Star Dust

Newsletter of National Capital Astronomers, Inc.

capitalastronomers.org

June 2021 ***Volume 79, Issue 10***

Celebrating 84 Years of Astronomy

Next Meeting

When: Sat. Jun. 12th, 2021

Time: 7:30 pm

Where: Online (Zoom)

See instructions for registering to participate in the meeting on Page 8.

Speakers: Science Fair Winners

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Image Credit – NASA, ESA, and the Hubble Heritage Team (STScI/AURA)

Looking like a cosmic rose, Arp 273 is composed of two gravitationally interacting spiral galaxies. More details about the image are at svs.gsfc.nasa.gov/30857.

Science Fair Winners

John Hornstein

Each spring, NCA members judge local regional science fairs in order to identify good projects in astronomy. Our awards consist of:

- A certificate
- An invitation to speak at our June meeting
- One year of free membership in the NCA
- A one-year subscription to Sky & Telescope

The 2021 winners are (in alphabetic order):

- **Dennis Chunikhin**, 'Minimizing Time to Transfer from an Earth Parking Orbit to Lunar Orbit in Emergency situations' (Dennis also won in 2019'.)
- **Rohan Ojha**, 'The Search for Co-Orbiting Super-Massive Black Holes in Merging Galaxies'
- **Atharve Shete**, 'How a Comet's Size Affects its Melting Rate'

NCA Elections and Astro-photos

John Hornstein

All members of the NCA can vote during the elections on June 12. 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. Nominations can be taken during the election.

Currently the candidates are:

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

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.

At the end of the meeting, we would like to see any interesting astro-photos that you have taken since last June. When Elizabeth tells you go ahead, either share your screen, or hold the photo up in front of you. We will be eager to hear how you made the photo.

Recent Astronomy Highlights

Supernova "Twins" May Lead to Improved Measures of Hubble Constant

Type 1A Supernovae have become one of the 'standard candles' of astronomy. These bright explosions happen with white dwarfs that have companion stars from which they strip material. The added weight of that material causes the pressure in the white dwarf's core to rise, eventually triggering fusion, causing an explosion powerful enough to destroy that white dwarf and bright enough to briefly outshine galaxies. This brightness means that they can be seen far across the Universe. The brightness also tends to follow the same pattern over time for each of these supernovae, so measurements of the apparent brightness, along with plots, known as light curves, of the amount of light received as the supernovae dim, can be used to calculate distances. These characteristics allowed for two separate research teams back in the 1990s to show evidence of Dark Energy. However, there are still uncertainties in those calculated distances. Now a new research team, known as the SNfactory, claims that the spectra of Type 1a Supernovae can be used to more accurately calculate the distances. Their strategy involves comparing the spectra of newer supernovae with those of older ones in order to find 'twins', giving a more precise measurement of the actual brightness of that new supernova, and thus a more precise distance. This in turn could improve understanding of the nature of Dark Energy and lead to a more precise measurement of the Hubble Constant, a measurement of the expansion rate of the Universe. An article on the research can be found at www.sciencedaily.com/releases/2021/05/210507093944.htm, and articles published by the research team are at arxiv.org/pdf/2105.02676.pdf and arxiv.org/pdf/2105.02204.pdf. One final point of interest to NCA members is that two future telescope facilities that will be key in future research by the SNfactory team are the Vera Rubin Observatory in Chile and the Nancy Grace Roman Space Telescope.

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Adventures in Silvering

Guy Brandenburg

Our first attempts at silvering and overcoating some mirrors in my driveway, as opposed to aluminizing them in a vacuum chamber, were a complete success!

Why did Alan Tarica and I bother? Basically, to save money. And because we were curious. And because the ATM workshop at the Chevy Chase Community Center is still locked up because of COVID. I can report that this silvering method is cheap, fast, and effective. It is also much safer and easier than any other **silvering** methods I have read about. For a protected **aluminum** coating for a 16.5-inch mirror I've been working on, Majestic Coatings in nearby Ruckersville VA quoted me a price of $475. The NCA's vacuum chamber maxes out at 12.5 inches diameter, so I can't aluminize my big mirror there. That $475 could purchase an entire Angel Gilding silvering kit which can coat and overcoat literally dozens to hundreds of mirrors!

