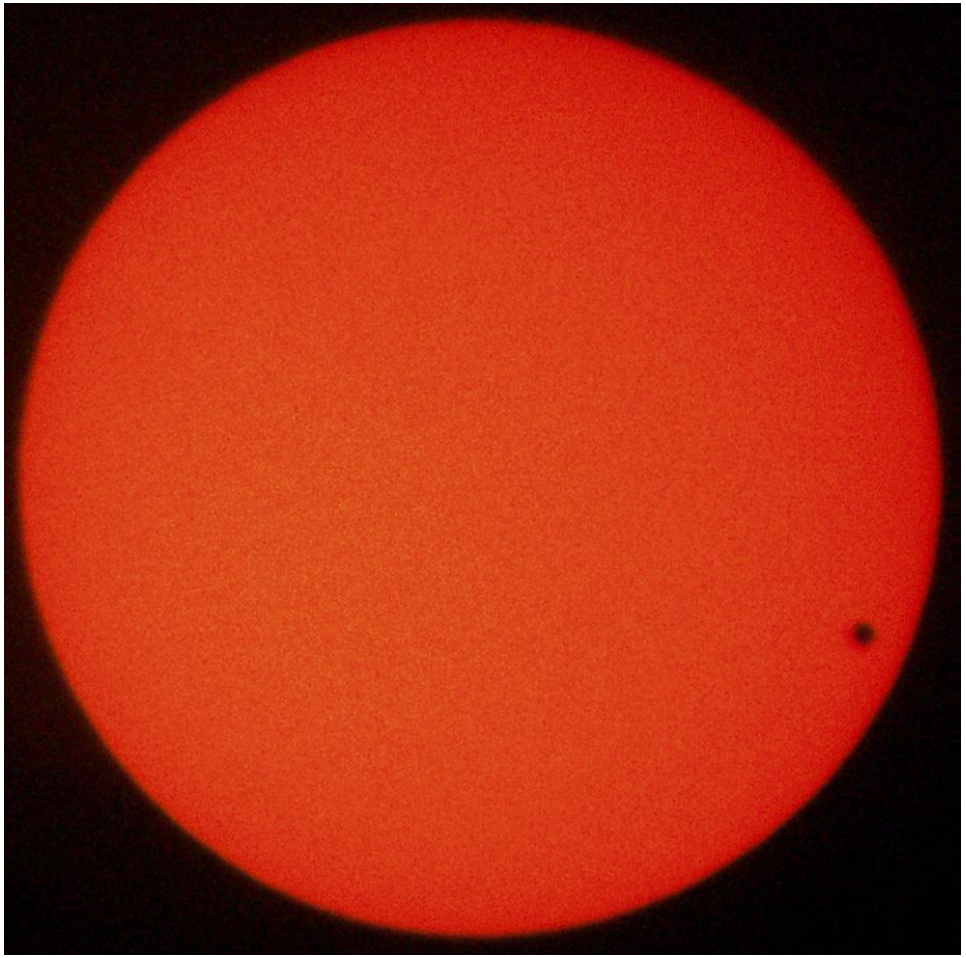
On the

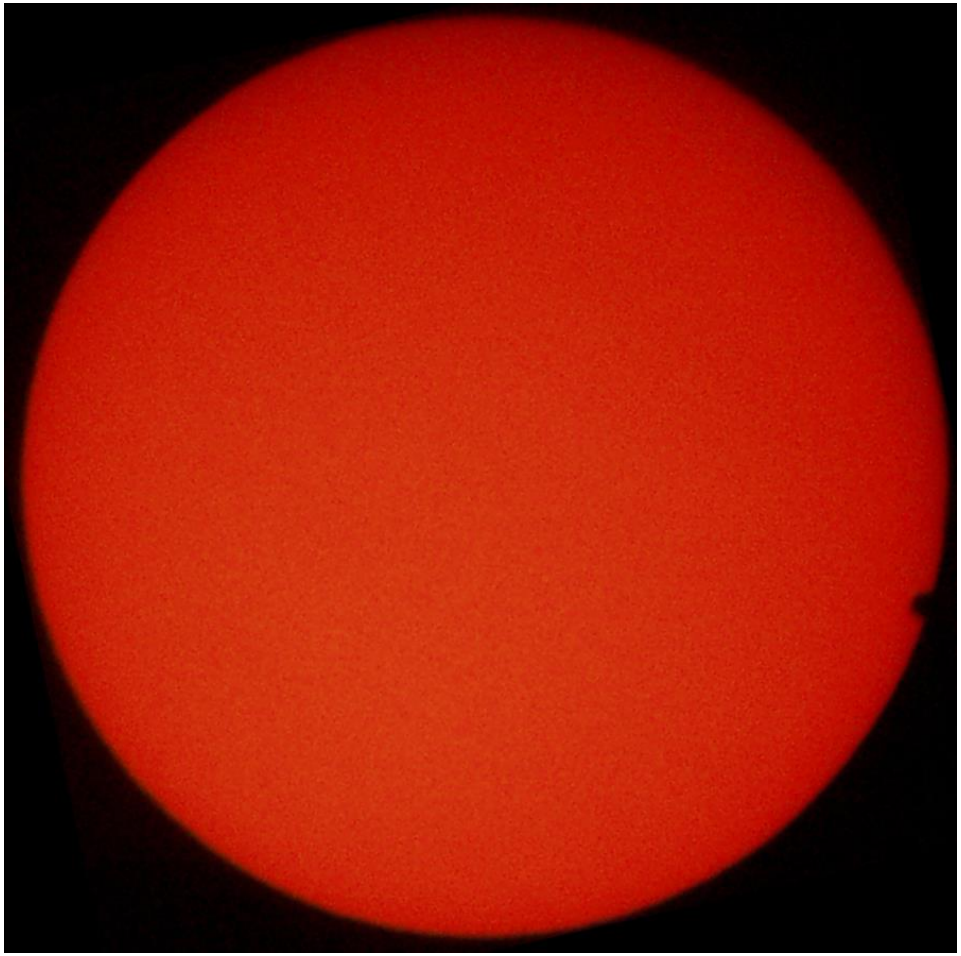
Transits of Venus

June 8, 2004

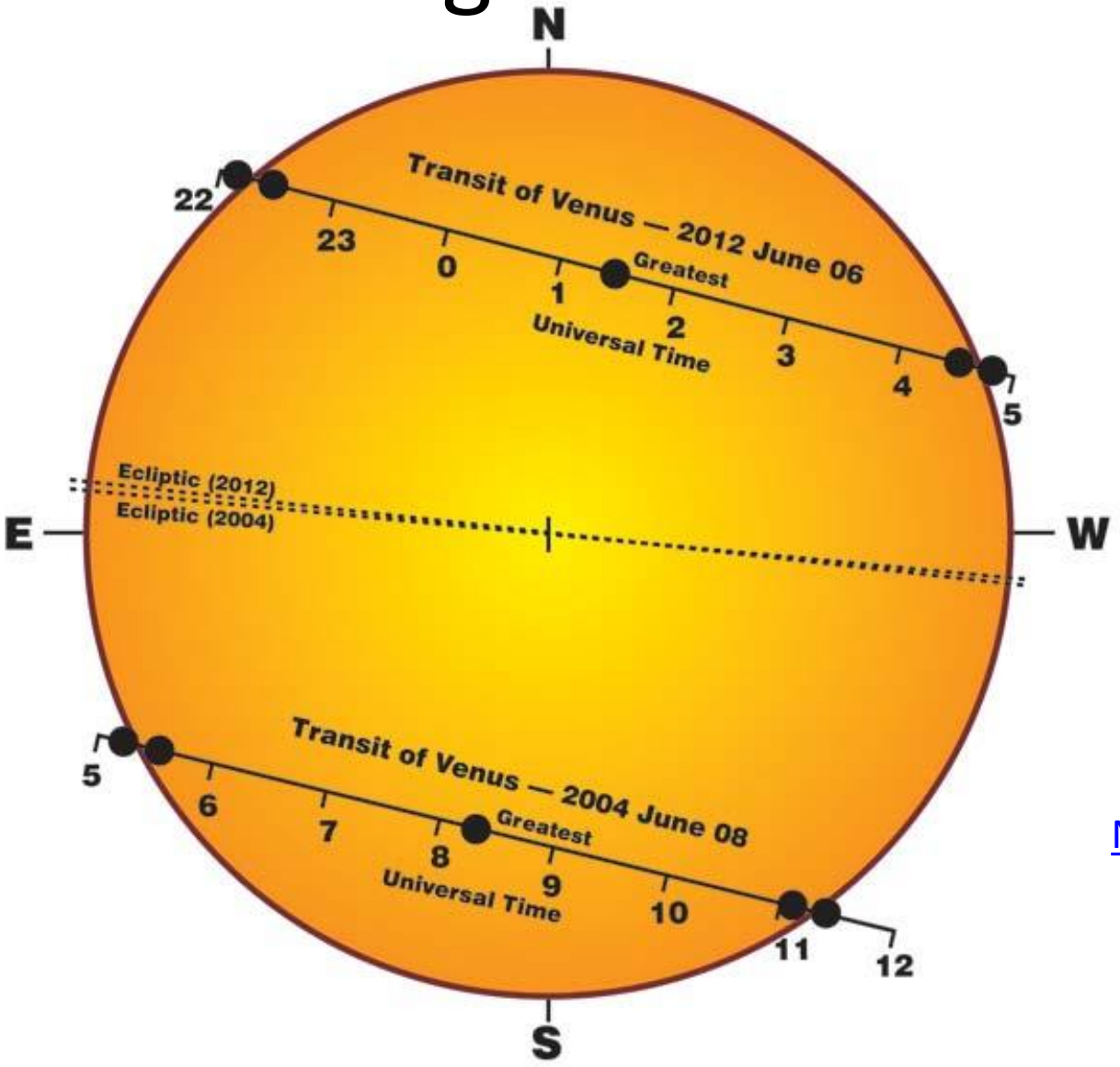


June 8, 2004

June 8, 2004



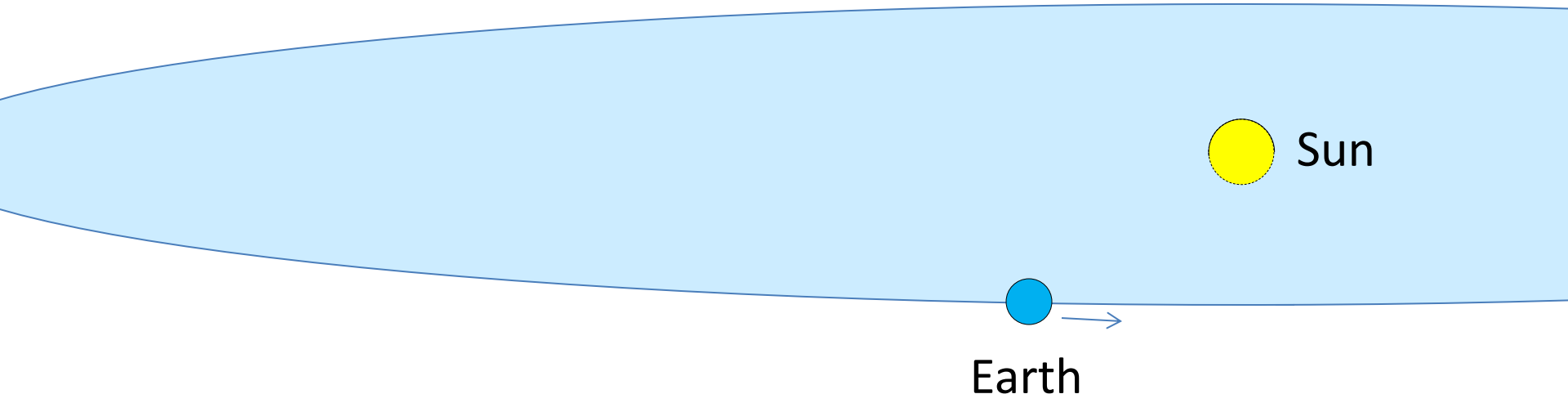
the crossings of ‘04 and ‘12



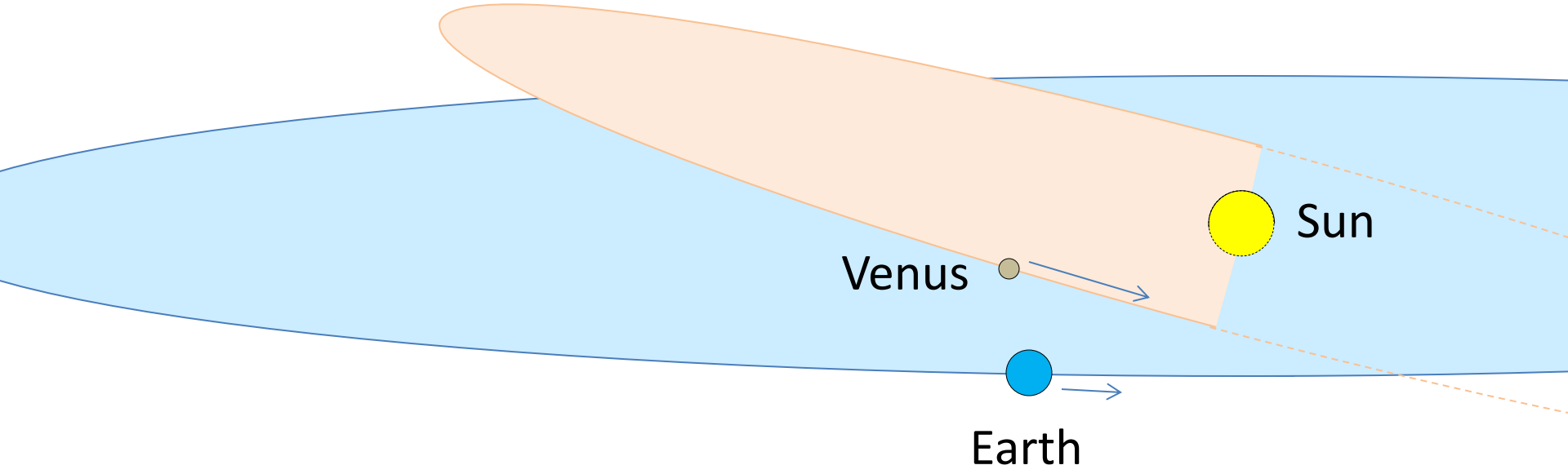
[NASA picture]

The Orbits of the Two Planets

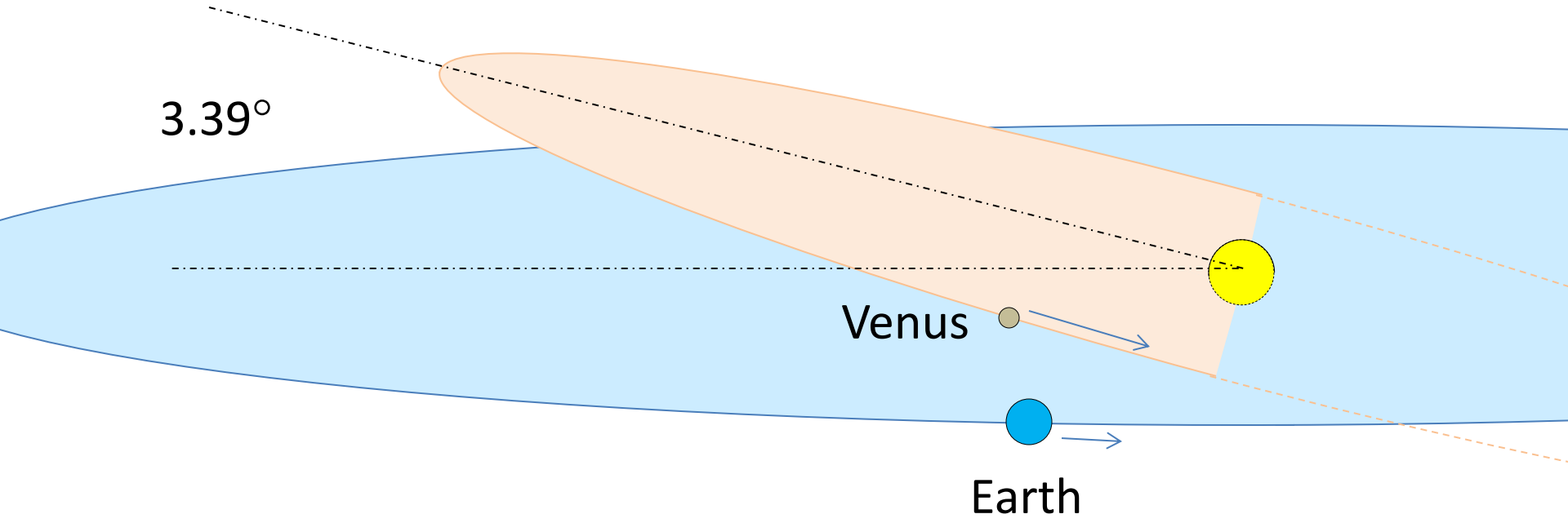
the plane of the ecliptic



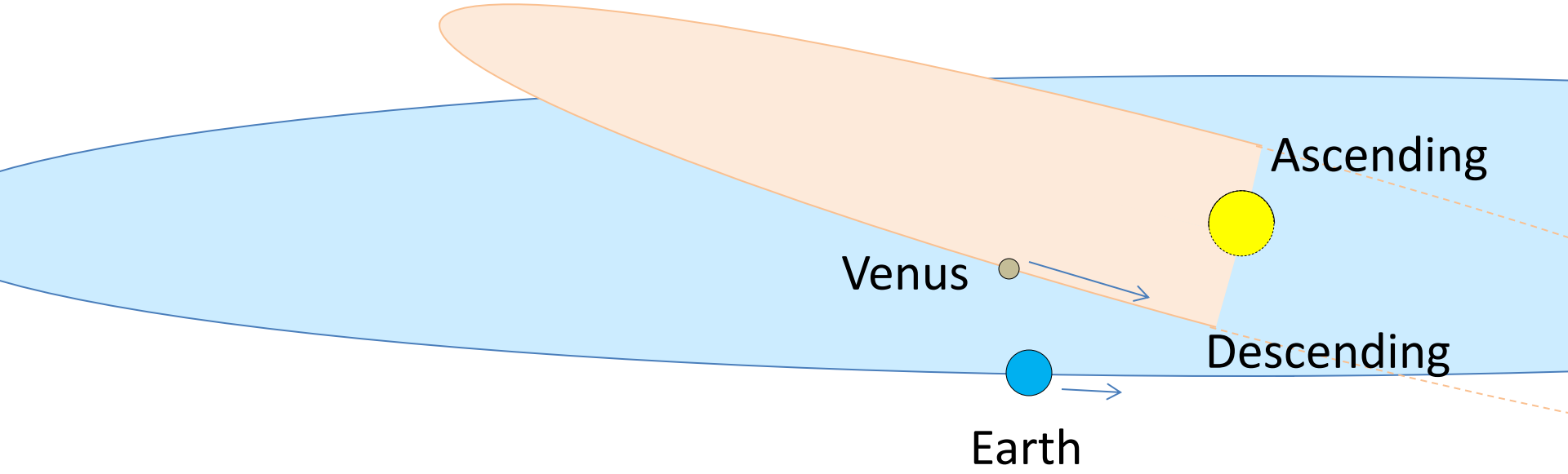
the two orbits



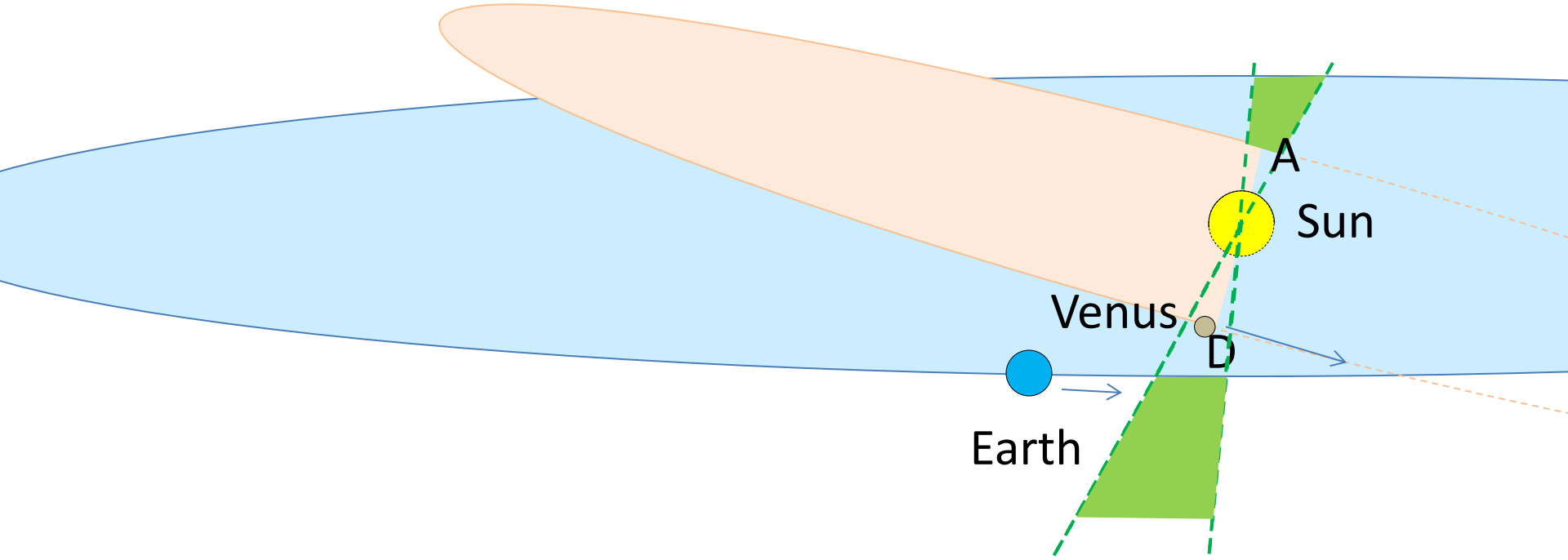
the inclination of Venus's orbit



the nodes

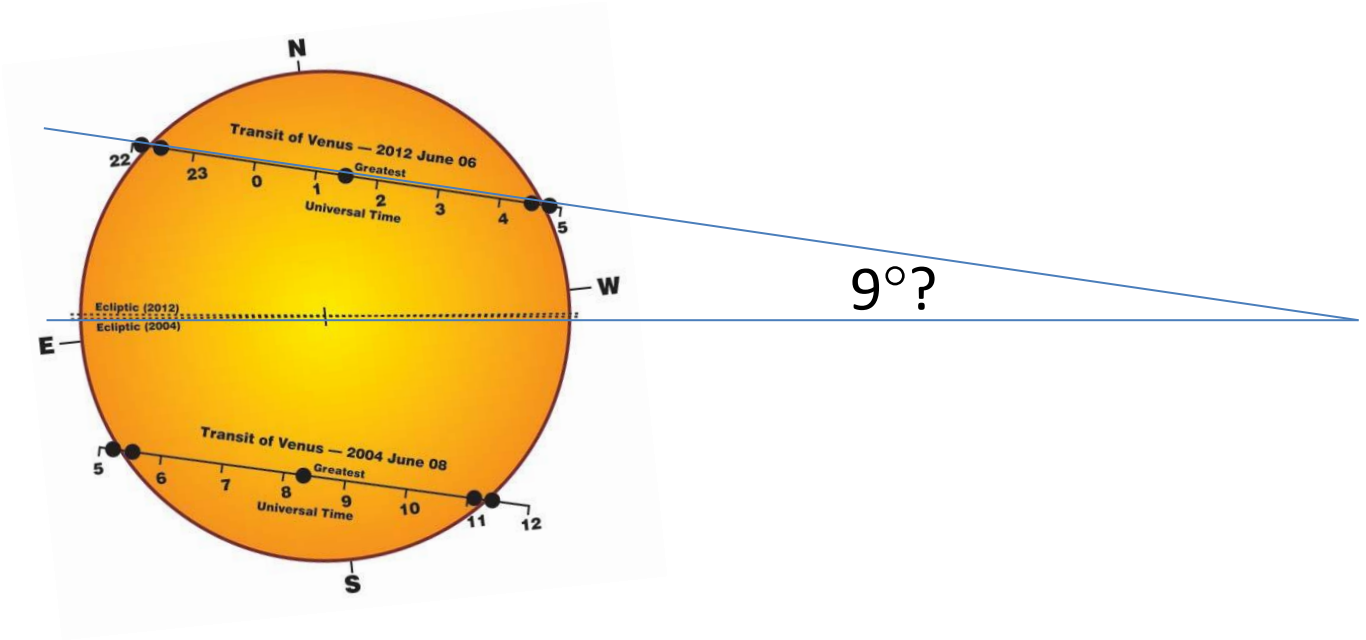


the green zones

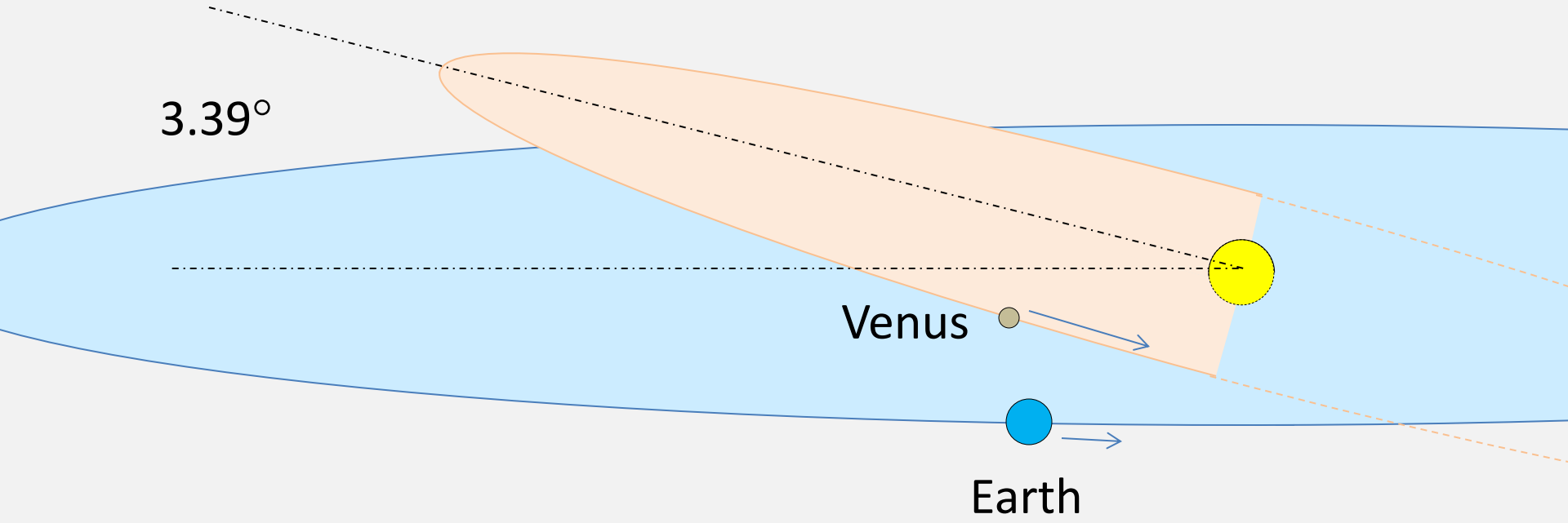


Size of the Green Zone:
The Angles of the Crossings

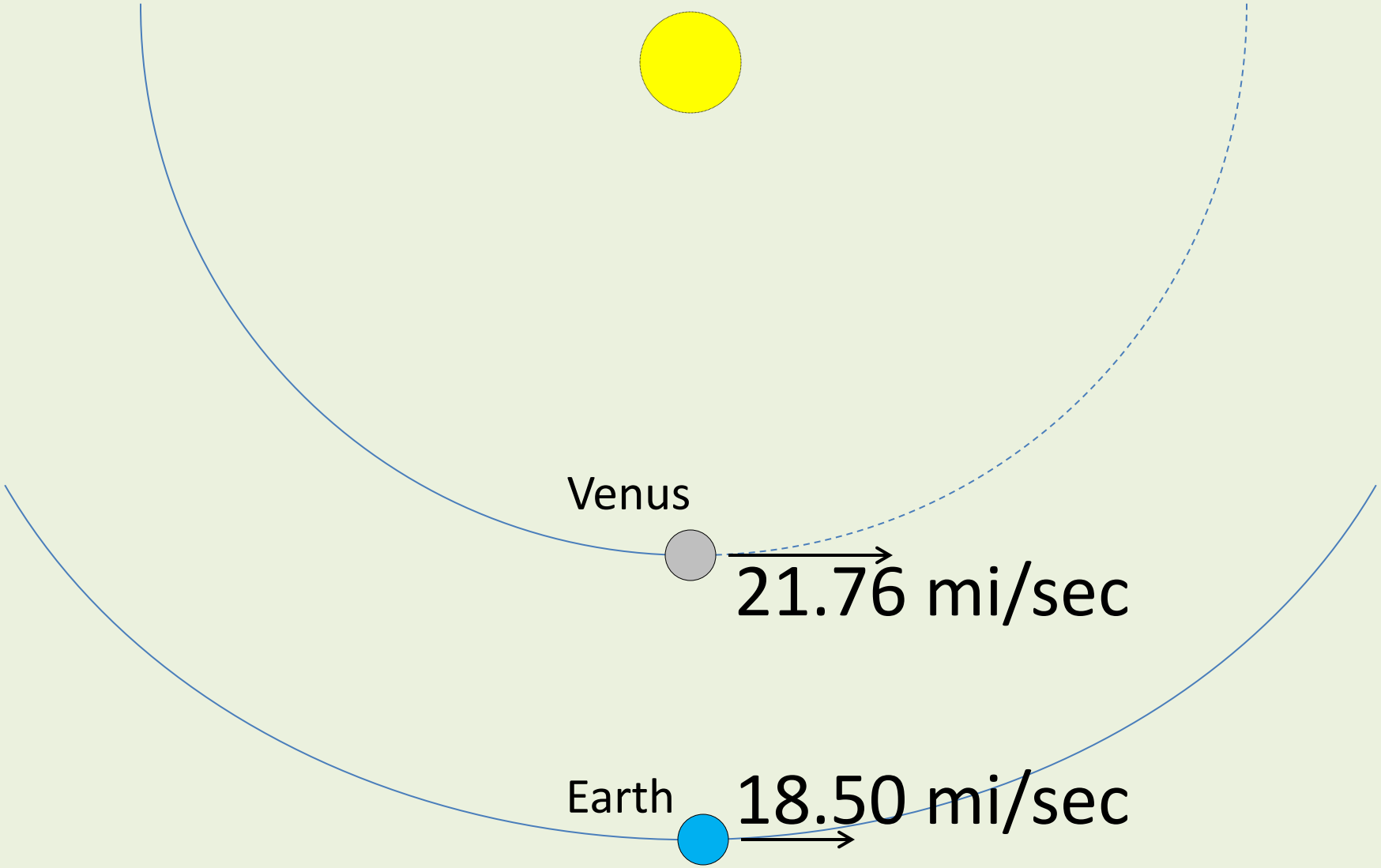
the solar angle:
a combination of three things



