Missions for Portable Meter Class Telescopes

David Dunham, president, IOTA

dunham@starpower.net

Light Bucket Astronomy Conference

January 2, 2011

Occultations by Trans-Neptunian Objects

- Certainly, observation of occultations by TNO's is a major justification for portable meter-class scopes
- TNO's move slowly so occultations are rare; if 16^{th} and 17^{th}-mag. stars can be considered, opportunities will be more frequent
- The larger aperture will give higher S/N for the brighter events, allowing information about TNO atmospheric fading to be measured, and/or higher time resolution of the recordings
- Large portable telescopes will allow filling in gaps in coverage by the fixed-site observatories that are now used for the fainter events
- This will result in more chords, better distributed across the object, with smaller timing errors (with shorter integration and dead times)
- More about TNO occultations have been discussed by others at this conference, so I'll talk more about other applications

Lunar Occultations

- When not making other observations, lunar occultations can be observed, if for nothing else, as practice, and to train new operators, to familiarize them with accurate timing procedures as well as with operating the large telescope
- Several events should be visible each night
- Issues with baffling and glare when the Moon is gibbous will need to be dealt with, which could help for other types of observation in twilight or light-polluted places
- With higher S/N, double stars and angular diameters might be recorded for many more fainter stars where only timings were possible with smaller scopes
- That is, Fresnel diffraction phenomena can be measured and deconvolved to reveal more information about occulted stars

Lunar Grazing Occultations

- A portable meter-class telescope can be transported into the path of a grazing occultation where multiple contacts at different position angles (PA's) can be recorded
- Video recordings with smaller telescopes should be made at locations about 20m north and south of the large telescope, so that local lunar slopes can be determined
- The deconvolution of the diffraction patterns at different PA's, as determined from the slope measurements, can reveal the light distribution across the occulted star
- This might reveal close faint companion stars, star spots, and disks of incandescent material, but probably not planets

Best 2011 N. American Lunar Grazes

RASC #	2011 Date	Star #	D	mag.	% Snl	L	w. UT h	m	w. end long	lat	States, Prov.	Star Name
2	JAN 1	ZC 2347		4.5	9-	N	13	32.1	-120	41	NV-TX	omicron Sco
5	JAN 8	ZC 3320	T	5.0	18+	S	22	56.1	-92	42	IA-QC	kappa Aqr (Situla)
6	JAN 9	ZC 3326	O	6.4	19+	S	1	3.2	-111	23	sBaja-NC	
8	JAN 10	ZC 3453	V	5.0	28+	S	2	9.7	-130	48	BC-SK	kappa Psc
14	JAN 18	ZC 946	Q	3.5	95+	S	0	24.5	-128	40	OR-ON	eta Gem (Propus)
15	JAN 18	ZC 976	G	2.9b	96+	S	3	54.8	-130	39	nCA-NC	mu Gem (Tejat)
23	JAN 28	ZC 2270		5.4	31-	S	8	28.7	-72	45	VT-ME	
26	JAN 29	ZC 2442		5.9	20-	S	11	50.3	-111	39	UT-LA	
38	FEB 11	ZC 472	K	4.9	50+	N	8	22.6	-122	55	BC-SK	zeta Ari
46	FEB 14	ZC 916	Q	4.3	79+	N	8	43.1	-130	40	sCA-MX	1 Gem
62	MAR 13	ZC 976	G	2.9d	60+	N	23	23.7	-130	49	BC-QC	mu Gem (Tejat)
77	MAR 25	ZC 2513	K	4.2	61-	N	11	17.8	-130	38	sCA-TX	44 Oph
81	APR 7	ZC 486	H	5.3	10+	N	0	0.2	-80	41	PA-NJ	tau Ari
85	APR 8	ZC 660	V	4.3	19+	N	5	22.6	-128	55	BC-WY	upsilon Tau
86	APR 10	ZC 946	Q	3.5	36+	N	4	28.9	-130	42	CA-MX	eta Gem (Propus)
87	APR 11	ZC 1077	B	4.0	44+	N	1	16.8	-85	55	QC-NS	zeta Gem (Mekbuda)
132	JUL 7	ZC 1713	V	5.6	37+	N	4	37.7	-130	41	n.Calif.	
139	JUL 26	ZC 660	V	4.3	21-	N	7	48.3	-90	22	s.Fla.	upsilon Tau
152	AUG 9	ZC 2513	K	4.2	79+	S	7	55.0	-130	36	nCA-ID	44 Oph
153	AUG 10	ZC 2779		3.8	92+	S	23	37.7	-68	45	ME-NS	omicron Sgr
160	AUG 22	ZC 599		4.4	46-	N	6	37.2	-106	26	MX(NL)-MA-NL	37 Tau
168	AUG 25	ZC 1077	B	4.0d	17-	N	12	39.4	-130	31	sCA-AZ	zeta Gem (Mekbuda)
173	SEP 4	ZC 2290	L	2.3b	42+	N	1	18.5	-130	32	MX-PA	delta Sco (Dschubba)
194	OCT 16	ZC 656	V	4.2	85-	N	5	32.1	-113	20	TX-NC	kappa Tau
198	OCT 17	ZC 817	T	4.9	76-	S	10	54.1	-130	46	WA-WI	114 Tau
204	OCT 21	ZC 1341	Y	4.3	37-	S	9	17.3	-130	45	WA-NS	alpha Cnc (Acubens)
211	NOV 5	ZC 3326	O	6.4	73+	S	4	19.7	-130	32	CA(SF)-MB	
222	NOV 28	ZC 2746		5.7	10+	S	1	23.5	-130	45	WA-AB	33 Sgr
224	NOV 29	ZC 3015	I	5.2	25+	S	22	49.4	-91	39	MO-QC	tau Cap
234	DEC 10	X 6484	M	8.0	0E	S	14	9.2	-130	51	BC-ID	(total lunar eclipse)
244	DEC 18	ZC 1713	V	5.6	47-	S	7	0.9	-91	48	MN-ME	

