

target : Uranus  
 target radius (km) : 25559.00  
 C/A epoch : 2031-12-26T14:59:19.920  
 Event type : PtRgt  
 : Uranus occs: topocentric, not geocentric  
 : Ring occs: geocentric, topocentric  
 Gaia source ID : 3404507188403061760  
 2Mass ID (if available) : 05352896+2328269

ICRS Star Coord at Epoch: 05h 35m 28.99072s +23:28:26.14948s

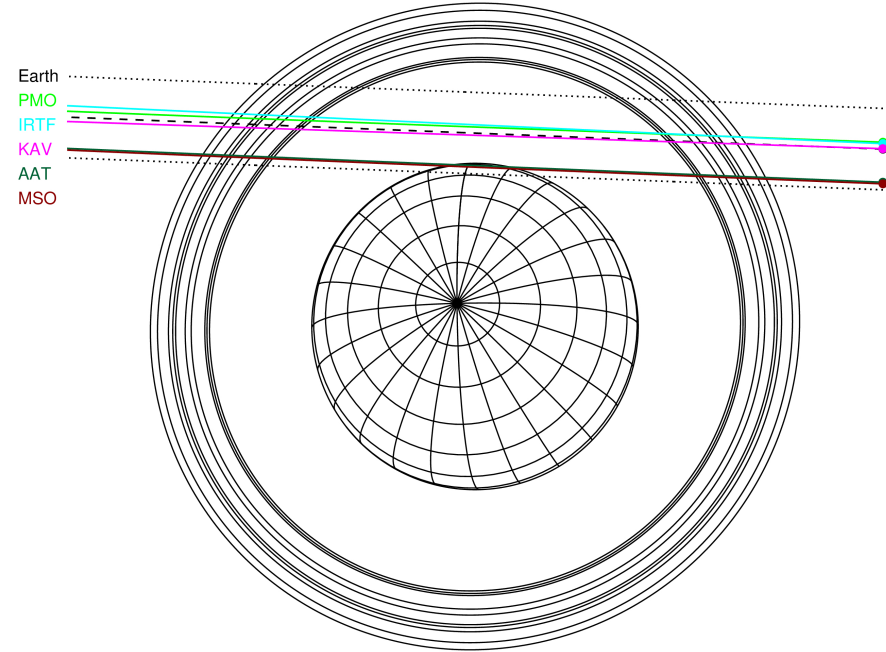
RUWE (>1.4 is poor) : 0.99  
 K magnitude : 13.016  
 G magnitude : 16.462  
 RP magnitude : 15.400  
 BP magnitude : 17.605  
 DUPflag : 0  
 Distance (au) : 18.115  
 f0 (km) : 0.000  
 g0 (km) : 0.000  
 skyplane vel. (km/s) : -23.00  
 Sun-Target sep (deg) : 170.19  
 Sun-Moon sep (deg) : 13.80  
 B (ring opening deg) : 79.65  
 PA of pole (deg) : 37.86

#	a(km)	ring
1	41837.2	6
2	42235.0	5
3	42571.2	4
4	44718.5	alpha
5	45661.1	beta
6	47176.1	eta
7	47626.3	gamma
8	48300.3	delta
9	50026.7	lambda
10	51149.4	epsilon



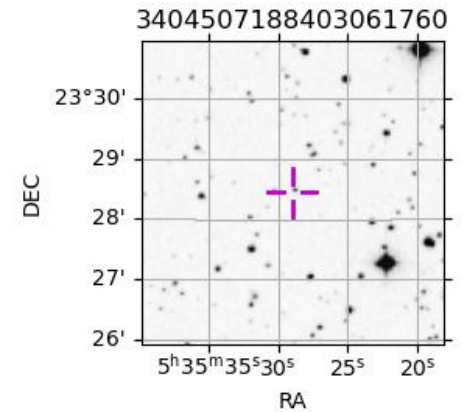
2031-12-26T14:59:19.9200 ra: 05 35 28.9907 s: +23 28 26.149 C/A 2.310° PA 177.75 deg v\_sky -23.00 km/s D 18.12 AU  
 Credit: Styled after SORA/Lucky Star

