Star Dust

Newsletter of National Capital Astronomers, Inc.

capitalastronomers.org

December 2020 ***Volume 79, Issue 4***

Celebrating 83 Years of Astronomy

Next Meeting

When: Sat. Dec. 12th, 2020

Time: 7:30 pm

Where: Online (Zoom)

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

Speaker: Dr. Bethany Cobb Kung

Table of Contents

Image Credit: NRAO's Green Bank Observatory

60 years ago, the Howard E. Tatel Radio Telescope, pictured above, was used in a celebrated study. For details see Page 2.

Shedding Light on Gravitational Waves

Bethany Cobb Kung

George Washington University

Abstract: In 2015, the LIGO collaboration made the first ever direct detection of gravitational waves produced by the collision of two black holes. Observational astronomers - those that use telescopes and light to study the universe - were excited, but what we were really looking forward to was the detection of gravitational waves associated with a source of electromagnetic radiation (light). We didn't have to wait long, because in August of 2017 (the same year in which the LIGO collaboration was awarded the Nobel Prize in Physics for their first detection of gravitational waves), the LIGO and Virgo observatories detected a gravitational wave signal from the collision of two neutron stars, and smashing together two neutron stars is bright! In this talk, I'll discuss what gravitational waves are, how they are detected, and describe this exciting binary neutron star merger event and what it means for the future of observational astronomy.

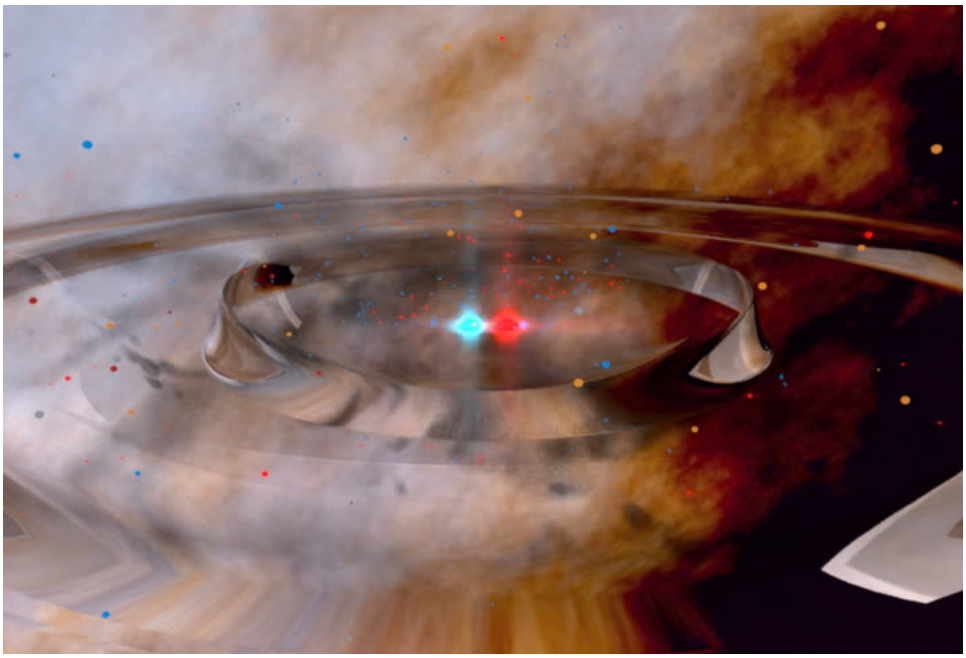


Image Credit: NASA Goddard

Biography: Bethany Cobb Kung is an Associate Professor of Honors and Physics at the George Washington University (GW), where she also directs the University Honors Program. She graduated from Williams College in 2002 and received her PhD in astronomy at Yale University in 2008 for research on massive stellar explosions called gamma-ray

