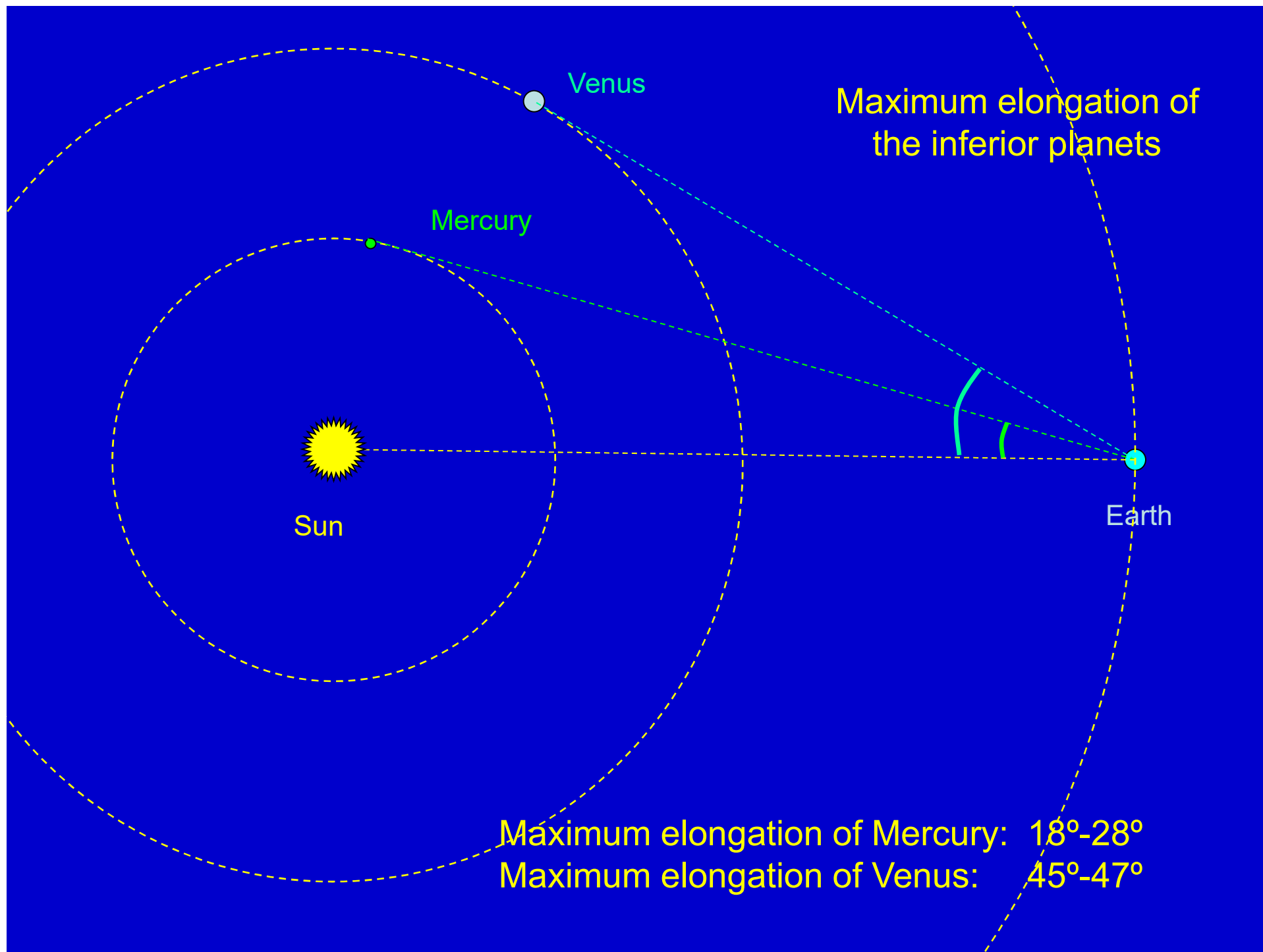


Elongations, conjunctions and oppositions of the planets



David Le Conte



Inferior and superior
conjunction of
the inferior planets

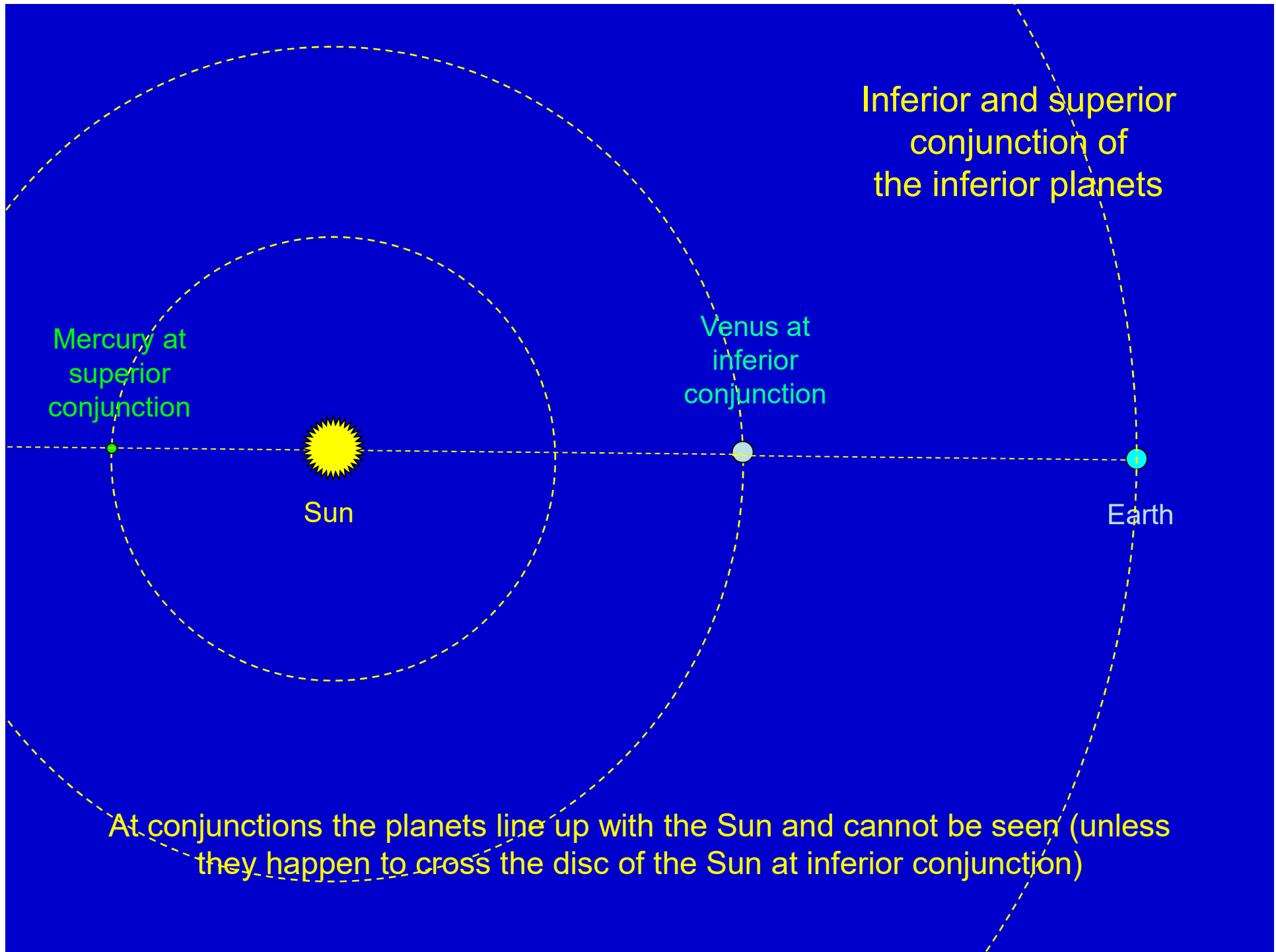
Mercury at
superior