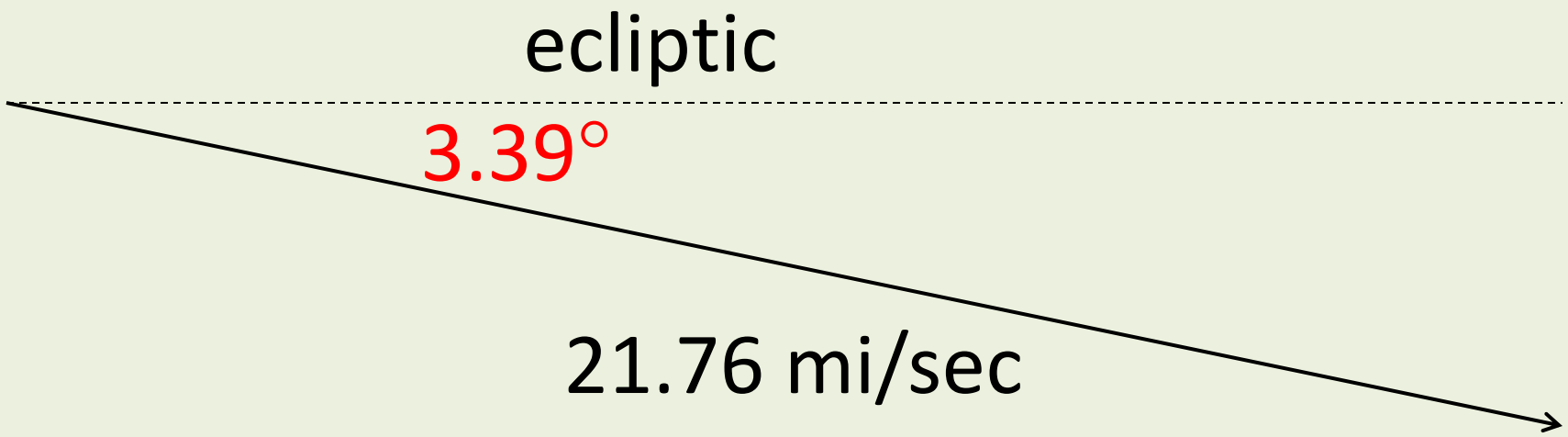
1. the sidereal angle



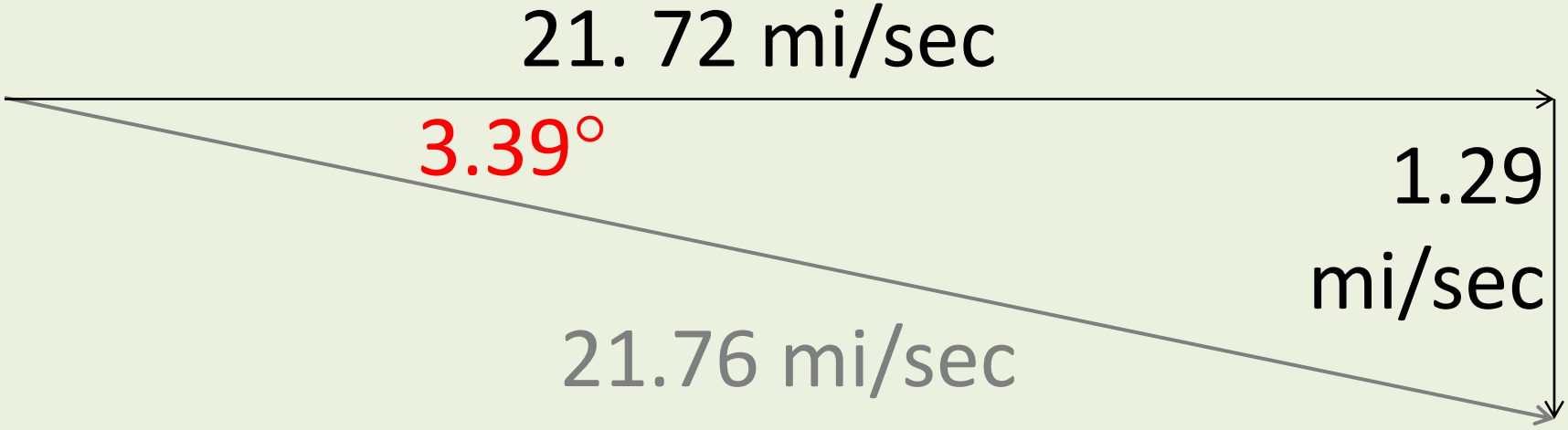
the orbital speeds of the planets



the sidereal path of Venus

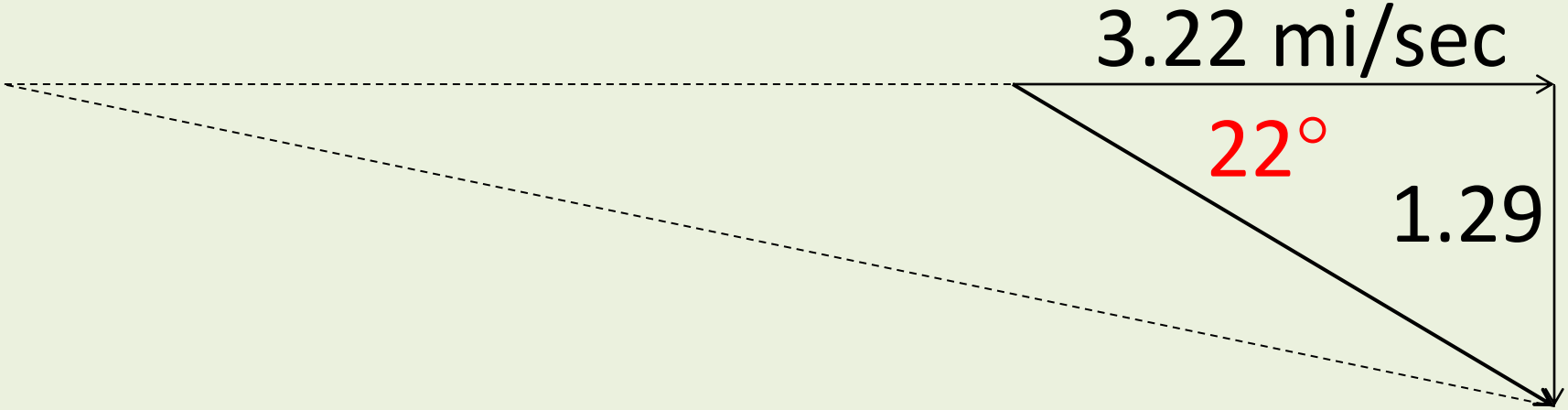


the sidereal path of Venus



the relative speed from our view

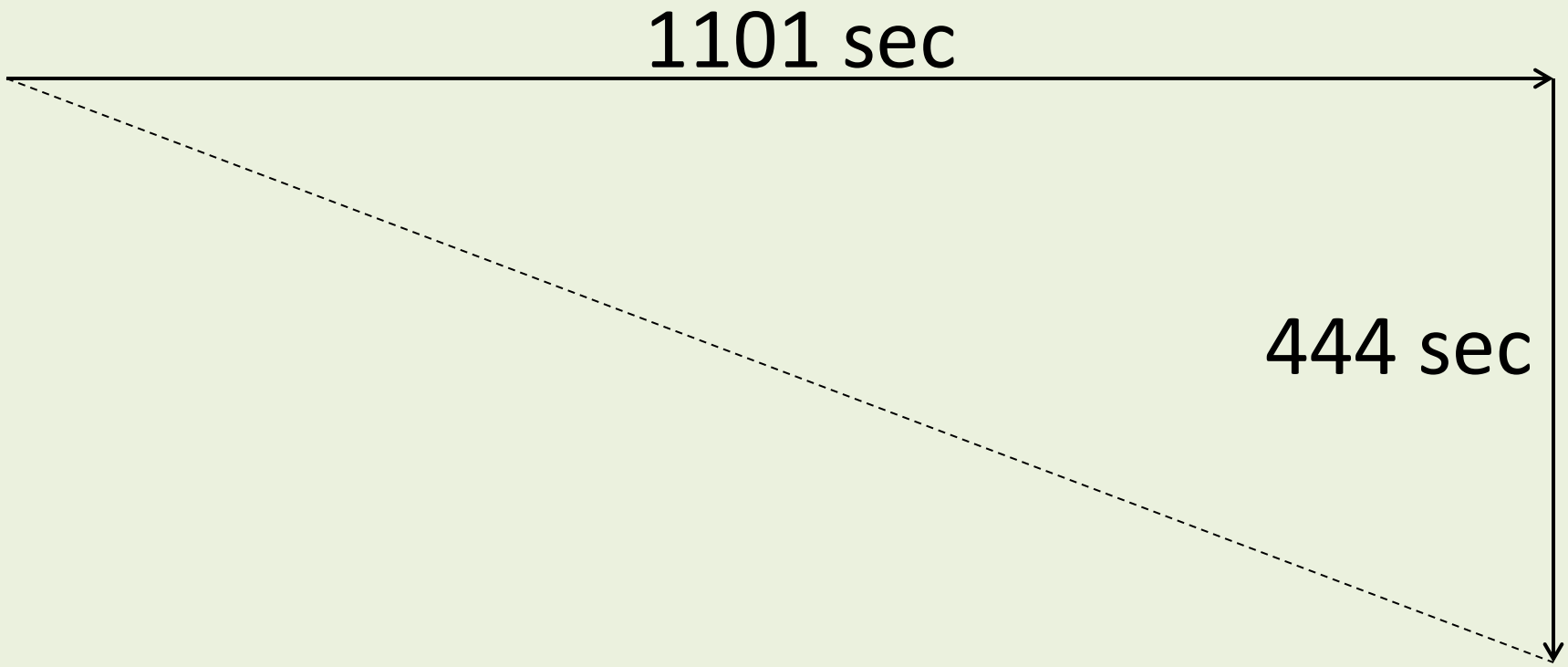
2. the terrestrial angle



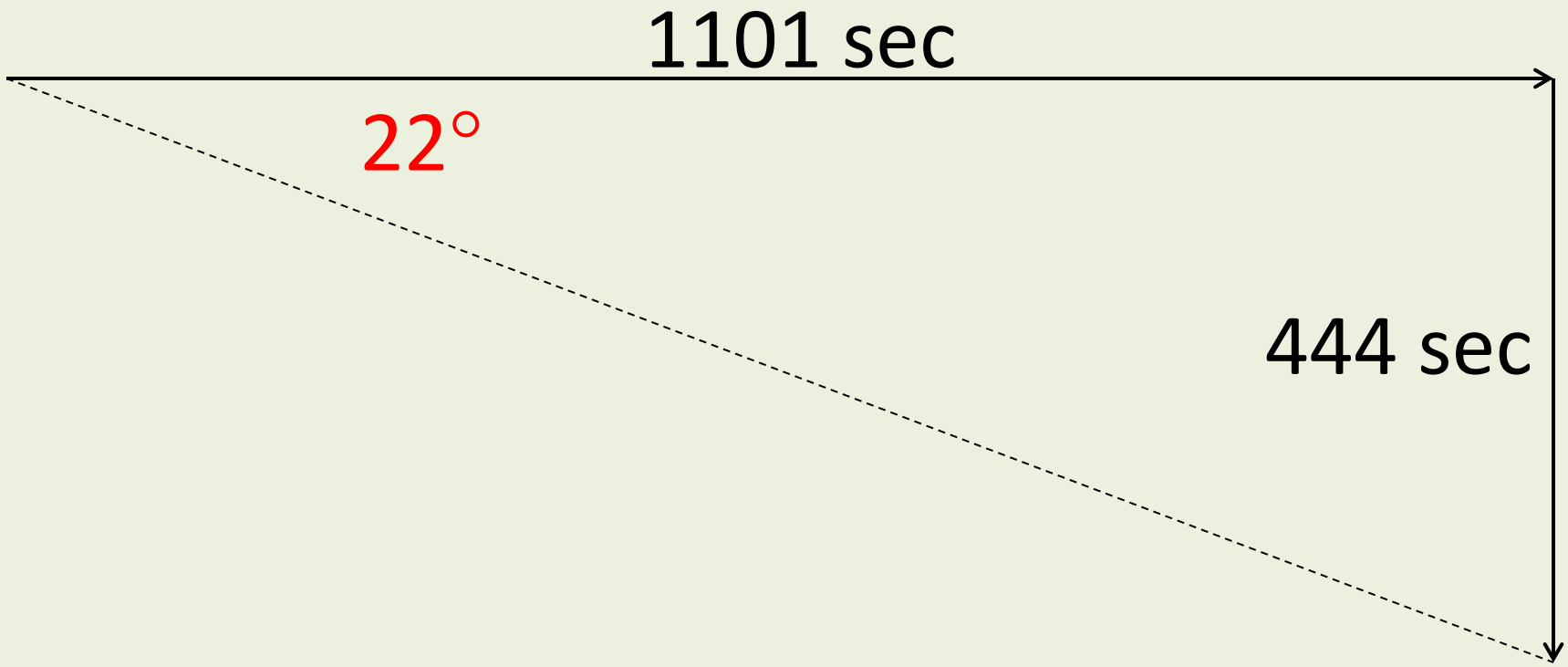
confirmation: ecliptic coordinates of Venus, June 5-6, 2012

3 pm	75 deg 53 m 57 s	0 deg 12 m 49 s
3 am	75 deg 35 m 26 s	0 deg 05 m 25 s
drift	- 18 m 21 s	- 7 m 24 s
	- 1101 s	- 444 s

