CHAPTER II

THE STUDY OF ISLAMIC ASTRONOMY *('ILM AL-FALAK)*

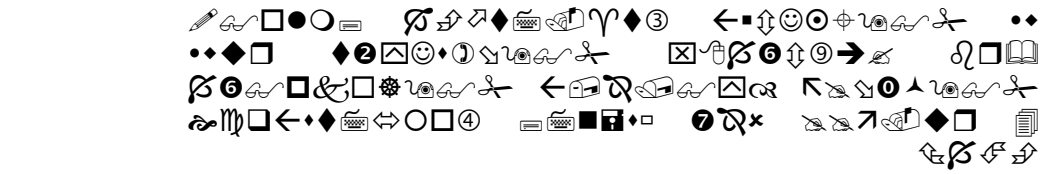
IN INDONESIA

A. The General Description of Islamic Astronomy *('Ilm al-Falak)*

1. The Definition of Islamic Astronomy *('Ilm al-Falak)*

Etymologically, the definition of *Falak* is the path of celestial objects, which is called *orbit*[1] in English. Terminologically, it is the science studying the path of celestial objects, such as Sun, Moon, stars, and others in order to determine the celestial objects' position.[2]

In Holly Quran, word *Falak* used twice, namely in both Chapter Yāsīn verse 40 and Chapter al-Anbiyā' verse 33.



Means: "*It is not for Sun to overtake Moon, nor does the night outstrip the day. They all float, each in an orbit."* (Yasin [36]: 40)[3]

Means: *"And He it is Who has created the night and the day, and Sun and Moon, each in an orbit floating."* (Al-Anbiya [21]: 33)[4]

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[1] Susiknan Azhari, *Ensiklopedi Hisab Rukyat*, Yogyakarta: Pustaka Pelajar, *Ed.* I, 2005, p. 54

[2] Ibid, p. 55

[3] Http://www.dar-us-salam.com/TheNobleQuran/index.html accessed on April 12, 2012

[4] Ibid

In the classical literatures, *'Ilm al-Falak* has some similar words, such as *'Ilm al-Haiah, 'Ilm al-Ḥisāb*[5]*, Ilm al-Rashd*[6]*, 'Ilm al-Mīqāt,* and *Astronomy*. Learning about geometric position of celestial objects to determine the time schedule on Earth is the part of *'Ilm al-Haiah*. Al-Mas'ūdi explained that *'Ilm al-Haiah* had a synonym with a Greek term, namely *Astronomy.*[7] Term *'Ilm al-Haiah* (Astronomy) is often called *'Ilm al-Falak.* However, in the Islamic history, it was more popular than term *'Ilm al-Falak*. Nevertheless, in this modern era, term *'Ilm al-Falak* is more popular than it. It almost lost.[8]

'Ilm al-Falak (Astronomy/*'Ilmu al-Haiah*) is more complex than just studying the geometric position of celestial objects for practical purpose such as determining the times.[9] The last one is just a part of *'Ilm al-Falak.* Muslim scholars in the middle ages called it as *'Ilm al-Mawāqīt* (the science explaining about times). Al-Qalqasyandī (w.821/1418) definined that *'Ilm al-Mawāqīt* examining the prayer times, determining the sacred direction *(Qibla)*, the other directions and positions of a place where is on Earth in the terms of longitude

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[5] *'Ilm al-Falak* is also called *'Ilm al-Ḥisab* (الحساب = calculation) because it uses calculation. Muhyiddin Khazin, *Ilmu Falak dalam Teori dan Praktik*, Yogyakarta: Buana Pustaka, Ed. III, p. 1

[6] *'Ilm al-Falak* is also called *'Ilm al-Raṣd* (الرصد = observation) because it needs an observation. Ahmad Izzuddin, *Ilmu Falak Praktis (Metode Hisab Rukyat Praktis dan Solusi Permasalahannya),* Semarang: Kamala Grafika, 2006, p. 1

[7] Tim Majelis Tarjih dan Tajdid PP Muhammadiyah, *Pedoman Hisab Muhammadiyah*, Yogyakarta: Majelis Tarjih dan Tajdid PP Muhammadiyah, 2009, p. 12.

[8] Ibid

[9] As Slamet Hambali's explanation, that *'Ilm al-Falak* just covers sun, earth, and moon. It just explains about their position because the commands of Islamic worship can not be separated from the time. The time based on the circulation of the celestial objects, especially Sun, Earth, and Moon. Slamet Hambali, *Ilmu falak, Penentuan Awal Waktu Shalat dan Arah Kiblat Seluruh Dunia*, Semarang: Program Pascasarjana IAIN Walisongo Semarang, Ed. I, 2011, p. 2

and latitude by knowledge of the sky, the height, the circulation, the light, and the shadow of celestial objects was a branch of *'Ilm al-Haiah*.[10] He also said that it was the most glorious branch of *'Ilm al-Falak ('Ilm al-Haiah)* according to the Shariah view.[11]

Muslim scholars in the middle ages defined that*'Ilm al-Falak* was a branch of knowledge examining the condition of the celestial objects in the form term, content term, quality term, and motion term.[12] As Ibn Khaldun's definition, it is the study of both the movements and positions of the stars and planets.[13]

In the next era, Muḥammad Aḥmad Sulaimān defined that*'Ilm al-Falak* was a science examining everything related to the universe of celestial objects where was outside of Earth's atmosphere, such as Sun, Moon, stars, the galaxy systems, planets, satellits, comets, and meteors in the origin, movement, physical, and chemical term by using the rules of Mathematics, Physics, Chemistry, and Biology.[14] Therefore, to distinguish *'Ilm al-Falak* in the astronomical sense with *'Ilm al-Falak*, which specially examines the motion of both Sun and Moon for determining the prayer times and the sacred direction is that the last one is called *'Ilm al-Falak Shar' ī.*[15]

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[10] Tim Majelis Tarjih dan Tajdid PP Muhammadiyah, Op. Cit, p. 12
[11] Al-Qalqasyandi, *Ṣubḥ al-A'shā*, al-Maktabah al-Shāmilah 3.8.
[12] Tim Majelis Tarjih dan Tajdid PP Muhammadiyah, Op. Cit., p. 13
[13] Read. Slamet Hambali, *Ilmu Falak, Penentuan Awal Waktu Shalat dan Arah Kiblat Seluruh Dunia*, Loc. Cit
[14] Tim Majelis Tarjih dan Tajdid PP Muhammadiyah, Loc. Cit
[15] Tim Majelis Tarjih dan Tajdid PP Muhammadiyah, Ibid

