Abu Rayḥān Muḥammad b. Aḥmad Bīrūnī, as required by the Choresmian pronunciation Bērūnī, or Bayrūnī in Arabic and sometimes called by the nisba al-Khwārizmī by certain Arab authors, stands out among scientists of the Golden Age of Islam not only for the number of his contributions but for his attentive modern scientific approach as well. He was an astronomer, astrologer, mathematician, physicist, geographer, chronologist, historian, linguist and an observer of traditions and creeds of other people. Contrariwise other Arab authors, like Avicenna and Averroes, so relevant for their influence on European culture, his writings did not spread in the Spanish al-Andalus, so that none of them was translated into Latin and consequently started circulating in the Middle Ages Europe. The knowledge of his writings in Europe dates back to a century and a half ago, thanks to the orientalist Joseph Toussaint Reinaud (1795-1867) and the geographer Alexander Von Humboldt (1769-1859), who were the first to notice the originality and excellence of his contributions.\footnote{Bausani (1974).}

Al-Bīrūnī was born in Kāth in the year 973 A. D. (362 A. H.) in the Choresmian region southern of the Aral Sea, in the independent principality of Khwārizm. For the first part of his life he was under the protection of the Maʾmūnids Khwārizmshāhs, who were originally Samanid vassals who reached independency during the X century. Next he went to the south of the Caspian Sea to the court of the Ziyārid sultan Abu Ḥasan Qābūs b. Woshmjir Shams al-Maʿālī, another Iranian prince to which is dedicated Āṯār al-bāqiya ʿan al-qurūn al-khāliya (literally “Remnants of the Past Centuries”), composed around the year 1000. Al-Bīrūnī returned to his country in the year 1009 where he gave his services to the Maʾmūnids until the 1017, year of the Khwārizmshāh murder by the Ghaznavid ruler Maḥmūd b. Subuktakīn. Al-Bīrūnī was held in captivity at the Ghazna court, in the role of official astrologer, by the way this detention was functional for his researches about India: he had the possibility to follow Maḥmūd of Ghazna in his expeditions to the north-west of the country where he learned Sanskrit and several Indian dialects, in
order to compound his writing Tārīkh al-Hind (literally History of India) in the year 1030. During the same period, only one year before, he wrote the Kitāb al-Taḥfīm li-Awā'il Ṣinā'at al-Tanjīm (literally “Book on the Principles of Astrology”) dedicated to Rayḥana. We have not certain and direct information about the dedicatee Rayḥāna but seems plausible that she was part of Maḥmūd’s court in Ghazna, and the dedication is directed to the Khwārizmian daughter of Al-Ḥasan².

After that he was under the protection of the sultan Masʿūd b. Maḥmūn to which is dedicated his masterly Kitāb al-Qanūn al-Masʿūdī fī al-Hay’a wa al-Nujūm (literally “The Masudic Canon on Stars and Astronomy”) in the year 1030.

These are his main writings but beside them he wrote more than 100 other works about various matters such as geodecy and mineralogy, pharmacology and natural philosophy; the only field that probably he did not touch was the juridical one. He died in the year 1050 A. D. (442 A. H.) probably in Ghazna³.

The Canon Masudicus

The Birunian Canon is the masterpiece and the last scientific and comprehensive effort of the Author. It gathers all his studies about astronomy, astrology mathematics, chronology, geography and more.

It differs from his other works not only because it is the most up-to-date account of his studies but even for his thorough and attentive approach to a scientific method which recalls the modern application to the present day sciences. This was the main reason for the recent attention given to him during the last century: as Bausani reported seems that his works reached the 11th century Europe but he was never translated in Latin, so that they never shared that fortune which is reserved to other Arab philosophers and scientists like the well known Avicenna and Averroes.

His works seemed to follow the same fate as the only translation we possess at the present state of research is a translation in Russian of his last outstanding effort. Has to be pointed out the many difficulties that such Canon presents both for translation and critical study of its content: except for the attested philological problems of transmission of the text, and all that concerns the circulation and copy of the manuscripts between different versions in Arabic and Persian, it has to be underlined that the present

³ Kennedy, (1981)
state of research for a critical edition - concerning linguistic, philology, history of science and human history - is unfortunately inadequate. The works of many scholars like Nallino, Bausani, Bickerman, Ginzel, Sezgin and Neugebauer among others are solid foundations for a development that such a matter deserves. It certainly requires complementary efforts from different and various fields of research which were brought together two centuries ago - I refer for example to the works of Suter, Sachau, Ideler- to then reach a point of interest from the 50’s until the 80’s with attentive scientific productions, but isolated and not uniform.

