Next Meeting
When: Sat. Oct. 8th, 2016
Time: 7:30 pm
Where: UMD Observatory
Speaker: Erin Kara

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

Need a Ride?
Please contact Jay Miller, 240-401-8693, if you need a ride from the metro to dinner or to the meeting @ observatory. Please try to let him know in advance by e-mail at rigel1@starpower.net.

How We rSee Supermassive Black Holes

Erin A. Kara
University of Maryland and NASA’s Goddard Space Flight Center

Abstract: The material spiraling toward the event horizon of a black hole is subject to the strongest gravitational distortions in the Universe, so

![Image of black hole accretion disk]

Courtesy NASA/Swift/Aurore Simonnet, Sonoma State University
Artist conceptualization of a black hole accretion disk where X-ray light and light echoes are produced.

continued on page 2
**Observing after the Meeting**

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

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**Stellar-Mass vs. Supermassive Black Holes**

**Stellar-mass black holes** are about 10-100 times the Sun's mass and form when massive stars reach the end of their lives. They can be found throughout galaxies, just as one finds any other stars.

**Supermassive black holes** can be million to billions of times the Sun's mass and are too big to be formed by collapsing stars (there are a number of theories on their formation). These black holes are found at the centers of galaxies. Sagittarius A*, the black hole at the center of the Milky Way (measured using the orbit of a circling star), is estimated to be about 4.3 million solar masses.

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**Hard & Soft X-Rays**

There are 2 types of X-rays: soft & hard. On the electromagnetic spectrum, soft X-rays (the weaker rays) have frequencies of about $3 \times 10^{16}$ to $10^{18}$ Hz and have photon energies of less than 5 keV. The photons are easily absorbed by air & water. Hard X-rays (the ones used by doctors & scientists) are stronger at $10^{15}$ to over $10^{20}$ Hz, with energies above 5 keV. They overlap the gamma-ray part of the spectrum, the only difference being the source (X-rays from accelerating electrons, gamma rays from atomic nuclei).

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**Black Hole Simulation**

Check out NASA's simulation of a stellar-mass black hole, showing X-rays around the accretion disk:

https://youtu.be/-OtUVDRL_wM

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**Supermassive Black Holes – continued from page 1**

studying these extreme environments can help us understand how gravity behaves when it is pushed to its limits. As material (mainly gas and dust) plunges into the black hole, a significant fraction of its gravitational potential energy is released into the surrounding environments, heating up the remaining infalling material. This material becomes so hot and energetic that it radiates light, much of which is in the X-ray band. So, while the common colloquialism is that black holes are black, they are, in fact, the most luminous objects in the universe because of the energetic material around them.

It is impossible to simply take a picture of the space-time around a black hole because the region is too small and too far away. Instead, astronomers develop sophisticated ways of analyzing the limited data available. In this talk, a new and innovative technique that was discovered just 5 years ago will be discussed. The technique is called X-ray reverberation, and it allows us to measure distances of tens of light seconds around black holes that are hundreds of millions of light years away. Just as sound waves reverberate in a large auditorium, X-ray light reverberates in the inflowing material. Since we know the speed of light, we can relate this reverberation time delay to a distance, which helps us determine the size and shape of the material spiraling toward the event horizon.

Understanding these environments close to the event horizon is helping us to understand how black holes grow and how they feed energy back into their surrounding environments.

**Biographical Sketch:**

Dr. Erin Kara is a Hubble Postdoctoral Fellow and a Joint Space-Science Institute Fellow, working at the University of Maryland and NASA's Goddard Space Flight Center. Her research is on understanding the inner accretion flows around black holes and other compact objects using X-ray observations. She works with a new technique called X-ray reverberation mapping that probes the flow's geometry and dynamics by measuring the echoes produced when light is scattered by the inner accretion flow. Dr. Kara completed her graduate studies at the University of Cambridge in the UK before moving to Maryland.

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**Favorite Star Trek Episode Survey**

**Hailing All Local Star Trek – Original Series Fans!**

Submit your favorite episode from each of the 3 broadcast seasons in this short survey:

https://www.surveymonkey.com/r/CHN7CLD

**Deadline: October 31, 2016 ~ Star Dust will post the results!**

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### Sky Watchers

#### Autumn Schedule

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>October</strong></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td><strong>International Astronomy Day!</strong> Global.</td>
</tr>
<tr>
<td>11</td>
<td><strong>Planets</strong>., N. Hemisphere. Mercury 0.9° north of Jupiter.</td>
</tr>
</tbody>
</table>
| 16 | **Full Moon**, Global.  
Other Moon Names: Full Hunter’s Moon, Full Travel Moon, Full Dying-Grass Moon (time to reap grain & stock up on meat for the winter) |
| 21 | **Dawn - Meteors**, N. Hemisphere. **Orionids** (debris from Comet Halley, radiant point west of Betelgeuse & Orion’s club) |
| **November** | |
| 2 | **Planets**., N. Hemisphere. Venus 7° south of Moon. |

