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The Ṣūfī Approach in the Manuscripts of Al-Khwārizmī's Zīj as-Sindhind al-kabīr, Shams al-Dīn al-Khafrī's Solution of the Insoluble, and Naṣīr al-Dīn al-Ṭūsī's Al-Tadhkīrah

Jamal Assadi[1], Mahmoud Naamneh[2], Khaled Sindawi[3],

Abstract

In this era of media convergence with rapid technological development, broadcasting practitioners are faced with the problem of how to use new technologies to enhance news dissemination and turn dilemmas into opportunities. This study uses media convergence theory and Chinese broadcasting theory to conduct a collective case study of positive examples of barrier-breaking, analyzing different presenters and their programs. It analyses the impact of changes in how audiences receive information, the relative lag in the speed of communication, the limitations of the form of communication, and the decline in the influence of communication on the communication of broadcasters and presenters. It puts forward positive suggestions in terms of guiding public opinion, strengthening one's influence, adapting to the form of communication, and transforming the language style. This will inform the career development of radio and television industry practitioners in the era of media convergence.

Keywords: *Shams al-Din al-Khafrī, Ḥall mā lā yanḥall, Al-Khwarizmi, Zīj al-Sindhind, circular Sufi cosmological conception of creation, Islamic mysticism, Al-Tadhkīrah, Nasir al-Din al-Ṭūsī, mathematical cosmological perspective, Sufi cosmogonic worldview.*

Introduction

The Development of Astronomical Theories in the Islamic Medieval Period

The Islamic medieval period, stretching from the eighth to the fourteenth century CE, represents a remarkable chapter in intellectual history, particularly in the realm of astronomy. This era witnessed an unparalleled synthesis of knowledge from diverse cultural traditions, including Greek, Indian, Persian, and Arab contributions, resulting in significant advancements in the understanding of celestial phenomena. Scholars of the period effectively engaged with this rich intellectual heritage, adapting and building upon existing frameworks to formulate new astronomical theories and practices that would influence the development of modern science (Kennedy 1956, 123–177).

Central to this intellectual flourishing was the interplay between inherited knowledge and innovative thinking. The Islamic medieval period is often referred to as the Golden Age of Islamic civilization, not only for its scientific and philosophical achievements but also for its profound cultural and societal impacts. In the domain of astronomy, the refinement of star theories was pivotal, serving as a tool for both understanding the cosmos and practical applications such as navigation and calendrical systems (Kennedy 1956, 123–150). This

blending of theoretical inquiry and practical utility highlights the sophistication of Islamic scientific endeavors during this era.

The transmission and adaptation of knowledge played a crucial role in shaping the astronomical achievements of the period. Islamic scholars inherited a vast body of astronomical texts from ancient civilizations, notably the Greeks and Indians. Foundational figures such as Ptolemy, Hipparchus, and Aryabhata provided the intellectual groundwork upon which Muslim scholars expanded. This legacy was not merely preserved but was critically examined, synthesized, and enriched through the addition of new insights and methodologies (Broug 2013). This dynamic process of engagement underscores the period's intellectual vitality, as it sought not only to preserve but also to transform and transcend earlier understandings of the universe.

The translation movement was instrumental in facilitating this intellectual transformation. By translating essential works from Greek, Roman, Indian, and Persian sources into Arabic, Islamic scholars ensured the survival of ancient knowledge while also making it accessible for further development. This movement was characterized by its vigor and scope, as it bridged cultural and intellectual divides, enabling the exchange of ideas that propelled scientific progress (Goldstein 1967, 1–53). The role of translation, therefore, was not merely one of linguistic conversion but also an act of intellectual synthesis, as translators and commentators integrated these texts into the Islamic intellectual tradition.

The era also saw the emergence of prominent Islamic astronomers who contributed significantly to the field. Among these was **Muhammad ibn Jabir Al-Battānī** (858–929 CE), known in the Latin West as "Albatenius." Al-Battani's work exemplifies the integration of rigorous observation with theoretical innovation. His precise determination of the solar year's length and his refinement of the measurement of the precession of the equinoxes stand as testaments to his observational and mathematical expertise. His contributions reflect a deep commitment to enhancing the accuracy and reliability of astronomical knowledge.

