# PLANETARY GROUPINGS

I have been unsatisfied with the way my almanac program has handled these events. The text description previously given in the almanac has been totally unsatisfactory and I think I have come up with a better way of presenting these events.

Planetary groupings are not well defined so I have set up some rules to define such events. I take the "planets" to be Mercury, Venus, Mars, Jupiter, Saturn, Uranus, Neptune, and the Moon. I define a group to be a gathering of two or more of these objects within a certain size circle on the sky. The size of the allowable circle depends on the number of objects in the group. A group is reported if, for some period of time,its members come closer than the maximum enclosing circle diameter. They might come much closer at some point.

| Number of objects | Maximum Enclosing circle diameter (deg) |
|---|---|
| 8 | 20 |
| 7 | 20 |
| 6 | 20 |
| 5 | 15 |
| 4 | 15 |
| 3 | 5 |
| 2 | 3 |

Note that for two objects, the enclosing circle is just the arc distance between the two objects. Also, the chosen enclosing circle size is an arbitrary value chosen by me.

I note that it is most unusual to get large groups because of the infrequency of conjunctions of the outer planets. Jupiter/Saturn conjunctions only occur about every 20 years. There was one in 2020 and there will be conjunctions in 2040 and 2060. Conjunctions of Uranus and Neptune occur every ~171 years and the next will be in about 2164. Simultaneous conjunctions of all four of the outer planets are even more rare. The tightest grouping of all four of these objects in the next 250 years will occur in February 2163when they will be contained in a circle with a diameter of 60 degrees. As a result, there are no groups of 7 or 8 objects from now to 2200 that meet the above enclosing circle constraints (and likely well beyond that date).

Then there is the question of visibility. Groups can be seen by eye at night if the group members are bright. They can be seen at night by telescopes at Lowell if the enclosing circle is small enough. The TEC 550 has the largest FOV of any public telescope and it only shows 3 degrees. Some groups with bright members can be seen telescopically in the daytime, but again,only if they are all within 3 degrees of each other.

Clearly, wide groups containing Uranus or Neptune cannot be seen by eye at night since these two objects are too faint. Are there instances where such groups get close enough that they could be seen at night by the TEC 550? I have looked from now to the end of 2200 (175 years into the future) and find that:

1) As mentioned above, there will be no groups containing 7 or 8 planets during this time period.
2) There is only one group with six planets in this time period and it has a minimum enclosing circle of 9.5 degrees which is too big to be viewed telescopically.

3) There are 32 groups of five planets in this time period. The tightest has a minimum enclosing circle of 6.3 degrees. Again, too big to be viewed telescopically
4) There are 384 groups of four planets in this time period. Of these only five have a minimum enclosing circle of less than three degrees, making these groups accessible to the TEC.

In addition to forming groups with each other, the 8 "planets" can also form groups with bright stars. It turns out that the only bright stars that can come close to the "planets" are Aldebaran, Pollux, Regulus, Spica, and Antares. So, I also look for groups with one planet and one of these stars (within 3 degrees, just as for two planets) and also for two planets and one of these stars (within 5 degrees, just as for three planets).

The other constraints on visibility of a group is whether the group can be seen (telescopically) in the daytime and when the group is above the horizon. For this purpose, I have (again arbitrarily) defined "night" as the time when the Sun is below -8 degrees altitude and "day" when it is above. Also, a group is considered to be "up" when all of its members are above +5 degrees altitude and "down" when any member of the group is below that altitude. I realize that objects this low cannot be seen at the GODO due to trees, but they can be seen from the roof of the ADC. I also note that these altitudes are arbitrary and may not precisely apply to all groups. A group with brighter objects might be visible when the sun is an -7 degrees rather than -8 and I might miss some marginal cases. Similarly, I may be including some groups that are not really visible until the Sun is lower. There simply is no simple solution which works for all marginal cases.

For groups containing only two or three objects there is a good chance that they can get close enough to be visible in telescopes other that the wide-field TEC. The MallinCam has a 0.6 degree field, the Clark has an 0.2 degree field and the Dyer also has a 0.6 deg field. The plots of the events (discussed below) show the separations as a function of time.

Each group found is assigned a "case" number:

Case 1: Groups of only two objects one of which is Uranus or Neptune. Groups of two objects are only shown when their separations are 3 degrees or less. Thus, these groups can *only* be seen at night by the TEC or possibly other telescopes if the separation gets small enough.

Case 2: Groups of only two objects neither of which are Uranus nor Neptune. These groups are visible at night by eye and, since two objects are only reported while the two objects are closer than 3 degrees, also in the TEC, and possibly in other telescopes if the separation gets small enough. If the objects are bright enough, they might also be visible by telescopes in the daytime.

Case 3: Groups of three or more objects one of which is Uranus or Neptune.. These groups can not be seen at night by eye and require the TEC when the enclosing circle is less than 3 degrees. Should the enclosing circle become even smaller such groups could become visible in other telescopes. If the enclosing circle never becomes smaller than 3 degrees, this group is rejected and not reported since it cannot be seen either by telescope or by eye.

Case 4: Groups of three or more objects which do not contain Uranus or Neptune. A group of this type is put in this case if they have enclosing circles which never get less than 3 degrees. Thus, they are not visible telescopically and can only be seen by eye at night.

Case 5: Groups of three or more objects which do not contain Uranus or Neptune. These groups are

visible at night by eye, or in the TEC at night when the enclosing circle is less than 3 degrees, and possibly in other telescopes if the circle gets small enough. The plots for this case will indicate when the enclosing circle is less than 3 degrees. If the objects are bright enough, they might also be visible by telescopes in the daytime.

Various things to be aware of. Because the Moon moves rapidly (about 12 deg per day), any group involving the Moon is going to be short lived – usually less than a day before the Moon moves far enough away. Groups involving planets (or planets and stars) are longer lived –usually days. And groups involving the outer planets can last for months – a group containing Saturn and Neptune in 2025 will last for almost 150 days while both planets are within 3 degrees of each other (see the examples, following). Another involving Uranus and Neptune in 2165 will last about 340 days (again, with both within 3 degrees of each other. That one is the longest in the next 175 years, but there will be 19 in the next 175 years lasting more than a month, All of them involve two of Saturn, Uranus, and Neptune. Lastly, I ignore planets and stars when they are within 15 degrees of the Sun. So a group may effectively form or end earlier if any one of its members starts or ends too close to the Sun.

Every event is associated with a plot output file. The files are each named YYYY-MM-DD—D_D_D_D where YYYY-MM-DD is the date at the time of minimum separation of the group and the D's are the planet identifiers. So, for example 2-5-10 is a group of Venus, Jupiter and the Moon while 1_4_6_8 would be Mercury, Mars, Saturn, and Neptune. The planets are always given in increasing distance from the Sun and the Moon (if present) is always last. For stars, there can be one or two planets followed by the star name. For example, 10_Regulus or 4_5_Antares. All files are pdf files.

When I run the program, I provide a year,month and the almanac program generates its standard output for year,month; year,month+1, and year, month+2. Because some planetary groupings can be very long, I calculate groupings starting for one full year centered on the middle of month+1. I then cull out any events for which the last day that the group is visible precedes the first day of year,month and those for which the first day that the group is visible follows the last day of year,month+2.