**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 & it’s free!

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**2016 Observation Dates for Autumn**

- **1 October (7:30 pm)** ‑ Summer Triangle
- **5 November (7:00 pm)** ‑ Pleiades & Winter Constellations

Hosted by: National Capital Astronomers, Inc and Rock Creek Park
SAO 164269 Occultation
David Dunham

The narrow zone for the grazing occultation of SAO 164269 on Monday evening, Nov. 7, will be between the two dark gray lines on the map of the Maryland suburbs (below). This is the zone that promises the most occultations of the star by hills and craters along the southern edge of the first quarter Moon. However, at least some of this area is likely to be sunlit, possibly rendering some of the contacts unobservable. The Sun altitude of -8 degrees should not pose any problems with most small telescopes. Another map showing the path over northern Virginia can be found at http://iota.jhuapl.edu/exped.htm. If the weather forecast is good, we’ll probably have a small expedition to observe the event from locations near Ammendale Road.

Local Map of Nov. 7th Occultation Path

NCA 2016 Board Meeting Report
Guy Brandenburg

The NCA Board had its annual meeting on August 7, 2016. To keep the membership up-to-date, here are the important business items from that meeting:

1. We are selling the NCA’s Celestron 14-inch Schmidt-Cassegrain telescope and all of its accessories, since it has not been used at all in a long time. Heinrich Bofinger and Guy Brandenburg volunteered to be in charge of figuring out a fair market value, placing ads, and so on. If you want to purchase it, please let us know.

continued on page 6
### Mid-Atlantic Occultations

**David Dunham**

#### Asteroidal and Planetary Occultations

<table>
<thead>
<tr>
<th>Date</th>
<th>Day</th>
<th>EST</th>
<th>Star</th>
<th>Mag</th>
<th>Asteroid</th>
<th>mag</th>
<th>dur. Ap.</th>
<th>Location, Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oct 8</td>
<td>Sat</td>
<td>6:13</td>
<td>4USS21587</td>
<td>13.3</td>
<td>Euallia</td>
<td>1.7</td>
<td>4</td>
<td>10 WV, NVa, SeMD; DC?</td>
</tr>
<tr>
<td>Oct 18</td>
<td>Tue</td>
<td>5:32</td>
<td>2UC3510087</td>
<td>11.1</td>
<td>Photographica 2</td>
<td>3</td>
<td>6</td>
<td>sde, seMD, DC, NVa</td>
</tr>
<tr>
<td>Nov 2</td>
<td>Wed</td>
<td>2:52</td>
<td>TYC13480737</td>
<td>10.9</td>
<td>Viola</td>
<td>5.0</td>
<td>4</td>
<td>5 miV, NVa, MD, DC, DE</td>
</tr>
<tr>
<td>Nov 5</td>
<td>Fri</td>
<td>22:55</td>
<td>2UC36231075</td>
<td>12.1</td>
<td>Eurynome</td>
<td>0.1</td>
<td>10</td>
<td>8 N3, Nde, eMD, DC, VA</td>
</tr>
<tr>
<td>Nov 6</td>
<td>Sun</td>
<td>2:33</td>
<td>PPM 51012</td>
<td>9.9</td>
<td>1936 SO</td>
<td>6.7</td>
<td>1</td>
<td>4 CVA, eMD, SePA, DC?</td>
</tr>
<tr>
<td>Nov 10</td>
<td>Thu</td>
<td>4:40</td>
<td>TYC12760010</td>
<td>10.3</td>
<td>Masaryk</td>
<td>5.7</td>
<td>3</td>
<td>5 Se&amp;CA, SWv, NlY</td>
</tr>
<tr>
<td>Nov 13</td>
<td>Sun</td>
<td>4:05</td>
<td>2UC47412446</td>
<td>12.0</td>
<td>Gudrun</td>
<td>1.6</td>
<td>15</td>
<td>8 Delmarva, DC, MD</td>
</tr>
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</table>

#### Lunar Grazing Occultations

<table>
<thead>
<tr>
<th>Date</th>
<th>Day</th>
<th>EST</th>
<th>Star</th>
<th>Mag</th>
<th>% alt</th>
<th>CA Location &amp; Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oct 21</td>
<td>Fri</td>
<td>2:02</td>
<td>SAO 95913</td>
<td>7.6</td>
<td>66-38</td>
<td>30N 10W, BearBrach, MD, NwFrdm, PA</td>
</tr>
<tr>
<td>Nov 5</td>
<td>Sat</td>
<td>20:57</td>
<td>162789</td>
<td>8.2</td>
<td>32+15</td>
<td>35S 74W, Friendsv, MD, Sunbury, WA, PA, 10N 10W, spec bin, close dbl?</td>
</tr>
<tr>
<td>Nov 7</td>
<td>Mon</td>
<td>18:39</td>
<td>164269</td>
<td>8.1</td>
<td>51+36</td>
<td>35S 74W, Bths&amp;LsrgLdl, MD</td>
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</tbody>
</table>

