

target : Uranus  
 target radius (km) : 25559.00  
 C/A epoch : 2031-12-02T20:27:27.030  
 Event type : PgtRgt  
 : Uranus occs: geocentric, topocentric  
 : Ring occs: geocentric, topocentric  
 Gaia source ID : 3404410981135593088  
 2Mass ID (if available) : 05395216+2330285

Uranus 2031-12-02T20:27:27 K14.17 G18.65 PgtRgt

ICRS Star Coord at Epoch: 05h 39m 52.16756s +23:30:28.58124s

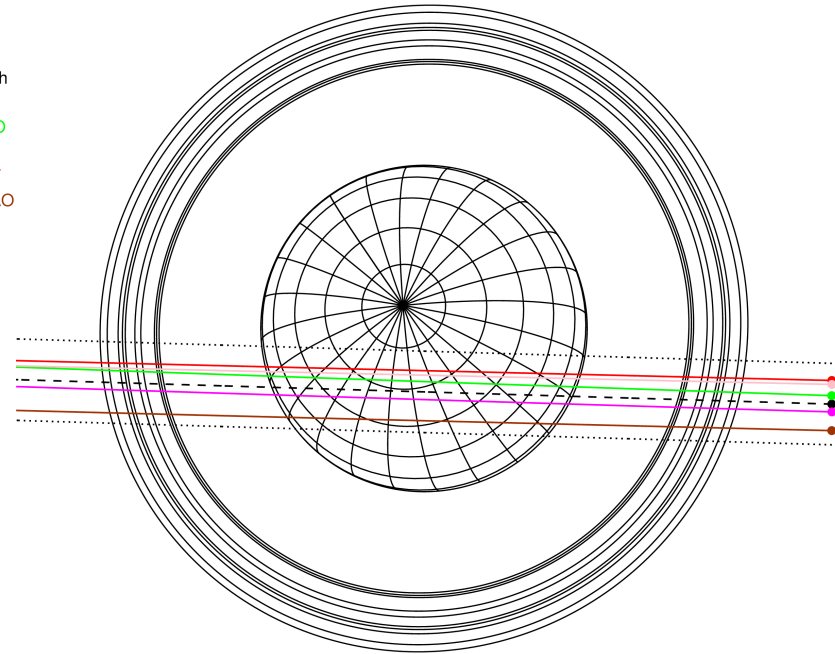
RUWE (>1.4 is poor) : 1.02  
 K magnitude : 14.173  
 G magnitude : 18.645  
 RP magnitude : 17.464  
 BP magnitude : 20.177  
 DUPflag : 0  
 Distance (au) : 18.137  
 f0 (km) : 0.000  
 g0 (km) : 0.000  
 skyplane vel. (km/s) : -22.36  
 Sun-Target sep (deg) : 164.62  
 Sun-Moon sep (deg) : 28.24  
 B (ring opening deg) : 78.98  
 PA of pole (deg) : 42.26

Uranus 2031-12-02T20:27:27 K14.17 G18.65  
 PgtRgt



2031-12-02T20:27:27.0300 ra: 05 39 52.1676 s: +23 30 28.581 C/A 0.7477 PA 358.28 deg v\_sky -22.36 km/s D 18.14 AU  
 Credit: Styled after SORA/Lucky Star

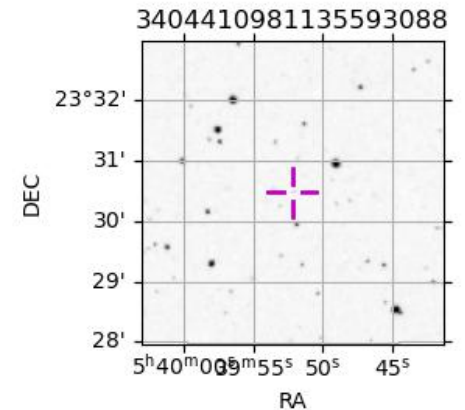
Earth  
 PIC  
 PMO  
 TEN  
 KAV  
 SAAO



