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MAYA RECORDS OF PLANETARY CONJUNCTIONS IN DRESDEN CODEX

J. Vondrák[1], **V. Böhm**[2] and **B. Böhm**[†]

[1] *Emeritus, Astronomical Institute, Czech Academy of Sciences Boční II 1041, 141 01 Prague, Czech Republic*
E–mail: *vondrak@ig.cas.cz*

[2] *Retired from The University for Political and Social Sciences, Barborská 52, 287 01 Kutná Hora, Czech Republic*

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SUMMARY: Old Mayas designed a very complicated calendar, and they also recorded important historical events and astronomical phenomena. Dresden Codex (DC), one of the four preserved Mayan hieroglyphic literal legacies, contains many of these, covering the classical period of Maya history. The records of these events in DC are given in the so-called Long Count (LC), the number of days elapsed from the origin of Maya chronology. The difference between LC and Julian Date, used in today's astronomy, is traditionally called correlation. More than fifty different values of the correlation have been published so far, and the differences among them can reach up to several centuries. The value, mostly accepted by Maya historians, is the one by Goodman-Martínez-Thompson (GMT), equal to 584 283 days. It is based mostly on events extracted from sources of the post-classical period of Maya history. Brothers Böhm used Maya astronomical records to derive the Böhm correlation (BB) of 622 261 days. It is in excellent agreement with the dates of astronomical phenomena recorded in DC. During past decades we published several papers supporting validity of the BB correlation. They are based on the records of different astronomical phenomena in DC and stelae, such as solar eclipses, planetary conjunctions, greatest elongations of Mercury and Venus from the Sun, or heliacal risings and settings. The present study is devoted to newly found recorded dates on page D74 of Dresden Codex. We were able to identify six of them with conjunctions of planets Venus through Saturn (corresponding to years 491, 495, 496, 501, 531, and 571), when BB correlation was applied.

Key words. Ephemerides – History and philosophy of astronomy

1. INTRODUCTION

Maya culture was a part of the cultural sphere of Mesoamerica (Coe 1972, Haberland 1974). It originated in early agricultural settlements on the Pacific coast of Guatemala and Guatemalan highland between 2200 and 1900 BC – see, e.g., Clark and Pye (2005) or Serrano and Schawrz (2005). The Maya territory covered, in the period of its heyday, the area of today's Mexican states Chiapas, Campeche, Yucatán, and the territory Quintana Roo in Mexico, Guatemala, Belize, northwest of Salvador, and west of Honduras. Maya culture, originally based on cultivating maize, later gradually developed ceremonial centers, splendid temple cities, and real cities. Simple barrows were builtd first, later followed by stone pyramids with temples on top, where stone stelae with altars were erected. The Mayans created a hieroglyphic scripture and calendar, in which a 365-day astronom-

[†] This paper is devoted to the memory of Bohumil Böhm who contributed to this study from the very beginning, deceased in 2015.

ical year (Haab) and a 260-day sacral cycle (Tzolkin) play dominant role (see Fig. 1 in the next section).

Cultural and economic progress expanded throughout the whole Mayan territory (Pérez 2013). Stone stelae and temple walls were covered with numerous carved hieroglyphic texts with calendar dates. One of the most elegant temple cities is Palenque in today's Mexican state of Chiapas. Attention was devoted to astronomical phenomena; the Maya observed motions of the Sun, Moon, visible planets and their conjunctions, and solar eclipses. Many of significant astronomical phenomena that they observed were recorded. All this was possible thanks to the efficient enabling the non-agricultural class to intensively practice civil engineering, advanced commerce, arts, letters, and also astronomy. However, after 800 AD came a disaster, and the classical period of Maya civilization ended. Very probably due to catastrophic draughts and invasion of militant groups from central Mexico, Mayan cities were abandoned. Thus, after the Spanish invasion the Mayans lived, at the beginning of the 16th century, only in simple villages.

More details of the history of Maya astronomical observations can be found in our preceding papers, e.g., Klokočník et al. (2008), Böhm et al. (2013), Vondrák et al. (2022) or Vondrák et al. (2023).

2. MAYA CALENDAR, DRESDEN CODEX, CORRELATION

The Maya developed a very complicated calendar system, described, e.g., by Foster (2002). Here we repeat its abridged description, as presented by Vondrák et al. (2023):

Maya calendar consisted of several cycles that can be represented by a simple scheme shown in Fig. 1. Tzolkin consists of twenty named days (Imix, Ik, Akbal, Kan, Chikchan, Kimi, Manik, Lamat, Muluk, Ok, Chuwen, Eb, Ben, Ix, Men, Kib, Kaban, Etznab, Kawak, Ajaw) and day numbers that go from 1 to 13. The days in this cycle start with 1 Imix, 2 Ik, 3 Akbal, etc. up to 13 Ben, then the day numbers start again at 1 while the named-day sequence continues onwards. Thus, the combination of number/named day is unique in the whole 260-day cycle.