Recently, *'Ilm al-Falak* is known as *'Ilm al-Ḥisāb al-Ruóyah* because it uses two approaches, namely observational approach *(Ruóyah Approach)* and calculating approach *(Ḥisāb Approach).*[16] Both of them have a mutual symbiosis.[17]

2. The Scope of Islamic Astronomy *('Ilm al-Falak)*

In outline, *'Ilm al-Falak* is divided into two kinds, namely *'Ilm al-Falak al-'Ilmī* (Theoretical Astronomy) and *'Ilm al-Falak al-'Amalī* (Practical Astronomy or Observational Astronomy).[18]

a. *'Ilm al-Falak al-'Ilmy* (Theoretical Astronomy)

'Ilm al-Falak al-'Ilmī (Theoretical Astronomy) is a science discussing about theory and concept of celestial objects in the origin and development aspect (Cosmogony),[19] the form and the set aspects (Cosmology).[20] In addition, it discusses about the circulation description of celestial objects (Cosmography)*;*[21] the size and the distance of celestial objects (Astrometry);[22] the motion and the gravity of celestial objects (Astromechanics);[23] the

[16] Read Ahmad Izzuddin, *Ilmu Falak Praktis* Loc. Cit

[17] Read Ahmad Izzuddin, *Fiqh Hisab Rukyah, Menyatukan NU dan Muhammadiyah Dalam Penentuan Awal Ramadhan, Idul Fitri dan Idul Adha,* Jakarta: Penerbit Erlangga, 2007, p. 46-47

[18] Muhyiddin Khazin, *Ilmu Falak Dalam Teori dan Praktik,* Op. Cit., p. 2. Compare with Ahmad Izzuddin, *Ilmu Falak Praktis,* Op. Cit., p. 2-3

[19] Muhyiddin Khazin, *Kamus Ilmu Falak,* Yogyakarta: Buana Pustaka, Ed. I, 2005, p. 16

[20] Ibid

[21] Ibid

[22] Astrometry is the basis for determination of the coordinate system of Astronomy, both path and motion of the celestial objects. Ibid, p. 9

[23] Ibid

characteristic and element of celestial objects based on Physiccs (Astrophysics).[24]

b. *'Ilm al-Falak al-'Amalī* (Practical Astronomy or Observational Astronomy)

'Ilm al-Falak al-'Amalī (Practical Astronomy or Observational Astronomy) is a science to know the positions of celestial objects by calculation.[25] This science is developed based on observations. Therefore, the observation data, which can correct the Ephimeris' data, is the primary data.[26] People know this as *'Ilm al-Falak* or *'Ilm al-Ḥisāb*.[27]

A consequence of the relation between *'Ilm al-Falak* with Islamic worship is that it only examines the four subjects, namely:[28] determination of the sacred direction *(Qibla)*, prayer times, the biginning of months of Hijri Calender, and eclipses.[29]

1) Determination of the Sacred Direction *(Qibla)*

The purpose of *'Ilm al-Falak* discussing about the determination of the sacred direction *(Qibla)* is to calculate how many degrees the angle, which is flanked beween meridian passing

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[24] Astrophysics is the basis for the emission study received from celestial objects, Ibid, p. 8

[25] Ahmad Izzuddin, *Ilmu Falak Praktis*, Op. Cit., p. 3

[26] Paper *"Pengembangan Kurikulum Ilmu Falak Di PTAI (Belajar Pada Prodi AS Konsentrasi Ilmu Falak IAIN Walisongo)"* presented by Ahmad Izzuddin in the national seminar of development of Islamic astronomy and the meeting of lecturers of Islamic astronomy all over Indonesia held by Shariah Faculty of Walisongo State Institute for Islamic Studies on Tuesday to Wednesday, 2 to 3 of December 2009 in Walisongo State Institute for Islamic Studies, p. 4

[27] Read Ahmad Izzuddin, *Ilmu Falak Praktis*, Loc. Cit. and Muhyiddin Khazin, *Ilmu Falak Dalam Teori dan Praktik*, Op. Cit., p. 4

[28] Muhyiddin Khazin, Ibid, p. 2-3

[29] Tim Majelis Tarjih dan Tajdid PP Muhammadiyah, Loc. Cit

through a place whose sacred direction is counted with the great circle passing through that place and Kabah *(Ka'bah).* In addition, it is to calculate when Sun goes path across Kabah.

2) **Determination of the Prayer Times**

The purpose of *'Ilm al-Falak* discussing about the determination of the prayer times is to calculate the grace period between the times when Sun is in the top culmination point with the time when Sun is in the position indicating the beginning of the prayer times.

3) **Determination of the Biginning of the Months of Hijri Calender**

The purpose of *'Ilm al-Falak* discussing about the determination of the beginning of the months of Hijri Calender is to calculate the time when Sun and Moon are in the same astronomical longitude (*Ijtimā'* or Conjunction) and to calculate where the new moon (*Hilāl*) will be in when Sun sets on the day of that conjunction.

4) **Determination of Eclipses**

The purpose of *'Ilm al-Falak* discussing about the determination of eclipses is to calculate when Moon covers and outs of Sun in the solar eclipse and when Moon begins to enter and gets out from umbra shadow of Earth in the lunar eclipse.

'Ilm al-Falak	
a. 'Ilm al-Falak al-'Ilmī **(Theoretical Astronomy)** 1) Cosmogony 2) Cosmology 3) Cosmography 4) Astrometry 5) Astromechanics 6) Astrophysics	**b. *'Ilm al-Falak al-'Amalī* (Practical Astronomy or Observational Astronomy)** 1) Determination of the Sacred Direction *(Qibla)* 2) Determination of the Prayer Times 3) Determination of the Biginning of the Months of Hijri Calender 4) Determination of Eclipses

Table 2.1: The Scope of Islamic Astronomy *(Ilm' al-Falak)*

B. The Development of the Study of Islamic Astronomy *('Ilm al-Falak)*

1. The Origin of Islamic Astronomy *('Ilm al-Falak)*

A science appears because of the people's responses to the problems existing in society.[30] The consequence is that a science has existed before it is found. Therefore, *'Ilm al-Falak* has existed before it is found.[31]

[30] Ahmad Izzuddin, *Ilmu Falak Praktis*, Op. Cit., p.6
[31] Ibid

Some classical literatures, in such like *al-Khalāṣah al-Wafiyyah* written by KH. Zubair 'Umar al-Jailanī,[32] stated that the first inventor of *'Ilm al-Falak* was Prophet Idris PBUH. [33] Therefore, it can be said that *'Ilm al-Falak* had existed before he found it.