Extra-Solar Planetary Transits

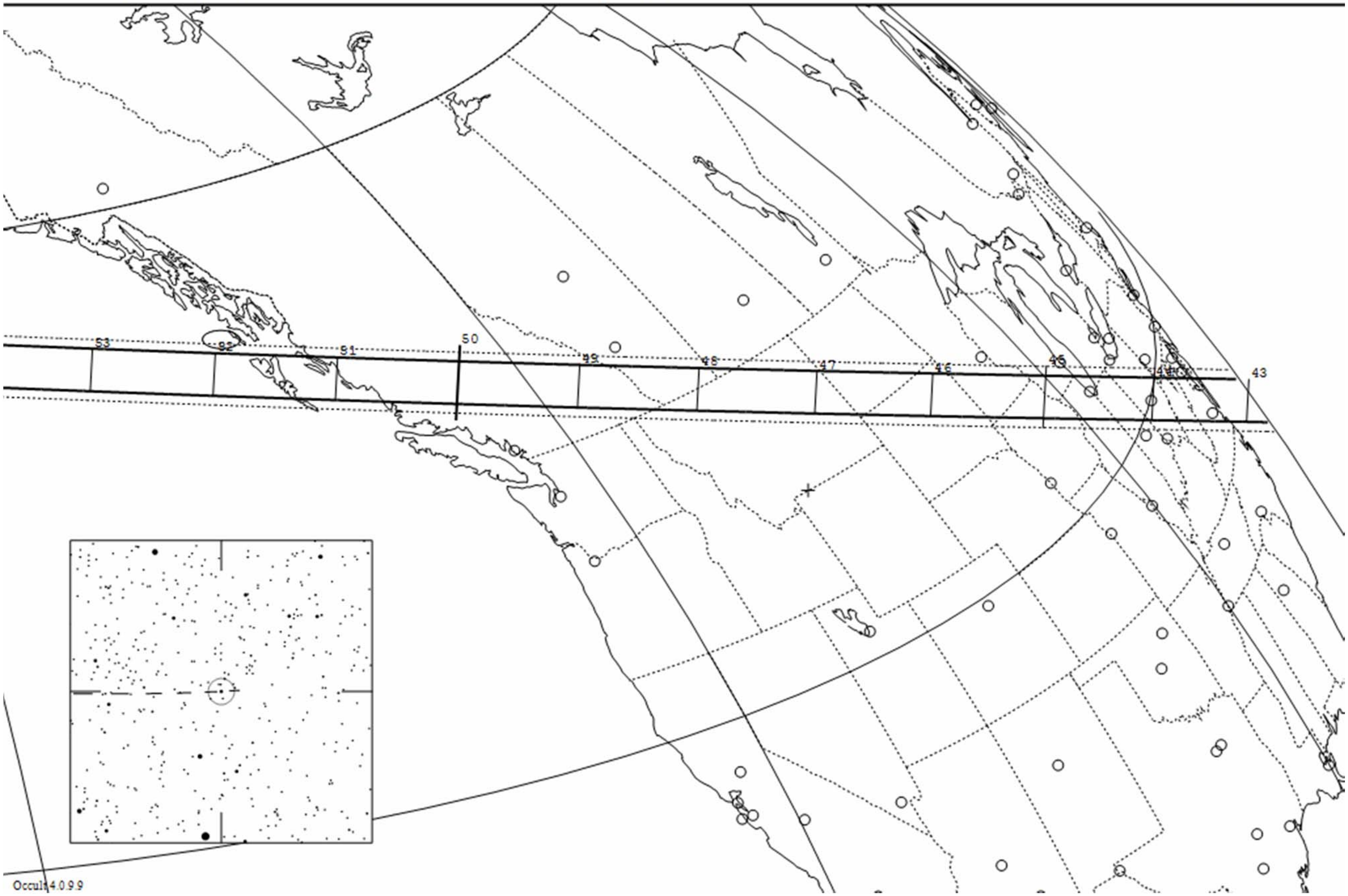
- Although extra-solar planets are unlikely to be detected from occultations (but maybe not impossible with the largest ones?),
- Transit of them across their stars can be observed, as is already being done
- The larger aperture will give better S/N for these observations, allowing detection of smaller planets than was possible with smaller telescopes
- Of course, this would be done when there aren’t any occultations to chase

