THE SOLAR CIRCULATION CONCEPT: COMPARATIVE STUDY OF NICOLAUS COPERNICUS AND FAKHR AL-DĪN AL-RĀZĪ

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Abstract: *This paper highlights how the concept of solar circulation according to Nicolaus Copernicus in On the Revolutions of the Heavenly Spheres Book and Fakhr al-Dīn al-Rāzī in Tafsīr Mafātīḥ al-Ghayb about the concept of solar circulation, and how are the similarities and differences about according to both of them. The study shows that Nicolaus Copernicus and Fakhr al-Dīn al-Rāzī agree that the sun is the center of the solar system, but they differ on three things, for example, Copernicus believes that the sun only stays in its orbit, while Fakhr al-Dīn al-Rāzī convinced that the sun goes around the earth, and so on. This study is library research with the descriptive-analytical method and comparative approach.*

Keywords*: Tafsīr ʿIlmī; Solar Circulation; Heliocentric; Copernicus; al-Rāzī.*

Abstrak: *Studi ini merupakan studi komparatif antara Nicolaus Copernicus dalam buku On the Revolutions of the Heavenly Spheres dan Fakhr al-Dīn al-Rāzī dalam Tafsīr Mafātīḥ al-Ghayb tentang konsep peredaran matahari: menyangkut persamaan dan perbedaan keduanya. Penelitian ini merupakan penelitian kepustakaan dengan metode deskriptif-analitis. Studi ini menunjukkan bahwa Nicolaus Copernicus dan Fakhr al-Dīn al-Rāzī menyepakati bahwa matahari adalah pusat tata surya, tetapi mereka berbeda pendapat dalam tiga hal, misalnya Copernicus percaya bahwa matahari hanya berada pada orbitnya, sedangkan menurut Fakhr al-Dīn al-Rāzī meyakini matahari mengelilingi bumi, dan lain-lain. Studi ini adalah studi kepustakaan dengan pendekatan komparasi dan analisis deskriptif.*

Kata Kunci*: Tafsīr ʿIlmī; Peredaran Matahari; Heliosentris; Copernicus; al-Rāzī.*

Introduction

The Quran as the main authority in Islam is considered that the universe and its contents are not the independent reality and the ultimate, but it becomes the sign verses.[1] This makes *mufassir* (the interpreter of the Quran) interested in interpreting the verses, one of which is the *kawnīyah* (the verse of the Quran that explains the sign of Allah in the universe), and the other is *tafsīr ʿilmī,* one of the kinds of the Quran interpretation that explain empirical science, and is one of contemporary exegesis.

The solar circulation is part of the astronomy that has been discussed that one of *tafsīr ʿilmī* content. The science of astronomy began to be categorized as part of mathematics by Muslim scientists in the Middle Century.[2] The efforts made by Muslim scientists in this astronomical discipline are the majority composed in the real movements studies of the sky objects and recorded in mathematical numbers, to the phenomena such as starlight and the objects, such as the meteors and comets and they are submitted to the field of physics and metaphysics as the basic nature of astronomy because it cannot be separated from the calculations. At first, the concept of the planet was inherited by the Greeks as a civilization that continued to establish that the earth as the center of the sky objects rotates around it. Long before the Muslim astronomers developed their advanced observational and theoretical methods, the Muslim astronomers have already possessed the expertise in applying astronomical knowledge such as the existence of *Falak* (the term form of Arabic language about spheres science) and *rukyat* (that is a science about stars research) science. In revealing the phenomena of nature, it is not surprising that they use the Quran as a reference because Quran is the source of all knowledge sources. But it is needed to remember that the Quran is not a book of

knowledge, but guidance to human life. Along with the time developing and the development of the style and methodology of tafsir, the *tafsīr ʿilmī* (scientific interpretation) has increasingly become a scientific reference in certain research and scientific discovery. It is included in the discussion of the sun in the Quran which is mentioned with the word *al-shams* 32 times and all in the form of *mufrad* (singular word).[3]

The debate around solar circulation among astronomy scientists is endless. This is caused by the different opinions of every scientist who says that the sun is the center of the solar system while other scientists say that the earth is the center of the solar system. Nicolaus Copernicus (English: Nicholas Copernicus) is one of the astronomers who stated that the sun is the center of circulation of the solar system in the 16th century.[4] This theory is later proved by Galileo Galilei and other celestial observers, and it is also strengthened by Kepler's law.[5] The theory known as the Heliocentric theory breaks the Geocentric theory (earth as the center of the solar system) proposed by Ptolemy.

This paper elucidates the solar circulation theory from the perspective of the Heliocentric theory of Nicolaus Copernicus and the thought of Fakhr al-Dīn al-Rāzī. Copernicus's theory overcomes the Geocentric theory, as well as the Heliocentric theory of Nicolaus Copernicus, which receives great attention from the latter philosophers. In this research, the full qualitative method, based on the library research was used, and supporting documents data relevant to the topic of this research was then analyzed descriptively.

