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The Role of Modern Observation in Understanding the Beginning of the Hijri Month

Frangky Suleman
Faculty of Sharia, Institut Agama Islam Negeri Manado, Sulawesi Utara, Indonesia, Jl. Dr. S.H. Sarundajang Kawasan Ring Road I Kota Manado, 95128
E-mail: frangkysuleman@iain-manado.ac.id

Djamila Usup
Faculty of Sharia, Institut Agama Islam Negeri Manado, Sulawesi Utara, Indonesia, Jl. Dr. S.H. Sarundajang Kawasan Ring Road I Kota Manado, 95128
E-mail: djamila.usup@iain-manado.ac.id

ABSTRACT

This study aims to observe the determination of the beginning of the Hijri month in the implementation of Islamic holidays and contribute to modern society. The implementation of this research uses phenomenological methods and scientific approach methods, where both methods will combine several conjunction theories that occur with the results of observations. The Ministry of Religion of the Republic of Indonesia made observations with several criteria used from observations in 1970 with the height of the new moon 2°, the elongation distance between the moon and the sun reaching 3° is the distance between the moon and the sun. The age of the sun and moon when it reaches 8 hours from ijtima. The results found are that for now, with light pollution, the new moon, an object, cannot reach a height of < 2° because the parameter in determining the image of the crescent moon is the object in the form of a thin and dim line. It is concluded that the observation of the new moon with a height of < 2° could not observe, either by using tools or with the naked eye. So science is the solution to understand the theory and implementation of determining the beginning of the Hijri month.

Keywords: Visibility of the hilal; criteria; science.

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INTRODUCTION

Islam makes every natural event a *sunnatullah*, starting from the movement of the moon, sun, and earth. The moon is a reference for determining the day of the Hijri month as the word of Allah *SWT.* in the Qur'an, surah *al-Isra*: 12, *al-Baqarah* (2): 189, *Yunus* (10): 5, *an-nahl* (16): 16, and *at-taubah* (9): 36.

Rukyatul hilal is one of the efforts to determine the beginning of the lunar month. Every decision requires caution because it is closely related to the worship of Muslims in starting the fasting of Ramadan, Eid al-Fitr, and setting the 1st of Zulhijjah for the implementation of Eid al-Adha. Tono Saksono said that the 3 (three) events that occurred were: the first was at the time of determining the end of the month of Sha'ban because it was related to the first day of the following month (Ramadan) when Muslims must start fasting, the second when determining the end of the month of Ramadan, because this is very closely related to the first day of the following month (the month of Shawwal) when the Eid al-Fitr worship procession carry out, and the third is at the time of determining the month of Zulhijjah (Sudibyo, 2011).

Indonesia still adheres to the notion of Imkanur Rukyat and embodiment of the hilal, where Imkanur Rukyat If the image of the moon can be seen and is included in the criteria that become the reference standard in the initial determination of the lunar. The criteria used by the Ministry of Religion of the Republic of Indonesia(One of them is the policy of the Ministry of Religion of the Republic of Indonesia: point (a) which reads in addition to Ramadan, Syawal, and Zulhijjah based on reckoning (import *Rukyat*, the height of the new moon + 2° or the age of the month is 8 hours between the time of *ijtimak'* and *ghurub*)(Guidelines for Hisab Rukyat, Ministry of Religion, Republic of Indonesia, 2006)is the MABIMS Hilal visibility criteria, criteria agreed upon by ASEAN countries such as Malaysia, Brunei Darussalam, Indonesia, and Singapore. Likewise, other Islamic organizations adhere to the same understanding that the determination of the beginning of Ramadan, Shawwal, and Zulhijjah must be based on Rukyat or seeing the new moon, which is performing on the 29th. If *Rukyat* does not appear because it cloudy or the weather at that time, then the determination of the beginning of the month must be standardized (perfected by 30 days). It is *ta'budi-ghairu al-ma'qul ma'na* (cannot be rationalized or cannot be expanded).

Furthermore, it developed only to see with the naked eye) (Izzuddin, 2003). *Hisab* is only a tool, not a determinant of the entry at the beginning of the lunar month. At the same time, the testimony is believed because the witness needs to sworn in. Sometimes, oaths are considered more potent than scientific arguments in the form of reckoning results.

In some cases, the moon is still horizon according to astronomical calculations reported seen and taken as a basis for determining the beginning of

the month, for example, in the determination of Eid al-Fitr 1413/1993. However, since 1994, PBNU has made guidelines that hilal testimony can reject if all reckoning experts agree that it is impossible for the new moon in *Rukyat*. it is more firmly state that the testimony of Rukyatul hilal can leave if it is not supported by science or accurate reckoning (Djamaluddin, 2004).

