

Star Dust

Newsletter of National Capital Astronomers, Inc.

capitlastronomers.org

May 2021

Volume 79, Issue 9

**Celebrating 84 Years
of Astronomy**

Next Meeting

When: Sat. May 8th, 2021

Time: 7:30 pm

Where: Online (Zoom)
See instructions for registering to participate in the meeting on Page 8.

Speaker: Joe Helmboldt

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Image Credit – NASA/JPL-Caltech

The black-and-white image above was taken by Ingenuity, the helicopter that hitched a ride to Mars attached to the NASA's Perseverance Rover, during its third flight. That flight covered over 100 meters on April 25, 2021.

Radio Astronomy Observes Earth's Ionosphere

Dr. Joe Helmboldt

US Naval Research Laboratory (NRL)

Abstract: Ultraviolet photons from the Sun create a shroud of plasma around the Earth within its upper atmosphere: the ionosphere. Any radio-frequency (RF) signal that passes through this region interacts with the free electrons there, delaying the signal. This is tantamount to a change in refractive index, so an RF-emitting object such as a satellite or a radio galaxy will appear offset from its actual location on the sky. As the electron density distribution evolves on a variety of time and length scales, this refractive effect also evolves, making it difficult to image astronomical radio sources. This is especially true at frequencies below ~500 MHz, where this effect is the strongest.

For several decades, this limited the size of interferometric imaging telescopes at these frequencies to <1 km. However, self-calibration methods developed in the 1980s and 1990s eliminated this barrier and allowed for the first sub-arcminute images below 100 MHz to be obtained in the early 2000s. Since then, low-frequency radio astronomy has seen something of a boom: new, large telescope arrays have been developed and installed in New Mexico, India, California, the Netherlands/Europe, and Australia. Buried within these calibration methods are very precise and detailed measurements of density gradients generated by ionospheric irregularities on spatial scales from a few km to hundreds of km, on temporal scales of a few minutes.

This talk will focus on efforts led by radio astronomers to turn the RF astronomy trash into ionospheric physics treasure. It will detail methods developed with the world's premier low-frequency RF telescopes, as well as measurements made with a much more modest telescope made with (mostly) commercial off-the-shelf parts for a tiny fraction of the cost of larger facilities.

Biography: Joe Helmboldt is a radio astronomer at the US Naval Research Laboratory (NRL) in Washington, DC. He specializes in HF/VHF interferometry, and in the use of cosmic radio sources within these frequency regimes for ionospheric remote sensing. He has led

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Recent Astronomy Highlights

Possible Source of the Highest-Energy Cosmic Rays

Supernovae had often been assumed to be the sources of the highest-energy cosmic rays, particles moving at nearly the speed of light. Yet scientists had difficulty explaining the existence of cosmic rays with energies from tera-electronvolts (10^{12} electronvolts) up to peta-electronvolts (10^{15} electronvolts) using models of such supernovae. Now the High-Altitude Water Cherenkov observatory (HAWC), an array of large water tanks on a mountainside in Mexico, have provided evidence that these highest-energy cosmic rays may be coming from an entirely different source – star forming regions. The Cygnus Cocoon is just such a region, having formed a number of O and B type stars, the largest known stars. It seems to be the source of many cosmic rays. The research team presenting the evidence theorizes that where the stellar winds blasting away from such stars meet, they produce shockwaves capable of accelerating cosmic rays to the high-energy ranges seen by HAWC. More details are available at earthsky.org/space/highest-energy-cosmic-rays-originate-in-star-clusters-not-supernovae and the research team's article detailing the discovery is available at arxiv.org/pdf/2103.06820.pdf.

Smallest and Closest Black Hole So Far Detected

Scientists at The Ohio State University have detected what is so far the closest, and one of the smallest, black holes known to exist. Dubbed the Unicorn, it lies 1500 light years away, in the direction of the constellation Monoceros (the Unicorn). Its mass is only three times that of the Sun. The researchers were able to detect the Unicorn because of the doppler shift of its red giant companion star during its orbit of the black hole, as well as by changes in the light coming from that star due to the fact that the Unicorn has distorted it into a tear-drop shape. More info is at news.osu.edu/black-hole-is-closest-to-earth-among-the-smallest-ever-discovered/.