This work does not pretend to fill the mentioned lacks but wants to shed light and gather attention at least on an abridged portion of the Birunian studies about chronology, through a transversal analysis of the Persian intercalation’s issue in al-Bīrūnī’s main works which precede the Canon: the Tafhim and the Chronology of Ancient Nations, the latter being at the present time re-edited by Professor François De Blois who is providing a translation of the text and a critical comment and on whose I rely for what concerns every aspect of Āthār al-bāqiya ‘an al-qurūn al-khāliya.

It has to be noticed that difficulties were encountered regarding the translation, both for identification of specific terms and probable typographical errors as well as textual errors. Due to these indicated difficulties I decided, where possible, to keep the literal translation as in the second to last paragraph of the Fourth Chapter - II Maqāla, leaving a more agile description in the commentary section.

I Maqāla, VI Chapter, p. 76.

As for what concerns Copts, people of Egypt, they fixed the five appendage days at the end of their year and called it “small month”. After Caesar Augustus’ cession to the Byzantines’ regulation for the intercalation, the appendage in the year became of seven days and the starting point differed in the ancient regulation and it was newly made. At the same manner Persians fixed the five

| Amā al-fiqūt ʾahl Mṣr fānām wastaʿu l-lāwāḥiq fī | As for what concerns Copts, people of Egypt, they |
| - ʾahl Mṣr fānām wastaʿu l-lāwāḥiq fī | fixed the five appendage days at the end of their |
| أخْرَ سَنتَهُم وَسُمُوعُهَا شِهْرًا صَغِيرًا | year and called it “small month”. After Caesar |
| وَبَعْدَ نُقْلِ اَضْغُسْ تَ | Augustus’ cession to the Byzantines’ regulation for |
| اَوْلِ الْقِيَاصَرَةِ إِيْاَمَ | the intercalation, the appendage in the year |
| إِيْاَمَ | became of seven days and the starting point |
| وَخَلَفَتْهَا | differed in the ancient regulation and it was newly |
| وَخَلَفَتْهَا | made. At the same manner Persians fixed the five |

*There is no distinction in Arabic between Western and Eastern Romans.*
stolen days at the end of the year, then transferred it to the end of the month of Kabīsa until consequently reached the month of Ābān and stayed in it for the disregard of the intercalation because the instruction has been dispersed. And Magians of Soghdia and Transoxania do not displace it and it remained at the end of their year, then they transferred now in the days of Daylamites in Persia to the end of the month of Isfandārmudh without intercalating the years of four months but this did not become well known afterwards, except in their own kingdoms, because many among the Magians of Khorasan refused it and do not accept it.

فيقيت في آخر سنتهم ثم نقلت الآن في أيام الديلم بفارس إلى آخر استفرد ماه من غير أن يكسب السنون باربعة أشهر، ولم يستقض ذلك بعد إلا في مما لكهم فقط لأن كثيرا من ماجوس خراسان أبوه ولم يقبلوه.

Here the Author is talking about the displacement of the five epagomenal days, or Gatha days, and about an additional intercalation. It is an important matter as, like in Persian, the word for “intercalating” indicates both the intercalation to keep the year fixed and the 5 Gatha Days at the end of every year. For the moment it is necessary to know that the Persian calendar was a lunisolar calendar composed of 12 months of 30 day each with the addition of five days at the end of the year, the before mentioned Gatha Days or panj rōz.

As Panaino and De Blois demonstrated the year looked like as it follows in the New Persian form, which I will adapt through over the text even when I am referring to Middle Persian forms:

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5 Buyids.

