

Star Dust

Newsletter of National Capital Astronomers, Inc.

capitalastronomers.org

January 2020

Volume 78, Issue 5

**Celebrating 83 Years
of Astronomy**

Next Meeting

When: Sat. Jan. 11th, 2020
Time: 7:30 pm
Where: UMD Observatory
Speaker: Dr. Amy Simon

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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

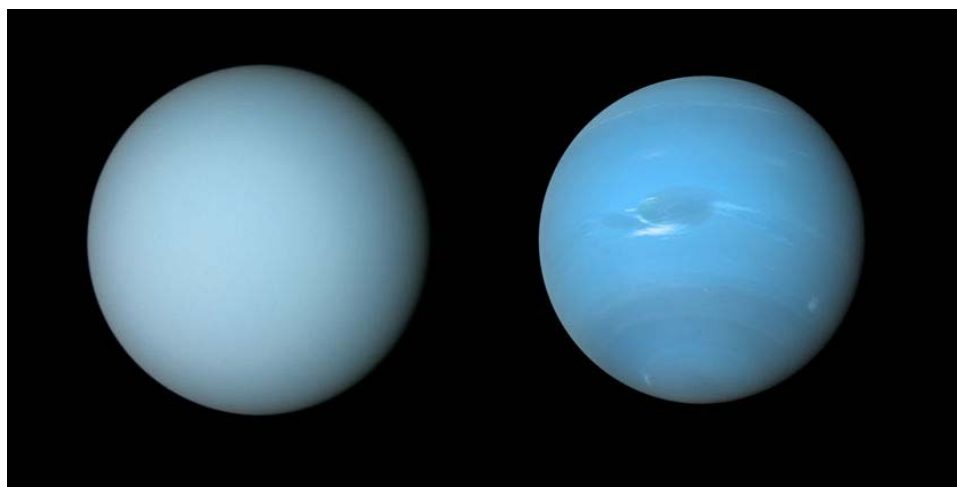
Following the meeting, members and guests are welcome to tour through the Observatory. Weather-permitting, several of the telescopes will also be set up for viewing.

The Mysteries of the Ice Giants

Amy Simon

NASA's Goddard Space Flight Center

Abstract: With only a brief flyby by Voyager 2, Uranus and Neptune are the least explored planet systems in our Solar System. They have a higher proportion of water and ices than do the other planets, so they've been dubbed the Ice Giants. Their observed extremes in tilts, winds, solar insolation, and internal heat flow, make them quite different than their distant, and larger, cousins, Jupiter and Saturn. However, with so many exoplanets falling in the Neptune mass range, it is important to better understand this class of object in our own Solar System. Here we will explore what we do and do not know about these enigmatic blue planets, including the latest findings from Hubble and ground-based facilities.



Voyager 2 images of Uranus (1986, left) and Neptune (1989, right).
Image Credit: NASA / JPL-Caltech / Björn Jónsson Image licensed under a [Creative Commons Attribution-NonCommercial-ShareAlike 3.0 Unported License](https://creativecommons.org/licenses/by-nc-sa/3.0/).

Biography: Dr. Amy Simon earned her PhD from New Mexico State University, studying the atmospheric dynamics of Jupiter and the effects of the impacts of comet Shoemaker-Levy 9. After a postdoctoral position at Cornell, she joined NASA in 2001. Her work on all four of the giant planets has included data from Hubble, Voyager, Cassini, Galileo and New Horizons, and she is currently on the OSIRIS-REx and Lucy mission

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Recent Astronomy Highlights

“Cotton-Candy” Planets

Astronomers using the Hubble Telescope have been studying planets in the young Kepler 51 system and have found that those planets have extremely low density, sort of like the density of cotton candy. Speculation is that the planets are so large and diffuse because they originated farther out in the system, then migrated inward where the heat from their star causes the planetary atmospheres to balloon out. The extended atmospheres, especially of the planet closest to the star, are expected to be stripped off over the next billion years, leaving the planets smaller and denser. More information is at phys.org/news/2019-12-cotton-candy-planet-mysteries-unravel.html

“Food” for Supermassive Black-Hole Growth Found

Astronomers studying ancient quasars have obtained images of enormous halos of cool hydrogen gas surrounding those quasars. Such reservoirs of gas are likely necessary in order to allow for the growth of the first black holes, theoretically formed at the deaths of the first stars, into the supermassive black holes that are seen today at the centers of galaxies. The images were made using the MUSE (Multi Unit Spectroscopic Explorer) instrument on the European Space Agency’s Very Large Telescope in Chile. More information can be found at www.sciencedaily.com/releases/2019/12/191219074632.htm.

