

Star Dust

Newsletter of National Capital Astronomers, Inc.

capitalastronomers.org

December 2019

Volume 78, Issue 4

**Celebrating 82 Years
of Astronomy**

Next Meeting

When: Sat. Dec. 14th, 2019
Time: 7:30 pm
Where: UMD Observatory
Speaker: Dr. Larry Nittler

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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 the Baltimore-Washington Parkway.

The National Capital Astronomers meeting is held at the UMD Astronomy Observatory on Metzert 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.

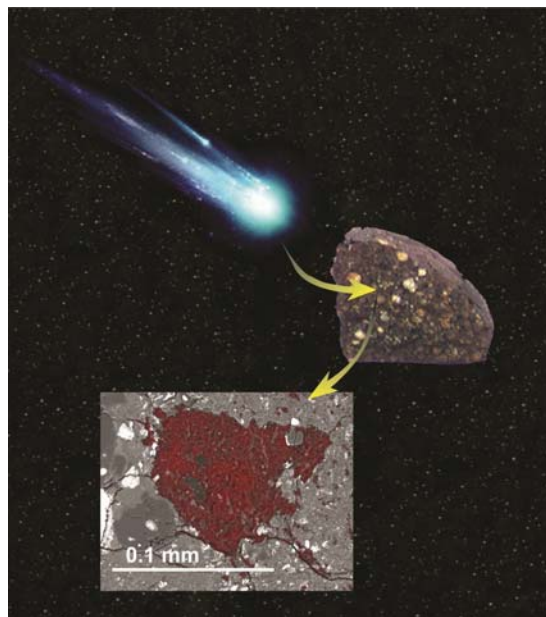
A Cometary Fossil Inside an Asteroidal Meteorite

Larry Nittler

Carnegie Institute of Washington

Abstract: Primitive asteroids and comets preserve a record of the starting materials and early evolution of the solar system. Most meteorites come from asteroids and have experienced more processing (for example, aqueous alteration) and have lower abundances of both presolar grains (dust grains that formed in prior generations of stars) and important volatiles like water and organic matter than is seen in extraterrestrial samples thought to originate from comets (mainly interplanetary dust particles and some micrometeorites). We recently reported* the discovery of an unusual, extremely carbon-rich, inclusion found in an asteroidal meteorite. The distinct properties of this clast, which is only about one tenth of a millimeter across, suggest that it

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Inclusion found in meteorite. Image Credit – Larry Nittler and NASA

* Nittler L. R., Stroud R. M., Trigo-Rodríguez J. M., De Gregorio B. T., Alexander C. M. O’D., Davidson J., Moyano-Camero C. E., and Tanbakouei S. (2019) A cometary building block in a primitive asteroidal meteorite. *Nature Astronomy*, **3**, 659–666.

Recent Astronomy Highlights

Water Vapor Above Europa

Scientists using the Keck Observatory over 17 nights between December 2016 and May 2017 detected the presence of water vapor above Jupiter's moon, Europa. But the signal for water vapor was detected only on one of the nights, indicating that the water came from a plume, the source of which is possibly a subsurface ocean. This confirms earlier observations by the Hubble telescope which detected the presence of hydrogen and oxygen in a plume erupting from Europa. NASA plans to send a spacecraft named the Europa Clipper to study the moon in the mid 2020s. More information about the discovery of water vapor can be found at <https://phys.org/news/2019-11-nasa-scientists-vapor-europa.html>.

Gamma-Ray Burst with the Highest-Energy Photons Ever Detected

On January 14, 2019, telescopes detected a gamma-ray burst which emitted the most energetic photons ever detected, in the 1 teraelectronvolt range, or a trillion times more energetic than photons of visible light. Such photons are generated in violent astronomical events such as neutron-star mergers, when matter accelerated to 99.999% of the speed of light strikes other surrounding matter. One of the researchers studying this event was Dr. Alexander van der Horst, who was the speaker at the November 2017 NCA meeting. (His talk is at https://www.youtube.com/watch?v=pFS_DTagWEXE.) The gamma-ray burst and its source have been studied by a number of telescopes across the light spectrum. More information is at <https://www.sciencedaily.com/releases/2019/11/191120131300.htm>

Oumuamou – A Cosmic Dust Bunny?

