

IDENTIFYING THE SHADIQ DAWN APPEARANCE USING THE SKY QUALITY METER IN MEDAN CITY FROM 2017-2023

Marataon Ritonga¹, Arwin Juli Rakhmadi², Hariyadi Putraga³, Muhammad Hidayat⁴, Abu Yazid Raisal⁵

^{*1, 2, 3, 4, 5}Universitas Muhammadiyah Sumatera Utara, Indonesia

^{*1}email: marataonritonga@umsu.ac.id

Abstract: The Fajr prayer begins at dawn until the Sun rises on the eastern horizon. In Indonesia, many Islamic astronomy experts have set criteria for the appearance of the shadiq dawn with the sun's depth ranging from 14°-20° degrees below the horizon. Meanwhile, the Indonesian Ministry of Religious Affairs sets the Sun elevation for the beginning of dawn prayers at 20° degrees below the horizon. This quantitative study uses a field research approach through observation to collect the data using the Sky Quality Meter (SQM). The data used in this study is data owned by OIF UMSU taken from 2017- 2023. The results showed that the shadiq dawn appeared on 11-14 degrees below the horizon.

Keywords: Fajr, sky quality meter.

Introduction

Determining the time of prayer is something that must be known to all Muslims, because for Muslims prayer is one of the means of communication to Allah in a day and night (Butar-Butar, 2018). In praying, Muslims cannot do it but must be in accordance with the time, because prayer is bound by predetermined times both based on instructions from the Qur'an and explanations from the traditions of the Prophet Muhammad saw as well as explanations from scholars (Raisal et al., 2019). In praying, Muslims must know when the prayer time is because praying must be in accordance with the time. As Allah says in QS. an-Nisā' verse 103.

إِنَّ الصَّلَاةَ كَانَتْ عَلَى الْمُؤْمِنِينَ كِتَابًا مَوْفُوتًا

“Indeed, prayer is an obligation prescribed for those who believe (QS. an-Nisā’/4:103)”.

The determination of prayer times is inseparable from the position and movement of the Sun (Alimuddin, 2012). The position and movement of the Sun are the main factors that cause time differences on Earth, resulting in differences in determining prayer times (Sado, 2015). The position of the Sun at the time of Fajr ṣādiq is below the horizon with a certain altitude value (Fuadi, 2021). There are differences in determining the beginning of the Fajr prayer time due to different understandings and interpretations of the altitude of the Sun at the time of the appearance of Fajr ṣādiq. The time of the Fajr prayer begins at the time of the appearance of Fajr ṣādiq until the Sun rises. As Allah says in QS. al-Baqarah: 187

وَكُلُوا وَاشْرَبُوا حَتَّى يَتَبَيَّنَ لَكُمُ الْخَيْطُ الْأَبْيَضُ مِنَ الْخَيْطِ الْأَسْوَدِ مِنَ الْفَجْرِ

“And eat and drink until it is light to you, white thread from black thread, which is the dawn”.

The dawn referred to in the verse is for the start of fasting and the beginning of the Fajr prayer. The above verse also gives an explanation of the parable of dawn with a white thread and a black thread. In its development, there are various interpretations and interpretations among

scholars related to 'white thread' and 'black thread'. Some of the scholars' opinions regarding the white and black threads are as follows:

Ash-Shukany stated as a simile (*tasybih baligh*), where the white thread referred to here is that which stretches (al-mu'taridh) on the horizon, not towering like a Wolf's tail.

Ibn Faris states the word 'khait' as something that is finely stretched (*imtidad ash-shay' fi diqqah*). The popular word *al-khaith* also means the white light of day (*bayadh an-nahar*) (Butar-Butar, 2021).