#### Total Lunar Occultations

<table>
<thead>
<tr>
<th>Date</th>
<th>Day</th>
<th>EST</th>
<th>Star</th>
<th>Mag</th>
<th>% alt</th>
<th>CA Location &amp; Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oct 8</td>
<td>Sat</td>
<td>19:46</td>
<td>D ZC 2758</td>
<td>7.0</td>
<td>48+31</td>
<td>74S B2</td>
</tr>
<tr>
<td>Oct 10</td>
<td>Mon</td>
<td>20:24</td>
<td>D ZC 3029</td>
<td>7.0</td>
<td>68+35</td>
<td>64N F2, Maybe close double?</td>
</tr>
<tr>
<td>Oct 13</td>
<td>Thu</td>
<td>21:41</td>
<td>D ZC 3333</td>
<td>6.4</td>
<td>88+24</td>
<td>28N A5, mag2 B.0, sep 4.0, PA307</td>
</tr>
<tr>
<td>Oct 17</td>
<td>Mon</td>
<td>21:21</td>
<td>R ZC 491</td>
<td>6.0</td>
<td>94-15</td>
<td>32S K0, Aldebaran</td>
</tr>
<tr>
<td>Oct 18</td>
<td>Thu</td>
<td>21:57</td>
<td>R 71 Tauri</td>
<td>4.5</td>
<td>87-12</td>
<td>48N F0, AZ 80, close dbl?</td>
</tr>
<tr>
<td>Oct 18</td>
<td>Thu</td>
<td>23:01</td>
<td>R Theta1 Tau</td>
<td>3.8</td>
<td>87-25</td>
<td>89N G7, close, maybe, 8.08, PA212</td>
</tr>
<tr>
<td>Oct 18</td>
<td>Thu</td>
<td>23:01</td>
<td>R Theta2 Tau</td>
<td>3.4</td>
<td>87-25</td>
<td>71S A7, close, maybe, 8.08, PA212</td>
</tr>
<tr>
<td>Oct 18</td>
<td>Thu</td>
<td>23:53</td>
<td>R ZC 677</td>
<td>4.8</td>
<td>87-35</td>
<td>67N A6</td>
</tr>
<tr>
<td>Oct 19</td>
<td>Wed</td>
<td>0:06</td>
<td>R 85 Tauri</td>
<td>6.0</td>
<td>86-13</td>
<td>37N F4, close, maybe, 8.08, PA212</td>
</tr>
<tr>
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<td>Wed</td>
<td>0:28</td>
<td>R ZC 3141</td>
<td>5.9</td>
<td>28+19</td>
<td>39S K3, maybe, close, maybe, 8.08, PA212</td>
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<tr>
<td>Oct 23</td>
<td>Sun</td>
<td>3:03</td>
<td>R SAO 97901</td>
<td>7.4</td>
<td>44-27</td>
<td>75S K5, Aldebaran</td>
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<tr>
<td>Oct 24</td>
<td>Mon</td>
<td>3:59</td>
<td>R ZC 1284</td>
<td>6.3</td>
<td>43-48</td>
<td>89N F0</td>
</tr>
<tr>
<td>Oct 24</td>
<td>Mon</td>
<td>3:54</td>
<td>R SAO 98580</td>
<td>7.5</td>
<td>34-25</td>
<td>15S K5</td>
</tr>
<tr>
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<td>Mon</td>
<td>4:36</td>
<td>R ZC 3399</td>
<td>6.9</td>
<td>33-30</td>
<td>51N K5, Aldebaran</td>
</tr>
<tr>
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<td>Mon</td>
<td>4:36</td>
<td>R SAO 98591</td>
<td>7.7</td>
<td>33-33</td>
<td>81N G0</td>
</tr>
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<td>Oct 24</td>
<td>Mon</td>
<td>4:54</td>
<td>R SAO 98595</td>
<td>7.7</td>
<td>33-33</td>
<td>85S G5, mag2 A.0, sep 5.3, PA272</td>
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<tr>
<td>Oct 25</td>
<td>Tue</td>
<td>5:01</td>
<td>SAO 118218</td>
<td>7.8</td>
<td>24-27</td>
<td>63S F5</td>
</tr>
<tr>
<td>Oct 25</td>
<td>Tue</td>
<td>5:25</td>
<td>R ZC 3516</td>
<td>6.6</td>
<td>25-46</td>
<td>58S K5, Aldebaran</td>
</tr>
<tr>
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<td>Mon</td>
<td>19:28</td>
<td>R ZC 2441</td>
<td>6.6</td>
<td>9+8</td>
<td>71N G0, Aldebaran</td>
</tr>
<tr>
<td>Nov 4</td>
<td>Fri</td>
<td>20:24</td>
<td>R ZC 2715</td>
<td>6.3</td>
<td>23+14</td>
<td>83N M4, Az, 23L</td>
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<tr>
<td>Nov 4</td>
<td>Fri</td>
<td>21:06</td>
<td>R ZC 2718</td>
<td>6.7</td>
<td>23+7</td>
<td>78S F3, Aldebaran</td>
</tr>
<tr>
<td>Nov 5</td>
<td>Sat</td>
<td>19:39</td>
<td>R ZC 162753</td>
<td>8.3</td>
<td>31+26</td>
<td>82S A5, mag2 A.0, sep 21, PA11</td>
</tr>
<tr>
<td>Nov 5</td>
<td>Sat</td>
<td>21:55</td>
<td>R ZC 2865</td>
<td>5.7</td>
<td>32+8</td>
<td>57N K0, Aldebaran</td>
</tr>
</tbody>
</table>