Parallel to these cycles, to track longer periods of time, there is also used the so-called Long Count (LC). It expresses the number of days elapsed since the mythological origin of Mayan chronology. Whole cycle of LC consists of 1 872 000 days. After its end, a new cycle began. All cycles shown in Fig. 1 and the LC met after 136 656 000 days, i.e., after 374 152 years. LC is similar to Julian Date (JD), used in astronomy. In the preserved texts in Dresden Codex (DC, see below) the dates expressed in LC are sometimes accompanied by dates in 260-day Tzolkin. Other cycles were not always used. To express the date in LC, the Mayans used a modified vigesimal (base-20) positional numeral system of five time intervals and their multiples. These intervals are as follows:

K'in = day,

Uinal = 20 K'ins,

Tun = 18 Uinals = 360 K'ins,

K'atun = 20 Tuns = 7 200 K'ins,

B'ak'tun = 20 K'atuns = 144 000 K'ins

LC date is written as five numerals. If denoted as n_1 through n_5 (corresponding to the number of B'ak'tuns to K'ins), the date is written as $n_1.n_2.n_3.n_4.n_5$. All these numbers go from 0 to 19, with the exceptions of n_1 (0 to 12) and n_4 (0 to 17). The number of LC days is then equal to

$$\mathrm{LC} = 144000n_1 + 7200n_2 + 360n_3 + 20n_4 + n_5. \quad (1)$$

Dresden Codex (DC) is one of the four hieroglyphic codices that survived the Spanish Inquisition; DC, discovered in Dresden, is a book consisting of folded 39 sheets (78 pages). Its origin comes from Yucatán Penninsula. It is probably a copy made around 1200 from three different original sources (Thompson (1972), Bricker and Bricker (2011), or `https://en.wikipedia.org/wiki/Dresden_Codex`). It covers the interval between 280 and 1325 AD, and contains calendar dates of both historical and astronomical events. DC also contains mathematical tables, serving to compute the length of the tropical year and revolution of planets. The dates in DC are usually expressed in LC, and they are not ranged chronologically. They often appear in pairs, sometimes only a date in the 260-day Tzolkin is given, or a difference from the preceding date is recorded.

In today's astronomy, we are using Julian Date (JD), the number of days counted from an arbitrarily chosen origin. The relation between the two counts is given by a difference between the two origins τ = JD − LC, called 'correlation'. The correlation can be determined if we know the date of at least one event in both LC and JD. During the past century, more than fifty different values of correlation were published (for their complete list see, e.g., Böhm et al. (2013)), based on both historical and astronomical events. However, they are mutually highly inconsistent; individual values of τ range from 394 483 to 774 083 days.

Historians mostly accept as standard the Goodman-Martínez-Thompson (GMT) value of 584 283 days (Thompson 1935). It is based mainly on events from the post-classical period of the Maya civilization. On the other hand, brothers Böhm published their correlation (BB with τ = 622 261days), based purely on numerous astronomical phenomena of classical period of the Maya civilization as recorded in DC, but also carved in stone stelae, alt-

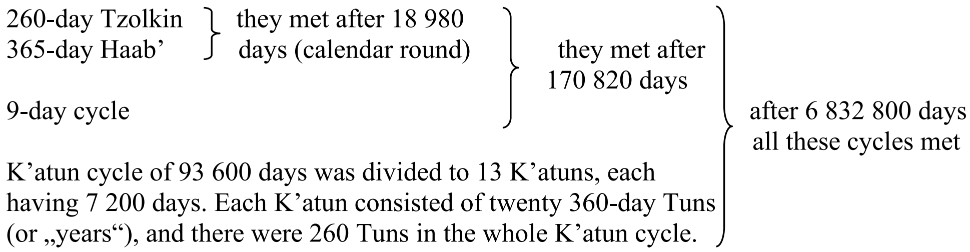

Fig. 1: Schematic representation of the Maya calendar.

ars, and walls of Maya temples (Böhm and Böhm 1991a,b, Böhm and Böhm 1996).

The difference between the BB and GMT correlation, 37 978 days, is almost exactly equal to 104 Haabs and also to 146 Tzolkins. This is probably not a mere random coincidence, as we stated earlier (Böhm et al. 2013). Vondrák et al. (2023) proposed the explanation that the GMT correlation is based on the assumption that the Maya calendar was continually used from the beginning of the Maya history up to the 16th century. The continuity between the classical and post-classical period, however, does not exist – the LC system of dating was interrupted during the 11th century. The reconstruction of LC backward from the sources of the post-classical period (16th century) into the classical one was therefore wrong.

During the past years, we studied the Maya records of astronomical phenomena in DC and some stelae. Klokočník et al. (2008) used solar eclipses, planetary conjunctions, greatest elongations of planets from the Sun, heliacal risings and settings to find out which correlation yields the best fit with reality. Only the BB correlation is compatible with all these astronomical data. Other correlations, including GMT, fit only a small subset of them. Böhm et al. (2013), to avoid ambiguities of short-periodic events, added the long-periodic ones, Vondrák et al. (2022) demonstrated that the old Mayans observed Mercury and made records of these events. 19 records of Mercury’s greatest elongations from the Sun and 9 records of its conjunctions with the Sun were found in DC. Vondrák et al. (2023) studied six records of planetary conjunctions, recently found in DC. Evidently, the BB correlation yields the best fit with astronomical phenomena studied above for the classical period of Maya history.

In the following, we continue our study with additional planetary conjunctions, whose records we found recently in DC.

3. PLANETARY CONJUNCTIONS

Conjunctions of Jupiter and Saturn are really very rare events. Considering the difference between the mean motions of both planets around the Sun, 0.04963° per day, their heliocentric conjunctions repeat on average every 19.86 years. Their relative motion is so slow that their heliocentric angular distance remains within 5° for about 200 days. Viewed from the Earth, these values are however different. Namely, when both planets are during the time of conjunction near the opposition with the Sun, they move in loops and they can remain close to each other for almost a year. At this period, a double conjunction usually occurs. In the interval between 400 and 800 this happened only nine times: in years 452, 491, 531, 571, 590/591, 610, 690, 709/710, and 729. In p. D74 of DC there are records of two of them, in 491 and 571, that we already mentioned in our previous paper (Böhm et al. 2013). Now we discovered that the same page contains more information enabling to detect four more mutual conjunctions of Venus, Mars, and Jupiter.

