

# MEDIEVAL COMETS EUROPEAN AND MIDDLE EASTERN PERSPECTIVE

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# **Medieval Comets**

## **European and Middle Eastern Perspective**

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#### Cover

Comet of 634 AD. This comet appeared during the Arab invasion of Syria, some time before the Muslim commander Khālid ibn al-Walīd conquered Damascus by treaty. (*art by M. Miani, 2022*)

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# Book summary

This book is intended to be the first volume in a series devoted to an in-depth study of medieval European and middle-east comet records. With the aim of covering the entire medieval period, widely understood as corresponding to the 5th to 15th centuries AD, this first volume deals with the 5th, 6th, and 7th centuries. The rest will follow until the period is completed.

Comet catalogs are a classic literary genre in the history of astronomy since before the 20th century. In them, the different authors presented reports of observations of different phenomena related to these celestial bodies but always presented a characteristic bias favorable to records from Asia, especially Chinese. This fact is understandable since, in those countries, there was a heritage of systematically writing chronicles of the successive reigns, pointing out astronomical events that, according to their traditions and beliefs, would influence the kingdom or the monarch in some way. This was not the case in Western countries, where we find fewer astronomical observations that are much more dispersed in works by different individual authors who often copy each other or, at least, tend to copy from the most prestigious ones.

As a result, to date, there has been no research dedicated to exhaustively studying European literary sources, searching for elements that allow expanding the historical databases on medieval comets, and, at the same time, carrying out astronomical analyses that allow in some cases, the improvement or even the proposal of a set of orbital elements associated with comets.

*Bernard of Chartres (sec. XII) taught us that the dwarves that arise  
on the shoulders of giants can see more of them and further  
away, even if they don't have a better view or a higher height. Following  
his lesson, the authors dedicate this catalog to  
Umberto Dall'Olmo (1925-1980) and Paolo Maffei (1926-2009)*



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# Foreword

The ancient observers of the night sky realized that, besides the fixed stars, a number of other bodies were moving; these bodies were the planets visible to the naked eye and the Moon, which was then considered a planet. The ancients also understood that those motions were somehow regular and predictable, and over time developed a kinematic picture of the heavens that was the first seed of the exact sciences.

From time to time, however, the unexpected apparition of a comet broke the order that was seemingly regulating the motions in the sky. Thus, comets were regarded as mysterious heavenly objects; the understanding of their nature and of their motion took a very long time, and led to important advancements of astronomy and exact sciences.

There are several historical examples of comets whose study substantially helped our understanding of the workings of the Solar System, even a long time after they had been discovered, and this is why it is worthwhile to collect and preserve as much as possible the records of comets of the past.

As an example, the study of the comet discovered on the night between 14 and 15 June 1770 by Charles Messier has been of fundamental importance for many developments of modern science. This comet was rapidly approaching the Earth, so much so that by 21 June had become visible to the naked eye, reaching the second magnitude three days later. It reached the minimum distance from the Earth on 1 July, at about six lunar distances, and after a few more days disappeared in the glare of the

Sun, from which it reappeared in early August. Messier then continued to observe it until the beginning of October.

However, the parabolic orbit that was customarily used at that time to compute the ephemerides for the comet turned out to be seriously inadequate to account for the entire set of observations. The Swedish astronomer Anders Lexell then stepped in, showing that the comet was on an elliptical orbit like comet Halley (the only other case known at the time), but with a much shorter period, 5.5 years instead of the 76 years of comet Halley. How was it possible that the comet, being on such a short period orbit, had not been seen at previous apparitions?

Lexell computed that in May 1767 the comet had passed rather close to Jupiter, so that the gravity of the planet had been able to strongly modify its orbit: before 1767 the comet was on an orbit of much larger perihelion distance, thus was impossible to see it from the Earth with the instruments available at the time. Moreover, Lexell computed that in 1779 the comet would come even closer to Jupiter and would be sent into an orbit of very large perihelion distance and period, thus becoming again invisible from the Earth.

Actually, the comet was not observed in 1782, as it should have been if it had remained in the orbit in which it had been discovered in 1770. Thus, Lexell had shown that the orbit of a celestial body can be changed by an encounter with a planet even within a very short time span, a concept that is still nowadays used in astrodynamics in order to change the orbit of a spacecraft in interplanetary space.

All these results by Lexell were obtained in the same decade in which the comet had been observed; but more was coming afterwards, showing that comet apparitions can have a great importance for the advancement of science even long after they have taken place.

In fact, about thirty years later Laplace dedicated a chapter of his *Traité de Mécanique Céleste* to Lexell's comet, introducing what is nowadays called the "sphere of influence" of a planet, within which one can consider that the comet moves in a planetocentric orbit perturbed by the Sun, while outside it the motion is heliocentric, with the action of the planet considered as a perturbation.

But the story about this comet was not over. Around the half of the nineteenth century, Urbain Le Verrier reexamined the available observational record and concluded that it was not possible to reliably determine a unique orbit for that comet because the observations, although covering a few months, were nevertheless insufficient.

But this finding did not discourage Le Verrier, who realized that the orbits compatible with the observations were arranged on a line in the space of orbital elements, and could be expressed as a function of a single unknown parameter; outside a certain range of this parameter, the comet trajectory would have been

measurably different from the observed one. Essentially, Le Verrier had in this way introduced the modern concept of “line of variations” that is at the heart of the first software robots introduced at the end of the twentieth century to monitor the possibilities of impact with the Earth of newly discovered near-Earth asteroids.

In addition, Le Verrier computed the effects of the 1767 and 1779 encounters with Jupiter undergone by comet Lexell for the entire range of orbits that were compatible with the observations, obtaining a global view of all the possible encounter outcomes. According to his calculations, in 1779 the minimum distance of the comet from Jupiter could have been as small as less than three and a half radii of the planet from its centre; however, it could not become a temporary jovian satellite in any case. Among the post-1779 orbits, many were similar to the pre-1779 one, but other were very different; among the various possibilities, Le Verrier even found that the comet could have been transferred into a hyperbolic orbit, leaving forever the Solar System.

With such a wide range of possible outcomes for the 1779 encounter with Jupiter, Le Verrier had in fact evidenced the extreme sensitivity of the orbital evolution comet Lexell to even small changes in the initial conditions; this sensitivity is an essential ingredient of the modern concept of chaos, i.e. that small changes in the initial state of the system lead to large differences afterwards.

Le Verrier’s computations probably represent the first instance of chaos in the scientific literature and it is interesting, in the light of the present book, that it was obtained re-examining comet observations taken many decades before.

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# Introduction

Comets have always played an important role in the history of mankind. In all cultures their appearance, with very few exceptions, has always been considered an ominous sign. In the East, the figure most involved was the reigning monarch who «theoretically was responsible for the orderly functioning of the entire cosmos as well as that limited part of it that constituted human society» (Cullen 1991: 114). The appearance of a comet was then perceived as a sort of reflection on his morality, his failures and more generally on his ability to lead the country. In the West, the widespread opinion considered their appearance to be an omen of wars, famine and plague. Still at the beginning of the eighteenth century, the Jesuit Franciscus Reinzer (1661-1708), professor at Linz, claimed that rarely a comet appears in the sky if not to scourge the Earth, announcing and inflicting all sort of doom; then, he goes on resuming the saying of the vate: *nunquam coelo spectatum impunè cometen* for which its tail serves for a rod, its hair for weapons, its light acts as a threat and its heat as anger and vengeance (Reinzer 1709: 56; White 1887: 23).

It is definitely more "philosophical" the interpretation of the abbot Diego Zunica (b. 1633), according to which the whole Nature is a mixture of good and evil: in the air doves fly and hawks stalk, zephyrs blow and typhoons rage; in the sea fierce monsters and innocent fish coexist; close to the sheepfolds the wolves frolic; in the midst of the glory of the lilies hemlocks sprout and where roses flourish snakes often nest; finally the sky itself does not vaunt complete innocence, since among its stars, a bloody comet sometimes mingles (Zunica 1700: 68- 69). Among the evil things that comets brought with their apparition, it was very popular the belief that they announced the death of

kings and princes and the changes of kingdoms. Valerio Castiglione, historiographer of the royal House of Savoy, recalling the death of the very young Duke Francesco Giacinto, which occurred on 4 October 1638, in the castle of Valentino (Turin), wrote that this sad event had been foretold by the fall of a salt shaker at the table and by a bearded comet seen towards the province of Asti (Tapparelli d'Azeglio 1863: 116). It seems that Alfonso VI (1643-1683), King of Portugal, after having launched a series of invectives against the comet of 1664, which was considered guilty of attempting on his life, he had even fired a gun at it (Baruffi 1835: 18). Louis XIV's brother, frightened by the appearance of a comet in 1680, overheard his courtiers talking about it in a light-hearted manner, turned to them and said: «You gentlemen talk about it with ease, you others are not princes» (Flammarion 1924: 303). Apparently, however, comets did not bother nobles of minor rank. The "Messagere Tirolese" of 16 July 1819, reports a conversation between an elderly Italian prince, worried about the appearance of the great comet of that year, and an impertinent Frenchman who, with a mocking tone, said: «tranquillisez vous, monseigneur, vous n'êtes pas un Prince à comete» (Don't worry, my lord, you are not such a Prince to make a comet concerned).

In the past, few men, even among the most erudite ones, could escape this conviction. One of them was the famous Florentine bishop Antonino Pierozzi (1389-1459). On the occasion of the appearance of comet Halley in 1456, he did not hide his perplexity: «one can not see why somebody should think such a thing, since - first of all - comets rise on the same land inhabited by the poor, the rich and the king. Secondly, however, the comet has a natural cause, which does not aim at anything. It is therefore clear that it has no relationship with the death of anyone or to wars» (Garbini 1996: 444). Melchior of Parma (d.1520), a friar of the order of the Minors, in the *Dialogo dell' anima* (Dialogue of the Soul), to Microcosm who asks: «where does it come from that in the death of the princes and kings comets appear?» he replies with "doi risposte bone" (two good answers) of St. Bonaventure [born Giovanni Fidanza (~1218-1274)]. In the first one, he explains that the apparition of comets does not necessarily mean the death of Kings and Princes but, if it did, it would only be the result of a fortuitous coincidence. As experience shows, writes Melchior, Kings and Princes, are also dead in periods when comets are entirely missing. In the second answer, he clarifies that it cannot be the stars to influence the death of the powerful, being this prerogative assigned solely to the "divine commandment". The Spanish Benedictine Benito Jerónimo Feijoo (1676-1764), who defined the comet as a "bragging of the sky", wrote: «perhaps they wanted to make it a bugbear for the sovereigns, to depress their vanity, on the consideration that they have less to worry about on the earth, than other men; but the monarchs have, down here, enough enemies to fear, without it being necessary to contain them that the brilliant agitations of the sky concur with the vapours of the earth. The ambition of neighbours, the complaints of subordinates, the annoyances of governing, such are the comets that monarchs must fear».

From the above point of view, some of the most outstanding figures of the ancient world, mentioning comets in their works, considered them as carriers of misfortunes or dire warnings. Orosio (died c. 423), in his *Historiae adversus paganos*, closely bounds the heavenly signs with the history of mankind. Hydatius (c. 400-c. 469), in his *Chronicle* covering the years from 379 to 469 AD, follows the same approach. Gregory of Tours (538-594), in the *Historia Francorum*, devotes numerous lines to the “wonders” and “signs” such as: strong storms devastating regions, moon darkened and comets preceding pestilence and destruction. Finally, the encyclopedist Isidore of Seville (560-636), who is considered as a point of connection between the ancient and medieval world, tries to give a “scientific” explanation for all natural phenomena against superstition. In the third book (of twenty) of his *Etymologies*, he points out the difference between the concepts of Astrology and Astronomy. About this latter, he says: «concern itself with the turning of the heavens, the rising, setting, and motion of the stars, and where the constellations get their names» (Barney et al. 2006: 99). However, in *De Natura Rerum* he did not deprive comets of their mystical and ominous meaning: «A comet (*cometa*) is a star, so named because it spreads out the ‘hair’ (*coma*) of its light. When this type of star appears it signifies plague, famine or war» (Barney et al. 2006: 105).

About the nature of comets, at least until most of the sixteenth century, there was an almost unanimous agreement around the thesis that Aristotle had expressed in his *Meteorology*, about two millennia before. The Philosopher, after refuting various hypothesis on the origin of comets, including that of the so-called Pythagoreans, according to which the comet is: «just one of the planets that appears only at long intervals of time», exposes his theory of earthly exhalations: the moist ones, namely vapours, form clouds and then rain, snow, sources of rivers, dew and frost; the dry ones, namely steamy substance, rise higher, condense and, between the layer of fire and the beginning of the space permeated by the ether, within the sublunar sphere, catch on fire forming shooting stars, comets and what we now call the northern lights. Probably if the cosmology of the Stagirite, based on the opposition between the four elements and the ether and the dichotomy terrestrial corruptibility vs celestial incorruptibility, had not been adopted by both Christian and Muslim culture, meteors, comets and northern lights would have been observed and recorded with systematicity and attention at least as much as those dedicated to the planets. It was only in the last quarter of the sixteenth century that accurate observations of the great comet of 1577 allowed Tycho Brahe to demolish this false theory. Moreover, a century later, Edmund Halley, in the opening of Newton's *Principia* (1687), could state: «Now it is clear to us what is the curved path of the terrible comets; now we are not (*longer*) surprised by the phenomena of the bearded stars». If Newton's discovery of the laws governing the motion of comets and Halley's intuition on the periodicity of one of them had finally torn the veil of mystery that surrounded them, much more difficult was to eradicate people's prejudices.



Today we tend to look at these fears with benevolent detachment, but judging them with hasty superficiality would be a mistake. Mario Rigutti (1997: 50), in one of his essays, invited us not to smile «at the thousands of stories of misfortune and death that have accompanied the appearance of comets in the skies of distant centuries». A judgment that closely resembles that of Charles Singer (1959: 1), according to which: «It therefore behoves the historian of science to be very charitable, very forbearing, very humble, in his judgements and presentations of those who have gone before him. He needs to remember that he is dealing with the work of erring and imperfect human beings, each of whom had, like himself, at best but a partial view of truth, but many of whom had a sweep of genius far beyond his own».

Evidently, this volume and the others for later centuries, do not claim to be exhaustive because the amount of texts not yet published is still remarkable, and it is expected that new mentions of comets will appear in the future. In this sense, the present work is intended to be an effort to reconcile observations of comets from such different cultures by combining, in particular, the Western and Middle Eastern literature with the rich and diligent heritage of the Far Eastern tradition. The aims of scholars have become more and more ambitious, thanks to the work of historians who have compulsorily collected primary sources, or their best editions, in the most varied languages in order to translate them into what has been the common language of scholars throughout the ages: Greek, Latin, French, German and English. Therefore, it is reasonable to assume that re-reading Western and Middle Eastern sources may help to solve semantic problems, complete chronological gaps, clarify dates, or raise new questions about what has been transmitted from the Eastern annals. A case in point involves a recent paper to improve the orbital elements of Halley's comet during its appearance in 760 AD (Neuhäuser et al. 2021: 19).

Generally speaking, the present work follows the path of previous studies devoted to resuming, ordering and interpreting, in a systematic way, all original observational notes on comets in specific geographical areas and historical periods. Even so, the references are rather numerous, for which we refer to the final bibliography. We must, however, mention at least half a dozen treatises. From the past: Johannes Hevelius' *Cometographia* (1668), Stanisław Lubieniecki's *Theatrum cometicum* (1668), the two volumes of Alexandre Guy Pingré's *Cométographie* (1783 and 1784), and John Williams' *Observations of Comets* (1871), whose covers are reproduced on the next page. In more recent times: the first volume of Gary W. Kronk's *Cometography* (1999), and John T. Ramsey's work *A Descriptive Catalogue of Greco-Roman Comets from 500 B.C. to A.D. 400* (2008).



COMÉTOGRAPHIE  
OU  
TRAITÉ  
HISTORIQUE ET THÉORIQUE  
DES COMÈTES.

Par M. PINGRÉ, Chanoine Régulier & Bibliothécaire de Sainte-Genève, Chancelier de l'Université de Paris, de l'Académie Royale des Sciences.

Tome Premier.



A PARIS,  
DE L'IMPRIMERIE ROYALE.

M. DCCLXXXIII.

OBSERVATIONS OF COMETS,

FROM B.C. 611 TO A.D. 1640.

EXTRACTED FROM THE CHINESE ANNALS.

TRANSLATED, WITH INTRODUCTORY REMARKS,

AND

An Appendix,

CONTAINING THE

TABLES NECESSARY FOR REDUCING CHINESE TIME TO EUROPEAN RECKONING;  
AND A CHINESE CELESTIAL ATLAS.

BY

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More specifically our research focused on retrieving extracts from annals, chronicles, manuscripts, and other sources on this topic recovered in Europe and the Middle East. For published work, where possible, we used the most recent edition and, in addition to the English translation, in most cases, we also reported the text in its original language. In this sense, therefore, this work should not be understood as a cometography *stricto sensu*, but rather as a list of historical comets independently confirmed in both Western and Eastern countries. A new interpretation of these texts has allowed us to compute a new orbit, for some particular comets, or alternatively to improve the already published one. These calculations took into account the reports obtained from the Chinese, Japanese or Korean observations. For this reason, for each catalogued comet, we have provided a table with a brief summary, taken from the Eastern annals records. The first column contains the reference texts from which we derived information. Columns two and three list dates and positions (*pinyin* spelling) by also crossing data from three different publications (Williams, 1871; Ho, 1962, and Pankenier et al. 2008). Finally, in the fourth column the determinative stars of the 28 Lunar Mansion "*xiu*" (see Stephenson 1997: 516-518; Sun and Kistemaker 1997: 114), and the approximate counterpart of the Western sky, are shown (see Ho 1962: 222-224; Sun and Kistemaker 1997: 147-191; Pankenier et al. 2008: 455-464; Stephenson and Green 2009: 35-51).

As we know, the term "comet" has sometimes been improperly used to indicate other types of celestial phenomena in the past. More frequently the opposite has happened when generic terms such as star, sign, portent, etc. have been used in its place (see, for example, Dall'Olmo, 1980). Moreover, in many cases, the chronicles refer, directly or indirectly, to a single primary source that is not always identifiable. This can be seen from the fact that some chronicles are very similar. The works gained prestige if they made reference to past authors famous for their wisdom, so that, on many occasions, the copyists transcribed the texts over and over again, although adapting them to their needs and not hesitating even to modify the dates to make them coincide with certain historical events that they wished to remark. In this process, not only voluntary changes were possible, but also the introduction of unwanted errors that could affect the meaning or data of the original text. For this reason, extreme precautions must be taken when working with historical treatises.

Since we can not report every single account, our choice was naturally to give priority to those chronologically closer to the event than to later chronicles. Those sources, in principle, are more reliable because they are less contaminated and sometimes contain first-hand testimonies. If no date is mentioned in the original document, this has been interpolated taking into account the events preceding and following the description of the cometary appearance. Further, the possible connection to comets already known in the literature was also checked based on the context. If the year reported in the source is clearly wrong, the comet has been related to the most

likely date; in any case, the year indicated by the chronicler (or the editor of the work) has been preserved, at the beginning of the description, by highlighting it in square brackets for any further investigations. As previously stated, according to the data obtained from the ancient texts, possible orbits have been calculated for some of the comets listed in this book. However, it should be emphasized that, due to the limited information available, the results thus obtained represent in good substance only an approximation of what could be the actual orbit. Some exceptions are those orbits based on previous returns of well-known comets such as 1P/Halley, 108P/Swift-Tuttle, or 12P/Pons-Brooks which are based on many accurate records and can even be improved based on trial-error methods. Comets preceded by the prefix X/ are instead those that, despite being well documented, do not have sufficient data to calculate an orbit (see Yeomans et al., 1997: 219; Marsden and Williams, 2005: 206). In addition to the officially recognized ones, our work has identified other comets, that deserve such a prefix. For these, we propose in brackets the new designation. In this first volume, as an example, those of the years 634 (X/634 S1) and 684 (X/684 Y1).

The first attempts to calculate orbits of historical comets were early in the second half of the eighteenth century mainly due to the translations of Oriental texts, finally available to Western scholars. Among the pioneering astronomers involved in the long and laborious calculations necessary for this type of computation, we should mention the names of Pierre Charles Le Monnier (1675-1757), Nicolaas Struyck (1686-1769), Alexandre-Gui Pingré (1711-1796), Heinrich Wilhelm Olbers (1758-1840), Johann Karl Burckhardt (1773-1825), Paul Auguste Ernest Laugier (1812-1872), John Russell Hind (1823-1895), Martinus Hoek (1834-1873), Lipót Schulhof (1847-1921), Giovanni Celoria (1863-1917), Andrew Claude de la Cherois Crommelin (1865-1939), Philip Herbert Cowell (1870-1949), Sinkiti Ogura (1884-1936), and Shigeru Kanda (1894-1974).



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# IV Century

## 400 C/400 F1

Usually, the oldest sources referring to a comet come from the East (China, Korea, or Japan), but, in this case, the most ancient are contemporary and come from Europe. That is why these testimonies should have a special weight. Claudian, in *De Bello Gothico*, composed after Stilicho's victory over the Goths of Alaric in Pollentia, which probably occurred in the spring of 402 AD, reports of a bright comet. This is just one of the many "signs", including Moon eclipses, heavy hailstorms, swarms of agitated bees and houses that caught on fire without apparent reason, which characterized this troubled period. The "star" would have headed from the eastern sky to the northern one, crossing the constellations of Cepheus, Cassiopeia and Ursa Major and then slowly fade away. Chinese sources confirm that a comet, starting from the second half of March 400 AD, followed a similar path, thus reinforcing the hypothesis that it was the same object. Chinese observations continued until the "third month" (between 10 April and 9 May), when the comet, after crossing Leo, finally moved towards the sky area including Coma Berenices and Virgo. Gundel [1921: 1190], Barrett [1978: 106], and Kronk [1999: 73] identify "Claudian's star" with another comet, observed by the Chinese in November-December 402, while Pingré [1783, I: 307-308] just writes "vers 402". However, it is very likely that the comet described by Claudian is the one of the year 400 [Hasegawa 1979: 260; Ramsey 2006: 185-189; Kronk 2021: 688-696].



In their *Ecclesiastical History*, Socrates Scholasticus (c. 380-post 439) and Hermias Sozomen (c. 400-c. 450) describe it as a vivid light, projected from the ground towards the sky, associating its appearance to the sleight of hand of the Goth-born general Gainas against the consul of Constantinople, Aurelianus (*fl.* 393–416). Both authors state that the city was invaded by the barbarians, and its inhabitants were reduced to a condition equivalent to that of captives. This thesis is also supported by John of Antioch (*fl.* 7th century), according to which the action of Gainas would have "barbarized" the city so much that the threat would have revealed itself through the appearance of this comet. Another contemporary historian, Philostorgius (*fl.* 5th century) considered the comet as a warning sign of the terrible epidemic that would have hit the city shortly afterwards. The dating of Prosper Aquitanus' text is uncertain since no details are reported. In any case, the words "eminentem iram Dei" and "igne super nubem terribiliter fulgente formidans", referred to Constantinople, come after Theodosius's death in the year 395 AD, making the mention of this comet a good possibility.

An allusion to the comet could finally be included in the *Aegyptius sive de Providentia* of Synesius (c. 370-413). At the end of the first of the two books of this allegorical work, the philosopher from Cyrene and disciple of the astronomer Hypatia (d. 415) affirms that things will improve only when the air surrounding the earth will be purified with "water and fire" [Cameron and Long 1993: 169]. About forty years ago, Hasegawa [1979: 260] published an orbit that, in general, matches the positions that have been reported in the eastern annals. The weak side of his solution is that the comet does not go through the box of *Běidou* or *Pei-Tou* [Kronk 1999: 71], a Chinese asterism formed by stars  $\alpha$ ,  $\beta$ ,  $\gamma$ ,  $\delta$  Uma, although it passes by, crossing the tail of Ursa Major. We barely find such an explicit reference in a cometary position, so the first author, on the basis of eastern observations and Claudian's text, computed an alternative orbit that satisfies this condition. More recently, Kronk (2021: 691) independently calculated a new orbit, rightly pointing out that the main problem with this comet is establishing dates for each observation, being the discovery date the only one available. Following his orbit, as shown in fig.1, the motion of the comet, at first very slow, increased its speed, crossing the bowl of the Big Dipper on 6 April. On the contrary, our proposed orbit makes the comet intersect the "bowl" four days before. Nevertheless, at the beginning of the 3rd lunar month (10 April), both the path and the position returned to being quite close. Kronk's comet remains below naked-eye visibility until early May, but since it does not appear to have been detected after April 10th, he explained the possible causes both astronomically (the full moon) and non-astronomically ('dust rain'). Without neglecting these possibilities, the comet we represent would have become unobservable sometime around the second week of April, a date that best fits the records (Martínez et al. 2022: 13-15). In any case, all the orbits place the perihelion date of this comet at the end of February at a distance between 24 and 31 million km from the Sun and a minimum distance from Earth, at the end of the following month, between 0.074 and 0.106 au.

Eastern sources: Williams (1871: 30), Ho (1962: 161), Pankenier et al. (2008: 52-53)			
Source	Dates	Positions	Reference to Coordinates of LM determinative stars (J2000) and approximate western asterisms
Song shu (c. 490)	Mar 19	Kui [LM 15] Gedao Ziwei (bowl of) Beidou Santai Taiwei Dizuo* <i>Tianmen</i>	ζ And, α = 00h 47m 20s φ Cas κ Dra α, β, γ, δ UMa ι UMa ( or ι, λ, ν UMa) β Vir α Her* 53 Vir (or between β and η Vir)
Jin shu (c. 648)	Mar 19  (between) Apr 10-May 9	Kui [LM 15] Lou [LM 16] Gedao Ziwei (bowl of) Beidou Santai Taiwei Dizuo* <i>Tianmen</i> Kui [LM 15] Lou [LM 16]	ζ And, α = 00h 47m 20s β Ari, α = 01h 54m 38s φ Cas κ Dra α, β, γ, δ UMa ι UMa ( or ι, λ, ν UMa) β Vir α Her* 53 Vir (or between β and η Vir) ζ And, α = 00h 47m 20s β Ari, α = 01h 54m 38s
Wei shu (c. 554)	(between) Apr 10-May 9	Kui [LM 15] Gedao Ziwei (bowl of) Beidou Taiyangshou Xiatai Nangong Dizuo* <i>Tianmen</i>	ζ And, α = 00h 47m 20s φ Cas κ Dra α, β, γ, δ UMa ψ UMa (or χ UMa) ν UMa Leo (near 92, 93 Leo) α Her 53 Vir (or between β and η Vir)
Jeungbo munheon bigo (1908) Samguk sagi (1145)	(between) Mar 12-Apr 9	Kui [LM 15] Lou [LM 16]	ζ And, α = 00h 47m 20s β Ari, α = 01h 54m 38s

\**Dizuo* = α Her, is a possible misprint in the sources. Actually, scholars agree it must refer to *Wu Dizuo* an area north of β Leo. The oldest sources, *Song shu*, *Wei shu* and *Jin shu* coincide in pointing out its appearance on 19 March (from 10 April to 9 May in the *Wei shu*). All the three sources agree about the comet entering in the bowl of *Beidou*. Two much later Korean sources, *Samguk sagi* (1145) and *Jeungbo munheon bigo* (published in 1908), only state that there was a comet in *Kui* [LM 15] and *Lou* [LM 16].

Claudianus Claudius, *De Bello Gothico*, 243-248

Et numquam caelo spectatum impune cometem, qui primum roseo Phoebi prolatus ab ortu, qua micat astrigera senior cum coniuge Cepheus; inde Lycaoniam paulatim expulsus ad Arcton crine vago Getici foedavit sidera Plaustri, donec in exiguum moriens vanesceret ignem.  
*And a comet, which never appears without causing damage, initially rose towards the rosy extension of Phoebus, where the elderly Céfeo shines next to his starry bride, then pushed towards the Bear, daughter of Lycaon and with his horse hair has darkened the stars of the Getic Chariot until it was extinguished in a pale fire.*

Socrates Scholasticus, *Ecclesiastical History*, Lib. VI, Chap. 6.6

Τοσοῦτος δὲ ἦν ὁ ἐπικρεμασθεὶς τῇ πόλει κίνδυνος, ὡς καὶ κομήτης μέγιστον ἐκ τοῦ οὐρανοῦ καὶ μέχρι τῆς γῆς διήκοντα, καὶ οἷον οὐδεὶς ἐθεάσατο πρότερον, μηνύειν αὐτόν.  
*Furthermore a comet of great brightness unfolded from Heaven to Earth, as had never been seen before, foreshadowed the danger looming over the empire.*

Philostorgius, *Ecclesiastica Historia*, Lib. XI, Frag. 7, Epitome di Photius

καὶ ταύτην ἄρα καὶ τὸν ξιφίαν σημαίνειν ἀστέρα.  
*And all this [a pestilence so serious that cannot be remembered in living memory] was foretold by a sword-shaped star.*

Sozomene, *Ecclesiastica Historia*, Lib. VIII, Chap. 4.10

Ὁ δὲ Γαῖνᾶς ἐπιορκεῖν ἤδη διενοεῖτο, καὶ τὴν πόλιν πορθεῖν. Ἦνίκα δὲ ταύτην τὴν ἐπιβουλήν προεμήνυσε κομήτης, ἐπὶ τῆς πόλεως φανείς μέγιστος, εἰς αὐτὴν σχεδὸν τὴν γῆν διήκων, καὶ οἷος πρότερον οὐ γεγενῆσθαι λέγεται.  
*Gaina intended to back off her oath and was planning to plunder the city when a huge comet appeared over the city foretelling this plot. The elongated comet quite reached the ground and it was said that by heart no one like it had appeared before.*

Prosper Aquitanus, *Chronicon Alterum sive Pseudochronicon*, col. 860

Constantinopolis eminentem iram Dei, igne super nubem terribiliter fulgente formidans, toto ad paenitentiam animo conversa subterfugit.

Joannis Antiocheni, *Fragmenta Historicum Graecorum*, p. 611

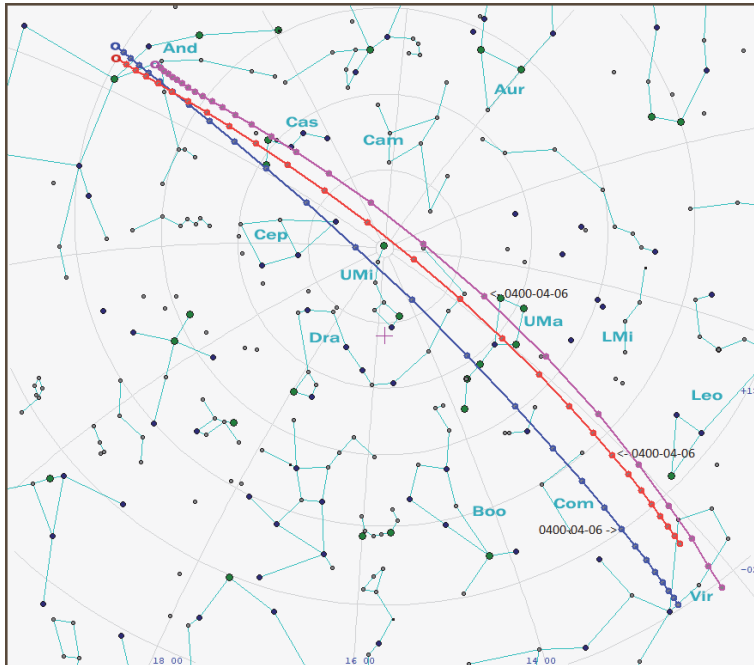
Τοσοῦτος [δὲ] ἦν ὁ ἐπικρεμασθεὶς τῇ πόλει κίνδυνος, ὡς καὶ κομήτην μέγιστον τοῦ οὐρανοῦ φανῆναι.  
*This was the danger that overlooked the city so that a large comet was also seen in the sky.*

Nicephorus Callistus, *Ecclesiasticae Historiae*, Lib. XIII, Cap. 6

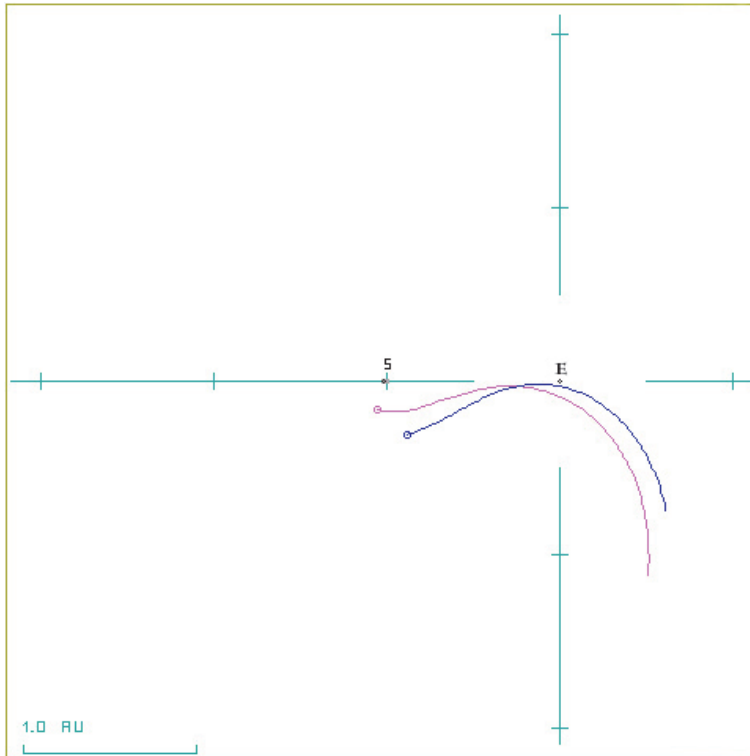
ἦν δῆτα ἐπιβουλήν ὁ ξιφοειδῆς ἐκεῖνος ἀστήρ προεμήνυσε, λαμπρὸς τις ὑπεράγαν, καὶ οἷος οὐ πρότερον γεγενῆσθαι ἰστόρηαι, ὑπὲρ τῆς πόλεως, οὐρανόθεν σχεδὸν εἰς αὐτὴν διήκων τὴν γῆν.  
*This plot [the revolt of Gaina] had been foretold by a star, bright beyond all limits, as is not found in any previous writing. Its light spreading over the city stretched across the sky to the ground.*

Orbital elements (eq. J2000.0); **L** is the ecliptic longitude and **B** the latitude of the perihelion:

T (UT)	q	e	$\omega$	$\Omega$	i	L	B	Author
400 Feb 25	0.21	1.0	47°	38°	32°			Hasegawa (1979: 260)
400 Feb 28.2	0.325	1.0	64.7	39.5	48.6			Kronk ((2021: 692)
400 Feb 27	0.16	1.0	39	37	41	68°	+24°	Sicoli (in Martínez et al. 2022: 3)

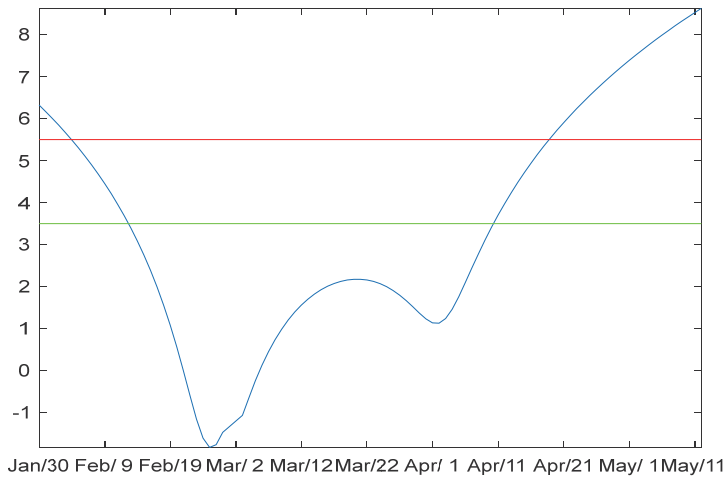


**Fig. 1** - Paths of comet C/400 F1 from 18 March (blank circle) to 13 April, 400 AD [step 1 day], from orbital elements: Hasegawa (*blue*), Sicoli (*red*), and Kronk (*fuchsia*). All the charts are prepared using MAPPA2 (v. 5.8a)



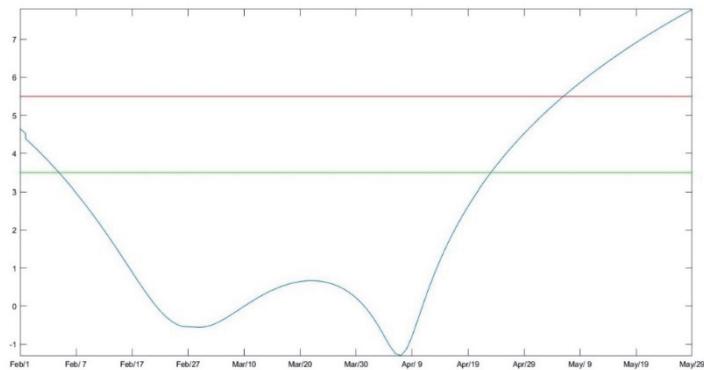
**Fig. 2** - Projection on the ecliptic plane of comet C/400 F1, in a coordinate system rotating with the Earth, from 27 February (blank circle) to 17 May; blue (Kronk), fuchsia (Sicoli)

Sicoli's orbit. The comet was within  $20^\circ$  of the Sun from 2 February to 14 March, reaching a minimum solar elongation of  $5^\circ$  between 22 and 24 February. The most northern declination was  $+87^\circ$  on 30 March. Closest to the Earth: 31 March (0.106 au).



**Fig. 3** – Estimated visual magnitude of comet C/400 F1 from Sicoli's orbit. The red horizontal line represents the limit of visibility ( $m_v = 5.5$ ), the horizontal green line represents visual magnitude 3.5, which is the evaluated magnitude at which a comet would be detected. We have considered that the behavior of the comet is the usual one taking an absolute magnitude  $H_{10} = 6$

Kronk's orbit. The comet was within  $20^\circ$  of the Sun from 2 February to 2 March, reaching a minimum solar elongation of  $15^\circ$  between 12 and 22 February. The most northern declination was  $+83^\circ$  on 4 April. Closest to the Earth: 6 April (0.073 au).



**Fig. 4** - Estimated visual magnitude of comet C/400 F1 from Kronk's orbit. For all figures, the red horizontal line represents the limit of visibility ( $m_v=5.5$ ), the horizontal green line represents visual magnitude 3.5, which is the evaluated magnitude at which a comet would be detected. Considering the behavior of the comet, Kronk set an absolute magnitude  $H_{10} = 4.30$



# V Century

## 418 C/418 M1

The Ecclesiastical History of Philostorgius, in the epitome of Photius (*fl.* 9th century), includes an interesting report of the 418 AD comet. The text, entirely included centuries later even in the *Ecclesiastical History* (Book XIII, ch. 36) by the Byzantine monk Nikephoros Kallistos Xanthopoulos (c. 1256-c. 1335), talks about the appearance of a strange cone-shaped star. Besides describing its appearance, the text reports that the comet, in the course of its movement on the celestial vault, had come just below the Ursa Major. A position also confirmed by the oriental chronicles according to which the star, observed from June to September, would have crossed several circumpolar constellations, and successively moved towards Leo and Virgo.

Several western chronicles, in addition to the comet, also mention the solar eclipse that occurred on 19 July of the same year, which could be an indication that the eclipse and the first comet sighting were simultaneous or that there was a short period of time between both phenomena. From the examination of historical records, the existence of up to three different objects could be deduced, depending on how the observations are grouped. Pingré [1783, I: 309-310], but above all, Hasegawa [1980: 69] lean towards two distinct comets; the first observed in June, the second in September. The translation given to the chronicle of Marcellinus has had some influence on this question because, in this chronicle, the duration of the apparition ap-



appears as *septem menses* which has been literally translated. However, some interpretations consider it as an abbreviation form of *september menses* (month of September).

In any case, Kronk [1999: 76], more inclined to consider the observations referring to a single comet, provided a parabolic orbit in order to satisfy all the positions recorded between June and September. An alternative, and quite different orbit, was first published by Zhou et al. [1997: 1554], but, at least from our point of view, it was unsatisfactory. Although the cometary orbit given by Kronk initially seems to suit eastern and western observations, the authors have their concerns regarding its period of visibility, which is assumed to range between the end of June and the month of November. Hence the requirements in terms of magnitude are very high. In order to fit this with his computed orbit, Kronk [1999:76] considered a magnitude  $H_{10} = 0.2$ , which would have allowed the visibility until November/December. However, in this case, when the comet was discovered, between the end of June and the beginning of July, it should have been at the limit of the naked eye ( $m_v = 5.0$ ). That is a magnitude that, although not impossible, makes the discovery of a new celestial body very difficult. It would be more logical then to adopt, for the first visibility, a magnitude of 3.5 or even less [Seargent 2009: 81; Cambó 2020].

Under this assumption, we assumed a value of  $H_{10} = -0.79$ , with which the comet would have reached a magnitude lower than -6 at the end of September and would have been visible until well beyond February 419. Taking all this into account, we reckoned on the existence of only one comet visible from July until November, for which we provide the orbit listed below. According to this new orbit, the interpretation of Philostorgius' statement: «During the time of the eclipse [...] It [the comet] was born in the east, in the place where the sun rises at the equinox», corresponds to that of its heliacal rise, in the east, around 15 September. It was a very bright object at this time, so probably Philostorgius (368-c. 439) must have described together both remarkable astronomical events that happened the same year. It should also be noted that of all Philostorgius' work only the epitome of Photius remains, hence relevant information has undoubtedly been lost.

