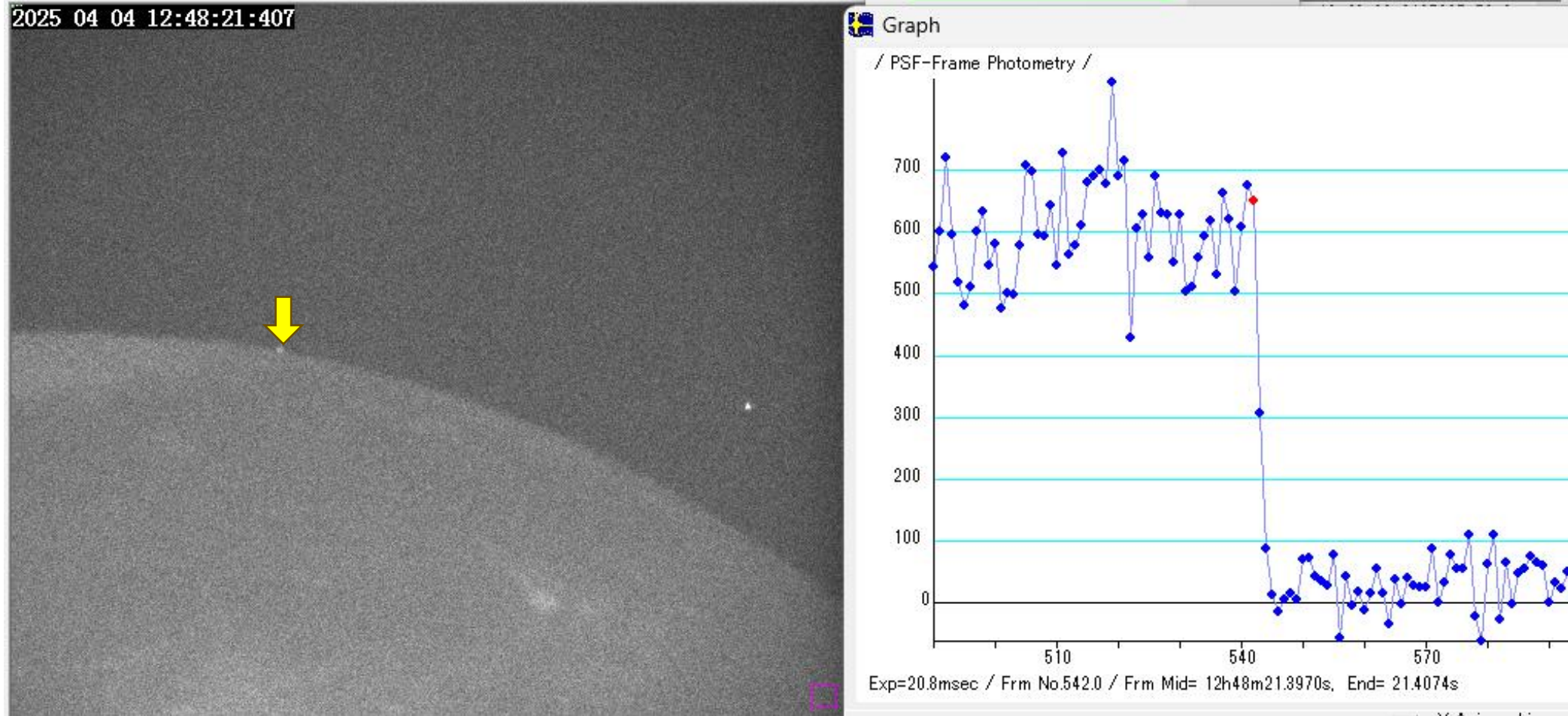


Statistics of observation reports on Lunar occultation & Grazing occultation



月による星食と接食の観測のまとめ
IOTA/EA 月による星食部局

Department of Lunar occultation, IOTA/EA
Kazuhisa Miyashita, Hideyoshi Karasaki, Mitsuru Soma

I will explain the following points.

1. Statistic results of reported phenomena
2. Three Topics
 - (1) $O-C(\text{disappearance}) < O-C(\text{appearance})$
 - (2) Grazing
 - (3) A new software for drawing the grazing map called “Route for grazing Limit Line” has been available
3. A new campaign on Double star observation.

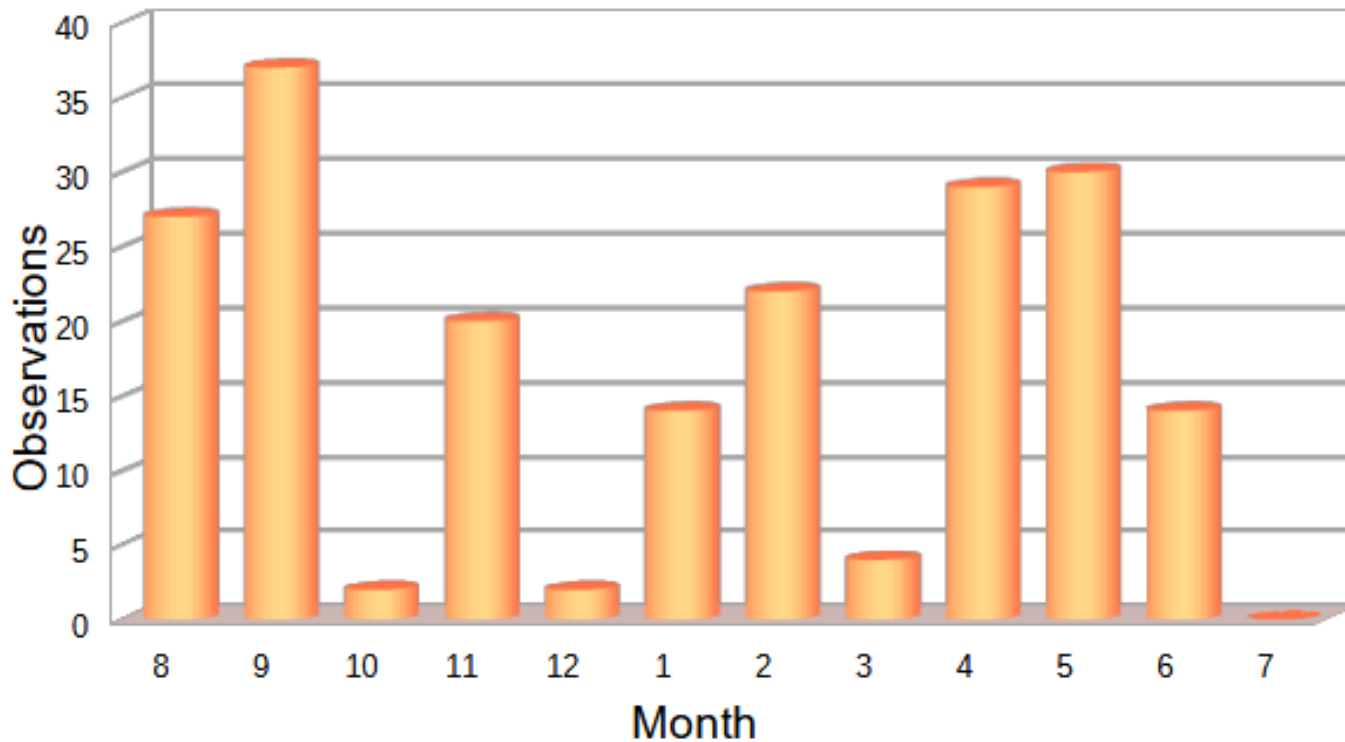
以下の諸事項についてお話しします

1. 観測報告の諸集計
2. 3件のトピック
 - (1) $O-C(\text{disappearance}) < O-C(\text{appearance})$
 - (2) 接食観測
 - (3) 観測マップ作製用ソフトウェア 限界線ルート II
3. 月による重星の観測.

