

Star Dust

Newsletter of National Capital Astronomers, Inc.

capitalastronomers.org

March 2020

Volume 78, Issue 7

**Celebrating 83 Years
of Astronomy**

Next Meeting

When: Sat. Mar. 14th, 2020

Time: 7:30 pm

Where: UMD Observatory

Speaker: Dr. Tony Farnham

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Directions to Dinner/Meeting

Our time and location for dinner with the speaker before this meeting is 5:30 pm at **Azteca Restaurant and Cantina** at 9505 Baltimore Avenue (Route 1), College Park, MD 20740 across from the Honda dealership.

The National Capital Astronomers meeting is held at the UMD Astronomy Observatory on Metzerott Rd about halfway between Adelphi Rd and University Blvd.

Observing after the Meeting

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

Spontaneous Outbursts: New Studies of Cometary Activity

Tony Farnham
University of Maryland

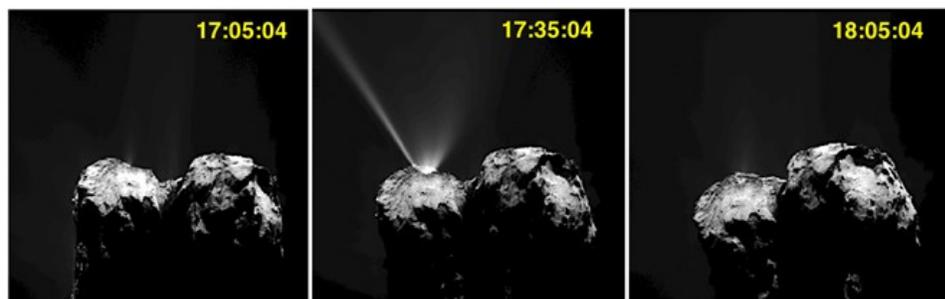
Abstract: Comets are the most primitive objects available for study in the Solar System, and they will provide insight into the conditions that were present in the proto-solar nebula, *if* we can understand what causes a comet's behavior to vary along its orbit, and how a comet evolves.

Cometary activity takes many forms, but the most spectacular activity tends to be explosive outbursts, where the comet rapidly brightens for a brief period of time. These events range from barely detectable blips in the comet's brightness as a function of time, to the massive explosion that caused comet 17P/Holmes to increase in brightness by ~14(!) magnitudes in 2007. Explosive outbursts have been observed for over a century, in comets of all family types, under a wide variety of conditions and heliocentric distances, and have even been imaged *in situ* by spacecraft.

However, despite this record of observations, little is known about explosive outbursts. Given that sunlight is the only energy source driving a comet's activity (with the exception of the occasional asteroid impact), the explosive nature of outbursts suggests that this energy is applied in a different manner from that producing normal activity, and understanding why it is different promises to reveal important information about the physical properties of cometary nuclei.

Recent developments in astronomical observing capabilities have opened a new era in the study of outbursts, and the Small Bodies Group at the

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Rosetta images of comet 67P/Churyumov-Gerasimenko from Aug 12, 2015 showing a small, short-duration outburst, consisting of a narrow jet accompanied by a broader fan. Image credit: ESA/Rosetta/MPS for OSIRIS Team MPS/UPD/LAM/IAA/SSO/INTA/UPM/DASP/IDA

Recent Astronomy Highlights

Binary-Star System Characterized by Gravitational Microlensing

Astronomers used the repeated brightening of light from a distant star to study the characteristics of a closer binary star system that they could not see. The brightening took place because of gravitational microlensing, when the gravity of a large mass deflects light from a farther source, making it appear brighter. In this case the periodic brightening episodes indicated that the gravitational lensing came from two sources, two stars orbiting each other. The brightening was first discovered by the European Space Agency's GAIA space observatory. For more information, go to phys.org/news/2020-01-global-gaia-campaign-reveals-secrets.html

Vampire-Star Outburst

A team of astronomers searching the archives from NASA's Kepler mission, which had a goal of finding exoplanets by the fading they caused when crossing in front of their host stars, turned up images of a system in which a star brightened in a single day by a factor of 1600. The system consists of a white dwarf, the remnant of a burned-out star with approximately the mass of the Sun in a sphere the size of Earth, and a brown dwarf, weighing about one-tenth as much, in close orbit. Material from the brown dwarf is being siphoned away by the white dwarf forming an accretion disk around the latter.

