Star Dust

Newsletter of National Capital Astronomers, Inc.

capitalastronomers.org

May 2018 ***Volume 76, Issue 9***

Celebrating 81 Years of Astronomy

Next Meeting

When:	Sat. May 12th, 2018
Time:	7:30 pm
Where:	UMD Observatory
Speaker:	Dr. Nathaniel Roth

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Directions to Dinner/Meeting

Our time and location for dinner with the speaker before this meeting is 5:30 pm at “Hunan Treasure” at 7537 Greenbelt Road, Greenbelt, MD 20770 in Greenway Center just east of where Greenbelt Road crosses over the Baltimore-Washington Parkway.

The National Capital Astronomers meeting is held at the UMD Astronomy Observatory on Metzerott Rd about halfway between Adelphi Rd and University Blvd.

Observing after the Meeting

Following the meeting, members and guests are welcome to tour through the Observatory. Weather-permitting, several of the telescopes will also be set up for viewing.

Stars Disrupted by Super-Massive Black Holes

Nathaniel Roth
University of Maryland

Abstract: Approximately once every ten-thousand years in a typical galaxy, the random perturbations of a star's path bring it near enough to the central super-massive black hole that the tidal forces from the black hole's gravity tear the star apart. As the stellar remains swirl around the black hole, they viscously heat and give rise to a flare of radiation known as a tidal disruption event (TDE). Predictions that such events should take place were made decades ago, but until recently the ability to detect them has been limited. Now, with the deployment of wide-field surveys searching for transient astronomical events, dozens of these events should be discovered each year. As TDE detections have begun to accumulate, a number of fascinating puzzles have arisen regarding the underlying emission mechanism, such as the origin of their unexpected brightnesses at ultraviolet and optical wavelengths. In this talk, Dr. Roth will review the history of TDE astrophysics and discuss how we can use TDEs to learn about accretion onto black holes in extreme conditions. He will also discuss how we can use TDEs to study the demographics of super-massive black holes across the Universe.

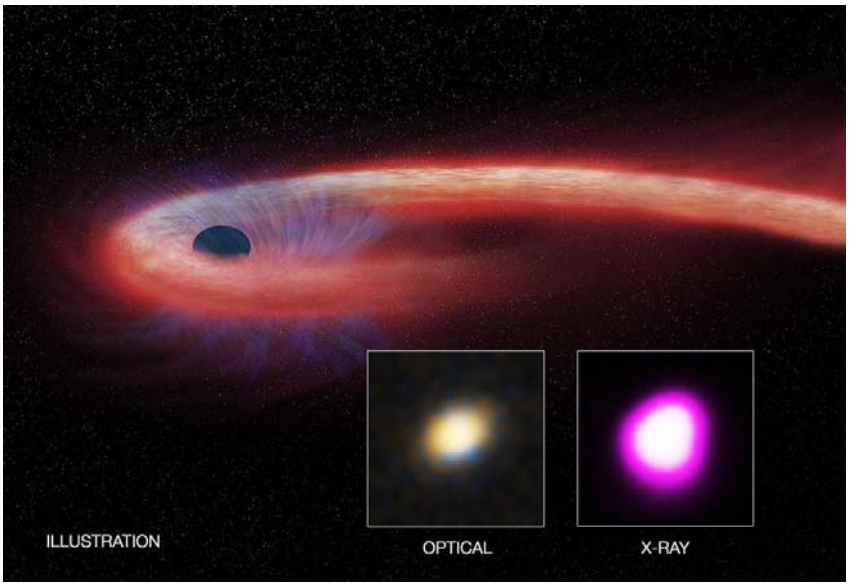

Image shows the calculated optical and X-ray emissions from a Tidal Disruption Event (TDE). (Nathaniel Roth, Copyright 2016)