Dying Galaxy in the Early Universe

Galaxies with a high rate of star formation are considered by astronomers to be living galaxies, while galaxies with little or no star formation are known as dead galaxies. Quenching galaxies, wherein star formation is slowing down, are in between the two extremes, and are considered to be in the process of dying. Astronomers are studying such a quenching galaxy which already existed 1.5 billion years after the Universe began. More information is at www.sciencedaily.com/releases/2019/12/191219101736.htm

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Biography – continued from page 1



teams. She is the Principal Investigator of the Hubble Outer Planet Atmospheres Legacy Program, which observes all four of the giant planets every year.

Sounding Rockets

The deep-space missions of NASA get a lot of publicity, and deservedly so, but the organization also does a lot of scientific research using rockets that never even make it to orbit. Sounding rockets are used to study the upper atmosphere and geospace, the region of outer space near the Earth, as well as astronomical objects out in the far reaches of space. The name ‘sounding rocket’ was derived from the mariner’s term ‘sounding’ which means taking a measurement of the depth of the sea.

Among the advantages of sounding rockets, are that they are far cheaper than rockets that go to orbit, often around two million dollars per sounding rocket, their missions can be put together fairly quickly, within six months to two years, and they can be launched when and where the conditions are ideal for studying specific phenomena, such as the Earth’s aurorae or the mysterious high-altitude electrical discharges from thunderstorms known as sprites, blue jets and ELVES. Sounding rockets are often used to test out new instruments and new technologies. During one recent effort, they were used to test prototypes of the supersonic parachutes that may be deployed to land future missions on Mars. Indeed, over the decades sounding rockets have allowed tests of new types of space telescopes such as those used for studying distant X-rays sources.

NASA’s Wallops Flight Facility, located on Virginia’s Eastern Shore, is the headquarters of NASA’s sounding rocket program. A number of sounding rockets, as well as rockets headed for orbit, are launched out of the facility annually. One outreach program at the facility involves the launching of two sounding rockets each year which contain experiments proposed and constructed by students. All launches from Wallops are open to the public, with a viewing area at the Wallops Visitors Center. An interesting video about NASA’s sounding rocket program is at www.youtube.com/watch?v=KkeCXrgrKuY&t=885s. The website for Wallops is www.nasa.gov/centers/wallops/home.

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 2019. 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

The article-submission deadline for February’s issue of Star Dust, is January 21st.

Clear Skies!

Sky Watchers

January/February

Jupiter joins Mars in the morning sky with Saturn transitioning to join them mid-January. Mercury transitions to the evening sky mid-January to join Venus.

1/27

Conjunction - Venus will be only 4' (1/15th of a degree or approximately 1/7th the width of the full Moon) south of Neptune at 2:21 p.m.

Times in EST

Fainting of Betelgeuse

Betelgeuse, the orange-red star at the shoulder in the constellation of Orion, is causing quite a stir these days because it has faded quite dramatically, down to a magnitude of approximately +1.3. Although Betelgeuse is a variable star, the current fading, called “fainting” by astronomers, seems to be more than normal. The internet is full of reports that this indicates that the red supergiant is about to go supernova. However, although the star is nearing the end of its life and will eventually go supernova, most astronomers dismiss the idea that it will happen soon, estimating that it will occur anytime from 100,000 to one million years from now. When this does happen, the supernova may shine brighter than the full Moon for weeks or months. So, what might be causing the dramatic fading? One theory is that Betelgeuse may be ejecting dust at a greater rate than normal, with that dust partially obscuring the star. The image below, taken by the ESO’s Very Large Telescope in the near-infrared, shows a large plume of gas and dust around the star.



Betelgeuse imaged in the near-infrared. Image Credit: ESO and P. Kervella

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Asteroid Bennu Eruptions

For the first time, an eruption of particles from an asteroid has been observed close up. NASA's OSIRIS-REx (Origins, Spectral Interpretation, Resource Identification, and Security-Regolith Explorer) spacecraft has been orbiting and observing the asteroid Bennu since late 2018. The probe is scheduled to take a sample from the asteroid in 2020 for return to Earth in 2023. The asteroid is carbonaceous and seems to be a pile of boulders and rocks that are loosely held together, a sort of rubble pile.

During its observations, OSIRIS-Rex took images of eruptions on January 6th and 19th as well as February 11th. The particles that were observed being ejected from the surface of the asteroid were between one and four inches in diameter. Smaller eruptions have also been observed. This discovery indicates that Bennu belongs to a class of objects known as active asteroids.