عَنْ مُحَمَّدِ بْنِ عَبْدِ الرَّحْمَنِ بْنِ ثَوْبَانَ , قَالَ: قَالَ رَسُولُ اللَّهِ صَلَّى اللَّهُ عَلَيْهِ وَسَلَّمَ: الْفَجْرُ فَجْرَانِ فَأَمَّا الْفَجْرُ الَّذِي يَكُونُ كَذَنْبِ السَّرْحَانِ فَلَا يُحِلُّ الصَّلَاةَ وَلَا يَحْرِمُ الطَّعَامَ , وَأَمَّا الَّذِي يَذْهَبُ مُسْتَطِيلًا فِي الْأُفُقِ فَإِنَّهُ يُحِلُّ الصَّلَاةَ وَيَحْرِمُ الطَّعَامَ.

Muhammad ibn 'Abdur-Rahman ibn Tsauban reported that the Messenger of Allah (SAW) said: "There are two kinds of dawn: The dawn that is like a wolf's tail (curved) does not make prayer (it is not yet Fajr time) permissible, but it does not forbid eating (for those who want to fast). As for the dawn that extends across the horizon, that is what makes prayer (Fajr prayer) permissible and food forbidden (for those who want to fast). (HR: ad-Dāruquthni)

From the above Hadīth, scholars have agreed to divide the dawn into two: the ṣādiq dawn and the kāzib dawn (Rohmah, 2012).

Sādiq Dawn

Fajr ṣādiq is a white light that appears and spreads on the Eastern horizon that appears time after Fajr Kāzib (Musonnif, 2011). Furthermore, the ṣādiq dawn is the phenomenon of the appearance of the Sun altitude a few moments before the Sun rises on the Eastern horizon . At the time of its appearance, Muslims are allowed to perform the Fajr prayer but are not allowed to eat Suhoor for those who want to fast. Fajar ṣādiq appears with a colorless white light (actually bluish, but not visible because it is very faint) due to the scattering of the Sun's light by the high atmosphere. The light of Fajr ṣādiq will continue to grow brighter until the Sun rises . The time for the Fajr prayer ends when the Sun rises.

Dawn Kadzib

Dawn is a light visible in the Eastern horizon that rises upwards and is often referred to as the zodiacal light (Saksono, 2017). Dawn is a phenomenon that arises due to the scattering of the Sun's rays by interplanetary dust. Furthermore, it is a light that rises into the sky like the tail of a wolf (Qomaruz Zaman, 2018). Astronomically speaking, the light that rises up is due to the reflection of the Sun's light by celestial particles scattered among the planets in the solar system. The appearance of this dawn is only temporary and will disappear again. At this time of dawn, Muslims are allowed to eat Suhoor for those who want to fast, but are prohibited from performing the Fajr prayer (Basthoni, 2020). According to an-Nawawi, fajar kāzib (false dawn) is said to be because it appears and shines at first but eventually disappears again. Thus, the appearance of the dawn has nothing to do with the Shari'ah ruling. Therefore, the scholars agree that the beginning of the Fajr prayer begins when the second dawn (fajr ṣādiq) actually breaks (Qomaruz Zaman, 2018).

Astronomers only recognize Fajr ṣādiq because the light that has become visible cannot return to darkness. The light that has become visible will continue to move towards its circling point by forming a larger angle. Morning twilight in astronomical terms is divided into three. First, civil twilight when the Sun is at an altitude of 6° below the horizon. Second, nautical twilight when the Sun is 12° below the horizon. Thirdly, astronomical twilight when the Sun is -18° below the horizon (Ritonga, 2022).

Literature Review

In Indonesia, the Ministry of Religious Affairs determines the time of Fajr prayer based on the paradigm of Fajr *ṣādiq*, which is when the Sun is at an altitude of 20° below the horizon, and this is considered in accordance with the Shariah and research results (Noor & Hamdani, 2018). However, until now, experts in astronomy have not found any data or scientific evidence that shows that the *ṣādiq* dawn appears at an altitude of 20° below the horizon (Tono Saksono dan Syamsul Anwar, 2021). This means that the 20° altitude is still disputed by people with expertise in the field of phalacology and astronomy, as evidenced by the number of experts who re-observe the appearance of the *ṣādiq* dawn using the *Sky Quality Meter* (SQM) instrument (Ritonga, Marataon, Arwin Juli Rakhmadi, Muhammad Qorib, 2024).