Eastern sources: Williams (1871: 31), Ho (1962: 161-162), Pankenier et al. (2008: 55-56)			
Source	Dates	Positions	Reference to approximate western asterisms
Song shu (c. 490)	Jul 6 Sep 15	(bowl of) Beidou (west) Taiwei Beidou Ziwei Zhongtai	α, β, γ, δ UMa β Vir UMa κ Dra λ UMa
Wei shu (c. 554)	(between) Oct 16-Nov 13 (418)  Nov 12* (between) Jan 12–Feb 10 (419)	Beidou Ziwei Nangong  Tianjin Taiwei Beidou Ziwei Tianbang	UMa κ Dra Leo (near 92, 93 Leo)  γ Cyg β Vir UMa κ Dra ξ Dra
Jin shu (c. 648)	Jun 24 Sep 15  Feb 17 ( 419)	(bowl of) Beidou (west) Taiwei Beidou Ziwei Zhongtai Taiwei	α, β, γ, δ UMa β Vir UMa κ Dra λ UMa β Vir
Jeungbo munheon bigo (1908) Samguk sagi (1145)	Feb 17 ( 419)	Taiwei	β Vir
<p>*Nov. 22 in Ho (1962: 162) and Pankenier et al. (2008: 55). Ho misdated this record to the year 416 AD whereas in Pankenier et al. (2008: 55) Nov. 22 could be a typo.</p> <p>The <i>Song shu</i> and the <i>Jin shu</i> state that a star appeared in the bowl of <i>Béidǒu</i>, although the former gives the date as 6 July and the latter 24 June. The two descriptions in <i>Wei shu</i> seem to correspond to the same comet but shifted in time therefore we suspect that the scribe mistook the month in both records. This would indeed be the same comet seen in the seventh month (18 August-15 September, 418) reported by both the <i>Song shu</i> and the <i>Jin shu</i>.</p>			

Philostorgius, *Ecclesiastica Historia*, Lib. XII, Frag. 8, Epitome of Photius

Ἐκλείποντι δὲ τῷ ἡλίῳ φέγγος τι κατὰ τὸν οὐρανὸν συνανεφάνη, κώνου σχῆμα παραδύομενον, ὃ τινες ἐξ μαθίας ἀστέρα κομήτην ἐκάλουν. καὶ γὰρ ὡν ἐκεῖνος ἐδείκνυ οὐδὲν ἦν κομήτου παράσημον· οὔτε γὰρ τὸ ἐγγος εἰς κόμην ἀπέβαινε οὔτε ἀστέρι ὄλωσ

έωκει, ἀλλ' οἷον λύχνου τις μεγάλη φλόξ ὑπῆρχεν καθ' ἑαυτὴν ὀρωμένη, μηδενὸς ἀστέρου θρυαλλίδος αὐτῷ τινος μορφῆν ὑποτρέχοντος· ἀλλὰ γὰρ καὶ τῆ κινήσει Παρήλλαπτεν. καὶ γὰρ κινήθεισ ὄθεν ὁ ἥλιος κατὰ ἰσημερίαν ἀνίσχει, ἐκεῖθεν τὸν κατὰ τῆς οὐρᾶς ἄρκτου τεταγμένον ἕσχατον ἀστέρα ὑπερενεγκῶν ἡρέμα προὔβαινεν ε πορευόμενος δυσμάς. ἐπεὶ δὲ διεμέτρει τὸν οὐρανόν, ἀφανῆς ἦν, πλείους τεσσάρων μηνῶν ἐξανουθεισίης αὐτῷ τῆς ορείας. ἡ δὲ κορυφή τοῦ φέγγους νῦν μὲν εἰς μῆκος μέγα ὠξύνετο ὡς ἐκβαίνειν τοὺς τοῦ κώνου λόγους, νῦν δὲ πρὸς τὸ ἐκείνου μέτρον συνεστέλλετο. καὶ ἄλλα δὲ παρεῖχεν τερατώδη θεάματα δι' ὧν τῆς τῶν συνήθων φασμάτων ἐξηλάττετο φύσεως. ἤρξατο δὲ ἀπὸ μέσου θέρους σχεδόν τι μέχρι τῆς τοῦ μετοπώρου τελευτῆς.

*During the time of the eclipse, a bright cone-shaped star appeared in the sky, which ignorant people called "horn". Since its light had no tail, it could not be a comet nor could it be a star but looked like rather the flame of a huge lamp, with no star underneath to feed it. Its path was different from that of comets. It was born in the east, in the place where the sun rises at the equinox. Then, after passing near the lowest stars of the Bear, it slowly stretched out, in all its length, towards the west; finally, after having traveled the whole sky, after four months, it disappeared. Its tip, at one point, had shrunk and elongated much more, compared to that of the cone, while at other times, it returned to its typical shape. It also revealed to everyone other prodigious aspects that made it clear how different it was from the common stars that exist in nature. It appeared around mid-summer, continuing being visible until the end of autumn. It was also a harbinger of wars and mortality.*

Victorio Aquitanus, *Cursus Paschalis annorum DXXXII ad Hilarum Archidiaconum Ecclesiae Romanae a. CCCCLVII, Add. IV, Adnotationes Antiquiores ad cyclos Dionysianos*, p. 755

Sol deficit hora III, XIII kal. Aug. et apparuit stella ab oriente ardens usque ad mensem Septembrem.

*The Sun eclipsed at the third hour of the morning of July 19th and a comet, which appeared in the east, remained visible until September.*

Prosper Aquitanus, *Chronicon Alterum sive Pseudochronicon*, col. 862

[418-419] XXVII. [year of Honorius' empire] Signum in coelo mirabile apparuit.

Marcellinus Comes, *Chronicon*, p. 74

Stella ab Oriente per septem menses surgens ardensque apparuit.

*A star appeared, rising up from the east, and it remained bright for seven months.*

*Excerpta Sangallensia*, p. 300

[418] sol eclipsim fecit XIII kl. Aug. et a parte Orientis apparuit stella ardens per dies XXX.

*The Sun eclipsed on July 19th and, from the east, a star shone for 30 days.*

De Rossi G.B., *Excerptum ex chronica Horosii*, p. 19

(an. 418) Honorio XII et Theodosio VIII cons. Sol eclipsim fecit XIII Kl. Aug. Et a parte Orientis apparuit stella ardens per dies XXX.

*At the time of the consuls Honorio and Theodosius there was an eclipse of the sun on July 19th. And from the eastern part, a star appeared and shone for 30 days.*

Herimannus Augiensis, *Chronicon*, p. 81

Eclipsis solis 14 Kal Augusti facta, et cometa habinc usque ad mensem Septembrem visa.

*Annales Chronographi Vetusti*, p. 716

Sol defecit hora III, 14 Kal. Ag[usta]s, et apparuit stella ab oriente ardens usque ad Septembrem.

*Annales Mellicenses*, p. 490

Eclipsis solis facta est 14 Kal Augusti et cometa usque ad mensem Septembris visa est.

*Annales Lundenses*, p. 191

Hoc pascha sub papa Zozyimo. Sol defecit hora tertia 14 Kal. Augusti, et apparuit stella ardens ab oriente usque Kal. Septembris.

*Annales Blandinienses*, p. 3

Sol defecit hora tertia, XIV kal. Augusti, et apparuit stella ab oriente ardens usque ad mensem Septembrem.

Conradus Lycosthenes, *Prodigiorum ac Ostentorum Chronicon*, p. 291

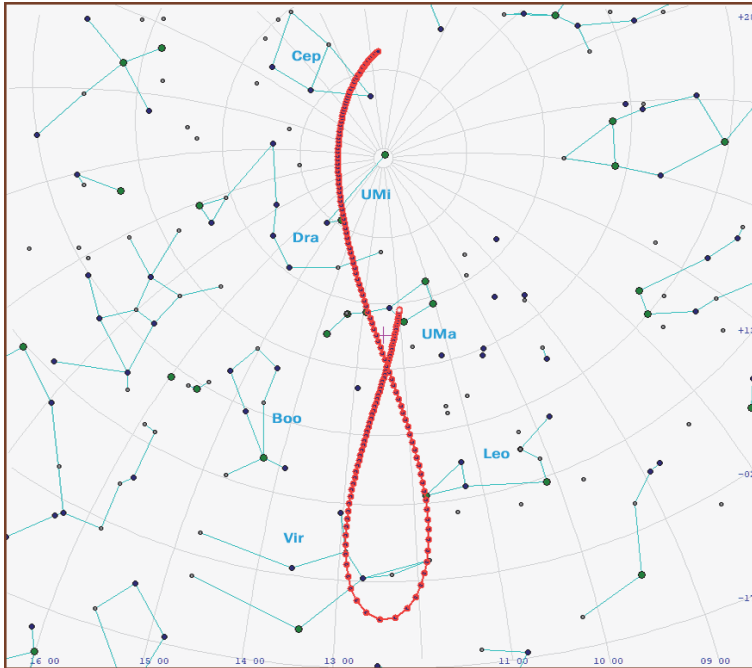
Cometa usque ad mensem septembrem visus est.

Signonius Carolus, *Historiarum de Occidentali Imperio*, Lib. XI, p. 296

XV Kal. Augusti Sol insigniter obscuratus apparuit. Inde per Septembrem mensem stella crinita ab Oriente refulsit.

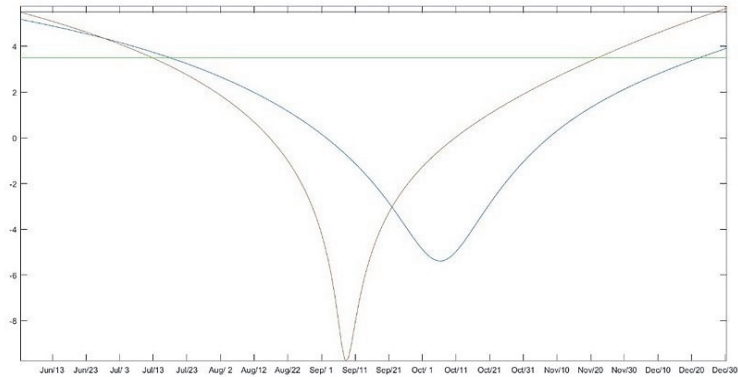
Orbital elements (eq. J2000.0); **L** is the ecliptic longitude and **B** the latitude of the perihelion:

T (UT)	q	e	$\omega$	$\Omega$	i	L	B	Author
418 Oct 5	0.35	1.0	240°	310°	110°			Kronk (1999: 76)
418 Sep 8	0.104	1.0	253	66	75	296°	-68°	Sicoli (in Martínez et al. 2022: 3)

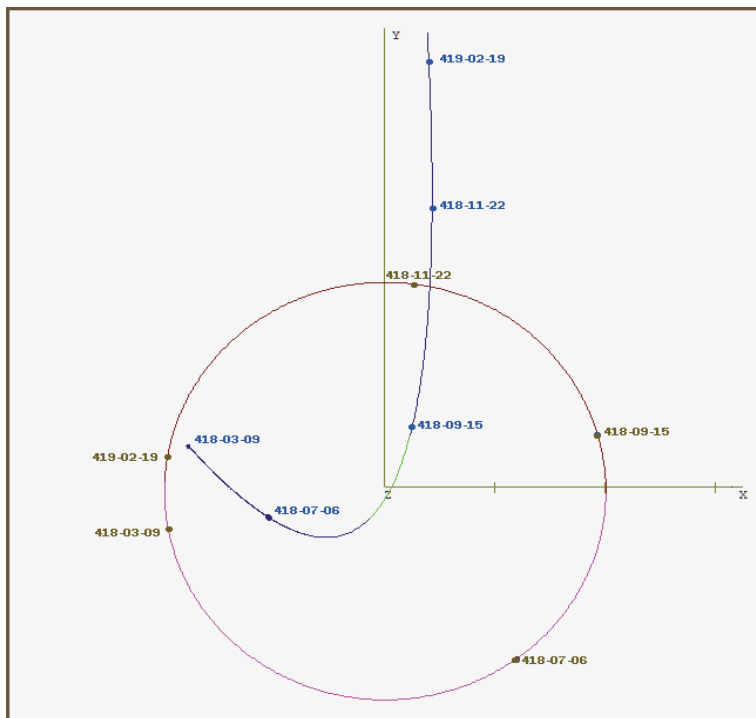


**Fig. 5** - Path of comet C/418 M1 from 6 July (blank circle) to 29 December, 418 AD [step 1 day] from Sicoli's orbit.

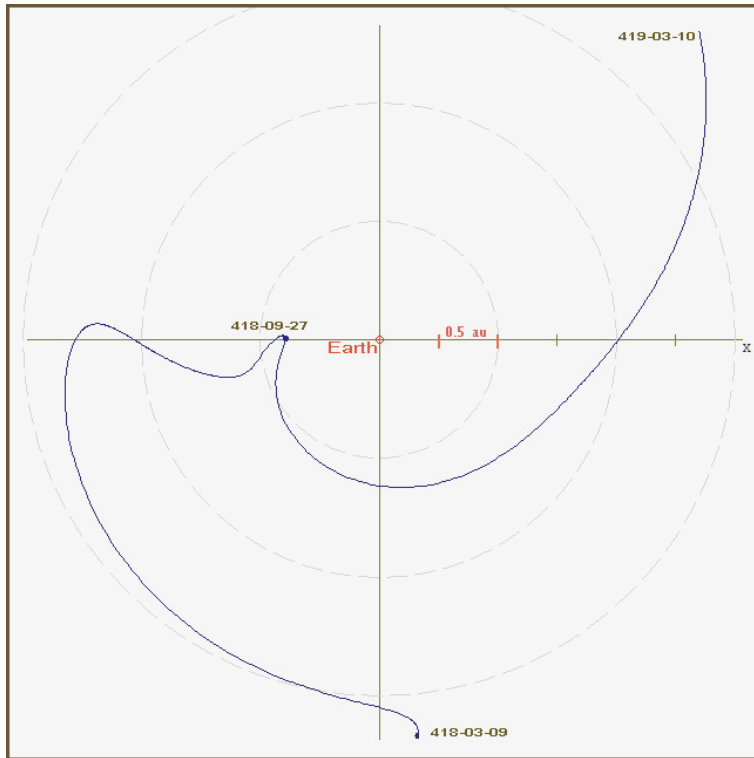
The comet was within  $20^\circ$  of the Sun from 28 August to 15 September, reaching a minimum solar elongation of  $6^\circ$  on 7 September. The most northern declination was  $+81^\circ$ , on 15 November and the lowest southern was  $-9^\circ$  on 8 September. Closest to the Earth: 27 September (0.794 au).



**Fig. 6** – Estimated visual magnitude of comet C/418 M1. Light curve are derived from the orbit calculated by Kronk (blue), absolute magnitude  $H_{10} = -0.79$  and Sicoli (grey), absolute magnitude  $H_{10} = 0.06$ . Scattering has been included. The green line represents visual magnitude 3.5



**Fig. 7** - Path of the comet C/418 M1 and the Earth on the X-Y plane from 9 March 418 to 10 March 419 AD, according to Sicoli's orbit. Brown and blue colors represent the orbital path north of the ecliptic. Pink and green the south.



**Fig. 8** - Path of the comet C/418 M1 in a planetocentric system so that the Earth position remains fixed.

## 422 X/422 F1

A comet was observed in China in the month of March [Williams 1871: 32; I: 1962, 162; Kronk 1999: 77, Pankenier et al. 2008: 56]. The *Chronicon Paschale* (7th century) reports the observation of a comet, with a very long white tail, in the *Dystro* month (March Lunation), while Michael the Syrian (d. 1199) includes it among the premonitions announcing an imminent end of the world. This scholar does not specify any date for the comet however, he places it after the end of the war between Rome and the Sassanids (422) and before the earthquake in southwestern Anatolia on 7 April 431 AD.

Over time there has been a certain debate between different authors about whether the comet mentioned in the *Chronicon Paschale* in 422 and the one seen in China and Europe in February-March 423 are, in fact, a single comet. Although it is true that the descriptions of both comets are indeed similar, considering them as a single one would mean imputing a big mistake to this source, which is only two centuries posterior to the event and which has proven reliable in most cases. Hence we are for the existence of two different comets. Due to the limited information available, no author had so far attempted to obtain orbital elements for this comet. However, from all available data, a possible orbit that fits the recorded positions has been recently calculated (see details and the whole discussion in Martínez et al. 2022: 4-5).

Eastern sources: Williams (1871: 32), Ho (1962: 162), Pankenier et al. (2008: 56-57)			
Source	Dates	Positions	Reference to Coordinates of LM determinative stars (J2000) and approximate western asterisms
Song shu (c. 490)	Mar 26	Xu [LM11] Wei [LM12] Tianjin Hegu	$\beta$ Aqr, $\alpha = 21^{\text{h}} 31^{\text{m}} 33^{\text{s}}$ $\alpha$ Aqr, $\alpha = 22^{\text{h}} 05^{\text{m}} 47^{\text{s}}$ $\delta, \gamma, \epsilon$ Cyg $\alpha$ Aql
Wei shu (c. 554)	Mar 16	Xu [LM11] Wei [LM12] Tianjin	$\beta$ Aqr, $\alpha = 21^{\text{h}} 31^{\text{m}} 33^{\text{s}}$ $\alpha$ Aqr, $\alpha = 22^{\text{h}} 05^{\text{m}} 47^{\text{s}}$ $\delta, \gamma, \epsilon$ Cyg
Nan shi (c. 659)	Mar 21	Xu [LM11] Wei [LM12]	$\beta$ Aqr, $\alpha = 21^{\text{h}} 31^{\text{m}} 33^{\text{s}}$ $\alpha$ Aqr, $\alpha = 22^{\text{h}} 05^{\text{m}} 47^{\text{s}}$
The exact period of visibility of this comet is unknown since three different sources provide non-matching dates of its appearance: 16 March in <i>Wei shu</i> , 21 March in <i>Nan shi</i> and 26 March in <i>Song shu</i> . However, it is assumed that the comet was seen at least from the first to the last date, i.e., 10 days. All the sources coincide that it was first seen in Xu [LM11] and Wei [LM12], implying a morning comet.			



*Chronicon Paschale*, p. 580

Ἐπι τούτων τῶν ὑπάτων ἐφμην ἐν τῷ οὐρανῷ ἀστήρ πέμπων ἀχτίνα λευκὴν μὴνὶ δύστρω ὡς ἐπὶ νίχτας ἰ μετρμ μλεχτρούνα χαί αὐτῷ τῷ ἔτει ἐγένετο σεισμός.

*In the month of Dystrus [March], in the early hours of the morning, a star with a very long white tail appeared in the sky for about 10 nights. In the same year there was also an earthquake.*

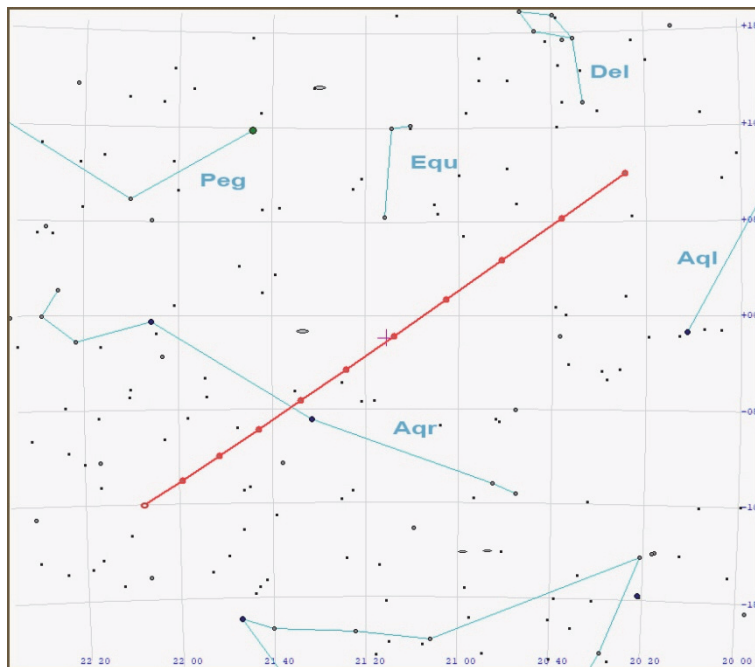
Michel Syrien, *Chronique*, Lib. VIII, Cap. V, p. 22

Une comète apparut. Il y eut de grandes sauterelles, et des perturbations en tous lieux. Beaucoup disaient que la fin du monde approchait, à cause des signes qui se multipliaient. [transl. from Syriac, Chabot (1901)].

*A comet has appeared. There were big grasshoppers, and movements (earthquakes?) in every place. Many said that the end of the world was approaching because of a multitude of omens.*

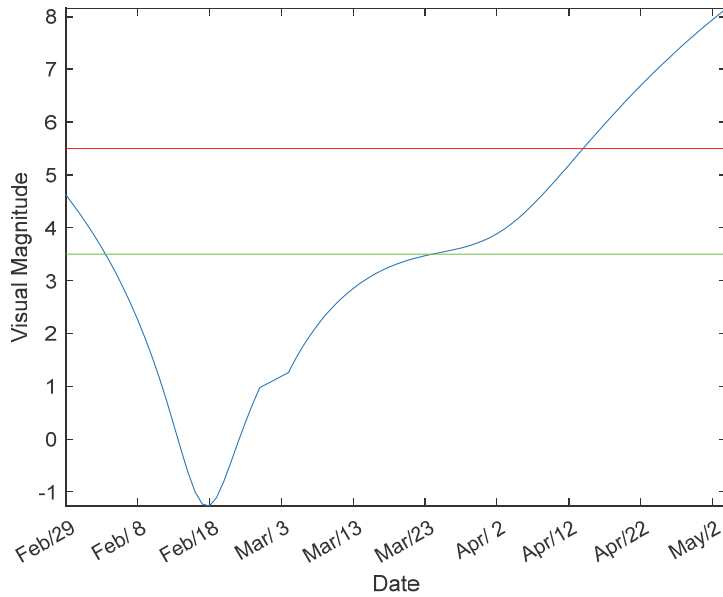
Orbital elements (eq. J2000.0); **L** is the ecliptic longitude and **B** the latitude of the perihelion:

T (UT)	q	e	$\omega$	$\Omega$	i	L	B	Author
422 Feb. 20.5	0.18	1.0	239°	227°	99°	32°	-58°	Martínez (in Martínez et al. 2022 : 4)



**Fig. 9** - Path of comet X/422 F1 from 16 March (blank circle) to March. 26, 422 [step 1 day], from Martínez's orbit.

The comet was within  $20^\circ$  of the Sun from 10 to 28 February, reaching a minimum solar elongation of  $8^\circ$  on 18 February. The most northern declination was  $+34^\circ$  on 14 April and the lowest southern was  $-17^\circ$  on 2 March. Closest to the Earth 30 March (0.322 au).



**Fig. 10** - Estimated visual magnitude of comet X/422 F1. Light curve is derived from the orbit calculated by Martínez, with a standard magnitude of  $H_{10} = 6$

## 423

The comet that preceded the death of Emperor Honorius in August 423 AD could be the same observed in the East in February [Williams 1871: 32; Ho: 1962, 162; Kronk 1999: 78]. Hasegawa [1979: 265] suggested that it might be a member of the *sungrazing* family. The main reason for this assumption is the fact that its description matches several characteristics that would point to its membership of Kreutz-Sungrazing comets (KS henceforth) [Hasegawa and Nakano 2001: 932; England 2002: 16]. As regards the tail length, since KS comets pass very close to the Sun, the intense sunlight makes their nuclei very active, so these comets produce a long, impressive tail such as the one reported in the Eastern chronicles. The comet may have reached such a magnitude that it could be visible, with the naked eye, close to the perihelion time, even in daylight [Schaefer: 1993, 311-361]. Also, the observation period corresponds to a KS, whose most favorable appearances occur for those comets that reach perihelion between January and early May. The date of the perihelion was therefore determined by considering that the comet was seen for 20 days in China. It was also speculated that it was related to the comet appeared in 1106 AD, today known as X/1106 C1 [Sekanina and Chodas 2007: 672-675; Sekanina 2021: 672]. This object, whose original nuclei would have separated into two superfragments with similar orbits, would have originated different families of KS comets. [Sekanina and Chodas 2004: 620-639]. From this paper, we have chosen the data corresponding to the Superfragment II, because they fit the observations slightly better. If we consider this possibility, the orbital elements obtained by numerical integration could correspond to that we have called *Solution A*.

However, reality seems to indicate that the comet of 423 would not be the parent comet referred to [Sekanina: 2021: 11]. The authors of this book have gone further by assuming that, in fact, it is not even a sungrazer comet thereby proposing an alternative orbit, namely *Solution B* (Martínez et al. 2022: 5-8). In addition, to complicate the picture, another comet had been observed, in China, in December of the previous year suggesting the possibility of a single comet, with visibility from December 422 to February 423. Since all attempts to link observations covering the entire observational period have failed, the authors suspect that the existence of two distinct comets may be the most plausible. In this case, the first would have gone unnoticed in Europe. Marcellinus (died c. 534), the oldest Western source, does not give a precise date, but it is reasonable to assume that, in his chronicle, he refers to the brighter comet of February 423. However, it cannot be ruled out *a priori* that the term "star saepe ardente crinita" does not intend to recall both instead. Other European sources are much later in date. Sigonius' *Historiarum de Occidentali Imperio Historiarum* was published in 1579 and Goutoulas' *Universa Historia Profana* is an even later source. This latter scholar, in his work written in the 17th century, refers to

Cassiodorus, a source the authors have not found, leading them to suspect that he was confused with Marcellinus.

Eastern sources: Williams (1871: 32), Ho (1962: 162), Pankenier et al. (2008: 57-58)			
Source	Dates	Positions	Reference to Coordinates of LM determinative stars (J2000) and approximate western asterisms
Song shu (c. 490)	Dec 18 (422) Feb 13 (423)	Yingshi [LM13] Dongbi [LM14] (south) Dongbi [LM14] Tianyuan	$\alpha$ Peg, $\alpha = 23^{\text{h}} 04^{\text{m}} 45^{\text{s}}$ $\gamma$ Peg, $\alpha = 00^{\text{h}} 13^{\text{m}} 14^{\text{s}}$ $\gamma$ Peg, $\alpha = 00^{\text{h}} 13^{\text{m}} 14^{\text{s}}$ $\gamma$ Eri
Wei shu (c. 554)	Dec 14 (422)  (between) Jan 28–Feb 25 (423)	Yingshi [LM13] Beidou Ziwei (south) Kui [LM15] Hé	$\alpha$ Peg, $\alpha = 23^{\text{h}} 04^{\text{m}} 45^{\text{s}}$ UMa $\kappa$ Dra $\zeta$ And, $\alpha = 00^{\text{h}} 47^{\text{m}} 20^{\text{s}}$ Milky Way
Nan shi (c. 659)	Dec 18 (422) Feb 13 (423)	Yingshi [LM13] Dongbi [LM14]	$\alpha$ Peg, $\alpha = 23^{\text{h}} 04^{\text{m}} 45^{\text{s}}$ $\gamma$ Peg, $\alpha = 00^{\text{h}} 13^{\text{m}} 14^{\text{s}}$
The <i>Song shu</i> and <i>Nan shi</i> date the appearance of a comet on 18 December 422, <i>Wei shu</i> and later <i>Wên Hsien Thung Khao</i> (1317) on 14 December 422. All these sources report another possible comet in <i>Dongbi</i> [LM14] and <i>Kui</i> [LM15] in the first lunar month of the following year which according to <i>Song shu</i> disappeared after 20 days.			

Marcellinus Comes, *Chronicon*, p. 76

Stella saepe ardente crinita Honorius imperator fatale munus implevit.

*After a comet ignited at certain times, Emperor Honorius met his fatal fate.*

Sigonius Carolus, *Historiarum de Occidentali Imperio*, Lib. XI, p. 299

XVIII Kal. Septembris eo consumptus interiit eius mortem [*Flavio Onorio (384-423)*] crinita stella per multo fulgens dies praecessit.

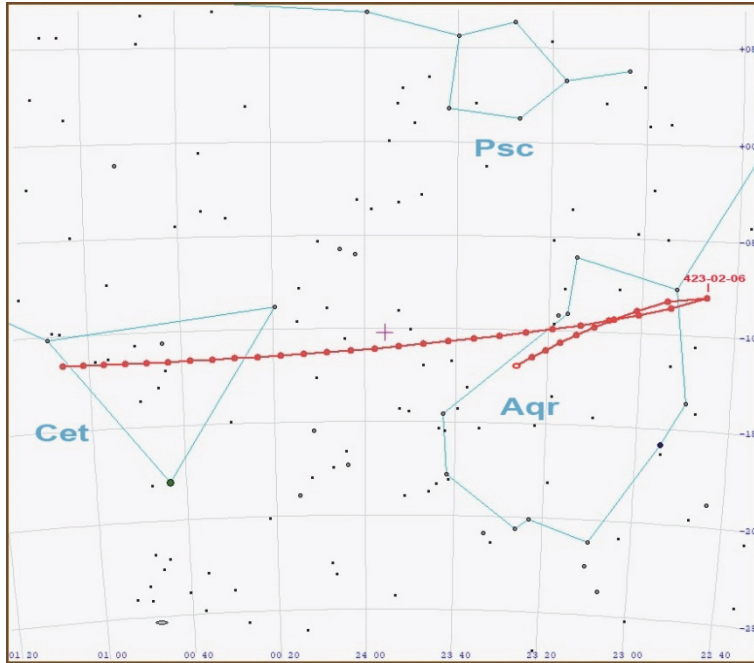
Goutoulas Jacobus, *Universa Historia Profana*, pars I, p. 512-513

Stella crinita Honorij Principis mortem portendens apparuit, anno Christi quadringentesimo vicesimo tertio *ut refert Cassiodorus*.

(According to Cassiodorus) *A tailed star appeared in the year 423 forecasting the Emperor Onorius' death.*

Orbital elements (eq. J2000.0), **Solution A**

T (UT)	q	e	$\omega$	$\Omega$	i	Author
423 Feb 6	0.0054	0.999	81.53°	1.91°	144.12°	See text

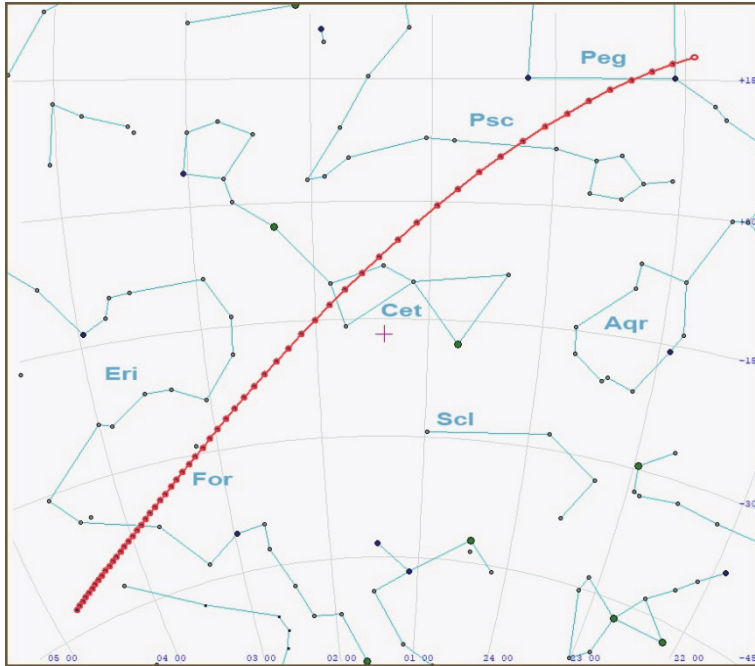


**Fig. 11 – Solution A.** Path of the comet from 3 February (blank circle) to 15 February 423 AD [step 8 hours], derived from the above orbit.

Orbital elements (eq. J2000.0), **Solution B**; **L** is the ecliptic longitude and **B** the latitude of the perihelion:

T (UT)	q	e	$\omega$	$\Omega$	i	L	B	Source
423 Feb 3.5	0.47	1.0	149°	315°	71°	124	+29	Martínez (in Martínez et al. 2022 : 4)

If this was the case, the comet would have reached a minimum solar elongation of  $\sim 24^\circ$  on 7 February) and the most northern declination  $+19^\circ$  on 26 January. It was closest to the Earth on 13 February (0.602 au).



**Fig. 12 - Solution B.** Path of the comet from 3 February (blank circle) to 15 February 423 AD [step 1 day], derived from the above orbit.

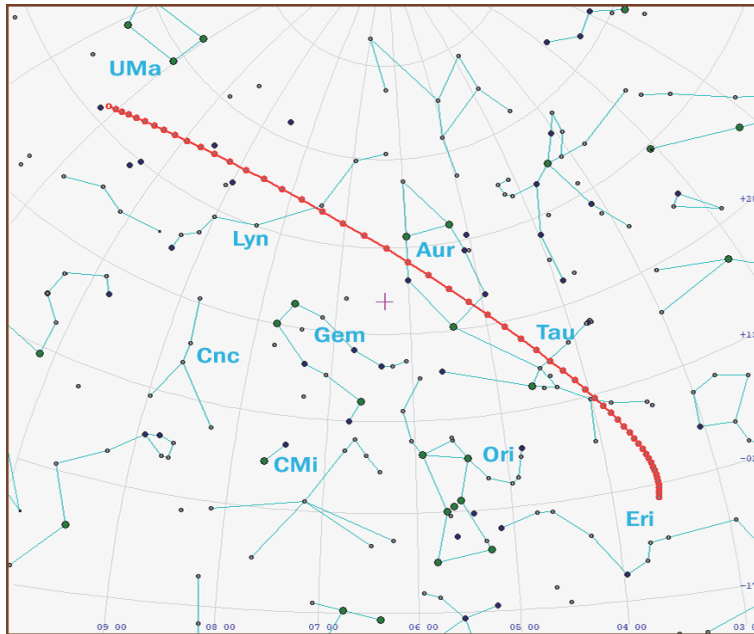
## 442 X/442 V1

Hydatius, (*fl.* 5th century) foresaw a great plague that would soon rage everywhere, in the appearance of a comet, in the winter of year 442. In more recent times, we find this interpretation again, in the same terms, in the *Anales del Reyno de Galicia* while Theodorus monachus, author of the *Annales Palidenses*, composed in the last twenty years of the 12th century, links the comet to an unidentified solar eclipse. Hydatius reports, a day apart, the total eclipse dated 23 December 447: «Solis facta defectio die IX kal. jan. qui fuit III feria» but not the annular eclipse on 17 March 443 that was closer to the date of appearance of the comet. Curiously, another eclipse, the third in just 30 years, occurred on 19 July 418, had affected the same geographical area, the current Chavez in Portugal, home of the episcopate of Hydatius. Marcellinus also mentions the comet of 442 in his *Chronicon* and the Irish monks of Inisfallen Abbey have probably drawn the news from this work [Mc Carthy and Breen 1997: 121]. The "star with hair", described by him, would remain visible in the sky for a long time, precisely in the year during which Attila and his brother Bleda, leading the Huns, put Illyria and Thrace, in eastern Europe, to fire and sword.

The Chinese chronicles estimate the duration of the comet, between November 442 and February 443, as over one hundred days [Ho 1962: 163; Kronk 1999: 79-80; Pankenier et al. 2008: 59]. Apparently, at first seen as a "guest star", it became a "broom star" (comet) when it entered the Ursa Major, as also reported by Biot [1843: 64]: «un étoile extraordinaire se montra dans le *Pe-teou* (le sept principales de la grande Ourse) elle se transforma en comète». An orbit, quite similar to that already published last century by Hasegawa (1979: 260), was derived. In any case, due to the uncertainty of the available data, these results must be interpreted with great caution. Its brightness in particular deserves some consideration. Kronk (1999: 80), evaluated, at the time of its discovery, a visual magnitude of 4, obtaining an absolute magnitude of 1.5. Considering the same conditions, at first we estimated a value close to zero, but after examining the historical context, a negative value of  $H_{10} = -1$  seemed to us more compatible with the observational period of the comet (Martínez et al. 2022: 17).

Eastern sources: Williams (1871: 32), Ho (1962: 163), Pankenier et al. (2008: 59)			
Source	Dates	Positions	Reference to Coordinates of LM determinative stars (J2000) and approximate Western asterisms
Song shu (c. 490)	(between) Oct 20-Nov 18	Beidou Tianyuan	UMa $\gamma$ Eri
Wei shu (c. 554)	Nov 10	Tianlao Wenchang Wuche (between)Mao [LM 18] and Bi [LM19] Tianyuan	44 UMa (or $\omega$ UMa ) $\theta$ UMa $\iota$ Aur 17 Tau, $\alpha = 3\text{h } 44\text{m } 52\text{s}$ $\varepsilon$ Tau, $\alpha = 4\text{h } 28\text{m } 37\text{s}$ $\gamma$ Eri
Nan shi (c. 659)	Nov 1	Beidou Wenchang Wuche Bi [LM19] TianJie Tianyuan	UMa $\theta$ UMa $\iota$ Aur $\varepsilon$ Tau $\alpha = 4\text{h } 28\text{m } 52\text{s}$ k Tau $\gamma$ Eri
<p>The comet was first seen sometime from 20 October 20 to 18 November in Ursa Major. Depending on the source: No specific date in <i>Song shu</i>, 1 November in <i>Nan shi</i>, 10 November in <i>Wei shu</i>. The <i>Wei shu</i> provides a duration of 100 days and specifies that it passed between <i>Mao</i> [LM 18] and <i>Bi</i> [LM19], whereas <i>Nan shi</i> says it disappeared the last month of winter. Combining the data, a duration of 100 days would have brought the comet's visibility to mid-February, near the beginning of the second month (15 February 15- 16 March), very close to the spring equinox.</p>			





**Fig. 13** - Path of comet X/442 V1 from 1 November 442 (blank circle) to 17 February 443 AD [step 2 days], from Sicoli's orbit.

Hydatius, *Chronicon*, p. 81-82

Cometae sidus apparere incipit mense decembri, quod per menses aliquot visum subsequentis in pestilentia plagae, quae fere in toto orbe diffusa est, praemisit ostentum.

*A comet that began to appear in December remained visible for several months. It was an omen of a plague that spread everywhere.*

Marcellinus Comes, *Chronicon*, p. 80

Stella quae crinita dicitur per plurimum tempus ardens apparuit.

*A star they call haired has been shining for some time.*

*Annales Palidenses*, p. 53

Comete, solis defectio.

*comet and eclipse of the sun.*

*Annales Inisfalenses*, p. 2

[443] An. Cccc xl iii. Kl.iv.l. Stella crinita apparuit.

*A haired star appeared.*

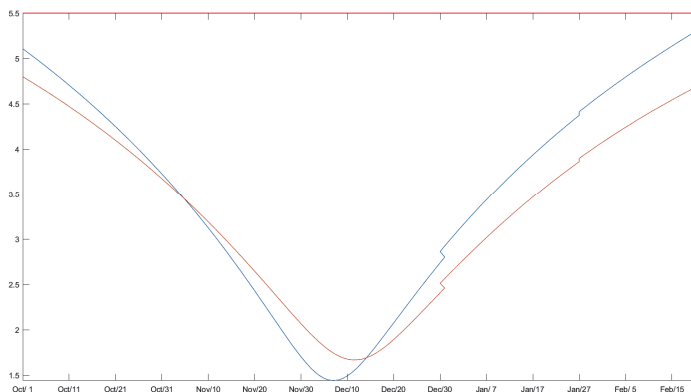
*Anales del Reyno de Galicia*, p. 319

[444]. En el año quatrocientos y quarenta y quatro. se viò en Galicia un Cometa por el mes de Diciembre, siguiose á èl una peste universal, que corriò por todo el Orbe: de el mesmo hace memoria el Conde Marcelino.

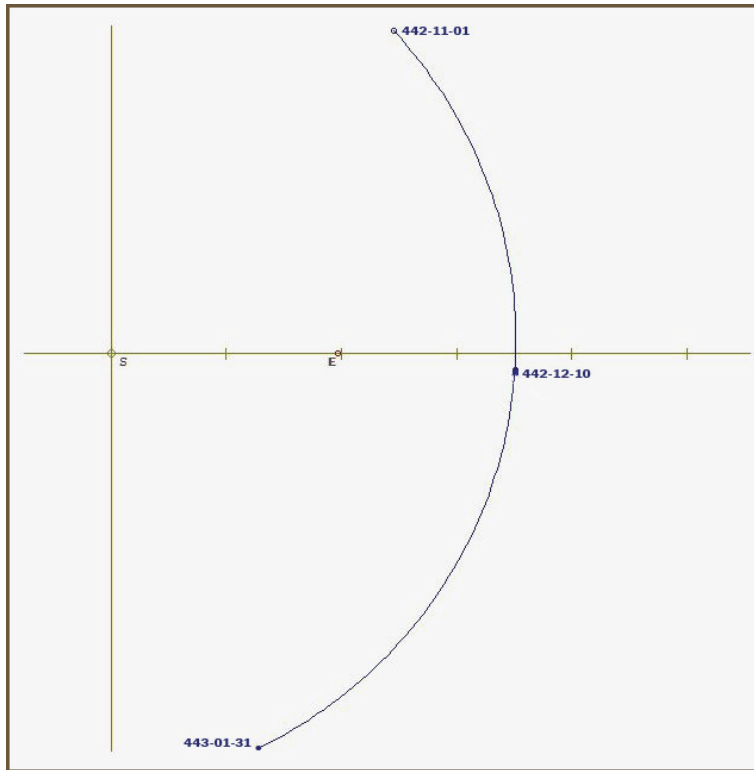
*In the year four hundred and forty-four, a comet was seen in Galicia in the month of December, followed by a universal plague, which ran through the whole world: the same thing, Count Marcellinus recalls.*

Orbital elements (eq. J2000.0); **L** is the ecliptic longitude and **B** the latitude of the perihelion:

T (UT)	q	e	$\omega$	$\Omega$	i	L	B	Author
442 Dec 15	1.53	1.0	178°	278°	106°			Hasegawa (1979: 260)
442 Dec 21	1.75	1.0	176	274	117	96°	+ 4°	Sicoli (in Martínez et al. 2022: 3)



**Fig. 14** – Estimated visual magnitude of comet C/442 V1. Light curves are derived from the orbital elements calculated by Hasegawa (blue), absolute magnitude  $H_{10} = 0.86$  and Sicoli (red), absolute magnitude  $H_{10} = - 0.12$ . These values have been calculated so that the comet had a visual magnitude of 3.5 on the day of its first detection.