As an example, I will shortly run the almanac program for 2024,12. It will create files for events dated 2024-12, 2025-01, and 2025-02. This will give several months to plan for interesting events. Next time I run it (at the beginning of January), the program will delete the existing files and create files for events dated 2025-01, 2025-02 and 2025-03. Note that two of the months I had before are repeated and a new one is added. This way older events roll off and new events appear two months before the events occur. These files are all stored in the ftp area in /ftp/pub/lhw/group_plots/86001/ and are available for anyone to grab and print. Checking the new events that appear each month should not require a huge amount of time. While the number of events in a given month varies, it appear that there will be about 5-10 events to check with each update.

One might ask why the plots are stored in a directory which is keyed to the local zip code? This is because I can run off these plots for *any* zip code. I have a cross reference which gives me the location of the zip code (latitude/longitude) and whether or not a given zip goes on daylight time. So I can calculate circumstances for that zip code and present the results in local time even allowing for daylight time in the summer. If I run this specifically for Joe Sixpack in Fargo, ND (zip 58017, I can put the files in /ftp/pub/lhw/group_plots/58017 and he can download them over the internet.

Now we can look at some examples.

Example 1.

I note that this explanation will be longer than the others as I need to explain things that will be common to all the files. Each event file consists of two pages. The first page gives the date of the minimum approach for the group and the members of the group at the top. In this case the members are Venus and the Moon. The next three lines describe the bars at the top of the plot. The first is the SRS (Sun Rise, Set) Bar. It is white where the Sun is up (above -8 degrees altitude -- day) and black where it is down (below -8 degrees altitude – night). The second is the TGV (Total Group Visibility) Bar. It is white where the entire group is up (all objects above +5 degrees altitude) and black where at least one member of the group is down (below +5 degrees altitude). The third is the NGV (Nighttime Group Visibility) Bar. It is white only where the entire group is up (TGV white) AND the Sun is down (SRS black); and otherwise black.

As to the plot. The X axis is the local calendar date and time (MST for Lowell). The left Y axis is different for different combinations. For single objects and the Moon, the distance is the distance from the object to the limb of the Moon (see Examples 1, 2, and 3); for two objects neither of which is the Moon, the distance is the separation between the two objects (see Examples 4 and 5). For more than two objects, the distance is the smallest enclosing circle for the entire group (see Example 6, 7 and 8), For two objects, one of which is the Moon, the distance from the object to limb can go negative, in which case we have an occultation by the Moon (see Examples 2 and 3). The right Y axis is the altitude of the group (calculated as the average altitude of all the group members). For groups that are only available at night, the altitude is plotted only within the NGV white windows (Cases 1, 3, 4 as defined above). For Cases 2 and 5, which can be visible both night and day, the altitude is plotted within the TGV white windows. This particular group is Case 2 (see the top line of the 2nd page of this example). Be careful reading the plot axes because all of the axis limits (X and both Y axes) is adjusted to the particular group. There are two lines on the plot. The line which corresponds to the left Y axis is the separation as a function of time. The one that corresponds to the right Y axis is the altitude of the group and in this case is plotted in the (only) TGV window. Looking at this particular event, we see that Venus comes within about 2.4 degrees of the limb of the Moon which is near full (see the 2nd page). As expected for events involving the Moon, the entire event is short, lasting from about 5:00PM till about 7:45PM when the group sets below 5 degrees altitude

The second page indicates that this is a Case 2 event. The text below that mirrors the description of Case 2 in the text, above. I also list the actual times that the windows span. In this case, since it can be seen day and night, I give the times for both the TGV and the NGV windows. I also give the V magnitude of the objects in the group. For the Moon, I draw a picture rather than giving a magnitude.

Example 2.

This is another Case 2 example but with Saturn and the Moon. In this case the distance between the Moon limb and the object goes negative and there will be an occultation. However, the occultation occurs when both the TGV and NGV windows are black. I also give the specifics for the occultation: Time of Immersion, Time of Emersion and the altitude of the Moon and Sun at the time of Immersion and Emersion. For both events, the altitude of the Moon is negative. Page 2 for this one is similar to that of Example 1 but the duration of the windows are (as evident from the plot) very short. The only time this group is visible is the very short window at the extreme left of the plot which contains the very short altitude curve. I also point out that the altitude scale on this plot is very different from the scale for Example 1. But I also note that while this event is not optimal as a public event at the

GODO, it would be a very pretty event through binoculars or with a telephoto camera at a location with a clear western horizon.

Example 3

A third Case 2 example with a planet and the Moon. This one involves Mars and the Moon and another occultation. However, this one is more promising. Both Immersion and Emersion occur when the Sun is down and the Moon is up. The only problem here is that Immerson occurs when the moon is only 14 degrees up and might not clear the trees at the GODO. Also, from Page 2, the Moon is full and thus very bright.

An occultation has to be observed with the MallinCam. The actual events are so quick that it makes no sense to be looking through a telescope where only one person can see it at the instant it occurs. In order to observe an occultation with the MallinCam, you would point the PlaneWave at the object to be occulted (Mars in this case) and wait for the Moon to sweep over it. For the reappearance (which can be a hour or so later) one would again point the PlaneWave at the object (which is now behind the Moon) and wait for it to be revealed.

Example 4.

This is a two planet Case 2 event – Venus and Saturn. Again, visible day and night so the altitude curves are plotted for the TGV windows. This event doesn't involve the Moon and is much longer (5 days) than an event involving the Moon. If one were looking at this in terms of the public and the GODO, I would look at the TGV and NGV window times on Page 2, the altitude curve on the first page, and the fact that the objects are always closer than 3 deg making them always visible in the TEC. Sunset is around 6:15PM (the start time of the NGV windows on Page 2) which is a time when the group is still fairly high in the sky. The group doesn't set until about 9:00PM (the end time for the TGV and NGV windows).

Example 5.

This is a Case 1 event involving Saturn and Neptune. It is only visible at night, but it extends over five months (!). For an event this long, the visibility bars are not very useful as the black windows start to blend with the white due to the resolution of plot and the NGV windows can not be discerned. There are so many NGV windows that I only plot every 11$^{th}$ window's altitude curve (this is indicated at the top of Page 1) and I limit the number of window start/end times on the second page by only listing every fifth day.

Example 6.

This is a Case 5 event involving Mercury, Mars, and Saturn. Nominally this would be visible at night by eye and also by telescope if the enclosing circle is small enough. However, there are no night windows at all. Thus, effectively, it is only visible in the daytime when the separation is small enough. The enclosing circle does get smaller than 3 deg so it will be visible in the TEC but the circle never gets smaller than about 1.8 deg, so no other telescope will work for this event. Page 2 shows the group is available from about 5:30AM till 4:30PM and the altitude plot shows it reaches a maximum altitude of over 50 degrees. The group is tighter than 3 degrees for about 4 days. Could this group actually be seen in the TEC in the afternoon during that time? Are the three objects bright enough (especially Mercury)? I don't know but it would be worth a try.

Example 7.

