THE VISUAL SCRIBE: TABLES AND DIAGRAMS IN MIDDLES EASTERN MANUSCRIPTS WORKSHOP

ABSTRACTS

Healing Figures: Avicenna's Geometry and Arithmetic

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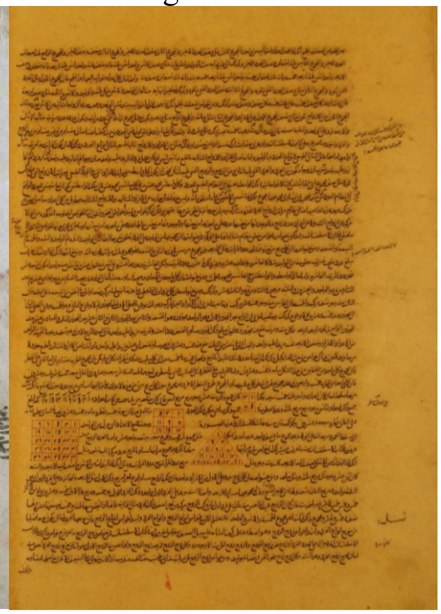
Ibn Sīnā, also known as Avicenna (980–1037), was a polymath whose encyclopedic work, *The Book of Healing* (*Kitāb al-Shifāʾ*), encompassed a wide range of disciplines, including mathematics. The mathematics section of the *Shifāʾ* demonstrates Avicenna's profound engagement with Greek mathematical traditions, particularly those of Euclid and Ptolemy, while also incorporating some of his own insights. He divided mathematics into four branches: geometry, arithmetic, music, and astronomy, emphasizing their interconnections.
Thanks to the Avicenn@ project, we now have detailed information about the manuscript tradition of this work, offering opportunities for precise analysis previously unattainable in this research area. As a quantitative starting point, it is notable that the Avicenn@ project lists 291 copies of the *Shifāʾ* Metaphysics section, whereas only 77 copies include some or all of the mathematics section. This means that for approximately every four manuscripts of metaphysics section, only one containing the mathematics section remains. However, the mathematics section is rich in figures, making it visually distinct from the other parts of the encyclopedia.
This research focuses solely on the sections devoted respectively to arithmetic and geometry. The arithmetic section includes standard tables alongside inline numerical representations, while the geometry section contains more than 400 diagrams. The arithmetic section appears to follow Nicomachus' *Introduction to Arithmetic*, while the geometry section represents the Arabic version of Euclid's *Elements*, including the books XIV and XV. To carry out this research, we have access to more than 25 copies (in addition to the Cairo edition of the book published in 1970), providing a representative sample of the variety of forms and versions of the diagrams and tables.
Regarding the figures in the geometry and arithmetic sections of the *Shifāʾ*, two key questions arise: firstly, we should ask how we should interpret the relationship between the figures in the *Shifāʾ* and the figures in their original sources. In fact, in *Geometry*, as it is not yet determined which translation of the *Elements* was the source for Avicenna, a proper study of these figures in comparison with their supposed model would be informative. Moreover, also in *Arithmetic* the study of figures could shed light on the preexisting materials used by Avicenna.
The second question concerns the possible variations in the figures in manuscripts made by different scribes and their impact on the text as a whole. For instance, in the Ms. Turkey, Istanbul, Süleymaniye Kütüphanesi, Ayasofya 2442 (fig. 1, fol. 256 V.), the scribe adopted a two-column page format and left-justified all the figures exclusively in the geometry section to present a more organized version of the text. Regarding the section devoted to arithmetic, the numerical tables can be found either in the margins of the text or among the lines themselves (e.g. fig. 2, Ms. Turkey, Istanbul, Nuruosmaniye Kütüphanesi, 2710, fol. 270 V.), depending on the manuscript, thus creating two very different visual configurations.

Fig.1

Fig.2



Sergius of Reshaina, Proba, and the Tradition of Presentation of Philosophical Divisions and Definitions in the Diagram Form

Yury Arzhanov*, University of Salzburg, Austria*

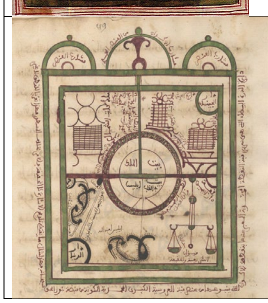
Syriac philosophical treatises, both translated from the Greek and originally composed in Syriac, often present philosophical definitions and divisions in the form of tree diagrams. This tradition most likely goes back to the Alexandrian commentaries on Porphyry's *Isagoge* and Aristotle's logical works. The earliest witnesses of it in the Syriac tradition are the *Commentary on Aristotle's Categories* composed in the early 6th century by Sergius of Reshaina (d. 536), and the *Commentary on the Isagoge* by the mid-6th-century Syriac author Proba. Although all textual witnesses containing Sergius' and Proba's commentaries contain these diagrams that are attached to the individual chapters of their works, there are good reasons to assume that they appeared at a later period, i.e. in the second half of the 6th century, as part of the philosophical education in Syriac schools.

"Popular art" and the Muḥammad Reality: the "Millstone of the spiritual energy". A diagram from Qandūsī (d. 1861, Fez).

Francesco Chiabotti, INALCO-CERMOM

Muḥammad b. al-Qāsim al-Qandūsī was a calligrapher and spiritual master who lived in Fez in the 18th century. Originally from Kenadsa, he went to the capital of the Alaouite kingdom on the pilgrimage route and following a vision of the Prophet when he was in the shrine of Moulay Idris, he decided to abandon his initial project, and settled in Fez, where he led a 'simple' life as a herbalist and calligrapher/copyist. In addition to his activity as a copyist, which attracted the attention of the city's wealthy circles, Qandūsī was also a prolific writer who composed a large number of mystical treatises, which are still in manuscript form today. In these texts, and especially in his main work, the *Kitāb al-ta'sīs* (The Book of the Foundation) he employed diagrams, often inserted at the end of a chapter, as a vivid illustration of the themes dealt with. The *Ta'sīs* is a complex, confusing book, melding cosmogony and alchemical anthroposophy, in the wake of Ibn ʿArabī's work, from which it departs in so many ways. In my presentation, I would like to study one diagram in particular, in which Qandūsī attempts to describe the way in which the supra-temporal and metaphysical reality of the Prophet Muḥammad is linked to man's action and the inspirations he receives in his heart. The movement of this 'millstone' is also the medium of an initiatory practice, which Qandūsī illustrates with the help of this 'poor' object of everyday life. I will try to tackle a number of questions that this simple drawing raises. First, to read it in the long tradition of the symbolic diagram in Sufi literature. From this point of view, Qandūsī does not innovate but nevertheless takes a remarkable step forward. Anxious to respect the prohibition on figurative representation of the Prophet, he focuses on how to translate his spiritual reality, the *ḥaqīqa muḥammadiyya*, into drawing. In this sense, he is perhaps the first to have dared to attempt a graphic setting of this key concept of post-classical Sufism. To do this, he uses 'poor' symbols. This observation leads us to question the nature of the addressee: who is Qandūsī's reader? We shall try to show that his esotericism is situated outside the brotherhood networks, towards which our author is fairly critical, and prefers to form the milieu of the Fez souk, made up of craftsmen and shopkeepers, even women who frequented his shop, which was also his writing and probably teaching workshop, where he used a language impregnated with Maghrebi dialectalisms. But why was this outsider, a man of the desert, able to build a bridge between this working-class environment and the Palais, while maintaining a critical and independent view of the world around him? And why his project, as we will show, was perceived by our author as a failure? We will therefore refer to Carlo Ginzburg's concept of micro-history to try to show how our author, consciously or unconsciously, articulates a dialectic between learned spiritual culture and 'poor' means of expression.