6 The supposed ninth, tenth, eleventh and twelfth intercalations. See De Blois, 1996.
As Egyptians did once they passed under Roman control and administration, they had to add two days to the epagomenal days to keep their calendar aligned with the Julian calendar. At the same manner every calendar in Persia had the appendage days at the end of their year, i.e. *Isfandārmudh*, and after this intercalation imposed from outside of the country they moved the 5 Gatha Days to the end of the month during which they decided to apply the foreign intercalation. As indicated by al-Bīrūnī the five epagomenal days laid down between Ābān and Ādhar, than for the “disregard of the intercalation because the instruction has been dispersed” stayed between the eighth and ninth month because they reached Ābān as anyone was caring about not to celebrate the five days but to apply the intercalation of one day every four years. On the other hand not everyone accepted this motion of the five days: the Magians of Soghdia and Transoxania never displaced their Gatha Days, which thus remained always at the end of the year, i.e. *Isfandārmudh*. Thus “now”, that means at the time of the author, Persians replaced the five Gatha Days to their original place but not everyone accepted this days’ motion as Magians of Khorasan kept the transition system.
As for what concerns the second category it is that of the Persians in the Mazdaism and they called the leap year *bihīzl* and its reason is that of Zarathustra of Ādhar by accusing their summoner/prophet of having become Magian, lest he does not add to them the intercalation including (what is) below the entire month, changing their glorification of God with the name of the present day’s king to the last king, and they instructed to repeat the months’ names despite calamities, and the stolen (days) were transferred to the last of the rectified/repeated indication, being wary of the misfortune: for the first *Kabīsa* there were two *Farwardīn* and for the second two *Ardībihisht*, and they do not intercalate after it but eight months, and it is the reasons for the setting in of the stolen (days) in the last month of Ābān. We stated already in tables/the main part⁷ that happened 277 years before Alexander’s Era, and that the years that were between it and between Yazdegerd make...[...]

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⁷ Al-Bīrūnī (1954), Vol. I, p. 90, n. 5 and Bacchi (before completion) in which the Feyzullah and the British Library manuscripts report *bihīrk*. The Persian word for intercalation is *wihezag*, with the meaning of moving and progression. See De Blois, 1996.

⁸ See Al-Bīrūnī (1954), Vol. I, p. 90, n. 6 in which *Mazdaism* or “main part”. I lean towards “tables” as Al-Bīrūnī commonly used to put the calendrical data he gathered in tables but employing another term in the *Tāfhīm* *jadwal-jadāwil*, see Al-Bīrūnī (1934), p. 165 and p. 170.
necessary 10 leap years, and they only intercalate until the month of Ābān, thus from these years is left behind (something) close to 260 years, and the reason comes from two points of view: the first of them is that the Arsacid period is close to 360 years, blending King Ardašīr son of Pāpak with the last Ardavān and it lags behind Alexander’s Era of 100 and 80 odd/some 80 years in them, the king assigned to the Shām’s Kings until the Arsacids emerged and the site of the authority between them (became) one country (for) 40 years until the hands of the Shām’s Kings failed to reach Iraq, thus the Arsacids did the conquest alone and Persians followed their undertaking of Alexander’s days, thus these years spread accidentally according to the report of the Shām’s Kings.

The last point of view is that a report in their annals, according to Zarathustra, was left behind in its days until the completion of the Kabīsa was an amount of years, they do not confirm this and it is less of their era and between Fīrūz\(^9\), forefather of Anušervān\(^10\), who was in charge of the last intercalation and between Yazdegerd\(^11\) there are

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\(^9\) Pērōz, Sasanian king from 459 until 484 CE.
\(^10\) Khosrow I, reigned from 531 until 579 CE.
\(^11\) Yazdegerd III, the last of Sasanian kings, reigned from 633 until 651 CE. See Al-Bīrūnī (1934), p. 172 and Bacchi (2013): “As for what concerns Persians they reckoned the days of their reign from the days of the reigning king, and kept on reckoning their year until his successor and after the disappearance of their reign they reckon from the year of the king Yazdegerd son of Shahryār son of Khosrow Parviz, the last of their kings, and they do not employ in their...
almost 170 years, and if it is added to them, from that remnant to the Kabīsa, 90 years, the years were 260, and God knows best.

As for what concerns the third category it is that of the ancient Copts before Augustus and he do not determined, as we know from their annals, and the source of their calculation in detail less satisfies its reputation, and only our acquisition (from them) of the totality is what we recorded.

