

# Islamic Astronomy in the Service of *Yuan and Ming* Monarchs

Shi, Yunli

University of Science and Technology of China, Hefei, Anhui

ylshi@ustc.edu.cn

## Abstract

In traditional Chinese ideology, the *tianwen* 天文 (Celestial Patterns) and *lifa* 曆法 (Calendar) are important matters in the legitimization and maintenance of a regime. From very early times, astrology and astronomy became a crucial element in statecraft and establishments were always installed in the government to take care of these matters, which formed a tradition very scrupulously observed and documented by every Chinese dynasty without substantial interruption in thousands of years. As a result, a special system consisting of astrology and astronomy was developed and kept on developing on its own track. Despite this long and independent tradition, however, most Chinese monarchs would not refuse, though sometimes with reluctance and selection, any art and knowledge from outside that might supplement and enhance the indigenous ones. Their interest provided a pivotal force under which the major introduction, adoption and documentation of foreign systems of either astronomy or astrology could happen. This is true for the dissemination of Indian astronomy in the *Tang* dynasty. Here in my talk, I would like to bring up a second example, viz. the introduction of Islamic astronomy into China. In fact, this is not a new topic at all. Since the 1940s, a number of leading scholars in the field have done important works on both the general history and some specific issues such as the Arabic and Persian sources of the Chinese works on Islamic astronomy and astrology, the identification of the Islamic instruments constructed in China in the 13th century, the decipher of the titles of the Arabic-Persian books on astronomy and mathematics preserved in the Bureau of Imperial Secretariat of the Yuan dynasty, and the theoretical basis of the Chinese-Islamic system of calendrical astronomy. On the basis of these works and the new materials of very high interest I

have discovered in recent years, I would like to discuss the role played by Islamic astronomy in the statecraft of the Yuan and Ming dynasties in China. Meanwhile, I will also show the efforts of Chinese astronomers in studying the Islamic system and assimilating it into their own tradition.

## 1. Early Contacts

According to materials from family genealogies, the earliest influence of Islamic astronomy in China may be traced back to the 961 when a Muslim astronomer from *Lumu* 魯穆 named *Ma Yize* 馬依澤 in Chinese came to the court of the Song dynasty and took part in a compilation project in astronomy.<sup>1)</sup> However, it was not until the rise of the Mongolian power in the north of Asia that much more substantial and better documented contacts between Chinese and Muslim astronomers took place. In 1220 and 1221, when *Genghis Khan* 成吉思汗 (1162-1227, r. 1206-1227) was campaigning in *Tashqant* and *Samarkant*, his famous *Khitan* consultant *Yelü Chucai* 耶律楚材 (1189-1243), an expert in astronomy and astrology as well, got in touch with some local Muslim astronomers in the prediction of two lunar eclipses. *Yelü Chucai*'s predictions turned out to be more precise in both cases, but this did not lead to his low opinion on Islamic astronomy. From the Muslim astronomers, he learnt the concept of time difference at different geographical longitudes and incorporated it into his own work *Xizhen gengwuyuan li* 西征庚午元曆 (*Gengwu* Epoch System of Calendrical Astronomy for Western Expedition). He also saw the superiority of Islamic astronomy in the calculation of the five major planets and adapted the related techniques into his *Madaba li* (*Madaba* Calendar), a work believed to be based on Islamic astronomy.<sup>2)</sup>

In 1260, *Khubilai* 忽必烈 (1215-1294, r.1260-1294) was enthroned in Kaiping as the Great Khan of the Mongolian Empire and emperor of the Yuan dyansty. Like most monarchs that had ruled China, he established a *Sitian jian* 司天監 (Bureau for the Administration of the Heaven) for calendar-making, sky-watching (chiefly for astrology), astronomical and meteorological observations, timekeeping and divination. In fact, he had

1) Chen Jiujiu 陈久金. *Huihui tianwenxueshi yanjiu* 回回天文学史研究 (*A Study of Islamic Astronomy in China*). Nanning: Guanxi jiaoyu chubanshe, 1996. pp. 52-66.