continued on page 2

Recent Astronomy Highlights

Sampling Bennu

On October 20th, NASA's probe OSIRIS-REx (Origins Spectral Interpretation Resource Identification Security Regolith Explorer) approached the surface of Bennu, the asteroid it had been orbiting for nearly two years, and retrieved a sample from it. The sample was retrieved by actually releasing gas, blowing some of the surface material up into the sampler head (see image below) before the probe returned back to orbit. Scientists were interested in retrieving such material from Bennu because it likely to have undergone very little change since the asteroid formed in the early days of the Solar System. The initial sample collection was so successful that NASA engineers actually had trouble getting the lid on the sampler head to close, leading to fears that the sample would slowly escape. Fortunately, the lid was closed a couple days later. OSIRIS-REx is expected to return the sample to Earth in September of 2023. More information about the sampling mission can be found at OSIRIS-REx | NASA

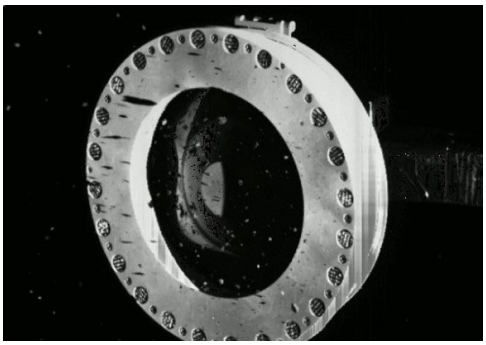


Image Credit: NASA

Birth of a Magnetar?

On May 22, 2020, astronomers recorded the most brilliant kilonova ever observed. A kilonova can be caused by radioactive decay of material created in the merger of two neutron stars or a neutron star and a black hole. One possible explanation for the brightness of this particular kilonova is that the compact objects formed a magnetar, a neutron star with an extremely powerful magnetic field. More information is at www.sciencedaily.com/releases/2020/11/201112134640.htm

continued on page 4

Biography – continued from page 1

bursts. From 2008 to 2010, she did research at the University of California, Berkeley as a National Science Foundation Astronomy & Astrophysics Postdoctoral Fellow. As a dedicated educator at GW, she specializes in teaching astronomy and physics to non-science-majoring students and was awarded the 2016 Morton A. Bender Teaching Award.

SETI @ Sixty (1960-2020): A "Meeting of the Minds" Someday?

Daniel J. Costanzo – NCA Past President (1991-1992)

Many of us think that presumed extraterrestrial intelligences, however truly alien as they would be to us, still would share with us both a logical curiosity, and a desire to use the electromagnetic spectrum (EMS), particularly via radio and/or lasers, to communicate with Others across the ethereal gulf of interstellar space separating us. Thus, despite those daunting distances, we could at least achieve a meeting of the minds, so to speak, via the EMS.

So, in this year 2020, during the depths of the global COVID-19/coronavirus pandemic's first wave, a 60th anniversary passed with little notice: the then audacious first Search for Extraterrestrial Intelligence (SETI) among distant planetary systems beyond the Solar System using a radio telescope by the then young Cornell University astronomer Frank Drake. That was his Project Ozma.

And for NCA, the great thing about Drake's Project Ozma is that it was conducted not far from the National Capital area at the National Radio Astronomy Observatory (NRAO) at West Virginia's Green Bank.

The objective of Drake's experiment was to search for signs of intelligent life in distant planetary systems by detecting any radio waves they were leaking (or deliberately broadcasting) into interstellar space.

Drake used the NRAO's Howard E. Tatel Radio Telescope (the first such telescope constructed at Green Bank), with a diameter of 26-meters (85-feet), to examine the relatively nearby stars Tau Ceti and Epsilon Eridani. Both are Sun-like stars that are both relatively nearby (at "only" 11.90 light-years and 10.50 light-years from the Sun, respectively), are not double stars or triple stars, and then (i.e., circa 1960) seemed reasonably likely to both have planets, and have planets that were inhabited. For the number of confirmed planets then known to orbit other stars was a big fat zero. (The significantly nearer Sun-like star Alpha Centauri A, at "only" 4.40 light-years away, wasn't considered conducive to having any inhabited planets orbiting by being part of a triple star system with Alpha Centauri B and Proxima Centauri.)