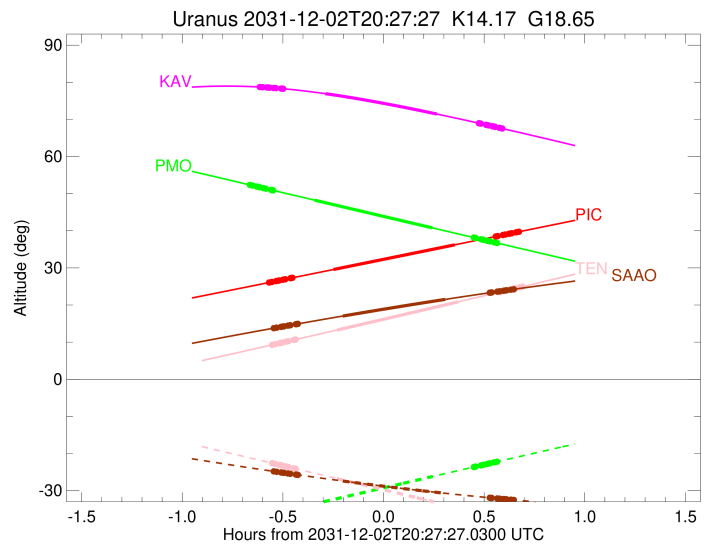
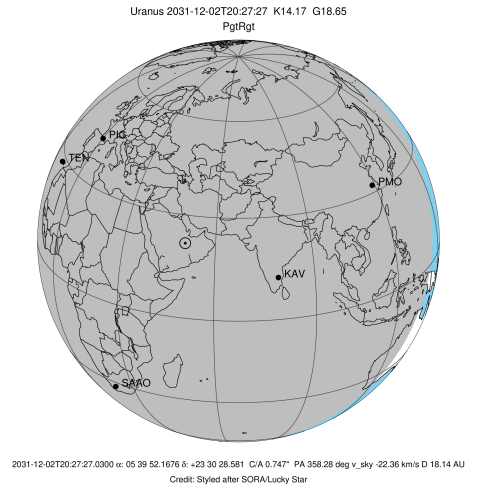
#	a(km)	ring
1	41837.2	6
2	42235.0	5
3	42571.2	4
4	44718.5	alpha
5	45661.1	beta
6	47176.1	eta
7	47626.3	gamma
8	48300.3	delta
9	50026.7	lambda
10	51149.4	epsilon

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	+++++	+ +	+++++	DEC 02 19:53 - DEC 02 21:07	PieRie
PAL	Palomar Mt (200")	33.4	243.1					PnnRnn
PMO	Purple Mtn Obs. Nanki	32.1	118.8	+++++	+ +	+++++	DEC 02 19:47 - DEC 02 21:01	PieRie
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	+++++	+ +	+++++	DEC 02 19:54 - DEC 02 21:08	PieRie
IRTF	Mauna Kea/IRTF	19.8	204.5					PnnRnn
KAV	Kavalur Observatory	12.6	78.8	+++++	+ +	+++++	DEC 02 19:50 - DEC 02 21:02	PieRie
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					PnnRnn
SAAO	So. Afr. Astro. Obs.	-32.4	20.8	+++++	+ +	+++++	DEC 02 19:54 - DEC 02 21:06	PieRie
MSO	Mt. Stromlo Observato	-35.3	149.0					PnnRnn

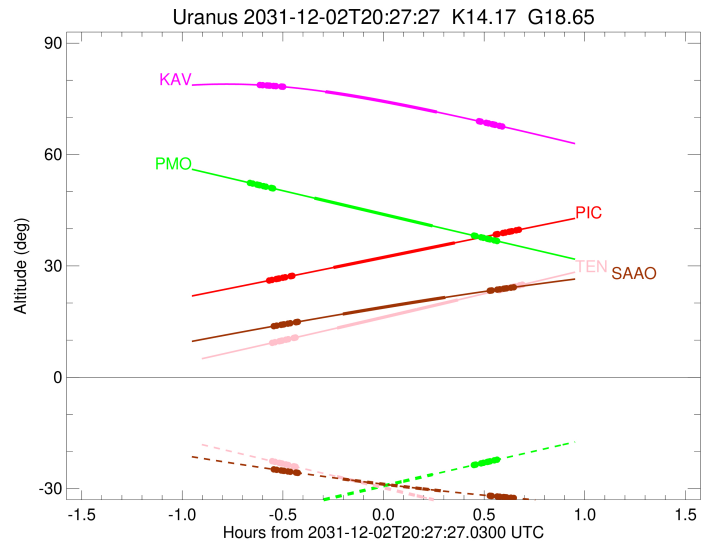
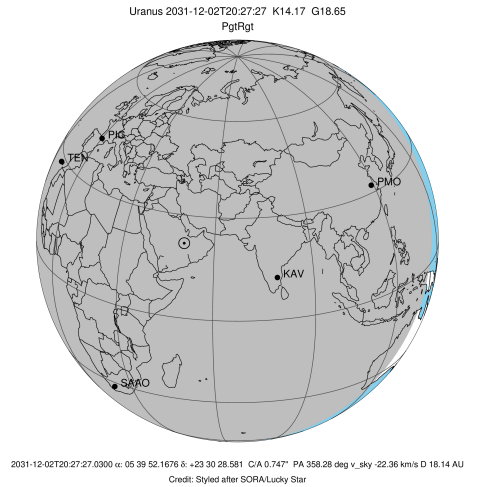