Problems with the timing of the Fajr prayer have occurred since 2010 until today. Back in 2010, Shaykh Mamduh Farhan al-Buhairi, in his article entitled “The Misunderstanding of Fajr Time” published in Qiblati magazine, questioned the Fajr prayer time, which was considered to be about 24 minutes too early from the schedule used at that time (Mughits, 2014). If the results of the research are correlated to the position of the Sun, the early Fajr time is obtained when the Sun's altitude is between 17° to -14° below the horizon. This result is very different from the criteria for the appearance of Fajr *ṣādiq* based on the decree of the Ministry of Religious Affairs, which is 20° below the horizon (Qusthalaani, 2018).

The momentum of the study of Fajr time returned and increasingly surfaced through a study conducted by the Islamic Science Research Network team of Muhammadiyah Prof. HAMKA University (ISRN UHAMKA) Jakarta chaired by Tono Saksono, which in the study concluded that the current Fajr prayer time is considered too fast about 26 (Ritonga, 2021). If the results of the research conducted above are true, then it becomes a very serious problem among Muslims because Muslims perform the Fajr prayer before it is due.

Method

This research is a quantitative research with field research studies, namely direct observation in the field to collect data using predetermined research instruments. In this study, the researcher emphasizes the study of the change from the night sky to the bright sky at the beginning of the Fajr prayer time through the observation of Fajr *ṣādiq* using the SQM instrument.

Fajr data collection was carried out in a span of approximately 1 hour with details of half an hour (30 minutes) before Fajr prayer time and half an hour (30 minutes) after Fajr prayer based on the hisab prayer schedule of the Indonesian Ministry of Religion. The duration of data collection is carried out between the range of 10 seconds which aims to minimize the occurrence of errors in observing the beginning of the emergence of fajar shadiq.

The observation of fajar shadiq was conducted at the Postgraduate Campus Building of Muhammadiyah University of North Sumatra (UMSU) located on Jalan Denai, Medan city, North Sumatra with coordinates $3^{\circ} 34' 55, 06''$ LU & $98^{\circ} 43' 17, 09''$ WEST. Indications of the appearance of fajar shadiq can be seen based on the data generated by SQM



Figure 1: Position of the SQM during dawn data collection

Result and Discussion

Observations and measurements of the conditions and quality of the night sky at the data collection site using the SQM photometer, obtained maximum readings for the Medan city area starting from 20.80, 19.20, and 18.56 MPSAS. The value obtained is the highest value of the data taken so that researchers can find out the maximum value that is different in each data collection. The difference in value can occur due to noise or interference during data collection such as thick clouds passing by, full moon light, light pollution at the location, and the state and condition of the atmosphere at the time of observation. The following is a map of light pollution in Medan (OIF UMSU).

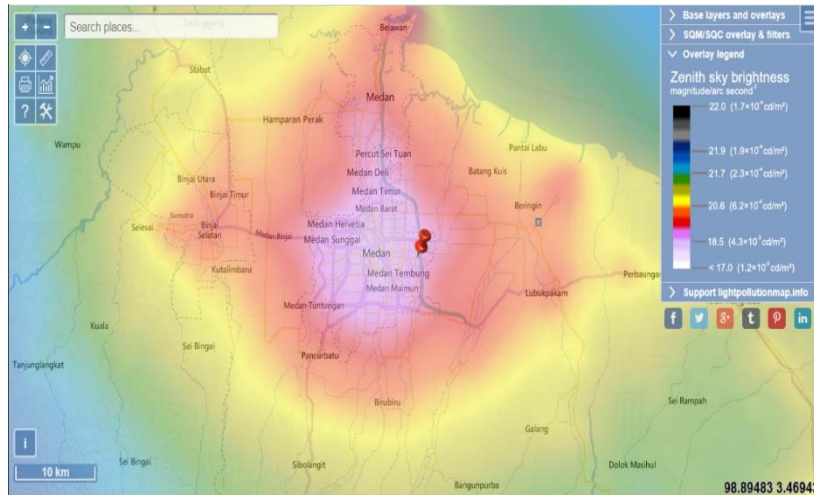


Figure 2. Light pollution map at OIF UMSU Medan (source lightpollutionmap.info)

The following are data on the night sky brightness values obtained during field data collection using SQM at OIF UMSU from 2017-2023.