The radio telescope's receiver was tuned to the EMS's radio wavelengths near 21-centimeters, the wavelength of electromagnetic radiation emitted by

continued on page 3

Exploring the Sky

*"**Exploring the Sky**"* is an informal program that, for over 70 years, has offered monthly opportunities for anyone in the Washington area to see the stars and planets through telescopes from a location within the District of Columbia. Presented by the National Park Service and National Capital Astronomers, sessions are held in Rock Creek Park once each month on a Saturday night from April through November, Beginners (including children) and experienced stargazers are all welcome—and it's free!

Hosted by: National Capital Astronomers, Inc and Rock Creek Park

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

More information can be found at NCA's web site, www.capitalastronomers.org or the Rock Creek Park web site, www.nps.gov/rocr/planyourvisit/expsky.htm. You can also call the Nature Center at (202) 895-6070. For general information on local astronomical events visit www.astronomyindc.org

---

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

Clear Skies!

SETI @ Sixty (1960-2020)… – continued from page 2

interstellar hydrogen. It was thought that the EMS's 21-centimeter hydrogen line would be familiar to all intelligent beings attempting interstellar radio communication as a kind of logical, universal standard for doing so.

Frank Drake (Circa 1960) at the Howard E. Tatel Radio Telescope used to conduct Project Ozma, the first SETI (Image Credit: NRAO's Green Bank Observatory)

This search conducted some 150 hours of intermittent radio observation during a four-month period, but detected no recognizable signals. There was a false alarm though when what seemed to be an intelligent signal was detected. However, it was determined to be a false signal originating from a high-flying aircraft, i.e., a "false positive" so to speak.

Project Ozma was publicized in articles in the popular news media of the time, such as *Time* magazine. Also, as the great science fiction author Arthur C. Clarke noted in his "Author's Note" for his science fiction novel *The Songs of Distant Earth* (1986), it helped change "the attitude of scientists toward the problem of Extraterrestrial Intelligence." For, "the whole subject did not become respectable (except among dubious characters like the writers of science fiction)" until later in the 1960s.

This publicity included *Sky & Telescope* Magazine, which, shortly before Drake started Project Ozma, published in its 1960 January issue his article titled "How Can We Detect Radio Transmissions from Distant Planetary Systems?" In it he described the assumptions to be considered for SETI, like how many stars have planets, how many of those planets might harbor intelligent life, etc., that he would soon formalize in what's now known as the Drake Equation. Drake went on to become one of the leading figures in the field of SETI.

What has happened regarding SETI in the now over six decades since Drake's Project Ozma is an incredible story of ups and downs that's well worth reading about. An immense reservoir on it is available online.

A good place to start is Kelly Beatty's 2010 article on Project Ozma's 50th Anniversary on *Sky & Telescope*'s Internet/Web site ("Astrobiology--Project Ozma: The First SETI"): search "ozma". It is but one of *S&T*'s section of articles on searching for extraterrestrial life.

Next, in Google, google on the phrase "seti 'giggle factor.'" ("The giggle factor" was the phrase SETI opponents in the U.S. Congress used in 1993 to kill NASA's then nascent SETI program to prevent American taxpayers from ever funding any future SETI efforts, with repercussions that reverberate through today.) Google will bring up two excellent and succinct descriptions of what happened with SETI both before, during, and after Project Ozma: a *Journal of the British Interplanetary Society* (1999) paper by NASA's Stephen J. Garber, and the *Science* 2020 September 10th article by Daniel Clery, "How Big Money is Powering a Massive Hunt for Alien Intelligence."

So, the search goes on. As Clarke noted in his "Author's Note" mentioned previously, "the radioastronomers, like gold miners panning for dust, quietly sieve through the torrents of noise pouring down from the sky."