The *ṭāḥūnatal-himma* from the *K. al-Ta'sīs* (Ta'sis I): autograph manuscript of 1252 H/1837. Edited by the owner under the title *Satan Tools against the religion of Allah*, on print on demand site Lulu (n.d.; s.l.). Qandūsī's name does not appear in the front cover.This edition is reliable nonetheless, accompanied by numerous notes explaining the author's dialecticisms. This edition has been withdrawn from trade.



The *ṭāḥūnatal-himma* from the *K. al-Ta'sīs* (Ta'sis II): manuscript 2526K from the Bibliothéque Nationale du Royaume du Maroc, copied in 1255 H/1840, during Qandūsī's lifetime, by Muḥammad ʿAbd al-Salām al-Ghumārī. This text is considerably longer than the first version. The text has been typeset but not yet published.

Diagrams in Sanskrit mathematical and astronomical works translated from Arabic and Persian at the court of Savaī Jai Singh II (1689 – 1743)
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Since my edition of the *Baudhāyana Śulbasūtra* and its commentary *Śulbadīpikā* in 2016, the purpose of my research is the study of the manuscripts that translate ancient mathematical and astronomical Greek and Arabo-Persian knowledge into Sanskrit. I especially read these Sanskrit manuscripts at the Library of the Man Singh II Museum of Jaipur (private institution, India), where my special status of *Non stipendiated visiting scholar* enables me to have access to these documents on a regular basis.

The principal aim of my research is the *Rekhāgaṇita* 'Mathematics of lines', translation into Sanskrit of Euclid's *Elements*, made not from Greek, but from the Arabic text of Naṣīr ad-dīn aṭ-Ṭūsī. This translation into Sanskrit was made around 1730 AD, in Jaipur, at the impulse of Savaī Jai Singh II, the founder of this city. Jai Singh II is a Hindu rāja who was so interested in astronomy that he had five observatories built, in Jaipur, Delhi, Mathura, Banaras and Ujjain. The observatory of Jaipur is still remnant and well maintained, thanks to its registration on the Unesco list. Jai Singh II also sent an embassy - led by Father Figueiredo, a Portuguese Jesuit based in Agra - to Lisbon in 1729 AD, in order to find books on European astronomy and instruments. Jai Singh II was also interested in portable instruments, and he sponsored the Sanskrit translation of Arabic and Persian books on the making and use of astrolabes, like The *Yantrarāja-vicāra-viṃśādhyāyī*, from the Persian *Risālah-i Bist Bāb dar Ma´rifat-i Usturlāb* of Naṣīr al-Dīn al-Ṭūsī.

I intend to study this last Sanskrit text, of which I found a copy in Jaipur, and to compare it to its equivalent, as I am already doing for the *Rekhāgaṇita* and its source, the *Taḥrīr kitāb uṣūl al-handasa li-Uqlīdis* of Naṣīr al-Dīn al-Ṭūsī. In this last case, I didn't find any copy of Naṣīr's work in Jaipur but I use two other manuscripts : Berlin, Staatsbibliothek, Ms.or.fol. 256 and Istanbul, Millet, Feyzullah 1359. Last year, I found in Tonk an Arabic manuscript that could have belonged to the Maharaja Public Library of Jaipur before being transferred to Tonk, but this is to be confirmed.

Comparing the Jaipur and Jodhpur's manuscripts to the edition of the *Rekhāgaṇita* (Bombay, 1901), and to the Berlin and Istanbul's manuscripts for the Arabic version, I noticed very interesting dissimilarities in the treatment of diagrams. By instance, while all the Sanskrit versions I resort to, replace the Arabic names of the points (ا ب ج د…) by their Sanskrit equivalents (अ ब ज द), the Sanskrit manuscripts represent the shapes as in the Arabic manuscripts, disposed from right to left, while the Bombay edition chooses a disposition from left to right, as in Sanskrit writing. Of course, many other remarks could be made about the diagrams in these texts, and I hope I will be able of doing more such remarks about other manuscripts translated into Sanskrit from Arabic or Persian, available at the Maharaja Public Library of Jaipur.

Historiographical musings on the *Taḥrīr Uṣūl Uqlīdis* of Muḥyi al-Dīn al-Maghribī and its geometrical diagrams: An application of cladistic analysis
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A recurring question in studies of medieval geometrical treatises is how do Euclidean geometrical diagrams get transmitted? What characteristics are preserved over time and what characteristics

can be modified by copyists or editors? How should modern editors approach the diagrams in medieval manuscripts? Although no consensus has yet emerged within the scholarly community, it is clear that diagrams can, in some contexts, present important evidence documenting lines of influence connecting authors and the texts they produced.
Muḥyi al-Dīn al-Maghrabī (died about 682 / 1283) produced an edition of Euclid's *Elements* early in his mathematical career, but his *Taḥrīr Uṣūl Uqlīdis* has been overshadowed in the history of medieval mathematics by the earlier *Taḥrīr Uqlīdis* of Naṣīr al-Dīn al-Ṭūsī (completed 646 / 1248). Al-Maghribī justified his new edition by criticizing three earlier versions – the epitome of Ibn Sīnā, the *Taḥrīr* of the *Elements* by Abū al-Qāsim `Alī ibn Ismā`īl al-Naysābūrī (4th--5th / 10th--11th c.), and an edition by Abū Jā`afer al-Khāzin (apparently not extant) -- for a variety of failings that he intended to repair in his own edition.
Following D. Raynaud's utilization of phylogenetic software to create a *stemma codicum* for diagrams in medieval manuscripts, I have recently begun coding diagrams in the known Arabic translation manuscripts of Euclid's *Elements* in preparation for making a phylogenetic study of Arabic translation manuscripts as well as manuscripts from several Arabic commentators. This project already reveals some unsuspected relationships. Despite his criticism of al-Naysābūrī's edition, a remarkable parallelism exists between it and the *Taḥrīr* of al-Maghribī, both in terms of diagrams and in terms of text. These parallels suggest that al-Maghribī's *Taḥrīr* often depends, at least in books I—III, on the *Taḥrīr* by al-Naysābūrī.

