Functions of *Astrofiqh* Observatories in Malaysia in Solving *Astrofiqh* Issues

Ibnor Azli Ibrahim

Universiti Kebangsaan Malaysia
Email: iabi@gmail.com

Mohd Hafiz Safiai

Universiti Kebangsaan Malaysia
Email: hafizsafiai@gmail.com

Ezad Azraai Jamsari

Department of Arabic Studies and Islamic Civilization, Faculty of Islamic Studies,
Universiti Kebangsaan Malaysia, 43600 UKM Bangi, Selangor, Malaysia
Email: eajsti@gmail.com

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Abstract

This article discusses the role of astrofiqh observatories in Malaysia in solving current issues concerning the astrofiqh field. Astrofiqh observatories also play the role of managing affairs of Muslim rituals related to falak (astronomy). Fewer studies have been done on astrofiqh observatories as compared to other Islamic institutions such as mosques and Islamic schools. Hence, this study is carried out with the aim of analyzing the role of astrofiqh observatories in Malaysia in solving current astrofiqh issues. In addition, this study also indirectly deliberates the history of existence and development of the observatories. This study employed a qualitative approach based on primary and secondary sources through the method of document analysis, interviews and observations. Results of the study found that there are five astrofiqh observatories in Malaysia which function as official sites for crescent or hilal sighting, research centers, education institutions and tourism destinations, simultaneously playing the role of solving current astrofiqh issues related to Muslims. The astrofiqh observatory institutions in Malaysia also give the Muslim community the exposure to understanding Islamic astronomy holistically.

Keywords: *observatory; astrofiqh; hilal observation; astronomical instruments; astrotourism;*

1. Introduction

Observatory is a facility to study and explore the creation and secrets of the universe. Observatories are among the most important existing institutions in Islamic civilization which focus on the development and advancement of Islamic astronomy or *falak*. The rapid growth of *falak* can be observed during the ruling era of Caliph al-Ma'mun (786-822) in Baghdad, which later on was spread and further advanced by the West until recently (Mujani, Ibrahim & Safiai, 2012). Progress in *falak* highlights the greatness of Islam in producing numerous accomplished scholarly figures who were well-known in that field (Hamid, n.d.). However, in spite of their fame and pride, there exist among the Muslims those who are less aware and informed of the existence and importance of observatories. Mostly, the public nowadays is heedless about the institutions, being only aware about their existence to manage and administer certain interests of the Muslims, including in Malaysia.

The advancement of Islamic observatory construction was considered to reach its zenith during the rule of Caliph Al-Ma'mun in the Abbasid era. Nevertheless, specific studies which were written about it in depth and great details are seldom found. Many, if not most, previous literatures on Islamic observatories only briefly discussed the historical aspects of their construction. Even though articles on observatories in Malaysia are limited, it cannot be denied that there are a number of writings on this subject which have been produced however brief the debate on it was. Considering that there are quite a number of them built in Malaysia, be it personal or official, it is only proper that such a study should be given an attention and done collectively involving various interested parties for the sake of advancing the science of *falak* in Malaysia specifically and in the Southeast Asian region generally.

Until now, there are several observatories which were built with a purpose of bringing the science of Islamic

astronomy to the center of attention, especially in the aspect of *falak* education in Malaysia. The observatories are put under the custody of some organizations such as Agensi Angkasa Negara (ANGKASA) or the National Space Agency, State Mufti Departments and local higher education institutions. Apart from that, researches done at the *astrofiqh* observatory institutions provide space and opportunity to and give exposure to the Muslim community to wholly understand the field of Islamic astronomy. Realizing the importance of the knowledge being acquired and reconquered, such studies should be carried out intensively as one of the efforts to dignify this almost forgotten field of knowledge. The aspects of its history of emergence, development and roles of *astrofiqh* observatories in Malaysia are also discussed to complete the data and information which are not available in previous studies. This is in line with efforts by interested parties in reinforcing the development of *falak* in Malaysia.