Al-Battani's influence extended through his seminal texts, such as *Kitab al-Zij al-Battani* (The Astronomical Tables of Al-Battani) and *Kitab al-Mukhtasar fi Umur al-Hisab* (A Compendium on Calculations). These works, rich in detail and systematic in their presentation, provided valuable resources for subsequent generations of astronomers. They also illustrate the meticulous attention to empirical data and theoretical coherence that characterized Islamic astronomy. These texts, particularly *Zij al-Battani*, reveal the depth of intellectual engagement with the cosmos during this era and underscore the enduring legacy of Islamic contributions to science (Al-Battānī 2008).

The Islamic medieval period, therefore, stands as a pivotal moment in the history of astronomy. It was marked by a dynamic interaction between inherited traditions and innovative scholarship, facilitated by an active translation movement and exemplified by the achievements of figures like Al-Battani. This legacy, rooted in a commitment to intellectual inquiry and cultural synthesis, continues to inspire contemporary reflections on the history and philosophy of science.

This encyclopedic and pioneering work on early astronomy, particularly its richly detailed indices, offers insight into the intersection of religious philosophy and astronomical science. From this, one can infer a nascent cosmological perspective that Al-Battani developed through his extensive observations of the stars. In his reflections, Al-Battani articulated a philosophy

emphasizing the "genius" of celestial creation, detailing the systems and orbits of stars within their celestial spheres.

In his various writings, Al-Battani established the mathematical and geometric foundations for what mathematicians now call "spherical trigonometry." These contributions significantly influenced the development of both Islamic and global astronomy. Among his notable innovations was the concept of "circumferential circles," a refinement of earlier Greek ideas. While the Greek philosopher Ptolemy had used the term "chord," Al-Battani introduced the concept of the "sine," which is defined in modern terms as the ratio of the length of the side opposite an angle to the hypotenuse in a right triangle (Hill, 1999).

Through this conceptual framework, Al-Battani laid the groundwork for a mystical and cosmological vision of the universe. His "circumferential circles" became the basis for calculating the areas, sides, and angles of various geometric shapes. Just as Pythagoras explored the right triangle through the squares of its three sides—a topic extensively discussed in earlier studies—Al-Battani advanced this work by employing circumferential circles.

Al-Battani and his contemporaries in the medieval Islamic period significantly advanced the field of astronomy. They inherited knowledge from the Greeks and transformed it, a process described by Professor George Saliba, a scholar of Islamic astronomical manuscripts at Columbia University. Saliba emphasizes that these scientists were not mere "transporters" of Greek scientific heritage. Instead, they internalized, developed, and disseminated this knowledge on a global scale.

During the same period, Al-Farghani, a ninth-century scholar, emerged as another significant figure in astronomy. His *Compendium of the Science of Stars and the Principles of Celestial Motions* (*Kitab Jawami' 'Ilm al-Nujum wa Usul al-Harakat al-Samawiya*) offered a comprehensive summary of Greek and Indian astronomical science (**Al-Fara'ani** 1998). **Al-Fara'ani**'s contributions included refinements to the Ptolemaic model and a detailed description of the celestial sphere (Hill, 1999).

Another prominent figure, Ibn Yunus (950–1009 CE), made groundbreaking contributions by compiling precise planetary motion tables. His meticulous observations of celestial phenomena laid the foundation for subsequent advancements in astronomy and profoundly influenced the scientific methodology for studying the cosmos.

These scholars collectively established the groundwork for the evolution of astronomical science. They did not merely preserve the knowledge inherited from Greek civilization but expanded it, offering innovative perspectives that bridged the realms of science, philosophy, and mysticism. Their contributions highlight the dynamic intellectual environment of the Islamic medieval period, an era marked by both the preservation and transformation of global knowledge.

Innovations and Legacies: Advancing Celestial Theories in the Medieval Islamic World

Building on the rich theoretical advancements and mathematical innovations of medieval Islamic astronomers, their development of sophisticated tools like the astrolabe and sundials exemplifies the practical application of their cosmic understanding, further solidifying their contributions to celestial studies.

Drawing from the practical tools and theoretical insights they cultivated, Islamic astronomers

not only refined celestial measurements but also critically engaged with and expanded upon inherited frameworks like Ptolemy's geocentric model. Ibn al-Haytham (965–1040 CE), known in the West as Alhazen, critiqued Ptolemy's geocentric model and made significant advancements in understanding the cosmos from a fresh perspective (Goldstein 1967, 1–53).