The Overview Heliocentric Theory

If traced back, history and western civilization, and even the world often claim Nicolaus Copernicus as the originator of the heliocentric theory or the sun as the center of the solar system. However, historians of astronomy have found the fact that the mathematical ideas in Nicolaus Copernicus' book on *The Revolutions of The Heavenly Spheres* have similarities with books written a hundred years earlier by Ibn al-Shāṭir (1304-1375 M.), a Muslim astronomer who lived in the 14th century.[6] The book by Ibn Shāṭir which is the reference for Nicolaus Copernicus is entitled *Nihāyat al-Sūl fi Taṣḥīḥ al-Uṣūl* which completely overhauled Ptolemy's geocentric theory. This is the initial hypothesis in the closing of the history of Ibn al-Shāṭir in the fourteenth century, which is a person who contributed to the formation of this theory. Scholars are more familiar with Nicolaus Copernicus as the "Father of Heliocentric". Astronomy only recognizes the theory built by Kepler and Copernicus after the collapse of the boundaries

of the Earth theory without considering the theory of Ibn al-Syāṭir which was precisely the first theory to map the motion of the planets in space; a theory believed to belong to the modern world as Kepler and Copernicus.

This shows that actually, Ibn al-Shāṭir's thought has influenced the thinking of Nicolaus Copernicus until the heliocentric theory was born.[7] In this book, Ibn al-Shāṭir drastically reformed the model of the sun, moon, and planets in the theory developed by Ptolemy. By introducing himself to a non-Ptolemaic model that abolished the epicycle of the solar model, which abolished the notion of eccentric and equant positions, Ibn al-Shāṭir's geocentric solar system model was the first work that truly excelled over the Ptolemaic model of the solar system because it was better and according to empirical observations.[8]

At first, Ibn al-Shāṭir then overhauled the geocentric theory proposed by Claudius Ptolemy or Ptolemy. Mathematically, Ibn al-Shāṭir has introduced the existence of the epicycle, which is a very complex system of circles within a circle. Ibn al-Shāṭir has also tried to explain how the planet Mercury moves if the earth is the center of the universe and Mercury moves around the earth. The model and form of Mercury studied by Ibn al-Shāṭir shows a doubling pattern of the epicycle using the Tusi-Couple which more or less criticizes the Ptolemaic theory.[9] Ibn al-Shāṭir was also the first astronomer to introduce experiments in planetary theory to empirically test the basic model of the Ptolemaic solar system. When testing the Ptolemaic-style model, Ibn al-Shāṭir explained the Ptolemaic Value Test of the shape and size of the sun using observations during a lunar eclipse. Thus, the theory developed by Ibn al-Shāṭir has been adopted by Copernicus to construct a heliocentric model of the solar system.[10]

Ibn al-Shāṭir was able to influence the development of the Western world. This is shown by the many theories developed by Western scientists such as Copernicus that are no different from the theory of Ibn al-Shāṭir. Thus it can be seen that the theory of Ibn al-Shāṭir has been adopted by Copernicus in the heliocentric theory. This was influenced by the Byzantine Greek manuscripts containing the Tusi-couple on which Ibn al-Shāṭir worked had reached Italy in the 15th century AD al-Shāṭir on his geocentric model.[11] So it is very possible that Copernicus was influenced by the work of Ibn al-Shāṭir. Ibn al-Shāṭir's theory of moon movement is very similar to that proposed by Copernicus some 150 years later.[12]

The most comprehensive and successful model introduced in the fourth-century model is Ibn al-Syāṭir. Ibn al-Syāṭir's model for using a perfect combination of movements where each circle rotates around a center is Ibn al-Syāir in his study Nihāyat al-Sūl Fi Tashih al-Uṣūl. Ibn al-Syāṭir was also

able to solve the problem of planetary distances and provide more accurate data for astronomical observations. Ibn al-Syāṭir was the first scientist to study the movement of planets in space, a theory that the modern world believes to belong to Kepler and Copernicus.[13] It can be seen that in the history of world astronomy, Ibn al-Syāṭir is overlooked. Only Copernicus was known after Ptolemy (1473-1543 AD). In his astronomical diagram, Ibn al-Syāṭir describes the movement of the planet Mercury. His findings at that time were considered a continuous representation of the motion of the planets in the solar system. Ibn al-Syāṭir's geometric model is the first work that is truly superior to the Ptolemaic model because it fits better with empirical observations. In making his new model, Ibn al-Syāṭir tested it by making empirical observations.[14]

However, according to Ikhwān al-Safā, between geocentric and heliocentric theories, one of them cannot be blamed, for the discussion about the sun as the center of the universe or the earth as the center of the universe, both of these opinions have two perspectives depending on the subject because the sun is only in the outer layer of the galaxy.[15] So if the sun is said to be the center of the universe, it is less precise and more accurate if the sun is said to be the center of the galaxy, because the sun is one of the billions of stars in the Milky Way galaxy. But according to Mulyadhi Kartanegara on International Integration of Knowledge UIN Jakarta 2021, the galaxy also cannot be said to be the center of the universe, because in the universe there are many galaxies. So geocentric and heliocentric cannot be said to be both right and wrong because it depends on how to position the subject. So even though the Ikhwan Shafa says the earth is the center of the other planets that revolve around it, it is correct to place the subject on earth. So if you place the subject in the sun, the sun is the center.