This study was carried out based on examination of previous works by Bahali (2006a) entitled 'al-Khawarizmi Astronomy Complex: Planning and future direction, Aziz (2010) entitled 'Observatory Technology: Then and now', Ismail, Nawawi, Yusuf and Niri (2008) entitled 'The role of Observatory Institutions in the development of Islamic civilization: A highlight', Zainuddin (2010) entitled 'Future Direction of Observatories in Malaysia' and Ibrahim, Ahmad, Safiai and Mujani (2012) entitled 'Islamic astronomy and the establishment of al-Khawarizmi Complex in Malaysia'. The afore-mentioned work deliberated, though in a holistic manner, the role of observatories from the aspects of research and education only. In fact, the work of Othman (1993) discussed the role and functions of Malaysian observatories from the aspect of research only. The main priority in building these observatories is in the aspect of research related to astronomic sciences. Hence, the objective of this study is to analyze the role of *astrofiqh* observatories in Malaysia in solving current *astrofiqh* issues, apart from discussing the history of existence and development of the observatories indirectly.

2. *Astrofiqh* Observatories in Malaysia

The Muslim society in Malaysia has long been influenced by the science of *falak* since ages ago. Then, observation activities were carried out traditionally, out of keen interest and on the basis of necessity of the society, on mosque towers and top of hills. The equipment used was typical instrument such as binoculars, telescope and theodolite because this equipment is portable and easy to handle. Observation activities at that time were done to see the crescent or *hilal* for determining the starting of Islamic calendar months, especially the months of *Ramadhan*, *Syawwal* and *Zulhijjah* which are related to fasting and celebration of the Muslims in Malaysia (Safiai, 2013).

In the Malaysian context, the use of the "*astrofiqh* observatory" term refers to observatory which is handled by the State Mufti Departments. According to Ibrahim and Nordin (2005), an *astrofiqh* observatory means an integrated center of *falak fiqh* or sciences which carries out activities of educational, research and tourism nature related to the science of Islamic astronomy (*falak*), particularly in matters pertaining to Muslim worship rituals such as the determination of *qiblah* direction and calculation of prayer times. The terminology '*astrofiqh*' has been introduced and used by certain quarters in Malaysia to refer to the science of *falak shar'ie* (Islamic astronomy). *Astrofiqh*, from the angle of Islamic rule deliberation, involves familial issues such as '*iddah* duration, *nasab* calculation and other issues of worship such as *qiblah* direction, prayer times, starting day of the fasting month of *Ramadhan*, *Eid-ul-Fitr* and *Eid-ul-Adha* (Ibrahim, Mohamad, Samsuddin, Omar & Yahaya, 2009). The term was coined by Ibrahim (2010) by combining it with the term *cosmofiqh*. Coupling of the two terms eventually forms a new corpus of knowledge which combines space science and Islamic *fiqh*. He defined "*fiqh al-falak wa al-kawn*" (*astrofiqh* and *cosmofiqh*) as, "a field of knowledge which studies the universe on the position and movement of celestial objects to determine the calendar, direction, and times which relate to the rules in aspects of worship, creed and morals based on the Shari'ah".

Ibrahim (2010) added that *astrofiqh* also covers the debate on *cosmofiqh* which concerns the aspect of creation of the universe and objects within it. *Astrofiqh* is a branch of knowledge which is endless because the knowledge about the universe is too vast to explore. If we are to analyze as to the new definition of this *falak shar'ie* discipline, we will find that the scope of its studies is broadened to include topics of Islamic faiths and morals apart from the shari'ah rulings on matters concerning the universe on the whole. It is not limited to the studies of space only. Therefore, the Shari'ah stand on what is on earth such as the oceans, air, clouds, earthquakes, thunders and other geographical matters falls under *al-kawn* as meant in the definition. Until recently, there are five *astrofiqh* observatories in Malaysia, namely Sheikh Tahir Falak Centre in Penang, Al-Khawarizmi Falak Complex in Melaka, Al-Biruni Observatory in Sabah, the Selangor Observatory and the Baitulhilal Complex in Teluk Kemang, Negeri Sembilan, all of which are run by the respective State Mufti Departments (Ibrahim, Ahmad & Safiai, 2013; Safiai, Jamsari & Ibrahim, 2014).