Bennu has a rotational period of approximately 4.3 hours. The major eruptions all took place when the erupting regions were in the late afternoon, when the Sun had heated the asteroid surface by up to 100 degrees Celsius. Scientists speculate that the extreme temperature variation might mean that the eruptions are caused by cracking and even bursting of some of the boulders. Or perhaps the solar heating could have caused the release of gas from the water-bearing minerals common to Bennu.

One final theory that does not involve the heating is that meteor impacts may be causing the eruptions.

Studies of the eruptions show that the particles had velocities up to 3 meters/second. Some of the particles fell back to the surface of Bennu, but others did escape the asteroid's gravitational pull. Such eruptions may explain some of the meteors that hit Earth. More information can be found at www.space.com/asteroid-bennu-eruptions-cause.html.



Image of the eruption of particles from Bennu on January 19, 2019. Erupting particles are seen leaving the surface to the right. (Image credit: NASA/Goddard/University of Arizona/Lockheed Martin)

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• **Thank you!**

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

• Duration of Young Star's Disk of Gas • Calls Into Question Current Planet • Formation Theory

• Recent study of a 40-million-year-old
 • star known as 49 Ceti has given
 • astronomers pause. The star has a
 • debris disk filled with more gas than
 • should be there this late in the star's life,
 • at least according to current planetary-
 • formation theory. The theory stipulates
 • that after the star forms, the radiation
 • pressure from it should strip away any
 • remaining gas, sending it into interstellar
 • space, leaving behind dust, asteroids,
 • planets, etc. No current theory seems to
 • be able to adequately explain how 49
 • Ceti has managed to hold on to so much
 • gas. For more information, go to
 • [phys.org/news/2019-12-massive-gas-
 disk-planet-formation.html](http://phys.org/news/2019-12-massive-gas-disk-planet-formation.html)

• *continued on page 7*

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

		Asteroid		Occultations		dur.		Ap.	
2020	Day	EST	Star	Mag.	Asteroid	dmag	s	"	Location
Jan 11	Sat	23:08	TYC02080596	11.5	Athamantis	0.5	10	6	NJ, sPA, nwMD, cOH
Jan 14	Tue	23:25	4UC54604922	13.5	Paolicchi	2.8	5	12	nVA, cMD, sNJ; DC?
Jan 15	Wed	18:01	TYC43130183	11.5	Bl anpai n*	?	1	6	DC? Mid-Atlanti
Jan 17	Fri	1:16	TYC13440331	11.8	Aguntina	2.8	5	6	neNC, se-cenVA, WV
Jan 22	Wed	4:42	4UC38567416	13.7	1989 TO11	4.7	2	12	WV, VA, NC; MD, DC?
Jan 23	Thu	2:12	TYC13311097	11.7	Aguntina	3.1	5	6	NJ, se-nwPA, swNY
Jan 23	Thu	3:57	4UC54447905	11.7	Euryanthe	3.3	4	6	se-nVA, neWV, nwMD
Jan 23	Thu	5:09	4UC56344287	13.9	Bondia	1.4	3	12	e&nVA, wPA; MD, DC?
Jan 27	Mon	5:30	TYC08470630	10.6	Werra	4.8	5	4	s&wMD, DC, nVA, wPA
Jan 28	Tue	22:45	4UC51604340	12.5	Sulami tis	2.5	4	8	sWV, ncVA, sMD, sDE
Jan 29	Wed	0:53	4UC62943003	13.9	Gri sel di s	1.6	3	12	sNJ, sPA, nMD, cOH
Jan 31	Fri	20:17	4UC415-0864	13.4	Begonia	2.5	2	12	PA, NJ; MD, nVA, DC?
Feb 1	Sat	19:47	4UC496-2664	12.1	Asta	3.4	2	7	w-cVA, MD, sNJ; DC?
Feb 5	Wed	20:39	4UC60144934	14.0	Novi kov	2.7	2	12	sNJ, DE, MD, DC, nVA
Feb 8	Sat	19:55	4UC493-4574	14.1	Lampetia	0.8	8	12	nVA, MD, DC, sPA, NJ
Feb 10	Mon	4:39	nu Ser	4.3	Kol ga	10.7	3	1	sTN, nGA, SC, sNC

*This is comet 289P/Bl anpai n so the prediction is very uncertain
 Most event details at www.asteroidoccul tati on.com/

