

Asteroidal and Lunar Occultations that the Dunhams plan to observe from Arizona (and the better events that others are encouraged to try around the State)

Summary of asteroidal and the better lunar occultations, rest of April and May.

<u>Asteroid</u>	<u>Day & Date-MST</u>	<u>MST</u>	<u>Loca- tion</u>	<u>Ra nk</u>	<u>GRCO Prob</u>	<u>Mag Drop</u>	<u>Star Mag</u>	<u>Alt/Az</u>	<u>Sun Alt</u>	<u>Moon Alt/Az</u>	<u>Dist</u>	<u>Illum</u>	<u>Max Dur</u>
1999 TZ1	Thu 30 Apr	21:06	PHX	33	18.5%	0.6	<u>17.7</u>	20/87	-22	60/249	98	53%	2.9
(18285)VladplatonovX	Fri 01 May	20:41	FLG	34	0.0%	4.4	11.7	40/132	-18	70/211	50	64%	1.8
(16560) Daitor	Sat 02 May	23:26	sPHX?	30	16%	2.7	<u>14.8</u>	45/140	-39	49/244	66	76%	2.7
(2326) Tololo X	Sun 03 May	21:45	Nogales	57	0.0%	5.9	10.5	20/275	-28	62/180	75	85%	1.2
(543) Charlotte X	Sun 03 May	21:49	FLG	66	0.1%	1.2	13.9	17/142	-28	62/183	53	85%	3.1
(781) Kartvelia	Tue 05 May	00:20	PHX	100	74.7%	1.1	13.6	70/178	-40	48/219	29	93%	6.0
(1712) Angola X	Wed 06 May	01:58	Tacna	76	0.0%	2.3	12.3	36/148	-35	37/226	61	98%	7.7
(3415) Danby X	Wed 06 May	20:09	Tubac	32	4.5%	5.9	11.5	<u>9</u> /118	-11	16/116	<u>7100%</u>		2.1
(1947) Iso-Heikkila	Sat 09 May	22:46	nPHX	51	27.5%	3.8	12.2	19/125	-34	6/122	14	90%	3.2
(363) Padua **10?	Sun 10 May	22:16	PHX	100	84.9%	9.0	<u>5.7</u>	27/284	-30	b/h	161	82%	3.3
(4709) Ennomos	Mon 11 May	01:19	FLG	84	9%	2.2	13.8	30/173	-37	20/138	33	81%	5.4
(1087) Arabis	Mon 11 May	01:47	Wik	53	5.6%	1.4	13.8	24/172	-35	23/144	25	81%	3.6
(3151) Talbot X	Mon 11 May	22:04	FLG?	17	0.0%	1.2	<u>6.3</u>	30/122	-29	b/h	56	73%	1.3
(404) Arsinoe	Thu 14 May	01:04	nPHX	100	14%	<u>0.1</u>	<u>14.5</u>	56/214	-37	b/h	104	52%	11.8
(1180) Rita X	Fri 15 May	04:54	FLG	99	0.0%	4.1	10.9	34/165	<u>-7</u>	29/134	27	41%	9.5
(1794) Finsen *2?	Sat 16 May	01:15	nePHX	51	25.7%	1.8	13.3	44/175	-36	b/h	97	33%	3.2
☽ occ'n R of 33 Psc	Sun 17 May	04:31	swUSA	100	100.0%		<u>4.6</u>	17/109	-11	17/109	0	23%	n/a
(217) Eudora	Fri 22 May	01:13	TUS	100	0.0%	1.3	<u>14.4</u>	21/264	-35	b/h	120	0%	144.
(617) Patroclus	Fri 22 May	23:18	sAZ?	91	2%?	1.0	<u>15.3</u>	46/197	-34	b/h	144	0%	6
(628) Christine X	Sat 23 May	03:11	sLAS	99	0.0%	1.1	12.2	40/211	-23	b/h	167	0%	5.1
(777) Gutemberga	Tue 26 May	03:58	FLG,CV	86	13.3%	1.4	13.9	34/182	-15	b/h	177	14%	12.0
(1233) Kobresia X	Wed 27 May	03:20	sPHX?	58	19.8%	1.3	<u>14.1</u>	28/191	-21	b/h	154	22%	5.4
(2120) Tyumenia *4?	Thu 28 May	23:41	BCC	43	18.8%	4.3	11.2	25/108	-34	14/280	140	40%	5.0
(995) Sternberga *2	Fri 29 May	21:57	nePHX	76	28.9%	1.4	12.9	41/155	-25	43/254	69	51%	2.4
(877) Walkure	Sat 30 May	04:04	PHX	87	59.7%	1.7	13.2	<u>14</u> /240	-14	b/h	77	54%	3.2
☽ occ'n D of v Vir	Sat 30 May	22:24	wUSA	100	100.0%		<u>4.0</u>	43/245	b/h	43/245	0	62%	n/a