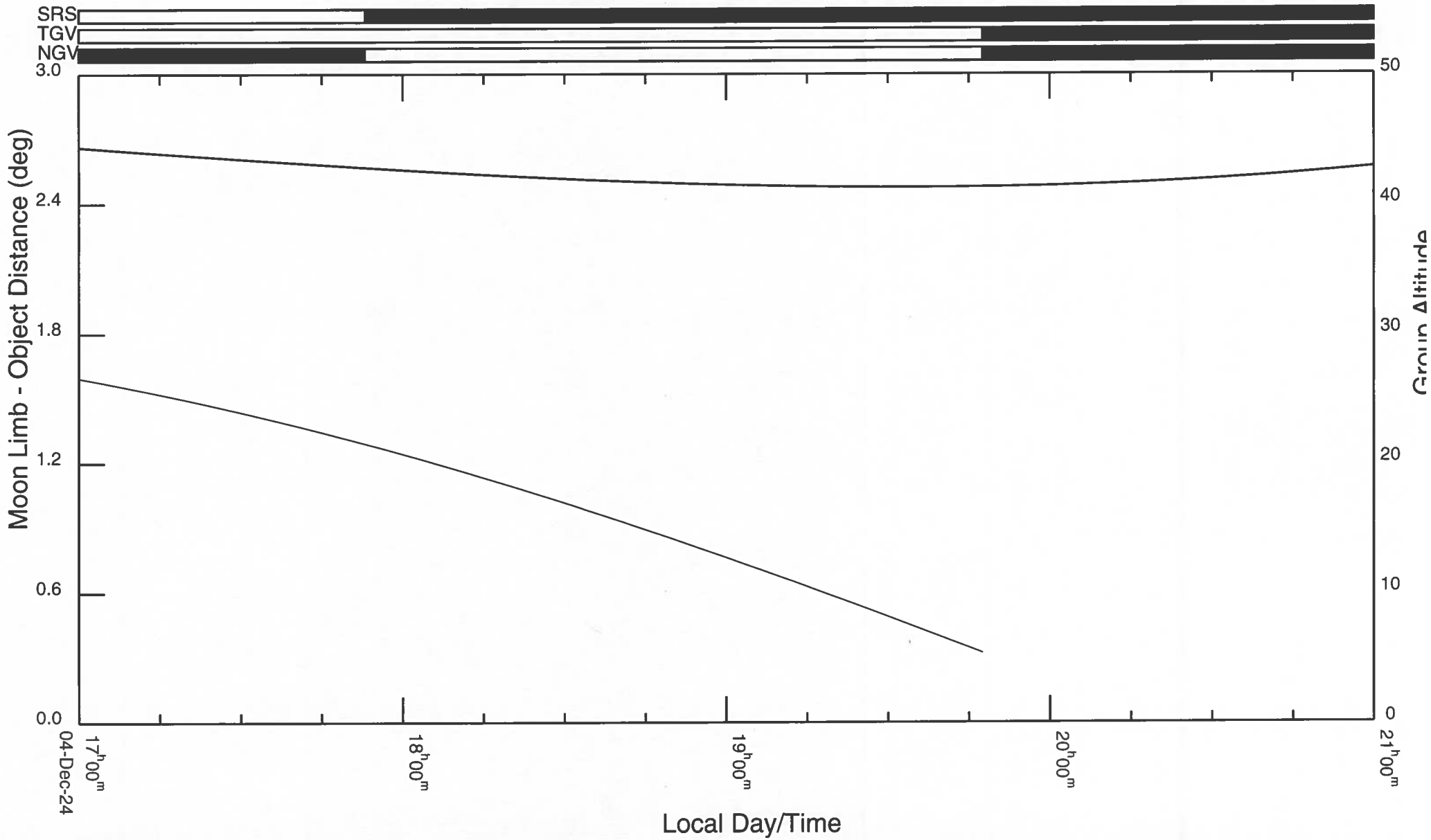
This is a Case 4 event involving four planets – Mercury, Venus, Jupiter and the Moon. It's wide enough so that it is only visible by eye at night. And the visibility window is very short, just before the group sets around 8:30PM. The enclosing circle is almost 15 degrees and it's not very high in the sky so it might not be available at the GODO but it might be visible from the roof of the ADC.

Example 8

This is a Case 3 event involving Saturn, Neptune and the Moon. Since it includes Neptune it can only be seen at night and then only when the group is tight enough that a telescope can be used. Unfortunately, there is only one short night time window available and in that window the enclosing circle is over 4 degrees. So, this group is effectively unobservable.

Ex 1

2024-12-04 Venus/Moon
SRS bar: Sun rise/set through -8 deg altitude. White is daytime. Black is night.
TGV bar: Group rise/set through +5 deg altitude. White is group up (visible --day or night). Black is group down (never visible).
NGV bar: Night group visiblity. White shows group up at night. Otherwise black.
Altitude curves (RH Y axis) are plotted for TGV windows.
More information about visibilty on Page 2.



2024-12-04 Venus/Moon [Case 2]

This group of two objects is visible at night by eye, or by the 5.5 TEC, and possibly by other telescopes if the separation is small enough.
It may also be visible in the daytime by telescope if the group members are bright enough.
V mags are given below.

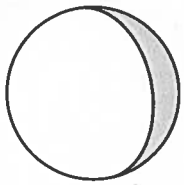
The NGV bar white windows show the times the group is up at night.
The TGV bar white windows show the times the group is up day and night.

Windows when this group is visible
(If more than 35, some will be skipped)

| Only at night (NGV) | Day and night (TGV) |
|---|---|
| 04-Dec-24 17:52 to 04-Dec-24 19:47 | 04-Dec-24 17:00 to 04-Dec-24 19:47 |

