# Star Dust

***Newsletter of National Capital Astronomers, Inc.***

*capitalastronomers.org*

***June 2020*** ***Volume 78, Issue 10***

***Celebrating 83 Years of Astronomy***

**The June 13, 2020 meeting of the National Capital Astronomers has been cancelled.**

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**(Please note – The June 2020 issue of Star Dust is digital only and has more pages than the usual format.)**

Infrared image of the Horsehead Nebula by the Hubble Space Telescope. See a larger version at https://images.nasa.gov/details-GSFC_20171208_Archive_e001518. Image Credit: NASA, ESA and Hubble Heritage Team (STScI/AURA)

# June National Capital Astronomy Meeting Is Cancelled

Because of the continuing coronavirus pandemic, the University of Maryland Observatory remains closed until further notice. In case the closure continues into September, the possibility of having NCA meetings over the internet is being explored. Updates will be sent to NCA members by email and in the September 2020 issue of Star Dust.

Image Credit – Elizabeth Warner

## NCA Annual Elections

With the June 13th NCA meeting cancelled, voting by email has started and will close on June 13. Each NCA member should email their votes to **both** Henry Bofinger, hbofinger@earthlink.net, and Jeff Norman, jeffreynorman@comcast.net. Results will be posted on June 14th.

**Current Slate of Officer and Board Member Positions for 2020-2021**

***John Hornstein, reporting for the Nominating Committee, May 2020***

| | Current Officeholder | Candidates |
|---|---|---|
| President | Harold Williams | Harold Williams |
| Vice President | John Hornstein | John Hornstein |
| Asst. Secy-Treasurer | Jeff Norman | Jeff Norman |
| Secy-Treasurer | Henry Bofinger | Henry Bofinger |
| Trustee | Benson Simon (to June 2021) | N/A |
| Trustee | Mike Brabanski (to June 2022) | N/A |
| Trustee | Guy Brandenburg (June 2023) | N/A |
| Trustee | Jack Gaffey (to June 2020) | Jack Gaffey (to June 2024) |

## *Recent Astronomy Highlights*

Despite the pandemic, discoveries in astronomy continue to be reported, including the closest black hole and the farthest exoplanet seen so far.

**Closest Black Hole**

Originally studying the supposedly binary star system designated HR 6819, astronomers were surprised to realize that there was also a third-unseen member of the system, a stellar-mass black hole. HR 6819 lies approximately 1000 light years away toward the southern constellation of Telescopium and can be seen with the naked eye. One of the stars in the system was determined to be orbiting the unseen black hole every forty days, while the other star orbits the system farther out. The discovery of a black hole so close to our Solar System provides support for the conjecture that there are hundreds of millions of stellar-mass black holes in our galaxy. More information is at https://www.sciencedaily.com/releases/2020/05/200506091537.htm

**Faraway Exoplanet Discovered**

A fortuitous alignment of two stars, an exoplanet and Earth has allowed for the discovery of a rocky exoplanet nearly 25,000 light years away that lies near or perhaps even within the bulge of the Milky Way. The gravity of the closer star, and the exoplanet which orbits that star, bent the light from the more distant star, causing more of that light to arrive at Earth, like a lens in a telescope. Astronomers studying this gravitational lensing event, designated OGLE-2018-BLG-0677, were able to use the changing light intensity from the farther star to calculate a number of properties of the foreground star-planet system, including their masses, the distances between them, and the orbit period of the planet. The planet turns out to be approximately four times the mass of Earth, while its star is 0.12 times the mass of the Sun. More information can be found at the first link below and a pre-publication copy of the paper on the discovery is at the second.

https://www.sciencealert.com/a-rare-super-earth-planet-has-been-found-almost-25-000-light-years-away

https://arxiv.org/pdf/2003.02983.pdf

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## Vera Rubin Observatory and Nancy Grace Roman Space Telescope

Vera Rubin and Nancy Grace Roman, both of whom were members of the National Capital Astronomers, have in recent months had facilities named in their honor.

Vera Rubin's work on the rotation curves of galaxies led to some of the earliest evidence of Dark Matter. The Vera Rubin Observatory, previously the Large Synoptic Sky Survey (LSST), is nearing completion of construction in Chile. Expected to go online in 2022, the observatory's telescope is expected to take a thousand images of the sky each night over a ten-year period, providing data about transient events, such as supernovae, as well as finding small objects within the Solar System. By the way, the acronym LSST has been repurposed to denote the Legacy Survey of Space and Time.

**Vera Rubin (Image Credit: NASA)**

Meanwhile the Wide Field Infrared Survey Telescope (WFIRST), has been renamed the Nancy Grace Roman Space Telescope in honor of the woman known as the Mother of the Hubble Telescope. The launch of the telescope is expected in the mid-2020s. It will take images in an effort to study the early Universe, as well as search for exoplanets, and provide data for many other areas of astronomical research.

**Nancy Grace Roman posing in front of a model of the Hubble Telescope. Image Credit: NASA**

## 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*

**2020 Exploring the Sky Sessions**
(Due to the coronavirus pandemic, the Exploring the Sky Sessions are being cancelled until further notice. NCA members are exploring ways to conduct the sessions virtually. If this happens, virtual sessions will be as follows.)
27 Jun. 9:00 p.m.
25 Jul. 9:00 p.m.
22 Aug. 8:30 p.m.
26 Sep. 8:00 p.m.
24 Oct. 7:30 p.m.
7 Nov. 7:00 p.m.
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

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**The article-submission deadline for September's issue of Star Dust, is August 21st.**

***Clear Skies!***

# Sky Watchers

## Summer Overview

Mercury is in the evening sky through June, transitions to the morning sky in early July, reaches Greatest Western Elongation on the 22nd (see below) then transitions back to the early evening sky in mid August. Venus remains in the morning sky throughout the Summer, reaching greatest Western Elongation in mid-August (see below). As Summer begins, Jupiter rises around 10:00 p.m., while Saturn follows about eighteen minutes later. Both planets will rise earlier each night until they reach opposition six days apart in mid July (see below). Jupiter will move closer to Saturn throughout the Summer and Fall, culminating in a conjunction of the two planets on December 21st, when they will be only a fifth of the Moon's width away from each other. (More on that event in Fall 2020 issues of Star Dust.) In mid June, Mars rises after 1:00 a.m., and by early September will rise at around 11:00 p.m.