268 phenomena have been reported.

2024年8月から2025年7月までの間に、221現象（重星については複数の減光（増光）一つの現象として数えています）の報告を受けました。

The number of reports per month



Weather conditions significantly affect the number of observations.

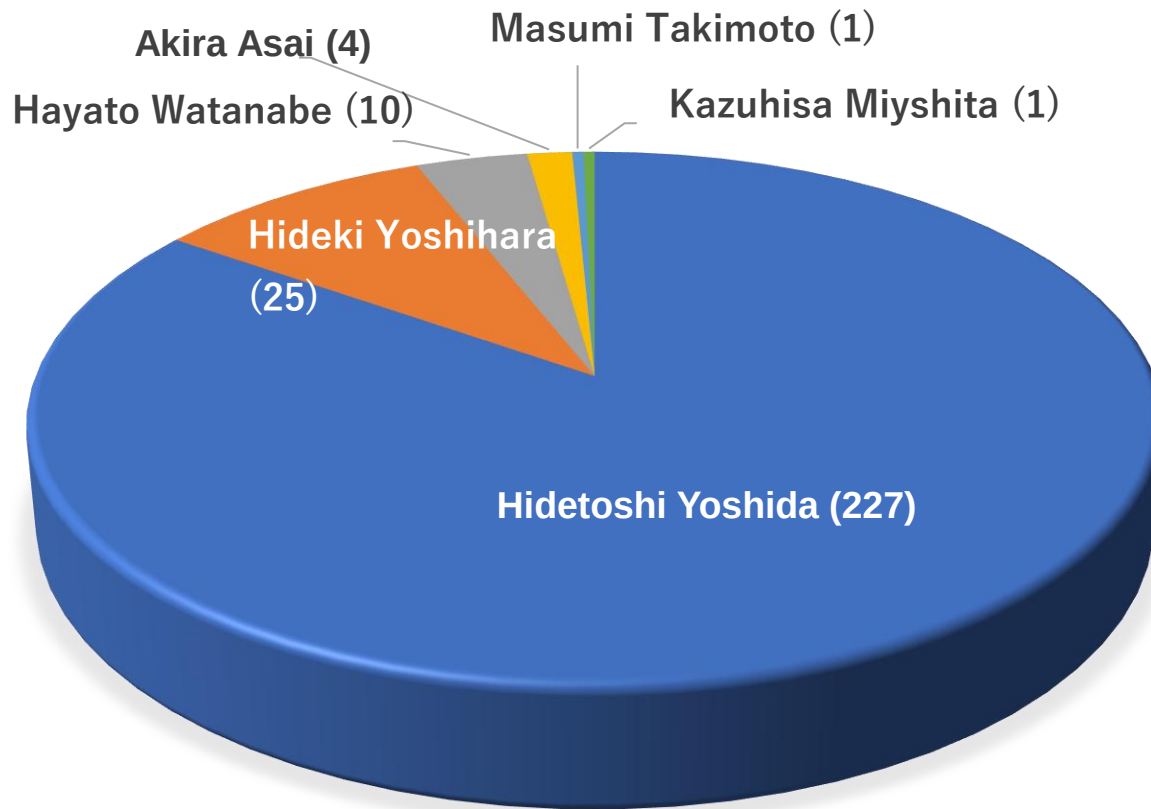
On October, December, March and July, there were many rainy/cloudy nights.

月ごとの観測数をまとめました。天候の影響を受け、多い月と少ない月の差が大きくなっています。

Observers

Six observers have reported lunar occultation observation during this period.

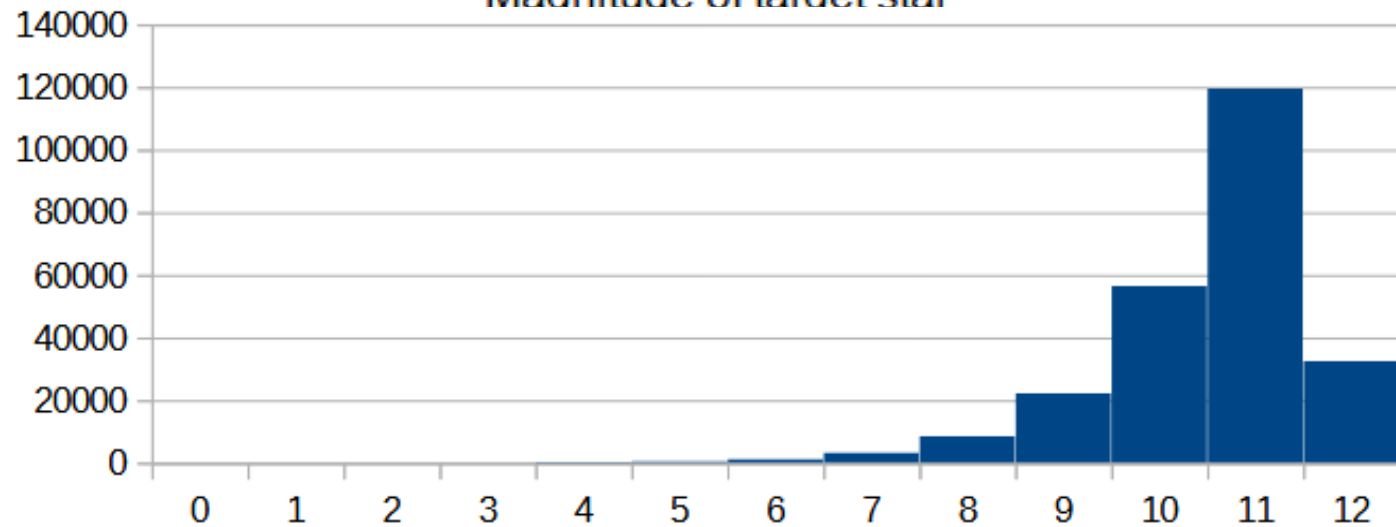
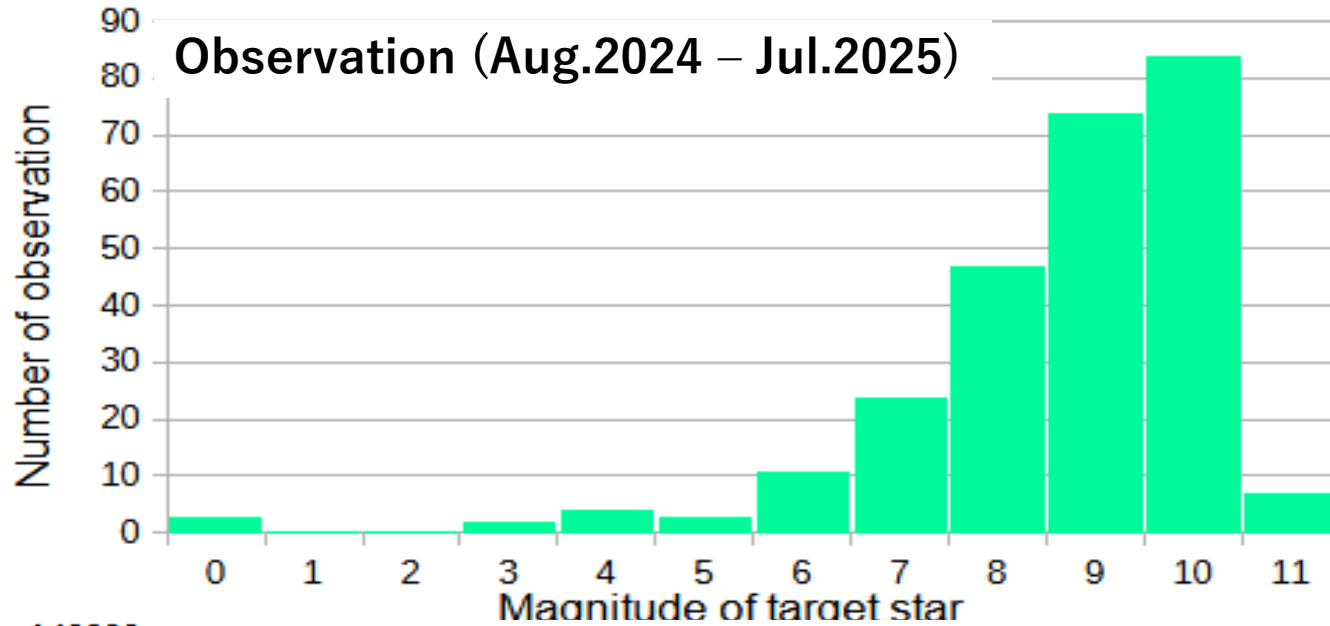
- All reports are from Japan.
- It is necessary to appeal the significance of lunar occultation more widely.