Nicolaus Copernicus and The Heliocentric Theory

Nicolaus Copernicus is a Polish astronomer, mathematician, and economist. He is also a church canon, judge, doctor, scientist, Catholic monk, governor, state official, military commander, astrologer, and diploma.[16] But the first universe observation was conducted by Aristarchus. He tried to calculate the angle between the location of the Sun, the Earth, and the Moon and to find a comparison of the distance between the Earth to the Sun, Earth to the Moon. Likewise, Aristarchus is the one who assumes that the Earth moves around the Sun in a circular trajectory which becomes the starting point of the Heliocentric theory. Thus, the Heliocentric theory has already been believed by philosophers and

astronomers before it was declared by Nicolaus Copernicus. Aristarchus' theory gained resistance from the Geocentrism theory of Hipparchus which states that all objects (stars, planets, and sun) move relatively surrounding the earth which is accepted as the basis of the geocentric model (the earth as the solar system).[17] The apparent motions of the relative planets, moon, and sun to the stars and each other are described almost completely in the Geocentrism theory of Hipparchus in about 140 BC. Furthermore, that theory was developed by Claudius Ptolemaeus (Ptolemy) circa 150 BC which is commonly called Ptolemaic.[18]

In Ptolemaic theory, the earth's position is in the center of the universe. The moon revolves around the earth in its closest orbit, while the stars lie on the large rounded spinning celestial spheres in the farthest orbit in which the moon and stars are located in the sun's orbit.[19] That time, Geocentrism theory was believed by experts for almost 1400 years, but the main difficulty in geocentric models is the periodic retrogression of the planets, and its weakness is the sun and moon move in the circle traces around the earth, while the planets do not move regularly in vertices series to the east.[20] In 1543 the Geocentrism theory was fallen by a great revolution of Nicolaus Copernicus (1473-1543) that justifies the concept of Aristarchus replacing the geocentric model with a simpler and more rational heliocentric model. The planets between the sun and the star revolved around the sun in a circular orbit. The heliocentric view was expelled by Aristarchus, a Greek astronomer about 310-230 BC.[21]

Nicolaus Copernicus's Thaught in *On the Revolutions of the Heavenly Spheres* Book

This theory assumes that the sun is at the center of the circulation of the planet, including the earth. While the moon surrounds the earth simultaneously then the earth revolves around the sun.[22] But the sun is just spinning on its axis. In this heliocentric view, the planets which exist in outer space are circling the sun with their rounded elliptical orbits, where the sun is the center of it. Copernicus announced his paper in 1543 AD about the earth surrounding the sun. So, it is clear that when we read the chronological history, it can be concluded that this heliocentric theory is also called the Copernicus system,[23] a system where the sun is the center of the Solar System. This system in English is called Heliocentric, and in Arabic called *Mukhtaṣ bi-Markaz al-Shams*.[24]

Nicolas Copernicus explicitly says that the sun becomes the center of the solar system, and the earth surrounds it in a circular orbit.[25] In this heliocentric system, the stars are still considered to exist in a celestial

sphere and also revolve around the sun (revolving in the center), there are planets (including the earth) that always revolve around those stars along the respective circular paths. The Copernicus system is simpler and easier to be used to predict the movement of celestial bodies than the Ptolemy System (the epicycles planets). He states that there was a fact he had known that the earth rotates on its axis (rotation) just as the other planets revolve around the Sun (revolution).[26]

It means, according to Copernicus, the sun is actually at the center of our solar system. However, Copernicus still considers the planets' orbits are still in circles. While the sun is silent as the center of circulation in the middle of the circle, the stars are also stationary. Copernicus knew very well the dangers of issuing opinions contrary to the opinion of the church, moreover the Pope's opinion at that time. For thirty years, he kept his book in a locked spot while making further observations. But eventually, he decided to publish it. The heliocentric theory of Copernicus was presented in its publication entitled De Revolutionibus Orbium Colestium to Pope III and accepted by the church. On May 24, 1543, at the time his book sample was shown to him, he passed away. This book Consist of 11 chapter below:[27]

1. That the Universe is Spherical
2. That the Earth also is Spherical
3. How Earth, with the Water on it, Forms one Sphere
4. That the Motion of the Heavenly Bodies is Uniform, Circular, and
5. Whether Circular Motion Belongs to the Earth; and Concerning its
6. Of the Vastness of the Heavens Compared to the Size of the Earth
7. Why the Ancients Believed that the Earth is at rest, like a Centre, in the middle of the Universe.
8. The issue efficiency of these Arguments and Their Refutation
9. Whether More than one Motion can be Attributed to the Earth, and of the Centre of the Universe.
10. Of the Order of the Heavenly Bodies
11. Explanation of the Threefold Motion of the Earth

Note:[28]

1. There is no one center of all the celestial circles or spheres.
2. The center of the Earth is not the center of the Universe, but only of gravity and the lunar sphere.
3. All the spheres revolve around the Sun as their mid-point, and therefore the Sun is the center of the Universe.
4. The ratio of the Earth's distance from the Sun to the height of the

firmament is so much smaller than the ratio of the Earth's radius to its distance from the Sun that the distance from the Earth to the Sun is imperceptible in comparison with the height of the firmament.