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Biography – continued from page 1



multiple NRL programs to develop methods for using astronomical observations to characterize irregularities within Earth's ionosphere and plasmasphere. He is also leading a DARPA-funded effort to develop a low-cost telescope array optimized for ionospheric measurements. He did his undergraduate work at Central Michigan University and received his Ph.D. in astronomy from New Mexico State University in 2005. He had postdoctoral fellowships at the University of New Mexico and at NRL, before becoming a civil servant scientist at NRL in 2009.

Hubble Celebrates Its 31st Birthday With An Image of A Star Beginning the Process of Destruction



**AG Carinae, surrounded by an expanding shell of dust and gas.
Image Credit - NASA, ESA and STScI**

For its 31st birthday, the Hubble Space Telescope imaged AG Carinae, one of the brightest stars in the galaxy, along with the shell of gas and dust that it ejected in one or several eruptions thousands of years ago, a shell that now measures five light years in diameter. More information on the image, the star and the shell of gas and dust can be found at esahubble.org/news/heic2105/.

Exploring the Sky



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

Due to the ongoing Coronavirus Pandemic, Exploring the Sky sessions are canceled. When the situation changes, sessions will once again be scheduled.

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 June’s issue of Star Dust, is May 21st.

Clear Skies!

Sky Watchers

May/June

Mars remains in the night sky, with Mercury and Venus also visible at sunset. Mercury reaches Greatest Eastern Elongation mid-May (see below). Jupiter and Saturn will rise in the hours after midnight.	
5/17	Mercury will be at Greatest Eastern Elongation, 22 degrees away from the Sun at sunset and in the best conditions for viewing in the western sky.
5/26	Full Moon (at 7:44 a.m.), a Supermoon, and a Total Lunar Eclipse (only the beginning of which, when the Moon just starts to enter the Earth’s Umbra, will be visible as the Moon sets on that evening in the DC area). Farther western parts of the United States will be able to see part or all of the eclipse.
6/10	Partial Solar Eclipse in the Washington DC area with 55% of the Sun blocked by the Moon at maximum coverage which will take place at 5:47 a.m., only a few minutes after sunrise at 5:44 a.m. Farther north in Canada, the Arctic Ocean, Greenland and eastern Russia, this event will be an Annular Eclipse, with a thin ring of the Sun surrounding the Moon. Further details can be found at www.timeanddate.com/eclipse/solar/2021-june-10 .

All times are in EDT (Eastern Daylight Savings Time)

Stellar Mysteries

Astronomers know a lot about stars; nevertheless, stars still have some surprises in store for those who study them. Two mysteries have become apparent recently, one about older stars and the other about new ones.

Older Stars Spin Faster Than Theorized

Stars spin quickly when they are born, due to the rotational energy of the clouds of gas from which they form. As they age, however, the rate of spin tends to slow down. The mechanism that causes this slowing is known as magnetic braking. The braking occurs when the ionized particles of stellar wind are dragged around by the star’s rotating magnetic field, causing them to maintain the same angular momentum as that star even as those particles move farther and farther away, which means that the particles must speed up in the direction of rotation. Due to conservation of energy, this means the star must slow down. Eventually the ionized particles leave the star’s system, taking the energy received from the star’s magnetic field with them.

The process is well understood, and models have been created to show what the expected slowdown in spin is through the lifetimes of stars. However, a new study seems to indicate that older stars do not slow down as much as the models predict, confirming the results of a study released in 2016. That 2016 study used changes in the amount of light received from stars due to their dark spots (like the sunspots on our Sun). The new study instead uses changes in the light received due to the oscillations passing through the stars. The study of stellar oscillations is

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NCA 2021-2022 Elections

John Hornstein

In the election that will be held on June 12, 2021, the following candidates have agreed to run for the indicated positions as 2021-2022 NCA Officers and Board Members:

President	Harold Williams
Vice President	John Hornstein
Asst. Secy-Treasurer	Jeff Norman
Secy-Treasurer	Henry Bofinger
Trustee	Benson Simon (to June 2025)

Trustees have staggered 4-year terms. The trustees whose terms continue through the June 12 election are:

Trustee	Mike Brabanski (to June 2022)
Trustee	Guy Brandenburg (June 2023)
Trustee	Jack Gaffey (to June 2024)

Any member is welcome to sign up to run for any of those positions. The duties of those offices can be found in the NCA constitution at capitalastronomers.org/documents/NCAconstitutionAdoptedNov2011.pdf. Please send all nominations by email to the Star Dust editor at NCAStardust@gmail.com by May 31. Self nominations are encouraged. If you are nominating someone else, please contact that person to make sure they are willing to serve in that office before nominating them.