Bulan	Arah SQM
	0
Januari	-
Februari	-
Maret	-
April	-
Mei	-
Juni	14.1
Juli	13.58
Agustus	13.57
September	12.23
Oktober	13.75
November	11.91
Desember	14.25
Rata-rata	13.34

Table 1: SQM processed data in 2017 as an indication of the emergence of fajar shadiq

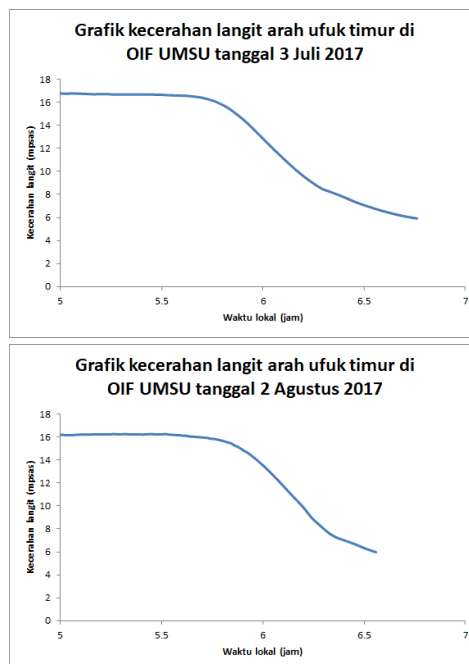


Figure 3: SQM chart of July 3 and August 3, 2017

Bulan	Arah SQM	
	0	90
Januari	10.35	
Februari	-	10.68
Maret	-	10.73
April	-	10.82
Mei	8.70	9.82
Juni	10.25	8.52
Juli	9.73	12.19
Agustus	10.24	13.22
September	10.40	12.19
Oktober	9.10	12.05
November	9.52	12.01
Desember	9.47	12.25
Rata-rata	9.75	11.31

Table 2: SQM processed data in 2018 as an indication of the emergence of fajar shadiq

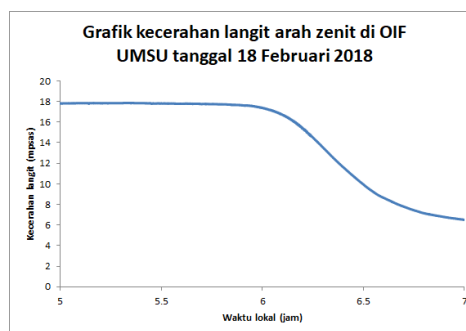
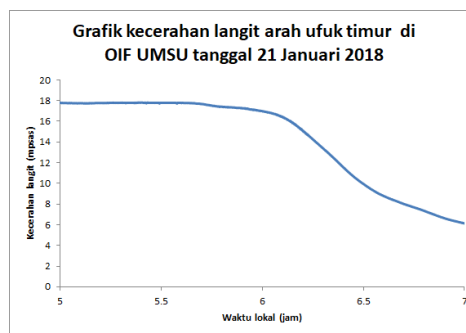


Figure 4: SQM chart of January 21 and February 18, 2018

Bulan	Arah SQM		
	0	45	90
Januari	9.89	-	12.09
Februari	10.51	-	12.76
Maret	9.92	-	12.20
April	8.92	-	11.47
Mei	8.75	-	10.99
Juni	9.25	-	11.95
Juli	9.33	-	11.30
Agustus	-	12.66	12.02
September	-	12.83	12.28
Oktober	-	11.21	10.68
November	-	11.14	10.52
Desember	-	10.14	10.49
Rata-rata	9.51	11.60	11.56