Tables and Diagrams in Christian Ethiopia and Eritrea
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Augustine Dickinson*, University of Münster*

The highlands of Eritrea and northern Ethiopia, a region with a written civilization dating back to the 1st millennium BCE, present a unique case of a cultural area with a long and uninterrupted manuscript tradition. Introduced to the region around the first centuries CE, parchment manuscripts have served as tools for knowledge transmission up to the present day. Among other materials, the manuscript culture of Christian Ethiopia and Eritrea has preserved over the centuries a corpus of texts and graphical elements, including tables and diagrams, related to calendars, astronomy, cosmology, mathematics, divination, and other topics. This corpus is conventionally referred to as *bāḥra ḥassāb* ("Sea of Computus" or "Sea of Concepts").
This still largely understudied tradition has absorbed a wide range of material from Hellenistic, Islamic, Copto-Arabic, European, and other traditions, in the form of texts, tables, and diagrams. At the same time, this cultural input facilitated local intellectual production, which generated unique cross-cultural ideas sometimes expressed in forms of diagrams of local origin.
A new project (2025–2030), *Bāḥra ḥassāb: Knowledge Transmission in Ethiopia and Eritrea from Antiquity to Modern Times*, funded by the German Research Foundation as part of the Emmy Noether Programme and based at the University of Münster, aims to study *bāḥra ḥassāb* as a local epistemic tradition of Ethiopia and Eritrea. Building on Otto Neugebauer's seminal work *Ethiopic Astronomy and Computus*, which, however, treats the tables and diagrams only sporadically, the project seeks to document the entire repertory of elements in the corpus, establish their origins and interconnections, and explore manuscriptological, philological, and cultural aspects of this tradition, including the processes of its adaptation and development over time. Our talk will

summarize the results of the first months of the project and introduce a preliminary repertory of the tables and diagrams transmitted in the corpus of *bāḥra ḥassāb*.

How to use and where to place a geometrical diagram? The case study of *Ḥibbur ha-Meshiḥah ve-ha-Tishboret* – on various copies, translations and critical editions

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Abraham bar Ḥiyya ha-Nasi (ca. 1065-1145), born in Barcelona, also known as Abraham Savasorda, is well known due to his manuscript in Hebrew *Ḥibbur ha-Meshiḥah ve-ha-Tishboret* ("Treatise on Measurement and Calculation"), written between 1116 and 1145, which was translated in 1145 into Latin by Plato of Tivoli, naming it as *Liber embadorum*. The manuscript is one of the well-known medieval mathematical treatises, presenting mainly geometrical propositions in Hebrew for the first time. The treatise is known to have (at least) eight copies, made during the 14th and the 16th centuries. However, if one concentrates only on the existing known copies and not on any attempt to (re)construct a history of an *Urtext*, either in Hebrew (or in Latin), one notices not only the various omissions, the comments and the notes added to the various copies, but also the different layers found in these copies. It is from these omissions and layers that one may attempt to reconstruct a possible history of transmission which would reflect the fluidity of the Hebrew manuscripts or the variations and changes between them. In my talk I aim to concentrate on another, more visual layer, which may shed a new light on such transmissions: the geometrical diagrams. While I aim to examine how such diagrams functioned epistemologically, also interesting is the 1912 critical edition of the *Ḥibbur*, prepared by Michael Guttmann. In such an edition one finds all the diagrams at the end of the book, although several of these diagrams are not to be found in any of the known copies. This may lead to the conclusion that such diagrams were in fact an invention of Guttmann: while not having access to several diagrams, Guttmann attempted to derive them from the text. Hence what was the role of the diagrams in each of these versions? And how the different copies, translations and critical editions shaped and re-shaped this role?

Manuscript to Digital: Records of Mapping Knowledge of Anatomy in Middle Eastern Manuscripts Project

***Mohammad Golshan**, Georg-August-Universität Göttingen and École des Hautes Études en Sciences Sociales (EHESS)*

MASMEM (Mapping *Anatomia Scientia* in Middle Eastern Manuscripts) is an interdisciplinary medical humanities initiative. The concentration of the project is on the academic investigation of anatomy knowledge in Middle Eastern manuscripts from 7th to 17th century CE, on the vast and varied anatomy knowledge from Persian, Turkish and Arabic manuscripts. Through a profound scholarly study of Anatomia Scientia, MASMEM attempts at achieving a systematic retrieval, interpretation, analysis and synthesis of the anatomy knowledge from the rich visual representations in tables and diagrams as well as textual elaborations.

The primary objective of this project is to establish a comprehensive understanding of Anatomia Scientia within the context of Middle Eastern history of science. To this end, the project employs a multifaceted approach that involves the exploration of Anatomia Scientia's conceptualization, documentation and transmission within Middle Eastern intellectual traditions. MASMEM applied two key strategies to achieve its objectives. First, it involves the collection of data from manuscripts including visual representations in tables and diagrams with/without textual elaborations. Secondly, the Anatomia Scientia will be extracted exclusively from texts and non-visual sources. The integration of visual and textual data will enable MASMEM to propose a more comprehensive and novel understanding of the Anatomia Scientia in Middle Eastern intellectual traditions and the knowledge transmitted to subsequent generations of the scholars, scientists and scribers over centuries.

The design of MASMEM entails the dissemination of scholarly outcomes across four volumes in English. Three first volumes will be dedicated to *Anatomia Scientia* articulated in one of the languages of project: Persian, Turkish and Arabic. Moreover, a comprehensive final volume will also be slated for comparative analysis approach to the findings in three language-based volumes. The process also includes digital reconstruction and re-modeling of the anatomical models represented visually, particularly those presented by diagrams. Regarding the other data of anatomy in tables and texts, the project attempts to propose a conceptual model of developments in portrayal of the anatomy knowledge over time. Moreover, In the interest of comprehensively addressing the subject, the content of these volumes will extend beyond the purview of history of science, encompassing artistic approaches to visual representations, including geometry, shapes, and orientations of diagrams and visual analysis of the tables. Accordingly, MASMEM will undertake a comprehensive examination of the Anatomia Scientia, taking into account its alignment with the cultural, scientific, and artistic contexts. This endeavor promises to offer invaluable insights into the field under study, particularly concerning the potential contributions of written legacies from the region to the advancement of Anatomia Scientia in the domain of medical science and other pertinent scientific disciplines within its own historical period.