**Fig. 15** – Comet C/442 V1 from 1 Nov. 442 to 31 Jan. 443 in a rotating reference frame according to Sicoli's orbit (S=Sun, E=Earth).

## 451 1P/451 L1 (*Halley*)

Around the middle of the fifth century, the Western Roman Empire, weakened by the continuous barbarian incursions, was slowly but inexorably sliding towards its irreversible destiny, which culminated, as it is well known, on 4 September 476, with the deposition of Romulus Augustus. On 20 June 451, Attila was stopped by Flavio Ezio in the battle of the Catalaunian Fields. Still the victory would have been only a brief pause before the invasion of Italy by the king of the Huns the following year. During its unique passage around the Sun of this century, Halley's comet transited in those days at the minimum distance from our star (0.57 au, on 28 June 451), reaching magnitude -3, its brightness peak, in Auriga. The computer reconstruction shows that around that date, in the northern mid-latitudes during the short summer nights, the comet was clearly visible toward north-east in the morning, before dawn, and toward the north-west, in the evening, after sunset. On 30 June, two days after reaching the minimum distance from the Sun, the comet moved to the minimum distance to the Earth, at about 73 million km. According to Hydatius' testimony, it had begun to be seen, before dawn, on 18 June and so up to 29 of the same month. Later its visibility had become evening until 1 August. It is interesting to remark that the interpretation made in the *Anales del Reyno de Galicia* of the *Chronicle of Hydatius* when stating that, between 29 July and 1 August, the comet was seen at the same time at sunrise and sunset as it actually happened.

In some sources, such as *Lib. Pontiff.*, the date of the comet's passage is not given, but this was related to the death of Galla Placidia (392-393-Nov. 450). Speaking of bad omens that occurred at that time, Isidore of Seville (c. 590-636) reports of frequent earthquakes, a large comet observed towards the west, strange bright rods seen in the northern sky, and a lunar eclipse. Precisely this last astronomical event, which happened on 26 September 451, allowed the other described phenomena to be dated with good approximation. It is not clear, however, whether the prodigy of the "*lineis clarioribus*" refers to the comet itself or whether it should be linked to northern lights that occurred in another period. In the *Liber Chronicarum*, of which we have reproduced only the paragraph referring to the comet, many mixed events appear, which did not necessarily occur according to the chronology reported by Hartmann Schedel (1440-1514). Thus, the mentioned Constantinople earthquake could be the one of 487 AD, although this data is not certain.

To identify the comet with Halley's passage, in the year 451, instead we focused on the mention of the lunar eclipse and, continuing with the paragraph, the reference to the Monophysitism heresy after the Council of Chalcedon (year 451). In the east, the comet was first sighted on 10 June [Kronk 1999: 81], rather than 17 May, as initially reported [Williams 1871: 33; Ho 1962: 163]. After crossing the constellations of Taurus, Perseus, Auriga, Lince, Leo Minor and Leo, it then moved towards the sky area occupied by the constellations of Virgo and Corvus, disappearing from the view after the

mid-August. The French astronomer Paul Auguste Ernest Laugier (1812-1872), using both the European and the Eastern chronicles, was the first to suggest identification with comet Halley [Laugier 1846b: 187-188], even without calculating the orbit by himself.

Eastern sources: Williams (1871: 33), Ho (1962: 163), Pankenier et al. (2008: 60)			
Source	Dates	Positions	Reference to Coordinates of LM determinative stars (J2000) and Western asterisms
Song shu (c. 490)	(between) Jun 15-Jul 14	Juanshe Taiwei Wu Dizuo Shangxiang Neiping (Ping) Tianmen Yi [LM 27] Zhen [LM28]	$\nu$ , $\epsilon$ , $\xi$ , $\zeta$ , $\omicron$ , and 40 Per $\beta$ Vir $\beta$ Leo $\gamma$ Vir, $\sigma$ Leo (or $\delta$ Leo) Virgo (or $\xi$ Vir) 53 Vir (or between $\beta$ and $\eta$ Vir) $\alpha$ Ctr, $\alpha = 10\text{h } 59\text{m } 46\text{s}$ $\gamma$ Crv, $\alpha = 12\text{h } 15\text{m } 48\text{s}$
Wei shu (c. 554)	(between) Jun 7-Jul 7 (449)* (between) Jun15-Jul 14 (451) Jul 22 Aug 15	(North) Mao [LM 18]  Juanshe Taiwei Wu Dizuo Shangxiang Ping (Hsing) Tianmen Yi [LM27] Zhen [LM28]	17 Tau, $\alpha = 3\text{h } 44\text{m } 52\text{s}$  $\nu$ , $\epsilon$ , $\xi$ , $\zeta$ , $\omicron$ , and 40 Per $\beta$ Vir $\beta$ Leo $\gamma$ Vir, $\sigma$ Leo (or $\delta$ Leo) Virgo (or $\xi$ Vir) 53 Vir (or between $\beta$ and $\eta$ Vir) $\alpha$ Ctr, $\alpha = 10\text{h } 59\text{m } 46\text{s}$ $\gamma$ Crv, $\alpha = 12\text{h } 15\text{m } 48\text{s}$
Nan shi (c. 659)	Jun 10 Jul 13	Mao [LM 18] Taiwei Wu Dizuo	17 Tau, $\alpha = 3\text{h } 44\text{m } 52\text{s}$ $\beta$ Vir $\beta$ Leo
*Probably this isolated record from <i>Wei shu</i> (with wrong year) also refers to Halley's comet. Hence, the mentioned fifth month of 451 would be from 15 June to 14 July. In this case, according to <i>Nan shi</i> , the comet should be first observed around 10 June north of the Pleiades. Finally, it vanished between <i>Yi</i> [LM27] and <i>Zhen</i> [LM 28].			

Hydatius, *Chronicon*, p. 91

Multa eo anno signa praecedunt. Quinto Kal. Octobr. à parte Orientis luna fuscatur. In diebus sequentis Paschae visa quaedam in coelo in regionibus Galliarum epistola de his Eufronij Augustodunensis Episcopi ad Agrippinum Comitem facta evidenter ostendit. Stella cometes a XIV kal. jul. apparere incipit, quae III kal. diluculo ab Oriente visa post occasum solis ab occidua parte mox cernitur; kal. Augusti a parte Occidentis apparet.

*Many signs appeared this year. On the fifth day before Kalends of October [Sept. 26th] the moon dimmed in the eastern sky. In the days following Easter, in the regions of Gaul, they saw some things in the sky as it is evident from a letter of Euphronius, bishop of Augustodunum [now Autun, France] to Comes Agrippinus. A comet began to appear from the fourteenth day before Kalends of July [June 18th]. Three days before Kalends (of July) [June 29th] it was seen, at the first light of dawn, in the eastern sky then later it was visible after sunset in the western region. On the kalends of August [Aug. 1st] it was sighted in the west.*

Prosper Aquitanus, *Chronicon Alterum sive Pseudochronicon*, col. 864

[451-452] II. Plurima hoc anno signa apparuerunt.

[Second year of Marcian's empire] *many signs have appeared.*

Isidorus Hispalensis, *Historia Gothorum, Wandalorum et Suevorum*, p. 28

Multa eodem tempore caeli et terrae signa praecesserunt, quorum prodigiis tam crudele bellum significaretur. Nam assiduis terrae motibus factis a parte orientis Luna fuscata est: a solis occasu stella cometes apparuit atque ingenti magnitudine aliquandiu fulsit. Ab Aquilonis plaga caelum rubens sicut ignis aut sanguis effectus est permistis per igneum ruborem lineis clarioribus in specie hastarum rutilantium deformatis.

*At the same time many signs appeared, in heaven and on earth, announcing the outbreak of a terrible war. There have been several earthquakes, to the east the Moon has darkened while to the west a comet of great splendor, that shone for some time, has appeared. In the north the sky became as hot as fire or blood and, mixed with that fiery blush, there were lines in the shape of shimmering rods.*

## Fasti Vindobonenses Post., p. 301

Stella apparuit ardens in caelo per dies XXX.

*A star shining in the sky for 30 days.*

*Chronicon Paschale*, p. 589

Τινὲς δὲ ἔλεγον χαί πυρ ἐν τῷ οὐρανὸν τεθεμισθαί.

*Someone said they saw a fire in the sky.*

De Rossi G.B., *Excerptum ex chronica Horosii*, p. 20

(an. 451) Marciano et Adelfio cons. Stella apparuit in coelo per dies XXX.

*In the year 451, at the time of the consuls Marcian and Adelfius, a star appeared in the sky for 30 days.*

Agnellus Ravennatis, *Liber Pontificalis*, p. 68

Apparuit post haec Stella in Coelo ardens per dies XXX., & capta, & fracta Aquileja ab Hunnis.

*Then a star shone for 30 days and Aquileia was conquered and destroyed by the Huns.*

*Historia Pseudo-Isidoriana*, p. 384

Eo tempore prodigia et signa magna erant in terra et terre motus et luna passa est eclipsin. Visa est in septentrione albedo magna cum rubedine designans magnam sanguinis effusionem super terram; et comete caudatus in occidente visus est. Quando nutu dei apparet in celo cometa, tria docet vel designat ventura, sicut antiqui experti sunt: intimat itaque mortalitate regum, destructionem regionum, famem validam super terram incumbentem.

Sigebertus Gemblacensis, *Chronicon ab anno 381 ad 1113*, p. 14v

[452] Terræmotus pene assidui, & signa plurima in cælo ostenduntur. Vespere ab aquilone coelum efficitur rubens ut ignis, intermixtis per igneum ruborem clarioribus lineis: in hastarum speciem deformatis, Luna obfuscat, cometes apparet, & multa alia quae non esse ociosa, ostendit instans rerum consequentia.

Antoninus Florentinus archiepiscopus, *Chronicorum*, pars II, p. 167

Anno autem praecedenti signa multa acciderunt. Nam terraemotus assidui, & signa plurima de coelo ostenduntur, vespere ab Aquilone coelum rubrum efficitur ut ignis, intermixtis per igneum ruborem clarioribus lineis in hanc speciem deformatis. Luna obscuratur, Cometes apparet, & multa alia quae non esse otiosa ostendit instans rerum consequentia.

Buzelinus Iohannes, *Annales Gallo-Flandriae*, pp. 21-22

Sub vesperum die quodam ad Boreae plagam, caelum multo igne conspicuum stetit: solum intermicabant lineae quaedam maiori lumine, hastarum similitudinem deformantes. Luna semel defecit. Ingentibus cometa crinibus horrorem incussit.

Trithemius Iohannes, *Compendium sive Breviarium primi voluminis annalium sive historiarum de origine regum et gentis Francorum*, p. 67

Eclipsin luna patitur, cometes horrendae magnitudinis apparuit, & alia multa sunt visa prodigia quae non fuisse penitus ociosa declarant, mala subsequuta.

Palmerius Matthaeus, *Liber de Temporibus*, p. 49

[453] Terremotus assidui, cometae et signa varia apparuerunt in caelo. Attila, post longam obsidionem capta Aquilegia, Vicentiam, Veronam, Mediolanum atque Ticinium pari terrore pervadit et multa opidanorum cede diripit.

*There were continuous earthquakes, a comet and several signs appeared in the sky. Attila, after a long siege conquered Aquileia, Vicenza and Verona spreading terror up to Pavia and many inhabitants who surrendered were plundered.*

Conradus Lycosthenes, *Prodigiorum ac Ostentorum Chronicon*, p. 293

[448] Cometa assidue multis diebus micante, in oriente terremotus factus est.

*A comet was seen shining for several days, and an earthquake occurred in the east.*

Bonfinius Antonius, *Rerum Hungaricarum decades*, p. 93

[454] Et quum superiore anno terraemotus assidui, & cometae fuerint, item multa loca de coelo tacta, variaque portenta, expiendam urbem decrevere, praeterea delectum per Italiam passim habendum, & ingentes copiarum apparatus.

Schedel H., *Liber Chronicarum*, fol. CXXI verso

Terraemotus maximus constantinopolim per quattuor menses continuos hisdem temporibus fuisse dicit [...] Signa quem plurima in celo apparuerunt [...] In aquilone celum videbat igneum fulgurantes quem haste vise sunt. Luna fuit obscurata, cometa apparuit apud dolosam.

*A very strong earthquake is said to have struck Constantinople, which lasted four consecutive months [...] Many signs appeared in the sky [...]. To the north the heavens appeared fiery, shafts of lightning were seen, the moon darkened, and a comet appeared at Toulouse [Dolosam].*

Mizaldus Antoninus, *Cometographia: crinitorum stellarum quas mundus nunquam impune vidit*, p. 235

Anno à natali Iesu 452, Cometes apparuit, post Lune Eclipsim, post terrae motum.

*In the year 452 a comet appeared followed by an eclipse of the moon and earthquakes.*

Goutoulas Jacobus, *Universa Historia Profana*, pars I, p. 531

[450] Sub vesperum die quodam ad Boreae plagam, caelum multo igne conspicuum stetit, anno Christi quadringentesimo quinquagesimo; Et vero lineae tantum quaedam, maiori lumine, hastarum similitudinem referentes intermicabant. Luna semel defecit; ingensque cometa, ingentem omnium animis terrorem incussit. *Buzelinus lib. 5. Ann. Gallo Flandriae.*

Olahus Nicolaus, *Strigoniensis Hungaria Et Atila Sive De Originibus Gentis, Regni Hungariae Situ, Habitu, Opportunitatibus Et Rebus Bello Paceque Ab Atila Gestis*, p.124

Coelum cruento hiatus apertum, mutuis hastis ignitis id oblique scindentibus; visus praeterea cometes aliquot noctibus radios suos Occidentem versus porrigens.

*The sky opened into an abyss staining itself with blood with luminous rods that went down obliquely; moreover a comet has been seen for some nights extending its rays towards the west.* Conradus Lycosthenes.

## Anales del Reyno de Galicia, p. 336

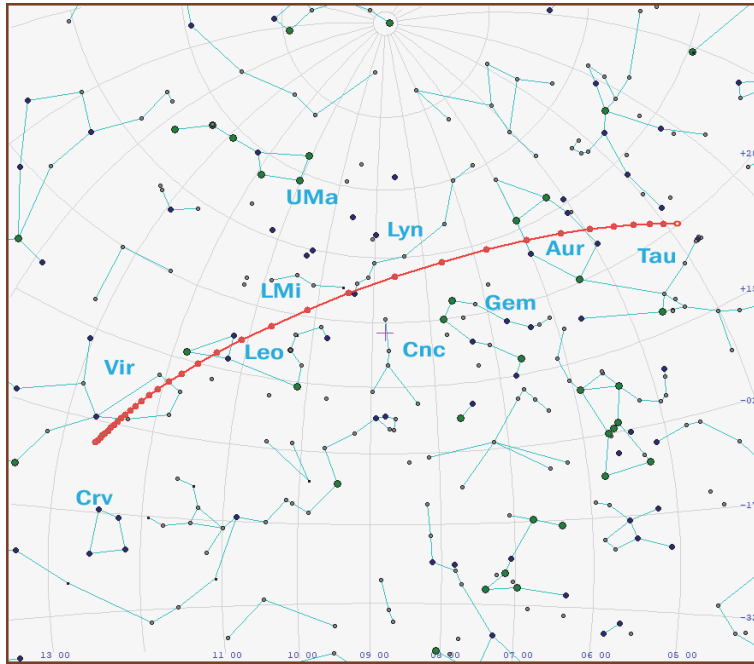
[452] A catorce del mes de Junio se descubrió un Cometa à la parte de el Oriente, en cuyo sitio se conservó hasta el día veinte y nueve de el mesmo mes, en el qual habiendo estado a el amanecer à el Oriente, se vió à el ponerse el Sol en el Occidente, en donde se conservó manifesto hasta el dia primero de Agosto. A veinte y siete de Septiembre se eclipsó la Luna, empezando à obscurecer sus rayos por la parte de el Oriente.

*On the fourteenth of June a comet was discovered towards the east, which remained in that position until the 29th of the same month, in which it was observable at dawn and was then seen to set in the West, where it remained visible until the first day of August. On the twenty-seventh of September the Moon was in eclipse, beginning to darken on the eastern side.*

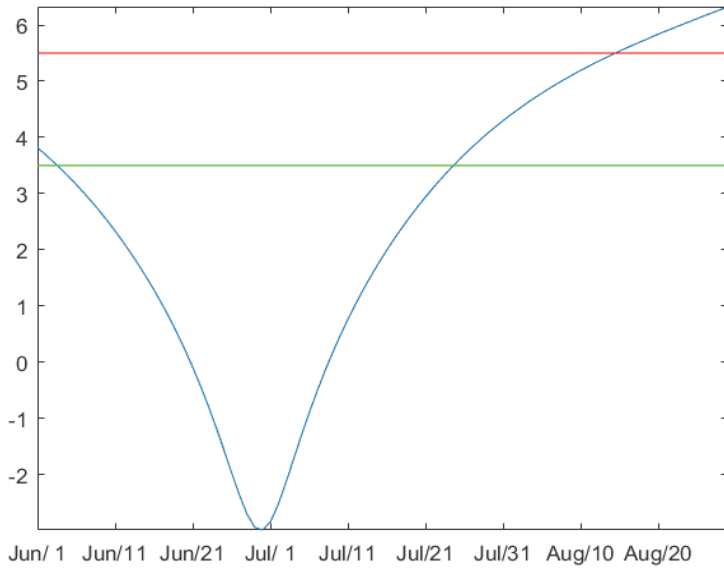


Orbital elements (eq. J2000.0):

T (UT)	q	e	$\omega$	$\Omega$	i	Author
451 Jun 28.249	0.57374	0.96891	97.028°	41.210°	163.479°	Yeomans and Kiang (1981: 643)



**Fig. 16** - Path of comet 1P/451 L1 (Halley) from 10 June (blank circle) to 17 August 451 AD. [step 2 days], based on Yeomans and Kiang's orbit.



**Fig. 17** - Estimated visual magnitude of 1P/Halley considering an absolute magnitude  $H_{10} = 3.5$

**467**

One Chinese text reports the observation, probably in the evening, of a white vapour, in the shape of a comet, on 6 February 467. The reference to a single day has led to the hypothesis that the phenomenon could be linked to an aurora. However, this same source continues and points out that it was called "*chhang-kêng*", which is a type of comet with two tails, so its interpretation as a comet remains open. A couple of Western sources, potentially associated with the same event, did not dispel the doubts. In his *Cométographie*, for the year 467, Pingré [1783, I: 314] wrote that during the consulship of Pusaëus and Johannes, the fifth indiction, a great wonder was seen in the heavens for some days: it was called by someone the trumpet; by others the pike; by others the little beam. Some scholars seem to validate the cometary hypothesis and the temporal location, but the period of its visibility has been reported differently by ancient sources. Theophanes Confessor (died c. 817) specifies that the comet was visible in the evening sky for 40 days, but *Chronicon Paschale*, confirming the straight line of the tail, reduces the time to some days (Whitby and Whitby 1989: 90). On the duration of the phenomenon, modern scholars have read the account of Victor of Tunnuna, one of the oldest sources, in two ways: 10 days, according to the *Chronicon* (in PL, Migne, Tome LXVIII, 1866: col. 944) and *Victoris Episcopi Tunnunensis, Chronicon*, [1600: 22]; or 40 days in *Victor Tunnunensis, Chronica* (in MGH, Auct. Ant. Ed. T. Mommsen, Tome XI, Vol II, 1894: p. 187). A recent edition of this work, however, appears to confirm the shorter period (Cardelle de Hartmann 2001: 11)

Moreover, a possible mention to this comet was recently found in an Anonymous *Commentary to Ptolemy's Tetrabiblos*. The comet is claimed to have appeared the year before the naval battle of Cape Bon in 468 that pitted Eastern Roman emperor Basiliscus (died 476/477) against Gensericus' Vandal fleet. In fact, the text tells how this comet foretold the destruction of many ships' masts during a battle. The report also relates the "affinity" of the planets Mars and Mercury, which occurred when the last planet was moving in direct motion, with the first sight of the comet. In contrast, its disappearance would occur at the end of the retrograde motion, which corresponds to approximately 39 days [Caballero-Sánchez 2021: 450]. However, another possible interpretation is that the duration refers to the period of actual observability of the two planets. In particular, on 2 February 467, at the latitude of Alexandria, Mars, and Mercury were in conjunction, just 1 degree apart, and were clearly visible just after sunset. Mercury continued its path on the celestial sphere in a northeast direction in the following days. Then, after reaching the maximum elongation, from 10 February, its motion turned westwards, and after the middle of the month, both planets became unobservable. If we consider that the comet was observed from 6 February, it could have also disappeared around the mid-month.

The greater or lesser period of visibility of the comet may have some relevance in discussing possible orbits. We may assume that the duration of forty days given by Theophanes Confessor may be a transcription mistake. On the other hand, the problem of the duration of this apparition has been considered by the thirteenth century greek monk Isaac Argyrus [Caballero-Sánchez 2021: 44-447] and investigated, in 1740, by the Dutch mathematician Nicholas Struyck, who pointed out that Byzantine writers had also attributed the value of 40 days to the comets of the years 389, 904 and 912 [Struyck 1740: 204]. Much later, chroniclers such as Gottfried of Viterbo (12th century), Rolevink, and Lycosthenes incorrectly place the comet's appearance in the years 434 and 434-454, respectively, i.e. just before another prodigy: the gushing of a stream of blood for a whole day in the city of Toulouse. This episode, possibly related to a geological phenomenon that actually happened [Alexandre 1990: 123], had been noted among the events that occurred in the years 467-468 by Hydatius (395-470) and taken up by other later authors, such as Fredegarius Scholasticus (c. 595-660), Aimoinus Floriacensis (950-1008), and Sigebert of Gembloux (c. 1030-1112), although none of them mentions the comet at all. However, the incompleteness of the contemporary Hydatius' text does not exclude that the comet and the Toulouse phenomenon were close in time. In fact, it is possible that Hydatius did indirectly mention this comet, writing that at the time of the first year of Olympiad 312 [year 468]: «Legati de rege Gothorum reuersi referunt portentosa in Gallis uisa aliquanta: in conspectu [*lacuna c. 14 litt.*] similem ipsi de continuo paruise solem alium uisum [*lacuna c. 26 litt.*] solis occasu; congregatis etiam quodam die concilii sui Gothis tela que habebant in manibus apafte ferri uel acie alia uiridi, alia roseo, alia croceo, alia nigro colore naturalem ferri speciem aliquandiu non habuisse mutata; medio Tolose ciuitatis hisdem diebus e terra sanguinem erupisse totoque diei fluxisse curriculo». Using the translation from Burgess [1993: 121]: «Envoys returning from the king of the Goths brought back news of a number of portents seen in Gaul. (They said) that before their eyes . . . another sun, like the real one, seemed to have appeared immediately. . . at sunset; that, when the Goths had gathered together on a certain day for their assembly, the iron sections and the blades of the spears which they carried in their hands had for a time not kept their natural appearance of iron but changed colour: some were green, some red, others yellow or black; and that at this time in the middle of the city of Tolosa blood had burst forth from the ground and flowed for an entire day». It has recently been suggested that this comet may be part of the Kreutz group [see Sekanina and Chodas 2007: 672]. In this assumption, they placed this comet in the so-called *scenario B* so that the comet of year 467 would correspond to a passage through the perihelion of the same fragment of the original parent comet that would be later observed as X/ 1106 C1. In their paper, the perihelion passage would take place on Feb 1.5, 467.

After revising the historical sources, a new perihelion time has been computed  $T = 467 \text{ Feb } 5$  (*see text*). Using this set of orbital elements, the observation of the comet before the perihelion would have been prohibitive, and only after the passage, when it began to move away from the sun, the conditions began to improve even if its luminosity was decreasing quickly. We have tried to check whether this set of orbital elements could agree with the recorded historical observations concluding that a four-day displacement of the date of the perihelion passage, placing it on 5 February 467, would lead to the implementation of visibility conditions. Assuming this last date, then the comet's tail could have been seen as a "white cloud" in south-west, after the sunset, heading south-east on 6 February and then it would have been seen as a "proper" comet for about a week after vanishing, as reported by Chinese. That would explain both the "white cloud", which would not correspond to an aurora, and the attribution that the same source makes of this object as a "*chhang-k'eng*".

In Europe, we guess the comet was seen after the perihelion for a very few days (namely 10). Also, Hydatius record might make sense in this context. In 466 Euric (c. 420-484) had risen to power as a king of the Visigoths, the Goths were surely coming from an embassy from the capital of the kingdom in Tolose (Nowadays Toulouse, France), from where the comet observing conditions were as bad as they were in China. Hydatius mentions that a second sun like the real one appeared immediately after sunset. This description matches that one of a KS comet that would have been seen on a day very close to perihelion. Estimating the magnitude of the comet is, in this case, problematic since its discovery date must have been very close to its maximum brightness. However, taking as absolute magnitude  $H_{10} = 6$ , the comet could have reached a magnitude of -14 around the perihelion date, and this magnitude would decrease very rapidly after that. As we mentioned earlier, a major problem in considering it as a KS, concerning its period of visibility. In any case, although it is not possible to be completely sure, we believe that the historical sources provide sufficient evidence to reinforce the hypothesis that such a comet belongs in fact to this category. Under this assumption, the perihelion date would have been moved to 5 February 467 and a new orbit has been proposed integrating the elements of the comet X/1106 C1.

Eastern sources: Ho (1962: 164)			
Source	Dates	Positions	Reference to approximate Western asterisms
Nan shi (c. 659)	Feb 6	A white vapor was seen stretching half across the heaven from the SW to the SE.	----
<i>Nan shi</i> is the only Eastern record to report this phenomena.			

Wolf H., *Claudii Ptolemaei Quadripartitum Enarrator Ignoti Nominis, Quem Tamen Proclum Fuisse Quidam Existimant Tunnunensis*, p. 76

Ὁ δὲ ἡμέτερος διδάσκαλος ἔλεγε δοκοῦ τινος ὀφθέντος εἰρηκέναι περὶ ξύλα ἀποβήσεσθαι τὸ σύμπωμα, καὶ ἀπέβη περὶ τὰς καταρτίους τῶν πλοίων· πολλὰ γὰρ τότε ναύγια συνέπεσεν ἐν τῇ τοῦ πολέμου ναυμαχίᾳ. καὶ ἄλλο δὲ παραδοξότατον διηγείτο. εἶπε γὰρ καὶ τὸ πότε παυθήσεται κατὰ τοιάνδε αἰτίαν. ἐπειδὴ τὰ τοιαῦτα τῶν σχημάτων ἀποτελεῖται ἐκ τῆς τοῦ Ἄρεος καὶ τοῦ Ἑρμοῦ συνοικειώσεως, εὗρισκε τότε τὸν Ἑρμῆν προσθῆτην καὶ εἶπε μέχρι τῆς ἀφαιρέσεως αὐτοῦ μένειν τὸ ἐπιφαινόμενον. καὶ οὕτω γέγονε. δεῖ οὖν σκοπεῖν τὴν ἐγγύς τοῦ Ἑρμοῦ ἢ τοῦ Ἄρεος ἀφάιρσιν καὶ λέγειν μέχρι τότε τὴν φαντασίαν διαμένειν.

Our master used to relate that a celestial beam-comet was once seen, and then he announced that a misfortune concerning tree trunks would be fulfilled, and so it did happen as to the masts of the ships: then, indeed, there were many shipwrecks in the naval battle of the war. And he told about a quite extraordinary achievement as well: indeed, he also said when and why the comet would disappear altogether. Since the effects of such appearances are due to their affinity with Mars and Mercury, he discovered that Mercury was then in direct motion, so he claimed that the appearance would be kept up until the retrogradation of Mercury. And so it did happen. One must therefore examine the nearest retrogradation of Mercury or Mars and say that the apparition remains until then [*transl. from Greek, Caballero Sánchez (2021) and (pers. comm. 26 March 2023)*].

Victor Tunnunensis, *Chronica*, p. 22

Buseo & Ioanne Coss. signum in coelo ex nube, velut contum apparuit per dies x.

[467] *Under the consulate of Buseus and John a sign appeared in the sky for ten days: a cloud like a spear.*

*Chronicon Paschale*, p. 597

Τῷ αὐτῷ ἔτει ἐφάνη ἐν τῷ οὐρανῷ σημεῖον μέγιστον, ἀπὸ τινων λεγόμενον σάλπιγξ, ἀπὸ τινων δὲ λογγία, καὶ ἀπὸ τινων δοκίς ἐφάνη δὲ ἐπὶ ἡμέρας τινάς.

[467] *In the same year, a great sign appeared in the sky remaining visible for some days. Someone called it a trumpet, others a spear and someone else called it a beam.*

Theophanes Confessor, *Chronographia*, p. 177

[458] Τοῦτῳ τῷ ἔτει σημεῖον ἐφάνη ἐν τῷ οὐρανῷ, νεφέλη ὡσπερ σάλπιγγος ἐχιύπωμα ἔχουσα ἐπὶ ἡμέρας μ' χαθ σπέραν.

(*Anno Mundi 5958= 466-467*). *In the same year, in the evening, a wonder was seen in the sky for forty days: an eye-catching trumpet-shaped cloud.*

Georgius Hamartolus, *Chronicon Breve*, col. 756

Ἐφ' οὗ (σημεῖον) ἐφάνη ἐν τῷ οὐρανῷ νεφέλη σαλπιγγοειδῆς ἐπὶ ἡμέρας μ'

[466-467] *In the ninth year [Leo I, the Thracian] there was a prodigy in the sky: for 40 days in the evening a trumpet-shaped cloud [was seen].*

Glycae Michael, *Annales*, p. 489

Ἐπὶ μέντοι τούτου τοῦ Μαρκιανοῦ και Συμεὼ ὁ μέγας ἐπέβη τοῦ στόλου. ἀχοινώνητος γὰρ μέγρι πολλοῦ ἔμενε διὰ τὸ καταρχὴν τοιαύτην ἐνδείξασθαι. πολλοὶ γὰρ οἱ μεμψίμοιροι.

*After Marcian, Leo the Great ruled for 18 years until an intestinal disease ended his life. During his reign a prodigy appeared in the sky: an evident cloud, in the shape of a trumpet, which lasted for 40 whole days.*

Gotifredi Viterbiensis, *Pantheon*, p. 499

[434-454] Luna obfuscat. Cometa apparet. Et post pauca, apud Tolosam Galliae rivus sanguinis longissimus fluxit tota die.

*The Moon has eclipsed. A comet appeared. And shortly afterwards, near Toulouse in Gaul, a very long stream of blood flowed throughout the day.*

Rolevinck Werner, *Fasciculus Temporum*, p. 499

[434-454] Cometa apparet. Et post pauca, apud Tolosam Galliae rivus sanguinis longissimus fluxit tota die.

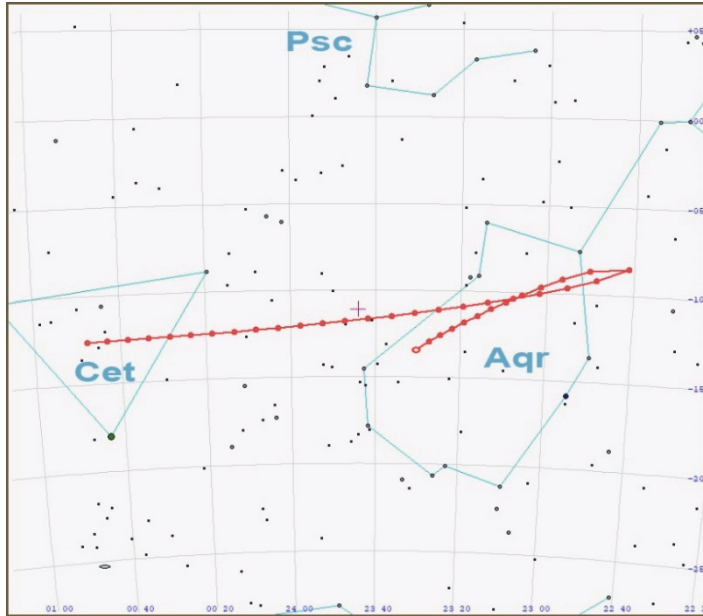
Conradus Lycosthenes, *Prodigiorum ac Ostentorum Chronicon*, p. 292

[434] Cometa apparuit & mox post paucos dies apud Tolosam sanguinis fluxit.

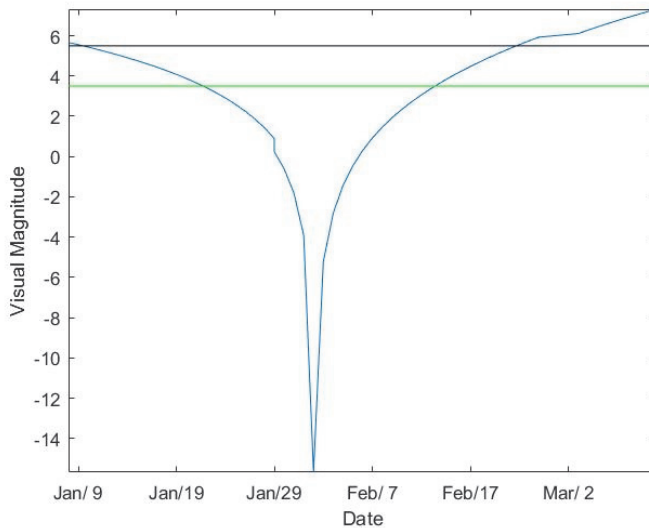
Orbital elements (eq. J2000.0):

T (UT)	q	e	$\omega$	$\Omega$	i	Author
467 Feb 1.5	0.00520	0.999933	86.25°	7.62°	144.62°	Sekanina and Chodas (2007: 672)
467 Fe 5	0.00538	0.999933	85.17°	6.32°	144.54°	Martínez (in Martínez et al. 2022: 4)

Following the above orbit, the comet was within 20° of the sun from 30 January to 11 February, reaching a minimum solar elongation of 0.2° on 4 February. The most northern declination was -9° on 4 February. Closest to the Earth: 11 February (0.836 au).



**Fig. 18** - Path of comet of 467 AD, from 1 February (blank circle) to 12 February 467 AD [step 8 hours] according to Martínez's orbital elements (see text).



**Fig. 19** - Estimated visual magnitude of comet 467 AD. Light curve is derived from the orbit calculated by Martínez et al 2022 and with a standard magnitude of  $H_{10} = 6$ . We show the magnitude curve of the comet for information only, since KS comets can have unpredictable behavior.



**498-499**

According to Eastern sources, maybe two comets appeared over the fifth and sixth centuries [Ho 1962: 164; Kronk 1999: 84]. In December 498 AD, the first one remained visible for several nights in the constellations of Leo, Lynx, and Cancer. The second has been reported only in one night on 13 February, or 14 April 501. [Williams 1871: 33; Ho 1962: 164; Pankenier et al. 2008: 61]. We do not exclude that these latter phenomena refer to a single fireball observation rather than a comet. In fact, the translated words "stretched across the sky" do not clarify anything about whether it is a comet or a shooting star. Unfortunately, the picture is even more confusing on the western side due to the lack of contemporary evidence. An exception is the chronicle of the monk Joshua the Stylite (late 5th - early 6th century), in which, however, there is not enough information to identify the comet reported in the East. Trombley and Watt [2000: 36-37] speculated that it was the same observed in the east between February and April 501, brought forward to the previous year to serve as an omen of the terrible famine that would hit the city of Edessa in the period 500-502 AD.

On the contrary, we think that Joshua refers to the previous "Chinese comet". The *Chronicle of Zuqnin*, which in fact takes up Joshua's text, dates the event to December 499 or January 500 [Witakowski 1996: 4, no. 30; Harrak 1999, 39, no. 7] but, about a century later, the *Chronicle of Edessa*, referring to the same comet, expressly indicates a date: month *kānūn* II, and Greek year 810, that is January 499 AD, thus making it probable that it was the same comet observed in December 498 in China. Subsequent chroniclers have only fueled the uncertainty. Michael the Syrian (1126-1199) and Joannes Zonaras (c. 1070-c.1140) limit themselves to a few lines. The former says that a comet was seen for a long time, around the eighth year of the reign of Anastasius I "Dicorus" (abt. 430-518); the latter that preceded the second invasion of the Bulgarians in Illyria, dated in the year 499 [Pingré 1783, I: 314]. Sigebert of Gembloux (abt. 1030-1112), speaking of a comet observed in Britain, at the time of the death of King Aurelius Ambrosius, places it in the year 457 but Pingré [1783, I: 313] and Struyck [1740: 205] point out that Sigebert must be wrong, since the death of the king (recognized as Ambrosius Aurelianus) should have occurred around the year 500 AD. In the *Historia regum Britanniae*, completed around 1135 AD, Geoffrey of Monmouth, does not mention dates but reports, with some details, the appearance of "a star with rays" as well as the role played by Merlin in his capacity as advisor to Uther, brother of the late King Ambrosius Aurelianus. But what type of "star" was it? Elizabeth Bryan wrote: «Geoffrey leaves open the question of just what kind of astronomical event this star is» adding that «while it is certainly possible to understand Geoffrey's description as referring to a comet in the twelfth century context, it is equally possible to understand his *stella* as a planet or star sending rays of unusually imagistic appearance toward the sublunary earth». (Bryan 2016: 149). The episode, which involves Uther and Merlin who, as we well known, will join the semi-legendary

character of King Arthur in his epic, is described, with minor variations in *Flores Historiarum* (12th-13th century), *Brut or Chronicles of England* (13th century) and *Croniklis of Scotland* (1523) by Hector Boethius. In the *Flores*, however, the event is chronologically framed in the year 498. This date is confirmed by the next passage, in which we read about the death of Pope Anastasius II (Nov. 19, 498): "*Anno gratiae CCCXCVIII. Anastasius sedit in cathedra Romana, anno uno, mensibus.xi.& diebus.xxiiij. Per idem tempus, Uther frater Aurelij regis Britonum defuncti ...*".

Could the "star" commented by Merlin be the same comet seen in the east in December 498? The information is too fragmentary to give a conclusive answer. To make things worse, another Ambrosius, who lived about half a century earlier, may have been mistaken for the Ambrosius Aurelian mentioned above. In the *Historia Brittonum*, compiled in the ninth century by the Welsh monk Nennio, mention is made of an Ambrosius who, leading the Bretons, defeated the Anglo-Saxon invaders, led by Guitolinus or Vitalinus, during the battle of Guolopum or Guoloph. Although there is no certain date of when the battle took place, historians agree to place it in a period between 437 and 458 AD. Assuming, with an effort of imagination, that this is the "real Ambrosius", the comet mentioned in the chronicles should then be backdated by about fifty years, making possible, although with a certain strain, the identification with Halley in its passage of 451 [Gaspani, 2015: 53-57]. Returning to Merlin's comet, another couple of possibilities deserve to be taken into serious consideration, namely that the «star of great splendour consisting of a single ray ending in a luminous globe similar to a dragon out of whose mouth two rays came out» was only a very bright fireball, which fragmented in the impact with the atmosphere, as this description fits very well with the appearance of such phenomena. Alternatively, because we are moving along a fine line between history and mythology, associated with the "Arthurian cycle", there was not even a real vision of any comet, but the tale has only served as a pretext to reinforce the myth.

Eastern sources: Williams (1871: 33), Ho (1962: 164), Pankenier et al. (2008: 61)			
Source	Dates	Positions	Reference to Coordinates of LM determinative stars (J2000) and approximate Western asterisms
Wei shu (c. 554)	(between) Nov 29-Dec 28 (498)	Xuanyuan (south) Yugui [LM 23]	$\alpha$ Leo $\theta$ Cnc, $\alpha = 08^h 31^m 36^s$
Nan shi (c. 659) Wên Hsien Thung Khao (1317)	Feb 13 (501) or Apr 14 (501)	tailed star in the horizon	---
Wên Hsien Thung Khao (1317)	(between) 5 Mar-3 Apr (501)?	---	---
In the East, a number of possible comets were observed in the late 5th and early 6th century. The object <i>Chih Yu</i> quoted by Ho (1962:164,n.213) in WHTK is a possible comet but the position is missing and the date uncertain.			

Josué le Stylite, *Chronique*, pp. XXXIII-XXXIV

Dans le mois de Konoun second, nous avons vu un autre signe à l'Occident et au midi, dans un coin; il ressemblait à une lance. Les uns disaient que c'était le balai de la perdition, et d'autres que c'était la lance de la guerre. [*transl. from Syriac, Martin (1876)*].

*In the month of Second Konoun [January], we saw another sign in the West and at noon, in a corner; it looked like a spear. Someone said it was the broom of perdition, and others said it was the spear of war.*

Harrak A. (edit by), *Chronicle of Zuqnin*, p. 38

[498-499] In this same year a sign was seen in the sky that looked like a dark cloud. [*transl. from Syriac, Harrak (1999)*].

