Star Dust

National Capital Astronomers, Inc.

February 2013 *Volume 71, Issue 6*

http://capitalastronomers.org

Celebrating 75 years 1937-2012

Next Meeting

When: Sat. Feb. 9, 2013
Time: 7:30 pm
Where: UMD Observatory
Speaker: Lindy Elkins-Tanton (DTM)

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Directions to Dinner/Meeting

Our new location for dinner with the speaker before each meeting is at Mulligan's Grill and Pub on the UM Golf Course. Mulligan's is one intersection closer to the observatory on Route 193 than UMUC. One turns on to "Golf Course Road" and drives a few hundred feet to the golf course building, where "Mulligan's Grill and Pub" is located.

The dinner menu can be downloaded from http://mulligans.umd.edu/

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 at the observatory. Please try to let him know in advance by e-mail at rigel1@starpower.net.

February 2013: Lindy Elkins-Tanton
Carnegie Institution for Science
Department of Terrestrial Magnetism

Magma and Water Oceans in the Early Solar System

***Abstract*:** How did the Earth get its water? How did Mars get the water that was once so abundant on it? What about Venus? What about the non-water volatiles? And what can we expect on exoplanets?

Planets obtain atmospheres, oceans, and interior volatiles during accretion. Accretion, however, changes character dramatically over the first hundred million years or so, changing from dust accretion, to relatively low-energy impacts of planetesimals, to high-energy impacts of embryos that produce magma oceans, and finally to infrequent small impacts. The physics of each of these stages influences the quantity, composition, and phase of volatiles being delivered to the growing terrestrial planet, and therefore influences the quantity, composition, and final disposition of the volatiles in the planet.

I will present a framework for thinking about these processes, with particular emphasis on the effects of early, interior magma oceans on planetesimals heated by aluminum 26, and on the effects of later surface magma oceans produced by impacts of embryos. A very small initial water content (less than a half mass percent) in the bulk magma ocean composition of the accreting Earth can produce a dense steam atmosphere, while a small change in chemistry can produce a carbon-based atmosphere, such as that on Venus. The low initial volatile contents required to degas a massive initial atmosphere that will collapse upon cooling into an ocean indicate that rocky super-Earth exoplanets may be expected to commonly produce water oceans within tens to hundreds of millions of years of their last major accretionary impact.

Biography: Linda T. Elkins-Tanton is the director of the Carnegie Institution for Science's Department of Terrestrial Magnetism. Her research is on the evolution of terrestrial planets, and the relationships between solid Earth and life on Earth.

An ongoing research effort addresses the chemistry and physics of the formation of terrestrial planets, with projects focusing on planetesimals, the Moon, Mercury, the Earth, rocky exoplanets, and on processes such as degassing the earliest atmospheres. A second project concerns the relationships between large volcanic provinces and global extinction events, focusing on the Siberian flood basalts and the end-Permian extinction. She has lead four field seasons in Siberia, as well as participated in fieldwork in the Sierra Nevada, the Cascades, and a fifth Siberian expedition.

Elkins-Tanton received her B.S. and M.S. from MIT in 1987, and then spent eight years working in business. She then returned to MIT for a Ph.D. Elkins-Tanton was a researcher at Brown University for five years, followed by five years on MIT faculty culminating as Associate Professor of Geology, before accepting her current position at the Carnegie Institution for Science.

Elkins-Tanton is a two-time National Academy of Sciences Kavli Frontiers of Science Fellow and served on the National Academy of Sciences Decadal Survey Mars panel. In 2008 she was awarded a five-year National Science Foundation CAREER award. In 2010 she was awarded the Explorers Club's Lowell Thomas prize. The second edition of her six-book series The Solar System, a reference series for libraries, was published in 2010. When not in the lab or in Siberia, she is home in Washington, DC, with her husband and son.

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.

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Thank you!

Reminder

After the meeting, everyone is invited to join us at Plato's Diner in College Park. Plato's is located at 7150 Baltimore Ave. (US Rt. 1 at Calvert Rd.), just south of the university's campus. What if it's clear and you want to stick around and observe? No problem -- just come over when you're through. This is very informal, and we fully expect people to wander in and out.

Update on Recently Uncovered NCA Records

Michael Chesnes

As reported in the December, 2012 *Star Dust*, while renovating the Hopewell Observatory attic, members of the Hopewell Astronomical Society (HAS) found three boxes which appear to have belonged to long-time NCA and HAS member Nancy Byrd. Upon closer inspection, one green sheet metal box, which I could not unlock with the attached key, was marked "NCJA MD-DC REGION Pamphlet Library". After searching online, this could refer to the National Criminal Justice Association, but I am not able to confirm that at this time.