The significance of MASMEM lies in its capacity to illuminate hitherto under-explored facets of the historical trajectory of Anatomia Scientia and the chronological evolution of this discipline within the broader context of ME and global history. By underscoring the intellectual underpinnings of Anatomia Scientia in ME, MASMEM not only contributes to the existing scholarship in the domains of history of science and medicine but also establishes a nexus between Anatomia Scientia and the scientific pursuits of diverse civilizations within ME. Furthermore, it proposes a novel, comprehensive narrative of ME intellectual history, encompassing diverse aspects of the scientific past. The narrative highlights the functions and relevance of under-studied manuscripts in a profound examination of Anatomia Scientia.

The impetus behind the establishment of this project is to provide a user-friendly, comprehensive, accessible platform for scholars and researchers in the domain of history of anatomy, with a particular emphasis on the knowledge depicted in Middle Eastern manuscripts. This scientific platform is designed to function as a substantial repository for researchers in the historiography of science and medical humanities, encompassing the collection, analysis, and organization of Anatomia Scientia in Persian, Turkish, and Arabic. The project's objective is twofold: first, to preserve the rich Anatomia Scientia in the region; and second, to reinterpret it in a way that takes into account new insights and methodologies. The platform's databases will provide interested users with detailed data and information about visual and textual sources related to Anatomia Scientia in different languages from the region.

As a part of this presentation, I will also exhibit the primary platform designed for this purpose, which itself requires a considerable amount of time. The platform comprises various components. In conjunction with the study of anatomical knowledge in tables, diagrams, and texts, this initiative will establish a link between people and places to map the ideas connected to these properties and enhance the organization of the results.

From the West and the East: “Tree of Porphyry” Diagrams in Hebrew Manuscripts

Sivan Gottlieb, *Marie Skłodowska-Curie Actions European Postdoctoral Fellow, Department of Semitic Studies, University of Granada, Spain*

Porphyry, the third-century Greek philosopher, wrote the treatise *Isagoge* as an introduction to Aristotle’s *Categories*. In *Categories*, Aristotle describes the world through ten categories, beginning with substance. In the *Isagoge*, Porphyry delves deeper into Aristotle’s substance category, developing a method to identify its distinguishing characteristics by progressing from the general substance to specific genera and species.

The Tree of Porphyry diagrams (*arbor porphyriana* in Latin; *ilan porphyrios* in Hebrew), which bear his name but are not explicitly found in his treatise, visually represent this method for defining “genera” and “species.” These diagrams became widely influential across cultures from the Middle Ages onward, appearing in various treatises. Although they can be used to classify the attributes of any substance, they were most commonly applied to defining human characteristics such as corporeality, animation, sensory ability, rationality, and mortality.

This presentation will examine the corpus of Tree of Porphyry diagrams found in Hebrew manuscripts from the late Middle Ages to the modern period. This corpus encompasses 120 diagrams across 96 manuscripts, dating from the fourteenth to the twentieth century, originating from diverse regions and written in various script styles. While many of these diagrams hail from Western Europe—particularly Spain and Italy—examples also exist in Byzantine script and from the Middle East.

These Hebrew examples illustrate the transmission of the diagram from both Latin and Arabic sources. I will explore the persistence of this visual form and the intricate interplay between its visual and textual elements, highlighting unique variations and adaptations within the Hebrew manuscript tradition.

Visualizing Verified Knowledge: Genealogical Charts in Seventeenth- and Eighteenth-Century North Africa

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This paper examines seventeenth- and eighteenth-century genealogical charts from North Africa that are part of detailed genealogical treatises documenting and investigating the lineages of alleged descendants of the Prophet Muḥammad (*sharīf*, pl. *shurafāʾ*). Such treatises were written in a historical context in which the Moroccan sultans ordered the compilation of comprehensive, country-wide registers of the Prophet’s descendants in order to counteract the phenomenon of impostors (*mutasharrifūn*) and to ensure that only “true” descendants of the Prophet received the corresponding privileges. Over time, this gave rise to complex and multilayered genealogical treatises on individual branches of families with prophetic descent.

The examples of such works examined in this paper deal with the descendants of ʿAbd al-Qādir al-Jīlānī (d. 561/1166)—a Ḥanbalī scholar and popular saint from Iraq who is said to be of prophetic descent. Some of his descendants, it is said, emigrated to the Iberian Peninsula in the wake of the Mongol conquests, and from there fled to Fez at the end of the fifteenth century. Shortly after their arrival in Fez, the so-called "Qādiriyyūn" seem to have succeeded in being recognized by the local elite as legitimate descendants of the Prophet through the presentation of family documents. As a result, they seem to have successfully integrated into the social fabric of the city of Fez.

This contribution analyzes the genealogical charts contained in the two most important of these works on the descendants of al-Jīlānī in the Maghrib:

(1) ***al-ʿArf al-ʿāṭir fī-man bi-Fās min abnāʾ al-shaykh ʿAbd al-Qādir*** **by ʿAbd al-Salām al-Qādirī (d. 1110/1698)**

The first text was written by the respected scholar and genealogist ʿAbd al-Salām al-Qādirī , who not only wrote the first monographic study about the descendants of al-Jīlānī in Fez, *al-ʿArf al-ʿāṭir*, but also the first compilation of all the prophetic descendants in Fez. He is held in high esteem by later generations of scholars, probably because of his meticulous examination of the family records of the Prophet's descendants throughout the country.

(2) ***al-Sirr al-ẓāhir fī-man aḥraza bi-Fās al-sharaf al-bāhir min aʿqāb al-shaykh ʿAbd al-Qādir*** **by Sulaymān b. Muḥammad al-Ḥawwāt (d. 1231/1816)**

The second text was written by the literary scholar and genealogist Sulaymān b. Muḥammad al-Ḥawwāt, who later in his life held the office of the Syndicate of the Prophet's Descendants (*naqīb al-ashrāf*). His work offers a comprehensive and thorough investigation of the lineage of al-Jīlānī's descendants, characterized by a critical review of the information in earlier works, an intricate consideration of various evidence, and theoretical considerations regarding the verifiability of descent. Al-Ḥawwāt aimed to provide reliable knowledge about the lineage of the Qādiriyyūn and explicitly framed his work as a project of verification (*taḥqīq*).