Oumuamou, the first detected interstellar visitor, continues to be a source of speculation. One mystery of Oumuamou is a slight acceleration it underwent in moving back toward interstellar space. A recent paper speculates that it may be 'fluffy', made up of ice and dust grains. More info is at <https://earthsky.org/space/was-oumuamua-a-cosmic-dust-bunny>

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• *Abstract – continued from page 1*

• formed much farther out in the Sun's protoplanetary disk than did its host meteorite, most likely in the formation region of comets. Its presence in an asteroid thus provides information about radial mixing of materials throughout the disk during the earliest stages of planet formation. This talk will show how chemical and isotopic measurements of primitive extraterrestrial materials, like this carbon-rich clast, can be used to probe key astronomical questions about the origin and early evolution of our solar system.

• **Biography:** Larry Nittler is a cosmochemist and planetary scientist on the scientific staff of the Carnegie Institution of Washington. His research interests span stellar evolution, nucleosynthesis, interstellar and interplanetary dust, meteorites, and the formation and evolution of planets. He earned a BA in Physics from Cornell University and a PhD in Physics from Washington University in St. Louis and joined the Carnegie staff in 2001 after two years as a staff scientist at NASA's Goddard spaceflight Center. His laboratory research focuses on isotopic and mineralogical properties of microscopic extraterrestrial materials including presolar grains in meteorites, interplanetary dust particles and spacecraft-returned samples, including solar wind and comet Wild 2 samples returned by the Genesis and Stardust missions, respectively. He also performs spacecraft-based remote-sensing geochemical research on planetary bodies. He led the analysis of X-ray fluorescence data for the Near Earth Asteroid Rendezvous mission, which orbited asteroid Eros in 2000-2001, and for the MESSENGER mission, which orbited Mercury from 2011-2015. He also served as Deputy Principle Investigator for MESSENGER. He is on the Science Team for the ESA-JAXA BepiColombo mission, launched last year and on its way to Mercury, and is a Participating Scientist on JAXA's Hayabusa2 asteroid sample return mission. He received the Nier prize of the Meteoritical Society in 2001 and became a Fellow of the same society in 2010. Asteroid 5992 Nittler is named in his honor. In addition to his scientific research, Larry is a jazz pianist and composer. He lives in Washington DC with his wife, their teen daughter and two cats.

JunoCam

• JunoCam, a small camera on board NASA's Juno spacecraft, has taken detailed images of Jupiter's poles. Those images show multitudes of long-lived cyclones. The story of the instrument itself, the need for it to be rugged in the harsh environment near Jupiter, as well as mission constraints, is told in a fascinating video which includes many of the best images the camera has taken. That video can be found at <https://www.youtube.com/watch?v=b6od7qMLlq&feature=youtu.be>. In addition the website for the JunoCam community, which includes the efforts of amateurs who help process the images, can be found at <https://www.missionjuno.swri.edu/junocam>.

Exploring the Sky



“Exploring the Sky” is an informal program that, for 70 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](#)

With the winter months, the Exploring the Sky program will take a hiatus until April of 2020.

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

November’s Exploring the Sky session, saw clear skies and over a hundred participants, including many members of a local Girl Scouts troupe. The Moon, Jupiter, Saturn and the Ring Nebula were among the astronomical objects participants saw through the telescopes brought by NCA members and others. Overall it was a very successful end to the 2019 Exploring the Sky season.

The submission deadline for January’s Star Dust, is December 21st.

Clear Skies!

