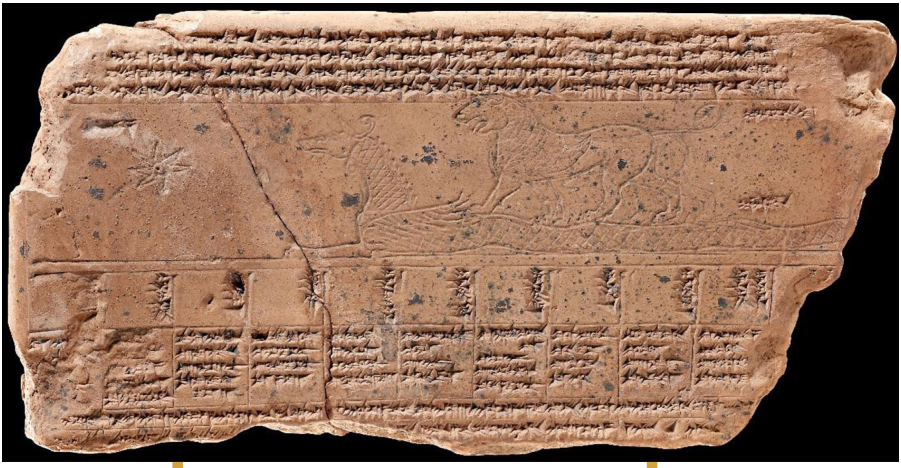

ASTERISMS –

The Relations among their Verbal, Numerical, and Visual Representations across Cultures in Research and Public Outreach

14-15 February 2024
White-Levy Room,
Institute for Advanced Study,
Princeton

Sponsor: Sabine Schmidtke, IAS, Convenor: Sonja Brentjes, IAS
Coordinators: Uta Nitschke-Joseph, IAS & Rana Brentjes, MPIWG

IAS | INSTITUTE FOR ADVANCED STUDY

Funding for this event provided by the Otto Neugebauer Fund.

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Asterisms – the relations among their verbal, numerical and visual representations across cultures in research and public outreach

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Program

14 February

8:30 Breakfast at White-Levy Room
9:00 Opening Sabine Schmidtke
9:05 Introduction Sonja Brentjes
9:15-10:15 **Mesopotamian Forms of Representing Asterisms.** Chair: Sabine Schmidtke
John Steele, The Babylonian Uranology Texts: Instructions for Drawing or Just Descriptions of the Constellations?
Francesca Rochberg, Representing and Writing with the Stars: The Cuneiform Astroglyphs
10:15-10:35 Discussion
10:35-10:55 Break
10:55-11:55 **Greco-Roman Treatment of Constellations in Cross-Cultural Contexts.** Chair: Kim Plofker
Mathieu Ossendrijver, The exaltations of Greco-Roman astrology and their possible relation to stars
Andreas Winkler, Constellations and Signs in Graeco-Roman Egypt
11:55-12:15 Discussion
12:15-1:45 Lunch
1:45-2:45 **Star Catalogues in Greek and Arabic and their**

Perspectives on the Verbal, the Numerical, and the Visual. Chair: John Steele
Francesca Schironi, Describing and visualizing constellations from Aratus to Ptolemy: some case studies
Pouyan Rezvani, Visualisation of mathematical astronomy in the medieval Arabic translations of Ptolemy's *Almagest*: diagrams and tables
2:45-3:05 Discussion
3:05-3:25 Break
3:25-3:55 **Constellations and Their Representations in Sanskrit Astronomy.** Chair: Andreas Winkler
Kim Plofker, Nakṣatra and Rāśi: Identifying and representing the lunar constellations and zodiacal signs in Sanskrit astronomy
3:55-4:15 Discussion
4:15-6:00 Recess
6:00-6:45 Public Event: **The astral sciences and early cultures: why do we study them, and how do we share our interest with the public? Alexander Jones** (ISAW, NYU) in conversation with **Sonja Brentjes**
7:00 Departure for Observatory – Strict time
7:30-9:00 Conversing with Astronomers at the Peyton Observatory

15 February

8:00-9:00 Breakfast at Simons Hall (Dining Hall)
9:00-10:00 **'Abd al-Rahman al-Sufi's *Book on the Fixed Stars* – Goals, Contradictions, Impact.** Chair: Francesca Schironi
S. Mohammad Mozaffari, Among the Stars: A New Look at al-Sūfī's Heritage
Hamid Bohloul and **Razieh Mousavi**, Versified Constellations: Ibn al-Ṣufī's Urjūza at the Crossroads of Stellar Traditions