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Recent Astronomy Highlights

Gaia Tracks Nearly 2 Billion Stars
The European Space Agency's Gaia probe has measured the positions and brightnesses on the sky of 1.7 billion stars as well as the parallaxes and proper motions of over 1.3 billion stars. This information will certainly lead to new insights into the history of the Milky Way Galaxy. More information is at: astronomynow.com/2018/04/25/gaia-data-pins-down-1-7-billion-suns-in-most-detailed-star-catalogue-ever/

Supermassive Black Holes and Galaxy Mergers
A recent study of the galaxy NGC 6240, which formed from the merger of two galaxies, shows that the two supermassive black holes are spiraling toward each other and creating stellar winds that are shutting down star formation. More information is at: www.sciencedaily.com/releases/2018/04/180418141517.htm

NGC 6240 - Credit: NASA, ESA, the Hubble Heritage (STScI/AURA)-ESA/Hubble Collaboration, and A. Evans (University of Virginia, Charlottesville/NRAO/Stony Brook University)

Ancient Galaxy-Cluster Formation
Using the Atacama Large Millimeter/submillimeter Array (ALMA), scientists have discovered a group of fourteen galaxies in the process of colliding to form a galaxy cluster when the Universe was only 1.4 billion years old. The fact that such a merger took place so soon after the Big Bang presents challenges for current cosmological theory. More information is at: phys.org/news/2018-04-astronomers-witness-galaxy-megamerger.html

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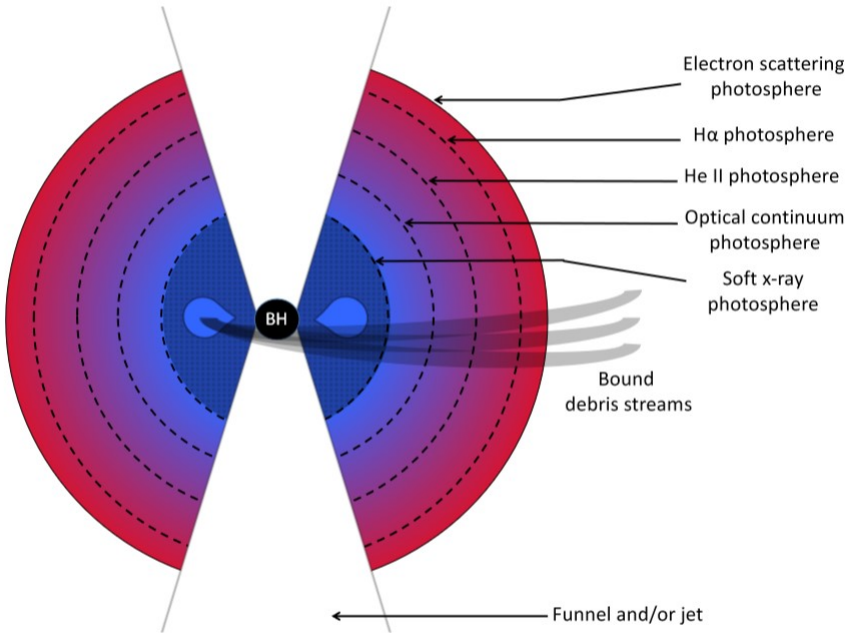
Stars Disrupted by Super-Massive Black Holes – continued from page 1



Anatomy of a Tidal Disruption Event. Illustration: CXC/M. Weiss; X-ray: NASA/CXC/UNH/D. Lin et al, Optical: CFHT

Biographical Sketch:
Nathaniel Roth is a Joint Space-Science Institute Fellow at the University of Maryland, College Park and NASA's Goddard Space Flight Center. Prior to coming to Maryland, he earned his PhD in physics from the University of California, Berkeley. He specializes in radiative transfer calculations that connect theoretical predictions of how light and matter behave near super-massive black holes to the data collected across the electromagnetic spectrum. Recently he has focused on understanding how accretion proceeds in the aftermath of the tidal disruptions of stars by these black holes, particularly by analyzing the optical and ultraviolet spectra from these events.