3. Role of *Astrofiqh* Observatories in Solving Current *Astrofiqh* Issues

The construction of *astrofiqh* observatories in Malaysia can further advance the science of *falak* of today. In addition to being a place for *hilal* surveillance activities, *astrofiqh* observatories also play the role of *falak* research centers and effective education institutions of *falak* sciences. Furthermore, they are also seen as potential sites for tourist attractions. In general, all of the observatories were built with a purpose of developing the science of *falak*, be it from the aspects of research, education or tourism. The roles of *astrofiqh* observatories in Malaysia are further discussed later on.

3.1 Official Hilal Observation Site (Determination of the Start of Islamic Month)

The history of official *hilal* observation activity in Malaysia began in 1970 when the National Council for Islamic Affairs was established and the council was chaired by the Yang Teramat Mulia Tunku Abdul Rahman Putra al-Haj. In line with the establishment of the council, several official committees for *hilal* sighting for *Ramadhan* and *Syawwal* were appointed at three sites, which were Telok Kemang in Negeri Sembilan, Johor Bahru in Johore and Kampung Pulau Sayak in Kedah. At the early stage, *hilal* sighting activities were carried out at official *hilal* observation sites throughout Malaysia using the naked eyes only. However, after the involvement of *Jabatan Ukur dan Pemetaan Malaysia* or the Department of Survey and Mapping Malaysia (JUPEM), modern optical equipment such as theodolite (see Appendix A) began to be used (Unit Falak Bahagian Penyelidikan, 2001). The Council of Malay Rulers through the National Council for Islamic Affairs on the 14th of December 1989 established a committee named as Committee to Determine the Start of Fasting and *Hari Raya* (*Eid*). It was then chaired by the Director-general of the Bahagian Hal-Ehwal Islam or Islamic Affairs Division (BAHEIS) of the Prime Minister's Department. The committee functions as the coordinator for the determination of the starting date of the fasting month and the dates of *Hari Raya* (*Eid*) in Malaysia (Unit Falak Syarie, 1993).

In Malaysia, deciding the start of the Islamic calendar month is done based on the method of *rukyah* and *hisab* (*falak* calculation). Both methods are used in establishing the starting date of the months in the Islamic Hijri calendar, particularly the three important months of *Ramadhan*, *Syawwal* and *Zulhijjah*. The same methods are also used for the purpose of establishing the Islamic calendar (Bahali, 2006b). The decision on the start of the Hijri months used by the Muslim community in particular in deciding the start of *Ramadhan*, *Syawwal* and *Zulhijjah* is based on the movement of the moon and earth orbiting the sun. The moon's orbit around the earth is from the west to the east (Unit *Falak* Bahagian Penyelidikan, 2001). The orbits of the moon and the earth around the sun become the basis for calculating the start of the month and year which is very much related to the rites of fasting and its celebration, the day of *eid*. Establishing the fasting starting date and the date of eid in Malaysia is based on *rukyah* and *hisab*.

Through the rapid development and progress in Malaysia, the existing official *hilal* observation stations until today have been equipped with facilities such as viewing galleries, observatory equipment pole, restrooms and prayer rooms. This makes the observers more comfortable and indirectly facilitates the sighting activity to gain a better quality and more accurate result of *hilal* observation. Various efforts have been made to modernize the official *hilal* sighting stations through renovation and addition of infrastructures at the observatories. As a result, official *hilal* sighting stations have undergone quality improvement process and good enhancement as witnessed today. Up until 2012, some 30 official *hilal* observation sites have been built throughout Malaysia (Jabatan Kemajuan Islam Malaysia, 2011).

Several *astrofiqh* observatories which are present at the moment originally were basic observation stations only. However, those stations underwent upgrading and were developed to become observatories considering the strategic locations of the observation sites which are suitable and able to meet the requirement of observation activities. The observatories are the Baitulhilal Complex in Teluk Kemang, the Al-Khawarizmi Falak Complex and the Al-Biruni Observatory. The Sheikh Tahir Falak Center and the Selangor Observatory were built from scratch and do not originate from an observation station. Nevertheless, both observatories, like other observatories, also function as official *hilal* sighting sites in their respective states.

3.2 Falak Research Centers

Parallel with current technological updates, *astrofiqh* observatories in Malaysia also play the role of *falak* research sites. Researches are done with the objective of studying current astronomical phenomena and solving issues concerning the science of astronomy. Among the research carried out at these observatories are *hilal* visibility studies which are performed at every end of the Islamic month to record data of the moon and its motion (see Appendix B). Preparation for the observation includes the process of obtaining data for the sun and moon motion. Observation may be done using the help of instruments such as theodolite, telescopes or binoculars. The use of such equipment is to facilitate the observer in

focusing onto the correct direction while looking for the crescent (Aziz, 2006).