10:00-10:20 Discussion
10:20-10:40 Break
10:40-11:40 **Astral Imagery and DH.** Chair: Sabine Schmidtke
Rana Brentjes, The relationship of image, text, and tables/ diagrams as represented on objects in VoH Database
Jade Norindr, Ptolemaic diagrams through computer vision: building a platform for research on astral sciences
11:40-12:00 Discussion
12:00-1:30 Lunch
1:30-2:30 **Star Lists in Latin Manuscripts and Their Numerical and Visual Elements.** Chair: Mathieu Ossendrijver
Matthieu Husson, Compiling star lists in early 14th century Oxford: Cambridge, University Library, Gg.6.3
Richard Kremer, The "Alfonsine" star catalog in late medieval Latin manuscripts
2:30-2:50 Discussion
2:50-3:10 Break
3:10-4:10 **'Abd al-Rahman al-Sufi's *Book on the Fixed Stars* – its Goals, Contradictions and Impact.** Chair: Richard Kremer
Sonja Brentjes, What was 'Abd al-Rahman al-Sufi up to? On the relationships between text, numerical table, and visual representations of a constellation and its stars in his *Book on the Constellations*
Heather Ecker, A View from the Seventeenth Century of al-Sufi's Mapping of Greek Constellations and Arab Asterisms in *The Book of Constellations of the Fixed Stars* (c. 965)
4:10-4:30 Discussion
4:30-5:00 Final Discussion Panel: Sonja Brentjes, Sabine Schmidtke, Rana Brentjes
6:00 Dinner

Abstracts

John Steele, **The Babylonian Uranology Texts: Instructions for Drawing or Just Descriptions of the Constellations?**

The Babylonian uranology texts are a small corpus of six tablets which contain descriptions of constellations. These accounts combine figurative descriptions with (at least in some cases) indications of where and how many individual stars are placed on the figure. An interesting feature of these texts is that they often refer to features of the constellations being 'drawn'. Only a small number of actual drawings of the Babylonian constellations are known, but in some cases, there is a good agreement between the drawing and the description in the uranology texts. This raises the question of how we should understand the reference to 'drawing' in the uranology texts – are the constellations drawn on the sky, drawn on a tablet, or both? In this paper, I will attempt to address this question and also to compare the descriptions in the uranology texts with existing drawings and with textual references to the parts of constellations in order to better understand the purpose and context of these texts.

Francesca Rochberg, **Representing and Writing with the Stars: The Cuneiform Astroglyphs**

To the ancient Babylonian and Assyrian literati of the middle of the first millennium BCE, the patterns of stars covering the sky were a celestial script. The "heavenly writing" was a poetic metaphor occasionally used in Babylonian royal inscriptions to refer to temples made beautiful "like the stars," literally, "like the heavenly writing." But it was more than a metaphor. While the heavenly writing evoked a fundamental aspect of the world in the view of the Babylonian and Assyrian scholars, namely that the heavens and human

beings on earth were interconnected, the "texts" written in the stars were literally a transmission from the divine about the fortunes of human beings. A different but no less dramatic instantiation of the correspondence between the heavens and the human, is evident in the use by two Neo-Assyrian monarchs (Sargon II and Esarhaddon) of so-called astroglyphs for the writing of their names and titles. These illustrated parts of prisms and other inscribed objects contain imagery—representations—of constellations to be read as a glyphic script, a "heavenly writing." This paper will review the astroglyphs, the constellations represented by them, and the nature of visual representation they evidence.

Mathieu Ossendrijver, **The exaltations of Greco-Roman astrology and their possible relation to stars**
In this presentation I will discuss some new ideas about a possible connection between the so-called exaltations in Greco -Roman astrology and a group of stars known from the Babylonian astronomical diaries and related texts.

Andreas Winkler, **Constellations and Signs in Graeco-Roman Egypt**
From the late 4th century BCE and onwards text referencing both zodiacal signs and constellations including the zodiacal ones start appearing in Egypt and are written in both Greek and Egyptian. Soon after also the first Images of such motifs are attested. My paper examines this material and will discuss how both Greek and Babylonian influences merged with earlier indigenous ideas about the skies.

Francesca Schironi, **Describing and visualizing constellations from Aratus to Ptolemy: some case studies**
Greek descriptions of constellations are attested in poetical form (Aratus' *Phaenomena),* mythical narratives

(Eratosthenes' *Catasterismi and* Hyginus' *Astronomy,* Book II), star catalogues belonging to mathematical astronomy (Hipparchus' and Ptolemy's Catalogues as well as Ptolemy's Handy Tables) as well as in easier introductions to astronomy (Geminus' *Introduction to the Phenomena* and Hyginus' *Astronomy,* Book III). We also have a few examples of globes and other depictions of constellations dating to antiquity. In my talk I will look at some examples of differing asterisms in these sources to explore whether we can detect some patterns or traditions in the descriptions and visualizations of constellations from the Hellenistic period to the third century CE.