## Late June

| | |
|---|---|
| 6/20 | Summer Solstice – 5:43 p.m. |
| 6/21 | Annular Solar Eclipse – With the Moon far away from the Earth in its orbit, it will not completely cover the Sun, instead leaving the outermost part of the Sun as a bright ring around it. The eclipse will begin in Africa and end in the Pacific Ocean after passing through China. |

## July

| | |
|---|---|
| 7/5 | Full Moon – 12:44 a.m. The Moon will experience a Penumbral Lunar Eclipse at this time, passing through the partial shadow of the Earth. The eclipse will be visible throughout North America, but darkening of the Moon will be minor. |
| 7/14 | Jupiter at Opposition, closest to Earth and viewable all night long. |
| 7/20 | Saturn at Opposition, closest to Earth and viewable all night long. |
| 7/22 | Mercury at Greatest Western Elongation. It will be 20.1º from the Sun, visible in the pre-dawn sky. |
| 7/28, 29 | Peak of the Delta Aquarids Meteor Shower – 20 meteors/hour. Unfortunately, a second quarter Moon will interfere with viewing. Best viewing in the hours before dawn. |

Times in EDT

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## Online Astronomy Resources

With NCA meeting cancelled and many colleges, universities and astronomy-related facilities around the country still closed because of the coronavirus epidemic, below is a final batch of online resources available for those interested in expanding their knowledge of astronomy and physics or simply enjoying the wonders of our Universe.

*Your Daily Equation* – Science writer and physicist Brian Greene is creating a series of talks on various equations and concepts involved in physics and astronomy, from the Heisenberg Uncertainty Principle to the cause of the Big Bang. Some math is involved. At the time of writing he has recorded thirty such talks. The playlist of the talks can be found at https://www.youtube.com/playlist?list=PLKy-B3Qf_RDVL6Z_CmgKf0tAbpXTua9mV.

*The World Science Festival* - The festival highlights many different branches of science, including astronomy. Geared toward the general public, the talks often involved leaders in the various fields. The playlist is at https://www.youtube.com/user/worldsciencefestival.

*The Biggest Ideas in the Universe!* – Physicist and science writer Sean Carroll is also creating a series of talks about physics topics, including concepts such as Space, Time and Quantum Mechanics. He has recorded ten of the talks so far, as well as Q & A sessions as followup to supplement the material for some talks. The playlist is at https://www.youtube.com/playlist?list=PLrxfgDEc2NxZJcWcrxH3jyjUUrJlnoyzX.

*ERC PhiloQuantumGravity* – The website for the European Research Council has numerous discussions and lectures about advanced topics often involving Quantum Gravity. The playlist can be found at https://www.youtube.com/channel/UCMpb8pocs6y6aBr272ngAgQ.

*Deep Sky Videos* – A website with lots of videos about astronomy and research telescopes. The site features a series of short videos, with each one highlighting one of the Messier Objects. The playlist is at https://www.youtube.com/user/DeepSkyVideos.

*Carnegie Science Institute* – Carnegie supports the research of numerous scientists, including astronomers, and hosts talks by those scientists. A list of such talks, which cover many subjects besides astronomy, can be found at https://carnegiescience.edu/past-events.

*Orbit – A Journey Around Earth in Real Time* - On the lighter side, if you're feeling shut in, unable to travel very far, the following video may be just what you need – a view of the Earth from the International Space Station as it orbits our beautiful home world. The video can be found at https://www.youtube.com/watch?v=7KXGZAEWzn0

*Journey to the Edge of the Universe* – If going into orbit isn't enough for you, then why not take an imaginary journey much farther? The video is at https://www.youtube.com/watch?v=bVQpwxgMQCg.

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**Please Get Star Dust Electronically**

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***Thank you!***

*Recent Astronomy Highlights – continued from page 2*

**Rotating Galaxy in Early Universe Leads to Questions About Current Galaxy Formation Theory**

Using the Atacama Large Millimeter/submillimeter Array (ALMA) astronomers discovered a large, faraway galaxy, catalogued as Galaxy DLA0817g, which shows signs of rotation even though those astronomers are seeing it as it was when the Universe was less than two billion years old. Astronomers had previously theorized that such galaxies, forming from mergers of smaller galaxies, should be irregular at first, only starting to show signs of rotation when the Universe was six billion years old. More information can be found at https://www.sciencedaily.com/releases/2020/05/200520124947.htm

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## Occultation Notes

- D following the time denotes a disappearance, while R indicates that the event is a reappearance.
- 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