In studying *hilal* sighting, observation should be done carefully because the process of *hilal* sighting requires a combination of knowledge in *falak shar'ie*, mathematics and optical physics (Ibrahim et al., 2012). The necessity of possessing the combination of those disciplines is important to ensure that the characteristics of the *hilal* are identified correctly to avoid any mistake done during the observation process (Laporan Kumpulan Fizik Angkasa UM, 2000-2006). Studies such as those are crucially important to provide feedback and improvement to the process of *hilal* visibility criteria review which was once considered in Malaysia and Indonesia. This was consequent to the criticism from professional groups about the unsuitability of the *hilal* visibility criteria used then. The criteria were said to be too low and deviated too much from the visibility data collected through surveillance in Malaysia and throughout the world (Aziz, 2006). These studies have been on-going at the Sheikh Tahir Falak Centre, Al-Khawarizmi Falak Complex, the Al-Biruni Observatory, the Selangor Observatory and the Baitulhilal Complex in Teluk Kemang which give more emphasis on local observation data in Malaysia.

In addition, sky brightness studies are also carried out to assess the brightness of the sky before sunrise and after sunset. The research is done to determine the position of the sun under the horizon to determine the time of the *Ishak* and *Fajar* prayers. With the help of equipment, sky brightness can be measured by looking at the effect of light scattering after sunset and this is linked with the sun's position under the horizon to decide the starting time of *Ishak* prayer (Niri et al., 2012). Meanwhile, for the dawn (*Fajar*) prayer time, the sky brightness is measured before sunrise. In practicality, the *Ishak* prayer time begins when 'red light' or *shafaq al-ahmar* disappears from the sky. This happens due to the position of the sun which is far below the horizon. The *Fajar* time meanwhile begins when 'white light' or *fajar sadiq* appears in the east horizon within the vicinity of the sunrise position (Shukor, Ahmad & Zainuddin, 2011). In Malaysia, the criterion used to determine the start of the *Ishak* prayer time is when the position of the sun is 18º below the horizon and, for the *Fajar* prayer time, 20º below horizon (Ahmad, Zainuddin, Ibrahim & Yahya, 2007). These studies have been done at the Sheikh Tahir Falak Centre and the Baitulhilal Complex, Teluk Kemang. Results of the studies found and confirmed that there is a difference in the angle of sunsets for prayer times of *Ishak* and *Fajar*. However, the obtained values do not undermine the existing values.

Among other researches carried out at the observatories are studies on refraction near the horizon. The purpose of this research is to determine the angle of refraction of celestial objects for a specific area which is usually done at the time the object rises and sets. Refraction correction is important in calculating the time of *Maghrib* and *shuruq* or sunrise. Also, it is important in knowing the effect of atmospheric refraction index factor on the position of *hilal* and the sun (Sadali, Sulung & Aziz, 2011). Refraction near horizon is a phenomenon which occurs due to light refraction by earth atmospheric layers. Difference in density between outer space and the multi-layered earth atmosphere with each layer having different physical properties cause a light refraction towards the sight of the sun at sunsets (Zainuddin, Saadon & Ahmad, 2011). However, studies from time to time are best done to enable a production of a better refraction model for areas of the country which are located near the Equator and by the sea. In Malaysia, *astrofiqh* observatories which run horizon refraction studies are Sheikh Tahir Falak Centre and the Teluk Kemang Baitulhilal Complex.

Research on sunrise is also carried out to record the difference in positions of sunrise each month. Such study is done because recorded data related to the sun are useful to know the time and direction in our daily life (Vasiliev & Tataridou, 2013). This study employs a stationary station and it must have its own reference point. Through this study, photographs of the sun are recorded using a camera fixed at the stationary station. Normally, this observation study is done on the 17-25th of the month at a fixed time, which is at 8:30 in the morning. This work is carried out at the Selangor Observatory (Burhanuddin, 2012).