Yes, a protected aluminum coating can last a decade. But the protected silver coating we employed is reported as lasting well over a year. With this method, there is no need to make a crate and pay to ship the mirror anywhere! (Have you tried shipping anything heavy recently?) Much to our surprise, we can also report that the apparent crudeness of the method does not in any way degrade the accuracy of the parabolic "figure" of the mirror!

We employed for our test project a mirror ground and figured some years ago by longtime NCA member Nancy Byrd and aluminized by the late Jerry Schnall. We used a silvering kit generously donated to the NCA ATM workshop by Bob Robinson of NOVAC. Bob had employed Angel Gilding's Drip Silver method and was discouraged by his results; we used their Spray Silver method instead, which I had seen demonstrated at Stellafane in 2019.

To begin our experiment, we took a video Ronchigram on Nancy's mirror and did zonal measurements à la Foucault and Couder. We then stripped the existing coating with ferric chloride as opposed to our usual nasty "green river" mixture of hardware-store muriatic acid and copper sulfate crystals. We cleaned it thoroughly, scrubbing it with cotton balls and Alconox, followed by another good scrubbing with powdered calcium carbonate, and a thorough rinse with more cotton balls and distilled water.

For the silvering and overcoating, we used a four-part kit sold by Angel Gilding. The first step is spraying on a solution of stannous fluoride and rinsing that off completely after about a minute. The second step is using two clean, new spray bottles I purchased at a hardware store, respectively filled with AG's solutions of ammonium hydroxide and silver nitrate. We sprayed the two bottles simultaneously and side-by-side at the still-wet mirror, and a beautifully smooth and shiny surface began appearing immediately. We continued spraying until the entire mirror was shiny.

By comparison, our vacuum chamber requires an hour or two of pumping down with a vintage rotary pump while we do high-voltage ion plasma cleaning, followed by some serious diffusion pump work to get the pressure down to 10^-4 Torr. We then fire up a high-current tungsten coil loaded with solid aluminum that melts and boils and coats everything it 'sees.' In both cases, the actual metal deposition only takes a minute at most, but the equipment and time required for preparation is much greater for aluminum versus silver.

Other silvering methods require really nasty chemicals, such as fuming nitric acid! The one that Leon Foucault described in his monograph of 1859, that I was apparently the first to translate into English, is quite complex. You can read it here: guysmathastro.com/2014/12/15/part-5-of-leon-foucaults-article/.

The Angel-Guard overcoating looks like a clear liquid car wax. One merely places the still-wet mirror face up, immediately after the mirror has received the nice shiny silver layer, and pours a tablespoon or so of the Angel-Guard liquid into the center of the mirror. Then one spreads the material around all over the

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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

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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 transits to the morning sky in mid-June, reaches Greatest Western Elongation on July 4th (see below), then transits back to the evening sky in the first days of August where it remains through the rest of the Summer. Venus climbs higher and Mars drops lower in the evening sky throughout the Summer, approaching to within half a degree of each other on July 13th (see below). Meanwhile, as Jupiter and Saturn continue to separate, they will rise earlier at night with Saturn reaching opposition on August 2nd (see below) and Jupiter reaching opposition two and a half weeks later on August 19th (see below).

Late June

6/20	Summer Solstice – 11:21 p.m.
6/24	Full Moon and Supermoon – 2:40 p.m.

July

7/4	Mercury at Greatest Western Elongation. It will be 21.6º from the Sun in the morning sky.
7/13	Conjunction of Venus and Mars – Our two closest planetary neighbors will appear to be a little less than half a degree apart on the sky.
7/23	Full Moon – 10:37 p.m.
7/28, 29	Peak of the Delta Aquarids Meteor Shower – 20 meteors/hour. Unfortunately, a nearly full Moon rising before midnight will interfere with viewing. Best viewing of brighter meteors will be in the hours before dawn.