5. Whatever motion appears in the firmament arises not from any motion of the firmament, but the Earth's motion. The Earth together with its circumjacent elements performs a complete rotation on its fixed poles in a daily motion, while the firmament and highest heaven abide unchanged.
6. What appears to us as motions of the Sun arise not from its motions but from the motion of the Earth and our sphere, with which we revolve about the Sun, like any other planet. The Earth has, then, more than one motion.
7. The apparent retrograde and direct motion of the planets arise not from their motion but the Earth's motion. The motion of the Earth alone, therefore, suffices to explain so many inequalities in the heavens.

Fakhr al-Dīn al-Rāzī and *Mafātīḥ al-Ghayb*

Fakhr al-Dīn al-Rāzī was born in Ray Iran (close to modern Tehran) in 543 H/1149 M. Fakhr al-Dīn al-Rāzī's full name is Abu ʿAbdillāh Muḥammad b. Umar b. al-Ḥusayn b. al-Ḥasan b. ʿAlī al-Tamīmī al-Bakrī al-Ṭabrasānī Fakhr al-Dīn al-Rāzī. He died in Herat (Afghanistan) in 1209 M./606 H. Fakhr al-Dīn al-Rāzī's thought in his tafsir, which was influenced by rational (ʿ*aqliyah*) sciences, as a result of various studies of medicine, logic, philosophy, and wisdom. This caused his interpretation to be out from the meanings of the Quran and its verses. It brought the passages of the book to the problems of ʿ*aqliyah* (rational) science and scientific terminology. Therefore, this interpretation had no *rūḥānīyah* (spiritual) explanation and Islamic guidance, until some scholars said, "There is everything on it except the tafsir itself."[29]

One of the monumental works of Al-Rāzī is *Tafsīr Mafātīḥ al-Ghayb* which is used as the main reference in some tafsir works of scholars and thinkers ranging from the classical, modern to the contemporary era.[30] Al-Rāzī *Tafsīr*'s work is categorized as the tafsir *taḥlīlī* method because in interpreting the Quran he starts it from surah *al-fātiḥah* to *al-Nās*. The approach form of his tafsir is bi *al-raʾyī* because it is dominated by ʿ*aqliyah* (rational) sciences so his style is ʿ*ilmīyah* (Scientifique). Besides, other styles present many disciplines such as physics, astronomy, philosophy, *kalām*, etc. which developed at that time.[31]

Fakhr al-Dīn al-Rāzī's Interpretation of the Solar Circulation

1. The Solar is the Center of the Universe

The word *al-shams* is mentioned 32 times and all are in the form of a *mufrad* shape.[32] Here are the following verses which reveal the sun in the Quran.

Table 1.2
The Verses of the Quran about the Solar

No.	Place of The Verse	Specification of The Verse
1	Al-Baqarah/2:28	Madanīyah
2	Al-Anʿām/6:78	Makkīyah
3	Al-Anʿām/6:96	Makkīyah
4	Al-Aʿrāf/7:4	Madanīyah
5	Yūnus/10:5	Makkīyah
6	Yūsuf/12:4	Makkīyah
7	Al-Raʿd/13:2	Madanīyah
8	Ibrāhīm/14:33	Makkīyah
9	Al-Naḥl/16:12	Makkīyah
10	Al-Isrāʾ/17:78	Makkīyah
11	Al-Kahf/18:17	Makkīyah
12	Al-Kahf/18:86	Makkīyah
13	Al-Kahf/18:90	Makkīyah
14	Thāhā/20:130	Makkīyah
15	Al-Anbiyāʾ/21:33	Makkīyah
16	Al-Ḥajj/22:18	Madanīyah
17	Al-Furqān/25:45	Makkīyah
18	Al-Naml/27:24	Makkīyah
19	Al-ʿAnkabūt/29:61	Makkīyah
20	Luqmān/31:29	Makkīyah
21	Faṭir/35:13	Makkīyah
22	Yāsīn/36:38	Makkīyah
23	Yāsīn/36:40	Makkīyah
24	Al-Zumar/39:55	Makkīyah
25	Fuṣṣilat/41:37	Makkīyah
26	Qāf/50:39	Makkīyah
27	Al-Raḥmān/55:5	Madanīyah
28	Nūḥ/71:16	Makkīyah
29	Al-Qiyāmah/75:9	Makkīyah
30	Al-Insān/76:13	Madanīyah
31	Al-Takwīr/81:1	Makkīyah
32	Al-Shams/91:1	Makkīyah

So many verses are told about the sun, but then I will explain only several verses from Al-Rāzī's interpretation. In the commentary of *Mafātīḥ al-Ghayb*, Al-Rāzī reveals that the sun has two headquarters called *Murakkaz al-ʿAlam* and *Fawqa Murakkaz al-ʿAlam* which are analogous to white and egg yolk color, the meaning of the sun (egg yolk) is likened to the central solar system while other planets (white color) surround on the sun.[33] From that statement, a contradiction appears between Al-Rāzī's thought

and Ptolemous's geocentrism theory which had developed and become a reference for human understanding in the 11th-12th century AD because it was dominated by Ancient Greek civilization. This phenomenon has been mentioned also in Surah Yasin verse 38.

