Reading Ptolemy's *Almagest* in the Ilkhanate

Remarks on Marginalia in Books I and II of Naṣīr al-Dīn al-Ṭūsī's *Taḥrīr al-Majisṭī*

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This paper examines a set of marginal annotations encountered in Ilkhanid manuscripts of Naṣīr al-Dīn al-Ṭūsī's (d. 672/1274) *Taḥrīr al-Majisṭī*. This recension of Claudius Ptolemy's prominent astronomical compendium, the *Almagest*, was composed while al-Ṭūsī resided at the Ismāʿīlī citadel of Alamūt and later studied at the Marāgha observatory under Mongol patronage; over time, it became the principal medium through which the *Almagest* was studied in the eastern Islamicate world, effectively replacing the uncommented base text. Today, the *Taḥrīr al-Majisṭī* survives in more than 170 Arabic manuscripts, as well as in Persian and Sanskrit translations, and through a rich body of summaries and super-commentaries. In this paper I wish to offer some observations on the kind and purpose of marginal annotations that were already present in copies of the *Taḥrīr* during al-Ṭūsī's lifetime. I focus this analysis on the marginalia to Books I and II as they are transmitted through Muḥammad b. Aḥmad b. Muḥammad b. Rabīʿ al-Zarkashī, the scribe of the multiple-text manuscript Tehran, Sipahsālār, 4727, a copy finished on 21 Rajab 671 (11 February 1273). A transcription of these annotations, along with comparative references indicating their presence or absence in other manuscripts, is provided in the appendix.

Keywords: Naṣīr al-Dīn al-Ṭūsī, Taḥrīr al-Majisṭī*, Ptolemy's Almagest, marginalia, Ilkhanid Persia, manuscript culture, knowledge transmission, astral sciences, textual reception, Arabic scientific tradition*

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In the mid-13th century, Naṣīr al-Dīn al-Ṭūsī (d. 672/1274) composed a recension of Claudius Ptolemy's prominent compendium on astronomy, the *Almagest*, which he entitled *Taḥrīr al-Majisṭī*. According to the preface, he undertook this work for himself and for fellow seekers of knowledge (*sāʾir ṭullāb al-ʿilm*), having found that none of the many available abridgments (*mukhtaṣarāt*) fully met the necessary criteria.[1] His aim was to produce a concise and accessible version that would simplify difficult passages, resolve problematic points (*ḥall al-ashkāl*), and incorporate innovations introduced by the moderns (*al-muḥdathūn*) as well as ideas adopted by later astronomers (*al-mutaʾakhkhirūn*). For his textual base, al-Ṭūsī primarily relied on the Arabic translation of the *Almagest* by Isḥāq b. Ḥunayn, as revised by Thābit b. Qurra, while also occasionally referencing the version of al-Ḥajjāj and the version attributed solely to Thābit.[2]

Today, al-Ṭūsī's *Taḥrīr* is extant in more than 170 manuscripts produced between the 13th and 20th centuries.[3] These copies are attested across various regions, with some colophons mentioning cities, including Marāgha[4], Isfahan[5], Shāhjahānābād (Delhi)[6], and Surat in the northwestern Indian state of Gujarat[7]. The prominence of al-Ṭūsī's *Taḥrīr* in the eastern regions of the Islamicate world is further reflected in its transmission and adaptation into Persian, in the 18th century (*Taqrīb al-Taḥrīr al-Majisṭī*) and into a Sanskrit version known as the *Samrāṭ Siddhānta* or *Siddhāntasārakaustubha*.[8] While only 14 manuscripts of the uncommented Isḥāq-Thābit version of the *Almagest* are known to have survived – many of them incomplete and primarily linked to transmission in the western Islamic world – the sheer prevalence of al-Ṭūsī's *Taḥrīr*, with more than ten times as many copies, demonstrates that it played a central role in the study of the *Almagest*, and became an important means for engaging with Ptolemaic astronomy in the post-classical Islamic tradition.[9]

In contrast to other Arabic commentaries on the *Almagest*, copies of al-Ṭūsī's *Taḥrīr* appear to have been particularly favored as prestige manuscripts. Some were produced with elaborately decorated incipit pages, likely for patrons who sought to present themselves as major supporters of literature and science. Notably, two copies were prepared for the

1 For a transcription of the Arabic preface in MS Istanbul, Nuruosmaniye Kütüphanesi, 2941 (fols. 1v-2r), see Hullmeine, Transcription of Naṣīr al-Dīn al-Ṭūsī. The text is partially translated and discussed in Saliba, *Almagest* commentaries.

2 Löhr, Taḥrīr al-Majisṭī.

3 Brockelmann lists some of these in *Geschichte der Arabischen Litteratur*, vol. 1, 511; and in its *Supplement*, vol. 1, 925 and 930-931. For a more extensive list, see also the database of the Islamic Scientific Manuscripts Initiative (ISMI) at the Max Planck Institute for the History of Science, ("Taḥrīr al-Majisṭī": https://ismi.mpiwg-berlin.mpg.de/index.php/text/122359), as well as Parra, List of Arabic manuscripts. The webpage of the Ptolemaeus Arabus et Latinus project provides the most complete account; see Löhr, Taḥrīr al-Majisṭī.

4 Löhr, MS Sipahsālār 592.

5 Boehm and van Dalen, MS Majlis, 3853.

6 MS Aligarh, Maulana Azad Library, Suleman 165/25, p. 185. See also Boehm, MS Suleman 165/25.

7 Van Dalen, MS Jaipur 348.

8 For this version, consult Sharma, *Samrād Jagannāth-Viracita*.

9 For descriptions of the manuscripts of the Isḥāq-Thābit version see Rezvani, al-Majisṭī (tr. Isḥāq/Thābit).

Ottoman sultan Mehmed II (r. 1444-1446 and 1451-1481): one completed in 849/1445-46[10] during his first reign, and a second, far more richly decorated, in 870/1465.[11] However, while such luxury copies exist – and occasionally also feature marginal annotations – the majority of surviving manuscripts are more modest in presentation and are frequently heavily annotated, hinting at active scholarly engagement with the text.

Many of the annotated manuscripts contain references to, and excerpts from, commentaries rooted in the same scholarly tradition. The parallel study of Niẓām al-Dīn al-Ḥasan al-Nīsābūrī's (d. 730/1329) *Tafsīr Taḥrīr al-Majisṭī*[12], al-Bīrjandī's (fl. 913/1507) *Sharḥ Taḥrīr al-Majisṭī*[13], and, less frequently, Qāḍīzāda al-Rūmī's (d. 840?/1436) *Ḥāshiya*[14] is well attested. The origins of these glosses are sometimes indicated at the end of a marginal note by abbreviated sigla formed through the omission of letters – for example, *nẓ* for Niẓām[15] or *brj* for Bīrjandī[16]. However, the manuscripts also contain numerous other notes that are not necessarily drawn from identifiable sources, including unique scholarly additions, readers' reflections, and calculations. In the 16th century, ʿAbd al-Bāsiṭ al-ʿAlmawī (d. 981/1573)[17] composed a guide on how students should use books as tools for acquiring knowledge, recommending that marginal notes relevant to a work's content may be added without hesitation.[18] His guide was heavily influenced by an earlier abridgment on the same topic by Badr al-Dīn b. Jamāʿa (d. 733/1333), who advises: "A student should always note down what he reads or hears of unique lessons, intricate issues, uncommon derivatives, solutions to problems and differentiation between similar rulings in every field of knowledge. He must not be content with merely listening to a useful lesson, nor overlook a rule by merely understanding it; rather, he should rush to write it down and memorise it."[19]

From a modern perspective, disentangling the multiple layers of marginal commentary, determining when, where, and by whom they were added, is a complex task; understanding the content and function of these notes poses a further challenge. In what follows, I wish to identify and discuss a number of marginal notes that are found in the earliest extant manuscripts of the *Taḥrīr al-Majisṭī*. These notes were also incorporated into several later copies, and thus a study of the annotations in manuscripts copied by Ilkhanid-era scribes can help identify, from a chronological perspective, at least some of the earliest layers of marginalia in extensively annotated exemplars. Such analysis may also offer insights into how the *Taḥrīr al-Majisṭī* was studied during the Mongol period.

10 Löhr, MS Turhan Valide Sultan 219.

11 Löhr, MS Feyzullah Efendi 1360.

12 Rezvani, Niẓām al-Dīn al-Ḥasan al-Nīsābūrī.

13 Löhr, al-Birjandī, Sharḥ Taḥrīr al-Majisṭī.

14 Rezvani, Ḥāshiya ʿalā Sharḥ al-Majisṭī.

15 See, for example, van Dalen, MS HL 2037; van Dalen, MS Lucknow 1342.

16 See, for example, van Dalen, MS Islamic Manuscripts N.S. 463.

17 For a partial translation, see Franz Rosenthal: *The Technique and Approach of Muslim Scholarship,* 6-40.

18 al-ʿAlmawī, *al-Muʿīd fī adab al-mufīd,* trans. Rosenthal, 17.