target : Uranus  
 target radius (km) : 25559.00  
 C/A epoch : 2031-12-02T20:30:32.870  
 Event type : PgtRgt  
 : Uranus occs: geocentric, topocentric  
 : Ring occs: geocentric, topocentric  
 Observer code : PIC  
 Location : Pic du Midi  
 Latitude (deg) : 42.93656  
 E. Longitude (deg) : 0.14231  
 Altitude (km) : 2.890  
 Gaia source ID : 3404410981135593088  
 2Mass ID (if available) : 05395216+2330285  
 ICRS Star Coord at Epoch: 05h 39m 52.16756s +23:30:28.58124s  
 RUWE (>1.4 is poor) : 1.02  
 K magnitude : 14.173  
 G magnitude : 18.645  
 RP magnitude : 17.464  
 BP magnitude : 20.177  
 DUPflag : 0  
 Distance (au) : 18.137  
 f0 (km) : 0.000  
 g0 (km) : 0.000  
 skyplane vel. (km/s) : -22.36  
 Sun-Target sep (deg) : 164.62  
 Sun-Moon sep (deg) : 29.06  
 B (ring opening deg) : 78.98  
 PA of pole (deg) : 42.26  
 Pole direction: RA (deg): 257.31100  
 Dec (deg): -15.17500  
 C/A sky separation (") : 0.502  
 C/A sky separation (km) : 6598.9  
 NAIF SPICE kernels : RAJobs\_U111+rgf15.spk  
 URKALLvl1.spk  
 ura111.bsp  
 IAU\_URANUS\_for\_RINGFIT.tpc  
 vgr2.ura111.bsp  
 ura161.bsp  
 vgr2.ura161.bsp  
 peph.ura160.bsp  
 earthstns\_itrfr93\_040916.bsp  
 earth\_720101\_070426.bpc  
 earth\_200101\_990628\_predict.bpc  
 pg3f0000r.bsp  
 pg490000r.bsp  
 naif0012.tls  
 earth\_flat\_IAU.spk