2) Yabuuchi Kiyoshi. "Islamic Astronomy in China during the Yuan and Ming Dynasties", translated and partially revised by Benno van Dalen. *Historia Scientiarum*, 1997, vol.7(1): pp. 11-43.

already begun to recruit experts in these arts while still being a prince, and a Muslim named *Zhamaluding* 札馬刺丁, or also *Zhamaluding* 札馬魯丁, supposedly Jamal al-Din in original form, from the West had come to his service in 1244. In 1267, he constructed seven astronomical instruments of Islamic style for Khubilai,<sup>3)</sup> who in turn set up an *Huihui Sitian jian* 回回司天監 (Muslim Bureau for the Administration of the Heaven) and appointed *Zhamaluding* as the first director. A quick comparison will show that the Muslim Bureau was largely modeled on the Chinese Bureau,<sup>4)</sup> only with a smaller size. From the structure, it is clear that the Muslim Bureau was also responsible for calendar-making, sky-watching or astrology, astronomical observation, timekeeping and divination. Presumably, the most important difference between the two parallel institutes is the tradition they followed: while the Chinese Bureau adhered to the well established Chinese tradition, Islamic systems were adopted in the Muslim Bureau. In calendar-making, for instance, the Muslim Bureau was responsible for compiling an Islamic almanac for the Muslim population in the country, while the Chinese Bureau was charged with the making of various Chinese almanacs according to Chinese tradition.<sup>5)</sup> The dual system of Chinese and Islamic astronomy was kept unchanged within the bureaucratic structure of the *Yuan* dynasty after *Khubilai* moved his capital to Beijing in 1267.

Although *Yuan* dynasty maintained a very impressive establishment of Islamic astronomy, equipped with a group of large instruments and a good library of Arabic-Persian books on astronomy, astrology, divination, instrumentation and mathematics,<sup>6,7)</sup> Chinese and Muslim astronomers in Beijing did not have any apparent communication, although they were both put under the jurisdiction of the *Mishu jian* 秘書監 (Imperial Secretariat) after 1273. In the hundred years of the *Yuan* history, no cooperation was encouraged. No single work in astronomy and astrology was ever translated from Arabic or Persian into Chinese. This situation was not broken until the Ming taking-over of the *Yuan* dynasty.

3) Willy Hartner. The Astronomical Instruments of Cha-ma-lu-ding, their identification, and their relations to the instruments of the observatory of Marāgha. *Isis*, 1950, 41: pp.184-194.

4) The description of the two bureaus can be found in the *Baiguan zhi* 百官志 (Annals of Officials) of the *Yuanshi* 元史 (History of the Yuan Dynasty).

5) According to the *Xu wenxian tongkao* 續文獻通考 (Comprehensive Examination of Literature Continued), an duty was taxed annually from 22 022 203 copies of the *Dali* 大曆 (Major Almanac), 915 725 copies of *Xiaoli* 小曆 (Minor Almanac) and 5257 copies of the *Huihuili* 回回曆 (Chinese-Islamic Almanac).

6) Tasaka Kōdō. *An Aspect of Islamic Culture Introduced into China*. Tokyo: Tōyō Bunko, 1957.

7) Ma Jian 馬堅. *Yuan mishujian huihui shuji shiyi* 元秘書監回回書籍釋義 (An Explanation of the Islamic Books in the Directorate of the Yuan Imperial Library). *Guangming ribao* 光明日報 (Guangming Daily), July 7, 1955.

## 2. Chinese Studies and Assimilations

The founding emperor of the *Ming* dynasty *Zhu Yuanzhang* 朱元璋(1328-1398, r.1368-1398) was also a deep believer in the importance of astrology and calendar-making for the security and authority of his ruling. As soon as his troops captured Beijing and Kaiping in 1368 and 1369, he summoned both Chinese and Muslim astronomers in the cities to the capital of the new dynasty Nanjing, where a Chinese and a Muslim Bureau for the Administration of the Heaven were set up. The number of Muslim astronomers recruited from the former Yuan Bureau ran up to Twenty-five, including former Directors of *Heidi'er* 黑的兒 and *Adula* 阿都剌, former Assistant *Dieliyueshi* 迭里月實 and former Officer for Calendar-making *Zheng Ali* 鄭阿里. Meanwhile, books from the royal library of the *Yuan* dynasty, including a number of Arabic and Persian books in astrology and astronomy, were transported in mass from Beijing into Nanjing. In 1370, *Zhu Yuanzhang* decided to change the names of the two Bureaus into the Bureaus for the Reverence of the Heaven (*qintian jian*, 欽天監) in the view that the Heaven could only be revered, rather than administrated, by human beings.<sup>8)</sup>