Most of the information in the table is taken from Wayne Thomas' longer lists that are posted at <http://iota.jhuapl.edu/AZoccs.htm>. Following Wayne, I've added a column for the maximum expected duration in seconds at the end (right side; it is not usually applicable for lunar occultations, since for them, most often, one event is observable on the dark side, while the other is not on the sunlit side). I use different color codes; the red type, that I've added to highlight noteworthy information, especially for bright stars, and black bold or underlined for factors making the events difficult to observe. I've edited out Wayne's multiple asterisk codes following the asteroid name, to include there instead * to indicate when we plan to deploy more than 1 station; if there's no * or ?, we just plan to observe only from our home in Fountain Hills. If there's an "X", we don't plan to try it since it is either too far from PHX, or it interferes with a multi-station deployment for another event or some other activity, but others might want to try it. The number after * is the number of stations that we might be able to deploy under the best of conditions; weather or other circumstances might decrease the actual #, or even cause us to cancel the effort and observe only from home. A ? means that a multi-station deployment is possible, but will be undertaken only if the weather forecast is poor for an adjacent better event; if the weather forecast is good for the better event, we would at most observe the ? event only from home, if at all. Two asterisks means that the weather has to be good the night before, in order to orient paver stones to reach the # of stations given; see <http://iota.jhuapl.edu/elektra.pdf> for a description of what that entails and an 11-meg. Power Point file at <http://iota.jhuapl.edu/Elektra.ppt> for more information & better images. If the * and # are in red font, the star is bright enough to use our smaller telescope systems; they are priority events. For locations, 3-letter airport

abbreviations are usually used, but BCC = Black Canyon City, CV = Camp Verde, GB = Gila Bend, Wik = Wikieup. A ? after the location means that an update has been requested and may move the path. More information (especially, the star's catalog number, its J2000 coordinates, and the predicted event duration) are given in the Web page for the event given for most events below. For some events, I give the star's catalog number and J2000 coordinates following the Web page (or instead of it, if a Web page is not available). For several events, I give links to the events from the IOTA feed (asteroidoccultation.com) where more accurate information, as well as star charts of different scales locating the target star, can be found; some of those events were not available at asteroidoccultation.com when Wayne Thomas prepared his lists.

I have added some Lucky Star Project events that aren't in some of the other lists. The Lucky Star Project at Paris Observatory has added to IOTA's Occult-Watcher system, most of their predictions; before, only a few of their events were available through the efforts of Dave Gault in Australia. The Lucky Star Project works with observatories in Brazil, Spain, and France to obtain new astrometry of Trojan and Centaur asteroids, and Trans-Neptunian Objects (TNOs), to improve their predictions, and especially when an occultation by one of these objects is observed, they can refine the predictions for future events considerably using the highly precise stellar data from ESA's Gaia spacecraft. So several of these events have been added to my list. Often, they involve very faint stars, needing large scopes to observe, but the scientific payoffs can be great, showing the sizes, shapes, rings, and moons of these distant objects.