٧١ قوله تعالى : والشمس تجري لمستقر لها . سورة يس .

وَٱلشَّمْسُ تَجْرِى لِمُسْتَقَرٍّ لَّهَا ۚ ذَٰلِكَ تَقْدِيرُ ٱلْعَزِيزِ ٱلْعَلِيمِ ﴿٣٨﴾

قوله تعالى : ﴿ والشمس تجرى لمستقر لها ذلك تقدير العزيز العليم ﴾ .

يحتمل أن يكون الواو للعطف على الليل تقديره : وآية لهم الليل نسلخ والشمس تجرى والقمر قدرناه ، فهى كلها آية . وقوله (والشمس تجرى) إشارة إلى سبب سلخ النهار فانها تجرى لمستقر لها وهو وقت الغروب فينسلخ النهار ، وفائدة ذكر السبب هو أن الله لما قال نسلخ منه النهار وكان غير بعيد من الجهال أن يقول قائل منهم سلخ النهار ليس من الله إنما يسلخ النهار بغروب الشمس فقال تعالى (والشمس تجرى لمستقر لها) بأمر الله فغرب الشمس سالخ للنهار فبذكر السبب يتبين صحة الدعوى ويحتمل أن يقال بأن قوله (والشمس تجرى لمستقر لها) إشارة إلى نعمة النهار بعد الليل كأنه تعالى لما قال (وآية لهم الليل نسلخ منه النهار) ذكر أن الشمس تجرى فتطلع عند انقضاء الليل فيعود النهار بمنافعه ، وقوله (لمستقر) اللام يحتمل أن تكون للوقت كقوله تعالى (أقم الصلاة لدلوك الشمس) وقوله تعالى (فطلقوهن لعدتهن) ووجه استعمال اللام للوقت هو أن اللام المكسورة فى الأسماء لتحقيق معنى الإضافة لكن إضافة الفعل إلى سببه أحسن الإضافات لأن الإضافة لتعريف المضاف بالمضاف إليه كما فى قوله : دار زيد لكن الفعل يعرف بسببه فيقال اتجر الربح واشتر للأكل ، وإذا علم أن اللام تستعمل للتعليل فنقول وقت الشىء يشبه سبب الشىء لأن الوقت يأتى بالأمر الكائن فيه ، والأمور متعلقة بأوقاتها فيقال خرج لعشر من كذا (وأقم الصلاة لدلوك الشمس) لأن الوقت معرف كالسبب وعلى هذا فمعناه تجرى الشمس وقت استقرارها أى كلما استقرت زماناً أمرت بالجرى فجرت ، ويحتمل أن تكون بمعنى إلى أى إلى مستقر لها وتقريره هو أن اللام تذكر للوقت وللوقت طرفان ابتداء وانتهاء يقال سرت

Picture.1.2

In this verse, al-Razi explains that the sun runs and spins on its axis, while the earth which is in front of the sun, also runs and rotates on its axis.[34] The word *tajrī* in the verse above means 'go, walk, circulate, or flow'. Because the subject of the verse is the sun, the exact meaning is circulating, it means that the sun is circulating to the place of its dismissal.

Al-Rāzī explains in detail the sun's circulation. He begins his interpretation by discussing the word *li-mustaqarr.* In terms he said, the

word li-mustaqarr can be interpreted in two kinds of interpretation, the first letter li in the word li-mustaqarr contains the meaning of time which means the sun is running in its time and its circulation. Similarly, in the Quran Surah al-Isrāʾ verse 78, "*aqim al-ṣalāt li-dulūk al-shams*" letter li in the verse means a time: "Establish prayer at the decline of the sun" which in this verse describes the time of zuhr prayer. The meaning of the word li-mustaqarr is the time when the sun remains, then the sun will return to run because of Allah's commands.

The second, the letter *li* on the word *li-mustaqarr* is interpreted as the letter *ilā* which means the sun is circulating to the place of its circulation, the highest and lowest place, the most east and west of the sun where it will rise from the east and set from the west. In the context of this verse the letter *li* in *li-mustaqarr* means *ilā* but it is not written by using *ilā* because the letter *li* is useful to remind the time when the time has two ends those are the beginning and the ending as the sun appears. When the dawn rises and ends and when the sun sets equally like the previous explanation.