Exploring the Sky

*"**Exploring the Sky**"* is an informal program that, for over 60 years, has offered monthly opportunities for anyone in the Washington area to see the stars and planets through telescopes from a location within the District of Columbia.

Presented by the National Park Service and National Capital Astronomers, sessions are held in Rock Creek Park once each month on a Saturday night from April through November, Beginners (including children) and experienced stargazers are all welcome—and it's free!

Hosted by: National Capital Astronomers, Inc and Rock Creek Park

2018 Exploring the Sky Sessions

2 Jun 9:00 pm – Jupiter, M13

14 Jul 9:00 pm – Jupiter, Saturn, M13

11 Aug 8:30 pm – Jupiter, Saturn, M13

1 Sep 8:00 pm – Jupiter, Saturn, Mars

6 Oct 7:30 pm – Saturn, Mars

17 Nov 7:00 pm – Saturn, Mars, Uranus, Moon

More information can be found at NCA's web site, www.capitalastronomers.org or the Rock Creek Park web site, www.nps.gov/rocr/planyourvisit/expsky.htm. You can also call the Nature Center at (202) 895-6070. For general information on local astronomical events visit www.astronomyindc.org

Do you have an astronomy story to share with your fellow NCA members? The submission deadline for June's Star Dust, is May 20th.

Clear Skies!

Citizen Scientists Can Join the Search for Rogue Planets

Many of you enjoyed Jonathan Gagné's talk on April 14, about rogue planets and brown dwarfs. The existence of rogue planets is a surprise and is sure to deepen our understanding of how planets form. Jonathan Gagné notes that citizen scientists can join the search for rogue planets. The web site is backyardworlds.org/.

Jonathan writes, "This project searches for Planet IX, brown dwarfs, and also rogue planets. The candidate selection step of my own survey for rogue planets will actually soon be merged with the Backyard Worlds project, so the citizen scientists who participate may get to select the targets that I'll follow up, and maybe even find their own rogue planets!"

Sky Watchers

May/June

Venus continues to dominate the early evening sky as it rises toward its maximum elongation which will take place in August. Having passed through opposition on May 9, Jupiter rises before sunset with Saturn rising approximately four hours later and Mars following after midnight. Mercury rises shortly before dawn until, in early June, it begins rising after the Sun, becoming visible in the early evening sky.

5/17	Occultation of χ^2 Orionis . Details on page 5.
5/19	Full Moon. Known as the Flower Moon 10:20 a.m.

Times in EDT

Occultation of Sabik (η Ophiuchi A) by (369) Aeria, 2018 February 18

David and Joan Dunham

On February 18 UT (19th local date), the brightest star occulted by a sizeable asteroid occurred in eastern Australia. The star was eta Ophiuchi = Sabik, a nearly equal binary; we tried to observe the occultation by the A component. The path for the 3.5-mag. B component was about 600 km farther north and not observed; it was probably too cloudy in that area, near Townsville, Queensland (Qld). The HIPPARCOS 2 catalog, based on 1991 data, did not take into account the orbital motion; with periastron expected in 2025, with an 85yr period and high eccentricity, and current separation of 0.5″ (the angular diameter of Aeria was expected to be only 0.034″) the effects are significant. I wasn't sure that my calculations, to modify the prediction to take the orbital motion into account, were correct, or that the errors of the binary orbital elements were realistic.