Asteroidal Occultations

- Besides TNO's, larger portable telescopes could be used to observe occultations by more "ordinary" closer asteroids
- Besides main-belt objects, the fainter stars recordable with large scopes will allow more opportunities for other rare occultations, such as by Centaur objects and comets
- For many main-belt asteroids, whose paths can be predicted quite accurately, the larger aperture will record diffraction phenomena,
- allowing detection of close faint companion stars, star spots, and disks of incandescent material, but probably not planets, at ten or more times the resolution of lunar occultations
- The next four slides show some outstanding asteroidal occultation possibilities in coming months

419 Aurelia occults HIP 25908 on 2011 Feb 2 from 7h 43m to 8h 11m UT

```
Star:                                          Max Duration = 21.5 secs                        Asteroid:
 Mv =  8.8  Mp =  9.0  Mr =  8.7                  Mag Drop =  5.0 (4.7r)                          Mag =13.8
 RA =  5 31 46.2305 (J2000)                    Sun :   Dist = 130 deg                              Dia = 129km,  0.070"
Dec =  19 33  4.302    ...                     Moon:   Dist =139 deg                          Parallax = 3.484"
[of Date:  5 32 28,  19 33 32]                   :  illum =  1 %                           Hourly dRA =-0.831s
 Prediction of 2010 Oct 20.0                   E 0.031"x 0.015" in PA 91                         dDec =  0.62"
```