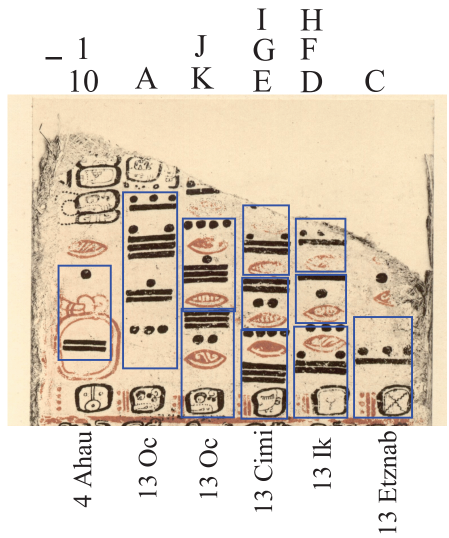

Fig. 2: Upper half of the page D74 of Dresden Codex.

There is a date in LC, denoted as A in the second column of p. D74, as seen in Fig. 2, where only the upper half of the page is displayed. For simplicity, each code A–K corresponds to information framed in the picture below. The glyphs in the last row depict Tzolkin dates. Unfortunately, this page is partly damaged, some numbers are missing so we were forced to do some reconstruction. There is also other important information included in page D74. We summarise them all in Table 1. Not only LC dates, but also Tzolkin dates are given, enabling an independent check of the dates recorded. Date B is obtained from A by subtracting the difference 1.10 (30 days). The rest of the information, denoted as C–K, contains an accompanying table that helps recalculating the dates to other epochs. All these items represent multiples of 364 days.

The Tzolkin dates shown there correspond to dates using the B epoch as the initial date. This check was useful for us to discover a misprint in the information K. Instead of 15.2.0, it should read 15.3.0, which also yields an integer multiple of 364.

Table 1: Information found in page D74 of DC.

Code	Date in LC	Tzolkin	note
A	8.17.11.3.0	4 Ahau	conjunction
	–1.10		difference
B	8.17.11.1.10	13 Oc	calc. from A
C	?.?.8	13 Etznab	2x364 = 728
D	3.0.12	13 Ik	3x364 = 1029
E	4.0.15	13 Cimi	4x364 = 1456
F	5.1.0	13 Oc	5x364 = 1820
G	10.2.0	13 Oc	10x364 = 3640
H	?.?.8.0	13 Oc	40x364 = 14560
I	?.0.12.0	13 Oc	60x364 = 21840
J	4.0.16.0	13 Oc	80x364 = 29120
K	15.(3).0	13 Oc	15x364 = 5460

For the following analysis, we accepted the date B as the Jupiter-Saturn conjunction, and also the next one, calculated from B by adding the interval J (about 80 years later). We decided so because the interval of 29 120 days between them contains integer multiples of three cycles – 73 synodic periods of Jupiter, 77 synodic periods of Saturn, and 112 Tzolkin 260-day periods. In both cases, there were double conjunctions, as shown in Table 2. They occurred near the opposition of both planets with the Sun. Then we added, step by step, the intervals coded as C–K to the date B, and tested if some conjunctions took place nearby. We succeeded in four cases that are listed in Table 2.

To get the DC date in the Julian calendar of each event, we first applied the BB correlation to convert the LC date to JD, then followed a standard procedure to obtain the date in the Julian calendar. To determine the real dates of the conjunctions, we used our own calculations based on the planetary theory VSOP87 by Bretagnon and Francou (1988). All calculations were made for the geographic position of Palenque (17°29′ N, 92°03′ W), assumed the center of Maya civilization. First, we calculated the geocentric ecliptic coordinates of both planets for local midnight of each day in close vicinity of DC dates. From these we further determined the date of conjunction (when ecliptic longitudes of both planets are equal) or, alternatively, the date of quasi-conjunction (occuring when the longitudes of both planets are different, but their angular distance achieves minimum).

The time evolution of mutual positions of both planets is graphically displayed in two versions: motion of the planets in ecliptic coordinates with respect to the stars, and motion of one planet with respect to the other one. Sometimes, namely, when it concerns double conjunction, the second version yields a better illustration of the moment of the conjunction. In order to find out if the corresponding phenomena were really visible at the Maya territory, we calculated, for the moments of civil twilight at Palenque (i.e., when the Sun was six degrees below the local horizon) horizontal coordinates of both planets (the azimuth A, counted from the south westward, and altitude h with the astronomical refraction applied). These coordinates, representing the mutual position of both planets with respect to the Sun 6° below the horizon, are then graphically displayed.

3.1. Double conjunction Jupiter–Saturn in 491

There were two stationary points of Jupiter and Saturn in longitude (i.e., the dates when the first derivative of the geocentric ecliptic longitude was zero) and two conjunctions of Jupiter with Saturn during the year 491. The evolution of this complicated phenomenon is represented in Fig. 3, where the motion of both planets is displayed in ecliptic coordinates. These motions predominantly take place in longitude; to show better the small distance of the planets in latitude, the vertical scale is significantly enhanced.