The other two boxes were cardboard bankers' boxes, one of which contained a single folder of HAS records, while the other contained ledger books chronicling NCA's financial activities from 1955 to 1979, as well as two copies of a 1987 NCA strategic plan, various other financial records, NCA stationery, and a homemade astrophotography apparatus. If anyone has additional information on the contents of these boxes, or can recommend an official home for them, please e-mail me at m.chesnes@verizon.net or call (301) 313-0588.

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APS Mid-Atlantic SeniorPhysicists Group

http://www.aps.org/units/maspg/

February 2013 Event

Date: Wednesday, February 20, 2013

Speaker: Kent S. Wood
Space Sciences Div. Code 7655,
Naval Research Laboratory

Topic: The Large Area Telescope on Fermi and Pan-STARRS-1 (PS1) as Contemporaneous All-Sky Monitors

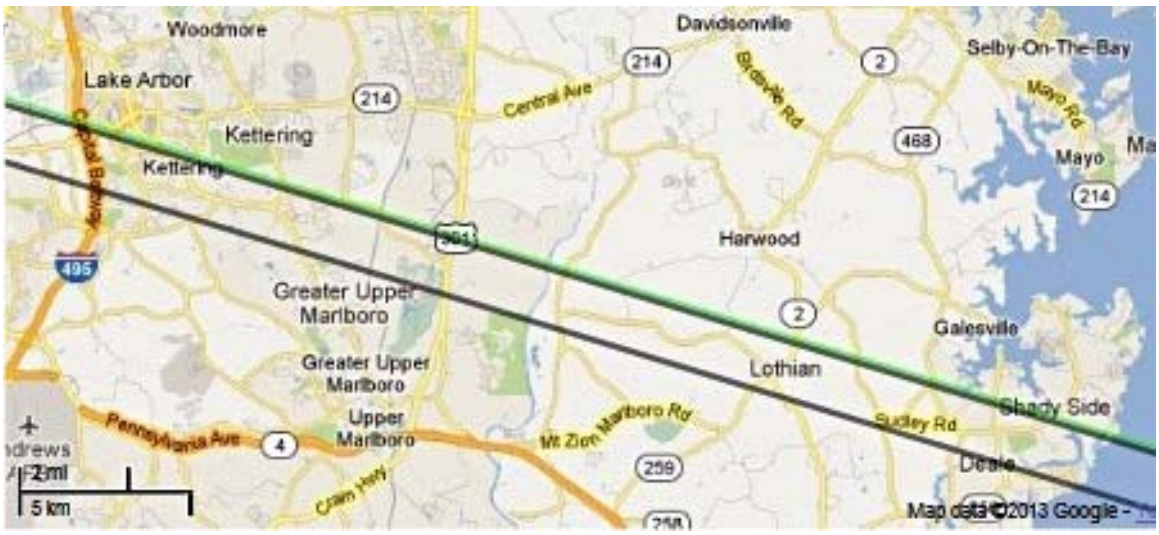
Time and Location: 1:00 PM, with Q&A to follow, in a 1st floor conference room at the American Center for Physics (www.acp.org),
1 Physics Ellipse, College Park, MD-- off River Rd., between Kenilworth Ave. and Paint Branch Parkway.

Abstract: Time domain astronomy is increasingly important in all bands of the electromagnetic spectrum. The Large Area Telescope (LAT) onboard NASA's Fermi satellite is effectively an all-sky monitor in high energy γ rays. It is the first such monitor in that band, but is also a highly sensitive instrument that catalogs the faintest sources yet detected at those energies. Sources found by Fermi emit across the entire electromagnetic spectrum. Multi-wavelength observing campaigns can be pursued a new way - on an all-sky basis - provided the LAT can be correlated with other all-sky monitors with comparably powerful sky coverage and sensitivity. The Pan-STARRS 1 (PS1) optical survey is currently the appropriate counterpart for visible wavelengths. It has completed coverage of three-fourths of the sky, all declinations north of -30 degrees, and continues repeated monitoring in five filters over all that sky. PS1 observations are contemporaneous with the Fermi satellite. The talk will describe Fermi and Pan-STARRS and then discuss how their all-sky data are merged for purposes such as cross-identifying sources by correlated variability or by establishing precise positions for optical counterparts to the Fermi sources.