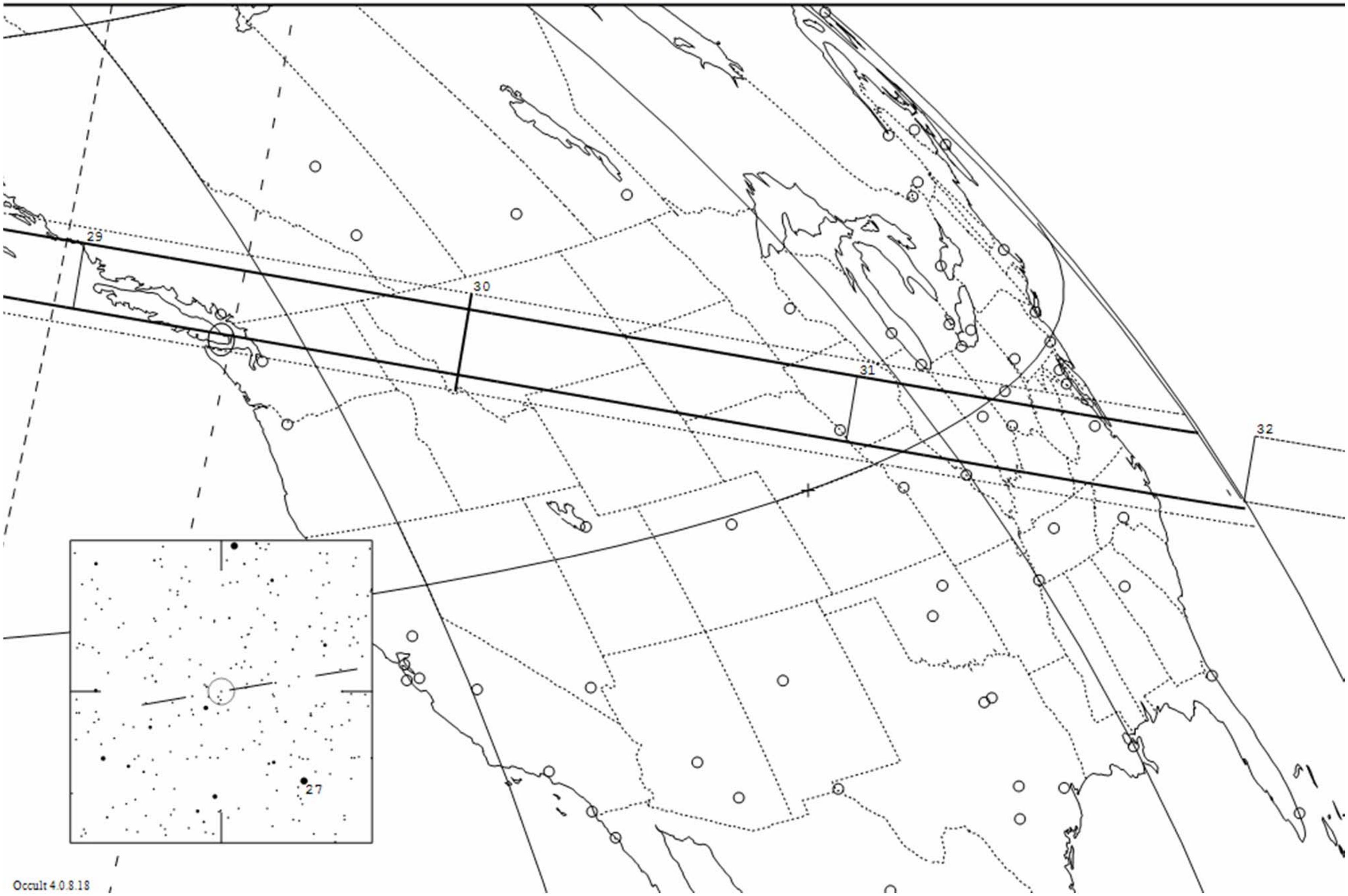


7 Iris occults TYC 0808-00566-1 on 2011 Apr 30 from 4h 24m to 4h 32m UT

Star:
Mv = 10.3 Mp = 11.1 Mr = 9.9
RA = 8 28 58.7143 (J2000)
Dec = 13 14 45.465 ...
[of Date: 8 29 37, 13 12 22]
Prediction of 2010 May 17.0

Max Duration = 10.1 secs
Mag Drop = 0.8 (0.7r)
Sun : Dist = 87 deg
Moon: Dist =121 deg
: illum = 9 %
E 0.030"x 0.024" in PA 1

Asteroid:
Mag =10.3
Dia = 200km, 0.123"
Parallax = 3.912"
Hourly dRA = 2.956s
dDec = -7.22"