conjunction

Venus at
inferior
conjunction

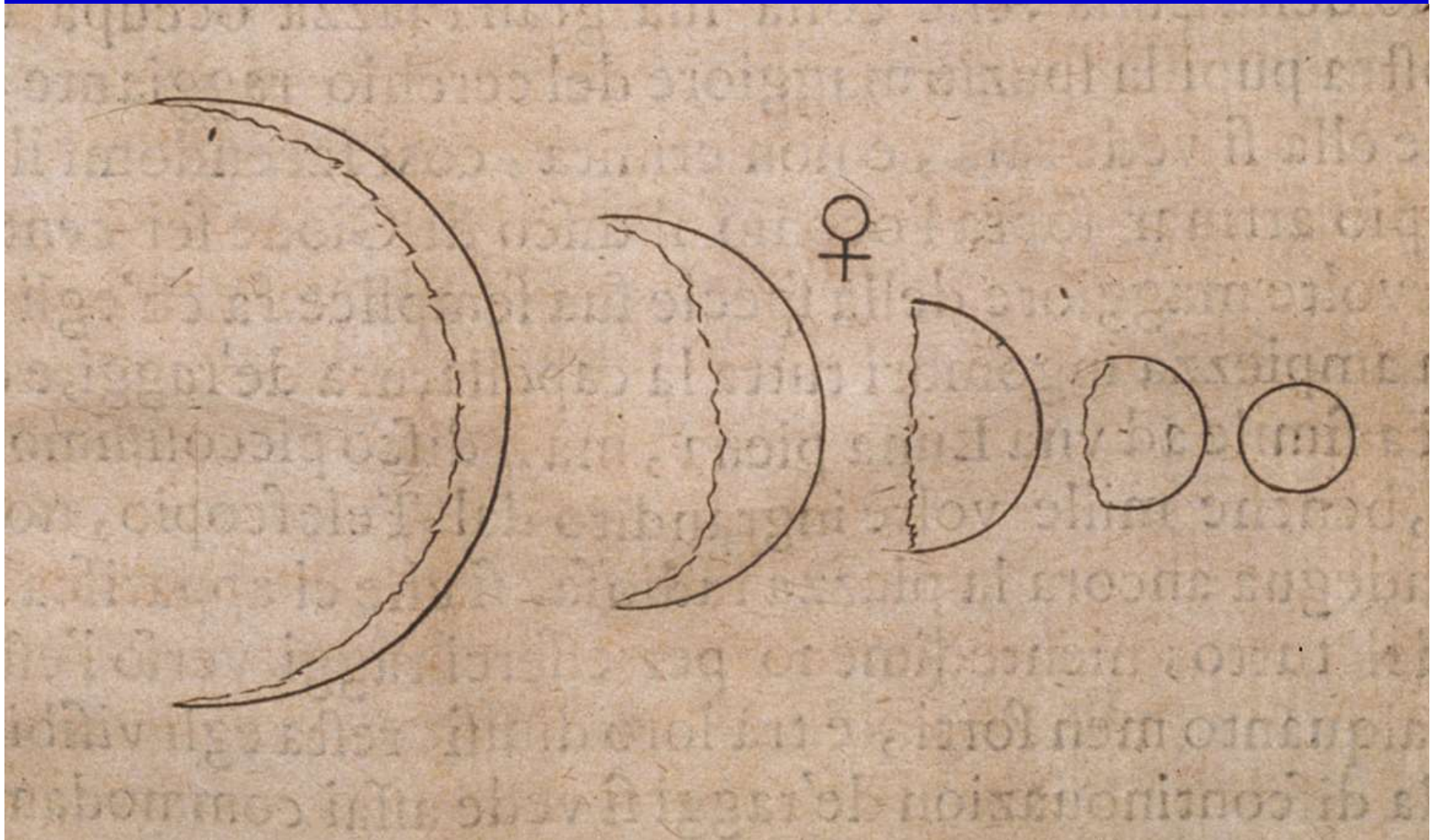
Sun

Earth

At conjunctions the planets line up with the Sun and cannot be seen (unless they happen to cross the disc of the Sun at inferior conjunction)