In this passage the Author is talking about the intercalation of an entire month, as he underlines Persians used to repeat the month of intercalation, without giving a name to the introduced month so that there were two Farvardin and then two Ordibehesht and so on. Being wary of the difficulties to maintain the tradition of intercalating one month every 120 years remembering what month was intercalated, Persian decided to move the five epagomenal days to the end of the intercalated month, as a sort of bookmark. This is the reason for the settlement of the Gatha Days at the end of Ābān and this happened 277 years before the Era of Alexander; there is the possibility that the Author applies the same rule of the Yazdegerd's Era - in other words if he starts counting from the end of his reign, i.e. 323 b.C. - and if we add, as he states, 277 years we reach 600 years to which we have to add the year of the death of Yazdegerd III that happened in 651 A.D. so that we have 1251; if we divide for 120 - the necessary years to reach the addition of one month - we have 10 intercalations in between and a small addition of 260 years. At this point he tries to calculate how many intercalations have been applied through the years that lagged behind and for what reason:

“thus these years spread accidentally according to the report of the Shām’s Kings”.

He gives two possibilities, and in the second of them he states that the last intercalation was under Pērōz:
“who was in charge of the last intercalation and between Yazdegerd there are almost 170 years, and if it is added to them, from that remnant to the Kabīsa, 90 years, the years were 260, and God knows best.”

II Maqāla, III Chapter, pp. 131-132.

[...], and about its measurement we calculate that what is between the Hijra and Yazdegerd are 3742 days - then we say in the Yazdegerd’s era that the issue of the Magians in their years is its intercalation (kabs) every 120 years of one month repeated successively to the regular months and it came immediately after the stolen appendage, and that comes from 1218 years. It is known that they required the intercalation of 10 months, and it was necessary to the stolen (days) of being in another Day month but its occurrence at the end of the month of Ābān at the time of Yazdegerd is an evidence of them, (and) they do not intercalate nothing but eight times after Zarathustra, if he was in charge of a correction that (happened) before him, then they thought that the last of the Kabīsas occurred in the days of Fīrūz son of Yazdegerd among their kings, and that he intercalated two months: one of them claimed in the past, while the other called to account for a lodging of appeals taken as a precaution because of the king’s opinion about the disappearance, and that (was) in front of the decay; the years towards him are close to 1400, and their Kabīsas are 8 and a half, and with the

12 See n. 4.
exception of (the one and a half) are seven, and their years are 840 (800 and 400) with an omission of what came close to 200 years. The reason of their lapse comes from the totality of 557 years that are between the slaughter of a land and the first Sasanian king in Iraq, and Persia after Alexander was in charge for the rule of northern residents of Antioch and during these years their Caliphs did it by turns. After Alexander at the time of their revolt the owner of the mountain was stronger and their side of the mountain was firmly established opposite one to another in battle until those desisted, thus the Arsacids dominated their place and Persians do not interfere except for local registration on their side only, and the time of Greeks felt down/dropped, and it is said that Ardashir compromised intentionally this history to hide in general the time of the ruin that they notified in advance of 1000 years, and these are all corrupted things in the same histories and annals. As for what concerns what has been established from the reckoning after the methods’ correction of my fundaments it is not a result of them (the corrupted things) because it does not come from their alterations with the exception of the substance deprived of the form/essence\(^\text{13}\).

\(^{13}\) See Roccato (2004), p. 75, n. 6.
In this passage the Author states that after 1218 years Persians had the necessity to add 10 months for the intercalation and that the stolen days had to stay at the end of the month Day so that their presence at the end of Ābān in the Yazdegerd Era is a proof of their misplacement. Persian intercalated only eight times after Zarathustra but we cannot make suppositions because, if it is true that it requires 960 years to reach eight intercalations we do not know how they applied them; for example it is possible that for the same intercalation they added more than one month:

“Zarathustra, if he was in charge of a correction that (happened) before him, then they thought that the last of the Kabīsas occurred in the days of Fīrūz son of Yazdegerd among their kings, and that he intercalated two months: one of them claimed in the past, while the other called to account for a lodging of appeals taken as a precaution because of the king’s opinion about the disappearance, and that (was) in front of the decay”.

During the last intercalation under Pērōz Persians intercalated two months for precaution, reports the Author.

It is interesting to notice that:

“the Arsacids dominated their place and Persians do not interfere except for local registration on their side only, and the time of Greeks felt down, and it is said that Ardashīr compromised intentionally this history to hide in general the time of the ruin that they notified in advance of 1000 years, and these are all corrupted things in the same histories and annals.”.