| 2020 | Day | EDT | Star | Mag. | Asteroid | dmag | dur. s | Ap. " | Location |
|---|---|---|---|---|---|---|---|---|---|
| Jun 16 | Tue | 4:36 | 4U374115254 | 16.1 | Quaoar | 2.7 | 46 | 14 | AllMidAtlantic |
| Jun 17 | Wed | 2:53 | TYC51231098 | 11.8 | Hela | 1.8 | 1.6 | 6 | eVA,DC,cMD,cPA |
| Jun 18 | Thu | 2:36 | TYC05831070 | 10.5 | Arequipa | 2.3 | 3 | 4 | sw&cVA,s&eMD;DC? |
| Jun 18 | Thu | 2:37 | 1N601720714 | 17.4 | Ixion | 2.3 | 22 | 16 | sCanada;USA? |
| Jun 20 | Sat | 4:52 | ZC 2644 | 6.2 | Bengt | 11.1 | 0.9 | 2 | cMD,n&swVA;DC? |
| Jun 21 | Sun | 3:11 | SAO 186109 | 9.1 | Lydia | 2.3 | 8 | 3 | nc-swPA,WV,seOH |
| Jun 28 | Sun | 2:39 | 1B601632809 | 17.1 | Ixion | 2.5 | 22 | 16 | c&wUSA;eUSA? |
| Jul 1 | Wed | 23:14 | 4UC27191717 | 13.7 | Tisiphone | 0.7 | 8 | 12 | eVA,eMD,ePA;DC? |
| Jul 2 | Thu | 23:28 | 4UC36684856 | 14.2 | Kalypso | 0.5 | 8 | 14 | NJ,sPA,nMD;DC? |
| Jul 5 | Sun | 2:28 | 4U355187966 | 13.3 | Ucclia | 2.6 | 2 | 10 | ePA,MD,n&wVA;DC? |
| Jul 10 | Fri | 1:50 | 4U314243004 | 12.0 | Josephina | 1.7 | 9 | 7 | NJ,MD,DC,VA |
| Jul 10 | Fri | 3:03 | 4U348185551 | 12.1 | Lipperta | 2.7 | 4 | 6 | e&sPA,wMD;DC,VA? |
| Jul 14 | Tue | 3:41 | PPM 116767 | 9.9 | Anna | 7.2 | 1.6 | 3 | e&nVA,wMD,PA;DC? |
| Jul 16 | Thu | 23:08 | 4U284104589 | 13.8 | Majuba | 0.8 | 6 | 12 | eNC,eVA,wMD;DC? |
| Jul 18 | Sat | 4:27 | 4UC51002236 | 13.7 | Phthia | 0.9 | 2 | 11 | wMD,sePA;nVA,DC? |
| Jul 23 | Thu | 3:08 | 4U365188299 | 12.9 | Klytia | 0.8 | 5 | 9 | NJ,MD,DC,n&wVA |
| Jul 27 | Mon | 4:28 | 4U361199325 | 10.2 | Turandot | 2.2 | 9 | 4 | wNY,nwPA,ne-swOH |
| Aug 15 | Sat | 5:03 | 4UC57712782 | 11.4 | Pompeja | 2.8 | 4 | 5 | WV,nVA,wMD,sePA |
| Sep 5 | Sat | 2:13 | TYC57570560 | 11.8 | Sigelinde | 2.6 | 10 | 5 | sMD,cVA,wNC,eTN |
| Sep 5 | Sat | 4:16 | SAO 127057 | 7.0 | 2014 NW65 | 16 | 2 | 2 | eUSA |

The list is only comprehensive through July. Sometime in mid-July, the predictions will be updated and more events will be added, for occultations during August and early September. Readers are thus encouraged to visit the Mid-Atlantic occultations Web site at http://iota.jhuapl.edu/exped.htm in late July to see those updates.

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Lunar Grazing Occultations

| 2020 | Day | EDT | Star | Mag | % | alt | CA | Location, Notes |
|---|---|---|---|---|---|---|---|---|
| Jun 17 | Wed | 3:52 | ZC 398 | 6.5 | 15- | 5 | -1S | Hagrstn,Emtsbrg,MD;RedLion,PA |
| Aug 10 | Mon | 5:32 | 64 Ceti | 5.6 | 62- | 56 | 19N | eHazltn,WV;Somrst,StateCol,PA |
| Aug 14 | Fri | 3:22 | SAO 77147 | 8.8 | 25- | 19 | 13N | Woodb,AlexndraVA;sDC;sBowieMD |
| Aug 15 | Sat | 3:12 | X 86244* | 9.5 | 17- | 8 | 12N | Berea,VA;Brndywine,Bristol,MD |
| Aug 16 | Sun | 4:55 | X100702 | 10.2 | 9- | 17 | 15N | Aldie,Ashburn,VA;nGlenelg,MD |

*in Kepler2 program so occultation light curves are sought.

More information about these is at http://iota.jhuapl.edu/exped.htm

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Lunar Total Occultations

| 2020 | Day | EDT | Ph | Star | Mag | % | alt | CA | Sp. | Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| Jun 14 | Sun | 4:19 | R | SAO 128784 | 7.0 | 40- | 23 | 69S | K5 | |
| Jun 14 | Sun | 4:19 | R | SAO 128784 | 7.0 | 40- | 23 | 69S | K5 | /ZC401 close double |
| Jun 17 | Wed | 4:37 | R | 85 Ceti | 6.3 | 15- | 13 | 57S | A2 | Sun -11, Az. 86, ZC 401 |
| Jun 18 | Thu | 4:32 | R | ZC 504 | 7.4 | 8- | 6 | 86N | A0 | Sun -12, Azimuth 76 |
| Jun 19 | Fri | 5:21 | R | ZC 639* | 6.1 | 84- | 9 | 75N | F3 | Sun alt -4, Azimuth 73 |
| Jun 26 | Fri | 22:09 | D | ZC 1659 | 6.7 | 35+ | 29 | 48N | K0 | |
| Jun 27 | Sat | 21:47 | D | SAO119317* | 8.0 | 47+ | 38 | 57N | A* | |
| Jun 27 | Sat | 23:39 | D | SAO119349* | 8.4 | 47+ | 18 | 37N | K0 | |
| Jun 28 | Sun | 23:47 | D | SAO139229 | 7.3 | 59+ | 21 | 51S | K2 | |
| Jun 29 | Mon | 23:03 | D | SAO139725* | 8.1 | 70+ | 31 | 56S | G0 | Mag2 11, sep 5", PA 340 |
| Jun 29 | Mon | 23:27 | D | 94 Vir* | 6.5 | 70+ | 28 | 65N | A0 | ZC 2020, close double?? |
| Jun 30 | Tue | 0:09 | D | 95 Vir* | 5.5 | 70+ | 22 | 39S | F2 | ZC 2022 |
| Jul 4 | Sat | 1:18 | D | 5 Sgr | 6.6 | 99+ | 25 | 69N | K0 | ZC 2593,Term. Dist. 19" |
| Jul 4 | Sat | 2:51 | D | ZC 2602 | 5.4 | 99+ | 18 | 63N | F2 | Terminator Distance 16" |
| Jul 4 | Sat | 3:19 | D | 9 Sgr | 5.9 | 99+ | 14 | 82N | O6 | Az.221,ZC2607,dbl,TmD20 |
| Jul 5 | Sun | 22:57 | R | ZC 2907 | 6.2 | 99- | 14 | 60N | K3 | Az.137,AA316,TermDst16" |
| Jul 8 | Wed | 2:15 | R | SAO 164674 | 7.6 | 90- | 29 | 49N | A8 | |
| Jul 8 | Wed | 3:17 | R | ZC 3202 | 6.2 | 89- | 32 | 13S | F0 | Terminator Distance 13" |
| Jul 11 | Sat | 1:49 | R | ZC 18 | 5.8 | 66- | 17 | 38N | K1 | Maybe a close double?? |
| Jul 11 | Sat | 3:40 | R | SAO 128644 | 8.1 | 65- | 35 | 51S | K2 | |
| Jul 16 | Thu | 4:08 | R | ZC 590 | 6.3 | 19- | 18 | 48S | A0 | |
| Jul 18 | Sat | 4:35 | R | ZC 876 | 7.7 | 6- | 8 | 73S | K0 | Az. 67,close double?? |
| Jul 18 | Sat | 5:33 | R | SAO 77613 | 8.4 | 6- | 18 | 31N | A2 | Sun altitude -5 deg. |
| Jul 18 | Sat | 5:38 | R | SAO 77614 | 8.1 | 6- | 19 | 42S | K2 | Sun -4,close double?? |
| Jul 23 | Thu | 20:52 | D | SAO 99474 | 8.4 | 14+ | 21 | 58N | F8 | Sun -5,mg2 10,D1s early |