Every member of the NCA can vote in the election on June 12. That election will be Zoom-based. During the Zoom session, when the beginning of the voting is announced, go to the bottom of your Zoom screen and note the 'Reactions' icon. To vote, click on that icon to see the options. When each combination of a candidate and a position is announced, click on either 'thumbs up' or on 'thumbs down' to indicate your choice. If there are multiple candidates for any office, alternate procedures for that election will be explained at that time.

Astronomical League 2021 Convention in August

The Astronomical League, a federation of over 300 astronomical societies, including the National Capital Astronomers, is turning 75 this year. Due to COVID, it will be holding an online convention during the afternoons and evenings of August 19th – 21st. Registration will be free, and there will be a fee of \$5 for anyone wanting a 75th Anniversary pin. More details should be available soon at the League's website, www.astroleague.org.

At the request of the Astronomical League President, Carroll Iorg, NCA will be sponsoring a door prize for the convention in order to help generate interest.

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Thank you!

Recent Astronomy Highlights – continued from page 2

Source of Earth's Carbon

For a long time, scientists believed that Earth's carbon came from the protoplanetary disk of gas that originally formed around the young, growing Sun. However, a group of scientists have pointed out that the carbon in such a disk would have been vaporized by the radiation from the Sun and would remain as a gas thereafter, unable to become part of the growing protoplanetary bodies that would make up Earth, at least not in any significant amount. The team's alternate theory is that the carbon that makes up the Earth actually came directly from the interstellar medium. More information about the study and results can be found at

www.sciencedaily.com/releases/2021/04/210402141742.htm.

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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

2021	Date	Day	EDT	Star	Mag	Planet or Asteroid	dmag	dur.	Ap. s in.	Location
	May 12	Sat	3:17	2UC24378882	13.4	2001 KA77	8.9	13	10	TNO - e.USA?
	May 16	wed	21:57	SAO 99050	9.1	Libya	6.4	8	3	nNY,sNewEnglnd
	May 19	Sat	23:05	SAO 78893	8.9	Venus	0.0	435	7	alt.7 dg.at DC
	May 22	Tue	21:07	TYC56160586	11.2	Charis	2.8	4	8	NJ,PA,neOH
	May 24	Thu	0:00	TYC19650020	11.0	Papagena	1.7	6	7	wNY,PA,eMD,NJ
	May 24	Thu	21:54	TYC19340103	10.1	Tabora	2.3	2	5	wNY,nePA,nNJ
	May 31	Thu	0:17	TYC14650134	11.4	Brucia	3.6	3	7	OH,nwPA,w&nNY
	Jun 2	Sat	22:05	SAO 79605	9.6	Athor	5.2	1	4	KY,wNC,SC
	Jun 7	Thu	22:25	TYC14340773	10.9	Backlunda	4.2	2	5	eKY,wNC,neSC

Lunar Grazing Occultations

DATE	Day	EDT	Star	Mag	% alt	CA	Location
May 10	Thu	9:10	delta Cap	2.9	47-	31-18S	Arlngtn,VA;DC;Beltsvl,MD;Sn36
May 18	Fri	21:41	ZC 885	5.6	7+	12 17N	Richmond & Norfolk, VA Sun-15
May 20	Sun	21:59	SAO 79790	8.7	22+	29 15N	Emigsville,PA; Aberdeen,MD
May 23	wed	23:01	SAO 99138	9.0	52+	36 15N	Massaponax, VA &Somerset, PA
Jun 19	Tue	21:20	Regulus	1.4	26+	35 16N	S. Carolina; Sun alt. -9 deg.

Detailed interactive path maps & other details are at <http://www.fingerlakessynthetic.com/occultations/GrazeMaps.html>.