As the historical records, Astronomy of Babylonian was the basis of many astronomical traditions developed by Greek, Ancient India, Sasanid (Persia), Byzantium and Europe.[34] The basis of western's Astronomy was found in Mesopotamia in the clay board form.[35] It is a relic of Sumerians[36] in 3500 – 3000 BC. Ancient Chinese also used Astronomy as a timer in 4000 BC. Thantawi al-Jauhari who was an expert of Astronomy said that the new Astronomy was reintroduced in the 28th century BC. It was used to determine the paganism time.[37]

In 500 BC, Ancient India has known Astronomy. The proof is that Aryabhata discovered the mathematical system of Astronomy based on the rotation of Earth. In addition, Braghmagupta[38] also

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[32] Zubair's statement is confirmed by al-Susy where is in Zubair's book. Zubair 'Umar al-Jailanī, *al-Khalāṣah al-Wafiyyah*, Kudus: Menara Kudus, p. 3-4

[33] Read. Ahmad Izzuddin, *Ilmu Falak Praktis*, Loc. Cit. and Slamet Hambali, *Pengantar Ilmu Falak, Menyimak Proses Pembentukan Alam Semesta*, Banyuwangi: Bismillah Publisher, Ed. I, 2012, p. 238

[34] Read. Rohmat Haryadi, *Ensiklopedia Astronomi, Sejarah Astronomi*, Jakarta: Erlangga, Volume I, 2008, p. 13

[35] Ibid

[36] Slamet Hambali, *Pengantar Ilmu Falak*, Op. Cit., p. 239

[37] As in Egypt, Egyptians used Astronomy as the time determining to worship Orisis, Isis and Amon. While, Babylon used it as the time for determining the worship to Astoroth and Baal, Ibid

[38] Slamet Hambali, *Pengantar Ilmu Falak,* Loc. Cit.

discovered the Algebraic Notation,[39] which could solve the astronomical calculation problem.[40] Ancient Greeks were also interested in Astronomy. In the 6th century BC, Thales who was an Ancient Greek Astronomer argued that Earth was flat.[41] Because Phytagoras was not satisfied with this opinion, he denied by arguing that the shape of Earth was round like a ball. Aristoteles also reinforced this argument in two centuries later.[42]

Arabs have the knowledge about Astronomy before the advent of Islam. They had an intimate knowledge of Sun, Moon, and the changing night sky throughout the year, as well as the meteorogical phenomena associated with the season.[43] Then, in the Muhammad PBUH's era, Astronomy has not been developed yet. Arab's knowledge about the Astronomy was still limited as a guide in the desert at night. They did not have the sophisticated knowledge about it.[44]

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[39] One of the most important characteristics of Brahmagupta's work is his style of algebraic notation. It is, like that of Diophantus, syncopated algebra. Syncopated algebra uses specialized symbols and abbreviations of words to convey the ideas involved. For instance, Braghmagupta used a dot above a number to indicate a negative number. To know more bout it, read John Tabak, *Algebra: Sets, Symbol, and the Language of Thought*, New York: Acid Free-Paper, 2004, p. 38-40.

[40] Slamet Hambali, *Pengantar Ilmu Falak, Menyimak Proses Pembentukan Alam Semesta*, Ed. I, 2012, Bismillah Publisher: Banyuwangi, p. 239

[41] Rohmat Haryadi, *Ensiklopedia Astronomi, Sejarah Astronomi*, Op. Cit., p. 16

[42] Slamet Hambali, *Pengantar Ilmu Falak*, Loc. Cit.

[43] David A. King, *Islamic Mathematical Astronomy*, London: Variorum Reprints, 1986, p. 1

[44] Tim Majelis Tarjih dan Tajdid PP Muhammadiyah, Op. Cit., p. 14

Since Sun, Moon, stars, and winds are specifically mentioned in Holy Quran, there was considerable interest in the heavens, both in the early Islamic community of the Hejaz.[45] During the millenium, which followed the introduction of a far more sophisticated mathematical Astronomy from Indian, Sasanian and Hellenistic sources to the vigorous cultural scene of Abbasid Iraq in the eighth and ninth centuries, Muslim scholars made substantial contributions to all aspect of Astronomy, spherical astronomy, timekeeping, instruments, and astrology.[46]

In that time, Muslim scholars began to translate some texts from India, Persia, and Greece, such as *Surya Siddhanta*, which is an Indian script written by Aryabhata (476-550 AD). It was translated by Muḥammad al-Farāzi and Ya'qūb ibn Ṭarīq in 777 AD under the title *al-Sindhind Zaij*.[47]

Furthermore, the Astronomy grew so rapidly in the Islamic culture and finally it became stagnant. Donald Rutledge Hill who was a science historian divided the history of Islamic Astronomy into four periods as below:[48]

a. Period I (700-825 AD) is the assimilation period for the integration beginning of Greek Astronomy, Indian Astronomy, and Sassanid Astronomy (Persia).

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[45] David King, *Islamic Mathematical Astronomy*, Loc. Cit.
[46] Ibid
[47] Rohmat Haryadi, *Ensiklopedia Astronomi, Sejarah Astronomi,* Op. Cit., p. 20
[48] Ibid

b. Period II (825-1025 AD) is the large-scale investigation, acceptance and modification system of Ptolemy.

c. Period III (1025-1450 AD) is the advancement of the Islamic Astronomy system.[49]

d. Period IV (1450-1900 AD) is a stagnation period.

2. The Treasury of Islamic Astronomy *('Ilm al-Falak)*

A massive effort to translate the Greek works into Arabic has become the beginning of the growing treasury of Islamic Astronomy *('Ilm al-Falak).* It engendered a great effort of the Muslims to research, to digest, and to make some corrections to these Greek works. Therefore, they could discover any new discoveries being the treasury of sciences, including Islamic Astronomy.

Those treasuries of Islamic Astronomy divided into four categories, namely instrumental category, observational category, theoretical category, and category for the religious purposes.

a. Instrumental Category

The achievement of the more accurate astronomical data is from not only the expertise of the observers but also the quality of the observational instruments.

[49] The supporting factor of the Islamic Astronomy's growth is Mulism scholars close to the countries, which had many educated people, such as Greek, India, and Sasanid (Persia). Ibid

Astrolabe[50] was an important calculation instrument in the beginning of Renaissance. It is a refinement form of the Greek astrolabes found in the second century BC.[51] It can be used to measure the celestial objects position on the celestial sphere by the simplest form.[52] It consists of a scout hole and two plates with the degrees scale. Both of them are placed in such a way to find out how many degrees the altitude and azimuth of a celestial object.