Occasionally, the accretion disk heats up dramatically, possibly because of an orbital resonance with the brown dwarf, leading to an increase in brightness. More information can be found at phys.org/news/2020-01-nasa-kepler-witnesses-vampire-star.html

Superluminous Supernovae

Astronomers now believe that one of the brightest supernovae ever observed, labelled SN2006gy, was caused by a white dwarf spiraling into a companion star that had puffed up in its final stage of life, blowing up when it reached the core of that companion. More info is at phys.org/news/2020-01-insights-brightest-explosions-universe.html

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• [Spontaneous Outbursts: New Studies of Cometary Activity – continued from page 1](#)

• University of Maryland is taking advantage of these capabilities to begin more detailed investigations into the physics of outbursts. This talk will review the history and current status of our understanding of these unique events, and will preview the new era of studies.

• **Biography:** Tony Farnham is a Senior Research Scientist in the Department of Astronomy at the University of Maryland. His primary research attempts to use both ground-based observations and spacecraft data to understand the mechanisms involved in the formation and development of the comas of comets, and the relationships between the coma and physical and dynamical properties of the nucleus. His other interests include the evolutionary processes that link the different comet families, Centaurs and Trans-Neptunian Objects, and the dynamics involved in active asteroids. Farnham earned BS and MS degrees in Aerospace Engineering at the University of Southern California, and MS and PhD degrees in Astronomy at the University of Hawaii at Manoa. He worked at the Lowell Observatory in Flagstaff, Arizona, and was the Harlan J. Smith Planetary Postdoc at the University of Texas, Austin, before coming to the University of Maryland in 2002. He was on the science teams for the Deep Impact mission to comet 9P/Tempel 1, the DIXI mission to comet 103P/Hartley2, and the Stardust-Next mission that returned to Tempel 1. He was the Project Scientist for the NASA Discovery Comet Hopper Mission (Phase A study), and has participated in numerous other proposed cometary missions. He is currently on the Double Asteroid Redirection Test (DART) team, developing the plans for the spacecraft approach and ground-based follow up observations. Asteroid 16946 Farnham is named in his honor.

Magnitudes in Astronomy

John Hornstein

• The abstract for this month's talk describes a comet that temporarily increased in brightness by 14 "magnitudes". What does *that* mean? Astronomers use a system of apparent magnitudes that is based on the method that is often ascribed to Hipparchus (en.wikipedia.org/wiki/Hipparchus) before 100 BC. Hipparchus used a system in which the brightest object was like the king in a procession. The king was the *first* in rank, those second in rank came next, and so on. So, in this system the *brighter* the object the closer it is to the front of the procession, and the *smaller* the number that gives its rank. So, the brightest objects have the smallest "magnitude". Based on Hipparchus' assignments of magnitudes, astronomers' quantitative system has a change of 5 magnitudes correspond to a factor of 100 in brightness. The calculation for 15 magnitudes is easier than it is for 14 magnitudes. Since $15 = 3 \times 5$, a change of 15 magnitudes corresponds to 3 factors of 100, i.e., to a factor of $100 \times 100 \times 100 =$ a million.

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

- 25 Apr. 8:30 p.m.
- 23 May 9:00 p.m.
- 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.

(Objects to be viewed will be listed in future issues of Star Dust.)

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 April’s issue of Star Dust, is March 21st.

Clear Skies!

Sky Watchers

March/April

Bright Venus dominates the evening sky, while all of the other visible planets – Mercury, Mars, Jupiter and Saturn - can be seen in the pre-dawn sky. There will be a couple of very close conjunctions as Mars, Jupiter and Saturn are grouped together through the latter part of March (see below).