Meanwhile, from the other Islamic organizations, the criteria for obtaining the start of a new moon: 1. There has been *ijtima*, 2. Ijtima occurs before sunset (*gurub*), and 3. At sunset, the moon is above the horizon (Tarjih, 2009).) These three criteria are used cumulatively in the sense that all three must be met at once. If one of them is not fulfilled, then the new month has not started. In other words, the approach taken by Muhammadiyah is an astronomical approach that the hilal is the slightest appearance of the moon facing the earth sometime after *ijtima;* this is what later became the reckoning criteria that the shape of the new moon marked the beginning of a new month. As a sign is when the sun sets before the moon (Djamaluddin, 2004).

These differences sometimes ignite and even shake the relationship between Muslims, which is still considered reasonable considering that these two schools are always symbolized by the two most prominent organizations in Indonesia, namely Nahdatul Ulama, which adheres to the *Rukyat* school. In contrast, Muhammadiyah is symbolized as an adherent of the Hisab school so that this supposedly classic problem always becomes actual, especially towards the beginning of the month (Thohari et al., 2017).

RESEARCH METHODS

This type of research is quantitative descriptive research (Fauzi, 2009) analytical, which describes all issues regarding the criteria that occur in Indonesia with several expert opinions, then analyzed with a phenomenological approach (Creswell & Poth, 2016). And the synthesis approach (Synthesis Approach). This two-approach combines scientific aspects of scientific theory when the conjunction occurs. The sun and moon move in the new moon phase in one ecliptic line, and several observations are made to determine the beginning of the month. So that understanding theory and making observations will get the right results and get the latest conclusions from the research. This synthesis approach is used because the problems at the beginning of the month of qadar are legal problems in one's worship, the use of reckoning or *rukyat*, and the legality of *imkanurrukyat* used by several mass organizations or groups, etc. In addition, the determination of the beginning of the month is an issue that is closely related to astronomy which is more scientific, namely scientific steps that build knowledge, so that discoveries are a highlight, namely observation, reasoning, understanding, and explanation in a justification.

RESULTS AND DISCUSSION

In the Indonesian Dictionary, the word criteria or criteria is a measure/benchmark, considered, or found (Poerwadarminta, 1952). In this preliminary determination of the lunation, the viewing technique is call *rukyat*, while the appearance of the crescent image is called visible or visibility. The statement "seeing" in the early lunar observations, When interpreted with the hadith of the Prophet, that seeing is the same as seeing visually. Many things can hinder the visual sighting of the new moon.

Hisab or precession model is used to calculate the position of the moon and sun. The essence of Rukyatul (observation) of the new moon can be taken into the soul in reckoning (calculation) to predict the visibility of the new moon. In the world of science, reckoning and *rukyat* are one unit that synergizes with each other. Rukyatul hilal is also using to test the results of reckoning predictions about the visibility of the hilal. The repeated testing process and theoretical understanding of the formation of the hilal will give birth to science about the hilal.

In 1395 AH / 1975 AD, the determination of Ramadhan Beginning and the beginning of Shawwal did not experience much difficulty. On July 5, 1974, the Directorate General of Islamic Guidance Organized the *Hisab* and *Rukyat*. The Ministry of Religion concludes, namely the Minister of Religion's initiative to pioneer cooperative relations with Malaysia and Singapore in *Hisab* and *Rukyat*, then on 9 to July 11, 1974, The Hisab and Rukyat Conference between Malaysia, Singapore, and Indonesia held in Jakarta. The Deliberation results included: the Indonesian *Hisab* and *Rukyat* Agency in collaboration with Malaysia and Singapore in *Hisab* and *Rukyat*, providing information on reckoning and *rukya*t as the forerunner to establishing MABIMS countries.

MABIMS is a term for the Ministers of Religion of Brunei Darussalam, Indonesia, Malaysia, and Singapore. The annual meeting held every year is responsible for the problems that occur in the four countries, maintaining the benefit and interests without interfering in political matters (Azhari, 2012). Located in Brunei Darussalam in 1989, MABIMS was established. Moreover, one of the most important issues is the Unification of the Islamic Calendar in the Region. The first meeting of the Office of the Harmony of Rukyat Taqwin Islam was held in Pinang, Malaysia, in 1991/1412. The last one was held in Malaysia in 2016 after the Bali meeting and resulted in 8 new formulations, namely: Empowering Religious Life, Building Youth Potential, improving the standard of living of the people Islam in need, increasing the human capital of the ummah, increasing community harmonization, expanding the role of MABIMS to the outside world and coordinating *rukyat* and *taqwim* of MABIMS Islam, and empowering MABIMS halal coordination (Suryana, 2016).

The convention in Bali that became a critical decision regarding the Islamic calendar is the theory of "hilal visibility" with the term "MABIMS Hilal Visibility", which requires the height of the hilal not less than 2 degrees, elongation not less than 3 degrees, and the age of the moon not less than 8 hours. In practice, the use of MABIMS hilal visibility varies between members. Indonesia is considered a "bearer" of the theory of the visibility of the hilal. MABIMS uses cumulatively and waits for the *isbat* session to determine the beginning of Ramadan and Shawwal. While Malaysia itself, before using the visibility of the hilal MABIMS used the visibility of the hilal resulting from the 1978 Istanbul resolution (Azhari, 2012).