Than the Author clears that he is only reporting facts and that he applies other methods to calculate eras and chronology, as he wants to take distance from the annals.

II Maqāla, IV Chapter about other eras, pp. 142-145.

As for what concerns the Era of the Magians it is from the King's year\textsuperscript{14} of Yazdegerd disregarding the year\textsuperscript{15} of his reign and its length was 20 years.

\textsuperscript{14} Al-Bīrūnī (1954), p.142 reports \textit{mahlik}: it is evidently a typographical error.

\textsuperscript{15} See note above.
So if it decreased from the era of its execution, remained the era of its destruction/transfer\(^{16}\). His murder was in Merv\(^{17}\) in the nearness of Soghdia, thus the Magians employ (the era) of his time but the Magians of Transoxiana are transgressors in the belief for the Magians of Kurasan and Persia in such a manner that it would not have taken much more to turn spontaneously to the delusion that their Prophet was not the Prophet of those, and the beginning of their years is from the Great Nōrūz occurring later than the Nōrūz of the Kings of five days, and for this reason their months diverge from Persian months to the first of Ādhar's month, then they adjust to the first of Isfandārmudh, and the five days appendix is enclosed in the twelfth among their months, numerable from its (the twelfth month) totality, and for this reason we subtracted from the Era of Yazdegerd, on account of them, 20 years and five days.

As for what concerns the Kabīsa of Al-Muʿtaḍid\(^{18}\), that some people called Kabīsa of the Persian with reference to Al-Muʿtaḍid I, it is what Persians used to practice in another manner related to their God,

\(^{16}\) Al-Bīrūnī (1954), p. 142, n. 2 reports نقل with the meaning of “transfer”. It seems more plausible as a transfer of the days in another period of the year without their sheer disappearance.

\(^{17}\) The present-day town near Mary, Turkmenistan.

\(^{18}\) The Abbasid caliph of Baghdad (857 - 902 CE).
and the Nōrūz was occurring already near to the Tropic of Cancer19 at the time of cereal ripening, thus Persian Kings used to start off the beginning of the tax-paying and because of their dynasty disappearance the leap year was disused after them, thus Nōrūz was left on its position until it produced a damage from the tax request, and because of the (time of) its land’s cereal ripening. For this reason Al-Mutawakkil20 realized it and examined his decree and he egged on sending back Nōrūz to its time, thus he died before its fulfilment, then Al-Mu‘taḍid put out for it through the computation and mended it. His attribution to (having put in its) right place - which happened in the time of Persian King’s extinction - he applied it to the months of the Syrians on the eleventh starting from Ḥazīrān, (with) the will of having intercalated it by himself (in order to) do not be concerned by his institutions afterwards, and on that year this Nōrūz was carried to the first day of the month of Khordād on the year 264 for Yazdegerd (era) and the year of Syrians, that fell on the month of Ābān: this year is the Kabīsa, thus has been intercalated with it (as) the first year of this era, and it is known that it occurred on the second year (from it), on the second month of Khordād and

19 It means that Nōrūz was ongoing already when the sun was approaching the celestial Tropic of Cancer, or rather the 21 of June of the Gregorian calendar.

20 The Abbasid Caliph (821 - 861).
it was stationary successively during these years.

Then the Kabīsa shifted to the third month of Khordād, and if we subtract from the Yazdegerd era what is between Nōrūz on a first year from his reign and between the preserved (intercalated) Nōrūz for Al-Mu‘taḍid, and it comes from the totality of years, (the result) is 263, and from the months (the result) is two months, and we obtained already a history of this kabīsa with years that are not preserved (intercalated). Since this it lagged behind a quarter of a day, thus if we gather its quarter it was the amount of the retrogradation’s days, and on the contrary we added to them three (because of them) years of history to the fragmented year and their first Kabīsa; thus when we added to them three, the quarters were mended in the beginning, and when we added the retrogradation’s days to the date on which the given day falls, among the months of the Persians, it returned to the position that al-Mu‘taḍid regulated.

And why we added to the years three? It was mended on the first of the month of Ābān of thirty six days, thus its amendment/union got to the

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21 Referring to the days.

22 Al-Bīrūnī (1954), p. 143, line 18 reports بومًا bawman. It is clearly another typographical error. We are going to see further that the whole paragraph is unclear.