3/20	Conjunction – Mars will be 0° 42’ south of Jupiter (approximately 1 ½ times the diameter of the Moon) at 2:21 a.m.
3/24	Mercury at Greatest Western Elongation, 27.8° from the Sun and highest in the eastern sky before sunrise.
3/24	Venus at Greatest Eastern Elongation, 46.1° from the Sun and highest in the western sky after sunset.
3/31	Conjunction – Mars will be 0° 55’ south of Saturn (a little less than 2 times the diameter of the Moon) at 7:56 a.m.
4/7	Full Moon (and Supermoon) at 10:35 p.m.

All times are in EDT (Eastern Daylight Savings Time)

Exploring the Sky – Letting Others See the Wonders of the Universe

Those who have been attending NCA meetings over a number of years can remember the late Joe Morris, former NCA President and coordinator of the Exploring the Sky sessions, asking for “those with telescopes and those without telescopes” to attend the sessions that have been a part of the NCA’s mission to show the night sky to others. Although there has seemed to be a correlation between cloudy skies and the times of those sessions, occasionally there is a break in that relationship. And on such nights, hundreds of curious people, young and old, have descended on a field in Rock Creek Park to catch a view of the Moon or the planets, or perhaps even a distant galaxy. If you haven’t attended a session before, and would like to know what it can be like, an award-winning video entitled “A New View of the Moon” will give you a feel for the reactions of people who see the Moon up close for the first time. The video is at www.mountainfilm.org/tour/films/detail/8726. Set to Claude Debussy’s *Clair de Lune* (Moonlight), it follows Wylie Overstreet, a resident of Los Angeles, as he sets up his 12” Dobsonian telescope in various places and lets those passing by look through it at the Moon. Enjoy watching, and, if you’d like to see such reactions for yourself, consider attending Exploring-the-Sky sessions, and showing the wonders of the Universe to those who have never seen them before – whether you have a telescope or not.

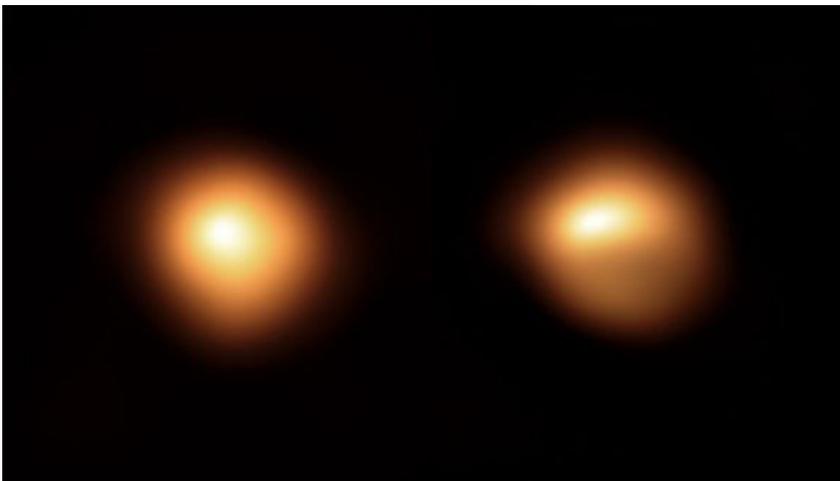
Wayne Warren Named an American Astronomical Society Fellow

Wayne H. Warren, Jr., a longtime member of the National Capital Astronomers, has been named to the first class of Fellows of the American Astronomical Society. As the website for AAS says (aas.org/grants-and-prizes/aas-fellows), "AAS Fellows are recognized for their contributions toward the AAS mission of enhancing and sharing humanity's scientific understanding of the universe." Throughout his career, Wayne has served as the head of NASA's Astronomical Data Center as well as in a number of positions in the International Astronomical Union. He has also served as an educator in astronomy at several institutions. Although retired to Florida, Wayne continues to be active in the NCA, including serving as an editorial advisor for Star Dust. Congratulations, Wayne.

Betelgeuse Update

In recent days, Betelgeuse, which has been fading for a number of months, has actually begun to brighten again, now brighter by approximately ten percent than at its most faded. The brightening has lessened some of the predictions that the star is about to go supernova, but astronomers don't know for sure what exactly would happen prior to such a star exploding. Scientists will continue to monitor the star to see whether or not the brightening continues.