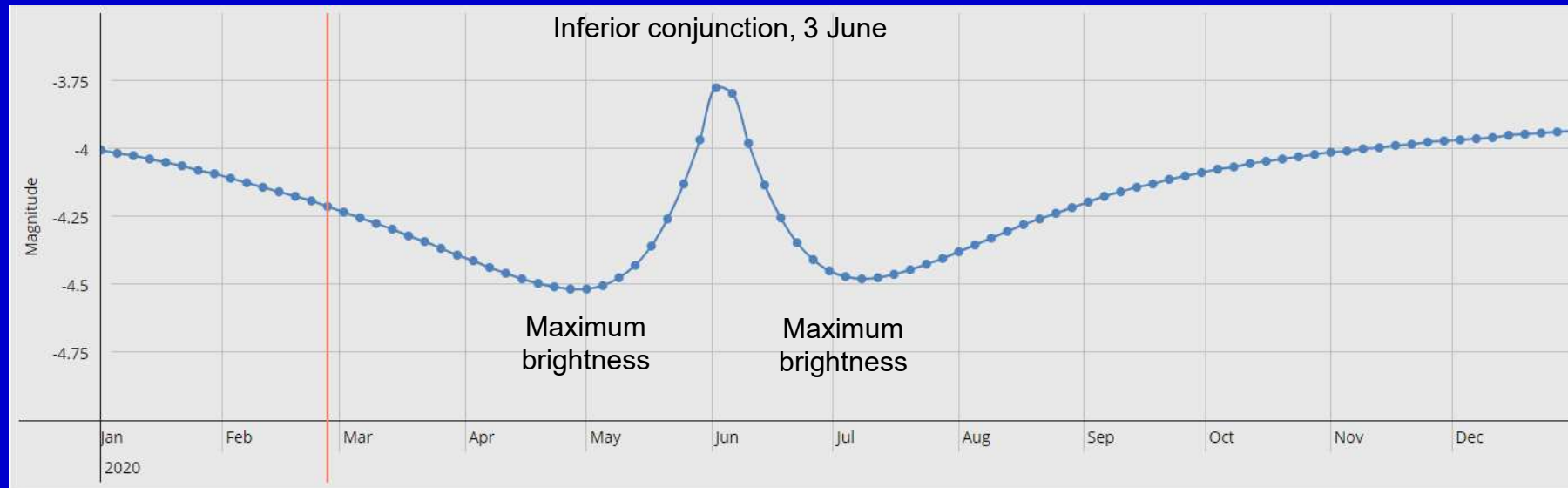
Galileo's drawings of the phases of Venus, 1610-11





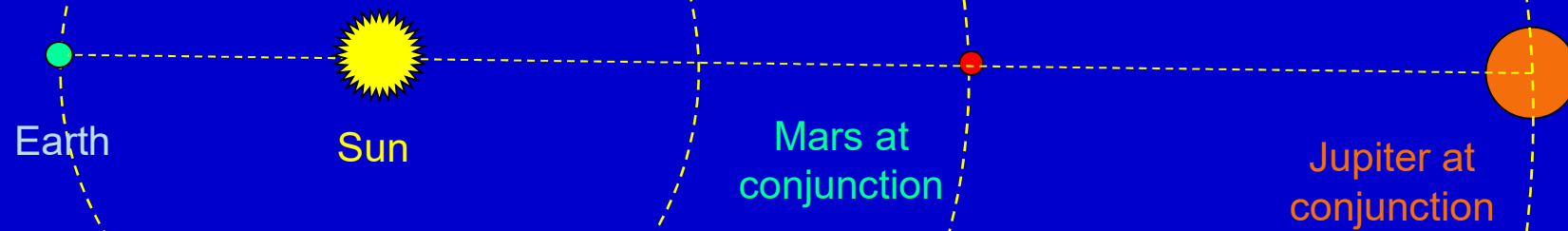
Modern telescopes
show the same phases

Brightness of Venus, 2020



The magnitude (apparent brightness) of Venus depends on its phase – a balance between its shape and its distance from the Earth.