Biography: Dr. Wood completed undergraduate work in physics at Stanford University and his Ph.D. in physics at MIT, with Prof. Philip Morrison. He has been at the Naval Research Laboratory since 1973, where he now heads the UV/X-ray Astrophysics and Applications Section. Most of his work at NRL has concerned celestial sources of X-ray and γ ray radiation, including development and operation of space-based sensor systems. He led scientific analysis on NRL's experiment on the HEAO-1 satellite leading to an all-sky X-ray source catalog that was the most complete for its era. His astrophysical research has emphasized compact objects such as neutron stars and black holes. Starting in the 1980s he led development of the USA Experiment on the ARGOS satellite, which conducted observations of highly variable X-ray sources and was the first systematic study of X-ray navigation, which is the use of celestial X-ray sources for navigation of satellites. He worked on the Fermi Gamma-ray Space Telescope since its conceptual inception in the 1990s and since 2005 has also been developing methods for using Fermi and the optical telescope Pan-STARRS jointly as tools for all-sky contemporaneous multi-wavelength observation.

February 16 SAO 93308
Grazing Occultation Maps

These three maps show the multiple-events zone
(between the gray lines, which are 0.1 and 0.7 km south of the
"smooth Moon" northern limit)
over northern Virginia, the District of Columbia, and the eastern Maryland suburbs, respectively.



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 and Expeditions

David Dunham

Asteroidal and Planetary Occultations

Date	Day	EST	Star	Mag.	Asteroid	dmag	dur. s	Ap. "	Location
2013									
Feb 14	Thu	20:14	TYC37130568	11.4	Kemi	3.6	1	7	wPA,w&sMD,DC,nVA
Feb 14	Thu	21:30	PPMX3013243	12.5	Genoveva	3.4	18	8	ePA,cMD,DC,eVA
Feb 16	Sat	23:59	2UC28020912	13.4	Diomedes	2.2	11	10	NJ,MD,DC,PA,VA
Feb 21	Thu	21:15	SAO 58004	6.8	Argentina	7.2	15	2	OH,WV,wVA,cNC,SC
Feb 22	Fri	4:28	TYC78380657	10.6	Zelinda	2.3	7	9	PA,MD,DC,eVA,eNC
Feb 27	Wed	19:29	2UC37298068	12.3	Sicilia	4.4	1	8	KY,WV,VA;DC,sMD?
Mar 7	Thu	4:48	SAO 140065	8.4	Svea	5.3	9	2	cNC,cVA,wMD,cPA

Lunar Grazing Occultations (*, Dunham plans no expedition)

Date	Day	EST	Star	Mag.	%	alt	CA	Location
2013								
Feb 13	Wed	20:45	SAO 109345	8.7	16+	10	9N	*MtAiry, Sykesville, Essex,MD
Feb 16	Sat	22:12	SAO 93308	8.5	43+	26	11N	Ashburn,GrtFls,VA;DC;Largo,MD
Feb 17	Sun	19:16	SAO 93672	8.9	51+	66	4N	Urbana,Woodstock,Rossville,MD