In addition, *Zhu Yuanzhang* even sent an envoy to Muslim countries to recruit Arabic astronomers. By his call, a Muslim astronomer Madeluding 馬德魯丁 came to Nanjing in 1369 with his three sons *Mashayihei* 馬沙亦黑, *Mahama* 馬哈麻 and *Mahasha* 馬哈沙. Madeluding was assigned to the directorship of the Muslim Bureau, while his sons became officials in the Bureau. They worked so hard in astronomy and astrology that *Zhu Yuanzhang* eventually granted the family an honorary title, “*Dace tang*” 大測堂 (the Hall of Great Measurement), and married *Mahsyihe* with one princess.<sup>9)</sup>

These efforts led to very important subsequences in the history of Islamic astronomy in China. *Zhu Yuanzhang* was very interested in the books taken from the royal library of the Yuan dynasty. When being spared from his duty as an emperor, he often asked official-scholars to give him tutorials on the basis of these books so that he could learn the way of ruling. He noticed the books in Arabic and Persian and knew that some of them were related to astronomy and astrology. But nobody among his official-scholars

8) Anonymous Author. *Mige yuangui zhengyao* 秘閣元龜政要 (A Summary of the Administrative Activities Adapted from the Archives of the Imperial Secretariate), j.6.

9) 马德鲁丁父子 and 回回天文学, 陈久金, 《自然科学史研究》, 1989年, 第8卷, 第1期

could understand a word of them. In view of the fact that Muslim astronomers were very precise in their calculation of celestial phenomena and that they commanded the technique for calculating the latitudes of the moon and five planets which was unknown in Chinese astronomy, he decided to initiate a project of translation. On 24 October 1382, he ordered two official-scholars from the Royal Academy named *Wu Bozong* 吳伯宗 (1334-1384) and *Li Chong* 李翀 to collaborate with four Muslim masters *Haida'er* 海達爾, *Adawudin* 阿答吾丁, *Mashayihei* 馬沙亦黑 and *Mahama* 馬哈麻 in order to translate some of the books into Chinese. By his order, an office for translation was set up in the capital, and a translated work on astrology was completed in March to April next year. The resulted book *Tianwen shu* 天文書 (Book on Celestial Patterns) turns out to be a translation of *Kushyar ibn Labban's* (971-1029) Introduction to Astrology (*al-Madkhal fī Sinā at Ahkām al-Nujūm*), an important Arabic work on horoscopolical astrology.<sup>10)</sup> It seems that the famous *Huihui lifa* 回回曆法 (Chinese-Islamic System of Calendrical Astronomy, *HHLF*), a book on mathematical astronomy, or more exactly a set of *Zij* with usage instructions, was also a work produced by the same office on the basis of selective translations.

Recently, I found another book on Islamic astronomy from the same period, which shows that *Zhu Yuanzhang's* plan in introducing Islamic astronomy and astrology was not limited to simple translation. The book is entitled *Weidu taiyang tongjing* 緯度太陽通徑 (A Gateway to the Islamic Method for the Calculation of the Sun) and turns out to be very rare. Up to now, only one copy is found in the *Kyujanggak* 奎章閣 Archives in the Seoul National University of Korea. The author Yuan Tong 元統 (fl. 1384-1396) was originally a Doctor of Clepsydra (*louke boshi*, 漏刻博士) at the Chinese Bureau for the Reverence of the Heaven, but was promoted to the Director of the Bureau in 1385 for his codification of the official system of calendrical astronomy, the *Datong li* 大統曆 (Great Union System of Calendrical Astronomy).