*Chronicon Edessenum* (A), p. 8

[499] Anni 810 [...] Mense kânûn hērāy (*ianuarii*), signum hastae simile apparuit in caelo multos dies. *transl. from Syriac, Guidi (1903)*.

*In the year 810 [of the Greek calendar] a sign that looked like a spear appeared in the sky for several days in January.*

*Chronicon anonymum, ad Annum Domini 846 pertinens*, p. 167

[498-499] Anno 810 [...] Et signum quod imitatur hastam apparuit in caelo [*transl. from Syriac, Chabot (1903)*].

*And a sign that looked like a beam appeared in the sky.*

Michel Syrien, *Chronique*, Lib. IX, Cap. VII, p. 154

On vit une comète pendant longtemps. [*transl. from Syriac, Chabot (1901)*].  
*A comet has been seen for a long time.*

Zonaras Ioannes, *Epitomae Historiarum*, Lib. XIV, p. 141

ὤν ἰὴν φθορὰν κομήτης ἀστήρ προεμήνυσε.  
*And a comet foretold their defeat.*

Abū I-Farağ, (Bar Hebraeus), *Chronicon Syriacum*, p. 77

Apparuit cometa per dies multos. Locustae irruerunt, & frumentum absumserunt, ut fames magna in Mesopotamia oriretur. Ignis vehemens visus est in plaga aquilonari, quae per totam noctem flamma obducta fuit. [*transl. from Syriac, Bruns and Kirsch (1789)*].

*A comet appeared for several days. Locusts came and destroyed the crops, thus fuelling a great famine in Mesopotamia. A huge fire was seen in the northern sector so that for the whole night a darkened flame was seen.*

Sigebertus Gemblacensis, *Chronicon ab anno 381 ad 1113*, pp. 16r-16v

[457] Super insulam Britanniae stella mirae magnitudinis apparuit: cuius radio globus igneus draconi similis adherebat. Ex cuius ore duo radij procedebant: quorum unus ultra Galliam se extendebat, alter vero versus Hyberniam tendens, in septem minores radios terminabatur. Eo tempore occiso Aurelio Ambrosio rege: interrogatus Merlinus vates a fratre regis Uther de stelle significatione: dicetum illo sydere & igneo dracone signatum per radium vero de ore draconis procedentem & Gallias respicientem: figurari filium ei potentissimum nasciturum. Altero autem radio portendi filiam: cuius filij & nepotes regnum Britannie succedenter essent habituri. Uther autem audita morte fratris sui, coepit dyadema insulae, duosque dracones ex auro iubens fabricari ad instar ignei draconis: obtulit unum in ecclesia, altero autem in pralis pro signo utebatur. & ex eo tempore cognomentum accepit Utherpendragon: id est caput draconis.

Galfridus Monumotensis, *Historia Regum Britanniae*, Lib. VIII, cap. XIV, p.112

Haec dum Guyntoniae agerentur, apparuit stella mirae magnitudinis et claritatis, uno radio contenta: ad radium vero erat globus igneus in similitudinem draconis extensus, et ex ore illius procedebant duo radii, quorum unus longitudinem suam ultra Gallicanum clima videbatur extendere, alter vero versus Hybernicum mare vergens, in septem minores radios terminabatur.

*While these events were taking place, a wonderfully bright star appeared, consisting of a single ray ending in a dragon-shaped ball of fire. From its mouth came out two rays, one extending in the direction of Gaul while the other, from which seven smaller rays came out, was directed towards the Irish Sea.*

Galfridus Monumotensis, *Historia Regum Britanniae*, Lib. VIII, cap. XV, p.113

Apparente vero praefato sidere, percussi sunt omnes metu et admiratione qui illud insipieiebant. Uther etiam frater regis, hostilem exercitum in Cambriam ducens, non minimo terrore percussus, quosque sapientes adibat, ut quid portenderet stella notificarent. Inter caeteros jussit vocare Merlinum: nam et ipse in exercitum venerat, ut consilio ipsius res praeliorum tractarentur. Qui ut in praesentiam regis ductus astisset, jussus est sideris enucleare significationem. Mox ille in fletum erumpens, revocato spiritu exclamavit et dixit: "O damnum irrecuperabile! O orbatum populum Britanniae! O nobilissimi regis migrationem! Defunctus est inclytus Britonum rex Aurelius Ambrosius [...] Te enim sidus istud significat, et igneus draco sub sidere. Radius autem, qui versus Gallicanam plagam porrigitur, portendit tibi filium futurum potentissimum, cujus potestas omnia regna habebit quae protegit. Alter radius filiam significat, ujus filii et nepotes regnum Britanniae successive habebunt.

*The appearance of this star had struck everyone. The king's own brother Uther in Cambria, who led the army against the enemy was so terrified that he asked the wise men what such a star meant. Among others, he asked Merlin, who had accompanied the army to give advice on how to act in case of battle. In the presence of Uther, who was asked to clarify the meaning of the star, Merlin burst into tears once the spirit had manifested itself and said: «Oh irreparable harm, Oh orphaned English people! Oh noble loss! The greatest king of the English, Aurelius Ambrosius, is dead». This means that you are the star and the dragon-shaped light below. The ray extending towards the land of the Gauls predicts that your son will have a portentous future that will lead him to rule and protect the entire kingdom. The other ray refers to your daughter, whose children and grandchildren will rule the kingdom of Britain dynastically.*

Flores Historiarum, Lib. I, pp. 179-180; Matthaëus Parisiensis, *Chronica Majora*, Vol. I, p. 227

[498] Sed tandem convaluit Uther, & interfectis Gillomannio atque Pascentio victoriam reportavit. His ita gestis, apparuit stella mirae magnitudinis & claritatis, uno tantum radio contenta, ad cujus radium erat globus igneus in similitudinem draconis estensus, & ex ore ejus duo radii procedebant, quorum unus longitudinem suam ultra Gallicana climata extendere videbatur, alter vero versus mare Hibernicum vergens, in septem radios minores terminabatur. Hoc sidere viso, Uther, nimio terrore percussus sapientes suos sollicitabat ut quid stella portenderet, indicarent; qui respondentes, dixerunt: "Te quidem sidus & igneus draco sub sidere significat; radius autem, qui versus Gallicanam plagam porrigitur, portendit filium tibi futurum potentissimum, qui plurima regna, quae sidus contegit, possidebi; alter vero radius filiam innuit, cuius filii et nepotes regnum Britanniae succedenter habebunt.

*But in the end, Uther brought victory, after killing Gillomanio and Pascentius. At that moment a star of great splendour appeared, consisting of a single ray ending in a luminous globe similar to a dragon, out of whose mouth two rays came out, one of which was seen to be directed towards Gaul, while the other one, which was directed towards the Irish Sea, ended in seven smaller rays. Uther, frightened, turned to his wise men and asked them what the star could predict. They replied that the bright star in the shape of a dragon represented his figure, while the ray extending towards Gaul meant that his son would become very powerful and rule over all the kingdoms the star overlooked. The other ray indicated that his daughter's sons and grandsons would succeed each other on the throne of Britannia.*

*Brut Chronicles*, part I, pp. 63-64

When the King Aurilambros was thus dede & enpysenede at Wynchestre, a morn, after that he was dede, aboute the tyme of prime there was seyn a sterr' grete and clere; and the beeme of the sterr' was brighter than the sone; and at the bought of the beeme apperede a dragounes heuede, and oute of his mouth comen ij huge lightegh that were as ligh as eny fire brynnyng. And that o beeme went towarde Fraunce, and straught overe the see thideward; and out of that beem comen vij beemes ful clere and longe as it were the light of fire. This sterre was seyne of meny man; but none of ham wist what it bitokende. Uter' that was the kyngus brother, that was in Walys with his hoste of Britouns, saw that sterre, and the grete light that ir ghaf. He wondrede theron gretly, what it might bitoken; he lete calle Merlyn, & praiede him forto telle what it might bitokene. Merlyn saw that sterre, and bihelde hit longe tyme, and sithenes he quok and wepte tenderly; & saide: "allas, allas! That so noble kyng and worthi is dede. And I do ghow to understonde that Aurilambros ghour brother, is enpoyssenede, and that I se wel in this sterre. And thoure-self bitokeneth bi the heuede of the dragoun that is seyne at the bought of the beeme: that is ghourself, that shal bene kyng, and regne. And by the beem that stode toward the Est, is understonde that ghe shal geten a sone that shal conquere al Fraunce and alle the landes that beth longeyng to the Kyng of Fraunce, that shal bene a worthier Kyng and more of honoure than euer' was eny of his ancestres. And by the beem that stracchet towarde Irland is bitokenede that ghe shul bigete a doughter that shal be quene of Irland; and the vij beemes bitokenes that ghe shul have vij sones; and everyche of ham shal bene kyng and regne with michel honououre. And abide ghe no longer' here, but go and ghif batail to ghoure enemys and feight with ham boldely for ghe shul overcome ham and haue the vistorie.

Boece Hector, *History and Chronicles of Scotland*, Libro IX, Cap.II, p. 63

At this time wer sene mony uncouth mervellis in Albioun, and wer interprete be Merline to the gret terroure of pepill. Ane firy comeit was sene, with mony terrible bemes; ane crownit dragoun was sene birnand in the lift [...] The reveir of Thamis apperit bludy [...] Thir mervellis, be interpretatioun of Merline causit the Britonis cum in battal aganis the Saxonis: for Merline interpret this comeit to King Ambrose; this crownit dragoun, to Uter, his brodir; the blude signifyt the uter exterminion of Saxonis. Uter gave sic credence to thir interpretationis of Merline, that he tuke the crownit dragon for his armis, and bure it birnand as gold, in ane feild of asure, to the coloure of the lift; and wes callit, thairfore, Uter Pendragon be the pepill.

*At that time, many strange omens were seen in Albion and were interpreted by Merlin with great terror of the people. A flaming comet with many terrible rays was seen; a fiery dragon with a crown was seen in the sky [...] The river Thames appeared blood-coloured [...]. Merlin's reading of these omens led to the battle of the Bretons against the Saxons: Merlin interpreted the comet as a reference to King Ambrosius; the dragon with the crown to Uther his brother while the blood meant Uther's extermination of the Saxons. Uther gave so much credence to Merlin's interpretation that he recognised the crowned dragon as his coat of arms and represented it in a brilliant gold colour on a blue field, blue as the colour of the sky; and for this reason he was called by the people, Uther Pendragon.*

Boece Hector, *Scotorum Historiae prima gentis*, Liber IX, p. 153v

Sub tempus quo Ambrosius vita excessit, prodigia quaedam Guyntoniae primatibus sunt nunciata, alia conspecta, quae quo magis credebat vulgus, interprete Merlino, eo etiam plura nunciabantur. Crinitam stellam (cometam vocant Graeci) faces emittentem longissimas, ac draconis effigiem coronatam & in caelo ardentem, complures noctes conspectas.

Conradus Lycosthenes, *Prodigiorum ac Ostentorum Chronicon*, p. 294

[457] Su per insulam Britannie stella mirae magnitudinis apparuit cuius radio glob. igneus draconi similis adhaerebat. Ex cuius ore duo radij procedebant, quorum unus ultra Galliam se extendebat, alter verò versus Hiberniam tendens, in septem minores radios terminabatur. Saxones post mortem Aurelij Ambrosij regis, à pactione foederis soluti, invaserunt civitates & promontoria, ac ab Albania usque Eboracum omnia devastarum

# VI Century

## 520

Annals from China reporting a comet in the year 520 AD are rather scarce, limiting themselves to state that it appeared "bright as a flame" at the beginning of October [Ho 1962: 164; Kronk 1999: 85-86; Pankenier et al. 2008: 62]. In this case, Western chronicles are more numerous, especially the Byzantine ones, which tell how its sudden appearance terrified all peoples. John Malalas (c. 491-578) and John of Nikiû (*fl.* late 7th century) write that the comet appeared sometime after Justin's coronation in July 518, while Joannes Zonaras (c. 1070-c. 1140) specifies that it occurred in the year of the murder of the *magister militum* Vitalian (d. 520). The Anno Christi 511, given by the translator of the 1839 edition of Theophanes' Chronographia, must be then considered incorrect. In fact, the Anno Mundi (A.M.) 6011, reported in the Greek text, actually corresponds to 519-520 AD.

Some debate has concerned the terminology used in the transcription of the Valesian text. Ludovico Antonio Muratori (1672-1750) and others reported the words "*cometes splendens* = shining comet" but the consultation of other manuscripts of this work and a careful philological investigation has preferred to read "*cometes pendens* = hanging comet" [Adams 1976: 34]. The apparition of the comet is reported together alongside another prodigy, probably due to a fireball, with these words: «Also a poor woman of the Gothic race, lying in a colonnade not far from the palace of Ravenna, gave birth to four snakes; two of these were seen going on clouds from west to east and then falling into the sea; the other two, which had one head, were taken away».



No dates are given, but the historical context for both phenomena occurred between the crowds' burning of the Synagogues in Ravenna (519), and the accusation of betrayal, directed by Cyprianus, the great referendary, to Albinus, for having woven correspondence with the Eastern Roman Empire (523 or 524 AD).

George Hamartolus (842-867), George Cedrenus (*fl.* 11th century), and Michael Glykas (c. 1125-1204), report a terrible earthquake that struck the Antioch region and which, due to its magnitude, could be ascribed to 29 May 526 [Ambraseys 2009:184]. All also write about a 'star' observed for 26 or 27 days above the great (or bronze) gate of the palace. This portal, which can be identified with the *Chalke Gate* or *Bronze Gate* of Constantinople, was the monumental entrance to the Imperial Grand Palace (or Sacred Palace), residence of the Byzantine emperors until 1081AD. Cedrenus records this event in the seventh year of Justin's accession to the throne (524-525) and the British astronomer W.T. Lynn deduced the presence of a comet in the year 524 AD [Lynn, 1894: 50-51]. The nature of this last object is actually far from clear and it cannot be completely excluded that it may be a Nova or another phenomenon rather than a comet.

Eastern sources: Ho (1962: 164), Pankenier et al. (2008: 62)			
Source	Dates	Positions	Reference to approximate Western asterisms
Liang shu (c. 635)	Oct 1	A flaming star in the east	---
Sui shu (c. 636)	Oct 1		
Nan shi (c. 659)	Oct 1		
Wei shu (c. 554)	Oct 7	A star with bright flames	---
Chinese sources, on two different dates, provide just the appearance of a morning comet in the east			

Malalas Ioannes, *Chronographia*, p. 411

Ἐν δὲ τῇ ἀρχῇ τῆς αὐτοῦ βασιλείας ἀνήλθεν ἐν τῇ ἀνατολῇ φοβερὸς ἀστὴρ, ὀνόματι κομήτης, ὃς εἶχεν ἀκτῖνα πέμπουσιν ἐπὶ τὰ κάτω κάτω, ὃν ἔλεγον εἶναι πωγωνίαν, καὶ ἐφοβοῦντο.

*At the beginning of his reign [Justin I] it rose in the east a terrible star called comet from which a ray pointed downwards; the frightened people called it "the bearded one".*

Anonymus Valesianus, *Excerpta Constantio Chloro, Constantino Magno* in *Rerum Ital. Script. Mediolani*, Vol. XXIV, col. 640 (VIII)

Stella cum facula apparuit, quae dicitur cometes, pendens (or splendens) per dies XV. & terrae motus frequenter fuerunt.

*A star like a torch appeared, they called comet and was hanging [or shone] for fifteen days. There were frequent earthquakes.*

*Chronicon Paschale*, p. 612

[519-520] Τῷ αὐτῷ ἔτει ἀνήλθεν εἰς πέραν ἐν τῇ ἀνατολῇ ἀστήρ φοβερός, ὄνοματι κομήτης, ὃς εἶχεν ἀκτῖνα πέμπουσιν ἐπὶ τὰ κάτω, ὄντινα ἔλεγόν τινες πωγωνίαν εἶναι, καὶ ἐφοβοῦντο οἱ ἄνθρωποι.

*In the same year, a frightening star rose in the far eastern parts, that people called comet, with a ray hanging below it. Some claimed it was a "Pogonia". It caused great terror among the people.*

*Chronicle of John, Bishop of Nikiú*, chapt. XC (5), p. 133

[519-520] In the beginning of the reign of Justin, a fearful and terrible comet rose in the east. And for this reason the emperor Justin sent and recalled Vitalian who had been the enemy of the emperor Anastasius, and appointed him head of the army. [*transl. from Ethiopian, Charles (1916)*].

Theophanes Confessor, *Chronographia*, p. 256

[511] Τᾷ δ' αὐτῷ ἔτει ἐφάνη ἀστήρ ἐν τῇ ἀνατολῇ φοβερός κομήτης, ὃς εἶχεν ἀκτῖνα ἐκπέμπουσιν ἐπὶ τὰ κάτω, ὃν ἔλεγον οἱ ἀστρονόμοι πωγωνίαν εἶναι [καὶ ἐφοβοῦντο].

*In the same year a terrible star called a comet, from which rays came out from underneath, appeared in the east. Astronomers called it "barbata" and it scared everyone.*

Zonaras Ioannes, *Epitomae Historiarum*, Lib. XIV, p.146

Ἐν τοῖς τούτου χρόνοις ἀστήρ ἐφάνη κομήτης ἐν τῇ ἀνατολῇ, κάτω τὰς ἀκτῖνας ἀφιεῖς δὴ πωγωνίαν οἱ μετεωρολογοῦντές φασιν.

*At that time a comet appeared in the east with rays bending downwards; meteorologists call it "Pogonia".*

Cedrenus Georgius, *Compendium Historiarum*, tomus prior, p. 638

Τᾷ δ' αὐτῷ ἔτει ἐφάνη ἀστήρ ἐν τῇ ἀνατολῇ φοβερός κομήτης, ὃς εἶχεν ἀκτῖνα ἐκπέμπουσιν ἐπὶ τὰ κάτω, ὃν ἔλεγον οἱ ἀστρονόμοι πωγωνίαν εἶναι [ἐφοβοῦντο].

[519-520] *That same year a comet appeared in the east, with rays bending downwards that Greeks call "Pogonia" as it was similar to a beard. It had, however, a ray pointing to the sunset.*

### 530 1P/530 Q1 (*Halley*)

Comet Halley passage in 530 AD is sufficiently well documented in both Eastern [Ho 1962: 164-165; Pankenier et al. 2008: 62] and Byzantine sources. This passage happened in relatively suboptimal observational circumstances that were even worse in Europe due to the historical context caused by the disorder provoked by the fall of the Western Roman Empire just 54 years earlier, and by the barbarian invasions still at their highest. The existing records were written a long time later and in a form that does not make it easy to identify the year of the appearance of the comet. Two time markers are usually mentioned, each of which does not allow to circumscribe a specific year with absolute certainty: the first is the year of the reign of Emperor Justinian I, called the Great, indicated both in the fourth year (Cedrenus) and in the fifth year (Zonaras). Justinian assumed the empire on 1 April 527, so the year should be 530 or 531. The name of the consuls gives the second marker in the year of the comet's appearance, Flavius Lampadius, and Rufius Gennadius Probus Orestes, who held the position in the year 530. However, they continued in the position for the next three years, so, again, there is a period of uncertainty of two years. Luckily the lack of appearances of other comets in Asia, besides this one, and the well-studied orbit of Halley's comet helped to clear up any dating doubts.

In those years, in addition to the appearance of the comet, two other extraordinary events occurred: the fading of the sunlight, which will be discussed later, and an intense meteor activity. This latter phenomenon could be the same observed in Asia according to which on 9 April 530: «more than 1000 stars to north west till dawn» [Hasegawa 1993: 212] or following another translation: «large meteors in their thousands, their trails unbroken, accompanied each other in the northwest» [Pankenier et al. 2008: 312]. These meteors, based on the date reported by the Chinese, are attributable to a shower of *Eta Aquaridi*, one of the two meteor showers originating from Halley's comet: This strong activity, coinciding with its appearance, confirms if needed the identity with this comet, because typically a meteor shower will be stronger when the Earth crosses the comet's path shortly after the parent comet has passed (e.g. Jenniskens 2003: 3).

Among the historians who cite the comet, only Theophanes indicates the precise period of the year: the month of September, which coincides with the observing period in Asia. From the fact that almost all authors mention that the comet appeared in the western part of the sky, we can deduce, on the basis of the calculated ephemeris for Halley's comet at this passage, that the period to which they refer must be between 2 September and the end of September-early October (the comet's visibility conditions from that date would make it visible only during twilight). Michael the Syrian (1126-1199) is the only author who writes that the comet appeared in the east, which could indicate it was first detected, at least from the Middle East, as early as late

August and early September, however since his chronicle is several centuries later, there may also have been an error in translation or transcription of earlier texts.

The Chinese observations, as usual more detailed, report without uncertainties the presence of the comet, starting from the end of August, in the sky before sunrise. Then, starting from the first days of the following month, the object became an evening object. It remained visible, after sunset, for almost the entire month of September and, more precisely, until the 27th, a date which also marks Halley's last documented observation at this return. Meanwhile, the comet had crossed several constellations, including Lynx, Leo Minor, Ursa Major, Coma Berenices, Bootes, Serpens, and finally Libra [Kronk 1999: 86-87]. None of the Middle Eastern chronicles provides indications of its location on the celestial sphere. However almost all agree both in the duration of the apparition, which is equal to twenty days, and in defining it as a large and threatening star. Michael the Syrian describes its shape as similar to that of a spear with its tip pointing downwards, a figure that is interpreted as a sort of premonition for the imminent difficulties that the Church will have to face. In the *chronicle of Zuqnān*, the phenomenon is instead generically inserted together with the events that occurred in the Greek year 854 (542-543 AD), so there may be some doubt regarding the identity of the consigned comet. The description of the "big and frightening star" and the duration of the phenomenon, however, seem to fit Halley's comet rather than the subsequent comet C/539 W1.

John Russell Hind (1823-1895), around the middle of the 19th century, was the first to suspect that the comet of 530 (or 531, at that time, the year was not yet certain) was comet Halley [Maffei 1987: 185]. According to his calculations, the comet would have reached its perihelion at the beginning of November, but with the professionalism that distinguished him, he hastened to add that he himself "doubted these results which he did not intend to insist on" [Hind 1850: 56]. Modern calculations have refined this prediction, anticipating the passage through perihelion on 27 September 530 [Yeomans and Kiang 1981: 643].

Eastern sources: Ho (1962: 164-165), Pankenier et al. (2008: 62)			
Source	Dates	Positions	Reference to Coordinates of LM determinative stars (J2000) and approximate Western asterisms
Wei shu (c. 554)	Aug 29	(east of) Zhongtai	λ UMa
Thung Chien	Sep 1	(northwest) Xiatai	ν UMa
Kang Mu (1189)	Sep 4	moved northwest Di [LM3]	α Lib, α = 14h 50m 41s
	Sep 23	barely seen	---
	Sep 27	extinguished	---
The <i>Wei shu</i> and <i>Thung Chien Kang Mu</i> are the only Eastern sources that mention Halley's comet passage in 530.			

Malalas Ioannes, *Chronographia*, p. 454

Ἐπὶ δὲ τῆς αὐτῆς βασιλείας ἐφάνη ἀστὴρ μέγας καὶ φοβερός κατὰ τὸ δυτικὸν μέρος, πέμπων ἐπὶ τὴν ἄνω ἀκτῖνα λευκὴν, ὃ δὲ χαρακτήρ αὐτοῦ ἀστραπαῖς ἀπέπεμπεν, ὃν ἔλεγόν τινες εἶναι λαμπαδίαν. ἔμεινε δὲ ἐπὶ ἡμέρας εἴκοσιν ἐκλάμπων, καὶ ἐγένοντο ἀνυδρίαὶ καὶ κατὰ πόλιν δημοτικοὶ φόνοι καὶ ἄλλα πολλὰ ἀπειλῆς πεπληρωμένα.

*During his reign [of Justinian I, (482-565)] there appeared a tremendous great star in the western region, sending a white beam upwards; its surface emitted flashes of light. Some people called it "firebrand". It continued shining for 20 days and there were murders, droughts and rebellions in all the cities and other events full of bad omens.*

Harrak A. (edit by), *Chronicle of Zuqñin*, p. 93

[542-543] Now in the same year, a star in the likeness of a "lance" was seen. A large and dreadful star in the likeness of a fiery lance was seen in the evening in the western region, while a great beam [of light] was emanating from it upward. It was shining and small rays of light were coming out of it in such a way that fear gripped all those who looked at it. The Greeks called it *Komētēs* (comet). And thus it would ascend and be visible for about twenty days. Afterwards, when many people had observed what had taken place after that sign, they witnessed numerous wars, dry wind, drought, lack of rain and aggression in cities. We are unable to write about the record of all the evils coming from all sides. [*transl. from Syriac, Harrak (1999)*].

Theophanes Confessor, *Chronographia*, p. 278

[531] Τοῦτω τῷ ἔτει μηνὶ Σεπτεμβρίου ἰνδικτῶνος θ' ἐφάνη μέγας καὶ φοβερός ἀστὴρ εἰς τὸ δυτικὸν μέρος κομήτης πέμπων ἐπὶ τὰ ἄνω τὰς ἑαυτοῦ ἀκτῖνας ἀστραπούσας, ὃν ἔλεγον Λαμπαδίαν, ἔμεινε ἐπὶ εἴκοσι ἡμέρας λάμπων, καὶ ἐγένοντο κοσμικαὶ δημοκρατίαὶ καὶ φόνοι.

*The same year, in the month of September at the ninth indiction, a big and terrible star was seen in the western sector of the sky, that is a comet, also known as "Lampadias". This, similar to a torch, projected light rays in the upper part of the sky, continuing like this for twenty days.*

Georgius Hamartolus, *Chronicon Breve*, col. 796

Καὶ ἀστὴρ ἐφάνη μέγας εἰς τὸ δυτικὸν μέρος κομήτης ἐπὶ τὰ ἄνω πέμπων τὰς ἀκτῖνας, ὃν ἔλεγον Λαμπαδίαν, καὶ διέμεινε ἐπὶ ἡμέρας καὶ νύκτας κ' φαίνων.

*A big star appeared from the western area; a comet called "Lampadium" threw its rays upward and remained bright for twenty days and nights.*

Cedrenus Georgius, *Compendium Historiarum*, tomus prior, p. 647

Τῷ δ' ἔτει γέγονεν ἐφάνη κομήτης μέγας καὶ φοβερός, εἰς τὸ δυτικὸν μέρος πέμπων ἐπὶ τὰ ἄνω τὰς ἑαυτοῦ ἀκτῖνας, ὃν ἔλεγόν λαμπαδίαν. καὶ ἔμεινε λάμπων ἐπὶ ἡμέρας εἴκοσι.

*In the fourth year [of Justinian I] a great and terrible comet, whose rays soared upwards, was seen in the western part; it was said that it was of the "lampadium-type" and it shone for twenty days.*

Zonaras Ioannes, *Epitomae Historiarum*, Lib. XIV, pp. 152-153

Κατὰ δὲ τὸ πέμπτον ἔτος τῆς βασιλείας αὐτοῦ ἀστέρος ὠφθη φαῦσις κομήτου, ὃς λαμπαδίας ὠνόμασται, ὡς ἄνω τὰς ἀκτῖνας ἰεῖς, ὃς ἐφ' ἡμέρας εἴκοσι φαίνων διήρκεσεν.

*In the fifth year of his reign [of Justinian I] a comet appeared whose rays were stretched upwards. It was therefore called "lampadias" and shone for twenty days.*

Glycae Michael, *Annales*, p. 500

Ἐφάνη καὶ κομήτης ἡμέρας κ', καὶ μετὰ χρόνον τιὰ γέγονεν ἀστέρων δρόμος ἀφ' ἑσπέρας ἕως πρωῒ, ὡς πάντας λέγειν ὅτι πίπτουσιν οἱ ἀστέρες. εἶτα ὁ ἥλιος ἔλαμψε χωρὶς ἀκτίνων, ὥσπερ καὶ ἡ σελήνη.

*A comet appeared for twenty days and for a long time the stars were seen moving rapidly from evening to morning, so that everyone was talking about it. Then the Sun found itself without its light shining as if it were the Moon.*

Michel Syrien, *Chronique*, Lib. IX, Cap. XII, p. 170

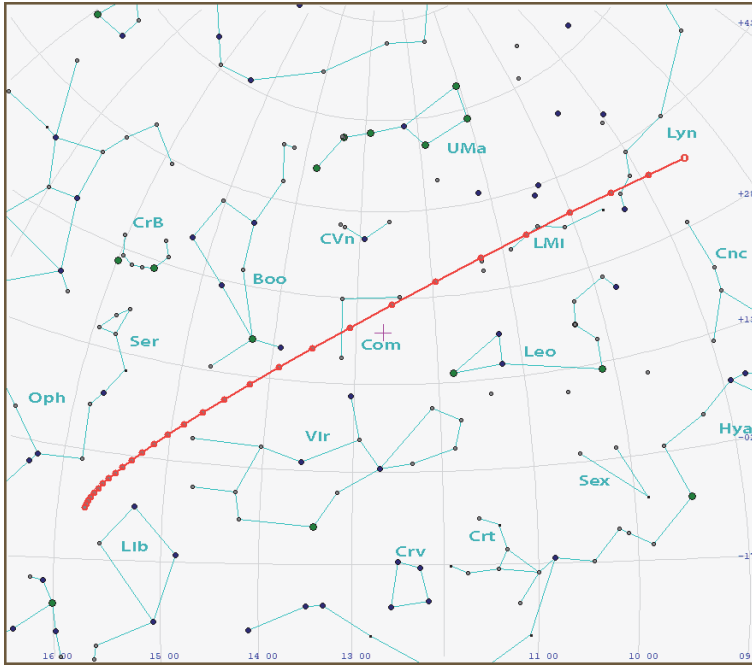
Au commencement du règne de Just[inian]us, parut en Orient une étoile sous l'aspect d'une grande lance. La pointe de la lance était dirigée en bas, menaçante, et des rayons terribles en sortaient. Tout le monde les voyait on l'appelle κομήτην, comme disent les Grecs. Sa vue remplit tout le monde de crainte, par la manière dont elle s'élevait et paraissait menaçante. C'était le signe de l'apostasie, de la destruction et de la ruine de l'Église, qui était sur le point d'arriver. [transl. from Syriac, Chabot (1901)].

*At the beginning of Justinian's reign, a star resembling a large spear appeared in the east. The tip of the threatening spear was pointing downwards and terrible rays were emanating from it. Everyone looked at it and called it κομήτην, as the Greeks say. The sight of her filled everyone with fear because of the way she rose and for how threatening she looked. It was the sign of apostasy, destruction and ruin of the church that was about to arrive.*

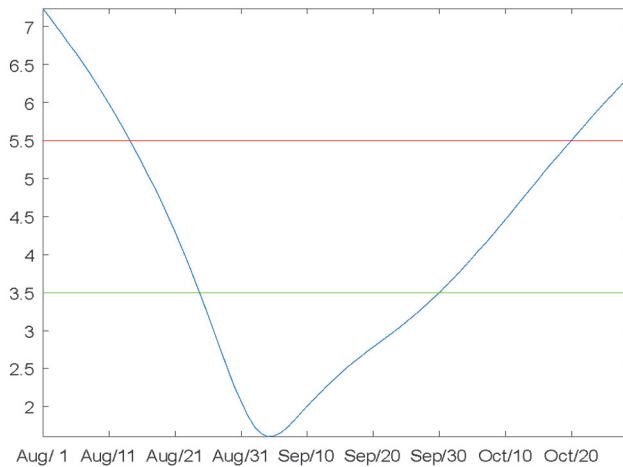
## Orbital elements (eq. J2000.0)

T (UT)	q	e	P	ω	Ω	i	Source
530 Sep 27.13	0.57559	0.96871	78.9	97°.582	41°.974	163°.394	Yeomans and Kiang (1981: 643)

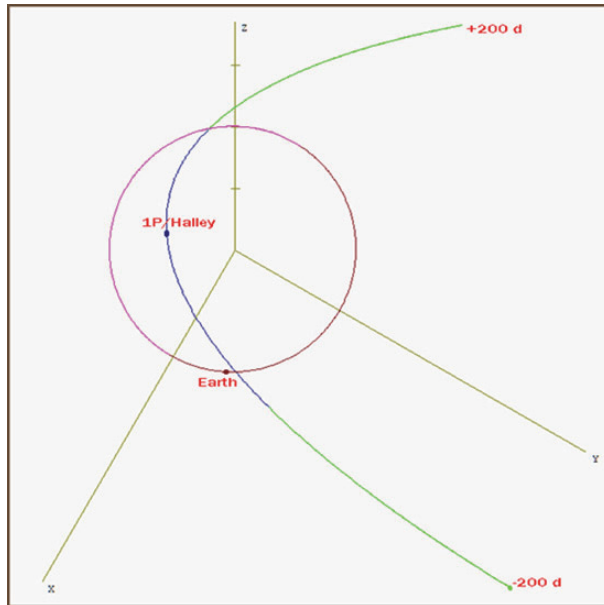
The comet was within 20° of the Sun from 9 October reaching a minimum solar elongation of 1.5° on 28 October. The most northern declination was 43° on 31 August. Closest to the Earth: 2 September (0.2807 au)



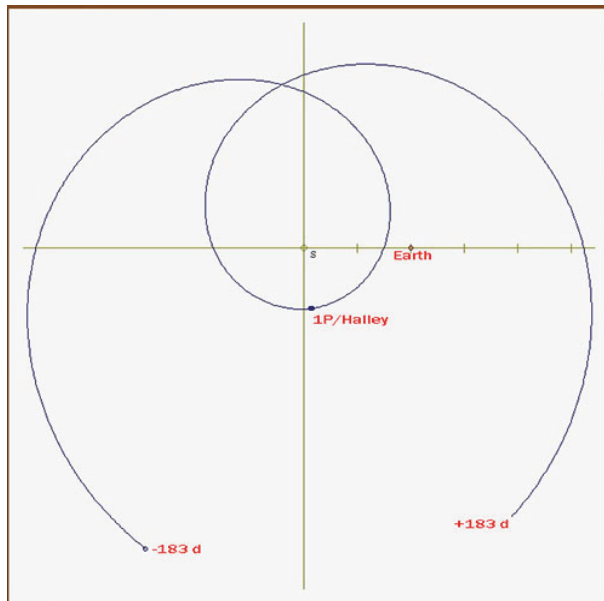
**Fig. 20** - Path of comet 1P/530 Q1 (Halley) from 28 August (blank circle) to 26 September 530 AD [step 1 day], based on Yeomans and Kiang's orbit



**Fig. 21**- Estimated visual magnitude of comet Halley 1P/ 530 Q1, considering an absolute magnitude  $H_{10} = 5.5$  [Kronk, 1999: 87]



**Fig. 22** - 530 AD. Positions of the Earth and comet 1P/Halley, at its perihelion, drawn in a axonometric oblique projection. Brown and blue colors represent the orbital path north of the ecliptic. Pink and green the south



**Fig. 23** - 530 AD. The motion of comet 1P/Halley, before and after perihelion in a rotating reference system so that the Earth and Sun positions remain fixed



**539 C/539 W1**

Just nine years after the passage of Halley's comet another bright comet appeared. Between them, but with no relationship, a strange event had meanwhile created certain bewilderment in the popular masses. For more than one year, in the period 535-537 AD, solar radiation had suffered a drastic and sudden drop, accompanied by a significant temperature decrease. An allusion to the phenomenon is found in the previous chronicle by Michael Glycas, who compares the light of the Sun to that of the Moon, but the details are provided by the contemporary Procopius of Caesarea (c. 490-c. 565): «This whole year was also marked by a great prodigy, appearing the Sun deprived of rays to likeness of the moon, and most of the days the human looks looked for it in vain; deprived therefore of its ordinary brightness it shone dark and gloomy rather than not: omen in all verified, of imminent war, of plague, hunger, and every other evil; it was that moment the tenth year of the Emperor Justinian». [Rossi 1833: 443]. All modern researchers are confident that the phenomenon was caused by a sudden increase of dust in the upper atmosphere. They are, however, divided on the cause. The possible scenarios are essentially two: the volcanic eruption [e.g. Larsen et al. 2008: 1-5; Helama et al. 2018: 1-12] and, less likely, the impact of an asteroid or small comet [e.g. Rigby et al. 2004: 1,23-1,26].

Back to the comet of 539, the primary Chinese sources are the *Wei shu* and the *Sui shu*, [Ho 1962: 165 and Pankenier 2008: 63]. During its appearance, the comet crossed the constellations of Sagittarius, Capricorn, Aquarius, Pisces, Pegasus, and Aries, but if the date of 17 November, as the first observation, is quite certain, the last one remains more doubtful. For someone, it would be 1 December 539 [Burckhardt 1807: 498; Williams 1871: 34; Ho 1962: 165; Yeomans 1991: 378], while others prefer 30 January 540 [Pingré 1783, I: 319-320; Hasegawa 1979: 261; Kronk 1999: 88-89]. This latter scholar, in particular, dwelled on the issue, concluding that the most plausible date of the comet's disappearance should be around 27 December 539 for Western observations and 30 January 540 for Eastern ones. According to him, the extra month of observation reported by the Chinese is justified by their greater dedication to observing the sky they have always had. However, doubling the observational period between the two cultures is rather difficult to sustain because the Chinese texts themselves do not agree about the lunar reference month. In fact, the time of disappearance reported: 乙卯 *Yǐ mǎo* (52), depending on the mentioned month, could be dated either 1 December 539 or 30 January 540. A further hypothesis about the date of the comet's disappearance could then be put forward, namely that there was, in the past, an exchange of terms in the transcription or interpretation of the text so that the ideogram 乙卯 *Yǐ mǎo* (52) should actually be read 己卯 *Jǐ mǎo* (16), that is 25 December 539.

If we accept this premise, the dates of Chinese annals and Middle Eastern chronicles would be in good agreement; in particular, Procopius (c. 500-post 565) and Euty chius of Alexandria (877-940) who estimate the comet's permanence in the sky at 40 days. About Euty chius, a very first edition of his *Annalis* dated 17th century, translated in Latin from Arabic, reports a duration of fourteen days: «apparuit in caelo stella magna quae quatuordecim dies duravit» [Selden and Pococke 1658: 171]. However, more recent revisions of the text have confirmed that it was an error and that it should be read “forty days” instead [e.g. Eutichio, *Gli Annali*, ed. by Pirone 1987: 296; Pearse, pers. comm. 17 July 2021]. Based on these assumptions, a set of orbital elements was first calculated in 2020 by Sicoli [Martinez and Marco 2021: 4]. Later, a new orbit has been computed by the same author considering 26 November 539 as the date of its approach to Venus cited in the Chinese text. This is supported by the fact that the day *bing xu* [23], mentioned by *Wei shu* [Pankenier 2008: 63], does not exist in the 11th lunar month. Could there have been a misinterpretation here too? If so, the most reasonable solution would be to read *Gēng xū* (庚戌), that is 26 November, instead of *Bǐng xū* (丙戌). However, the new orbital elements, as shown in the table below [Sicoli: this work], do not differ too much from each other.

As seen from this heterogeneous and contradictory set of information, the resulting scenario is somewhat confusing, which explains the uncertainties of previous researchers, particularly those who have worked on calculating a possible orbit. The first to engage in this task, at the beginning of the 19th century, was Johann Karl Burckhardt (1773-1825). Emphasizing the fact that Chinese sources had not provided useful records to determine the latitude of the comet, he left open the question of the inclination of its orbit, which he estimated to be close to 10 degrees. Standing by what the German astronomer naturalized French said, it was impossible to understand whether the comet was at the ascending or descending node on 22 November thus, he obtained two different orbital solutions, in which the angles represented by the argument of perihelion and the longitude of the node are reversed by 180 degrees [Burckhardt 1807: 497-500]. However, the most accepted orbit is the one proposed about forty years ago by the Japanese Ichiro Hasegawa [1979: 260]. According to his data, at the time of its discovery, the comet could be seen in Sagittarius after sunset, then moving northwards, away from the Sun, its brightness diminished. On 24 November, when it was still at the peak of its splendour, it would transit at about 5 degrees from Venus and the following 11 December, 10 degrees from Jupiter.

Jenniskens et al. [2019: 1-7] have recently suggested a possible correlation between the 15-Bootids and the comet of 539, after noticing that the orbital parameters of this shower were quite similar to those calculated by Hasegawa. The only exception was the perihelion distance, which appeared significantly smaller for the latter. Following the idea proposed by Jenniskens et al. [2019: 4], according to

which the "parent comet" would have appeared around the middle of the 13th century, a further investigation was carried out among the comets that appeared during that century [Martínez and Marco, 2021: 1-5]. In this span of time, comet C/1245 D1 was found to be the only one to meet the required criteria. The orbital elements of the 15-Bootids were thus integrated backwards to the 13th century. After revising the perihelion date, the calculations proceeded backwards to obtain a new perihelion passage time for the year 539. The two new sets of orbital elements thus obtained (that of 1245 and that of 539 AD) were finally used to recalculate a new orbit for comet C/539 W1 [Martinez and Marco: 2021: 4]. This one turned out to be adequate to meet the required conditions in terms of magnitude, visibility, and approach to Venus. However, it should be emphasized that the two orbits, calculated independently by Sicoli, also satisfy all the above conditions, although this implies that the comet of 539 is in no way connected to the 15-Bootids shower.