Uranus 2031-12-26T14:59:19 K13.02 G16.46 PtRgt

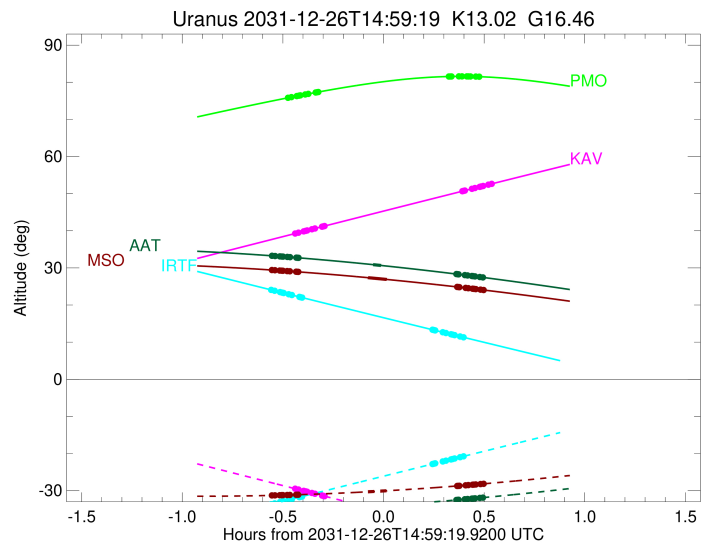
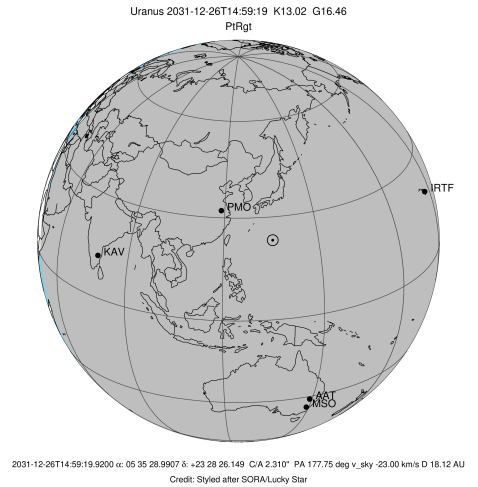


Observable events with sun below -5 deg and altitude above 5 deg unblocked by planet

Obs	Location	lat	Elon	Rings I	Planet	Rings E	Observed Events Interval	OEcode
PIC	Pic du Midi	42.9	0.1					PnnRnn
PAL	Palomar Mt (200")	33.4	243.1					PnnRnn
PMO	Purple Mtn Obs. Nanki	32.1	118.8	+++++		+++++	DEC 26 14:30 - DEC 26 15:27	PnnRie
KPNO	Kitt Peak Natl Obs	32.0	248.4					PnnRnn
MCD	McDonald Obs. 2.7m	30.7	256.0					PnnRnn
TEN	Teide Obs./Tenerife	28.3	343.5					PnnRnn
IRTF	Mauna Kea/IRTF	19.8	204.5	+++++		+++++	DEC 26 14:25 - DEC 26 15:22	PnnRie
KAV	Kavalur Observatory	12.6	78.8	+++++		+++++	DEC 26 14:32 - DEC 26 15:31	PnnRie
RIO	Rio de Janeiro	-22.9	316.8					PnnRnn
ESO	European Southern Obs	-29.3	289.3					PnnRnn
AAT	Siding Spring (AAT)	-31.3	149.1	+++++	+ +	+++++	DEC 26 14:25 - DEC 26 15:28	PieRie
SAAO	So. Afr. Astro. Obs.	-32.4	20.8					PnnRnn
MSO	Mt. Stromlo Observato	-35.3	149.0	+++++	+ +	+++++	DEC 26 14:25 - DEC 26 15:28	PieRie



target : Uranus  
 target radius (km) : 25559.00  
 C/A epoch : 2031-12-26T14:59:43.460  
 Event type : PtRgt  
 : Uranus occs: topocentric, not geocentric  
 : Ring occs: geocentric, topocentric  
 Observer code : PMO  
 Location : Purple Mtn Obs. Nanking  
 Latitude (deg) : 32.06667  
 E. Longitude (deg) : 118.82089  
 Altitude (km) : 0.364  
 Gaia source ID : 3404507188403061760  
 2Mass ID (if available) : 05352896+2328269  
 ICRS Star Coord at Epoch: 05h 35m 28.99072s +23:28:26.14948s  
 RUWE (>1.4 is poor) : 0.99  
 K magnitude : 13.016  
 G magnitude : 16.462  
 RP magnitude : 15.400  
 BP magnitude : 17.605  
 DUPflag : 0  
 Distance (au) : 18.115  
 f0 (km) : 0.000  
 g0 (km) : 0.000  
 skyplane vel. (km/s) : -23.00  
 Sun-Target sep (deg) : 170.19  
 Sun-Moon sep (deg) : 13.97  
 B (ring opening deg) : 79.65  
 PA of pole (deg) : 37.86  
 Pole direction: RA (deg): 257.31100  
 Dec (deg): -15.17500  
 C/A sky separation (") : 2.376  
 C/A sky separation (km) : 31220.7  
 NAIF SPICE kernels : RAJobs\_U111+rgf15.spk  
 URKALLvl.spk  
 ura111.bsp  
 IAU\_URANUS\_for\_RINGFIT.tpc  
 vgr2.ura111.bsp  
 ura161.bsp  
 vgr2.ura161.bsp  
 peph.ura160.bsp  
 earthstns\_itr93\_040916.bsp  
 earth\_720101\_070426.bpc  
 earth\_200101\_990628\_predict.bpc  
 pg3f0000r.bsp  
 pg490000r.bsp  
 naif0012.tls  
 earth\_flat\_IAU.spk