19 Ibn Jamāʿa, *Tadhkirat al-sāmiʿ,* trans. Shah, 64.

The date of al-Ṭūsī's autograph can with relative certainty be established as 5 Shawwāl 644 (13 February 1247), as this date appears either copied or paraphrased in the colophons of numerous manuscripts. At that point, al-Ṭūsī was residing at the citadel of Alamūt, under the patronage of the Ismāʿīlīs.[20] The preface of the work mentions a certain Ḥusām al-Dīn al-Ḥasan b. Muḥammad al-Sīwāsī, to whom it is dedicated, though he remains otherwise unidentified.[21]

As F.J. Ragep has observed, many of al-Ṭūsī's most innovative works were composed prior to his engagement with the Mongols, during his service to Naṣīr al-Dīn Muḥtasham in Quhistān (*c.* 630/1232-33 to 643/1245-46). Among these are the *Akhlaq-i Nāṣirī* and the *Risāla-yi Muʿīniyya* and its continuation *Ḥall-i mushkilāt-i Muʿīniyya*, in which he introduced new planetary models, as well as the logical treatise *Asās al-iqtibās*. His engagement with philosophical discourse is evident in his Arabic commentary on Ibn Sīnā's *al-Ishārāt wa-l-tanbīhāt*. Notably, with the exception of the latter, these works were composed in Persian – a linguistic choice that likely reflects both the demands and conventions of the scholarly milieu in eastern Iran during the early phase of his career.[22]

A shift in al-Ṭūsī's scholarly output must have occurred following his relocation to Alamūt and his subsequent entry into Mongol service. In the post-conquest period, he increasingly wrote in Arabic, aligning his scientific production with the broader traditions of the Islamic world. Hülagü's designation of Marāgha as the Ilkhanid capital in 654/1256, together with the Mongols' traditional reverence for the heavens – rooted in Tengrism, a steppe belief system that emphasized cosmic order and divine legitimation through celestial signs – created a supportive environment for the establishment of a state-funded observatory.[23] Al-Ṭūsī capitalized on this context to obtain substantial patronage and is reported to have requested a thirty-year endowment for the observatory, corresponding to a full Saturn cycle, though this request was not met.[24] In Marāgha, scholars and students benefited from institutional support, including funding and stipends, and found an ideal infrastructure for the study of various disciplines, particularly the mathematical sciences.

The earliest surviving manuscripts of the *Taḥrīr* are closely tied to this scholastic environment and largely reflect patterns of transmission between teachers and students. This is especially evident in the group of manuscripts produced by students based on an exemplar by al-Shīrāzī, the well-known scholar and former student of al-Ṭūsī, whose copy was made directly from al-Ṭūsī's autograph.[25] Unfortunately, the autograph from the Ismāʿīlī period – nor indeed any copies from the pre-Mongol era – does not appear to have survived. One manuscript, allegedly in al-Ṭūsī's own hand, is said to be preserved in a private European

20 Ragep, *Memoir on Astronomy*, 23.

21 See also Löhr, Taḥrīr al-Majisṭī.

22 On this, see Ragep, *Memoir on Astronomy*, 21.

23 More detailed accounts on al-Ṭūsī as agent within Ilkhanid milieu are found in, e.g., Yang, Like stars in the sky; Roughan, Out of Maragha.

24 Sayili, *The Observatory in Islam*, 204.

25 See Löhr, Taḥrīr al-Majisṭī; Parra, List of Arabic manuscripts, esp. 311-312.

collection, but its authenticity remains uncertain.[26] Another copy, held in the Najaf collection, bears a title page with notes identifying it as an autograph, though this attribution appears to be spurious.[27]

The Taḥrīr al-Majisṭī *in Ilkhanid Iran*

The autograph copy of al-Ṭūsī's *Taḥrīr al-Majisṭī*, dated to the Ismāʿīlī period, is attested in Marāgha in Dhū l-Ḥijja 662 / October 1264[28] and again about a year later, when Maḥmūd al-Khaṭīb made a copy of it at the madrasa of Marāgha, which he finished in Ramaḍān 663 / July 1265. Although it is uncertain whether this latter copy is still extant, at least six other manuscripts claim to have used it as a template, and it was at some point moved to India where it is recorded in Delhi in 1927 for the last time.[29]

In total, twelve surviving manuscripts with scribal colophons dated to the Ilkhanid period (1256-1335) can be identified (see list below). Although only a few specify their place of copying, all appear to have originated within the Persianate regions. The majority of these manuscripts are listed by Parra together with some concluding remarks on several early copies.[30] A closer examination of these manuscripts and their marginal annotations, along with the identification of additional copies, may help refine our understanding of the reading and transmission of the *Taḥrīr* in the 13th and early 14th centuries.

The following list gives an overview of copies of the *Taḥrīr al-Majisṭī* produced in the Ilkhanid period, in chronological order.

Shelfmark (short)	Date of copy	Place of copying
Tehran, Sipahsālār, 592[31]	29 Dhū l-ḥijja 662 / 23 October 1264	Marāgha
Cairo, Dār al-kutub, *hayʾa* Talʿat 43[32]	between 30 Ramaḍān 670 / 20 April 1272 and 9 Rabīʿ al-awwal 673 / 12 September 1274; later additions dated 898/1492-93	not mentioned
Tehran, Sipahsālār, 4727[33]	21 Rajab 671 / 11 February 1273	not mentioned

26 It is said to have belonged to Shaykh ʿAbd al-Ḥusayn al-Tihrānī (d. 1285/1868-69) and apparently later found a new owner in Europe; see Āqā Buzurg, *al-Dharīʿa ilā taṣānīf al-Shīʿa*, vol. 3, 390-391, no. 1402; Ansari, *9th Book*, 25.

27 See MS Najaf 9476.

28 MS, Sipahsālār, 592, fol. 143v.

29 On the copy from Delhi based on Maḥmūd al-Khaṭīb's exemplar, see Boehm, MS Suleman 165/25; on the others, see Bellver, MS Sprenger 1838; Löhr, MS hayʾa 17; and MS Suleman 164/24. See also Parra, list of Arabic manuscripts, esp. 312.

30 See Parra, List of Arabic manuscripts.

31 Löhr, MS Sipahsālār 592; Parra, List of Arabic manuscripts, 300 (no. 112).

32 Löhr, MS hayʾa Talʿat 43; Parra, List of Arabic manuscripts, 263-265 (no. 19).

33 Löhr, MS Sipahsālār 4727; and Parra, List of Arabic manuscripts, 302-303 (no. 114).

Shelfmark (short)	Date of copy	Place of copying
Istanbul, Topkapı, Ahmet III 3453[34]	20 Rabīʿ al-thānī 678 / 30 August 1279	not mentioned, other parts in the same collection finished in Baghdad and Shirwan
Tehran, University, microfilm 2885[35]	last day of Jumādā l-ūlā 678 / 7 October 1279	not mentioned
Istanbul, Nuruosmaniye, 2941[36]	late Shaʿbān 684 / late October 1285	not mentioned
Istanbul, Süleymaniye, Ayasofya 2583[37]	5 Shawwāl 686 / 13 November 1287	not mentioned
Dublin, Chester Beatty Library, Ar. 3637[38]	10 Shawwāl 691 / 23 September 1292	Shiraz in the madrasa ʿAḍūdiyya
Istanbul, Topkapı, Ahmet III 3332[39]	late Jumādā l-thāniyya 692 / May-June 1293	not identified
Hyderabad, OMLRI, riyāḍī 405[40]	mostly in the hand that copied other parts in the same collection in 709/ 1309-10	other parts in Tabriz
London, British Library, IO Islamic 1148[41]	6 Muḥarram 722 / 25 January 1322	Soltaniyeh (Zanjan)
Istanbul, Beyazıt, Veliyüddin 2302[42]	25 Ramaḍān 732 / 20 June 1332	Tabriz

The manuscript witnesses of al-Ṭūsī's *Taḥrīr al-Majisṭī* from the Mongol period offer a relatively detailed view of their production. Above I referenced only locations explicitly mentioned in the colophons; in other cases, the origin may be inferred from scribes, or internal notes. We know with certainty that copies of the *Taḥrīr* were produced in Marāgha (662/1264), Shiraz (691/1292), Tabriz (732/1332), and Soltaniyeh (722/1322). Various manuscripts further include statements and notes that are important for an understanding of the early transmission of the text, but cannot be addressed in detail here. These manuscripts attest to the role of madrasas as key sites for copying and collation: mentioned are the madrasa ʿAḍūdiyya in