Sky Watchers

December/January

Mercury transits from the morning sky to the evening sky in mid-December leaving Venus as the only planet in the morning sky, while Mars remains in the evening sky along with Jupiter and Saturn which complete their approach to each other, coming together for their Great Conjunction on December 21st (see below) and then begin to separate from each other before meeting again in approximately 20 years.	
12/13-14, 15	The Geminids Meteor Shower peaks on the evening of the 13th into the morning of the 14th with approximately 120 meteors/hour, but may also extend through the evening of the 14th through the morning of the 15th. With a new Moon on the 14th, viewing conditions will be ideal especially in the morning hours.
12/14	Total Solar Eclipse – This eclipse will only be visible in the Southern Pacific, southern Chile and Argentina and the southern Atlantic.
12/21	Winter Solstice - At 6:02 a.m. EST, the Sun will shine directly over the Tropic of Capricorn at 23° 26'.
12/21	The Great Conjunction of Jupiter and Saturn. At 9:22 a.m. EST the two gas giants will come within 7' (arc minutes) of each other, a little over 0.1 degrees (or approximately a quarter the diameter of the full Moon.) It will be the closest conjunction since 1653.
12/21-22	The Ursids Meteor Shower peaks on the 21st into the morning of the 22nd. A quarter Moon sets just after midnight, leaving morning viewing conditions ideal.
12/29	Full Moon at 11:30 p.m. EST
1/2-3	Peak of the Quadrantids Meteor Shower – Approximately 40 meteors/hour. Unfortunately, a waning gibbous Moon will make viewing conditions less than ideal.

All times are in EST (Eastern Standard Time)

NCA an IOTA Affiliate Member

Joan Dunham

The National Capital Astronomers, Inc., has been granted an Affiliate Membership in the International Occultation Timing Association (IOTA). As most NCA members are aware, IOTA is a volunteer organization whose purpose is to promote, collect, and analyze timings of astronomical occultations. The Affiliate Membership category, freely offered to organizations, is intended to help distribute information on occultation observing, on major upcoming occultation events, and to provide notices of IOTA meetings.

(More details about this membership will be presented in the January 2021 issue of Star Dust.)

Star Dust is published ten times yearly September through June, by the National Capital Astronomers, Inc. (NCA).

ISSN: 0898-7548

Editor: Todd Supple

Editorial Advisors:

- Michael Chesnes
- John D. Gaffey, Jr.
- Jeffrey Norman
- Elizabeth Warner
- Wayne Warren
- Marjorie Weissberg
- Harold Williams

Electronic Distributor: Jay Miller

Please Get Star Dust Electronically

NCA members able to receive Star Dust, the newsletter of the NCA, via e-mail as a PDF file attachment, instead of hardcopy via U.S. Mail, can save NCA a considerable amount of money on the printing and postage in the production of Star Dust (the NCA's single largest expense), save some trees and have one-click access to all the embedded links in the document. If you can switch from paper to digital, please contact Henry Bofinger, the NCA Secretary-Treasurer, at hbofinger@earthlink.net

Thank you!

Recent Astronomy Highlights – continued from page 2

New Study Results Indicate that the Solar System Formed More Quickly Than Previously Thought

Study of young planetary systems has allowed scientists to arrive at the theory that the cloud forming our Solar System collapsed within one or two million years, however a new study purports to show that the collapse took place in only a fraction of that time. The evidence for this claim comes from molybdenum isotopes found in meteorite inclusions. These inclusions were formed close to the young, still-forming Sun, before being transported farther out to where they were trapped in carbonaceous chondrite meteors. More information can be found at Meteorites Show That Our Solar System Formed in Less Than 200,000 Years (scitechdaily.com).