August

8/2	Saturn at Opposition, closest to Earth and viewable all night long.
8/12, 13	Peak of the Perseids Meteor Shower – 60 meteors/hour. A waxing crescent Moon will set well before midnight making for ideal viewing conditions throughout the rest of the night. Best viewing in the hours before dawn.
8/19	Jupiter at Opposition, closest to Earth and viewable all night long.
8/22	Full Moon – 8:02 a.m.

All times are in EDT (Eastern Daylight Savings Time)

Special Campaign for the (4337) Arecibo Occultation Wed. morning, Jun. 30, across the DMV

David W. Dunham, dunham@starpower.net

This occultation could be valuable for determining the parameters of this binary asteroid, so we are promoting observations across our region for this relatively faint event. If you have a large-enough telescope, you are encouraged to monitor, and preferably record, 12.7-mag. UCAC4 323-113857, which is 0.9 deg. from 3rd-mag. theta Ophiuchi, around 1:52am EDT the morning of June 30. If you have a 10-inch or larger telescope that you can point to the star, we can loan some timing equipment, and some cameras, that you could use with your scope to record the occultation with your laptop computer. Let me know if you can help with this project, weather permitting. Shortly after the June Stardust is distributed, we will post finder charts, observing instructions, and detailed event information on a Web page for the event that will be linked to from near the top of iota.jhuapl.edu/exped.htm . At the time of the occultation, the target star will be 21° above the south-southwest horizon (azimuth 206°) in our region. The map in Figure 1 shows the predicted path of the occultation and the larger area from which an occultation by the satellite of Arecibo is possible. The occultation by Arecibo should last almost 2 seconds for a central event, while the occultation by the satellite will be 1 second or less.

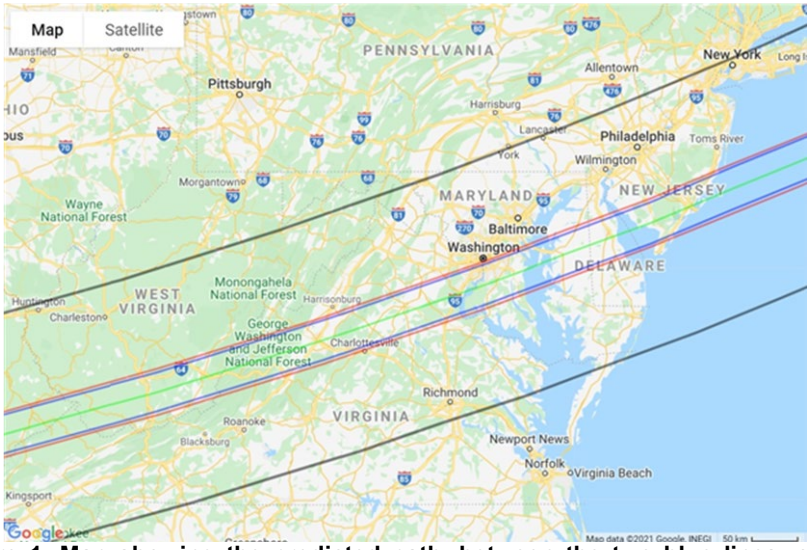

Figure 1. Map showing the predicted path, between the two blue lines, of the occultation of UCAC4 323-113857 by (4337) Arecibo around 1:52am June 30, 2021. Observers anywhere between the two dark gray lines may have an occultation by the approximately 10-km satellite of Arecibo that was discovered during another occultation observed in Australia last month. The light-green line is the predicted central line. Image credit IOTA and Google Maps.

Arecibo was found to be a binary asteroid, from occultations by both components that were recorded by David Gault and Peter Nosworthy from their home observatories west of Sydney, Australia on May 19. Arecibo is 19 km across (confirmed by its occultation on May 19) while the satellite is at least 6 km, and probably 9 km, across, separated from Arecibo by 35 km. The position angle (PA) was 91 deg., but since we don't know the orbit, we don't know what the PA will be on June 30, and the distance might be greater than 35 km. Consequently, we want to try to cover as much of the path region as we can from 50 km north to 50 km south, but these are distances in the plane of the sky. Since the asteroid is rather low in the south, the distances on the sky plane project by a factor of 2.5 on the ground, so in order to catch a possible occultation by the satellite, we want observers to try to time the occultation out to 125 km from the center, as shown in Figure 1.