The Maragha Observatory, established in the 13th century in present-day Iran, played a pivotal role in advancing astronomical knowledge. Scholars such as Nasir al-Din al-Ṭūsī (1201–1274 CE)—whose works and theories on celestial spheres will be detailed in subsequent chapters of this study—enhanced planetary models and introduced innovations such as "the Ṭūsī couple." These refinements contributed to the development of circumferential geometry and trigonometry, offering a more accurate understanding of celestial movements (Ragep 2010, 137–160).

Rooted in their foundational contributions, the advancements in celestial theories during the medieval Islamic period laid a robust groundwork for subsequent astronomical progress. Islamic scholars not only preserved and enriched ancient knowledge but also set the stage for transformative developments that extended beyond their own civilizations. Their works, translated into Latin, became vital resources for European scientists during the Renaissance. Figures such as Copernicus, Kepler, and Galileo drew extensively from the insights of Islamic astronomers. The detailed observations, refined calculations, and innovative models created by scholars like al-Battani, Ibn al-Haytham, and Nasir al-Din al-Ṭūsī reshaped the understanding of celestial mechanics. For example, Ṭūsī's geometric models directly influenced Copernicus's heliocentric theory, demonstrating how Islamic contributions bridged ancient traditions with modern scientific revolutions.

By integrating diverse traditions and challenging established frameworks, Islamic astronomers illuminated paths for exploration that transcended cultural and temporal boundaries. Their legacy endures, not only in the scientific advancements they inspired but also as a testament to the interconnectedness of human knowledge across civilizations.

Ṣūfism and the Mystical Perception of the Stars

The Islamic Golden Age, celebrated for its groundbreaking contributions to science and astronomy, also bore witness to a profound spiritual engagement with the cosmos, deeply rooted in the mystical tradition of Sufism. This interplay between empirical observation and spiritual interpretation reveals a complex and layered understanding of the celestial realm. Sufism, with its emphasis on transcending material existence and seeking divine unity, infused astronomy with symbolic and metaphysical significance, transforming the study of the stars into a journey of the soul.

For ***Ṣūfī*** poets and thinkers, the stars and celestial phenomena served as metaphors for divine attributes and the human quest for spiritual enlightenment. Figures such as Jal**ā**l al-Dīn Rūmī (1207–1273 CE) and Farīd al-Dīn 'Att**ā**r (1145–1221 CE) frequently employed stellar imagery in their poetry to articulate profound spiritual truths. The stars, in their luminous constancy and inscrutability, became symbols of the infinite nature of God. The night sky, vast and mysterious, mirrored the ineffable essence of the divine, offering an endless canvas for Sufi reflection. As Rumi wrote, "The stars are not merely points of light, but reflections of a divine order calling us to transcendence" (Samsó, 1994). The celestial realm was not just a backdrop for spiritual musings; it was an active participant in the Sufi experience. Through contemplation of the

heavens, Sufis sought to harmonize their inner selves with the cosmic rhythms, using the movements of the stars as guides for their spiritual journey. This practice, rooted in both metaphor and direct experience, underscored the Sufi belief in *tawḥīd,* the unity of all existence in God. By meditating on the celestial harmony, they sought to dissolve the illusions of separation, experiencing themselves as integral parts of a divinely unified cosmos (Nasr, 1993).

In their interpretation of the cosmos, Sufis often diverged from the Ptolemaic and Aristotelian models that dominated Islamic scientific thought. While astronomers meticulously charted the stars' movements and debated their mechanics, Sufis approached the heavens as a reflection of spiritual realities. The celestial bodies, in their cyclical motion, were seen as metaphors for the soul's ascent toward divine enlightenment. Each planet and star symbolized a stage on the seeker's path, where spiritual struggles mirrored the dynamic movements of the cosmos (Al-Khalili, 2011). This fascination extended to specific stars. The North Star, or ***al-Qutb***, held particular spiritual significance, representing the unchanging axis around which the heavens revolved. For Sufis, this star embodied the steadfastness required on the spiritual path. Its constancy served as a reminder of the eternal divine presence, a guiding light for those navigating the complexities of the soul's journey (King, 1993).

While Sufism embraced celestial metaphors, its cosmological views also subtly challenged prevailing scientific paradigms. Sufi thinkers like Muḥyī al-Din Ibn 'Arabī (1165–1240 CE) incorporated celestial imagery into their metaphysical systems. Ibn 'Arabī famously described the Prophet Ibrahim (Abraham) as the "first Sufi" who, by gazing at the stars, discerned their true nature—not as divine entities but as signs pointing to the oneness of God. This interpretation underscored a central Sufi tenet: that all physical phenomena are veils concealing the ultimate reality of the divine (Saliba, 2004). The Sufi rejection of a purely mechanistic understanding of the cosmos allowed for a vision of the universe imbued with divine intentionality. The harmony observed in celestial movements was not merely the result of natural laws but an expression of the divine order. This perspective infused the heavens with a sacredness that transcended empirical observation, suggesting that the ultimate truths of existence could only be grasped through spiritual intuition.