Conjunction of
the superior planets

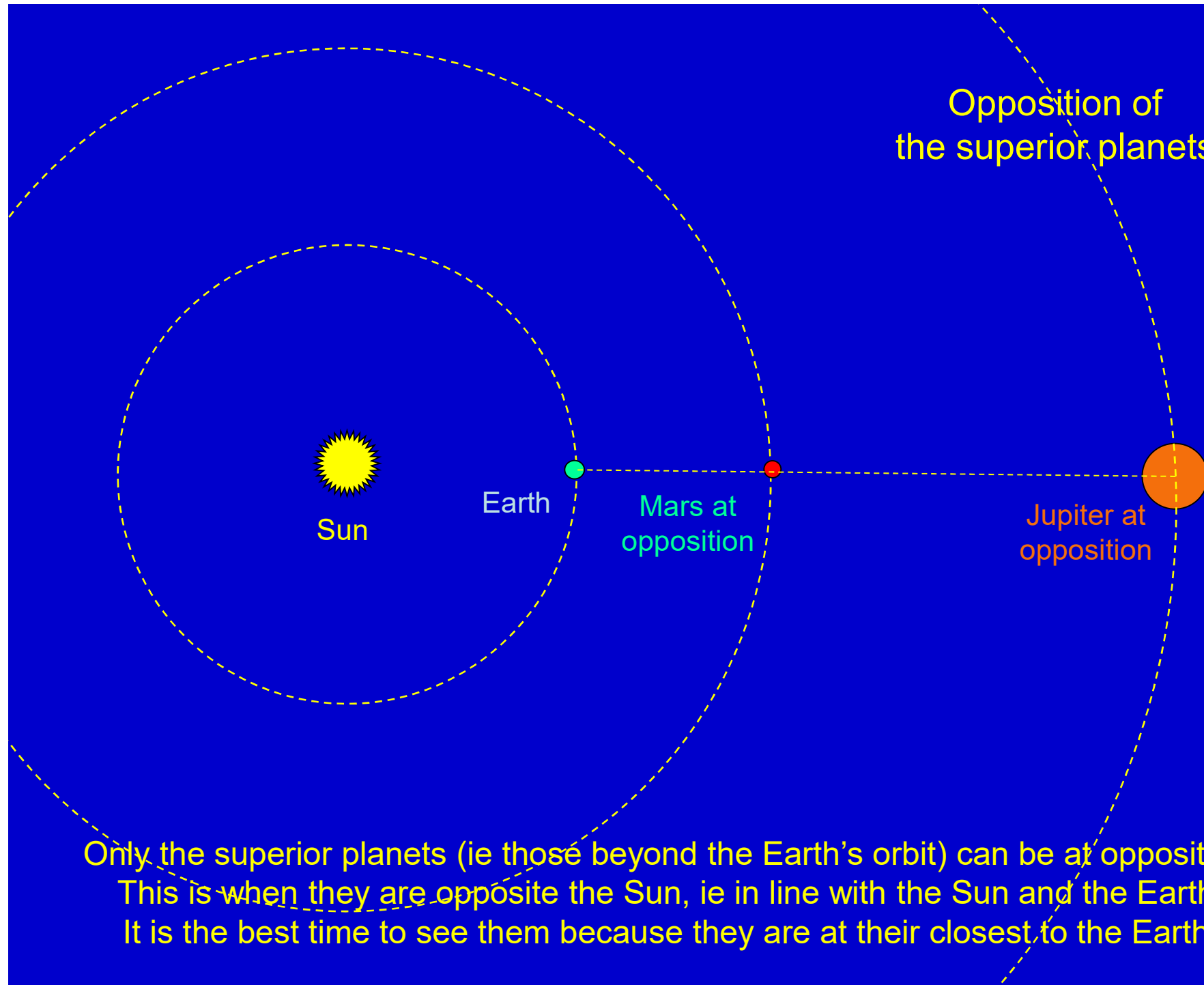


At conjunctions the superior planets (ie those beyond the Earth's orbit) line up with the Sun and cannot be seen

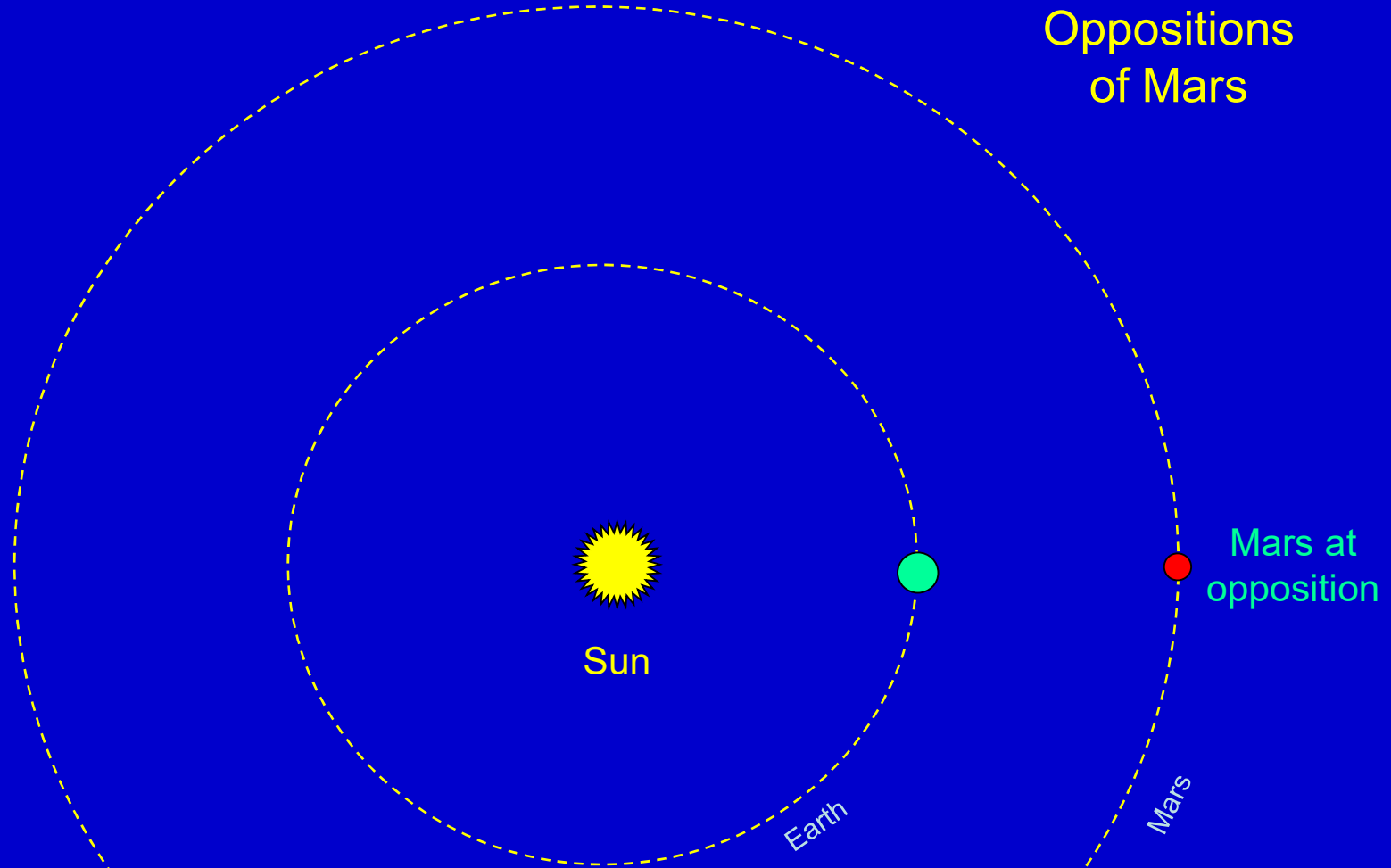
The term 'conjunction' is also used for groupings of planets in the sky.
This is a conjunction of five planets, and the Moon, on 14th May 2002.