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Thank you!

Recent Astronomy Highlights – continued from page 2

Ancient Star Discovered

SPLUS J210428.01−004934.2 may be the most ancient star discovered so far, well over 13 billion years old. The evidence for the star's age came from the Southern Photometric Local Universe Survey (S-PLUS) which uses a 0.8m telescope (T80S) at Cerro Tololo, Chile to map out the southern sky. SPLUS J210428.01−004934.2 lies about 16,000 light years away and has been designated an ultra-metal-poor (UMP) star due to its unusually low concentration of heavier elements, including carbon and iron. Astronomers speculate that the star formed from the remnants of the supernova of a first-generation star approximately 30 time the mass of the Sun. An article by the research team is available at arxiv.org/abs/2105.04573.

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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	Day	EDT	Star	Mag.	Asteroid	dmag	dur. s	Ap. "	Location
Jun 16	Wed	0:10	4U306234450	15.3	Priamus	0.6	7	14	NJ,e&nPA;MD,DC?
Jun 20	Sun	2:46	see website	15.0	Cebriones	1.5	6	13	MD,DC,nVA,nOH
Jun 21	Mon	22:40	4U346152061	14.4	Pandarus	1.7	6	12	MD,DC,nVA,nOH
Jun 27	Sun	2:59	TYC68120410	11.5	Misa	3.3	5	5	NJ,MD,DC,n&swVA
Jun 30	Wed	1:52	4U323113857	12.7	Arecibo	4.1	1.9	8	sNJ,MD,DC,n&cVA
Jul 3	Sat	1:15	4U296217438	11.8	Beatrix	0.7	9	5	sMD,c&sVA,n&wNC
Jul 4	Sun	21:22	SAO 141964	8.8	Lowengrub	7.9	2	3	cSC,nGA,sOK,nAZ
Jul 8	Thu	4:24	PPM 750811	9.5	Machin	5.3	3	3	seMD,seVA,NC-I95
Jul 8	Thu	23:01	see website	14.3	Deiphobus	1.3	7	13	eMD,DC,PA;nVA?
Jul 11	Sun	23:25	SAO 139453	9.7	Aguntina	6.2	4	3	w&sMD,n&cVA;DC?
Jul 12	Mon	23:34	4U344158220	14.4	Jena	1.2	3	13	sMD,DC,nVA,cWV
Jul 15	Thu	23:03	TYC05401709	10.0	Ulula	3.3	4	4	cNJ,sPA,cOH;nMD?
Jul 16	Fri	4:47	4UC63717475	14.5	Hippo	0.8	3	13	cNC,cVA,DC,eMD
Jul 20	Tue	1:23	4U410134897	14.3	Armenia	0.4	8	12	NJ,cMD,DC,n-scVA
Aug 2	Mon	2:18	4U405122575	12.2	Honoria	0.5	9	6	sNJ,sMD,cVA;DC?
Aug 12	Thu	2:42	4UC49973093	12.4	Artemis	0.6	11	6	sMD,c&eVA,NC;DC?
Aug 15	Sun	21:01	TYC68222938	9.9	Arai	7.3	4	3	c&nVA,DC,cMD,ePA
Aug 24	Tue	21:43	TYC68491321	10.3	Higson	5.8	6	4	c&nVA,DC,cMD,cPA

Lunar Grazing Occultations

2021	Day	EDT	Star	Mag	% alt	CA	Location, Notes
Jul 18	Sun	23:19	nu Librae	5.2	69+ 20	6N	Harrisburg, Lawn, &Malvern,PA
Aug 14	Sat	22:38	SAO 158842	7.2	44+ 9	4N	Chantily,TysonsVA;DC;Bowie,MD
Aug 19	Thu	0:15	Nunki	2.1	86+ 20	1N	sDunn,Crsp,Moyock,NC&BckBayVA

