

**Celebrating 80 Years  
of Astronomy  
1937-2017**

# Star Dust

Newsletter of National Capital Astronomers, Inc.

[capitlastronomers.org](http://capitlastronomers.org)

November 2017

Volume 76, Issue 3

## Next Meeting

**When:** Sat. Nov. 11th, 2017

**Time:** 7:30 pm

**Where:** UMD Observatory

**Speaker:** Dr. Alexander van der Horst

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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 “The Common”, the restaurant in the UMD University College building located at 3501 University Blvd.

The National Capital Astronomers meeting is held at the UMD Astronomy Observatory on Metzert 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.

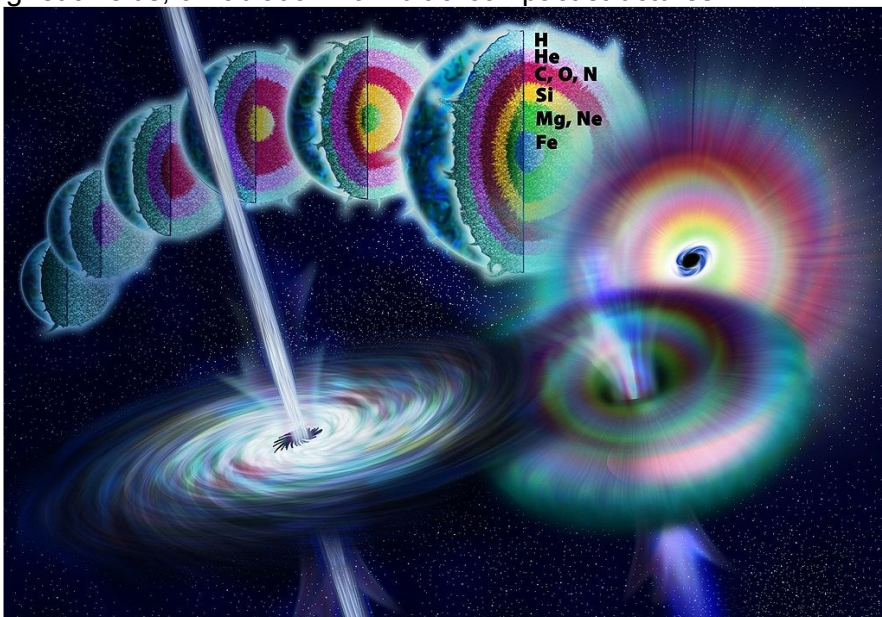
## Hunting for Jets in the Radio Sky

Alexander van der Horst  
George Washington University

**Abstract:** A large fraction of the observable Universe is steady, in the sense that it does not change on human timescales. But there are objects that vary on timescales of years to days, or even within small fractions of a second. These cosmic transients are usually associated with the most extreme phenomena in the Universe, such as neutron stars, black holes, or the formation of these exotic objects.

In most of these transient phenomena, matter is accelerated to very high velocities in collimated outflows called *jets*.

The variability of cosmic transients can be observed across the entire electromagnetic spectrum, and now also by gravitational waves. Among the electromagnetic emissions from transients, the radio regime reveals synchrotron emission of high-energy particles moving in ambient magnetic fields, or radiation from ultra-compact structures.



Artist's illustration showing the life of a massive star as nuclear fusion converts lighter elements into heavier ones. When fusion no longer generates enough pressure to counteract gravity, the star rapidly collapses to form a black hole. Theoretically, energy may be released during the collapse along the axis of rotation to form a gamma-ray burst. (National Science Foundation, 12 September 2005 - [https://en.wikipedia.org/wiki/Gamma-ray\\_burst](https://en.wikipedia.org/wiki/Gamma-ray_burst) ) (Star Dust Editor's note – Depending on mass, such a star could also collapse to form a neutron star.)

*continued on page 2*

## Recent Astronomy Highlights

High speeds figure heavily in this month's highlights as well as one spectacular crash that took place a long time ago in a galaxy... Well, you know how the saying goes.