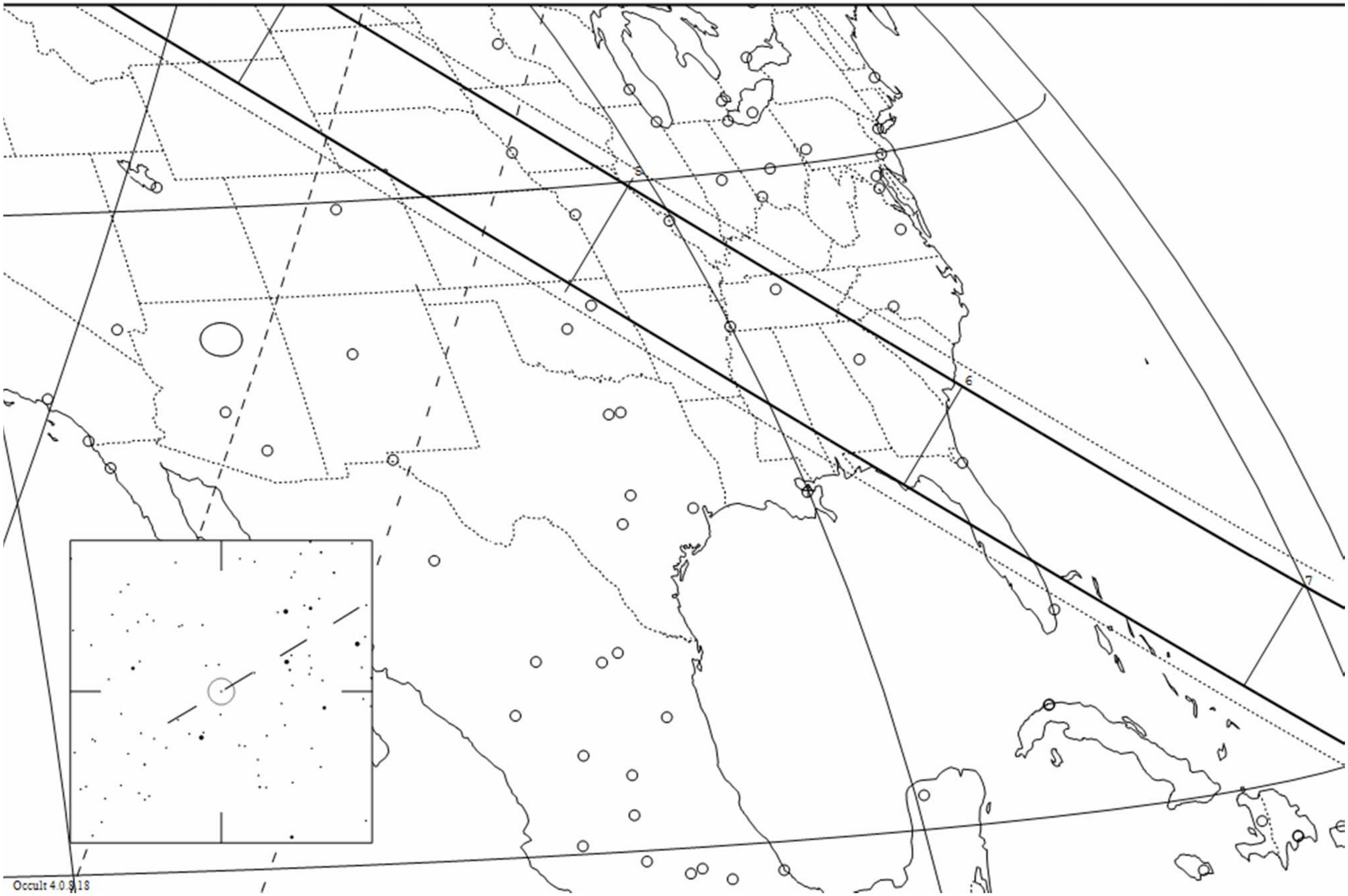
Occult 4.0.8.18

52 Europa occults TYC 0292-00339-1 on 2011 Jul 4 from 3h 0m to 3h 8m UT

Star:
Mv = 10.1 Mp = 10.3 Mr = 10.0
RA = 12 33 5.2376 (J2000)
Dec = 4 31 28.510 ...
[of Date: 12 33 41, 4 27 37]
Prediction of 2010 May 17.0