At the end of his interpretation of Surah Yasin verse 38, Al-Rāzī said that his opinion about the sun circulation is very much, but he thinks that the word *li-mustaqarr* is where the sun runs; the sun runs to its place. God predestined the sun not only to run, but also to provide its benefits for humans for the humans can gain knowledge from it, so it can be developed as the science that discusses the sun and astronomy science specifically. From this, it can be seen that a large star does not just sit alone somewhere but moves and circulates on its outline.[35]

The verse above shows that the sun and moon circulate until the end of their time, which is marked by the Day of Judgment. A time limit is a form of God's power. The sun runs while spinning on its axis, the earth is in front of it also runs while turning on its axis.[36] The sun, which is a great star, not only stops somewhere but moves and circulates in its spin.[37]

2. The Nature of the Sun

Sunlight

Surah Nuh verse 16:

وَجَعَلَ الْقَمَرَ فِيهِنَّ نُورًا وَجَعَلَ الشَّمْسَ سِرَاجًا

"And made the moon a light in their midst and made the sun as a (glorious) lamp?"

In Arabic, the meaning of the sun is al-shams. Fakhr al-Din al-Razi explains that the moonlight is weaker than the sunlight; the word nūr is equated with the moon because the moon shines at night while the sunset becomes the sign of the earth's darkness and the sun appears to obliterate its very strong rays called sirāj.[38] The Quran distinguishes the size of the sun and moon by distinguishing the term light (nūr) for the moon and lamp (sirāj) or ray (*ḍiyā'*) for the sun, in which the word ray (*ḍiyā'*) is stronger than light (nūr).[39] First, the moon's body is exposed to light. The second is the space which is fixed in combustion as a constant source of light and heat. It is a source of light in the form of the sun. The sun is not a solid surface and rigid like the earth, but it is a big gas ball, and also becomes one of the stars in this universe. The sun becomes the closest star to the earth, so the research on this star is easier to do than on other stars. The word (*ḍiyā'*) is the light generated from the sun, whereas the word (nūr) is a former of the sunlight itself.[40]

The sun emits white light, but white light is the combination of all wavelengths. This is by the word of God in the Surah *al-Shams* verse 1: *wa-al-shams wa-ḍuḥāhā* "*by the sun and its light*". The purpose of the word *ḍuḥāhā* in that verse is the incandescent sunlight.[41] If the sun's white rays are passed through the prism glass, certain wavelengths are dispersed, and those rays are divorced into a rainbow-colored belt consisting of red, orange, yellow, blue, indigo, and purple. These are called the visible or continuous spectrum is taken from the Law Kirchoff which states that the solid, liquid or gaseous substances are glowing under high pressure will produce a spectrum.[42]

Initially, Al-Rāzī explains the previous relations (munasabah) verse, after Allah confirmed the Judgment Day when all beings will return to Him and he relates it to the creation of heaven and the earth. In this case, Al-Rāzī mentions the sunshine and luminous moon, he sets the places of the sun and moon circulation in orbit to know the number of years and months which are useful for humans and can be used to organize important programs in agriculture, and the calculation winter and summer.[43]

Al-Rāzī distinguishes the word *nūr* and *ḍiyā'*. The word *nūr* shows a relative light situation, so the moonlight is weaker than sunlight, while the word *ḍiyā'* shows a light situation that shines very strong (light). Furthermore, Al-Rāzī explains the benefits of the sun's creation and the enormous moonlight as a form of the extent of grace and great attention of Allah to beings. The sun is the daytime ruler whose circulation causes the change of seasons, while the moon is the night ruler,[44] which from the circulation we can know the number of months *(hijriyah)*, the phases

(changes in shape) affect the moisture content of nature, and its daily circulation influence the daylight and night, where the noon as a time to work and night time to rest for humans. Then Al-Rāzī explains also in other verses:

Yasin:40

لا الشمس ينبغي لها ان تدرك القمر و لا الليل سابق النهار ج و كل في فلك يسبحون

"It is not allowable for the sun to reach the moon, nor does the night overtake the day, but each, in an orbit, is swimming."

لَا ٱلشَّمْسُ يَنۢبَغِى لَهَآ أَن تُدْرِكَ ٱلْقَمَرَ وَلَا ٱلَّيْلُ سَابِقُ ٱلنَّهَارِ ۚ وَكُلٌّ فِى فَلَكٍ يَسْبَحُونَ ﴿٤٠﴾

ويقال لبعض الأشياء إنه قديم ، وإن لم يكن له سنة ، ولهذا جاز أن يقال بيت قديم وبناء قديم ولم يجز أن يقال فى العالم إنه قديم ، لأن القدم فى البيت والبناء يثبت بحكم تقادم العهد ومرور السنين عليه ، واطلاق القديم على العالم لا يعتاد إلا عند من يعتقد أنه لا أول له ولا سابق عليه .