### Neutron Star Merger Detected

130 million years ago, two neutron stars completed their final orbits around each other, bleeding off gravitational energy in the form of gravity waves, as they circled at a significant fraction of the speed of light, until they merged in a cataclysmic event known as a kilonova. In the chaos, clouds of neutrons spraying off the merger went on to form incredible amounts of the heaviest elements in the Universe, including gold and platinum.

On August 17, 2017, evidence of that merger reached Earth. For the first time, gravitational energy and electromagnetic energy radiated from an event were used to pinpoint the location of the merger, a galaxy known as NGC 4993 lying in the direction of the constellation of Hydra. The joint observations confirmed the theory that such mergers are sources of gamma-ray bursts. In addition, the fact that the gamma-ray burst and the gravitational waves were detected within two seconds of each other confirms that gravitational waves travel at the speed of light as predicted by Einstein, at least to within one part in  $10^{15}$ .

For those curious, numerous articles and images are available online.

### Hypervelocity Stars

Two of these strange stars have been discovered. Moving so fast that they will escape the Milky Way Galaxy, their velocity is a mystery. One theory is that they were flung out after interacting with Sagittarius A\*, the supermassive black hole at the center of the Galaxy.

Citation - Y. Huang et al 2017 *ApJL* **847** L9. [doi:10.3847/2041-8213/aa894b](https://doi.org/10.3847/2041-8213/aa894b)

*continued on page 4*

*Hunting for Jets in the Transient Sky – continued from page 1*

In the past, studies of transient jet sources at radio frequencies have mostly been prompted by detections at higher frequencies, in part because most radio observatories were limited in their fields of view and/or in their sensitivity. This has changed significantly in the last few years: all major radio observatories in the world have recently been upgraded or are currently being upgraded, and several new facilities have been or are being built. This means large improvements in sensitivity, bandwidth, and in spatial, spectral and temporal resolution. Some new observatories explore the low-frequency radio sky down to tens of MHz, with unprecedented sensitivity. Furthermore, several new radio facilities have a wide field of view, perfectly suited for efficient surveys of the entire sky, and hence for searches for transient radio phenomena. This provides a new way of studying jet sources and for understanding the physics behind the observed phenomena.

In this talk I will discuss the progress that has been made in our understanding of a variety of transient jet sources due to radio observations, discoveries of new phenomena in the radio regime, and the current efforts and future opportunities in the hunt for jets in the radio sky.



### Biographical Sketch:

Dr. Alexander van der Horst is an assistant professor in astrophysics at the George Washington University in Washington, DC. He earned a double Master's degree in astronomy and in theoretical physics at the University of Amsterdam, followed by a PhD in astrophysics at the same university. After his PhD he moved to Huntsville, Alabama, where he worked as a NASA Postdoctoral Program Fellow at NASA's Marshall Space Flight Center. After this first adventure in the US, he worked for three years as a postdoctoral researcher at the University of Amsterdam, after which he moved from the Netherlands' capital to the US capital for a faculty position. Dr. van der Horst's research focuses on observing and modeling transient cosmic emissions: short, very energetic explosions or bursts of energy or radiation, including emissions by the most extreme objects in the Universe. His modeling efforts are focused on developing and applying computer codes that extract physical information from observations of the objects that he studies. His main observational work is done with gamma-ray satellites in space, and with radio telescopes all over the world.

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## Exploring the Sky



“Exploring the Sky” is an informal program that, for over 60 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!

### Final 2017 Observation Date

**18 November (7:00 pm)** – Pleiades & Winter Constellations  
Exploring the Sky will resume in April of 2018.

Hosted by: [National Capital Astronomers, Inc](#) and [Rock Creek Park](#)

### Report on the October 21<sup>st</sup> session of Exploring the Sky – Jay H. Miller

Very successful even though it looked cloudy at the start. We were still able to see objects through the clouds and it got clearer as the night went on. Tony Linforth with the National Park Service said we had about 90 attendees. There were five telescopes. I’m not sure there were any other NCA members besides me. There was one regular who I don’t think is an NCA member and one young woman was there for the first time and will probably join NCA. My ‘scope worked well and people saw many objects.