Among Western testimonies, the Chronicle of Edessa (here in two versions) reports the observation of a "sign in the shape of a spear" on 5 October 539. It is not excluded that this phenomenon is related to a fireball or an aurora rather than a comet. In fragments of a Syriac Chronicle reconstructed on the texts of Michael the Syrian, Bar Hebraeus, and Jacob of Edessa, attributed to Pseudo-Zacharias of Mytilene, an anonymous author of the sixth century, the lifetime of the comet varies from "several days" according to Michael up to "one hundred days" according to Jacob. [Hamilton and Brooks, 1899: 312, note 5; Greatrex, 2016: 413 note 117]. By placing the comet in Sagittarius, Procopius is the only one, among the non-oriental chroniclers, to provide a position in the sky. John the Lydian (c. 490-c. 565) instead, explains how its appearance gave the possibility to prove the thesis of the ancients, regarding the predictive value of the celestial signs. [Rodgers 1952: 178]. In this case, the comet would have predicted the invasion, in June 540, of the Persian army led by King Khosrow I (c. 501-579). During that campaign, the "wicked Persians", after having crossed the Orontes region, had pushed as far as the gates of Antioch, killing or deporting most of its inhabitants. Paul the Deacon (here called Aquilegiensi) confirms that the appearance of the comet would have occurred in the thirteenth year of Justinian, whose coronation dates back to 527. In the "Brescia chronicle" of Giacomo Malvezzi (c. 1380-c. 1454) among the events that the "comet star" would have predicted, stands out instead the war that confronted the byzantine general Belisarius (c. 500-565) against the Ostrogoth king Vitige (d. 542). Finally, the spear of fire appeared after the comet, mentioned by Euty chius, could be the same phenomenon mentioned by Agapius for the year 542 AD: «At this time [the sixteenth of Justinian's reign] a fire sign in the shape of a sword, appeared in the sky moving from east to west; it remained visible throughout the winter ». It is supposed to be an Northern Lights.

Eastern sources: Williams (1871: 34), Ho (1962: 165), Pankenier et al. (2008: 63)			
Source	Dates	Positions	Reference to Coordinates of LM determinative stars (J2000) and approximate Western asterisms
Wei shu (c. 554)	Nov 17 Nov 26* Dec 25*	Nandou [LM8] 3 <i>chi</i> from Venus Lou [LM16]	$\varphi$ Sgr, $\alpha = 18^{\text{h}} 45^{\text{m}} 39^{\text{s}}$ --- $\beta$ Ari, $\alpha = 01^{\text{h}} 54^{\text{m}} 38^{\text{s}}$
Sui shu (c. 636)	Nov 17 Dec 25*	Nandou [LM8] Lou [LM16]	$\varphi$ Sgr $\alpha = 18^{\text{h}} 45^{\text{m}} 39^{\text{s}}$ $\beta$ Ari, $\alpha = 01^{\text{h}} 54^{\text{m}} 38^{\text{s}}$
* see text Two Chinese sources mention this comet. One of them, the <i>Wei shu</i> , is contemporary. Both documents provide compatible information, noting its appearance in <i>Nandou</i> [LM8] and its disappearance in <i>Lou</i> [LM16], but the first also mentions a detail that can provide additional information on the path followed by the comet: namely its position 3 <i>chi</i> (about 3 degrees) from planet Venus.			

*Chronicon Edessenum (B)*, p. 416

[539] Anno decimo tertio Imperii Justiniani, qui fuit annus 850. Indictione secunda, die quinta Octobris, signum hastae in speciem in coelo apparuit. [*transl. from Syriac, Assemani (1719)*].

*In the thirteenth year of Justinian's reign, which was 850 [of the Greek calendar], in the second indiction, on October 5th, a sign in the shape of a spear appeared in the sky.*

*Edessenische Chronik*, p. 131

Im 13. Jahre der Herrschaft des Justinianos, dem Jahr 850, der II. Indiction, am 5. Tešrin ķedem wurde am Himmel ein Zeichen sichtbar, das einem Speer glich. [*transl. from Syriac, Hallier (1892)*].

*In the 13th year of the reign of Justinian, the year 850, of the 2 indiction, on 5 Tešrin ķedem [October 5th] a sign was visible in the sky that resembled a spear.*

Pseudo-Zacariah of Mitylene, *Syriac Chronicle (fragments chs. 6-8, from auctores varii)* p. 312

[538-539] In the eleventh year of Justinian, which is the year eight hundred and fifty of the Greeks, in the month of December [or January, it hasn't been stated whether it was the 1<sup>st</sup> or the 2<sup>nd</sup> Khonun (note 3)] a great and terrible comet appeared in the sky at evening-time for one hundred days [or several days (note 5)]. [*transl. from Syriac, Hamilton and Brooks (1899)*].

Procopius Caesariensis, *De Bello Persico*, Lib. 2, Cap. 4, p. 167

Τότε και ὁ κομήτης ἀστήρ ἐφάνη, τὰ μὲν πρῶτα ὅσον εὐμήκης ἀνὴρ μάλιστα, ὕστερον δὲ καὶ πολλῶν μείζων. καὶ αὐτοῦ τὸ μὲν πέρασ πρὸς δύοντα ἥλιον, ἢ δὲ ἀρχὴ πρὸς ἀνίσχοντα ἦν, αὐτῷ δὲ τῷ ἡλίῳ ὀπισθεν εἶπετο. ὁ μὲν. γὰρ ἐν αἰγοκέρω ἦν, αὐτὸς δὲ ἐν τοξότη. καὶ αὐτὸν οἱ μὲν τινες ἐκάλουν ξιφίαν, ὅτι δὴ ἐπιμήκης τε ἦν καὶ λίαν ὀξεῖαν τὴν ἀρχὴν εἶχεν, οἱ

δὲ πωγωνίαν, ἡμέρας τε πλείους ἢ τεσσαράκοντα ἐφάνη. οἱ μὲν οὖν ταῦτα σοφοὶ ἀλλήλοις ὡς ἦκιστα ὁμολογοῦντες ἄλλος ἄλλα προὔλεγον πρὸς τοῦτου δὴ τοῦ ἀστέρος σημαίνεσθαι: ἐγὼ δὲ ὅσα γενέσθαι ξυνηνέχθη γράφων δίδωμι ἐκάστω τοῖς ἀποβεβηκόσι τεκμηριοῦσθαι ἢ βούλοιοτο.

*A comet appeared at that time, in the constellation of Sagittarius; at first as great as a man and then greater. The head was facing east while the tail turned west, it was in Sagittarius and followed the Sun in Capricorn. Some said that, being the tail pointed, it was identical to the "xifias" in shape, to others it seemed similar to a "pogonia"; It was visible for over forty days, giving to the wise men an argument to discuss its possible effects.*

Lydus Ioannes, *Libri de Ostentis Argumenta*, pp. 273-274

ἐπειδὴ δὲ ἡ κείρα τὴν περὶ αὐτῶν ἀλήθειαν ἔδειξε καὶ ἡ γενομένη τοῦ κομήτου πρώην ἐπιτολή (ἰππέως δὲ ἄρα ἦν τὸ λεγόμενον σχῆμα) καὶ ἡ διὰ ταύτην συμβᾶσα τῶν κακοδαιμόνων Περσῶν ἔφοδος, μέχρι μὲν τῶν Ὀρόντου.

*Circumstances have shown me the truth, namely the recent appearance of the comet (of the type called hippeos) and the consequent attack of the evil Persians who have gone beyond the Orontes region.*

Paulus Diaconus Aquilegiensi, *Historia Miscellae à Paulo Aquilegiensi Diacono primum collectae*, pp. 484-485; *Historia Miscella*, p. 109

[539] Tricesimo imperij Iustiniani anno apparuit in coelo cometa ardens quasi species lanceae, à Septentrione usq; ad Occidentem.

*In the thirteenth year of Justinian's Empire, a luminous comet with the shape of a spear [spread out] from north to west, appeared in the sky.*

Agapius, *Kitāb al-'unwān* (o Histoire Universelle), p. 426

En cette année, le Perse, c'est-à-dire Chosroès le Perse, fit une expédition contre Edesse où il tua beaucoup de gens. Une comète parut dans le ciel et resta durant quarante et une nuits.

*In the same year, the Persian, that is Chosroes the Persian, [Khosrow I (c. 513-579)] made an expedition against Edessa where he killed many people. A comet appeared in the sky and stayed for forty-one nights.*

Agapius, *Kitāb al-'unwān* (o Histoire Universelle), p. 430

Le même année, un signe, pareil à une lance de double grandeur, parut dans le ciel et resta pendant quarante jours.

*In the same year, a sign, like a spear of double size, appeared in the sky and remained for forty nights.*

Eutyhii Patriarchiae Alexandrini, *Annalium*, Tomus Alter, p. 171

Porrò tempore Iustiniani Imperatoris apparuit in caelo stella magna quae quatuordecim dies (?) duravit: ac postea apparuit in caelo hasta ignea quae dies aliquot mansit. [*transl. from Arabic, Selden and Poccocke (1658)*].

*Then during Emperor Justinianus' time a big star appeared in the sky for fourteen days [possibly 40 days, see next] . Then a spear of fire appeared in the sky and remained there for several days.*

Eutichio, *Gli Annali*, p. 296

Ai tempi del re Giustiniano apparve nel cielo una grande stella che vi restò per quaranta giorni. In seguito apparve nel cielo una lancia di fuoco che vi restò per parecchi giorni. [transl. from Arabic, Pirone (1987)].

*In the time of king Justinian there appeared in the sky a big star that remained there for forty days. Then appeared in the sky a spear of fire which remained there for several days.*

Abū I-Faraġ, (Bar Hebraeus), *Chronicon Syriacum*, p. 82

[537-538] Anno undecimo Iustiniani pax inter Persas Romanosque soluta est, & cometa grandis tremendusque tempore vespertino per multos dies apparuit. [trad. dal siriano, Bruns and Kirsch (1789)].

*In the eleventh year of Justinian, the peace between the Persians and the Romans ended and a great and terrible comet appeared in the evening for many days.*

Abū I-Faraġ, (Bar Hebraeus), *Historia Orientalis*, p. 94

Hoc tempore Cosra Persarum Rex urbem Roham oppugnavit, magnamque hominum multitudinem trucidavit. Apparuit etiam Cometa, qui quadraginta noctes permansit. [trad. dall'arabo, Pocockio (1672)].

Malvecio Jacobo, *Chronicon Brixianum*, col. 815

Horum factorum eventus praevenit stella Cometes, quae cunctis Italiae urbibus apparens, humanis cordibus pavores maximos inducebat.

*The occurrence of these events was anticipated by a comet which, visible from all Italian cities, with its flame, aroused great fear in the hearts of men.*

Camerarius Joachim, *Norica sive de ostentis*, p. 322

[539] Anno imperij Iustiniani XIII. mense decembri, cometes in Sagittario visus.

Conradus Lycosthenes, *Prodigiorum ac Ostentorum Chronicon*, p. 301

Mense decembri cometa cometa in Sagittario visus est.

*A comet was observed in Sagittarius in December.*

Abū I-Faraġ, (Bar Hebraeus), *Historia Orientalis*, p. 94

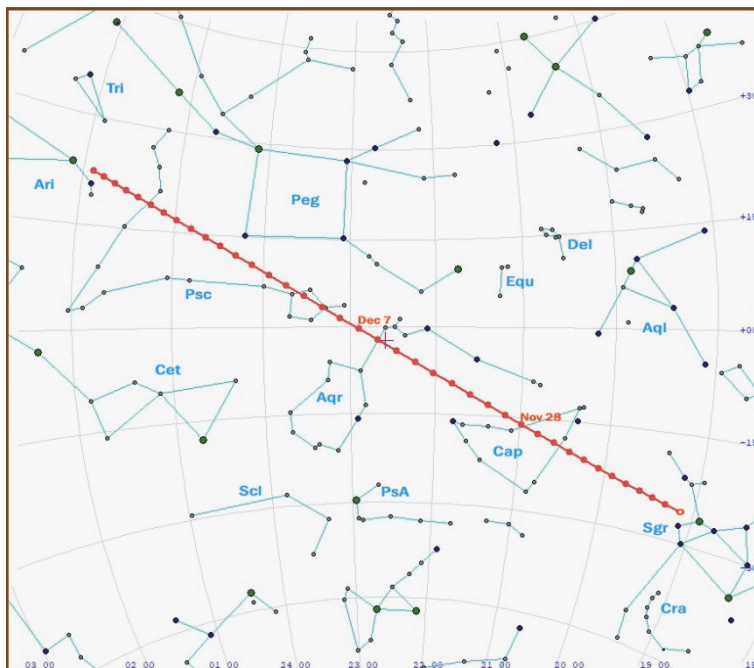
Hoc tempore Cosra Persarum Rex urbem Roham oppugnavit, magnamque hominum multitudinem trucidavit. Apparuit etiam Cometa, qui quadraginta noctes permansit. [trad. dall'arabo, Pocockio (1672)].

Orbital elements (eq. J2000.0); **L** is the ecliptic longitude and **B** the latitude of the perihelion:

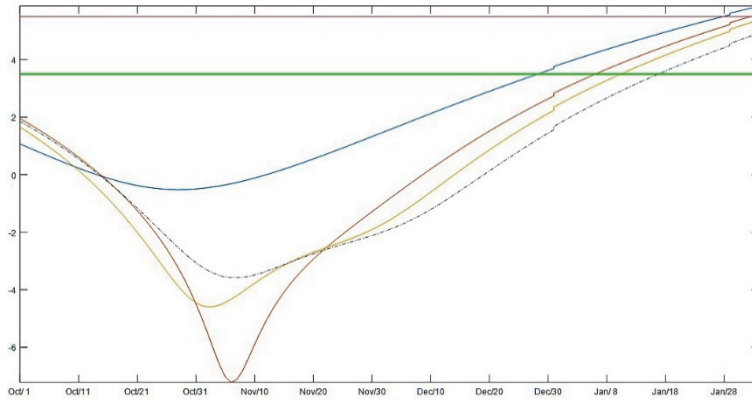
T (UT)	q	e	$\omega$	$\Omega$	i	L	B	Source
539 Nov. 6	0.16	1.0	246°	33°	19°			Hasegawa (1979: 260)
539 Oct. 21.1	0.341	1.0	255.6	60	10			Burckhardt (1800: 415)
539 Oct. 21.1	0.341	1.0	75.4	240	10			Burckhardt (1800: 415)
539 Nov. 1.5	0.28	1.0	262	55	14	317°	-14°	Sicoli (2020: 28767)
539 Nov. 4	0.36	1.0	274	57	11	331	-11	Sicoli (this work)
539 Oct. 22	0.31	1.0	250.26	83.3	15.69	333	-15	Martinez and Marco (2021: 4)

Sicoli’s orbit (this work). The comet was within 20° of the Sun from 28 August to 4 November 539 reaching a minimum solar elongation of 9° on 5 October. The minimum angular distance between the comet and Venus was ~ 2.5° on 26 November. Closest to the Earth: 4 November (0.360 au).

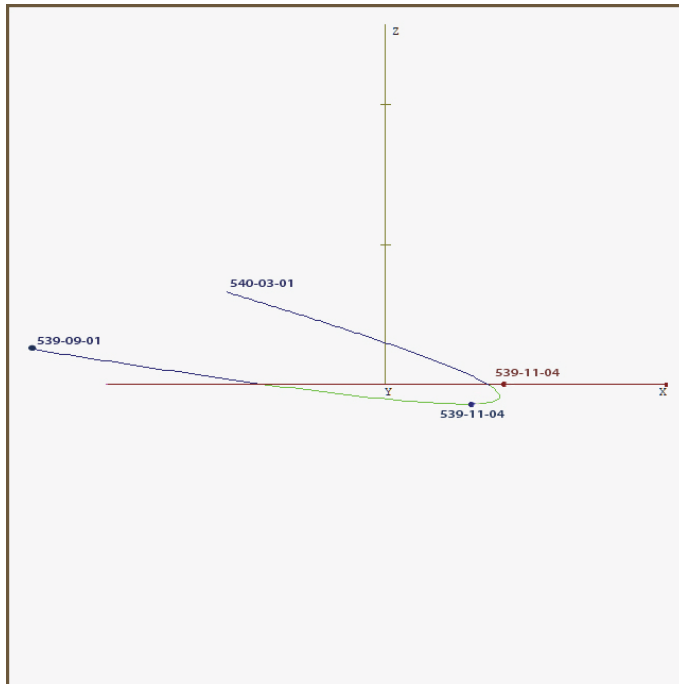
Martínez & Marco’s orbit. The comet was within 20° of the sun from 23 July to 2 October 539 reaching a minimum solar elongation of 12.6° around the beginning of October. The minimum angular distance between the comet and Venus was ~ 2° on 25 November. Closest to the Earth: 22 October (0.310 au).



**Fig. 24** - Path of C/539 W1 from 17 November (blank circle) to 25 December 539 AD from Sicoli’s orbit (this work) [ step 1 day]

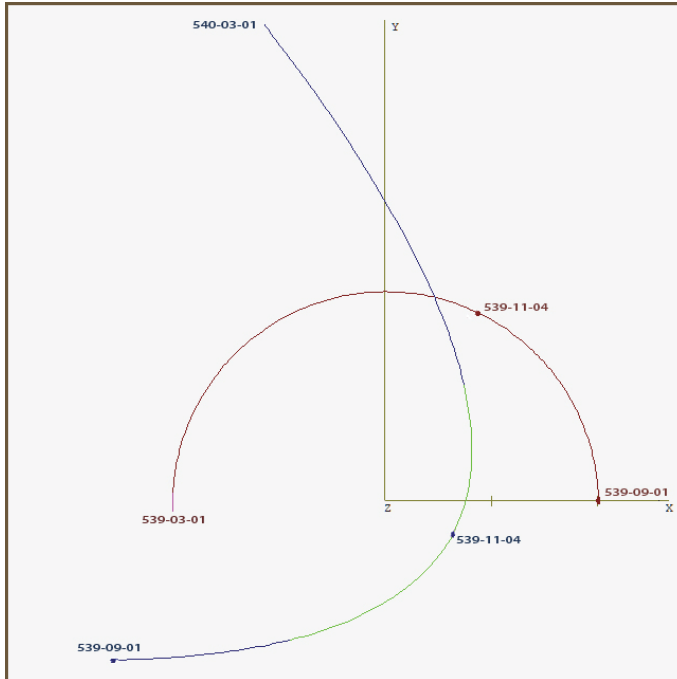


**Fig. 25** - Comparison of the apparent magnitude of comet C/539W1 using Hasegawa’s orbital elements (red) and those obtained by M&M (blue), Sicoli [2020] (yellow), and Sicoli [this work] (dotted black) The red horizontal line represents the limit of naked eye visibility  $m_v=5.5$ , the green horizontal line stands for  $m_v=3.5$ . We have used an  $H_{10}=0.8$  for all the comets



**Fig. 26** - Earth and comet of C/539 W1 at its perihelion, 4 Nov 539, along the Z-axis, according to Sicoli’s orbit (this work). Blue colors represent the orbital path of the comet north of the ecliptic, green south





**Fig. 27** - Earth and comet of C/539 W1 at its perihelion 4 Nov 539, along the X-Y-axis, according to Sicoli's orbit (this work). Blue colors represent the orbital path of the comet north of the ecliptic, green south

## 565 C/565 O1

In 565 AD, the most important event in the Mediterranean area was the death of the Byzantine emperor Justinian I. His reign lasted 38 years, from 1 August 527 until his death on 14 November 565 and was characterized by some important facts. Among these, the promulgation of the "Corpus Iuris Civilis", a work which is still the basis of the law in many European countries, and the epidemic known as the "plague of Justinian", which spread from 542 AD and continued to rage for several years, killing tens of millions of people across the continent. To make the conditions of the population even worse, in the period 535-553, the long war with the Goths, culminated with the sack of Rome by Totila in 546 after a long siege and the escape of all the inhabitants of the city. In 565 the Eastern sources speak of two possible comets: one observed on 21 April, the other in the period between July and October [Ho 1962: 165; Hasegawa, 1980: 70; Kronk 1999: 91-92]. Apart from a single observation, there is no information on the first alleged comet. On the contrary, the second one was certainly a more interesting object, being well documented also in the Western countries, where most chronicles associate its appearance to the death of Justinian. The comet was first detected on 22 July, before dawn in Ursa Major and, according to Chinese sources, it lasted up to 100 days in the sky. In the West Marius of Avenches (532-596) says that the comet remained for 70 days and Agnellus of Ravenna (c. 800-c. 850) writes that it was observed from August to 1 October. Gregory Bar Hebraeus' announcement about the comet staying for an entire year, does not seem credible [Hind 1860: 81]. The text of Michael the Syrian seems to combine two separate events. The first concerns the present comet, which in the Armenian version of the Chronicle, translated in 1871 by Robert Bedrosian, recites: «In the first year of his reign [*Justin II*] a blazing flame appeared in the sky and many said that it portended bloodshed». The second, which evidently occurred sometime later, is clearly ascribed to a meteorite: «Once again in the north-eastern sky fire appeared. Many died after looking at it. It brought with it the smell of burning reeds or burning paper. Many people gathered in baskets [what had fallen from the sky]».

An interesting and little-known reference to this comet is also found in a "commentary on Aristotle", written in the second half of the sixth century [Neugebauer 1975: 1045; Bezza 1993: 15]. The commentary is a so-called "apo phones", (literally "from the voice" or "from the oral teachings") which means that the text is actually a series of lecture notes that were written down by a student (or possibly several students) during the course that Olympiodorus of Alexandria (c. 495-c. 570) held on Aristotle's Meteorology. It is possible anyway that Olympiodorus himself read and revised them, but we cannot be sure of this [Baksa, pers. comm. 20 July 2021]. As reported in this text, the comet was first seen in Draco, in the month of *Mesore* [27 July-25 August], a location that would have made it circumpolar. Then, it reached Capricornus at the end of *Thoth* [31 August-29 September].

The *Chronicle of Zuqnīn*, although quite circumscribed, proves to be more difficult to interpret. On the one hand, the appearance of a comet is placed in the Greek year 885, corresponding to 573-574 AD [Schove 1984: 292], but on the other, the same text ends by stating that the star disappeared at the death of Justinian, inferring thus the year 565 [Stein 1949: 780, note 2]. This Chronicle, attributed to Joshua the Stylite, a monk of the monastery of Zuqnīn near Amid (now Diyarbakır in Turkey), was completed in the second half of the 8th century, but probably the passage quoted here comes from earlier texts, one of which was written by John Ephesus (c. 507- c. 588). The dating mismatch in some of the events reported by Joshua could be related to the fact that, in addition to the traditional Seleucid Era, it seems that at least one of his sources also may have used the Philip Era. This dating: «might be relevant to the fact that dates for Roman or Byzantine emperors from the late sixth to the early eighth century are recorded on an era that began about 12 years before the traditional Seleucid Era which is employed for other events» [Whitby 1992: 181].

Another controversial point is the observation period. It is not easy to understand why the chronicle mentions “May” instead “July or August”. Harrack's translation [1999: 136-137] reports that the comet «was seen in the northern region during the whole month of *lyyār* (May)» while, according to Witakowski 's interpretation (quoted here), the comet appeared starting from “one day of May” (Witakowski, pers. comm. 21 August 2021). Since the month of May falls within the observational period of the comet of the year 574, another option would be to consider that the “Zuqnin text” represents a mix of testimonies about the appearance of both comets of 565 and 574.

At the beginning of the nineteenth century, for comet C/565 O1, a couple of similar orbits were calculated by Burckhardt [1804: 163]. At first, he noticed some resemblance with the elements of comets appeared in 1683 and 1739, but finally, he deduced that: «a closer examination has shown that neither of these two orbits can represent the observations of the year 565» [Burckhardt 1804: 164]. A conclusion also confirmed by a more recent in-depth investigation [Martinez and Marco 2021: unpublished]. Furthermore, a new computation of the orbital elements for this comet gives results not far from Burckhardt's ones [Sicoli: this work]. Some resemblance with the elements of comet C/1014 C1, published by Hasegawa [1979: 257], have been noticed but, also in this case, there is no evidence confirming such an identification.

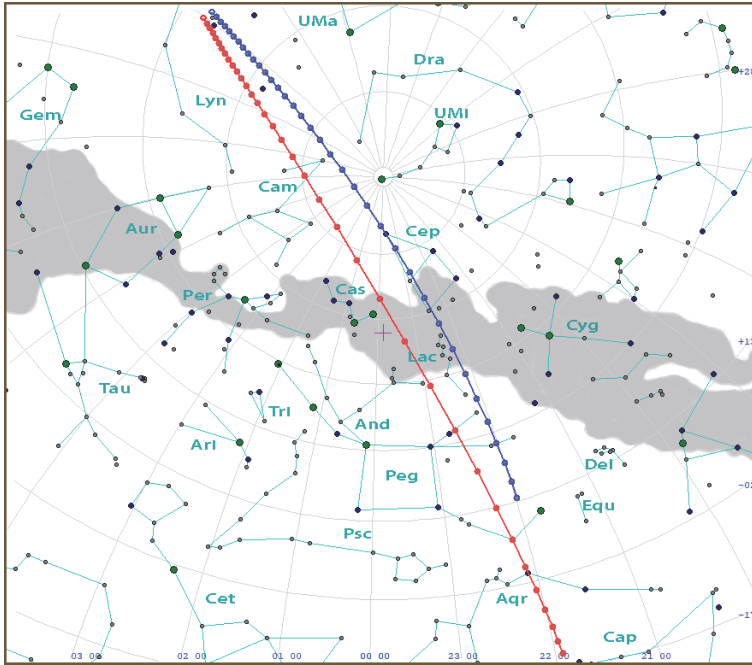
Eastern sources: Williams (1871: 34 and 36-37), Ho (1962: 165), Pankenier et al. (2008: 64-65)			
Source	Dates	Positions	Reference to Coordinates of LM determinative stars (J2000) and approximate Western asterisms
Zhou shu (c. 625) Sui shu (c. 636) Bei Shi (643-659)	Jul 22-24 Jul 22-24 Jul 22	Santai Wenchang Shangjiang western wall of Ziwei Wei [LM12] Yingshi [LM13] Dongbi [LM14]	$\iota$ UMa ( or $\iota$ , $\lambda$ , $\nu$ UMa) $\theta$ UMa $\omicron$ UMa  $\alpha$ Aqr, $\alpha = 22^{\text{h}} 05^{\text{m}} 47^{\text{s}}$ $\alpha$ Peg, $\alpha = 23^{\text{h}} 04^{\text{m}} 45^{\text{s}}$ $\gamma$ Peg, $\alpha = 00^{\text{h}} 13^{\text{m}} 14^{\text{s}}$
Nan shi (c. 659)	Jul 23	(North) Santai	$\iota$ UMa ( or $\iota$ , $\lambda$ , $\nu$ UMa)
Bei Qi shu (c. 636)	Jul 24	(north-east) Wenchang	$\theta$ UMa
According to Chinese texts, this comet was visible for about 100 days and there is consensus on its appearance in the Big Dipper ( <i>Santai</i> or <i>Wenchang</i> , depending on the source) following a path crossing <i>Wei</i> [LM12] and to become extinct between <i>Xu</i> [LM11] and <i>Wei</i> [LM12]			

Orbital elements (eq. J2000.0); **L** is the ecliptic longitude and **B** the latitude of the perihelion:

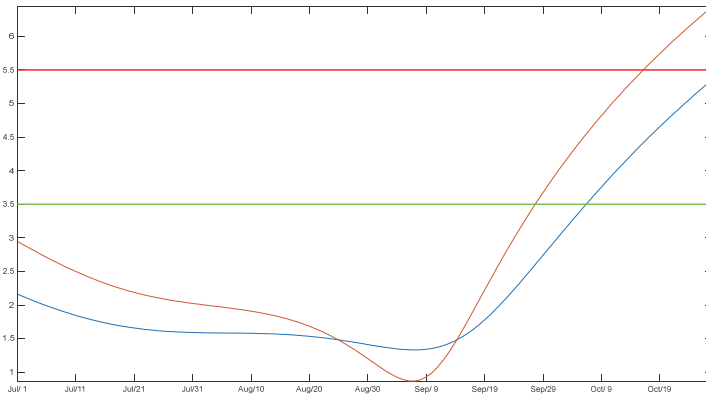
T (UT)	q	e	$\omega$	$\Omega$	i	L	B	Source
565 Jul 15	0.832	1.0	79°	180°	121°			Burckhardt (1804: 163)
565 Jul 9.5	0.719	1.0	70	178	118			Burckhardt (1804: 163)
565 Jul 19.2	0.776	1.0	92	182	121	88°	+59°	Sicoli ( this work)

First Burckhardt's orbit. The comet reached a minimum solar elongation of 28.6° on 4 July and the most northern declination of +70.5° on 3 September. Closest to the Earth: 20 September (0.570 au)

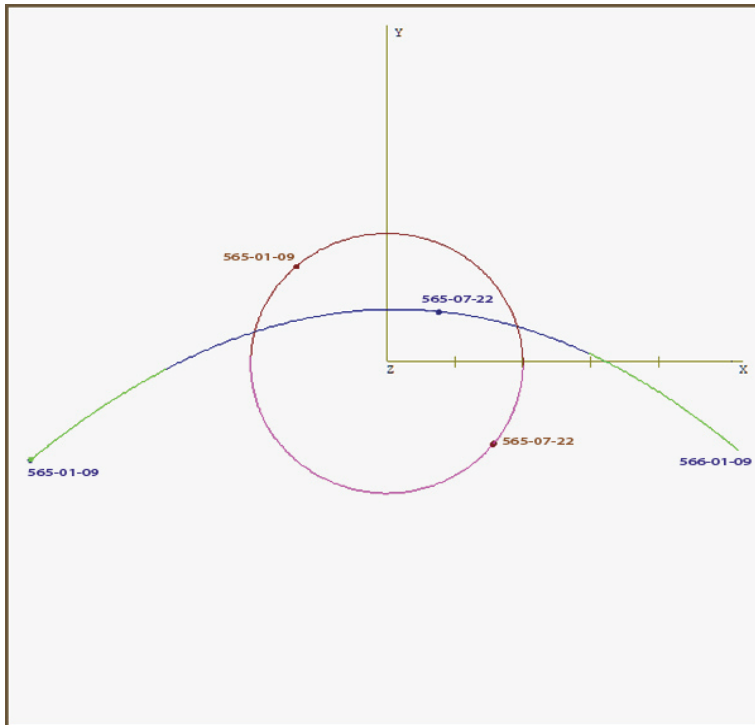
Sicoli's orbit. The comet reached a minimum solar elongation of 22.5° on 3 July and the most northern declination of +71° on 29 August. Closest to the Earth: 8 September (0.320 au).



**Fig. 28** - Path of C/565 O1, from 22 July (blank circle) to 30 September 565 AD. [step 2 days], from Sicoli's orbit (red) and the first Burckhardt's one (blue)



**Fig. 29** - Estimated visual magnitude of comet C/ 565 O1. Light curve derived from the first Burckhardt's accepted orbit (blue), absolute magnitude  $H_{10} = 1.5$  and using the set calculated by Sicoli (red), taking a  $H_{10} = 2.5$ . The green line represents visual magnitude 3.5, the estimated magnitude at which a comet would be detected, and the red one the limit of the naked eye visibility  $mv = 5.5$ )



**Fig. 30** - 1-year path of Earth and comet C/565 O1 along the X-Y axis, according to the Sicoli orbit. Blue colors represent the comet's orbital path north of the ecliptic, green the south. Positions at the date of discovery (a few days after perihelion) are also shown

Olympiodorus, *Aristotelis meteora commentaria*, pp. 52-53

καὶ ἵνα τὰ λοιπὰ παρῆς μνημονεύσω τοῦ καθ' ἡμᾶς γενομένου κομήτου, ὅστις συνέστη τῷ <σπα> ἔτει Διογενειανοῦ κατὰ Αἰγυπτίους Μεσῶρη μηνὶ ἀπὸ τοῦ περὶ τὴν ἄρκτον Δράκοντος καὶ τοῦ ἀπὸ τῆς κεφαλῆς· καὶ ἐκινήθη ἕως τοῦ Αἰγοκέρωτος διαμείνας ἄχρι Θῶθ μηνὸς πληρουμένου διελθὼν καὶ τὸν γαλαξίαν.

[565]. *To leave aside the rest, I will [only] refer to the comet that appeared in our time, the one that occurred in the 281st year of Diocletian, in the Egyptian month Mesore, moving from the northern part of Draco, from its head, as far as the Capricorn, lasting until the end of the month Thoth, passing through the Milky Way as well. [transl. from Greek, Baksa (pers. comm. 20 July 2021)]*

Marius Aventicensis, *Chronica*, p. 238

[566] Hoc anno signum apparuit in caelo per dies LXX. Eo anno mortuus est Iustinianus Augustus, et suscepit Iustinus nepos ipsius imperium.

Witakowski W. (edit by), *Pseudo-Dionysius of Tel-Mahre, Chronicle*, p. 128

[573-574] The year 885: one day in the month of May a great and terrible spear lance was of fire appeared in the northern quarter (of the sky). Its beginning, that is lower end, sprang from a star, and it was very long. First, it was seen to be rising towards the middle of night, but subsequently, in the (following) evening, it appeared to bow its head towards the east and gradually it became straight and stood upright, like a great lance. Later, towards the morning, it bent again and leant toward the western quarter. For two or three months it thus rose southern quarter, but on the death of the emperor Justinian it disappeared and was seen no more.

De Rossi G.B., *Excerptum ex chronica Horosii*, p. 22

(an. 565) Quattuor decies proconsul Basilius. Eo anno apparuit in caelo stella ardens sicut facula; et mortuus est Justinianus imp. et levatus Justinus imp. XI Kl. Ianuarias.

*In the twenty-fourth year [of Basil's consulship] a bright star like a torch appeared in the sky and Emperor Justinian died, succeeded by Justin [Justin II, (520-578)] on December 22nd.*

*Excerpta Sangallensia*, p. 335

Quattuor decies [XXVIII] proconsul Basilius eo anno apparuit in caelo stella ardens sicut facula et mortuus est Iustinianus imp., et levatus est Iustinus imp. XI kl. Ianuarias.

Agnellus Ravennatis, *Liber Pontificalis*, p. 114

In diebus istius expulsi sunt Franci de Italia per Narsetem Patricium. Et post haec apparuit stella Comis mense Augusto usque in Kal. Octobris. Et mortuus est Justinianus Augustus Constantinopoli quadagesimo anno Imperii sui, & luctus ingens ubique fuit, & moeror nimis de tali orthodoxo viro. Et apparuit signa rubra in Coelo, & civitas Fano igne concremata est, & multitudo hominum flamma consumta est.

*In those days the Franks were driven out of Italy by the Byzantine general Narses [478-566 or 573]. Then a comet appeared in August and lasted until the first of October. Emperor Justinian died in Constantinople in the fortieth year of his reign and there was great mourning and deep sadness everywhere for this man of the Orthodox faith. Red signs appeared in the sky and the city of Fano burned and many people perished in the flames.*

Elias Nisibenus, *Opus Chronologicum*, pars prior, p. 59

[565-566] 877. Eo apparuit lanceae ignis magna ac terribilis [in plaga] septentrionum hastae instar. Et eisdem diebus rex Romanorum [obiit]; et regnavit post eum Iu[stinus]. [transl. from Syriac, Brooks (1910)].

*In the year 877 [of the Greek calendar] a great and terrible torch appeared in the northern areas, similar to a spear. And in those days the king of the Romans [Justinian I] died and was succeeded by Justin [Justin II].*

Michel Le Grand (Michael the Syrian), *Chronique*, p. 201

La première année de son règne, une étoile flamboyante parut dans le ciel du côté du nord; elle était tellement prodigieuse que plusieurs personnes furent frappées de mort dès son apparition. Il tombait du ciel du papier et du bois brûlé que beaucoup de gens recueillirent dans des corbeilles. Tout le monde fut saisi d'effroi. [transl. from Armenian, Langlois (1868)]

*In the first year of his reign, a flaming star appeared in the sky on the northern side; it was so prodigious that many people were struck dead at its appearance. Paper and burnt wood fell from the sky, which many people collected in baskets. Everyone was seized with fear.*

Abū I-Faraġ, (Bar Hebraeus), *Historia Orientalis*, p. 95

[566] Anno imperii ipsius secundo [Giustino II, (520-578)], apparuit in coelo ignis flammans iuxta polum Arcticum, qui annum integrum permansit. [trad. dall'arabo, Pocockio (1672)].

Riccobaldus Ferrariensis, *Compilatio Chronologica*, col. 226

Stella cometa apparuit. Justinianus Imperator gloriosus defecit.

Iacopo da Acqui, *Della cronaca dell'immagine del mondo*, p. 1436

Post dies paucos stella comata fuit nuntia de morte Iustiniani imperatoris predicti et mortuus est postquam imperavit annis XXXVIII.

*A few days later, the comet announced the death of Emperor Justinian, who had died after reigning for 38 years.*

Iohannes de Lignano, *De Cometa*, ms. Vat. Lat. 2639, Biblioteca Apostolica Vaticana.

Item tempore Iustiniani cometa apparuit et statim post apparitionem Iustiniani morbo moritur.

*A comet also appeared in Justinian's time and soon after its appearance Justinian died of an illness.*

*Corpus Chronicorum Bononiensium, Cronaca A*, parte I, p. 304

Stella cometa aparuit ante tempus Iustiniani in stantis mortis de mense augusti usque in Kal. octobris. Iustinianus morbo moritur gloriosus. Multa signa rubea tunc apparuerunt in celo.

Rubeus Hieronymus, *Historiarum Ravennatum*, p. 170

Moritur Iustinianus, uti Nicephorus tradit, Constantinopoli idibus novembr. anno imperii XXXIX. aetatis LXXXII. Cum eam mortem crinita stella a sextili ad kalen. octobr. in caelo visa praecessisset.

*According to Nicephorus, Justinian died in Constantinople on November 13th in the 39th year of his empire at the age of 82 (years). His death was preceded by the appearance of a comet from August to October 1st*



## 568 C/568 O1

According to the Oriental chronicles, two possible comets appeared in 568 AD. The first observed on 20 July, was apparently followed for about a month [Kronk 1999: 93-94]; for the second comet, officially designated as C/568 O1, Ho [1962: 166] and Kronk [1999: 92-93] propose July 28 as the first detection. Knut Lundmark (1921: 233) and Xi Zezong, (1958: 119), including this record in their suspected novae lists, date erroneously 28 June 568 and 28 July 567 respectively. Pankenier [2008: 65-66], for this second comet, instead provides 3 September as the discovery date and early November as the time of its disappearance. It is plausible that this latter comet could be part of a series of wonders which, in Gregory of Tours (c. 538-594) opinion, followed the collapse, in 563, of the Swiss mountain Tauredunum (today Grammont), located on the southern side of Lake Geneva. Several of these were astronomical phenomena, in particular a partial eclipse of the Sun on 3 October 563 ( 1 October, according to Gregory) and a comet that Kronk [1999: 90-91] places chronologically in the same year as the eclipse. However, he adds that the observation could also refer to the comet of 565 or, more likely, to that of 568. On his behalf, the American Chambers (1841-1915) catalogues this comet in the year 563 but, at the same time, he wonders whether the term "year", used by Gregory for the duration of the comet, should not be replaced by "month" [Chambers 1889: 565].

It is certainly not easy to understand which of the three dates, 563, 565, or 568, is the correct one but, as Gregory mentions, the comet, shortly before the terrible pestilence of 571, which also spread in the French region of Auvergne, where: «tanta strages de populo illo facta est per totam regionem», seems to strengthen the choice of the year 568: «Sic enim et ante pestilentia Avernae regionis apparuit, pendens per annum integrum super regionem illam». In addition, the *Siglos Geronymianos*, which looks like a late copy of Gregory's chronicle, except for a reference to a local parheliion *phenomena*, places this event in the year 569. This text, as Gregory did, dates the eclipse on 1 October, stating that the Sun was almost all dark, although in the Iberian peninsula, the eclipse darkened only slightly more than 25% of the Sun at best. A first attempt to compute an orbit was performed by Hind [1844: 282] followed, some years later, by the French astronomer Paul Auguste Ernest Laugier (1812-1872), who was keen to point out that: «Nos résultats offrent un accord fort remarquable si l'on égard à l'incertitude de positions basées sur telle observations», finally adding that: «L'arc géocentrique décrit par cette comète a 150 degrés environ; je crois les elements tre-exacts» [Laugier 1846a: 155-156]. Similar orbital elements were confirmed, with small differences, also by Hasegawa [1979: 260] and more recently by Martinez and Marco [this work].