34 Löhr, MS Ahmet III 3453; Parra, List of Arabic manuscripts, 272 (no. 43).

35 Van Dalen *et al.*, MS Tehran F 2885; and Parra, List of Arabic manuscripts, 307 (no. 122).

36 Bellver, MS Nuruosmaniye, 2941; Parra, List of Arabic manuscripts, 271 (no. 39).

37 Löhr, MS Ayasofya 2583; Parra, List of Arabic manuscripts, 269-270 (no. 37).

38 Bellver, MS Ar. 3637; Parra, List of Arabic manuscripts, 266-267 (no. 22).

39 Löhr, MS Ahmet III 3332.

40 Van Dalen, MS riyāḍī 405; Parra, List of Arabic manuscripts, 267 (no. 25).

41 Bellver, MS IO Islamic 1148; Parra, List of Arabic manuscripts, 273-274 (no. 47).

42 Boehm and van Dalen, MS Veliyüddin 2302; Parra, List of Arabic manuscripts, 268 (no. 30).

Shiraz,[43] the Qārfasiyya in Nishapur,[44] the madrasa Rashīdiyya in Soltaniyeh,[45] the Muʿīniyya madrasa in Qayṣariyya,[46] and the madrasa of Marāgha.[47]

Reaching the last page of a text was not necessarily considered the end of the copying process – a point vividly illustrated in a brief exchange transmitted in al-ʿAlmawī's guidelines on the scholarly use of books: "ʿUrwah b. az-Zubayr asked his son Hišām (God show favor unto them): *Did you do your copying? – Yes. – Did you compare your copy, i.e. with another correct text? – No. – Then you did not do any copying*."[48]

There is no doubt that collation was a crucial part of ensuring a manuscript's accuracy and authenticity. Some of the manuscripts listed above even record exact dates for the completion of the collation process, and this ranges from a few days to as much as one year after the copy was finished – intervals that do not necessarily reflect the actual time spent on collation:

Manuscript	Copy finished	Collation finished
Tehran, Sipahsālār, 592	29 Dhū l-ḥijja 662 / 23 October 1264	5 Rabīʿ al-thānī [663] / 25 January 1265
Istanbul, Süleymaniye, Ayasofya 2583	5 Shawwāl 686 / 13 November 1287	21 Dhū l-qaʿda 686 / 28 Dezember1287
Dublin, Chester Beatty Library, Ar. 3637	10 Shawwāl 691 / 23 September 1292	13 Shawwāl 691 / 26 September 1292
London, British Library, IO Islamic 1148	6 Muḥarram 722 / 25 January 1322	Muḥarram 723 / January-February 1323

The guidelines suggest that collation should be done against a copy which is known to be correct, or it should be done together with the teacher.[49] The scribes of some of the copies from the Ilkhanid period did this: MS Tehran, Sipahsālār, 592 was copied from and collated against the autograph; the text in MS Istanbul, Süleymaniye, Ayasofya 2583 was compared to a manuscript that was corrected and read in the presence of the author; and al-Zarkashī, the scribe of MS Tehran, Sipahsālār, 4727, collated a multiple-text manuscript including the *Taḥrīr al-Majisṭī.* In the collation process of one of the works in this collection, the *Tadhkira*, he even incorporated marginalia that were written by al-Ṭūsī on a copy of his works which was read to al-Zarkashī.[50]

This vivid culture of correcting and safeguarding texts likely also influenced the transmission of marginal notes when these were copied from the exemplar. At the same time, this

43 MS Ar. 3637, fol. 164v.

44 MS Ayasofya 2583, fol. 113r.

45 MS IO Islamic 1148, fol. 62r.

46 MS Tehran, F 2885, fol. 50r.

47 This was the place of copying for a manuscript in the hand of Maḥmūd al-Khaṭīb, preserved for example in MS Suleman 165/25, p. 185.

48 al-ʿAlmawī, *al-Muʿīd fī adab al-mufīd,* trans. Rosenthal, 14.

49 Ibn Jamāʿa, *Tadhkirat al-sāmiʿ,* trans. Shah, 83.

50 On this, see also Ragep, *Memoir on Astronomy*, vol. 1, 74 and 81.

challenges the assumption that marginalia reflect active engagement with the text; if considered integral to its scholarly value or authority, their reproduction may have adhered to established copyist etiquette rather than resulting from interaction with the text.

Some Marginal Notes from the Ilkhanid or Pre-Ilkhanid Period

While cataloging copies of the *Taḥrīr*, I observed that many manuscripts produced in the Mongol period contain marginal notes written in the scribes' own hands, which then reappear, identical in wording, in later copies. This prompts the question of whether an analysis of marginalia found in Ilkhanid-period manuscripts can yield a better grasp of how the *Almagest* was read, studied, and transmitted in 13th-century Iran. A further question is whether some of these notes may derive from the autograph – possibly even from al-Ṭūsī himself.

As a starting point for a better understanding of this situation, I wish to focus on marginalia to Books I and II of the *Taḥrīr al-Majisṭī*. To ensure that the annotations are contemporaneous with the manuscript's production in the 13th or early 14th century and not later additions, I propose to focus on a copy with marginalia that can with relative certainty be identified as having been written in the scribe's hand. This would imply either that the notes originated with the scribe or were copied from the exemplar. Since an autograph is, to the best of our knowledge, no longer extant or possibly held in an unknown private collection, the ideal Ilkhanid manuscript for such an examination would be one closely connected to al-Ṭūsī – produced from his autograph, under his supervision, or copied by a student or close associate.

Several manuscripts come into closer consideration for this. First, MS Tehran, Sipahsālār, 592, copied in Marāgha in 662/1264 directly from the autograph while al-Ṭūsī was still active there. This manuscript contains numerous marginalia in different hands; however, its margins have been heavily repaired, and although most glosses appear to have been restored or completed, this complicates their analysis. Second, MS Cairo, Dār al-kutub, *hayʾa* Talʿat 43, written around 670-673/1272-1274, largely in the hand of Muʾayyad al-Dīn al-ʿUrḍīʾs son Shams al-Dīn Muḥammad al-ʿUrḍī, presents itself as a logical candidate, but its trimmed margins impede the reading of some marginalia in his hand. The most suitable choice I believe is MS Sipahsālār, 4727, copied in 671/1273 – approximately one year before al-Ṭūsī's death – by Muḥammad b. Aḥmad b. Muḥammad b. Rabīʿ al-Zarkashī, whose activity may be linked to the scholarly environment of Marāgha. As mentioned above, this manuscript is a multiple-text codex that includes Naṣīr al-Dīn al-Ṭūsī's recensions of both the *Elements* and the *Almagest*, together with his recension of the "Middle Books" (*al-Mutawassiṭāt*), al-Ṭūsī's collection of revised treatises that a student should study between the two major works. Al-Zarkashī copied the entire book, explicitly mentions having provided the diagrams for the *Taḥrīr al-Majisṭī*, and leaves several notes of collation in the margins of the text. Compared to the other manuscripts from the Ilkhanid period, this manuscript contains relatively few marginal notes to the first two books of the *Taḥrīr al-Majisṭī*, but apart from one on p. 442, all share the distinctive features of al-Zarkashī's hand and are written with the same thick-nibbed pen as the main text.[51]

51 A detailed description is provided in Löhr, MS Sipahsālār 4727.

In the appendix to this paper, I provide a transcription of the marginalia to Books I and II of the *Taḥrīr al-Majisṭī* as transmitted through al-Zarkashī. Each note is numbered for ease of reference; I preserve al-Zarkashī's original color-coding and retain the abjad references in their undotted form, exactly as found in the manuscript. My interpretations of these notes can be inferred from the accompanying English translations and discussion in this article. In the appendix, I also provide references to folio numbers in other Ilkhanid copies where marginal notes with generally identical phrasing appear. While I will refer to the set of marginalia preserved in the margins of MS Sipahsālār, 4727 as "al-Zarkashī's notes", I do not wish to suggest that these annotations originated with al-Zarkashī himself; rather, he appears to be one of several scribes involved in their transmission.

The first marginal note to the *Taḥrīr al-Majisṭī* in al-Zarkashī's hand (MI-1) provides information about three different versions of the *Almagest* and notes structural changes in the division of chapters.

> حاشية للمجسطي ثلث نسخ مشهورة أحدها من نقل الحجّاج والثانية من نقل إسحق وقد صحّحها ثابت والثالثة منسوبة إلى ثابت وحده ويوسم الفصول في نسخة الحجّاج بالأنواع وفي نسخة ثابت بالأبواب وقد يختلف النسخ في أعدادها وأعداد الأشكال في بعض المقالات.[52]

> "There are three well-known versions of the text. One is the transmission of al-Ḥajjāj, the second is that of Isḥāq, which was corrected by Thābit, and the third is attributed to Thābit alone. In al-Ḥajjāj's version, the chapters are labeled as *anwāʿ*, while in Thābit's version they are called *abwāb*. The copies may differ in the number of chapters and in the number of figures in some of the treatises."