continued on page 7

Occultation Notes

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

Mid-Atlantic Occultations

David Dunham

Asteroidal Occultations

2020/21 Dy	EST	Star	Mag.	Asteroid	dmag	dur. s	Ap. "	Location
Dec 18 Fri	0:43	4UC43608619	13.6	Seppina	0.8	5	10	sMD,cVA,sWV,KY
Dec 18 Fri	2:34	4UC63821314	13.4	Alauda	0.3	13	10	sMD,VA,sWV;DC?
Dec 18 Fri	5:20	4UC50454664	12.3	Atalante	1.7	10	7	wPA,MD;nVA,DC?
Dec 21 Mon	1:15	4UC52033263	13.2	Endymion	0.7	7	9	sMD,cVA;DC,nVA?
Dec 24 Thu	1:28	4UC60737142	11.3	Monterosa	2.0	3	5	sMD,nVA,nWV;DC?
Dec 24 Thu	6:44	4UC56048881	12.9	Aurora	0.6	57	10	e&nVA,MD,DC,wPA
Dec 31 Thu	21:05	TYC00210525	11.6	Ohio	3.7	7	6	nVA,DC,cMD,sNJ
*** Dates above are 2020, those below are 2021 ***								
Jan 2 Sat	0:02	4UC47030247	12.3	Meliboea	1.7	9	7	NJ,PA,OH;nMD?
Jan 2 Sat	18:44	4UC52316053	12.1	Erigone	0.5	12	7	sMD,c-swVA,seKY
Jan 5 Tue	22:36	TYC06280492	11.2	Poltava	5.3	3	5	nKY,sWV,cVA
Jan 10 Sun	21:37	SAO 80257	9.4	Tucson	6.9	2	4	cNJ,ec-swPA,sOH

Lunar Grazing Occultations

2020/21 Dy	EST	Star	Mag	% alt	CA	Location, Notes
Dec 18 Fri	17:18	ZC 3178	6.2	21+ 28	13S	BolngGrn,VA;Benedict,MD:Sun-6
*** Dates above are 2020, those below are 2021 ***						
Jan 1 Fri	5:09	gamma Cnc	4.7	95- 46	14S	Opal,Brooke,&KingGeorge,VA
Jan 7 Thu	2:09	ZC 1994*	6.6	39- 11	8S	n.Halifax&whaleBoneJct,NC

*in Kepler2 program so occultation light curves are sought.

Lunar Total Occultations

2020 Day	EST	Ph	Star	Mag	% alt	CA	Sp.	Notes
Dec 17 Thu	17:14	D	ZC 3037	7.3	13+ 22	81S	F7	Sun -6; close double?
Dec 18 Fri	17:10	D	ZC 3178	6.2	21+ 29	25S	A0	Sun -5;close dbl?;graze
Dec 18 Fri	17:27	R	ZC 3178	6.2	21+ 28	0S	A0	Sun alt. -8 deg.
Dec 20 Sun	22:11	D	ZC 3458	6.2	41+ 10	55N	K0	Azimuth 249 deg.
Dec 21 Mon	18:57	D	ZC 18	5.8	50+ 45	60S	K1	close double?
Dec 23 Wed	22:07	D	nu Piscium	4.5	69+ 42	62S	K3	ZC 249
*** Dates above are 2020, those below are 2021 ***								
Jan 1 Fri	5:18	R	gamma Cnc	4.7	95- 46	30S	A1	AA 202,ZC1308, VA graze
Jan 3 Sun	5:17	R	46 Leonis	5.4	81- 58	84N	M2	ZC1544
Jan 7 Thu	2:27	R	ZC 1994	6.6	39- 12	42S	F8	Az111,dbl, NC graze

*in Kepler2 program so occultation light curves are sought.

More information is at iota.jhuapl.edu/exped.htm

David Dunham, dunham@starpower.net

Occultation by (11) Parthenope over eastern USA on Election Night

David and Joan Dunham

I proclaimed in my email message before this occultation early in the evening of November 3rd, "Vote for Parthenope", and several across the northern Mid-Atlantic did, to obtain the outline of the large asteroid shown in the sky plane plot below. The UT date was early on 2020 Nov. 4 when the 9.6-mag. asteroid (11) Parthenope occulted 9.9-mag. SAO 110209 = TYC 0033-01170-1 that conveniently was only 7' from 4.6-mag. xi Piscium. Since Parthenope was 0.3 mag. brighter than the star, there was only a 0.6-mag. drop when the occultation occurred, but that was obvious in all of the recordings of the event. The predicted path crossed the DMV region, with the s. limit expected to be near Yorktown, VA and the predicted n. limit over Sterling, Rockville, n. Laurel, and BWI. But the actual path was north of the prediction, giving longer occultations than expected for those in the Maryland suburbs north of DC. Joan and I recorded the occultation from two locations 4 km apart on the south side of Waldorf, MD with small 120mm scopes; we had to scramble because we had less than an hour of useful dark time before the event, to pre-point both telescopes. At least 7 others recorded the occultation; the observing sites for those for which we have coordinates and timings are shown on the map below. The green line is the predicted central line, the blue lines mark the expected limits, and the red lines are the limit in case of a 1-sigma path shift to the north or south. In addition, Elizabeth Warner recorded the occultation from the UMD Observatory (but confused about the event time in her rush to set up, she only recorded the disappearance). Also, Mike Skrutskie, of the