The Sufi engagement with celestial symbolism found expression not only in poetry and theology but also in Islamic art and architecture. Mosques, shrines, and ***zāwiyas*** (Sufi lodges) often featured intricate geometric patterns inspired by celestial motifs, such as stars and constellations. These designs were not merely decorative but served to evoke a sense of the divine harmony reflected in the heavens. By adorning sacred spaces with these patterns, Sufis sought to create environments that would elevate the spirit and remind worshippers of their connection to the cosmic order (Nasr, 1993).

The relationship between Sufism and the scientific study of the stars during the Islamic Golden Age exemplifies a dynamic interplay between two modes of knowing: empirical analysis and spiritual insight. While astronomers such as al-Battani and al-Ṭūsī advanced rigorous mathematical models of celestial mechanics, Sufi thinkers added a layer of metaphysical meaning, interpreting the stars as symbols of divine unity and pathways to transcendence. This synthesis of science and mysticism enriched the intellectual landscape of the era, demonstrating that the pursuit of knowledge could encompass both the material and the spiritual. In conclusion, the Sufi interpretation of the stars offers a compelling vision of the cosmos as a reflection of divine unity and an invitation to spiritual transformation. By weaving together scientific

observation and mystical insight, Sufism illuminated the heavens as a realm not only of physical order but of profound spiritual significance. This legacy challenges us to consider the ways in which science and spirituality can coexist, enriching our understanding of the universe and our place within it.

Introduction: Al-Khwārizmī and His Mathematical Vision

Al-Khwarizmi stands as one of the most influential figures in the history of Arab and human sciences, excelling in fields as diverse as algebra (*al-jabr*), mathematics, and philosophy. His exceptional talent and deep knowledge earned him a place in the renowned *Bayt al-Ḥikma* (House of Wisdom) in Baghdad, a center for translating, preserving, and expanding human knowledge. This association enabled Al-Khwarizmi to collaborate with scholars across disciplines, exchange ideas, and contribute to the development of various scientific fields. Scholars such as Rashed (1996) and Katz (1998, 163–174) have noted his significant contributions, many of which are intertwined with a form of "gnostic knowledge" that parallels mystical and cosmological understandings.

A novel hypothesis presented in this study posits that Al-Khwarizmi and his intellectual successors, like Qutb al-Din al-Shirazī and al-Khafrī, proposed a mathematical vision to comprehend the universe's creation and logic. This vision is deeply rooted in what can be described as a Ṣūfī cosmological perspective, revealing how mathematics and astronomy were interwoven with metaphysical inquiry.

In his works, Al-Khwarizmi demonstrates an ability to integrate observational precision with mathematical ingenuity. Among his most celebrated contributions is the *Zīj al-Sindhind*, a foundational text offering profound insights into the cosmological understanding of the universe through celestial movements and numerical systems (Kumar 1991). This study views *Zīj al-Sindhind* as a groundbreaking attempt to align cosmological knowledge with celestial observations. The book, consisting of thirty-seven chapters, includes calculations of celestial bodies, comprehensive tables for calendars, and detailed analyses of astronomical and astrological phenomena.

By bridging Greek scientific heritage, particularly the Ptolemaic *Almagest*, and Islamic intellectual traditions, Al-Khwarizmi introduced a transformative approach that went beyond mere translation of earlier texts. For instance, Ptolemy's model proposed a geocentric universe with celestial spheres revolving around the Earth (Kostro 2015, 7–21). Al-Khwārizmī expanded upon this framework by employing advanced trigonometric calculations and algebraic principles, positioning his work as a turning point in Islamic astronomy.

What distinguishes Al-Khwarizmi's work further is the resonance of his mathematical vision with early Ṣūfī cosmological thought. The Qur'anic narrative of Prophet Ibrahim's reflection on the stars provides a compelling parallel: *"And he looked at the stars and said, 'Indeed, I am sick.'" (Qur'an, al-Ṣaffāt 37:88).* This cosmic reflection, which embodies the unity of creation and causality, aligns with the intellectual trajectories of Ṣūfī thinkers like Ibn ʿArabī and Ibn Sabʿīn. Ibn Sabʿīn, for example, considered astronomy a core discipline within mathematics, emphasizing its philosophical and spiritual dimensions. His *Kalām ʿalā al-Masāʾil al-Ṣiqilliyyā* integrates celestial studies into a broader cosmological framework, mirroring Al-Khwarizmi's focus on celestial movements as pathways to understanding divine unity (Naʿamna 2022).