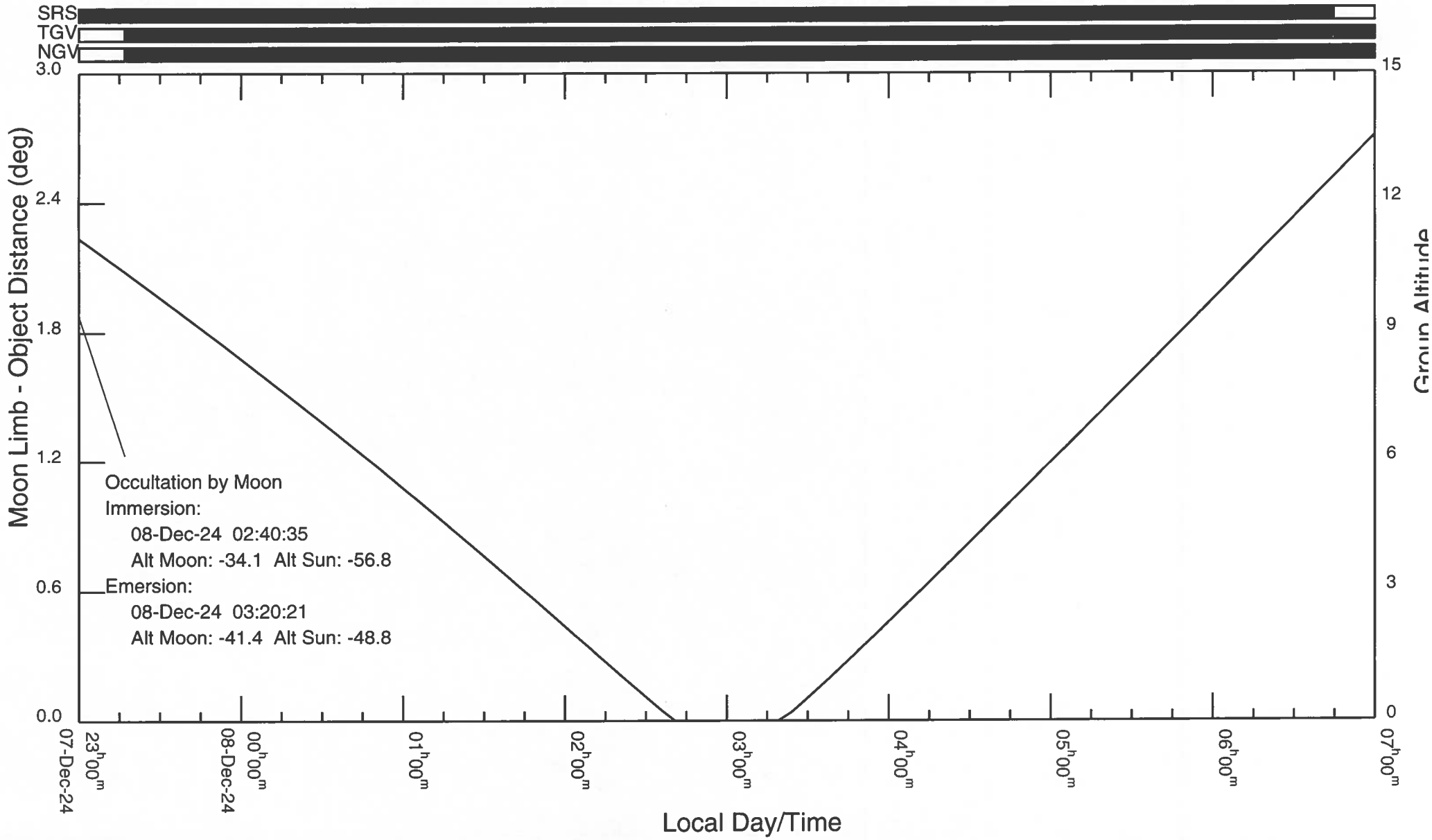
V Mags at minimum separation time

Venus -4.20
Moon -- see diagram



Ex. 2

2024-12-08 Saturn/Moon
SRS bar: Sun rise/set through -8 deg altitude. White is daytime. Black is night.
TGV bar: Group rise/set through +5 deg altitude. White is group up (visible --day or night). Black is group down (never visible).
NGV bar: Night group visiblity. White shows group up at night. Otherwise black.
Altitude curves (RH Y axis) are plotted for TGV windows.
More information about visibilty on Page 2.



2024-12-08 Saturn/Moon [Case 2]

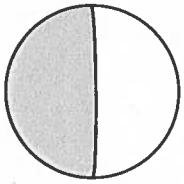
This group of two objects is visible at night by eye, or by the 5.5 TEC, and possibly by other telescopes if the separation is small enough.
It may also be visible in the daytime by telescope if the group members are bright enough.
V mags are given below.

The NGV bar white windows show the times the group is up at night.
The TGV bar white windows show the times the group is up day and night.

Windows when this group is visible
(If more than 35, some will be skipped)

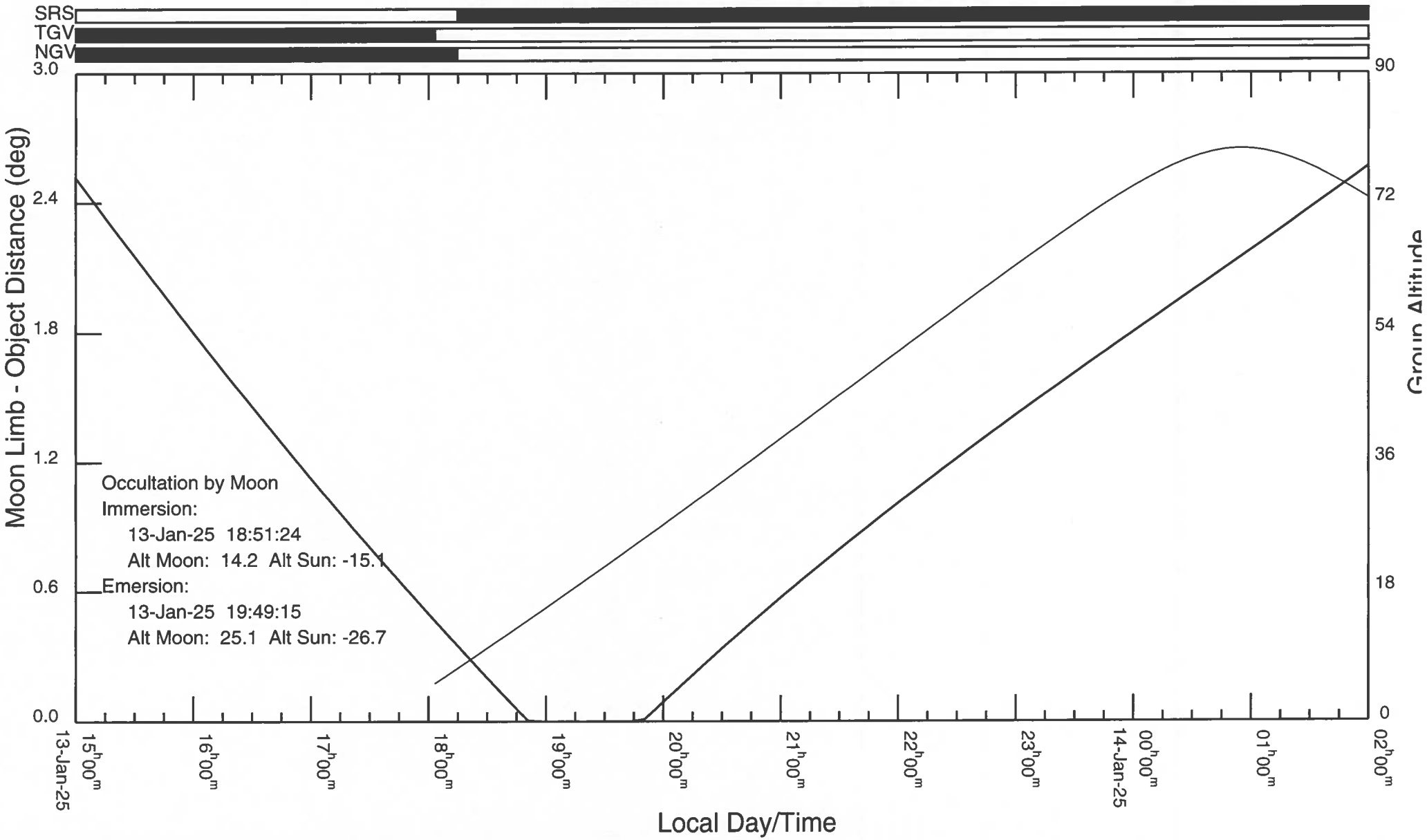
| Only at night (NGV) | Day and night (TGV) |
|---|---|
| 07-Dec-24 23:00 to 07-Dec-24 23:16 | 07-Dec-24 23:00 to 07-Dec-24 23:16 |

V Mags at minimum separation time
Saturn 0.97
Moon -- see diagram



Ex 3

2025-01-13 Mars/Moon
SRS bar: Sun rise/set through -8 deg altitude. White is daytime. Black is night.
TGV bar: Group rise/set through +5 deg altitude. White is group up (visible --day or night). Black is group down (never visible).
NGV bar: Night group visiblity. White shows group up at night. Otherwise black.
Altitude curves (RH Y axis) are plotted for TGV windows.
More information about visibilty on Page 2.