観測報告はすべて日本の観測者からのものです。
6人の方が星食観測報告を寄せてくださっています。
より多くの方に観測していただいていくために、
月による星食観測の意義を広く知らせていく必要があります

Statistics on star's magnitude

観測された恒星の等級



Number of star listed onto XZ catalog

A large percentage of observations are in the 8-10 magnitude range.

This is because it is difficult to observe stars fainter than 10th magnitude in the following cases.

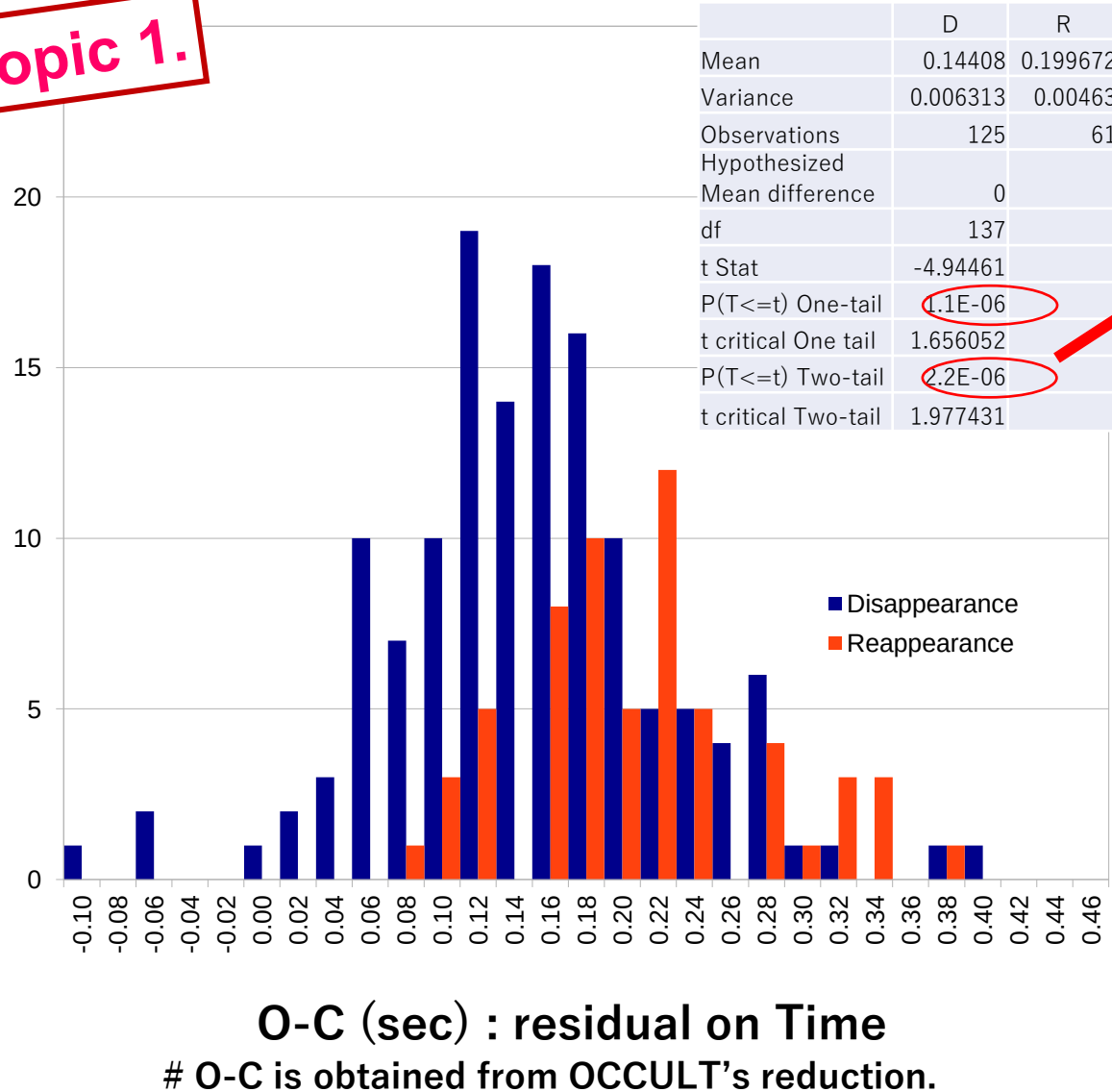
- The dark limb is bright by earthshine
- Through thin clouds
- Strong atmospheric turbulence

8～10等級の観測数が多くなっています。
次のような場合に、10等級より暗い星の現象は観測しにくくなるためだと考えられます。

- ◇ 月縁が地球照で明るい場合
- ◇ 薄雲がある場合
- ◇ 大気の揺らぎの影響の大きい場合

Statistics of lunar occultation residual (Aug. 2024 – Jul. 2025)

Topic 1.