*continued on page 6*

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Lunar Total Occultations (Continued)

| 2020 | Day | EDT | Ph | Star | Mag | % | alt | CA | Sp. | Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| Jul | 25 | Sat 22:54 | D | SAO 139080 | 7.8 | 34+ | 9 | 33S | K0 | Azimuth 259 degrees |
| Jul | 26 | Sun 22:05 | D | SAO139581* | 7.3 | 45+ | 23 | 64S | K0 | |
| Jul | 26 | Sun 22:36 | D | ZC 1985* | 6.9 | 45+ | 18 | 28S | K0 | |
| Jul | 26 | Sun 23:16 | D | SAO 139602 | 8.3 | 45+ | 11 | 86N | K2 | Azimuth 251 degrees |
| Jul | 28 | Tue 21:41 | D | ZC 2232* | 7.2 | 67+ | 30 | 59S | G8 | |
| Aug | 1 | Sat 23:11 | D | 51 Sgr | 5.6 | 97+ | 26 | 37S | A1 | ZC2861,TermDist 19" |
| Aug | 7 | Fri 7:20 | R | 30 Piscium | 4.4 | 86- | 26 | 7S | M3 | Sun +11,ZC3536,TrmDst6" |
| Aug | 9 | Sun 3:56 | R | SAO 109873 | 7.4 | 72- | 50 | 67N | A0 | |
| Aug | 9 | Sun 5:36 | R | ZC 210 | 6.6 | 71- | 55 | 76S | B9 | Sun -8,mg2 9 R .7s late |
| Aug | 9 | Sun 6:06 | R | SAO 109899 | 7.6 | 71- | 54 | 62N | K2 | Sun altitude -3 |
| Aug | 10 | Mon 5:27 | R | SAO 110383 | 8.2 | 62- | 59 | 74N | G5 | Sun altitude -10 |
| Aug | 10 | Mon 5:49 | R | 64 Ceti | 5.6 | 62- | 60 | 43N | G0 | Sun -6,ZC 322,double?? |
| Aug | 10 | Mon 7:17 | R | xi1 Ceti | 4.4 | 62- | 56 | 43N | G8 | Sun +10,ZC 327,double?? |
| Aug | 12 | Wed 2:45 | R | SAO 93542 | 8.4 | 44- | 26 | 44N | A0 | |
| Aug | 12 | Wed 4:44 | R | SAO 93565* | 7.8 | 43- | 48 | 53S | B9 | |
| Aug | 13 | Thu 2:02 | R | Ain=epsTau | 3.5 | 35- | 11 | 38S | K0 | Az. 74, ZC 668, double |
| Aug | 13 | Thu 6:03 | R | ZC 691* | 6.3 | 33- | 56 | 41S | G5 | Sun -4, close double |
| Aug | 13 | Thu 6:13 | R | SAO 94021* | 7.2 | 33- | 58 | 61S | F8 | Sun altitude -2 deg, |
| Aug | 15 | Sat 3:23 | R | 11 Gem | 6.9 | 17- | 9 | 71N | B0 | Azimuth 67, ZC 962 |
| Aug | 15 | Sat 3:24 | R | 12 Gem | 7.0 | 17- | 9 | 64S | A0 | Az. 68, ZC 964 |
| Aug | 15 | Sat 3:45 | R | X08814* | 7.6 | 16- | 13 | 86S | B9 | Az. 70, close double? |
| Aug | 15 | Sat 6:03 | R | ZC 982 | 6.8 | 16- | 39 | 36S | K1 | Sun -4, close triple |
| Aug | 15 | Sat 6:08 | R | SAO 78344 | 7.2 | 16- | 40 | 80N | F0 | Sun altitude -3 degrees |
| Aug | 16 | Sun 4:41 | R | SAO 79302 | 8.3 | 9- | 13 | 58N | A2 | Azimuth 70 degrees |
| Aug | 17 | Mon 5:23 | R | ZC 1253 | 7.3 | 4- | 9 | 59S | K0 | Sun-12,Az. 69,double?? |
| Aug | 24 | Mon 20:56 | D | ZC 2197* | 7.6 | 42+ | 23 | 89S | K2 | |
| Aug | 25 | Tue 20:59 | D | SAO184316* | 8.1 | 53+ | 25 | 39S | A5 | |
| Aug | 26 | Wed 22:58 | D | SAO185322 | 8.2 | 65+ | 16 | 77S | K0 | |
| Aug | 27 | Thu 23:15 | D | ZC 2659 | 6.2 | 75+ | 19 | 83S | M3 | |
| Aug | 28 | Fri 21:12 | D | SAO 187895 | 7.6 | 83+ | 26 | 32N | A1 | |
| Aug | 29 | Sat 2:18 | D | chi Sgr | 5.0 | 84+ | 3 | 73N | A4 | Az.235, ZC2834, double |
| Aug | 30 | Sun 21:22 | D | chi Cap | 5.3 | 95+ | 22 | 68S | A0 | ZC 3089 |
| Aug | 31 | Mon 2:18 | D | phi Cap | 5.2 | 96+ | 21 | 45S | K0 | ZC 3106 |
| Sep | 5 | Sat 6:03 | R | 35 Ceti* | 6.6 | 91- | 38 | 69N | F8 | Sun -8,ZC 178,mg2 9 1" |
| Sep | 6 | Sun 0:49 | R | SAO 110166 | 7.7 | 86- | 37 | 42S | K0 | |
| Sep | 9 | Wed 1:30 | R | ZC 617 | 6.6 | 61- | 28 | 35S | F6 | |
| Sep | 9 | Wed 3:55 | R | SAO 93825 | 8.1 | 60- | 55 | 52S | F0 | |
| Sep | 9 | Wed 6:41 | R | SAO 93844 | 7.6 | 59- | 70 | 61N | K0 | Sun altitude -1 degree |
| Sep | 10 | Thu 2:41 | R | iota Tauri | 4.6 | 51- | 34 | 86N | A7 | ZC 752, close double?? |
| Sep | 10 | Thu 3:23 | R | SAO 76940* | 8.0 | 50- | 42 | 82S | B3 | close double 0.3s steps |
| Sep | 10 | Thu 5:11 | R | 105 Tauri | 5.8 | 50- | 62 | 23S | B2 | ZC 766,close double?? |
| Sep | 11 | Fri 3:10 | R | SAO 77785 | 7.6 | 40- | 31 | 30S | K0 | |
| Sep | 11 | Fri 4:36 | R | SAO 77842 | 7.4 | 40- | 47 | 26S | B3 | |
| Sep | 11 | Fri 4:41 | R | SAO 77839 | 8.2 | 40- | 48 | 37S | B2 | mag2 11 R 73s earlier |
| Sep | 11 | Fri 5:03 | R | SAO 77852 | 8.2 | 40- | 52 | 52N | A0 | |
| Sep | 11 | Fri 5:05 | R | SAO 77851 | 7.4 | 40- | 53 | 63N | A0 | |
| Sep | 12 | Sat 2:05 | R | ZC 1050 | 5.7 | 31- | 9 | 33S | K5 | Azimuth 67 degrees |
| Sep | 12 | Sat 3:50 | R | SAO 78870 | 7.8 | 30- | 29 | 78N | B2 | |