b: ring blocked by planet x: target alt < 5.0 deg or sun > -5.0 deg

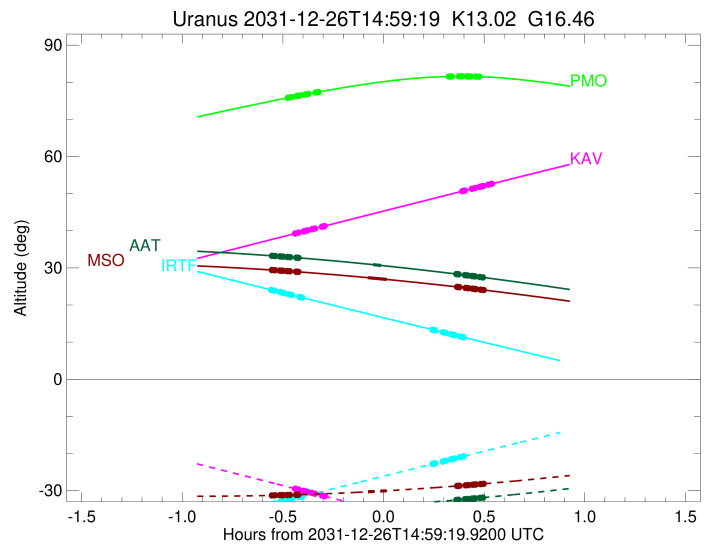
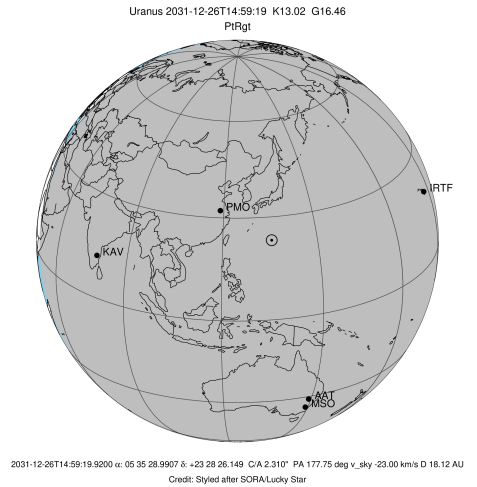
Ring	I/E	UTC	b?	alt	alt-sun	radius	r-dot	lat-geo	lat-geodetic
epsilon	I	2031-12-26T14:30:45.618		75.81	-67.47	51272.36	-18.46		
lambda	I	2031-12-26T14:31:53.230		76.01	-67.70	50026.71	-18.28		
delta	I	2031-12-26T14:33:28.819		76.29	-68.02	48300.35	-17.83		
gamma	I	2031-12-26T14:34:06.644		76.40	-68.15	47629.31	-17.65		
eta	I	2031-12-26T14:34:32.424		76.47	-68.24	47176.12	-17.51		
beta	I	2031-12-26T14:35:59.107		76.72	-68.53	45678.50	-17.03		
alpha	I	2031-12-26T14:36:55.367		76.88	-68.72	44729.36	-16.69		
4	I	2031-12-26T14:39:06.643		77.25	-69.16	42593.14	-15.84		
5	I	2031-12-26T14:39:33.008		77.32	-69.25	42178.88	-15.66		
6	I	2031-12-26T14:39:57.119		77.39	-69.33	41802.65	-15.45		