2025-01-13 Mars/Moon [Case 2]

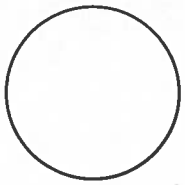
This group of two objects is visible at night by eye, or by the 5.5 TEC, and possibly by other telescopes if the separation is small enough.
It may also be visible in the daytime by telescope if the group members are bright enough.
V mags are given below.

The NGV bar white windows show the times the group is up at night.
The TGV bar white windows show the times the group is up day and night.

Windows when this group is visible
(If more than 35, some will be skipped)

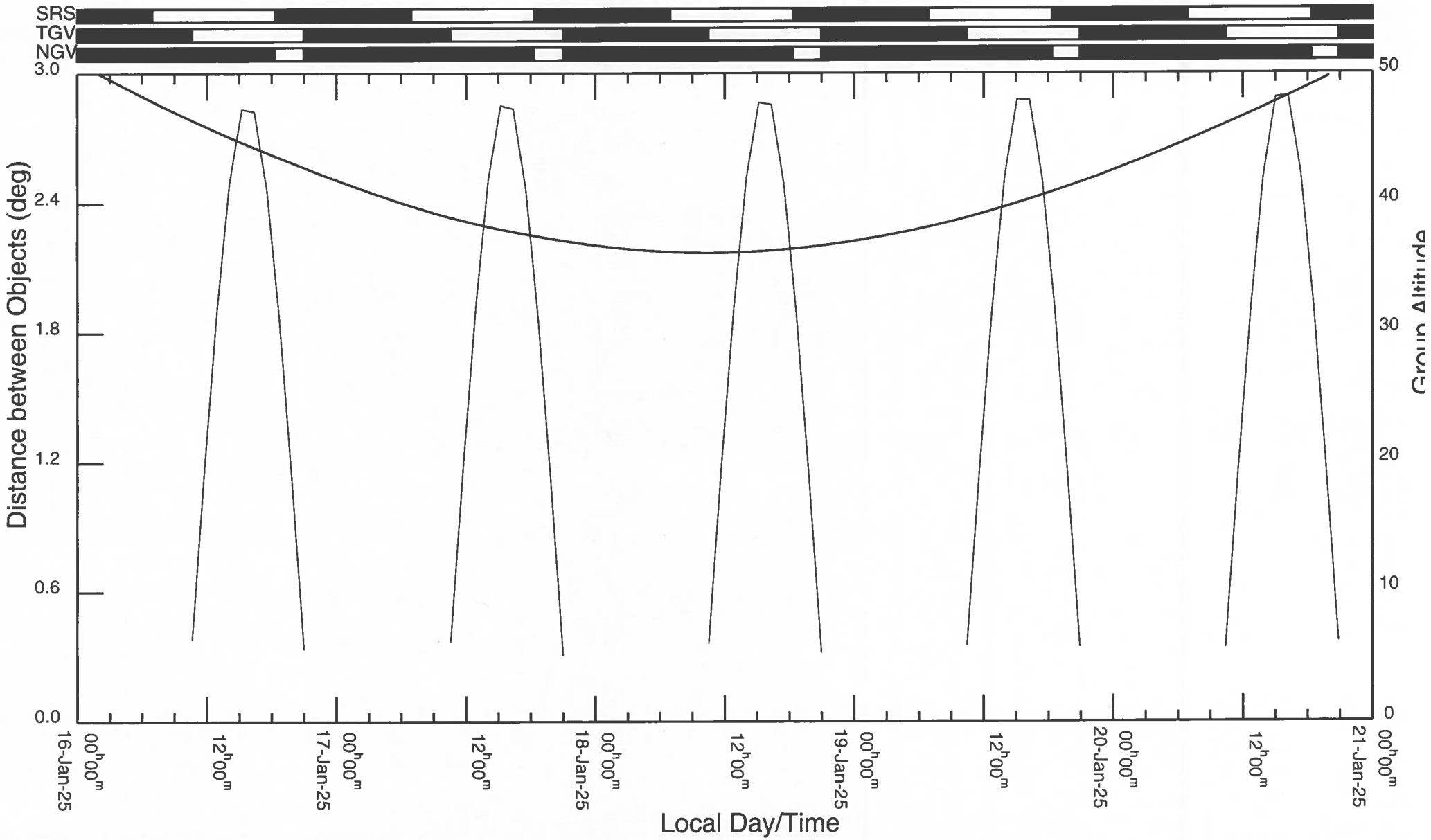
| Only at night (NGV) | Day and night (TGV) |
|---|---|
| 13-Jan-25 18:14 to 14-Jan-25 02:00 | 13-Jan-25 18:03 to 14-Jan-25 02:00 |

V Mags at minimum separation time
Mars -1.41
Moon -- see diagram



Ex 4

2025-01-18 Venus/Saturn
SRS bar: Sun rise/set through -8 deg altitude. White is daytime. Black is night.
TGV bar: Group rise/set through +5 deg altitude. White is group up (visible --day or night). Black is group down (never visible).
NGV bar: Night group visiblity. White shows group up at night. Otherwise black.
Altitude curves (RH Y axis) are plotted for TGV windows.
More information about visibilty on Page 2.



2025-01-18 Venus/Saturn [Case 2]

This group of two objects is visible at night by eye, or by the 5.5 TEC, and possibly by other telescopes if the separation is small enough.
It may also be visible in the daytime by telescope if the group members are bright enough.
V mags are given below.

The NGV bar white windows show the times the group is up at night.
The TGV bar white windows show the times the group is up day and night.

Windows when this group is visible
(If more than 35, some will be skipped)