Lunar Total Occultations

2021	Day	EDT	Ph	Star	Mag	%	alt	CA	Sp.	Notes
Jun 15	Tue	19:59	D	eta Leo	3.5	27+	52	27N	A0	Sun alt. +5,ZC1484,dbl?
Jun 15	Tue	20:17	R	eta Leo	3.5	27+	49	-1N	A0	Sun +2,AA 356,closedbl?
Jun 16	Wed	20:49	D	ZC 1598	6.5	38+	48	44N	F5	Sun alt. -3,close dbl??
Jun 17	Thu	18:04	D	nu Vir	4.0	48+	54	54S	M0	Sun alt. +27, ZC 1702
Jun 19	Sat	20:57	D	74 Vir	4.7	71+	45	73S	M3	Sun alt. -4, ZC1941
Jun 28	Mon	1:04	R	SAO 164654	7.7	84-	14	77S	F6	Azimuth 130 degrees
Jun 29	Tue	3:14	R	ZC 3336	7.1	75-	29	57S	K4	
Jun 29	Tue	5:57	R	69Aquarii*	5.7	74-	37	80S	B9	Sun alt. +1, ZC 3343
Jun 30	Wed	5:36	R	ZC 3480	7.2	65-	42	58N	F5	Sun altitude -2 degrees
Jul 2	Fri	3:19	R	26 Ceti	6.1	46-	22	80N	F1	ZC 150,mg2 9,dTime -39s
Jul 4	Sun	4:45	R	ZC 376	7.0	27-	29	80S	A0	Sun altitude -11 deg.
Jul 6	Tue	5:07	R	SAO 93778*	7.8	12-	21	87N	A2	Sun -8,mag2 11, dT -12s
Jul 6	Tue	5:19	R	omega1 Tau	5.5	12-	24	45S	K2	Sun -6,ZC 614
Jul 18	Sun	23:03	D	22 Librae*	6.4	69+	24	81N	A1	ZC 2160
Jul 18	Sun	23:12	D	nu Librae	5.2	69+	23	21N	K5	ZC 2159, PA graze
Jul 20	Tue	20:56	D	SAO 184964	7.3	88+	24	83N	K1	Sun alt. -6 deg.
Jul 20	Tue	21:30	D	SAO 184991	7.3	88+	26	66N	K0	Sun alt. -11 deg.
Jul 25	Sun	1:41	R	33 Cap	5.4	98-	30	45N	K0	AA 335,ZC3130,TrmDst18"
Jul 28	Wed	3:11	R	30 Piscium	4.4	80-	40	40S	M3	ZC 3536, close double?
Jul 29	Thu	3:18	R	SAO 128965	7.6	71-	41	29S	K0	
Jul 29	Thu	4:29	R	ZC 106*	6.6	71-	49	18S	K0	
Aug 1	Sun	3:22	R	ZC 449	7.9	42-	30	28S	K0	
Aug 4	Wed	5:43	R	121 Tauri	5.4	16-	36	28S	B2	Sun alt. -6, ZC 839
Aug 4	Wed	5:50	R	SAO 77276	6.8	16-	38	86N	K0	Sun alt. -5 deg.
Aug 5	Thu	4:00	R	ZC 977	6.4	10-	9	85S	K2	Az. 65, spec. binary
Aug 5	Thu	14:20	D	Mebsuta =	3.1	8-	45	-22S	A3	Sun +63, ZC 1030
Aug 5	Thu	14:50	R	epsilonGem	3.1	8-	39	25S	A3	Sun +59, ZC 1030
Aug 6	Fri	5:41	R	57 Gem	5.0	5-	17	68N	G8	Sun-6,ZC1117,close dbl?
Aug 11	Wed	21:19	D	ZC 1758	6.9	13+	9	9S	G5	Azimuth 265 degrees
Aug 12	Thu	20:40	D	SAO 139130	7.6	22+	22	42N	F0	Sun alt. -7 deg.
Aug 12	Thu	20:59	D	48 Vir	6.7	22+	18	44S	F0	Sun-10,ZC1875,close dbl
Aug 13	Fri	20:59	D	X 37082*	7.8	32+	22	81S	F0	Sun-11, mag2 11, dT +7s
Aug 13	Fri	21:09	D	ZC 1996*	6.7	32+	20	80S	K5	
Aug 13	Fri	21:31	D	ZC 1997*	6.9	32+	16	42S	F5	mag2 12, dTime +17s
Aug 14	Sat	21:58	D	SAO 158831	7.9	43+	16	66S	F0	
Aug 14	Sat	22:40	D	SAO 158861	7.8	44+	10	62N	K2	Azimuth 241 degrees
Aug 16	Mon	22:56	D	SAO184646*	7.9	66+	17	59S	B8	
Aug 18	Wed	20:54	D	ZC 2735*	7.2	85+	22	57S	A5	Sun alt. -11 deg.
Aug 18	Wed	21:53	D	ZC 2740*	6.3	86+	24	84S	G8	
Aug 22	Sun	23:43	R	69 Aqr*	5.7	99-	30	36S	B9	AA 251,ZC3343,TrmDst 5"
Aug 23	Mon	1:16	R	tau Aqr	4.1	99-	37	75S	K5	AA 288,ZC3349,TrmDst14"
Aug 25	Wed	23:48	R	33 Ceti	6.0	85-	22	63S	K4	ZC 170
Aug 26	Thu	5:11	R	89 Piscium	5.1	84-	52	29S	A3	ZC 192
Aug 27	Fri	5:23	R	ZC 300	7.5	77-	59	88N	G5	close double
Aug 29	Sun	4:12	R	ZC 517	6.1	59-	57	86S	K1	
Aug 30	Mon	0:51	R	omega2 Tau	4.9	50-	13	68S	A3	Az. 74,ZC 628,double
the star's 9.6mag. companion, 3' away in PA 119, with dTime +160s										
Aug 30	Mon	3:13	R	ZC 642*	6.8	50-	40	72S	F5	close double??
Aug 30	Mon	3:19	R	SAO 76565*	7.1	50-	41	77N	F8	