From *Yuan Tong's* self-preface to the book, it is very clear that *Zhu Yuanzhang* hoped to gain more from the translation of Islamic books. So in December 1385, he ordered his astronomers to integrate both Chinese and Islamic techniques for calendar-making and thus to produce a united system of calendrical astronomy for the new dynasty. Three official-astronomers from the Chinese Bureau for the Reverence of the Heaven *Zhang Fu* 張輔, *Cheng Zhu* 成著 and *Hou Zheng* 侯政 were dispatched to

10) Michio Yano. *Kusyar Ibn Labban's Introduction to Astrology*. Studia Cultrae Islamicae, vol. 62. Tokyo: Institute for the Study of Languages and Cultrues of Asia and Africa, 1997.

learn from Muslim masters. They completed the study in three years and came back with a notebook on what they learnt. Apparently, this notebook is also an early version of the famous *HHLF*.

As soon as the notebook was brought back, *Yuan Tong* began a careful research. He found that the astronomical year in the Islamic system started on the day of spring equinox, which was different from the Chinese convention using the day of winter solstice as the beginning of an astronomical year. So he tried to convert the tables and the algorithms in the *HHLF* to meet the Chinese standards, which led to the completion of the *Weidu taiyang tongjing* in February 1396. The book falls in twelve sections. While the first seven sections discuss the calculation of the Islamic calendar and the conversion between Islamic and Chinese calendars, the rest sections are about the concrete steps of computing the longitude of the sun.<sup>11)</sup>

Beginning from this period, more Chinese astronomers were able to learn Islamic astronomy. In 1398, the Muslim Bureau for the Reverence of the Heaven was formally shut down, and its staff was merged into the Chinese Bureau to make up four divisions: *tianwen ke* 天文科 (Division for Celestial Patterns), *louke ke* 漏刻科 (Division for Clepsydra), *datong ke* 大統科 (Division for Chinese Calendar [viz. Datong li]), and *huihui ke* 回回科 (Division for Muslim Calendar). Theoretically, this provided better opportunity for Chinese and Muslim astronomers to communicate with each other. Two other Chinese experts in Islamic astronomy were produced from this period, viz. *Liu Bowan* 劉伯完 and his son *Liu Xin* 劉信.

*Liu Bowan* was originally recommended by local officials to the central government on account of his expertise in astrology and divination and became a disciple of *Liu Ji* 劉基 (1311-1375), the founding Director the Chinese Bureau for the Reverence of the Heaven. He was good enough to be eventually promoted to the position of Vice-Director of the Chinese Bureau for the Reverence of the Heaven.<sup>12)</sup> In the meantime, he also got an opportunity to learn the *HHLF* and became so versed in it<sup>13)14)15)</sup> that he was assigned Vice-Director of the Muslim Bureau as well.<sup>12)</sup> During

11) Yuan Tong 元統. *Weidu taiyang tongjing* 緯度太陽通徑 (*A Gateway to the Islamic Method for the Calculation of the Sun*).

12) Chen Zhanshan 陳占山. Ming qintianjian xiaguanzheng Liu Xin shiji kao 明欽天監夏官正劉信考 (*A Study of the Biography of Liu Xin, the Summer Officer of the Bureau for the Reverence of the Heaven of the Ming Dynasty*). *Ziran kexueshi yanjiu* 自然科學史研究. 2009, vol. 8 (2): pp.205-213.

13) Jiao Hong 焦竑. *Xichao mingchen shilu* 熙朝名臣實錄 (*Veritable Records of the Famous Officials of the Present Dyansty*), j.6.

14) Tu Shufang 屠叔方. *Jianwen chaoye huibian* 建文朝野彙編 (*A Compilation of the Anecdotes of from the Court to Country during Jianwen's Reign*). J.13.

the civil war between the second *Ming* Emperor *Zhu Yunwen* 朱允炆 (1377-?, r. 1398-1402) and his uprising uncle *Zhu Di* 朱棣 (1360-1424, r. 1403-1424), *Liu Bowan* was captured by *Zhu Di*'s troops. After being released, he selected to seclude himself from officialdom, apparently as a way to avoid serving a usurper like *Zhu Di*, but he trained his son *Liu Xin* into an astronomer who worked in the Bureau for the Reverence of the Heaven and became the Summer Officer (*xiaguan zheng*, 夏官正) between 1429 and 1449.<sup>15)</sup>