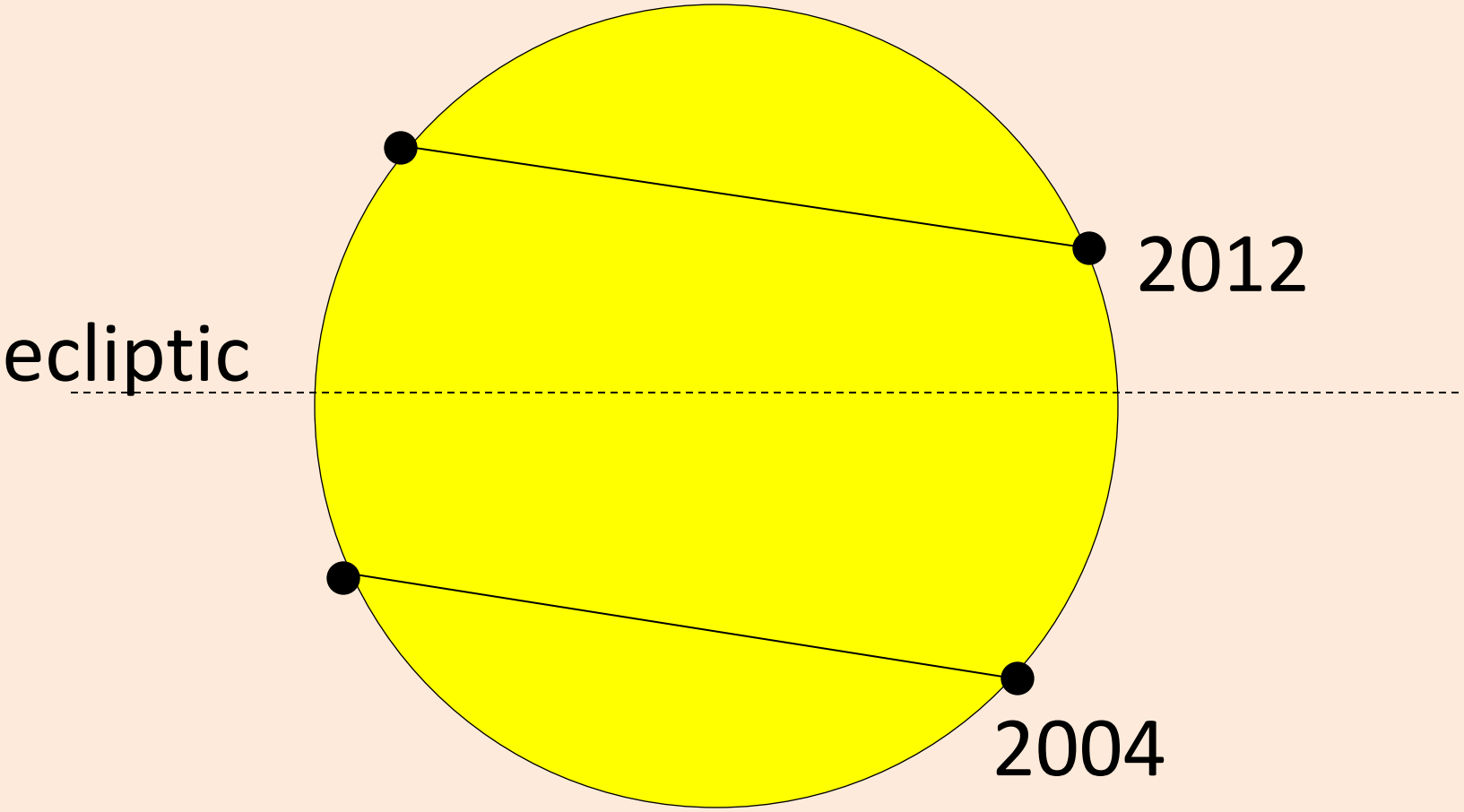
the path from our view



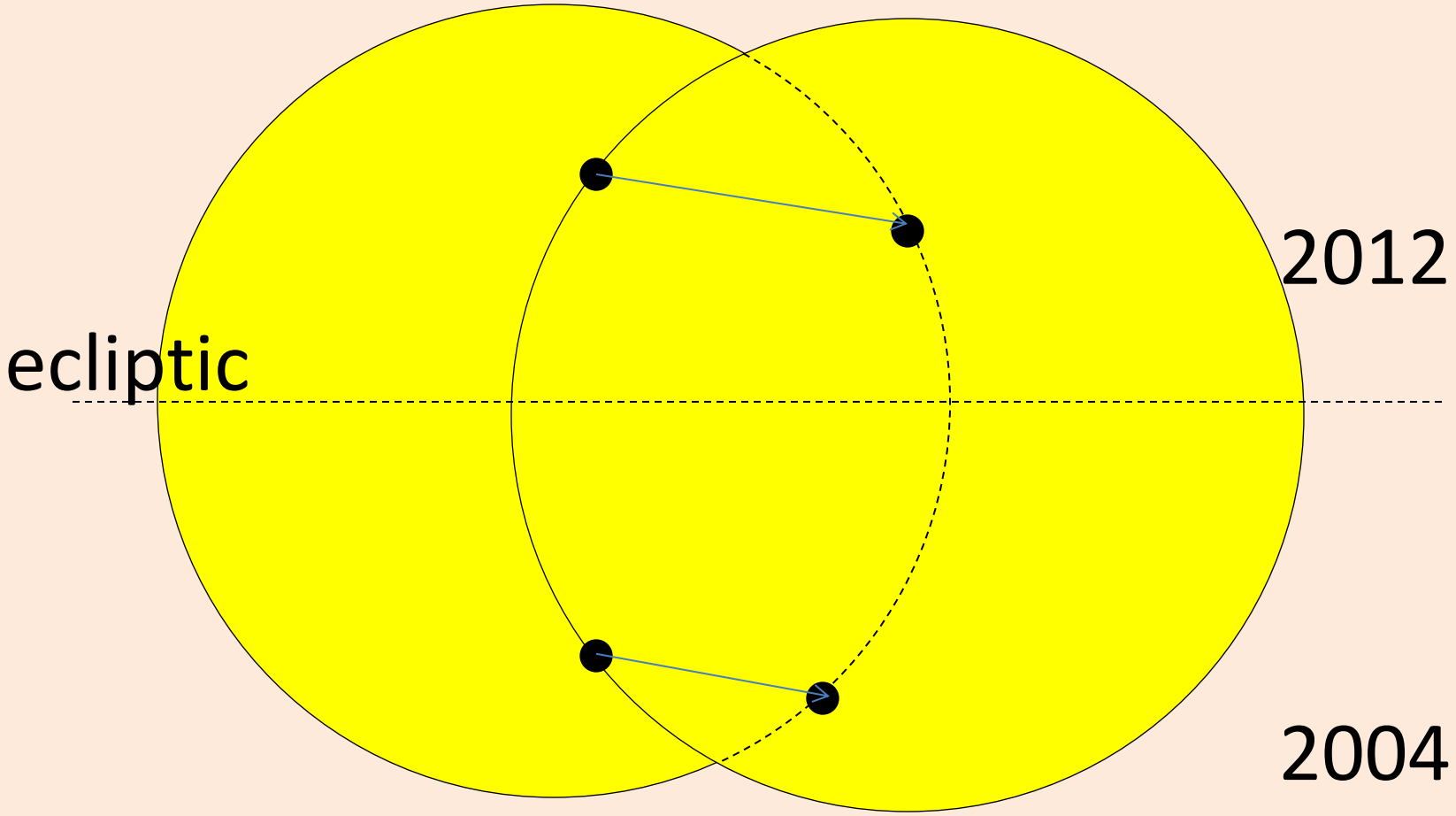
the terrestrial angle



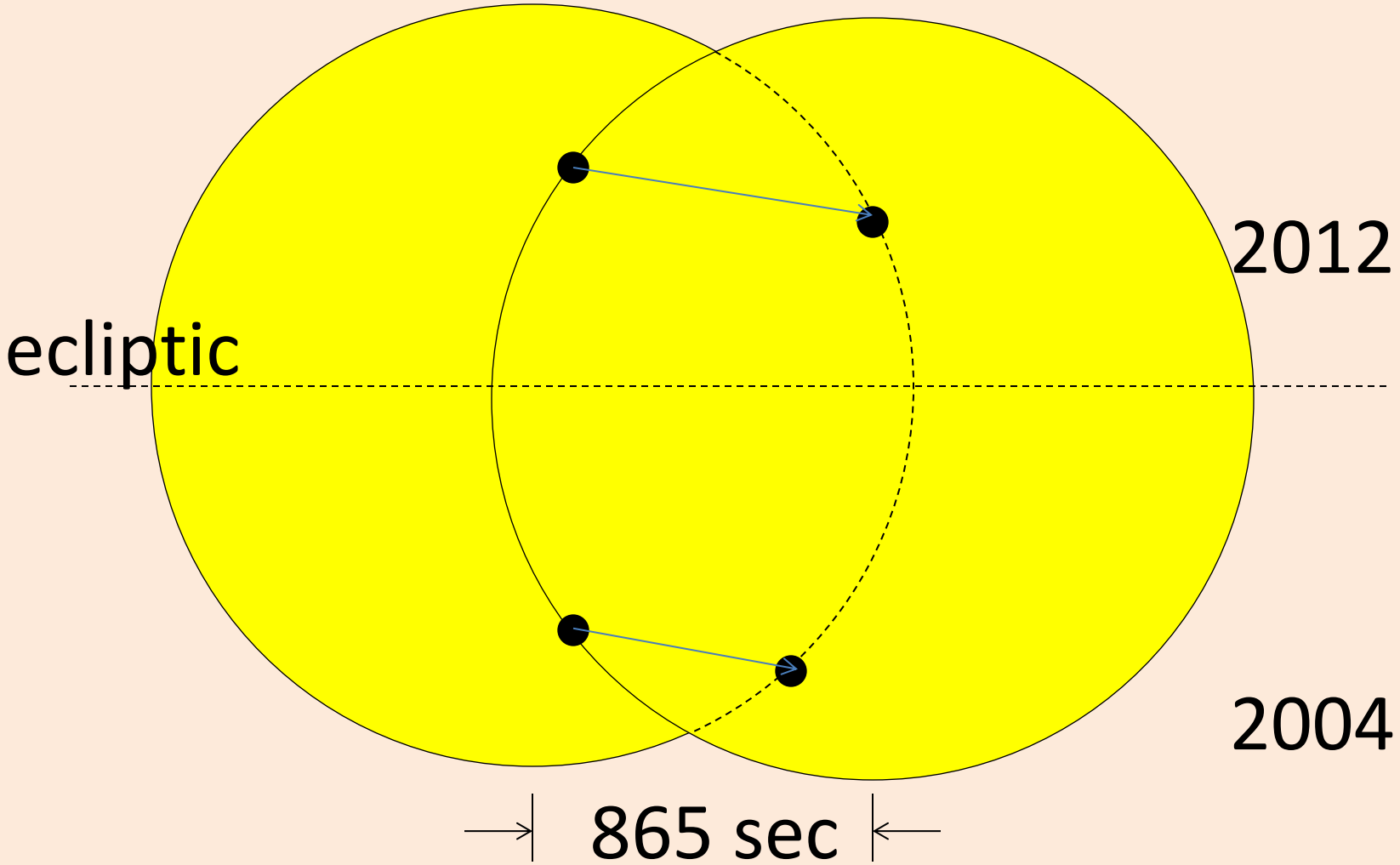
the apparent crossings



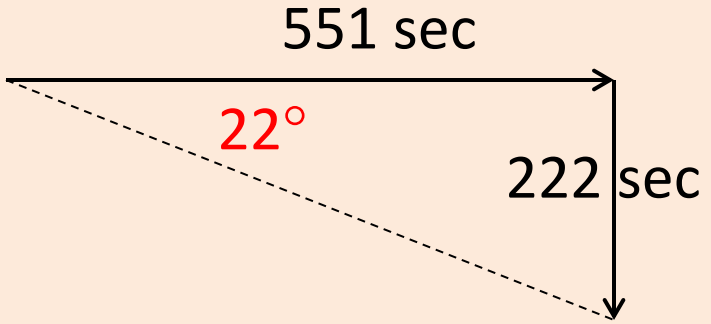
3. the actual crossings



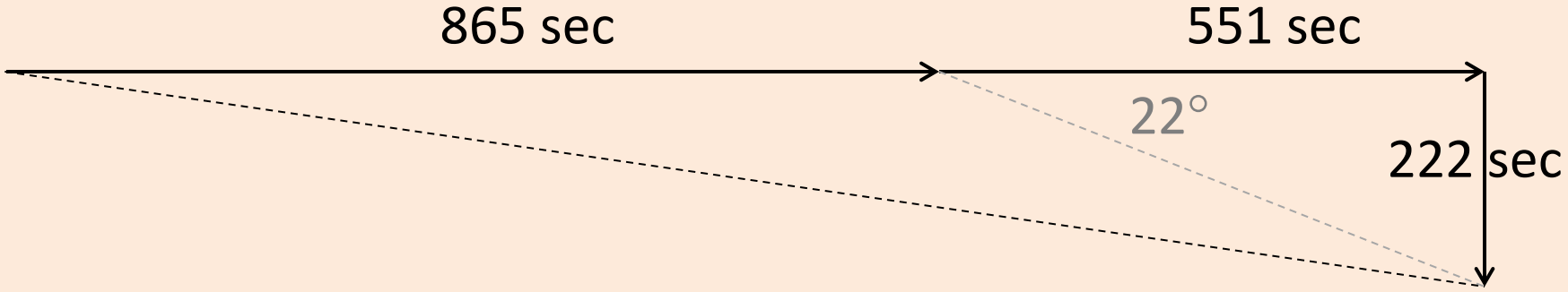
the Sun's 2012 drift



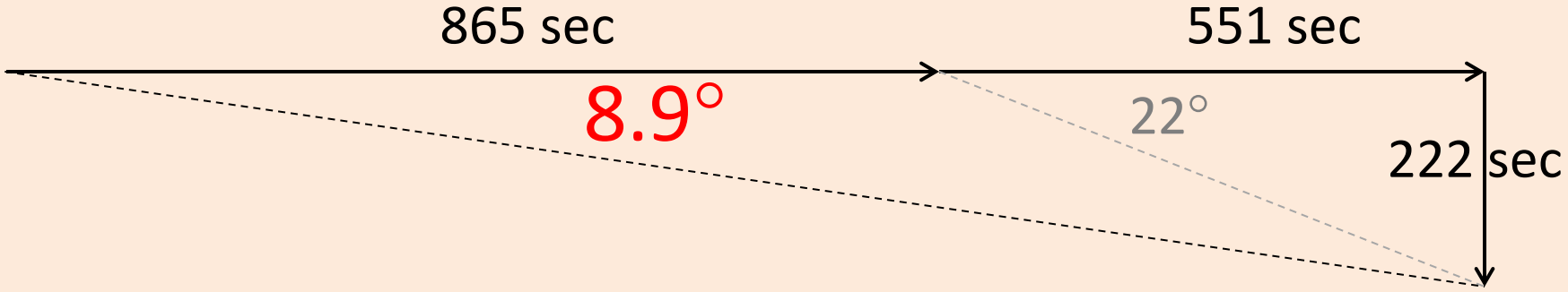
the terrestrial angle



the apparent path across the Sun

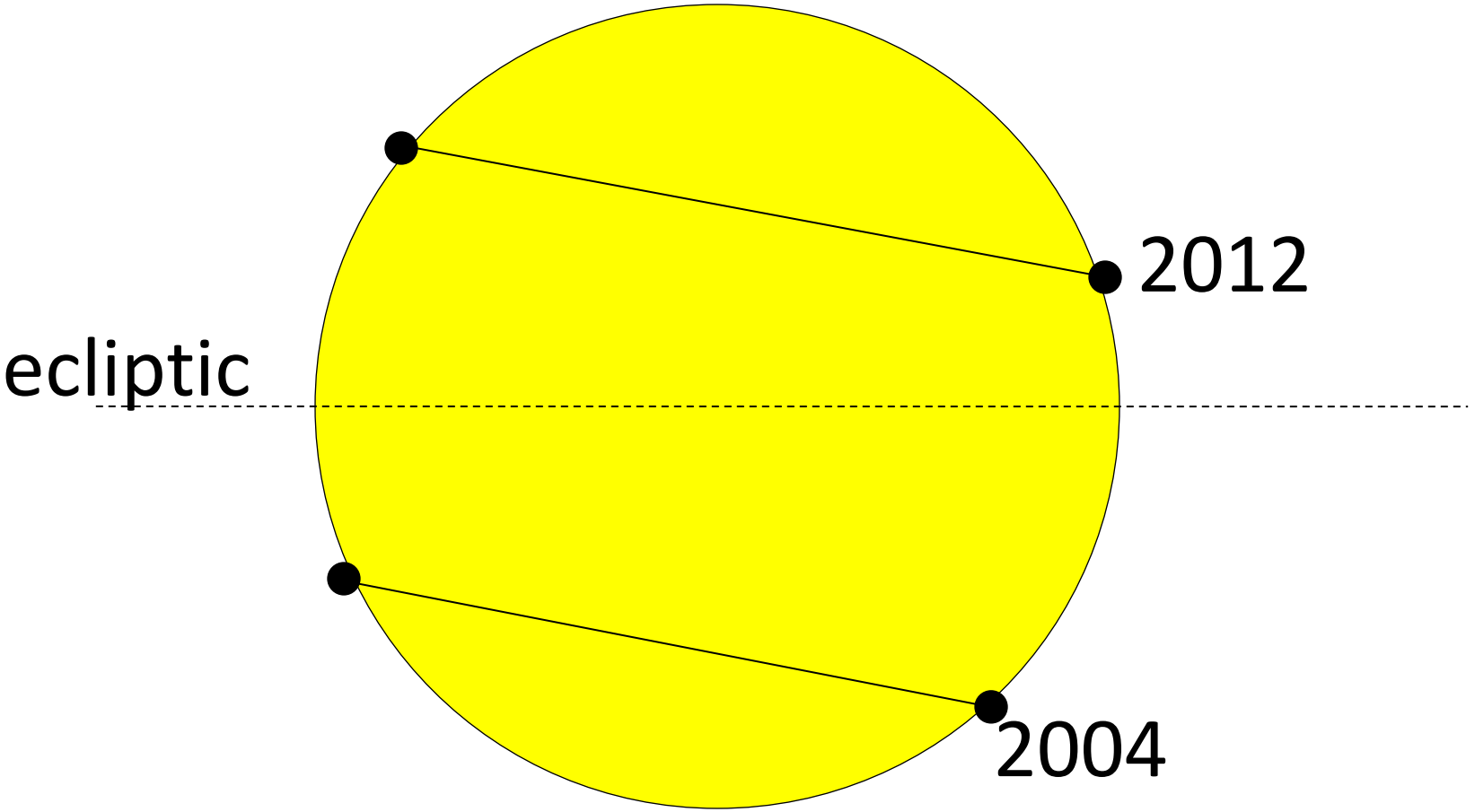


the solar angle

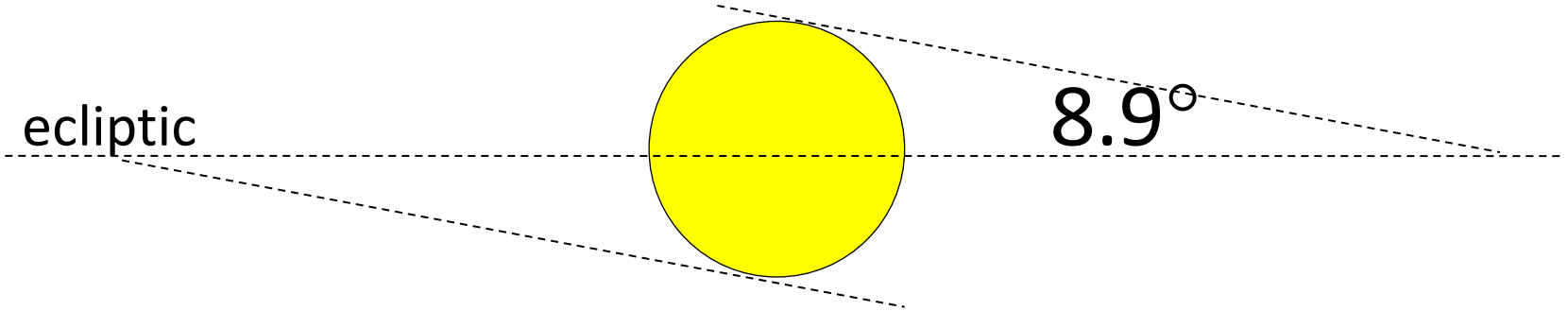


The Size of the Green Zone

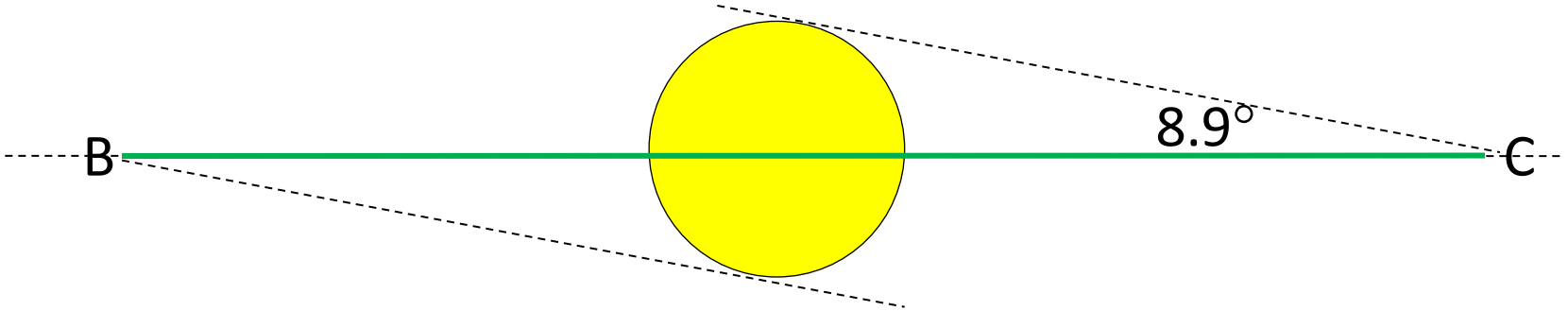
the apparent crossings



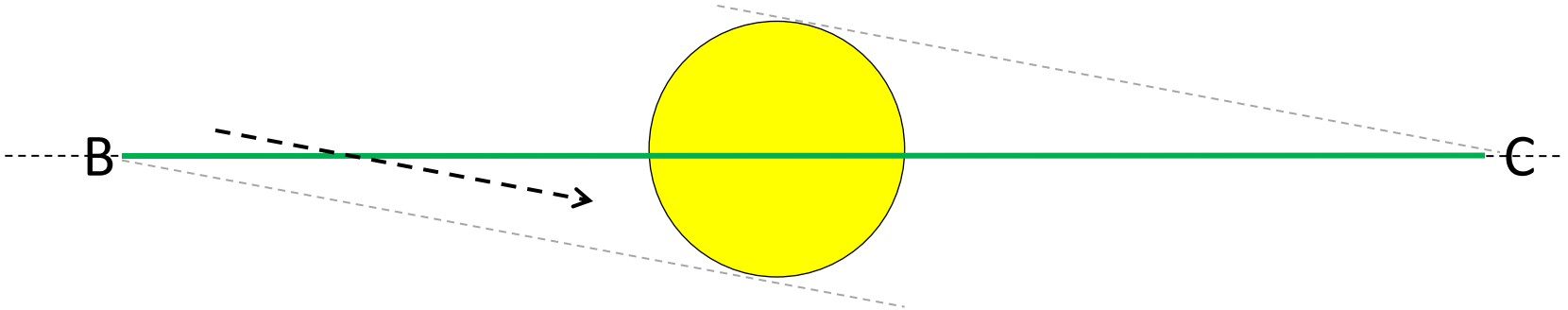
the tangents to the Sun



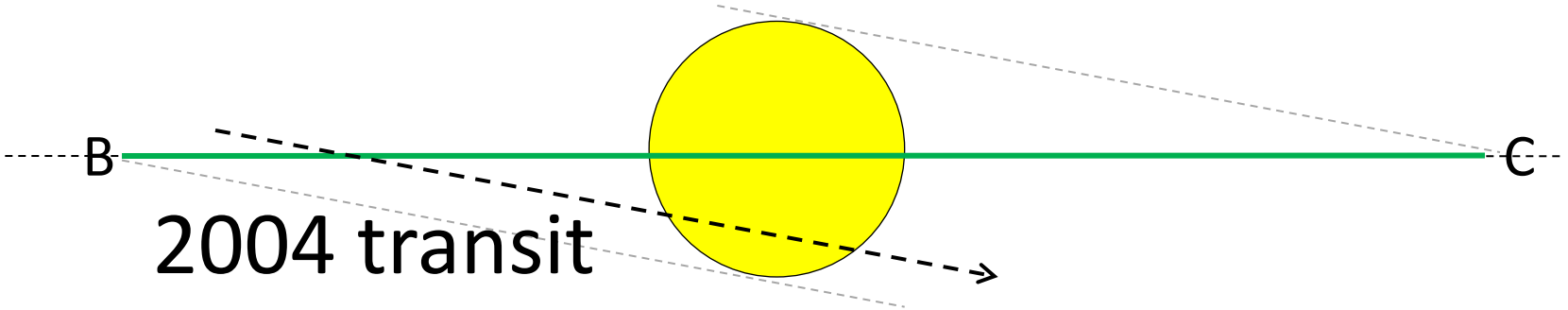
the green zone
seen from Earth



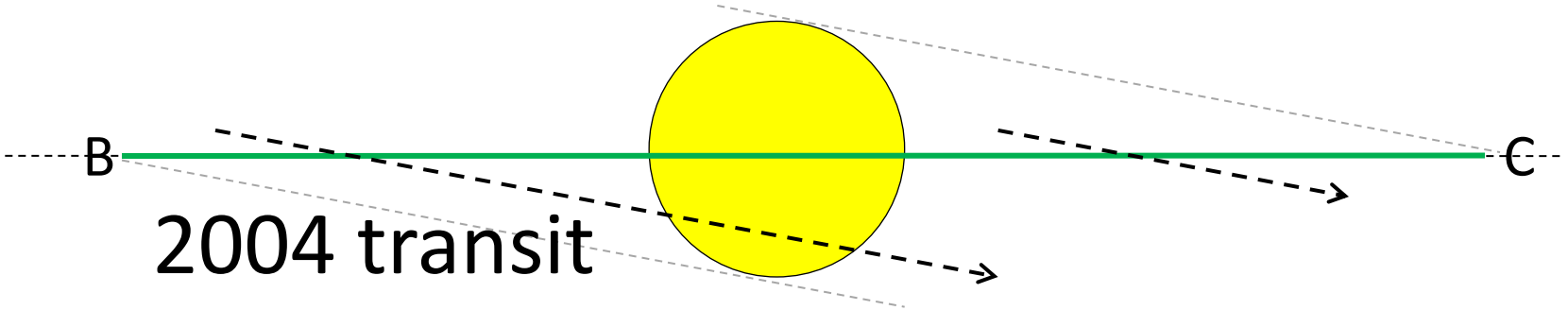
the green zone
seen from Earth



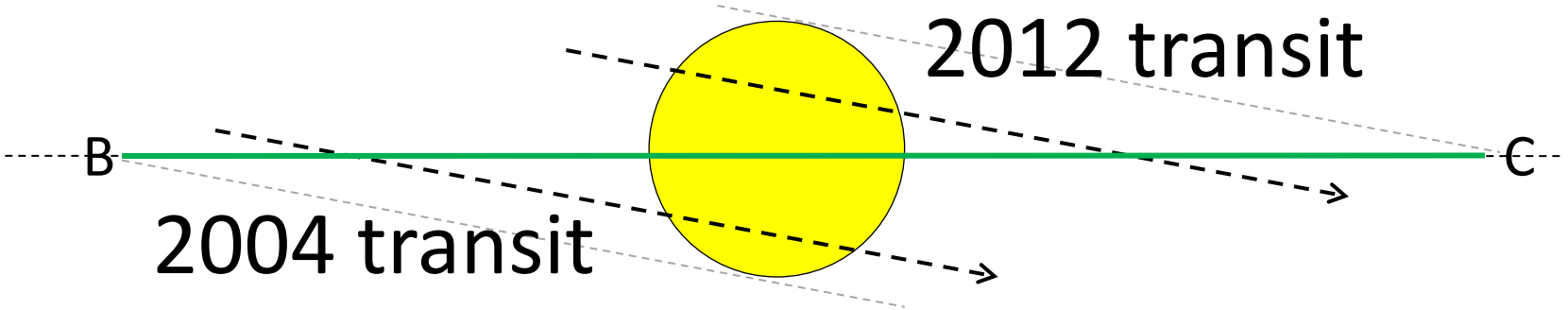
the green zone
seen from Earth



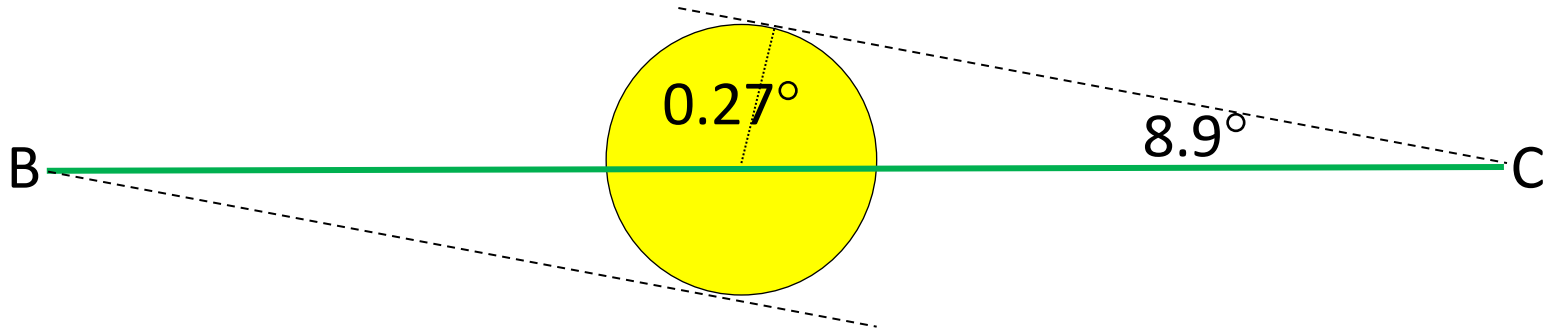
the green zone
seen from Earth



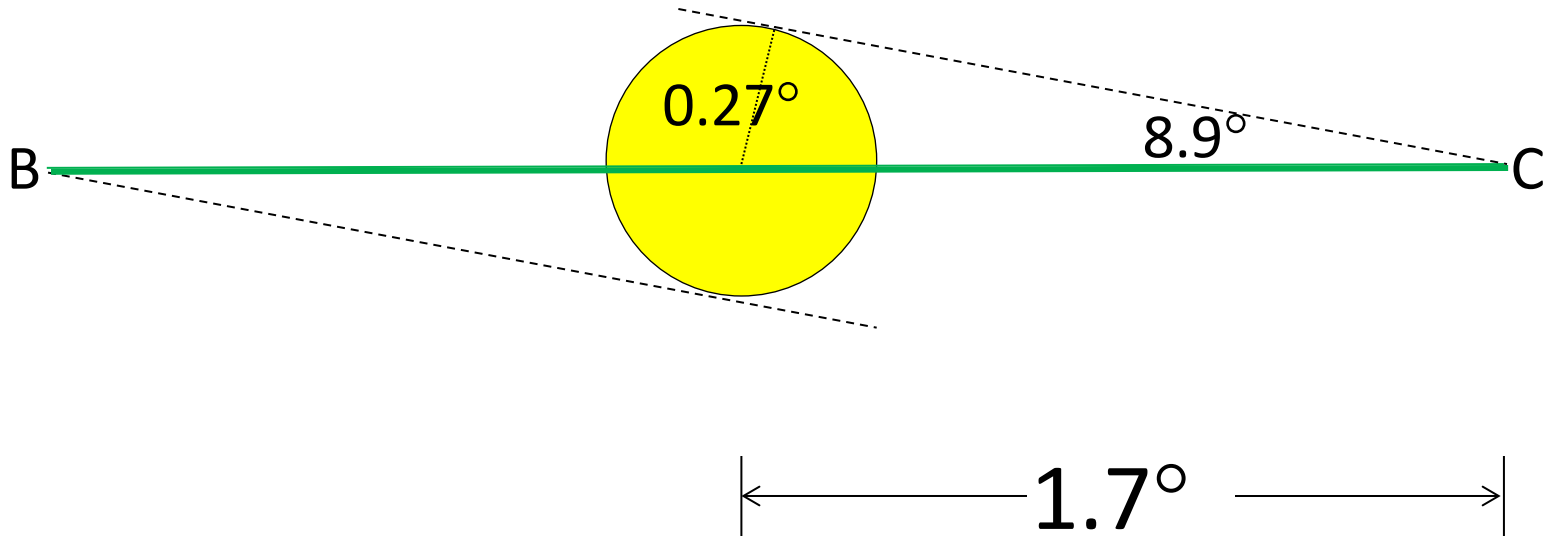
the green zone
seen from Earth



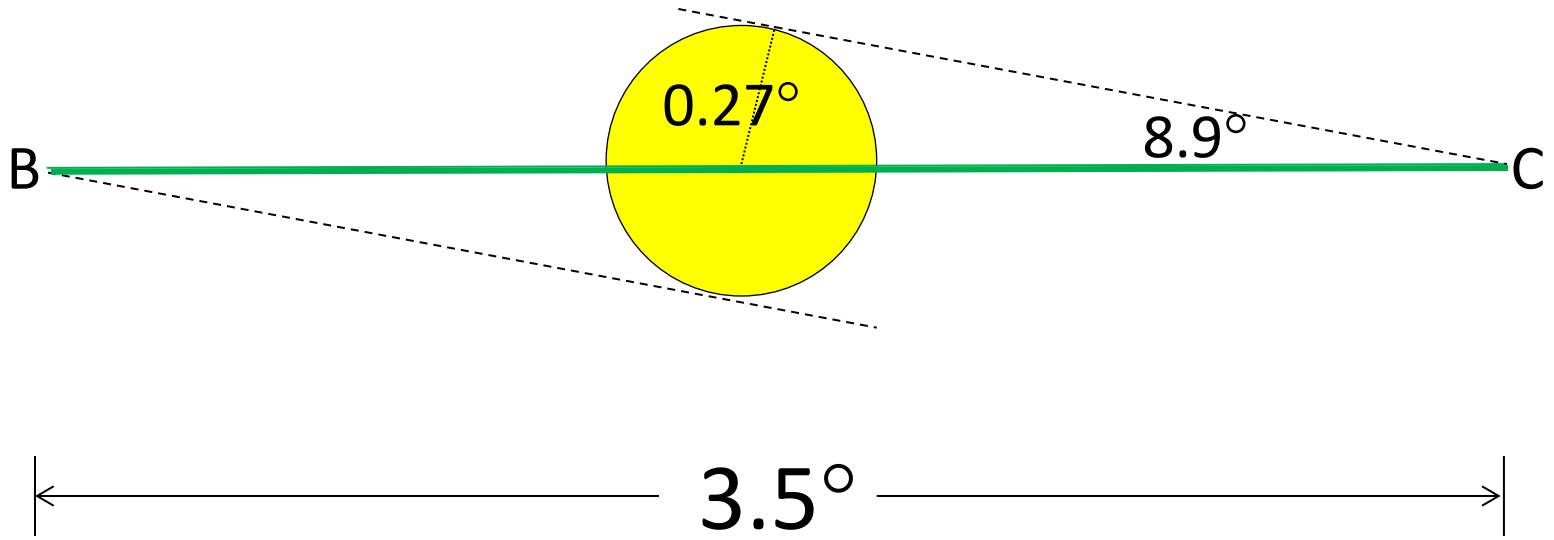
measuring the green zone



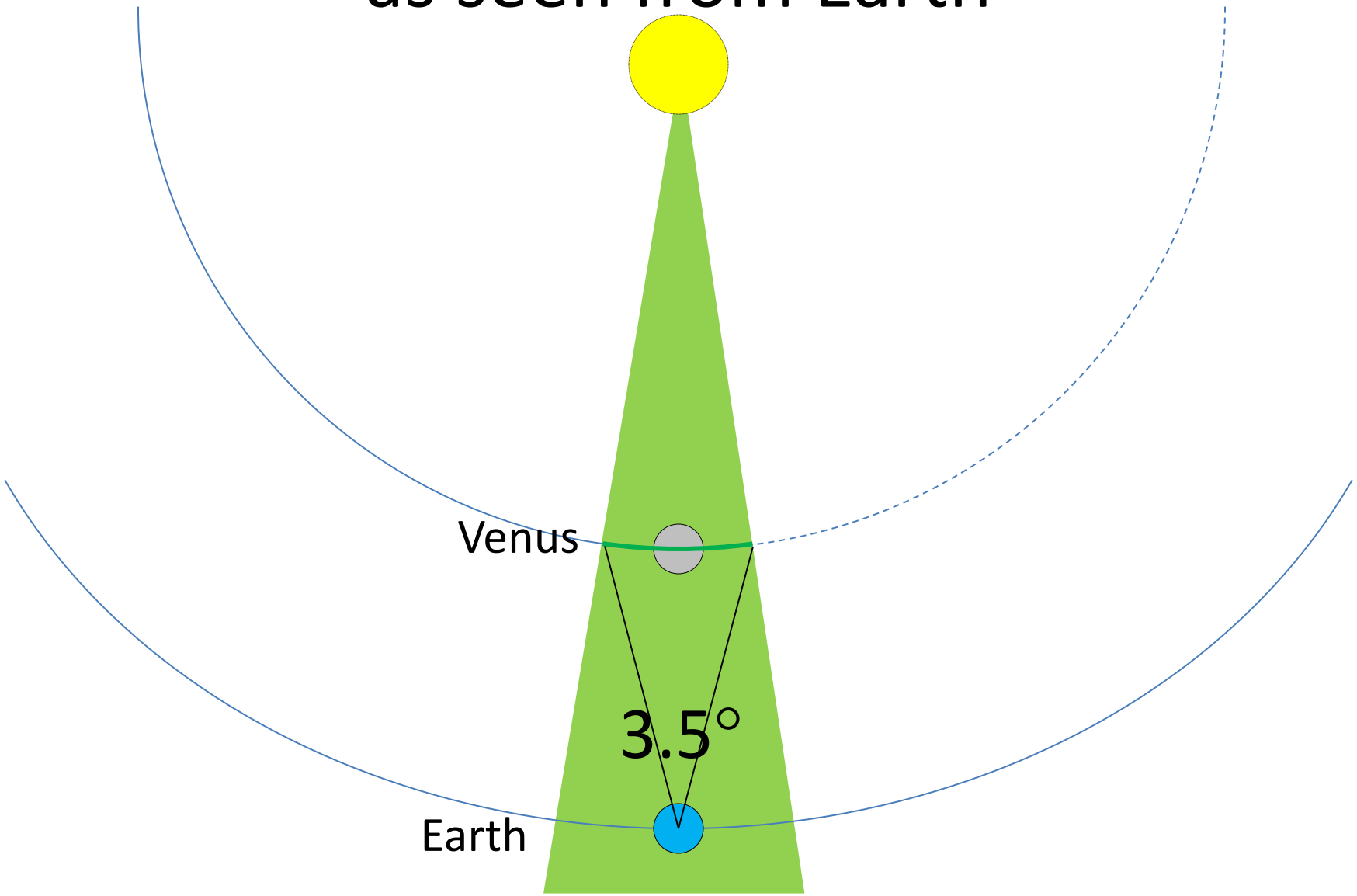
measuring the green zone



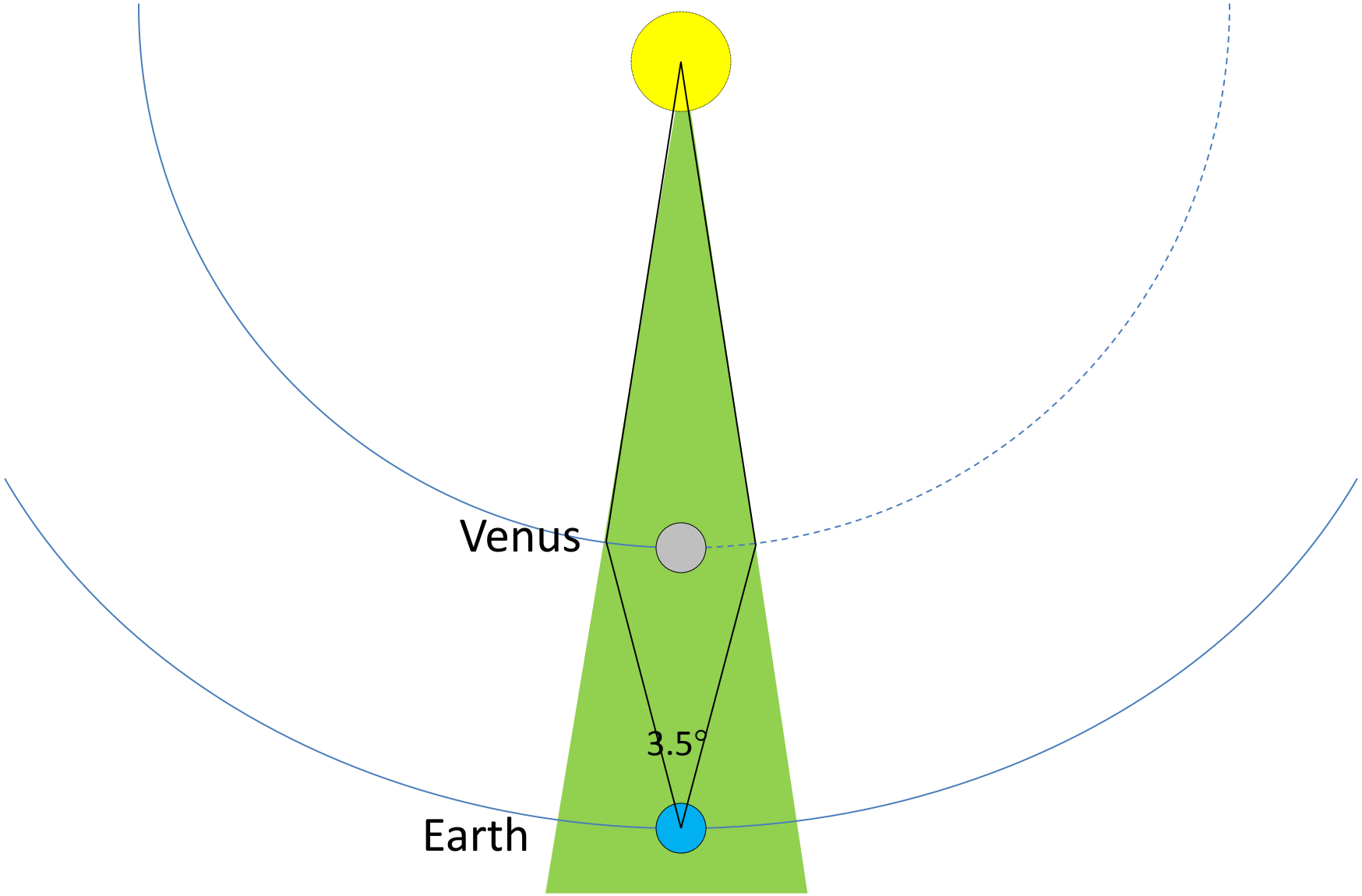
the angular size of the green zone as seen from Earth



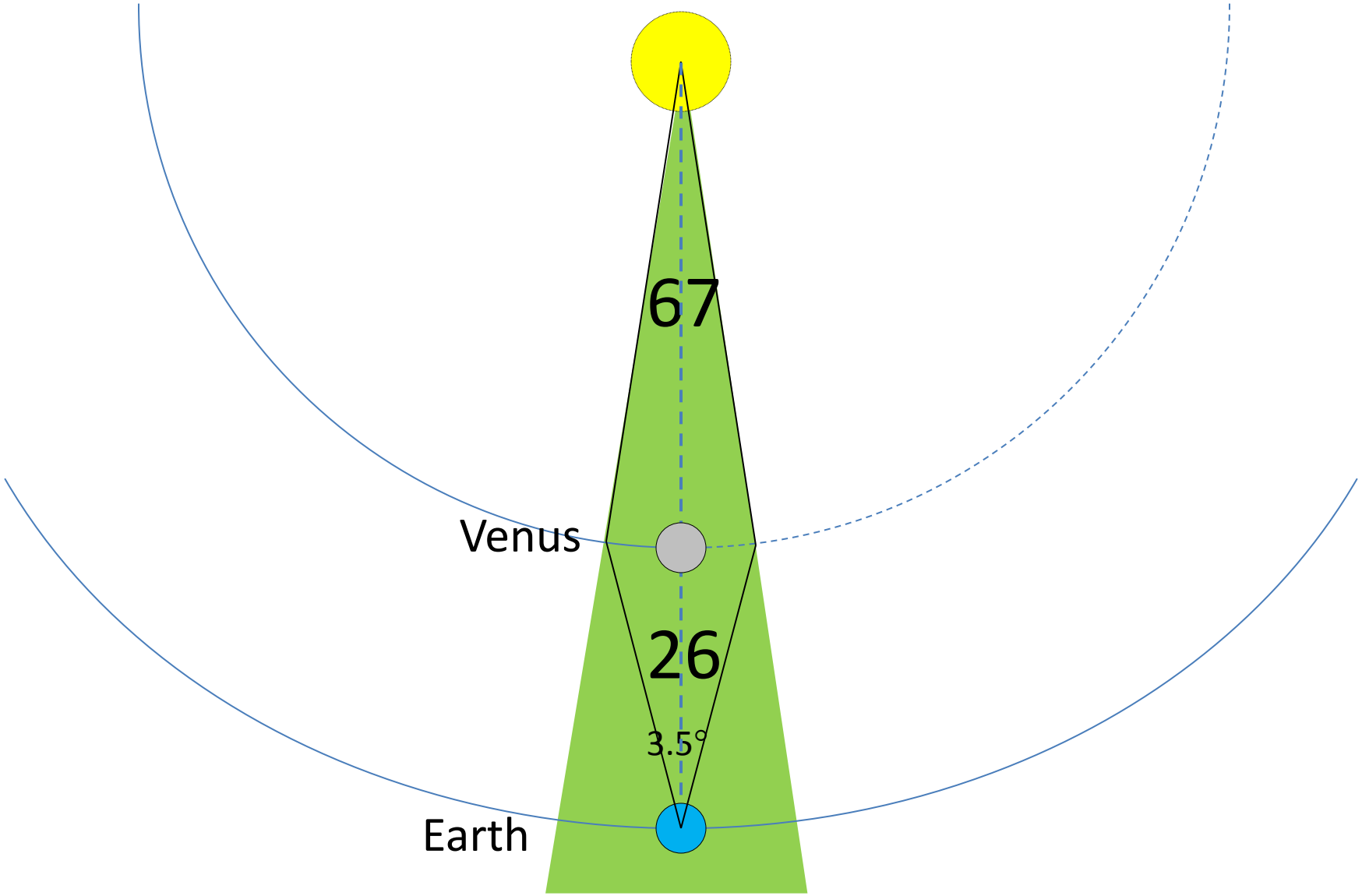
the angular size of the green zone as seen from Earth