Table 3: SQM processed data in 2019 as an indication of the emergence

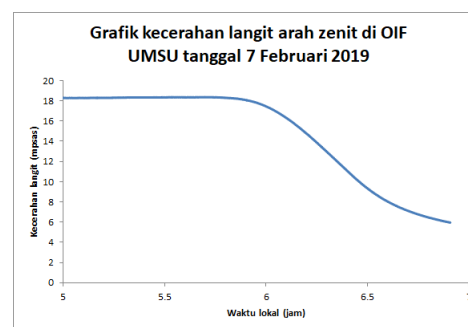
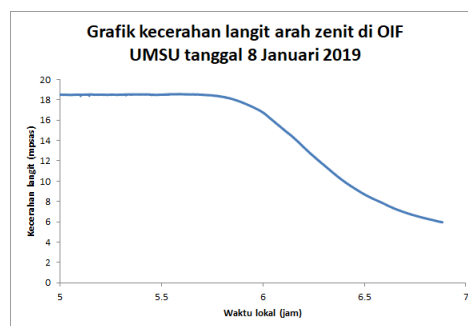


Figure 5: SQM chart of January 08 and February 07, 2019

of fajar shadiq

Bulan	Arah SQM	
	45	90
Januari	11.73	11.35
Februari	11.48	10.99
Maret	12.16	11.97
April	11.71	11.66
Mei	10.42	10.53
Juni	10.82	10.63
Juli	11.72	11.28
Agustus	-	11.13
September	-	-
Oktober	-	-
November	-	-
Desember	-	-
Rata-rata	11.43	11.19

Table 4: SQM processed data in 2020 as an indication of the emergence of fajar shadiq

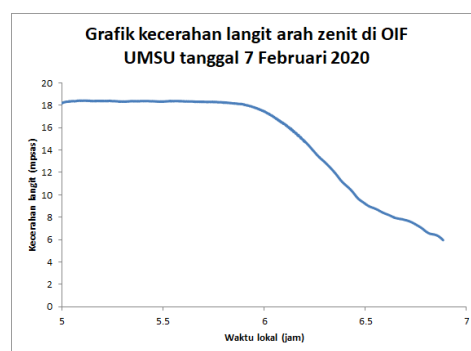
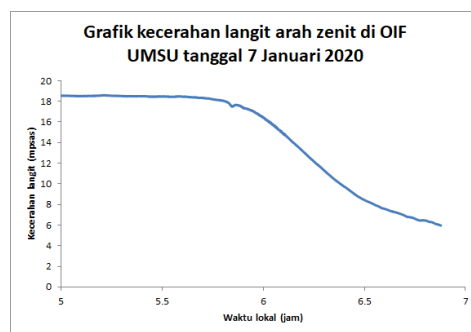


Figure 6: SQM chart of January 07 and February 07, 2020

Bulan	Arah SQM	
	45	90
Januari	11° 41'	11° 39'
Februari	11° 54'	12° 03'
Maret	13° 11'	13° 18'
April	13° 11'	13° 04'
Mei	12° 15'	12° 14'
Juni	11° 37'	11° 37'
Juli	12° 34'	12° 30'
Agustus	11° 25'	11° 18'
September	12° 15'	12° 00'
Oktober	-	-
November	09° 56'	09° 49'
Desember	09° 47'	10° 04'
Rata-rata		