قوله تعالى : ﴿لا الشمس ينبغى لها أن تدرك القمر ولا الليل سابق النهار وكل فى فلك يسبحون﴾ . إشارة إلى أن كل شىء من الأشياء المذكورة خلق على وفق الحكمة ، فالشمس لم تكن تصلح لها سرعة الحركة بحيث تدرك القمر وإلا لكان فى شهر واحد صيف وشتاء فلا تدرك الثمار وقوله (ولا الليل سابق النهار) قيل فى تفسيره إن سلطان الليل وهو القمر ليس يسبق الشمس وهى سلطان النهار ، وقيل معناه ولا الليل سابق النهار أى الليل لا يدخل وقت النهار والثانى بعيد لأن ذلك يقع إيضاحاً للواضح والأول صحيح إن أريد به ما بينته وهو أن معنى قوله تعالى (ولا الليل سابق النهار) أن القمر إذا كان على أفق المشرق أيام الاستقبال تكون الشمس فى مقابلته على أفق المغرب ، ثم إن عند غروب الشمس يطلع القمر وعند طلوعها يغرب القمر ، كأن لها حركة واحدة مع أن الشمس تتأخر عن القمر فى ليلة مقداراً ظاهراً فى الحس . فلو كان للقمر حركة واحدة

Picture.1.3

Al-Rāzī explains the position of the sun as the day ruler. When the moon is on the eastern horizon will not be preceded by the position of the moon, as the night ruler will not also be preceded. Then the sun will meet the moon on the western horizon. When the sun goes down, the moon rises. It reveals the regularity of the planets, so there will not a collision because each planet runs in its round orbit.[45] Al-Rāzī mentions there are seven kinds of planets in space one of them is the moon which circulates faster than other planets. On the other hand, the moon has a rounded and broad orbit and its position is in the last order.[46]

Al-Raʿd: 2

وسخرالشمس و القمر ﷺ كل يجري لا جل مسمي ﷻ.....

> "Then He established Himself above the Throne and made subject the sun and the moon, each running [its course] for a specified term."

Al-Rāzī mentions that the submission of the sun and the moon (sakhkhara al-shams wa-al-qamar) is a sign of the existence of the Essence of the creator and ruler that is Allah.[47] The existence of movement and the silence of the sun and the moon produce balanced numbers and circulation at a certain time. As for the verse kullun yajrī li-ajalin musammā quoted from Ibn ʿAbbās: every day the sun circulates one hundred and eighty times completed for six months until it returns to the starting position, so much a month it is a proof of the God-power against the creation of the planets in control with a certain rate of speed and slowness. In addition, Al-Rāzī also tries to correlate the phenomenon that will occur on the Day of Judgment such as the phenomenon of splitting the sky, the gathering of the sun, and the moon at the same time which has been determined.[48]

The Similarity of Nicolaus Copernicus and al-Rāzī's Thought

The sun is the center of the universe

Copernicus and Al-Rāzī have the same opinion that the sun is the center of the universe. Copernicus thinks that the sun is the center of the circulation of the planets, including the earth, while the moon is around the earth and then the earth revolves around the sun together. The planets which exist in outer space are circling the sun with their elongated orbital rotation, where the sun is the center of it. Similarly, according to Al-Rāzī, the sun has two headquarters in the sense of being the center or source, which are called *Murakkaz al-ʿAlam* and *Fawqa Murakkaz al-ʿAlam* and they are analogous to white and egg yolk color[49] in the sense of the sun (egg yolk) is likened to the center of the solar system while the other planets (white color) surround it over the yellow. This is Al-Rāzī's interpretation in surah Yasin: 40.

Al-Rāzī explains the position of the moon as the night ruler which will not precede the sun as the day ruler when the moon is on the eastern horizon, then the sun will meet it on the western horizon when the sun sets then the moonrises and vice versa. So, it shows the regularity of the planets and there will be no collision because each running is by its orbit (circular) is round.[50] According to Al-Rāzī, each planet has its distinct orbit, both in terms of speed, slowness, and line lanes. As Al-Rāzī says that the center of the solar system is the sun while the other planets surround it Al-Rāzī also mentioned there are seven kinds of planets in space, one of which is

the moon which circulates faster than other planets, the moon has a broad orbit of round shape and its position is in the last order.[51]

The Distinction of Nicolaus Copernicus and al-Rāzī's Interpretation in the *Mafātiḥ al-Ghayb* Tafsīr

The Sun Circulates on the outline

After Copernicus states that the sun is the center of the solar system where the sun is accompanied by the planets that surround it, then he also states that the sun also rotates on the axis. Because the true things which run around the sun are planets and the moon, and the moon circling the earth then also circling the sun, the moon circulates the globe in an average synodic average over 29 days 12 hours 44 minutes 2.8 seconds.[52] In heliocentric theory, Copernicus does not deeply explain how the movement of the sun, he merely says that the sun is just revolving around its axis only, in the sense that the sun doesn't only move in its place of light. In this case, Copernicus's opinion at a glance is in line with Al-Rāzī's opinion which also says that the sun revolves on its axis.[53]

While Al-Rāzī adds that the sun spinning on its axis, the sun also runs around the earth, so when the earth and the moon surround the sun, the sun also goes around, this is what causes the turn of day and night. In the interpretation of the surah Yasin verse 38 in that verse, Allah SWT uses the word tajrī in the sense of running. In Arabic, not just a word *tajrī* which has a meaning 'running', but there is a word *sarā-yasrī* which also has the meaning of running as mentioned in surah al-Isrāʾ verse 1. In this verse, Allah uses the word *asrā* which means that "God walks his servant one night from the al-Haram mosque to the al-Aqsa mosque ". In this case, *asrā* which is a form of word fragmentation of words *sarā-yasrī* has a meaning, which is meant run here is to go on and not to return to the place where it started (in the sense of running but not to his stop) that is telling the events of Isra Mi'raj when Prophet Muhammad walked from the mosque of al-Haram to the mosque of al- Aqsha (the passage of the Prophet from the al-Haram mosque does not return to the starting place/ the mosque of al-Haram, but continue to walk up to the al-Aqsa mosque).