This annotation appears in ten of the twelve copies of the *Taḥrīr* that are known to have been produced before the fall of the Ilkhanate.[53] In my interpretation, the note is in all these cases written in the hand of the main scribe. Of the two exceptions that omit the note, one is MS Istanbul, Nuruosmaniye, 2941, which is largely devoid of marginal annotations, and the other is MS Istanbul, Beyazıt, Veliyüddin 2302, in which the first folio – where the note would be expected – has been replaced.

For the insight it provides into the textual transmission of the *Almagest*, this gloss has attracted considerable interest from historians. The first Arabic version mentioned here was made from the Greek in 212/827-28 by al-Ḥajjāj b. Yūsuf b. Maṭar and Sarjūn b. Hiliyā al-Rūmī for the Abbasid caliph al-Maʾmūn (r. 813-833).[54] The second version, by Isḥāq b. Ḥunayn (*c*. 830-*c*. 911) with revisions by Thābit b. Qurra (836-901), is dedicated to Abū al-Ṣaqr Ismāʿīl b. Bulbul (844-892), the minister of the Abbasid caliph al-Muʿtamid ʿalā Allāh (r. 870-892).[55] These two versions have survived in full, though the Isḥāq–Thābit translation is the most widespread and served as the base text for al-Ṭūsī's *Taḥrīr*. An uncorrected

52 MS Sipahsālār, 4727, p. 426.

53 See appendix.

54 For an overview and related literature, consult Rezvani, al-Majisṭī (tr. al-Ḥajjāj).

55 For an overview and related literature, consult Rezvani, al-Majisṭī (tr. Isḥāq/Thābit).

translation by Isḥāq may have survived in some manuscripts.[56] The note above then mentions a third version, *attributed to Thābit alone*, which is attested in two incomplete manuscripts. The existence of this version was established by Grupe, who also identified multiple references to it – both in the main text of the *Taḥrīr* and in marginal annotations.[57]

In his 17th-century bibliographic encyclopedia *Kashf al-ẓunūn*, Ḥājjī Khalīfa quotes a passage from Qāḍīzāda al-Rūmī's (d. after 1436) commentary on the *Almagest* that corresponds exactly to the gloss found in the margins of al-Ṭūsī's *Taḥrīr*.[58] Kunitzsch later adopts this reference in his study on the *Almagest*, suggesting that the passage originated in Qāḍīzāda's commentary and was subsequently inserted as a note into the margins of the *Taḥrīr* copies.[59]

Without a thorough study of the early copies of al-Ṭūsī's *Taḥrīr*, this assumption makes sense. In the only known surviving copy of Qāḍīzāda's commentary, quotations from al-Ṭūsī's *Taḥrīr* are introduced with *qawlu-hu* written in red, and conclude with the abbreviation *ilkh*, short for *ilā ākhiri-hi*, meaning "until the end of it".[60] In the beginning of the text, the short quotations are additionally marked with an overline from *qawlu-hu* to *ilkh*. The gloss in question appears where the second quotation from al-Ṭūsī's *Taḥrīr* ends with *ilkh*, giving the impression that it is Qāḍīzāda's own explanatory remark.[61]

MS Tehran, Sipahsālār, 4727, along with other 13th-century manuscripts – including MS Tehran, Sipahsālār, 592, allegedly copied from the autograph in Marāgha in 662/1264 – contains the note in the hand of the main scribe.[62] These witnesses demonstrate that the gloss was already featured in the manuscripts when al-Ṭūsī was still alive. It is therefore more plausible that the note originated in the margins of al-Ṭūsī's *Taḥrīr* and was only later incorporated into the commentary tradition.

The Berlin copy of Qāḍīzāda's commentary includes only a few quotations explicitly introduced with *aqūlu* ("I say") and offers no indication of the origin of the remaining explanatory notes. While the commentary still awaits thorough study before definitive conclusions can be drawn, it may like most commentary literature represent a mixture of Qāḍīzāda's own remarks and selected material he considered useful for a better understanding of the astronomical text. After Qāḍīzāda, al-Bīrjandī (d. 1528) and ʿAlī al-Jīlānī (d. 1017/1609?) also incorporated this note into their commentaries on the *Taḥrīr al-Majisṭī*.[63] The gloss thus offers a good example of how a marginal note can become an integral part of the textual tradition, moving from the margin of the uncommented base text into the main body of the commentary (or in this case from the commentary into the super-commentary).

56 Van Dalen et al., Hitherto unknown Arabic manuscript, 628.

57 On this version and its establishment, see Grupe, Thābit-version; Grupe, *Latin Reception*, esp. 126-128; Grupe, Thābit ibn Qurra's version. See also Rezvani and van Dalen, al-Majisṭī (tr. Thābit).

58 Ḥājjī Khalīfa, *Kashf al-ẓunūn*, ed. Flügel, vol. 5, 386-387.

59 Kunitzsch, *Der Almagest*, 26-27, 30-31, 48.

60 That is, MS Or. oct. 274; see also Rezvani, Ḥāshiya ʿalā Sharḥ al-Majisṭī.

61 MS Or. oct. 274, fol. 1v.

62 In MS Sipahsālār, 592 on the incipit page, partially damaged and later completed.

63 See also Löhr, Sharḥ Taḥrīr al-Majisṭī.

Engagement with Thābit's version of the *Almagest* is reflected in five additional notes that al-Zarkashī left in the margins to Books I and II of al-Ṭūsī's *Taḥrīr*.[64] These notes reflect again a structural comparison, particularly with the chapter layout attributed to Thābit b. Qurra's version, which shows the most significant differences compared to the translation by Isḥāq b. Ḥunayn (revised by Thābit b. Qurra).

MI-2	حاشية وفي نسخة ثابت بنقصان بابين وزيادة أربعة أشكال
"Marginal note: In Thābit's version, there are two chapters less and four propositions added."	
MI-6	حاشية هذا الفصل وما قبله من باب ح في نسخة ثابت والجداول من باب ط
"Marginal note: This chapter and what precedes it is Chapter 8 in the version of Thābit, and the tables are from Chapter 9 [in Thābit's version]."	
MI-10	هذا الفصل مع ما قبله من باب يا في نسخة ثابت
"This chapter, together with what precedes it, constitutes Chapter 11 in Thābit's version."	
MII-1	حاشية المقالة في نسخة ثابت يب بابًا بنقصان فصل للجدول
"Marginal note: In Thābit's version, the book consists of 12 chapters, with the omission of the chapter containing the table."	
MII-13	حاشية هذا الفصل هو التاسع في نسخة ثابت
"Marginal note: This chapter is the ninth in Thābit's version."	

An examination of the surviving 13th-century copy of Thābit's version[65] confirms the statements of marginalia MI-10 and MII-13. The marginal notes MI-2 (mentioning four additional propositions or figures) and MII-1 (which claims that Book II encompasses 12 chapters) are more challenging to harmonize with our source. The remaining note, MI-6, makes sense: the proposition in Chapter 10 in the main text of the *Taḥrīr* is addressed in Chapter 8 in Thābit's version, and the tables may be assumed to be part of Chapter 9 if a reader misses the heading of Chapter 10 in MS Patna, Khuda Bakhsh, HL 3390.[66]

These marginal references to certain chapters, along with structural differences in Thābit's version compared to the Isḥāq–Thābit version, are also reproduced in the margins of nearly all *Taḥrīr* manuscripts copied in the Mongol period. Exceptions are again MS Istanbul, Nuruosmaniye, 2941, which contains hardly any marginalia, MS Istanbul, Beyazıt, Veliyüddin 2302, and MS Ar. 3637.[67] Furthermore, MI-10 is omitted in some of the witnesses.[68] MS

64 MS Sipahsālār, 4727, pp. 426 (MI-2), 430 (MI-6), 439 (MI-10), 440 (MII-1), 449 (MII-13).

65 On MS Patna, Khuda Bakhsh, HL 3390, see van Dalen et al., Hitherto unknown Arabic manuscript.

66 Some of these notes to Thābit's version have previously been discussed in Grupe, Thābit-version, esp. 150; Grupe, *Latin Reception*, 126-128; Grupe, Manuscript Jaipur 20, esp. 142-143, 145. See further Kunitzsch, *Der Almagest*, 31-32, on some glosses found in MS Paris, Bibliothèque nationale de France, ar. 2485, including MI-2; he assumes all these glosses ultimately derive from Qāḍīzāda.

67 MS Veliyüddin 2302, fol. 14v.

68 See appendix.

Tehran, Sipahsālār, 592, copied from the original, suggests that the references to Thābit's version – written in the hand of the scribe Ibn al-Bawwāb al-Baghdādī – were either present in al-Ṭūsī's autograph or added by the scribe around 1264. If the latter is correct, this would imply that most other manuscripts examined here are either directly dependent on MS Tehran, Sipahsālār, 592, or that the notes were independently incorporated into the exemplars used for other Ilkhanid copies, possibly as part of a deliberate effort by scholars in al-Ṭūsī's circle to promote a specific text-critical reading of the *Taḥrīr*.