Some have questioned the value of lunar occultation observations. It's true, they have much less value now, than observations of asteroidal occultations. But recordings of lunar events can still resolve close double stars; grazing occultations are especially good at that, to achieve resolutions down to about 0.02" and for the brighter stars, that are difficult to observe well by Hipparcos & Gaia, they can even give proper motion information. However, perhaps the main value of lunar events is to provide opportunities to train for asteroidal events, and grazes usually force use of mobile equipment, a capability that can be valuable for asteroidal events.

1999 TZ1 Thu 30 Apr 21:06 PHX 33 18.5% 0.6 **17.7** 20/87 -22 60/249 98 53% 2.9
This Trojan is unnumbered. Details at https://lesia.obspm.fr/lucky-star/feed/20200501_611239_summary.html

(18285)VladplatonovX Fri 01 May 20:41 FLG 34 0.0% 4.4 11.7 40/132 -18 70/211 50 64% 1.8
Details are at http://ukoccultations.info/UKOCL/20200502_056070_summary.html

(16560) Daitor Sat 02 May 23:26 sPHX? 30 16% 2.7 **14.8** 45/140 -39 49/244 66 76% 2.7
As above, a Lucky Star Trojan, see https://lesia.obspm.fr/lucky-star/feed/20200503_62225a_summary.html

(2326) Tololo X Sun 03 May 21:45 Nogales 57 0.0% 5.9 10.5 20/275 -28 62/180 75 85% 1.2
http://www.harvestmoonorchard.com/astro/occultations/LowMagEvents/20200504_037040_summary.html

(543) Charlotte X Sun 03 May 21:49 FLG 66 0.1% 1.2 13.9 17/142 -28 62/183 53 85% 3.1
http://www.harvestmoonorchard.com/astro/occultations/LowMagEvents/20200504_078051_summary.html

(781) Kartvelia Tue 05 May 00:20 PHX 100 74.7% 1.1 13.6 70/178 -40 48/219 29 93% 6.0
For details see http://www.asteroidoccultation.com/2020_05/0505_781_73156.htm

(1712) Angola X Wed 06 May 01:58 Tacna 76 0.0% 2.3 12.3 36/148 -35 37/226 61 98% 7.7
For details see http://www.asteroidoccultation.com/2020_05/0506_1712_73158.htm
UCAC4 379-101711 Mag 12.3 J2000 R.A. 18h 08m 27.2s, Dec. -14° 17' 10.8"

(3415) Danby X Wed 06 May 20:09 Tubac 32 4.5% 5.9 11.5 **9/118** -11 16/116 **7100%** 2.1
For details see http://www.asteroidoccultation.com/2020_05/0507_3415_73160.htm

(1947) Iso-Heikkila Sat 09 May 22:46 nPHX 51 27.5% 3.8 12.2 19/125 -34 6/122 14 90% 3.2
For details see http://www.asteroidoccultation.com/2020_05/0510_1947_73162.htm
UCAC4 371-080075 Mag 12.2 J2000 R.A. 17h 02m 03.9s, Dec. -15° 48' 19.3"

(363) Padua **10? Sun 10 May 22:16 PHX 100 84.9% 9.0 **5.7** 27/284 -30 b/h 161 82% 3.3
This great binoculars event whose path passes centrally over Phoenix may be the best asteroidal occultation of 2020 for the region. Tucson is also in the path. We will try to record (with a high-speed camera) the event Fresnel diffraction patterns to measure the star's angular diameter, expected to be 1 mas. The star is 14 Cancri = psi Cancri = ZC 1233 = SAO 79995 = HIP 40023, spectral type G8IV. It is sometimes called psi2 Cancri. The Gaia mag. of the star is 6.6, but the generally recognized Johnson V mag. is 5.7, which I give. The 6.6-mag. number is from a VERY DUBIOUS claim, from a 1928 visual lunar occultation observation, that the star may be double, but the "gradual" event reported was probably instead due to Fresnel diffraction of the star's light. **We will need help for this occultation**, since besides deploying remote stations, many on paver mounts, we also want to use our 16-in. scope to obtain a high-speed recording of the target star, to augment the VERITAS data from a different chord. Kingman is a little north of the northern limit. Sacramento, Calif. is north of the southern limit. The path should be accurate since the orbit has been updated with Gaia and past occultation data by the JPL Horizons team. Tony George notes that there is an 11.4-mag. companion 15" away, but that is too faint and too far away to significantly affect the astrometry for the star. Since the HIP2 formal errors are small, I assume that HIP didn't find any duplicity, but we should be able to tell from the May 11th occultation.