Opposition of the superior planets



Only the superior planets (ie those beyond the Earth's orbit) can be at opposition. This is when they are opposite the Sun, ie in line with the Sun and the Earth. It is the best time to see them because they are at their closest to the Earth.



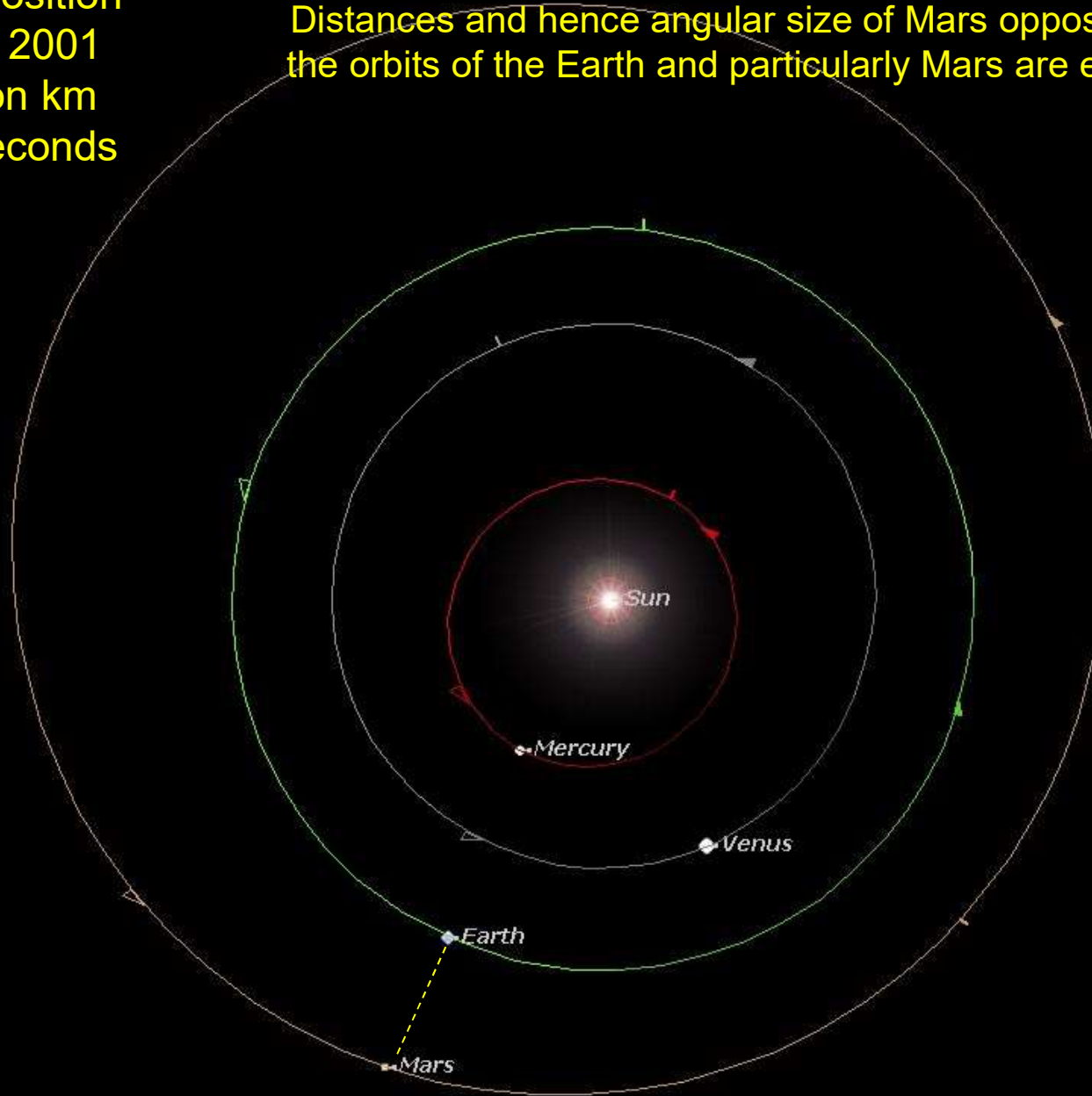
Oppositions of the planet Mars are particularly important because it is then that they appear largest, and so more surface detail can be seen. They happen when the Earth (year 365 days) overtakes Mars (year 687 days) at intervals of about 780 days (2 years and 7 weeks). Its distance at opposition varies from 54 to 103 million km (34 to 64 million miles).

This graphic shows the difference between appearances of Mars at its most distant and its closest.