*in Kepler2 program so occultation light curves are sought.

More information is at http://iota.jhuapl.edu/exped.htm
David Dunham, dunham@starpower.net

*Sky Watchers – continued from page 3*

### August

| | |
|---|---|
| 8/3 | Full Moon. 11:59 a.m. |
| 8/11, 12 | Peak of the Perseids Meteor Shower – 60 meteors/hour. A second quarter Moon will interfere with viewing. Best viewing in the hours before dawn. |
| 8/15 | Venus at Greatest Western Elongation, 45.8º from the Sun in the morning sky. |

### Early September

| | |
|---|---|
| 9/2 | Full Moon. 1:23 a.m. |
| 9/11 | Neptune at Opposition, closest to Earth and viewable through a telescope all night long. |

*Times in EDT*

(Editor's Note: Two NCA members, Jim Simpson and Guy Brandenburg, have written up their recent work on telescopes. Enjoy!)

# Restoring the former-NCA Celestron C-14

***Jim Simpson***

The National Capital Astronomers, after extensive research, acquired a Celestron C-14 Schmidt-Cassegrain telescope from Astro-Physics[1] along with a selection of accessories such as a tripod, equatorial wedge, off-axis solar filter and drive corrector. For its time, that was a very impressive telescope package. Over the years, it appears to have been used in both public viewing as well as support to some research programs. But as the years passed, it fell into disuse and was stored at the University of Maryland Observatory.

By about 2016 it was clear that the C-14 wasn't going to be used by the club and a decision was made to sell it. It languished on one of the on-line Astronomy sale sites for some time with little or no interest. Finally, with the untimely passing of Joe Morris, it, along with Joe's equipment, was auctioned by the club. I was the winning bidder.

Over the years, the C-14 had suffered the fate of many things that are owned by a group; no single individual has pride of ownership, so it became neglected. Aluminum components started to corrode, steel parts rusted, and small items disappeared. When I picked it up after the auction, the original eyepieces, hand controller, and a couple of other minor items were long gone.

**Figure 1: C-14 in shipping case prior to cleanup. Duct tape covered a home-made dew heater.**

**Figure 2: Note surface rust on tripod leg; "0000" steel wool and automobile chrome polish worked wonders.**

[1] *This surprised several of us, but along with the telescope was a binder of documents that included the receipt!*

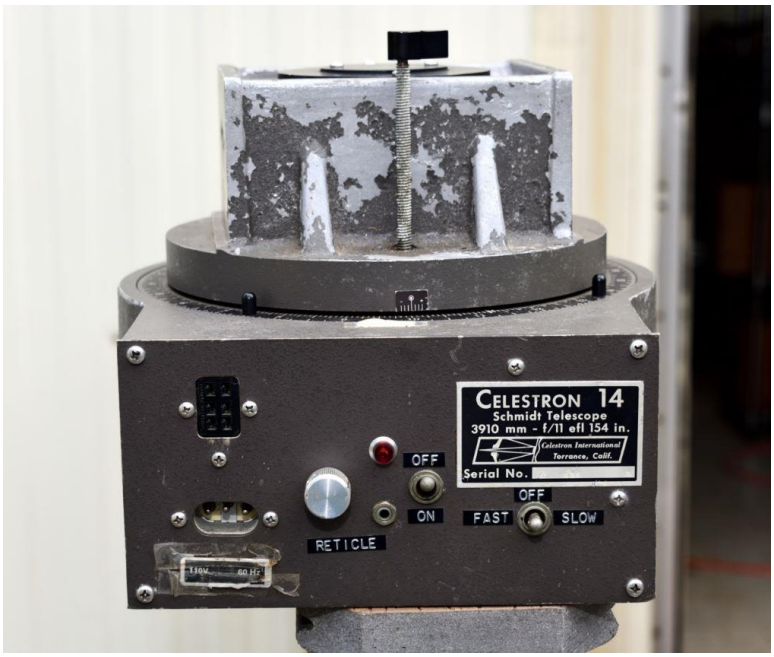


**Figure 3: Motor drive base showing corrosion and flaking paint. Luckily, the motor, drive gears and bearings were in excellent condition.**

But the good news was that the optics seemed to be in good condition; the front corrector was a bit dusty and dirty, but the mirrors were bright and untarnished. And nothing seemed to be broken.