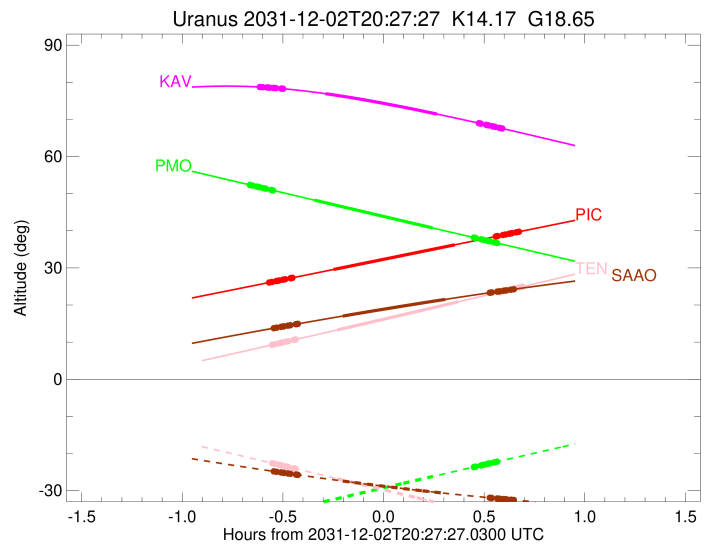
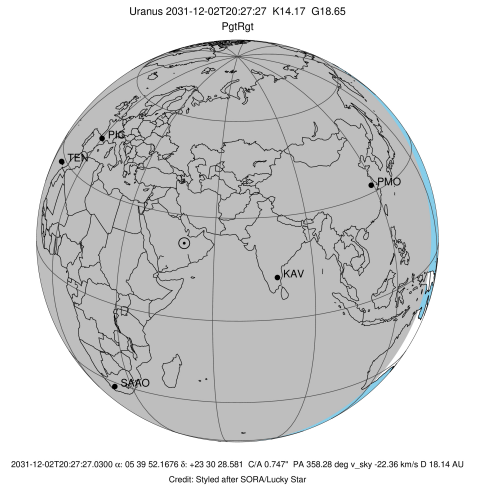
Ring	I/E	UTC	b?	alt	alt-sun	radius	r-dot	lat-geo	lat-geodetic
epsilon	I	2031-12-02T19:53:12.974		26.04	-37.30	51354.37	-22.47		
lambda	I	2031-12-02T19:54:12.137		26.22	-37.48	50026.71	-22.44		
delta	I	2031-12-02T19:55:29.104		26.45	-37.71	48300.35	-22.42		
gamma	I	2031-12-02T19:55:59.061		26.54	-37.81	47628.71	-22.42		
eta	I	2031-12-02T19:56:19.252		26.61	-37.87	47176.12	-22.41		
beta	I	2031-12-02T19:57:26.040		26.81	-38.07	45679.08	-22.40		
alpha	I	2031-12-02T19:58:08.403		26.94	-38.20	44729.97	-22.39		
4	I	2031-12-02T19:59:43.616		27.23	-38.49	42596.75	-22.36		
5	I	2031-12-02T20:00:02.442		27.28	-38.55	42185.58	-22.36		
6	I	2031-12-02T20:00:19.410		27.34	-38.60	41799.60	-22.36		
Uranus	I	2031-12-02T20:12:33.864		29.57	-40.84	25141.86		-9.42	-9.86
Uranus	E	2031-12-02T20:48:43.687		36.22	-47.36	25426.16		5.25	5.50
6	E	2031-12-02T21:00:57.140		38.47	-49.51	41879.17	22.45		
5	E	2031-12-02T21:01:14.066		38.52	-49.56	42262.27	22.45		
4	E	2031-12-02T21:01:26.551		38.56	-49.60	42535.43	22.45		
alpha	E	2031-12-02T21:03:03.531		38.86	-49.88	44716.87	22.49		
beta	E	2031-12-02T21:03:44.874		38.99	-50.00	45646.56	22.50		
eta	E	2031-12-02T21:04:52.819		39.19	-50.20	47176.12	22.51		
gamma	E	2031-12-02T21:05:12.649		39.25	-50.26	47622.62	22.52		
delta	E	2031-12-02T21:05:42.741		39.35	-50.35	48300.35	22.53		
lambda	E	2031-12-02T21:06:59.351		39.58	-50.57	50026.71	22.54		
epsilon	E	2031-12-02T21:07:44.094		39.72	-50.70	51035.56	22.57		

target : Uranus  
 target radius (km) : 25559.00  
 C/A epoch : 2031-12-02T20:24:19.090  
 Event type : PgtRgt  
 : Uranus occs: geocentric, topocentric  
 : 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 : 3404410981135593088  
 2Mass ID (if available) : 05395216+2330285  
 ICRS Star Coord at Epoch: 05h 39m 52.16756s +23:30:28.58124s  
 RUWE (>1.4 is poor) : 1.02  
 K magnitude : 14.173  
 G magnitude : 18.645  
 RP magnitude : 17.464  
 BP magnitude : 20.177  
 DUPflag : 0  
 Distance (au) : 18.137  
 f0 (km) : 0.000  
 g0 (km) : 0.000  
 skyplane vel. (km/s) : -22.36  
 Sun-Target sep (deg) : 164.62  
 Sun-Moon sep (deg) : 28.04  
 B (ring opening deg) : 78.98  
 PA of pole (deg) : 42.26  
 Pole direction: RA (deg): 257.31100  
 Dec (deg): -15.17500  
 C/A sky separation (") : 0.632  
 C/A sky separation (km) : 8308.3  
 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