Pouyan Rezvani, **Visualisation of mathematical astronomy in the medieval Arabic translations of Ptolemy's *Almagest*: diagrams and tables**
Out of multiple Arabic translations of Ptolemy's *Almagest,* carried out in the early Abbasid caliphate, only three have survived in the form of manuscripts, none of which has been published yet. The earliest extant translation is made by al-Ḥajjāj ibn Yūsuf ibn Maṭar (786–833) and Sarjūn ibn Hiliyā al-Rūmī in 827–8, commissioned by the seventh Abbasid caliph, al-Maʾmūn (reg. 813–833). Around half a century later, a couple of other translations were produced by Isḥāq ibn Ḥunayn (*c.* 830–*c.* 911) and Thābit ibn Qurra (836–901). Isḥāq's translation was later revised by Thābit, which is referred to as the 'Isḥāq-Thābit translation' and is different from Thābit's own translation. The Isḥāq-Thābit translation is dedicated to Abū al-Ṣaqr Ismāʿīl ibn Bulbul (844–892), the minister of the Abbasid caliph al-Muʿtamid ʿala Allāh (reg. 870–892), and was the main source of many commentaries that were written upon the *Almagest* by later scholars in the Islamic scientific tradition. As the manuscripts of these translations were copied in different centuries (ranging from the 11th to the 16th century) and regions, each one of them has

its own visual characteristics. This talk will attempt to examine how the mathematical context of the *Almagest* is reflected in geometric diagrams and tables of the manuscripts. In this connection, the manuscripts will be inspected in order to figure out whether the scribes applied systematic methods in their illustrations

Kim Plofker, **Nakṣatra and Rāśi: Identifying and representing the lunar constellations and zodiacal signs in Sanskrit astronomy**
The principal asterisms of classical Indian astronomy were the various ecliptic constellations essential to defining celestial positions: the twenty-seven or twenty-eight nakṣatras (lunar constellations), and the twelve zodiacal signs adapted from Hellenistic astronomy. This talk surveys the quantitative concepts (coordinates and junction-stars) used to specify their locations, and aspects of their visual representation. We compare the roles of non-ecliptic asterisms such as Dhruva (the pole-star), and the early modern emergence of comprehensive star-maps in Sanskrit.

Alexander Jones, **The astral sciences and early cultures: why do we study them, and how do we share our interest with the public?**
Alexander Jones will present a brief survey on his experience, as a faculty member and director of the Institute for the Study of the Ancient World (NYU), with different approaches to the study of the astral sciences in early cultures and the presentation of the research results to varied audiences in academia and beyond. He will answer questions by Sonja Brentjes on how, during his time at ISAW, changes have occurred in the ways that researchers and audiences have come together, exchanged views and insights, and found new paths for exploring the wealth of historical artifacts testifying to the multifaceted

engagement of people of long gone times with the night sky and its marvels and threats.

S. Mohammad Mozaffari, **Among the Stars: A New Look at al-Sūfī's Heritage**

ʿAbd al-Raḥmān al-Sūfī's *Book on the Constellations of the Fixed Stars developed* stellar astronomy in the medieval period in three significant ways: (1) re-measuring the stars' brightness after Ptolemy, (2) making a comprehensive measurement of the angular distances between them, and (3) identifying some star clusters and nebulae. His work remained unsurpassed in the medieval Middle East, but not in Islamic astronomical traditions in other regions, as a star catalogue prepared by Jamāl al-Dīn Zaydī of Bukhārā (13th ct., working in the service of the Yuan dynasty of China) and Ibn al-Shāṭir's star table contain some remarkable improvements in the magnitudes of a few bright stars. Some important questions concerning al-Ṣūfī's legacy are still to answer, of which I will address two in my talk: (A) why does he prefer to employ the ancient method of astrometry, i.e., measuring the angular distances between the stars and demarcating their positions in relation to each other, instead of cataloging them according to the ecliptic coordinates (as is in the *Almagest*); (B) his numerical value of 2;20° for the angular unit "cubit" (dhirāʿ), although unanimously found in all of the preserved manuscripts, seems to be simply a scribal mistake for 2;30°, seemingly having occurred in a very early prototype (or autograph) of which the entire of the surviving manuscripts descended.