In this paper, I will address the following questions:

1. How was lineage visually represented in these genealogical works? What decorative and graphic elements are used? What information do these charts contain? How do they differ from other forms of genealogical representations, for example from the eastern Islamic world?
2. How does visual representation change from the seventeenth to the eighteenth century? How are family members born during the eighteenth century incorporated into the later versions of the genealogical chart? How is the same material represented in a nineteenth-century lithograph and in the modern edition?
3. What is the function of these visual representations within the works? Where are they inserted and how are they introduced or framed? How do they relate to the written text?

In my contribution, I will show that the genealogical relationships depicted in these charts are all presented in the form of a family tree. This tree is organized in all manuscripts as a chain of names running counterclockwise and almost exclusively in horizontal and vertical directions, with only a few curved elements. The name chain always begins with the Prophet Muḥammad and continues through al-Jīlānī to his descendants alive during the authors' lifetime. In some, but not all, cases, the names of Muḥammad and ʿAbd al-Qādir al-Jīlānī are highlighted in color or thickened script. The chain of descent is linked by the small word *bin* (son of), as is common in genealogical charts in the Islamic world, so that no lines are needed to hold the chain together. The names of the male descendants are given for some members of the family tree, connected by straight lines arranged in a radial pattern. Daughters and wives are not included, except for Fāṭima, the daughter of Muḥammad; nor are dates of birth or death or any other additional information given.

I will argue that the genealogical charts in the works examined have two main functions: They serve as visual representations of verified knowledge, making the results of textual investigation accessible, and they protect the results of this investigation from subsequent unauthorized changes. First, the genealogical charts provide an at-a-glance representation of a selection of information previously discussed in detail in the written text. As such, visual representations can be considered a tool to aid the genealogist's memory and orientation in the text. This is also supported by the numbers inserted in some places, which correspond to numbers in the text.
Second, the genealogical charts serve as a means of codifying knowledge. This is particularly relevant to genealogical knowledge, given its procedural and ever-changing nature. The chosen form of representation, the family tree, and the use of certain tools, such as the note "discontinued" (*munqaṭiʿ*), minimize the risk of unauthorized information being added later. Complementary strategies, such as the codification of the verified knowledge in poems or the insertion of intermediate conclusions in the text, reinforce this function and ensure the correct transmission of the verified knowledge.
By combining visual, textual, and poetic elements, genealogists such as ʿAbd al-Salām al-Qādirī and Sulaymān b. Muḥammad al-Ḥawwāt created a system designed to ensure the integrity of their findings. Thus, I will show that the representations examined in this paper aim to visualize the results of the verification process and make them easily accessible to scholars and genealogical experts.

Astronomical Diagrams accompanying the *Book of Enoch* in two Ethiopic Manuscripts

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The Ethiopic manuscripts of the *Book of Enoch* is the only manuscript tradition preserving the full version of this text, and the European scholars began to reconstruct and study this Ethiopic text in the late 18th century. However, until now, only little attention has been paid to the astronomical diagrams that often accompany the text of Enoch in the Ethiopic manuscripts. The diagrams are found in some of the oldest Ethiopic Enoch manuscripts written in the 17th century, modelling on which the diagrams in the latter manuscripts were drawn. This presentation deals the diagrams in EAP432/1/60 and EMML 1950, both written in the 17th century. Both the ideas and data of the diagrams relate to the astronomical part of the text of Enoch. Drawn within circles or squares with cardinal directions, they contain the numerical description of the monthly lunatic and solar changes, demonstrating the heavenly laws in the *Book of Enoch*. However, there are also clear divergences between the diagrams and the text: The astronomical data and the zodiac months in the diagrams are nowhere to be found in the text. In conclusion, this case study provides another example of the relationship between text and diagrams in the manuscripts and also contributes to the history of science in Christianity.

Tables and Diagrams in Greek Mathematical Papyri

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This paper surveys means of visual presentation in Greek mathematical papyri. Preserved in the sands of Egypt and dating from the Hellenistic though the Umayyad period, these texts belong to what is sometimes called mathematics of practitioners, with only a few isolated examples containing works of theoretical mathematics. Most mathematical papyri comprise arithmetical and metrological tables and problems aimed at teaching and training computational and mensurational skills. Since such texts are poorly presented in the later manuscript tradition, and when they are, both their texts and accompanying diagrams are often corrupt (cf. collections of mensurational problems in the pseudo-Heronic corpus), investigation of earlier papyrological evidence is invaluable for understanding the acquisition and transmission of elementary mathematics and computational skills in Greco-Roman antiquity.

Colors of stars in pre-modern texts, tables, and drawings

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We study and discuss the meaning of color in descriptions and depictions of stars in the pre-telescopic time. This is an interdisciplinary collaboration with scholars of philosophy (D.L. Neuhäuser, M. Cosci) and philology for the different languages (P. Rezvani, P. Schmidl, J. Chapman, D. Luge).

We surveyed a large number of texts, tables, diagrams, and depictions of stars and constellations (a) to find examples, where the true color of stars was meant to be given and (b) to determine the naked-eye limit for color detection empirically. Color descriptions are particularly credible and quantifiable (as astronomical color index B-V), if they are compared to colors of planets or other stars (gold standard). We present examples from MUL.APIN, the star catalog of Ptolemy and its revision regarding star colors by Al-Ṣūfī, as well as from the Bedouins, etc. When surveying the many colorful *depictions* of stars and constellations, we noticed only few cases, where a true star color seems to be displayed on purpose - partly originated from the Orient. In total, we found 19 yellow, red, and orange stars and also 22 white and blue stars with correct color description in pre-telescopic time, both down to a magnitude of about 3.2, the limit between photopic and scotopic vision. (The last was Mira in 1596, Neuhäuser & Neuhäuser et al. 2024 Astron. Notes.) Secular changes in star color over historical time can be used to constrain astrophysical theories and to better understand the evolution of massive stars, such as the change of color in Betelgeuse from yellow two millennia ago (Sima Qian: “yellow” in comparison to the red Antares and Mirach and the blue-white Bellatrix and Sirius, Hyginus: “in color like Saturn”, i.e. B-V=1.06 mag) over Al-Ṣūfī and Tycho Brahe (1573) to its current deep red at B-V=1.78 mag (R. Neuhäuser et al., 2022, MNRAS, doi.org/10.1093/mnras/stac1969).