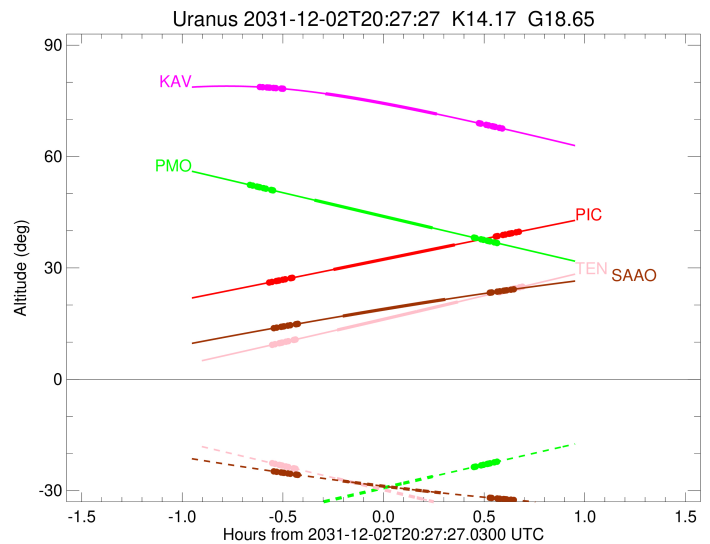
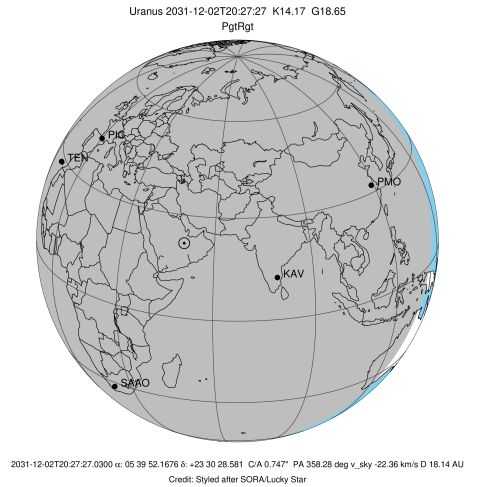
Ring	I/E	UTC	b?	alt	alt-sun	radius	r-dot	lat-geo	lat-geodetic
epsilon	I	2031-12-02T19:47:27.882		52.39	-37.68	51369.77	-22.57		
lambda	I	2031-12-02T19:48:27.465		52.17	-37.47	50026.71	-22.53		
delta	I	2031-12-02T19:49:44.127		51.90	-37.20	48300.35	-22.51		
gamma	I	2031-12-02T19:50:13.987		51.80	-37.09	47628.49	-22.50		
eta	I	2031-12-02T19:50:34.099		51.73	-37.02	47176.12	-22.49		
beta	I	2031-12-02T19:51:40.664		51.49	-36.79	45679.50	-22.46		
alpha	I	2031-12-02T19:52:22.861		51.34	-36.64	44731.54	-22.45		
4	I	2031-12-02T19:53:58.045		51.00	-36.31	42594.78	-22.39		
5	I	2031-12-02T19:54:16.911		50.94	-36.24	42182.36	-22.39		
6	I	2031-12-02T19:54:33.641		50.88	-36.18	41800.68	-22.38		
Uranus	I	2031-12-02T20:06:52.016		48.26	-33.58	25103.35		-9.86	-10.32
Uranus	E	2031-12-02T20:42:03.573		40.78	-26.20	25453.60		4.68	4.90
6	E	2031-12-02T20:54:24.547		38.16	-23.64	41879.36	22.31		
5	E	2031-12-02T20:54:41.473		38.10	-23.58	42259.94	22.31		
4	E	2031-12-02T20:54:54.084		38.05	-23.53	42534.60	22.32		
alpha	E	2031-12-02T20:56:31.681		37.71	-23.20	44717.83	22.37		
beta	E	2031-12-02T20:57:13.213		37.56	-23.05	45646.94	22.38		
eta	E	2031-12-02T20:58:21.476		37.32	-22.82	47176.12	22.41		
gamma	E	2031-12-02T20:58:41.396		37.25	-22.75	47622.52	22.41		
delta	E	2031-12-02T20:59:11.631		37.15	-22.65	48300.35	22.42		
lambda	E	2031-12-02T21:00:28.584		36.88	-22.38	50026.71	22.45		
epsilon	E	2031-12-02T21:01:13.923		36.72	-22.22	51044.63	22.49		