These connections suggest that Al-Khwarizmi's work is not merely an astronomical treatise but also a deeply philosophical exploration. His focus on celestial harmony and interconnectedness evokes parallels with early Ṣūfī cosmological interpretations, where the heavens are viewed as reflective of divine attributes.

The tables in *Zīj al-Sindhind* facilitated precise predictions of eclipses, planetary positions, and prayer times, revolutionizing Islamic astronomy (Pingree 1978, 96–99). These contributions underscore the methodological rigor with which Al-Khwarizmi approached his studies, blending empirical precision with philosophical inquiry. By employing advanced trigonometry and geometry, Al-Khwarizmi laid the groundwork for later Islamic astronomers, such as al-Battani and al-Majriti (Charette 2004, 101–198). His use of Indian astronomical traditions, as reflected in the term *Sindhind*, further illustrates the intercultural synthesis that characterized his approach.

The celestial observations detailed in *Zīj al-Sindhind* also resonate with the logical inquiries of Prophet Ibrahim's narrative, where his reflections on the Sun and Moon lead to a recognition of divine transcendence: *"When he saw the sun rising, he said, 'This is my Lord; this is greater.' But when it set, he said, 'O my people, indeed I am free from what you associate with Allah.'" (Qur'an, al-Anʿām 6:78).*

This mathematical and astronomical framework reveals how Al-Khwarizmi's contributions extend beyond empirical observations to embrace a metaphysical understanding of the universe. His integration of celestial movements and symbolic geometry parallels Ibn ʿArabī's explorations of cosmic harmony in works like *Inshāʾ al-Dawāʾir* (The Creation of Circles), reflecting a shared commitment to uncovering the unity underlying existence.

The enduring influence of *Zīj al-Sindhind* is evident in its reception and adaptation by subsequent Islamic and European scholars. While the original Arabic manuscript was lost, Latin translations preserved its content, influencing European astronomy through figures like Adalard of Bath (Fazlur 1972). The Andalusian astronomer al-Majrīṭī further developed Al-Khwarizmi's methodologies, ensuring their lasting relevance in the Islamic Golden Age (Seyyed Hossein 2006).

Through his pioneering work, Al-Khwarizmi not only shaped the trajectory of Islamic astronomy but also contributed to a broader cosmological vision. His meticulous integration of mathematical principles and celestial observations affirms the harmony between scientific inquiry and metaphysical reflection, underscoring the richness of Islamic intellectual traditions and their capacity to synthesize diverse strands of thought into a coherent understanding of the cosmos.

Shams al-Dīn al-Khafrī and His Manuscript *Solving the Insoluble*

Shams al-Dīn al-Khafrī, a prominent philosopher of the 14th century, left a profound mark on Islamic thought, philosophy, and the development of astronomy within Arabic, Islamic, and global traditions. His work, particularly the manuscript *Resolving the Insoluble* (*Ḥall mā lā yanḥall*), serves as a cornerstone for understanding the intersections of metaphysics, cosmology, and spiritual philosophy in the Islamic intellectual tradition. The richness of Khafri's contributions becomes evident when we explore his historical and intellectual context, as well as his enduring influence.

Born in Jahrom, Iran, in 1550, Khafrī thrived in a vibrant intellectual milieu. He studied under eminent scholars such as Nasir al-Dīn al-Ṭūsī and Fakhr al-Dīn al-Razī, whose teachings shaped his approach to Islamic jurisprudence and philosophy. Alongside this scholastic foundation, Khafrī embraced the spiritual dimensions of *Sufism*, particularly through the Qadirī tradition imparted by his mentor, Abu al-Fath al-Dabbī. These dual streams of formal study and mystical engagement defined his intellectual pursuits, which were further enriched by extensive travels across the Islamic world. In his journeys, Khafrī engaged with diverse cultures and exchanged ideas with scholars and mystics, a dynamic reflected in the breadth and depth of his writings.