We worked with John Broughton, who lives in the Gold Coast area of s.e. Qld. John planned to deploy up to 9 stations across the path and the northern uncertainty zone, while Joan and I decided to go about 500 km inland, to use St. George, Qld. as a base to also deploy across the path, but concentrating on it

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Occultation of Sabik (η Ophiuchi A) by (369) Aeria – continued from page 3

and the southern uncertainty zone; the weather was expected to be better there. We hoped to deploy as many as 11 mighty mini stations, but the evening before the night of the event, I came down with a severe 24h flu. By the next afternoon, I recovered, but felt very weakened. I decided to regain some strength by sleeping a couple of hours in the early pm, leaving our motel at 10pm for the 3am event, hoping to deploy 6 stations rather than 11. We both ran out of time; John had clouds at one station and deployed 7 stations, while we managed 5 (kangaroos made night driving slow). We recorded the occultation from our 3 middle stations, with a miss (no event) at our northernmost Station 1 and southernmost Station 5. John had misses at all his stations, with his southernmost Station 7 being closest to our positive Station 2 relative to the path (map below). The green line shows the nominal prediction, including my correction for the binary orbital motion, while the yellow line is the Hipparcos 2 prediction, without any correction for the binary orbit. The blue lines are the predicted northern and southern limits, while the red lines are the limits in case of a 1-sigma shift of the path north or south.

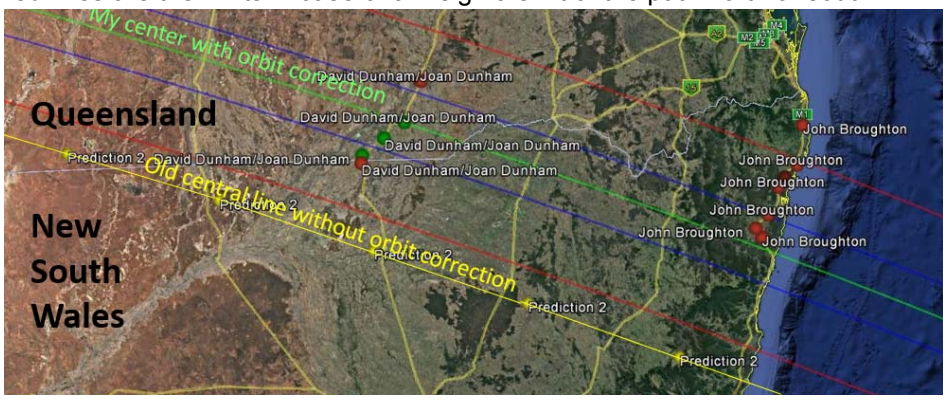

Image Credit: Brad Timerson and Google Earth

The observations showed a 25 km (about 0.3 path-widths, 0.010", or 0.3 sigma) south shift of the path from the nominal. But the event occurred 6 s early, a 162-km shift along the path, which is 0.071", 7 times the cross-track error, that was expected to be larger.

After we had set up Sta. 4, we were running short of time, so we drove only about halfway from Sta. 4 to our intended Sta. 5; that is, our actual Sta. 5 location, just 4 km south of the Queensland-N.S.W. border, was farther north than we wanted, only about 7 km south of Sta. 4 in the sky plane at Aeria. Our first review of the Sta. 5 recording showed a miss, but a more careful review showed a small dimming at the right time, but not with a depth as large as that expected from a real occultation) at "A" in the light curve shown below.

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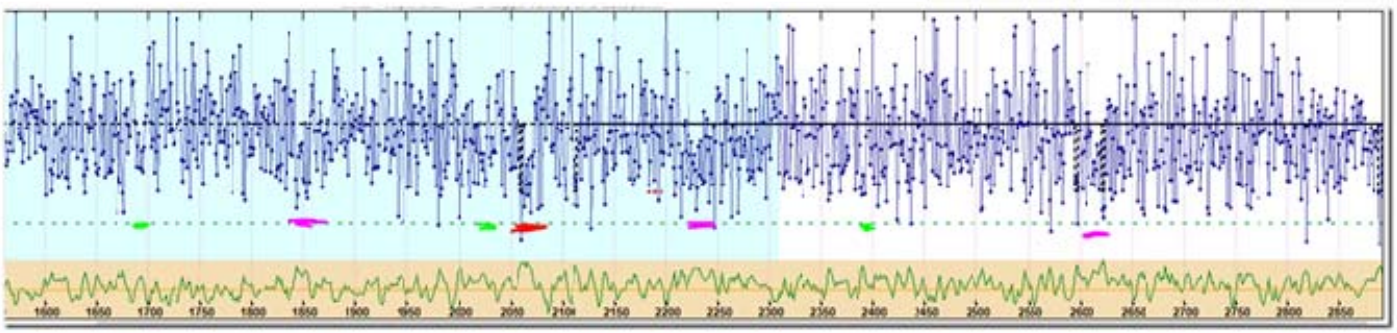
Thank you!