target : Uranus  
 target radius (km) : 25559.00  
 C/A epoch : 2031-12-02T20:31:30.940  
 Event type : PgtRgt  
 : Uranus occs: geocentric, topocentric  
 : Ring occs: geocentric, topocentric  
 Observer code : TEN  
 Location : Teide Obs./Tenerife  
 Latitude (deg) : 28.30050  
 E. Longitude (deg) : 343.48909  
 Altitude (km) : 2.395  
 Gaia source ID : 3404410981135593088  
 2Mass ID (if available) : 05395216+2330285  
 ICRS Star Coord at Epoch: 05h 39m 52.16756s +23:30:28.58124s  
 RUWE (>1.4 is poor) : 1.02  
 K magnitude : 14.173  
 G magnitude : 18.645  
 RP magnitude : 17.464  
 BP magnitude : 20.177  
 DUPflag : 0  
 Distance (au) : 18.137  
 f0 (km) : 0.000  
 g0 (km) : 0.000  
 skyplane vel. (km/s) : -22.36  
 Sun-Target sep (deg) : 164.62  
 Sun-Moon sep (deg) : 29.09  
 B (ring opening deg) : 78.98  
 PA of pole (deg) : 42.26  
 Pole direction: RA (deg): 257.31100  
 Dec (deg): -15.17500  
 C/A sky separation (") : 0.556  
 C/A sky separation (km) : 7308.7  
 NAIF SPICE kernels : RAJobs\_U111+rgf15.spk  
 URKALLvl1.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	2031-12-02T19:54:06.477		9.24	-22.57	51358.79	-22.32		
lambda	I	2031-12-02T19:55:06.220		9.44	-22.79	50026.71	-22.29		
delta	I	2031-12-02T19:56:23.694		9.71	-23.06	48300.35	-22.27		
gamma	I	2031-12-02T19:56:53.854		9.81	-23.17	47628.65	-22.27		
eta	I	2031-12-02T19:57:14.178		9.88	-23.24	47176.12	-22.26		
beta	I	2031-12-02T19:58:21.415		10.11	-23.48	45679.20	-22.25		
alpha	I	2031-12-02T19:59:04.055		10.26	-23.64	44730.44	-22.24		
4	I	2031-12-02T20:00:39.992		10.59	-23.98	42596.16	-22.20		
5	I	2031-12-02T20:00:58.977		10.65	-24.05	42184.59	-22.20		
6	I	2031-12-02T20:01:16.003		10.71	-24.11	41799.91	-22.19		
Uranus	I	2031-12-02T20:13:37.421		13.27	-26.77	25128.31		-9.58	-10.02
Uranus	E	2031-12-02T20:49:37.389		20.84	-34.58	25440.62		4.96	5.19
6	E	2031-12-02T21:01:56.870		23.46	-37.27	41879.29	22.31		
5	E	2031-12-02T21:02:13.839		23.52	-37.33	42260.84	22.31		
4	E	2031-12-02T21:02:26.433		23.57	-37.38	42534.92	22.31		
alpha	E	2031-12-02T21:04:04.041		23.92	-37.73	44717.48	22.36		
beta	E	2031-12-02T21:04:45.605		24.06	-37.88	45646.80	22.37		
eta	E	2031-12-02T21:05:53.918		24.31	-38.13	47176.12	22.39		
gamma	E	2031-12-02T21:06:13.854		24.38	-38.20	47622.55	22.40		
delta	E	2031-12-02T21:06:44.110		24.49	-38.31	48300.35	22.41		
lambda	E	2031-12-02T21:08:01.123		24.76	-38.60	50026.71	22.43		
epsilon	E	2031-12-02T21:08:46.371		24.92	-38.76	51041.73	22.46		