Lunar Grazing Occultations

2020	Day	EST	Star	Mag	% alt	CA	Location, Notes
Jan 15	Wed	0:01	nu Vir	4.0	75-	25	3S Mechancsville & Glenn, VA
Jan 22	Wed	6:30	ZC 2641	7.6	6-	9	15S Rstn, Al xndri a, VA; Brndywi ne, MD
Feb 4	Tue	0:31	Ai n	3.5	70+	24	2N Arrowhead, El mont, Ol dChurch, VA
Feb 6	Thu	1:00	Tejat	2.9	88+	41	-2S Boston, Fal mouth, Accomac, VA

Links for interactive maps are at lota.jhuapl.edu/exped.htm

Lunar Total Occultations

2020	Day	EST	Ph Star	Mag	% alt	CA	Sp. Notes
Jan 12	Sun	1:06	R ZC 1329*	6.8	97-	70	70S F8 AA 242, close double
Jan 14	Tue	23:51	R SAO 119030	7.1	75-	23	50N K0
Jan 15	Wed	0:09	R SAO 119034	7.7	75-	26	60N F2
Jan 15	Wed	0:15	R nu Vir	4.0	75-	27	28S M0 ZC 1702
Jan 15	Wed	2:18	R SAO119066*	7.9	74-	47	44N G5
Jan 15	Wed	7:13	R ZC 1725	7.6	73-	40	58N K0 Sun -3deg, close double
Jan 18	Sat	2:24	R ZC 2072	6.6	41-	12	31N K0 Azimuth 113 degrees
Jan 18	Sat	3:26	R SAO 158598	7.9	40-	22	60S K0
Jan 19	Sun	3:33	R 30 Li brae	6.5	30-	11	89S K4 Az 120, ZC 2196
Jan 19	Sun	6:51	R ZC 2210	6.8	29-	34	61N K0 Sun alti tude -6 deg.
Jan 21	Tue	5:03	R SAO185220*	7.5	12-	4	62N G3 Azimuth 122 degrees
Jan 22	Wed	6:25	D ZC 2641	7.6	6-	7	6S F0 Sun-11, Az128, mg2 11 11"
Jan 22	Wed	6:36	R ZC 2641	7.6	6-	8	24S F0 Sun -9, graze s. of DC
Jan 29	Wed	20:00	D ZC 60	6.9	22+	22	80S K2
Jan 31	Fri	18:35	D ZC 286	7.6	39+	54	43N B9
Jan 31	Fri	21:55	D DE Pi sci um	7.4	40+	22	79N K5 SAO 110268
Feb 1	Sat	19:19	D 85 (Ceti)	6.3	49+	57	58S A2 ZC 401, cl ose dbl , in Ari
Feb 2	Sun	18:31	D ZC 504	7.4	59+	66	43N A0
Feb 3	Mon	0:06	D ZC 523*	6.4	60+	19	60S A5 cl ose double??
Feb 3	Mon	19:13	D ZC 643*	6.8	69+	69	83S F6
Feb 3	Mon	19:13	D SAO 93880*	8.0	69+	69	48S A2 28s after ZC 643' s D
Feb 3	Mon	21:48	D SAO 93915*	7.4	69+	56	43N B8
Feb 3	Mon	22:18	D V1233 Tau*	7.7	70+	50	72N G5 Close double; SAO 93926
Feb 4	Tue	18:22	D ZC 782	7.2	78+	58	26N A2 Sun alt. -10 deg.
Feb 5	Wed	19:44	D Propus	3.5	86+	64	48S M3 ZC 946=eta Gem, mg2 6 2"
Feb 6	Thu	0:48	D Tejat =	2.9	88+	44	15S M3 ZC 976, n. VA graze
Feb 6	Thu	1:10	R mu Gem	2.9	88+	40	-20S M3 Axis Angle 198
Feb 6	Thu	2:07	D SAO 78352	7.2	88+	30	10S A3 TmD 9", mg2 9 ". 6, PA 262
Feb 6	Thu	3:46	D ZC 997	7.0	88+	12	72S A0 Azimuth 289 degrees
Feb 7	Fri	0:03	D 58 Gem	6.2	94+	64	47N A1 ZC 1118
Feb 8	Sat	1:10	D ZC 1269*	6.9	98+	61	65N G5
Feb 8	Sat	3:54	D eta Cancri	5.3	99+	31	36S K3 ZC 1277, Term. Dist. 9"

*in Kepler2 program so occultation light curves are sought.