Sky Watchers

December/January

Jupiter and Saturn continue to be visible in the early evening sky, Jupiter setting first after 7:00 p.m. then Saturn roughly an hour later. Venus also remains visible in the evening sky, setting around 9:30 p.m. Mercury has joined Mars in the morning sky until early January when it again transits to the evening sky.

| | |
|-----------|---|
| 12/21 | Winter Solstice – 11:19 p.m. At that time, the Sun will shine directly over the Tropic of Capricorn which is at 23° 26'. (Interesting fact - Because of the precession of the equinox, the 25,772-year wobble of the Earth’s rotation axis, the Tropic of Capricorn is currently moving northward at about 15 meters/year.) |
| 12/21, 22 | Peak of Ursids Meteor Shower. Approximately 5 – 10 meteors per hour. Viewing conditions should be good due to there only being a waning-crescent Moon rising after 3:00 a.m. |
| 12/26 | Annular Solar Eclipse (not visible in the DC area) – The eclipse will first be visible in Saudi Arabia, then will move east across parts of Asia, ending in the Pacific Ocean. During an annular solar eclipse, the Moon is so far from the Earth that it cannot completely cover the Sun, therefore the outer part of the Sun appears as a ring around the Moon. |
| 1/3, 4 | Peak of the Quadrantids Meteor Shower – Approximately 40 meteors/hour. A quarter Moon sets near midnight leaving ideal viewing conditions afterward. |
| 1/10 | Full Moon at 2:23 p.m. |

Times in EST

Birth of a Binary-Star System

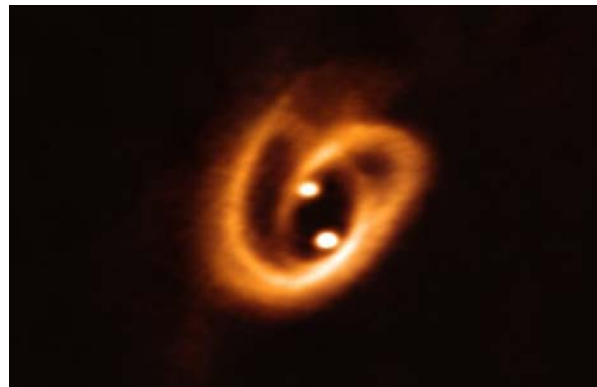


Image Credit: ALMA (ESO/NAOJ/NRAO), Alves, et al.

The stunning image shown above, taken by ALMA (Atacama Large Millimeter/submillimeter Array), is of a binary protostar system

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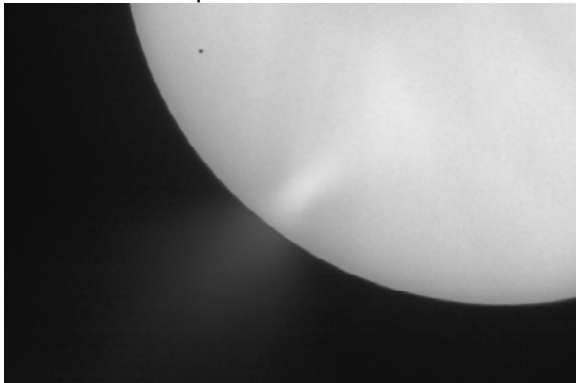
Mercury Transit – November 11, 2019

The night before, weather conditions didn't look like they were going to be very good for Mercury's transit across the Sun. Like Punxsutawney Phil, the groundhog with his own holiday, NCA member Elizabeth Warner explained in an email that if she could see her shadow that morning, telescopes would be set up for viewing the transit at the University of Maryland. If she couldn't, then unless the clouds abated sometime during the transit, people would have had to wait until November of 2032 and travel to Europe, Asia, Africa or Antarctica, to see the next such transit. Fortunately, on the morning of November 11th, the forecast clouds mostly stayed away and a shadow was seen, portending 5 ½ hours of viewing the transit.