• *Biographical Sketch – continued from page 2*

• In his research he handles very large quantities of data obtained with several radio telescopes, including the Low Frequency Array in Europe, and the Very Large Array in New Mexico; and in the near future also MeerKAT in South Africa. He is also project scientist for a new instrument on the Gemini Observatory, which will do follow-up observations of interesting sources found by the new Large Synoptic Survey Telescope (LSST). Dr. van der Horst’s research has resulted in 140 publications in refereed journals, with a total of more than 7600 citations. He has received the International Union of Pure and Applied Physics (IUPAP) Young Scientist Medal and Prize in Astrophysics, a special mention at the Cefalu Prize for Astrophysics, and three NASA Group Achievement Awards.

## Sky Watchers

### November/December

While Mercury moves toward its greatest elongation (see below), Saturn becomes more difficult to see as it sets earlier and earlier in the evening sky. Mars rises in the early morning hours while Venus and Jupiter rise near dawn.	
11/17, 18	The Leonids meteor shower peaks from the evening of the 17 <sup>th</sup> into the morning of the 18 <sup>th</sup> . About 15 meteors per hour at peak. A new moon on the 18 <sup>th</sup> will make for ideal viewing conditions.
11/24	Mercury will be at its greatest elongation from the Sun, 22°, and will be at its highest in the sky at sunset.
11/28	Conjunction – Mercury will be 3° 3’ south of Saturn. 4:36 a.m.
12/3	Full Moon and the only Supermoon of 2017. Known as the Cold Moon and the Long Nights Moon.
12/13, 14	The Geminids meteor shower peaks from the evening of the 13 <sup>th</sup> into the morning of the 14 <sup>th</sup> . Approximately 120 meteors per hour at peak.

• *Times - Eastern Standard Time*

## Tales of the Eclipse – Part 2

• From planning out a family get together, to going it alone, to making a challenge-filled trek with a local astronomy club, NCA members share one more batch of stories about their experiences with the Total Solar Eclipse of August 21, 2017 as well as some pictures. Enjoy.

*continued on page 4*



*Tales of the Eclipse – continued from page 3*

### **Wayne Warren and Family - Gilbert SC (Total Eclipse)**

I might have gone to the West as many others did, but I wanted everyone in my immediate family to experience a total solar eclipse. I had seen seven, but no one else had seen even one. Since my two daughters live in Florida and my son lives in Baltimore, we decided to meet in Santee SC, which was almost on the center line and convenient to I-95. Reservations were made at the Comfort Inn in Santee in 2016 October and we all converged there on August 20, 2017. We had five adults and three grandchildren.

We made a longer eclipse trip than originally planned, but the result was well worth the extra miles. We stayed overnight in Santee, planning to observe the eclipse from that location. But a cloud buildup on Monday and a prediction for iffy weather in the afternoon caused us to make a decision to drive northwest and stay within the path of totality. I had made a list of towns in SC, TN, and KY and we left Santee around 1030 hours. By the time of first contact, we had made it almost to Lexington SC. We began to look for suitable observing locations along US 1. An abandoned store with an overhanging roof was found in Gilbert SC. We stopped there and set up chairs under the overhanging roof.

The sky was almost entirely clear at this location and the few cumulus clouds that were present condensed as the atmosphere cooled. A total eclipse was a new phenomenon to everyone except me and they were all very excited and affected by it. We had had a meeting in the motel suite the night before where I gave a short talk on the Sun and on what events would take place the next day. Everyone, especially the children, was instructed on how to observe, when to take off the eclipse glasses, etc. Everything went smoothly and we all observed a beautiful eclipse.