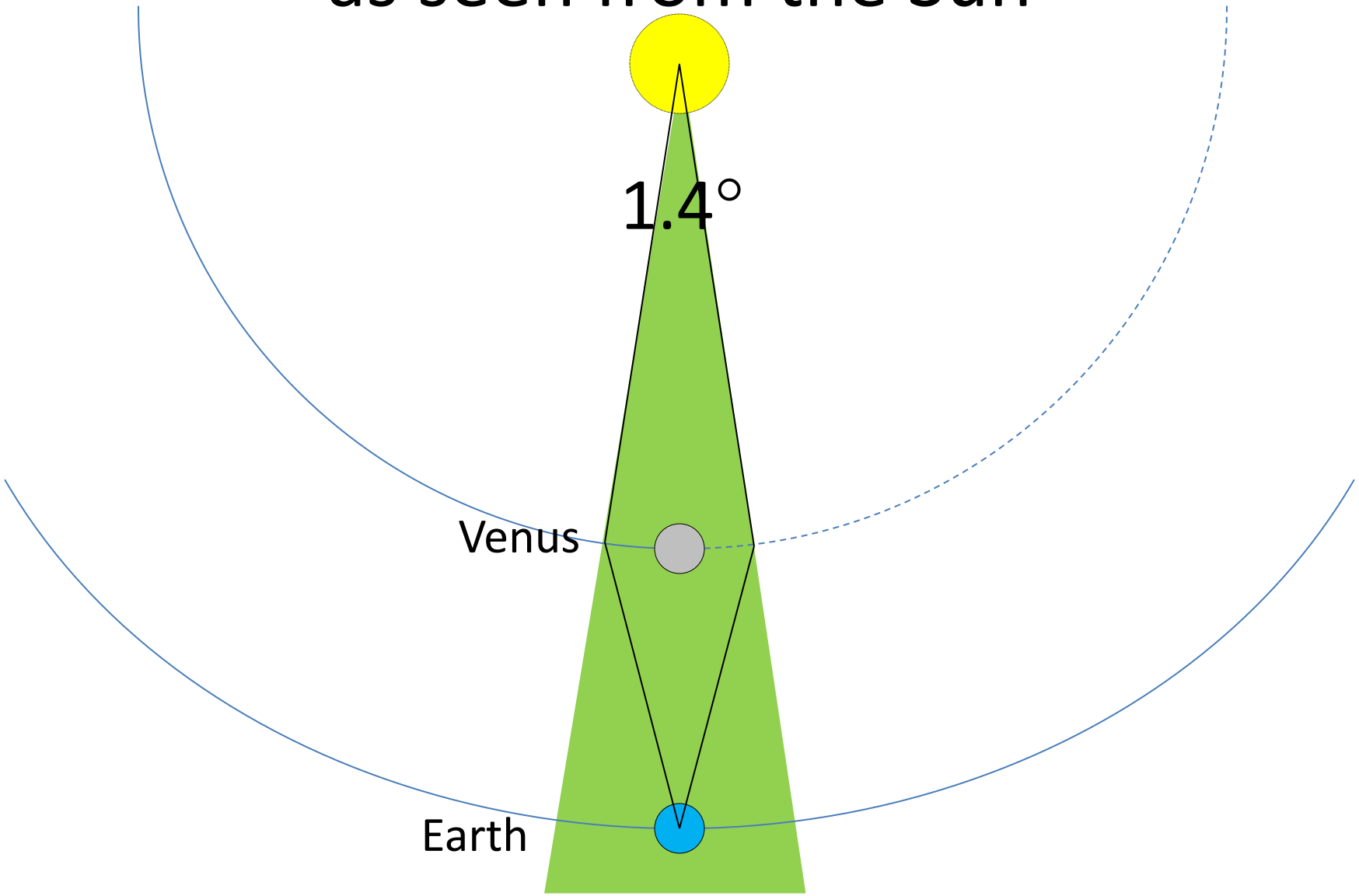
distances



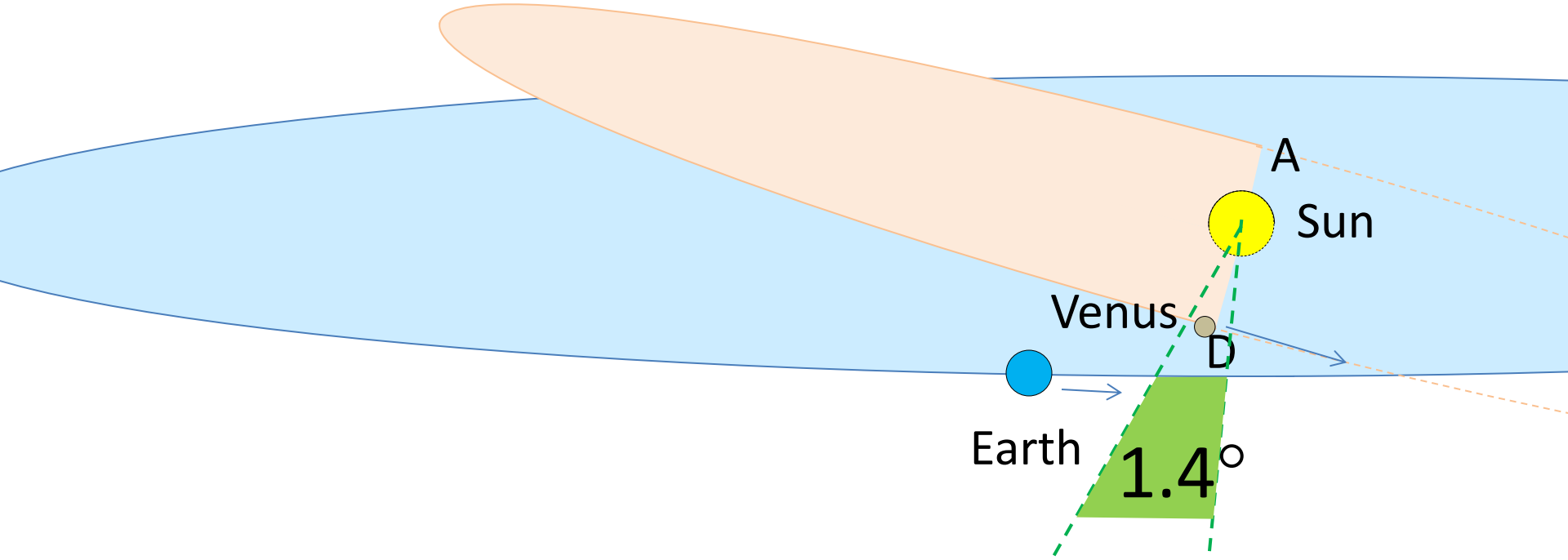
distances



the angular size of the green zone as seen from the Sun

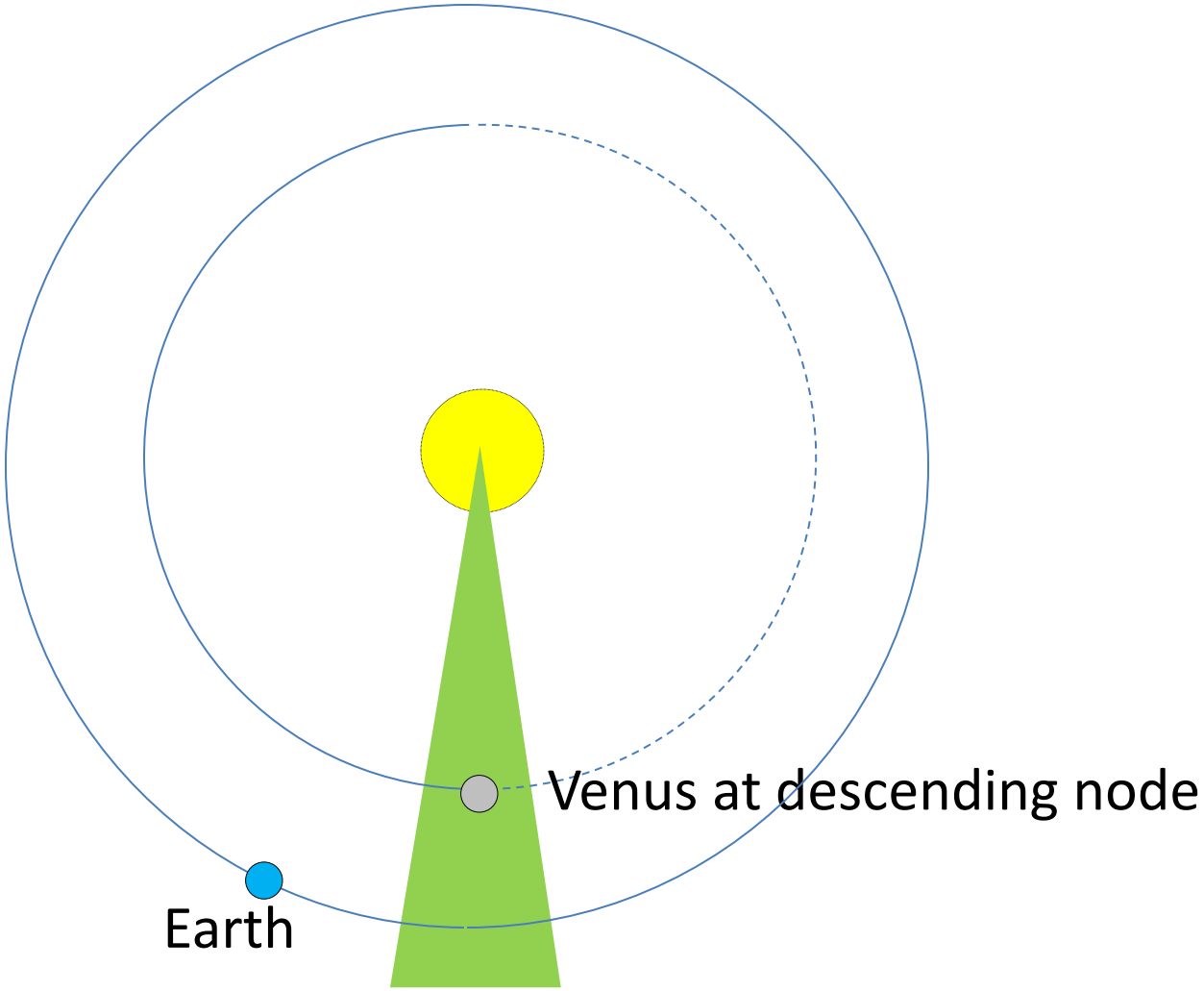


the descending green zone

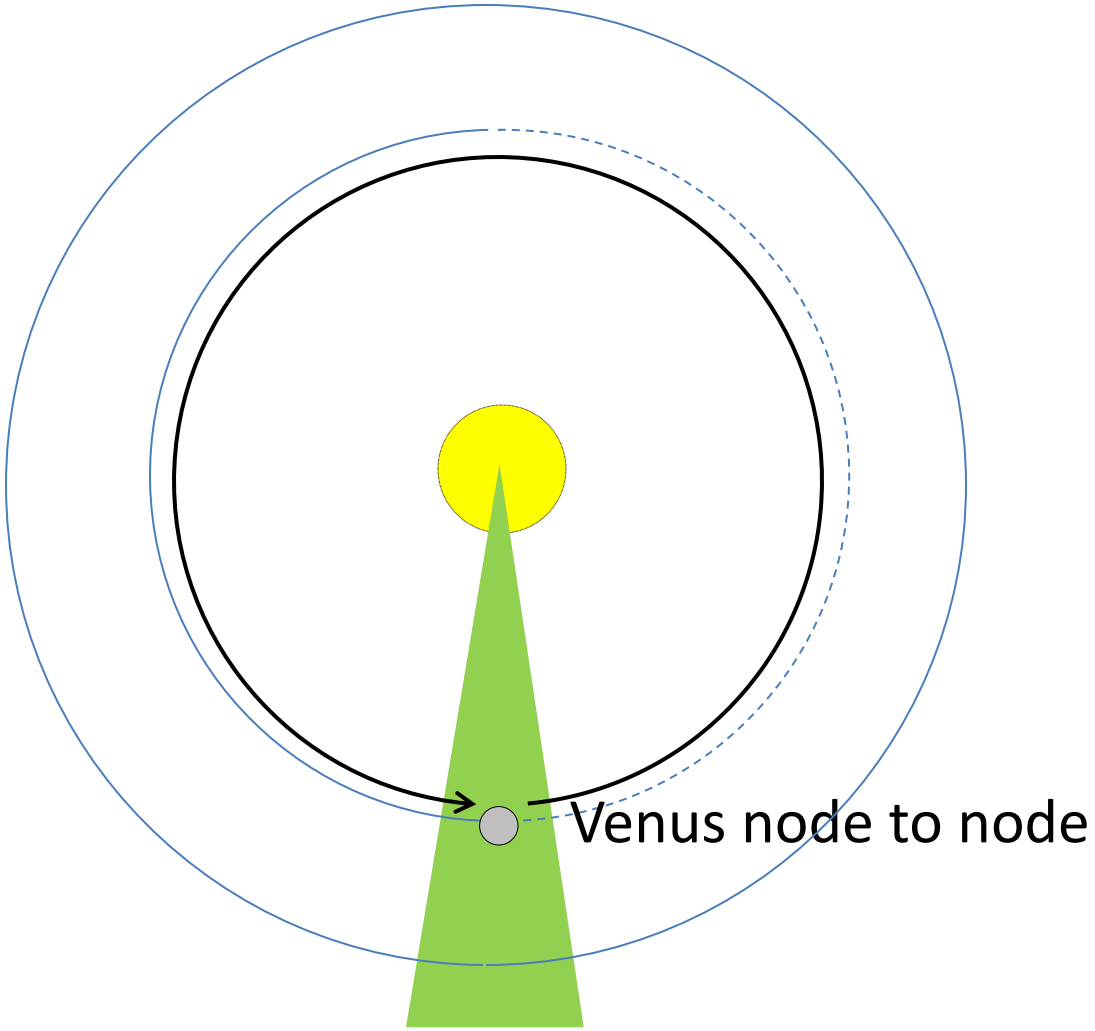


The Occurrence
of
Descending Transits

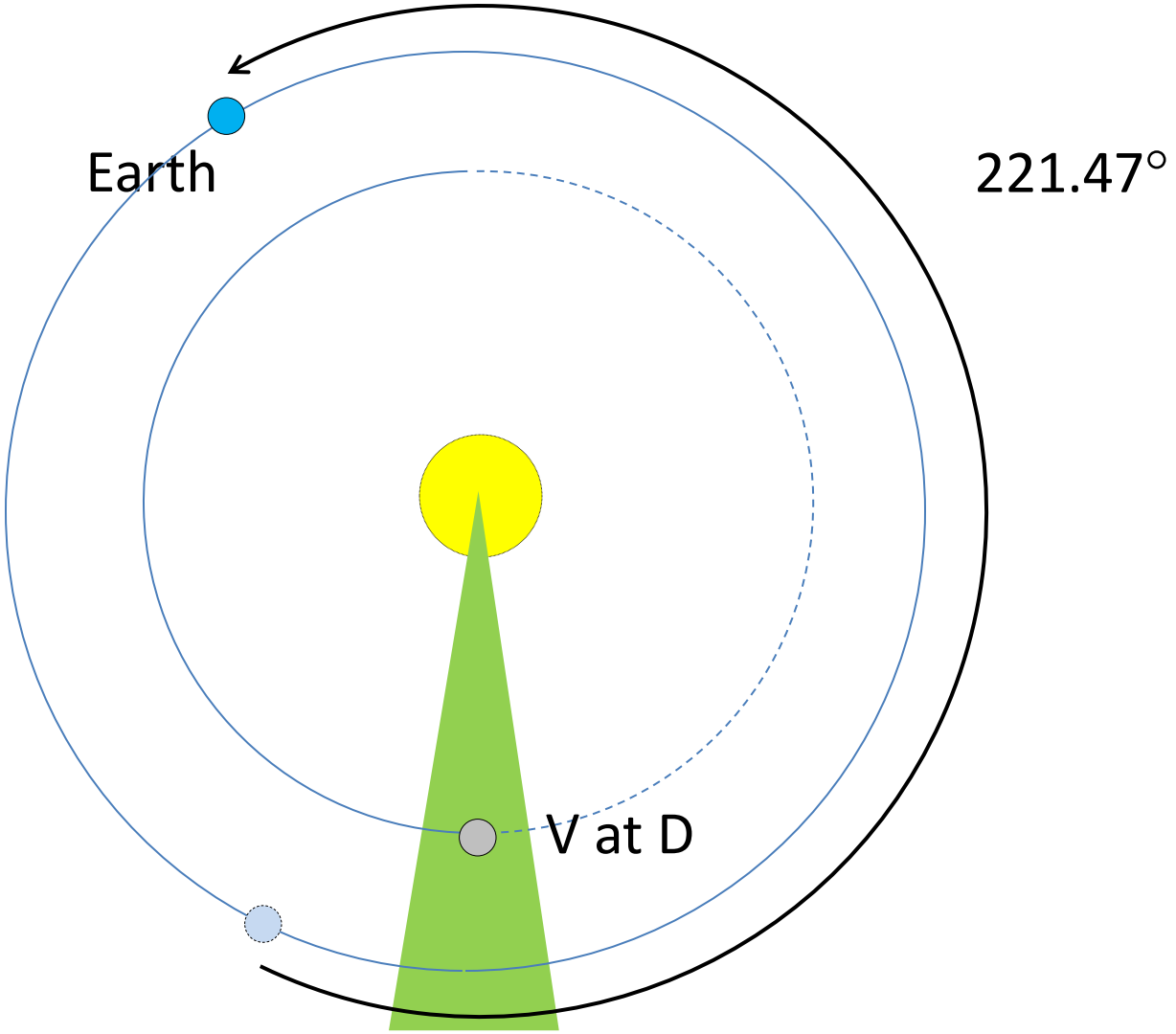
Earth in orbit:
vyear 0



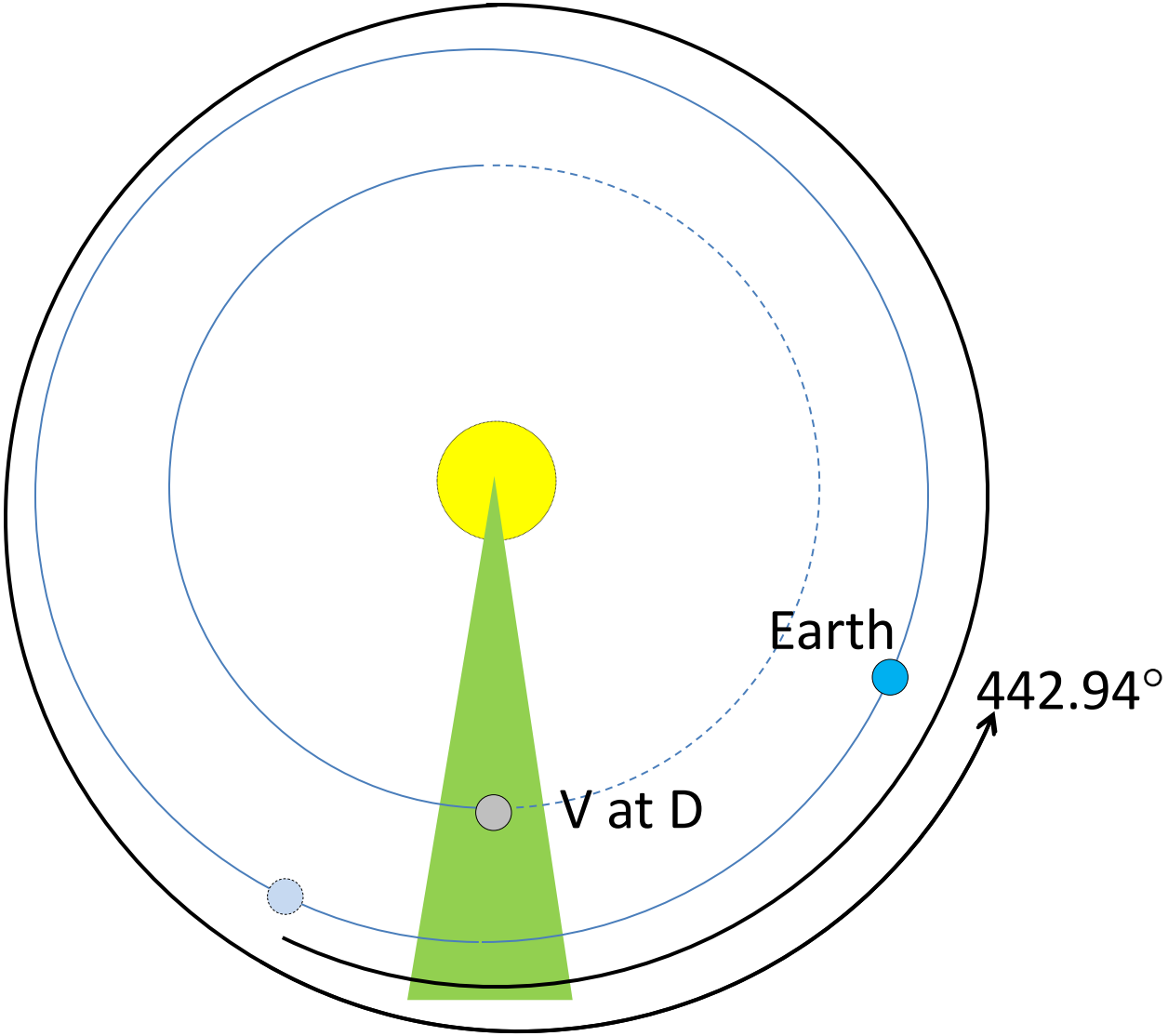
Venus in orbit:
1 vyear = 224.7 days



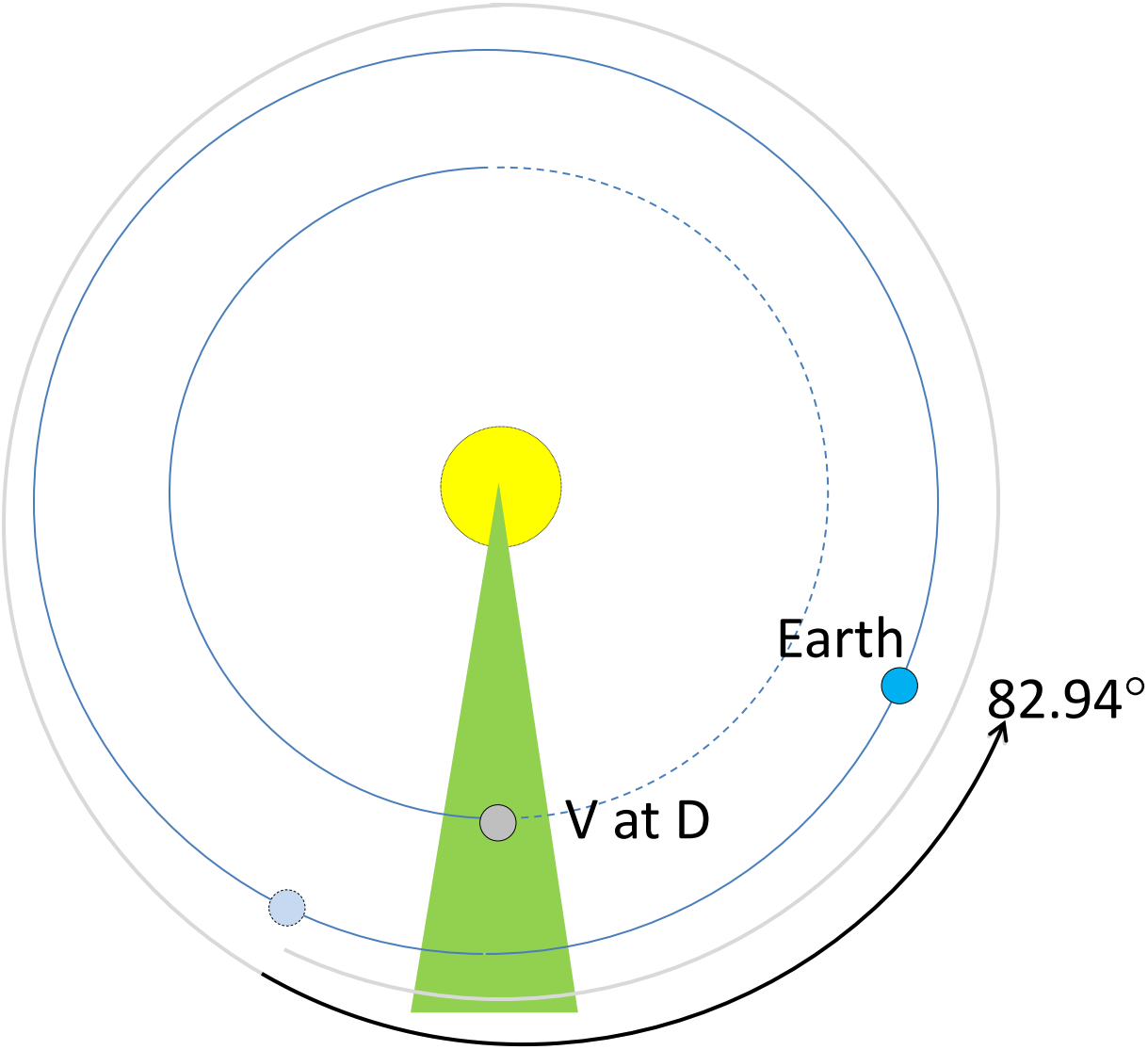
Earth in orbit: vyear 1



Earth in orbit: vyear 2



Earth in orbit: vyear 2



Earth in orbit: vyears 0 to 9

vyear number	Earth position
0	0.00
1	221.47
2	82.94
3	304.41
4	165.87
5	27.34
6	248.81
7	110.28
8	331.75
9	193.22

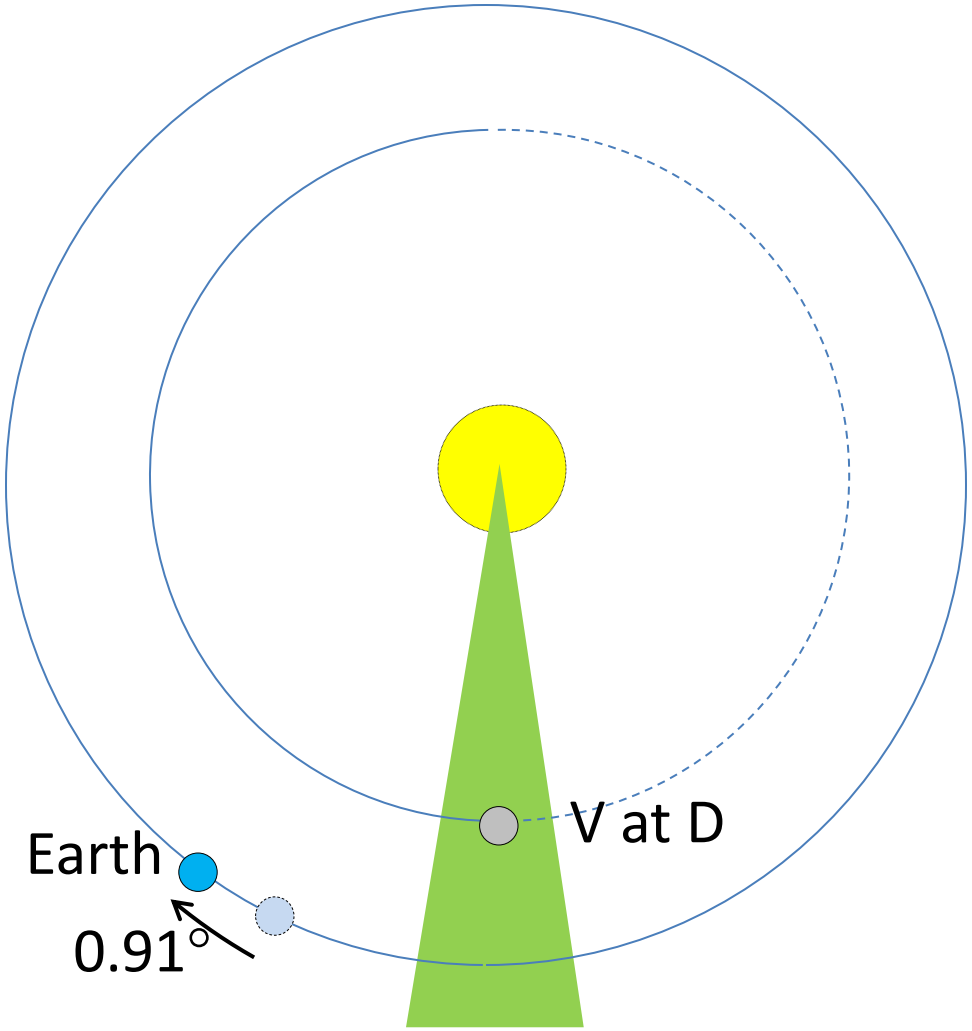
Earth in orbit: vyears 10 to 19

vyear number	Earth position
10	54.68
11	276.15
12	137.62
13	359.09
14	220.56
15	82.03
16	303.50
17	164.96
18	26.43
19	247.90

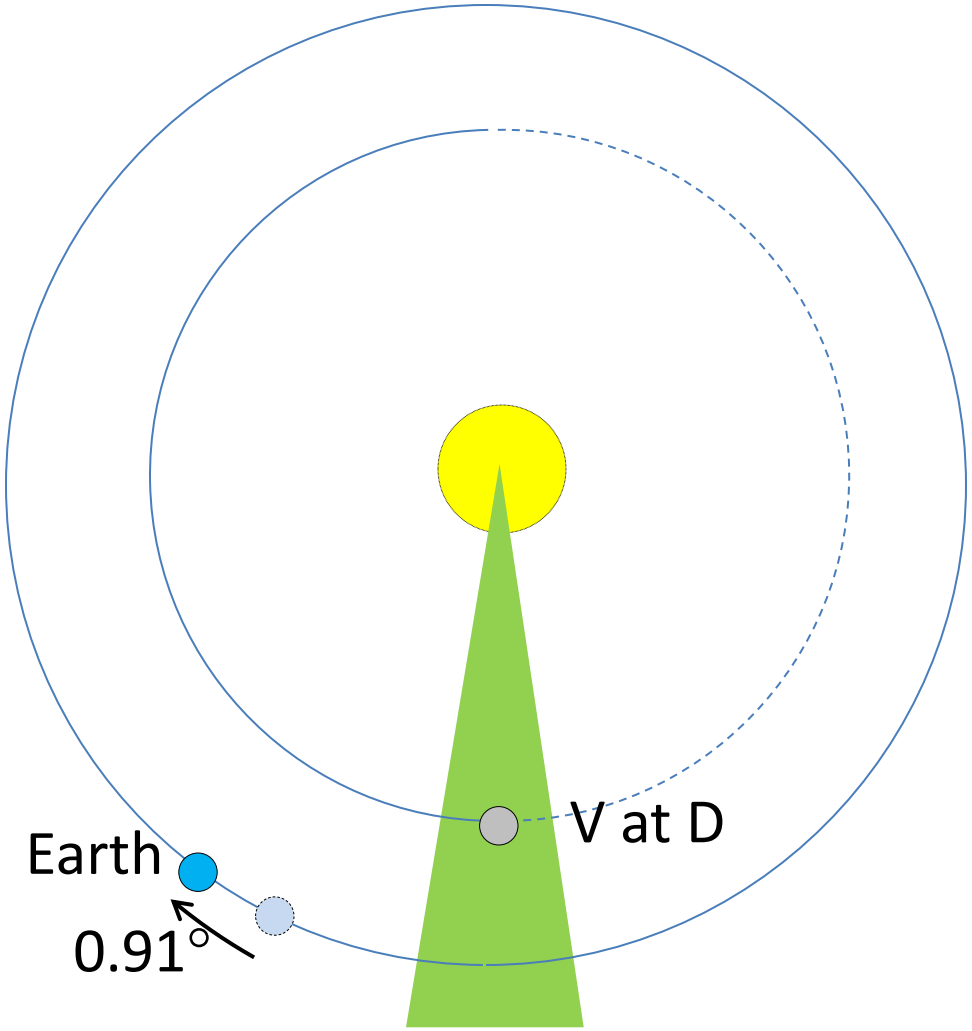
Earth in orbit: vyears 10 to 19

vyear number	Earth position
10	54.68
11	276.15
12	137.62
13	359.09
14	220.56
15	82.03
16	303.50
17	164.96
18	26.43
19	247.90

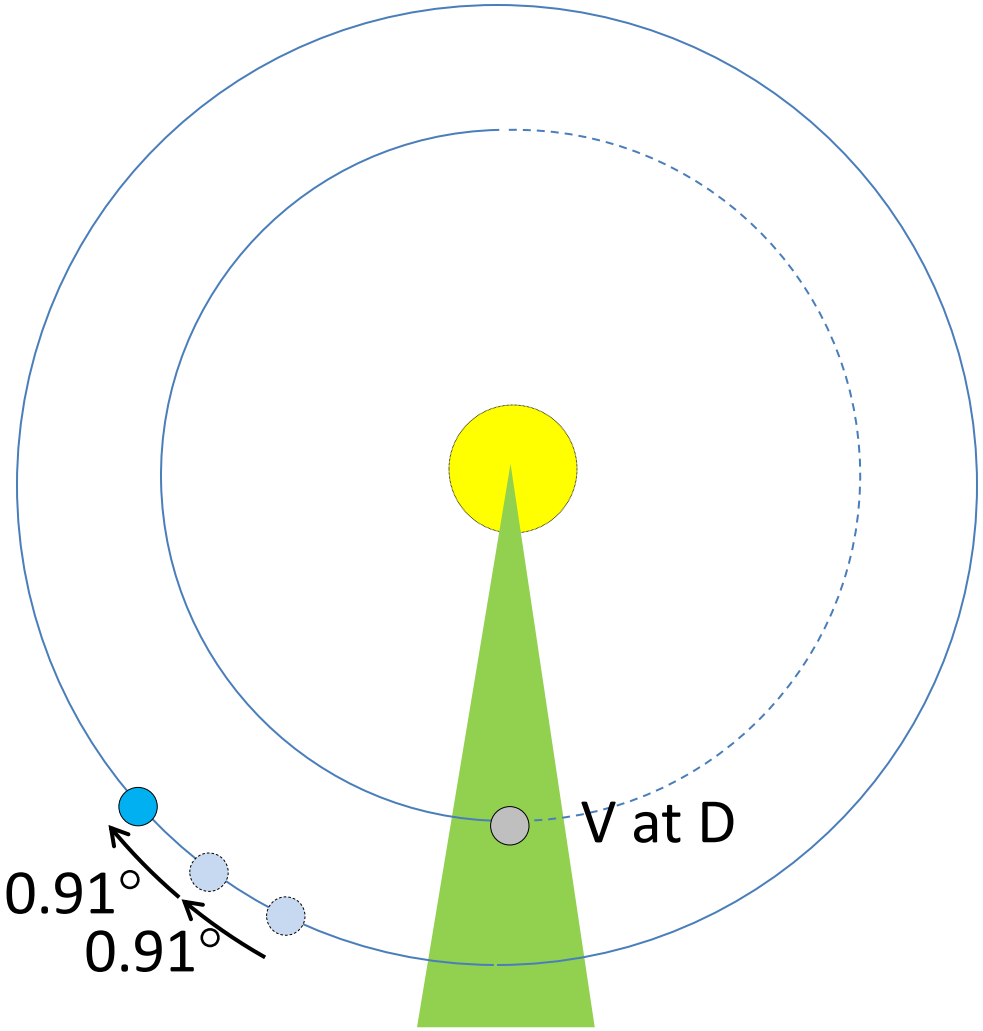
Earth in orbit: vyear 13



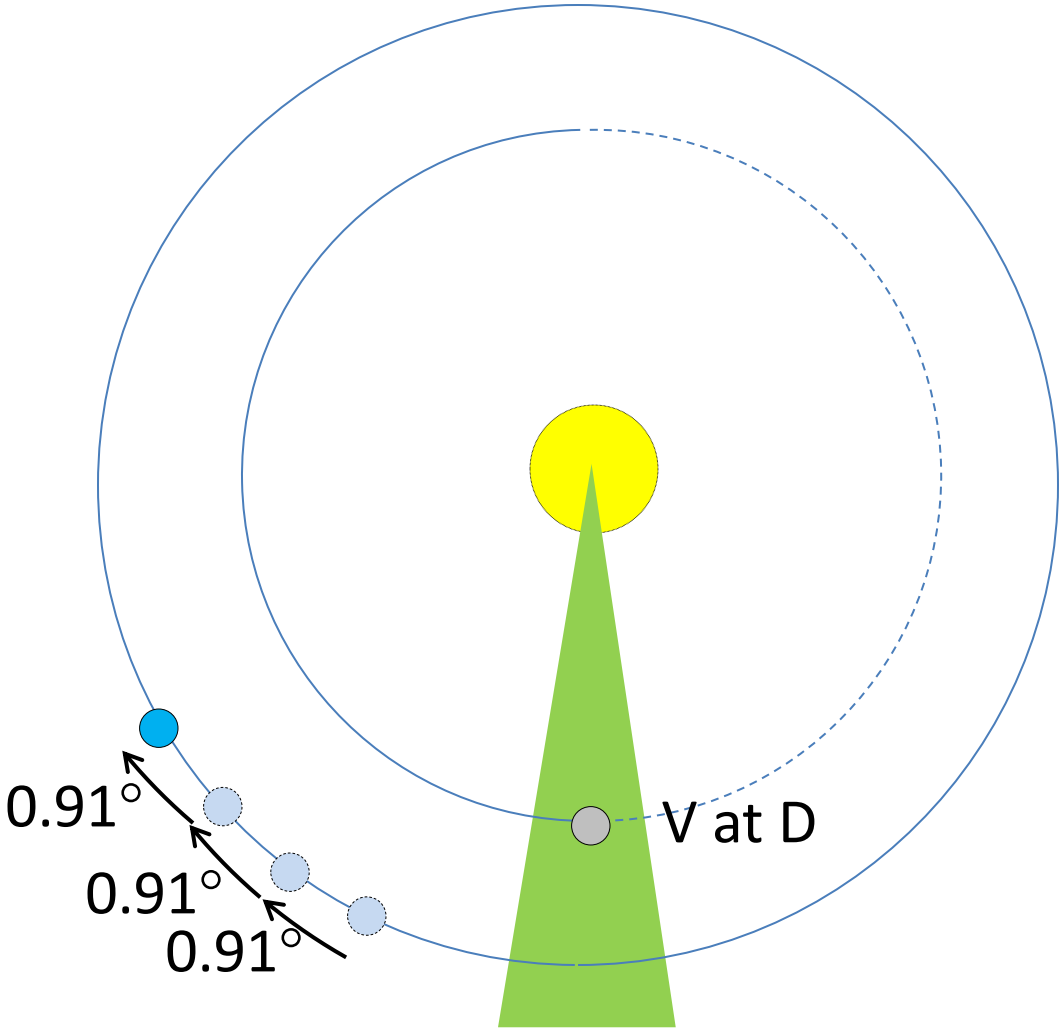
Earth in orbit:
vyear 13 = 7.998 years



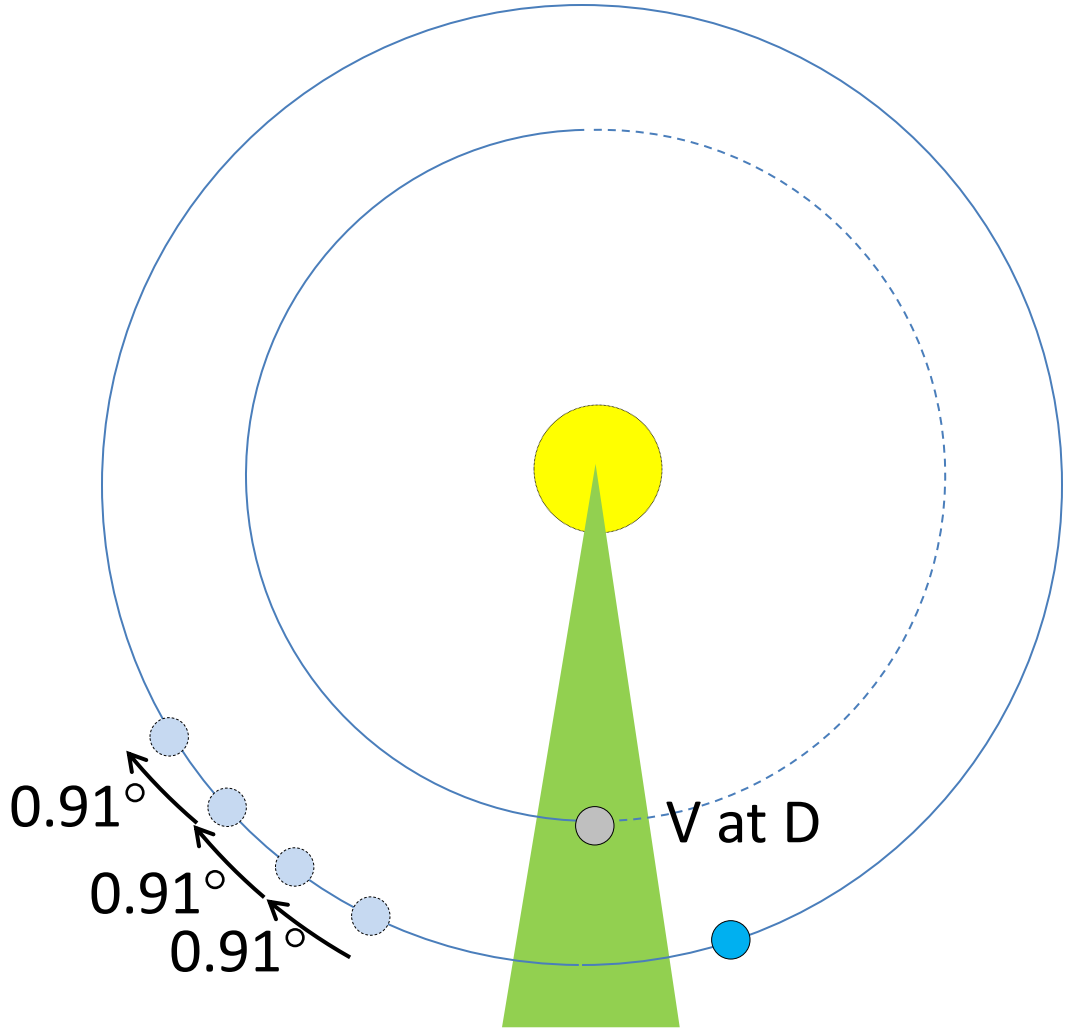
Earth in orbit: vyear 26



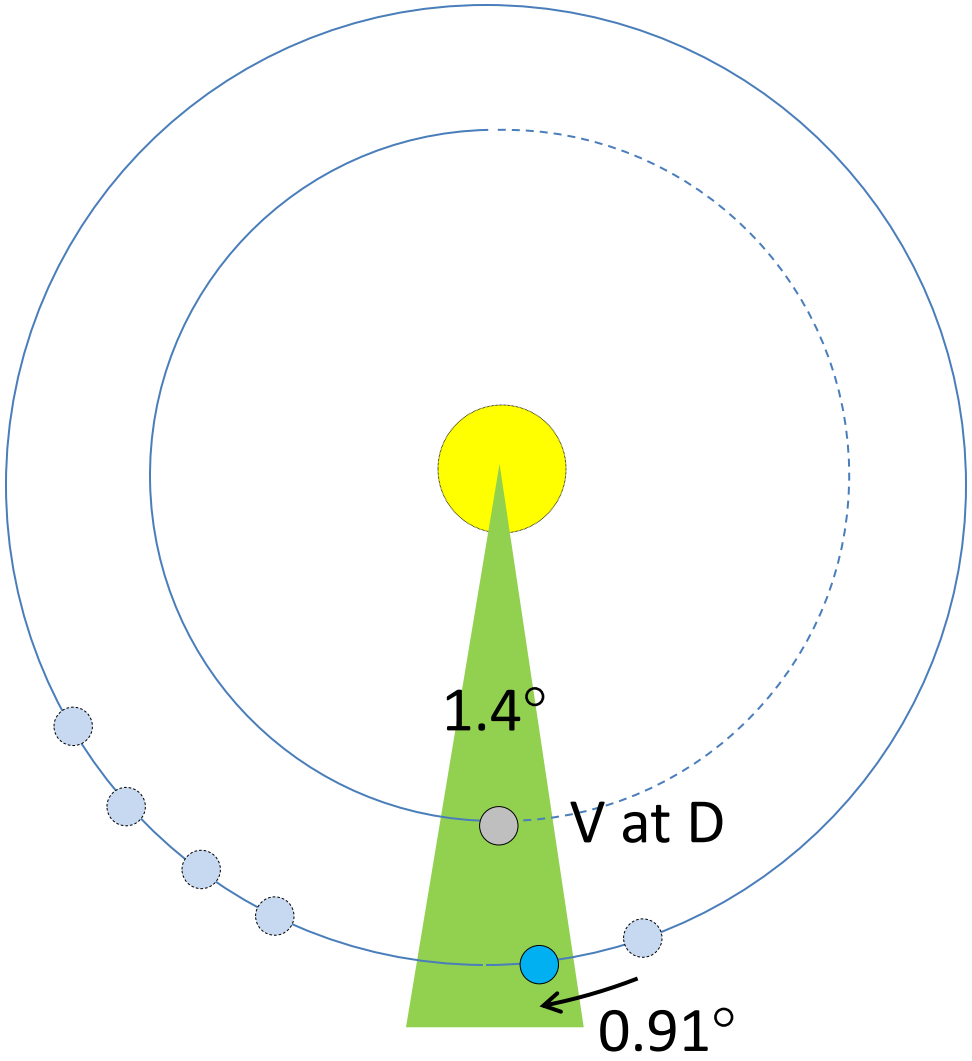
Earth in orbit:
vyear 39



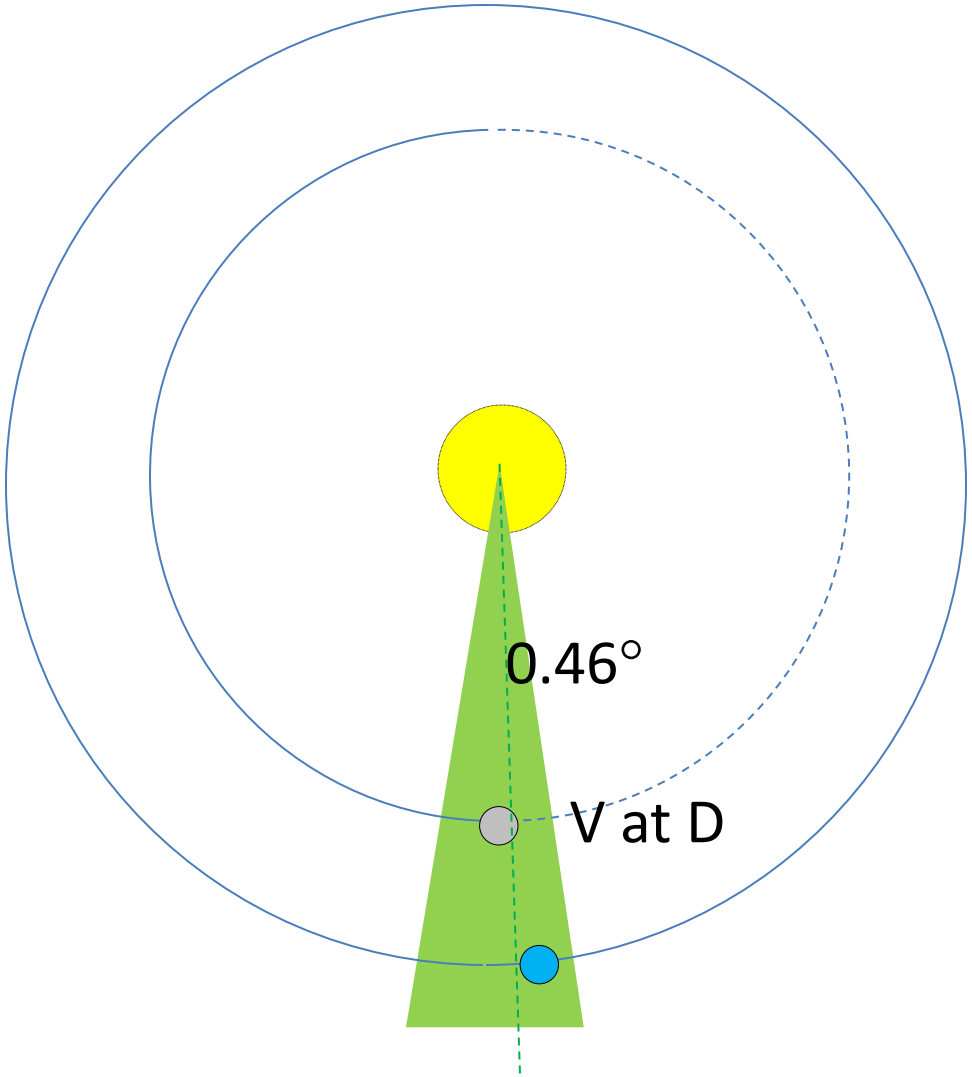
Earth eventually makes it to just before the Green zone…



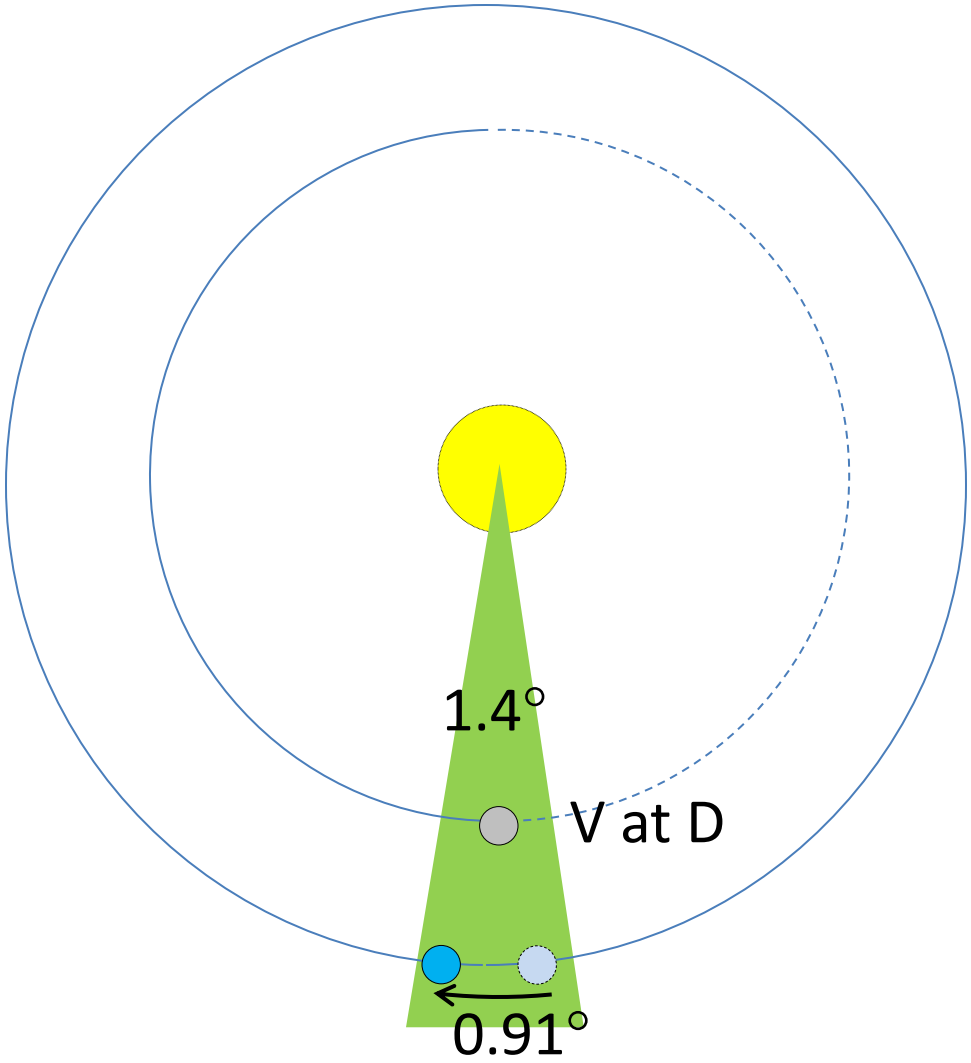
… and it cannot miss the green zone.