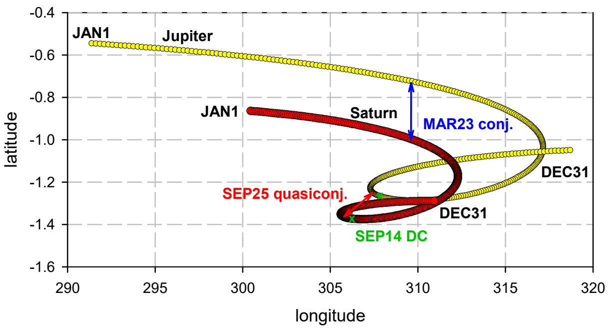

Fig. 3: Two stationary points and two conjunctions of Jupiter with Saturn in 491.

The year 491 surely provided a spectacular view. On March 23, Jupiter and Saturn approached their conjunction in longitude, with the minimum angular distance between them 0.27°. Two months later, they were in stationary points (Saturn on May 22, Jupiter on June 5). The recorded date in DC, September 14, occurred only eleven days before the quasi-conjunction that happened on September 25, with the minimum distance between the two planets of 1.61°. Shortly afterwards, there arrived the second stationary points of both planets (Jupiter on October 2, Saturn on October 8). Saturn and Jupiter

Table 2: Planetary conjunctions as found in page D74 of Dresden Codex.

Code	Date in DC	Tzolkin	LC	JD	Jul. cal.	phenomenon
B	8.17.11.1.10	13 Oc	1 278 390	1 900 651	Sep 14, 491	2 conj. Jup-Sat
B+E	8.17.15.2.6	13 Cimi	1 279 846	1 902 107	Sep 9, 495	conj. Mar-Jup
B+F	8.17.16.2.10	13 Oc	1 280 210	1 902 471	Sep 7, 496	2 conj. Ven-Mar
B+G	8.18.1.3.10	13 Oc	1 282 030	1 904 291	Sep 1, 501	2 conj. Ven-Mar
B+H	8.19.11.9.10	13 Oc	1 292 950	1 915 211	Jul 26, 531	conj. Mar-Jup
B+J	9.1.11.17.10	13 Oc	1 307 510	1 929 771	Jun 6, 571	2 conj. Jup-Sat

were in opposition with the Sun on August 1 and 4, respectively. A better illustrative view of the evolution of mutual positions of both planets is provided in Fig. 4, in which the motion of Jupiter with respect to Saturn is displayed. The angular distance of both planets was changing very slowly during this period – it changed from 1.61° on September 14 to 1.75° on Ocober 8. These differences are too small to be distinguished by naked eye.

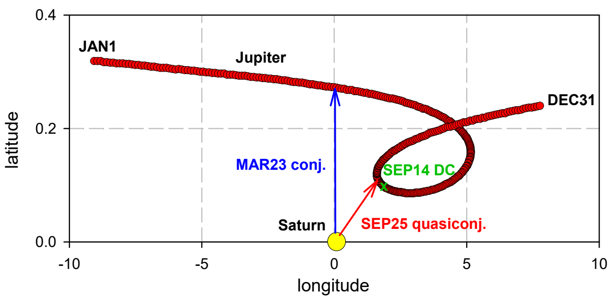

Fig. 4: Motion of Jupiter with respect to Saturn in 491.

Both planets were well visible on the night sky, high above the horizon of Palenque (between 30° and 40°) during both conjunctions. Excellent visibility was achieved in southeast (before sunrise in March, after sunset in September), as demonstrated by Figs. 5 and 6, respectively. Both planets were sufficiently bright; the magnitude of Jupiter was −2.4 during the first conjunction and −2.6 during the second one, and the magnitude of Saturn 1.4 and 1.1, respectively.

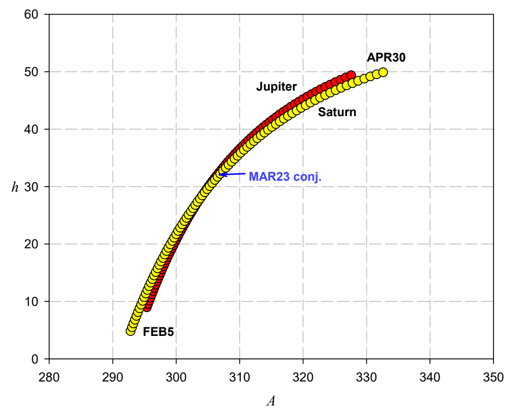

Fig. 5: Visibility of Jupiter and Saturn at Palenque around their first conjunction in March 491.

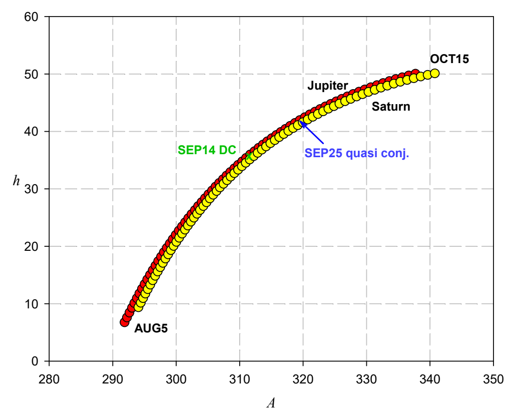

Fig. 6: Visibility of Jupiter and Saturn at Palenque around their second conjunction in September 491.