Meanwhile an image (shown below to the right) has been taken which shows that one hemisphere of the star appears much more faded than the other. A comparison shot of Betelgeuse before the fading began is to the left. What has caused the asymmetric fading? One theory is that a very cool convection cell has surfaced. On stars like the Sun, convection cells tend to be small in comparison to the size of the star, but on red supergiants, like Betelgeuse, it is theorized that such convection cells can be nearly as big as the star itself. Another theory holds that a dust cloud in front of part of the star is absorbing the light, blocking it from reaching Earth. Stay tuned for updates as astronomers continue to investigate the mystery.



Betelgeuse before the fading began (left) and during the fading (right). Image credit: ESO/M. Montargès *et al.*

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Thank you!

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

• Biggest Explosion Discovered So Far

• Astronomers have discovered evidence
 • of an explosion five times larger than
 • any previously discovered. The
 • explosion was presumably caused by
 • the jets from a supermassive black hole
 • feeding on an enormous amount of
 • matter. The event took place, thankfully
 • far away, in the Ophiuchus Cluster
 • which lies approximately 390 million
 • light years from Earth. X-ray and radio
 • emissions show the curved wall of a
 • cavity formed within the cluster. The
 • energy necessary to form such a cavity
 • is estimated to have been around 5×10^{54}
 • joules. For comparison, it would take
 • one trillion Sun-like stars approximately
 • 400 million years to put out that amount
 • of energy. For more information, go to
 • [www.space.com/biggest-cosmic-
 explosion-universe-discovery.html](http://www.space.com/biggest-cosmic-explosion-universe-discovery.html)

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Occultation Notes

- D following the time denotes a disappearance, while R indicates that the event is a reappearance.
- When a power (x; actually, zoom factor) is given in the notes, the event can probably be recorded directly with a camcorder of that power with no telescope needed.
- The times are for Greenbelt, MD, and will be good to within +/-1 min. for other locations in the Washington-Baltimore metropolitan areas unless the cusp angle (CA) is less than 30 deg., in which case, it might be as much as 5 minutes different for other locations across the region.
- Some stars in Flamsteed's catalog are in the wrong constellation, according to the official IAU constellation boundaries that were established well after Flamsteed's catalog was published. In these cases, Flamsteed's constellation is in parentheses and the actual constellation is given in the notes following a /.
- Mag is the star's magnitude.
- % is the percent of the Moon's visible disk that is sunlit, followed by a + indicating that the Moon is waxing and - showing that it is waning. So 0 is new moon, 50+ is first quarter, 100+ or - is full moon, and 50- is last quarter. The Moon is crescent if % is less than 50 and is gibbous if it is more than 50.
- Cusp Angle is described more fully at the main IOTA Web site.
- Sp. is the star's spectral type (color), O,B,blue; A,F,white; G,yellow; K,orange; M,N,S,C red.
- Also in the notes, information about double stars is often given. "Close double" with no other information usually means nearly equal components with a separation less than 0.2". "mg2" or "m2" means the magnitude of the secondary component, followed by its separation in arc seconds ("), and sometimes its PA from the primary. If there is a 3rd component (for a triple star), it might be indicated with "mg3" or "m3". Double is sometime abbreviated "dbl".
- Sometimes the Axis angle (AA) is given. It is the angle measured around the Moon's disk, from the Moon's axis of rotation. It can be used with a lunar map to tell where a star will reappear relative to lunar features.