Starting at 7:35 a.m. EST, Mercury touched the Eastern Limb of the Sun and moved westward until the transit ended at 1:04 p.m. During the event many people viewed the Solar System's smallest and fastest planet moving against the background of the Sun through binoculars and telescopes with solar filters. And some took pictures, such as NCA member Jim Simpson, who got the images shown below.



Direct-projection image with Mercury at upper right, as indicated by the tick marks. Images Credit: Jim Simpson



Mercury near the end of its transit across the Sun. Jim reports, "The photo was taken using a 4" Meade APO refractor (102 mm, F-9) with a 25 mm eyepiece projecting the image to a Nikon d750 DSLR camera. I used a Baader solar film white light filter. There's some flair in the image, probably from internal reflections in the eyepiece or eyepiece holder."

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Thank you!

• [Recent Astronomy Highlights – continued from page 2](#)

• NICER Detects Brightest and Strangest Pulsar X-Ray Burst So Far

• NICER, Neutron Star Interior Composition
 • Explorer Mission, is an X-ray telescope on
 • board the International Space Station. (Dr.
 • Keith Gendreau gave a talk about NICER at
 • the NCA meeting in March 2019.) On
 • August 20, NICER detected an X-ray burst
 • coming from a pulsar located approximately
 • 11,000 light years away in the direction of
 • the constellation of Sagittarius. The pulsar,
 • known as SAX J1808.4-3658, has an
 • accretion disk composed of gas from a
 • companion brown dwarf. Hydrogen gas from
 • the accretion disk, feeding down onto the
 • pulsar, builds up enough every few years
 • that it can fuse into helium which can begin
 • to fuse into carbon, causing the X-ray burst
 • and ejecting the hydrogen and helium layers.
 • The burst had some unusual characteristics
 • scientists are still trying to explain. More
 • information is at <https://phys.org/news/2019-11-nicer-record-setting-x-ray.html>.

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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

| 2019 | Day | EST | Star | Mag. | Asteroid | dmag | dur. s | Ap. " Location |
|---|-----|-------|-------------|------|------------|------|--------|---------------------|
| Dec 16 | Mon | 3:46 | 4UC51816650 | 13.2 | Suzuki | 2.3 | 3 10 | swMD, nVA, WV; DC? |
| Dec 16 | Mon | 4:31 | 4UC40224794 | 13.5 | Artemis | 0.5 | 10 11 | sNJ, MD, DC, n&wVA |
| Dec 18 | Wed | 21:56 | 4UC43941340 | 10.7 | Svea | 3.0 | 10 4 | NJ, sPA, nMD, nVA |
| Dec 21 | Sat | 4:12 | 4UC44627927 | 13.0 | Hansa | 0.4 | 5 10 | sNJ, sMD, cVA; DC? |
| Dec 21 | Sat | 4:23 | 4UC44627922 | 12.2 | Hansa | 0.7 | 5 6 | NJ, sePA, nMD, nVA |
| Dec 22 | Sun | 0:41 | SAO 75593 | 8.8 | Bezovec | 4.7 | 4 3 | s-ncNC, cVA, cOH |
| Dec 26 | Thu | 19:19 | 4UC56341060 | 11.7 | Yvette | 4.2 | 2 5 | NJ, cMD, DC, nVA |
| Dec 26 | Thu | 23:25 | 4UC55844724 | 12.1 | Davida | 0.2 | 27 6 | e&nVA, MD, DC, OH |
| Dec 27 | Fri | 19:02 | TYC17160959 | 12.3 | Pichunem | 1.3 | 0.2 6 | MD, DC, VA? |
| Above is a small satellite of (702) Alauda, whose path is over NY | | | | | | | | |
| Dec 30 | Mon | 23:45 | 4UC58120151 | 10.7 | Pariana | 1.8 | 4 4 | sNJ, neMD, s&wPA |
| *** Dates and times above are 2019, those below are 2020 *** | | | | | | | | |
| Jan 4 | Sat | 0:15 | 4UC63245097 | 12.8 | Ornamenta | 0.7 | 9 8 | neNC, se-cVA, cOH |
| Jan 7 | Tue | 22:54 | 4UC59532898 | 13.8 | 1999 JZ78 | 1.2 | 3 11 | e&nVA, sMD, OH; DC? |
| Jan 8 | Wed | 5:15 | TYC07910747 | 12.5 | Ampella | 0.5 | 4 7 | sMD, DC, nVA, sOH |
| Jan 8 | Wed | 17:24 | TYC33840690 | 9.1 | Abastumani | 5.6 | 7 3 | ePA, wMD; DC, nVA? |
| Jan 8 | Wed | 19:18 | 4U390139071 | 12.5 | Fatme | 3.0 | 3 7 | w&nVA, DC, MD, NJ |
| Jan 11 | Sat | 0:20 | 4UC50240373 | 13.3 | Cucula | 3.1 | 3 11 | sNJ, s&wPA; neMD? |