No planet occultations

6	E	2031-12-26T15:18:46.461		81.56	-76.65	41807.93	15.45		
5	E	2031-12-26T15:19:16.857		81.57	-76.73	42285.34	15.66		
4	E	2031-12-26T15:19:38.363		81.57	-76.79	42612.85	15.85		
alpha	E	2031-12-26T15:21:45.550		81.59	-77.15	44686.36	16.69		
beta	E	2031-12-26T15:22:42.729		81.60	-77.30	45650.27	17.04		
eta	E	2031-12-26T15:24:11.004		81.59	-77.54	47176.12	17.52		
gamma	E	2031-12-26T15:24:36.828		81.58	-77.61	47630.22	17.65		
delta	E	2031-12-26T15:25:14.589		81.57	-77.71	48300.35	17.84		
lambda	E	2031-12-26T15:26:50.147		81.54	-77.96	50026.71	18.28		
epsilon	E	2031-12-26T15:27:29.237		81.52	-78.06	50744.76	18.46		

```

target                : Uranus
target radius (km)   : 25559.00
C/A epoch            : 2031-12-26T14:54:51.520
Event type          : PtRgt
: Uranus occs: topocentric, not geocentric
: Ring occs: geocentric, topocentric
Observer code       : IRTF
Location            : Mauna Kea/IRTF
Latitude (deg)      : 19.82622
E. Longitude (deg)  : 204.52800
Altitude (km)       : 4.168
Gaia source ID      : 3404507188403061760
2Mass ID (if available) : 05352896+2328269
ICRS Star Coord at Epoch: 05h 35m 28.99072s +23:28:26.14948s
RUWE (>1.4 is poor) : 0.99
K magnitude          : 13.016
G magnitude          : 16.462
RP magnitude         : 15.400
BP magnitude         : 17.605
DUPflag             : 0
Distance (au)       : 18.115
f0 (km)             : 0.000
g0 (km)             : 0.000
skyplane vel. (km/s) : -23.00
Sun-Target sep (deg) : 170.19
Sun-Moon sep (deg)  : 14.71
B (ring opening deg) : 79.65
PA of pole (deg)    : 37.86
Pole direction: RA (deg): 257.31100
Dec (deg): -15.17500
C/A sky separation (") : 2.402
C/A sky separation (km) : 31557.0
NAIF SPICE kernels  : RAJobs_U111+rgf15.spk
URKALLvl1.spk
ural11.bsp
IAU_URANUS_for_RINGFIT.tpc
vgr2.ural11.bsp
ural61.bsp
vgr2.ural61.bsp
peph.ural60.bsp
earthstns_itr93_040916.bsp
earth_720101_070426.bpc
earth_200101_990628_predict.bpc
pg3f0000r.bsp
pg490000r.bsp
naif0012.tls
earth_flat_IAU.spk
  
```



b: ring blocked by planet x: target alt < 5.0 deg or sun > -5.0 deg

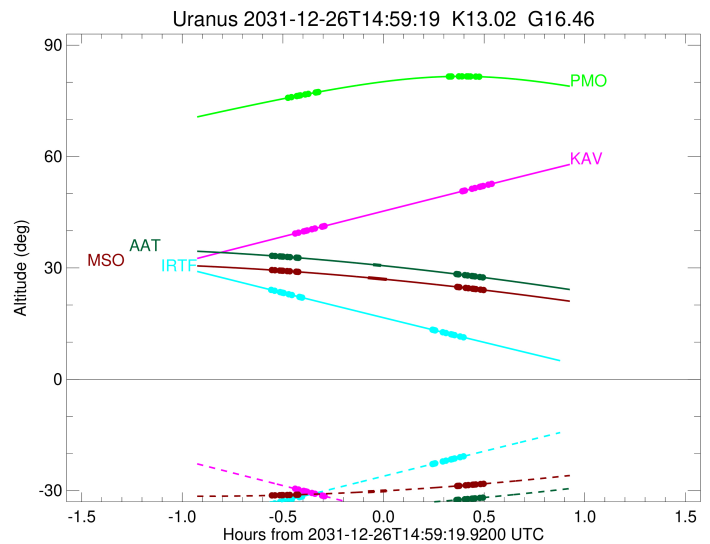
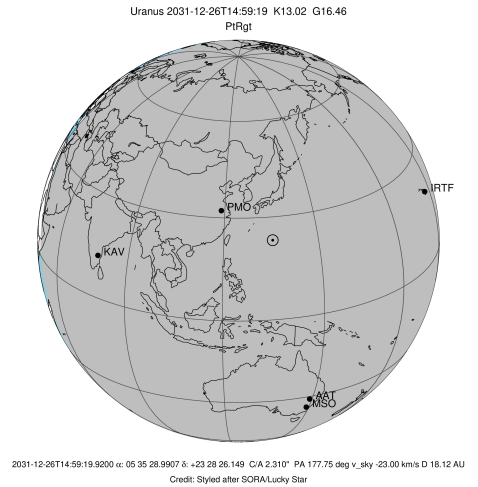
Ring	I/E	UTC	b?	alt	alt-sun	radius	r-dot	lat-geo	lat-geodetic
epsilon	I	2031-12-26T14:25:44.387		24.10	-33.70	51272.53	-18.15		
lambda	I	2031-12-26T14:26:53.174		23.84	-33.44	50026.71	-17.96		
delta	I	2031-12-26T14:28:30.495		23.48	-33.07	48300.35	-17.51		
gamma	I	2031-12-26T14:29:09.035		23.33	-32.92	47629.31	-17.32		
eta	I	2031-12-26T14:29:35.313		23.23	-32.82	47176.12	-17.18		
beta	I	2031-12-26T14:31:03.742		22.90	-32.49	45678.49	-16.68		
alpha	I	2031-12-26T14:32:01.200		22.69	-32.27	44729.29	-16.33		
4	I	2031-12-26T14:34:15.489		22.19	-31.77	42593.26	-15.46		
5	I	2031-12-26T14:34:42.504		22.08	-31.66	42179.08	-15.27		
6	I	2031-12-26T14:35:07.245		21.99	-31.57	41802.56	-15.06		