The manuscript *Resolving the Insoluble* stands as a pinnacle of Khafrī's intellectual legacy, delving into questions of existence, human purpose, and the nature of absolute reality. The title itself underscores a central theme: the exploration of truths that transcend conventional understanding. Khafrī postulates that absolute reality is ineffable, eluding descriptive language and intellectual constructs. His argument suggests that such reality can only be apprehended through direct intuitive experience, a premise deeply rooted in Sufi traditions of spiritual realization. This manuscript's philosophical inquiries resonate not only within Islamic metaphysical discourses but also extend their influence to later Sufi thinkers, as seen in the works of Seyyed Hossein Nasr and others.

Central to *Resolving the Insoluble* is Khafrī's conception of circularity as a foundational principle of existence. He presents the cosmos, human life, and divine attributes as inherently cyclical, arguing that this pattern reflects a metaphysical unity underlying all creation. This notion aligns with earlier insights by Ibn 'Arabī, whose seminal work *The Bezels of Wisdom* articulates a similar vision of cosmic circularity. However, Khafrī's approach diverges by emphasizing the existential implications of these patterns over anthropocentric models like Ibn 'Arabī's "Perfect Man." Instead, Khafri frames the circle as a symbol of completion, perfection, and interconnectedness, arguing that it embodies the dynamic relationships between creation and Creator.

In advancing his cosmological theories, Khafrī's manuscript explores the ontological significance of circularity in divine attributes. He contends that qualities such as knowledge, power, and beauty do not exist in linear or hierarchical arrangements but rather in circular relationships that reflect their interdependence. This perspective challenges prevailing notions of divine transcendence by proposing a model that underscores the immanence and accessibility of divine qualities within the created world.

Khafrī's insights into the circularity of existence and metaphysics draw parallels with other philosophical traditions, notably the cosmological models of Ibn Arabi. Both thinkers propose that circularity underpins the coherence of creation, though their emphases differ. Ibn Arabi's framework prioritizes the anthropological and spiritual dimensions of circularity, while Khafrī's treatment foregrounds the existential and metaphysical implications of this principle.

The manuscript *Resolving the Insoluble* ultimately presents a profound synthesis of cosmological, metaphysical, and spiritual insights. It invites readers to contemplate the interconnectedness of existence and challenges them to transcend the constraints of intellectualism in favor of intuitive understanding. By situating Khafrī's theories within broader Islamic and philosophical contexts, this study not only highlights his unique contributions but also underscores the enduring relevance of his ideas in contemporary discourses on metaphysics and spirituality.

The Ṣūfī Vision and the Celestial Circles of Maslama al-Majrīṭī

Maslama al-Majrīṭī, a renowned 10th-century Andalusian astronomer, mathematician, and astrologer, played a pivotal role in shaping scientific and metaphysical thought in the medieval Islamic world. His contributions, particularly in the study of celestial movements and astrolabes, significantly influenced the transmission of Islamic scientific knowledge to medieval Europe. Al-Majrīṭī's insights were instrumental in the development of the *Alfonsine Tables*, a collection of astronomical data and methods compiled under the patronage of Alfonso X of Castile in the 13th century. This text serves as a remarkable example of how Islamic scientific achievements were integrated into European intellectual traditions (Saliba, 1994; Sezgin, 2003; Julio, 2008, 7–25; Stearns, 2009).

Al-Majrīṭī's era witnessed vibrant intellectual exchanges between Islamic and European cultures, exemplified by his profound impact on astronomy, mathematics, and astrology. His work on astrolabes, particularly his detailed treatises, became foundational for later European scholars (Ragep, 1996). The translation of al-Majrīṭī's works into Latin marked a significant milestone in the dissemination of Islamic science, further influencing the *Alfonsine Tables* and advancing European medieval astronomy (Swerdlow, 2001, 123–160).

One of al-Majrīṭī's notable contributions lies in his metaphysical exploration of the cosmos, particularly through his treatise on celestial circles. His theories on "ṭawāfir" (circles or rings) bridged the realms of metaphysics and astrology, offering a framework that combined spiritual and physical dimensions of celestial movements (Lorch, 1991, 1–41). Al-Majrīṭī viewed the universe as inherently circular, emphasizing that the act of creation and human cognition itself follow a circular logic. This concept resonated with Ṣūfī metaphysics, which often employs circular symbolism to depict the unity and return to the divine essence.