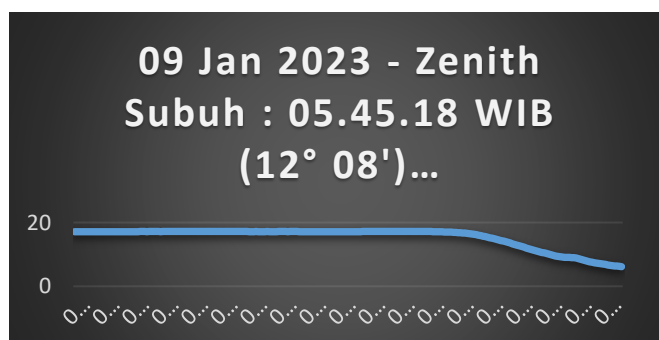
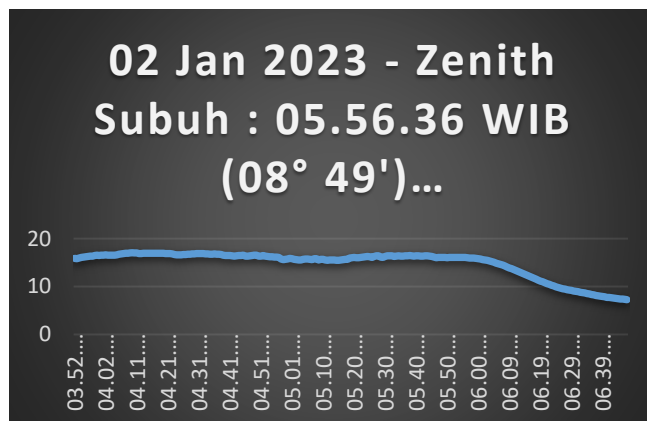


Table 5: SQM processed data in 2023 as an indication of the emergence of fajar shadiq

Figure 7: SQM chart of January 02 and January 09, 2023

Based on the data obtained through observations using the SQM photometer, the altitude of the sun is quite varied at the time of the appearance of fajar shadiq as an indication of the beginning of dawn prayer and fasting in the range of 11^0 degrees to 14^0 degrees below the horizon. The difference in the altitude of the Sun's position obtained through observations made using the SQM is due to the weather conditions at the location when the observations were made. The less disturbance that is obtained during the observation, the results obtained will be better and easier to detect when fajar shadiq appears.

When viewed on a map related to light pollution at OIF UMSU, OIF UMSU does get quite high pollution from the lights of tall buildings around OIF UMSU. So that the data obtained from SQM is also quite diverse, it is because when the sky conditions are darker, it will get good sky brightness data, on the other hand, if the sky conditions are bright due to the surrounding lights, it will get a bad value so that it will be more difficult to detect the appearance of fajar shadiq (Herdiwijaya, 2020).

Nights that are not perfectly dark are due to the many contributions of natural light such as the scattering of the Earth's atmosphere from starlight and zodiacal light or what is commonly known as false dawn (fajar k̄azib). Zodiacal light comes from the scattering of the Sun's light by dust particles (1-300 micrometers in size) in interplanetary space or outside the Earth's atmosphere. There are six (6) factors that contribute to the brightness of the night sky by celestial bodies: 1. the combination of light from distant galaxies, 2. the combination of starlight within the Milky Way galaxy, 3. zodiacal light, 4. night airglow, 5. aurora, and 6. twilight emission lines. Night airglow, aurora and twilight emission lines are the result of the atmosphere and magnetic fields. Night airglow is the luminescence of atoms and molecules in the air from photochemical excitation (Ritonga, 2023).

Conclusion

The sky conditions in Medan (OIF UMSU) are strongly influenced by the surrounding lights so that the value or sky brightness obtained and obtained is not stable or fixed. This condition can be seen from the highest sky brightness frequency in the range of low sky brightness values. The average value of sky brightness obtained in Medan is 18.56 mpsas. Based on the data obtained, the appearance of fajr shadiq based on the SQM reading is in the range of 11^0 - 14^0 below the horizon. Based on the bortle scale, the Medan area (OIF UMSU) is in the ninth grade area, which is the inner city sky. In this condition, light pollution is so high that the entire sky is brightly lit even to the zenith. The only celestial objects that can be observed with the naked eye directly are the moon, stars, and other bright celestial objects.

Bibliography

- Alimuddin. (2012). Perspektif Syar'i dan Sains Awal Waktu Shalat. *Al-Daulah*, 1(1), 120–131.
- Basthoni, M. (2020). A Prototype of True Dawn Observation Automation System (Prototipe Sistem Otomatisasi Observasi Fajar). *Jurnal Sains Dirgantara*, 18(1), 33–42. <https://doi.org/10.30536/j.jsd.2020.v18.a3475>
- Butar-Butar, A. J. R. (2018). *Pengantar Ilmu Falak Teori, Praktik, dan Fikih*. Rajawali Pers.
- Butar-Butar, A. J. R. (2021). *Esai-Esai Waktu Subuh*. UMSU Press.
- Fuadi, L. (2021). Fajar Penanda Awal Waktu Shubuh dan Puasa. *Minhaj: Jurnal Ilmu Syariah*,

2(1), 107–120.