Graphing the Cosmos: The Astronomical Illustrations of Ṭūsī’s *Risāla-yi Muʿīnīya*

Kaveh Niazi

Composed in 632/1235 *Risāla-yi muʿīnīya* is the earliest known astronomical work of Naṣīr al-Dīn al-Ṭūsī (597/1201 - 672/1274). However, Ṭūsī included a great deal of the material from *Risāla-yi muʿīnīya*, and from the author’s appendix to this work (written less than a decade later and often referred to as *Dhayl-i muʿīnīya*) in the phenomenally popular *al-Tadhkira fī ʿilm al-*

hayʾa, composed in 659/1261. Of the unusual features of *Risāla-yi muʿīnīya* is the presence of the author's appendix itself, written by Ṭūsī at the behest of his patron. The figures in the richly illustrated appendix are evenly distributed, with practically each chapter containing a figure. The distribution of figures in *Risāla-yi muʿīnīya* is notably uneven, with the figures that Ṭūsī included largely confined to the discussions on the celestial orbs. That the illustrations in *Risāla-yi muʿīnīya* and *Dhayl-i muʿīnīya* were integral to the conception of the work can be seen by the fact that they are, without exception, referenced in Ṭūsī's text. Ṭūsī was to subsequently include figures from *Dhayl-i muʿīnīya* in his *al-Tadhkira fī ʿilm al-hayʾa*. Since there is little reason to doubt Ṭūsī's claim that *Dhayl-i muʿīnīya* was written in response to follow-up queries by his patron, the figures in *Dhayl-i muʿīnīya* could be viewed as having been carefully curated by the author, with the specific goal of clarifying astronomical concepts for his patron. Through Ṭūsī's *al-Tadhkira fī ʿilm al-hayʾa*, some of these figures entered the standard illustrations of the cosmos in works by Ṭūsī's successors.

Visual aspects of tabular texts in Babylonian Mathematical Astronomy
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Alessia Pilloni, *Freie Universität Berlin*

Babylonian tables with computed lunar and planetary data are arranged in several distinct layouts. Typical features of layout in these tables are rulings, alignments, spacing, and headers. These features are shaped by multiple factors, including conventions inherited from the scribal tradition, functional considerations connected to computational practice, and representational purposes. In this presentation, a selection of Babylonian lunar tables is investigated with a focus on layout and representational features. The tables were written between ca. 350 BCE and 50 BCE in Babylon and Uruk, the only two Babylonian centers of scholarship where the methods of mathematical astronomy are attested. This enables the pursuit of two research perspectives: a diachronical one and a cross-regional one. The aim is to demonstrate that visual aspects can be fruitfully mobilized in order to answer questions about the production and the functionality of the Babylonian tables and about the cross-regional transfer of astronomical knowledge and its representation.
With regard to the latter topic it is striking that in most cases, the content of the mathematical astronomical cuneiform texts from Babylon and Uruk are, by and large, identical in terms of the computational systems, suggesting that there was close contact and collaboration between the two astronomical centers. Occasional systematic formal differences, such as the organization and selection of the content of an astronomical tabular text, reveal certain details about their transmission between the two cities. In this contribution, we will present which types of systematic differences can be encountered in the astronomical tabular texts and what they may imply in terms of the exchange of knowledge between the two centers of Babylonian astral knowledge.

The Arabic Manuscript of Dioscorides' Materia Medica in the University Library of Bologna: The Dialogue between Plants and Text
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In around 70 a.C, the ancient pharmacologist Pedanius Dioscorides of Anazarbus (fl. 40- 80) penned the then most comprehensive attempt in Greek to compile and make sense of these diverse ancient accounts of the botanical world. The result, his Περὶ ὕλης ἰατρικῆς, *On medicinal matter*, is today often called by its Latin name, *De materia medica*. This vast text comprises over 800 different substances, originally divided into five books: on aromatics, oils, salves, trees and shrubs; on animal parts and products, cereals, pot herbs, and sharp herbs; on roots, juices, herbs and seeds; on more herbs and roots; on wines and minerals. *De materia medica* did not originally have illustrations, but other ancient works on medical botany did. In time Dioscorides' work, too, was illustrated with pictures drawn from these other works. It was also abridged – made to focus just on herbs –and rearranged alphabetically.

De materia medica served as the basis for the study of botany and pharmacology in Greek and Arabic throughout the Middle Ages. Greek, Arabic, and later, Latin, scholars not only copied the text, but rearranged, edited, glossed, and commented on it. Pictures played a prominent role within this tradition. They appear in the earliest surviving "complete" versions of the text dating to the sixth century, and were reproduced throughout the Middle Ages, eventually making their way into the virtually text-free botanical atlases of the fifteenth century.

The Arabic translation was undertaken by an associate of Hunayn known as Istifan b. Basil (Stephanos son of Basilius, ca. 860), who apparently worked under Hunains supervision and whose Arabic evidently was not as good as that of Hunain. The medieval Arabic sources report that the translation was made directly from Greek into Arabic. We are told that Hunain reviewed the completed translation and that the final product was authorized by him. Of course Hunain's earlier translation into Syriac must have helped him to control the fresh translation given his previous experience with the original language of the text.

Compared with the translation process, the surviving manuscripts of the Materia Medica reflect an even more complicated reality. First, the manuscripts are scattered throughout the world, and because nearly all of them are illustrated they are generally treated as works of art, making them far less accessible than many other types of scientific manuscripts.

Despite the prominence and abundance of plant depictions in the ancient and medieval Dioscorides, their role within the Arabic botanical tradition has attracted only cursory attention by scholars, who often regard the illustrations as either having had a purely aesthetic or decorative function, or as having been so error-riddled from centuries of copying as to be effectively useless. On the contrary this contribution will show that botanical illustration played an important role in the Arabic practice of botany through the example of a manuscript of the *Materia Medica* never previously investigated in detail and recently fully digitized. The manuscript in question is ms. BUB 2954, dated 642/1245 and containing a vast range of illustrations of plants and minerals.

The Arabic tradition of botanical illustration in Dioscorides's Materia Medica was a dynamic and critical tradition that developed, expanded, and experimented with modes of depiction, including "from life" plant depiction.

Zodiac Man in Armenian Tradition

Anush Sargsyan*, Matenadaran: Mesrop Mashtots Scientific Research Institute of Ancient Manuscripts, The Department Studies the Scriptoria*

The theory of the Zodiac Man, which correlates the twelve zodiac signs with the twelve parts of the human body, originates from the Assyro-Egyptian macrocosmic-microcosmic analogy and developed by Greco-Roman scholarship and subsequently transmitted to medieval authors. The pictorial representations of this theory, commonly known as Zodiac Man diagrams, emerged within

Western medieval literature. The evolution of the theory, both in its visual representations and its integration into a predominantly medical-astrological framework, reflects the significant influence of translations of medical and astrological works from the Arabic world. Due to their widespread popularity, these diagrams were disseminated across various cultures, including the Armenian manuscript tradition.
This presentation will focus on the distinctive adaptation of the Zodiac Man in Armenian tradition, examining its connection to the evolution of the zodiacal theory in Armenian literature, its specific contextual usage, and the broader influence of cross-cultural exchange. In the first part of my study, I will address the development of the zodiacal theory and its application in Armenian literature. Before delving into diagrammatic interpretations, I will examine the usage of diagrammatic representations in Armenian literature. Then, through the lens of the Zodiac Man diagrams, I will demonstrate how they are interconnected with Armenian literary traditions and in which kinds of texts they were utilized. By showcasing their iconographic and stylistic variations, I will highlight the broader context through which these diagrams were influenced in Armenian literature.