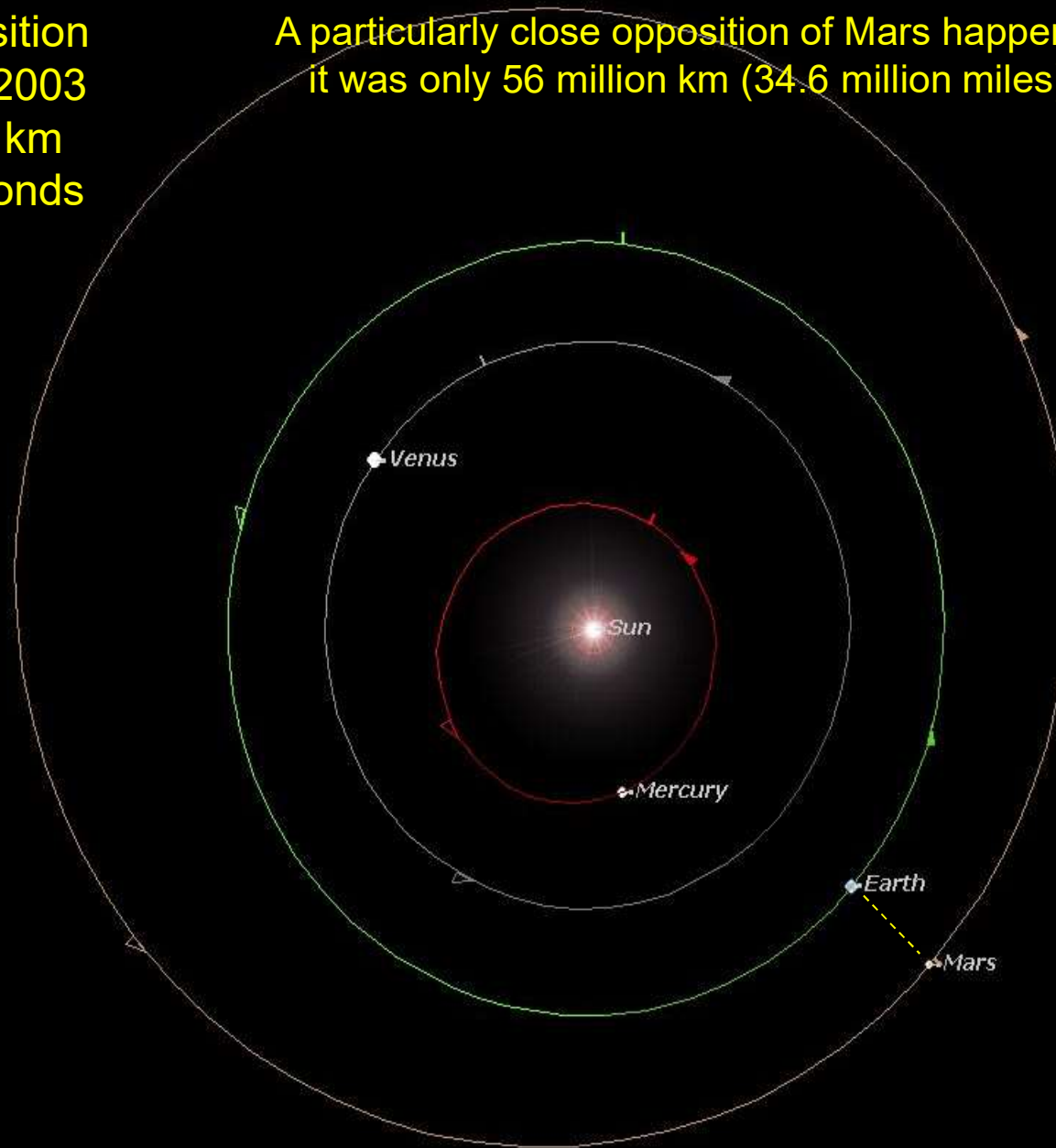
Mars opposition
13 June 2001
68 million km
21 arc-seconds

Distances and hence angular size of Mars oppositions vary because the orbits of the Earth and particularly Mars are elliptical, not circular.



Mars opposition
28 August 2003
56 million km
25 arc-seconds

A particularly close opposition of Mars happened in 2003, when it was only 56 million km (34.6 million miles) from the Earth.