More, esp. total lunar occultations, at lota.jhuapl.edu/exped.htm
 David Dunham, dunham@starpower.net

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Occultations – Continued from page 6

The grazing occultation of 7.6-mag. ZC 2641 on Wednesday morning, January 22, will be a highlight of the month, occurring far on the dark side of a thin (6% sunlit) crescent Moon. The graze is late enough in the morning (6:30am) that observers need to get up only a little earlier than usual to observe it, then have breakfast and go to work. With a Sun altitude of -10 degrees, the sky will be dark enough in any small telescope to see the event, but you need to find a location, across a field, lake, or parking lot, where you will have an unobstructed view of the Moon that will be 9 degrees above the southeastern horizon. There will be about 5 occultations of the star by mountains and hills near the lunar South Pole, in a band about 800 meters wide that passes over Wheatland, Kabletown, Purcellville, Woodburn, Oak Grove, Herndon, Reston, n. Vienna, West Falls Church, Lake Barcroft, s. Baileys Crossroads, and Alexandria, VA; and n. Friendly, Brandywine, and Cedarville, MD. The star has an 11th-mag. companion 11 arc seconds north of the star that would be visible only with larger telescopes.

At 6:01pm Jan. 15, Comet 289P/Blanpain may occult an 11.5-mag. star in Cassiopeia. The prediction is very uncertain; also, the comet brightness is uncertain, it could have an outburst and is near the Earth. The Sun altitude is -10 deg. while the comet will be high in the northern sky. Event details are at occultacions.astroabadell.org/COMETOC/20200115_0183-1_summary.html.

Fainting of Betelgeuse – Continued from page 3

Another theory involves the fact that Betelgeuse seems to have at least two overlapping cycles of fading and brightening. One cycle is approximately 400 days and another is around 2100 days. Perhaps these cycles are simultaneously hitting their most faded part at the same time, leading to more fainting than has been seen in modern times.

Or perhaps both mechanisms are working together. Scientists will no doubt continue to monitor Betelgeuse to figure out what is happening. More information can be found at

earthsky.org/space/betelgeuse-fainting-probably-not-about-to-explode.

Update on Upcoming NCA Meetings

The NCA's remaining 2019-2020 meetings are listed below. Please note that the speaker for the March 14th meeting has changed.

Feb 08 Tim Livengood (GSFC) **The Depletion of Mars' Atmosphere**

Mar 14 Tony Farnham (UMD) **A Cometary Outburst, Watched as it Developed**

Apr 11 Bethany Cobb Kung (GWU) **Shedding Light on Gravitational Waves**

May 09 Joe Helmboldt (NRL) **Radio Astronomy Observes the Earth's Ionosphere**

Jun 13 **Science Fair Winners, Election, Astrophoto Show & Tell**

Recent Astronomy Highlights – continued from page 4

Supernova 1987A’s Neutron Star Found

In February of 1987, astronomers witnessed the supernova of a blue supergiant star named Sanduleak – 69 202 in the Tarantula Nebula in the Large Magellanic Cloud, a companion galaxy to the Milky Way. Dubbed Supernova 1987A, it was the first nearby supernova observed in almost four centuries. As research continued over the years, astronomers anticipated being able to study the supernova remnant, expected to be a neutron star, using radio telescopes. However, for decades the dust surrounding the remnant kept detection of the neutron star from taking place. Now astronomers using ALMA (Atacama Large Millimeter/submillimeter Array) finally report finding a very bright region of dust where the remnant neutron star was expected to be. More information is available at earthsky.org/space/astronomers-find-missing-neutron-star-sn1987a.

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
- **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: **8 February** 7:30 p.m., Tim Livengood, (GSFC), *The Depletion of Mars’ Atmosphere*
- **The APS Mid-Atlantic Senior Physicists Group:** “Analysis of Organics in Solar System Samples” by Jamie Elsila Cook, NASA’s Goddard Space Flight Center, Jan. 15th 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.

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.?

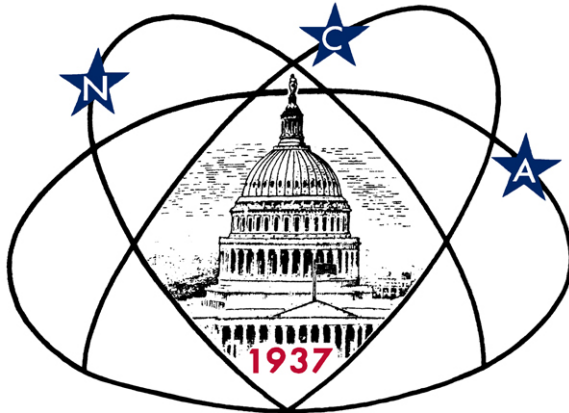
Are you interested in volunteering for: Telescope making, Exploring the Sky, Star Dust, NCA Officer, etc.?

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

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Celebrating 83 Years of Astronomy

Next NCA Meeting:

2020 January 11th

7:30 pm

@ UMD Observatory

Dr. Amy Simon

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