No planet occultations

6	E	2031-12-26T15:13:53.319		13.36	-22.84	41807.30	15.01		
5	E	2031-12-26T15:14:24.542		13.24	-22.72	42284.06	15.22		
4	E	2031-12-26T15:14:46.770		13.16	-22.64	42613.20	15.41		
alpha	E	2031-12-26T15:16:57.388		12.68	-22.15	44686.57	16.27		
beta	E	2031-12-26T15:17:56.031		12.46	-21.94	45650.58	16.62		
eta	E	2031-12-26T15:19:26.461		12.13	-21.60	47176.12	17.10		
gamma	E	2031-12-26T15:19:52.908		12.03	-21.50	47630.28	17.24		
delta	E	2031-12-26T15:20:31.560		11.89	-21.36	48300.35	17.43		
lambda	E	2031-12-26T15:22:09.324		11.53	-20.99	50026.71	17.88		
epsilon	E	2031-12-26T15:22:49.328		11.39	-20.84	50745.34	18.06		

```

target                : Uranus
target radius (km)    : 25559.00
C/A epoch             : 2031-12-26T15:02:39.600
Event type            : PtRgt
: Uranus occs: topocentric, not geocentric
: Ring occs: geocentric, topocentric
Observer code         : KAV
Location              : Kavalur Observatory
Latitude (deg)        : 12.57556
E. Longitude (deg)    : 78.83167
Altitude (km)         : 0.722
Gaia source ID        : 3404507188403061760
2Mass ID (if available) : 05352896+2328269
ICRS Star Coord at Epoch: 05h 35m 28.99072s +23:28:26.14948s
RUWE (>1.4 is poor)  : 0.99
K magnitude           : 13.016
G magnitude           : 16.462
RP magnitude          : 15.400
BP magnitude          : 17.605
DUPflag              : 0
Distance (au)         : 18.115
f0 (km)               : 0.000
g0 (km)               : 0.000
skyplane vel. (km/s)  : -23.00
Sun-Target sep (deg)  : 170.19
Sun-Moon sep (deg)    : 13.32
B (ring opening deg)  : 79.65
PA of pole (deg)      : 37.86
Pole direction: RA (deg): 257.31100
Dec (deg): -15.17500
C/A sky separation (") : 2.278
C/A sky separation (km) : 29926.9
NAIF SPICE kernels    : RAJobs_U111+rgf15.spk
URKALLvl1.spk
ural11.bsp
IAU_URANUS_for_RINGFIT.tpc
vgr2.ural11.bsp
ural61.bsp
vgr2.ural61.bsp
peph.ural60.bsp
earthstns_itr93_040916.bsp
earth_720101_070426.bpc
earth_200101_990628_predict.bpc
pg3f0000r.bsp
pg490000r.bsp
naif0012.tls
earth_flat_IAU.spk
  
```

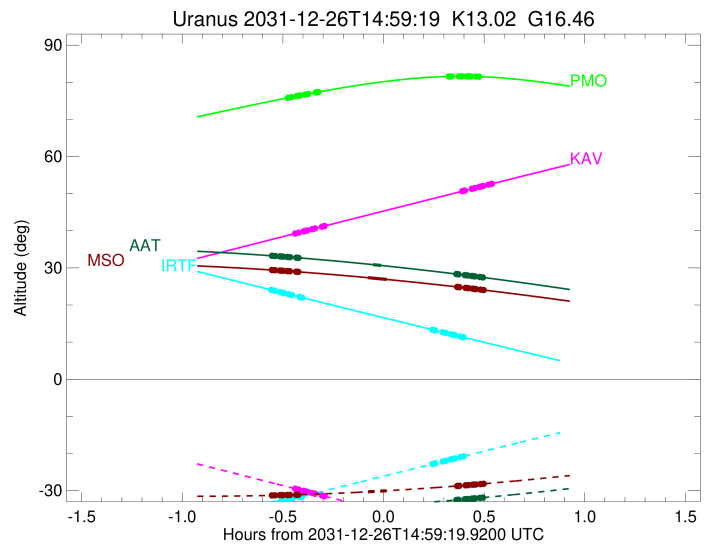
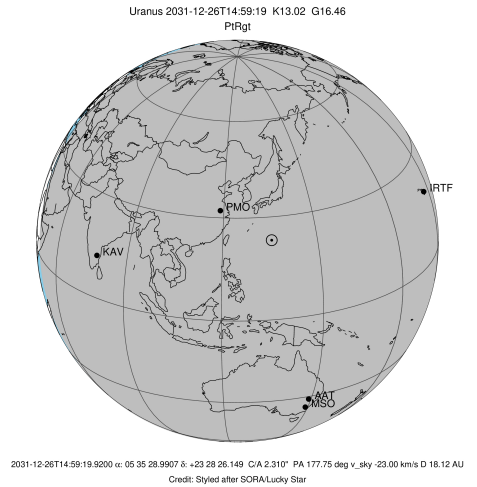