### **Todd Supple – Carthage, TN (Total Eclipse)**

After having a couple people drop out of accompanying me, I definitely had second thoughts about trying to go see the eclipse alone. But I knew I'd regret it if I didn't. So, having no idea where I would end up, except that it would probably be in Tennessee, where the weather looked promising, I packed my car on Saturday the 19<sup>th</sup> and headed out at 4:00 a.m. on Sunday. Twelve hours and several bottles of Mountain Dew Code Red later, I found myself in a Walmart parking lot in the town of Carthage, a couple miles from the eclipse centerline. Sleeping in my car's backseat was less than ideal, especially when the alarm in the car next to mine went off not once, but twice overnight.

Bleary-eyed the next morning, I set up my little solar telescope. Locals and travelers stopped by to check out the view, especially as the Moon worked its way across the Sun. I met people from Alabama, California, Indiana, Kentucky, Massachusetts, Pennsylvania, Canada and even a man from the Republic of Slovenia. As we awaited totality, we talked about life and about our adventures getting to Carthage. But when totality arrived, there was quiet. The view was incredible. And though I had come there by myself, I was surrounded by fellow eclipse enthusiasts. So, I didn't have to see it alone after all.

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### **Please Get Star Dust Electronically**

• NCA members able to receive Star Dust,  
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**Thank you!**

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

### **Visitor from Outside the Solar System**

• On October 19<sup>th</sup>, an object that is either  
 • an asteroid or a comet was detected by  
 • the Pan-STARRS 1 telescope in Hawaii.  
 • Temporarily designated A/2017 U1, the  
 • object is less than a quarter mile in  
 • diameter and is speeding through the  
 • solar system at 27 miles/second.

• Scientists have determined that the  
 • object came into the solar system from  
 • above the ecliptic plane, therefore it was  
 • not tidally accelerated by a planet, at  
 • least not any of the planets in our solar  
 • system. Efforts continue to determine  
 • the object's origin even as it speeds out  
 • of our solar system, never to return.

• For more information and updates visit:  
 • <https://www.nasa.gov/feature/jpl/small-asteroid-or-comet-visits-from-beyond-the-solar-system> .

## 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 Watts angle (WA) is given; it is aligned with the Moon's rotation axis and can be used to estimate where a star will reappear relative to lunar features. The selenographic latitude is WA -270. For example, WA 305 - 310 is near Mare Crisium.

## Mid-Atlantic Occultations

David Dunham

### Asteroidal Occultations

Date	Day	EST	Star	mag.	Asteroid	dmag	dur. s	Ap. "	Location, Notes
Nov 10	Fri	4:28	4UC54028979	12.9	Megaira	1.3	23	10	e&nVA,e&nOH;DC?
Nov 11	Sat	23:00	4UC564-6870	12.6	Putilin	2.6	4	9	nNJ,e&scPA,nMD
Nov 13	Mon	19:22	TYC12440491	12.3	Mathesis	1.2	6	7	sePA,MD,DC,nVA
Nov 13	Mon	23:16	4UC60628277	13.1	Malva	1.7	10	10	SMD,nVA,SOH;DC?
Nov 14	Tue	3:45	4UC54139333	15.7	2013 wv107	4.9	4	14	e&scUSA-Centaur
Nov 15	Wed	20:59	TYC52290980	11.4	Tata	4.4	6	7	nMD,SPA;DC,nVA?
Nov 17	Fri	3:33	4UC54427739	12.7	Virginia	0.7	25	9	DE,SMD,DC,nVA
Nov 19	Sun	21:13	PPM 243007	10.4	Trubetskaya	4.5	2	5	CVA,ewV,WMD,CPA
Nov 20	Mon	23:58	2UC43063710	12.0	Charlotte	1.5	5	8	DE,MD,n&wVA;DC?
Nov 22	Wed	5:08	4UC43656428	14.0	Erigone	1.0	2	12	COH,nVA,DC,seMD
Nov 23	Thu	1:47	SAO 81100	8.7	Virtus	6.0	7	3	n.e. Florida
Nov 26	Sun	3:03	4UC62146115	13.7	Perepadin	1.8	6	12	eVA,eMD,DE;DC?
Nov 28	Tue	0:02	2UC42890181	12.4	Charlotte	1.1	4	8	SDE,SMD,c&wVA
Nov 28	Tue	18:01	TYC68940837	10.8	Elisabetha	4.1	2	6	w&nVA,MD,DC,ePA
Dec 3	Sun	4:06	4UC47551158	12.7	Xanthe	2.6	2	10	nMD,SPA,SNJ;DC?
Dec 5	Tue	5:45	TYC61220169	11.5	Bathilde	2.9	2	7	COH,nwV,e&nVA
Dec 5	Tue	20:36	TYC12310967	11.1	Tugela	4.0	7	7	e&sVA,nwNC,TN