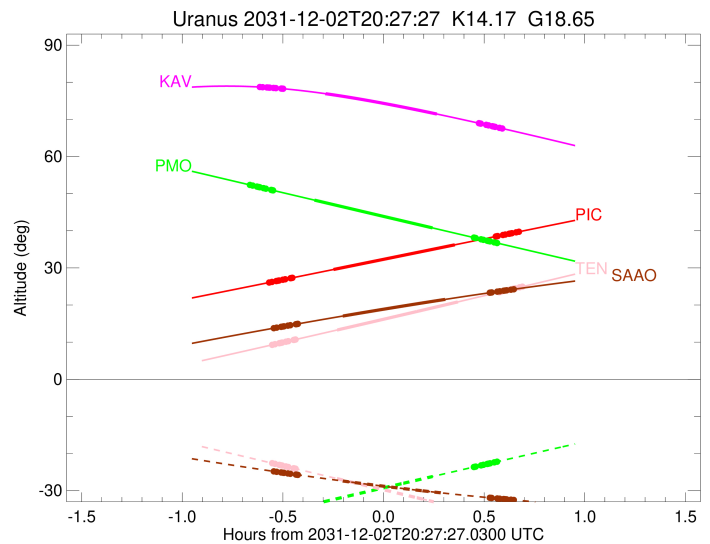
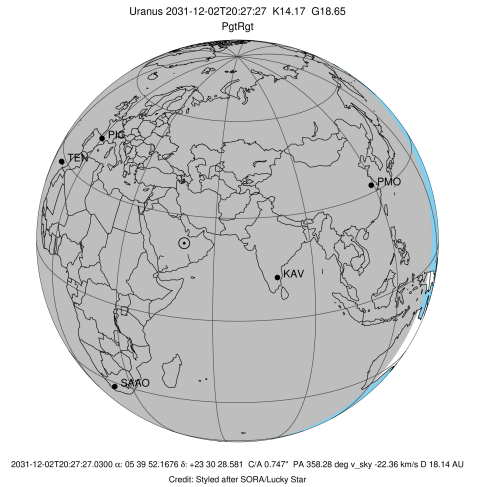
target : Uranus  
 target radius (km) : 25559.00  
 C/A epoch : 2031-12-02T20:26:33.420  
 Event type : PgtRgt  
 : Uranus occs: geocentric, topocentric  
 : Ring occs: geocentric, topocentric  
 Observer code : KAV  
 Location : Kavalur Observatory  
 Latitude (deg) : 12.57556  
 E. Longitude (deg) : 78.83167  
 Altitude (km) : 0.722  
 Gaia source ID : 3404410981135593088  
 2Mass ID (if available) : 05395216+2330285  
 ICRS Star Coord at Epoch: 05h 39m 52.16756s +23:30:28.58124s  
 RUWE (>1.4 is poor) : 1.02  
 K magnitude : 14.173  
 G magnitude : 18.645  
 RP magnitude : 17.464  
 BP magnitude : 20.177  
 DUPflag : 0  
 Distance (au) : 18.137  
 f0 (km) : 0.000  
 g0 (km) : 0.000  
 skyplane vel. (km/s) : -22.36  
 Sun-Target sep (deg) : 164.62  
 Sun-Moon sep (deg) : 28.48  
 B (ring opening deg) : 78.98  
 PA of pole (deg) : 42.26  
 Pole direction: RA (deg): 257.31100  
 Dec (deg): -15.17500  
 C/A sky separation (") : 0.846  
 C/A sky separation (km) : 11124.9  
 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