Ring	I/E	UTC	b?	alt	alt-sun	radius	r-dot	lat-geo	lat-geodetic
epsilon	I	2031-12-26T14:32:52.951		39.24	-29.46	51282.95	-18.82		
lambda	I	2031-12-26T14:33:59.777		39.49	-29.71	50026.71	-18.67		
delta	I	2031-12-26T14:35:33.218		39.85	-30.07	48300.35	-18.28		
gamma	I	2031-12-26T14:36:10.112		39.99	-30.21	47629.17	-18.11		
eta	I	2031-12-26T14:36:35.212		40.09	-30.31	47176.12	-17.99		
beta	I	2031-12-26T14:37:59.411		40.41	-30.63	45678.84	-17.57		
alpha	I	2031-12-26T14:38:53.837		40.62	-30.84	44730.50	-17.26		
4	I	2031-12-26T14:41:00.393		41.10	-31.32	42591.54	-16.53		
5	I	2031-12-26T14:41:25.670		41.20	-31.42	42176.59	-16.36		
6	I	2031-12-26T14:41:48.532		41.29	-31.50	41803.71	-16.18		

No planet occultations

6	E	2031-12-26T15:22:47.710		50.65	-40.90	41809.53	16.22		
5	E	2031-12-26T15:23:16.820		50.76	-41.01	42288.39	16.41		
4	E	2031-12-26T15:23:37.121		50.84	-41.09	42611.92	16.57		
alpha	E	2031-12-26T15:25:39.311		51.30	-41.56	44685.91	17.31		
beta	E	2031-12-26T15:26:34.514		51.51	-41.77	45649.55	17.62		
eta	E	2031-12-26T15:28:00.087		51.83	-42.09	47176.12	18.04		
gamma	E	2031-12-26T15:28:25.161		51.92	-42.19	47630.07	18.17		
delta	E	2031-12-26T15:29:01.890		52.06	-42.33	48300.35	18.33		
lambda	E	2031-12-26T15:30:35.029		52.41	-42.69	50026.71	18.73		
epsilon	E	2031-12-26T15:31:13.161		52.56	-42.83	50743.86	18.89		