continued on page 6

2020-2021 Officers

President:
Harold Williams
haroldwilliams@me.com or
Harold.Williams@montgomerycollege.edu
240-461-4948

Vice-President:
John Hornstein
jshgwave@yahoo.com
301-593-1095 (h)

Secretary-Treasurer:
Henry Bofinger
hbofinger@earthlink.net
202-675-1075

Asst. Secretary-Treasurer:
Jeffrey B. Norman
jeffreynorman@comcast.net

Trustees:
- Benson Simon (2021)
- Michael Brabanski (2022)
- Guy Brandenburg (2023)
- Jack Gaffey (2024)

Appointed Officers and Committee Heads:

Exploring the Sky
Jay Miller
jhmiller@me.com

Telescope Making
Guy Brandenburg
gfbrandenburg@yahoo.com
202-635-1860 (leave message)

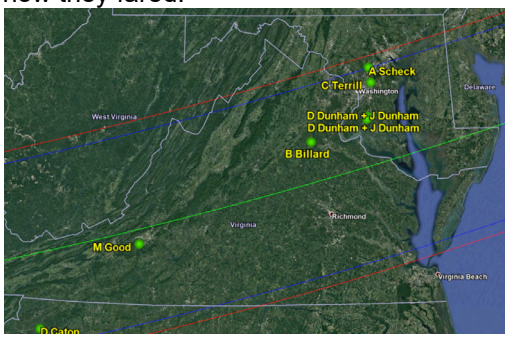
NCA Webmaster
Elizabeth Warner
warnerem@astro.umd.edu
301-405-6555

Star Dust Editor
Todd Supple
NCAStardust@gmail.com
301-595-2482 (h)

Social Media
Twitter: @NatCapAstro

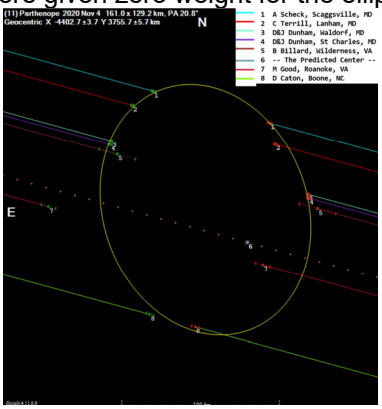
Occultation of (11) Parthenope… – continued from page 2

Univ. of VA Astronomy Dept., made a mobile observation of the event from Colleen, VA using an 8-cm "Mikey Mini" while other observations may have been attempted by other UVA observers from Charlottesville and Fan Mtn. Obs., but I have not heard yet how they fared.



Map of known observer locations. Credit: John Moore, IOTA and Google Earth

A plot of the timings of the observers in the figure above are shown on the plane of the sky at Parthenope in the figure below. The observations are fit quite well with a 161 km by 129 km ellipse, except for chord #7. Although Michael Good obtained a good drift-scan recording of the faded star/asteroid trail during the occultation, he had to walk several feet from his computer showing time to about 0.1s, to the telescope to start his camera exposure, so he could only estimate the time of that walk by counting. Although his event duration was determined to an accuracy of about 0.1s, it's clear that his counting estimate gave a time for the start of the exposure (and therefore for the event times) that was about 3s too late. So, Good's times were given zero weight for the elliptical fit.