Whereas in Surah Yasin verse 38 Allah uses the word *tajrī* because the meaning of that word goes that will return to the place of dismissal, in which it is interpreted by Al-Rāzī that the sun circulates from its stopping point and will return to its place of dismissal. The verse above is meaning, go, walk, circulate, or flow. Since the subject of the verse is

the sun, the exact meaning is circulated, which means that the sun is circulating to the place of dismissal.

The opinion of Fakhr al-Dīn al-Rāzī is also in line with the opinion of Nawawī, in his Tafsīr (*Tafsīr Marāḥ Labīd*). Nawawī said that in addition to the sun spinning on its axis, the sun also goes to its place of dismissal, in this case, the place where the dismissal of the sun is under the *arsy*[54] which when beneath *arsy* bowed to God every night for a whole night later when the day God permitted to the sun to rise from the east like the ordinary sun was commanded by God to come out from the east. But at the end of time, God will no longer allow the sun to rise from the east, but God commands the sun to rise from wherever the sun likes, then the sun will rise from the west and this is one sign of the judgment day.

In this case, the author assumes, event Al-Rāzī assume that the sun runs around the earth, but it will not break his hypothesis that the solar is the center of the universe is in line with the heliocentric theory of Nicolaus Copernicus because the main point of the heliocentric theory is the solar as the center of the universe, this case has been explained by Nicolaus Copernicus that what appears to us as motions of the Sun arise not from its motions but from the motion of the Earth and our sphere, with which we revolve about the Sun, like any other planet. The Earth has, then, more than one motion.[55]

Number of Planets that Surround the Sun

In the case of Copernicus and Al-Rāzī's solar system centers having the same opinion that the sun is the center of the solar system, Copernicus has a different opinion from Al-Rāzī regarding the number of planets that surround the sun.[56] In this case, it can be concluded that Al-Rāzī said that the moon is a planet, not a satellite that surrounds the earth. Meanwhile, according to Copernicus the moon and the planet are different things as he explains that the moon and planets circle the sun in a similar orbit, which means that the moon and the planet are different, while the moon is a planet that follows the sun.

Orbit Lines Planets

According to Copernicus, the planets are in outer space surrounding the sun with their rounds of elliptic orbits. Then it was perfected by Johannes Kepler in Law 1, the laws of the ellipse (1609). Johannes Keppler explained the planetary orbit of the Copernicus model was later refined by

Johannes Kepler (1572-1630), an assistant and successor of astronomer Tycho Brahe.[57]

Based on Keppler's law, the planets move in an elliptical orbit to the sun which lies in one focus on the long axis. This law states that the planet's orbit is an ellipse, not a circle or around one. Due to an elliptical planetary orbital path, it is long as a planet moves around the sun through a full cycle called a one-year planetary, the distance between the planet and the Sun will always change.[58] The point on the planet's orbital path which marks the planet's closest position to the Sun is called perihelion. While the point on the orbital path of the planet which marks the farthest position of the planet to the sun is called aphelion. The direction of the planets rotates in the opposite direction from the clockwise direction, except for the planets Venus and Uranus. Astronomers set the direction of rotation counterclockwise with directional direction, while the direction of rotation in the direction of clockwise rotation is called a retrograde.[59] Meanwhile, according to Al-Rāzī circulation of planets with the orbit (circular) is round. Al-Rāzī mentions some views of scientists at the time, among others: (1) idle orbits and moving planets, this view is rejected as impossible for a silent orbit in place; (2) orbits and planets are equally moving, this opinion is prevalent because the planets move because they are influenced by their orbital movement; (3) moving orbits and silent planets, this opinion is justified because there is conformity with the Quran which shows moving orbits while other planets accompany.

Conclusions

This study describes two great thinkers from the East and the West: Nicolaus Copernicus and Fakhr al-Dīn al-Rāzī about the center of the universe in astronomy. They both agree that the sun is the center of the solar system. But they differ in three ways. First, according to Copernicus the sun only stays in its orbit, while according to Al-Rāzī the sun goes around the earth. Second, the planets that revolve around the sun according to Copernicus there are nine planets, while according to Al-Rāzī there are seven planets. Third, according to Copernicus, the planets that revolve around the sun are in the form of elliptical orbits, while according to Al-Rāzī they are round. The ideas of Al-Razi in the 12th century and Ibn al-Shatir in the 14th century on astronomy that preceded Copernicus show that astronomy in Islam has become a very interesting, empirical, and scientific science before it is explored in modern science by scientists in the West.

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