The Commentator's Role

These references to other versions of the *Almagest* reflect a high level of philological awareness and a deliberate engagement with textual plurality, where a reader is invested in documenting multiple textual traditions. This approach to reading and annotating the *Taḥrīr* should be seen in the context of broader methodological developments in philosophical commentary literature emerging from the 11th century onward.

Wisnovsky has demonstrated that the methods and styles of early Arabic commentaries on Avicenna's *Ishārāt* provided templates for later derivative works, including al-Ṭūsī's *Ḥall mushkilāt al-Ishārāt*. A central concern in this tradition was *taḥqīq* (verification), which operated on multiple levels.[69] At the philological level, it required the commentator to assess the authenticity of the text as genuinely written by the author "and – more commonly – in order to verify that the manuscript witness at hand truly represented the original text that was composed by the author".[70] This established the foundation for a second, philosophical level of verification, involving critical engagement with the author's theories and arguments.

Philological *taḥqīq* required, among other elements, that a commentator identify the author, title, volumes, and chapter divisions of a work.[71] This is exemplified by the marginal note (MI-1) addressing the three Arabic versions of the *Almagest* and their respective chapter divisions, placed next to the preface of the *Taḥrīr* where al-Ṭūsī's discusses of the arrangement of chapters and propositions in the Isḥāq–Thābit version. Some of the marginal notes referring to the Thābit version go further by attempting to reconcile the internal structure of specific chapters in the Isḥāq–Thābit recension with that of Thābit's independent version. These notes highlight differences in the distribution of content – possibly reflecting an effort to harmonize structural discrepancies between the versions and to verify their completeness.

Scholarly settings in which a commentary was read probably employed the same methodological techniques[72] and may have been the origin of annotating practices of this kind. A careful textual comparison of chapter divisions in the different versions of a work did not only set grounds for an evaluation of the authenticity of the *matn* it also allowed for a more

69 For a list of the various functions of *taḥqīq*, see Wisnovsky, Avicennism and exegetical practice, 345-357.

70 Wisnovsky, Avicennism and exegetical practice, 354. On *taḥqīq* in early modern works on logic, see El-Rouayheb, Khaled, Opening the gate of verification.

71 Wisnovsky, Avicennism and exegetical practice, 354.

72 Brentjes, Codex Arab. 2697, 452.

nuanced understanding of other commentaries which discussed the same text. Among the glosses in al-Zarkashī hand we find also a note that cites al-Nayrīzī (d. 309/921) (MII-12):

حاشية قال النيريزي من حقّ هذا الشكل أن يقدّم على ما قبله لأنّه يتعلّق بفصل مطالعي المنتصبة. والمائلة أقول ليس ذلك بواجب لأنّ البرهان المتعلّق به هو الذي بعده.[73]

"Al-Nayrīzī said: This figure ought to be placed before the previous one, because it relates to the section on the rising of upright and oblique signs. I say: This is not necessary, because the proof related to it comes only in the following section."

This marginal comment apparently refers to al-Nayrīzī's lost commentary on the *Almagest* and appears in the margins of eight Ilkhanid-period copies of al-Ṭūsī's work.[74] Its presence in al-Bawwāb's handwriting in the Sipahsālār manuscript confirms that it became part of the textual tradition by 1264 or earlier.[75] This suggests that the *Taḥrīr* was, at some point, compared with al-Nayrīzī's commentary by – or in the presence of – an authoritative figure, and that the outcome of this comparison was recorded in the citation, as indicated by the use of the first-person singular *aqūlu* ("I say").

The marginalia in al-Zarkashī's hand clearly go beyond the study of the *Almagest* itself. In addition to references to al-Nayrīzī, they also include references to other mathematical works. The following table gives a list of authors and works cited in al-Zarkashī's marginalia to Books I and II of the *Taḥrīr*, arranged in the order of their first appearance.

Author	**Work mentioned**[76]
Thābit b. Qurra	*Nuskhat Thābit* (his version of the Almagest)
al-Ḥajjāj b. Yūsuf b. Maṭar	*Nuskhat al-Ḥajjāj* (his version of the Almagest)
Theodosius of Bithynia	*Ukar Thāwdhūsiyūs / al-Ukar*
Autolycus	*[al-Kura al-mutaḥarrika]*
Euclid	*al-Muʿṭayāt / al-Muʿṭayāt li-Uqlīdis al-mutaḥarrika*
Menelaus	*Kuriyyāt*
Euclid	*Ẓāhirāt Uqlīdis / al-Ẓāhirāt*
al-Nayrīzī	Probably his lost commentary on the *Almagest*

The references to Arabic treatises with Greek origin are perhaps best described as cross-referential or intertextual marginalia. They link specific content in the *Almagest* (or its *Taḥrīr*) to related discussions, proofs, or propositions found in a range of traditional mathematical texts as preserved and transmitted within the Arabic tradition. The multiple-text manuscript

73 MS Sipahsālār, 4727, p. 445.

74 It is not found in MSS Tehran, F2885; Nuruosmaniye, 2941; Ahmet III 3332 and Veliyüddin 2302, see the appendix for details.

75 MS Sipahsālār, 592, fol. 22r.

76 Authors and works listed here are mentioned in several notes; for references, see appendix.

copied by al-Zarkashī includes several of these texts in al-Ṭūsī's editions, often grouped under the title *Taḥrīr al-Mutawassiṭāt* ("Recension of the *Middle Books*").[77] The *Middle Books* were intended to be studied between *Euclid's Elements* and the *Almagest*. These collections varied in content but, in their standard form, typically included short treatises and selected chapters by Theodosius, Autolycus, Euclid, Archimedes, and others, designed to bridge the conceptual and technical gap between elementary geometry and Ptolemaic astronomy. Extant collections that combine the Mutawassiṭāt and the Taḥrīr al-Majisṭī in a single volume date only from the Ilkhanid period.[78] While many more survive without the *Almagest* recension – perhaps reflecting pedagogical priorities in Mongol Iran – practical considerations likely played a role as well: codices including the *Taḥrīr al-Majisṭī* required around 150 additional folios, making them significantly larger and heavier, and thus more conveniently kept in a separate volume or separated from the collection at some point

The marginalia in Books I and II of the *Taḥrīr al-Majisṭī* penned by al-Zarkashī include cross-references to several of the treatises usually found in the *Mutawassiṭāt* collections. However, there is greater variation in the transmission and annotation practices across the Ilkhanid-period manuscripts than in the previously discussed examples. Not all of al-Zarkashī's references to the *Mutawassiṭāt* are preserved in other copies, and conversely, some additional references of the same type appear in other manuscripts but are absent from his marginalia. Moreover, certain manuscripts incorporate this material as brief interlinear reference codes rather than full marginal notes. A few examples are provided below to illustrate this practice.

Interlinear variant[79]	Standard form[80]	Marginal note
رمعط	حاشية بيّن ذلك في سابع المعطيات	MI-7
	"Marginal note: this was explained in [proposition] seven of [Euclid's] *al-Muʿṭayāt*"	
ه ح ب معط	حاشية تبيّن ذلك في ه ح ب المعطيات	MI-9
	"Marginal note: this is explained in the [propositions] 5 8 2 of [Euclid's] *al-Muʿṭayāt*"	
د منالاوس	حاشية لما في د هي كريات منالاوس	MII-6
	"Marginal note: regarding what is mentioned in [proposition] 4 this concerns Menelaus's *Spherics*"	

77 On the "Middle Books" in Islamic teaching context, see for example Brentjes, *Teaching and Learning the Sciences*, esp. 227-237.

78 See MSS Sipahsālār, 4727; Ahmet III 3453; Āstān-i Quds, 5456; riyāḍī 405; F2885.

79 Represented as found in MS Ahmet III 3332: fols. 15r (MI-7, MI-9), 21r (MII-6), 21v (MII-10).

80 MS Sipahsālār, 4727: pp. 437 (MI-7), 437 (MI-9), 444 (MII-6), 445 (MII-10).

MII-10	حاشية لما في ى من ب من الأكر	ى ب اكر
	"Marginal note: Regarding what is in [proposition] 10 it relates to [proposition] 2 in *al-Ukar*"	

I found the shortened variants in several manuscripts, sometimes with abbreviations that deviate from Istanbul, Topkapı, Ahmet III 3332. The scribes were likely familiar with the literary context and considered the abbreviated sigla sufficient for navigation. A later reader of MS Istanbul, Ahmet III 3332, however, either overlooked the interlinear reference or chose to add the notes MI-7 and MI-9 again in their extended form in the adjacent margin – possibly as part of a collation process or to track his own engaged reading.