Mid-Atlantic Occultations

David Dunham

Asteroidal Occultations

2020	Day	EDT	Star	Mag.	Asteroid	dmag	dur. s	Ap. " Location
Mar 16	Mon	22:32	4UC62219450	13.9	Feodosia	1.8	4 11	nWV,nVA;DC,SMD?
Mar 20	Fri	21:59	4UC55327606	12.9	Industria	0.6	6 9	n&eKY,swVA,n&eNC
Mar 20	Fri	23:20	4UC55513496	13.9	Nanon	1.5	3 12	nKY,swV,c&seVA
Mar 21	Sat	0:10	4UC60921426	12.6	Peterson	4.6	1.6 8	eOH,cVA;nVA,DC?
Mar 22	Sun	21:32	4UC45512597	13.2	Aethra	0.4	2 10	nMO,nKY,swV,cVA
Mar 23	Mon	4:28	4UC44783893	13.6	Eunike	0.6	7 11	nMD,PA;nVA,DC?
Mar 23	Mon	22:22	SAO 156799	8.0	Fantasia	7.1	1.1 2	s&wNC,nWTN,CKY
Mar 24	Tue	23:38	4UC56213561	13.9	Botolphia	1.8	1 12	nw-sePA,SNJ;nMD?
Mar 25	Wed	22:47	4UC58532335	12.3	Elisabetha	2.3	7 7	nMO,nEY,swV,svA
Mar 30	Mon	21:50	4UC57023796	12.6	Laodica	2.5	2 9	swPA,nMD,DE;DC?
Mar 31	Tue	1:15	4UC59045216	13.3	Juewa	0.3	17 10	NJ,eMD,eVA;DC?
Apr 4	Sat	1:31	4UC45543580	11.8	Ekard	3.4	12 8	sw-nePA,nNJ,seNY
Apr 8	Wed	2:37	TYC73200253	10.4	Leonora	5.2	8 4	svA,n&CNC,e&nKY
Apr 12	Sun	22:28	SAO 94025	8.2	Kathleen	8.3	1.6 3	nw-seTN,swNC,nSC
Apr 13	Mon	22:56	TYC13080185	9.8	Jacqueline	7.7	1.2 4	w&swNY,neNE,nNJ
Apr 14	Tue	22:30	4UC35366940	12.3	Leda	0.8	9 7	se&wNY,nNJ,nePA

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

Lunar Grazing Occultations

2020	Day	EDT	Star	Mag	% alt	CA	Location, Notes
Mar 26	Thu	19:57	xii Ceti	4.4	6+ 17-10N	sFFx	Alxndra,VA;AndrewsAFB,MD
Apr 11	Sat	2:10	ZC 2338	6.4	86- 26 16S		neColumbia,sHanover,Arnold,MD

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

Lunar Total Occultations

2020	Day	EDT	Ph Star	Mag	% alt	CA	Sp. Notes
Mar 14	Sat	7:02	R SAO159520*	7.6	71- 29	63S	F2 Sun -4, close double??
Mar 16	Mon	5:15	R SAO185634	7.6	50- 22	75N	G8
Mar 16	Mon	6:22	R SAO185674	7.3	49- 26	53S	F0 Sun altitude -11 deg.
Mar 17	Tue	6:43	R SAO187145	7.6	39- 24	82N	F2 Sun altitude -7 deg.
Mar 18	Wed	4:55	R ZC 2857	6.5	30- 6	74N	K4 Azimuth 127 degrees
Mar 19	Thu	5:36	R ZC 2991	6.1	21- 5	87N	K5 Azimuth 124 deg.
Mar 28	Sat	19:46	D ZC 554	8.4	18+ 42	71S	K0 Sun altitude -5 degrees
Mar 28	Sat	20:13	D SAO 93608*	8.0	18+ 37	57N	F2 Sun altitude -10 deg.
Mar 28	Sat	23:20	D ZC 577	6.0	19+ 2	11N	F4 Azimuth 291 deg.
Mar 29	Sun	13:18	D epsilon	3.5	24+ 37	77N	K0 Sun+55,ZC668,close dbl?
Mar 29	Sun	14:32	R Tauri =Ain	3.5	25+ 51	-70S	K0 Sun alt.+50, AxisA. 251
Mar 30	Mon	22:25	D SAO 77286	8.4	36+ 33	43N	F8
Mar 30	Mon	23:09	D ZC 843	7.0	36+ 25	11S	F8 mag2 7.0, sep. 4" (12s)
Mar 31	Tue	22:06	D SAO 78452	8.3	46+ 48	31N	A0
Mar 31	Tue	23:20	D SAO 78493	8.4	46+ 34	74S	K0
Apr 1	Wed	0:50	D ZC 1014	7.0	47+ 17	76S	A0 NEW close double??
Apr 1	Wed	22:45	D SAO 79429	7.7	57+ 50	12S	M*
Apr 2	Thu	0:02	D ZC 1144	6.6	57+ 36	89N	F8 mag2 8 sep. 12" (+4s)
Apr 2	Thu	1:00	D SAO 79519	8.1	58+ 25	49N	G5
Apr 4	Sat	3:31	D ZC 1421	8.0	79+ 15	78N	K0 Azimuth 280 deg.
Apr 5	Sun	20:38	D ZC 1647	6.7	94+ 41	62N	A2
Apr 5	Sun	23:26	D ZC 1659	6.7	94+ 60	36N	K0
Apr 6	Mon	2:08	D ZC 1669*	6.7	95+ 44	38S	F5 /=nu Sco C 41" from A
Apr 10	Fri	23:50	R SAO 159763	6.5	86- 7	68S	Az. 122, nuScOD 2" from C
Apr 10	Fri	23:50	R nu Sco A-B	4.1	86- 7	66S	B2 ZC2322=Jabbah B 1"fromA
nuSco mags. Aa 4.5,Ab 6.8,B 5.3,C 6.6,D 7.2;Sep. Aa-Ab = 0.1"; A= C+16s							
Apr 11	Sat	3:50	R ZC 2343*	6.3	85- 31	64S	K0
Apr 11	Sat	4:21	R SAO159860*	7.4	85- 31	64N	B9 mg2 8.1,sep. 47"(-103s)
Apr 11	Sat	4:38	R SAO159864*	7.6	85- 31	69N	B9 mg2 8.5,sep. .2"(+0.3s)
Apr 12	Sun	6:18	R ZC 2504*	7.4	76- 26	47N	B9 Sun alt. -4 deg.