Finally, studies in sun-crossing *qiblah* are done to check and ensure that the schedule of sun-crossing *qiblah* produced by State Mufti Departments is correct and accurate. The work uses the existing schedule as a reference. Should there be any changes or improvement, observatory officers shall inform the state mufti departments for further actions. In Malaysia, the phenomenon of the sun being right above *qiblah* line occurs throughout the year except for certain days in January, June, July and December. Therefore, Burhanuddin (2012) carries the opinion that the method of the sun crossing give better opportunity for the Muslims to check and determine the direction of *qiblah* at any place as compared to the phenomenon of the sun being right above the Ka'bah which occurs only twice a year. This study is done at the Selangor Observatory.

3.3 Education Institutions for Falak Science

In line with the progress of observatories in Islamic civilization, *astrofiqh* observatories in Malaysia also act as education centers for *falak science*. This is natural since Islam emphasizes on education, including *falak* education (Hassan,

Abiddin & Ahmad, 2011). Numerous activities have been organized by the observatories, be they at the observatory itself or at other locations. The activities received good response and support from the locals and this somewhat helps to advance the progress of *falak* in Malaysia. Organized activities include basic courses in *takwim* (calendar) and *hilal* sighting. Through these courses, in the Islamic calendar course for example, participants are exposed to the introduction of Islamic calendar existing in Malaysia. In addition, participants are also given guidance to the calculation methods of converting Gregorian dates to Hijri dates and vice versa. At the end of the program, the participants are given opportunity to observe *hilal* at sunset.

Al-Munajjid (2009) asserted that basic course in *qiblah* direction determination is run to give exposure to participants on the method of determining *qiblah* direction in theory and practice. In Malaysia, this course is run by experts in *falak*. Through this course, participants are informed of the procedures and guidelines in determining and checking *qiblah* direction in Malaysia. In addition, *astrofiqh* observatories also organize basic course in prayer time calculation. Through this course, participants are exposed to matters related to prayer including the history of commandment of the prayers. Since prayer time is determined based on the movement of the sun, some information related to the sun is also discussed (Niri et al., 2012; Man et al., 2012). Apart from that, participants are also taught how to calculate prayer time using a specific mathematical formula.

Other activities include basic course in *rubu' mujayyab* which introduces the use of traditional astronomical instrument by earlier Muslim scientists (Ali, 2011). Participants are exposed to the use of *rubu' mujayyab* and trigonometry in solving trigonometric equations using the instrument. In addition, several ways of constructing and preparing the instrument are also taught, apart from learning the correct techniques of using it. On top of that, *astrofiqh* observatories also run basic course in telescope operation with the aim of providing the participants with an understanding of the design of telescopes and its advantages, disadvantages and its suitability for use in current conditions. Besides, telescope operating procedures in technical aspects of observation and its correct and complete maintenance are also explained (see Appendix C).

Further activities include night sky gazing program which is run with the objective of showing secrets of the universe and its contents such as the moon, planets and stars to participants. Observing celestial objects is done using stationary or mobile telescopes at night depending on the astronomical phenomena which occur every month. In addition to that, participants of the program are able to directly see and know first-hand the structures of objects in the sky and their movement. Furthermore, eclipse observation program is also organized to explain to the public on the concept of sun and eclipse occurrence. In the program, the structure of the sun and the moon is also studied and understood through their movement using telescopes available at the observatory. Apart from that, the program also explains the types of sun and moon eclipse. Aside from carrying out observation activities, eclipse prayers are also offered among Muslim participants as a gratitude for the blessing bestowed by Allah. After performing the prayer, a sermon is delivered to remind the Muslims to always obey the commands of Allah as stipulated in Islamic teachings. During the time of eclipse, Islam encourages its adherents to do a lot of *zikr* to Allah.

Other activities include seminars and *falak* day celebration. *Astrofiqh* observatories in Malaysia also organize talks and seminars to broadcast information and explanation to the public on the science of *falak* (see Appendix D). Such programs can stimulate public interest and enthusiasm towards the heyday of *falak* in history and Islamic civilization. Through them, the public can get to know the history and development of *falak* as well as famous Islamic scholars in the field. Meanwhile, *falak* day festival is held annually in May to encourage public participation in astronomical activities organized in *astrofiqh* observatories. Activities done on *falak* day among others include quizzes, photography contest, water rocket competition, video shows and exhibition (Bahali, 2006).