- A slight difference between the peak and average values for D and R.
 - p value is extremely small than 0.05.
- it is convincing enough to say that the average value of O-C between D and R differ significantly.

↓

A possibility that the diameter of moon obtained from aircraft and others is slight smaller than real size.

- In both case of Disappearance and Reappearance, almost all of O-C (on Time are plus value.
- ↓

A possibility that the real position of the moon on the celestial sphere is different from the almanac (or OCCULT's calculation).

時刻のO-Cは、潜入時・出現時ともにプラス。その平均値は潜入・出現でわずかに異なる。月の半径（平均月縁の）が既知の値より大きい？

- This will need to be investigated in the future.

Results of graze occultation (Aug. 2024 – Jul. 2025)

Star	Date	Region	Observer	Phenomena	Correction for Reduction (arcsec)	RUWE
ZC 561	Aug. 26, 2024	Belgium The Netherlands	Tom Tenbergen H. J. Bril	3D3R 5D5R	-0.05	1.303
XZ 13749	Oct. 25, 2024	Belgium	O. Schreurs J. Bourgeois	3D3R 15D15R	-0.03	1.147
SAO 188426	Nov. 07, 2024	Japan	M. Ishida	5D5R	-0.06	1.045
SAO 146653	Nov. 11, 2024	Japan	M. Ishida	1D1R	-0.09	1.160
ZC 201	Jan. 07, 2025	Japan	Ha. Watanabe H. Yamamura	1D-- 1D1R	-0.05	1.502
XZ 703	Feb. 02, 2025	Belgium	C, Alacoque J. Bourgeois	4D5R	-0.10	1.029
XZ 1518	Feb. 03, 2025	Japan (Campaign by EA)	H. Yamamura Ono high school	1D1R 2D2R	-0.06	0.909
ZC 435	Feb. 05, 2025	Japan	H. Yoshihara	2D1R	0.00	1.092
ZC 297	Mar. 03, 2025	France	J. Bourgeois	5D5R	-0.04	3.115
ZC541	Apr. 01, 2025	U.K. Switzerland Switzerland Switzerland	T. Haymes B. Gaehrken B. Gaehrken B. Kattentidt	5D5R 3D3R 5D5R 7D7R	+0.020	3.542
SAO 78480	May. 01, 2025	Germany	B. Kattentidt B. Kattentidt B. Kattentidt	4D4R 6D6R 6D6R	+0.035	0.981
ZC 1658	May. 07, 2025	Japan	M. Ishida	4D4R	+0.015	2.252
ZC 3412	Jun, 18, 2025	Hungary	T. Weiland	4D4R	-0.080	2.853

Topic 2.

Results of graze occultation (Aug. 2024 – Jul. 2025)

Star	Date	Region	Observer	Phenomena	Correction for Reduction (arcsec)	RUWE
ZC 561	Aug. 26, 2024	Belgiu Netherlands	Tom Tenbergen H. J. Bril	3D3R 5D5R	-0.05	1.303
XZ 13749	Oct. 25, 2024	Belgium	O. Schreurs J. Bourgeois	3D3R 15D15R	-0.03	1.147
SAO 188426	Nov. 07, 2024	Japan	M. Ishida	5D5R	-0.06	1.045
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ZC 3412	Jun. 18, 2025	Hungary	T. Weiland	4D4R	-0.080	2.853

In this period, 13 events are observed in the world. Among them, observations on East Asia region, 6 events on 8 sites, and 7 persons and one group succeed observation of grazing occultation.

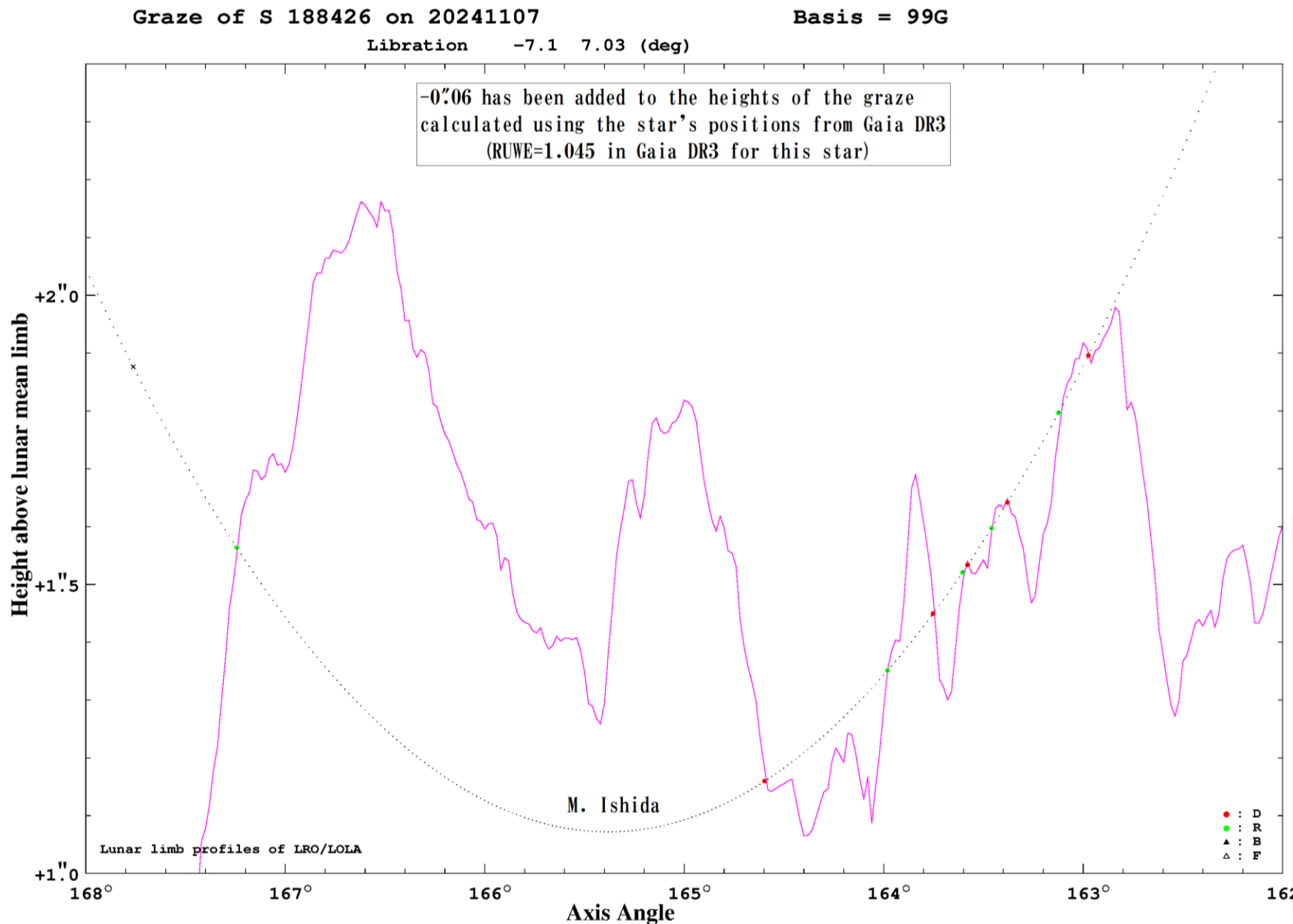
➤ XZ1518 on Feb. 03, 2025 is the campaign observation of IOTA/EA lunar department.