3.2. Conjunction Mars–Jupiter in 495

We found, in a close vicinity of the Maya date September 9, 495 (code B+E in Table 2) the conjunction of Mars with Jupiter, if the BB correlation is considered. Motion of the two planets around this date, in August - September, with respect to stars is depicted in Fig. 7. Both planets moved almost parallel to each other, and their conjunction occurred on September 3, only 6 days before the date recorded in DC. Their angular distance was then 0.66°. It should be noted that the vertical scale (latitude) is again enhanced with respect to the horizontal one. The elongation of the planets from the Sun was 67° at the date of conjunction. A view of the evolution of

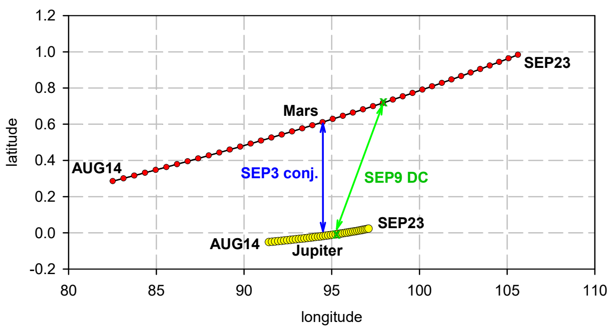

Fig. 7: Conjunction of Mars with Jupiter in 495.

the motion of Mars with respect to Jupiter is provided by Fig. 8.

Fig. 9 demonstrates the excellent visibility of the conjunction at Palenque – both planets were very high above the northeast horizon (about 60°), before sunrise. Mars and Jupiter were also very bright, their magnitudes being 1.1 and -2.0, respectively.

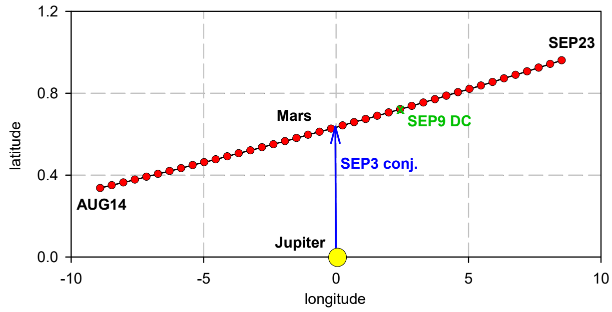

Fig. 8: Motion of Mars with respect to Jupiter in 495.

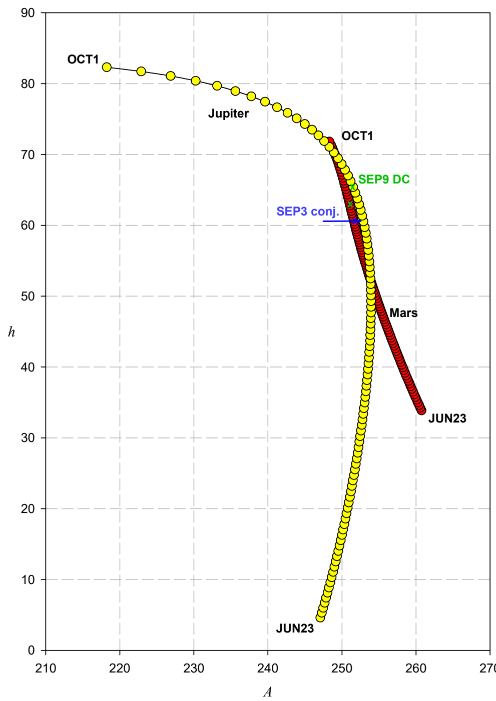

Fig. 9: Visibility of Mars and Jupiter at Palenque around their conjunction in 495.

3.3. Double conjunction Venus–Mars in 496

A double conjunction of Venus with Mars occurred near the recorded Maya date September 7, 496 (code B+F in Table 2). The motion of both planets with respect to stars is depicted in Fig. 10. The conjunctions happened on August 17 and October 7; these dates are better visible in Fig. 11 displaying the motion of Venus with respect to Mars. The angular distance between the planets at the conjunctions was 1.97° and 5.66°, respectively. The elongation of both

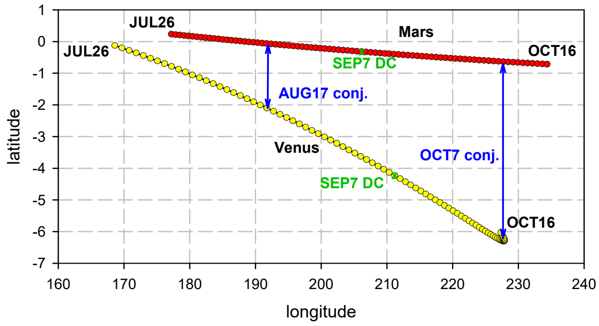

Fig. 10: Two conjunctions of Venus with Mars in 496.

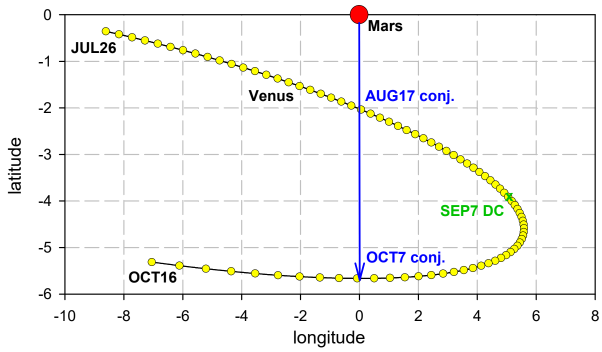

Fig. 11: Motion of Venus with respect to Mars in 496.

planets from the Sun was 46° during the first conjunction and 32° during the second one. The date recorded in DC is about halfway between the two conjunctions.