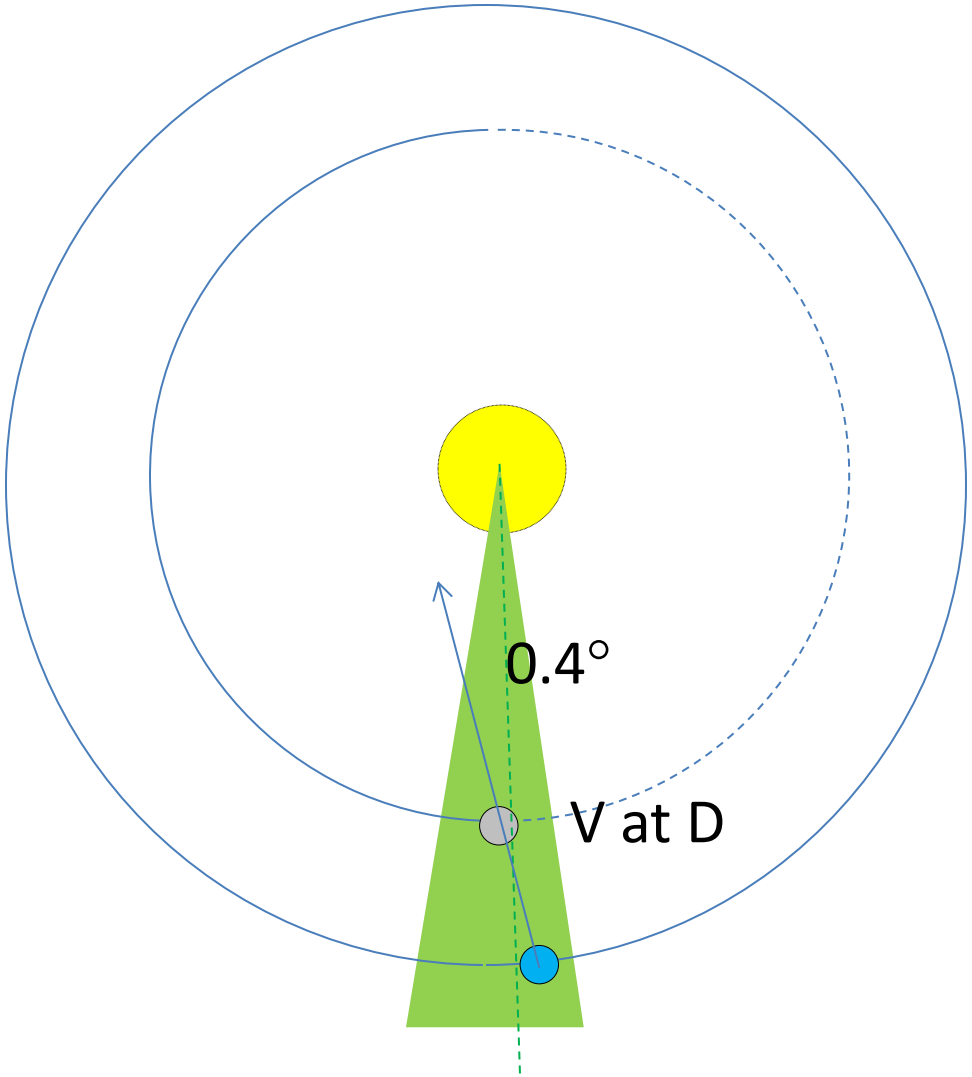
If Earth hits the right third of the green zone …



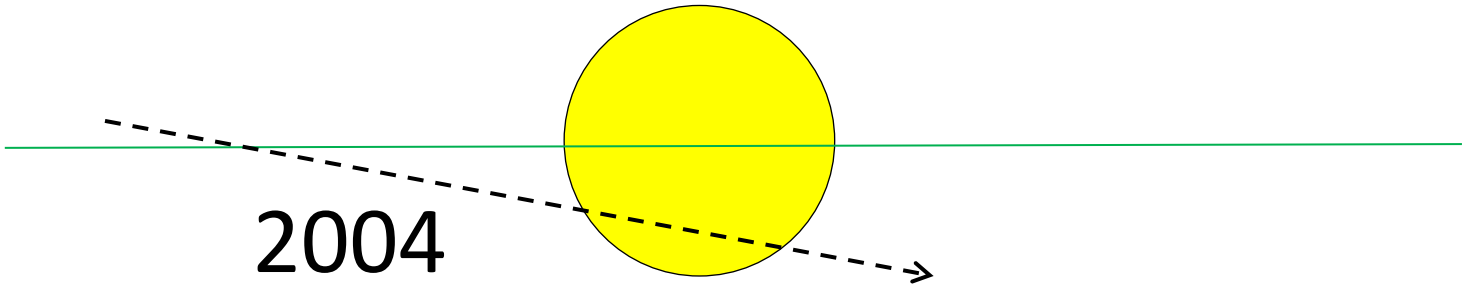
… then 8 years later, it is still in the zone.



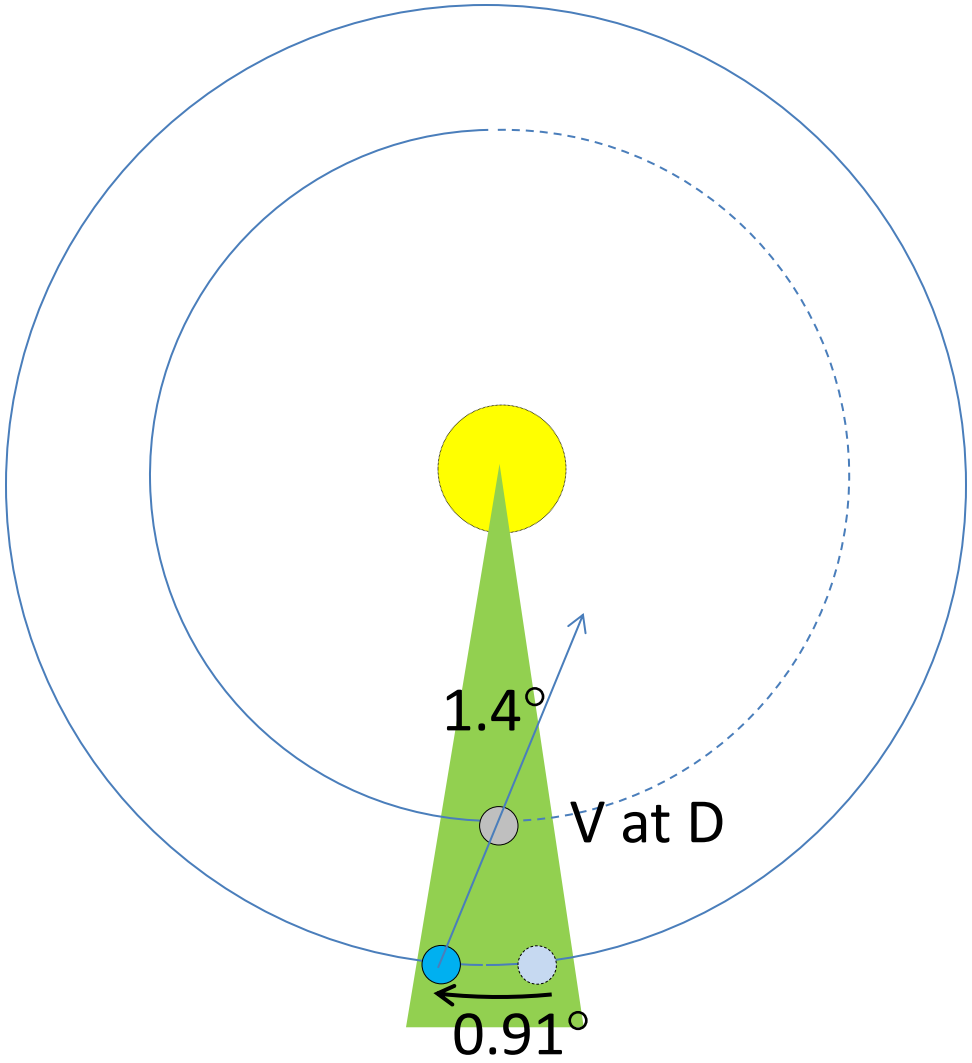
In the first one, we look towards the left…



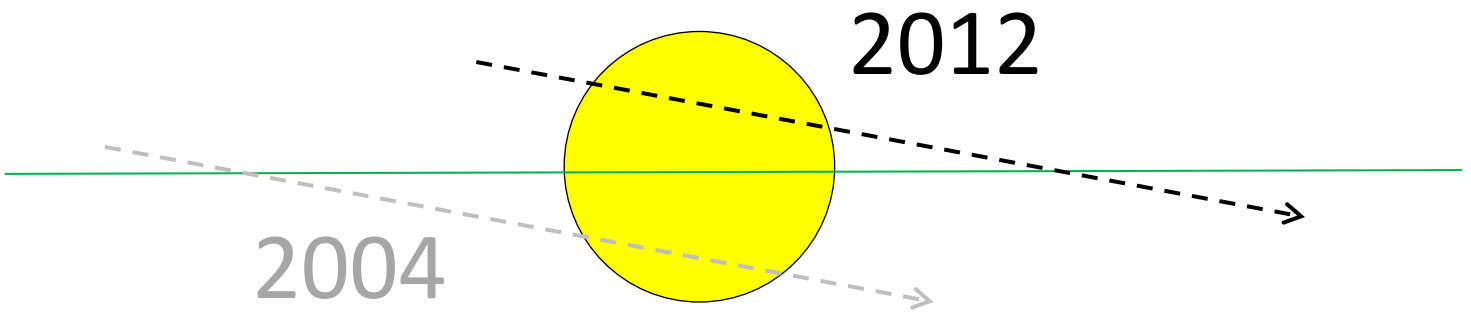
… to see this kind of transit.



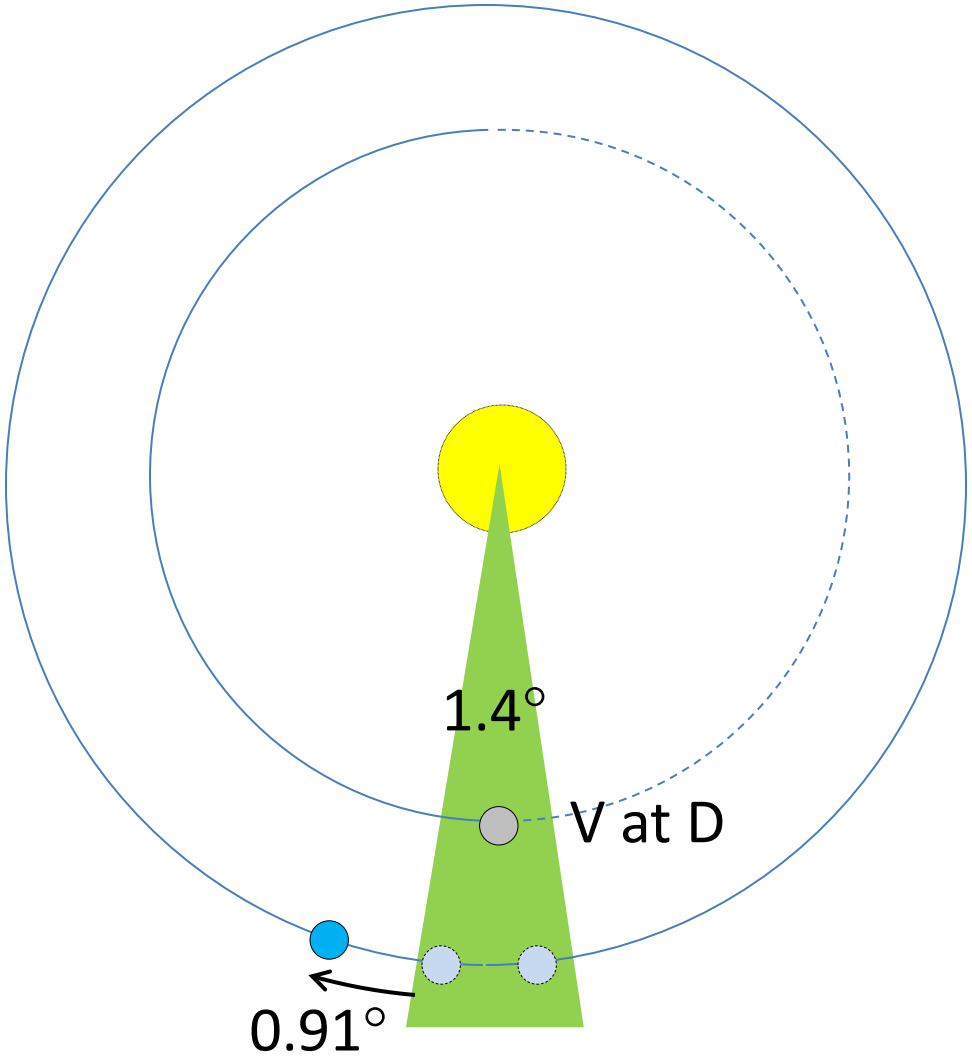
Eight years later, we look towards the right …



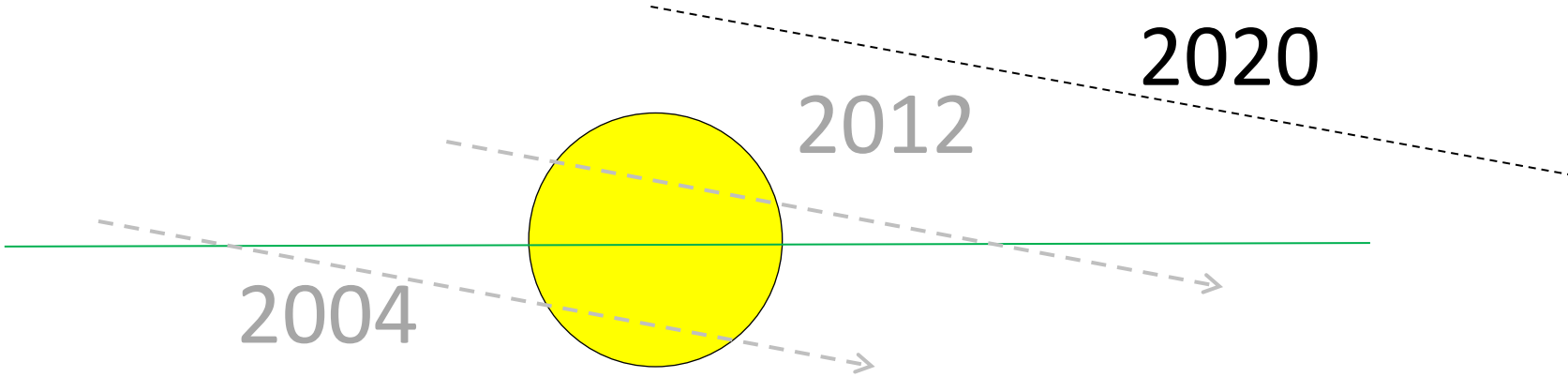
… to see this one.



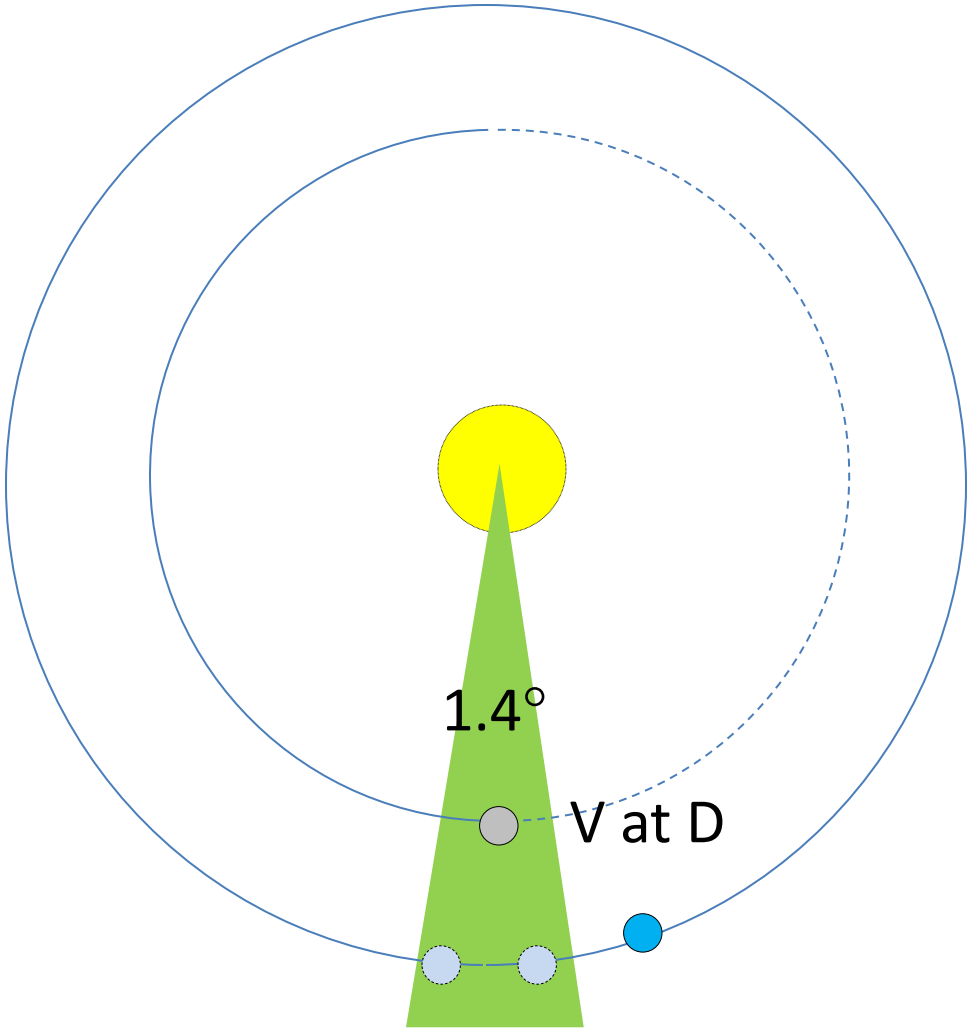
Eight years after the second transit …



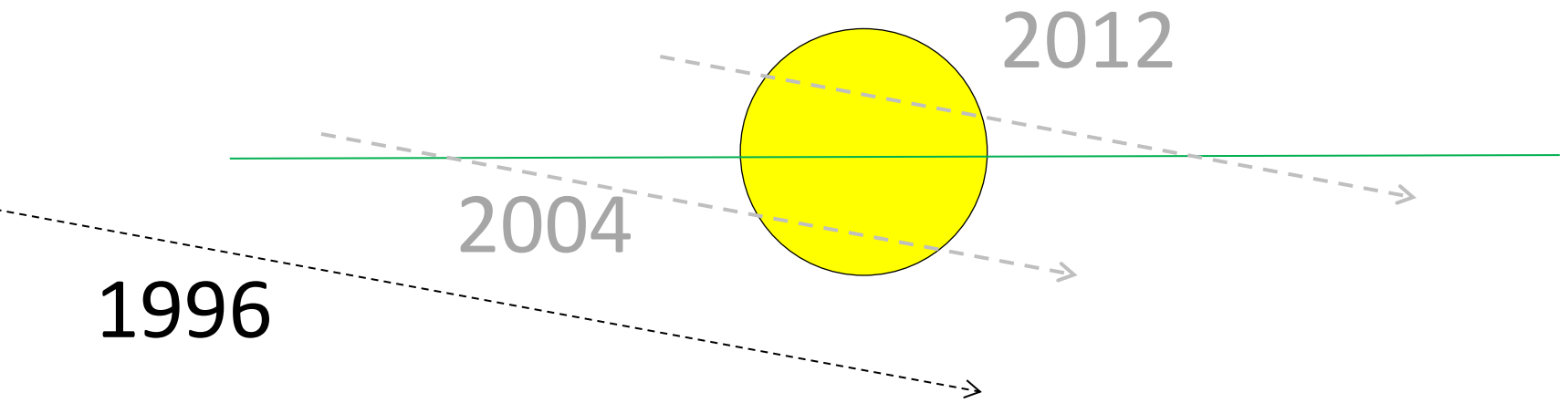
… Venus misses right.



Eight years before the first transit …

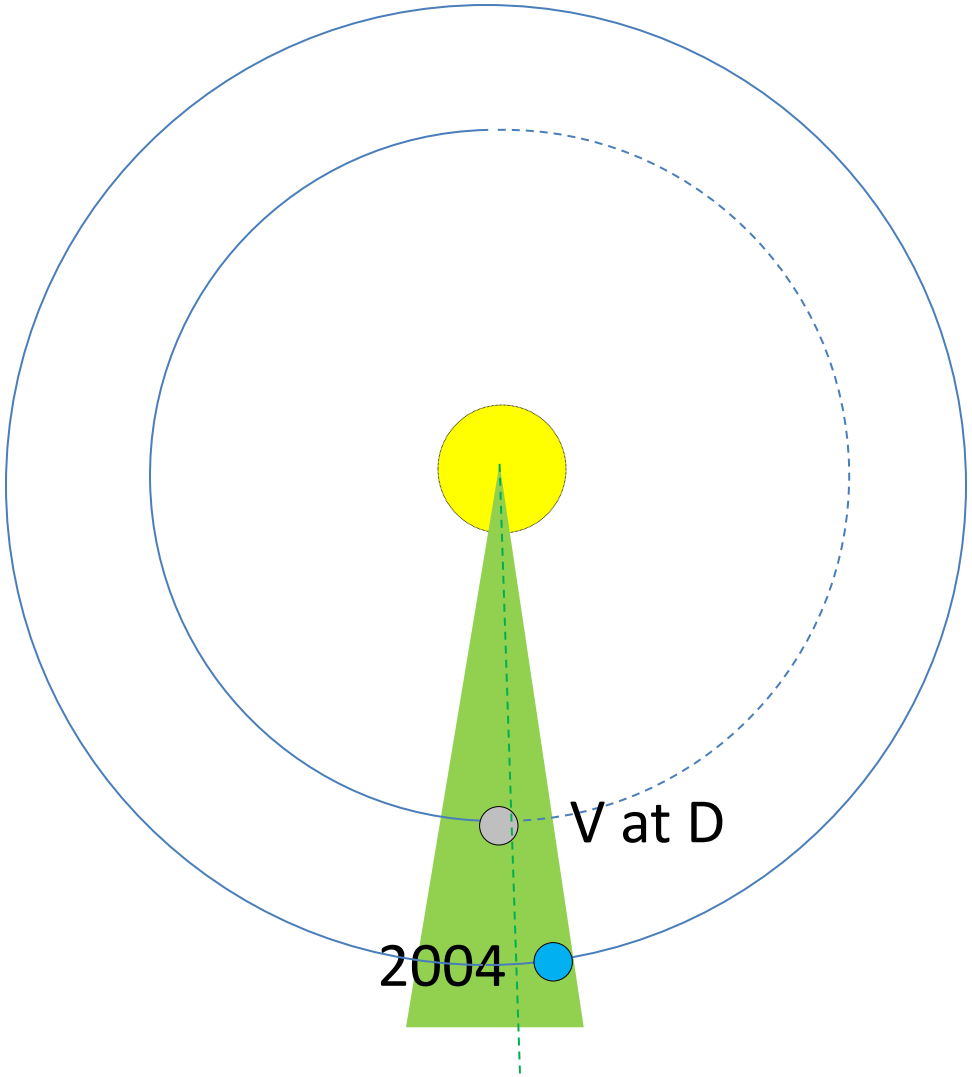


… Venus missed left.



The Frequency of Descending Transits

Start counting at 2004.



When is the next descending transit? vyears 1-100

1	221.47
2	82.94
3	304.41
4	165.87
5	27.34
6	248.81
7	110.28
8	331.75
9	193.22
10	54.68
11	276.15
12	137.62
13	359.09
14	220.56
15	82.03
16	303.50
17	164.96
18	26.43
19	247.90
20	109.37
21	330.84
22	192.31
23	53.77
24	275.24
25	136.71
26	358.18
27	219.65
28	81.12
29	302.59
30	164.05
31	25.52
32	246.99
33	108.46
34	329.93
35	191.40
36	52.87
37	274.33
38	135.80
39	357.27
40	218.74
41	80.21
42	301.68
43	163.14
44	24.61
45	246.08
46	107.55
47	329.02
48	190.49
49	51.96
50	273.42
51	134.89
52	356.36
53	217.83
54	79.30
55	300.77
56	162.23
57	23.70
58	245.17
59	106.64
60	328.11
61	189.58
62	51.05
63	272.51
64	133.98
65	355.45
66	216.92
67	78.39
68	299.86
69	161.32
70	22.79
71	244.26
72	105.73
73	327.20
74	188.67
75	50.14
76	271.60
77	133.07
78	354.54
79	216.01
80	77.48
81	298.95
82	160.41
83	21.88
84	243.35
85	104.82
86	326.29
87	187.76
88	49.23
89	270.69
90	132.16
91	353.63
92	215.10
93	76.57
94	298.04
95	159.50
96	20.97
97	242.44
98	103.91
99	325.38
100	186.85

When is the next descending transit? vyears 101-200

vyear number	Earth position
101	48.32
102	269.78
103	131.25
104	352.72
105	214.19
106	75.66
107	297.13
108	158.59
109	20.06
110	241.53
111	103.00
112	324.47
113	185.94
114	47.41
115	268.87
116	130.34
117	351.81
118	213.28
119	74.75
120	296.22
121	157.69
122	19.15
123	240.62
124	102.09
125	323.56
126	185.03
127	46.50
128	267.96
129	129.43
130	350.90
131	212.37
132	73.84
133	295.31
134	156.78
135	18.24
136	239.71
137	101.18
138	322.65
139	184.12
140	45.59
141	267.05
142	128.52
143	349.99
144	211.46
145	72.93
146	294.40
147	155.87
148	17.33
149	238.80
150	100.27
151	321.74
152	183.21
153	44.68
154	266.14
155	127.61
156	349.08
157	210.55
158	72.02
159	293.49
160	154.96
161	16.42
162	237.89
163	99.36
164	320.83
165	182.30
166	43.77
167	265.23
168	126.70
169	348.17
170	209.64
171	71.11
172	292.58
173	154.05
174	15.51
175	236.98
176	98.45
177	319.92
178	181.39
179	42.86
180	264.32
181	125.79
182	347.26
183	208.73
184	70.20
185	291.67
186	153.14
187	14.60
188	236.07
189	97.54
190	319.01
191	180.48
192	41.95
193	263.41
194	124.88
195	346.35
196	207.82
197	69.29
198	290.76
199	152.23
200	13.69

When is the next descending transit? vyears 201-300

vyear number	Earth position
201	235.16
202	96.63
203	318.10
204	179.57
205	41.04
206	262.51
207	123.97
208	345.44
209	206.91
210	68.38
211	289.85
212	151.32
213	12.78
214	234.25
215	95.72
216	317.19
217	178.66
218	40.13
219	261.60
220	123.06
221	344.53
222	206.00
223	67.47
224	288.94
225	150.41
226	11.87
227	233.34
228	94.81
229	316.28
230	177.75
231	39.22
232	260.69
233	122.15
234	343.62
235	205.09
236	66.56
237	288.03
238	149.50
239	10.96
240	232.43
241	93.90
242	315.37
243	176.84
244	38.31
245	259.78
246	121.24
247	342.71
248	204.18
249	65.65
250	287.12
251	148.59
252	10.05
253	231.52
254	92.99
255	314.46
256	175.93
257	37.40
258	258.87
259	120.33
260	341.80
261	203.27
262	64.74
263	286.21
264	147.68
265	9.14
266	230.61
267	92.08
268	313.55
269	175.02
270	36.49
271	257.96
272	119.42
273	340.89
274	202.36
275	63.83
276	285.30
277	146.77
278	8.24
279	229.70
280	91.17
281	312.64
282	174.11
283	35.58
284	257.05
285	118.51
286	339.98
287	201.45
288	62.92
289	284.39
290	145.86
291	7.33
292	228.79
293	90.26
294	311.73
295	173.20
296	34.67
297	256.14
298	117.60
299	338.07
300	200.54

When is the next descending transit? vyears 301-397

300	200.54
301	62.01
302	283.48
303	144.95
304	6.42
305	227.88
306	89.35
307	310.82
308	172.29
309	33.76
310	255.23
311	116.70
312	338.16
313	199.63
314	61.10
315	282.57
316	144.04
317	5.51
318	226.97
319	88.44
320	309.91
321	171.38
322	32.85
323	254.32
324	115.79
325	337.25
326	198.72
327	60.19
328	281.66
329	143.13
330	4.60
331	226.06
332	87.53
333	309.00
334	170.47
335	31.94
336	253.41
337	114.88
338	336.34
339	197.81
340	59.28
341	280.75
342	142.22
343	3.69
344	225.15
345	86.62
346	308.09
347	169.56
348	31.03
349	252.50
350	113.97
351	335.43
352	196.90
353	58.37
354	279.84
355	141.31
356	2.78
357	224.25
358	85.71
359	307.18
360	168.65
361	30.12
362	251.59
363	113.06
364	334.52
365	195.99
366	57.46
367	278.93
368	140.40
369	1.87
370	223.34
371	84.80
372	306.27
373	167.74
374	29.21
375	250.68
376	112.15
377	333.61
378	195.08
379	56.55
380	278.02
381	139.49
382	0.96
383	222.43
384	83.89
385	305.36
386	166.83
387	28.30
388	249.77
389	111.24
390	332.70
391	194.17
392	55.64
393	277.11
394	138.58
395	0.05
396	221.52
397	82.98

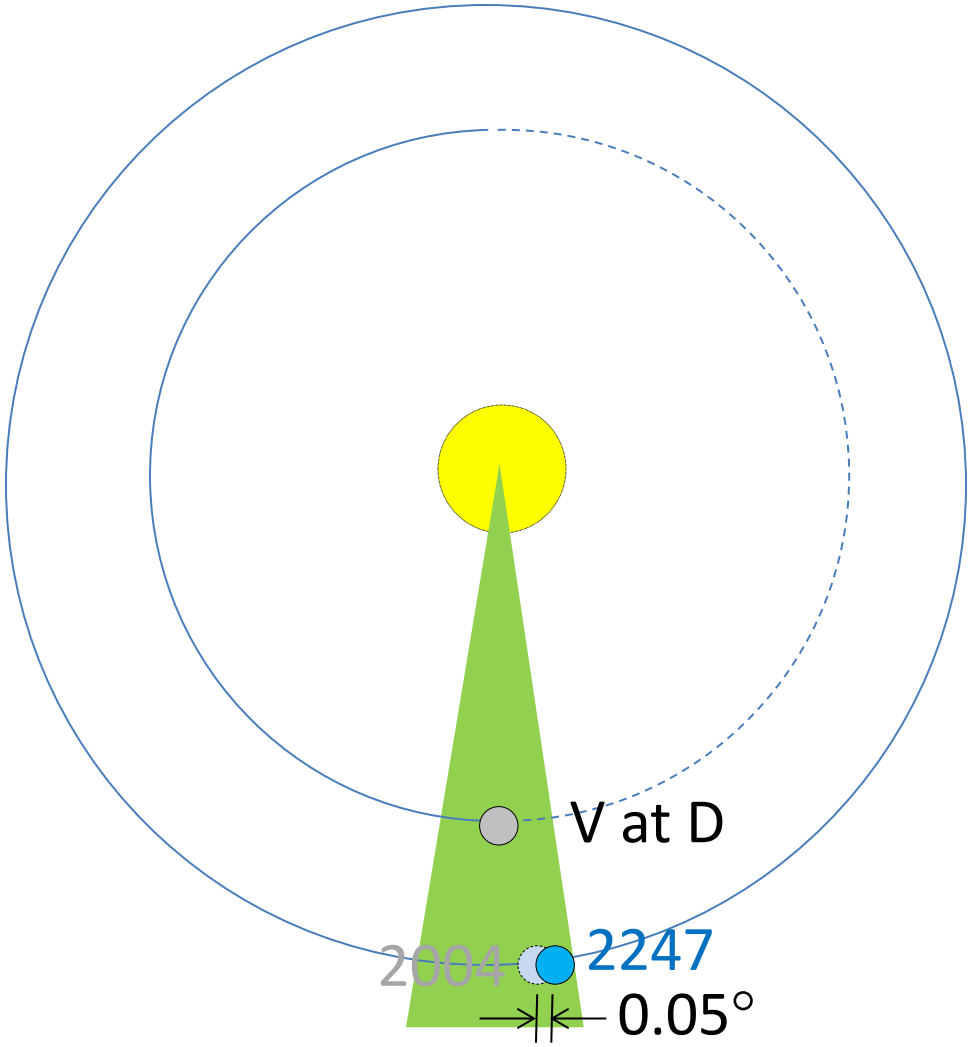
At vyear 395 …

vyear number	Earth position
391	194.17
392	55.64
393	277.11
394	138.58
395	0.05
396	221.52
397	82.98

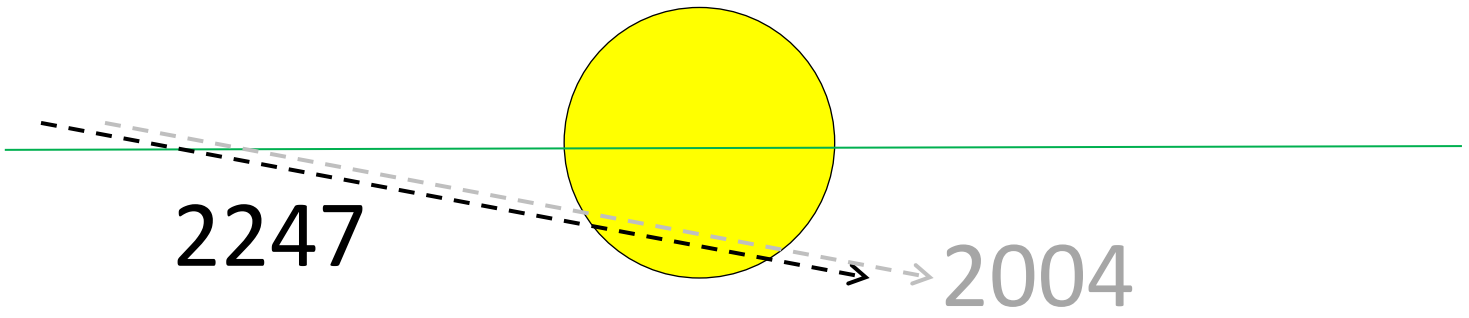
At vyear 395
= 243.009 years …

vyear number	Earth position	Earth years
391	194.17	240.548
392	55.64	241.163
393	277.11	241.778
394	138.58	242.393
395	0.05	243.009
396	221.52	243.624
397	82.98	244.239

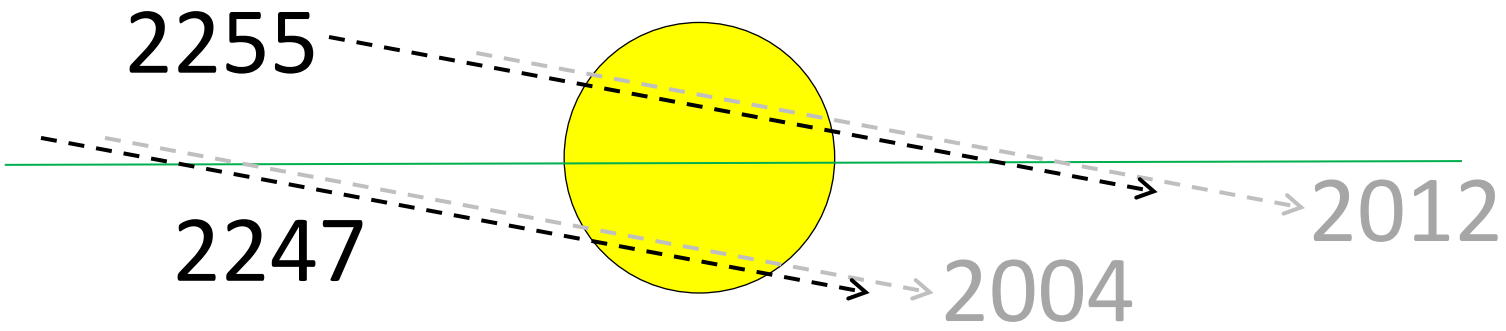
… Earth returns rightward of the 2004 position…



… and the transit moves left.