Astrolabe has many types. They are Persian Astrolabe (12th Century) marked Ḥamīd ibn Ḥamīd Maḥmūd al-Isfaḥāni, Persian Astrolabe (18th Century) made by Ḥasan Muḥammad Khalīl, Spanish Astrolabe (14th Century) signed by Aḥmad ibn Ḥusain ibn Baso, Universal Astrolabe made by Aḥmad ibn al-Sarrāj in 1328 – 1329 AD. In addition, there are Spherical Astrolabe (15th Century) signed "Work of Mūsā, year 885", An Exquisitely Detailed Astrolabe Mater (17th Century) signed "Decorated by the rich (in God), the servant, the son of Muḥammad Amīn, Muḥammad Mahdi al-Yazdī," and An Astrolabe with a Date Converter-Detail (18th Century) maked by Muḥammad ibn Aḥmad al-Battūti.[53]

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[50] Astrolabe word comes from the Greek, namely *Astro* (star) *Labio* (the distance measuring). Susiknan Azhari, *Ensiklopedi Hisab Rukyat,* Op. Cit., p. 28

[51] Howard R. Turner, *Science in Medieval Islam: An Ilustrated Introduction,* Texas: University of Texas Press, Ed. II, 2002, p.88

[52] Iratius Radiman, *Ensiklopedi Singkat Astronomi dan Ilmu yang Bertautan*, ITB Bandung: Bandung, Volume IX, 1980, p. 6

[53] To know more detail about the functions of those astrolabes, read Howard R. Turner, Op. Cit., p. 91-97

b. Observational Category

The Muslims regularly started to observe the celestial objecs after they had done the initial expansion. In eighth Century AD, Abū Ja'far Muḥammad ibn Mūsā al-Khawarizmi who was a cheaf of al-Ma'mun Observatory successfully repaired the astronomical data where is from the *Sindhind* translation by arranging the table of logarithms.

Nasiruddin Muḥammad al-Ṭūsi was a Muslim astronomer who not only observed the celestial objects regularly in the observatorium in Maragha because of Hulagu's command but also made *Jadāwil al-Kāniyān,* which is some astronomical data tables of the celestial objects.[54]

Ibn Jabr al-Battani could determine the slope of Sun's motion, the length of the sidereal and tropical year, the seasons, and the function of Sine in his research at the al-Raqqah Observatory, Baghdad.[55] He also popularized the trigonometric terms including Tangent and Cotangent[56] through a Gnomon.[57]

[54] Muhyiddin Khazin, *Ilmu Falak dalam Teori dan Praktek,* Op. Cit., p. 26
[55] Ibid
[56] Ibid
[57] Gnomon is a tool used to determine the height of Sun. It is made from a piece of wood, which is perpendicular to the horizontal plane. The length of the wood has already known, so the high angle of Sun can also be known. Muhyiddin Khazin, *Kamus Ilmu Falak,* Op. Cit., p. 27

The other Muslim astronomer is Ulugh Beik. He arranged the astronomical data tabel used on the next development of Islamic Astronomy.[58]

c. Theoretical Category

Ptolomy's Geocentric Theory has dominated the Muslim astronomers's thought until in 16th Century AD. The Geosentric Theory could not explain some of the commonly observed phenomenon such as the size variation of some planets, and the retrograde motion of planets. Therefore, Ptolomy fixed the epicycle mechanism by adding Equant, which is the mathematical concept to account the motion of celestial objects. It made the Ptolomy's thought dominated the Muslim astronomers's thought until 16th Century AD.

Although Ptolomy's thought was still regarded as the truth until 16th Century AD, but in the 14th Century AD, Ibn Shaṭir has offered a new view assuming that Sun is the center of the solar system. This innovation was the great step of Muslims in Astronomy.[59]

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[58] This astronomical data is still used in Indonesia. The proof is that Ministry of Religious Affairs of Indonesia still uses some *'Ilm al-Falak* books whose the astronomical data based on Ulugh Beik's astronomical data, such as *Sullam al-Nayyirain fī Ma'rifat al-Ijtima' wa al-Kusufain* written by Muḥammad Manṣūr ibn 'Abdulḥamīd Damiri al-Batawī and *Fatḥ al-Rauf al-Mannān* written by Abu Ḥamdān 'Abduljalīl ibn 'Abdulḥamīd al-Quds. Ahmad Izzuddin, "Melacak Pemikiran Hisab Rukyah Tradisional (Studi Atas Pemikiran Muhammad Mas Manshur al-Batawi)," Individual Research, Semarang, IAIN Walisongo, p. 43

[59] Wahyu, *99 Ilmuwan Muslim Perintis Sains Modern*, Yogyakarta: DIVA Press, Ed. II, 2011, p. 333-334

d. Category for the Religious Purposes

In order to meet the administrative and communication needs, Muslims created the Islamic calendar because of their more extensive territories. Therefore, the caliphate who ruled in 7th Century created a new calendar based on Moon's cycles by new system, which is different from the Gregorian Calender and Julian Calender. This new calendar is started on the first day of Prophet Mumammad PBUH's *Hijrah* from Mecca to Medina.[60]

3. The History of the Study of Islamic Astronomy *('Ilm al-Falak)* In Indonesia

As part of Islamic worship, the existence of Islamic Astronomy in Indonesia can not be separated from the advent of Islam to Indonesia. The early development history of Islamic Astronomy in Indonesia is since the enactment of the Islamic Javanese Calender System (*Sistem Kalender Jawa Islam*). It is the comibnation result of Soko and Hijri Calendar. In 1043 AH/1633 AD/1555 *Soko*[61], Sultan Agung created the new calendar (Islamic Java Calendar) whose both year continues the Calendar Soko and calculation base bases on the Hijri Calendar's calculation base.