Virtual Tour of the Moon

Using data collected since 2009 by the Lunar Reconnaissance Orbiter, NASA has recently created a brief, but fascinating tour of the Moon for everyone to enjoy. It includes stops at several of the largest impact craters, a lunar lander site and both poles. The video can be seen at the following link: www.youtube.com/watch?time_continue=297&v=nr5Pi6GQL2o



Occultation Notes

- D following the time denotes a disappearance, while R indicates that the event is a reappearance.
- When a power (x; actually, zoom factor) is given in the notes, the event can probably be recorded directly with a camcorder of that power with no telescope needed.
- The times are for Greenbelt, MD, and will be good to within +/-1 min. for other locations in the Washington-Baltimore metropolitan areas unless the cusp angle (CA) is less than 30 deg., in which case, it might be as much as 5 minutes different for other locations across the region.
- Some stars in Flamsteed's catalog are in the wrong constellation, according to the official IAU constellation boundaries that were established well after Flamsteed's catalog was published. In these cases, Flamsteed's constellation is in parentheses and the actual constellation is given in the notes following a /.
- Mag is the star's magnitude.
- % is the percent of the Moon's visible disk that is sunlit, followed by a + indicating that the Moon is waxing and - showing that it is waning. So 0 is new moon, 50+ is first quarter, 100+ or - is full moon, and 50- is last quarter. The Moon is crescent if % is less than 50 and is gibbous if it is more than 50.
- Cusp Angle is described more fully at the main IOTA Web site.
- Sp. is the star's spectral type (color), O,B,blue; A,F,white; G,yellow; K,orange; M,N,S,C red.
- Also in the notes, information about double stars is often given. "Close double" with no other information usually means nearly equal components with a separation less than 0.2". "mg2" or "m2" means the magnitude of the secondary component, followed by its separation in arc seconds ("), and sometimes its PA from the primary. If there is a 3rd component (for a triple star), it might be indicated with "mg3" or "m3". Double is sometime abbreviated "dbl".
- Sometimes the Axis angle (AA) is given. It is the angle measured around the Moon's disk, from the Moon's axis of rotation. It can be used with a lunar map to tell where a star will reappear relative to lunar features.

Mid-Atlantic Occultations

David Dunham

Asteroidal Occultations

Date	Day	EDT	Star	mag.	Asteroid	dmag	dur. s	Ap. "	Location, Notes
2018									
May 11	Fri	4:44	4UC38292396	13.2	Ellicott	2.6	7	10	eNC,sVA,WV;cVA?
May 14	Mon	1:04	1B833446685	17.3	2002 MS4	3.2	56	14	TNO;NL;eUSA?
May 14	Mon	23:04	TYC56220340	10.4	2000 GE147	12.8	3	5	TNO,cenAmer;NA?
May 15	Tue	4:26	2UC19276129	12.3	Happelia	1.2	18	8	eOH,cWV,cVA,cNC
May 17	Thu	21:22	SAO 77629	8.6	Venus	0.0	249	5	eastern USA
May 18	Fri	4:23	4UC38174924	13.2	Suevia	0.5	6	10	DE,MD,DC,nVA,OH
May 21	Mon	22:34	4UC61644037	13.0	Walker	4.6	1.3	9	sON,cNY,ePA,NJ
May 28	Mon	4:35	4U326107960	11.8	Jiangxi	4.1	3	8	DC,VA,wNC,nAL
Jun 1	Fri	1:47	2UC28609348	12.1	Bathseba	2.8	5	8	sNJ,nMD;DC,nVA?
Jun 3	Sun	1:46	4U322125603	13.7	2010 GX34	6.7	4	12	TNO;Brazil;USA?
Jun 5	Tue	2:33	4U358104334	13.8	Aeria	0.2	6	12	n&wPA,sOH;wMD?
Jun 6	Wed	4:34	2UC18032168	12.0	Emanuela	1.5	9	10	sPA,wMD;DC,nVA?