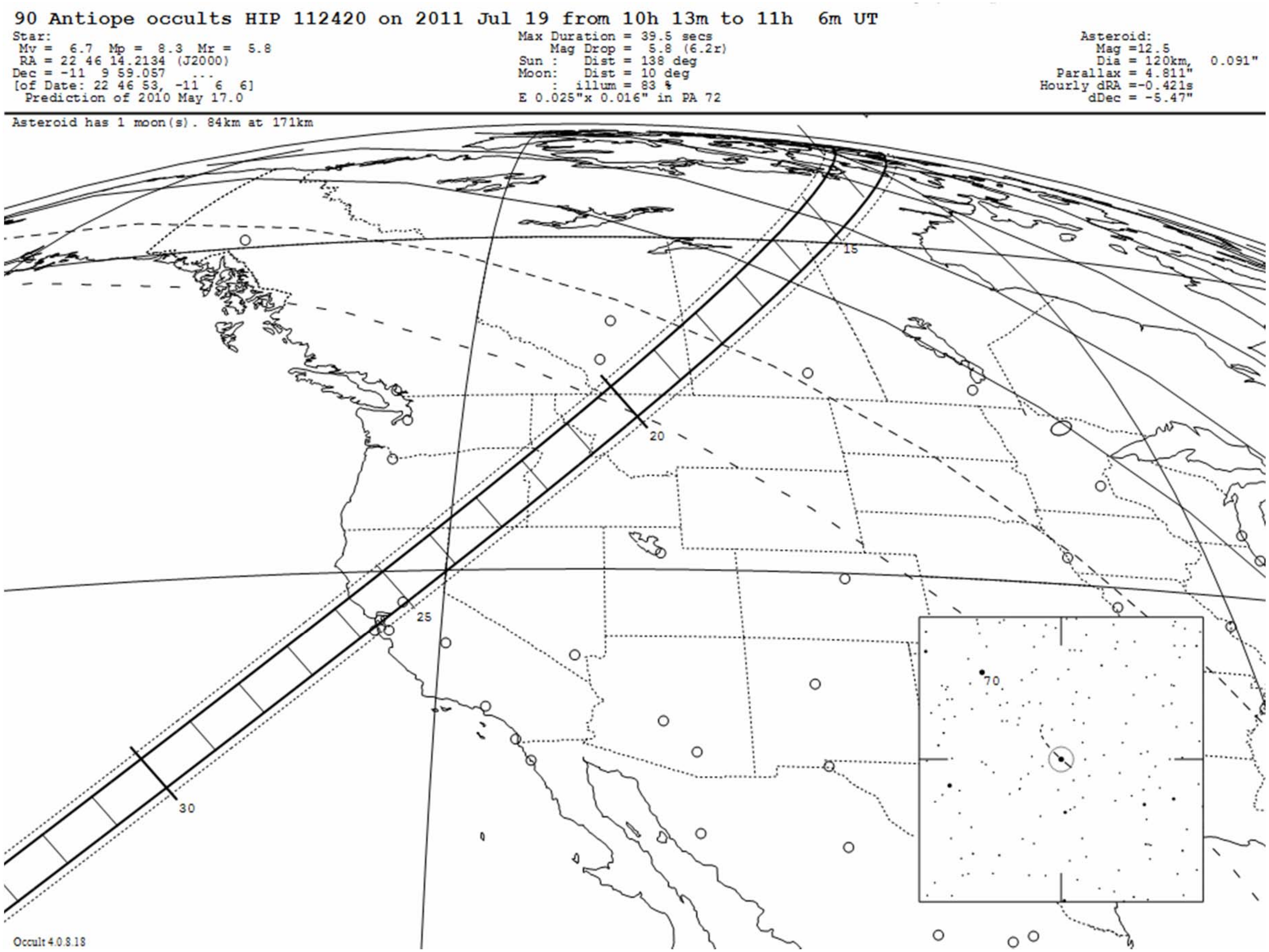
Max Duration = 17.3 secs
Mag Drop = 2.2 (1.9r)
Sun : Dist = 84 deg
Moon: Dist = 50 deg
: illum = 9 %
E 0.029"x 0.023" in PA 93

Asteroid:
Mag =12.1
Dia = 341km, 0.156"
Parallax = 2.924"
Hourly dRA = 1.869s
dDec =-16.62"