### Lunar Grazing Occultations

Date	Day	EST	Star	Mag	% alt	CA	Location & Remarks
Nov 23	Thu	20:25	ZC 2949	7.6	25+	7	3S Purcelvil,VA;MtAiry,Gamber,MD
Nov 28	Tue	21:15	ZC 49	6.1	73+	46	4S Camden,VA;Helen,n.Oakville,MD
Dec 9	Sat	0:44	ZC 1529	6.6	61-	23	6N Stauntn,Dahlgrn,VA;Holywod,MD
Dec 10	Sun	1:27	SAO 118803	8.1	50-	19	5N n.Woodbrdge,VA;s.Brndywine,MD

\*\* Observations valuable since the star is in the Kepler2 program

Interactive detailed maps at <http://www.iota.timerson.net/>

### Total Lunar Occultations

Date	Day	EST	Ph Star	Mag	% alt	CA	Sp. Notes
Nov 13	Mon	4:25	R ZC 1686	8.4	23-	28	49S K0
Nov 13	Mon	4:38	R X17445*	9.7	23-	30	49S K0
Nov 13	Mon	6:25	R SAO118987*	8.3	23-	48	37N F2 Sun alt. -5 deg.
Nov 14	Tue	3:55	R SS Vir	7.7	15-	11	62S C5 Azimuth 98, x54025
Nov 23	Thu	17:06	D ZC 2940	7.4	24+	30	60S G0 Sun alt. -4 deg.
Nov 24	Fri	18:38	D SAO 164076	7.9	33+	29	40S A3
Nov 25	Sat	21:29	D BU Cap	7.8	43+	15	53S M2 Azimuth 237,SAO 164750
Nov 28	Tue	17:43	D SAO 128698	7.0	72+	39	68N G5 Sun alt. -11 deg.
Nov 28	Tue	21:05	D ZC 49	6.1	73+	46	19S K1 VA,sMD graze
Nov 29	Wed	0:38	D 11 Ceti	7.5	74+	16	61N F0 ZC 62
Nov 29	Wed	18:40	D 35 Ceti*	6.6	82+	44	31N F8 ZC178,mg2 9 1.3" PA133
Nov 29	Wed	20:51	D ZC 188*	7.6	82+	54	83S F0
Nov 29	Wed	23:03	D SAO 109805	7.5	83+	43	62N K0
Nov 30	Thu	18:01	D ZC 306	6.8	90+	33	47N F0
Dec 1	Fri	1:30	D SAO 110464	6.8	91+	31	60S K0
Dec 1	Fri	16:50	D ZC 444	5.9	95+	12	48S K6 Sun -2,Az85,close dbl?
Dec 1	Fri	22:05	D ZC 462	6.0	96+	62	39S B8 maybe close double?
Dec 4	Mon	20:36	R 71 Orionis	5.2	97-	25	28S F6 AA217,ZC947,TermDst15"
Dec 5	Tue	6:29	R 22 Gem	7.1	95-	26	60S A0 Sn-8,AA 247,ZC1006,SpB
Dec 6	Wed	0:22	R ZC 1130	7.2	90-	55	19S G5
Dec 6	Wed	5:53	R ZC 1151	6.9	89-	45	66S F0
Dec 7	Thu	1:00	R SAO 97878	7.7	81-	50	30S K2
Dec 7	Thu	3:59	R SAO 97955*	8.1	81-	68	76S K0
Dec 7	Thu	5:12	R ZC 1289*	8.1	80-	60	58S F5
Dec 8	Fri	4:08	R 7 Leonis	6.3	71-	65	87S A1 ZC 1415, close double?
Dec 8	Fri	5:17	R 11 Leonis	6.6	70-	64	60N F2 ZC 1420
Dec 9	Sat	0:18	R SAO 99103	8.2	61-	18	80S F5
Dec 9	Sat	0:32	R SAO 99111	7.5	61-	21	86S K0
Dec 10	Sun	2:28	R ZC 1645	6.7	49-	30	64S F8
Dec 10	Sun	3:33	R ZC 1648	6.9	49-	41	88N G5