Most event details at <http://www.asteroidocculatation.com/>

Lunar Grazing Occultations

| 2019 | Day | EST | Star | Mag | % alt | CA | Location, Notes |
|--------|-----|-------|------------|-----|--------|-----|-------------------------------------|
| Dec 20 | Fri | 2:39 | ZC 1856 | 6.8 | 37- 16 | 3S | Fairplay, PA; Parktn, Peryvil, MD |
| Dec 29 | Sun | 18:26 | SAO 164543 | 8.4 | 14+ 17 | 11S | seFairfx, VA; nwDC; Lauril, BWI, MD |

Links for interactive maps are at <http://iota.jhuapl.edu/exped.htm>

Lunar Total Occultations

| 2019 | Day | EST | Ph Star | Mag | % alt | CA | Sp. Notes |
|--|-----|-------|--------------|-----|---------|-----|------------------------------|
| Dec 14 | Sat | 21:25 | R mu Cancr | 5.3 | 90- 21 | 53S | G2 ZC 1224 |
| Dec 16 | Mon | 2:11 | R ZC 1377* | 7.0 | 81- 61 | 62S | A3 |
| Dec 16 | Mon | 7:05 | R ZC 1392 | 7.3 | 79- 44 | 80S | G0 Sun -3, close double |
| Dec 19 | Thu | 3:01 | R IZ Vir | 7.1 | 48- 33 | 81N | M SAO 119200 |
| Dec 19 | Thu | 5:03 | R SAO 119227 | 7.5 | 47- 51 | 73N | K0 |
| Dec 20 | Fri | 4:09 | R SAO 139070 | 8.0 | 36- 32 | 67S | A2 |
| Dec 20 | Fri | 5:10 | R ZC 1867 | 7.5 | 36- 41 | 90N | A3 |
| Dec 28 | Sat | 17:25 | D 17 Cap | 5.9 | 7+ 17 | 57S | A1 Sun-6, ZC3031, close dbl? |
| Dec 29 | Sun | 17:25 | D SAO 164524 | 7.2 | 13+ 25 | 52N | F3 Sun altitude -6 deg. |
| Dec 29 | Sun | 18:26 | G SAO 164543 | 8.4 | 14+ 17 | 11S | G5 |
| Dec 30 | Mon | 17:15 | D SAO165066* | 8.0 | 21+ 33 | 56N | K0 Sun -4, close double?? |
| Dec 30 | Mon | 20:03 | D 56 Aquari | 6.4 | 21+ 12 | 79S | B8 Azimuth 240 deg., ZC3304 |
| Dec 30 | Mon | 20:28 | D SAO 165136 | 7.8 | 21+ 8 | 63S | K0 Azimuth 244 degrees |
| Dec 31 | Tue | 18:45 | D ZC 3413* | 6.1 | 29+ 33 | 86N | K5 Mag2 11, sep. 4", PA 258 |
| Dec 31 | Tue | 20:29 | D SAO165597* | 8.0 | 30+ 18 | 43N | F8 |
| Dec 31 | Tue | 20:30 | D SAO165603 | 8.1 | 30+ 18 | 85S | G5 |
| *** Dates and times above are 2019, those below are 2020 *** | | | | | | | |
| Jan 1 | Wed | 19:46 | D ZC 3529 | 6.6 | 39+ 34 | 15N | G5 close double? |
| Jan 1 | Wed | 20:15 | D SAO 147033 | 7.7 | 39+ 31 | 69N | K0 |
| Jan 1 | Wed | 20:17 | D SAO 147032 | 7.8 | 39+ 30 | 59N | F5 |
| Jan 1 | Wed | 20:42 | D 30 Pisci | 4.4 | 39+ 26 | 53S | M3 ZC3536, close double? |
| Jan 3 | Fri | 17:13 | D ZC 208* | 7.0 | 57+ 49 | 51N | F0 Sun altitude -4 deg. |
| Jan 3 | Fri | 22:20 | D SAO 109952 | 7.4 | 58+ 30 | 54S | K0 |
| Jan 3 | Fri | 23:39 | D SAO 109982 | 8.2 | 59+ 16 | 76N | F5 |
| Jan 5 | Sun | 23:40 | D ZC 454 | 5.6 | 77+ 38 | 42N | K3 |
| Jan 6 | Mon | 21:34 | D ZC 581 | 6.8 | 85+ 67 | 83S | G0 Mag2 11, sep. .4", PA 237 |
| Jan 7 | Tue | 1:50 | D ZC 590 | 6.3 | 85+ 25 | 39N | A0 |
| Jan 8 | Wed | 18:11 | D ZC 851 | 6.4 | 96+ 32 | 61N | A1 close double?? |
| Jan 10 | Fri | 20:25 | R ZC 1167 | 6.3 | 100- 36 | 76N | K0 AxisA 267, TermDist. 2" |
| Jan 12 | Sun | 1:06 | R ZC 1329* | 6.8 | 97- 70 | 70S | F8 AA 242, close double |
| Jan 13 | Mon | 2:41 | R ZC 1462 | 7.3 | 92- 68 | 26N | K0 |

