed.[27]

Furthermore, Slamet Hambali explained the rukyatul hilal process which uses astrophotography and *image processing* To clarify the existing image of the Hilal, the law is equated with *rukyyat bil fi'li*. To ensure an image is generated from the process *image processing* is not an engineering, it must be legitimized with calculation data that shows that the position of the hilal at the time of observation is in accordance with the criteria *Imkan al-Rukyyat* and carried out in a *real-time*. In principle, the results *image processing* and astrophotography that is in the form of photos and has been legit according to the criteria is acceptable, even if in *eyepiece* cannot be seen with the naked eye.[27]

From these expert opinions, we can at least formulate three (3) conditions so that the images of the new moon produced from the astrophotography process can be accepted as the basis for the testimony of the new moon, namely:

1. Image-taking is carried out when the hilal has met the criteria *of imkan al-rukyyat*
2. Image capture and processing is carried out directly (*realtime*) when the rukyatul hilal procession is carried out (at sunset)
3. Image processing is carried out only to clarify the image of the existing hilal, not to process the hilal that cannot be observed at all and then engineered so that the hilal can be seen.

D. Conclusion

From the discussion above, it can be concluded that two (2) related to the acceptance of the image of astrophotographic results as the basis for testimony of the appearance of the

hilar which is used as the main legitimacy in determining the entry of the hijri month, the two (2) conclusions are: *First*, the position of the hilar image produced through the astrophotography process is allowed in fiqh, because astrophotography can be equated with a telescope which is a tool to help make the hilar more clearly visible. In addition, the image of the hilar is positioned as the basis for testimony, where the testimony is delivered orally by *the martyr* (the person who testifies). *Second*, to avoid data engineering, the hilar image produced by astrophotography must meet 3 main prerequisites, namely: (1) Image taking is carried out when the hilar has met the criteria *of imkan al-rukyat*. (2) Image capture and processing is carried out directly (*realtime*) when the rukyatul hilar procession is carried out (at sunset). (3) Image processing is carried out only to clarify the existing image of the new moon, not to process the new moon that cannot be observed at all and then engineered so that the new moon can be seen.

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