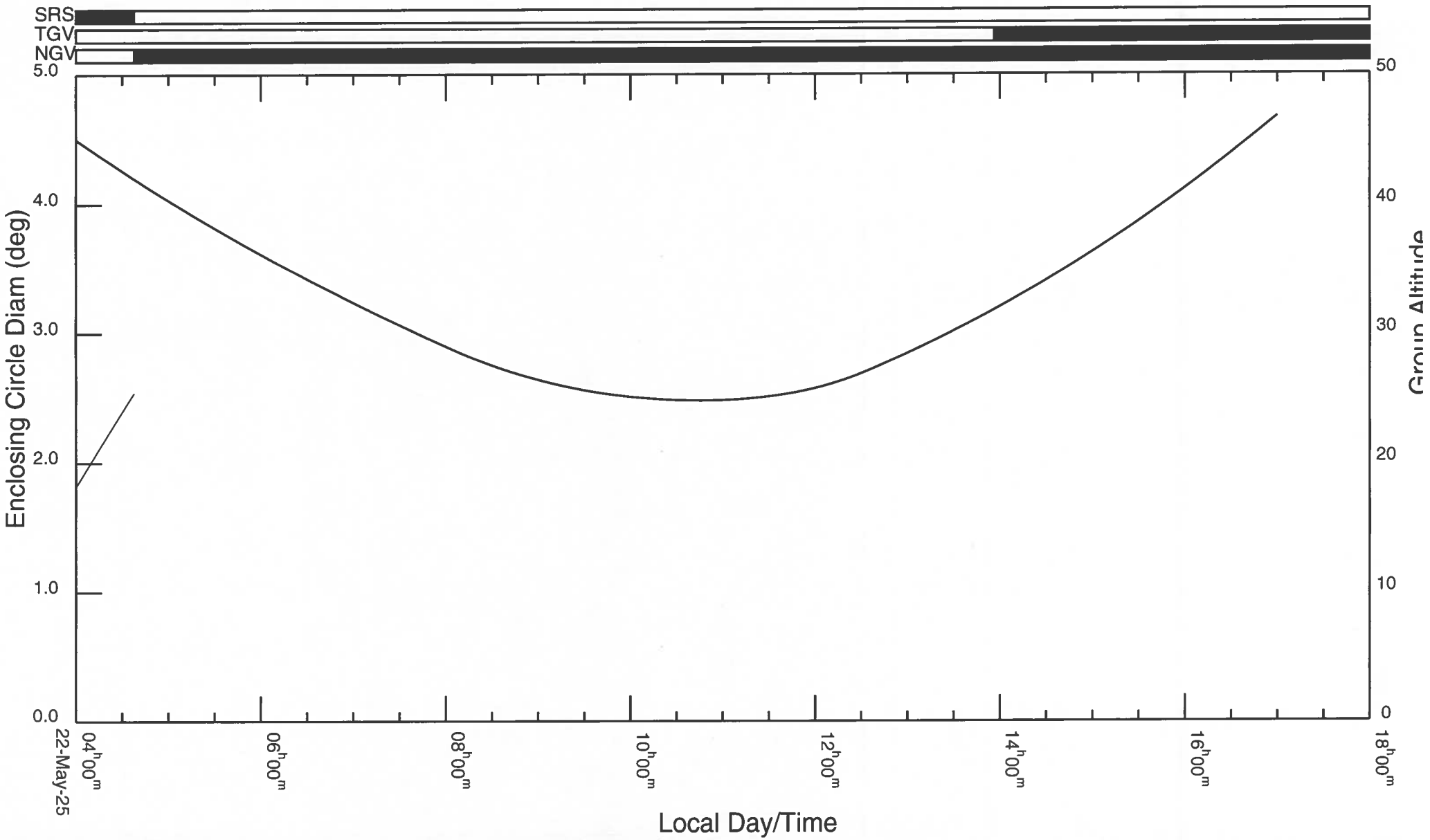
| Only at night (NGV) | Day and night (TGV) |
|---|---|
| 16-Jan-25 18:17 to 16-Jan-25 20:59 | 16-Jan-25 10:38 to 16-Jan-25 20:59 |
| 17-Jan-25 18:18 to 17-Jan-25 21:00 | 17-Jan-25 10:34 to 17-Jan-25 21:00 |
| 18-Jan-25 18:19 to 18-Jan-25 20:57 | 18-Jan-25 10:30 to 18-Jan-25 20:57 |
| 19-Jan-25 18:20 to 19-Jan-25 20:54 | 19-Jan-25 10:27 to 19-Jan-25 20:54 |
| 20-Jan-25 18:21 to 20-Jan-25 20:51 | 20-Jan-25 10:23 to 20-Jan-25 20:51 |

V Mags at minimum separation time

| | |
|---|---|
| Venus | -4.61 |
| Saturn | 1.09 |

Ex 5

2025-05-22 Saturn/Neptune/Moon
SRS bar: Sun rise/set through -8 deg altitude. White is daytime. Black is night.
TGV bar: Group rise/set through +5 deg altitude. White is group up (visible --day or night). Black is group down (never visible).
NGV bar: Night group visiblity. White shows group up at night. Otherwise black.
Altitude curves (RH Y axis) are plotted for NGV windows.
More information about visibilty on Page 2.



2025-05-22 Saturn/Neptune/Moon [Case 3]

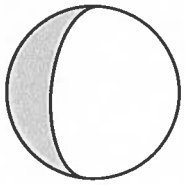
This is a group of three or more objects containing Uranus or Neptune. It can only be seen at night by the 5.5 TEC when the enclosing circle is < 3 degrees and possibly by other telescopes if the separation is small enough. See the plot.

The NGV bar white windows show the times the group is up at night.

Windows when this group is visible
(If more than 35, some will be skipped)

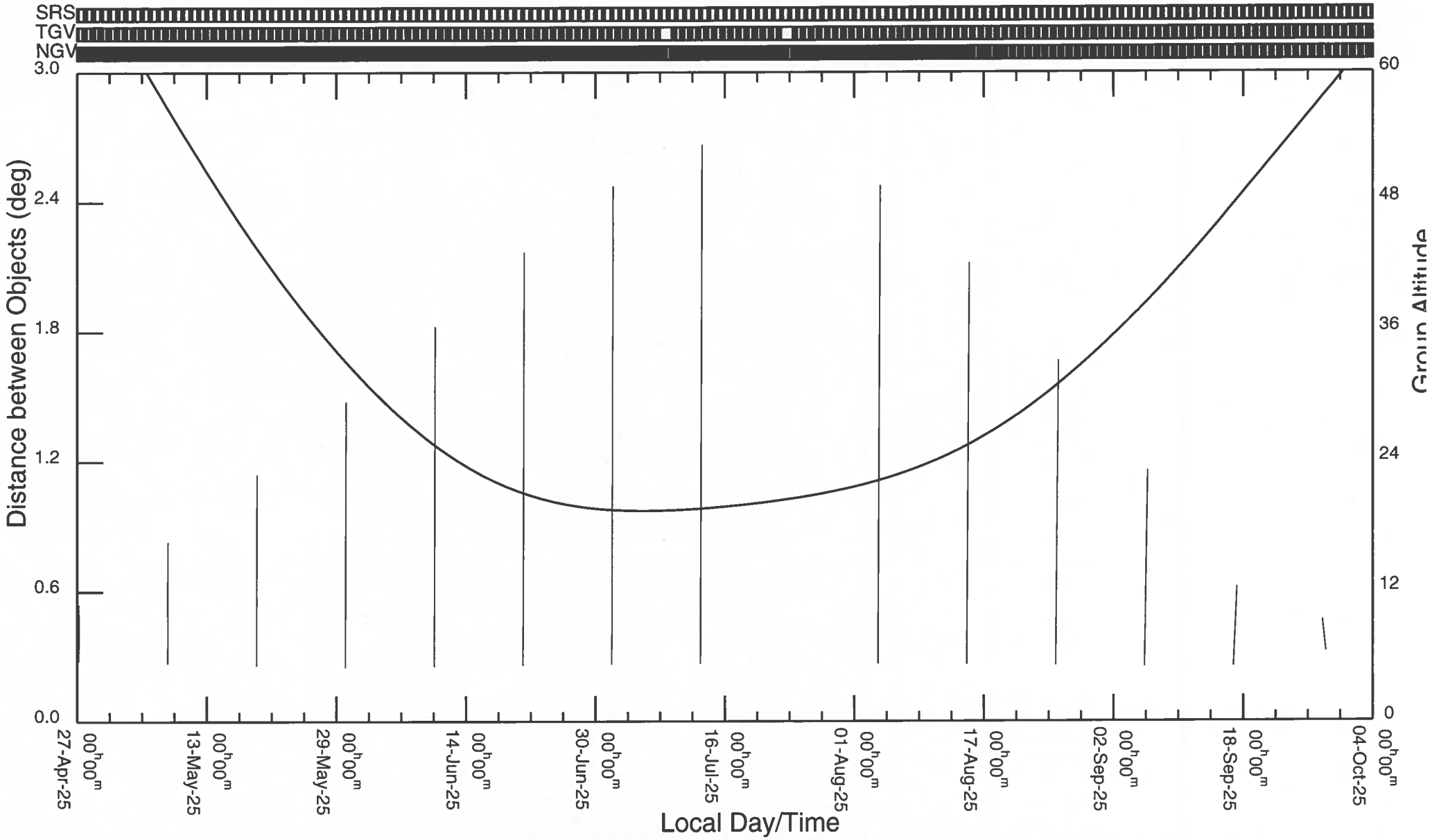
Only at night (NGV)
22-May-25 04:00 to 22-May-25 04:37