My priority was then to clean it all up and somehow replace any essential missing parts such as the hand controller. Luckily, I had the original documentation and there is an enthusiastic on-line user's group who could provide advice and guidance on how Celestron built this telescope.

As you can see in the photo, the optical tube looked awful. At some point in the past, someone had hand-made a dew heater. It was ingenious; they had wrapped about 10 feet of resistance wire around the top of the tube and then covered it with corrugated cardboard as thermal insulation. But then they covered the whole thing with "duct tape". That would have been ok if it had been just for an overnight session, but when duct tape is left in place for months and years, the adhesive hardens into something nearly impossible to remove. Removing that was a major challenge – there was no way to get it off without further damaging the original paint. I wish there had been a way of salvaging the original paint; Celestron used an extremely hard (baked on?) paint. While I was able to match the color, the new coating does not seem as durable as the original.

**Figure 4: Tube assembly after refinishing.**

**Figure 5: Motor drive base after refinishing.**

The rest of the mount was primarily cast aluminum and storage in an unconditioned environment caused extensive surface corrosion and paint flaking. So, all the aluminum components had to be stripped down to bare metal and repainted. (And while I was doing that, I also removed the "NCA" etchings; while perhaps of historical interest, they didn't do anything for the appearance.)

I tried to locate an original hand controller to replace the missing one; that was unsuccessful, so I made my own.

I decided to improve upon the original and give the telescope at least a modicum of modern capability by including a ST-4 compatible autoguiding port. (The C-14 mount has DC powered slow-motion motors on both the RA and DEC axes. With modern electronics, you can put the entire control system in the hand-held box.) While I haven't tested the auto-guide system under the night skies, it responds in all the right ways. There doesn't seem to be very much play or hysteresis in the slow-motion drives so it should work O.K..

**Figure 6: Optics and new collimation knobs.**

**Figure 7: Home-made hand controller with ST-4 autoguide port.**

I haven't really touched the optics. I made a gentle pass at getting the worst of the dirt off the corrector plate, but there is still more. But it's not enough to affect the imaging so I may just leave it. I did replace the collimation screws; the originals required fitting an Allen wrench into tiny holes which is hard enough in the daytime, but almost impossible in the dark. I looked at "Bob's Knobs", but they are rather flimsy nylon thumbscrews, so I made my own brass screws. They seem to work well.

Using the C-14. Celestron used to advertise the C-14 as the largest portable telescope they made that could be managed by one person. Perhaps that's true – provided you don't mind the fact that "some assembly is required". It's big. It's heavy. The optical tube alone weighs 50 lbs. If you were to transport it to a dark sky site, you first set up the tripod. Next you attach the equatorial wedge – while that is mostly cast aluminum, it weighs around 20 lbs. Then there's the motor drive base – that's massive and weighs ~35 lbs. Next come the two fork arms at ~15 lbs. each; they bolt to the sides of the motor base. Now you are ready for the optical tube assembly. I hope you've been practicing your bench presses – it not only weighs 50 lbs. (assuming you have removed the finder and counterweights), but it is very awkwardly shaped with no obvious hand-holds. You carefully lift this over your head and lower it down between the fork arms. Celestron did design in pins to hold it in place while you install the retaining bolts. This is not something you want to repeat very often. In my opinion, the C-14 belongs in a permanent observatory.

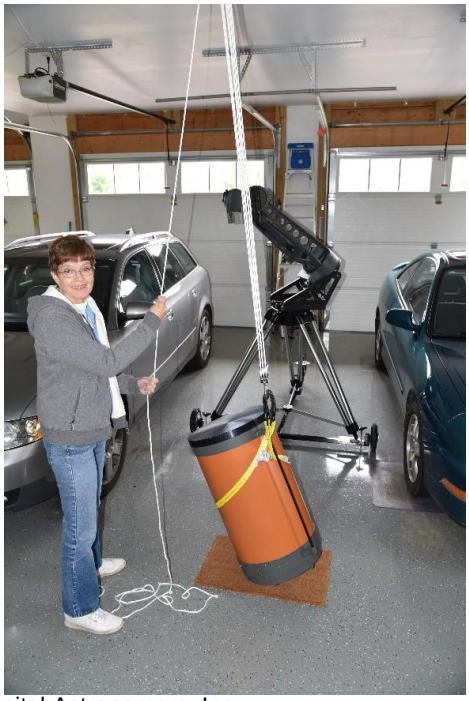

**Figure 8: We use a block and tackle to hoist the optical tube.**

Since I do not have an observatory, I made a cart loosely modeled on the JMI ScopeBuggy design. I had to teach myself welding which I'm still not very good at it; but the cart is functional and allows me to move the telescope from my garage out to the back yard. Now if we just had some decent weather!

**Figure 9: Completed C-14 on cart.**

# A COVID Quarantine Telescope

Or, how I built a slumped, nine-inch, f/6.2, Schwartz-Traube Dob-Newt telescope during the coronavirus lockdown

***Guy Brandenburg***

Like many people, I went into self-quarantine around the middle of March, and soon ran out of home improvement projects that needed doing.

I also needed a mental and physical break from worrying about the pandemic.

**WET, CLOUDY WEATHER** I very much enjoy making telescopes, observing, and trying to do imaging. Unfortunately, the weather has been better for gardening than for astronomy, so there have been very few nights when the 50-mile drive out to Hopewell Observatory (of which I'm a member) was worth it for observing or imaging. Also unfortunately, all of the telescope- and mirror-making projects that I and other people had been working on at the DC-area and NCA-sponsored ATM workshop located at the Chevy Chase Community Center were locked up and unavailable, since all DC Parks and Recreation facilities were closed to the public, even to instructors such as myself.