Here are comparison images of Mars leading up to the 2003 opposition

August 2002



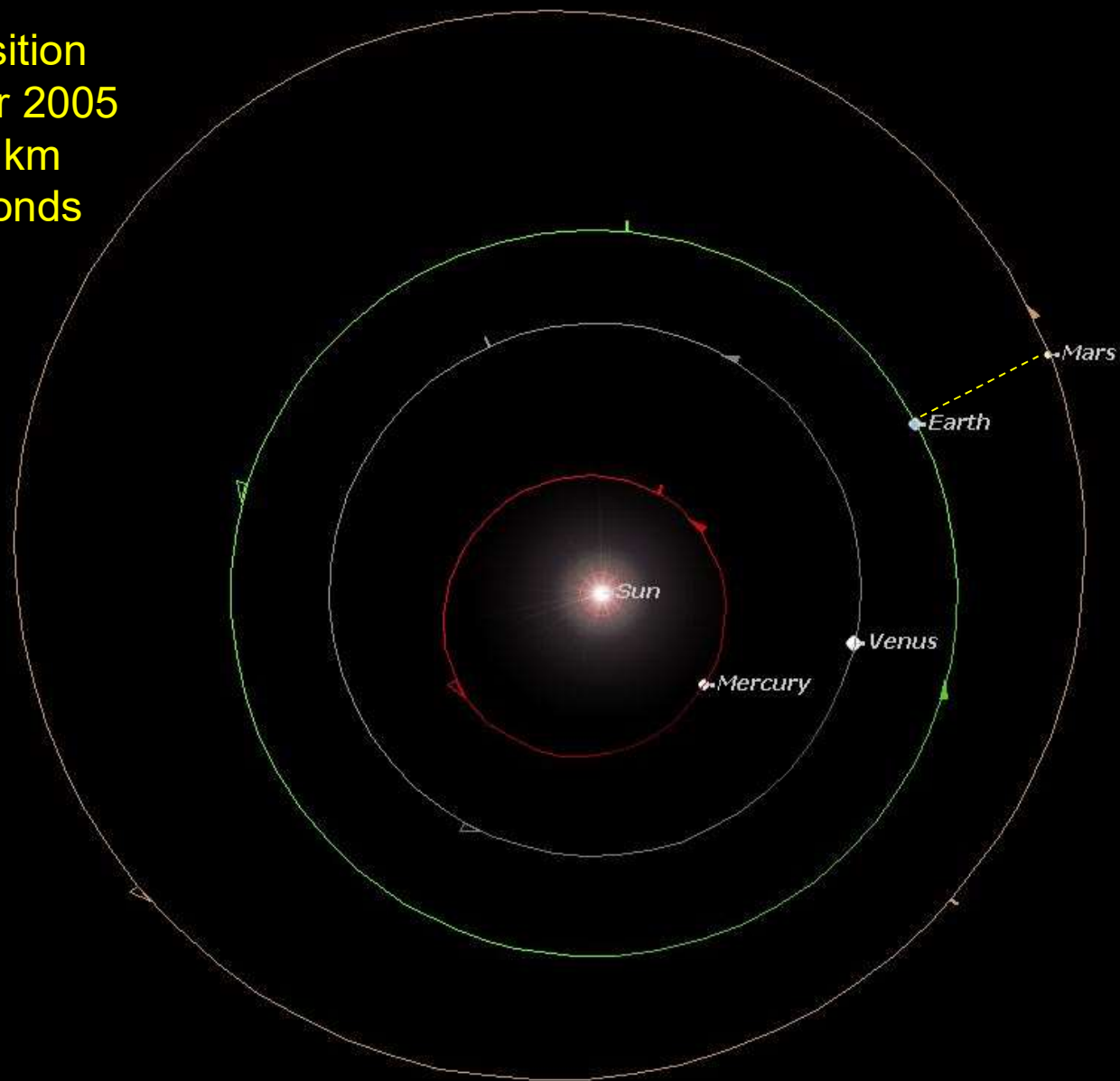
20 February 2003



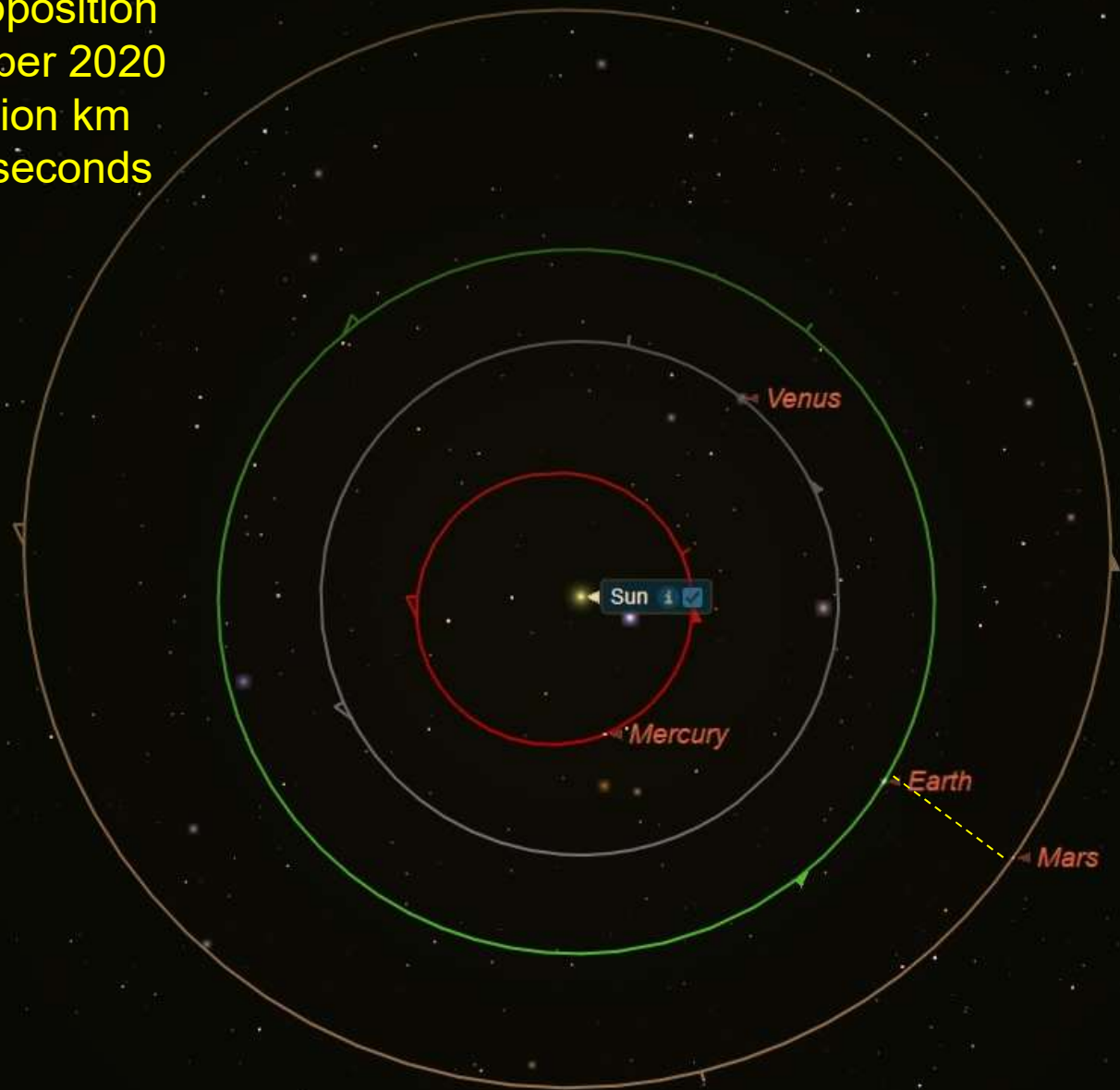
27 August 2003



Mars opposition
07 November 2005
70 million km
43 arc-seconds



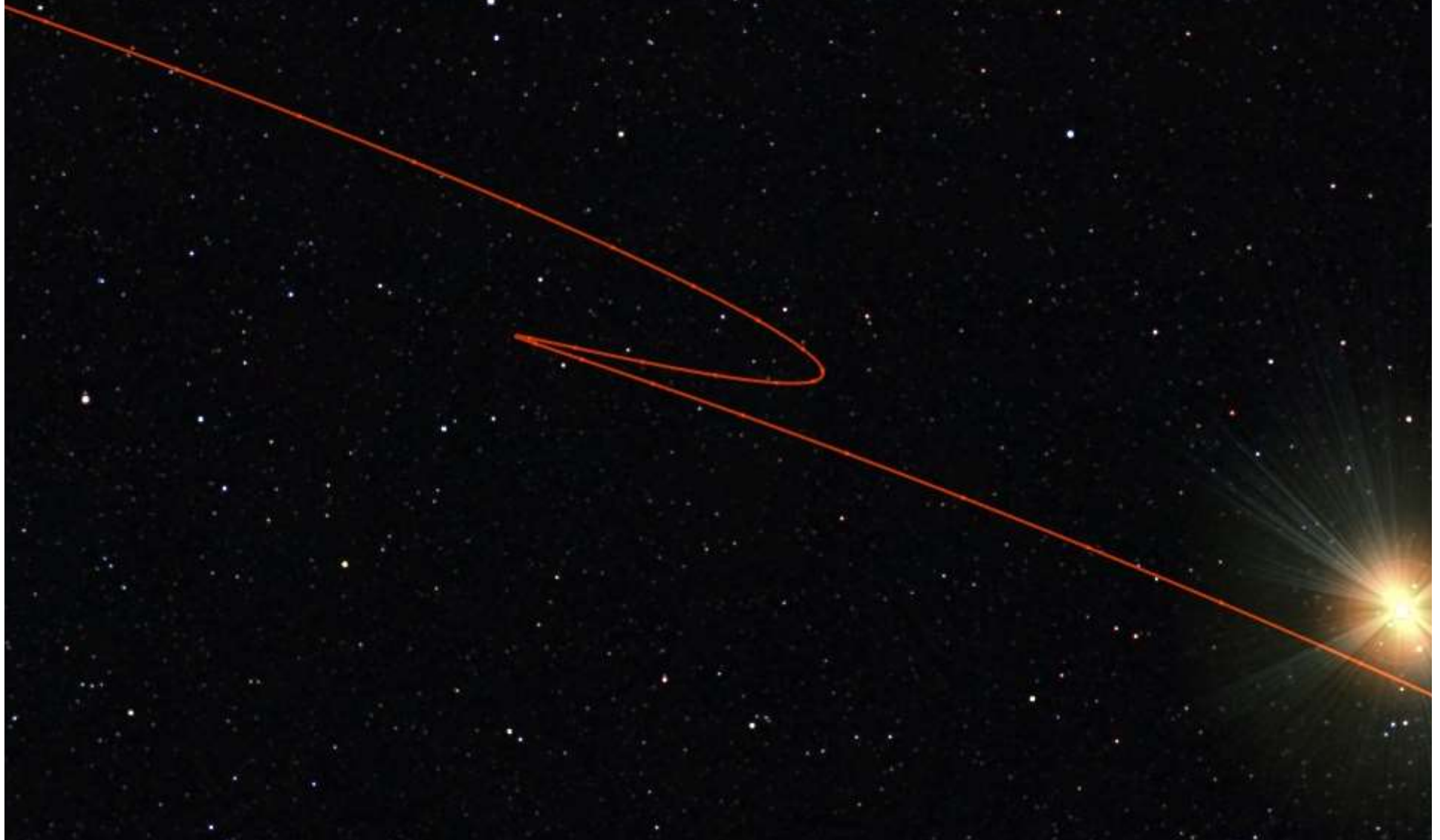
Mars opposition
13 October 2020
63 million km
39 arc-seconds



Opposition in longitude between Mars and Sun

Date UT	Distance AU	Distance million km	Distance million miles	Declination deg's mins
2001 Jun 13	0.4556	68.16	42.35	-26° 30'
2003 Aug 28	0.3728	55.77	34.65	-15° 49'
2005 Nov 07	0.4700	70.31	43.69	+15° 54'
2007 Dec 24	0.5929	88.70	55.11	+26° 46'
2010 Jan 29	0.6644	99.39	61.76	+22° 09'
2012 Mar 03	0.6741	100.84	62.66	+10° 16'
2014 Apr 08	0.6209	92.89	57.72	-05° 08'
2016 May 22	0.5094	76.21	47.35	-21° 39'
2018 Jul 27	0.3862	57.77	35.90	-25° 29'
2020 Oct 13	0.4192	62.71	38.97	+05° 26'
2022 Dec 08	0.5496	82.22	51.09	+24° 59'
2025 Jan 16	0.6437	96.30	59.84	+25° 06'
2027 Feb 19	0.6779	101.41	63.01	+15° 22'
2029 Mar 25	0.6491	97.10	60.34	+01° 04'

As the Earth overtakes Mars at opposition the planet appears to make a retrograde loop with respect to the stars. Here is shown the retrograde motion at opposition in October 2020.



Of historical interest is a sketch made by Guernseyman Warren De La Rue of Mars at opposition in 1852, including a polar ice cap.



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