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Occultations – continued from page 5

Lunar Total Occultations (continued)

2021	Day	EDT	Ph	Star	Mag	%	alt	CA	Sp.	Notes
Aug 30	Mon	6:24	R	SAO 76609*	7.4	49-	71	50S	F8	Sun alt. -3 deg.
Aug 31	Tue	6:37	R	ZC 789	6.9	39-	69	71S	K0	Sun alt. -1 deg.
Sep 2	Thu	4:50	R	ZC 1068	7.1	22-	32	84S	A2	
Sep 2	Thu	4:56	R	SAO 78995	7.4	22-	33	68S	A3	
Sep 11	Sat	21:24	D	SAO 159309	7.7	29+	8	21N	A2	Az.238,mag2 11,dT -140s
Sep 13	Mon	19:12	D	ZC 2514*	6.4	51+	25	15S	B9	Sun alt. 0
Sep 13	Mon	19:57	D	SAO 185433	7.2	51+	24	32N	F3	Sun -8,mag2 8.5,dT +.7s

*in Kepler2 program so occultation light curves are sought.
More information is at iota.jhuapl.edu/exped.htm
David Dunham, dunham@starpower.net

Adventures in Silvering – continued from page 2

shiny surface with a few cotton balls, waits five minutes, and then rinses it all off thoroughly with a spray of distilled water with the mirror held at an angle. Done – and already overcoated!

By comparison, depositing silicon or magnesium oxide over-coatings over silver or aluminum requires much more sensitive and expensive equipment than we possess or can afford with our NCA-owned, government-surplus vacuum chamber. Aluminum evaporative coatings like we use require a two-stage pump and pressures in the range of 10^-4 Torr or lower, and quite a lot of electrical power. In contrast, this procedure can be done under a dust-free canopy or screened porch, with no special machines or electricity required at all.