The MABIMS criteria adopt from the results of experience during the early implementation of Ramadan in 1394, and the *ijtima* took place on Monday 29 Sha'ban 1394 H/September 16, 1974 at 09:45:47, and based on the reports of 10 witnesses (observers) in three locations. Different people witnessed and claimed to have seen the new moon with their own eyes without any disturbance. According to astronomical calculations, the height of the new moon is about 2 degrees with an azimuth difference of 6 degrees, and the age of the moon since *ijtima* is 8 hours, the distance between the moon and the sun is 6.8 degrees. This result is not much different from the donjon limit of about 7 degrees for the average human eye. This criterion later adopted as the *imkanur rukyat* MABIMS criteria in 1996 (Djamaluddin, 2005).

However, in the field implementation, astronomical data has been prepared, both data on the position of the new moon and various equipment to support observation activities, but in reality, the new moon is sometimes not visible, so calculations still held to calculate the number of Sha'ban to 30 days, because the determination is base on Rukyatul hilal from its *matlak* area, provided that it is a maximum distance of 8 degrees longitude to the west (Khazin et al., 2010).

This difference in perspective impacts differences in determining the beginning of the Hijri month among MABIMS members, such as Shawwal 1432 H/2011 M's beginning where there are differences in the decision. Some set on Tuesday and Wednesday. Meanwhile, Malaysia and Singapore set the beginning of Shawwal to fall on Tuesday, August 30, 2011, while Brunei Darussalam and Indonesia set Shawwal 1432 H to fall on Wednesday, August 31, 2011 (Hambali, 2012).

According to Susiknan Azhari, this case was based on the MABIMS agreement in Jakarta on August 1-5 1992, starting from 1993-2020/1414-1442 H Takwin *Hijriah*, decided that 1 Shawwal 1432 H fell on Tuesday, August 30 2011 (Khazin et al., 2010).

Criteria for the Visibility of the New Moon

Understanding the visibility of the new moon causes problems in the process of unification of the Islamic calendar, namely the birth of various ideas (divergence) about the definition of the new moon as a determinant of the beginning of the Islamic month, according to Moedji Raharto, this diversity: first that all crescent moons are after *ijtima* or conjunction and at sunset which is closest after *ijtima* , the position of the moon is still above the horizon, in this case, the crescent area fraction known as the new moon is F > 0% and the height of the moon h month = 0° at t = sunset time. The two crescent moons that naked human eyes can observe for the first time after *ijtima*. Implicitly at sunset, which is closest after *ijtima*. In this case, the crescent area fraction referred to as the new moon is F > F critical (F > 0.7%-1%), and the height of the month h month > h critical and h critical > 0° when t = to + At. T = time interval between the sighting of the new moon and sunset. The three crescent moons with agreed criteria. For example, the crescent moon after *ijtima* has a height of 2° at sunset, which is closest after *ijtima* . In this case, the fraction of the crescent area of the moon referred to as the new moon is F > 0% (??), and the height of the moon h month is > 2° at sunset. The four crescent moons hallucinate, the success of seeing the new moon even though *ijtima* has not yet taken place. In this case, the fraction of the crescent area of the moon referred to as the new moon is F > 0% (??), and the height of the moon h month is > 2° at sunset. The four crescent moons hallucinate, the success of seeing the new moon even though *ijtima* has not yet taken place. In this case, the fraction of the crescent area of the moon referred to as the new moon is F > 0% (??), and the height of the moon h month is > 2° at sunset. The four crescent moons hallucinate, the success of seeing the new moon even though *ijtima* has not yet taken place (Raharto, 2004).

He says that the human eye can recognize the new moon for the first time after *ijtima* takes place because at *ijtima* the position of the sun moon is so close that it is impossible to see it by human eyes. The positions of the moon and sun are in a radius of 5 degrees. The brightness of the sky, when the sun has set, 6 degrees below the horizon (civil twilight) reaches 3.0x10-1 foot-candle (1 foot-candle = 10.76 lumen m-2 = 10.76 lux, 1 lumen = 0.0014705882 watt (W) at length wave 5550 micrometer = 555 nanometer (nm) = 0.555 micrometer (μm)) or 4.4747 x 10-3 W m-2 (Raharto, 2004).

Based on the astronomical analysis of the possibility of the hilal that resulted in the criteria for rukyat Imkanur, several studies conducted by Thomas Djamaluddin in 1962-1967 stated that: by using three different locations where reports of hilal observations were insufficient, they tended to look at the background. Objects (e.g. lamps), which are just the moon. Error in observing the new moon due to confusion of objects from the planets Venus and Mercury. It is also evident for the low hilal observation reports. After the foreground and background disturbance factors are eliminated, several criteria for the visibility of the new moon will be obtained, namely: (1). The age of the new moon must be >

8 hours, (2) the distance between the moon and the sun must be > 5.6°, (3). Height difference > 3, (hilal height > 2°), for azimuth difference of ~6° but azimuth < 6, it is necessary to have a higher height difference (Djamaluddin, 2000).