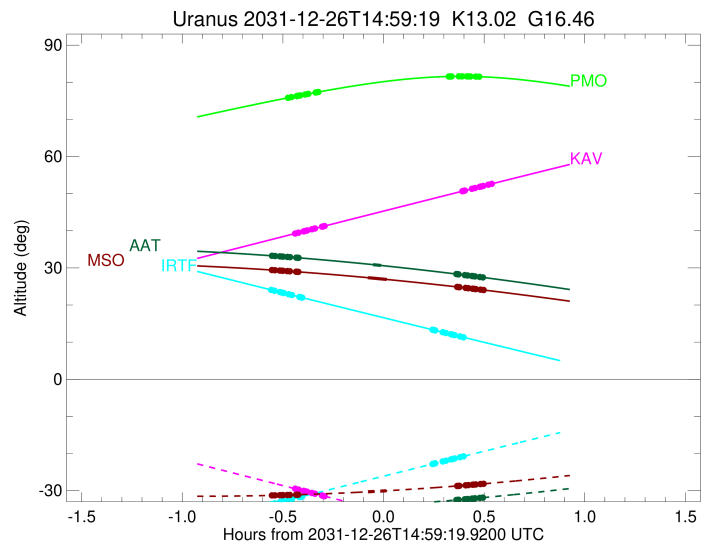
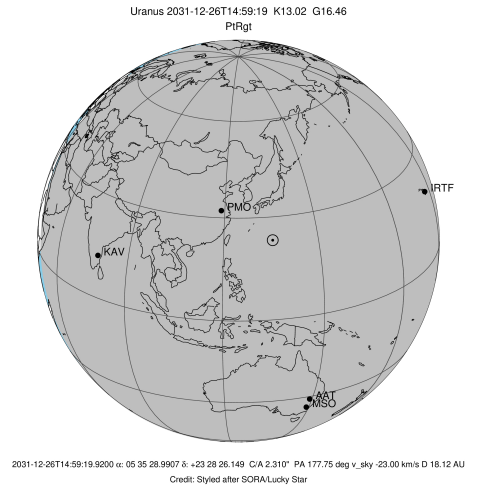
target : Uranus  
 target radius (km) : 25559.00  
 C/A epoch : 2031-12-26T14:57:48.520  
 Event type : PtRgt  
 : Uranus occs: topocentric, not geocentric  
 : Ring occs: geocentric, topocentric  
 Observer code : AAT  
 Location : Siding Spring (AAT)  
 Latitude (deg) : -31.27703  
 E. Longitude (deg) : 149.06608  
 Altitude (km) : 1.164  
 Gaia source ID : 3404507188403061760  
 2Mass ID (if available) : 05352896+2328269  
 ICRS Star Coord at Epoch: 05h 35m 28.99072s +23:28:26.14948s  
 RUWE (>1.4 is poor) : 0.99  
 K magnitude : 13.016  
 G magnitude : 16.462  
 RP magnitude : 15.400  
 BP magnitude : 17.605  
 DUPflag : 0  
 Distance (au) : 18.115  
 f0 (km) : 0.000  
 g0 (km) : 0.000  
 skyplane vel. (km/s) : -23.00  
 Sun-Target sep (deg) : 170.19  
 Sun-Moon sep (deg) : 14.10  
 B (ring opening deg) : 79.65  
 PA of pole (deg) : 37.86  
 Pole direction: RA (deg): 257.31100  
 Dec (deg): -15.17500  
 C/A sky separation (") : 1.916  
 C/A sky separation (km) : 25177.9  
 NAIF SPICE kernels : RAJobs\_U111+rgf15.spk  
 URKALLvl.spk  
 ura111.bsp  
 IAU\_URANUS\_for\_RINGFIT.tpc  
 vgr2.ura111.bsp  
 ura161.bsp  
 vgr2.ura161.bsp  
 peph.ura160.bsp  
 earthstns\_itr93\_040916.bsp  
 earth\_720101\_070426.bpc  
 earth\_200101\_990628\_predict.bpc  
 pg3f0000r.bsp  
 pg490000r.bsp  
 naif0012.tls  
 earth\_flat\_IAU.spk



b: ring blocked by planet x: target alt < 5.0 deg or sun > -5.0 deg

Ring	I/E	UTC	b?	alt	alt-sun	radius	r-dot	lat-geo	lat-geodetic
epsilon	I	2031-12-26T14:25:57.400		33.27	-35.29	51328.01	-20.37		
lambda	I	2031-12-26T14:27:01.299		33.20	-35.27	50026.71	-20.28		
delta	I	2031-12-26T14:28:26.985		33.10	-35.23	48300.35	-20.02		
gamma	I	2031-12-26T14:29:00.640		33.06	-35.22	47628.56	-19.91		
eta	I	2031-12-26T14:29:23.413		33.04	-35.21	47176.12	-19.83		
beta	I	2031-12-26T14:30:39.378		32.95	-35.18	45680.00	-19.55		
alpha	I	2031-12-26T14:31:27.949		32.89	-35.15	44734.97	-19.36		
4	I	2031-12-26T14:33:20.334		32.76	-35.10	42584.95	-18.89		
5	I	2031-12-26T14:33:42.442		32.73	-35.09	42168.61	-18.79		
6	I	2031-12-26T14:34:01.705		32.71	-35.08	41808.37	-18.67		
Uranus	I	2031-12-26T14:56:14.904		30.87	-34.14	25272.81		7.27	7.61
Uranus	E	2031-12-26T14:58:34.321		30.66	-34.01	25200.67		8.16	8.54
6	E	2031-12-26T15:21:01.530		28.35	-32.52	41814.52	18.65		
5	E	2031-12-26T15:21:27.166		28.30	-32.49	42296.40	18.76		
4	E	2031-12-26T15:21:44.324		28.27	-32.47	42608.70	18.86		
alpha	E	2031-12-26T15:23:32.854		28.06	-32.33	44684.99	19.33		
beta	E	2031-12-26T15:24:22.446		27.97	-32.26	45647.60	19.52		
eta	E	2031-12-26T15:25:40.171		27.82	-32.16	47176.12	19.79		
gamma	E	2031-12-26T15:26:03.038		27.78	-32.13	47629.61	19.87		
delta	E	2031-12-26T15:26:36.703		27.71	-32.08	48300.35	19.98		
lambda	E	2031-12-26T15:28:02.552		27.55	-31.96	50026.71	20.24		
epsilon	E	2031-12-26T15:28:37.927		27.48	-31.91	50744.31	20.33		