**RAW MATERIALS: Finders and Primary** As luck would have it, I happened to have in my basement a Celestron 8X50 finderscope missing its rail, a brand-new Telrad missing its base, and most importantly, an excellent nine-inch mirror that had been fine-ground, polished, and parabolized by Bob Traube, a member of Northern Virginia Astronomy Club and a very fine astrophotographer to boot. The glass in question was ordinary float (or 'plate') glass, about ¾" thick, which is considered to be quite thin (12:1 instead of 6:1 diameter to thickness, the standard for many years).

**SLUMPING** The mirror blank had been slumped some years ago by Richard Schwartz, an iconoclastic amateur telescope maker based in California. Slumping means creating a convex or concave ceramic mould, placing the flat glass on top of the mould, carefully heating up the glass until it softens enough to follow the curvature of the mould, and then carefully annealing the glass to remove any residual strain.

There are several advantages to **slumping** a mirror, and two disadvantages.

Pluses:

1. Very little glass will need to be removed via rough grinding, because the blank already has the proper amount of overall curvature.
2. An already-thin mirror like this will NOT become super-thin in the middle.
3. The curved geometry supposedly makes the mirror stiffer, so it won't sag under its own weight as it points to different areas in the sky.

Minuses:

1. You need to support the back side of the mirror blank during the polishing and figuring with a curved substrate, or else you will bend the glass so much, in unpredictable ways, that you will never achieve a sphere or a paraboloid.
2. Slumping requires a large computer-controlled kiln, a whole lot of electricity, and considerable practice and expertise in casting forms from refractory clay.

While he was working on the mirror, Bob cast the concave support for the convex back side of the mirror out of 'dental stone,' which is a nearly-waterproof type of plaster used by dental firms for making casts of teeth and gums.

The blank had already been tested and aluminized by Bob and myself. I don't recall the wave error rating or the Strehl or RMS ratios generated, but I thought at the time that he did a very fine job on the mirror.

**HOW'D I GET THE MIRROR**? As I mentioned, Bob is an excellent astrophotographer, and uses motorized and computerized mounts and high-end refractors to do that, not Dobsonian reflectors. At the time, his wife was terminally ill, and he was caring for her. But one night a week he had a caretaker to watch over her so he could do something related to astronomy – so he made a mirror at the NCA ATM workshop at the CCCC. I found him also to be a very kind and interesting fellow to talk to as well. A while later, (I think after his wife passed away) he sold the mirror back to me for exactly what he had paid for it – an amazing bargain for me.

**MATERIALS LACKING** Unfortunately, I had almost nothing else on hand at home for building a scope besides the mirror. No spiders, no secondary elliptical diagonal flat mirrors, no focusers, no mirror-testing devices of any sort, and no sheets of laminate or Teflon for the azimuth or altitude bearings. I didn't know the exact focal length of the mirror, since neither Bob nor I could find any records on it. Nor did I have anything to make the tube out of or sufficient plywood for the rest of the mount.

I wanted to see how much of this I could build without resorting to mail order or breaking quarantine.

The answer was, not all that much.

I had many random pieces of wood, plenty of screws, glue, and varnish, and a fairly decent set of power and hand tools such as saws, sanders, and drills. But no suitable plywood sheets and nothing from which to fabricate a tube.

**BIG BOX HARDWARE** So I broke quarantine, put on a mask and gloves, and went to Lowes or Home Depot to purchase a 4 by 8 sheet of ¾-inch so-so oak veneer plywood. I went to TW Perry in Rockville and bought a 12-foot length of 10-inch diameter Sonotube; I used a hand saw to cut the tube in half in their parking lot so it would fit in my car. Any other pieces of hardware needed were purchased from our locally-owned Annie's Ace Brookland Hardware store.

**HOLEY TELESCOPE BOX, B-MAN**! I decided that I wanted to reduce the weight of the rocker box by cutting a lot of circular holes, so I did, as you can see. The 3.5" biscuits produced by my hole saw have come in handy for a variety of purposes, including feet for putting the cradle down on the ground without harming the trunnions. Unfortunately, all those holes produced a lot of rough edges. Those edges could be sanded down or filed off by hand, but that was more work than I was prepared to put in, and I thought they would also probably look uneven. The ideal tool for finishing those holes was a router – of which the NCA ATM workshop has not one, but THREE. But they were out of reach. So, I broke quarantine again and purchased a modest little router at the DC Home Depot, enabling me to finish off the holes.

**Figure 1: Holey Rockerbox**

As you can imagine, cutting all that wood required quite a bit of sanding. Naturally, my belt sander gave up the ghost close to the beginning of the project, so I once again needed to go don mask and gloves to purchase another one, along with some different-sized sanding belts. I used bandannas and home-made masks for much of the work, as well as safety goggles and hearing protection.

**EXPENSIVE PARTS** I have made spiders from scratch before, but they are a LOT of work, and I didn't have any secondary mirrors on hand, so I decided to order a brand-new, custom spider/secondary/holder from **AstroSystems**. That took several weeks to arrive but fit perfectly. I ordered and received an inexpensive rack-and-pinion 1.25" focuser from Orion.

**FINDER SCOPES** Do you recall the missing Vixen-style dovetail rail? Rather than purchase one online, I decided to see how difficult it would be to fabricate one BY HAND without using the (unavailable) machinist's mill we have at the CCCC. I had some chunks of aluminum and a fair assortment of machine screws, along with a tap-and-die set. Using a drill press, hacksaw, hand files, and rulers I was able to produce an acceptable rail. It involved an intense multi-hour upper-body workout spread out over a couple of days. You can see the result in one of the photos. I kept thinking about apprentice machinists and engineers learning about their craft by filing perfect cubes. However, I still need to order the Telrad base (which I think are wildly overpriced).

**Figure 2: Hand-hewn rail for finder scope**

**BEARINGS** Another conceptual hurdle was the bearings – no Teflon or Formica on hand (but lots of it locked away at the CCCC). After considerable thought about what I might use for the altitude trunnions, I discovered and cut down a sparkly old wooden drum shell that had been given to me by a neighbor a few years earlier, specifically to use for part of a telescope. I reinforced the wooden veneer layers with some pieces of scrap plywood stained to look a little like Pac-Man.