Many researchers such: Mauder, Danjon, Bruin, McNally, Schaefer, Ilyas, Odeh, and others have developed empirical methods in detecting and predicting the sighting of the new moon based on statistically processed observational data to obtain the minimum elongation of the sun and moon (Utama & Siregar, 2013). Based on the data of each researcher, the minimum distance between sun and moon so that the new moon can be observed has a religious value between 6°-12°. Moreover, this value is much different from the prevailing values in Indonesia. Instead of only considering the geometric configuration of the three celestial bodies (the sun, the earth, and the moon), Bruin Schaefer, Yallop, and the sultan also considered the influence of the atmosphere and the sensitivity of other optical instruments, including the eye (Utama & Siregar, 2013).

As the data produced by the Islamic Cresent Observation Project (ICOP), which receives observation data every month from The Arab Union For Astronomy and Space Sciences (AUASS) and The Jordanian Astronomical Society (JAS). The implementation of this observation aims to develop new criteria. The data results obtained both old data and new data to predict the appearance of the visibility of the new moon with the naked eye or using optical aids (Odeh, 2006).

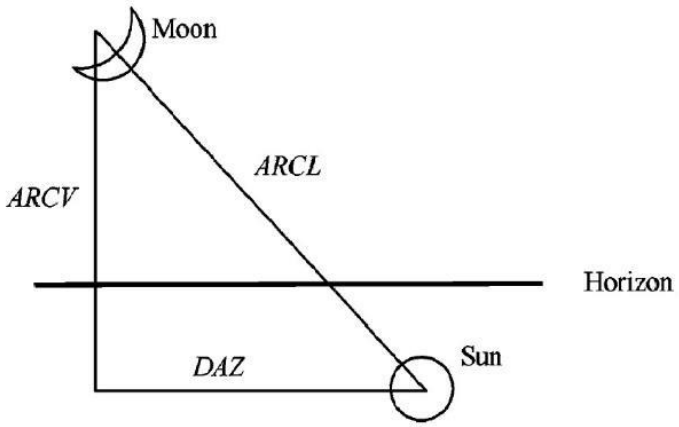

Figure 1. Variable to predict the visibility of the new moon

The parameters used are:

a) Moon Age (age): the interval between conjunction and observation time
b) Lunar Lag Time (Lag) is when the sun and the moon setting or the sunrise and the sun.
c) The height of the moon is the angular distance of the moon above the equator.

d) *Arc of Light* (ARCL) is the angle of elongation between the sun and the moon.
e) *Arc of Vision* (ARCV) is the difference in elevation angle between the sun and the moon.
f) *Relative azimuth* (DAZ) is the difference in the azimuth angle between the sun and the moon.
g) *Crescent width* (W), i.e., the width of the moon area measured along the moon's diameter. (Odeh, 2006)

Odeh's crescent criteria cannot be predicted using only one parameter, such as age or lag (time difference between the sun and the full moon). However, using a minimum of two parameters simultaneously so that the calculations carried out can be accurate. Therefore the Odeh criterion is a comparison of the criteria used in Indonesia as is the case with the MABIMS criteria: a) The age of the moon is 8 hours after conjunction, b) the height of the month of *Mar'i* (topocentric) 2 horizons (3 M) and c). Moon-Sun angular distance (elongation) 3,≥≥ ° ≥ ° ≥ °(Sudibyo, 2009)The MABIMS criteria tend to be inconsistent, so that of the three provisions, only two are often applied (namely the age of the moon and the height of the month of *mar'i*. Likewise, if only one of the two conditions meets the requirements, the criteria are considered to have been met. Consequently, to distinguish whether the reported new moon is observer is the actual moon or bright object in the sky background.

It was said by: Thomas Djamaluddinn that the use of criteria at the time of the initial determination of the lunar by the adherents of Imkanur *rukyat* and embodiment of the new moon throughout Indonesia (before using the Imkanur *rukyat* 2° criteria). Reporting differences will occur if the results of *rukyat* at that time are below the Imkanur *rukyat* criteria they use (height of the new moon 2°. Moreover, when the height of the new moon is positive but less than or about 2°, the potential for differences in holidays is very open. As showing the height of the new moon at the beginning of Ramadan, Shawwal (Eid Al-Fitr) and Zulhijjah (Eid Al-Adha) when there was a difference a few years ago (Djamaluddin, nd).