Revealing the latent mathematics in historical horoscopes through a digital reconstruction method

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Horoscopes are astronomical diagrams that depict the position of the planets along the circle of ecliptic (i.e., the annual path of the sun in the sky) for a given moment of time, in a specific location on the Earth. The backbone of a horoscope is a twelve-part division of the ecliptic, each of which is called a *cusp* or *astrological house*. Together, the cusps form an astro-mathematical framework in which the planets are arranged according to their location along the ecliptic (i.e. ecliptic longitude). Dividing the circle of ecliptic into twelve parts was not historically as straightforward as it might sound. Historical methods for dividing the ecliptic into twelve cusps are astronomically and mathematically diverse and often complicated, with each method resulting in a different horoscope for the same moment and place. A horoscope is then an artifact that encapsulates firstly, a frozen moment in time as determined by the sky above a specific place, and secondly, an astro-mathematical method that translates that moment into its base structure, i.e., the boundaries of the twelve cusps. Since the cusp calculation methods are most often unstated in the historical horoscopes, studying the development and transmission of these astro-mathematical methods across time and place is often only possible through reverse engineering the horoscopes to find the underlying method. In this workshop, I aim to introduce a digital reconstruction methodology that I developed for detecting the latent cusp calculation methods in historical horoscopes using MATLAB, a software environment and programming language.
Through a visual introduction, participants will first gain insight into the astronomical and mathematical concepts behind horoscopes and their structure as well as how they represent the sky in the form of schematic diagrams. We will then review the astronomical/astrological theories and mathematical techniques behind seven most common cusp-calculation methods used in casting medieval horoscopes. Subsequently, we will explore how MATLAB can be utilized for reproducing different versions of a given pre-modern horoscope according to these methods, and to find the closest matching version which represents the method used in it. The session will conclude with a brief review of the user interface and a live demonstration of the computer program in analyzing a sample horoscope.

“Visual Idioms” in Islamicate Astronomy (*ʿilm al-hayʾa*) Diagrams

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Abstract: The tradition of Islamicate astronomy known as *ʿilm al-hayʿa*, or “the science of the configuration [of the orbs],” aimed to set forth a cosmology based on uniformly-rotating physical orbs, while at the same time preserving the predictive accuracy of models inherited from Ptolemy’s *Almagest*. Indeed, many works in this tradition identified “doubts,” and unresolved “problems” that arose when interpreting the *Almagest* models in terms of physical bodies, and offered innovative solutions, yet the manuscript diagrams presenting these models remain little studied by modern historians. In this talk, I explore examples of manuscript diagrams as specific physical objects found in Islamicate astronomy texts and commentaries produced from the 13th-16th centuries by authors such as al-Kharaqī (d. 1158), al-Ṭūsī (d. 1274), and al-Shīrāzī (d. 1311). In particular, I analyze their visual idioms - their particular uses of line, color, and labels - as a way to reflect on how diagrams functioned on a material as well as mental basis to convey meaning to the reader alongside, as well as independent of, the text. I argue that diagrams were not merely helpful visual aids but in fact fulfilled a vital function as tools of reasoning, reflecting specific ways of thinking about problems, concepts, and models in astronomy and communicating these thoughts to other readers/viewers. Diagrams not only helped to illustrate celestial phenomena, but served as a crucial means by which astronomers could visualize problems associated with the three-dimensional structure of complex astronomical models, propose new solutions, and analyze and critique the work of their predecessors.

Strings, Lines, and Circles: Diagramming Musical Pitch and Perception in the Treatises of Ṣafī al-Dīn al-Urmawī

***Hallie Voulgaris**, Yale University, Department of Music*

The two extant music-theoretical treatises of Ṣafī al-Dīn al-Urmawī (d. 1294 CE)— *Kitāb al-Adwār fī’l-mūsiqa* (Book of Cycles in Music, c. 1235 CE) and *al-Risāla al-Sharafiyya fī’l-nisab al-ta’lifiyya* (Treatise for Sharaf al-Dīn on Proportions in Musical Composition, c. 1267 CE)—rely heavily on visual communication. Unlike the largely textual works of his predecessors, al-Urmawī’s treatises are distinctive for the number and variety of diagrams they contain. His widespread popularity and lasting influence proliferated these diagrams across the Middle East in Arabic, Persian, and Ottoman Turkish manuscripts for many centuries.

This paper examines a subset of these diagrams, focusing on the three main ways that al-Urmawī represents pitch space, or the set of possible musical pitches in a given context. Each method uses distance and shape on the page to represent a different mode of musical perception and thought. The first type of diagram depicts pitch pictorially on a physical object of sound production, namely a string of the *ʻūd* or lute. The second type abstracts this pictorial representation into an evenly-spaced number line. The third re-shapes the abstracted number line, wrapping it into a circle based on the perceptual phenomenon of perfect consonance at the octave.

I ultimately argue that each of these three diagram types respond directly to the challenges presented by music as a mathematical science with a uniquely ephemeral and invisible object of study. The task of visualization required to create music-theoretical diagrams balances between abstract numerical conceptualizations and their material manifestations. But those material manifestations themselves are sonic, only made visible in their originating instruments like the *ʿūd* or via listener perception of sounding similarity as spatial proximity.

A Sufi Gestaltpsychologie? Diagrams of nafs in the Manuscripts of Ibrāhīm al-Qirīmī (d. 1593)

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The Ottoman Sufi scholar Ibrāhīm al-Qirīmī (d. 1593) belonged to the generation of the intellectual elite of the Empire during the reign of Murad III (1574 – 1595). Coming from Crimea with the education related to the Khalwatiyya brotherhood, he generally contributed to the two fields of Islamic scholarship of his time: the history of Qur'an interpretation and the Sufi theology (strongly linked with the tradition of the "greatest Sheikh", Ibn ʻArabī, 1165–1240. A number of insightful studies have already built up a general picture of the Sufi Khalwatiyya tradition, especially its associated doctrines of the stages of "ascending and descending" of the human soul on the journey to achieving the level of the "perfect man" (al-insān al-kāmil).