*in kepler2 program so occultation light curves are sought.

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

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Many Eyes on the Sun

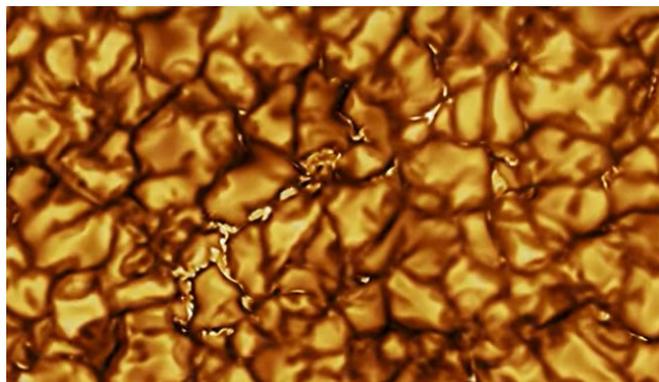


Artist's impression of the Parker Solar Probe exploring the Sun
 Image Credit: NASA/Johns Hopkins APL/Steve Gribben

On January 29th, NASA's Parker Solar Probe (PSP) reached its fourth and, so far, closest aphelion with the Sun. Only 11.6 million miles away from the Sun, it also set a speed record, orbiting at 244,255 mph (393,044 kph) over fourteen times as fast as the International Space Station orbits the Earth, and 0.04% of the speed of light. Temperatures on the sunward side of the probe's heat shield reached 1134 degrees F (612 degrees C). But as impressive as those numbers are, achieving them isn't the purpose of PSP. Gaining a better understanding of the Sun is the reason the PSP is going deeper into our star's corona than any mission ever before. Recently a series of papers reporting on the results of previous dives into the corona were published in the journal *Nature*. More information can be found at www.uah.edu/news/items/first-parker-solar-probe-scientific-papers-are-published-in-nature.

Meanwhile the Solar Orbiter, a joint mission of NASA and the European Space Agency, successfully launched on February 9th. While it will go nowhere near as close to the Sun as the PSP, it will take up a solar orbit that takes it above and below the Sun where it is expected to give us our first images of those polar regions. (While the Ulysses probe orbited the Sun's poles between 1994 and 2008, it did not take images.) More information is at www.nasa.gov/feature/goddard/2020/esa-nasa-solar-orbiter-launch-voyage-to-sun-heat-shield.