Fig. 12 demonstrates the visibility of both conjunctions at Palenque – both planets were seen well above the southwest horizon (higher than 15°, and almost 30°) after sunset. Venus and Mars were also very bright, their magnitudes being -4.5 and 1.3, respectively.

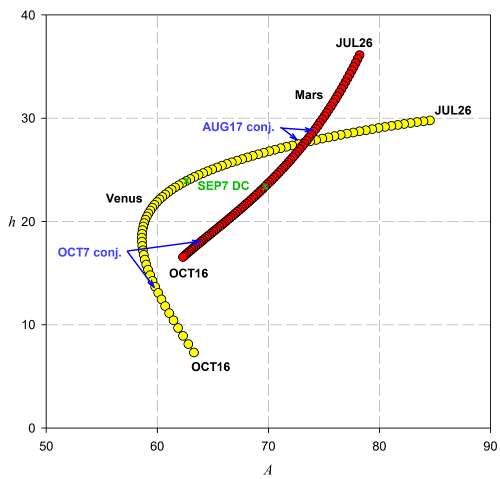

Fig. 12: Visibility of Venus and Mars at Palenque around their two conjunctions in 496.

3.4. Double conjunction Venus–Mars in 501

There were again two conjunctions of Venus with Mars in 501, on September 6 and October 26. The first one occurred only five days after the recorded Maya date September 1 (code B+G in Table 2), and very close to the stationary point of Venus. The motion of both planets with respect to stars is depicted in Fig. 13. We also offer Fig. 14 displaying the motion of Venus with respect to Mars. The angular distance between the planets at the conjunctions was 7.94° and 0.50°, respectively. The elongation of both planets from the Sun was 28° during the first conjunction and 47° during the second one. It is a little astonishing that the date recorded in DC is close to the first conjunction at which the angular distance between the planets was much larger than at the second one.

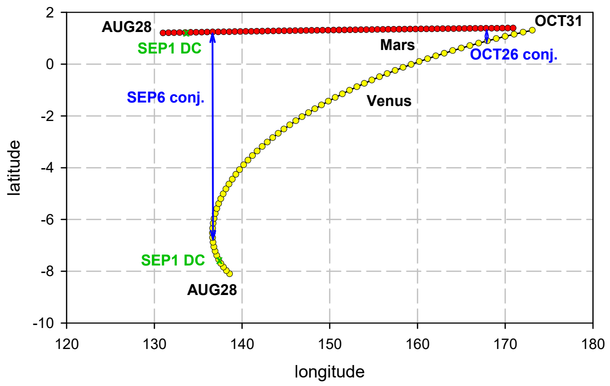

Fig. 13: Conjunctions of Venus with Mars in 501.

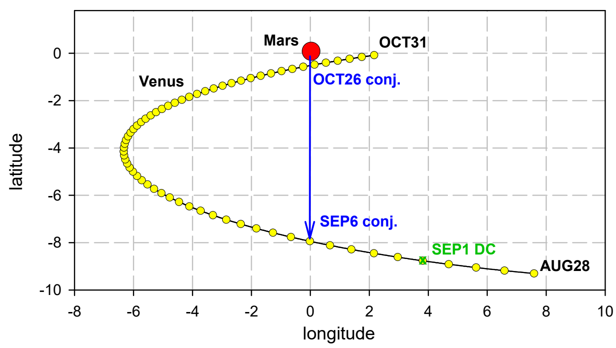

Fig. 14: Motion of Venus with respect to Mars in 501.

Fig. 15 demonstrates the visibility of both conjunctions at Palenque – both planets were seen well above the eastern horizon (about 20° and 40°, respectively) before sunrise, at the dates of both conjunctions. Venus and Mars were also very bright during September–October, their magnitudes being about −4.6 and 1.7, respectively.

3.5. Conjunction Mars–Jupiter in 531

Conjunction of Mars with Jupiter in 531 is demonstrated in Fig. 16. It occurred on July 22, only four

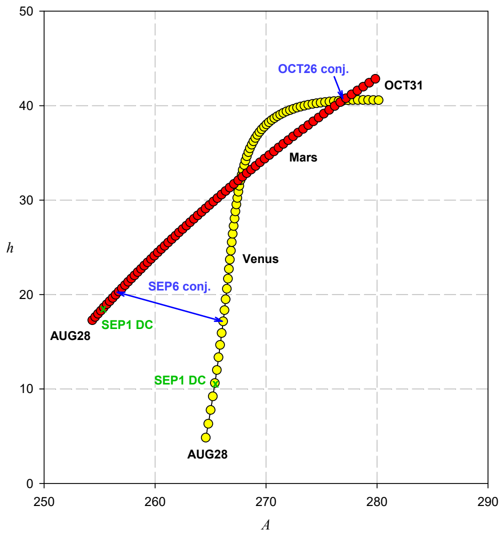

Fig. 15: Visibility of Venus and Mars at Palenque around their conjunctions in 501.