As a noteworthy points, many students of three high school participated to this observation.

➤ Again, it is necessary to publicize the significance of lunar/graze occultation observation.

2024年8月から2025年7月までの間に、ヨーロッパと東アジア地域から22地点で13事象が観測されました。この内、東アジア地域は8地点、6現象の報告がありました。
ヨーロッパでの観測が増加したのは、相馬先生が一昨年のIOTA年会で接食観測の現状と価値についてお話したことも効果的であったと思われます。
これからも呼びかけを継続するとともに、多数の観測がなされることを期待したいと思います。

Value of the grazing occultation observation



An example of reduction is shown.

- RUWE of this star is small (1.045), however rather not negligible correction value (-0.06 arc sec) is applied to lunar limb on reduction. It is a valuable observation to investigate errors in stellar positions.

2024年11月7日のSAO 188426の接食について整約図を示します。
RUWEが1.045と小さい値であるにもかかわらず、整約では月縁に-0/06秒角の補正をしないと観測と月縁がフィットしません。
多くの観測でこのような補正が必要であり、月の位置と恒星の位置データを比較して調べていくために、接食観測は重要な役割を果たしています。

Topic 3.

A new software “Route for Graze Limit Line II” for supporting observation was produced

Predictions by Dr. Soma

2025年の接食の予報

- ➡ 限界線地図 [各限界線に月日と星番号を表示]
- ➡ 状況図(1月6日 ZC 58 – 7月16日 X 439)
- ➡ 状況図(7月19日 X 4031 – 12月31日 ZC 541)

- ➡ 2025年1月6日(UT) ZC 58 限界線 月縁
- ➡ 2025年1月7日(UT) ZC 201 限界線 月縁
- ➡ 2025年1月20日(UT) ZC 1888 限界線 月縁
- ➡ 2025年2月2日(UT) ZC 24 限界線 月縁
- ➡ 2025年2月3日(UT) X 1477 限界線 月縁
- ➡ 2025年2月3日(UT) X 1518 限界線 月縁
- ➡ 2025年2月4日(UT) ZC 297 限界線 月縁
- ➡ 2025年2月5日(UT) ZC 435 限界線 月縁
- ➡ 2025年2月18日(UT) X 20195 限界線 月縁
- ➡ 2025年2月20日(UT) ZC 2287 限界線 月縁
- ➡ 2025年3月4日(UT) ZC 399 限界線 月縁

Route for Graze Limit 1.0.3.1

145	15.0	43	12	36.9	11	30.5	27	23	18	15.1	245.6	3.695	-16	325.73	346.92	-----	U
145	22.5	43	14	41.3	13	34.9	27	23	20	15.0	245.7	3.721	-16	325.76	346.94	-----	U
145	30.0	43	16	45.1	15	38.8	27	23	23	14.9	245.8	3.748	-16	325.78	346.97	-----	U
145	37.5	43	18	48.4	17	42.1	27	23	25	14.8	245.9	3.775	-16	325.81	346.99	-----	U
145	45.0	43	20	51.1	19	44.9	27	23	27	14.7	246.0	3.803	-16	325.84	347.02	-----	U
145	52.5	43	22	53.3	21	47.1	27	23	29	14.6	246.0	3.831	-16	325.86	347.04	-----	U
146	0.0	43	24	55.0	23	48.8	27	23	31	14.5	246.1	3.859	-15	325.89	347.07	-----	U

Paste

Line draw
☐ Sea level ☒ Elevation corrected ☐ Both

☒ Disp line from -1.0" to -2.0"
☐ Disp line from -2.1 to -3.0, from 0.1 to 2.0

Elevation of observation site 0 m

Apply

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140.250000,41.6607278,0 140.375000,41.7019722,0 140.500000,41.7430000,0 140.625000,41.7838611,0 140.750000,41.8245556,0
140.875000,41.8650556,0 141.000000,41.9054611,0 141.125000,41.9455778,0 141.250000,41.9856000,0 141.375000,42.0254056,0
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143.375000,42.6394889,0 143.500000,42.6764333,0 143.625000,42.7132611,0 143.750000,42.7499000,0 143.875000,42.7863444,0
144.000000,42.8227000,0 144.125000,42.8588389,0 144.250000,42.8948111,0 144.375000,42.9306444,0 144.500000,42.9663333,0
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Latitude, Longitude (display only)
(e.g. 35.12345, 135.67890 copy from Map)