Al-Majrīṭī proposed that celestial bodies influence earthly events through a system of concentric circles, where each planet corresponds to a specific circle. These interactions, he argued, shape occurrences on Earth, reflecting a cosmological order rooted in divine wisdom (Kennedy, 1956, 398–401). This perspective aligns with the Ptolemaic model of the cosmos, where planets revolve in circular orbits around the Earth. However, al-Majrīṭī's synthesis of astronomy with Ṣūfī principles added a spiritual dimension, suggesting that celestial movements hold metaphysical significance and can guide individuals toward higher spiritual insights.

The integration of al-Majrīṭī's astronomical theories with Ṣūfī metaphysics highlights the intricate relationship between science and spirituality in the Islamic intellectual tradition. By studying celestial patterns, al-Majrīṭī sought to uncover not only the physical laws of the universe but also its metaphysical and spiritual truths. This dual approach reflects a broader Islamic perspective that views knowledge as a means of understanding the divine order (King, 1992).

In comparison, scholars like al-Khwārizmī, often regarded as the "father of algebra," focused primarily on foundational mathematical innovations. His *Kitāb al-Mukhtaṣar fī Ḥisāb al-Jabr wal-Muqābala* laid the groundwork for algebra and introduced systematic methods for solving equations (Burnett, 1997, 493–510). While al-Khwārizmī's contributions were more mathematical, al-Majrīṭī's work encompassed diverse fields, blending astronomy, metaphysics, and Ṣūfī thought. Together, they exemplify the rich intellectual diversity of the Islamic Golden Age.

Al-Majrīṭī's integration of Ṣūfī principles with scientific inquiry underscores the dynamic

interplay between empirical observation and spiritual reflection in medieval Islamic thought. His vision of the cosmos as a harmonious system of interconnected circles continues to inspire contemporary discussions on the intersections of science, philosophy, and spirituality. By merging the empirical with the metaphysical, al-Majrīṭī contributed to a holistic understanding of the universe, offering a legacy that transcends time and cultural boundaries.

Comparative Analysis of Al-Khwārizmī's *Zīj as-Sindhind al-Kabīr*, Shams al-Dīn al-Khafrī's *Solution of the Insoluble*, and Naṣīr al-Dīn al-Ṭūsī's *Al-Tadhkirah*: Intersections with Ṣūfism

The works of Al-Khwārizmī, Shams al-Dīn al-Khafrī, and Naṣīr al-Dīn al-Ṭūsī represent the intellectual breadth of the Islamic Golden Age, showcasing how empirical science, philosophy, and metaphysics were harmonized within a unified intellectual framework. Each scholar, though operating in different historical and intellectual contexts, contributed uniquely to the advancement of astronomy and mathematics while reflecting broader philosophical themes, including echoes of Ṣūfī thought.

Al-Khwārizmī's *Zīj as-Sindhind al-Kabīr* laid the groundwork for Islamic astronomy through its systematic approach to celestial calculations and its emphasis on observational precision. While primarily focused on empirical methodologies, the work aligns with a broader Islamic intellectual tradition that viewed the study of celestial patterns as a pathway to understanding divine order. This foundational approach influenced the development of astronomical studies in the Islamic world, providing tools and frameworks that later scholars like Shams al-Dīn al-Khafrī and Naṣīr al-Dīn al-Ṭūsī would expand upon.

Building on this legacy, Shams al-Dīn al-Khafrī's *Solution of the Insoluble* delves deeper into celestial mechanics and planetary models while incorporating philosophical and metaphysical considerations. Unlike Al-Khwārizmī, whose work was primarily empirical, al-Khafrī explored the interconnectedness of celestial and terrestrial realms in a manner that resonates with Ṣūfī ideas of cosmic unity and harmony. His synthesis of scientific rigor and metaphysical insight illustrates an intellectual evolution within Islamic astronomy, reflecting the integration of empirical inquiry with spiritual exploration. Although there is no direct evidence of influence from Al-Khwārizmī's *Zīj*, the scientific tradition initiated by the latter shaped the intellectual environment that allowed al-Khafrī to innovate.

Naṣīr al-Dīn al-Ṭūsī's *Al-Tadhkirah fī ʿIlm al-Hayʾah* represents another significant advancement, integrating rigorous empirical astronomy with philosophical and metaphysical reflections. Al-Ṭūsī's contributions, such as *al-Ṭūsī Couple*, addressed inconsistencies in Ptolemaic astronomy and laid the groundwork for future astronomical advancements. While primarily a scientific treatise, *Al-Tadhkīrah* reflects al-Ṭūsī's engagement with the metaphysical dimensions of celestial movements, drawing on the idea that the cosmos mirrors divine order. This alignment with Ṣūfī metaphysics is evident in his acknowledgment of the spiritual implications of understanding the universe, where circularity serves as a metaphor for the unity of existence and the soul's journey toward the divine.