V Mags at minimum separation time
Saturn 1.12
Neptune 7.80
Moon -- see diagram



EX 6

2025-07-05 Saturn/Neptune
SRS bar: Sun rise/set through -8 deg altitude. White is daytime. Black is night.
TGV bar: Group rise/set through +5 deg altitude. White is group up (visible --day or night). Black is group down (never visible).
NGV bar: Night group visiblity. White shows group up at night. Otherwise black.
Altitude curves (RH Y axis) are plotted for NGV windows.
Altitude plotted for only every 11th window.
More information about visibilty on Page 2.



2025-07-05 Saturn/Neptune [Case 1]

This is a group of two objects containing Uranus and/or Neptune. It can only be seen at night by the 5.5 TEC, and possibly by other telescopes if the separation is small enough.

The NGV bar white windows show the times the group is up at night.

Windows when this group is visible
(If more than 35, some will be skipped)

Only at night (NGV)

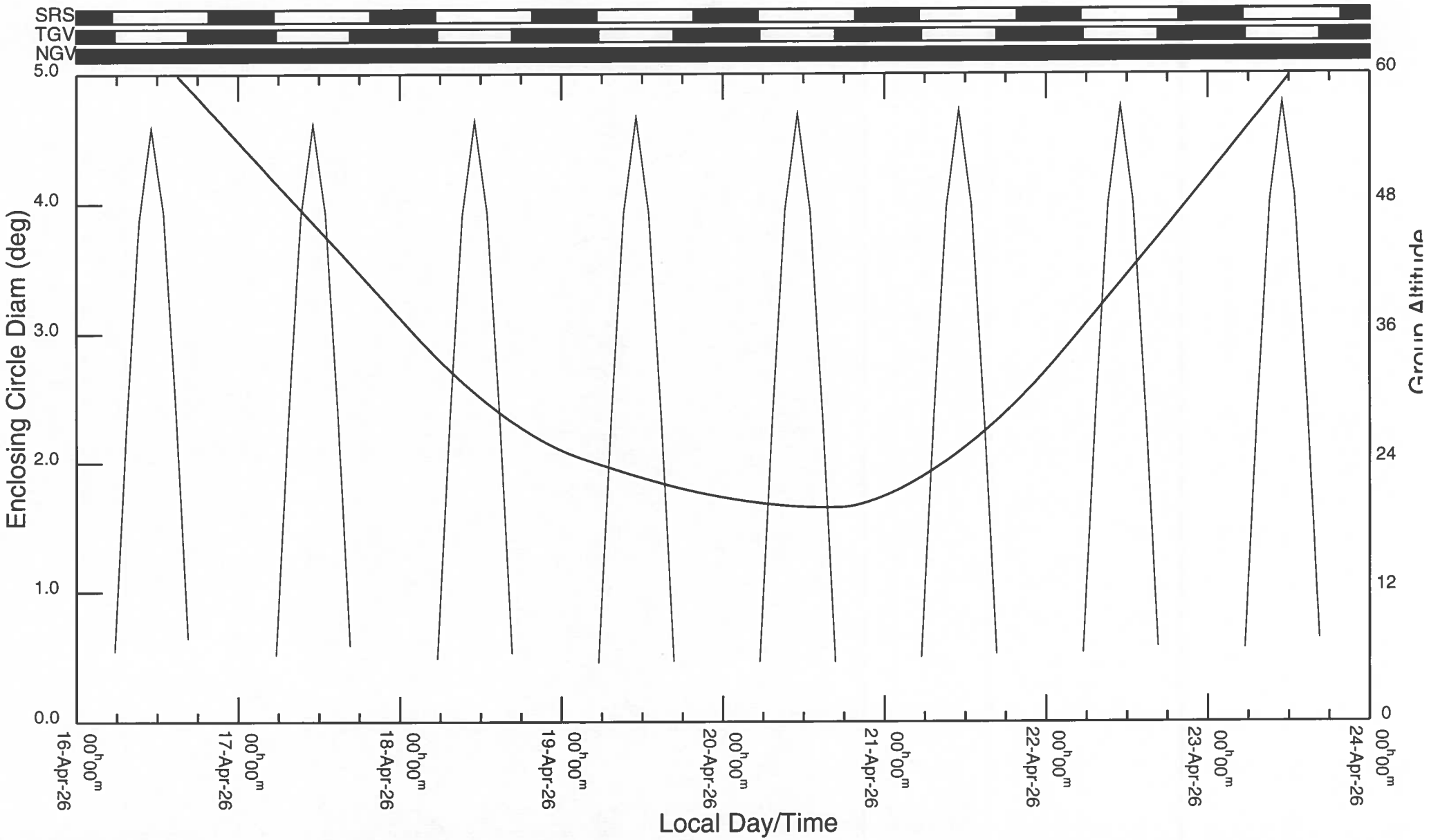
27-Apr-25 04:36 to 27-Apr-25 05:02
02-May-25 04:17 to 02-May-25 04:56
07-May-25 03:57 to 07-May-25 04:50
12-May-25 03:38 to 12-May-25 04:45
17-May-25 03:19 to 17-May-25 04:41
22-May-25 02:59 to 22-May-25 04:37
27-May-25 02:40 to 27-May-25 04:34
01-Jun-25 02:21 to 01-Jun-25 04:32
06-Jun-25 02:02 to 06-Jun-25 04:30
11-Jun-25 01:43 to 11-Jun-25 04:30
16-Jun-25 01:24 to 16-Jun-25 04:30
21-Jun-25 01:05 to 21-Jun-25 04:30
26-Jun-25 00:46 to 26-Jun-25 04:32
01-Jul-25 00:26 to 01-Jul-25 04:34
06-Jul-25 00:07 to 06-Jul-25 04:37
10-Jul-25 23:48 to 11-Jul-25 04:40
15-Jul-25 23:28 to 16-Jul-25 04:44
20-Jul-25 23:08 to 21-Jul-25 04:47
25-Jul-25 22:49 to 26-Jul-25 04:52
30-Jul-25 22:29 to 31-Jul-25 04:56
04-Aug-25 22:09 to 05-Aug-25 05:00
09-Aug-25 21:49 to 10-Aug-25 05:05
14-Aug-25 21:28 to 15-Aug-25 05:09
19-Aug-25 21:08 to 20-Aug-25 05:13
24-Aug-25 20:48 to 25-Aug-25 05:17
29-Aug-25 20:27 to 30-Aug-25 05:22
03-Sep-25 20:07 to 04-Sep-25 05:26
08-Sep-25 19:46 to 09-Sep-25 05:29
13-Sep-25 19:26 to 14-Sep-25 05:33
18-Sep-25 19:06 to 19-Sep-25 05:37
23-Sep-25 18:56 to 24-Sep-25 05:36
28-Sep-25 18:49 to 29-Sep-25 05:15
03-Oct-25 18:42 to 04-Oct-25 00:00

V Mags at minimum separation time

| | |
|---|---|
| Saturn | 0.94 |
| Neptune | 7.75 |

Ex 7

2026-04-20 Mercury/Mars/Saturn
SRS bar: Sun rise/set through -8 deg altitude. White is daytime. Black is night.
TGV bar: Group rise/set through +5 deg altitude. White is group up (visible --day or night). Black is group down (never visible).
NGV bar: Night group visiblity. White shows group up at night. Otherwise black.
Altitude curves (RH Y axis) are plotted for TGV windows.
More information about visibilty on Page 2.