Total Lunar Occultations

DATE	Day	EDT	Ph Star	Mag	% alt	CA	Sp. Notes
May 12	Sat	4:23	R ZC 3437	6.8	26-	11	73S A0 Azimuth 105 deg.
May 18	Fri	20:56	D SAO 77604	7.0	7+	20	33S K0 Sun alt. -8 deg.
May 18	Fri	21:14	D SAO 77621	7.5	7+	17	73S M3 Sun -11; Az. 292 deg.
May 18	Fri	21:20	D SAO 77619	7.1	7+	15	31S F2 Sun -12; Az. 293 deg.
May 18	Fri	22:07	D 136 Tauri	4.6	7+	8	77S A0 close dbl;ZC890;Az299
May 19	Sat	21:24	D SAO 78853	7.7	14+	25	50S A0
May 20	Sun	21:52	D SAO 79790	8.7	22+	29	30N A5 graze, Aberdeen, MD
May 20	Sun	22:20	D SAO 79804	7.4	23+	24	59S G0 mg2 7.9,sep0.19",PA38
May 20	Sun	22:27	D ZC 1195	6.8	23+	23	45S B8
May 21	Mon	0:14	D ZC 1200	6.9	23+	3	10S K0 Azimuth 297 deg.
May 21	Mon	0:26	D ZC 1208	6.4	23+	2	37N K1 Azimuth 299 deg.
May 21	Mon	21:11	D SAO 80439	8.2	32+	45	47N K2 Sun -10; NY graze
May 21	Mon	23:55	D SAO 98198	7.6	33+	14	44S K5 Azimuth 284 deg.
May 22	Tue	0:05	D SAO 98212	8.4	33+	12	59N M0 Az286;mg2 12 .9",PA351
May 23	wed	22:40	D 45 Leonis	6.0	52+	39	66N A0 ZC1531;mg2 11 37",PA132
May 27	Sun	1:26	D chi Vir	4.7	80+	18	47S K2 ZC1815;mg2&3 9,".1&174"
May 27	Sun	22:14	D SAO 157849	7.3	86+	38	64S F2
May 28	Mon	21:16	D ZC 2011	6.3	92+	30	75S K2 Sun alt. -9 deg.
May 30	wed	22:34	D SAO 183731	7.3	99+	21	66S F0 Term.16";mg2 9 6",PA289
May 31	Thu	0:37	D ZC 2250	7.7	99+	26	66N M1 Terminator distance 14"
May 31	Thu	4:10	D l Scorpii	4.6	99+	7	60N B1 Az229; ZC2263;spec.bin.
Jun 3	Sun	3:37	R ZC 2702	6.8	95-	22	69S K0 WA 259 deg.
Jun 8	Fri	2:08	R 82 Aquarii	6.2	52-	8	47N M2 ZC 3383; Az. 105 deg.
Jun 8	Fri	2:56	R SAO 146488	7.5	52-	16	57S K0 Azimuth 113 deg.
Jun 9	Sat	3:23	R XZ Piscium	5.8	40-	17	72S M5 ZC 3520; Az. 104 deg.
Jun 10	Sun	4:54	R 62 Piscium	5.9	29-	30	83S G8 ZC 103; Sun alt. -8 dg.
Jun 10	Sun	5:11	R delta Psc	4.4	29-	33	54N K5 ZC 105; Sun alt. -6 dg.

More information is at <http://iota.ihuapl.edu/exped.htm>. David Dunham, dunham@starpower.net, phone 301-474-4722

Stellar Mysteries – continued from page 3

known as asteroseismology, a relatively young field in astronomy. The oscillations, actually sound waves in the star's plasma, are affected by the spin of the star and can therefore be used to gauge the rate of rotation of that star. Astronomers theorize that the decrease in magnetic braking occurs because of changes in a star's magnetic field as it ages. More information is available at www.eurekalert.org/pub_releases/2021-04/uob-tso042021.php, and the original article published by the research team is available at arxiv.org/pdf/2104.10919.pdf.

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Stellar Mysteries – continued from page 5

Hubble Discovery Calls Current Star-Formation Theory Into Question



Star Formation region known as the Orion Complex, near the sword of Orion. Image Credit - NASA/JPL-Caltech/T. Megeath (University of Toledo, Ohio)

Commonly accepted theory about star formation holds that once a protostar forms, the radiation from it should begin to force the gas in the protoplanetary disk surrounding that star outward into interstellar space, forming a larger and larger cavity in the gas surrounding that star. In addition, the magnetic fields of the growing protostar should also sweep up ionized gas, drawing it to the poles of that protostar where it can be ejected in jets of plasma. Both of these processes are known as Stellar Feedback.

But a new study, using images of the Orion Complex taken by the Hubble Telescope sheds doubt on the concept of such cavities growing as newly formed stars age.

Obviously, researchers don't have the luxury of observing the complete process involved in forming any one star, a process that can take millions of years. However, by looking at many protostars, at various points in their formation, those researchers can gain information about the process. Using this method, researchers categorized 304 protostars by age in the Orion Complex, an active star-forming region. The researchers also measured the sizes of the cavities surrounding them. To their surprise, the sizes of those cavities were not related to the age of the protostars producing them, seeming to indicate that such cavities do not grow as protostars age.