On May 17, Venus' 12 arc-second disk will be 84% sunlit.

Lunar Grazing Occultations

Date	Day	EDT	Star	Mag	% alt	CA	Location & Remarks
2018							
May 17	Thu	20:56	chi2 Ori	4.6	8+ 19	-2N	Oakton,Alexandria,VA;see map

Interactive detailed maps at http://www.iota.timerson.net/

Total Lunar Occultations

Date	Day	EDT	Ph	Star	Mag	%	alt	CA	Sp.	Notes
2018										
May 12	Sat	5:31	R	ZC 106*	6.6	12-	10	50N	K0	Sun -6, Azimuth 99deg.
May 17	Thu	20:24	D	64 Orionis	5.1	8+	25	53S	B8	Sun -3,ZC 913,close dbl
May 18	Fri	22:08	D	SAO 96588	7.8	17+	17	61S	F5	
May 18	Fri	22:32	D	SAO 96610	8.1	17+	12	88S	A2	Az. 286,mg2 10 sep .5"
May 19	Sat	22:17	D	SAO 97648*	9.0	27+	25	55S	K2	
May 19	Sat	23:39	D	ZC 1245*	7.7	27+	10	38N	K0	Az. 286, close triple
May 20	Sun	23:26	D	ZC 1374*	8.3	38+	22	82N	F5	
May 21	Mon	20:58	D	ZC 1481	7.4	49+	55	38S	A5	Sun altitude -8 deg.
May 21	Mon	21:05	D	SAO 98959	8.4	49+	55	67N	F8	Sun altitude -9 deg.
May 22	Tue	22:15	D	SAO 118637	8.1	60+	49	50N	F5	
May 23	Wed	22:47	D	SAO119122*	8.6	71+	47	48N	A2	
May 24	Thu	0:13	D	ZC 1728*	6.7	71+	34	60S	M4	
May 24	Thu	1:04	D	7 Virginis	5.4	72+	25	35N	A1	ZC 1733
May 25	Fri	22:11	D	80 Vir	5.7	88+	46	79S	G6	ZC 1950
May 27	Sun	0:50	D	ZC 2072	6.6	94+	37	58N	K0	
Jun 4	Mon	5:09	R	31 Cap	7.1	72-	33	81S	F0	Sun -6 deg., ZC 3115
Jun 5	Tue	3:21	R	SAO 164844	7.4	64-	23	34N	K5	
Jun 5	Tue	5:39	R	ZC 3240	6.7	63-	36	69S	A2	Sun altitude -1 deg.
Jun 9	Sat	3:41	R	SAO 109787	7.6	25-	6	57S	K0	Az 93,mg2 10.7 sep 1.8"
Jun 9	Sat	3:50	R	SAO 109783	7.3	25-	8	82N	G5	Az 94,mg2 9.6 sep 39"
Jun 9	Sat	4:28	R	SAO109799*	9.4	24-	15	63S	G0	

*The star is in the Kepler 2 exoplanet search program so lightcurves of the occultation are desired to check for close stellar duplicity

Further explanations & more information is at
http://iota.jhuapl.edu/exped.htm .
David Dunham, dunham@starpower.net