*in Kepler2 program so occultation light curves are sought.

More, esp. total lunar occultations, at <http://iota.jhuapl.edu/exped.htm>
David Dunham, dunham@starpower.net

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Occultations – Continued from page 5

Path of 8.4-mag. SAO 164543 Graze, Dec. 29, 2019



Across n.w. Washington, DC and Maryland suburbs to South Laurel



Across northern Virginia suburbs

Images Credit – David Dunham and Google Maps

There is a narrow zone, only 200 meters wide, from which as many as 10 occultations of the star will occur, according to the predicted profile of the Moon's edge generated from high-resolution Lunar Reconnaissance Orbiter lunar laser altimeter observations; it is between the two dark gray lines shown on the maps above. In parallel bands equally wide north and south of the one shown, there will still be a good show, with up to 7 occultations of the star expected. The lunar profile lines up again for about 5 occultations, 4.8 to 5.0 km north of the predicted southern limit line (shown as the thin green line about a kilometer south of the dark gray lines), and from there to 1.2 km south of the s. limit, there should be at least 2 occultations of the star, all during a 3- to 7-minute period (longer the farther north you are, but all should start observing at least by 6:22pm EST). One high mountain will occult the star for less than a minute, around 6:27pm, for observers as far as 4.5 km south of the southern limit. The Moon will be a crescent 14% sunlit, altitude 17° in the southwest, on dark side 11° from the south cusp, with the star appearing to approach from the Moon's dark side. The predicted lunar profile, and a Google map that will let you zoom in on the path in greater detail for any desired location along it, can be found in a paragraph about the event below the grazing occultation list at <http://iota.jhuapl.edu/exped.htm>.