Ring	I/E	UTC	b?	alt	alt-sun	radius	r-dot	lat-geo	lat-geodetic
epsilon	I	2031-12-02T19:50:24.469		78.73	-69.48	51387.32	-22.49		
lambda	I	2031-12-02T19:51:25.105		78.68	-69.26	50026.71	-22.42		
delta	I	2031-12-02T19:52:42.169		78.61	-68.99	48300.35	-22.38		
gamma	I	2031-12-02T19:53:12.216		78.58	-68.88	47628.21	-22.36		
eta	I	2031-12-02T19:53:32.439		78.55	-68.81	47176.12	-22.35		
beta	I	2031-12-02T19:54:39.430		78.48	-68.57	45679.95	-22.30		
alpha	I	2031-12-02T19:55:21.870		78.43	-68.42	44733.42	-22.28		
4	I	2031-12-02T19:56:58.065		78.31	-68.08	42592.23	-22.19		
5	I	2031-12-02T19:57:17.177		78.28	-68.01	42178.54	-22.17		
6	I	2031-12-02T19:57:33.800		78.26	-67.95	41802.18	-22.17		
Uranus	I	2031-12-02T20:10:09.028		76.93	-65.22	25056.40		-10.38	-10.86
Uranus	E	2031-12-02T20:43:19.794		71.46	-57.79	25502.29		3.42	3.58
6	E	2031-12-02T20:55:55.190		68.98	-54.93	41879.67	22.15		
5	E	2031-12-02T20:56:11.999		68.92	-54.86	42254.30	22.16		
4	E	2031-12-02T20:56:24.829		68.88	-54.81	42532.77	22.17		
alpha	E	2031-12-02T20:58:03.194		68.54	-54.44	44720.17	22.26		
beta	E	2031-12-02T20:58:44.863		68.40	-54.28	45647.93	22.29		
eta	E	2031-12-02T20:59:53.347		68.17	-54.02	47176.12	22.33		
gamma	E	2031-12-02T21:00:13.321		68.10	-53.94	47622.28	22.34		
delta	E	2031-12-02T21:00:43.655		67.99	-53.83	48300.35	22.36		
lambda	E	2031-12-02T21:02:00.780		67.73	-53.53	50026.71	22.41		
epsilon	E	2031-12-02T21:02:47.252		67.57	-53.36	51068.48	22.47		

```

target                : Uranus
target radius (km)   : 25559.00
C/A epoch            : 2031-12-02T20:30:21.250
Event type          : PgtRgt
: Uranus occs: geocentric, topocentric
: Ring occs: geocentric, topocentric
Observer code       : SAAO
Location            : So. Afr. Astro. Obs. (Sutherland)
Latitude (deg)      : -32.37953
E. Longitude (deg)  : 20.81070
Altitude (km)       : 1.768
Gaia source ID      : 3404410981135593088
2Mass ID (if available) : 05395216+2330285
ICRS Star Coord at Epoch: 05h 39m 52.16756s +23:30:28.58124s
RUWE (>1.4 is poor) : 1.02
K magnitude          : 14.173
G magnitude          : 18.645
RP magnitude         : 17.464
BP magnitude         : 20.177
DUPflag             : 0
Distance (au)       : 18.137
f0 (km)             : 0.000
g0 (km)             : 0.000
skyplane vel. (km/s) : -22.36
Sun-Target sep (deg) : 164.62
Sun-Moon sep (deg)  : 28.78
B (ring opening deg) : 78.98
PA of pole (deg)    : 42.26
Pole direction: RA (deg): 257.31100
Dec (deg): -15.17500
C/A sky separation (") : 1.098
C/A sky separation (km) : 14440.3
NAIF SPICE kernels  : RAJobs_U111+rgf15.spk
URKALLvl1.spk
urall1.bsp
IAU_URANUS_for_RINGFIT.tpc
vgr2.urall1.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	2031-12-02T19:54:32.806		13.73	-24.79	51407.10	-21.88		
lambda	I	2031-12-02T19:55:36.076		13.90	-24.93	50026.71	-21.79		
delta	I	2031-12-02T19:56:55.428		14.12	-25.10	48300.35	-21.72		
gamma	I	2031-12-02T19:57:26.412		14.20	-25.17	47627.87	-21.69		
eta	I	2031-12-02T19:57:47.252		14.26	-25.22	47176.12	-21.67		
beta	I	2031-12-02T19:58:56.376		14.45	-25.37	45680.40	-21.59		
alpha	I	2031-12-02T19:59:40.148		14.56	-25.46	44735.58	-21.54		
4	I	2031-12-02T20:01:19.989		14.83	-25.68	42589.10	-21.40		
5	I	2031-12-02T20:01:39.864		14.88	-25.72	42174.30	-21.37		
6	I	2031-12-02T20:01:56.782		14.93	-25.75	41804.17	-21.36		
Uranus	I	2031-12-02T20:15:18.365		17.03	-27.41	25014.82		-10.82	-11.32
Uranus	E	2031-12-02T20:45:51.790		21.52	-30.71	25543.89		1.76	1.85
6	E	2031-12-02T20:59:09.964		23.32	-31.93	41879.73	21.43		
5	E	2031-12-02T20:59:27.033		23.36	-31.95	42247.24	21.45		
4	E	2031-12-02T20:59:40.468		23.38	-31.97	42530.79	21.47		
alpha	E	2031-12-02T21:01:22.112		23.61	-32.11	44723.03	21.62		
beta	E	2031-12-02T21:02:04.917		23.70	-32.17	45649.23	21.67		
eta	E	2031-12-02T21:03:15.227		23.85	-32.27	47176.12	21.75		
gamma	E	2031-12-02T21:03:35.717		23.89	-32.30	47622.02	21.77		
delta	E	2031-12-02T21:04:06.849		23.96	-32.34	48300.35	21.81		
lambda	E	2031-12-02T21:05:25.881		24.13	-32.45	50026.71	21.88		
epsilon	E	2031-12-02T21:06:14.798		24.23	-32.51	51098.13	21.98		