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[60] Muhyiddin Khazin, *Ilmu Falak Dalam Teori dan Praktik*, Op. Cit., p. 110

[61] *Tahun Soko* or *Tahun Hindu Jawa* is the year whose calculation based on the course of Sun. This year is from the calendar that created by Maharaja Kaneskha of Sakha Tribes in North India. To know more detail ebout it, read Muh. Choeza'i Aliy, *Pelajaran Hisab Isthilah, Untuk Mengetahui Penanggalan Jawa Islam, Hijriyah dan Masehi*, Semarang: Ramadhani, Ed. I, 1977, p. 6-10. Read also Shofiyulloh, *Mengenal Kalender Lunisolar Di Indonesia*, Malang: Pondok Pesantren Miftahul Huda Mojosari, Ed.II, 2006, p. 18-33

According to Dr. H. Ahmad Izzuddin's opinion that *'Ilm al-Falak* entered to Indonesia through two ways, namely through the experts of Islamic law and Europeans (Dutchmen).[62] As a guide of the Islamic worship, *'Ilm al-Falak* entered to Indonesia through the experts of Islamic law whereas, as an astronomical science, it entered to Indonesia through Europeans (Dutchmen). In the next development, it develops through the combination of them.

a. The Development of the Study of Islamic Astronomy *('Ilm al-Falak)* as a Guide for Islamic Worship

As a guide for Islamic worship, *'Ilm al-Falak* entered to Indonesia through the experts of Islamic law. It can be seen from the Islamic Astronomy's study method taught under the Islamic law framework, such as in Islamic boarding schools, Islamic schools *(madrasah),* and colleges of Islamic religion (PTAI) having Shariah faculty. Generally, It divided into two classifications, which are Islamic Astronomy *('Ilm al-Falak)* influenced by Ulugh Beik's astronomical data and Islamic Astronomy *('Ilm al-Falak)* influenced by the books of Islamic Astronomy, namely *Maṭla' al-Sa'īd fī Ḥisāb al-Kawākib 'alā Rashd al-Jadīd* and *al-Manāhij al-Ḥamīdiyyah.*

[62] Paper "*Pengembangan Kurikulum Ilmu Falak Di PTAI,* Op. Cit., p. 3

1) The Development of the Study of Islamic Astronomy *('Ilm al-Falak)* Influenced by Ulugh Beik's Astronomical Data

After Muslim scholars went home to Indonesia from studying *(Ṭalab al-'Ilmī)* in the Middle East, this development began to appear.[63] They began to study in the Middle East since 17th Century. They are Nūruddīn al-Rāniri (death. 1068 H/1658 M), 'Abdurra'uf al-Sinkili (1024-1105 H/1615-1693 M) and Muḥammad Yūsuf al-Maqashari (1037-1111 H/1627-1701).[64] Then in 18th Century, some Muslim scholars also followed them. They are 'Abdulṣamad[65] (1704-1788), Muḥammad Arshad al-Banjarī (1122-1227 H/1710-1812 M), 'Abdurraḥman al-Miṣrī[66] al-Batawi, Muḥammad Nāfis ibn Idrīs ibn Ḥusain al-Banjarī

[63] Ahmad Izzuddin, "Melacak Pemikiran Hisab Rukyah Tradisional", Op. Cit., p. vi

[64] Azyumardi Azra, *Jaringan Ulama Timur Tengah dan Kepulauan Nusantara Abad XVII dan XVIII (Edisi Revisi)*, Jakarta: Prenada Media, Ed. I, 2004, p. 197, 228 and 259

[65] According to Malay's sources that his full name is 'Abdulṣamad Ibn 'Abdullah al-Jawī al-Palimbanī, but according to Arabic sources that his full name is Sayyid 'Abdulṣamad Ibn 'Abd ulraḥman al-Jawī. To know clearly about the reasons why he has the different name, read Azyumardi Azra. Ibid, p. 304-314

[66] 'Abdurraḥman added his last name with al-Miṣhrī after he went to Cairo with Muḥammad Arshad and 'Abdulṣamad. They went to Cairo after they finished their study in Mecca for about 30 years. In fact, the purphose of this visiting is to study there because they thought that they did not have enough knowledge, which they would transfer for people where were in their country. However, Aṭa'Allah al-Miṣhrī who was their teacher in Mecca suggested them to go back to their country because he considered having more than enough knowledge. Therefore, they still decided to go to Cairo. Then, 'Abdurraḥman added his last name with al-Miṣhrī because of as a sign of both good relations with Aṭa'Allah al-Miṣhrī. In addition, it was a proof that he has ever visited Cairo. Ahmad Fadli HS, *Ulama Betawi (Studi Tentang Jaringan Ulama Betawi dan Kontribusinya Terhadap Perkembangan Islam Abad Ke-19 dan 20)*, Jakarta: Manhalun Nasyi-in Press, Ed. I, 2011, p. 6

(born in 1148 H/1735 M)[67] and Dawūd ibn ‘Abdullāh ibn Idrīs al-Fatani[68] (1153-1182 H/ 1740-1768 M).

In the Middle East, they studied *‘Ilm al-Tafsīr, ‘Ilm al-Fiqh, ‘Ilm al-Tauḥīd,’Ilm al-Tasawwūf,* and *‘Ilm al-Falak.* After they went home to Indonesia, they applied their knowledge. For example, After Muḥammad Arshad al-Banjarī went home to Indonesia in 1186 AD / 1773 H, he corrected the sacred direction *(Qibla)* of Jembatan Lima Mosque in Betawi, Jakarta on Mey 7, 1772 AD (Ṣafar 4, 1187 H)[69]. The other example is that after ‘Abduraḥman al-Batawi went home to Indonesia in 1186 AD / 1773 H, he also suggested to correct the sacred direction *(Qibla)* in Palembang in 1800 AD.[70]

There are Muslim scholars studying in the Middle East transferred their knowledge to Indonesian people after they went home to Indonesia. For example, Syekh ‘Abdurraḥman ibn Aḥmad al-Miṣrī taught *‘Ilm al-Falak* to the young scholars by introducting the Ulugh Beik’s Astronomical data called *Ulugh Beik’s Zaij.* His students were Aḥmad Dahlan al-Samāranji and

[67] To find out the involvelment of Muḥammad Nāfis ibn Idrīs ibn Ḥusain al-Banjarī in the Indonesian scholars network, read Azyumardi Azra, Ibid, p. 320

[68] According to Azyumardi Azra’s version, He was the most famous Patani’s scholar. He was not both the first and the only Patani’s scholar involved in the Indonesian scholars’ network. ‘Alī ibn Isḥāq al-Fatanī and Muḥammad ṣāliḥ Ibn ‘Abdurraḥman Al-Fatani was earlier than he. Although they were contemporaries, Dawud was the youngest of them, Ibid, p. 327

[69] Susiknan Azhari, *Ensiklopedi Hisab Rukyat,* Op. Cit, p. 145

[70] Azyumardi Azra, Op. Cit, p. 304-314

Sayyid ‘Uthmān.[71] In addition, ‘Abdulḥamīd ibn Muḥammad Damirī[72] was also his student.[73]