Event details are at http://www.occultationpages.com/events/20200511_363_Padua.html .

Ψ Cnc = HIP 40023 Mag 5.7 J2000 R.A. 08h 10m 27.1s, dec +25° 30' 19.3"

(4709) Ennomos Mon 11 May 01:19 FLG 84 9% 2.2 13.8 30/173 -37 20/138 33 81% 5.4
Another Lucky Star Trojan. See https://lesia.obspm.fr/lucky-star/feed/20200511_86313n_summary.html

(1087) Arabis Mon 11 May 01:47 Wik 53 5.6% 1.4 13.8 24/172 -35 23/144 25 81% 3.6
http://www.harvestmoonorchard.com/astro/occultations/LowMagEvents/20200511_116937_summary.html

(3151) Talbot X Mon 11 May 22:04 FLG? 17 0.0% 1.2 **6.3** 30/122 -29 b/h 56 73% 1.3
The star is SAO 140945 = HIP 78849 at J2000 R.A. 16h 05m 44.6s, Dec. -6° 17' 28". The star is a close double, FIN 384, with each component mag. 7.1. Only one component is likely to be occulted while the other one will not be occulted (remain visible during the occultation of the one component), explaining the small mag. drop. It looks like the component separation will be 0.07" in PA ~280° while Talbot's motion will be in ~315°; Talbot's angular diameter is only 0.014", so most likely, the paths for both occultations will be nearby but separated (unlikely that an observer would see an occultation of one component, followed quickly by an occultation of the other component, but with uncertainties, that could occur). The predicted event central duration is 1.3s. For details see: http://www.asteroidoccultation.com/2020_05/0512_3151_66998.htm .

(1180) Rita X Fri 15 May 04:54 FLG 99 0.0% 4.1 10.9 34/165 -7 29/134 27 41% 9.5
For details see: http://www.asteroidoccultation.com/2020_05/0515_1180_64948.htm

(404) Arsinoe Thu 14 May 01:04 nPHX 100 14% **0.1 14.5** 56/214 -37 b/h 104 52% 11.8
This event is not on the Web; it's a personal event posted on OW by Aart Olsen. Stellar data are below.
UCAC4 472-050456 Mag 14.5 J2000 R.A. 14h 47m 44.8s, Dec. +04° 20' 20.5"

(1794) Finsen *2? Sat 16 May 01:15 nPHX 51 25.7% 1.8 13.3 44/175 -36 b/h 97 33% 3.2
For details see: http://www.asteroidoccultation.com/2020_05/0516_1794_73164.htm

♃ occ'n R of 33 Psc Sun 17 May 04:31 swUSA 100 100.0% **4.6** 17/109 -11 17/109 0 23% n/a
This might be seen with steadily-held binoculars. The reappearance will be on the Moon's dark side 39° from the north cusp. The star, 33 Piscium, is ZC 5, spectral type K1. A northern-limit graze of the star will be visible from the Utah-Idaho border area. Joan and I recorded another graze of this star near Tonopah, AZ on January 1st.