Researchers speculate that other processes that take far longer may be involved in causing the remaining gas to be pushed away from the maturing star and shutting off the potential for further growth. More research will be needed to determine the nature of such processes.

More information about the study of the protostars is available at www.sciencealert.com/material-blasted-from-baby-stars-doesn-t-seem-to-switch-off-their-growth-after-all and the research team's paper, to be published in *The Astrophysical Journal*, is available at arxiv.org/pdf/2102.06717.pdf.

Recent Astronomy Highlights – continued from page 4

New All-Sky Map of the Milky Way’s Outer Halo and the Wake of the Large Magellanic Cloud

A new All-Sky map, based on data from the European Space Agency’s Gaia mission and NASA’s Near Earth Object Wide Field Infrared Survey Explorer, NEOWISE, gives new information about the outer part of the Milky Way’s galactic halo. It also maps out the wake created by the Large Magellanic Cloud, a companion galaxy, as it orbited through the galactic halo, stirring up the stars and gas located there. Scientists speculate that the new data may provide information on the nature of the Dark Matter that is posited to make up most of the mass in the halo. The study also seems to confirm models indicating that the Large Magellanic Cloud is still on its first orbit of the Milky Way, an orbit of 13 billion years. More information about the study can be found at www.jpl.nasa.gov/news/astronomers-release-new-all-sky-map-of-milky-ways-

Calendar of Events

NCA Mirror- or Telescope-making Classes: The Chevy Chase Community Center is currently closed due to the coronavirus pandemic. When it reopens, classes will be 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 (leave message) or at gfbrendenburg@yahoo.com. More info is at guysmathastro.wordpress.com/ and home.earthlink.net/~gfbrenden/GFB_Home_Page.html

Open house talks and observing at the University of Maryland Observatory in College Park are temporarily suspended. When they resume, they will be on the 5th and 20th of every month at 8:00 pm (Nov.-Apr.) or 9:00 pm (May-Oct.). Updates are posted at www.astro.umd.edu/openhouse.

Next NCA Meeting (Zoom): 12 June 7:30 p.m., NCA Elections, Science Fair Awards and Astro-photo Show

The APS Mid-Atlantic Senior Physicists Group: (Zoom Meeting) May 19th at 1:00 p.m., Dr Charles Adler, St. Mary’s College of Maryland, will give a talk entitled "How Science Fiction Becomes Science". More information is available at www.aps.org/units/maspg/meetings/meeting.cfm?name=SENIOR0521. To attend the meeting, use the following link and meeting info: apsphysics.zoom.us/j/96365046707?pwd=MGt6SDk0RFFwUG5nejVQNy9sZUJSdz09
Meeting ID: 963 6504 6707 Passcode: 145160
Dial in access 301 715 8592 (Washington DC).

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.?

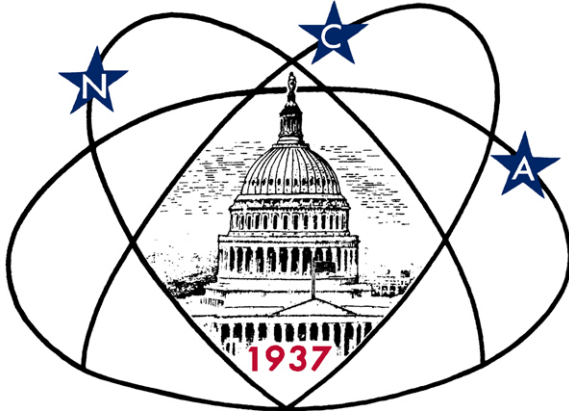
Are you interested in volunteering for: Telescope making, Exploring the Sky, Star Dust, NCA Officer, etc.?

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
NCA c/o Elizabeth Warner
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Alexandria, VA 22314

First Class
Dated Material



Celebrating 84 Years of Astronomy

Next NCA Meeting:

2021 May 8th

7:30 pm

(On Zoom)

Dr. Joe Helmboldt

The NCA Zoom meetings are open to anyone, however, you must register ahead of time. To register, go to: umd.zoom.us/meeting/register/tJA1c-6sqjsiHdfRNCJnuI3iawoOyahnYPh. The website is set up so that you can register for any or all of the NCA meetings scheduled for this year. After registering, you will receive a confirmation email containing logon information for the meeting. Do not share the logon you receive in the confirmation email. Instead, if there is somebody you know who wants to participate, share the link above instead.

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