Eastern sources: Williams (1871: 34 and 37), Ho (1962: 166), Pankenier et al. (2008: 65-66)			
Source	Dates	Positions	Reference to Coordinates of LM determinative stars (J2000) and approximate Western asterisms
Zhou shu (c. 625)	July 20	Dongjing [LM22] Yugui [LM23]	$\mu$ Gem, $\alpha = 06^{\text{h}} 22^{\text{m}} 57^{\text{s}}$ $\theta$ Cnc, $\alpha = 08^{\text{h}} 31^{\text{m}} 36^{\text{s}}$
Bei Shi (643-659)	July 20	Dongjing [LM22]	$\mu$ Gem, $\alpha = 06^{\text{h}} 22^{\text{m}} 57^{\text{s}}$
Sui shu (c. 636)	July 20 Aug 18	Dongjing [LM22] (North)Yugui [LM 23]	$\mu$ Gem, $\alpha = 06^{\text{h}} 22^{\text{m}} 57^{\text{s}}$ $\theta$ Cnc, $\alpha = 08^{\text{h}} 31^{\text{m}} 36^{\text{s}}$
First comet reported by Chinese sources for this year. All three texts indicate his appearance in <i>Dongjing</i> [LM22] on 20 July, although only one of them specifies the date of his disappearance in <i>Yugui</i> [LM 23] on 18 August.			
Source	Dates	Positions	Reference to Coordinates of LM determinative stars (J2000) and approximate Western asterisms
Zhou shu(c. 625)	Sep 3	Fang [LM4] Tianshi Yingshi [LM13] Kui [LM15]	$\pi$ Sco, $\alpha = 15^{\text{h}} 58^{\text{m}} 51^{\text{s}}$ $\zeta$ Oph $\alpha$ Peg, $\alpha = 23^{\text{h}} 04^{\text{m}} 45^{\text{s}}$ $\zeta$ And, $\alpha = 00^{\text{h}} 47^{\text{m}} 20^{\text{s}}$
Sui shu (c. 636)	Sep 3	Fang [LM4] and Xin [LM5]	$\pi$ Sco, $\alpha = 15^{\text{h}} 58^{\text{m}} 51^{\text{s}}$ $\sigma$ Sco, $\alpha = 16^{\text{h}} 21^{\text{m}} 11^{\text{s}}$
	Between Sep 7-Oct 6	Tianshi Hegu	$\zeta$ Oph $\alpha$ Aql
	Sep 27	Hugua Yingshi [LM13] Ligong	$\zeta$ Del (or $\alpha$ Del) $\alpha$ Peg, $\alpha = 23^{\text{h}} 04^{\text{m}} 45^{\text{s}}$ $\alpha$ And $\lambda$ Peg
	Oct 16 Nov 5	Kui [LM15] (North) Lou [LM16]	$\zeta$ And, $\alpha = 00^{\text{h}} 47^{\text{m}} 20^{\text{s}}$ $\beta$ Ari $\alpha = 01^{\text{h}} 54^{\text{m}} 38^{\text{s}}$

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Sui shu (c. 636)	Between Aug 9-Sep 6	Fang [LM4] Xin [LM5]	$\pi$ Sco, $\alpha = 15^{\text{h}} 58^{\text{m}} 51^{\text{s}}$ $\sigma$ Sco, $\alpha = 16^{\text{h}} 21^{\text{m}} 11^{\text{s}}$
	Between Sep 7-Oct 6	Tianshi Hugua Xu [LM11] Wei [LM12] Yinshi [LM13] Ligong	$\zeta$ Oph $\zeta$ Del (or $\alpha$ Del) $\beta$ Aqr, $\alpha = 21^{\text{h}} 31^{\text{m}} 33^{\text{s}}$ $\alpha$ Aqr, $\alpha = 22^{\text{h}} 05^{\text{m}} 47^{\text{s}}$ $\alpha$ Peg, $\alpha = 23^{\text{h}} 04^{\text{m}} 45^{\text{s}}$ $\alpha$ and $\lambda$ Peg
	Between Oct 7-Nov 4	Kui [LM15] Lou [LM16]	$\zeta$ And, $\alpha = 00^{\text{h}} 47^{\text{m}} 20^{\text{s}}$ $\beta$ Ari, $\alpha = 01^{\text{h}} 54^{\text{m}} 38^{\text{s}}$
<p>Much more information exists for the second comet seen this year, including three versions of the <i>Sui shu</i>. For this latter, everything seems to indicate that the star was seen between early September and early November, confirming the 69-day period reported by <i>Sui shu</i>.</p>			

Gregorius Turonensis, *De Cursu Stellarum Ratio*, p. 419

HAEC STELLA comitis vocatur a plerisque peritis. Non omni tempore, sed maxime aut in obitu regis aut in excidio apparet regionis. Qualiter ergo intellegatur, haec est ratio. Cum capud crinitum deadimate apparuerunt fulgorans, regalem adnuntiat letum; si autem gladium ferens, rutilans, cum negre sparserit comas, patriae monstrat excidium. Sic enim et ante pestilentia Avernae regionis apparuit, pendens per annum integrum super regionem illam. Quod enim has proferat tristitias, Prudentius cum de nativitatis dominicae stella prudenter disseret, haec in hymno sanctae Epyphaniae ait : *Tristis comita intercedat, Et sicut astrum sibi Offeruerit vapore, iam Dei Sublucendis tractu cadat.*

Gregorius Turonensis, *Historia Ecclesiasticae Francourm Libri Decem*, Lib. IV, 31, p. 191-192

Quadam tamen vice in calendis Octobribus, ita sol obscuratus apparuit, ut nec quarta quidem pars in eodem lucens remaneret, sed teter atque; decolor apparens quasi saccus videbatur nam & stella quam quidam cometen vocant, radium tanquam gladium habens super regionem illam, per annum integrum apparuit, & caelum ardere visum est, et multa alia signa apparuere.

*Once on the first of October the Sun became so dark that only a quarter of it continued to shine but it seemed cloudy and colourless almost like sackcloth. Also, a star that some call a comet, with a sword-like ray, appeared over the region for a whole year; the sky seemed on fire and many other signs appeared as well.*

Siglos Geronymianos, Tome 6, p. 391

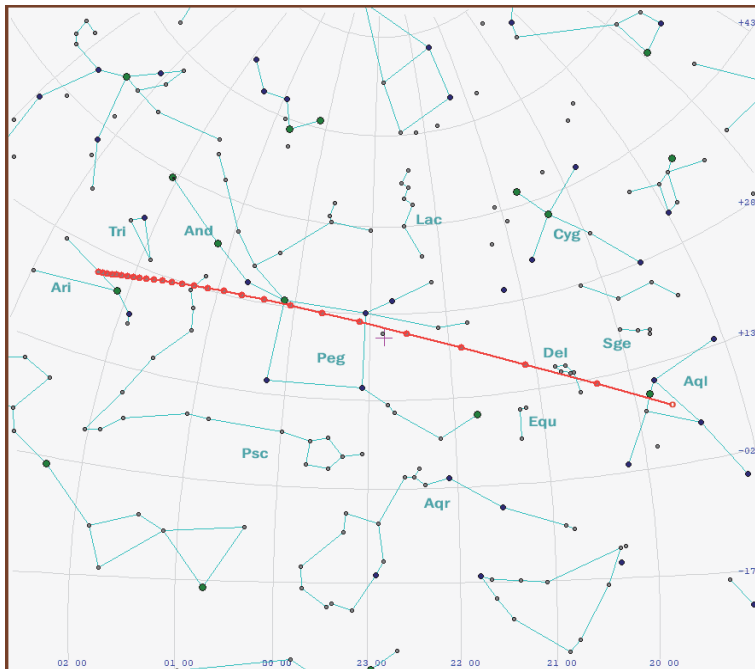
[569] En las Kalendas de Octubre el sol padeci6 un eclipse desusado, que le obscureci6 casi todo; algunos d6as alrededor del sol se vueron como tres soles, y un cometa, con forma de espada, se vio sobre Francia muchos d6as.

*On the Kalends of October the sun suffered an unusual eclipse, which obscured almost everything; some days around the sun were seen as three suns, and a comet, in the shape of a sword, was seen over France for many days.*

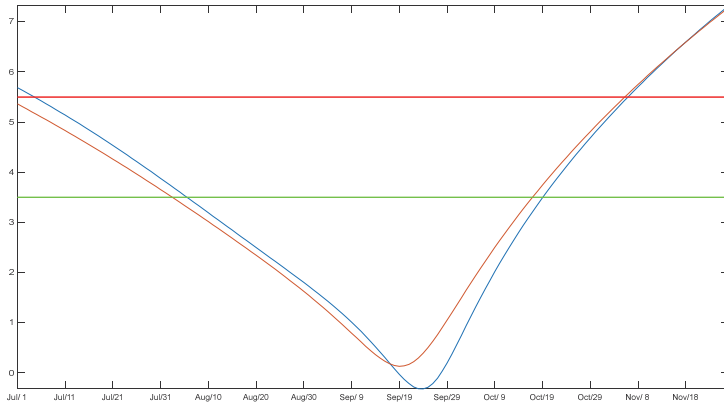
Orbital elements (eq. J2000.0); **L** is the ecliptic longitude and **B** the latitude of the perihelion:

T (UT)	q	e	$\omega$	$\Omega$	i	L	B	Source
568 Aug. 27.7	0.870	1.0	34.9°	301.8°	4.0°			Hasegawa (1979: 260)
568 Aug. 29.8	0.907	1.0	22.6	315.9	4.3			Laugier (1846a: 156)
568 Aug. 28.8	0.890	1.0	20.4	316.3	4.2			Hind (1844: 282)
568 Aug. 28.0	0.950	1.0	10.3	331.7	4.1	342°	+1°	Martinez and Marco (this work)

Martinez and Marco's orbit. The comet reached the maximum northern declination of +20° on 6 October. Closest to the Earth: 20 September (0.0997 au).



**Fig. 31** - Path of C/568 O1 from 18 September (blank circle) to 9 November 568 A.D. [step 2 day], according to Martinez and Marco's orbit.



**Fig. 32** - Considering  $H_{10} = 5$ , both Hasegawa (blue) and M&M (red) show similar visual magnitudes behaviour

## 574 C/574 G1

The Eastern sources report the appearance of two possible comets between April and June 574 AD [Ho 1962: 166-167; Kronk 1999: 94-95; Pankenier et al. 2008; 66-67]. A third object, marked by a single source in April 575 AD, places it near the star  $\alpha$  Boötis. The Chinese astronomer Xi Ze-zong (Hsi-Tsé-Tung) considered this last celestial body a *nova* going so far as to speculate that it could be the same one that appeared in 204 BC [Hsi-Tsé-Tung 1958: 119]. Returning to 574 the fact that both comets were observed on the same dates and in the same area of the sky, raised some doubts about the existence of two distinct objects. The comet described as white-green, now catalogued as C/574 G1, was first observed on the evening of 4 April. Then, moving from west to north-east, or more properly from Auriga to Ursa Major, it became circumpolar. From an astronomical point of view and considering the Eastern descriptions, it seems clear that comet C/574 G1 was not a very bright one. In fact, the best scenario implies that it grew up to a size of 2 *chi* (between  $2^\circ$  and  $3^\circ$ ). This makes it difficult for a visibility of 93 days, taking into account the information from *Sui shu* and the orbit calculated by Hasegawa, which would imply an observational period between 4 April and 6 July. Suppose we accept that the comet was tracked until early July. In this case the absolute magnitude requirements are high, around  $H_{10} = 1$  (the value 2.8 assigned by Kronk would not be sufficient). But, then, its visual magnitude would have been negative in mid-March, and would also have been prominent at sunset from China by the end of February. One wonders why it was not detected in this period. If one accepts the presence of a second comet, one might consider the hypothesis that the 93-day period refers to the duration of both comets.

In any case, with the aim of calculating a possible alternative orbit, we assumed that the comet was located after its perihelion passage so that the observations were not interrupted by its excessive proximity to the sun. Therefore, the perihelion should have occurred a couple of weeks after its first detection. Based on this assumption, the authors independently calculated a pair of similar solutions. (Martinez and Marco, this work; Sicoli, this work). We also considered that the comet should not have been excessively bright at any time in order to pass unnoticed before the perihelion, and thus we calculated an orbit that turned out to be more similar to the one proposed by Hind. We verified that taking  $H_{10} = 2$ , "Hind's comet" would cease to be seen at the beginning of July without being excessively bright at any time while, for the orbit calculated in this work, it is sufficient to take  $H_{10} = 3$ . Again, Hind's comet has the problem that it would have been perfectly visible to the naked eye in mid-March or even earlier, in a well-known area of the sky (between Orion and Taurus), making it difficult to explain why it was not observed. It is unfortunate that there is no sure evidence from non-Eastern sources. Gregory of Tours, however, probably also includes this comet among the "*crinita multitis*", that appeared before and after the death of the Frankish king of Austrasia Sigebert I, which occurred around 575 AD. Finally, in 1994, Ichiro

Hasegawa noted a similarity between his orbits, calculated in 1979, and a comet discovered, by Robert H. McNaught and Kenneth S. Russell using the U. K. Schmidt Telescope in Australia, on 17 December 1993. At that time, according to Nakano’s computations, this new comet had an estimated period of  $1430 \pm 30$  and its positions could be linked with those of comet of 574 AD (Nakano and Hasegawa: 1994). Nowadays the period of this comet, designated C/1993 Y1 (McNaught-Russell), has been calculated to be about 1560 years, and the possibility of a connection with the comet of 574 AD remains doubtful.

Eastern sources: Williams (1871: 37), Ho (1962: 166), Pankenier et al. (2008: 66-67)			
Source	Dates	Positions	Reference to approximate Western asterisms
Sui shu (c. 636)	Apr 4	(south-east) Wuche	$\iota$ Aur
	May 8	Wenchang	$\theta$ UMa
	May 23	(Bowl of) Beidou	$\alpha, \beta, \gamma, \delta$ UMa
	May 31	(Outside the wall) Ziwei	k Dra
	Jun 9	(North) Santai	$\iota$ UMa (or $\iota, \lambda, \nu$ UMa)
Zhou shu (c. 625)	Jun 2	(north-east the wall) Ziwei	Dra, UMi, Cam, (k Dra)
Bei shi (643-659)	Jun 2	Dongjing [LM22]	$\mu$ Gem, $\alpha = 06^h 22^m 57s$
Data from sources indicate the observations of one or two comets between 4 April and 9 June.			

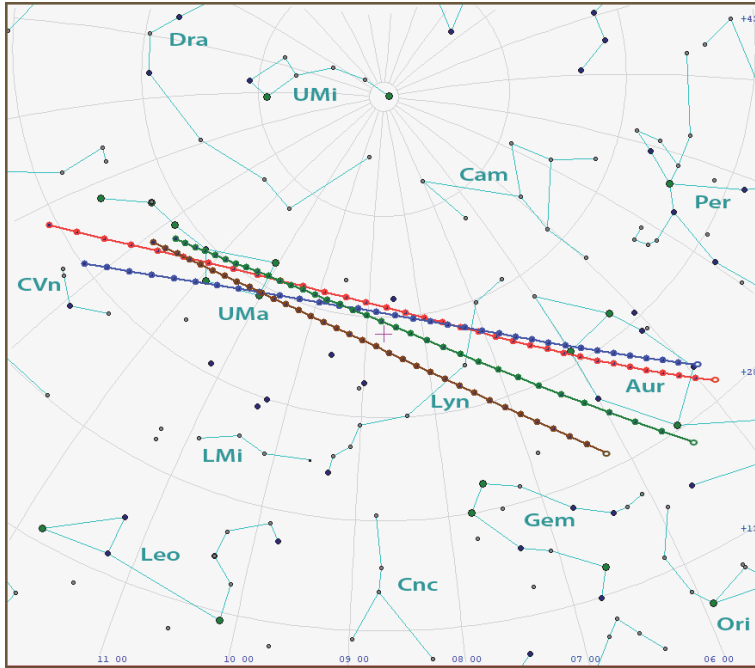
Gregorius Turonensis, *De cursu stellarum ratio*, p. 420

Nam et prisquam Sigibertus rex obierit, crinita multis apparuit.

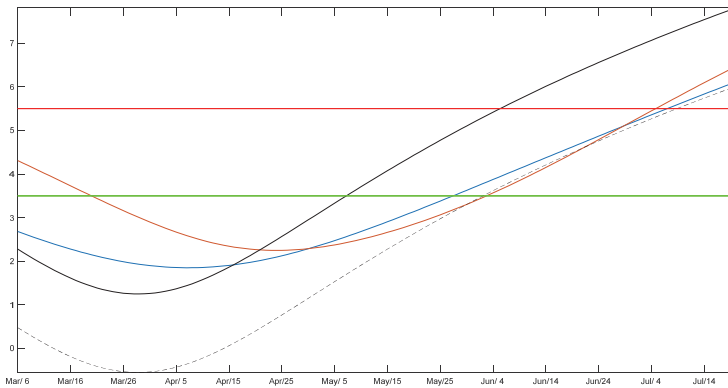
*Before and after the death of King Sigebert (Sigebert I, c. 535- 575) many comets appeared.*

Orbital elements of comet C/574 G1 (eq. J2000.0); **L** is the ecliptic longitude and **B** the latitude of the perihelion:

T (UT)	q	e	$\omega$	$\Omega$	i	L	B	Source
574 Mar 25	0.73	1.0	342°	155°	54°			Hasegawa (1979: 260)
574 Apr 7.78	0.963	1.0	15.5	148	46.34			Hind (1844: 282)
574 Apr 17.0	0.80	1.0	49.8	111	40	153°	+29°	Martinez and Marco (this work)
574 Apr 19.0	0.73	1.0	52	116	36	162°	+28°	Sicoli (this work)

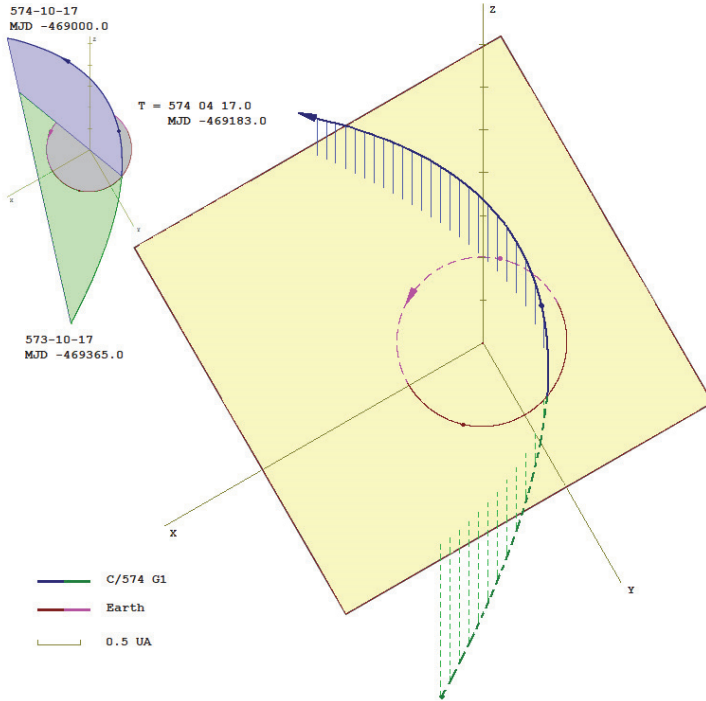


**Fig. 33** - Path of comet C/574 G1 from 4 April (blank circle) to 9 June 574 AD [step 2 days], according to the orbits of Hasegawa (brown), Hind (green), Sicoli (red) and Martinez and Marco (blue)



**Figure 34** - Apparent magnitude of Hind's comet (blue), this work (orange) and Hasegawa (black), in black dotted line apparent magnitude Hasegawa's comet considering  $H_{10} = 1$





**Fig. 35** - Orbital planes of Earth and comet C/574 G1, according to Martinez's orbit.

**582**

Chinese annals report the observation of a comet in January 582 AD [Ho 1962: 167; Hasegawa, 1980: 71; Kronk 1999: 96]. Pingré quoting the «Douzième année *Ta-kien*, douzième Lune» [1783, I: 605], misdated the event to 20 January 581 [Pankenier, pers. comm. 19 July 2021]. Evidently, in another part of his work, he did not connect it with Gregory of Tours' chronicle dated January 582 [Pingré 1783 I: 324]. This comet anyway, is missing from Pankenier's book because the record does not allow to deduce with precision neither the date nor the position in the celestial sphere of the object. Gregory of Tours (c. 538–594), in his *Historia Ecclesiasticae Francorum*, in addition to the comet, also reports a lunar eclipse. In 582 AD there were two: the first one on 25 March, whose phase of totality (1 hour and 46 minutes) was the longest of the century; the other one on 18 September, which lasted only eight minutes less, but was more favourable for an observer located in Europe. Gregory, in another part of his work, exposing the rise to power of Childelbert II, Chilpericus I, and Gontranus, gave a precise date of a series of prodigies that took place during that period. In addition to the few lines mentioning the comet, we also transcribe some of these portents to highlight how the alteration of historical information has generated confusion in subsequent chroniclers. First, The Chronicle of Fredegar (c. 7th century) which, in summarizing the first six books of Gregory's work, arbitrarily fixes at Easter day (!) the date of appearance of the comet (instead, on this day, Gregory of Tours refers to a brightness in the sky, probably an aurora, seen in the city of Soissons [Pingrée 1783, I: 324]). Then, Sigebert of Gembloux (c.1030-1112) who strangely anticipates the date of the comet's appearance in the year 541 AD [Pingré 1783, I: 321]. Maybe he mistakenly associated the appearance of the comet with the terrible epidemic known today as the "plague of Justinian". In any case, the fact remains that, in retrospect, many annalists, misled in turn by these two sources, ended up making the same mistakes.

A misunderstanding that still drags on today: Gary Kronk, for example, deceived by the wording: "in Anno autem Justiniani XIII", quoted by Andrea Dandolo, connects this chronicle to the comet of 539 AD [Kronk 1999: 89]. Andrew of Regensburg (c.1380-post 1442), in his *Chronicle of the Popes and Roman Emperors*, although approaching the correct date, concludes that the appearance of the comet and the other prodigies mentioned by Gregory happened under the pontificate of Benedict I (575-579), instead of that of Pelagius II (579-590). No source reports the duration of the apparition, which probably occurred between January 15 and 20, just after sunset, but it can be easily inferred that it disappeared within a few days, if not hours. This has suggested that it belongs to the Kreutz-type comets [England 2002: 17] a family consisting of a considerable number of comets, estimated at over 20,000 members [Knight 2008: 82]. Computer simulations have shown that an object belonging to this family is fully compatible with a comet, visible in the second half of January to the southwest setting almost simultaneously with the Sun. Less probable, though not to

be excluded entirely, that Gregory's description of a "ray of such large size as to resemble the smoke of a large fire seen from a distance" refers to a fireball rather than a comet.

Eastern sources: Williams* (1871: 35), Ho (1962: 167)			
Source	Dates	Positions	Reference to approximate Western asterisms
Chen Shu (c. 636) Sui Shu (c. 636) Wên Hsien Thung Khao (1317)	Jan 15	----	---
Suí Shū (c. 630) Wên Hsien Thung Khao (1317)	Jan 20	south-west	---

\* Williams, dates 26 January 580 AD but it was misprinted as 26 January 416 AD

Gregorius Turonensis, *Historia Ecclesiasticae Francorum Libri Decem*, Lib.V, 41, p. 280

Luna contenebricata est, & cometes stella apparuit.

*The moon was eclipsed and a comet appeared.*

Gregorius Turonensis, *Historia Ecclesiasticae Francorum Libri Decem*, Lib.VI, 14, p. 325-326

[582] Anno igitur septimo Childeberti regis, qui erat Chilperici & Guntchramni vicesimus & primus, mense Ianuario, pluvia, coruscationes, atque tronitrua gravia fuerunt: flores in arboribus ostenti sunt: stella, quam cometen superius nominavi, adparuit ita ut in circuitu eius magna nigredo esset. Et illa tanquam in foramine aliquo posita, ita inter tenebras relucebat, scintillans, spargénsque comas. Pro dibat autem ex ea radius mirae magnitudinis, qui tanquam fumus magnus incendij adparebat à longe. Visa est autem ad partem occidentis in hora noctis prima. In die autem sancto paschae apud Suessionas civitatem caelum ardere visum est, ita ut duo apparerent incendia: & unum erat maius, aliud verò minus. Post duarum verò horarum spacium coniuncta sunt simul: factâque pharo magna, evanuerunt. In Parisiaco verò termino, verus sanguis ex nube defluxit, & super vestimenta multorum hominum cecidit, & ita tabe maculavit, ut ipsi propria indumenta horrentes abnuerent.

*In the seventh year of the reign of Childebert [Childebert II (c. 570-596)], which corresponds to the twenty-first of Gontrand [Guntram (c. 532-592)] and Chilpericus [Chilperic I (c. 539-584)] there were, in the month of January, rains, lightning and great thunder, and on the trees flowers sprouted. A star, which I had previously called a comet, appeared in the sky and all around it there was great darkness. It seemed to be embedded in some kind of hole and, with its diffuse canopy, it shone so brightly in the darkness that it was sparkling. From it also departed a ray of such large size as to resemble the smoke of a large fire seen from a distance. [The comet] was observed towards the west in the first hour of the night. Also, on the day of Holy Easter, near the city of Soissons the sky was seen burning as if there were two fires, one large and one smaller. In the course of two hours they came together then, after releasing a large blaze, they disappeared. In the territory of Paris, there fell from the clouds a rain, of real blood, on the clothes of many men, soiling them with such stains that they got rid of them with horror.*

*Fredegarii Scholastici Epitome et Chronicum*, col. 581-582

Anno igitur septimo Childeberti regis, qui erat Chilperici et Guntramni vigesimus-primus, stella cometes apparuit in die sanctae Paschae. Apud Sexsionas civitatem caelum ardere visum est. In Parisiaco verò sanguis denuo fluxit, & super vestimenta multorum hominum cecidit.

*In the seventh year of the reign of Childebert, which corresponds to the twenty-first of Guntram and Chilperic, a comet appeared on the day of Holy Easter. Near the city of Soissons the sky was seen to burn. In the region of Paris blood has flowed from the clouds over the clothes of the people.*

*Annonius Floriacenses, De regum procerumque: Francorum origine gestisque Floriacenses, De regum procerumque: Francorum origine gestisque clarissimusque ad Philippum Augustum*, Libro III, Fol. XXXVIII recto, Cap. XXXIX

Anno septimo Childeberti regis qui fuit XXI. Chilperici atque Guntranni, stella cometes visa est in die sancto pasche. Apud Suessionensem civitatem caelum ardere visus est: in Parrhisiaco pago sanguis de nube fluens vestimenta multorum hominum cruentavit. Valitudines varię ac mortalitas magna eo anno Francorum attrivere gentem.

*Sigebertus Gemblacensis, Chronicon ab anno 381 ad 1113*, p. 27v

[541] In diversis Galliarum locis diversa signa visa sunt. Cometes apparuit die sancto paschae; caelum ardere visum est; verus sanguis ex nube defluxit in vestimentis hominum.

*Bernoldi, Chronicon*, p. 413

[580] Cometa die paschae visa. Suessionis celum ardere visum est. Pestilentia ingens fit.

*Romualdus Salernitanus, Chronicon*, col. 118

Coelum quoque ardere visum est. Anno septimo Childeberti regis, qui fuit XXI. Chilperici regis, atque Gunthramni, stella cometes visa est in die Sancto Paschae. Apud Suessionam civitatem coelum ardere visus est.

*The sky was seen burning. In the seventh year of the reign of Childebert which was the twenty-first of Chilperic and Guntram a comet was seen on Holy Easter Day. In the cities of Saxony the sky was seen on fire.*

*Flores Historiarum*, Lib. I, p. 191; *Matthaeus Parisiensis, Chronica Majora*, Vol. I, p. 241

[541] Anno gratiae Dxli. In Gallia cometa apparuit, ita quòd coelum ardere videbatur. Eodem etiam anno verus sanguis ex nubibus effluxit.

*In the year of grace 541 a comet appeared so bright that the whole sky seemed to be on fire. In the same year, moreover, authentic blood spilled from the clouds.*

*Conrad of Lichtenau, Chronicon*, p. 113

[583] Porro nocte illa visa est stella, quae dicitur cometa.

*Martinus Polonus, Summi Pontificis Poenitentiarij, Chronicon expeditissimum, ad fidem veterum manuscriptorum codicum emendatum & auctum*, p. 258

Cometes apparuit, die sancto Pascha caelum ardere visum est, versus sanguis ex nube defluxit in vestimentis hominum. Domus cuiusdam ab intus sanguine respersa apparuit, & secutae clades variae & malae valetudines cum pustulis & vesicis populum affligerent.

Andreas Dandolo, *Chronicon*, Lib. V, cap. X, col. 88

[541] In Anno autem Justiniani XIII, in diversis Galliarum locis varia signa visa sunt; Cometa apparuit in Paschaté, coelum ardere visum est; verus sanguis ex nube defluxit in vestimentis hominum.

*Corpus Chronicorum Bononiensium, Cronaca B*, parte II, p. 345

Uno teremoto fuo in Franza che quasi tuta la citade de Brudegalle ruinoe. E lla citade Aureliens quasi tuta arse. Et nel dì de pascqua apparve una stella cometta per la qual cosa l'anno sequente piove sangue nel contado de Parise e fuo grandissima mortalitade.

*There was an earthquake in France that destroyed almost the entire city of Bordeaux. And the city of Orleans was almost all on fire. And on Easter day a comet appeared because of which the following year blood rained in the countryside of Paris and there was a great mortality.*

Andreas Ratisbonensis, *Chronicon*, col. 2006

[575-579] Huius temporibus cometa in die Paschae visa est. Item Suessionis coelum ardere visum est. Item Parisius sanguis de nubibus fluxit. Item pestilentia ingens & mortalitatas facta est.

*At that time [during the pontificate of Benedict I, (d. 579)] on Easter Day a comet was seen. Also in Saxony the sky was seen to be on fire and in Paris blood rained from the clouds. Finally there was an epidemic that caused many deaths.*

Conradus Lycosthenes, *Prodigiorum ac Ostentorum Chronicon*, p. 292

[541] In diversis Galliarum locis diversa signa visa sunt. Cometes apparuit die sancto Paschae, coelum ardere visum est, veris sanguis ex nube defluxit in vestimenta hominum.

Gaguin Robert, *Rerum Gallicarum Annales*, p. 24

Per hos dies cometa visus est, fusca nube circumdatus, radio uno fulgens. Suessione coelum ardere conspectum est, Parisii sanguis à nube in multorum vestimenta stillavit.

Massaeus Christianus, *Chronicorum*, p. 173

[541] Per Gallias diversa signa videbantur. Cometes. In die pasche coelum ardere visum. Sanguis è nubibus fluere.

Mizaldus Antoninus, *Cometographia: crinitorum stellarum quas mundus nunquam impune vidit*, p. 235

Anno 541. Ipso die resurrectionis Domini cometes insignis conspectus est: quem diversa aeris signa praecesserunt in varijs Galliarum locis. Nam praeterquam quòd caelum ardere visum est.

Pontanus Ioannes Iovianus, *Historiae Gelricae*, Lib. II, p. 42

[581] Meroveus verò, Chilperici filius, relictam Sigeberti patruis viduam Brunichildem in matrimonium accepit. qui haud multo post eam ob causam necatus est anno Christi 581 quo & Cometes non sine horrore apparuit.

## 595 X/595 A1

Chinese chronicles describe the observations of a couple of comets (most likely the same) starting from 9 January. The first one, visible in the morning, the other in the evening, while a Korean source reports only the morning one [Ho 1962: 167; Kronk 1999: 96-97; Pankenier 2008: 6 and 68]. On the Western side, Theophylact Simocatta (*fl.* 7th century) and The Chronicle of Fredegar (c. 7th century) only say that a comet appeared, without providing further details, while in John of Nikiu (*fl.* 7th century), an Egyptian bishop and historian, in his chronicle states that the "appeared star" had provided a pretext to envious people, close to Emperor Maurice (c. 539-602), to put in bad light Aristomachus, one of his officials, accusing him (it seems falsely) of organizing a plot against the Emperor. Perhaps Maurice himself refers to this comet when, some years later, before being assassinated by Phocas (547-610), trusted his brother-in-law Philippicus (*fl.* 580-610) and told him about a premonitory dream in which he had glimpsed the death of him and his family. Paul the Deacon (c. 720-799) is the only author that provides some information about the duration of this apparition, and although "*totum mensem*" (all the month) probably should not be read literally, we can deduce that the comet remained visible for several days.

He and Agnello of Ravenna (c. 801 - post 846) confirm the morning and evening visibility of the comet connecting it to the death of the bishop of Ravenna, Giovanni Romano, which occurred on 11 January 595 [cfr. Bedina, 2001: 510-512]. Based on the timing of his pontificate and a possible misunderstanding in the calculation between the Roman and the Vulgar calendar, it has been suggested that the date *XI Januari* should be read *XI kal. Februar*, moving in fact the death of the bishop to 22 January [Codex Pontificalis, *Ecclesiae Ravennatis* in Raccolta degli Storici Italiani 1922: 245, n. 4]. Although this latter date better matches the possible disappearance of the comet, all modern historians, supported by the documentation collected, agree that the bishop of Ravenna effectively died on 11 January [Bedina, pers. comm. 18 September 2021]. Tolomeo da Lucca (1236-1327) speaks about prodigies that anticipated the death of Pope Gregory the Great (540-604): the comet in the first place and the birth in Byzantium of a child with four feet, then two kinds of monsters and finally a very bright light, that lasted all night long, formed by bloody spears. This last phenomenon, probably associated with a northern light, happened around the year 600 and was also reported by many other annalists. In a recent paper, it has been proposed a possible connection between comet X/595 A1 and C/1975 T2 (Suzuki-Saigusa-Mori) [Zhang and Zhao, 2011: 153]. However, as reported by the same authors, due to the uncertainty of the calculations and the lack of information, this link must be seen as a mere possibility. In fact extensive computations by the authors, integrating backward the motion of the comet C/1975 T2, were not able to link the observations of comet C/595 A1.

Eastern sources: Williams* (1871: 38), Ho (1962: 167), Pankenier et al. (2008: 68)			
Source	Dates	Positions	Reference to Coordinates of determinative stars and asterisms (J2000)
Sui shu (c. 636)	Jan 9  Jan 9	Jiao [LM1] Kang [LM2] Xu [LM11] Wei [LM12] Kui [LM15] Lou [LM16]	$\alpha$ Vir, $\alpha = 13^{\text{h}} 25^{\text{m}} 12^{\text{s}}$ $\kappa$ Vir, $\alpha = 14^{\text{h}} 12^{\text{m}} 54^{\text{s}}$ $\beta$ Aqr, $\alpha = 21^{\text{h}} 31^{\text{m}} 33^{\text{s}}$ $\alpha$ Aqr, $\alpha = 22^{\text{h}} 05^{\text{m}} 47^{\text{s}}$ $\zeta$ And, $\alpha = 00^{\text{h}} 47^{\text{m}} 20^{\text{s}}$ $\beta$ Ari, $\alpha = 01^{\text{h}} 54^{\text{m}} 38^{\text{s}}$
Samguksagi (1145) Jeungbo munheon bigo (1908)	Jan 9	Jiao [LM1] Kang [LM2]	$\alpha$ Vir, $\alpha = 13^{\text{h}} 25^{\text{m}} 12^{\text{s}}$ $\kappa$ Vir, $\alpha = 14^{\text{h}} 13^{\text{m}} 54^{\text{s}}$
* Williams dates 594 AD. Chinese chronicles describe the observations of one/two comets from January 9th. One visible in the morning, in [LM1] and [LM2] and the other one in the evening, in [LM15] and [LM16]. Korean sources only mention the morning one.			

### Theophylactus Simocattus, *Historiarum*, p. 281

Ἐν ταύταις ταῖς ἡμέραις κομήτης ἐν τῷ ὑπεκκαύματι φαίνεται. περὶ τούτων τοιγαροῦν τῶν δοκούντων συνεστάναι ἀστέρων οἱ μὲν φιλόσοφοι πρὸς μετεωρολογικὰς καταφεύγουσιν ἀφορμὰς, ἃς Σταγειρίται καὶ Πλάτωνες ἐν τῷ Ἑλικῶνι τῆς μνήμης βίβλοις ἐναπεγράψαντο. ἀστρολόγοι δὲ καὶ ἱστοριογράφοι τινὲς προαγόρευσιν ἐσομένων τινῶν λυπηρῶν ἀπεφίηναντο.

*In the same days a comet was seen. About these stars that are seen, according to philosophers who rely on the books of Helicon and the conclusions of the Stagirite and Plato, they have meteorological causes. Astrologers and ancient writers say instead that they are an omen of sad events.*

### Chronicle of John, Bishop of Nikiu, Ch. XCV (18-19), p. 154

And whilst they were engaged in such designs a prefect who knew astrology came forward, and likewise another person named Leon, the logothete, and, observing a star which had appeared in the heaven, they said that this star which had appeared portended the assassination of the emperor. And they went and made this announcement to the empress Constantina [abt. 560 -abt. 605] and said unto her: "Learn what thou shouldst do and take measures that thou and thy children may escape destruction; for this star which has appeared is a presage of a revolt against the emperor".

### Fredegarii Scholastici *Epitome et Chronicum*, col. 601

[595] Anno III Childeberto in Burgundia regnante, multa signa in caelo ostensa sunt, apparuit stella cometes.

*In the third year of Childebert's reign in Burgundia [Childebert II, (570-596)], many signs were seen in sky and a comet appeared.*

Paulus Diaconus, *De Gestis Langobardorum*, Book IV, Ch. XI, p.457

Inter haec sequenti mense Januario, apparuit stella cometa manè & vespere per totum mensem. Eo quoque temporis mense defunctus est Johannes Archiepiscopus Ravennae.

*Meanwhile, the following January, a comet appeared throughout the month in both the morning and evening. In the same month John Archbishop of Ravenna died. [Giovanni Romano (? - Jan.11, 595)].*

Agnellus Ravennatis, *Liber Pontificalis*, p. 126

Temporibusque istius mense Januario apparuit Stella Cometis manè, & vespere, & in ipso mense praedictus defunctus est Pontifex, & sydus recessit. Iste, ut dixi, Romae natus, ab ipsa Sede, hic missus doctrinam Apostoli instanter praedicabat, & ut omnes à peccato se averterent.

*At that time, in the month of January, a comet appeared in the morning and evening, and when the aforementioned bishop died [Giovanni Romano (? - Jan.11, 595), the star disappeared. The bishop was born in Rome and, coming from there, he preached without ceasing the doctrine of the apostles so that all might turn away from sin.*

*Historia Miscella*, p. 121

Et referebat Philippico somnii revelationem. Porrò nocte illa visa est stella in coelo, quae dicitur cometa.

*And he [Emperor Maurice (539 - 602)] told Filippico about his dream. A star had been seen that night in the sky that was called a comet.*

Aimoini Monachi Floriacensis. *Historiae Francorum*, Lib. III, Cap. LXXXIII, col. 753

Sequenti anno multa in coelo signa sunt ostensa et apparuit stella cometes.

Herimannus Augiensis, *Chronicon*, in *Annales et Chronica aevi Salici*, p. 90

Cometa et multa signa apparuerunt in caelo.

*A comet and many other signs appeared in the sky.*

Cedrenus Georgius, *Compendium Historiarum*, tomus prior, p. 705

χαὶ διηγῆσατο ὁ βασιλεὺς τὸ ἐνύπνιον [...] τῆ δὲ νυχθὶ ἐχέϊνη ἐφάνη ἄστηρ χομήτης ἐν τῷ οὐρανῷ ὁ λεγόμενος ξιφίας.

*The emperor told him the dream [...] an evil comet in the shape of a sword, called "xifia" had appeared in the sky.*

*Chronicon S. Benigni Divionensis*, col. 771

[595] Anno tertio Childeberti regnantis in Burgundia, multa signa coelo ostensa sunt, et stella cometes apparuit.

*Annales Magdeburgenses*, p. 128

[602] Porro nocte illa visa est cometa.

*Then at night a comet was seen.*



Radulphus Niger, *Chronicon*, p. 56

Eo tempore cometes apparuit, et nata sunt prodigia, ut homo quadrupes, et caput duos habens vertices.

Ptholemaeus Lucensis, *Historiae Ecclesiastica*, Book XI, Ch. XII, col. 918

Signa autem haec ponuntur ab Historiis praelibatis. Primò quidem de Cometa, quae mane, & vespere apparebat: quod est contra solitum cursum ejus. In suburbanis Byzantii, sive Constantinopolis, puer nascitur quadrupes, & alter duos vertices habens, ut scribit Isidorus in sua Chronica. Tunc etiam temporis signum sanguineum in Coelo apparuisse visum est, & quasi hasta sanguinea, et lux clarissima per totam quasi videbatur.

*These signs are collected in the Histories. First of all, a Comet that went against its usual path was visible both in the morning and in the evening, which is contrary to its usual course. in the suburbs of Byzantium, or Constantinople, a child was born with four feet and another with two heads as Isidore wrote in his Chronicle. At that time a sign of blood was also seen in the sky, like a bloody spear with a very bright light everywhere.*

Nicephorus Callistus, *Ecclesiasticae Historiae*, Book XVIII, Ch. 35

Π ρωτον μὲν γὰρ κομήτης μέγιστος ὤφθη ἐπὶ πλείστας περιφανῶς διαλάμπων ἡμέρας.

*At first, a large comet was seen shining for several days.*

Malvecio Jacobo, *Chronicon Brixianum*, p. 829

Verùm ipso Agilulpho regnante fuit siccitas nimiùm gravis à mense Januarii usque ad Septembrium mensem, & facta est fames magna. Inter haec etiam apparuit Cometa mane & vespere per unum mensem. Subsequenti tempore signum sanguineum in coelo apparuisse visum est, & quasi hastae sanguineae, & lux clarissima per totam noctem fulsit.

*In the time of king Agilulf [c.555–616] there was a very serious drought from the month of January until the month of September which caused a great famine. In the fragment, a comet appeared both in the morning and in the evening for a month. Then a blood colored sign similar to a bloody rod was seen in the sky and a great brightness shone all night long.*

Palmerius Matthaeus, *Liber de Temporibus*, p. 60

[594] Cometes per mensem in caelo est visus.

*A comet has been seen in the sky for a month.*

Pontanus Ioannes Iovianus, *Historiae Gelricae*, Book II, p. 43

[602] Obtruncatus est eo tempore, qui annus circiter Christi sexcentusimus secundus fuit, à *Phocae Mauritius* Imp. praelucente paulo ante ingenti cometa, qui ab ensis specie *Ξίφιας* est appellatus.

Giacomo Filippo da Bergamo, *Supplementi delle Cronache*, p. CLXXVII

[594] Questo anno medesimo apparve una lucidissima stella chiamata cometa in Bisantio, & fu visto un fanciullo con 4 piedi, & et ne la isola di Delon doi animali marini totalmente furono in forma humana, & molti altri segni simili a questi in varii luoghi.