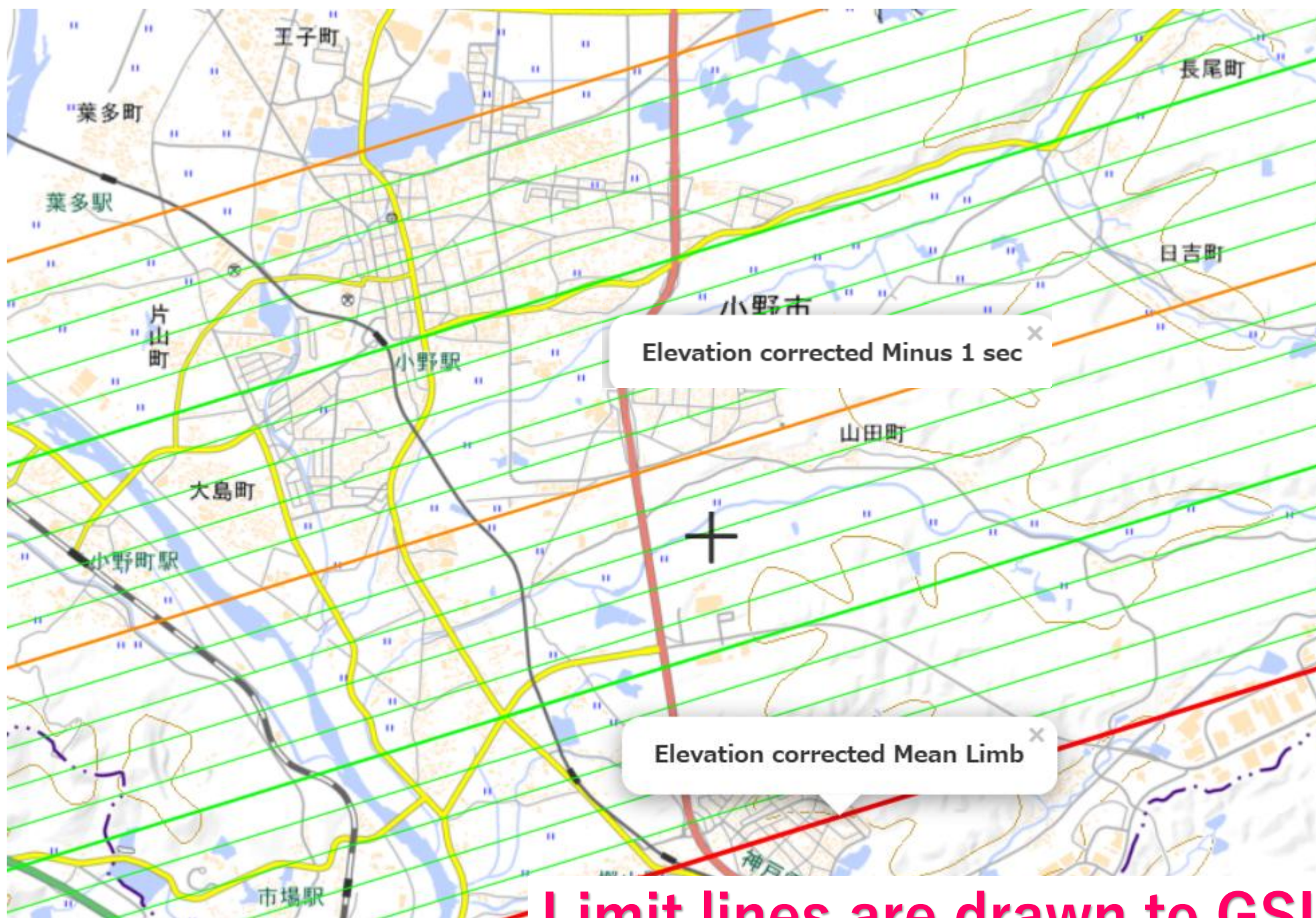
Event central Time

Save kml file

paste Time text

KML text for google maps and the map of
Geospatial Information Authority of Japan