Sky Plane Plot of the known observer chords. Image Credit - John Moore and IOTA

This underscores the need for robust timing for occultations. IOTA prefers solutions that use GPS 1PPS signals since these can result in timing accuracies under a millisecond. But the whole seconds will be correct only if the GPS almanac data are updated, usually achieved after 5 to 10 minutes after turning on a GPS receiver. The IOTA-VTI, which informs you if the almanac has been updated, is the best solution for time-stamping video recordings, see occultations.org/observing/recommended-equipment/iota-vti/ . But it doesn't help those using long CCD drift-scan exposures (like M. Good), or other astronomical cameras that don't generate video output. For them, setting the computer clock shortly before the occultation using NTP or sites like time.is/ allow timing to better than visual accuracies, and common camera software like firecapture time stamps your images with the computer time. But it's still best to calibrate any recording with a GPS 1PPS signal. IOTA member Aart Olsen in Illinois has designed an Arduino board device that receives the 1PPS signal and generates an LED flash and audio pip from it that can be used to accurately time non-video recordings. Since the parts cost less than $50, it's significantly cheaper than an IOTA-VTI. IOTA is looking for ways to manufacture these units; in the meantime, Aart Olsen can provide the design for those who can build electronic devices.

Recent Astronomy Highlights – continued from page 4

Fossil Galaxy in the Middle of the Milky Way

Having taken near-infrared spectra of approximately half a million stars throughout our galaxy, APOGEE, the Apache Point Observatory Galactic Evolution Experiment, a part of the Sloane Digital Sky Survey, has detected the presence of a 'fossil' galaxy near the center of the Milky Way. The fossil galaxy has been designated Heracles after the character from mythology. Its collision with the Milky Way may have taken place ten billion years ago. But not all of the star from Heracles remain near the center of the Milky Way. It is estimated that other stars from the fossil galaxy make up a third of the mass of the Milky Way's diffuse halo, an indication that the collision was a very big event in the history of our galaxy. More information about Heracles can be found at Astronomers Discover New "Fossil Galaxy" Buried Deep Within the Hidden Depths of Our Own Milky Way (scitechdaily.com).

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 (Zoom): **9 Jan.** 7:30 p.m., Tony Farnham (UMd)
Spontaneous Outbursts from Comets

The APS Mid-Atlantic Senior Physicists Group: **(Zoom Meeting)** Dec. 16th at 1:00 p.m., Timothy DelSole, George Mason University, will give a talk entitled "The Science of Climate Change." More information is available at www.aps.org/units/maspg/meetings/meeting.cfm?name=SENIOR1220
To attend the meeting, use the following link and meeting info:
apsphysics.zoom.us/j/91410702505?pwd=UlA2ekVGL29kTE9tOWJFM2c0eVR0QT09
Meeting ID: 914 1070 2505 Passcode: 343804
Dial in access 301 715 8592 (Washington DC).

National Capital Astronomers Membership Form

Name: _____ **Date:** ___/___/___

Address: _____ **ZIP Code:** _____

Home Phone: ____-____-_____ **E-mail:** _____ **Print / E-mail Star Dust (circle one)**

Membership (circle one): Student….. $ 5; Individual / Family…..$10; Optional Contribution…..$__

Please indicate which activities interest you:

- Attending monthly scientific lectures on some aspect of astronomy ____
- Making scientific astronomical observations ____
- Observing astronomical objects for personal pleasure at relatively dark sites ____
- Attending large regional star parties ____
- Doing outreach events to educate the public, such as Exploring the Sky ____
- Building or modifying telescopes ____
- Participating in travel/expeditions to view eclipses or occultations ____
- Combating light pollution ____

Do you have any special skills, such as videography, graphic arts, science education, electronics, machining, etc.?

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

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

National Capital Astronomers, Inc.

If undeliverable, return to
NCA c/o Elizabeth Warner
400 Madison St #2208
Alexandria, VA 22314

First Class
Dated Material

Celebrating 83 Years of Astronomy

Next NCA Meeting:

2020 December 12th

7:30 pm

(On Zoom)

Dr. Bethany Cobb King

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.

Inside This Issue