Next, Aḥmad Dahlan al-Samāranji, Sayyid ‘Uthmān and ‘Abdulḥamīd ibn Muḥammad Damirī transferred their knowledge to their students and they made the Islamic Astronomy books. Aḥmad Dahlan not only taught his students which one of them was KH. Aḥmad Dahlan (the founder of Muḥammadiyyah Social Organization)[74] but also made the Islamic Astronomy book entitled *Tadzkirah al-Ikhwān fī ba’ẓ Tawārikh wa al-A’māl al-Falakiyyah bi Samāranji.*[75] Ḥabib ‘Uthman taught *‘Ilm al-Falak* in Jakarta and he made the book entitled *Īqādz al-Niḍām fīmā Yata’allaq bi al-Ahillah wa al-Ṣiyām.*[76] This book is not the Islamic Astronomy book but it related to Islamic Astronomy.[77]

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[71] Ibid

[72] He is Muḥammad Manṣūr ibn ‘Abdulḥamīd Damiri al-Batawī’s father. Read Muḥammad Manṣūr, *Mīzān al-I’tidāl*, Jakarta: al-Manṣūriyyah, p. 18. Also, read Muḥammad Manṣūr, *Sullam al-Nayyirain fī Ma’rifat al-Ijtima’ wa al-Kusufain,* Jakarta: al-Manṣūriyyah, p. 3. In addition, read Ahmad Fadli HS, *Ulama Betawi,* Op. Cit. p. 13

[73] Read Muḥammad Manṣūr, *Sullam al-Nayyirain,* Ibid. Also, read Ahmad Izzuddin, “Melacak Pemikiran Hisab Rukyah Tradisional”, Op. Cit., p. 32

[74] His first name was Muḥammad Darwis. He was born in Kampung Kauman, Yogyakarta in 1868 AD / 1285 H. He died on February 23, 1923 AD / Rajab 7, 1342 H. His Islamic Astronomy teachers were Aḥmad Dahlan al-Samāranji, Ṣāliḥ Darat (Semarang), Syekh Muḥammad Djamil Djambek and Syekh Muḥammad Khātib Minangkabau. To know more about Aḥmad Dahlan, read Susiknan Azhari, *Ensiklopedi Hisab Rukyat,* Op. Cit., p. 8

[75] It has done to be written on *Jumādī al-Akhīr* 28, 1321 H / September 21, 1903 AD. This book contains the calculation of both the conjunction and eclipses based on the astronomical data of Semarang. Muhyiddin Khazin, *Kamus Ilmu Falak,* Op. Cit., p. 98

[76] This book had been reviewed before *Sullam al-Nayyirain* book existed. Nevertheless, its calculation model is almost same as calculation model of *Sullam al-Nayyirain.* The difference is just on the new moon's first visibility criterion. If this book uses the criterion below 7°, *Sullam al-Nayyirain* explains that it is not possible to be observed. Read Muḥammad Manṣūr, *Mīzān al-*

‘Abdulḥamīd ibn Muḥammad Damirī also taught *‘Ilm al-Falak* to the young scholars in Betawi. One of his students was Muḥammad Manṣūr ibn ‘Abdulḥamīd Damirī al-Batawī. Although ‘Abdulḥamīd did not make Islamic Astronomy book, his student made it. Muḥammad Manṣūr made Islamic Astronomy book entitled *Sullam al-Nayyirain fī Ma’rifat al-Ijtima’ wa al-Kusufain.* [78] This book uses the Ulugh Beik’s astronomical data, which has been summarised by his father who is ‘Abdulḥamīd ibn Muḥammad Damirī.[79]

Because of the large influence of this book, Muḥammad Manṣūr is considered as the Indonesian pioneer[80] using the Ulugh Beik’s astronomical data.[81] Ulugh Beik’s astronomical data was also used by other experts of Islamic Astronomy in their masterworks, such as Aḥmad Dahlan al-Samāranji uses it in *Tadzkirah al-Ikhwān*, Abū Ḥamdān ‘Abduljalīl ibn

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I’tidāl, Loc. Cit. Also, read Ahmad izzuddin, “Melacak Pemikiran Hisab Rukyah Tradisional”, Op. Cit., p. 34

[77] Muhyiddin Khazin, *Ilmu Falak Dalam Teori dan Praktik*, Loc. Cit

[78] It was written by Muḥammad Manṣūr ibn ‘Abdulḥamīd Damiri al-Batawī as the result of his study with Ḥabib ‘Uthman. This book was first published in 1344 H / 1925 AD by Borobudur Printing, Batavia. Ibid, p. 30

[79] Muḥammad Manṣūr, *Sullam al-Nayyirain*, Loc. Cit

[80] The proof is that *Sullam al-Nayyirain* is still used as the reference book to determine the beginning of *Qamariyah* months by not only Indonesian Muslims community, such as al-Manṣūriyyah al-Khairiyah Foundation, and Islamic boarding school of Ploso, Mojo, Kediri but also Ministry of Religious Affairs. Read Ahmad Izzuddin, “Melacak Pemikiran Hisab Rukyah Tradisional”, Op. Cit., p. 42

[81] Geosentrik is an earth-centered view. Geosentrik position is the celestial objects’ position, which originates in the center of Earth in the coordinate system. Meanwhile Geosentrik Universe is the Ptolomaic Geosentric Universe, which assumes that Earth is the center of the universe. Read Iratius Radiman, *Ensiklopedi Singkat Astronomi dan Ilmu Yang Bertautan*, Op. Cit., p. 35

‘Abdulḥamīd al-Quds uses it *Fatḥ al-Rauf al-Mannān*, ‘Abdulfatḥ al-Sayyid al- Ṭūfī uses it in *al-Qawā’id al-Falakiyyah*, Anwār Kathīr al-Malanjī uses it in *al-Syamsu wa al-Qamar*. In addition, Qushairi al-Pasuruanī uses it in *Jadwal al-Falakiyyah*, Nawāwī Muḥammad Yūnusi al-Kadirī uses it in *Risālah al-Qamarain*, and Ramli Ḥasan al-Grisikī uses it in *Risālah al-Falakiyyah*. These Islamic Astronomy books are classified into *Ḥisāb Ḥakīkī Taqrībī*[82]

Syekh Ṭāhir Jamaluddin al-Azhari is also a famous expert of Islamic Astronomy in this period.[83] He made many Islamic Astronomy books. They are *Pati Kiraan Pada Menentukan Waktu Yang Lima, Natījah al-Ummi (the al-Manac: Muslim and Christian Calender and Direction of Qibla According to Shafie Sect), Jadāwil al-Nukhbah al-Taqrīrāt fī Ḥisāb al-Auqāt wa Simt al-Qiblah* and *Mathematical Tables.*[84]