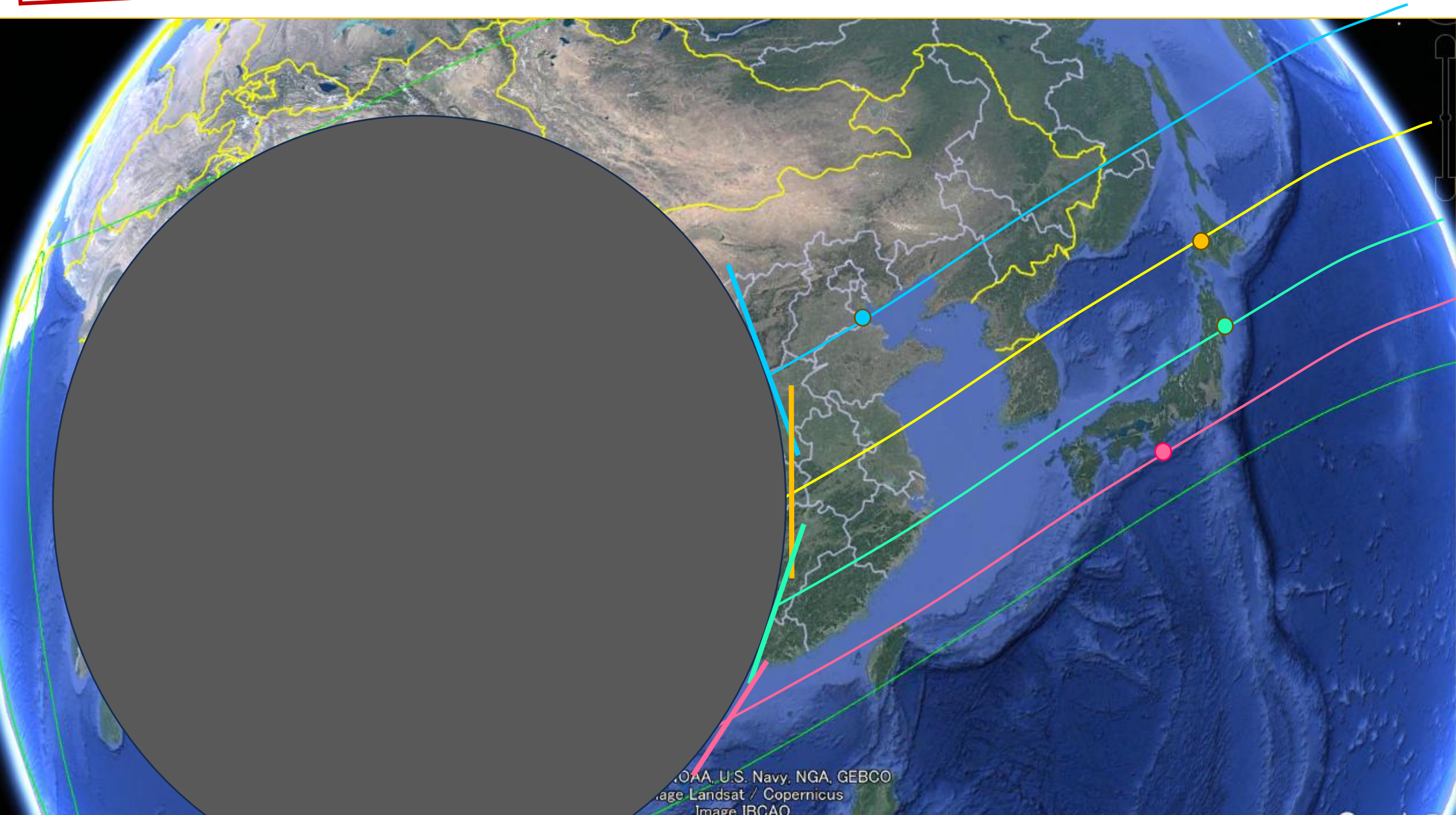
ソフトウェア 限界線ルート II



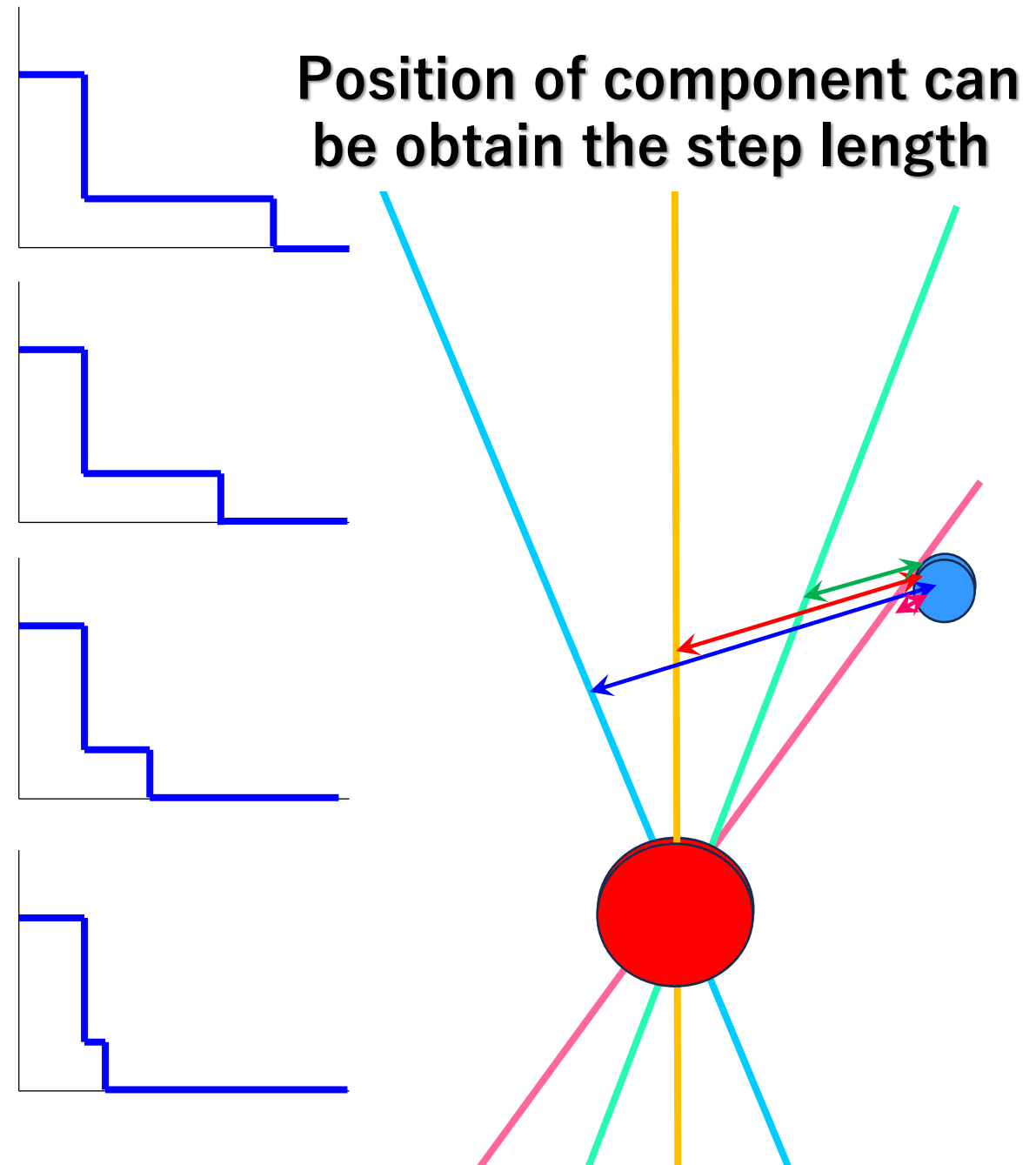
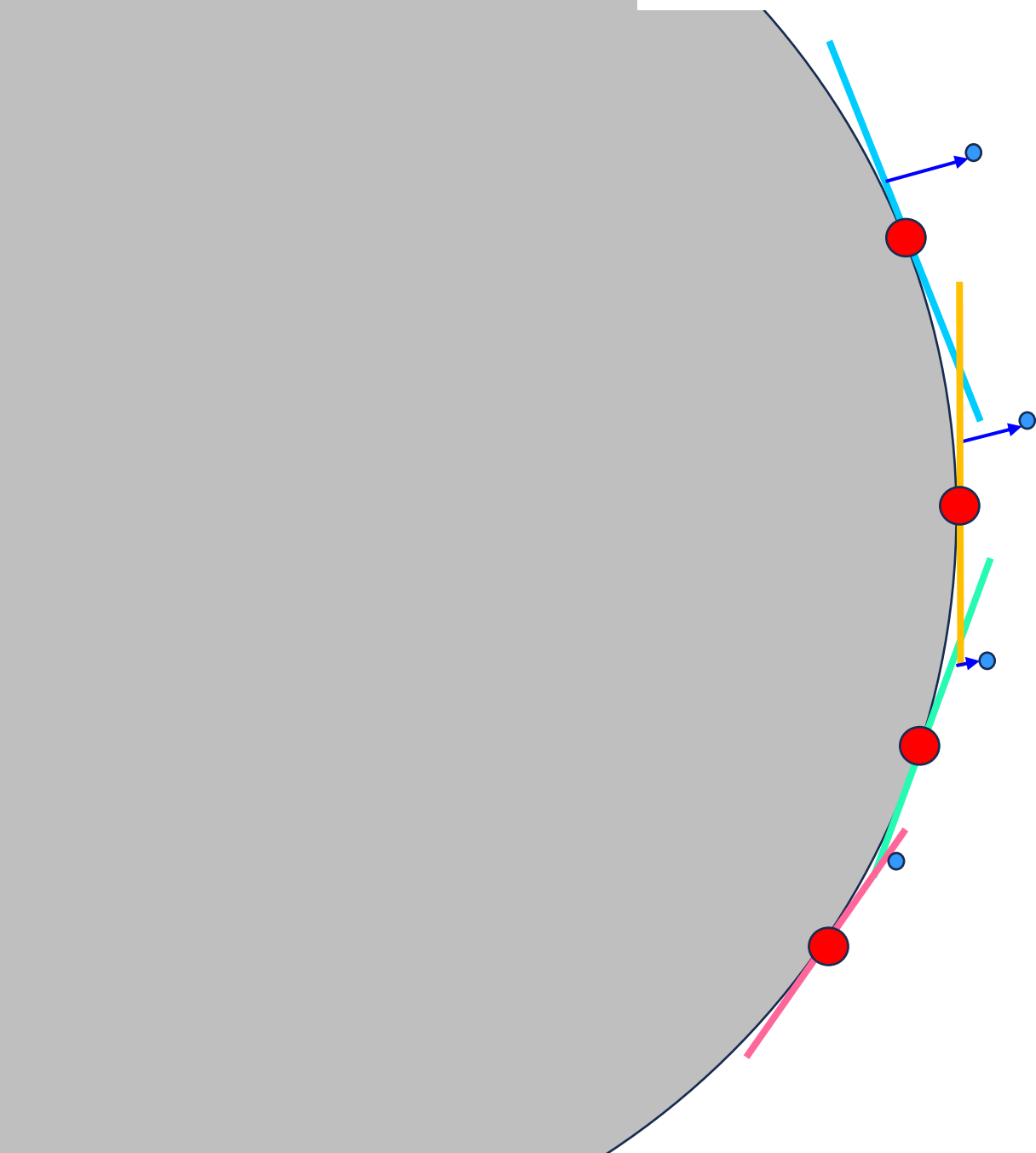
Limit lines are drawn to GSI map

A new campaign!

Depending on the observation location, it will be difference on the position of the moon limb occults the star and the contact angle.