*This same year, a very bright star called comet appeared in Byzantium, & a child with 4 feet was seen, & in the island of Delos two sea animals were totally seen in human form, & many other signs similar to these in various places.*

Platina, *Liber de Vita Christi ac Omnium Pontificum*, p. 99

Tanta vero hoc tempore apparuerunt prodigia, quanta nunquam antea, quibus certe futurae calamitates portendebantur. Nam et cometes visus est perlucidus, et Byzantii puer quadrupes nascitur. Et apud Delon insulam duo marina monstra, omnino humanam speciem habentia, visa sunt.

*At that time [Pontificate of Sabinian I (d. 606)] many wonders appeared, as never before, and they were an announcement of future calamities. A bright comet appeared, & in Constantinople a child with four feet was born; and in the island of Delos two sea monsters were seen, which very naturally represented the human effigy.*

Conradus Lycosthenes, *Prodigiorum ac Ostentorum Chronicon*, p. 314

[594] Eodem Agilulfo regnante mense Ianuario apparuit stella cometis, mane et vespere. Quo mense etiam Ioannes Archiepiscopus Ravennae obiit.

*Where Agilulf is reigning a comet star appeared in January, morning and evening. The same month John, archbishop of Ravenna, died.*

Arethius Benedictus, *Brevis cometarum explicatio: physicum ordinem & exempla historiarum praecipua complectens*, no page

[594] Anno domini 594. visus cometa per mensem.

Bizaro Petro, *Rerum Persicarum Historia*, Book V, p. 158

Hic tantummodo subiungam ipsius Mauritij tragicum ac funestissimum exitum, quem etiam Cometes, cui nomen est Xiphias, & pleraque alia prodigia praecesserunt.

Cavriolo Helia, *Delle Historie Bresciane*, Book IV, p. 70

Fu in quei tempi da Genaio fin al vegnente Settembre tanta secchezza, et fame in tutta Italia, che d'immatura morte perirono molte migliaia d'huomini di fame, et di sete. Quai cose furono accennate da quel gran Cometa che per tutto un mese apparve sera e mattina, et da quel sanguinoso segno che dopò fu visto in Cielo, et da quelle insanguinate lanze, che con chiarissima luce molte notti scorsero.

*It was at that time, from January until the following September, that there was great dryness and hunger in all Italy, the reason for which thousands of men died of hunger and thirst. These things were by a great comet that for a whole month appeared in the evening and in the morning and by that bloody sign that was seen the sky and by those bloody spears very bright that were seen for many nights.*

Fino Alemanio, *Dell'istoria di Crema*, Book I, pp. 3-4

Fu un gran secco, il quale durò dal mese di Gennaio fin'al Settembre. Nel qual tempo non venne mai pioggia. Venne parimente quest'anno gran copia di cavallette, le quali consumarono quel poco di verde, che c'era rimasto, La onde ne seguì carestia tale, che infinite persone morirono di fame. Pronosticò questi gravi danni una Cometa, la quale fu molte fiato veduta con spaventevoli modi per l'aria.

*It was a great dry, which lasted from January to September. At that time it never rained. Likewise this year came a large number of grasshoppers, which they consumed all the little green that was left, the resulting famine was such that countless people died of hunger. A Comet predicted these serious damage, which was seen many times with frightening ways in the air.*

Frytschius Marcus, *Catalogus prodigiorum atque ostentorum, tam coelo quàm in terra*, p. G 4(A)

Cometes integros mense in coelo apparuit.

*A comet appeared in the sky for a whole month.*

Sigonius Carolus, *Historiarum de Regno Italiae*, Book I, p. 34

Sequenti Ianuario crinita stella manè, et vespere toto apparuit.

*In the following January a comet appeared in morning and evening.*

# VII Century

## 607 1P/607 H1 (*Halley*)

The oldest Western report of this passage, together with the one concerning another comet observed at the end of the same year, is contained in a passage of the *Historia Langobardorum*, composed by Paul the Deacon (720-799) between 787 and 799 AD. Pingré [1783, I: 325-326], based on previous authors, places both apparitions reported by Paul "around 605" but, at the same time, he adds that he is strongly convinced that they are to be linked to the two comets recorded in China in 607 AD. Today we know that this supposition was fundamentally correct also because the Patriarch of Aquileia, Severus, whose death was mentioned together with the comet sighting by Conradus Lycosthenes, died in November 606. Paradoxically, however, the large number of Eastern testimonies of the comets observed that year provided many difficulties to those scholars who have dealt with the reconstruction of this return of Halley's comet in the past. Hind [1850: 56] wondered why, despite the transit at perihelion was scheduled for 607, none of the comets reported that year by the Chinese could be linked with certainty with the famous comet.

The same conclusion was reached by Cowell and Crommelin [1908: 666], who branded as "definitely tangled" the observations of 607. Even the addition, in more recent times, of a hitherto unknown chronicle, which reported an object observed for twenty days from 28 February [Ho 1962: 167], did not help to unravel the skein [Kiang 1972: 53; Stephenson and Yau 1985: 204-205]. Only a good knowledge of Halley's orbital parameters and better confidence in the calculation of perturbations and non-

gravitational forces eventually allowed to interpret and try to solve the contradictory information contained in the Eastern annals, thus allowing to reconstruct, with certain reliability, its orbital path [Yeomans and Kiang 1981: 643; Landgraf 1986: 258]. From these calculations, we infer that the comet passed perihelion around 15 March at a distance from the Sun of 0.581 au, reaching its minimum from the Earth of 0.089 au the following 19 April. This value, along with that of the year 374 AD, represents the second closest approach to the Earth in the known history of the comet, surpassed only by that of 837 AD, when Halley’s comet approached up to about 5 million km.

It has been argued that, if the date of perihelion in 607 had fallen five days earlier, the distance of the comet from our planet would have been less than that of the Moon [Seargent 2009: 42]. From our calculations, there is indeed a minimum distance of about 350,000 km, but only if comet Halley had transited at perihelion a dozen days earlier, that is around 3 March. This distance, more or less, also represents its Earth-MOID value, calculated for this passage, equal to around 0.002 au (see fig). The MOID parameter, acronym for Minimum Orbital Intersection Distance, as it is well known, represents the minimum distance between the orbits of two celestial bodies, and it is considered an excellent marker of the risk of impact for objects, such as asteroids and comets, moving along orbits that intersect that of the Earth or other planets. However, the "real" minimum distance between the two bodies only occurs when both reach the "MOID point" simultaneously.

Eastern sources: Williams (1871: 38-39), Ho (1962: 167), Pankenier et al. (2008: 68-69)			
Source	Dates	Positions	Reference to Coordinates of LM determinative stars (J2000) and approximate Western asterisms
Sui shu (c. 636)	Apr 4	Kui [LM15] Lou [LM16] Jiao [LM1] Kang [LM2]	ζ And, α = 00h 47m 20s β Ari, α = 01h 54m 38s α Vir, α = 13h 25m 12s κ Vir, α = 14h 12m 54s
Bei shi (643-659)	Feb 28 Mar 13	Dongbi [LM14] Dongjing [LM22] Wenchang Daling Wuche Beihe Taiwei Wu Dizuo (?)	γ Peg, α = 00h 13m 14s μ Gem, α = 06h 22m 57s θ UMa 9 Per ι Aur α Gem β Vir β Leo
Records of Halley’s Comet. Both sources indicate a long trajectory over the sky. The <i>Sui shu</i> reports that it passed through 4 LMs, while the <i>Bei shi</i> for 2 while listing a series of asterisms. This last source also gives two periods of appearance: 20 and 100 days.			

Paulus Diaconus, *De Gestis Langobardorum*, Lib. IV, Cap. XXXIII, p. 463

Civitates quoque Tusciae, hoc est Balneus regis, & urbs vetus à Langobardis invasae sunt. Tunc etiam mense Aprili et Majo, apparuit in coelo stella, quam Cometem dicunt. Dehinc Agilulfus rex iterum fecit pacem cum Romanis tribus annis.

*The cities of "Tuscia", Bagnoregio and Orvieto, were occupied by the Langobards. In the months of April and May a star they called comet appeared in the sky. Afterwards King Agilulf stipulated a peace of three years with the Romans.*

Agnellus Ravennatis, *Liber Pontificalis*, p. 136

In huius igitur temporibus Agilulphus, Rex Langobardorum, pace cum Smaragdo Patricio facta per annum unum, stabilis fuit; post namque annum expletum Balneum regis, & civitas Tusciae quae cognominatur Orbevetus, ab exercitu invasae sunt Langobardorum. Et in mense Aprilis et Maji Stella Comis in Coelo apparuit, & iterum fecerunt Romani pacem cum praedicto Rege tribus annis.

*In this time Agilulf, King of the Langobards, stipulated with the patrician Smaragdus a peace in the established duration of one year. After a year passed, Bagnoregio and the city of "Tuscia", called Orvieto, were invaded by the Langobard army and, in the months of April and May, a comet star appeared in the sky; and again the Romans made a peace of three years with the aforementioned king.*

Herimannus Augiensis, *Chronicon*, in *Annales et Chronica aevi Salici*, p. 91

Mense Aprili et Maio cometa visa est.

Conradus Lycosthenes, *Prodigiorum ac Ostentorum Chronicon*, p. 314

[604] Mense Aprili & Maio, apparuit in coelo stella, quam cometam vocamus, et eodem anno Severus patriarcha Aquileiensis [*Severus of Aquileia, d. 606 AD*] die suum obiit.

Bernoldi, *Chronicon*, p. 414

[606] Mense Aprili et Maio cometa videtur.

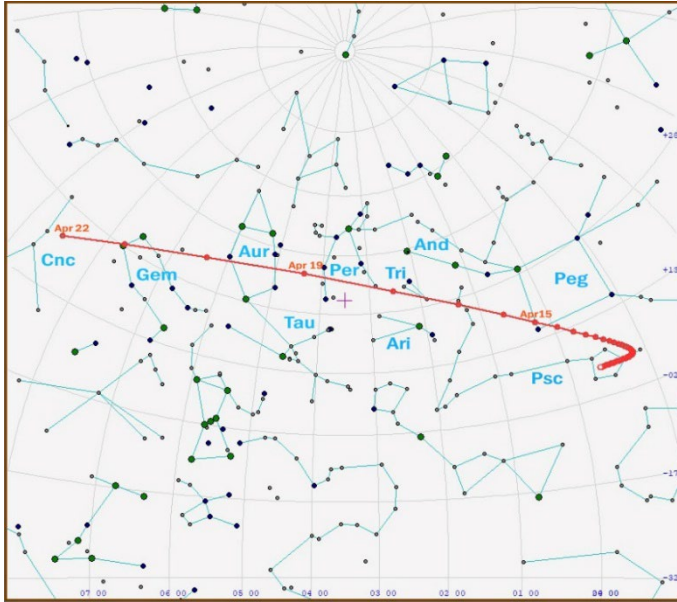
Gonzalo de Illescas, *Historia Pontifical y Catholica*, p. 129r

[604-606] Vióse un muy espantable cometa que duró por muchos días.

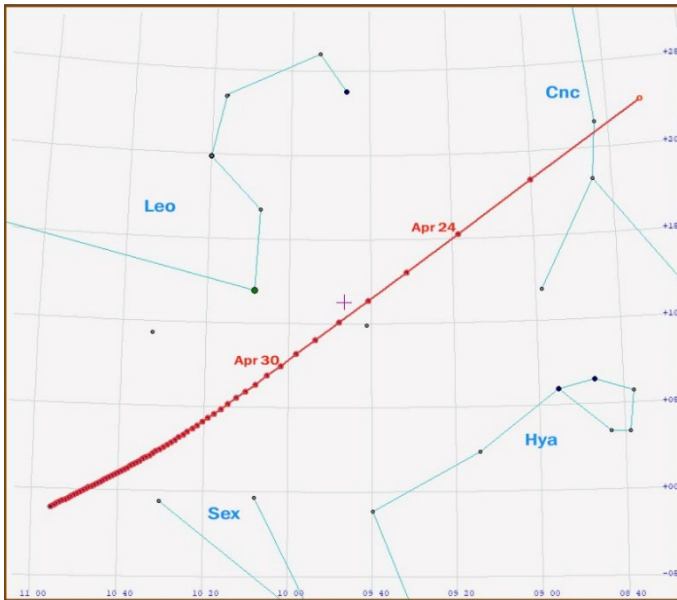
*There was a very frightening comet that lasted for many days.*

Orbital elements (eq. J2000.0):

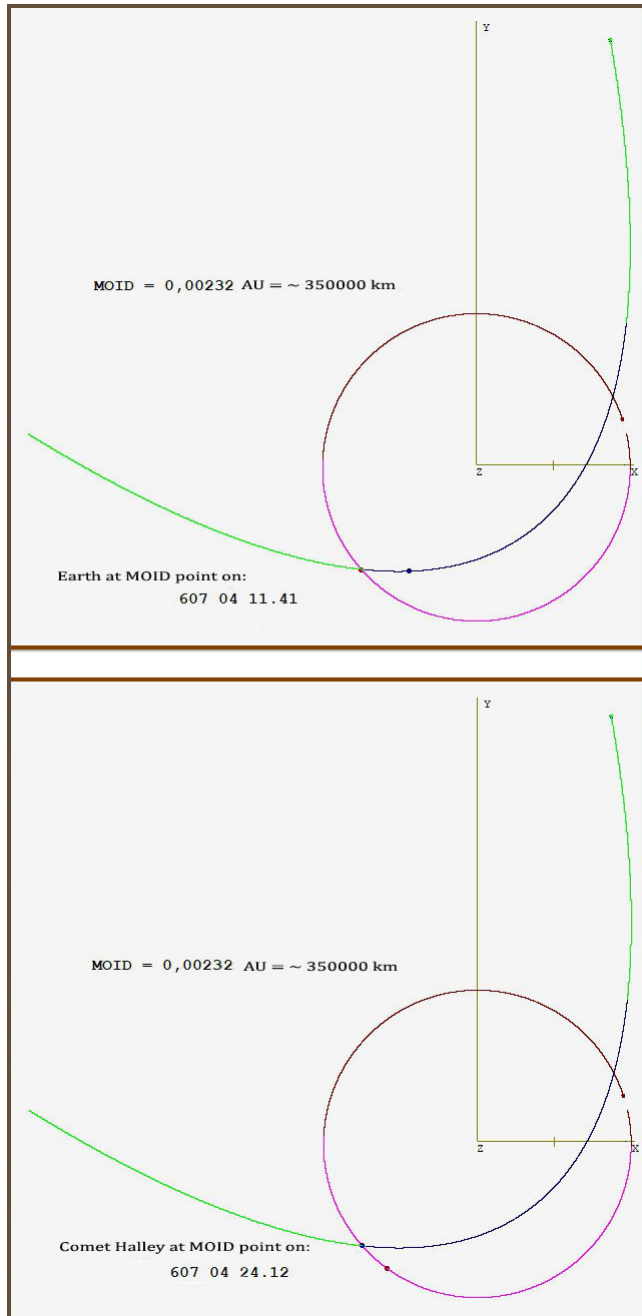
T (UT)	q	e	$\omega$	$\Omega$	i	Source
607 Mar 15.476	0.58083	0.96804	98.799°	43.261°	163.476°	Yeomans and Kiang (1981: 643)



**Fig. 36** - Path of comet 1P/607 H1 (Halley) from 28 February (blank circle) to 22 April 607 AD [step 1 day], based on Yeomans and Kiang's orbit.

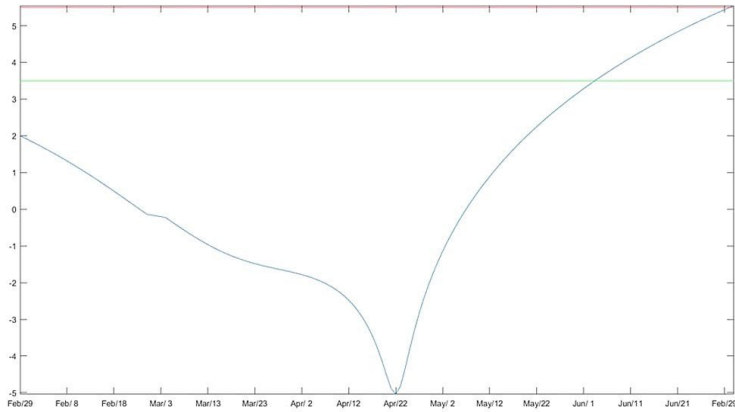


**Fig. 37** - Path of comet 1P/607 H1 (Halley) from 22 April (blank circle) to 25 June 607 AD [step 1 day], based on Yeomans and Kiang's orbit.

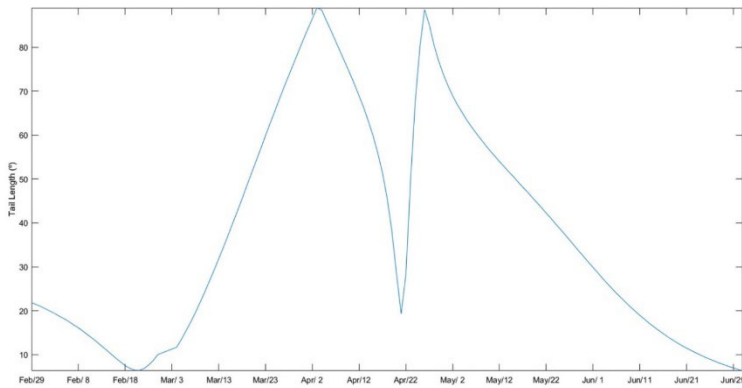


**Fig. 38** - Relative positions of Earth and 1P/607 H1 (Halley) at MOID point dates.





**Fig. 39** - Estimated visual magnitude of comet 1P/607 H1 (Halley) considering  $H_{10} = 0.5$ . The red horizontal line represents the limit of visibility ( $m_v=5.5$ ), the horizontal green line represents visual magnitude 3.5, which is the magnitude at which a comet would be detected.



**Fig. 40** - Evolution of the tail length of comet 1P/607 H1 (Halley) from 29 February to 29 June 607.

## 607 X/607 U1

After the death of the patriarch Severus, which occurred at the end of 606 AD, the group of dioceses under the city of Aquileia was divided into two parts, giving rise to a new patriarchate in the city of Grado. Here, with the support of the Byzantines, Candidiano da Rimini was elected to the highest ecclesiastical office. At the same time, the title of Patriarch of Aquileia was assumed by John I, supported by the Lombard Duke Gisulfo II of Friuli. Paul the Diacon, in the continuation of his chronicle, affirms that the same year, again, a comet (evidently after the one of April-May) had appeared in the months of November and December. Eastern sources confirm the presence of this second comet in the morning skies, starting from 21 October. Observations, which continued until January of the following year, place the “star” in the constellations of Coma Berenices, Leo, and Virgo, while the mention of the passage through the Chinese asterism Ti-Tso ( $\alpha$  Herculis) reported by Ho [1962: 167], must be considered wrong [Kronk 1999: 100].

It is very likely instead that the comet was positioned near the star  $\beta$  *Leonis*, corresponding to the asterism *Wu-Ti (-Tso)* or, as defined by Williams [1889: 38], *Te Tso*. The chronicle of Agapius of Hierapolis (d. after 942) that speaks of a large star, visible from April to October, projecting blood-coloured rays, is difficult to interpret. This paragraph is located after the capture of Dara by Chosroes II (604) and in the same year as Heraclius the Elder, the Exarch of Carthage, rebelled against Phocas (608-609). One hypothesis is that the text may contain multiple astronomical phenomena including comets Halley of 607 and X/607 U1. In addition a Chinese source states that on 22 October 608 a comet emerged in Auriga, swept Ursa Major and disappeared in Scorpius area (Kronk 1999: 101).

Eastern sources: Williams (1871: 38-39), Ho (1962: 167), Pankenier et al. (2008: 68-69)			
Source	Dates	Positions	Reference to Coordinates of LM determinative stars (J2000) and approximate Western asterisms
Sui shu (c. 636)	Oct 21, 607	Jiao [LM1] Kang [LM2] Taiwei (Dizuo)	$\alpha$ Vir, $\alpha = 13^{\text{h}} 25^{\text{m}} 12^{\text{s}}$ $\kappa$ Vir, $\alpha = 14^{\text{h}} 12^{\text{m}} 54^{\text{s}}$ $\beta$ Vir
<i>Sui shu</i> is the only Oriental source that records this comet. It states that it would crossed all the Lunar Mansions except <i>Shen</i> [LM 21] and <i>Dongjing</i> [LM22], disappearing around 23 January 608.			

Paulus Diaconus, *De Gestis Langobardorum*, Lib. IV, Cap. XXXIV, pp. 463-464

Hiis diebus defuncto Severo Patriarcha, ordinatur Johannes Abbas Patriarcha in Aquileja vetere, cum consensu regis, & Gisulfi ducis. In Grados quoque ordinatus est Romanis Candidianus antistes. Rursum mense Novembrio, & Decembrio, stella cometes apparuit.

*In these days after the death of Patriarch Severus, Abbot John was ordained patriarch, in ancient Aquileia, with the consent of the King and Duke Gisulf. In Grados [Grado] also Candidianus was ordained bishop by the Romans. Again in the months of November and December a "comet star" appeared.*

Agapius, *Kitāb al-'unwān* (o Histoire Universelle), p. 448

[609-610] En l'an 8 de Phocas, il parut dans le ciel un signe semblable à une grande étoile resplendissante de laquelle partaient des rayons comme du sang qui s'étendaient à la majeure partie du ciel et de l'air; et ce signe resta (visible) da mois de tichrin 1 (octobre) au mois de nisan (avril). [*transl. from Arabic, Vasiliev (1912)*].

*In the eighth year of Phocas there appeared in the sky a sign like a great shining star, from which rays like blood spread over most of the sky and air; and this sign remained (visible) from the month of Tichrin 1 (October) to the month of Nisan (April).*

Conradus Lycosthenes, *Prodigiorum ac Ostentorum Chronicon*, p. 314

[604] Eodem deinceps anno mense Novembri & Decembri iterum cometa apparuit.

*In the months of November and December of the same year the comet reappeared.*

## 626 X/626 F1

According to Chinese sources, on 26 March 626 AD, a very bright star appeared between the Pleiades and Aries. However, It is unclear if the reference to 28 days is related to its actual duration in the sky or whether, as suggested, the correct interpretation should be read in the sense of "until the 28th day" (Pankenier et al. 2008: 70). In the latter case, which is considered the most likely, the comet would then have disappeared in the asterism called *Juanshe*, an area in Perseus that includes  $\nu$ ,  $\epsilon$ ,  $\xi$ ,  $\zeta$ , and 40 Persei [Stephenson and Green, 2009: 36], on the 28th day [*dīng hài*] of the second month: a date that corresponds to 31 March. This scenario might also agree with the *Chronicon Paschale*, which speaks of a duration of only four days. Ho [1962: 168] refers to this object with the term "*po*", which is usually (but not always) associated with comets without tail; Williams [1871: 40] in turn speaks of a comet, while Kronk [1999: 102] defines it as a "*shining star*". Curiously, on the date, and roughly at the position reported by the Chinese, was also Venus at its brightest (abt. - 4.5 magnitude). The planet had crossed the Pleiades, a little more than ten days earlier, in its movement across the sky. Finally, the chronicle of Agapius, reported here, in its translation from Arabic, also speaks of a comet seen in the West, although it cannot be taken for sure that it refers to the object mentioned here.

Eastern sources: Williams (1871: 40), Ho (1962: 168), Pankenier et al. (2008: 70)			
Source	Dates	Positions	Reference to Coordinates of LM determinative stars (J2000) and approximate Western asterisms
Jiu Tang shu (c. 9th century)	Mar 26	(between) Wei [LM 17] and Mao [LM 18] Juanshe	35 Ari, $\alpha = 02^h 43^m 27^s$ 17 Tau, $\alpha = 03^h 44^m 52^s$ $\nu$ , $\epsilon$ , $\xi$ , $\zeta$ , $\sigma$ , and 40 Per
Xin Tang shu (c. 11th century)	Mar 26	(between) Wei [LM 17] and Mao [LM 18]	35 Ari, $\alpha = 02^h 43^m$ 17 Tau, $\alpha = 03^h 44^m$
	Mar 31	Juanshe	$\nu$ , $\epsilon$ , $\xi$ , $\zeta$ , $\sigma$ , and 40 Per
According to the Eastern sources an evening comet moved northwest at the end of March.			

### *Chronicon Paschale*, p. 715

Τούτω τῷ έναυτῷ μηνὶ δύστρω κατὰ Ῥωμαίους μαρτίῳ, ἐφάνη ἐπὶ δ' ἡμέρας ἀστὴρ φαιδρὸς πάνυ κατὰ δυσμὰς μετὰ δύστυ ἡλίου.

*In the same year, in the month 'dystrus' [March], according to the Romans, a very bright star appeared for four days, towards the west, after the setting of the Sun.*

Agapius, *Kitāb al-'unwān* (o Histoire Universelle), p. 452

[628-629] En cette année, parut dans le ciel une comète, dans la région de l'occident.  
[transl. From Arabic, Vasiliev (1912)].

*In that year a comet appeared in the sky in the western region.*

Dionysius I, Patriarcha Jacobitarum, p. 102

Christi 626. Anno 937 visus est cometa in trabis formam.

*AD 626. In the year 937 [of the Greek calendar] a lightning-shaped comet was seen.*

## 634 (X/634 S1)

On 8 June 632 AD, with the death of Muhammad (c. 570-632), the Islamic community chose Abū Bakr (573-634) as successor and leader. By this time much, if not all, of the Arabian peninsula had been submitted to Islam, which eventually began to expand into Byzantine lands. Two years later, under the leadership of Khalid ibn al-Walid (c. 590-642), a capable and valiant Arab general, the Muslim army marched into Syria and conquered much of its territory, including Damascus. Here, after a siege that lasted about a month, on 19 September 634 the city capitulated just while a bright comet appeared in the southern sky. Chinese sources confirm the presence of this comet, beginning on 20 September and observed for eleven days, in the celestial zone that includes Aquarius and Pegasus [Ho 1962, 168; Kronk 1999: 102-103; Pankenier et al. 2008: 70-71]. In the text of George Hamartolos (*fl.* middle 9th century), it is said that a sword star was seen from the Midday to Arcturus. We believe that the Greek term Ἄρκτου, in ancient Greek Ἄρκτοῦρος (Arktoûros) from ἄρκτος (árktos = Bear, Ursa), should not be referred either to Arcturus (α Boötis, the brightest star of the constellation of Boötes) nor to the Big or Little Dipper but more simply wants to describe the northern polar regions of the sky. This is supported by the fact that the text of Hamartolos is almost identical to that of his contemporary Landolfus Sagax (*fl.* late 9th century), who in *Historia Miscella* depicts the figure of the comet "à Mesembria usque ad Arcturum" (Sicoli et al. 2022: 220). In his chronicle, Cedrenus states that the comet appeared after Muhammad's death without specifying how long afterwards. In Theophanes, on the other hand, the star is associated with an earthquake in Palestine that occurred on the 23rd year of Heraclius, the same year Abu Bakr's invasion of Gaza (Ambraseys 2009: 220).

Both Pingré, in the first place [1783, I: 328-329], and Kronk later [1999: 102] linked these chronicles to a hypothetical comet that appeared in 632 AD: the year of the death of the prophet of Islam. It is very likely, however, that these two passages are also part of the evidence relating to the comet of 634. Cedrenus' text goes on to say that in the 24th year after the coronation of Heraclius I, which took place in October 610 AD, Caliph Abū Bakr (573-634) also died. The passage in which Theophanes reports both the appearance of the comet and the earthquake relates to the same year as the Arab invasion and the subsequent death of the patriarch *Sergius*. According to the Byzantine historian, Sergius had faced the opposing militia supported by only 300 soldiers and was killed in the first moments of the clash [Mango and Scott 1997: 467]. This battle must be dated to 634 AD [Mayerson 1964: 158; Gil 1997: 38] and to the same year should be ascribed both the earthquake (month of August or September) and the subsequent appearance of the comet. [Hoyland 2011: 93-94]. Despite the difference between Western and Eastern records about the comet's stay in the sky (30 days for the former, 11 days for the latter), in our opinion, this comet has all the credentials to be classified as X/634 S1.

Eastern sources: Williams (1871: 40), Ho (1962: 168), Pankenier et al. (2008: 70-71)			
Source	Dates	Positions	Reference to Coordinates of LM determinative stars (J2000) and approximate Western asterisms
Nihon shoki (c. 720) Ichidai yōki (c. 13th century)	(between) Aug 29-Sep 27	Seen in the south	---
Jiu Tang shu (c. 9th century)	Sep 20  Sep 22	Xu [LM11] Wei [LM12] Xuanxiao [LM 10-12] Xu [LM11] Wei [LM12] Di [LM 3]	$\beta$ Aqr, $\alpha = 21^{\text{h}} 31^{\text{m}} 33^{\text{s}}$ $\alpha$ Aqr, $\alpha = 22^{\text{h}} 05^{\text{m}} 47^{\text{s}}$ $\alpha = 22^{\text{h}} 47^{\text{m}}$ and $\alpha = 22^{\text{h}} 05^{\text{m}}$ $\beta$ Aqr, $\alpha = 21^{\text{h}} 31^{\text{m}} 33^{\text{s}}$ $\alpha$ Aqr, $\alpha = 22^{\text{h}} 05^{\text{m}} 47^{\text{s}}$ $\alpha$ Lib, $\alpha = 14^{\text{h}} 50^{\text{m}} 41^{\text{s}}$
Xin Tang shu (c. 11th century)	Sep 22	Xu [LM11] Wei [LM12] Xuanxiao [LM 10-12]	$\beta$ Aqr, $\alpha = 21^{\text{h}} 31^{\text{m}} 33^{\text{s}}$ $\alpha$ Aqr, $\alpha = 22^{\text{h}} 05^{\text{m}} 47^{\text{s}}$ $\alpha = 22^{\text{h}} 47^{\text{m}}$ and $\alpha = 22^{\text{h}} 05^{\text{m}}$
In this case, there are significant differences between the Eastern sources. While the Japanese merely indicate the appearance of a comet to the south, between late August and late September, the Chinese are more explicit, specifying its date of appearance as September 20-22, within LM10 and LM12, and its disappearance about 10 days later, probably on 3 October.			

Theophanes Confessor, *Chronographia*, p. 516

[A.M. 6124 = 632-633] Αὐτῷ δὲ τῷ χρόνῳ σεισμὸς ἐγένετο κατὰ τὴν Παλαιστίνην καὶ ἐφάνη σημεῖον ἐν τῷ οὐρανῷ κατὰ μεσημβρίαν, ὃ λεγόμενος δοκίτης, προμηνύων τὴν τῶν Ἀράβων ἐπικράτησιν ἔμεινε δὲ ἐπὶ ἡμέρας τριάκοντα διατείνων ἀπὸ μεσημβρίας ἕως ἄρκτου. ἦν δὲ ξιφοειδής.

*In the same year an earthquake occurred in Palestine and a clear sign was seen in the sky called "δοκίτης", towards the southern sector, which foreboding the Arab conquest. it was in the shape of a sword and remained visible for thirty days, moving from south to north.*

*Historia Miscella*, Lib. XVIII, p. 133

[633-634] Porrò eodem anno terraemotus factus est in Palestina. & apparuit signum in coelo quod dicitur δοκίτης. Contra meridiem, praenuncians Arabum potestatem. Perduravit autem diebus triginta extentum à Mesembria usque ad Arcturum: erat autem in modum gladii.

*Then in the same year [the twenty-third of the reign of Heraclius I (575-641)] there was an earthquake in Palestine and a sign appeared in the sky, which they call a "beam", towards midday foretelling the power of the Arabs. It lasted thirty days and was stretched out, in the shape of a sword, from south towards the north.*

Georgius Hamartolus, *Chronicon Breve*, col. 873

Μετὰ δὲ γε τὸν θάνατον τοῦ θεηλάτου Μαχούμετ ἐφάνη κατὰ μεσημβρίαν ἀστὴρ λεγόμενος Δοκίτης προμηνύων τὴν τῶν Ἀράβων ἐπι κράτειαν καὶ ἔμεινεν ἡμέρας λ', διατείνων ἀπὸ μεσημβρίας ἕως Ἄρκτου ξιφοειδῶς.

*After the death of the ascetic Muhammad, a star called Δοκίτης appeared towards the south, announcing the domination of the Arabs; this [star] remained for thirty days in the shape of a sword from South to Arktos.*

Agapius, *Kitāb al-'unwān* (or *Histoire Universelle*), p. 454

En cette même année, il y eut un violent tremblement de terre et il parut un signe dans le ciel, sous la forme d'une colonne de feu, qui commença à se mouvoir de l'orient à l'occident et du nord au sud et ensuite disparut. [transl. from Arabic, Vasiliev (1912)].

*In this same year there was a powerful earthquake and a sign appeared in the sky in the form of a pillar of fire; it started moving from east to west and from north to south and then disappeared.*

Cedrenus Georgius, *Compendium Historiarum*, tomus prior, p. 745

[633-634] Μετὰ δὲ γε τὸν θάνατον τοῦ θεηλάτου Μουχούμετ ἐφάνη κατὰ μεσημβρίαν ἀστὴρ ὁ λεγόμενος δοκίτης, προμηνύων τὴν τῶν Ἀράβων ἐπικράτειαν. ἔμεινε δὲ ἐπὶ ἡμέρας τριάκοντα, διατείνων ἀπὸ μεσημβρίας ἕως ἄρκτου. ἦν δὲ ξιφοειδής.

And after the death of the inspired Muhomet was seen towards the south a comet, similar to a beam, which the Greeks call it *δοκίτης*. It presaged the rule of the Arabs. And remained thirty days, unfolding from south to north. Its shape was that of a sword.

Sigebertus Gemblacensis, *Chronicon ab anno 381 ad 1113*, p. 38v

[632] Terremotus factus est per triginta dies: apparuit in coelo signum in modum gladijportendens imminentem Sarracenorum principatum.

Michel Syrien, *Chronique*, Lib. XI, Cap. IV, p. 414

[634] En l'an 945 des Grecs, il y eut un violent tremblement de terre, au mois d'iloul, et après le tremblement, il y eut un signe dans le ciel; il se présenta sous la forme d'un glaive s'étendant du sud au nord, et demeura pendant 30 jours. Il sembla à plusieurs qu'il signifiait la venue des Taiyayê. [transl. from Syriac, Chabot (1901)].

*In the year 945, of the Greek calendar, there was a violent earthquake between the second fortnight of August and the first fortnight of September and after the earthquake there was a sign in the sky; it came in the form of a sword stretching from south to north and remained there for 30 days. To many it seemed to signify the advent of the Arabs.*

Glycae Michael, *Annales*, p. 515

Μετὰ μέντοι τοῦ θεηλάτου Μωάμεθ θάνατον ἐφάνη ἀστὴρ ἐπὶ μεσημβρίαν δοκίτης, ἐπὶ ἡμέρας λ', σημαίνων τὴν τῶν Ἀράβων ἔφοδον.

*Then as a sort of divine punishment, at the death of Muhammad, a star depicted as a beam was seen around midday that lasted 30 days and signifying the Arab invasion of the Roman Empire.*



Abū I-Faraġ, (Bar Hebraeus), *Chronicon Syriacum*, p. 105

Hoc tempore terra concussa est mense Elul & apparuit stella in coelo, quae a meridie ad septentrionem processit, similis hastae, & coronae, per 30 dies, quae aperte indicavit victoriam Arabum. [transl. from Syriac Bruns and Kirsch (1789)].

*At that time the earth tremored in the month of September and a star appeared in the sky, moving from north to south, resembling a spear with a crown. It lasted 30 days and clearly announced the victory of the Arabs.*

Massaeus Christianus, *Chronicorum*, p. 188

[632] Eodem anno factus terremotus terribilis, visusque gladius in aëre. 30 diebus significans dominum Saracenorum, qui tunc Persas deinde magnam orbis partem subiugarunt.

Frytschius Marcus, *Catalogus prodigiorum atque ostentorum, tam coelo quàm in terra*, p. G 6 (A)

Signum in coelo visum gladij formam habens, quod triginta diebus versus meridiem sese exervit.

## 676 X/676 P1

In the years immediately preceding and following 676 AD, the most important historical event in the Islamic world was the takeover by the Umayyads, their conquest of the southern coasts of the Mediterranean Sea, and the entire Middle-East, except for Turkey. According to Western sources, a comet that had caused astonishment among people appeared in the morning towards the end of August, remaining visible for three months. The *Ethelwerd Chronicorum* mentions that the comet appeared three years after the battle fought between King Wulfhere of Mercia (or Wulfar d. 675) and Cenwalh of Wessex (or Coenwalh d. 672). According to the *Anglo-Saxon Chronicle*, the clash, known as the battle of 'Bedanheafeford' (today's Great Bedwyn, east Wiltshire), would have occurred in 675, between Wulfhere and Aescwine of Wessex (d. ~676). Bartholomew of Cotton refers to Centwine as the son of Cynegils, but this appears to be an error «by a West Saxon genealogist who had no knowledge of his true paternity» [Kirby, 2020: 43]. The *Life of Saint Léger* (or *The Passion of Saint Léger*) is one of the oldest texts in the French language, dating from the end of the 10th century, where the mention of the comet comes immediately after the information of the death of the king of Austrasia Childeric II (c. 653-675). In the *Historia Pseudoisidoriana* (also known as the *Chronicle of Pseudo-Isidore* or *Chronica Gothorum Pseudoisidoriana*), a 12th century anonymous Latin chronicle of southern France, the date is given in accord with "the Spanish Era". It was a calendar era used in the Iberian Peninsula from the 5th to the 15th century. Elijah of Nisibis (975-1046) and Michael the Syrian (d. 1199), whose source is supposed to be a chronicle written around 690 AD by Jacob of Edessa (c. 640-708) or later ones by Theophilus of Edessa (695-785) [Hoyland 2011: 168], circumscribe the period of its observability between 28 August and 26 October. This suggests that the "three months", mentioned in many chronicles, should be interpreted in the sense of "three different months", namely August, September, and October. In this way, the actual duration would correspond to about 60 days, a period that fits very well to that reported by the Eastern sources.

The Japanese text *Nihon Shoky* (~720 AD) and the Korean *Samguk sagi* (~1145 AD) describe the apparition of a star with a tail long 8 *chi* (about 8 degrees) on a date between 15 August 15 and 12 September. More accurately, the Chinese report its appearance on 4 September in Gemini. During the 58 days in which it would remain visible, moving to the north-east, the comet would have developed a tail up to 30 degrees. Finally, progressively decreasing its brightness, it would have definitely disappeared on day *yi you* [22] of the 9th lunar month: a date corresponding to 1 November 676 AD. According to some scholars, the account of the comet, written by the Venerable Bede in the *Ecclesiastical History*, would have been borrowed from the *Liber Pontificalis* [Poole 1918: 29; Colgrave and Mynors 1969: 371]. It is generally accepted that Bede made a mistake dating its appearance two years later, in 678, but Reginald Poole, referring to a couple of ancient manuscripts, believes that the year

indicated by Bede would actually be 677 [Poole 1918: 28-29; Chifflet 1681: 392]. It is also interesting that in the *Annales Cambriae*, depending on the version, the year is either 677 or 678 AD.

Eastern sources: Williams (1871: 41), Ho (1962: 169), Pankenier et al. (2008: 75-76)			
Source	Dates	Positions	Reference to Coordinates of LM determinative stars (J2000) and approximate Western asterisms
Nihon shoki (c. 720)	Aug 15-Sep 12	seen in the east	---
Dai Nihon shi (15th-19th century)	Aug 15-Sep 12	seen in the east	---
Fusō ryakuki (c. 1169)	Aug 15-Sep 12	seen in the east	---
Jiu Tang shu (c. 9th century)	Sep 4	Dongjing [LM 22] Nanhe Jixin Santai Wenchang	$\mu$ Gem, $\alpha = 06^h 22^m 57^s$ $\beta$ Cmi (or $\alpha$ Cmi) $\varphi$ Gem (or $\kappa$ Gem) $\iota$ UMa (or $\iota$ , $\lambda$ , $\nu$ UMa) $\theta$ UMa
Xin Tang shu (c. 11th century)	Sep 4	Dongjing [LM 22] Beihe Santai Wenchang	$\mu$ Gem, $\alpha = 06^h 22^m 57^s$ $\alpha$ Gem $\iota$ UMa (or $\iota$ , $\lambda$ , $\nu$ UMa) $\theta$ UMa
Samguk sagi (c. 1145) Jeungbo munheon bigo (1908)	Aug 15-Sep 12	(between) Beihe and Jishui	$\alpha$ Gem $\lambda$ Per
All the Japanese texts report the appearance of a comet towards east between mid-August and mid-September.			

Anastasius Bibliothecarius, *Vitae Romanorum Pontificum ab Petro Apostolo ad Nicolaum I*, Tomus III, p. 142; *Liber Pontificalis*, Vol. I, LXXX, p. 348

[676] Hic dum esset electus per Augusti mensem, apparuit stella à parte Orientis à galli cantu usque mane per menses tres. Cujus radii coelum penetrabant. In cujus visione surgentis omnes provinciae, & gentes mirabantur, quae post in semetipsam reversa disparuit. Pro quo capitulo & maximo mors à parte Orientis subsequuta est.