Finally, although earthbound, the Daniel K. Inouye Solar Telescope in Hawaii recently provided the highest resolution images of solar granules, the tops of convection cells, on the Sun in its first-light images. A video showing images taken by the telescope every 5 seconds over a 10-minute period, from which the screen shot below was taken, can be found at apod.nasa.gov/apod/ap200203.html.



Solar Granules. Image Credit: NSO, NSF, AURA, Inouye Solar Telescope

Recent Astronomy Highlights – continued from page 4

Images of Newborn Stars

Radio astronomers used the Karl G. Jansky Very Large Array (VLA) and the Atacama Large Millimeter/submillimeter Array (ALMA) to image the protoplanetary disks of three hundred newborn stars in a star-forming region named the Orion Molecular Cloud Complex. The study, known as VANDAM (VLA/ALMA Nascent Disk and Multiplicity) is the largest study of such young stars and their disks performed so far. Much of the material in such disks will continue to feed into the growing stars, while some of it may go on to form planets. The disks around four of the newborn stars have a blobby appearance, as if they have not yet flattened out, indicating that these stars are extremely young, perhaps as little as 10,000 years old. For more information on the VANDAM study, as well as images of a number of the stars and their disks, go to www.space.com/infant-stars-planet-forming-disks-images.html

Calendar of Events

- **NCA Mirror- or Telescope-making Classes:** Tuesdays AND Fridays, from 6:30 to 9:30 pm at the Chevy Chase Community Center (intersection of McKinley Street and Connecticut Avenue, N.W.) Contact instructor Guy Brandenburg at [202-635-1860](tel:202-635-1860) or at gfbrandenburg@yahoo.com.
- Additional information is at guysmathastro.wordpress.com/ and home.earthlink.net/~gfbranden/GFB_Home_Page.html
- **Open house talks and observing at the University of Maryland Observatory** in College Park on the 5th and 20th of every month at 8:00 pm (Nov.-Apr.) or 9:00 pm (May-Oct.). Details: www.astro.umd.edu/openhouse
- **Next NCA Meeting** at the University of Maryland Observatory: **11 April** 7:30 p.m., Bethany Cobb Kung, (GWU), *Shedding Light on Gravitational Waves*
- **The APS Mid-Atlantic Senior Physicists Group:** “Multidisciplinary Aspects of Developing Small Sensing Devices for Monitoring Chemicals and Biochemicals” by Steve Semancik, Biological Measurement Division, NIST, Mar. 11th at 1:00 pm at the American Center for Physics (1st floor conference room). (Note - This is the **second Wednesday of the month**, not the third.) Physics Ellipse, College Park MD -- off River Rd. between Kenilworth Ave. and Paint Branch Parkway. For more information, go to www.aps.org/units/maspg/meetings/meeting.cfm?name=SENIOR0320

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.?

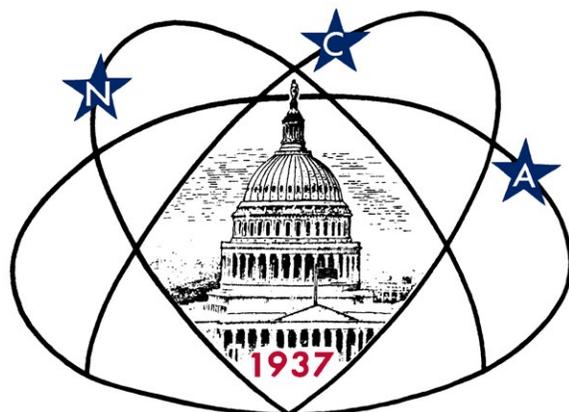
Are you interested in volunteering for: Telescope making, Exploring the Sky, Star Dust, NCA Officer, etc.?

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
400 Madison St #2208
Alexandria, VA 22314

First Class
Dated Material



Celebrating 83 Years of Astronomy

Next NCA Meeting:

2020 March 14th

7:30 pm

@ UMD Observatory

Dr. Tony Farnham

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