Table 1. Month and Year Difference

Hijri/AD Year	**High Degree of the moon in Bandung at the beginning of the month**		
	Ramadan	Syawal	Zulhijjah
1422 / 2001-02	1.7		2.5
1423 / 2002-03		1.2	1.3
1427/2006		0.9	
1428 / 2007		0.7	
1431 / 2010			1.7
1432 / 2011		2.0	
1433 / 2012	2.0		
1434 / 2013	0.7		
1435 / 2014	0.8		0.8

Source: (Djamaluddin, n.d.-a)

So the effort made is to formulate date criteria that can provide new hope that the dichotomy between reckoning and *Rukyat* can be dissolved and can be combined towards a uniform determination of the beginning of the lunar month can be realized. (Djamaluddin, nd)The Imkanur Rukyat criterion is the root cause of all differences, no longer the difference between reckoning and *rukyat* methods. According to Thomas Djamaluddin, MABIMS criteria can bring together reckoning and *rukyat* circles. This criterion has become a reference for the national calendar and several Islamic organizations except for Muhammadiyah because there is no scientific support; this is true according to Thomas Djamaluddin because this criterion is based on a simple analysis. It does not consider the difference in azimuth of the moon-sun as is done with the astronomical criteria.

Moreover, if he wants to be honest, he will say that Muhammadiyah also has no scientific support (Djamaluddin, 2004). Furthermore, the MABIMS criteria are only used in making the standard *takwim* of the Ministry of Religion of the Republic of Indonesia, which is a reference for Islamic holidays in Indonesia (Djamaluddin, n.d.-b)

In this paper, the author tries to take the middle ground that Islamic science is one of the efforts to unify the criteria used as a reference for determining the criteria for the beginning of the lunar month and can be used by all parties.

The Role of Modern Science Observations in Determining the Beginning of the Hijri Month

The development of science, especially astronomy, began to develop in 700 AD-1025 AD. The most significant contribution given in astronomy was the caliph I of the Abbasid dynasty centred in the cities of Baghdad and Damascus. Moreover, it reached the pinnacle of Islamic astronomy when Baghdad became the centre of Islamic civilization (Ramdan & Bani, 2009). Ibn Syathir (d. 777/1375) in the 8/14th century had made a time-keeping device based on the shadow of an object called "al-basis." This tool is placed in the Tower of the Great Mosque of Damascus and is a pride and adds to the city's beauty (Rakhmadi, 2016).

Especially since the 3/9th century, Islamic astronomy has started to have a dynamic and robust foundation. Astronomy has successfully elaborated and integrated into various other branches of science, which formed new disciplines (science). However, underlined in this astronomical development is the inherent tradition of continuous sky observation and study (Rakhmadi, 2016).

The most basic early observation of the lunar month sees the new moon (*imkan*) when making observations. The movement pattern of each celestial body is based on the rotation of the earth around the sun (Shamsiah calendar), which has a period of 365 days (one short year) and 366 days. For one long year. As well

as rotation of the moon around the earth (lunar calendar) occurs for 354 days, known as the short year, and 355 days for the long year (Hambali & Rokhmad, 2011).

The sun, earth, and moon are celestial bodies closely related to early lunar observations where their position is always changing, but when the geometric position of the moon phase begins. The sun is a star, which is not much different from other stars visible at night. What distinguishes it is that the orbit from the earth is around 150 million kilometres and is the centre of all solar systems. (Initially, Ptolemy (100-170) stated that the earth was the centre of the universe (geocentric). This theory lasted until 1350 years, and then this opinion was challenged by Nicolaus Copernicus (1474-1543), who stated that the sun is the centre of the solar system (heliocentric). This theory developed by Kepler (1551-1630) and Galileo Galilei (1564-1642), whom the church challenged at that time). (MD, 2006:22-24) It has 1.99x1030Kg of mass, 696,000 km of radius, a rotation period at the equator of 26 days, and an acceleration of gravity at the surface of 274 m/s2, a surface temperature of 6000°C (Admiranto, 2009).

According to some astronomers, conditions and areas of Indonesia are relatively challenging to observe the new moon due to the concurrent physical and dynamic processes. Based on BMKG data, Indonesia has three climate types. In addition, Indonesia can have much rainfall throughout the year; this also illustrates that the air's cloud or water vapour content is relatively large, which is indicated by the relatively high humidity (RH) throughout the year. So the observation is often difficult. Such as the observation of the new moon made on June 24, 2017, at 17:00 (Thohari et al., 2017).

The advantage of reckoning is determining the moon's position without being obstructed by clouds, fog. By analysis, it can know when *ijtima* (conjunction) occurs, whether the moon is already above the horizon or not. While *rukyat* is an accurate scientific method as evidenced by the development of astronomy in the golden age of Islam so that experts can produce *zij-zij* (Astronomical Tables), which astronomers still use. For example, Zij al- Jadid by Ibn Shatir (1306). M/706 H), Zij Jadidi Sultani by Ulugh Begh (1394 1449 AD/797 853 H), (Susiknan Azhari, 2007: 130). Then Galileo Galilei used observation using binoculars as a medium to prove a truth. He said that "*objects approach three times and are nine times larger on the surface than the naked eye*" (Thompson, 2003).