[82] This classification based on the result of “Seminar Sehari Hisab Rukyah” on April 27, 1992 in Tugu Bogor. Read Ahmad Izzuddin, *Ilmu Falak Praktis*, Op. Cit., p. 135-136

[83] Harun Nasution, *Ensiklopedi Islam Indonesia*, Jakarta: Djambatan, Ed.I, 1992, p. 324

[84] Susiknan Azhari, *Ensiklopedi Hisab Rukyat*, Op. Cit., p. 146

2) The Development of the Study of Islamic Astronomy *('Ilm al-Falak)* Influenced by the Books Entitled *Maṭla' al-Sa'īd fī Ḥisāb al-Kawākib 'Alā Rashd al-Jadīd* and *al-Manāhij al-Ḥamīdiyyah.*

In this period, many *Ilmu Falak* books are influenced by *Maṭla' al-Sa'īd fī Ḥisāb al-Kawākib 'Alā Rashd al-Jadīd* written by Ḥusain Zaid al-Miṣrā and *al-Manāhij al-Ḥamīdiyyah* written by Abdulḥamīd Murshī Gaish al-Falakī al-Syhafi'ī. Both of these books were brought to Indonesia by people who both did *Ḥaji* (one of the Muslims obligations where is done in Mecca) and studied in Mecca. M. Taufik[85] argued that most Islamic Astronomy books written in this period imitated these books.[86]

In this period, Zubaer 'Umar al-Jailani is considered as the Indonesian pioneer using the astronomical data based on heliocentric principle[87] in his book entitled *al-Khalāṣah al-Wafiyyah.*[88] This book is the result of his study in Mecca for five

[85] Taufik is an expert of Islamic Astronomy. He was Director of Rukyat Hisab Agency (BHR). Ahmad Izzuddin, "Zubaer Umar Al-Jaelani," Op. Cit. p. 47

[86] Ibid, p. 47-48

[87] Heliocentric principle is a view that Sun is the center of the celestial objecs' circulation in the solar system. Read Muhyiddin Khazin, *Kamus Ilmu Falak,* Op. Cit., p. 28.

[88] This book contains the history of astronomy, include the geocentric view and the heliocentric view, Gregorian Calender, Hijri Calender, Islamic Javanese Calender, the calculation of planets' position, *Pronoto Mongso* calculation, and the calculation of prayer times, the sacred direction *(Qibla),* eclipses based on the astronomical data of Mecca. This book was published in 1935 AD by Melati Printing, Solo. Then, it was published by Menara Kudus on 1955 AD. Slamet Hambali, *Pengantar Ilmu Falak,* Op. Cit., p. 292

years (1930-1935 AD).[89] In addition, Muḥammad Wardan Diponingrat also uses the astronomical data based on heliocentric principle in his book entitled *Hisab Urfi dan Hakiki.* Both Muḥammad Wardan and Zubair 'Umar al-Jailanī use the astronomical data where is in *al- Maṭla' al-Sa'īd.*[90] If *al-Khalāṣah al-Wafiyyah* uses Arabic Language and astronomical data of Mecca, *Hisab Urfi dan Hakiki* uses both Indonesian language and astronomical data of Yogyakarta. The development embryo of *Ḥisāb Ḥakīky Taḥkīki* comes from both of them.[91]

In the next development, many Islamic Astronomy books imitate from both *al-Khalāṣah al-Wafiyyah* and *Hisab Urfi dan Hakiki.* Some books, which imitate from *al-Khalāṣah al-Wafiyyah* are *N*ūr *al-Anwār,* which uses the astronomical data of Jepara written by Abū Saif al-Mujāb Nūr Aḥmad, *al-Maksūf* written by Aḥmad ṣāliḥ Maḥmūd Jauharī and *Kalender Menara Kudus* written by Turaiḥān al-Juhrī al- Sharofī.[92] While *Hisab*

[89] His Islamic Astronomy teacher in Mecca was '*Umar Ḥamdān* by reviewing both *Maṭla' al-Sa'īd* written by Ḥusain Zaid al-Miṣrā and *al-Manāhij al-Ḥamīdiyyah* written by Abdulḥamīd Murshī. Both of them are the modivication result of *Tabril Magesty* based on Geosentric principle. Ibid, p. 63

[90] Muhyiddin Khazin, *Kamus Ilmu Falak*, Op. Cit., p. 117 dan 119

[91] Ahmad Izzuddin, "Zubaer Umar Al-Jaelani", Op. Cit., p. 70

[92] Ibid, p. 70-71

Urfi dan Hakiki is imitated by experts of Islamic Astronomy of Muhammadiyah group, such as *Saadoeddin Djambek.*[93]

b. The Development of the Study of Islamic Astronomy *('Ilm al-Falak)* as an Astronomical Science

As an astronomical science, Islamic Astronomy *('Ilm al-Falak)* entered to Indonesia through Europeans (Dutchmen). Bosscha Observatory, which was built in 1932 AD, is the proof of this.[94] Pieter Dirkszoon Keyser and Frederick de Houtman were experts of Astronomy from Dutch and the first sailor who could get in Indonesia in the last of 16th Century.

In 1765 AD, Johan Maurits Mohr who was a Dutch missionary could build his private observatory in Batavia. On June 3, 1769 AD, he could observe the transit of Venus[95] with the amazing result.[96] Unfortunately, this observatory has been broken in 1780 AD and it has gone to pot in 1812 AD.[97]

This Islamic Astronomy type rapidly developed because of the existence of Bosscha Observatory in Lembang, West Java. In order to develop Astronomy in Nederlandsch-Indische, "Nederlands-Indische Sterrenkundige Vereeniging" (NISV)

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[93] Ibid

[94] Makalah Ahmad Izzuddin, *Pengembangan Kurikulum Ilmu Falak Di PTAI*, Op. Cit., p. 3

[95] Transits of Venus are emong the rarest of predictable astronomical phenomena. They occur in a pattern that repeats every 243 years. To know more about it, access http://en.wikipedia.org/wiki/Transit_of_Venus accessed on April 12, 2012. In addition, to know their story, you can access http://www.transitofvenus.nl/history.html accessed on on April 12, 2012.