Interactive detailed maps at http://www.timerson.net/IOTA/

Total Lunar Occultations

DATE	Day	EST	Ph	Star	Mag.	%	alt	CA	Sp.	Notes
Feb 12	Tue	19:22	D	SAO 128380	8.1	9+	14	38N	G5	Az. 263, close double?
Feb 13	Wed	18:27	D	SAO 109306	7.8	15+	35	70N	F5	Sun alt. -9 deg.
Feb 14	Thu	19:31	D	ZC 211	8.3	23+	35	61N	K0	
Feb 15	Fri	20:39	D	SAO 92878	7.7	33+	33	11S	F0	
Feb 16	Sat	21:37	D	SAO 93307	7.7	42+	32	44S	K2	
Feb 19	Tue	0:31	D	SAO 94210	8.0	62+	19	79S	K0	
Feb 19	Tue	21:16	D	ZC 856	8.1	70+	63	68S	K5	
Feb 20	Wed	23:30	D	SAO 95873	7.6	79+	48	85S	K0	
Feb 21	Thu	21:02	D	ZC 1116	7.2	86+	68	85N	B9	
Feb 22	Fri	19:37	D	ZC 1234	6.2	92+	49	24S	A1	close double??
Feb 23	Sat	2:58	D	ZC 1256	7.3	93+	24	40S	A2	
Feb 23	Sat	17:53	D	Acubens	4.3	96+	19	45N	A5	Sun-1,ZC1341,db?,alfCnc
Feb 24	Sun	0:09	D	kappa Cnc	5.2	97+	58	59S	B8	ZC 1359, spec. binary
Feb 25	Mon	23:30	R	36 Sex	6.3	100-	51	59S	K4	AA 287,ZC1566,TmDist 4"
Feb 27	Wed	0:59	R	ZC 1688	6.4	98-	48	47N	G9	AA 326
Feb 28	Thu	6:19	R	ZC 1809	7.0	92-	16	71S	A0	Sun altitude -5 deg.
Feb 28	Thu	23:23	R	62 Vir	6.7	87-	20	79N	K0	ZC1914, spec. binary
Mar 2	Sat	4:37	R	ZC 2063	6.7	77-	34	80S	A1	
Mar 4	Mon	3:22	R	SAO 184316	8.1	56-	22	55S	A5	
Mar 5	Tue	3:31	R	xi Oph	4.4	44-	16	74N	F2	ZC 2498,mg2 9, 5",PA 29
Mar 5	Tue	5:26	R	ZC 2509	5.8	44-	27	46S	K0	mag2 12,sep. 7", PA 173
Mar 5	Tue	6:34	R	SAO 185402	7.2	43-	30	39S	K4	Sun alt. -1 deg.
Mar 6	Wed	4:03	R	ZC 2662	7.6	33-	13	31S	K5	Azimuth 130 deg.
Mar 6	Wed	5:20	R	21 Sgr	4.9	33-	23	61S	A1	ZC2666,mg2 7,1.7",PA284
Mar 7	Thu	3:47	R	rho2 Sgr	5.8	23-	3	68N	K0	Az.116, ZC2828, double?
Mar 7	Thu	5:04	R	ZC 2833	7.0	22-	15	29S	K0	Azimuth 129 deg.

Explanations & more information are at http://iota.jhuapl.edu/exped.htm .
David Dunham, dunham@starpower.net ,
Phone 301-526-5590

Thank you Nancy Grace Roman for composing this article.

Small Bodies in Planetary Systems

Partly Based on Two NASA News Releases

Several decades ago, we thought we had a good understanding of the form of our Solar System. The terrestrial planets were too near the Sun to retain ice and, thus hydrogen so there was less material to condense into these plants. The major planets formed in a region cold enough for ice and, hence, the retention of hydrogen, the most abundant element in the Universe by far. Therefore, they were much more massive.

The discovery of hot Jupiters in other planetary systems led to a reexamination of our Solar System, leading theorists to conclude that planets moved within the Solar System after their birth. Moreover, more recent analysis of the composition of comets that come from the Oort cloud and, therefore, spent most of their life in deep freeze contained molecules that could only be formed near the Sun.

We now realize that the early Solar System was somewhat chaotic. The collision of a Mars-sized body with the Earth and the cratering of the Moon during the late heavy bombardment were not the only collisions. The smaller bodies collided with each other occasionally creating double asteroids but more often knocking off small pieces or even shattering into small rocks, some of which recombined to form asteroids little more dense than water. This led to debris disks that eventually settled into the asteroid belt and the Kuiper belt. The asteroid belt is kept in place by Jupiter and the gravity of the terrestrial planets and the Kuiper belt is controlled by Neptune. We do now know what controls the Oort cloud.

Continued on next column

We can observe debris clouds about young stars, particularly in the infrared. Two relatively close stars, Fomalhaut and Vega show evidence of the debris collected into belts similar to those in the Solar System. Astronomers were surprised to find the debris belt on Fomalhaut spans a section of space from 14 to nearly 20 billion miles from the star. Even more surprisingly, the latest Hubble images have allowed a team of astronomers to calculate the shepherding planet follows an unusual elliptical orbit that carries it on a potentially destructive path through the vast dust ring. Fomalhaut b, swings as close to its star as 4.6 billion miles, and the outermost point of its orbit is 27 billion miles away from the star according to the newest Hubble observation made last year. There may be other planet-like bodies in the system that gravitationally disturbed Fomalhaut b to place it in such a highly eccentric orbit.