Before his premature death in 1449 during a war against the invading Mongolian troops, *Liu Xin* completed a very voluminous work on Islamic astronomy entitled *Xiyu lifa tongjing* 西域曆法通徑 (A Gateway to the Islamic System of Calendrical Astronomy), which arguably bears an abridged title *Xiyu lishu* (Treatise on Islamic System of Calendrical Astronomy). The book was not printed, and now only eight hand-written volumes of it still exist in the National Library of China in Beijing, viz. volumes 11-14 and 21-24, meaning that the whole book is at least in 24 volumes. The remaining volumes are all handy tables that are arguably derived from the same planetary models as those in the *HHLF* but much more detailed and convenient for practical use. In his preface to the book, *Liu Xin*'s close friend *Xu Youzhen* makes it clear:

“My friend *Liu Zhongfu* 劉仲孚 [viz. *Liu Xin*] ... is also proficient in Western [viz. Islamic] methods. He noticed that the Muslim computus is somewhat inconsistent and devoid of uniform rules, and would therefore become more and more confusing with the lapse of time. Consequently, he translated the Muslim texts precisely, prescribed rules for its usage, and pre-calculated the essential ready tables. The resulting procedures are brief, simple and clear. They form an orderly book devoted to the [Muslim] school of astronomy which is feasible to be used indefinitely and to remain essential to students of mathematical astronomy.”<sup>16)</sup>

Presumably, part of *Liu Xin*'s knowledge in Islamic astronomy came from his father,

15) Shi Yunli 石云里, Yuan Tong *Taiyang weidu tongjing* de faxian--jianlun Beilin *Huihui lifa* de yuan keben 元統《太陽緯度通徑》的發現——兼論貝琳《回回曆法》的原刻本 (On the Discovery of Yuan Tong's *A Gateway to the Islamic Method for the Calculation of the Sun*, with a Discussion on the Original Version of Bei Lin's *Chinese-Islamic System of Calendrical Astronomy*). *Zhongguo keji shi zazhi* 中國科技史雜誌 (The Chinese Journal for the History of Science and Technology). 2009, Vol. 30 (1): pp. 31-45.

16) Xu Youyzen 徐友貞, *Xiyu lishu xu* 西域曆書序 (A Preface to the Book on Calendar from Western Areas)//Xu Youzhen. *Wugong ji* 武功集 (Collected Writings of Xu Youzhen), j.2.

but he must also have an access to the original sources of the *HHLF* so that he was able to redo the translation and recalculate the handy tables.

The study of the *HHLF* still maintained among Chinese astronomers after the death of *Liu Xin*. In November 1477, the Vice-Director of the Bureau for the Reverence of the Heaven in Nanjing *Bei Lin* 貝琳 (?-1490) reedited the *HHLF* into six volumes and printed the whole book. Eighteen years later, it was reprinted again by *Zhou Xiang* 周相, another officer of the Bureau for the Reverence of the Heaven in Nanjing.<sup>17)</sup> From that time on, the *HHLF* became more easily available to much wider Chinese readership across the country and became a source of inspiration for the calendar reform in the 16th century.

### 3. The Actual Use of Islamic Astronomy

The Islamic system was used by the Ming government as “a reference” in parallel with the mainstream Chinese system (*canyong*, 參用). According to official documents, the *HHLF* was frequently used in the prediction of luni-solar eclipses, two of the most severe portents that the Bureau for the Reverence of the Heaven had to take great care of. Our recent analysis shows that within the time span of the *Ming* dynasty this system was spectacularly worse than the *Datong li* in the prediction of eclipse times, but much better than the latter in predicting the magnitude of the eclipses, meaning that *HHLF* could really provide important reference in some respect of the eclipse prediction, especially in the prediction of eclipses with very small magnitudes.<sup>18)</sup>

In calendar-making, evidence shows that the *HHLF* was also adopted in parallel with the *Datong lifa*. In Book 7 of the *Neige cangshu mulu* 內閣藏書目錄 (A Catalogue of Books Preserved in the Cabinet) edited by *Sun Nengchuan* 孫能傳 et al. in 1603, we can find the following entries:

- *Datong li ershiwu ce, qi Hongwu sannian zhi sanshiyi nian zhi*

17) Shi Yunli 石云里, Yuan Tong *Taiyang weidu tongjing* de faxian--jianlun Beilin *Huihui lifa* de yuan keben 元統《太陽緯度通徑》的發現——兼論貝琳《回回曆法》的原刻本 (On the Discovery of Yuan Tong's *A Gateway to the Islamic Method for the Calculation of the Sun*, with a Discussion on the Original Version of Bei Lin's Chinese-Islamic System of Calendrical Astronomy). *Zhongguo keji shi zazhi* 中國科技史雜誌 (The Chinese Journal for the History of Science and Technology). 2009, Vol. 30 (1): pp. 31-45.

18) The detailed results will be published in another paper.



大統曆二十五冊，起洪武三年至三十一年止 (The Grand Union Almanac, 25 volumes, from the 3rd to 31st years of the Hongwu reign) ;

- Daming yongle datong li shice 大明永樂大統曆十冊 (The Grand Union Almanac of the Yongle Reign, 10 volumes);
- Daming Hongwu huihui li shisi ce 大明洪武回回曆十四冊 (Chinese-Islamic Almanacs of the Hongwu Reign of the Grand Ming Dynasty, 14 volumes);
- Canjiao lifa yice, weixiang canjiao xingshi, zi Hongwu jiazi zhi wanly shier nian dong, nei jie tuibufa ye 參校曆法一冊，未詳參校姓氏，自洪武甲子至萬曆十二年冬，內皆推步法也 (Calendar-making Methods for Cross Reference, 1 volume, without the name of the cross-reference maker, from winter [solstice] of the year jiazi in the Hongwu Reign [viz. 1384] to the 12th year of the Wanli Reign [viz. 1584], and the contents being all about calculating methods).

The last book is very interesting because at least two different systems are needed for a cross-reference. From the fact that the *HHLF* was said to be adopted together with the *Datong li* as a reference (*canyong*, 參用), it seems highly possible that the book is devoted to a step-by-step comparison of the *Datong* and *Huihui* systems in the practical calculation of almanacs from 1384 to 1584.

Besides civil almanacs, the Bureau for the Reverence of the Heaven was also required to calculate astronomical ephemerides for each year. Apparently, the *HHLF* was also applied for this purpose, because in Book 88 of the *Xu wenxian tongkao* 續文獻通攷 (Comprehensive Examination of Literature Continued) by Wang Qi 王圻 (1529-1612) it is clearly recorded that astronomical officials were required to calculate the “*Huihui qizheng jiangweidu li* 回回七政經緯度曆 (Ephemeris Detailing the Longitudes and Latitudes of the Seven Governing-Luminaries Calculated with the Chinese-Islamic System,” together with “the *Datongli yulan tianxiang lu* 大統曆御覽天象錄 (A List of Celestial Events for the Imperial Reference, Calculated with the Great Union System of Calendrical Astronomy), [*Datong*] *Qizheng chandu li* [大統]七政躔度曆 (Ephemeris Detailing the Positions of the Seven Governing-Luminaries [Calculated with the Grand Union System]).”

Recently, I found another important document from the *Kyujanggak* Archives, which reveals another important application of the *HHLF* in the *Ming* Bureau for the Reverence of the Heaven. It is a small pamphlet entitled *Xuande shinian yue wuxing*

*lingfan* 宣德十年月五星凌犯 (The Encroachments of the Moon and Five Planets in the 10th Year of the *Xuande* Reign, XSYWLF), which was imported from China to Korea in the early 15th century and reprinted in 1447 at the court of the *Joseon* dynasty with a number of other Chinese books on astronomy. The book contains very detailed information about the *lingfan* 凌犯 (Encroachment) for the whole of the 10th Year of the *Xuande* Reign (Jan. 29, 1435- Jan.17, 1436). *Lingfan* is a very important concept in Chinese astrology, denoting the mutual-approaching of the moon and five major planets to each other, as well as their approaching to the fixed stars. The XSYWLF is a pre-calculation of this type of phenomena for a whole year. It begins with a general description of the situation for the given year, and then runs into a day by day prediction:

“The general list of the encroachments of the moon and five planets in 1436:

Total number is 325:

Encroachments 136 times, entry into lunar-lodges 41 times, non-encroachments 148 times.