[96] Ibid

[97] Ibid

decided to build an observatory in Indonesia in its first meeting.[98] Because of the benignity of Karel Albert Rudolf Bosscha who was a tea planter in Malabar to be first benefactor, Bossca Observatory has built successfully. The name of this observatory took his last name (Bosscha) because it is as an appreciation for him.[99]

After Indonesia got independence, Bandung Institute of Technology (ITB) opened the formal astronomical education officially. Then, government of Indonesia entrusted Bosscha Observatory fully to Faculty of Mathematics and Natural Sciences of Bandung Institute of Technology.[100]

State institution, which is actively involved to develop Astronomy in Indonesia, is National Institute of Aeronautics and Space (LAPAN) Indonesia. LAPAN was established on November 27, 1963 by Presidential Decree 236. In the process, it engaged in aerospace technology and utilization of atmospheric science, climate, and space.

In order to develop astronomy in Indonesia, the government of Indonesia established not only formal institutions but also informal institutions of Astronomy. In 1968, the government of

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[98] Adriana Wisni Ariasti, dkk, *Perjalanan Mengenal Astronomi*, Bandung: ITB Bandung, 1995, p. 8

[99] Ibid

[100] Bosscha Observatory took shelter under Nederlands Indische Sterrenkundige Vereeniging (NISV) since 1923 to 1949, and then it took shelter under Japan since 1942 to 1945. Next, it takes shelter under Natural Sciences Faculty of University of Indonesia in 1947. Finally, it has been managing by Faculty of Mathematics and Natural Sciences of Bandung Institute of Technology (ITB) since 1951, Ibid

Indonesia inaugurated the Planetarium of Jakarta. Since then, it becomes a beacon in the introduction of Astronomy to the public in the capital of Indonesia.

That government policy was welcomed by the lovers of Astronomy. The proof is that they established the Indonesian Astronomical Society (HAI) in 1977 AD. Then in 1984, they also established Jakarta Amateur Astronomers Association (HAAJ).

In addition, many Indonesian astronomers are involved in the astronomical activites in the world, such as Prof. Dr. Bambang Hidayat, Prof. Ahmad Baiquni, MSc, PhD, Dr. Djoni N Dawanas, Dr. Moedji Raharto and Dr. Thomas Djamaluddin.[101] Therefore, *'Ilm al-Falak* as the astronomical science not only has grown rapidly in Indonesia but also has gained recognition at the international level.

c. The Development of the Study of Islamic Astronomy *('Ilm al-Falak)* as the Comibnation Between *'Ilm al-Falak* as A Guide for Islamic Worship with *'Ilm al-Falak* as An Astronomical Science

The developmnent of *'Ilm al-Falak* in this period tries to combine between *'Ilm al-Falak* as a guide to Islamic worships and *'Ilm al-Falak* as an astronomical science.

[101] Ahmad Izzuddin, "Zubaer Umar Al-Jaelani," Op. Cit., p. 56

Saadoe'ddin Djambek is regarded as an astronomer pioneer in this period. Even, he is regarded as a reformer in *'Ilm al-Falak.*[102] Susiknan Azhari explains in his thesis that Saadoe'ddin is both a modernist and a reformer in *'Ilm Ḥisāb.* He tried to combine between the traditional *'Ilm al-Falak* and the modern *'Ilm al-Falak,* so his astronomical data was always up to date.[103]

Saadoe'ddin tried to develop a new calculation system of *'Ilm al-Falak* as a guide for Islamic worship by introducing the Spherical Trigonometry Theory.[104] It was happen because he had both the knowledge of *'Ilm al-Falak* as a guide for Islamic worship and the the knowledge of *'Ilm al-Falak* as an astronomical science. Based on this theory, he tried to construct some *'Ilm al-Falak* theories, such as the theory of determining the sacred direction *(Qibla)* using Sun's shadow, the prayer times theory, and the theory of determining the beginning of *Qamariyah* months.[105]

Saadoe'ddin's system is easier and more modern. Moreover, its calculation prosedure can use a calculator. By calculator, students who do not have the basic science can both find out the geometry functions of an obtuse angle and calculate them to the most decimal places easily.[106] Because this system is

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[102] Slamet Hambali, *Pengantar Ilmu Falak*, Op. Cit., p. 294

[103] Susiknan Azhari, *Pembaharuan Pemikiran Hisab di Indonesia, Studi atas Pemikiran Saadoe'ddin Djambek*, Yogyakarta: Pustaka Pelajar Offset, Ed. I, 2002, p. 100

[104] Ibid, p. 50

[105] Ibid

[106] Ibid, p.51

considered as the most suitable astronomical system with the development of modern science, the *'Ilm al-Falak* syllabuses of Shariah Faculties of State Institute for Islamic Studies all over Indonesia use this system.[107]

The influence of the developed countries's astronomical data, such as United States's Nautical Almanac and Soviet Union's Ephimeris, which have the higher accuraty than the astronomical data that have already existed in Indonesia, gave Saadoe'ddin initiative to use these astronomical data in Islamic Astronomy. The proof is that in his book entitled *Hisab Awal Bulan Qamariyah,*he explains how to calculate the beginning of the *Qamariyah* months based on Nautical Almanac and basic formula of spherical triangle.[108]

Although at that time the calculation of astronomy has achieved the high accuracy, but the calculation steps was too long. In addition, the data of Nautical Almanac was only published every year and sometimes its publication was late. Therefore, in 1993, Drs. H. Taufiq and his son set up the astronomical data software and it was funded by Departmen of Religious Affairs (now it is Ministry of Religious Affairs). This software's name is *Hisab for Windows Version 1.0,* which has the similar result to Nautical

[107] Ibid
[108] Muhyiddin Khazin, *Ilmu Falak Dalam Teori dan Praktik,* Op. Cit., p. 35

Almanac.[109] In 1998, it was enhanced by both the name *WinHisab Versi 2.0* and licensing rights to Departmen of Religious Rukyat Hisab Agency.

In the last development, Islamic Astronomy has given the easy and convenience for its users. The proof is that many softwares circulate in cyberspace, such as *Mawaaqit* programmed by Indonesian Muslim Scholar Association (ICMI) in 1993,[110] *Falakiyah Najmi* programmed by Astronomy Major of Mathematics and Natural Sciences Faculty of Bandung Institute of Technology in 1996, *Badī'ah al-Mithāl Program* programmed by Muhyiddin Khazin in 2000. In addition, there are *Ahillah, Misal, Pengetan* and *Tsaqib* programmed by Drs. Muhyiddin Khazin, M.Si in 2004, *Mawaaqit versi 2002* programmed by Dr. Ing Khafid in 2002, *Al-Miqaat* programmed by Dr. H. Ahmad Izzuddin, M.Ag and Aliq Burhani, ST.

[109] Ibid, p. 36
[110] Ibid, p. 37