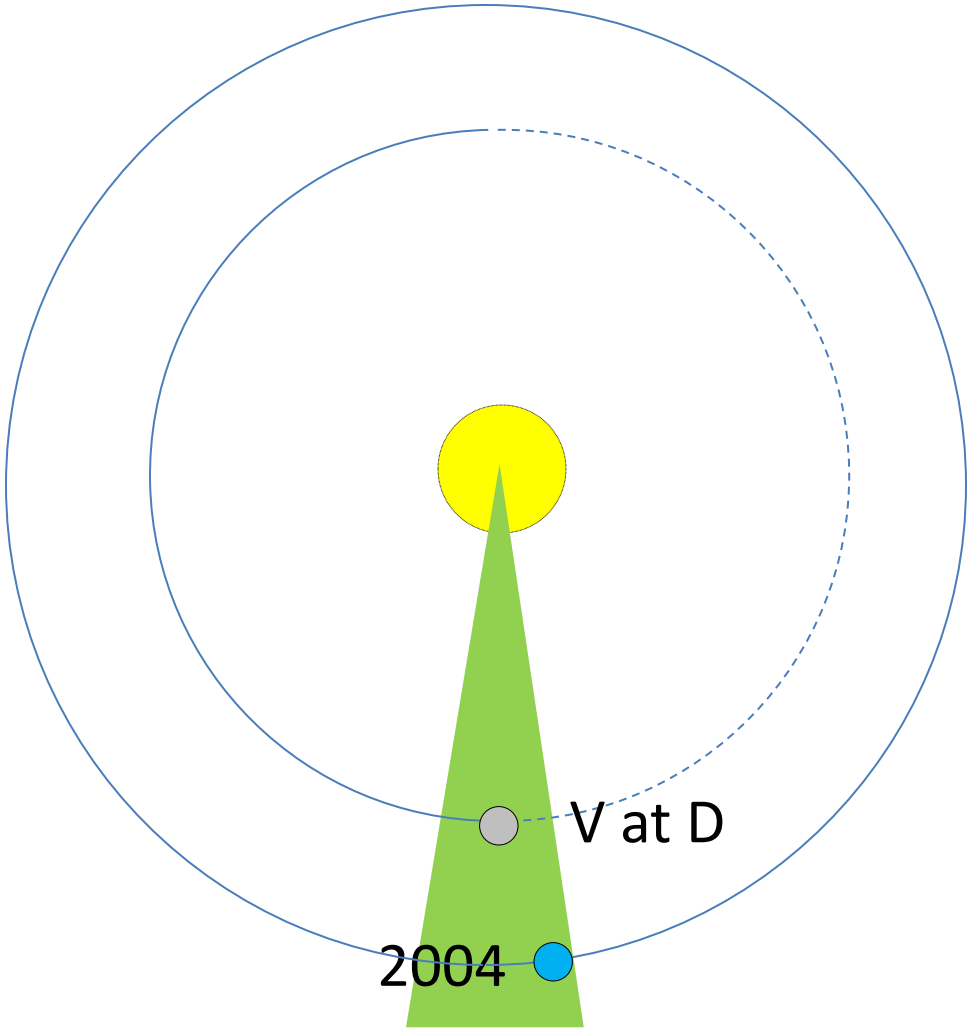


So does the follower.



The Ascending Node

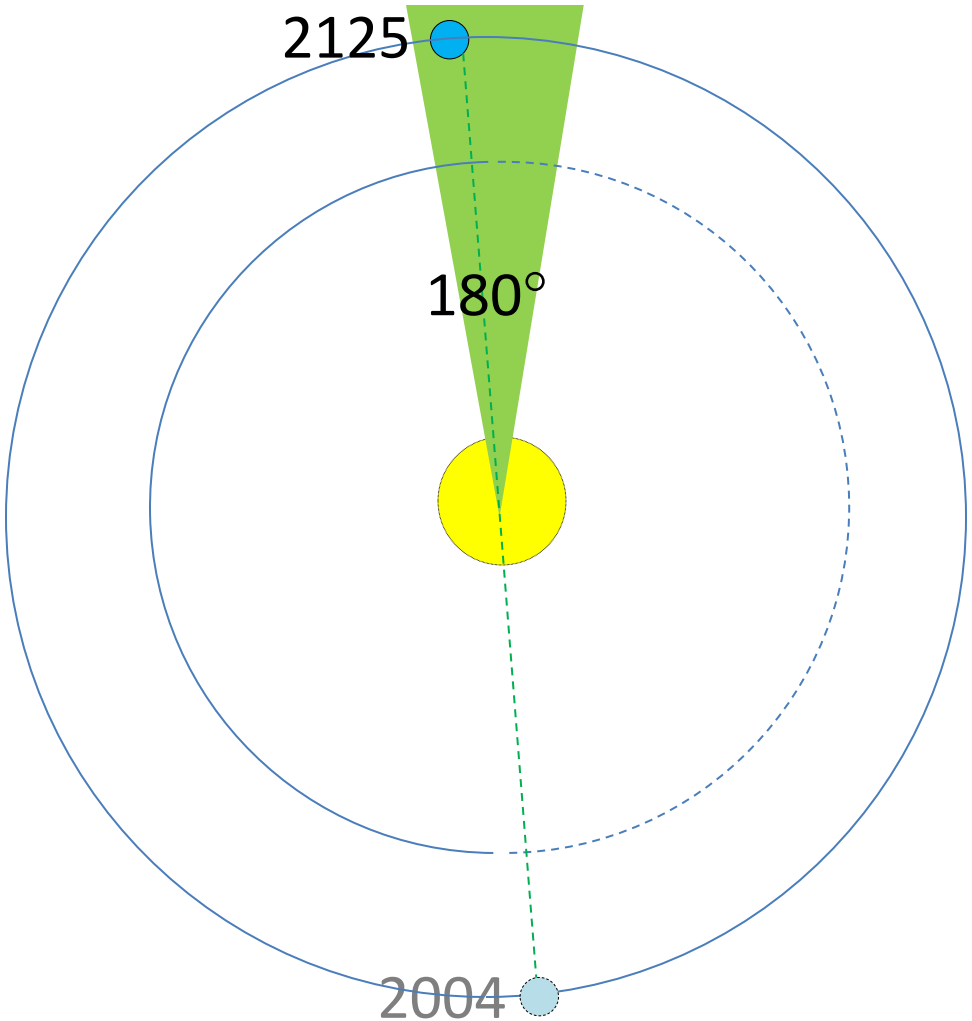
halfway to 395 vyears:
197.5 vyears = 121.5 years



prediction on paper

vyear number	Earth position	Earth years
197.500	180.02	121.50
198.500	41.49	122.12
199.500	262.96	122.73
200.500	124.43	123.35
201.500	345.90	123.97
202.500	207.37	124.58
203.500	68.83	125.20

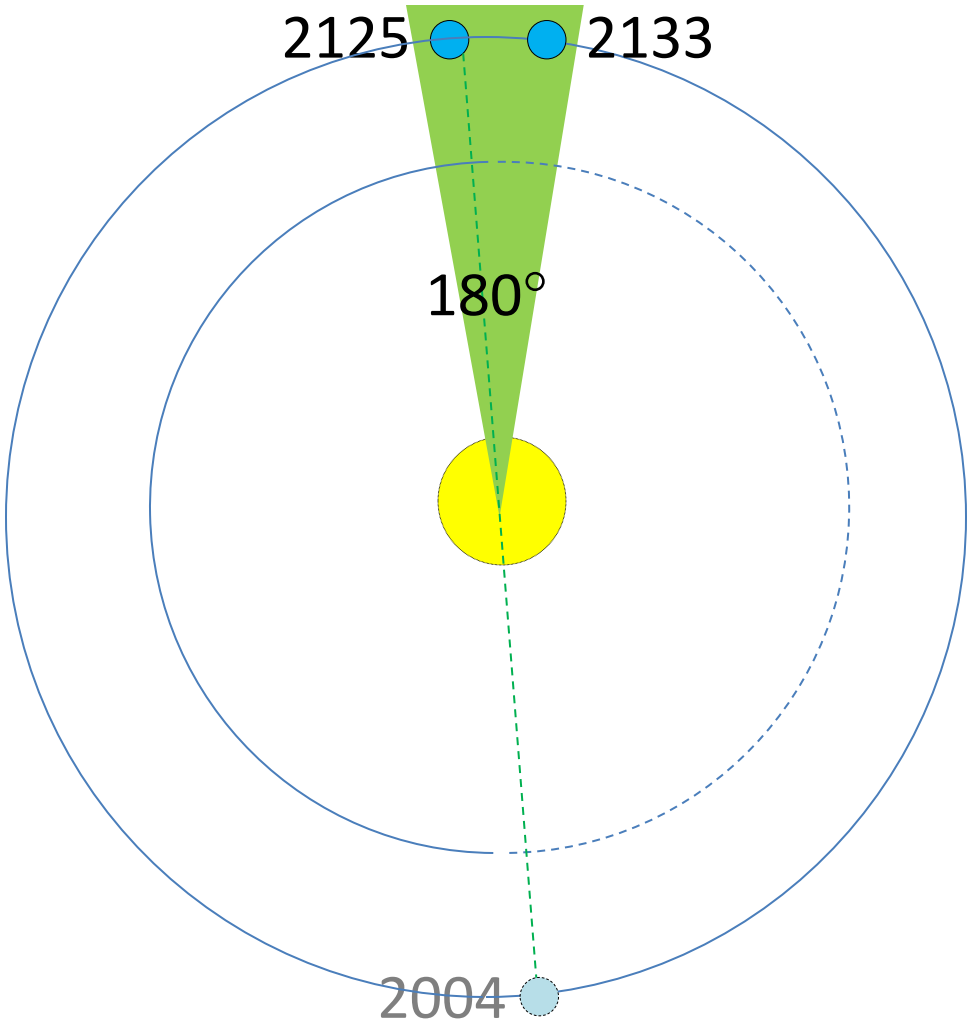
prediction in space



prediction on paper

vyear number	Earth position	Earth years
204.500	290.30	125.81
205.500	151.77	126.43
206.500	13.24	127.04
207.500	234.71	127.66
208.500	96.18	128.27
209.500	317.65	128.89
210.500	179.11	129.50

prediction in space



SIX MILLENNIUM CATALOG OF VENUS TRANSITS: 2000 BCE TO 4000 CE

A transit is the passage of a planet across the Sun's bright disk. At this time, the planet can be seen as a small black disk slowly moving in front of the Sun. The orbits of Mercury and Venus lie inside Earth's orbit, so they are the only planets which can pass between Earth and Sun to produce a transit. Transits are very rare astronomical events. In the case of Venus, there are on average two transits every one and a quarter centuries. A transit of Venus occurs only if the planet is in inferior conjunction with the Sun (between Earth and Sun) and is also crossing the through Earth's orbital plane (the Ecliptic). During the present period in Earth's history, Venus's orbit crosses Earth's orbital plane in early June and early December each year. If the Venus is passing between the Earth and Sun at that time, a transit will be seen.

During the six millennium period 2000 BCE to 4000 CE[1], Earth experiences 81 transits of Venus across the Sun. These events can be organized into two groups:

All Transits = 81 = 100.0%

June (Descending Node[2]) = 44 = 54.3 %
December (Ascending Node[3]) = 37 = 45.7 %

NASA Catalog

DATE	TIME	SERIES	DEPTH
1631 Dec 07	3:51	6	0.2609
1639 Dec 04	14:57	4	0.1454
1761 Jun 06	2:02	3	0.1584
1769 Jun 03	19:15	5	0.1693
1874 Dec 09	1:49	6	0.2305
1882 Dec 06	13:57	4	0.1770
2004 Jun 08	5:13	3	0.1741
2012 Jun 06	22:09	5	0.1540
2117 Dec 11	23:58	6	0.2010
2125 Dec 08	13:15	4	0.2046
2247 Jun 11	8:42	3	0.1920
2255 Jun 09	1:08	5	0.1366

NASA Catalog

DATE	TIME	SERIES	DEPTH
1631 Dec 07	3:51	6	0.2609
1639 Dec 04	14:57	4	0.1454
1761 Jun 06	2:02	3	0.1584
1769 Jun 03	19:15	5	0.1693
1874 Dec 09	1:49	6	0.2305
1882 Dec 06	13:57	4	0.1770
2004 Jun 08	5:13	3	0.1741
2012 Jun 06	22:09	5	0.1540
2117 Dec 11	23:58	6	0.2010
2125 Dec 08	13:15	4	0.2046
2247 Jun 11	8:42	3	0.1920
2255 Jun 09	1:08	5	0.1366

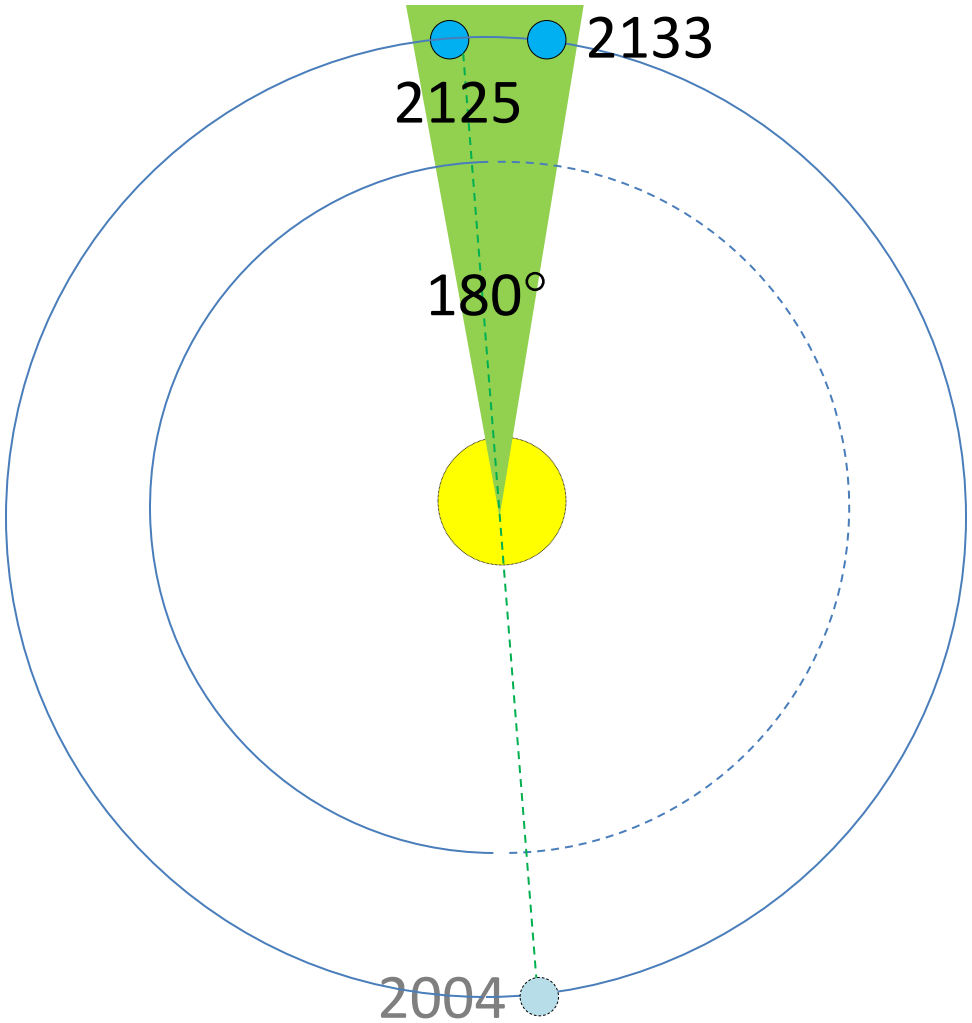
NASA Catalog

DATE	TIME	SERIES	DEPTH
1631 Dec 07	3:51	6	0.2609
1639 Dec 04	14:57	4	0.1454
1761 Jun 06	2:02	3	0.1584
1769 Jun 03	19:15	5	0.1693
1874 Dec 09	1:49	6	0.2305
1882 Dec 06	13:57	4	0.1770
2004 Jun 08	5:13	3	0.1741
2012 Jun 06	22:09	5	0.1540
2117 Dec 11	23:58	6	0.2010
2125 Dec 08	13:15	4	0.2046
2247 Jun 11	8:42	3	0.1920
2255 Jun 09	1:08	5	0.1366

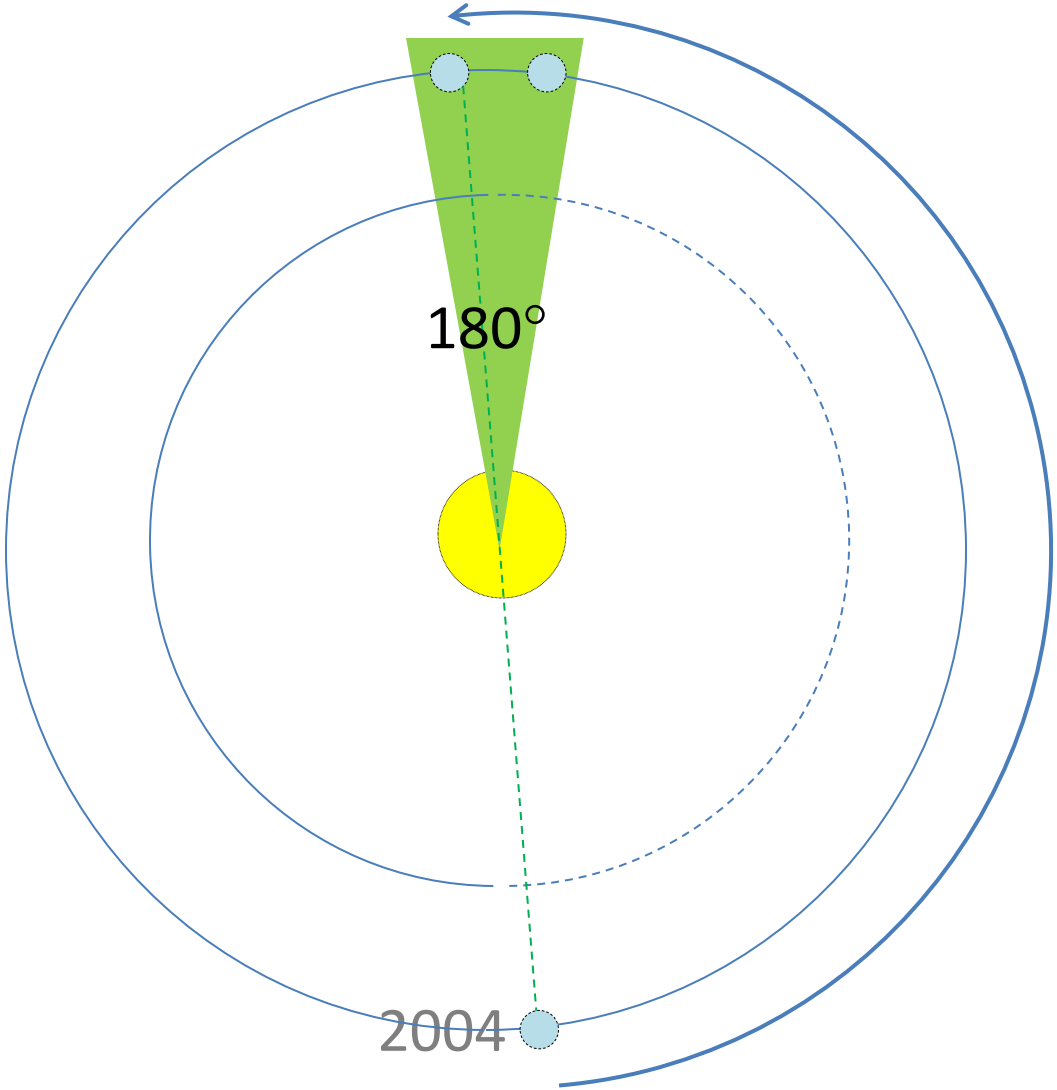
gaps since 1631

DATE	TIME	SERIES	DEPTH	
1631 Dec 07	3:51	6	0.2609	
1639 Dec 04	14:57	4	0.1454	] 121.5 yr
1761 Jun 06	2:02	3	0.1584	
1769 Jun 03	19:15	5	0.1693	] 105.5
1874 Dec 09	1:49	6	0.2305	
1882 Dec 06	13:57	4	0.1770	] 121.5
2004 Jun 08	5:13	3	0.1741	
2012 Jun 06	22:09	5	0.1540	] 105.5
2117 Dec 11	23:58	6	0.2010	
2125 Dec 08	13:15	4	0.2046	] 121.5
2247 Jun 11	8:42	3	0.1920	
2255 Jun 09	1:08	5	0.1366	