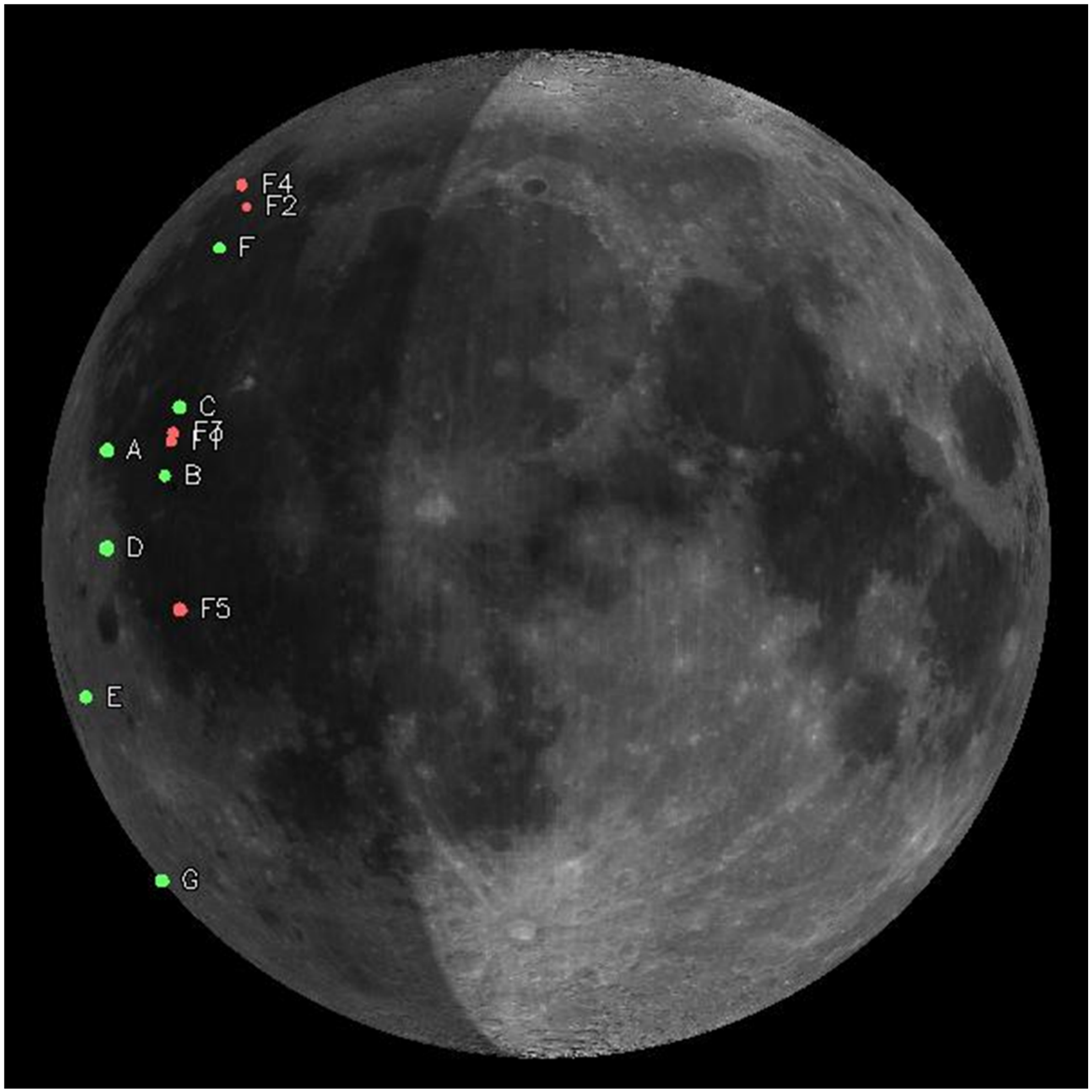
Occult 4.0.9.18

Occultation of ZC 3339 by the binary asteroid (90) Antiope, 2011 July 19 morning



Locations of 1999 Leonids Lunar Impacts

that I recorded Nov. 18 with 13cm telescope at Mt. Airy, MD; many fainter ones can be recorded with 1m scopes