\*The star is in the Kepler 2 exoplanet search program so lightcurves of the occultation are desired to check for close stellar duplicity

Further explanations & more information is at <http://iota.jhuapl.edu/exped.htm> .  
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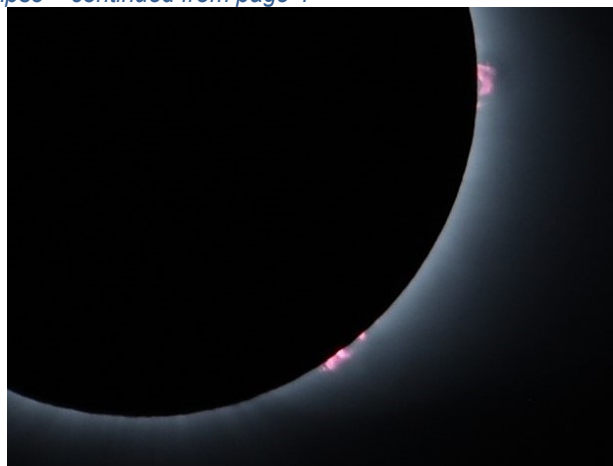
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*Tales of the Eclipse – continued from page 4*

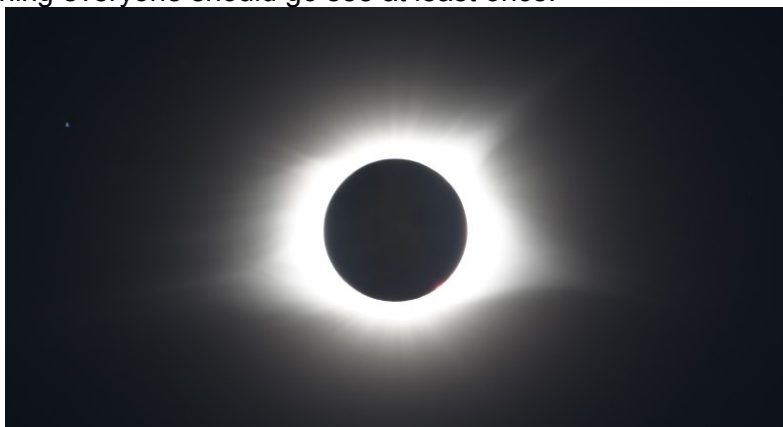


Prominences – Picture by Jeff Guerber

### **Jeff Guerber – Oak Grove, KY (Total Eclipse)**

Along with other members of the NASA Goddard Astronomy Club, I traveled to the town of Oak Grove, in western Kentucky a couple miles north of the Tennessee line and just outside Fort Campbell (home of the 101st Airborne). Despite making the entire drive the day (and night) before (which they tell you never to do!), a supposedly 10.5-hour drive that took 16 (mainly due to I-81), the hotel giving away my confirmed room, getting 3 hours of sleep, and using a brand-new DSLR literally seeing its First Light (which they ALSO tell you never to do!), in the end it all worked out and I not only had a spectacular view under terrifically clear skies both naked-eye and with 10x50 binoculars, but managed to get some great photos too.