From Ibn Jamāʿa, active in the 13th-century Mamluk regions, we learn that the practice of red interlinear annotations was frowned upon: "A student should not write notes in between lines. Some scholars did so with a red pen to tell them apart from the text, but this is not advisable."[81] Furthermore, al-ʿAlmawī recommends that if abbreviations are used, they should be preceded by a key at the beginning of the book – though this practise was hardly followed in the context of a study session. Nonetheless, it reflects an awareness of the difficulties such practices pose for other readers of the manuscript.[82]

In any case, the varying styles of cross-referencing indicate that these annotations were not simply copied from one exemplar to the next; rather, readers applied the same method across manuscripts which is possibly reflecting oral study sessions in which the same cross-references were discussed. MS Istanbul, Beyazıt, Veliyüddin 2302 offers a good example of critical engagement with the notes, though probably dating from the post-Mongol period: in one instance, a reader crossed out a reference to Proposition 4 in [al-Ṭūsī's recension of] Autolycus after failing to verify it;[83] in another, a reader added a note that conveys the same intent as a reference found in al-Zarkashī's manuscript, but formulates it differently.

أحدها فوق الأفق والأخرى تحته [85]	في بعض النسخ نرسم م ک فوق الأرض ول ح تحته[84]
"One of them is above the horizon, and the other beneath it"	"In some copies: *we draw M-K above the earth and L-KH beneath it*"

Cross-references are also found in the margins of the several treatises that are part of the *Taḥrīr al-Mutawassiṭāt* and are transcribed and discussed by Roughan as referential scholia.[86] Furthermore, Brentjes has shown that marginal annotations to al-Ṭūsī's recension of Euclid's

81 Ibn Jamāʿa, *Tadhkirat al-sāmiʿ*, trans. Shah, 86.

82 al-ʿAlmawī, *al-Muʿīd fī adab al-mufīd,* trans. Rosenthal, 17.

83 That is MI-5 on fol. 2v.

84 MS Sipahsālār, 4727 (MII-5), p. 442.

85 MS Veliyüddin 2302, 11r.

86 See her transcription and discussion of the scholia in Roughan, *Little Astronomy*, 308-315.

Elements preserved in a copy kept in Munich, display both functions of *taḥqīq,* philological and philosophical.[87]

Some functions of *taḥqīq* can also be identified in the main text of the *Taḥrīr al-Majisṭī*, where al-Ṭūsī states in the introduction that he follows the Isḥāq–Thābit version and consistently specifies, both in the general preface and at the beginning of each book, the exact number of chapters and corresponding propositions. In Chapter II.6, alternative readings drawn from a table of parallels in another copy in the hand of al-Bīrūnī (*nuskha ʾukhra bi-khaṭṭ Abī Rayḥān*) are included;[88] these alternatives are marked interlinearly in red and it remains unclear whether they should be regarded as later annotations or as part of the *matn*. Throughout the *Taḥrīr*, the boundaries between annotation and main text are occasionally blurred, as al-Ṭūsī deliberately incorporates variant sources, perhaps even at different stages of his career. It is also known that al-Ṭūsī composed a small collection of glosses intended to accompany the study of the *Almagest.* This text includes several glosses drawn from Abū Rayḥān al-Bīrūnī's *Qānūn* and is closely connected to the scholarly environment of Marāgha.[89] Treatises like this and the marginalia in Ilkhanid copies of the *Taḥrīr* reflect sustained efforts to read the *Almagest* alongside and in contrast to various mathematical texts and different manuscript versions, drawing on sources that may have been more accessible there than ever before. The above-mentioned table also references the version of the *Almagest* by al-Ḥajjāj, although the degrees cited do not match the variant readings in either of the two surviving manuscripts;[90] the reasons for this discrepancy may be manifold.

Although it cannot be determined with certainty whether the alternative readings from a copy of al-Ḥajjāj or from al-Bīrūnī were inserted into the table by al-Ṭūsī himself, their presence in all Ilkhanid-period copies, including those based on the autograph, strongly suggests that they were already part of what the copyists found in the original. Likely much of al-Ṭūsī's later work – beginning with *Ḥall mushkilāt al-Ishārāt* completed in 644/1246 while he was still residing in the citadel of Alamūt under Ismāʿīlī patronage[91] – adopts a variety of *taḥqīq* functions. His reworkings of the *Middle Books*, along with his editions of the *Almagest* and *Elements*, all belong to this period. In the final phase of his life (654-672/1256-1274), during his service under Mongol patronage, he seems to have focused on consolidating and systematizing these earlier achievements rather than breaking new ground.[92]

As with the interlinear cross-references and the alternative readings in Chapter II.6, al-Ṭūsī and those studying his texts made deliberate and systematic use of red ink to distinguish layers of content. The surviving manuscripts consistently preserve this distinction: diagrams from the Isḥāq–Thābit corpus are typically drawn with red lines and black geometric points, while supplementary material reverses this scheme – black lines with red points –

87 Brentjes, Codex Arab. 2697.

88 See for example MS Sipahsālār, 4727, p. 443.

89 See Hullmeine, Naṣīr al-Dīn al-Ṭūsī, Multaqaṭāt.

90 cf. MSS Leiden, Universiteitsbibliotheek, Or. 680, fol. 19r and London, British Library, Add. 7474, fol. 37r.

91 Dating from Ragep, *Memoir on Astronomy*, 23.

92 Ragep, *Memoir on Astronomy*, 21.

a convention al-Ṭūsī explicitly notes in his introduction.[93] Additionally, the numbering of propositions in al-Ṭūsī's reference works appears in red in the margins visually separated from the text block, allowing for quick browsing and navigation between the propositions of the individual works. The layout of marginal numbering and the visual separation of different sources, achieved through the strategic use of red ink, in manuscripts featuring al-Ṭūsī's *Taḥrīr* literature appears particularly well suited for *taḥqīq*.

From ḥāshiya *to* min-hu

Philological *taḥqīq* is attested also in a marginal note ascribed to al-Ṭūsī own hand, reproduced in two manuscripts of Avicenna's *Shifāʾ*.[94] In this instance, two scribes copy a note from the margin of al-Ṭūsī's own copy, in which he remarks that the total number of theorems in a given treatise – when including one added by Thābit – amounts to thirty-eight, suggesting that al-Ṭūsī annotated his personal books according to the principles of *taḥqīq*. The cases in which explicit mention to al-Ṭūsī is made in selected notes are rare. In some manuscripts copied several centuries after the Mongol period, however, scribal practices and forms of attribution suggest that the notes from the Ilkhanid copies are presented as the work of al-Ṭūsī himself.

During the Ilkhanid period, the set of notes copied by al-Zarkashī – as well as similar annotations in the other Ilkhanid manuscripts – are introduced by the term *ḥāshiya* (lit. "margin" or "gloss"), typically spelled out in full and often rubricated. This term is commonly found in the margins of manuscripts, though more often appears in abbreviated forms such as *ḥ*, *ḥh*, *ḥyh(a)*, or *ḥsh*.[95] In general usage, it refers to any content added in the margins, but more specifically it is used for substantial marginal commentaries – multi-line notes either composed by a reader or copied from another source. Over time, the term appears to have been transferred from manuscript annotation practices to the titles of works, where it came to function synonymously with *sharḥ* (commentary), or as part of compound titles for super-commentaries (*ḥāshiya ʿalā sharḥ*).[96] Notably, Qāḍīzāda al-Rūmī's commentary, which incorporates the marginal note on the three versions of the *Almagest*, is itself referred to as *Ḥāshiyat Majisṭī li-Qāḍī Zāda*.

In the later manuscript tradition, the use of the fully spelled-out term *ḥāshiya* becomes less common for identifying the marginalia transmitted through al-Zarkashī. Instead, some annotations already attested in the Ilkhanid period appear in 17th- and 18th-century manuscripts marked with the siglum *min-hu*. One such example is MS Mashhad, Dānishgāh, Ilahiyyāt 673,[97] a copy of the *Taḥrīr* completed on 12 Ṣafar 1086 / 8 May 1675 in Isfahan. The

93 see Hullmeine, Transcription of Naṣīr al-Dīn al-Ṭūsī or the translated extracts in Saliba, *Almagest* commentaries.

94 For transcriptions and translations of these notes, see Di Vincenzo, Early exegetical practice, 43. The reference pertains to MSS Istanbul, Nuruosmaniye 2710, fol. 261r; Cairo, Maktabat al-Azhar al-Sharīf, Bekhīt 331, fol. 259r.

95 Gacek, *Vademecum*, 114-117.

96 Brentjes, Mathematical commentaries, 56.

97 Boehm, MS Ilahiyyāt 673.

scribe, Muḥammad Fakhr al-Dīn al-Najafī, notes that his exemplar had been collated against a manuscript attributed to al-Ṭūsī himself.