target : Uranus  
 target radius (km) : 25559.00  
 C/A epoch : 2031-12-26T14:57:53.550  
 Event type : PtRgt  
 : Uranus occs: topocentric, not geocentric  
 : Ring occs: geocentric, topocentric  
 Observer code : MSO  
 Location : Mt. Stromlo Observatory  
 Latitude (deg) : -35.32000  
 E. Longitude (deg) : 149.00833  
 Altitude (km) : 0.770  
 Gaia source ID : 3404507188403061760  
 2Mass ID (if available) : 05352896+2328269  
 ICRS Star Coord at Epoch: 05h 35m 28.99072s +23:28:26.14948s  
 RUWE (>1.4 is poor) : 0.99  
 K magnitude : 13.016  
 G magnitude : 16.462  
 RP magnitude : 15.400  
 BP magnitude : 17.605  
 DUPflag : 0  
 Distance (au) : 18.115  
 f0 (km) : 0.000  
 g0 (km) : 0.000  
 skyplane vel. (km/s) : -23.00  
 Sun-Target sep (deg) : 170.19  
 Sun-Moon sep (deg) : 14.07  
 B (ring opening deg) : 79.65  
 PA of pole (deg) : 37.86  
 Pole direction: RA (deg): 257.31100  
 Dec (deg): -15.17500  
 C/A sky separation (") : 1.897  
 C/A sky separation (km) : 24927.5  
 NAIF SPICE kernels : RAJobs\_U111+rgf15.spk  
 URKALLvl.spk  
 ura111.bsp  
 IAU\_URANUS\_for\_RINGFIT.tpc  
 vgr2.ura111.bsp  
 ura161.bsp  
 vgr2.ura161.bsp  
 peph.ura160.bsp  
 earthstns\_itr93\_040916.bsp  
 earth\_720101\_070426.bpc  
 earth\_200101\_990628\_predict.bpc  
 pg3f0000r.bsp  
 pg490000r.bsp  
 naif0012.tls  
 earth\_flat\_IAU.spk



Ring	I/E	UTC	b?	alt	alt-sun	radius	r-dot	lat-geo	lat-geodetic
epsilon	I	2031-12-26T14:25:55.013		29.43	-31.29	51330.06	-20.42		
lambda	I	2031-12-26T14:26:58.848		29.37	-31.27	50026.71	-20.33		
delta	I	2031-12-26T14:28:24.290		29.28	-31.24	48300.35	-20.08		
gamma	I	2031-12-26T14:28:57.842		29.25	-31.22	47628.53	-19.97		
eta	I	2031-12-26T14:29:20.540		29.23	-31.21	47176.12	-19.89		
beta	I	2031-12-26T14:30:36.239		29.15	-31.18	45680.04	-19.63		
alpha	I	2031-12-26T14:31:24.618		29.09	-31.16	44735.17	-19.43		
4	I	2031-12-26T14:33:16.544		28.97	-31.11	42584.63	-18.98		
5	I	2031-12-26T14:33:38.547		28.95	-31.10	42168.28	-18.88		
6	I	2031-12-26T14:33:57.688		28.93	-31.09	41808.60	-18.77		
Uranus	I	2031-12-26T14:54:42.427		27.37	-30.31	25323.86		6.58	6.89
Uranus	E	2031-12-26T15:00:17.321		26.89	-30.03	25152.47		8.71	9.11
6	E	2031-12-26T15:21:15.910		24.88	-28.75	41814.80	18.74		
5	E	2031-12-26T15:21:41.429		24.84	-28.72	42296.79	18.85		
4	E	2031-12-26T15:21:58.471		24.81	-28.70	42608.51	18.95		
alpha	E	2031-12-26T15:23:46.534		24.62	-28.57	44684.95	19.40		
beta	E	2031-12-26T15:24:35.931		24.53	-28.51	45647.50	19.59		
eta	E	2031-12-26T15:25:53.386		24.40	-28.41	47176.12	19.86		
gamma	E	2031-12-26T15:26:16.177		24.35	-28.38	47629.59	19.94		
delta	E	2031-12-26T15:26:49.736		24.29	-28.34	48300.35	20.04		
lambda	E	2031-12-26T15:28:15.334		24.14	-28.23	50026.71	20.29		
epsilon	E	2031-12-26T15:28:50.622		24.08	-28.19	50744.46	20.38		