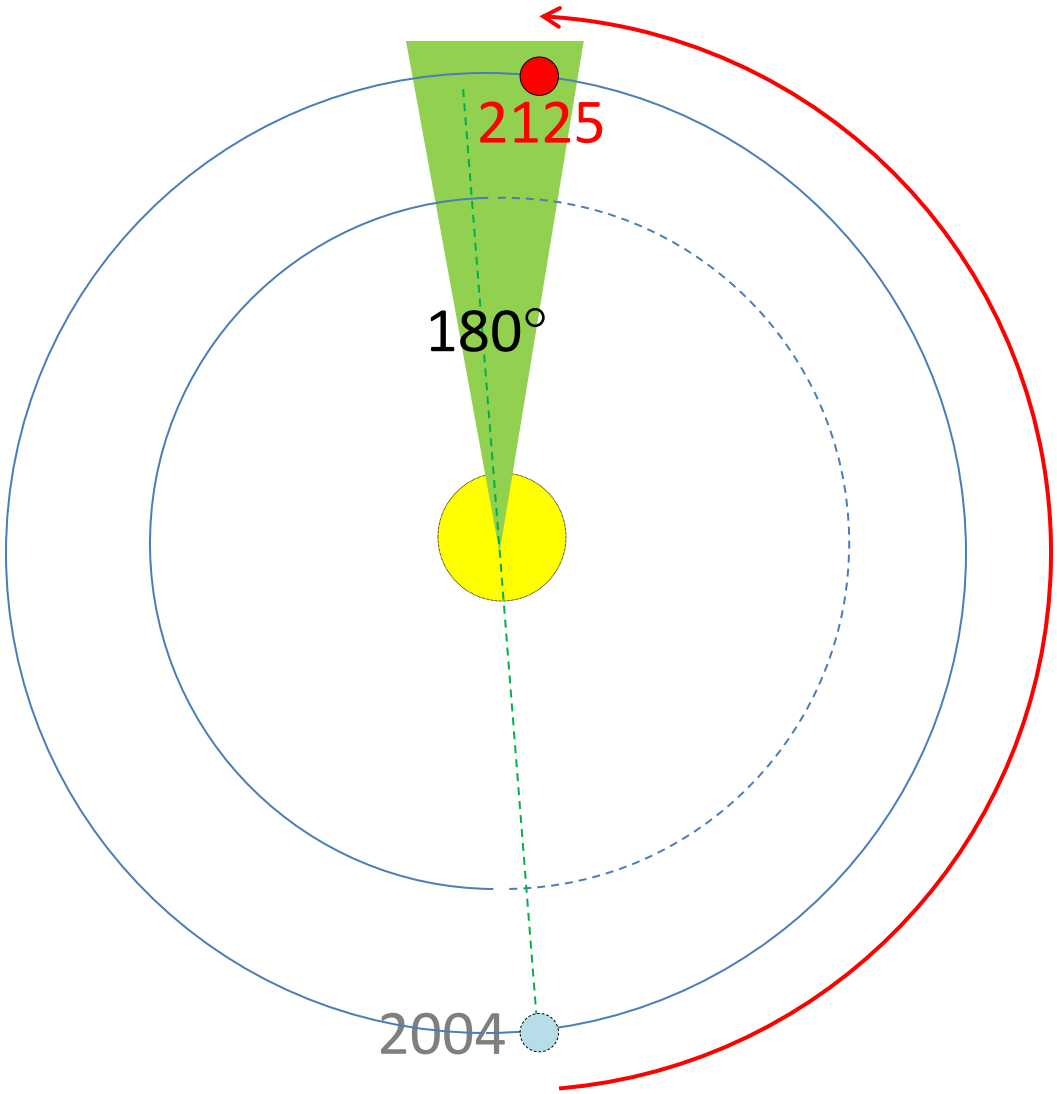
uniform-gaps prediction



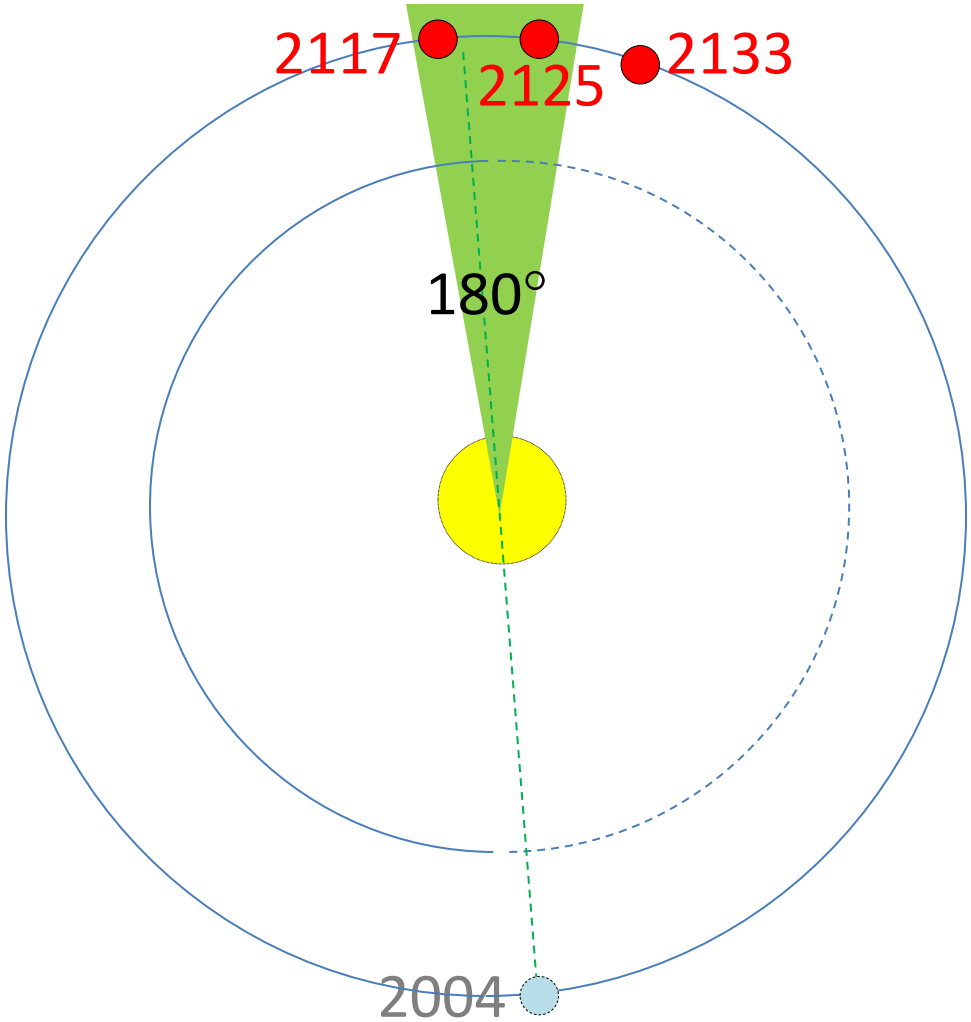
Earth’s predicted 121.5-year reach



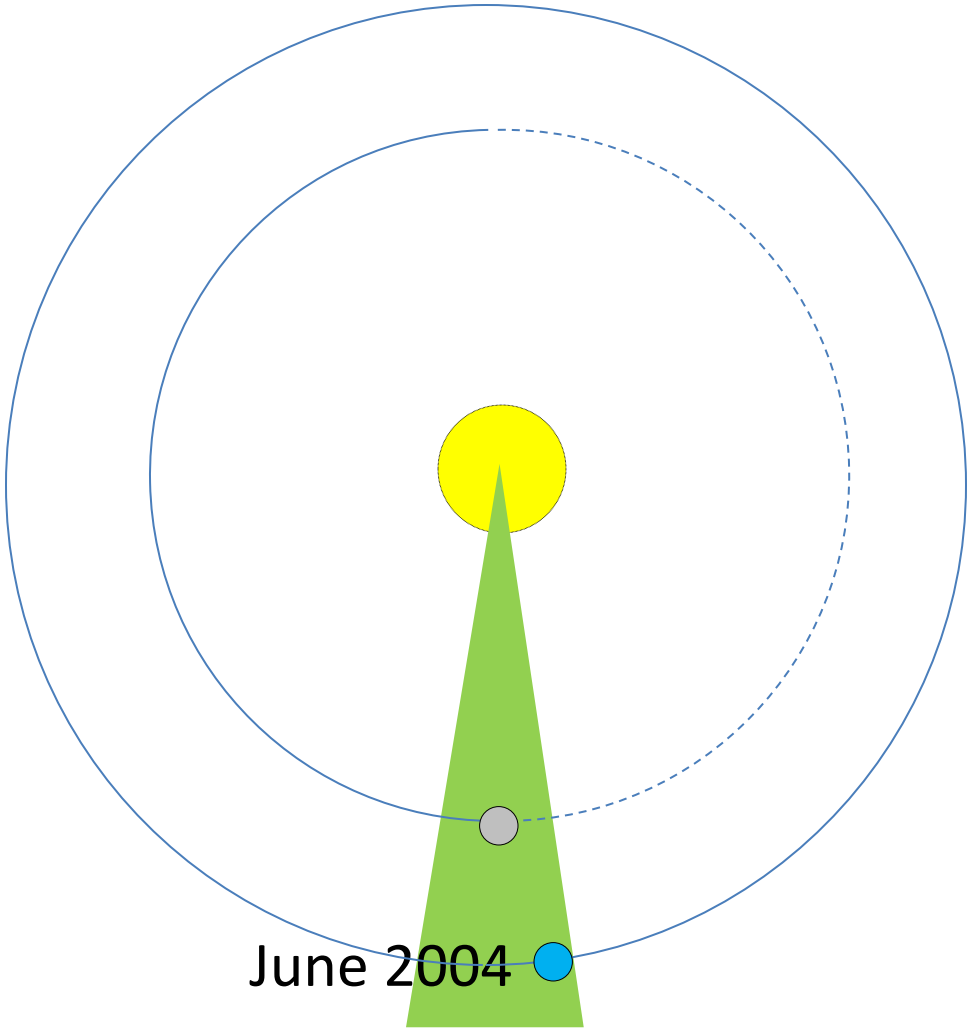
Earth's actual 121.5-year reach



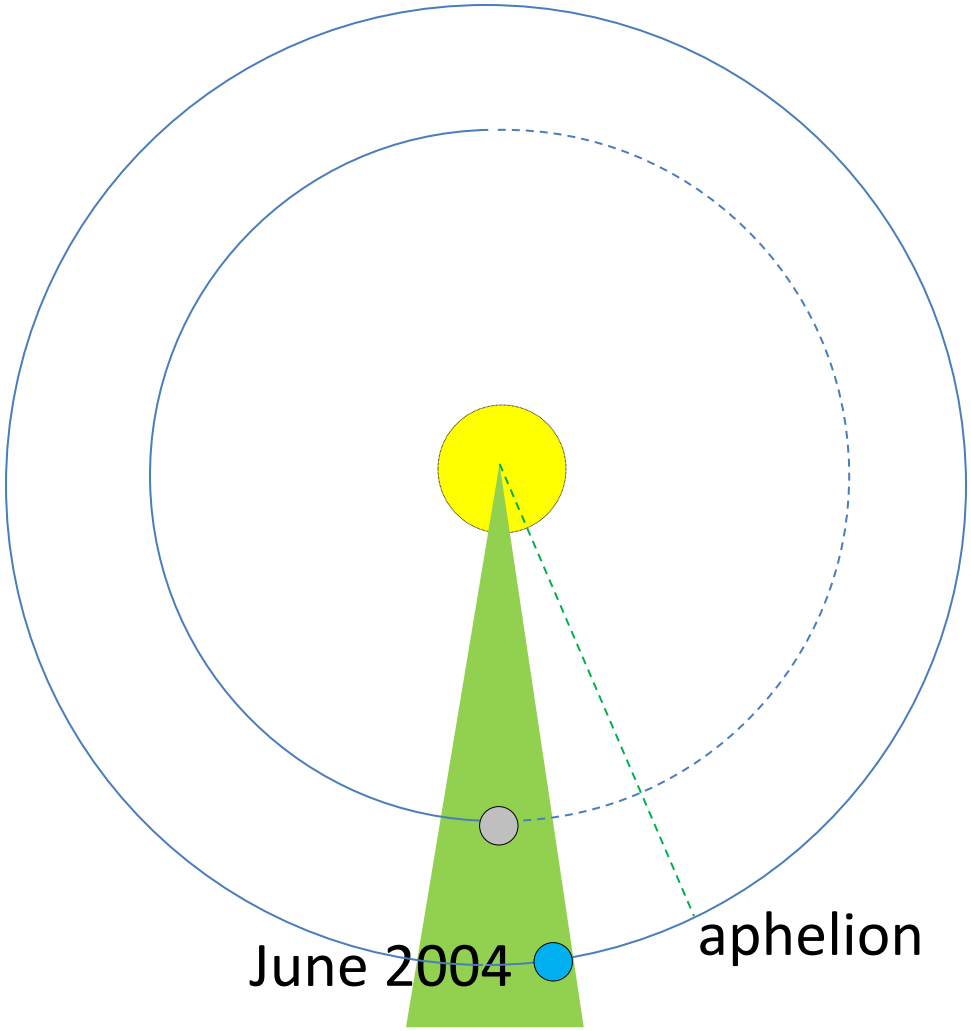
and 113.5 and 129.5 years



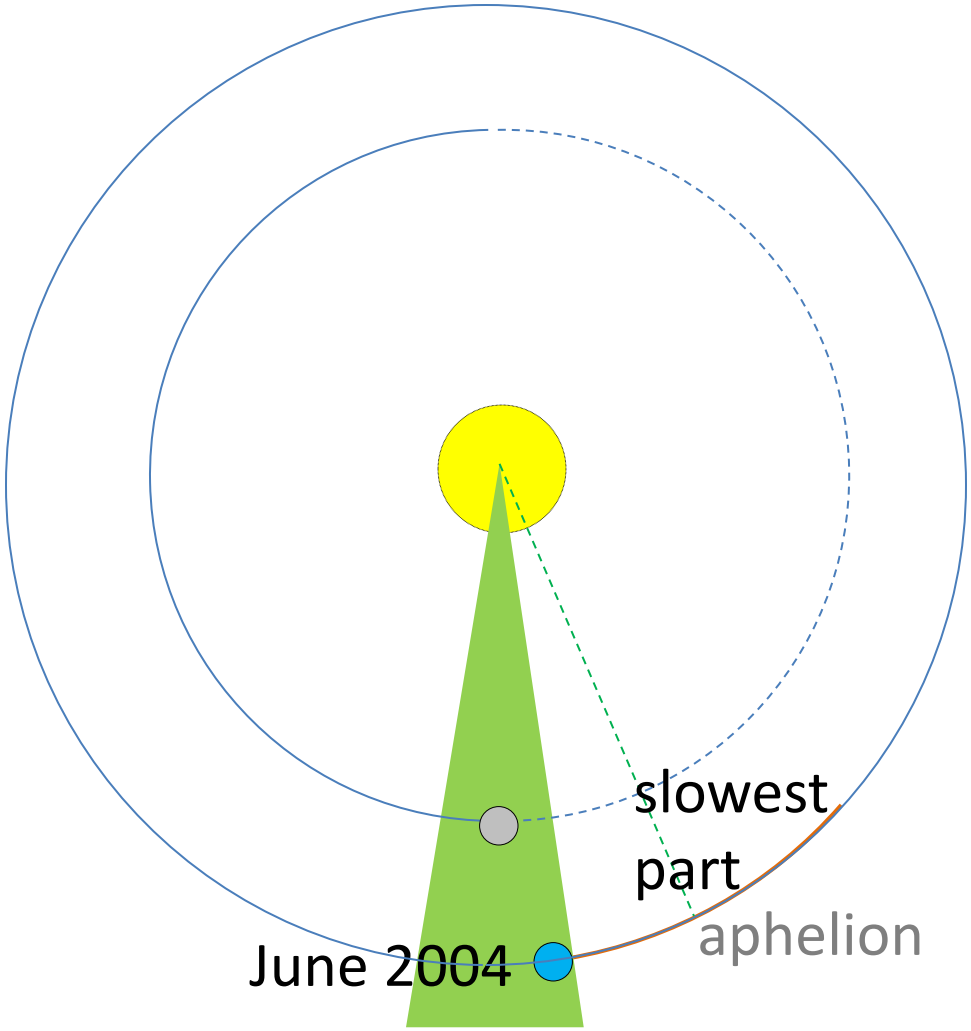
back to the start



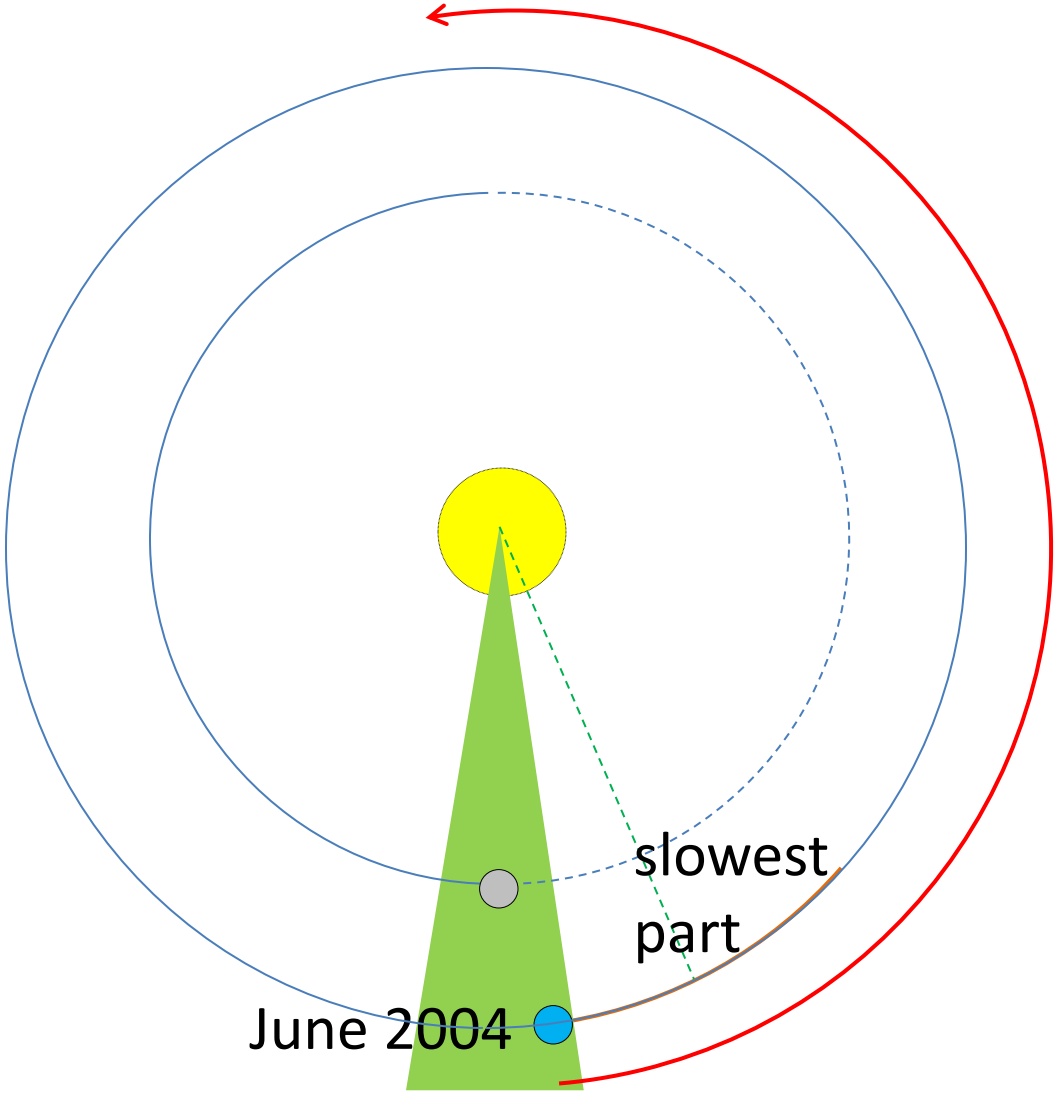
aphelion is around July 4



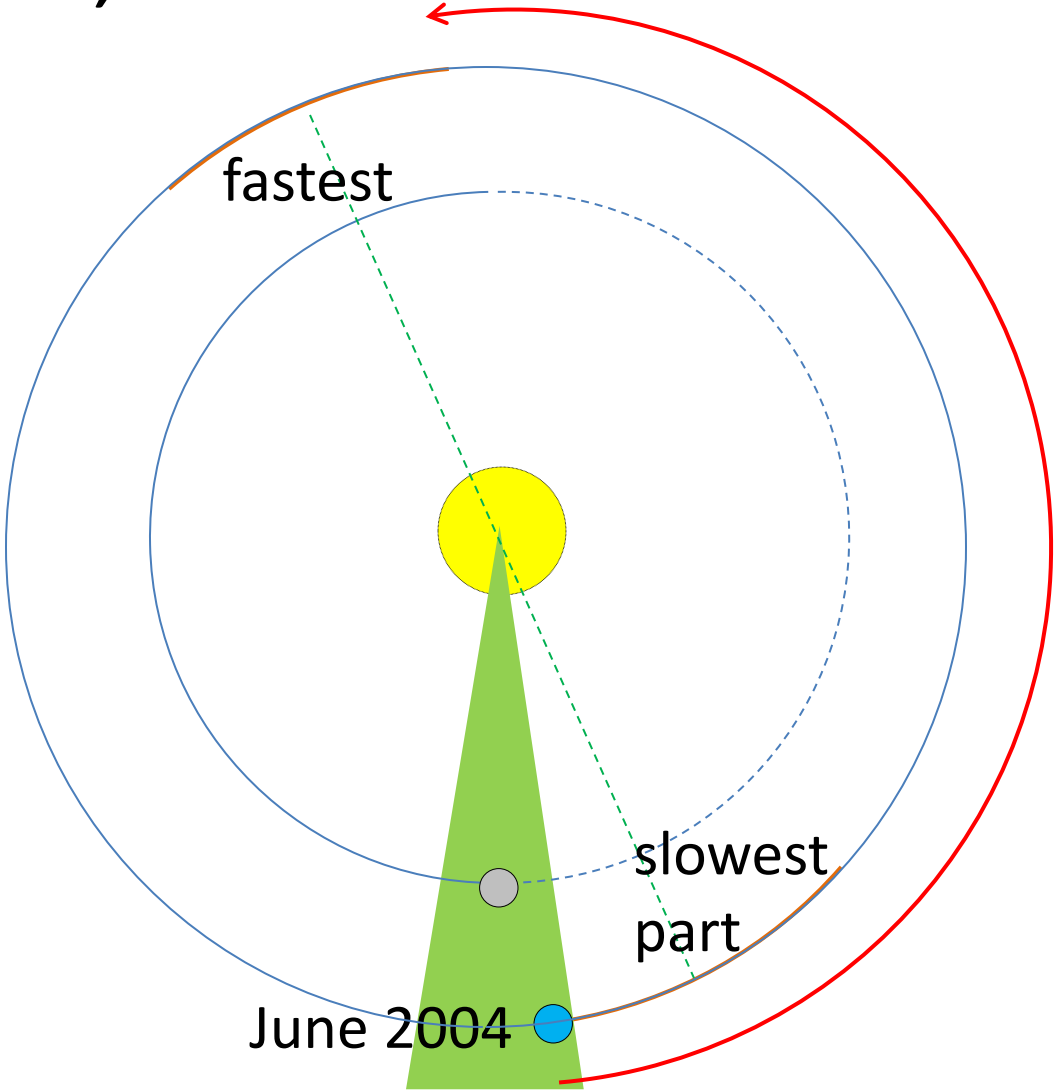
near aphelion



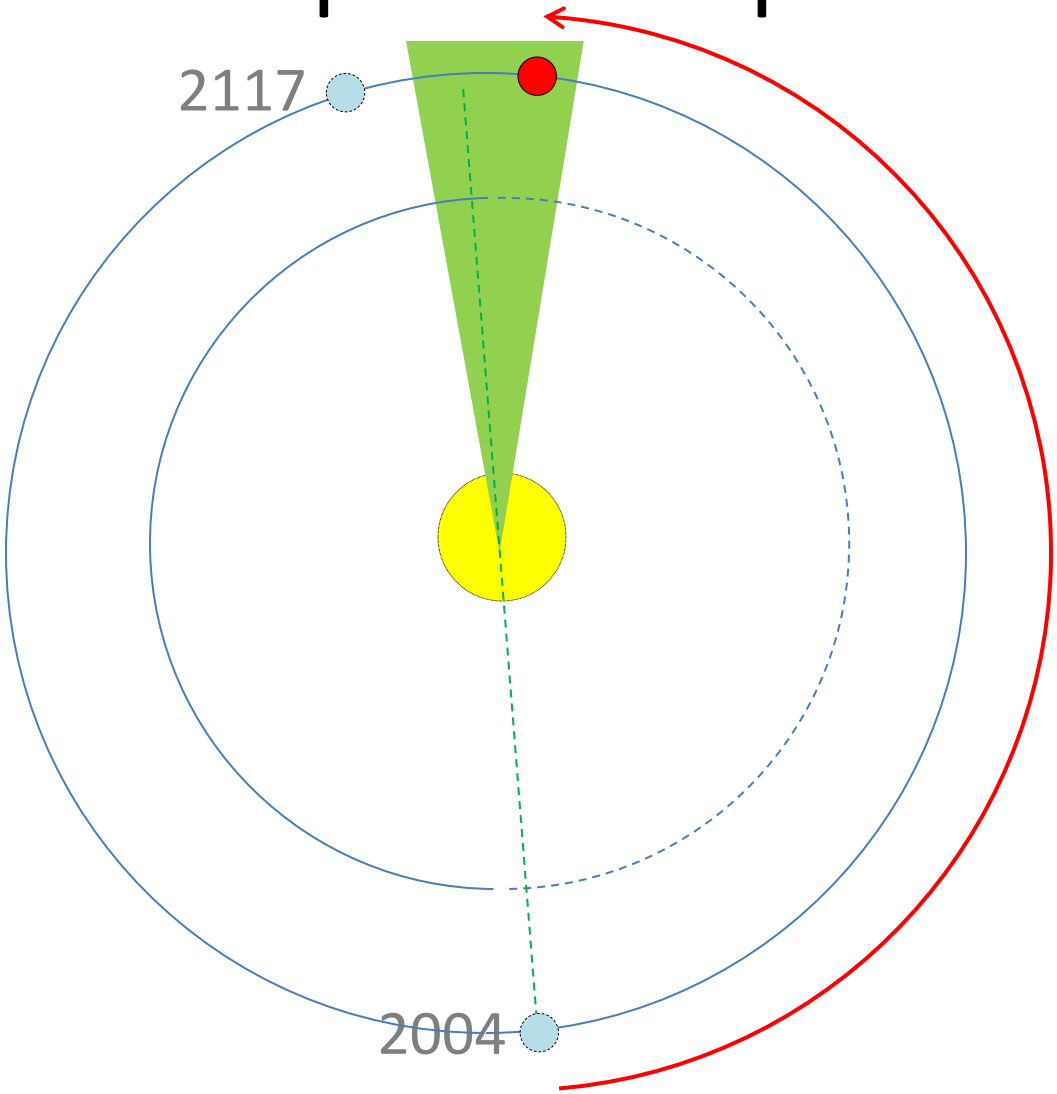
Going halfway around …



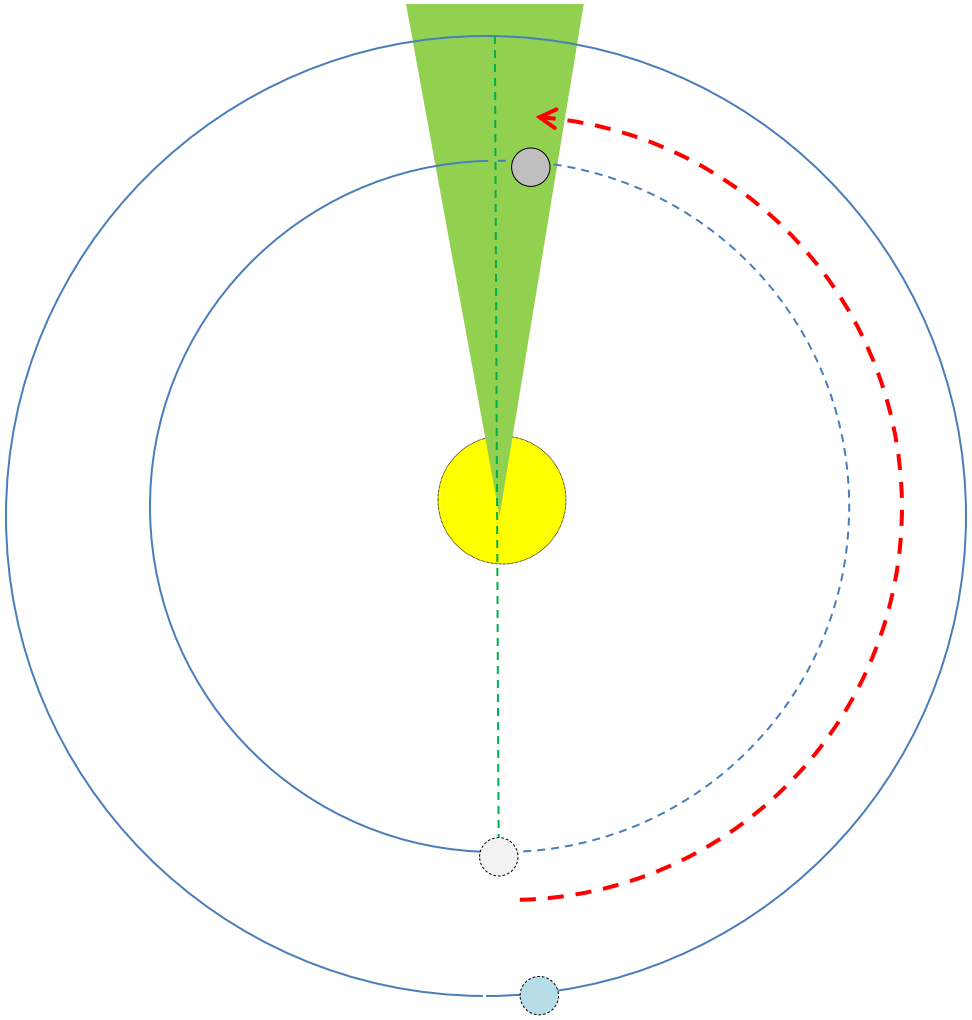
… Earth covers the slowest part, leaves out the fastest.



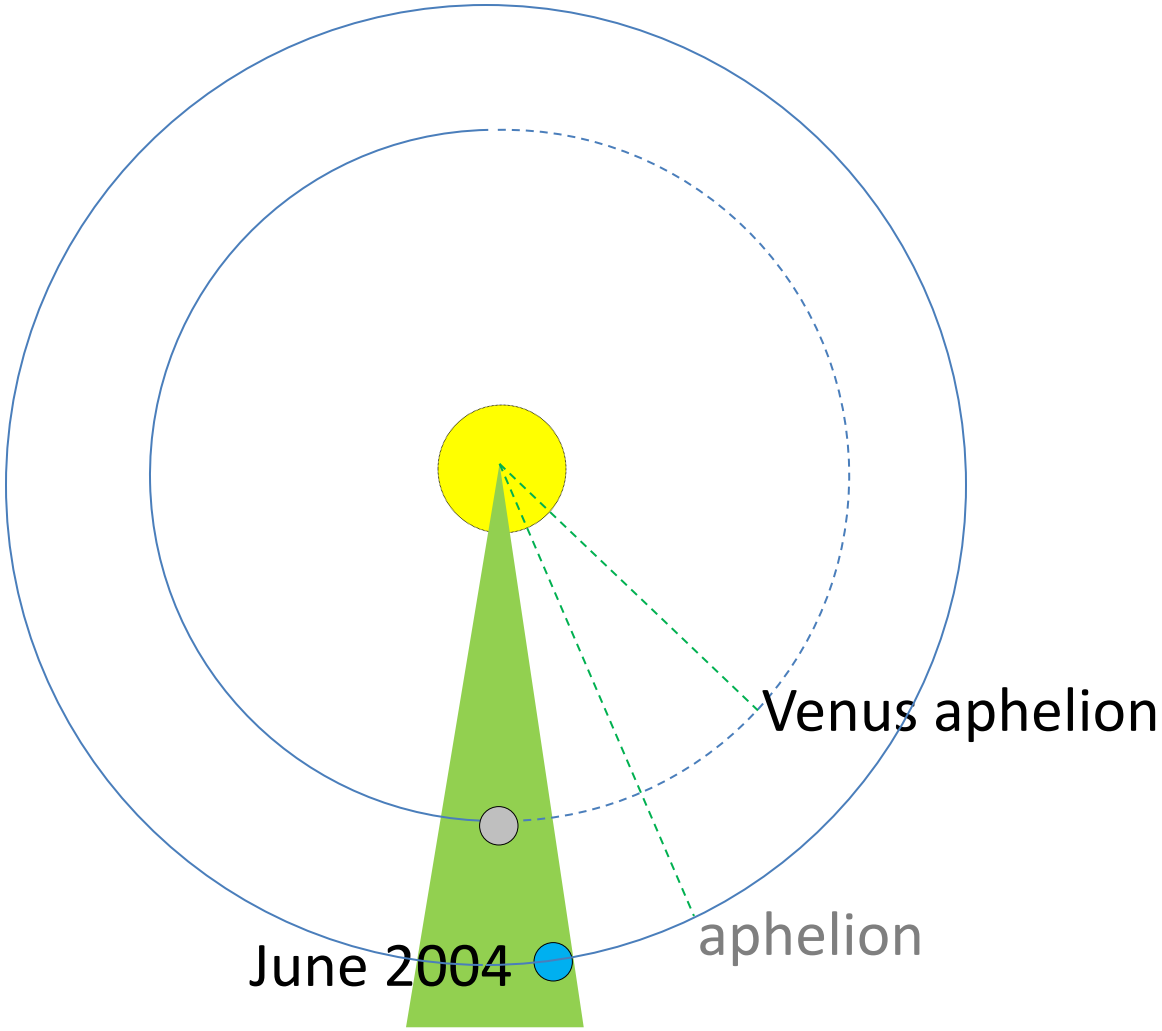
Earth travels about 99% of the predicted path.



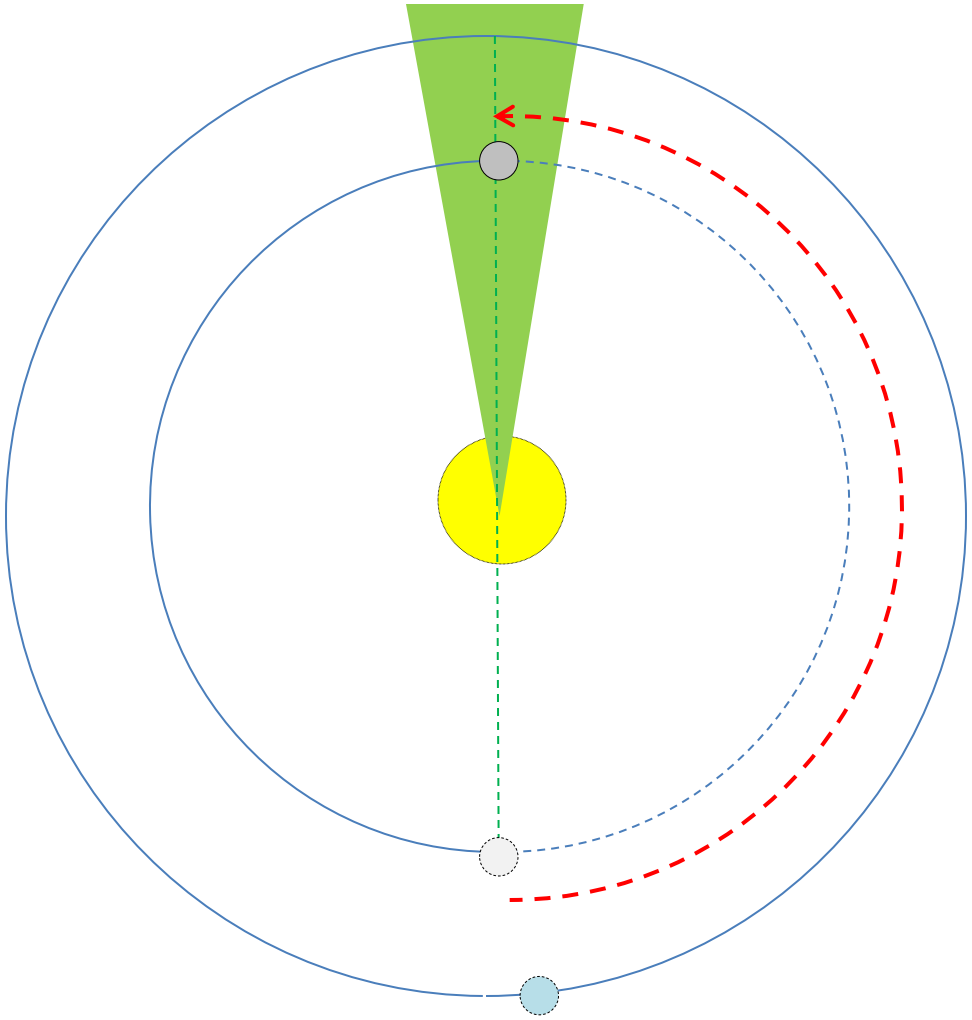
Venus is likewise late.



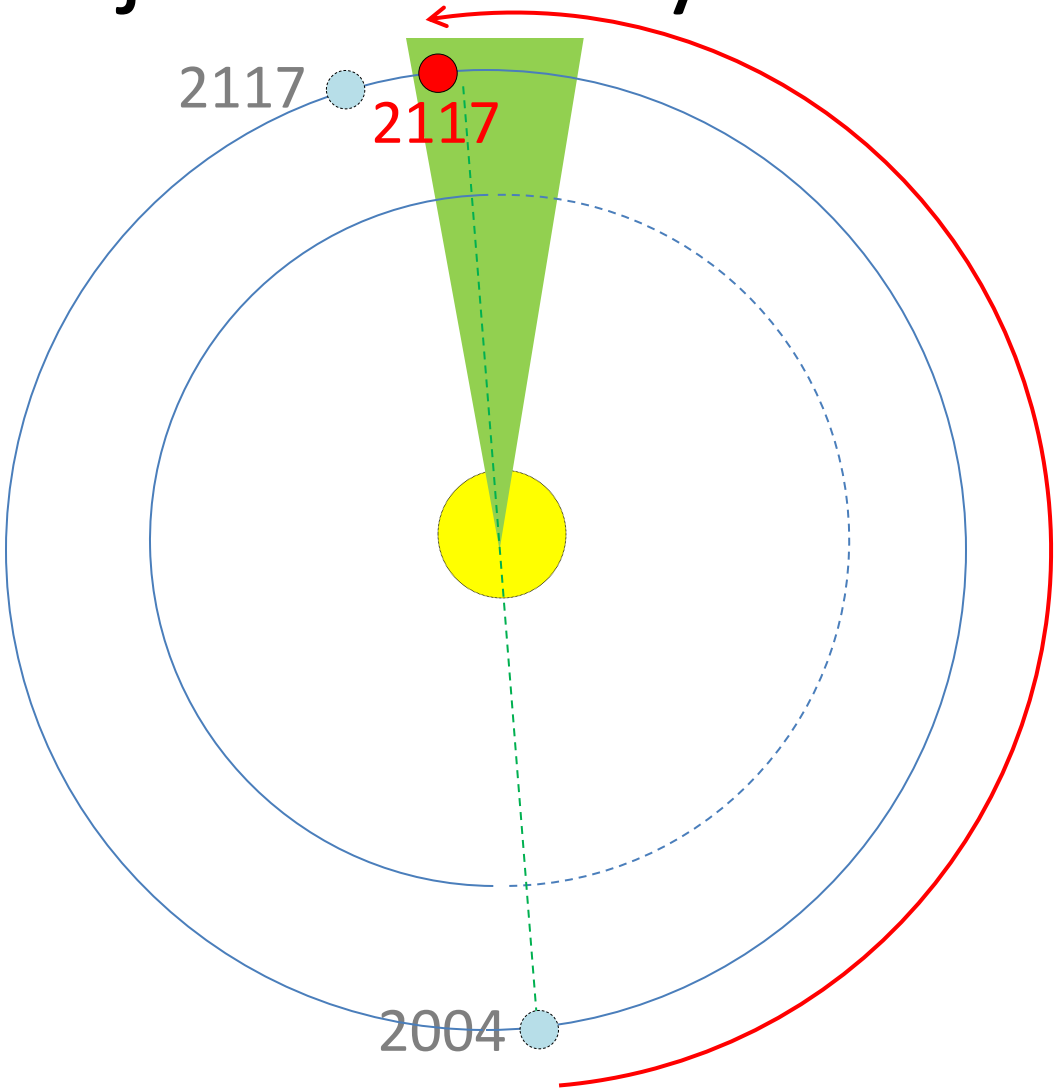
Venus also had aphelion ahead.



Venus needs about 0.503 vyear to reach the ascending node.



The combination moves Earth's place just under 8 years back.



uniform-gaps prediction

vyear number	Earth position	Earth years
197.500	180.02	121.50
198.500	41.49	122.12
199.500	262.96	122.73
200.500	124.43	123.35
201.500	345.90	123.97
202.500	207.37	124.58
203.500	68.83	125.20
204.500	290.30	125.81
205.500	151.77	126.43
206.500	13.24	127.04
207.500	234.71	127.66
208.500	96.18	128.27
209.500	317.65	128.89
210.500	179.11	129.50

extend Venus's trip by 0.6%

vyear number	Earth position	Earth years
197.503	180.02	121.51
198.503	41.49	122.12
199.503	262.96	122.74
200.503	124.43	123.35
201.503	345.90	123.97
202.503	207.37	124.58
203.503	68.83	125.20
204.503	290.30	125.81
205.503	151.77	126.43
206.503	13.24	127.04
207.503	234.71	127.66
208.503	96.18	128.27
209.503	317.65	128.89
210.503	179.11	129.50

shorten earth's trip by 1%

vyear number	Earth position	Earth years
197.503	179.29	121.51
198.503	41.32	122.12
199.503	261.89	122.74
200.503	123.92	123.35
201.503	344.49	123.97
202.503	206.52	124.58
203.503	68.55	125.20
204.503	289.12	125.81
205.503	151.16	126.43
206.503	13.19	127.04
207.503	233.76	127.66
208.503	95.79	128.27
209.503	316.36	128.89
210.503	178.39	129.50

Now 2133 is out of the green zone …

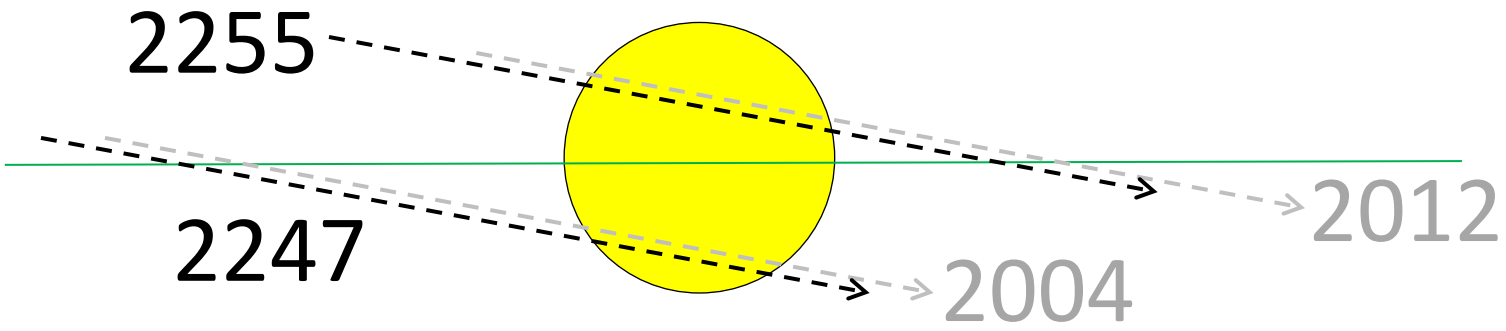
vyear number	Earth position	Earth years	
197.503	179.29	121.51	2125
198.503	41.32	122.12	
199.503	261.89	122.74	
200.503	123.92	123.35	
201.503	344.49	123.97	
202.503	206.52	124.58	
203.503	68.55	125.20	
204.503	289.12	125.81	
205.503	151.16	126.43	
206.503	13.19	127.04	
207.503	233.76	127.66	
208.503	95.79	128.27	
209.503	316.36	128.89	
210.503	178.39	129.50	2133

… 2117 is in.

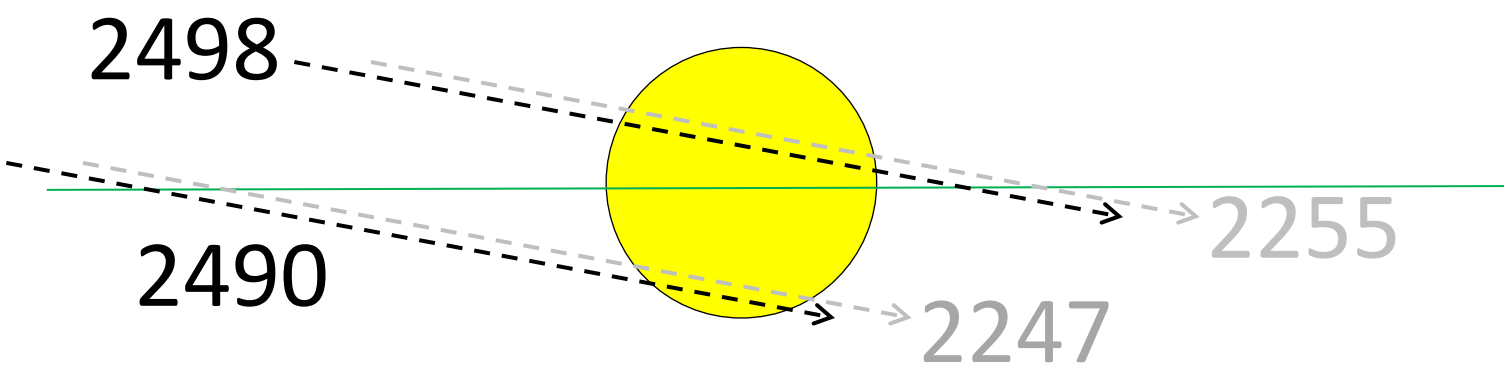
vyear number	Earth position	Earth years	
184.503	180.20	113.51	2117
185.503	42.23	114.12	
186.503	262.80	114.74	
187.503	124.83	115.35	
188.503	345.40	115.97	
189.503	207.43	116.58	
190.503	69.46	117.20	
191.503	290.03	117.81	
192.503	152.06	118.43	
193.503	14.09	119.05	
194.503	234.66	119.66	
195.503	96.69	120.28	
196.503	317.26	120.89	
197.503	179.29	121.51	2125

Persistence of the Pairs

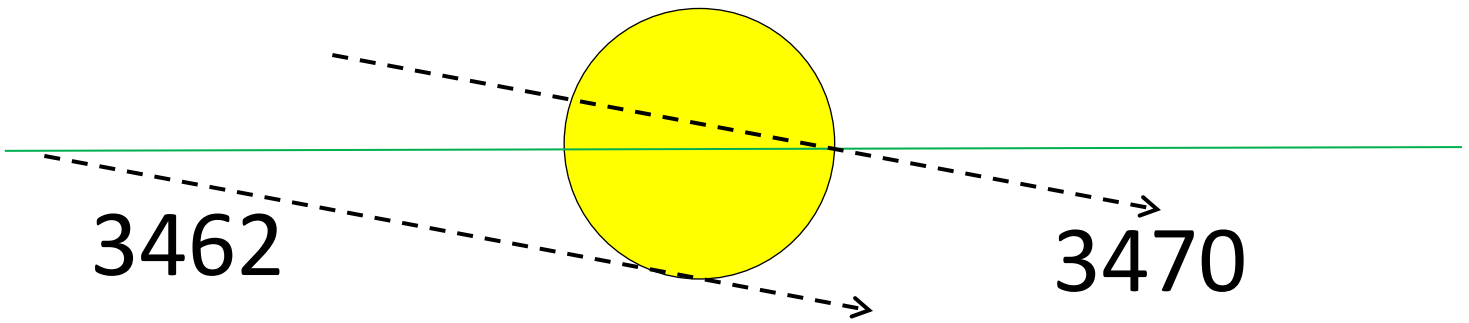
The descending transits move left.



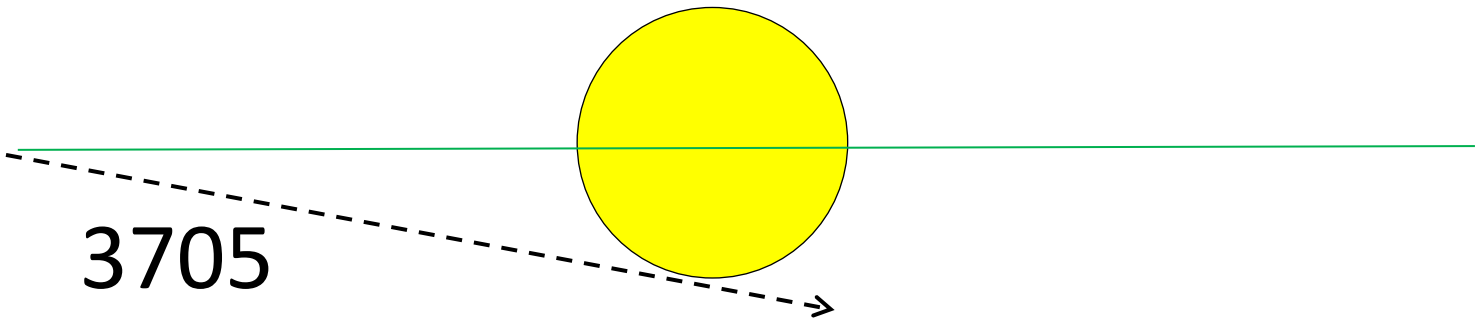
The shifting left continues …



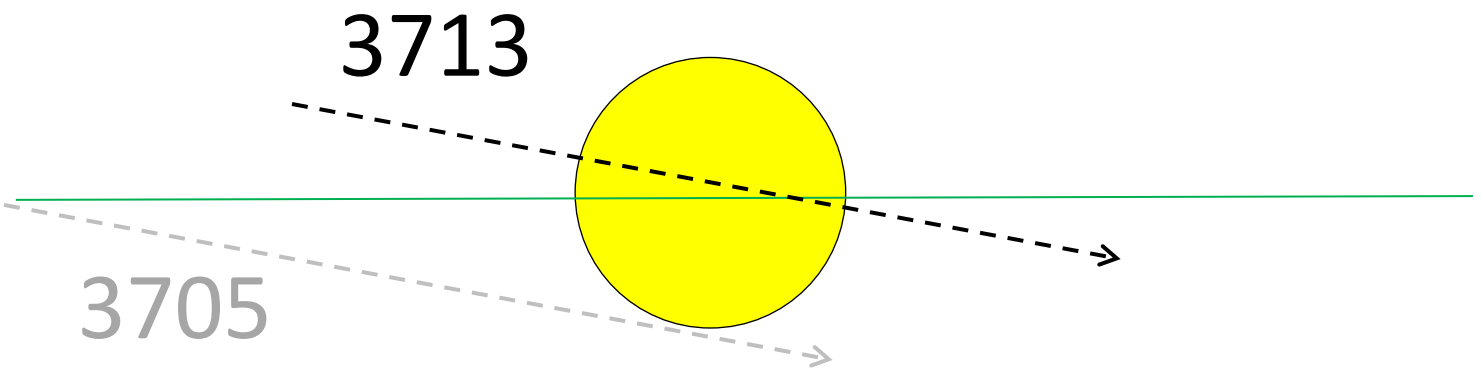
… until 3462
and its follower.