Upcoming Occultation of χ^2 Orionis

David Dunham

The map at the top of Page 6 shows the path of the northern-limit grazing occultation of χ^2 Orionis that will occur across the Washington DC region between 8:54 and 8:58 pm EDT May 17th. The Sun altitude will be -8°, so the sky will be dark enough in any telescope to see this bright graze. The graze occurs at the northern cusp, 2° on the bright side, but at only 8% sunlit, the cusp will be very thin and the star should be easily visible against the sunlit peaks, which are likely to be fainter than the star. The graze zone, where multiple occultations of the star by lunar mountains and craters will occur, is between the two dark-gray

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Upcoming Occultation of χ^2 Orionis – continued from page 4

Image Credit: Brad Timerson and Google Maps

lines. For locations north of the northern gray line (including at the light green line, that should be ignored), the star will narrowly miss the Moon, while south of the southern gray line, only one occultation, 4 to 5 minutes long, will occur. You can zoom in on any area of interest, using offset values of +1.3 and +3.0 to define the graze zone as shown on the above map, using the Google Map at iota.jhuapl.edu/20180517_Graze_of_915_Greenbelt_MD_Dunham~David_W.___I.htm. Note that half an hour before the graze, there will be a total occultation disappearance of 5.1-mag. 64 Orionis 53° from the south cusp, but twilight will be strong then, with the Sun altitude -3°. And less than 25 minutes after the graze, Venus will occult 8.6-mag. SAO 77629, a more difficult event that will require high magnification, as the disappearance will occur within 2″ of Venus' dazzling terminator.

Occultation of Sabik (η Ophiuchi A) by (369) Aeria – continued from page 4

But the seeing was terrible and there were many other dimmings, including a stronger one at B, 17s after the closest approach time at A, that must have been atmospheric as it was more than 100 km from Aeria on the sky plane. The figure below shows the best-fit ellipse, with dimensions of 64 by 54 km. Although the evidence for a real event at Dunham Sta. 5 (line 13 in the figure) from the light curve is weak, the best-fit ellipse from the clear occultations at Sta. 2-4 (lines 9, 11, & 12) shows a graze at Sta. 5. Although this is evidence that dip "A" is a true graze, the actual shape of Aeria is irregular, so we can't know for sure; officially, it will be called a miss (likely atmospheric).

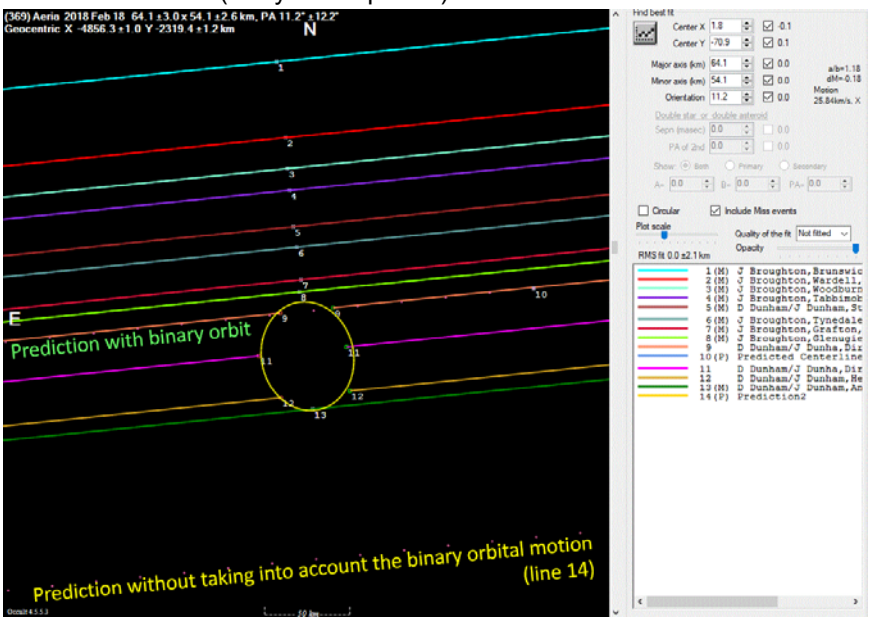

Image credit – asteroidoccultation.com

Recent Astronomy Highlights – continued from page 2

Asteroid Water from Impacts
Experiments with projectile cannons have shown that asteroids may be able to deliver more water to the surfaces of planets than was previously theorized. Although most of the water would return to space, some would be locked up by melted rock of the impact. For more information, use to the following link: www.sciencedaily.com/releases/2018/04/180425162042.htm