2026-04-20 Mercury/Mars/Saturn [Case 5]

This group of three or more objects is visible at night by eye.
It will be visible in the 5.5 TEC when the enclosing circle is < 3 degrees and possibly by other telescopes if the separation is small enough. See the plot.
It may also be visible in the daytime by telescope if the group members are bright enough.
V mags are given below.

The NGV bar white windows show the times the group is up at night.
The TGV bar white windows show the times the group is up day and night.

Windows when this group is visible
(If more than 35, some will be skipped)

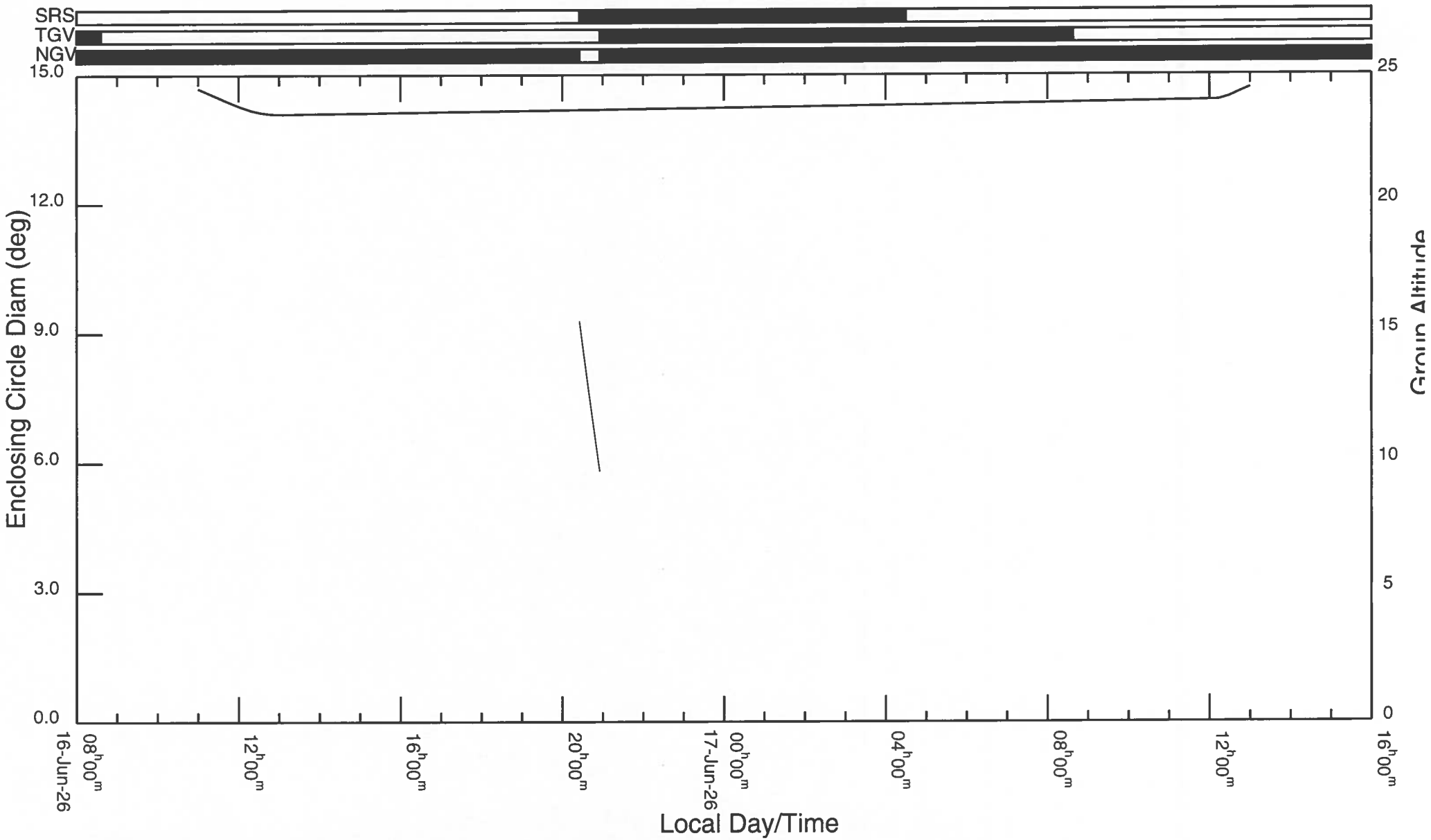
| Only at night (NGV) | Day and night (TGV) |
|---|---|
| | 16-Apr-26 05:40 to 16-Apr-26 16:31 |
| | 17-Apr-26 05:37 to 17-Apr-26 16:35 |
| | 18-Apr-26 05:33 to 18-Apr-26 16:38 |
| | 19-Apr-26 05:29 to 19-Apr-26 16:41 |
| | 20-Apr-26 05:28 to 20-Apr-26 16:42 |
| | 21-Apr-26 05:28 to 21-Apr-26 16:38 |
| | 22-Apr-26 05:28 to 22-Apr-26 16:35 |
| | 23-Apr-26 05:28 to 23-Apr-26 16:32 |

V Mags at minimum separation time

| | |
|---|---|
| Mercury | -0.19 |
| Mars | 1.22 |
| Saturn | 0.93 |

Ex 8

2026-06-16 Mercury/Venus/Jupiter/Moon
SRS bar: Sun rise/set through -8 deg altitude. White is daytime. Black is night.
TGV bar: Group rise/set through +5 deg altitude. White is group up (visible --day or night). Black is group down (never visible).
NGV bar: Night group visiblity. White shows group up at night. Otherwise black.
Altitude curves (RH Y axis) are plotted for NGV windows.
More information about visibilty on Page 2.



2026-06-16 Mercury/Venus/Jupiter/Moon [Case 4]

This is a group of three or more objects which does not contain Uranus or Neptune.
It is only visible at night by eye as it is always too wide for a telescope.

The NGV bar white windows show the times the group is up at night and are shown below.

Windows when this group is visible
(If more than 35, some will be skipped)
Only at night (NGV)
16-Jun-26 20:25 to 16-Jun-26 20:55

V Mags at minimum separation time
Mercury 0.58
Venus -4.01
Jupiter -1.84
Moon -- see diagram