- Herdiwijaya, D. (2020). On the beginning of the morning twilight based on sky brightness measurements. *Journal of Physics: Conference Series*, 1523(1). <https://doi.org/10.1088/1742-6596/1523/1/012007>
- Mughits, A. (2014). Problematika Jadwal Waktu Salat Subuh di Indonesia. *Jurnal Ilmu Syari'ah Dan Hukum*, 48(2), 467–487.
- Musonnif, A. (2011). *Ilmu Falak Metode Hisab Awal Waktu Shalat, Arah Kiblat, hisab Urfi dan Hisab Hakiki Awal Bulan*. Teras.
- Noor, L. A. H., & Hamdani, F. F. R. S. (2018). THE DAWN SKY BRIGHTNESS OBSERVATIONS IN THE PRELIMINARY SHUBUH PRAYER TIME DETERMINATION. *Qijis*, 6(1).
- Qomaruz Zaman. (2018). Terbit fajar dan waktu subuh (Kajian Nash Syar'i dan Astronomi). *Mahakim*, 2(1), 27.
- Qusthalaani, I. (2018). Kajian Fajar Dan Syafaq Perspektif Fikih Dan Astronomi. *Mahkamah : Jurnal Kajian Hukum Islam*, 3(1), 1. <https://doi.org/10.24235/mahkamah.v3i1.2744>
- Raisa, A. Y., Pramudya, Y., Okimustava, & Muchlas. (2019). Pemanfaatan Metode Moving Average dalam Menentukan Awal Waktu Salat Subuh Menggunakan Sky Quality Meter (SQM). *Al-Marshad: Jurnal Astronomi Islam Dan Ilmu-Ilmu Berkaitan*, 5(1), 1–13. <https://doi.org/10.30596/jam.v5i1.3121>
- Ritonga, Marataon, Arwin Juli Rakhmadi, Muhammad Qorib, H. P. (2024). Shdiq Dawn Observation Using All Sky Camera In Deli Serdang, North Sumatera. *ELFALAKY: Jurnal Ilmu Falak*, 8(No. 2), 280–293.
- Ritonga, M. (2021). Problematika Syafaq dan Fajar dalam Menentukan Waktu Salat Isyak dan Subuh. *Al-Marshad: Jurnal Astronomi Islam Dan Ilmu-Ilmu Berkaitan*, 7(2).
- Ritonga, M. (2022). *Pengamatan Fajar Shadiq Menggunakan All Sky Camera di Kota Medan* [UIN Walisongo Semarang]. https://eprints.walisongo.ac.id/id/eprint/20843/1/Tesis_2002048001_Marataon_Ritonga.pdf
- Ritonga, M. (2023). Penentuan Waktu Subuh Menggunakan All Sky Camera dan Metode Moving Average di Kota Medan. *Mahkamah: Jurnal Kajian Hukum Islam*, 8(1), 13–20.
- Rohmah, N. (2012). *Syafak & Fajar Verifikasi dengan Aplikasi Fotometri: Tinjauan Syar'i dan Astronomi*. Lintang Rasi Aksara Books.
- Sado, A. B. (2015). Waktu Shalat dalam Perspektif Astronomi; Sebuah Integrasi Antara Sains dan Agama. *Mu'amalat*, VII(1), 69–83.
- Saksono, T. (2017). *Evaluasi Awal Waktu Subuh & Isya Perspektif Sains, Teknologi dan Syariah*. Uhamka Press & LPP Aika Uhamka.
- Tono Saksono dan Syamsul Anwar. (2021). *Premature Dawn The Global Twilight Pattern*. Suara Muhammadiyah.