Birth of a Binary-Star System – continued from page 3

designated [BHB2007] 11. The system lies approximately 600 light years away in the Pipe Nebula which lies in the constellation of Ophiuchus. It is the highest resolution image taken to date of the formation of a future binary-star system. The bright spots are not the protostars themselves, but the circumstellar disks surrounding and feeding gas onto those protostars. The filaments swirling about the binary contain gas pulled from a larger circum-binary disk surrounding both protostars. 0.01 Jupiter masses, or approximately 2×10^{25} kilograms, is how much gas researchers estimate is being pulled into the binary each year. For more information on this image and what has been gleaned from it, go to <https://www.sciencealert.com/for-the-first-time-stunning-images-reveal-the-complex-birth-of-binary-stars>.

Recent Astronomy Highlights – continued from page 4

Hygiea – Possibly The Smallest Dwarf Planet So Far

The dwarf planets of our Solar System, like the planets, must directly orbit the Sun, and must not be a moon. Unlike planets, dwarf planets cannot dominate their orbital region of the Solar System, in other words, they can't have cleared out all other objects in that region as planets do. One final characteristic of dwarf planets is that they must be massive enough that their gravity causes them to be spheroidal in shape. Astronomers using the SPHERE (Spectro-Polarimetric High-contrast Exoplanet REsearch) instrument on the Very Large Telescope recently showed that Hygiea, an object in the Asteroid Belt, has such a spheroidal nature, and therefore may join Ceres, as a dwarf planet in the inner Solar System. Pluto, Haumea, Makemake and Eris are dwarf planets in the outer parts of the Solar System. More information is at <https://www.sciencedaily.com/releases/2019/10/191028164353.htm>

Calendar of Events

• **NCA Mirror- or Telescope-making Classes:** Tuesdays AND Fridays, from 6:30 to 9:30 pm at the Chevy Chase Community Center (intersection of McKinley Street and Connecticut Avenue, N.W.) Contact instructor Guy Brandenburg at [202-635-1860](tel:202-635-1860) or at gfbrandenburg@yahoo.com. Additional information is at guysmathastro.wordpress.com/ and [home.earthlink.net/~gfbranden/GFB Home Page.html](http://home.earthlink.net/~gfbranden/GFB_Home_Page.html)

• **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

• **Next NCA Meeting** at the University of Maryland Observatory: **11 January** 7:30 p.m., Amy Simon (GSFC) *Uranus and Neptune: The Ice Giants*

• **The APS Mid-Atlantic Senior Physicists Group** usually has a talk on the third Wednesday of the month at 1:00 pm at the American Center for Physics (1st floor conference room). 1 Physics Ellipse, College Park MD -- off River Rd. between Kenilworth Ave. and Paint Branch Parkway. www.aps.org/units/maspg

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.?

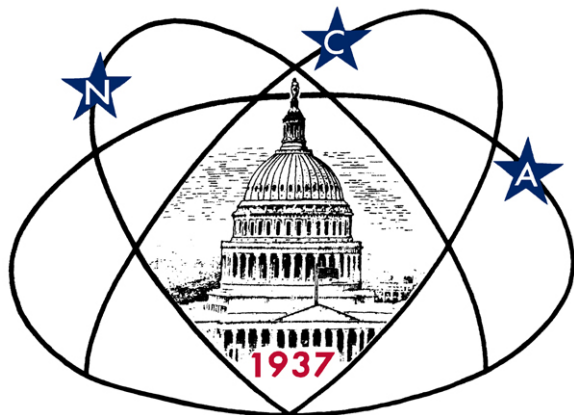
Are you interested in volunteering for: Telescope making, Exploring the Sky, Star Dust, NCA Officer, etc.?

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.

If undeliverable, return to
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400 Madison St #2208
Alexandria, VA 22314

First Class
Dated Material



Celebrating 82 Years of Astronomy

Next NCA Meeting:

2019 December 14th

7:30 pm

@ UMD Observatory

Dr. Larry Nittler

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