This was my third total eclipse, after the eclipses of July 11, 1991 in Sayulita, Mexico and Feb. 26, 1998 in Curacao, so it had been a while. I think what really impressed me this time was the transition from near-normal but fading sunlight, to a tiny brilliant white spotlight in the sky as the 2nd contact diamond ring approached, which then faded out as the pearly white ring of the corona faded into view in its place. Every total eclipse is different; this time, the corona had three long streamers with short spiky ones in between, and several bright-red prominences along the inner edge. Plus, the bright star Regulus was easily visible just to the left of the Sun. Seeing that pearly ring of corona in the sky where the Sun should be is one of the most spectacular of natural phenomena, and something everyone should go see at least once!



Picture by Jeff Guerber

**Editor's Note:** Publishing stories of the experiences of NCA members during the eclipse has been a lot of fun and seems to have been popular with readers. Hopefully we can continue the Star Dust tradition of reporting stories of the astronomical endeavors and experiences of NCA members.

If you've had such an experience and want to share it with others, or if you have taken astronomy pictures that you'd like to share, please consider submitting them for an upcoming issue of Star Dust.

Unfortunately, because of space limitations, we can't guarantee that everything will be published, but we will make every effort to do so. Thank you.

**The submission deadline for December's Star Dust, is Nov. 20th.**

**Clear Skies!**

## Calendar of Events

**NCA Mirror- or Telescope-making Classes:** Tuesdays AND Fridays, from 6:30 to 9:45 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 [gfbrendenburg@yahoo.com](mailto:gfbrendenburg@yahoo.com). (Guy reports that thanks to the recent efforts of a number of amateur telescope makers (ATMers) and others, the proposed cutback of evening hours at the Center has been withdrawn.)

**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 can be found at: [www.astro.umd.edu/openhouse](http://www.astro.umd.edu/openhouse)

**Mid-Atlantic Senior Physicists Group:** "Primary Frequency References at NIST: Atomic Clocks" with Dr. Steven Jefferts, National Institute of Standards and Technology, Boulder. Wed. Nov. 15, at 1 pm at the American Center for Physics (1<sup>st</sup> floor conference room). 1 Physics Ellipse, College Park, MD-- off River Rd., between Kenilworth Ave. and Paint Branch Parkway. <http://www.aps.org/units/maspg/>

**Upcoming NCA Meeting** at the University of Maryland Observatory: **9 December:** Mario Gliozzi (George Mason U), *What X-rays Tell Us About Black Holes*

## 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.?

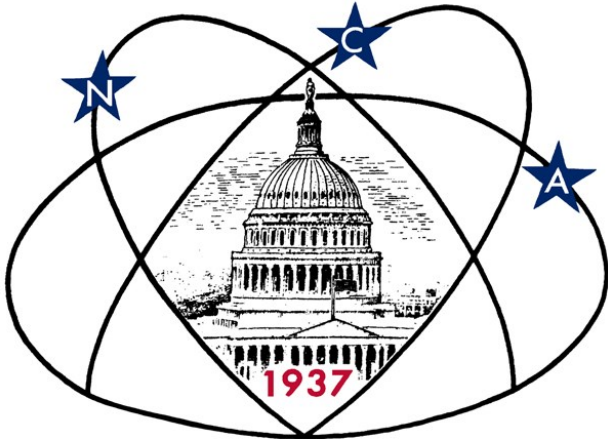
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*Celebrating 80 Years of Astronomy  
1937-2017*

*Next NCA Meeting:*

2017 November 11<sup>th</sup>

7:30 pm

@ UMD Observatory

Dr. Alexander van  
der Horst

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