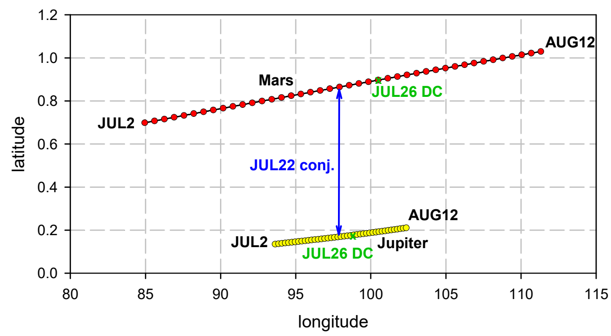

Fig. 16: Conjunction of Mars with Jupiter in 531.

days before the date recorded in DC. Their elongation from the Sun was 22°. The angular distance between the two planets was equal to 0.70°, and it changed very slowly, due to the almost parallel motion of both planets. For the same reason, the motion of Mars with respect to Jupiter as depicted in Fig. 17, looks very similar.

Fig. 18 demonstrates the visibility of the conjunction at Palenque – both planets could be seen above the northeast horizon before sunrise, and their altitude at the date of the conjunction was about 15°. Mars and Jupiter were again very bright; their magnitudes were 1.7 and −1.8, respectively.

3.6. Double conjunction Jupiter–Saturn in 571

Eighty years after the first double conjunction in 491 the situation in 571 was similar (code B+J of Table 2); two stationary points of Jupiter and Saturn in longitude and two conjunctions of Jupiter with Saturn occurred. The progression of this phenomenon is depicted in Fig. 19 where the motion of both planets among the stars is shown in ecliptic coordinates.

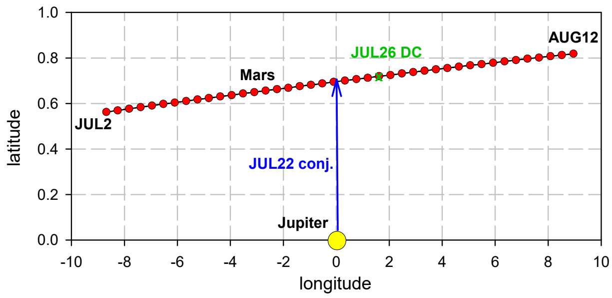

Fig. 17: Motion of Mars with respect to Jupiter in 531.

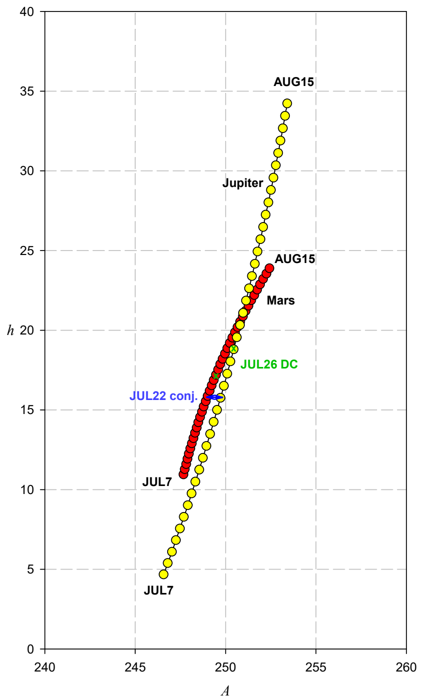

Fig. 18: Visibility of Mars and Jupiter at Palenque around their conjunction in 531.

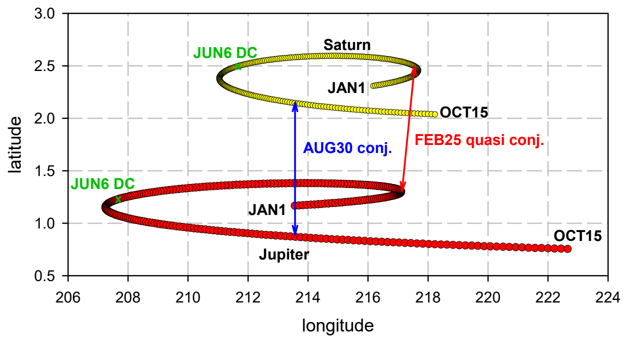

Fig. 19: Two stationary points and two conjunctions of Jupiter with Saturn in 571.

Again, the motion of both planets took place predominantly in longitude. In order to show the difference in latitude better, the vertical scale is enlarged.

It must have been a spectacular view; during almost ten months Jupiter and Saturn remained relatively close (not more than 4°) to each other and exhibited loops among the stars. Their slow prograde motion was stopped first for Saturn (February 13) and then for Jupiter (February 19), and their retrograde motion began. Shortly afterwards, on February 25, Jupiter and Saturn approached their quasi-conjunction with minimum angular distance 1.28°. After the stationary points of Jupiter (June 23) and Saturn (July 4) their prograde motion began, and about two months later both planets achieved the second conjunction (August 30) with the angular distance equal to 1.28°. The recorded day in DC, June 6 (i.e., a month before the stationary points) is about halfway between the two conjunctions. Jupiter and Saturn were in opposition with the Sun on April 21 and 23, respectively. A more illustrative view of the evolution of mutual position of both planets is provided in Fig. 20, where the motion of Jupiter with respect to Saturn is displayed.

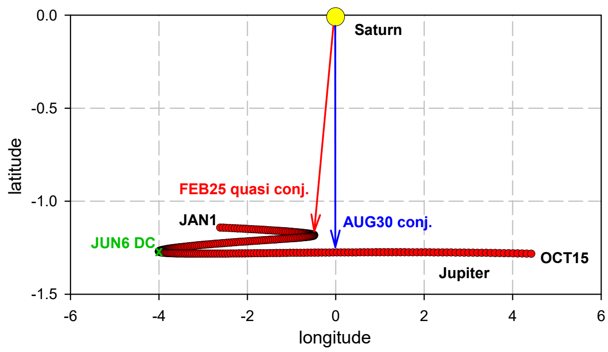

Fig. 20: Motion of Jupiter with respect to Saturn in 571.