Observation in terminology is paying attention or following in the sense of observing carefully and systematically the intended behavioural target or a process of seeing, observing, observing, and recording behaviour systematically for a particular purpose and can provide a conclusion. (Herdiansyah, 2010). *Rukyat* means seeing with the eyes of the head visually (seeing with the naked eye) (Azhari, 2008). Some think that the calculation to determine the hilal by ignoring it has no legal basis. Even considered heresy; this used as a basis for the

official fatwa in Egypt during the Fatimid reign when general Jawhar ruled in 359 AH/969 AD (Saksono, 2007).

Observation of the moon (Rukyat Hilal) is different from astronomical observations. Observations of the *rukyat hilal* usually observe the crescent moon, namely the beginning or end of the month. In contrast, astronomical observations are not limited to the phase of the crescent moon due to the observation of the crescent moon (because the hilal (young crescent) with an altitude lower than 5^o cannot be verified astronomically. Hilal with a minor elongation in the world observed after sunset is 6^o, while the hilal (young crescent) with the minor elongation in Indonesia observed after sunset is 7^o).

The variables that can be used as a test tool for the sighting of the new moon are the time of conjunction (*ijtimak*) and altitude. The calculation of conjunction time is the starting point in the implementation of *rukyat*/observation. Accuracy and accuracy in the calculation of *ijtima* affect the accuracy of other calculations (Nashirudin, 2013). So the process of observation (observation) requires two stages, namely: First: the physical process (optical and physiological to be precise), and second is the psychological process (Ruskanda, 1994).

Physical process using binoculars/optics where the optical media used will clearly show the light from the object being seen, either directly or indirectly. Focused and forming a shadow (shadow, image) on the retina (retina) then with physiological processes, images, which is the focus of light, converted by the nervous system into electrical signals. From here, the brain will interpret or do perception (perception) so that the impression of seeing is formed. While the psychic process is an integral part of the biological system, the psychic aspect constantly interacts with all aspects of humanity as a sub-system of human existence. Therefore, the mental and psychic aspects cannot separate from one another (RDS, n.d.).

Therefore, the eye and the telescope are inseparable units because they both have the same role and purpose in observing the image of the crescent moon (hilal). To get maximum results, an observer must have the ability to observe the beginning of the lunar month, including a.*Rukyatul hilal implementation technique and b. Use of Media Technology.*

Binoculars

Binoculars are devices that can assist observations that have the function of collecting as many electromagnetic (EM) waves as possible from distant objects. In general, we know two types of telescopes, namely: Optical and Radio. The optical telescope is an arrangement of mirrors or lenses to focus light. The larger the diameter, the more light can collected to detect very far away and dim objects. Moreover, a radio telescope is a parabolic antenna that captures radio waves emitted from celestial objects. The larger the size and resolution, the higher the ability to detect cold objects in the universe (Djamaluddin, n.d.-b).

In general, the telescope (Mirqab) divide into three parts, namely: 1). Refractor Telescope, 2). Reflector Telescope and 3). Catadioptry Telescope. Of the three types, this telescope has the function of increasing the eye's ability to see dim objects, especially celestial objects (Moore, 2002). Meanwhile, according to Admiranto. The telescope collects light, enlarges the shadow, and broadens the power of separation (Admiranto, 2009). AE Roy said in more detail about the uses of the telescope, among others: To allow the collection of light to cover a larger area so that faint objects can be detected and measured more accurately. and to enable the achievement of higher resolution angles so that position measurements can be made more accurate and detailed so that information about celestial objects can be recorded (Roy & Clarke, 1978).

Refractory Telescope

This telescope is the first type of telescope discovered in the world. It was using the lens as a light medium. Refractory telescopes use two lenses located at the end of the tube (objective lens) and behind (ocular lens). The advantage of this telescope is that it can see two (double stars) celestial bodies seen with the naked eye, it will appear as a single star, but when viewed using this refractor telescope, it will be seen as two stars that are close to each other. This refractor telescope is very suitable for observing celestial bodies that have bright light. This telescope has a weakness, namely the emergence of chromatic aberration, which is the effect produced by the dispersion of light when the lens fails to direct all the colour waves to the same focal point; This is because lenses have different refractive indices for different wavelengths of light. According to Marimont, the refractive index of transparent materials decreases with increasing wavelength (Marimont & Wandell, 1994). And spherical aberration (Spherical aberration) is a defect in a spherical shell-shaped mirror that results in a difference in the angle of reflection between a light beam falling at a point near the mirror axis and the beam. light falls at a point far from the mirror's axis (e.g. at the edge of the mirror). (Wikipedia.org, nd) caused by a lens defect that creates a rainbow image on the object (celestial body) to be viewed (Knowing the Types of Telescopes | (*Mengenal Tipe-Tipe Teleskop*, 2016).

Reflector Binoculars

Reflector Binoculars use a parabolic mirror to collect light instead of an optical media refractor telescope whose function is to collect light at the back of the objective lens. This binocular model was made by Sir Issac Newton with the reason to eliminate the weakness that occurs in refractor binoculars in the form of chromatic aberration so that there is an additional lens (flat secondary mirror) on the objective lens to be directed to the other lens. On the other hand, the telescope's ability to collect so much light makes it very suitable for observing dim celestial bodies (*Mengenal Tipe-Tipe Teleskop*, 2016). The weakness of this reflector telescope still has a coma of spherical aberration and astigmatism.