23 I could not find the form of جبر in any dictionary.
point in it where recommenced a separation for its equivalent, and we gradually applied Al-Muʿtaḍid’s ) Nōrūz on the eleventh starting from Hazīrān, thus it became distinct, as though separate from the others, and thus it became plain for us from a surplus that was between our Nōrūz and the Nōrūz when the Kabīsa shifted (after it), and (it is?) the month of Ābān, ‘Alī bin Yahyā al-Munajjim said that for al-Muʿtaḍid the day of (your) Nōrūz is one day that is not in late from Hazīrān, and the beginning appears on the eleven.

Here the Author states that Magians adopt the Yazdegerd era starting from his death. He explains why when calculating Yazdegerd Era is necessary to include five days after his reign of twenty years. Moreover he points out that not every Magian adopt the same era: the ones from Transoxiana begin their years from the Great Nōrūz that occurs later than the Nōrūz of the Kings - i.e. the Nōrūz of the Magians from Khorasan and Persia- of five days; moreover their year starts from Ādhar and only later they adjusted the calendar in order to have Isfandārmudh as first month, moving the appendix to the last month of the year.

The Author passes now to al-Mutawakkil adjustment of the calendar starting from the 11th of Hazīrān:

“Persian Kings used to start off the beginning of the tax-paying and because of their dynasty disappearance the leap year was disused after them, thus Nōrūz was left on its position until it produced a damage from the tax request”.

And this was the first intercalation of their era, i.e. the era of the Author.

24 I suggest  viagra instead of viagra as the conjugation of the perfective for (شاء) viagra does not present such form.

25 Astronomer of the Munajjim family.

26 Here we find another typographical error: viagra.
Conclusion

As a thorough analysis of François De Blois demonstrated in 1996, the account of al-Bīrūnī reports different traditions about the intercalation of the Persian calendar in its history, gathering them altogether. As pointed out by the scholar through a keen and transversal philological analysis, the data that the author reports in his *Canon* come from different Muslim sources in Persian and Arabic, respectively the *Bundahišn* and the account of the historian al-Masʿūdi among others. As a result the “legend” of the intercalation of one month every 120 years starts circulating in the 10th century in Muslim sources and, surprisingly, is attested even in later Zoroastrian sources during the 11th and 12th century.

Still in Zoroastrian sources, precisely in the 25th chapter of the *Bundahišn*, is presented a theoretic coexistence of a secular calendar and another with special or notional months that are necessary to explain the cycles of seasons despite the issues of missed (or supposed) intercalations of one day every four years or, as stated by al-Bīrūnī, of one month every 120 years that is highly improbable. It looks like there is an open polemic regarding the lunar Muslim calendar which does not apply the intercalation as commanded by the Prophet Muhammad, an important matter that brought al-Muʿtaṣid and al-Mutawakkil to adjust the calendar because the period for the tax collection came before the harvest and fruit ripening. Trying to avoid the problem with the land holders they made this reform even pushed by the institutions as well:

“His attribution to (having put in its) right place - which happened in the time of Persian King’s extinction - he applied it to the months of the Syrians on the eleventh starting from Ḥazīrān (with) the will of having intercalated it by himself (in order to) do not be concerned by his institutions afterwards”.

Furthermore al-Bīrūnī presents an analysis trying to demonstrate the exactness of computations comparing different calendars and eras, as the one of Yazdegerd and the Muslim calendar with its start at the beginning of Hijra.

The matter itself is still far away from being unravelled, as we have seen that at a certain point interpolated sources made their entrance in the issue of the Persian intercalation, the same sources al-Bīrūnī relied on. On the other hand he recognizes that the same annals and histories he possesses are not trustful in a way he takes distances from what he is writing, though reporting facts as he read them.

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27 De Blois, 1996.
On the other hand, integrating the data from the *Canon* with the other known sources brings the possibility to shed light on intercalations. As opinion of the present writer this makes necessary further deepening about the matter, connecting different fields of research such as computational astronomy, linguistic and history of science.

As for what concerns the field of Arabistic, the need of a proper glossary about astronomical terms is urgent as we are not in possess of a comprehensive edition able to fill the heavy lack of textual instruments necessary for an attentive and thorough carrying out of such a wide and unfortunately unexplored field for linguistic.

**Bibliography:**