Hamid Bohloul and Razieh Mousavi, **Versified Constellations: Ibn al-Ṣufī's Urjūza at the Crossroads of Stellar Traditions**

The earliest derivative work from ʿAbd al-Raḥmān al-Ṣufī's *Book on the Star Constellations* (*Ṣuwar al-kawākib al-thābita*)

is acknowledged to be *The Poem on the Stars (Urjūza fī-l-kawākib*), composed by al-Ṣūfī's son, known as Ibn al-Ṣūfī. In this poetic composition, he versifies selective details of each constellation from his father's *Book* and other unspecified sources. This paper commences with offering brief remarks on Ibn al-Ṣūfī's biography, the genre of the poetry, and the noteworthy existing copies of the work. We then analyze the poem's presentation techniques and the astronomical information it includes. Our primary objective is to explore the Poem's connection to classical Ptolemaic constellations and the folk astronomical tradition of Bedouin Arabs. To this end, we underscore a wealth of evidence indicating the poem's closer affinity to the Bedouin tradition rather than Ptolemaic tradition in relation to al-Sufi's treatise. Finally, considering the prominent role of Ursa Minor in medieval navigation techniques, this paper seeks to examine the potential interplay between the ways constellations were envisaged in this poem and other mapping traditions, such as maritime and qibla-finding practices.

Rana Brentjes, **The relationship of image, text, and tables/diagrams as represented on objects in VoH Database**

In my presentation, I will address three points. First, what can the VoH Database contribute to the question of the conference: the relationship between text, tables, and images in the history of astral knowledge? I will present a selection of examples to highlight the variability in these relationships. Second, I will raise the issue of the flexibility of any of the three elements from a composition that intentionally combines all three into new contexts. This means that I will present objects where the primarily pictorial element has moved into a new context. The goal here is to discuss a few examples of such cultural processes that highlight different types of transformations that took place. Finally, I will offer

some thoughts about further digital tools that may facilitate for comparative analysis of text, tables, and images.

Jade Norindr, **Ptolemaic diagrams through computer vision: building a platform for research on astral sciences**

By creating digital humanities tools for research in history of science, the EIDA project – started in February 2023 – incorporates artificial intelligence into the study and analysis of a corpus of manuscripts of Ptolemaic tradition and early prints of mathematical astronomy. With the help of computer vision algorithms to accelerate specific steps (such as visual elements extraction, clustering, and vectorization) of the processing of the sources, EIDA opens new perspectives for the study of astral diagrams. The information system created for the project, based on a data model enabling the detailed description of the sources, will provide a diversity of tools dedicated to the exploration, analysis, and edition of diagrams in historical sources.

This presentation synthesizes how computer vision algorithms can be integrated to the work of historians and automate multiple steps of the processing of their source material. The presentation will also include an exploration of the tools developed by the EIDA project to support the work of researchers, and lay the groundwork for a public platform featuring reusable resources.

Matthieu Husson, **Compiling star lists in early 14th century Oxford: Cambridge, University Library, Gg.6.3**

The MS Gg.6.3 of Cambridge University Library is a compendium of 400 leaves assembling different mathematical astronomical works (tables, instruments, canons) in currency at Oxford during the first half of the 14th century. Among these, three star-lists are going to be of special interest to us. The first two, set for Oxford 1316, can be ascribed to John

Maudith and contains respectively 86 (f. 127r) and 11 stars, the third with 15 stars, Oxford 1327, attributed to Richard of Wallingford. The relations between these lists, especially with respect to the precession values and theory they rely on were clarified in North 1976. Building on these established results and seeking to understand the type of practices associated with the compilation of stars list, I intend to reflect on other aspects of the star lists, asking questions about the various sets of stars selected ultimately from Ptolemy's *Almagest* and the different numerical coordinates that are associated to them beyond longitude.

Richard Kremer, **The "Alfonsine" star catalog in late medieval Latin manuscripts**

Three types of star lists circulated in medieval Latin manuscripts: short lists of stars (20-50) to be placed on astrolabes (studied by Kunitzsch); intermediate lists of stars (80-250) of the first and second magnitudes (studied by Chabás and Goldstein); and long catalogues (+1000) based on Ptolemy's *Almagest* but precessed for medieval dates (I do not consider here the widely studied revisions of Ptolemy's catalog by al-Sufi or revised Aratus Latinus [Hadravová, Hadrava, Lippincott 2019]). In this paper, I will discuss the so-called "Alfonsine star catalog", a Latin long catalog of Ptolemy's stars precessed 17;08 degrees from Ptolemy's longitudes. Kunitzsch 1986 studied this material using only the 1483 printed edition; I have found more than 35 earlier manuscript copies, some of which are illustrated with constellation figures, that raise new questions not considered by Kunitzsch about the place of star catalogs in Alfonsine astronomy.