**Figure 3: Plastic furniture pads for altitude trunnions**

**Figure 4: Preparing to cut notches for felt pads inside cradle**

**Figure 5: Pads to allow movement of tube**

For the azimuth bearing, I decided against trying to purchase a large sheet of laminate (which is the correct substance to use, NOT a lazy-susan bearing). I had a sheet of Lexan (aka Plexiglas) available, so I cut that up and glued it to the bottom of the rocker box. For the Teflon azimuth and altitude pads, I used white plastic furniture guides that I found in my basement. For the feet, I cut up, sanded, stained, and varnished some lengths of two-by-four lumber to look like very short hockey sticks

**Figure 6: Upside down view of azimuth bearing and ground feet**

**CRADLE** In order to allow for adjustments of the tube for balance or convenience inside its cradle, I used a wooden knob-and-spring brake design that I believed I had originated. I later found out someone else had invented something similar and had written it up on the Stellafane website. My version has only one brake, not two. As a finishing touch, I routed out 3-inch-wide but shallow grooves about ¼" deep on two sides of the cradle so that I could attach some self-adhesive felt furniture pads to prevent the painted tube from sticking to the interior of the varnished cradle.

**Figure 7: Bottom of Cradle**

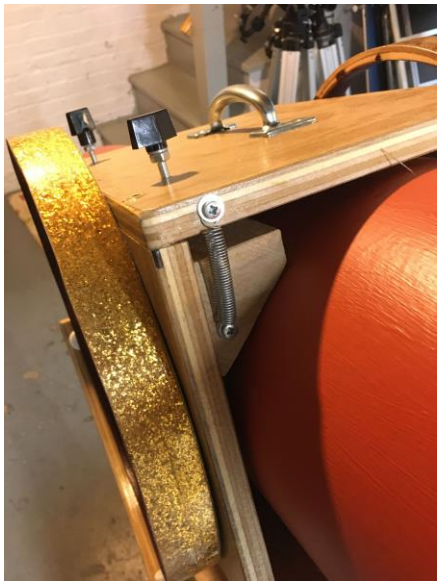

**Figure 8: Cradle Brake Mechanism – my version**

**REINFORCEMENTS** To reinforce the top of the tube, I decided to cut a short length of Sonotube and to reduce its circumference (and therefore its diameter) by cutting out a short piece, then clamping and gluing it inside the tube, which I painted with flat black latex mixed with some sawdust to reduce reflections.

**Figure 9: Reinforcing the top of tube**

**PRIMARY HOLDER** I made the primary mirror holder using scraps of plywood and some springs, screws, washers, wingnuts, and small steel angle braces that I had on hand. I used silicone caulk to glue the mirror in six places – three on the back, and three on the edge.

**OPTICAL TESTING** In order to measure the focal length, I built a simple wooden tester and stand using various springs, pipe, screws, LEDs, laser components, switches, battery holders and so on that I had on hand. I found that the traditional ¼”-20 screw with markings around a knob was very difficult to use for measurements, so I attached a dial indicator that I had been saving for just such a project. I used the setup to measure the exact focal length of the mirror and to take another look at its figure using a Ronchi grating that I had on hand. It still looks quite nice!

**Figure 10: Back of Focault-Ronchi tester**


**Figure 11: Front of Optical Tester**

**Figure 12: Optical Testing of Mirror**

## FIRST LIGHT

I finally had the chance to test the scope on Polaris last night (May 31-June 1) at Hopewell Observatory. The star test results (see Richard Suiter's book for a reference) look perfect except that I can see that the glue that I used at three points along the edges of the mirror is producing some local distortion. The friction produced by the chair bases against Lexan sheet is totally unacceptable and requires a huge effort to turn in azimuth, causing the rocker box to twist.


**Figure 13: Mostly completed telescope**

## IMPROVEMENTS NEEDED

1. Remove the three glued attachments at the edges of the mirror
2. Shorten the tube by about six inches
3. Replace the furniture glide bearings with Teflon (already ordered), and find some better laminate (such as Formica) for the azimuth bearing at a second-hand surplus furniture store like Community Forklift
4. Consider shortening and stiffening the rocker box if the Teflon and Formica aren't sufficient
5. A Telrad base is on order.

**MORE STUDY NEEDED**. I still haven't tried it out under dark skies.

## CONCLUSIONS

1. Building this scope gave me many hours of much-needed relief from worrying about the current pandemic. My workmanship improved a bit, and the color scheme has garnered compliments.

2. All the parts for all the items (not counting the router or sander) cost me about $300, which is quite a bit less than what I see Orion Telescopes are asking for their 8" or 10" Dobsonians.

3. Like every other single person on the planet, I am not self-sufficient. This allegedly home-made telescope benefited from the labors, organizations, resources, and machinery of many, many other people to bring it to completion. It also required several quarantine-breaking visits to hardware stores and some online mail orders.

*Recent Astronomy Highlights – continued from page 4*

**Many Strong Gravitational Lensing Candidates Recently Discovered**
Distant galaxies and galaxy clusters can serve as gravitational lenses for the light from even more distance galaxies and clusters. Weak gravitational lenses may only magnify such distant sources to a small degree, while strong gravitational lenses give much greater magnification of the light of such sources, allowing astronomers to resolve those sources more than would possible otherwise. However, until recently such strong gravitational lenses have been a rare find. But astronomers studying the data from the Dark Energy Spectroscopic Instrument (DESI) in Arizona, have come up with a database of 335 new strong gravitational lensing candidates. The Hubble Telescope will be used to study the most promising candidates to determine their value in studying parts of the ancient Universe. More information can be found at https://www.sciencedaily.com/releases/2020/05/200514143600.htm.

## 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 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 are suspended until further notice**. 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.). Details can be found at www.astro.umd.edu/openhouse

**Next NCA Meeting** tentatively scheduled at the University of Maryland Observatory: **12 September** 7:30 p.m.

**The APS Mid-Atlantic Senior Physicists Group**: "Science, Politics and Peace: Antarctica and the International Geophysical Year" by Dian Belanger, independent historian, June 17th at 1:00 pm. For details, go to https://www.aps.org/units/maspg/meetings/meeting.cfm?name=SENIOR0620 (This will be an online meeting.)

## 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.?

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# *Please Note:*

*The June 13, 2020 NCA meeting has been cancelled.*

## Inside This Issue