Catadioptric Telescope

This telescope combines reflector telescopes and refractor telescopes. Both telescopes have weaknesses in observing celestial bodies; the lens and mirror are combined in one tube (tube), combining the lens system and the mirror system enough light where the mirror is a light collector. Schmidt Cassegrain invented this telescope; The advantage of this telescope is that it can correct errors in the lens, chromatic aberration and spherical aberration. And other optical defects (*Mengenal Tipe-Tipe Teleskop*, 2016).

Mounting

The mounting system has the function of supporting the movement of the telescope on the object of observation; therefore, this mounting is divided into two types, namely: equatorial mounting and altazimuth mounting. An altazimuth mount is a simple two-axis mount to support and rotate the instrument (binoculars) using two perpendicular axes (one vertical axis and one horizontal axis). The vertical axis rotation varies depending on the azimuth. Rotation about the horizontal axis varies with altitude. While the equatorial mount is a mounting that works by compensating for the earth's rotation by having one axis of rotation parallel to the world's axis of rotation.

Stellarium Software

This software is software that provides a complete globe illustration of the solar system database in it. This software is "open source", (Open Source is: Open source (open source) is a development system that a central individual/institution does not coordinate, but by actors who work together by utilizing existing source code, means of communication, internet) This development pattern takes the bazaar model so that this Open Source pattern has a characteristic for its community, namely the encouragement that comes from the culture of giving, meaning that when a community uses Open Source programs and has felt the benefits, it will be motivated to ask what to do with them. Can users give back to many people) (Ministry of Communication and Information of the Republic of Indonesia, 2019), which turns a computer into a virtual planetarium. Stellarium is licensed under the GNU (General Public License)

Hilal Image Precessing

Moedji Raharto said that the things that are permanent in observing the new moon are: a. The difference between the brightness of the crescent moon and the brightness of the night light varies over time, its radiance increasing as the sun moves away from the horizon. b. Limits of sensitivity range, resolution of separation power, a contrast of optical system and detector of observation equipment, and c. Transparency and sky-wide variability near the horizon are generally worse than in the sky region near the observer's zenith (Raharto, 2004).

So when taking pictures of the crescent moon, images sometimes experience quality problems (degradation), such as defects or noise (interference). Alternatively, the colour is too contrasting, not sharp and blurry; this will be more difficult to interpret because the information in the form of images conveyed is reduced. (Hidayatullah, 2005:3)So that the viewer does not easily understand the image of the *hilal*, a new image processing is held so that the resulting image is of better quality. after processing the results expected by everyone or the observers. Image processing can be classified into several parts, namely Image Enhancement, Image Restoration, Image Compression, Image Segmentation, Image Analysis and Image Reconstruction. This process aims to reshape objects from several projected images, such as images used in surgical reconstruction in the medical field. (Introduction to Image Processing, nd), then by processing the hilal image, it will impact the prominent appearance (contrast) of the hilal image produced at that time. If there is interference or degradation in the resulting image and is seen by ordinary people, the interpretation of the new moon will be different.

CONCLUSION

The crescent image of the moon for the MABIMS criteria is still in doubt by international observers for now. Astronomy is a solution to understand the theory and implementation of *rukyat* so that all parties can unify the concept of criteria for using technology, both props and processing. Astronomical observations are evidence of the results of r*ukyat*, so that testimonies and oaths are precious for worship for Muslims in particular. Science and technology are also proof that when combined with current developments, it is beneficial and solves the problem of differences in recognizing the image of the crescent moon so that the use of technology can be a new hope in increasing objectivity in observing and witnessing the new moon.

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REFERENCES

Admiranto, A. G. (2009). *Menjelajah Tata Surya*. Canisius.

Azhari, S. (2008). *Ensiklopedi Hisab Rukyat*. Pustaka Pelajar.

Azhari, S. (2012). *Visibilitas Hilal MABIMS dan Implementasinya*. Museum Astronomi Islam. http://museumastronomi.com/visibilitas-hilal-mabims-dan-implementasinya/

Creswell, J. W., & Poth, C. N. (2016). *Qualitative inquiry and research design: Choosing among five approaches*. Sage publications.

Djamaluddin, T. (n.d.-a). *Analisis Visibilitas Hilal untuk Kriteria Tunggal yang Diusulkan di Indonesia: Matahari dan Lingkungan Luar Angkasa*. LAPAN.

Djamaluddin, T. (n.d.-b). *Imkanur Rukyat, parameter penampakan hilal dan berbagai kriterianya-Menuju penyatuan penanggalan Islam di Indonesia*.

Djamaluddin, T. (2000). New Crescent Moon Visibility in Indonesia(Visibilitas Hilal Di Indonesia). *RECON No. 20010023280. Warta LAPAN*, *2*, 137–145.