Sonja Brentjes, **What was 'Abd al-Rahman al-Sufi up to? On the relationships between text, numerical table and visual representations of a constellation and its stars in his *Book on the Constellations* (dated 964)**

In his uncommonly long and detailed introduction, 'Abd al-Rahman al-Sufi claims that he wrote his book against the bookish practices of his predecessors among the authors of Zij works (astronomical handbooks), compilers of Anwa' texts (works on the astronomical traditions of the pre-Islamic Bedouins), and globe makers in order to teach how to see the heavens and do so correctly. This is, however, not fully born out in the following verbal, numerical, and visual descriptions of the 48 Ptolemaic constellations and their pre-Islamic Arabic relatives. In particular, the how to see and how to visualize remain largely unexplained. Moreover, the three components – Sufi's texts, Ptolemy's coordinate tables, and the images of the constellations on the globe and in the sky – seem often to be either unrelated or in part contradictory. In its execution, Sufi's book does not present itself recognizably as a textbook teaching how to see and how to visualize constellations. But what is it and can we nonetheless recognize a layer of teaching how to see and perhaps even one of how to visualize? In my talk I will approach this question by discussing what the relationship between text, table, and images appears to be in a number of cases. Some of the results are unexpected and raise further questions on the character of astronomical practices in the 10th century.

Heather Ecker, **A View from the Seventeenth Century of al-Sufi's Mapping of Greek Constellations and Arab Asterisms in *The Book of Constellations of the Fixed Stars* (c. 965)**

Al-Sufi's mid-tenth-century *Book of the Constellations of the Fixed Stars* has two structural innovations that kept it relevant, ensuring its broad dissemination and driving its translation into various languages, Eastern and Western. The first is its conceptual insertion of drawings between Ptolemy's tables of star coordinates from the *Almagest* and Sufi's long-winded lists of relative distances between those stars. Both

Ptolemy's tables and the drawings are derived from the conceptual model of the celestial globe, which posits that the earth exists within a sphere to which the visible stars are affixed. In this sense, Sufi brought Ptolemy's spherical grid locations (the tables) and the figures of the constellations that hover on the globe's surface into a book format, that anyone could copy and almost anyone could afford. The drawings were given two mirrored, symmetrical orientations—as they would appear on a celestial globe and as they would appear in the sky—with the result that the book served two manners of study: the first in concert with a mathematical instrument (if available) and the second through comparison with the observed night sky. Throughout the al-Sufi recensions, the drawings were never integrated with the gridlines of ecliptic latitude and longitude. However, the earliest drawings may have been produced in collaboration with a professional artist and represent a distinct class of images within the Islamic tradition that follow an ancient Greek model, drawn without groundlines, foreground or background.

Al-Sufi's second structural innovation was his integration and coextensive mapping of an entirely different system of star naming, mythology, and figuration onto these drawings, that of the indigenous Arabian Peninsula. While al-Sufi added a descriptive section on the Arabian cosmos (often called the anwā' stars) to each of his chapters on the Greek constellations ("according to the Arabs..."), he mapped them graphically in three ways: As text annotations, as additional (unlabeled) star points in those drawings (usually in a different color), and as complete iconographies that exist only in some of the earliest copies. Although the anwā' system has been called "folk astronomy," lacking the prestige or authority of a figure like Ptolemy, al-Sufi took it seriously enough to include and analyze it in his book and was the first to organize this material taxonomically according to the Greek constellations.

This paper will focus on the reception of this tradition by the early seventeenth-century astronomer/translator Hasan bin Sa'd al-Qayini, and his collaborator, the painter, Malik Husayn al-Isfahani, who worked together on a remarkable new, Persian version of al-Sufi's text, completed in 1631 for the governor-general of Mashhad, Abu'l Fath Manuchihr Khan (d. 1636). Al-Qayini insistently added glosses to the passages on the Arab stars, but also measured their relative distances in the sky for the first time so that new, proportionate iconographies could be prepared by his artistic collaborator and added to the work. Interestingly, al-Qayini continued and extended Sufi's methodology and technique of using different colors to indicate stars beyond those accounted for by Ptolemy, stars that he claimed to have charted himself. Sufi's co-mapping of the anwā' stars may have arisen from their continued practical use for calendarization and navigation in the tenth century, or out of antiquarian interest or perhaps as part of the 'Abbasid project to catalogue all knowledge. In al-Qayini's case, the anwā' star tradition, as correlated by al-Sufi, seems to have inspired an appetite for textual and visual completeness and perhaps a platform for artistic creativity that celebrated the poetic imagination of late antique Arabia within a Safavid-era modality.