Moon 196 times: ...

The five planets 129 times: ...

Saturn 5 times: ...

Jupiter 7 times: ...

Mars 16 times: ...

Venus 53 times: ...

Mecurry 38 times: ...

The encroachments of the moon and five planets in 1436:

1st Month:

Night of the 2nd day, Venus encroaches the 1st star of the west of Outer-screen, and is 3 min. below it.

Night of the 4th day, Mars encroaches the 14th star of the Ophiuchus, and is 18 min. below it.

Night of the 5th day, Mars approaches the 13th star of the Ophiuchus, and is 1 deg. 5 min. below it, which is not an encroachment.

Night of the same day, Venus encroaches the 12th star of the Pisces, and is 38 min above it. [...]"

The prediction of such phenomena involves the calculation of the latitudes of the

moon and planets, a difficult problem that all traditional Chinese systems up to the Ming dynasty did not resolve. However, every existent version of the *HHLF* contains sections especially devoted to the topic, including sections on “*Taiyin weidu*” 太陰緯度 ([Computation of] the Latitudes of the Moon), “*Wuxing weidu*” 五星緯度 ([Computation of] the Latitudes of the Five Planets) and “*Taiyin wuxing lingfan*” 太陰五星凌犯 ([Computation of] the Encroachments of the Moon and the Five Major Planets). From a verifying calculation with the computer program imitating all functions of the *HHLF*, it is clear that the predictions in the *XSYWLF* are all done with the *HHLF*.

Before the translation of the *HHLF* in China, the encroachment astrology was always done after such portents were discovered through actual observations. To an ancient believer in astrology, however, it must be a very attractive idea to know the portents beforehand so that prophylactic measures could be taken in easing the foreshadowed bad-luck even before the portents turned up. Apparently, this was the key reason why *Zhu Yuanzhang* became so interested in Islamic astronomy, and why he emphasized its capability in the calculation of the lunar and planetary latitudes while ordering his officials to carry out translation. The existence of the *XSYWLF* shows that the Bureau for the Reverence of the Heaven did apply the *HHLF* to such a calculation. In the in the *Neige cangshu mulu*, we can find another entry related to this practice as well:

- Hongwu ershisi nian yue ji wuxing lingfan yice  
洪武二十四年月及五星凌犯一冊 (The Encroachments of the Moon and  
Five Planets in the 24th Year of the Hongwu Reign, one volume).

Doubtlessly, this is a book similar to the *XSYWLF*. We did not see how the Chinese version of *Kushyar ibn Labban's* Introduction to Astrology was used by the astrologers from the Bureau for the Reverence of the Heaven, but here we interestingly find how an Islamic system of calendrical astronomy was used for the purpose of Chinese astrology!

## 4. Concluding Remarks

In this paper, we have shown how Islamic astronomy was used in parallel with Chinese astronomy in the service of the Mongolian *Yuan* and Chinese *Ming* monarchs.

Through the newly discovered materials, it is clear that Muslim astronomers of the *Ming* dynasty were charged with similar responsibilities with Chinese astronomers. They actually did more than we used to know. Except the prediction of luni-solar eclipses, they also had to calculate both civil almanacs and astronomical ephemerides just as their Chinese colleagues did every year. In addition, they even did something that their Chinese colleagues were not capable of, viz. the prediction of the encroachments of the moon and the five planets, a category of portent very important in traditional Chinese astrology. Both *Yuan* and *Ming* monarchs relied mostly on Chinese tradition to show their legitimacy to rule China. But this did not stop them in adopting any non-Chinese technique as long as it proved to be useful to meet their interests, which largely promoted the reception and assimilation of scientific knowledge from outside. In such a pragmatically orientated milieu, however, little attention was paid to theoretical aspect. That must have been the reason why no book on geometrical astronomy was translated and studied in the early *Ming* dynasty.