In the margins of this manuscript, several notes – including the one on the different Arabic versions of the *Almagest* and those concerning the chapter arrangement in Thābit's version – conclude either with the phrase *bi-khaṭṭi-hi* ("in his hand"),[98] or with *min-hu* ("from him").[99] The reference to al-Nayrīzī's now-lost commentary also concludes with *min-hu*.[100] Both expressions are described by Gacek as gloss categories "which in most cases can be traced to the author himself".[101] The abbreviation *min-hu* was typically employed to denote non-obligatory additions by the author or glosses drawn from other works by the same author.[102] The notes thus serve as indicators used by scribes to mark material believed to originate with the author.

As Quiring-Zoche has pointed out, the earliest occurrences of *minhiyyāt* appear in mid-13th-century Damascus, and the term only becomes gradually more common in manuscripts from the Persianate regions beginning in the 14th century, well after al-Ṭūsī wrote the *Taḥrīr*.[103] In the case of the marginal notes in the Mashhad copy – apparently written in the hand of the scribe Muḥammad Fakhr al-Dīn al-Najafī – the phrases *bi-khaṭṭi-hi* and *min-hu* may at first appear to be used interchangeably. However, it is more likely that the scribe intended to convey a distinction in meaning. In the colophon, al-Najafī refers both to the hand of the editor, that is, al-Ṭūsī (*khaṭṭ al-muḥarrir*), and to the hand of the exemplar's scribe, that is, Niẓām al-Dīn Muḥammad (*khaṭṭ al-nāsikh*). He explicitly states that the marginal notes in the exemplar were copied in the hand of Niẓām al-Dīn Muḥammad: *ḥawāshī naqlan bi-khaṭṭ al-sharīf ʿalā al-ʿabd Niẓām al-Dīn Muḥammad*.

From this, I understand that several notes known from the Ilkhanid period were already present in the exemplar written by Niẓām al-Dīn Muḥammad, who had compared his manuscript against the autograph. The copyist of the Mashhad manuscript, al-Najafī, noticed that the marginalia were written in Niẓām al-Dīn's handwriting, marking them in his own copy with the phrase *bi-khaṭṭihi*. The *min-hu* siglum, on the other hand, following general annotation practices, typically indicates a connection to the author of the work. It may reflect the interpretation of the scribe of the exemplar, who possibly encountered the notes in the autograph. Alternatively, it could have been added by al-Najafī himself or derived from another source containing the same glosses. That *minhiyyāt* may not only have been replicated but also composed by copyists and readers, an aspect also noted by Quiring-Zoche, complicates any attempt at analysis or attribution to the original author.

What this phenomenon suggests is that by marking annotations with *min-hu* – some of which originate in the Ilkhanid or even pre-Ilkhanid period – they came to be attributed to

98 MS Ilahiyyāt 673, fols. 1r (MI-1, MI-2), 5v (MI-6).

99 MS Ilahiyyāt 673, fols. 16r (MI-10), 17r (MII-1).

100 MS Ilahiyyāt 673, fol. 21v (MII-12).

101 Gacek, *Vademecum*, 115.

102 On this scribal practise see also Şen, Authoring and Publishing.

103 Quiring-Zoche, Minhīyāt, 987.

Naṣīr al-Dīn al-Ṭūsī, as they were perceived as notes deriving from him, whether as glosses or excerpts from other works. While the historical accuracy of this attribution remains uncertain, the transmission history shows that these glosses became closely associated with al-Ṭūsī through the very act of labeling them *min-hu*.

Conclusion

This essay has aimed to offer some preliminary observations on the marginal annotations found in copies of al-Ṭūsī's *Taḥrīr al-Majisṭī* transmitted from the Ilkhanid period. The focus was on the marginalia in the first two books of the *Taḥrīr*, as found in the hand of the scribe al-Zarkashī in MS Sipahsālār, 4727. This manuscript appears to be the earliest Ilkhanid copy in which such annotations are clearly preserved in the scribe's own hand, and not trimmed, damaged, or partially restored.

A closer examination of these annotations offers a glimpse into a scholastic environment in which the *Almagest* was not read in an isolated way but in comparison to related textual traditions. The marginalia analyzed here refer to other Arabic versions of the *Almagest* (particularly that of Thābit), engage with al-Nayrīzī's now-lost commentary, and include cross-references to classical Greek mathematical works frequently found in multiple-text manuscripts that transmit al-Ṭūsī's recension of the *Kitāb al-Mutawassiṭāt*. This exegetical approach can be linked to broader methodological practices applied in philosophical commentary literature from the 12th century onward, known as *taḥqīq* (verification). The notes in al-Zarkashī's hand found in the first two books of the *Taḥrīr* clearly reflect a philological function of this method, taking multiple textual traditions into account as a means of verifying the authenticity of both the text and the manuscripts that transmit it. The glosses also reflect discussions about the arrangement and correct sequencing of figures and propositions, but they do not apply *taḥqīq* in a more philosophical sense – where individual propositions are critically examined – at least not in the marginalia al-Zarkashī transmits in the first two books. As noted, al-Ṭūsī employs red ink in the *Taḥrīr* to distinguish between different sources and to help the reader navigate more efficiently through the text. This layout, while also found in other works of his, clearly facilitated a critical reading within the framework of *taḥqīq*, enabling readers to move easily between propositions. It appears as well in the *Mutawassiṭāt* and would have been especially useful in multi-text manuscripts like MS Sipahsālār 4727, where readers navigated – perhaps during reading sessions – between the *Taḥrīr al-Majisṭī* and other texts.

The marginalia in the first two books of al-Ṭūsī's *Taḥrīr al-Majisṭī*, as preserved in MS Sipahsālār, 4727 and written in the hand of al-Zarkashī, are – aside from a few exceptions – also found in the other copies from the Ilkhanid-era. While references to al-Nayrīzī and other versions of the *Almagest* are generally transmitted with consistent wording, the cross-references to the *Mutawassiṭāt* show greater variation. Some are omitted entirely, while others appear abbreviated in red, inserted between the lines – so compressed that later readers sometimes missed or struggled to understand the intended reference and added it again in full in the margin.

The annotations examined here are typically written in the same hand as the main text in Ilkhanid manuscripts, and were likely regarded as part of the established commentary tradition. A particularly noteworthy example is the copy produced by the illuminator al-Bawwāb in 1264, reportedly copied directly from al-Ṭūsī's autograph. While it is possible that al-Bawwāb was the first to add these exegetical glosses – several of which are later reproduced

verbatim in other Ilkhanid copies – it is more plausible that the glosses were already present in the autograph, during al-Ṭūsī's lifetime, or were preserved and transmitted by scholars in al-Ṭūsī's immediate circle as part of an authoritative exegetical reading.

Over time, authors of super-commentaries may have included elements of Ilkhanid or even pre-Ilkhanid marginalia. The first of the marginalia transmitted through al-Zarkashī – which discusses the existence of multiple Arabic versions of the *Almagest* – holds a particularly prominent place in the later transmission tradition. It not only appears in numerous subsequent manuscript copies but is also cited in the super-commentaries of al-Bīrjandī Qāḍīzāda, and ʿAlī al-Jīlānī. Some of these marginal notes including a quote from al-Nayrīzī's lost commentary were later classified as *minhiyyāt*. A case in point is MS Mashhad, Dānishgāh, Ilahiyyāt 673, based on a copy collated against the autograph, where the scribe ends several notes known from MS Sipahsālār, 4727 with the siglum *min-hu*, suggesting that scribes several generations removed from the original production of the *Taḥrīr* regarded al-Ṭūsī as the author of at least some of these annotations.

Appendix

The following table presents a transcription of al-Zarkashī's marginal annotations to Books I and II in Sipahsālār 4727, compared to other extant copies of Naṣīr al-Dīn al-Ṭūsī's *Taḥrīr al-Majisṭī* from the Ilkhanid period. I have provided the *abjad* notation as it appears in the manuscript, undotted and preserving the scribes' original color coding. (For references to the PAL Catalogue and Parra, here now 231-232.)