3.4 Astrotourism Destination

In tandem with the advancement of *falak*, the role of *astrofiqh* observatories also widens. Apart from playing the role of official *hilal* observation sites, research centers and educational institutions, those observatories also play the role as *falak* tourism destinations. This is an area which can be used to spread information and thereby attract the interest of the public to the discipline of *falak* through the tourism sector. In addition, the role of these observatories in the tourism industry also acts as a source of economy. Tourism activities based on astronomy science and use of observatory equipment facilities are known as astrotourism. Astrotourism is a popular tourism activity in developed countries such as the United States, Japan and European countries. It is more popular during astronomical phenomena such as transit of planets, comet crossing, and sun and moon eclipses (Anonymous, 2000).

Normally, the position of observatory in Malaysia is located on the coastal area. Such area at the same time serves as an interesting tourist destination for the public. Night sky gazing activities require the observers to spend long time and

stay overnight at the observatory. Therefore, the construction of hotels at observatories can assist in improving the role of observatories in the tourism sector. In the United States, there is a hotel known as the *Observer's Inn* which is equipped with an observatory for observation activities. It is located 4500 feet above sea level on a hill in San Diego. In addition, programs in astronomy education are also held at the hotel. The hotel is among the many hotels in developed countries which make astrotourism as a source of economy (Observer's Inn, n.d.). *Astrofiqh* observatories which have managed to penetrate the tourism sector in Malaysia are the Al-Khawarizmi Falak Complex, Melaka and Baitulhilal Complex at Teluk Kemang, Negeri Sembilan (Anonymous, 2010). Both observatories offer visitors staying package of rooms and use of observatory equipment (see Appendix E).

4. Conclusion

The existence of astrofiqh observatories has fortified the role of their institutions as important landmarks in the advancement of falak sciences in Malaysia. Their presence proves that the state governments give much emphasis on matters concerning religious affairs, particularly in the field of falak shar'ie. Moreover, the role of astrofiqh observatories is also expanding. Their role is not merely to administer affairs related to religious matters such as determining the start of Islamic months especially the month of Ramadhan, Syawwal and Zulhijjah only, but also to function as research centers and scientific academic institutions. It is hoped that in the future these observatories can penetrate the market in the area of astrotourism and become well-known throughout the world.

In Malaysia, various measures have been implemented to fulfil shar'ie requirements based on al-Qur'an and al-Sunnah. The use of scientific knowledge, especially in the field of astronomy, has addressed and explained all questions concerning Muslim daily routine requirements in details. Fulfilling these requirements has reinforced the faith and conviction of the Muslim ummah in their religious rituals. All sources of knowledge have been utilized and made the basis in fulfilling Islamic religious commands. The use of such knowledge sources is important so that each deed is carried out in accordance with and based on pre-determined Islamic shari'ah. Various activities such as hilal sighting for the determination of the start of the month, education and research activities are carried out from time to time centered around practical experience and theories. Such activities are done in the hope that they can give help and understanding to the Muslim community in falak-related worship rituals in Malaysia, particularly in the issue of determining qiblah direction, prayer times and the start of fasting month as well as the day of Eid.

Therefore, the responsibility of the State Mufti departments in running the operation of astrofiqh observatory institutions in absolute terms can enhance the advancement of Muslims in Malaysia in the aspects of worship, education and research. The Muslim community can be proud of this positive development as it indirectly can improve the quality of their worship. In fact, astrofiqh observatories in Malaysia can play a role in the tourism sector more progressively with a potential of penetrating international market prospect.

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Appendix A. Official *hilal* sighting sites


Source: www.islam.gov.my Source: www.islam.gov.my

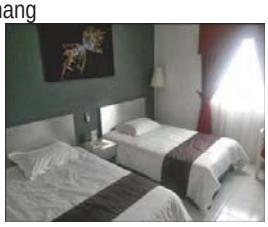
Appendix B. *Hilal* visibility study


***Source*:** www.khawarizmiobs.com

Appendix C. Telescope operation course


Appendix D. Talks and seminars


Appendix E. Hotel facility available at Baitulhilal Complex, Teluk Kemang

Source: http://qulamirulhakim.blogspot.com/ **Source:** http://cubitsanasini.blogspot.com/