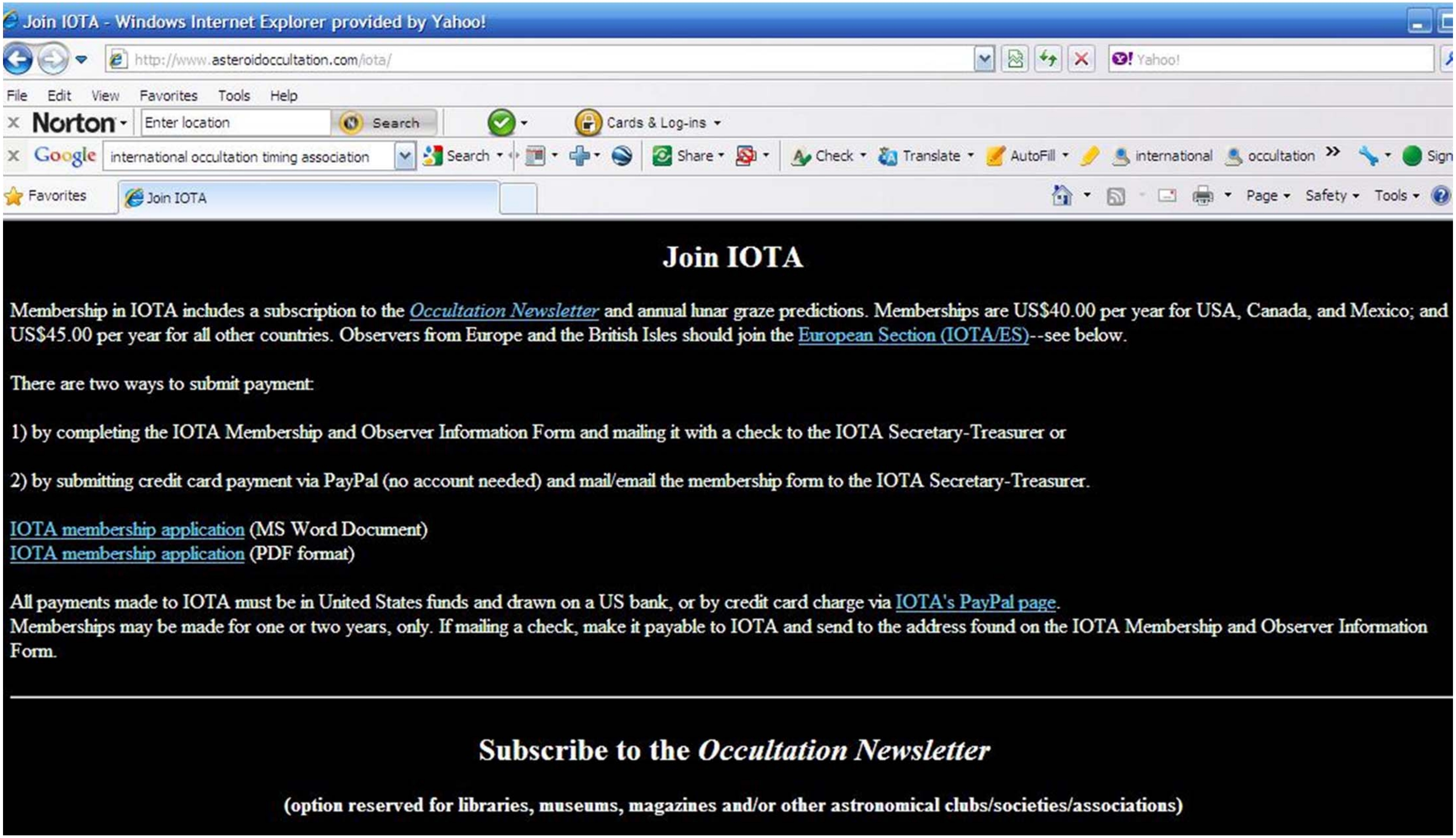
The green dots mark impact flashes that were confirmed by other IOTA observers at distant locations.

This is another activity where larger telescopes would be useful; with diffraction gratings and/o higher-speed recordings, more information about these very transient events could be learned.

Leonid Lunar Impact

Recorded 2001 Nov. 18, 23:19:15 UT, Laurel, MD
confirmed by Tony Cook at Arlington, VA
and Roger Venable, Augusta, GA

IOTA's public access website



This is where prospective new members should be directed, not the previous page; now refer to this at: http://www.asteroidoccultation.com/iota/ - you're welcome to join our exciting work, we welcome large telescopes and their owners/operators!