Arlington Streetlight Management (SMP) Plan

As every astronomy lover in the area knows, the night skies of the Washington Metropolitan region are getting less and less dark. For those NCA members who live in Arlington, you're being given the chance to see what the proposed LED lighting will be in the near future. And you can comment on it. More information on locations and events can be found at the following link: projects.arlingtonva.us/projects/streetlig

Calendar of Events

NCA Mirror- or Telescope-making Classes: Tuesdays AND Fridays, from 6:30 to 9:45 pm at the Chevy Chase Community Center (intersection of McKinley Street and Connecticut Avenue, N.W.) **(Please note that there will be no meeting on Friday, May 11th.)** Contact instructor Guy Brandenburg at 202-635-1860 or at gfbrandenburg@yahoo.com

Open house talks and observing at the University of Maryland Observatory in College Park on the 5th and 20th of every month at 8:00 pm (Nov.-Apr.) or 9:00 pm (May-Oct.). Details: www.astro.umd.edu/openhouse

Mid-Atlantic Senior Physicists Group: (***Note New Time)*** "Black Hole Entropy, Entanglement and Holographic Spacetime" with Ted Jacobson, University of Maryland. Wed. May. 16, at **2 pm** at the American Center for Physics (1st floor conference room) with Q&A to follow. 1 Physics Ellipse, College Park, MD-- off River Rd., between Kenilworth Ave. and Paint Branch Parkway. www.aps.org/units/maspg/

Upcoming NCA Meeting at the University of Maryland Observatory:
9 June: 7:30 p.m Science Fair Winners, Elections and Astrophotographs

Howard B. Owens Science Center Turns 40 – To round out the school year, the Center will have two free concerts. On Friday, May 11th at 7:00 p.m., the College Park Chamber Singers will perform "Lux Aeterna" in the planetarium. On Friday, May 18th at 7:00 p.m. the Thomas Johnson Middle School Symphonic Band and Orchestra will perform a concert "Under the Stars." The address is 9601 Greenbelt Road, Lanham, MD 20706. The website is www1.pgcps.org/howardbowens.

National Capital Astronomers Membership Form

Name: _____ **Date:** ___/___/___

Address: _____ **ZIP Code:** _____

Home Phone: ____-____-_____ **E-mail:** _____ **Print / E-mail Star Dust (circle one)**

Membership (circle one): Student….. $ 5; Individual / Family…..$10; Optional Contribution…..$__

Please indicate which activities interest you:

- Attending monthly scientific lectures on some aspect of astronomy ____
- Making scientific astronomical observations ____
- Observing astronomical objects for personal pleasure at relatively dark sites ____
- Attending large regional star parties ____
- Doing outreach events to educate the public, such as Exploring the Sky ____
- Building or modifying telescopes ____
- Participating in travel/expeditions to view eclipses or occultations ____
- Combating light pollution ____

Do you have any special skills, such as videography, graphic arts, science education, electronics, machining, etc.?

Are you interested in volunteering for: Telescope making, Exploring the Sky, Star Dust, NCA Officer, etc.?

Please mail this form with check payable to ***National Capital Astronomers*** to:
Henry Bofinger, NCA Treasurer; 727 Massachusetts Ave. NE, Washington, DC 20002-6007

National Capital Astronomers, Inc.

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First Class
Dated Material

Celebrating 81 Years of Astronomy

Next NCA Meeting:

2018 May 12th

7:30 pm

@ UMD Observatory

Dr. Nathaniel Roth

Inside This Issue