*Before he [Pope Dono] was elected in the month of August, a star appeared from the eastern side and for three months remained visible from the first light of dawn until morning. Its rays penetrated the sky and it rose in every province, inspiring astonishment among the people; then, after traveling backward on its path, it disappeared. After its appearance, a great mortality followed in the east.*

Beda Venerabilis, *Historia Ecclesiastica Gestis Anglorum*, p. 274

[678] Anno Dominicae incarnationis sexcentesimo septuagesimo octavo, qui est annus imperii regis Ecgridi octavus, apparuit mense Augusto stella, quae dicitur cometa; et tribus mensibus permanens matutinis horis oriebatur, excelsam radiantis flammae quasi columnam praefrens.

*In the year of the Lord 678, that is the eighth of King Ecgrith, in the month of August, a star appeared, which they call a comet. It rose in the morning emitting a pillar-like flame and remained visible for three months.*

Paulus Diaconus, *De Gestis Langobardorum*, Lib. V, Cap. XXXI, p. 485

In sequenti post tempore mense Augusto, à parte Orientis stella Cometes apparuit mimis fulgentibus radiis, quae post semet ipsam reversa disparuit. Nec mora, gravis perstilentia ab eadem parte orientis secuta, Romanum populum devastavit.

*Some time later, in August, a comet star appeared in the east with very bright rays, which after returning on its own steps disappeared. Moreover, also from the east, followed a plague that decimated the Roman people.*

Johanne Diacono, *Chronicon Episcoporum Sanctae Neapolitanae Ecclesiae*, p. 305

Hic dum adhuc esset electus, à parte Orientis Augusto mense Stella apparuit à galli cantu usque manè per menses tres. Cujus radii Coelos penetrabant. In cujus visione surgentes omnes Provinciae, & Gentes mirabantur. Quae post in semetipsam reversa disparuit. Ea recedente maxima mors à parte Orientis subsequuta est.

*Anglo-Saxon Chronicle*, (ms. Bodl. Laud. 636), Vol. I, p. 61

An. DC.LXXVIII. Her ateowede cometa se steorra on Auguste; scan III. monðas aelce morgen-swilce sunne beam.

Year 678. This year a comet appeared in August and shone for three months, every morning, like a ray of sunshine.

*Ethelwerd Chronicorum*, Lib. II, Cap.VIII, p. 476 b

[673-676] Scilicet post annum Wulfhere Penda filius, & Cenuualh alternum inter se inierunt bellum in loco qui Bedanheasde dicitur. Póstque decursum triennij apparuit stella cometa.

*On the following year Wulfhere, Penda's son and Cenwalh made war on each other in a place called Bedanheasde. Then, after three years a comet appeared.*

Elias Nisibenus, *Opus Chronologicum*, pars prior, p. 70

[675-676]. Anni 987 Graecorum [...] Et eo apparuit cometa terribilis matutinus, et incepit a die 28<sup>o</sup> àb, et perduravit usque ad diem 26um tešrin I. [*transl. from Syriac, Brooks (1910)*].

*In the year 987 of the Greek [calendar], a terrible comet appeared in the morning and began to be seen from August 28th until October 26th.*

*Vie De Saint Léger*, p. 339

[675-676] Nous connûmes bientôt que la colère de Dieu était venue; car nous vîmes se montrer dans le ciel l'étoile que les astrologues nomment comète, et dont l'apparition présage à la terre troublée par la famine, le changement des rois, les attaques des Gentils et les maux de la guerre. Mais, comme il est écrit, les insensés ne se laissent pas corriger par les paroles, encore moins par des signes; aussi ceux qui étaient revenus de l'exil où ils avaient été à cause de leurs mauvaises actions, accusaient le parti de Léger de toutes leurs souffrances.

*Soon we knew that the wrath of God had come, for we saw the star in the sky, which the astrologers call comet, and whose appearance portends to the earth troubled by famine, the change of kings, the attacks of the Gentiles and the evils of war. But, as it is written, foolish men are not corrected by words, much less by signs; so those who had returned from the exile where they had been because of their evil deeds, blamed the party of Léger for all their sufferings.*

Liutprandus Cremonensis (incerto auct.), *De pontificum Romanorum vitis*, col. 1235-1236

Donus, natione Romanus, ex patre Mauritio, sedit annum unum, menses quinque, dies decem. Hic ordinavit episcopus sex, diaconos quinque. Post electionem hujus, Augusto mense apparuit stella praeifulgida valde in Oriente. Oriebatur autem assidue in galli cantu apparens usque mane, sed emenso trium mensium spatio, suae pulchritudinis radios nunquam parens abscondit, quam in eadem plaga Orientis innumerae multitudinis hominum mors secuta est.

[Pope] *Donus, Roman by birth, by his father Maurice, sat [on the papal throne] for one year, five months and ten days. He ordained six bishops and five deacons. After these elections, in August, a very bright star appeared in the east. It rose steadily at cockcrow, appearing until morning and for the space of three months, it showed itself without ever occulting its beautiful rays. After that, in the same eastern region, the deaths of a large number of men followed.*

Bernoldi, *Chronicon*, p. 416

[676] Cometa per 3 menses visa.

Herimannus Augiensis, *Chronicon*, in *Annales et Chronica aevi Salici*, p. 95

[676] Cometa per 3 menses visa, et magna hominum pestilentia in oriente subsecuta est.

*Chronicum Scotorum*, p. 105

[673] Kal. A bright and luminous comet was seen in the months of September and of October. [transl. from old Irish, Hennessy (1866)].

*Annals of Tigernach*, p. 204

*Stella cometes visa est luminosa in mense Septembir et Octimbir.*

*Annales Cambriae*, E-text, p. 16, note 62

[677-678] Her ateowede cometa se steorra on Auguste 7 scan.iii. monðas ælce morgen swilce sunnebeam.

Sigebertus Gemblacensis, *Chronicon ab anno 381 ad 1113*, p. 44r

[677] Ab Augusto per tres menses stella radijs coelos penetrans, a parte orientis a galli cantu usque in mane apparebat: & maxima mortalitas a parte orientis, subsequuta est.

Ordericus Vitalis, *Historiae Ecclesiasticae*, col. 218

Tunc cometes in Oriente, Augusto mense apparuit, et per tres menses a galli cantu usque mane in multis regionibus intuentes terruit, et mors hominum ab Oriente successit.

Florentius Wigorniensis, *Chronicon ex chronicis*, Tomus I, p. 34

[677] Anno imperii Ecgfridi VIII<sup>o</sup>. apparuit mense Augusto stella cometes.

*In the eighth year of King Ecgfrid [Ecgfrith of Northumbria (c.645-685)] a comet appeared in August*

Henricus Huntindoniensis, *Historiarum*, Lib. III, p. 354

Anno eodem Cometa apparuit tribus mensibus mane.

Romualdus Salernitanus, *Chronicon*, col. 129

Huius temporibus mense Augusto, apparuit Stella splendidissima à parte Orientis, à Galli cantu usque manè, mensibus tribus, cujus radii coelos penetrabant

*At that time in the month of August a very bright star appeared in the eastern part [of the sky] for three months from the first dawn until the sunrise whose rays penetrated the sky.*

Michel Syrien, *Chronique*, Lib. XI, Cap. XIII, p. 456

[677] En l'an 988, un comète terrible apparut, le matin depuis le 28 de'ab (août) jusqu'au 26 de tešrîn ler (oct.): soixante jours. [*transl. from Syriac, Chabot (1901)*].

*In the year 988 [of the Greek calendar], a terrible comet appeared in the morning from August 28th until October 26th [for a period of] sixty days.*

*Annales Palidenses*, p. 56

[678-679] *Stella cometes apparuit, et terre motus factus est per Mesopotamiam. Fames ac mortalitas magna facta est in Siria.*

*Historia Pseudo-Isidoriana*, p. 387

[672] Un terrible cometa en le cielo, que duró por espacio de tres meses: y tras el un fuego que por diez días enteros parecia que el cielo se quemaua.

*A terrible comet was seen in the sky, which lasted for three months: and, after this, a fire that for ten full days seemed to burn the sky.*

Helinandus monachus, *Chronicon*, Lib. XLV, col. 797

[677] Apparuit stella a parte orientis, a galli cantu usque mane per menses tres: cujus radii coelos penetrabant, in cujus visione omnes gentes mirabantur: quae postquam disparuit in semetipsam reversa, maxima mortalitas a parte orientis secuta est.

*A star appeared on the eastern side, from cockcrow until dawn for three months: its rays penetrated the sky. At its sight, all the people were astonished and after it had disappeared, turning back upon itself, there followed a great mortality in the eastern regions.*

Flores Historiarum, Lib. I, p. 238; Matthaeus Parisiensis, *Chronica Majora*, Vol. I, p. 299

Anno gratiae. Dclxxvij. Donus sedit in cathedra Romana anno uno, mensibus. v. diebus.x. & cessavit sedes mensibus. x et diebus xv. Hoc tempore floruit sancta Aetheldreda in insula Eliensi. Sub his quoque diebus, cometa per tres menses apparuit, & unoquoq; die mane velut Sol resplenduit.

Anno Domini 677. [Pope] *Dono remained on the Pontifical throne one year, five months and ten day. [The soglio] remained vacant for ten months and fifteen days. At that time lived Saint Etheldreda [636-679] on the island of Ely. In those days a comet appeared for three months and one day, shining in the morning almost like the Sun.*

Bartholomaeus de Cotton, *Historia Anglicana*, p. 349

[679] *[King Æscwine of Wessex] cui successit Kentuinus, [Centwine d. after 685] filius Kingili [Cynegils of Wessex, d.~642] cujus anno iii. cometa apparuit tribus mensibus, et unoquoque mane velut sol resplenduit.*

Andreas Dandolo, *Chronicon*, Lib. VI, cap. XI, col. 122

[678] *Per tres menses a parte Orientali a galli cantu usque in mane cometa apparebat.*

Ranulph Higden, *Polychronicon*, Lib.V, Cap XIX, p. 134

*Hoc etiam anno apparuit stella cometa per tres menses tempore auctumnali.*

*Cronica apostolicorum et imperatorum Basileensia*, p. 283

DCLXXVI. Donus, natione Romanus, ex patre Mauricio, anno I, men. V, d. X; cessavit men. II, diebus XV. Huius temporibus stella splendidissima nec antea visa apparuit in celo.

[676] *Dono, son of Maurice, [was Pope] of the Roman nation, for one year, five months and ten days. [The chair] remained vacant for two months and fifteen days. In his time a most luminous star, such as had never been seen before, appeared in the sky.*

Ptholemaeus Lucensis, *Historiae Ecclesiastica*, Lib. XII, Cap. XXIV, col. 944

Hujus tempore dicit Cusentinus, & Historia Longobardorum, quòd apparuit stella in Oriente clarissima, quae comata erat, & à galli cantu usque ad mane apparebat, cujus coma videbatur penetrare Coelos.

*At that time, say the Cosentino and the History of the Lombards, appeared in the east, a very bright star with a coma. It was visible as soon as it was light until dawn and its hair seemed to cleave the sky.*

Anonymi Zwetlensis, *Historia Romanorum Pontificum*, col. 1016

[676-678] Donus sive Donatus, natione Romanus, ex patre Mauricio, annum I menses V, usque ad annum Domini 678. Cessavit menses II. Qui inter alia bona studia porticum S. Petri marmore stravit. Hic dum esset diaconus, mense Augusto, ingens stella per menses III, a galli cantu surgens apparuit.

*Cronica Pontificum et Imperatorum Tiburtina*, p. 248

[670] DCLXX [ind. XIII]. Bonus [*Pope Donus*], natione Romanus, ex monachis, ex patre Mauricio, sedit an. I, men. V, di. X. Huius temporibus stella splendidissima nec ante visa apparuit in celo.

*Chronicle of Holyrood*, p. 95

[678] Anno dclxxviii, qui est annus imperii Egfridi viii, apparuit mense Augusto stella quæ dicitur cometa; et tribus mensibus permanens matutinis horis oriebaturm excelsa[m] radiantis flam[m]e quasi columpnam preferens.

*In the year 678, that is, the eighth year of Egfrid's reign, a star, called a comet, appeared in August; for the remaining three months, it rose brightly in the early morning hours, showing a lofty column of brilliant flame.*

*Corpus Chronicorum Bononiensium, Cronaca B, pars II*, p. 350

Nel qual tempo del mese de agosto apparve una stella cometta verso oriente dalla prima ora de nocte infino alla matina. Et duroe questo per spacio de tre mesi; li cui ragii pareva che penetrasseno el cielo.

*At that time in the month of August a comet star appeared towards the east from the first hour of the night until morning. And this lasted for three months; whose rays seemed to penetrate the sky.*

Palmerius Matthæus, *Liber de Temporibus*, p. 66

[676] Stella maximis radiis per tres menses apparuit.

*A star with large rays appeared for three months.*

*Annals of Ulster*, p. 129

[676] Kal Jan. (Thurs., m. 21.) A.D.676. A bright comet was seen in the months of September and October.

*Annals of Clonmacnoise*, p. 109

[673] There was a comet & a star of great brightness seen in ye months of September & October. The Leinstermen gave a battle to K. ffneaghty in a place hard by Loghgagawar, where K. Finnaghty was victor. [*transl. from old Irish, Mageoghagan (1896)*].

Platina, *Historia delle vite de i sommi pontefici*, p. 93

La Cometa, ch'era per tre mesi continui apparsa, e le gran pioggie con terribili tuoni, quanto mai prima, tutte queste calamità, e flagelli della povera Italia predette havevano.

*The Comet, which had appeared for three continuous months, and the heavy rains with terrible thunder, as never before, all these calamities, and plague of poor Italy [it] had predicted.*



Giacomo Filippo da Bergamo, *Supplementi delle Cronache*, p. CXCII

Una cometa così volgarmente chiamata da greci, apparve questo anno, & duro tre mesi continui & piogge grandissime con molti toni, in tal modo che non furono mai simili uditi, & tutte dimostravano certe calamità & flagelli, per la qual cosa in brevi tempi seguito una peste universalmente & grandissima, per la quale fu spento il popolo di Pavia & abbandonata per spatio d'uno anno.

*A comet so popularly called by the Greeks, appeared this year and lasted three continuous months and very heavy rains with many thunders, so that they were never similar heard, and all proved certain calamities and afflictions, for which in a short time followed a general and great plague, for which the people of Pavia was decimated and [the city] was abandoned for one year.*

Mizaldus Antoninus, *Cometographia: crinitorum stellarum quas mundus nunquam impune vidit*, p. 236

Anno 676, Cometa tres menses à galli cantu usque ad Solis exortum in orientali tractu apparuit.

Arethius Benedictus, *Brevis cometarum explicatio: physicum ordinem & exempla historiarum praecipua complectens*, no page.

[676] Anno Domini 676. Theodato Pp: Crinita stella terrifico aspectu tribus mensibus apparuit.

*Holinshed's Chronicles of England, Scotland and Ireland*, Vol. 1, p. 630

[678] In the yéere of our Lord 678 in the moneth of August, a blasing starre appéered, with a long bright beame like a piller. It was séene euerie morning for the space of thrée monethes together.

Iohannis de Deo, *Cronica*, p. 314

[671] Adeodatus primus, natione Romanus, cepit anno Domini sexcentesimo septuagesimo primo, sedit annis quatuor, imperante Constantin o Constantini filio, qui imperavit annis septemdecim. Adeodati quoque tempore quedam magna stella apparuit.

Gonzalo de Illescas, *Historia Pontifical y Catholica*, p. 144v

[671-675] Vióse un terrible cometa en le cielo, que duró por espacio de tres meses: y tras el un fuego que por diez días enteros parescia que el cielo se quemaua.

*A terrible comet was seen in the sky, which lasted for three months: and after thist a fire that for ten whole days seemed to burn the sky.*

Angelocrator Daniel (alias Engelhart), *Rationis temporum et rerum totius orbis memorabilium ab initio mundi usque ad Rodolphum II*, Lib. VI, p. 317

Anno 678. cometa terribilis apparuit tribus continuis mensibus, mense Augusto incipiens horis matutinis.

Riccioli G. B., *Almagestum novum astronomiam veterem novamque complectens*, Book VIII, sect. 1, p. 6

Anno Christi 676. Vel ut alij narrant 678. Terribilis Cometes per tres menses Romae spectatus est.

### 684 1P/684 R1 (*Halley*)

Also, this return of comet Halley was accompanied, or would it be better to say followed, by another possible comet that appeared between Christmas 684 and Epiphany 685 AD. Comet Halley had made its appearance in the evening and morning skies of China and Japan, between Leo Minor and Coma Berenices, on 6 and 7 September respectively [Pingré I, 1783: 333; Ho 1962: 170; Kronk 1999: 109-111]. The duration of its visibility is uncertain, ranging between 33 and 42 days. Apart from the Eastern chronicles, very few ancient sources mention it. Kronk [1999: 110] reports that the comet “really shook up the Europeans” even if no contemporary evidence has been found to confirm such a claim. From this point of view, one of the earliest European references of this return seems to be the one that appeared in *Nuremberg Chronicles*, a work also known as *Liber Chronicarum*, written in Latin by Hartmann Schedel (1440- 1514), first published in Nuremberg in 1493. A very brief mention only says that a comet appeared for three continuous months has brought doom and destruction. The chronicle of the Armenian Ghevond Yeretzi, who lived in the eighth century, is more useful. In his *History of Armenia*, he reports the presence of a star with a crown, similar to a luminous column, during the first year of Ashot Bagratuni’s governorship. Although the description is not particularly original, it allows us to distinguish, without any ambiguity, the observation of Halley’s comet from the later year-end tailless one.

Michael the Syrian speaks explicitly of more comets but also in this case, Halley’s comet can be identified as the one of 41 days duration as it fits perfectly with the date of Halley’s appearance. Instead, it is uncertain which comet would have distressed Ibn’ Abbas (c.619 - c. 687), cousin of Muhammad, one of the first scholars of Koranic traditions. There is no date in the text, so the reminder may indeed relate to one of several comets that appeared during his maturity. However, there is a good chance that Ibn’ Abbas’ fears are associated with Halley’s comet return [Cook 1999: 135; Basurah 2004, 21]. The scant information available made it hard to reconstruct the trajectory of comet Halley. Therefore, the path across the sky was obtained based on interpolations of its later and earlier orbits. The comet, theoretically, should have already been observable in the morning from the second fortnight of August 684, first in Gemini, then Lynx, Leo Minor, and Canes Venatici. From 6-7 September (dates of the first Eastern recordings), it was in Coma Berenices, becoming not only a morning but also an evening celestial body. Subsequently, visible only in the evening sky, it moved from west to east, passing south of  $\alpha$  Boötis (Arcturus), and Serpens and then disappearing between Ophiuchus and Libra, a few degrees above the claws of Scorpius.

Eastern sources: Williams (1871: 42), Ho (1962: 170), Pankenier et al. (2008: 78)			
Source	Dates	Positions	Reference to approximate Western asterisms
Tang huiyao (c. 961)	Sep 6	In the northwest	---
Xin Tang shu (c. 11th century)	Sep 6	In the west	---
Ichidai yōki (c. 13th century)	Sep 7	In the west	---
Dai Nihon shi (15-19th century)	Sep 7	Comet seen	---
Eastern reports of this return of Halley's comet are rather sketchy. <i>Tang huiyao</i> reports that lasted more than 42 days and <i>Xin Tang shu</i> affirms that it disappeared on 9 October.			

Gurzadyan V.G., *Halley 684 Viewed from Armenia*, p. 127

[684-685] In the first year of his reign [of Prince Ashot Bagratuni (b. 647?)] a hairy star of surprising sight appeared, having a pillar-like shining and was called a comet. It became a sign of starvation, massacre and great earthquake.

Cook D., *A Survey of Muslim material on comets and meteors*, p. 135

I [*Ibn Abi Mulayka*] came early in the morning to Ibn 'Abbas that day and he said: «By Allah, I did not sleep a wink until the dawn!». I said «Why is that?» He said: «They said that the star with a tail has risen, and I was frightened that the Antichrist has come, so by Allah I did not sleep a wink until the dawn».

Michel Syrien, *Chronique*, Lib. XI, Cap. XV, p. 471

[684] Ensuite une grande comète apparut de nouveau, le soir, pendant 41 jours; puis d'autres apparurent en face de celle-ci pendant sept jours. Elles commencèrent au mois d'éloul de l'année 995. [*trans from Syriac, Chabot, (1901)*].

*Afterwards a great comet appeared again in the evening for 41 days; then others appeared in opposition to it for seven days. They began in the month of Elul [Aug. 20th –Sep. 17th] in the year 995 [of the Greek Calendar].*

Schedel H., *Liber Chronicarum*, fol. CLVII recto

Stella crinita quam greci Cometes vocant indicabat perfecto tot clades quam tribus continuis mensibus apparuit.

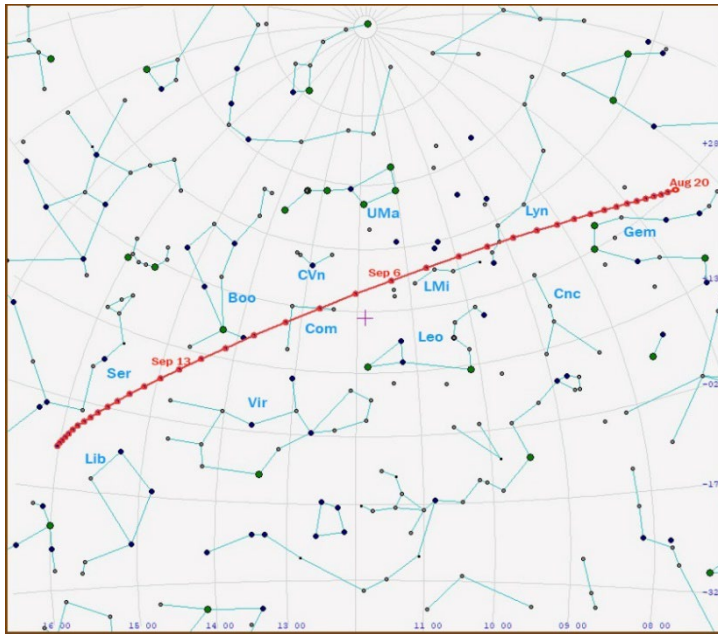
*A hairy star, called a comet by the Greeks, showed so much ruin for as long as its appearance lasted for three continuous months.*

Arethius Benedictus, *Brevis cometarum explicatio: physicum ordinem & exempla historiarum praecipua complectens*, n.p.

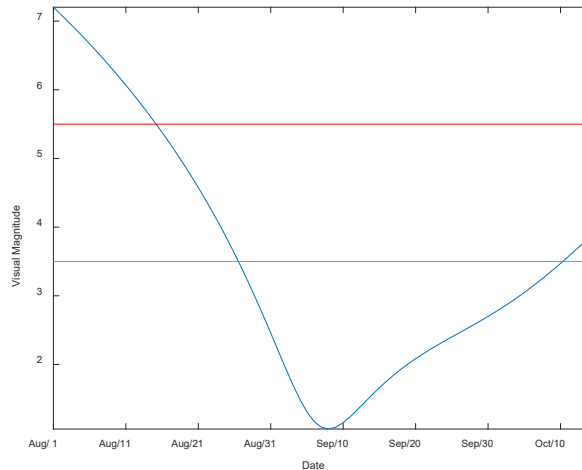
Anno Dom: 684, si alius est à superiori, Cometa tribus mensibus apparuit.

Orbital elements (eq. J2000.0):

T (UT)	q	e	$\omega$	$\Omega$	i	Source
684 Oct 2.767	0.57958	0.96815	98.149°	43.800°	163.418°	Yeomans and Kiang (1981:643)

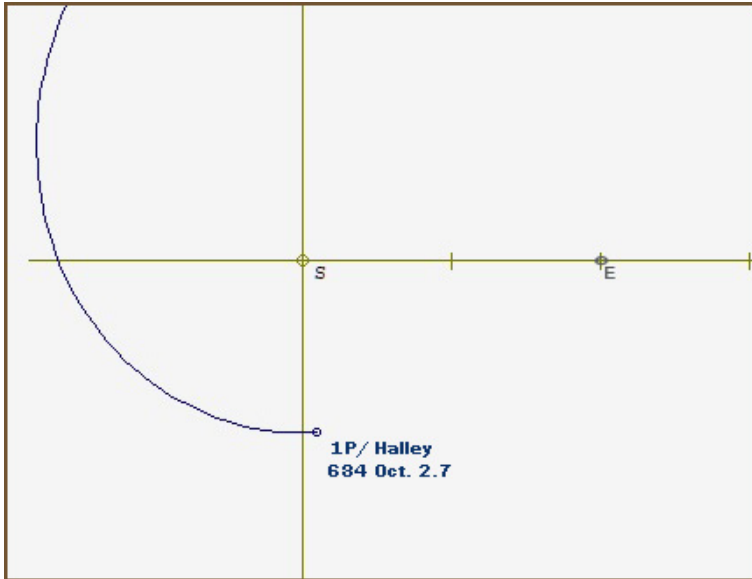


**Fig. 41** - Path of comet 1P/684 R1 (Halley,) from 20 August (blank circle) to 28 September 684 AD [step 1 day] based on Yeomans and Kiang's orbit



**Fig. 42** - Magnitude curve considering an absolute magnitude  $H_{10}= 5$ .

The elongation of the comet was always larger than 40 degrees for the period between 20 August and 28 September, with a minimum solar elongation of  $41.4^\circ$  on 1 August. The comet reached the most northern declination of  $45^\circ$  on 4 September and it was closest to the Earth on 6 September (0.2563 au).



**Fig. 43** - Relative position of Sun, Earth and 1P/684 R1 (Halley) at its perihelion

## 684 (X/684 Y1)

The echo of the appearance of Comet Halley had not yet died down when, between the end of 684 AD., and the first days of the following year, a "new star" appeared to disturb people's lives. The Japanese text *Nihongi* describes it in the following terms: "During the eleventh month a comet (po) appeared in the middle of the sky, moving together with the Pleiades (Mao) until the end of the month, when it disappeared from view" [Ho 1962: 170]. Initially considered to be a late observation of Halley's comet, the hypothesis was later definitively dismissed [Kronk 1999: 111], both because, at that date, the comet should have been already well beyond the threshold of visibility to the naked eye but mainly because its position, calculated on the basis of the last published elements, was placed in an area of the sky opposite to the Pleiades. However, there is still some doubt about the real nature of this object. Let us summarize the information on the phenomenon: in the East, the "new star" was observed, near the Pleiades during the eleventh month (26 December  $26 \pm 15$  days). In the West it was close *Vergilias* (Pleiades) between Christmas and Epiphany (31 December  $\pm 6$  days) while the total duration, according to Michael the Syrian, was limited to eleven days.

From these data, it can be deduced that the object made its appearance on 26 or 27 December 684 and disappeared on 5 or 6 January of the following year. Some perplexity is aroused by the text of Bartolomeo Sacchi, known as Plätina (1421-1481), who, after confirming the presence of the comet under the pontificate of Benedict II, strangely argued that it could not be near the Pleiades since this asterism would be unobservable by this period of year! According to the Western sources, if the moon-like aspect behind a cloud and the sudden appearance in the middle of the sky are compatible with a comet that passed within a short distance of our planet, the absence of any mention to a fast moving seems to contradict this conjecture. A few decades ago, a connection described as "possible but questionable" by the author herself, was proposed to link this alleged comet to a meteor shower. [Kresáková 1986: 343; Kresáková 1987: 78]. In any case, in view of the above, we suggest designating this comet as X/684 Y1. Concerning the object seen crossing the sky from west to east in broad daylight in February, recorded by several Western sources, it is more than certain that it was an exceptionally bright meteor, which had nothing to do with the 'Christmas comet' [Maffei 1987:193].

Eastern sources: Williams (1871: 42), Ho (1962: 176), Pankenier et al. (2008: 78)			
Source	Dates	Positions	Reference to Coordinates of LM determinative stars (J2000)
Nihon shoki (c.720)	(between) Dec 12-Jan 10 (685)	Mao [LM 18]	17 Tau, $\alpha = 3\text{h } 44\text{m } 52$
Ichidai yōki (c. 13th century)	(between) Dec 12-Jan 10 (685)	Mao [LM 18]	17 Tau, $\alpha = 3\text{h } 44\text{m } 52\text{s}$
Dai Nihon shi (15-19th century)	(between) Dec 12-Jan 10 (685)	Mao [LM 18]	17 Tau, $\alpha = 3\text{h } 44\text{m } 52\text{s}$
The only Eastern records about this object come from Japan.			

Paulus Diaconus, *De Gestis Langobardorum*, Lib. VI, Cap. IX, pp. 493-494

Hac tempestate noctu stella juxta vergilias coelo sereno, inter Domini natalem & theophaniam, apparuit, omnimodo inumbrata, veluti cūm Luna sub nube est constituta. Post haec mense Februario die media, stella ab occasu exiit, quae cum magno fulgore in partes orientis declinavit.

*Between Christmas and Epiphany, with a clear sky, a totally veiled star, similar to the Moon behind a cloud, appeared near the Pleiades. Then in February, in the middle of the day, a star emerged in the west and with great light disappeared in the east.*

Anastasius Bibliothecarius, *Vitae Pontificum*, p. 146; *Liber Pontificalis*, Vol. I, LXXXIII, p. 363-364

Huius temporibus apparuit stella noctu juxta vigilias per diem coelo sereno inter Nativitatem Domini et Theophaniam omnimodo obumbrata, veluti luna sub nube. Itemque mense Februario, post natale Sancti. Valentini in die ab occasu exiit stella meridie et in partes orientis declinavit.

*In his time [Pope Benedict II] with a clear sky a star appeared at night between Christmas and Epiphany, near the Pleiades (Vergilias), constantly dimmed as the Moon appears covered by a cloud. Also in February, after Valentine's Day, at noon it went out to the west setting in the east.*

Ordericus Vitalis, *Historiae Ecclesiasticae*, col. 219

Benedictus junior Romanus, de patre Joanne, sedit mensibus X, diebus XII. Hic ab infantia Ecclesiae militavit et bonis operibus studuit. Tempore Justiniani et Heraclii floruit. Tunc luna velut sub nube omnino obumbrata est coelo sereno in Theophania. Februario autem in die stella ab occasu exiit, et in partes Orientis declinavit.

[Pope] *Benedict the younger, Roman by his father John, sat [on the papal throne] for 10 months, twelve days. He served in the church from childhood and studied good deeds. He flourished in the time of Justinian and Heraclius. At that time [a star similar to] the moon, completely obscured under a cloud, [was visible] in the clear sky at Epiphany. But on the day of February the star went out from the west, and waned in the eastern parts.*

Romualdus Salernitanus, *Chronicon*, col. 131

Huius temporibus apparuit Stella juxta Virgilians per aliquot dies & noctes, Coelo sereno, inter Natalem Domini, & Epiphaniam omnimodo obumbrata, veluti Luna sub nube. Post haec eodem anno, mense Martio, mons Vesuvius, qui est in Campania, eructavit incendium, & omnia circumquaque adjacentia prae cinere ipsius exterminata sunt.

*At that time for several days and nights, in a clear sky, a star appeared near the "Virgilians" [Pleiades] between the Christmas of our Lord, and Epiphany. It was as if totally shadowed, as when the moon appears behind a cloud. After this, in the month of March of the same year, Vesuvius, which is in Campania, erupted in a sort of fire, and all the surrounding areas were destroyed by its ashes.*

Ptolemaeus Lucensis, *Historiae Ecclesiastica*, Book XI, Ch. XII, col. 953

Refert autem sic, quòd tempore istius Pontificis juxta vigilias noctis Coelo sereno inter Natalem Domini, & Epiphaniam stella apparuit omnimodo obumbrata, veluti cum Luna est sub nube constituta. Post hoc mense Februarii die medio stella ab occasu exiit, quae cum magno fulgore in partes Orientales declinavit.

Platina, *Liber de Vita Christi ac Omnium Pontificum*, p. 114

[684-685] Sunt qui scribant Benedicti temporibus, stellam iuxta Vergilians per aliquot dies et noctes apparuisse sereno caelo Inter Natalem Domini et Epiphaniam. Stellam ipsam apparuisse non negaverim, et quidem crinitam atque aliquid protendentem. Sed de ortu Vergiliarum non coheret, nisi id quoque prodigiose factum arbitremur. Aequinoctio enim verno oriuntur Vergiliae, cum Sol Arietis signum ingreditur; quod fieri consuevit nono kalendas aprilis, occidereque incipiunt aequinoctio autumnali. Quod autem ex Vesevo monte Campaniae tantus ignis tum eruperit, ut loca circumquaque posita exusta sint, minus mirum videtur, cum Plinius ille, qui naturalem historiam scripsit, ex classe, cui tum iussu Traiani praeerat, ad visendum spectaculum profectus, consumptus incendio dicatur. Utunque sit, constat tamen non ita multo post, caedes, rapinasm incendia, mortes principum subsequatas esse, maxime vero Benedicti pontificis, qui ut aequae omnibus in vita carus fuit, ita post mortem ab omnibus ut sanctus, et bene de humano genere meritis celebratur.

*Some people write that, in the time of Benedict [Pope Benedict II], a star appeared for many nights between the Lord's birth and Epiphany in a clear sky near what they call the Virgilians [Pleiades]. I do not deny that this star appeared to be haired and was forecasting something. But this is not consistent with the rising of the "Virgilians", unless one thinks it was a miraculous event. This is because the Virgilians arise at the spring equinox, when the sun enters the sign of Aries; which usually takes place on the ninth day of the Kalends of April, and begins to set at the beginning of the autumnal equinox. But that from Mount Vesuvius in Campania great flames erupted, so that places in the surroundings were burnt, seems to me less surprising. In fact, Pliny, the author of natural history then in command of the fleet, having gone to see the event, is said to have succumbed to the flames. Be that as it may, it is certain that not long afterwards followed murders, robberies, fires and deaths of princes, and especially that of Pope Benedict who, as he was equally dear to all in life, so after his death was celebrated by all the people as a saint.*



*Corpus Chronicorum Bononiensium, Cronaca B, parte I, p. 355*

[680] *Nel tempo de questo papa [Pope Benedict II] apparse una stella cometa per alquanti di e alquante nocte e fuo tra la nativitate de Christo e lla Phiphania.*

*Sigonius Carolus, Historiarum de Regno Italiae, Book II, p. 79*

[684] *Initio inde Ianuarij apparuit Stella noctu coelo sereno ea obscuritate infecta, veluti cum lunam nubes subiit et mense Februario meridie altera ab occasu cum magno fulgore ad orientem decurrit. Martio verò Vesuvius mons in Campania per dies aliquot ignes evomuit atque omnia virentia circumquaque adussit. Haec preannunciasset obitum Benedicti pontificis iudicata.*

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# Appendix

**Geographical Coordinates of Historical Cities**

<b>City</b>	<b>Latitude</b>	<b>Longitude</b>
Adrianopolis (Edirne)	41° 40' 28" N	26° 33' 39" E
Alexandria	31° 11' 51" N	29° 53' 33" E
Amida (Diyarbakır)	37° 58' 55" N	40° 12' 38" E
Antioch (Antakya)	36° 12' 09" N	36° 09' 38" E
Aquileia	45° 46' 11" N	13° 22' 16" E
Arles	43° 40' 36" N	04° 37' 40" E
Athens	37° 59' 03" N	23° 43' 41" E
Augustodonum (Autun)	46° 56' 56" N	04° 18' 03" E
Bordeaux (Brudegalle)	44° 50' 19" N	00° 34' 42" W
Caesarea	32° 30' 00" N	34° 54' 00" E
Cartagena	37° 36' 00" N	00° 59' 00" W
Carthage	36° 51' 47" N	10° 19' 57" E
Chaves	41° 44' 02" N	07° 28' 15" W
Constantinople (Istanbul)	41° 00' 50" N	28° 57' 20" E
Cordoba	37° 53' 04" N	04° 46' 46" W
Cyrene	32° 49' 30" N	21° 51' 29" E
Damascus	33° 30' 47" N	36° 17' 31" E
Edessa	37° 08' 44" N	38° 47' 02" E
Ephesus	37° 56' 28" N	27° 20' 31" E
Jerusalem	31° 46' 44" N	35° 13' 32" E
Larissa	39° 38' 30" N	22° 25' 00" E
Lisbon	38° 43' 31" N	09° 09' 00" W
London	51° 30' 26" N	00° 07' 39" W
Malaga	36° 43' 18" N	04° 25' 24" W
Milan	45° 28' 01" N	09° 11' 24" E
Naissus	43° 18' 00" N	21° 54' 00" E
Naples	40° 51' 01" N	14° 16' 01" E
Nicea	40° 25' 74" N	29° 43' 17" E
Nicomedia	40° 45' 45" N	29° 55' 03" E
Ratisbon	49° 01' 00" N	12° 05' 00" E
Ravenna	44° 24' 58" N	12° 12' 06" E
Rome	41° 53' 36" N	12° 28' 58" E
Salzburg	47° 48' 00" N	13° 02' 42" E
Strasbourg	48° 34' 59" N	07° 44' 00" E
Sirmium	44° 59' 00" N	19° 37' 00" E
Syracuse	37° 04' 09" N	15° 17' 15" E
Tarragona	41° 07' 03" N	01° 15' 10" E
Thessaloniki	40° 38' 25" N	22° 56' 05" E
Toulouse	41° 36' 16" N	01° 26' 38" E
Tours	47° 23' 39" N	00° 41' 06" E
Tripoli	32° 54' 08" N	13° 11' 09" E
Valencia	39° 28' 12" N	00° 22' 35" W
Zaragoza	41° 38' 38" N	00° 53' 10" W



## 28 Chinese Lunar Mansion

Name / Number	Determinative Star / J2000.0 Right Ascension
Jiao [LM1]	$\alpha$ Vir = 13h 25m 12s
Kang [LM2]	$\kappa$ Vir = 14h 12m 54s
Di [LM3]	$\alpha$ Lib = 14h 50m 41s
Fang [LM4]	$\pi$ Sco = 15h 58m 51s
Xin [LM5]	$\sigma$ Sco = 16h 21m 11s
Wei [LM6]	$\mu^2$ Sco = 16h 52m 20s
Ji [LM7]	$\gamma$ Sgr = 18h 05m 48s
Nandou [LM8]	$\varphi$ Sgr = 18h 45m 39s
Niu [LM9]	$\beta$ Cap = 20h 21m 01s
Xunu [LM10]	$\varepsilon$ Aqr = 20h 47m 40s
Xu [LM11]	$\beta$ Aqr = 21h 31m 33s
Wei [LM12]	$\alpha$ Aqr = 22h 05m 47s
Yingshi [LM13]	$\alpha$ Peg = 23h 04m 45s
Dongbi [LM14]	$\gamma$ Peg = 00h 13m 14s
Kui [LM15]	$\zeta$ And = 00h 47m 20s
Lou [LM16]	$\beta$ Ari = 01h 54m 38s
Wei [LM17]	35 Ari = 02h 43m 27s
Mao [LM18]	17 Tau = 03h 44m 52s
Bi [LM19]	$\varepsilon$ Tau = 04h 28m 37s
Zui [LM20]	$\varphi$ Ori = 05h 34m 49s
Shen [LM21]	$\delta$ Ori = 05h 32m 00s
Dongjing [LM22]	$\mu$ Gem = 06h 22m 57s
Yugui [LM23]	$\theta$ Cnc = 08h 31m 36s
Liu [LM24]	$\delta$ Hya = 08h 37m 39s
Xing [LM25]	$\alpha$ Hya = 09h 27m 35s
Zhang [LM26]	$\text{u}^1$ Hya = 09h 51m 28s
Yi [LM27]	$\alpha$ Crt = 10h 59m 46s
Zhen [LM28]	$\gamma$ Crv = 12h 15m 48s

## Reference to mentioned Chinese asterisms

Name	Approximate Western counterpart
(bowl of) Beidou	$\alpha, \beta, \gamma, \delta$ UMa
Beihe	$\alpha$ Gem
Dajiao	$\alpha$ Boo
Daling	9 Per
Dizuo	$\alpha$ Her
Gedao	$\varphi$ Cas
Hé	Milky Way
Hegu	$\alpha$ Aql
Hugua	$\zeta$ Del (or $\alpha$ Del)
Jixin	$\varphi$ Gem (or $\kappa$ Gem)
Juanshe	$\nu, \epsilon, \xi, \zeta, \omicron$ , and 40 Per
Nangong	Leo (near 92, 93 Leo)
Nanhe	$\beta$ CMi (or $\alpha$ CMi)
Neiping (Ping)	$\zeta$ And
Ping (Hsing)	Virgo, ( $\xi$ Vir)
Santai	$\iota$ UMa ( or $\iota, \lambda, \nu$ UMa)
Shangjiang	$\omicron$ UMa
Shangxiang	$\gamma$ Vir, $\sigma$ Leo
Taiyangshou	$\psi$ UMa (or $\chi$ UMa)
Taiwei	$\beta$ Vir
Tianbang	$\xi$ Dra
Tianjie	$\kappa$ Tau
Tianjin (Hejin)	$\delta, \gamma, \epsilon$ Cyg
Tianlao	44 UMa (or $\omega$ UMa)
Tianmen	53 Vir (or between $\beta$ and $\eta$ Vir)
Tianyuan (Celestial Meadows)	$\gamma$ Eri
Tianyuan (Celestial Orchard)	$\upsilon 1$ Eri
Wenchang	$\theta$ UMa
Wuche	$\iota$ Aur
Wu Dizuo	$\beta$ Leo
Wudinezuo (Wudizuo)	$\gamma$ Cep
Xuanxiao [LM 10–12]	$\alpha = 22^{\text{h}} 47$ and $\alpha = 22^{\text{h}} 05^{\text{m}}$
Xuanyuan	$\alpha$ Leo
Xiatai	$\nu$ UMa
Zhongtai	$\lambda$ UMa
Ziwei	$\kappa$ Dra