**Notes:**
- Oct 8 and Oct 13 are the star's desired to check for close stellar duplicity
- Further explanations & more information are at [http://www.iota.tiemerson.net/](http://www.iota.tiemerson.net/)

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

#### 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 selengonic latitude is WA -270. For example, WA 305 - 310 is near Mare Crisium.

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2016-2017 Officers

President:
Joseph Morris
jc.morris@verizon.net
703-620-0996 (h)

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 (2017)
- Andrew Seacord (2018)
- Wayne Warren (2019)
- Harold Williams (2020)

Appointed Officers and Committee Heads:
Exploring the Sky
Jay Miller
jhmillerm@me.com

Telescope Making
Guy Brandenburg
gfbrandenburg@yahoo.com
202-635-1860

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

Star Dust Editor
CA Brooks
NCASDustardust@gmail.com
301-860-3266

Social Media
Liz Dervy
Twitter: @NatCapAstro

Board Meeting Report – continued from page 4

2. The club will have a membership coordinator position. Among other things, the MC will welcome new members and connect new and current members with tasks that need doing. Guy Brandenburg volunteered to take this on until another person steps up to take over.

3. John Hornstein will be coordinating the science fair judgings.

4. Dues will remain at $10/member until our bank account is reduced to $5,000. Meanwhile, you will soon be able to pay your dues for anything up to five years at one time, instead of needing to renew every single year.

5. We will have a contest to design a new NCA logo, with a deadline of New Year’s Eve 2016. A vote will be taken on winning designs, and one option will be to retain the current one.

6. The current Stardust editor (CA Brooks) will be stepping down from that position in June 2017, and will need to be replaced by another volunteer.

______________________________

Courtesy Eric Kaufman
Eric Kaufman, son of NCA member, Bernard Kaufman, took this beautiful picture of the Milky Way this summer from the dark skies of West Virginia.

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Hopewell Open House & Star Party
Guy Brandenburg

All are welcome to attend a star party at the Hopewell Observatory. The event is scheduled for the night of October 29-30. The observatory is about 30 miles due west from the DC beltway, near the intersection of I-66 and US-15 at Haymarket, VA. You can stay all night looking for celestial wonders through our telescopes or through your own.

You can find a very complete guide at this link: http://bit.ly/1MPDNQW
There’s still time to enter Air & Space Magazine’s 4th Annual Photo Contest

Courtesy Ivan Eder (cc)
Comet 17P/Holmes (2007)

There are 4 categories: Astronomy, Military, Civilian and People & Planes. You can compete to win cash prizes.

The contest is free to enter and open until midnight (EST), November 1, 2016.

The submission deadline for the November issue of Star Dust is October 29th.

Clear Skies!

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 or email him at gbrandenburg@yahoo.com.

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

Lockheed Martin IMAX Theater in DC: “The Voyage of Time” (not rated), Premieres Fri. Oct. 7, $9 (adults) and $7.50 (youth), evening shows only. Check dates here: https://www.si.edu/Imax/Movie/1260


Owens Science Center Planetarium (First Friday of the Month): “Follow the Sun,” (includes a preparation for the Great North American Eclipse of 2017), Fri. Nov. 4, 7:30 pm; $5/adult; $3/students/senior/teachers/military; children under 3 free. www1.pgcps.org/howardbowens

Upcoming NCA Meetings at the University of Maryland Observatory:
12 Nov: Pamela Conrad (GSFC), “Why the Earth and Mars are so Different.”

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
Next NCA Meeting:  
2016 October 8th  
7:30 pm  
@ UMD Observatory  
Dr. Erin A. Kara  

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