S 4727 = Tehran, Madrasa-yi ʿĀlī-i Shahīd Muṭahharī (Sipahsālār), 4727 (671/1273; glosses in the hand of the scribe Muḥammad b. Aḥmad b. Muḥammad b. Rabīʿ al-Zarkashī; mostly introduced with rubricated *ḥāshiya;* manuscript collated; marginalia for another text in this codex derived from al-Ṭūsī)	D 3637 = Dublin, Chester Beatty Library, Ar. 3637 (691/1292 in Shiraz; copied in the hand of al-Shīrāzī's student al-Arzawānī al-Turkistānī, "al-Zarkashī's" glosses occasionally introduced with *ḥāshiya)*
S 592 = Tehran, Madrasa-yi ʿĀlī-i Shahīd Muṭahharī (Sipahsālār), 592 (662/1264 at Marāgha from the autograph; "al-Zarkashī's" glosses in the hand of the scribe Ibn al-Bawwāb al-Baghdādī; mostly introduced with rubricated *ḥāshiya*; margins repaired; some marginalia erased)	T 3332 = Istanbul, Topkapı Sarayı Müzesi, Ahmet III 3332 (692/1293; "al-Zarkashī's" glosses in the hand of the unknown scribe, often introduced by rubricated *ḥāshiya*)
C 43 = Cairo, Dār al-kutub, *hayʾa* Talʿat 43 (mostly 670–673/1272–1274; "al-Zarkashī's" glosses in the hand of Shams al-Dīn Muḥammad al-ʿUrḍī, introduced with *ḥāshiya*; occasionally trimmed; pages typically containing MI-7 to MI-9 in a later hand)	H 405 = Hyderabad, OMLRI, riyāḍī 405 (around 709/1309-10; copied by Maqbūl b. Aṣīl al-Rūmī al-Qīrshahrī from al-Shīrāzī who copied it from al-Ṭūsī's autograph; "al-Zarkashī's" glosses mostly by the scribe and often labelled *hāshiya*)
T 3453 = Istanbul, Topkapı Sarayı Müzesi, Ahmet III 3453 (678/1279; "al-Zarkashī's" glosses mostly in the hand of the scribeʿAbd al-Kāfī b. ʿAbd al-Majīd b. ʿAbd Allāh al-Tabrīzī and often introduced with *ḥāshiya*)	L 1148 = London, British Library, IO Islamic 1148 (686/1287; "al-Zarkashī's" glosses by the unknown scribe, often labelled *hāshiya*)

F 2885 = Tehran, Kitābkhāna-yi markazi-i Dānishgāh-i Tehrān F2885
(678/1279; text and some marginalia copied from a MS in the hand of al-Shīrāzī; "al-Zarkashī's" glosses probably in the scribe's hand and mostly introduced with *ḥāshiya*)

B 2302 = Istanbul, Beyazıt Devlet Kütüphanesi, Veliyüddin 2302
(732/1332 in Tabriz by Abū ʿAbdallāh al-Ḥusayn b. Muḥammad b. al-Ḥasan al-Qummī, later al-Astarābādī, first folio replaced; extensive glosses, including a significant part from Qāḍī-Zāda's commentary)

N 2941 = Istanbul, Nuruosmaniye Kütüphanesi, 2941
(684/1285; with a long note by al-Shīrāzī on the title page; generally devoid of glosses)

* = as interlinear glosses in abbreviated forms

A 2583 = Istanbul, Süleymaniye Kütüphanesi, Ayasofya 2583
(686/1287; notes in the hand of the scribe al-Arzawānī, born al-Turkistānī, student of al-Shīrāzī, introduced with the rubricated word *ḥāshiya;* compared to a manuscript that was corrected and read in the presence of the author)

Sig.	7274 S	S 592	C 43	T 3453	F 2885	N 2941	A 2583	D 3637	T 3332	H 405	L 1148	B 2302
MI-1 (p.426)	حاشية للمجسطي ثلث نسخ مشهورة أحدها من نقل الحجّاج والثانية من نقل إسحق وقد صحّحها ثابت والثالثة منسوبة إلى ثابت وحده ويوسم الفصول في نسخة الحجّاج بالأنواع وفي نسخة ثابت بالأبواب وقد يختلف النسخ في أعدادها وأعداد الأشكال في بعض المقالات.	2v	1v	184v	54v	--	1v	2r	1v	249v	1v	--
MI-2 (p.426)	حاشية وفي نسخة ثابت بنقصان بابين وزيادة أربعة أشكال	3r	1v	184v	54v	--	2r	--	1v	249v	1v	--
MI-3 (p.426)	حاشية هي في المقالة الخامسة من كتاب بعد الطبيعة	3r	1v	184v	55r	--	2r	2v	2r	--	--	--
MI-4 (p.429)	لشكل د من مقالة ا من أكر ثاودوسيوس	--	3v	186r	--	--	4r	5v*	--	251v	-- (?)	--
MI-5 (p.429)	لما في شكل حـ من كتاب اوطولوقس	5v	4r	186v	--	--	4v	6v	4r	252r	3r*	2v
MI-6 (p.430)	حاشية هذا الفصل وما قبله من باب ح في نسخة ثابت والجداول من باب ط	6r	4v	186v	57r	--	4v	7r	4v	252	3r	3r
MI-7 (p.437)	حاشية بيّن ذلك في سابع المعطيات	--	--	191v	63r*	--	11v	16r*	15r*	257r	7r*	7v*
MI-8 (p.437)	حاشية تبيّن؟ ذلك في ه ح ب المعطيات	14v	--	191v	63r*	--	11v	16r*	15r*	257v	7r*	7v*
MI-9 (p.437)	حاشية تبيّن؟ في ب من ا من الأكر ثاودسيوس	--	--	191v	63r*	--	11v	16r*	15v*	257v	7r*	-- (?)
MI-10 (p.439)	هذا الفصل مع ما قبله من باب يا في نسخة ثابت	16v	11v	193r	--	--	13v	--	--	259r	8r	--

MI-11 (p.440)	حاشية الجيوب الموضوعة في جميع هذا الكتاب هي أنصاف الأوتار الموضوعة في الأصل وكذلك القسي المنصّفة	--	12r	--	65r	--	13v	--	--	259r	8r	--
MII-1 (p.440)	حاشية المقالة في نسخة ثابت **ب** بابًا بنقصان فصل للجدول	17v	12v	--	65v	--	14v	--	18v	259v	--	--
MII-2 (p.441)	حاشية لما في **ى** من **ب** من الأكر و**ب** من الكرة المتحرّكة	--	12v	194r	65v*	--	14v	22r*	18v*	260r	8v*	-- (?)
MII-3 (p.441)	حاشية لما في **كا** من ا من الأكر	--	12v	194r	65v*	--	14v	22r*	18v*	260r	--	10r*
MII-4 (p.442)	حاشية لما بين في شكل **ط ط و ب** من الأكر	19r*	13r	194v	66r*	--	15v	23r*	19v*	om	9r*	11r*
MII-5 (p.442)	في بعض النسخ نرسم **م ك** فوق الأرض و**ل ح** تحتها	--	13r	194v	--	--	15v	--	19v	260v	9r	--
MII-6 (p.444)	حاشية لما في **د** من كريات منالاوس	21v*	15r	195v	67*	--	17v	26r*	21r*	262r	10r*	12v*
MII-7 (p.444)	حاشية لما في ظاهرات اقليدس أيضًا	--	15r	195v	-- (?)	--	17v	--	--	262r	10r*	--
MII-8 (p.444)	حاشية **ك ل م** كأفق لخطّ الاستواء ول يطلع قبل م لما بيّن في سابع الظاهرات	21v	15r	195v	68r	--	17v	26v	21r	262v	--	--
MII-9 (p.445)	حاشية وقد بيّن تساويهما في **د** من هذه المقالة و**ه** من الظاهرات	22r	--	196r	--	--	18r	27r	21v	262v	--	--
MII-10 (p.445)	حاشية لما في **ى** من **ب** من لأكر	--	15v	196r	68r*	--	18v	27r*	21v*	262v	10r*	13r*
MII-11 (p.445)	حاشية لما في **ب** من لأكر المتحرّكة	--	15v	196r	68r*	--	18v	27r*	21v*	262v	10v*	13r*
MII-12 (p.445)	حاشية قال النيريزي من حقّ هذا الشكل أن يقدّم على ما قبله لأنّه يتعلّق بفصل مطالعي المنتصبة. والمائلة أقول ليس ذلك بواجب لأنّ البرهان المتعلّق به هو الذي **بعده**	**22r**	**15v**	**196r**	--	--	**18v**	--	**21v**	**262v**	**10r**	--
MII-13 (p.449)	**حاشية هذا الفصل هو** التاسع في نسخة ثابت	24r	16v	197r	69v	--	19v	29r	--	264r	--	14v
MII-14 (p.449)	حاشية بعكس د من ا من كريات مانالاوس	24v	16v	197r	70r*	--	20r	29v	23v*	264v	11v*	14v*
MII-15 (p.449)	لما في **ب** من **ا** من كريات مانالاوس	24v*	16v	197r	70r*	--	20r	30r*	23v*	264v	11v	14v*
MII-16 (p.449)	حاشية **ا ب حـ, ب ه د** تقاطعًا على قوائم بشك **بو** من **ا** من الأكر و**ب ه د** يمرّ بقطب **ا ب حـ** بشكل **بد** منه وكذلك **ا ه حـ** بقطب **ا ب حـ** فه قطب **ا ب حـ** فه **د** ربع	24v	16r	197r	70r	--	20r	30r	23v	264v	11v	--

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