Both planets were well visible in the night sky, high above the horizon of Palenque (almost 50° and 35°) during both conjunctions. Excellent visibility was achieved in southwest sky (in February before sunrise, in August after sunset), as demonstrated by Figs. 21 and 22, respectively. Both planets were sufficiently bright; the magnitude of Jupiter was −2.3 during the first conjunction and −1.9 during the second one, and the magnitude of Saturn were 1.2 and 1.5, respectively.

4. DISCUSSION AND CONCLUSIONS

We found six new Maya records of planetary conjunctions, they concern planets Venus through Saturn. Four of them are double, accompanied by stationary points of the considered planets. All of them happened in sufficiently large elongation from the Sun, so they were well visible in the Maya territory. They happened close to the recorded dates in DC, when the BB correlation is applied.

Old Mayans deserve our admiration for their ability to observe with high accuracy different astronom-

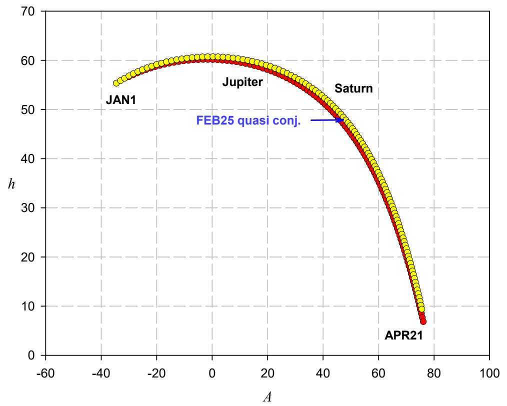

Fig. 21: Visibility of Jupiter and Saturn at Palenque, around their first conjunction in February 571.

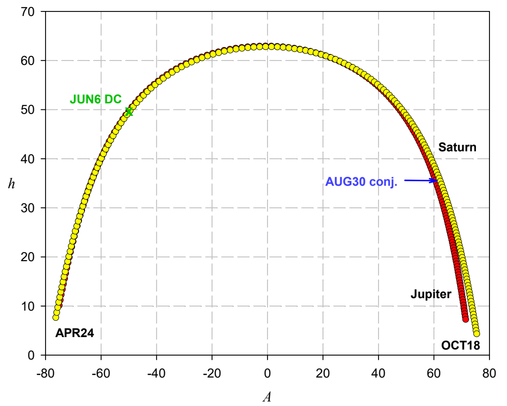

Fig. 22: Visibility of Jupiter and Saturn at Palenque, around their second conjunction in August 571.

ical phenomena. Their mathematical skills enabled them to use their observations to predict the dates of these events. They recorded the results of their observations and predictions; the records fortunately survived Spanish Inquisition, namely, in Dresden Codex, and preserved stelae. Again, the results of the present study contribute to confirm the validity of the BB correlation for the classical period of Maya civilization. The GMT correlation can probably be used for the events in the post-classical period only.

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МАЈАНСКИ ЗАПИСИ О КОЊУНКЦИЈАМА ПЛАНЕТА У ДРЕЗДЕНСКОМ КОДЕКСУ

J. Vondrák[1], **V. Böhm**[2] **and** **B. Böhm**

[1] *Emeritus, Astronomical Institute, Czech Academy of Sciences*
Boční II 1041, 141 01 Prague, Czech Republic

E–mail: *vondrak@ig.cas.cz*

[2] *Retired from The University for Political and Social Sciences,*
Barborská 52, 287 01 Kutná Hora, Czech Republic

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Култура древних Маја осмислила је веома сложен календар, а такође забележила и битне историјске догађаје и астрономске феномене. Дрезденски кодекс (ДК), једно од четири сачуваних мајанских хијероглифских писаних наслеђа, садржи многе од њих, и обухвата класичан период мајанске историје. Записи ових догађаја у ДК дати су у такозваном Дугом рачуну, који представља број дана протеклих од почетка мајанске хронологије. Разлика између Дугог рачуна и Јулијанског датума, који се користи у данашњој астрономији, традиционално се назива корелација. До сада је објављено више од педесет различитих вредности корелације, а разлике међу њима могу достићи неколико векова. Вредност која је углавном прихваћена од стране историчара Маја је она коју су одредили Гудман-Мартинез-Томпсон (ГМТ), а која износи 584 283 дана. Ова вредност се углавном заснива на догађајима из извора посткласичног периода мајанске историје. Браћа Бем користили су мајанске астрономске записе да би одредили Бемову корелацију (ББ) од 622 261 дан. Бемова корелација је у одличном складу са датумима астрономских феномена забележених у ДК. Током протеклих деценија објавили смо неколико радова који подржавају валидност ББ корелације. Засновани су на записима различитих астрономских феномена у ДК и на стелама, као што су помрачења Сунца, планетске коњункције, највеће елонгације Меркура и Венере од Сунца, као и излазака и залазака пре Сунца. Ова студија је посвећена новооткривеним записаним датумима на страни Д74 Дрезденског кодекса. Применивши ББ корелацију успели смо да идентификујемо шест од њих са коњункцијама планета од Венере до Сатурна (које одговарају годинама 491, 495, 496, 501, 531 и 571).