Through his manuscripts has been largely neglected yet, most of Ibrāhīm al-Qirīmī's legacy is available for research in various libraries in Turkey (in Istanbul, Izmir and Kastamonu), Germany (Berlin), USA (Princeton), Switzerland (Basel), and Hungary (Library of Academy of Sciences). What remains a general feature of his manuscripts is the presence of schemes, tables and diagrams in almost all his manuscripts, especially those explaining the "spiritual" path of the soul from 'ascending' (urūj) to 'descending" (nuzūl) via 12 stages of perception. Mostly covering his view of soul with emotions and intellectual abilities (projected into ontology of the "Unity of Being" idea), those pictures constitute an important kind of 'psychological figures' being a key to understand the Khalwatiyya Sufi doctrine. The most important of these manuscripts (written in Arabic) is his Mawāhib al-raḥman (Kastamonu People's Library, MS 3649), which comprises 236 folios and is essentially a manuscript copied from the original autograph during al-Qirīmī's lifetime (in 1591) by a scribe named Muṣṭṣaṭ fā ʿĀbid "Shekerzādeh", who was a member of his student circle at the Küçük Ayasofya Mosque in Istanbul.

With more than 50 diagrams and other pictures of al-Qirīmī's spiritual doctrine included in the middle of the book, this source is the main object of this study. However, several other of Ibrāhīm al-Qirīmī's treatises with similar diagrams are also important, notably the selected Qur'anic interpretations included in a seventeenth-century collection of earlier Khalwati treatises (Süleymaniye Cârullah Efendi, MS 2079), al-Risāla al-sharīfa tāʾwīl shaykh al-Islām wa l-Muslimīn (Atatürk Kitaplığı, Istanbul, MS 321); Risālat fī al-taṣawwūf (Süleymaniye, MS Laleli 1512); and Fatḥ marātib al-qulūb (Süleymaniye, MS Hasan Pasha, 763); as well as numerous other works located mainly in libraries in Turkey and Germany (in the Staatsbibliothek zu Berlin). The Staatsbibliothek zu Berlin also holds a unique copy of a handwritten work by one of Ibrāhīm al-Qirīmī's students: Abū Bakr b. Rasūl's, al-Maṭālib al-ʿāliya ("The Highest Goals", Petermann, No. II 441), dated to 1612. Main aim of the study is to compare Ibrāhīm al-Qirīmī's "psychological figures" to other manuscripts from the same Sufi Ottoman tradition, arguing for the novelty in his writings, especially in a newly systematizing encyclopedic way emerging in 16th-17th century Ottoman Empire. The study also supports the idea of rather personal dialogue between the author and the text in late Sufi tradition, proposing evolutionary research approach for further manuscripts studies.

User-Friendliness in Islamicate Zijes: A Comparative Study of Planetary Latitude Tables
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The primary audience for Zij literature in the Islamicate astronomical tradition were practical astronomers engaged in practical astronomical work. For this reason, Zij books were also known as Kutub al-'amal" ,(كتب العمل) books of operations." Kutub al-'amal can also be considered equivalent to "Handy Tables," which is a translation of what astronomical tables were called in other traditions. The professional astronomers who compiled Zij tables pursued the following main astronomical objectives:

- Accurate calculation of astronomical parameters (especially if the Zij resulted from a new observational program).
- Construction of precise tables, which required accurate mathematical calculations.
- Although it does not appear that non-Ptolemaic Hay'a (هيئه) models were used in the tables of later Islamic Zijes, other mathematical or geometric methods were sometimes used to create more user-friendly tables. For example, the process of constructing tables of planetary latitudes in the *Ulugh Beg's Zij (زیج الغ بیگ)* is based on a geometric theorem different from Ptolemy's and, in general, different from Hay'a models.

Beyond these technical objectives, most authors of astronomical tables also aimed to design tables that practical astronomers could use more easily. This focus on accessibility meant designing Zij books with greater user-friendliness in mind.

In this presentation, I examine the tables of outer planet latitudes from Ptolemy's *Almagest*, several Zijes from the early Islamicate era, and the major Zijes of the later Islamic period, including the *Zīj-i Īlkhānī* (*زیج ایلخانی*) (written by Naṣīr al-Dīn al-Ṭūsī at the Marāgha observatory), the Zīj-i *Khāqānī (زیج خاقانی)* (written by Jamshīd Kāshānī), and the *Zīj-i Sulṭānī* (*زیج سلطانی*) (written by Ūlūgh Beg at the Samarqand observatory), based on manuscript sources. Adopting the perspective of a practical astronomer, I attempt to calculate the latitude of an outer planet using the latitude tables in these various Zijes. In doing so, I will trace the usage of each Zij's tables from beginning to end. By examining a single table across several different Zijes, I aim to illuminate the extent to which each Zij's author considered ease of use.

Finally, I will compare the table values (the value extracted for a fixed input and the maximum planetary latitude) across the various Zijes to determine whether the maximum planetary latitude can provide insights into a Zij's novelty.

Diagrams of the Two Planetary Equations in the Ninth Book of the Almagest: Insights from Arabic Medieval Manuscripts
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Planetary motions do not align with simple uniform circular orbits in Ptolemy's model. To address this, Ptolemy introduced two key mathematical corrections: the equation of center and the equation of argument. The equation of center, an angular difference between a planet's position as seen from Earth and its position as if it moved uniformly around an off-center point (the deferent), accounts for planets' apparent motion along their orbits. The second equation or equation of argument, adjusts the position of a planet within its epicycle. Since the planet moves along the epicycle while the epicycle itself moves along the deferent, the observed motion deviates from simple uniform motion. Ptolemy presents his demonstrations related to these equations in the ninth book of the *Almagest*. Still, he dealt with Mercury separately for particular features in Mercury model, while taking advantage of two lines other than the true radii of the deferent in its demonstration. Later, his commentators noticed it and made efforts to alter the original demonstration.

In this workshop, I make a quick review of those modifications related to Mercury anomalies recorded in several Arabic astronomical books and scrutinize three fellow scholars' treatises of the 13th century, namely Mu'ayyad al-Dīm al-ʿUrdī, al-Tūsī, and Muḥī dīn al-Maghribī. Their approaches to the subject are described in *Muqaddima fī tashīh burhān al-shakl al-rabiʿ min tāsʿat al-Majisṭī* (Introduction on Explanation of the Demonstration of the Fourth Proposition of Ninth [Book] of *Almagest*) by Mu'ayyad al-Dīm al-ʿUrdī, *Khulāsat al-Majisṭī* (Essence of *Almagest*) and *Muqaddima tata'allaqu bi ḥarakāt al-kawākib* (Introduction Related to Movements of Planets) by Muḥī dīn al-Maghribī, and *Taḥrīr al-Majisṭī* (Exposition of *Almagest*) by Al-Ṭūsī.