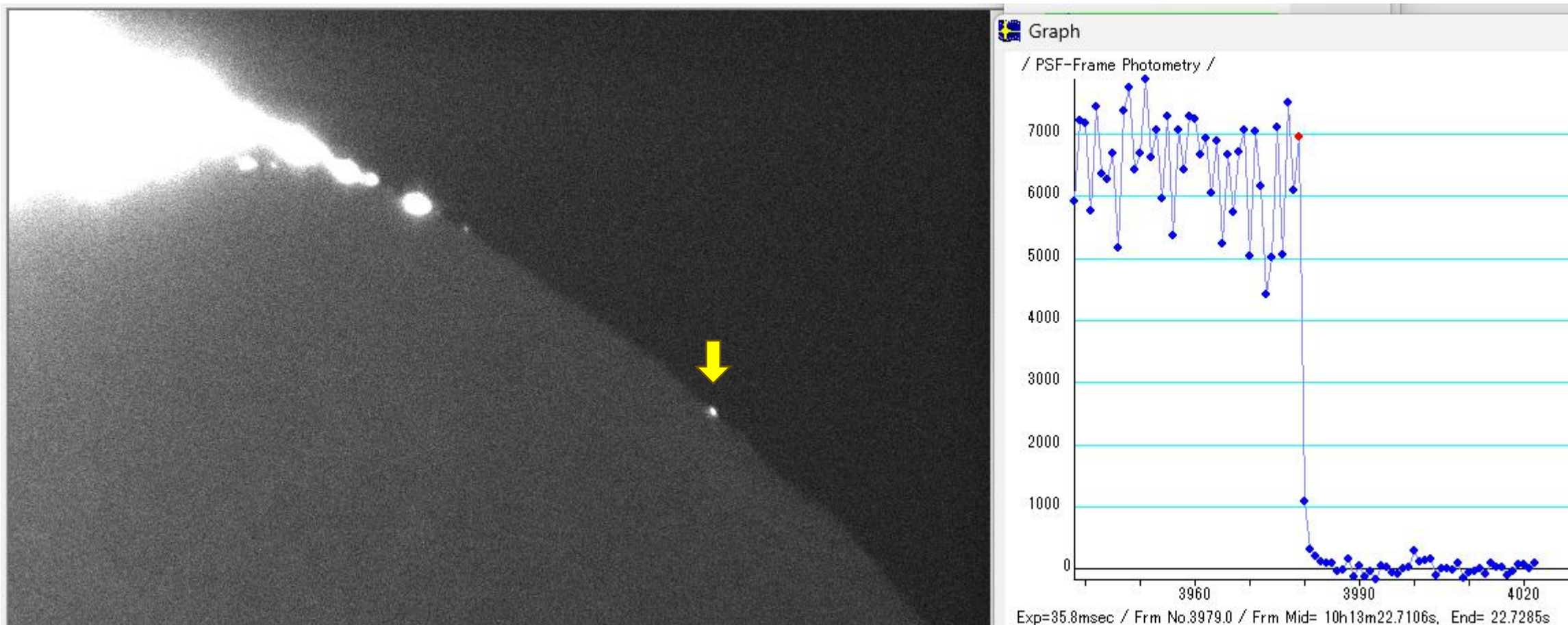


Double star makes different length step on light curve.



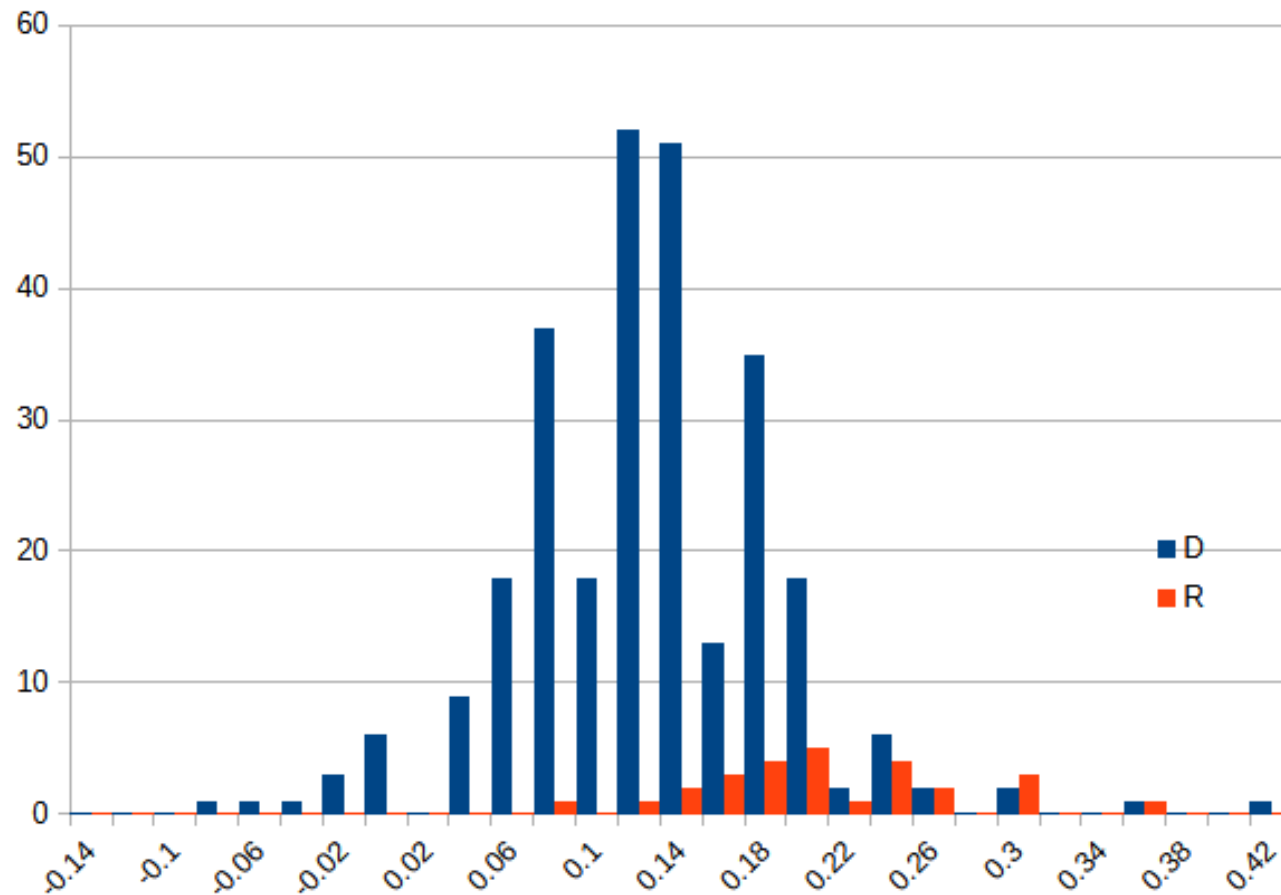
We look forward to your lunar occultation observation reports!

星食・接食の現象から価値のある観測ができます。
皆様のご参加をお待ちしております！



Feb. 03, 2025 Grazing occultation of XZ1815 (Observed by by Ono high school students)

Appendix



実は．．．昨年度の観測からも、 $O-C(d) < O-C(r)$ という傾向が明らかになっていました。Rの観測数が少なかったので、公表はしなかったのですが．．．

時刻のO-Cは、潜入時・出現時ともにプラス。その平均値は潜入・出現でわずかに異なる。月の半径（平均月縁の）が既知の値より大きい？