(217) Eudora Fri 22 May 01:13 TUS 100 0.0% 1.3 **14.4** 21/264 -35 b/h 120 0% 144.
The extremely slow motion means that the Fresnel diffraction pattern might be resolved. JPL updated the orbit, moving it south from the first path. Details: http://www.asteroidoccultation.com/2020_05/0522_217_72986.htm

(617) Patroclus Fri 22 May 23:18 sAZ? 91 2%? 1.0 **15.3** 46/197 -34 b/h 144 0% 6
Another Lucky Star Trojan event. It is especially important as it is also the final target of NASA's Lucy mission that will visit multiple Trojan asteroids during the next 14 years. However, the prediction seems to be for the center of mass of the binary Patroclus - Menoetius system. The two components, each a little over 100 km across, are in a roughly circular orbit about 680 km apart. The orbit is fairly well-known from various observations that have been made since Menoetius was discovered in 2001, including a well-observed occultation by both objects in October 2013. I have requested predictions for the separate components from the Lucky Star project, and will update the path prediction after they respond. The path for the occultation by the center of mass passes over northern Sonora and southernmost AZ, but the occultation path by one of the components could be much farther north, possibly over PHX or even FLG (and TUS has the best chance).
Details are at https://lesia.obspm.fr/lucky-star/feed/20200523_58552a_summary.html

(628) Christine X Sat 23 May 03:11 sLAS 99 0.0% 1.1 12.2 40/211 -23 b/h 167 0% 5.1
For details see: http://www.asteroidoccultation.com/2020_05/0523_628_65016.htm

(777) Gutemberga Tue 26 May 03:58FLG,CV 86 13.3% 1.4 13.9 34/182 -15 b/h 177 14% 12.0
For details see: http://www.asteroidoccultation.com/2020_05/0526_777_73172.htm

(1233) Kobresia X Wed 27 May 03:20 sPHX? 58 19.8% 1.3 **14.1** 28/191 -21 b/h 154 22% 5.4
The central line is over Red Rock and TUS is just s. of the s. limit; the n. 1-sigma limit is just n. of Phoenix.
http://www.harvestmoonorchard.com/astro/occultations/LowMagEvents/20200527_212427_summary.html

(2120) Tyumenia *4? Thu 28 May 23:41 BCC 43 18.8% 4.3 11.2 25/108 -34 14/280 140 40% 5.0
Details at http://www.asteroidoccultation.com/2020_05/0529_2120_68138.htm.
UCAC4 448-116406 Mag 11.2 J2000 R.A. 19h 35m 48.1s, Dec. -00° 30' 15.3"

(995) Sternberga *2 Fri 29 May 21:57 nePHX 76 28.9% 1.4 12.9 41/155 -25 43/254 69 51% 2.4
For details see: http://www.asteroidoccultation.com/2020_05/0530_995_73174.htm
UCAC4 389-062680 Mag 12.9 J2000 R.A. 15h 14m 46.2s, Dec. -12° 22' 49.2"

(877) Walkure Sat 30 May 04:04 PHX 87 59.7% 1.7 13.2 14/240 -14 b/h 77 54% 3.2
For details see: http://www.asteroidoccultation.com/2020_05/0530_877_73176.htm
UCAC4 374-073741 Mag 13.2 J2000 R.A. 16h 00m 57.4s, Dec. -15° 16' 15.1"

♃ occ'n D of ♃ Vir Sat 30 May 22:24 wUSA 100 100.0% **4.0** 43/245 b/h 43/245 0 62% n/a
This is the brightest occultation of May, visible with steadily-held binoculars, but perhaps not quite as good as the May 17th event with 33 Piscium since this time, the Moon will be gibbous. The disappearance, time given above, will be nearly at the center of the Moon's dark side 88° from the north cusp. The star is ZC 1702, a red giant with spectral type M0.

Much more information is on the Web sites given, with this .pdf file, Wayne Thomas's .pdf files and his maps, and some more at <http://iota.jhuapl.edu/AZoccs.htm>. The AZoccs.htm Web site will be updated with Wayne's information as he provides it. We plan to return to Maryland in mid- or late-May, so we likely won't be trying any of the late May events, and will suspend these "Dunham" lists until we return to AZ in Sept. or October.

David Dunham, IOTA, dunham@starpower.net, cell 301-526-5590, 2020 April 29