The similarities among these works lie in their integration of scientific inquiry with broader philosophical and metaphysical questions. Each scholar viewed the study of celestial patterns as not only a scientific endeavor but also a means of understanding deeper truths about the universe and humanity's place within it. This shared approach reflects the holistic intellectual tradition of

medieval Islamic scholarship, where disciplines such as astronomy, mathematics, and philosophy were not isolated but interconnected.

At the same time, the differences among these works highlight the diversity of approaches within this shared tradition. Al-Khwārizmī's *Zīj* is characterized by its emphasis on mathematical precision and practicality, while al-Khafrī's work blends empirical inquiry with metaphysical depth, exploring the spiritual implications of celestial phenomena. Al-Ṭūsī's contributions further expand this scope, integrating advanced geometric modeling with a nuanced philosophical framework. These differences reveal how each scholar, building on the intellectual heritage of their predecessors, added unique dimensions to the field.

In terms of influence, Al-Khwārizmī's methodological contributions provided the foundation for Islamic astronomy, creating a framework that later scholars like al-Khafrī and al-Ṭūsī could build upon. Although there is no direct citation of Al-Khwārizmī in the works of al-Khafrī or al-Ṭūsī, the methodological rigor and intellectual curiosity he exemplified undoubtedly shaped the scholarly environment in which they operated. Similarly, while al-Khafrī and al-Ṭūsī drew on different intellectual traditions, their works share a philosophical depth that reflects the broader evolution of Islamic scientific thought.

These contributions remain significant both historically and in contemporary discourse. Al-Khwārizmī's work continues to be foundational in mathematics and astronomy, while al-Khafrī's synthesis of celestial mechanics and metaphysics inspires interdisciplinary studies. Al-Ṭūsī's innovations, particularly *al-Ṭūsī Couple*, remain critical in the history of astronomy and continue to influence discussions on the intersection of science and philosophy. Together, these works demonstrate the intellectual richness of the Islamic Golden Age and its enduring impact on the relationship between empirical science and metaphysical inquiry.

Conclusions

The works of Shams al-Dīn al-Khafrī, al-Khwārizmī, Maslama al-Majrīṭī, and Naṣīr al-Dīn al-Ṭūsī collectively exemplify the rich interplay of scientific inquiry and metaphysical exploration in the Islamic intellectual tradition. These scholars approached complex and often contentious questions of cosmology, astronomy, and mathematics with methodologies that blended empirical precision and philosophical depth. Their contributions, rooted in diverse fields such as algebra, astronomy, geometry, and the encompassing science of celestial circles, demonstrate a commitment to uncovering the underlying principles of the universe.

Each of these thinkers engaged with the notion of a cosmogonical design, employing their distinct frameworks to investigate the structure and purpose of the cosmos. Through their work on circles and numerical systems, they collectively advanced the idea that the universe is not only circular in its geometric and metaphysical essence but also indicative of a higher-order causality. This shared understanding emphasized the necessity of a prime mover or creator as the ultimate cause and designer of the celestial order.

Their collective impact extends beyond the confines of their respective disciplines. The synthesis of mathematical rigor, astronomical observation, and philosophical reasoning in their works not only advanced scientific knowledge in their time but also set a foundation for subsequent developments in both the Islamic and Western intellectual traditions. For example, al-Khwārizmī's pioneering work in algebra and astronomical tables informed later advancements in European science, while Ṭūsī's contributions to planetary models and the Ṭūsī couple

significantly influenced Copernican heliocentrism.

In addition to their scientific contributions, their engagement with Ṣūfism added an additional layer of depth to their explorations. By aligning cosmological phenomena with metaphysical principles, they bridged the gap between the material and the spiritual, suggesting that understanding the universe was also a means of drawing closer to the divine. This synthesis reflects the holistic approach of Islamic intellectual tradition, wherein science and spirituality are not seen as opposing forces but as complementary paths to knowledge.

The works of these scholars illustrate a profound intellectual curiosity coupled with a deep sense of spiritual inquiry. They highlight a worldview where scientific exploration and metaphysical speculation are harmoniously integrated, offering a vision of the cosmos that is as much about understanding its physical mechanics as it is about uncovering its ultimate purpose and meaning. Such an approach continues to resonate, offering valuable insights into the relationship between science, philosophy, and faith in the quest for knowledge.

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