Djamaluddin, T. (2004). Hasil Hisab dan Rukyat dapat digabungkan. In *Hisab Rukyat dan Perbedaannya* (pp. 232–255). Pusat Penelitian dan Pengembangan Kehidupan Beragama.

Djamaluddin, T. (2005). *Memulai Fiqh Astronomi: Mempelajari Hisab Rukyat dan Mencari Solusi Perbedaan Hari Raya*. Cakrawala.

Fauzi, M. (2009). *Metode penelitian kuantitatif*. Walisongo.

Hambali, S. (2012). Fatwa Sidang Isbat dan Penyatuan Kalender Hijriyah. *Makalah Lokakarya Internasional Dan Call for Paper IAIN Walisongo Fakultas Syariah, Semarang*, 12–13.

Hambali, S., & Rokhmad, A. (2011). *Almanak sepanjang masa: sejarah sistem penanggalan masehi, hijriyah dan jawa*. Program Pascasarjana IAIN Walisongo Semarang.

Herdiansyah, H. (2010). *Metodologi penelitian kualitatif untuk ilmu-ilmu sosial* (Vol. 8). Salemba Humanika.

Izzuddin, A. (2003). *Fiqh hisab rukyah di Indonesia: upaya penyatuan mazhab rukyah dengan mazhab hisab*. Logung Pustaka.

Khazin, M., Achwani, M., Fauzan, A., Fahmi, I., & Zahroh, M. (2010). *Almanac Hisab Rukyat*. Bimas Islam, Kementerian Agama Indonesia.

Marimont, D. H., & Wandell, B. A. (1994). Matching color images: the effects of axial chromatic aberration. *JOSA A*, *11*(12), 3113–3122.

Mengenal Tipe-tipe Teleskop. (2016). Kafe Astronomi. http://kafeastronomi.com/menkenal-tipe-tipe-teleskop.html

Moore, P. (2002). *Philip's Astronomy Encyclopedia*. Philip's Astronomy Encyclopedia.

Nashirudin, M. (2013). *Kajian atas Sistem dan Prospeknya di Indonesia*. El-Wafa.

Poerwadarminta, W. J. S. (1952). *Kamus umum bahasa Indonesia*. Balai pustaka.

Raharto, M. (2004). Teknologi Optik sebagai Pembantu Penetapan Awal Bulan Hijriyah/Qamariyah. In *Hisab Rukyat dan Perbedaannya*. Proyek Peningkatan Pengkajian Kerukunan Hidup Umat Beragama, Puslitbang Kehidupan Beragama, Badan Litbang Agama dan Diklat Keagamaan, Departemen Agama RI.

Rakhmadi, A. J. (2016). *Khazanah Astronomi Islam Abad Pertengahan*. UMP Press.

Ramdan, A., & Bani, A. S. (2009). *Islam dan astronomi*. Bee Media Indonesia.

RDS, R. D. S. (n.d.). *Kesehatan Mental: Pengaruh Psikis, Gejala, Diagnosis, & Pengobatan*. Dokter Sehat. Retrieved February 20, 2019, from https://doktersehat.com/psikologi-kesehatan-mental/

Roy, A., & Clarke, D. (1978). *Astronomy: Principles and Practices*. JW Arrowsmith.

Ruskanda, F. (1994). *Teknologi Rukyat secara Objektif dalam Rukyat dengan Teknologi, Upaya Mencari Kesamaan Pandangan tentang Penentuan Awal Bulan Ramadhan dan Syawal*. Gema Insani Press.

Saksono, T. (2007). *Mengkompromikan rukyat & hisab*. Amythas Publicita: Center for Islamic Studies (CIS).

Sudibyo, M. (2011). Variasi Lokal Dalam Visibilitas Hilaal : Observasi Hilaal di Indonesia pada 2007-2009. *Prosiding Pertemuan Ilmiah XXV HFI Jateng & DIY*, 118–122.

Suryana, W. (2016). *MABIMS Hasilkan Delapan Bidang Kerja Sama 2016-2020*. Republika.co.id. https://republika.co.id/berita/dunia-islam/islam-nusantara/16/12/06/ohr7il396-mabims-hasilkan-delapan-dalam-kerja-sama-20162020

Tarjih, M. (2009). *Pedoman Hisab Muhammadiyah*. Majelis Tarjih dan Tajdid Pimpinan Pusat Muhammadiyah.

Thohari, F., Sasmito, A., Andy, E. S., Murjaya, J., & Kurniawan, R. (2017). Kondisi metereologi saat pengamatan hilal 1 Syawal 1438H di Indonesia: upaya peningkatan kemampuan pengamatan dan analisis data hilal. *AHKAM: Jurnal Ilmu Syariah*, *17*(1).

Thompson, A. J. (2003). *Making your own telescope*. Courier Corporation.

Utama, J. A., & Siregar, S. E. (2013). Usulan Kriteria Visibilitas Hilal di Indonesia Dengan Model Kastner. *Jurnal Pendidikan Fisika Indonesia*, *9*(2).