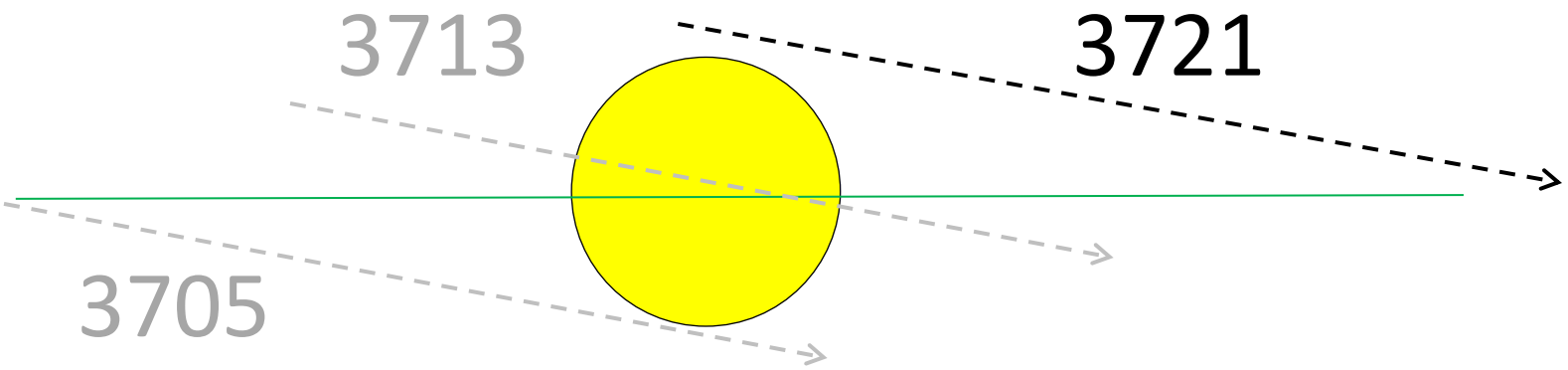
In 3705,
Venus barely misses left …



… so that the follower crosses near the middle of the green zone…

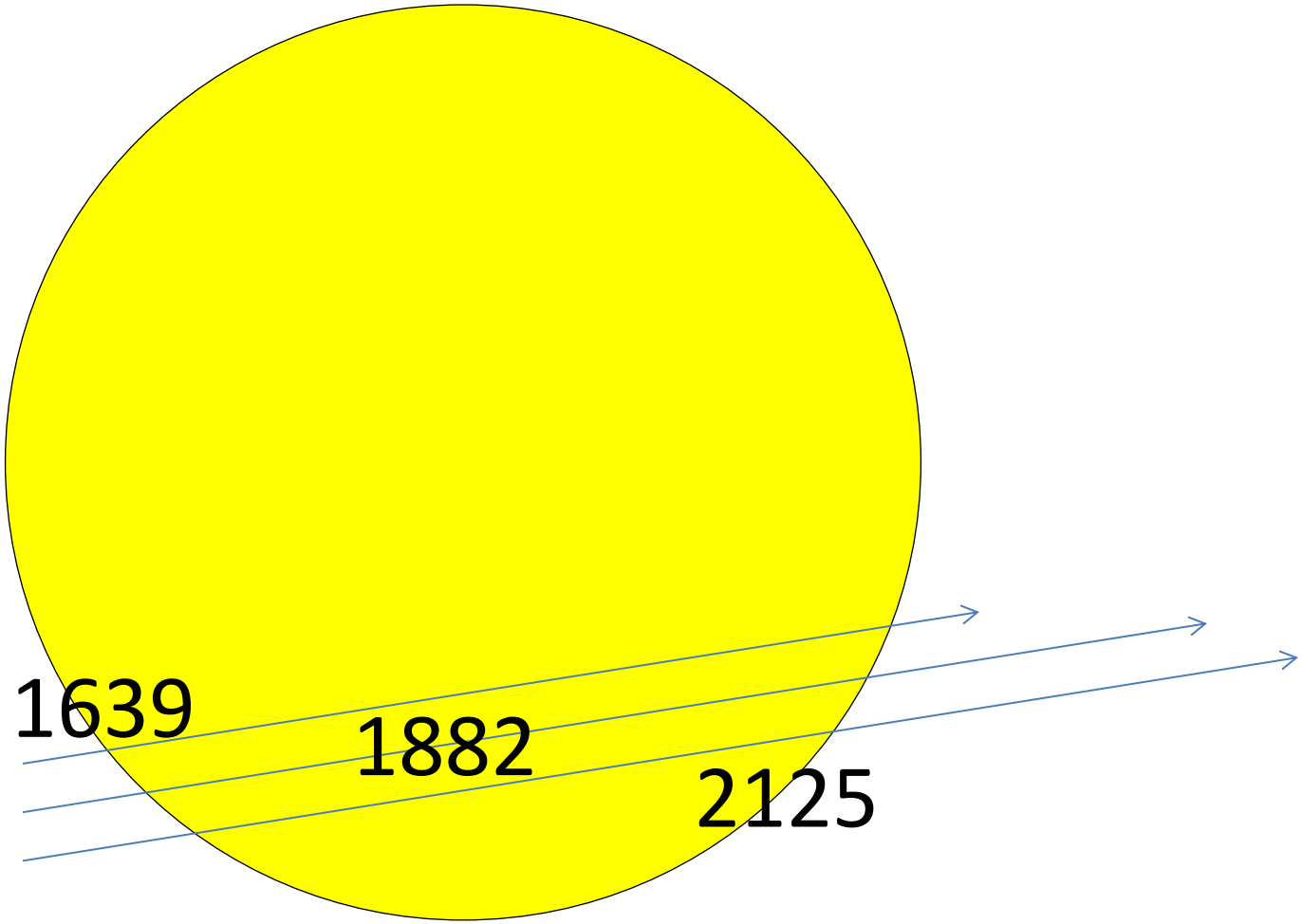


… and the next one misses right.

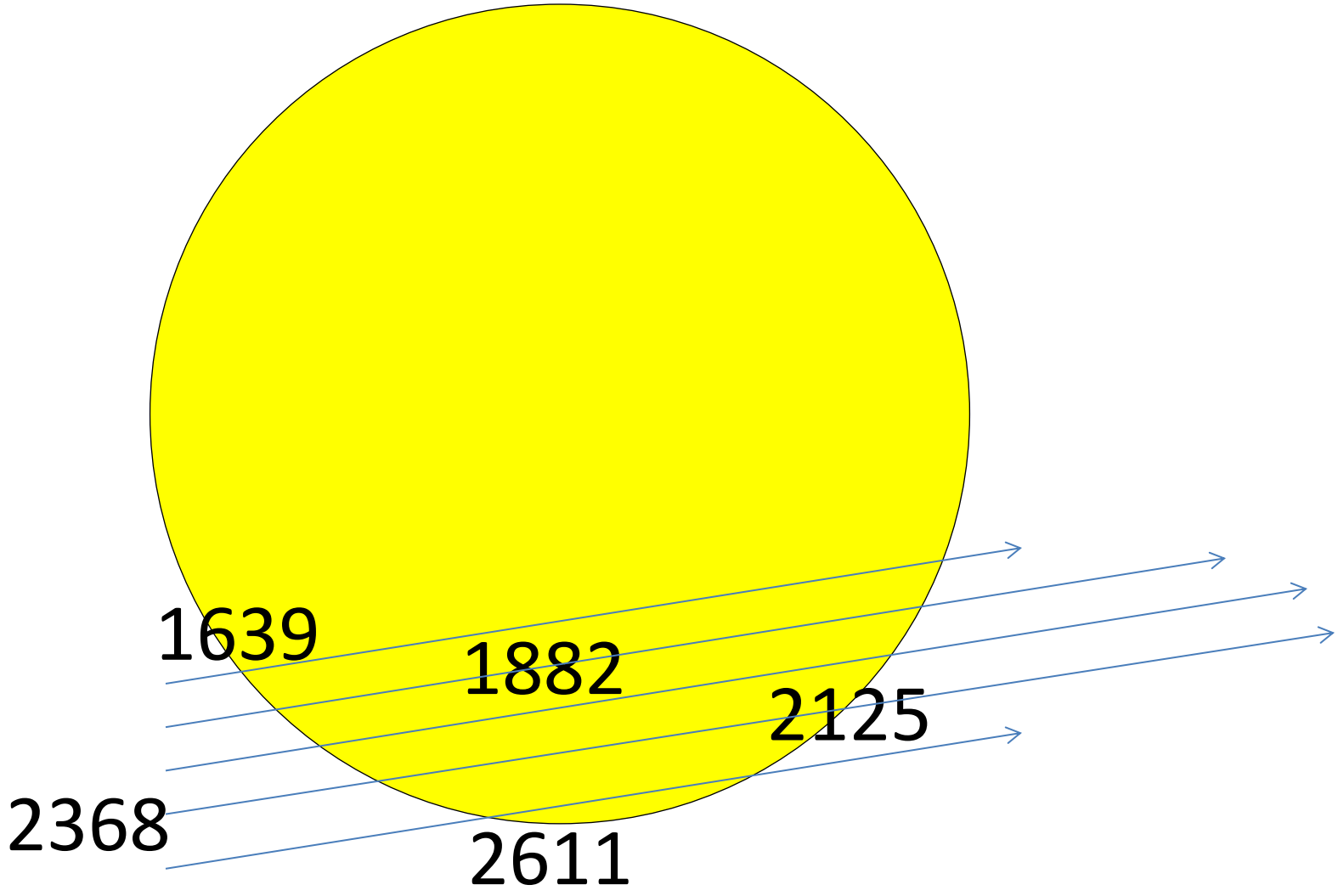


At the ascending node, they move right …

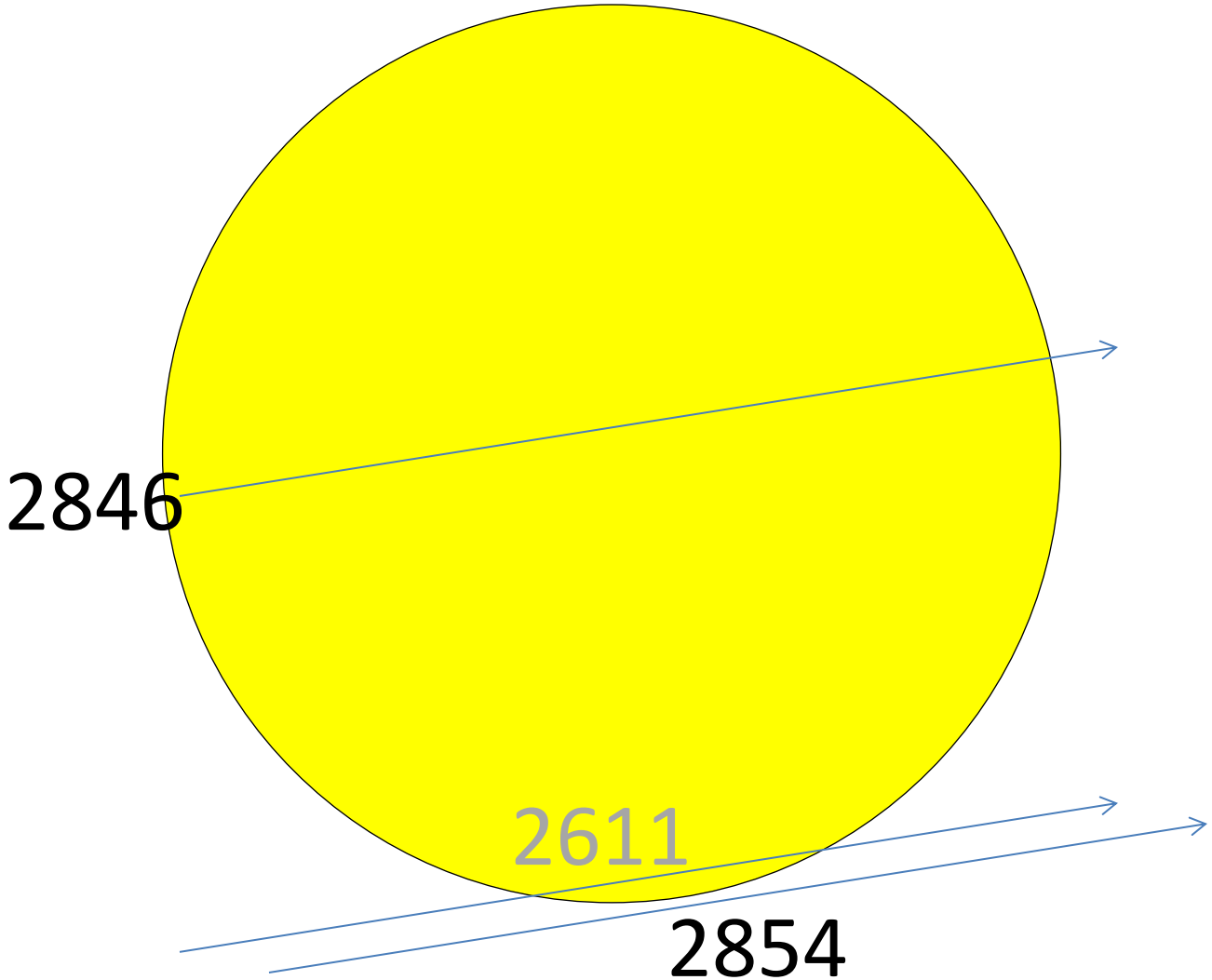
from NASA picture



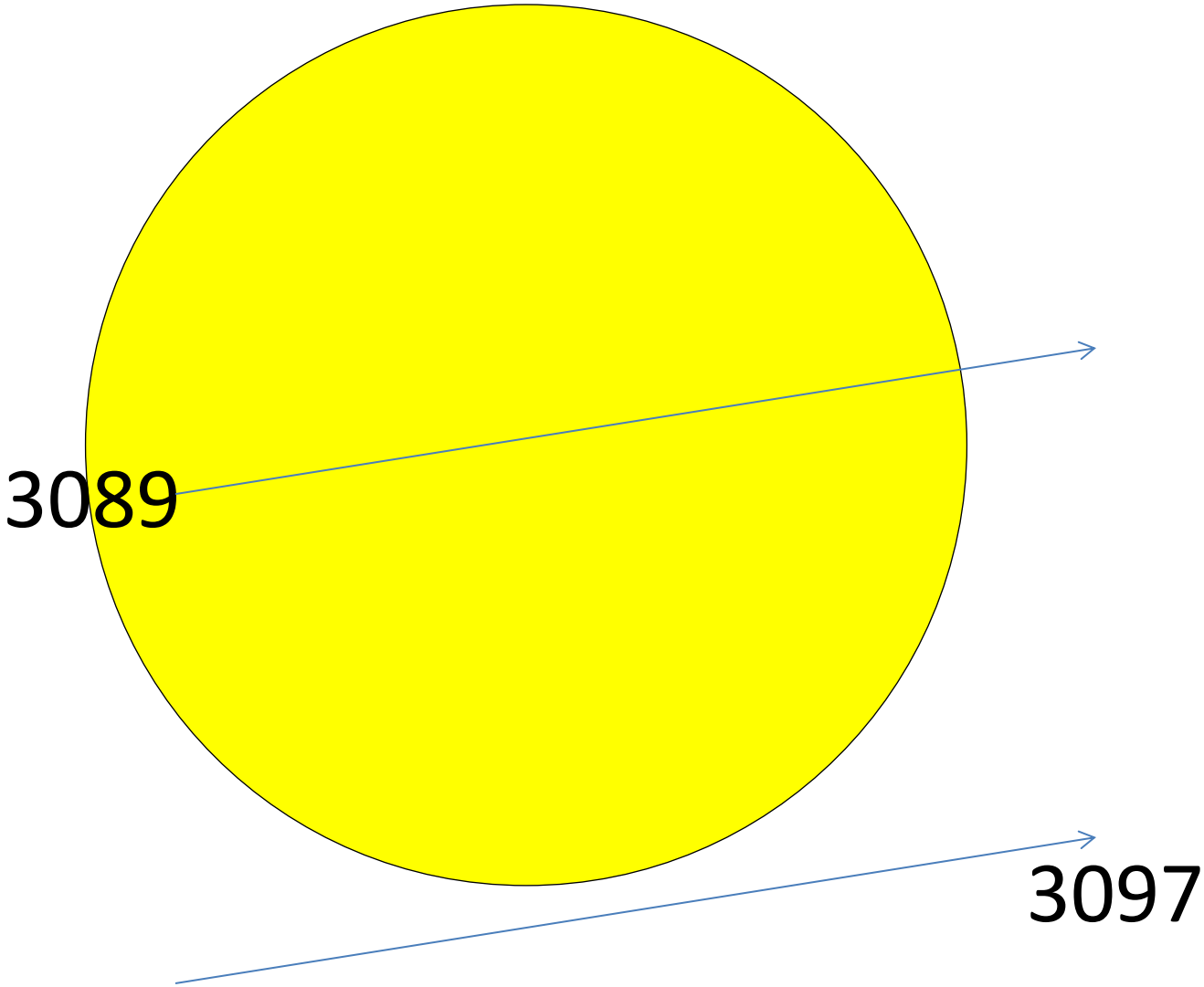
… faster than the descenders move left.



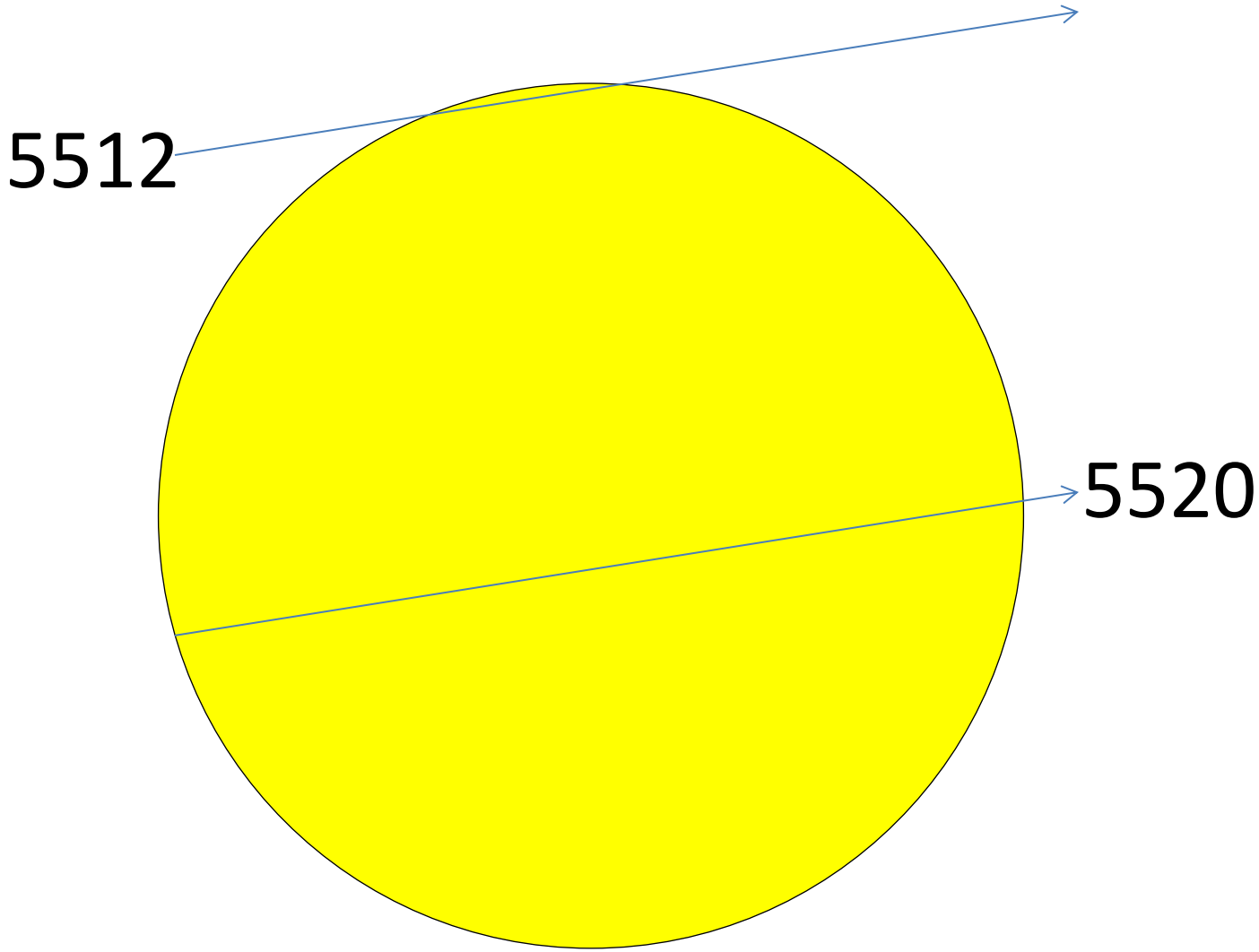
By 2854, the *followers* miss right.



After 2846, there are single ascending transits until …



… 5512

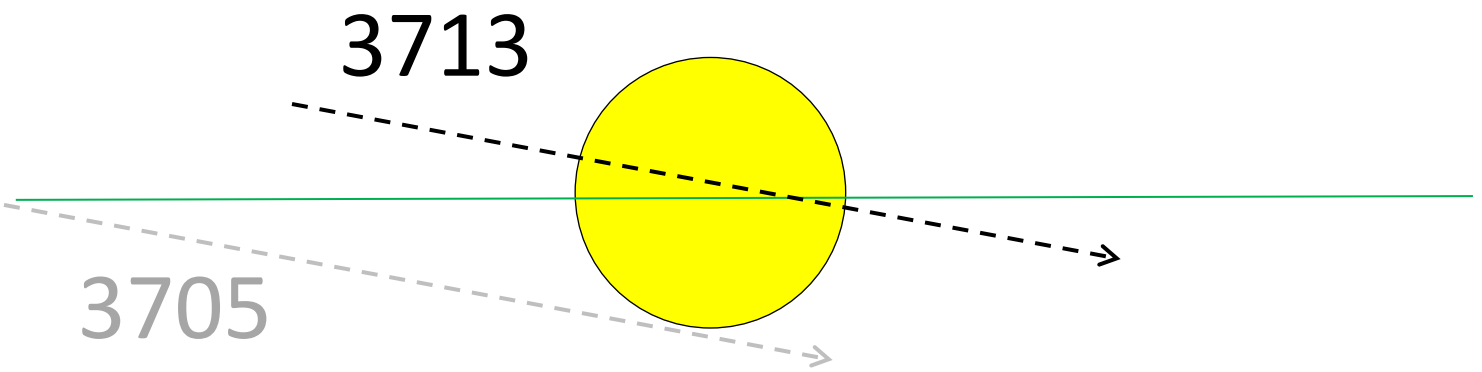


Transits of Venus from Earth

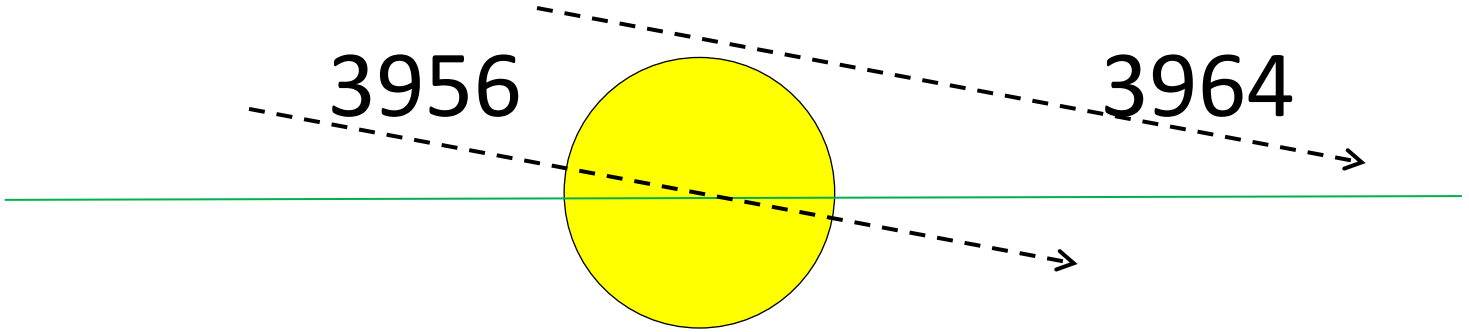
Fourmilab *Quarter Million Year Canon of Solar System Transits*. Please see that

```
2603-12-16 00:43 G
2611-12-13 13:55 G
2733-06-15 18:00 G
2741-06-13 10:48 G
2846-12-17 00:00 G
2976-06-16 20:52 G
2984-06-14 13:55 G
3089-12-18 22:48 G
3219-06-19 23:45 G
3227-06-17 16:48 G
3332-12-20 22:04 G
3462-06-22 02:38 G
3470-06-19 19:40 G
3575-12-23 21:07 G
3713-06-21 22:19 G
3818-12-25 20:24 G
3956-06-24 01:11 G
4061-12-26 19:40 G
4199-06-26 03:50 G
4304-12-29 19:11 G
4442-06-28 06:28 G
4547-12-31 18:43 G
4685-06-30 08:52 G
4791-01-02 18:14 G
4928-07-02 11:31 G
5034-01-04 18:00 G
5171-07-05 13:40 G
5277-01-05 17:45 G
5414-07-07 16:19 G
5512-01-12 03:35 G
5520-01-09 17:31 G
5657-07-08 18:14 G
```

After the 3713 transit …



… there are single descending transits until …



Transits of Venus from Earth

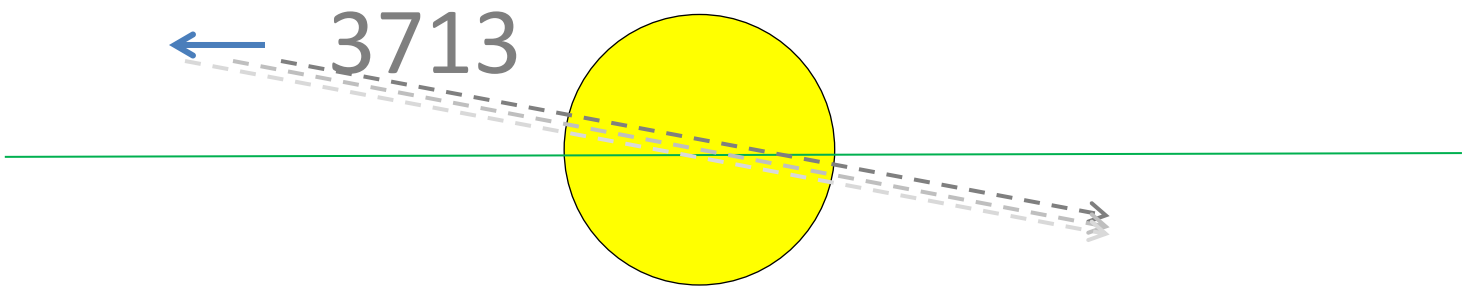
Fourmilab *Quarter Million Year Canon of Solar System Transits*. Please see that

```
3713-06-21 22:19 G
3818-12-25 20:24 G
3956-06-24 01:11 G
4061-12-26 19:40 G
4199-06-26 03:50 G
4304-12-29 19:11 G
4442-06-28 06:28 G
4547-12-31 18:43 G
4685-06-30 08:52 G
4791-01-02 18:14 G
4928-07-02 11:31 G
5034-01-04 18:00 G
5171-07-05 13:40 G
5277-01-05 17:45 G
5414-07-07 16:19 G
5512-01-12 03:35 G
5520-01-09 17:31 G
5657-07-08 18:14 G
5755-01-13 03:35 G
5763-01-10 17:31 G
5900-07-11 20:24 G
5998-01-15 03:21 G
6006-01-12 17:31 G
6143-07-13 22:33 G
6241-01-17 03:35 G
6249-01-14 17:45 G
6386-07-16 00:28 G
6484-01-19 03:35 G
6492-01-16 18:00 G
6629-07-18 02:24 G
6727-01-22 04:04 G
6735-01-19 18:28 G
6872-07-19 04:04 G
6970-01-23 04:19 G
6978-01-20 18:43 G
7115-07-23 05:45 G
7213-01-25 04:48 G
7221-01-22 19:11 G
7358-07-24 07:11 G
7456-01-28 05:16 G
7464-01-25 19:40 G
7601-07-26 08:38 G
7699-01-29 05:45 G
7844-07-28 10:04 G
7942-02-01 06:43 G
8087-07-30 11:16 G
8185-02-02 07:26 G
8330-08-02 12:57 G
8428-02-05 08:23 G
8573-08-03 13:40 G
8671-02-07 09:21 G
8816-08-05 14:52 G
8914-02-09 10:19 G
9059-08-08 15:36 G
9157-02-11 11:31 G
9302-08-10 16:33 G
9400-02-13 12:43 G
9545-08-12 17:02 G
9643-02-15 14:09 G
9780-08-16 02:38 G
9788-08-13 17:45 G
9886-02-17 15:36 G
10023-08-19 03:36 G
10031-08-16 18:28 G
10129-02-19 17:16 G
10266-08-21 04:04 G
```

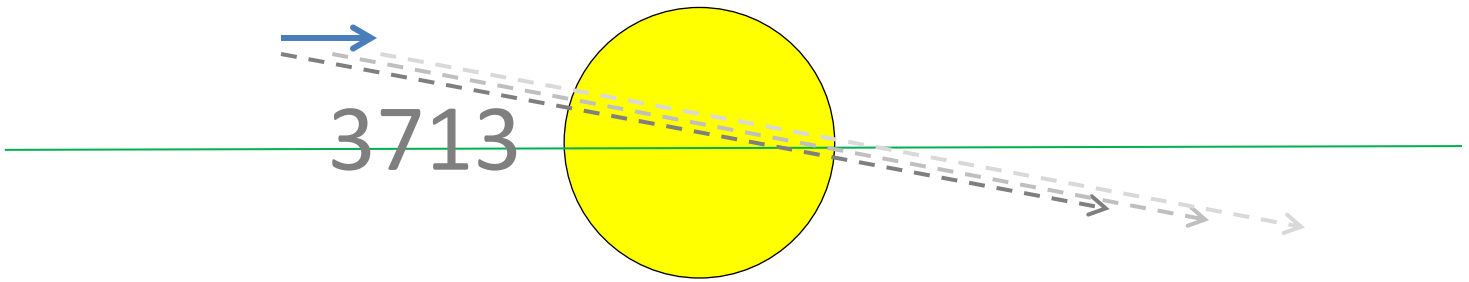
NASA Catalog

DATE	TIME	SERIES
-0920 May 23	16:00	1
-0912 May 21	9:11	3
-0791 Nov 22	0:43	4
-0783 Nov 19	13:58	2
-0669 May 22	14:03	3
-0548 Nov 22	0:54	4
-0540 Nov 19	13:53	2
-0426 May 22	18:41	3
-0305 Nov 23	0:30	4
-0183 May 22	23:04	3
-0062 Nov 23	0:16	4
0060 May 23	3:23	3
0181 Nov 22	23:39	4
0303 May 24	7:28	3
0424 Nov 22	23:05	4
0546 May 24	11:31	3
0554 May 22	4:51	5
2004 Jun 08	8:20	3
2012 Jun 06	1:29	5

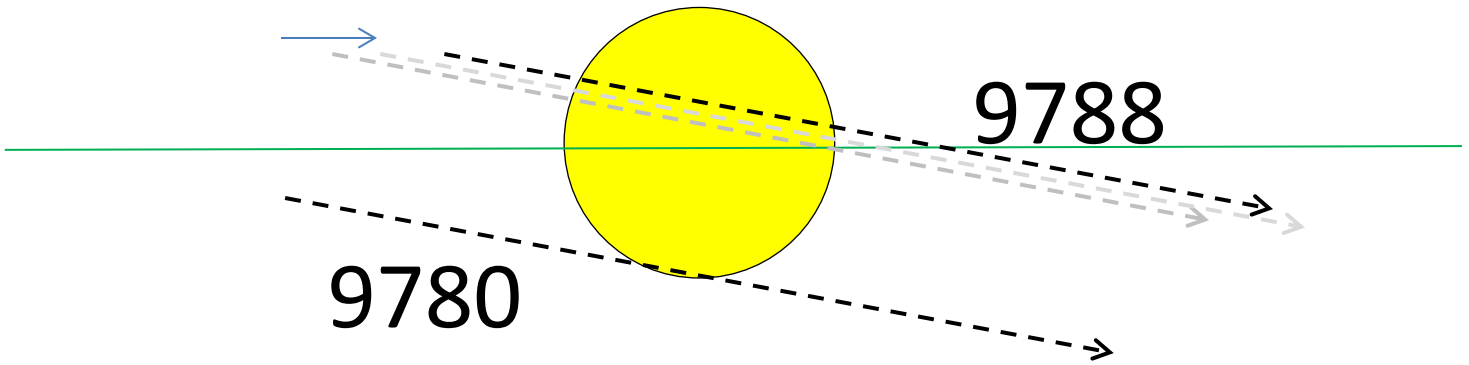
According to Fourmilab, the lone transits move slowly left …



… then right, as the ascending transits do now …



until our followers become followers *again*.



The gaps go from …

DATE	TIME	SERIES	DEPTH	
1631 Dec 07	3:51	6	0.2609	
1639 Dec 04	14:57	4	0.1454	] 121.5 yr
1761 Jun 06	2:02	3	0.1584	
1769 Jun 03	19:15	5	0.1693	] 105.5
1874 Dec 09	1:49	6	0.2305	
1882 Dec 06	13:57	4	0.1770	] 121.5
2004 Jun 08	5:13	3	0.1741	
2012 Jun 06	22:09	5	0.1540	] 105.5
2117 Dec 11	23:58	6	0.2010	
2125 Dec 08	13:15	4	0.2046	] 121.5
2247 Jun 11	8:42	3	0.1920	
2255 Jun 09	1:08	5	0.1366	

… to…

DATE	TIME	SERIES	DEPTH	
2603 Dec 16	0:13	6	0.1436	
2611 Dec 13	13:34	4	0.2597	] 121.5 yr
2733 Jun 15	17:18	3	0.2245	
2741 Jun 13	10:17	5	0.1071	] 105.5
2846 Dec 16	23:11	6	0.1200	] 129.5
2854 Dec 14	12:19	4	0.2852	
2976 Jun 16	19:44	3	0.2363	
2984 Jun 14	12:49	5	0.0934	] 105.5
3089 Dec 18	21:31	6	0.0891	] 129.5
3219 Jun 19	22:19	3	0.2523	
3227 Jun 17	15:13	5	0.0815	

… to…

DATE	TIME	SERIES	DEPTH	
3332 Dec 20	20:14	6	0.0654	] 129.5
3462 Jun 22	0:27	3	0.2634	
3470 Jun 19	17:26	5	0.0689	] 105.5
3575 Dec 23	18:32	6	0.0365	
3705 Jun 24	2:32	3	0.2748	] 137.5
3713 Jun 21	19:22	5	0.0598	] 105.5
3818 Dec 25	17:01	6	0.0114	] 137.5
3956 Jun 23	21:21	5	0.0487	

… to variable.

Fourmilab *Quarter Million Year Canon of Solar System Transits*. Please see that

97.5 [
6006-01-12 17:31 G
6143-07-13 22:33 G
6241-01-17 03:35 G
6249-01-14 17:45 G
6386-07-16 00:28 G
] 137.5
6484-01-19 03:35 G
6492-01-16 18:00 G
6629-07-18 02:24 G
6727-01-22 04:04 G
6735-01-19 18:28 G
6872-07-19 04:04 G
6970-01-23 04:19 G
6978-01-20 18:43 G
7115-07-23 05:45 G
7213-01-25 04:48 G
7221-01-22 19:11 G
7358-07-24 07:11 G
7456-01-28 05:16 G
7464-01-25 19:40 G
97.5 [
7601-07-26 08:38 G
7699-01-29 05:45 G
7844-07-28 10:04 G
] 145.5
7942-02-01 06:43 G
8087-07-30 11:16 G
8185-02-02 07:26 G
8330-08-02 12:57 G
8428-02-05 08:23 G
8573-08-03 13:40 G
8671-02-07 09:21 G
8816-08-05 14:52 G
8914-02-09 10:19 G
9059-08-08 15:36 G
9157-02-11 11:31 G
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9545-08-12 17:02 G
9643-02-15 14:09 G
9780-08-16 02:38 G
9788-08-13 17:45 G
9886-02-17 15:36 G
10023-08-19 03:36 G
10031-08-16 18:28 G
10129-02-19 17:16 G
10266-08-21 04:04 G

with thanks to:

NASA
(http://eclipse.gsfc.nasa.gov/transit/catalog/VenusCatalog.html)

Fourmilab
(https://www.fourmilab.ch/documents/canon_transits/tr_Venus_from_Earth.html.gz)

Sky and Telescope
(https://www.skyandtelescope.com)