Our coatings all came out very beautifully, and did not need the buffing that some authors report. After blowing off and drying any remaining droplets, we did another video Ronchigram and performed Foucault-Couder zonal knife edge tests, just as we had done prior to stripping off the aluminum. Granted, we do not yet have the capability of doing interferograms, but as far as we could tell, the silvered surface on Nancy's mirror was optically indistinguishable from the aluminized one. Except for one thing: the silver was noticeably brighter!

How this simple silvering process ends up being as evenly distributed as our vacuum aluminization process is a question I cannot answer. Ronchi and Foucault-Couder tests are extremely sensitive. With this silvering process, you can do any size mirror you like. All you need, besides the kit, is an adjustable jig to hold the mirror at various angles. The jig can be made out of almost anything. I used pieces of two-by-four lumber, some nylon pads for chair legs, a few inexpensive PVC plumbing bits, a couple of old hinges, and some screws. To catch the runoff, one can use any sort of plastic basin.

We did find that one had to be much more thorough in the cleaning process than when aluminizing. If not, one's errors become obvious, because the silver doesn't stick to any dirt or finger grease you left behind. Capillary action will draw oils from your fingers from the edges of the glass disc onto the surface of the mirror, if you are not careful. (Part of the aluminization process is a high-voltage plasma cleaning or ion bombardment.) We also found it to be helpful to have two people – one to do the cleaning and application of chemicals, and the other one to spray distilled water when needed and adjust the angle of the mirror.

To recap, this is basically a five-step process:
1. Get everything all ready and mix the stannous fluoride solution afresh.
2. Put the mirror on its back and clean if off **very** thoroughly with cotton balls, nitrile or latex gloves, and a slurry of precipitated $CaCO_3$ (Alconox detergent sold for cleaning laboratory test tubes and beakers doesn't hurt); rinse thoroughly with distilled water, raising it to an angle of 30 degrees or so.
3. Sensitize the mirror by spraying all over with the tin solution; rinse again.
4. Spray on the silver solution and its reducer at the exact same time with two separate new one-pint hand-squirt bottles, until fully silvered & shiny; rinse again.
5. Spray on the Angel-Guard overcoat with the mirror supine; wait five minutes; tilt it up, rinse again; dry.

With many thanks to: Bob Robinson for the materials; Léon Foucault, Howard Banich, and Peter Pekurar for the ideas; and Angel Gilding for the supplies.

Recent Astronomy Highlights – continued from page 4

New Dark Matter Map Reveals Local Filaments in the Cosmic Web
Using a machine-learning model, as well as catalogues of the distribution and peculiar motions of 17,000 galaxies within 200 megaparsecs of the Milky Way, a research team has created a map of the distribution of dark matter in the nearby part of the Universe. The team originally used Universe simulations, such as Illustris-TNG, to build the model before using the data of the actual Universe. The fact that the latter model showed previously revealed structures including the 'local sheet' which contains the Milky Way and the 'local void' lends credence to its results which include evidence of filaments of gas and dark matter that had not previously been discovered. More information can be found at www.sciencedaily.com/releases/2021/05/210525101716.htm and the article from the research team is available at arxiv.org/pdf/2008.01738.pdf.

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 gfbrandenburg@yahoo.com. More info 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 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: **11 September** 7:30 p.m.

The APS Mid-Atlantic Senior Physicists Group: **(Zoom Meeting)** June 16th at 1:00 p.m., Dr. Peter M. Valone, NIST, will give a talk entitled "An Introduction to Forensic DNA Typing". More information is available at www.aps.org/units/maspg/meetings/meeting.cfm?name=SENIOR0621. To attend the meeting, use the following link and meeting info: apsphysics.zoom.us/j/96656965258?pwd=VS85RlBHVFNaRWJkSVNJNFNNaC9Gdz09 Meeting ID: 966 5696 5258 Passcode: 923304
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

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Next NCA Meeting:

2021 June 12th

7:30 pm

(On Zoom)

Science Fair Winners, NCA Elections and Astro-photos

The NCA Zoom meetings are open to anyone, however, you must register ahead of time. To register, go to: umd.zoom.us/meeting/register/tJAlc-6sqjsiHdfRNCJnu_I3iawoOyahnYPh. 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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