Among several scenarios to explain Fomalhaut b's 2,000-year-long orbit is the hypothesis that an as yet undiscovered planet gravitationally ejected Fomalhaut b from a position closer to the star, and sent it flying in an orbit that extends beyond the dust belt. Hubble also found the dust and ice belt encircling the star Fomalhaut has an apparent gap slicing across the belt. This might have been carved by another undetected planet. Hubble's exquisite view of the dust belt shows irregularities that strongly motivate a search for other planets in the system. Fomalhaut b's extreme orbit may explain why the planet is unusually bright in visible light, but very faint in infrared light. It is possible the planet's optical brightness originates from a ring or shroud of dust around the planet, which reflects starlight. The dust would be rapidly produced by satellites orbiting the planet, which would suffer extreme erosion by impacts and gravitational stirring when Fomalhaut b enters into the inner planetary system after a millennium of deep freeze beyond the main belt.

An analogy can be found by looking at Saturn, which has a tenuous, but very large dust ring produced when meteoroites hit the outer moon Phoebe. Fomalhaut looks like it may provide a snapshot of what our Solar System was doing 4 billion years ago. The planetary architecture is being redrawn, the comet belts are evolving, and planets may be gaining and losing their moons.

Using data from NASA's Spitzer Space Telescope and the European Space Agency's (ESA) Herschel Space Observatory, astronomers have discovered what appears to be a large asteroid belt around the star Vega, the second brightest star in northern night skies. The discovery of an asteroid belt-like band of debris around Vega makes the star similar to Fomalhaut. The data are consistent with both stars having inner, warm belts and outer, cool belts separated by a gap similar to that of the asteroid and Kuiper belts in our own Solar System. The observations strongly suggest that multiple planets shape both systems. Vega and Fomalhaut are similar in other ways. Both are about twice the mass of the Sun and burn a hotter, bluer color in visible light. Both stars are relatively nearby at about 25 light-years away. The stars are thought to be around 400 million years old, but Vega could be closer to its 600 millionth birthday.

Fomalhaut has a single known candidate planet orbiting it at the inner edge of its cometary belt. Both the inner and outer belts in both systems contain far more material than our own asteroid and Kuiper belts. The reason is twofold: the star systems are far younger than our own, which has had hundreds of millions more years to clean house, and the systems likely formed from an initially more massive cloud of gas and dust than our Solar System.

Upcoming Science Fairs

For information on the county science fairs below, or the March 23 Udvar-Hazy Girl Scout event, email Jay Miller at rigel1@starpower.net

Feb. 22 – Forest Heights Elementary School, MD; e-mail Elizabeth Levin elizabeth.levin@pgcps.org

Feb. 23 – Long Reach High School (Howard County)

Mar. 2 - Wakefield High School, Arlington, VA (Arlington, Alexandria and Falls Church)

Mar. 9 - Prince George's Community College, Largo, MD (PG County)

Mar. 14 – Tuscarora High School (Loudon County)

Mar. 16 – Robinson Secondary School (Fairfax County)

Mar. 16 - Food and Drug Administration White Oak Campus, 10903 New Hampshire Avenue, Silver Spring, MD 20993 (Montgomery County)

Mar. 23 – Wilson High School (District of Columbia)

Mar 23 – GS Day @ Udvar Hazy Center

Calendar of Events

NCA Mirror- and Telescope-making Classes: Tuesdays Feb. 5, 12, 19, 26 and Fridays, Feb. 1, 8, 15, 22, 6:30 to 9:30 pm at the Chevy Chase Community Center, at the northeast corner of the intersection of McKinley Street and Connecticut Avenue, N.W. Contact instructor Guy Brandenburg at 202-635-1860 or email him at gfbrandenburg@yahoo.com. In case there is snow, call 202-282-2204 to see if the CCCC is open.

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

Dinner: Saturday, Feb. 9 at 5:30 pm, preceding the meeting, at *Mulligan's Grill and Pub* at the University of Maryland Golf Course.

Owens Science Center Planetarium: "Skywatchers of Africa" Fri. Feb. 8 at 7:30 pm; $5/adult; $3/students/senior/ teachers/military - children 3 and under are free. Doors open 7:15. http://www1.pgcps.org/howardbowens

Montgomery College Planetarium:
7621 Fenton Street, Takoma Park, MD (240) 567-1463. Sat. Feb. 16 at 7:00 pm. "African Skies" in the Planetarium. http://www.montgomerycollege.edu/Departments/planet/

Mid Atlantic Senior Physicists Group : "The Large Area Telescope on Fermi and Pan-STARRS-1 (PS1) as Contemporaneous All-Sky Monitors"
Wed. Feb. 20 at 1:00pm. American Center for Physics, College Park, MD. See page 3.

Upcoming NCA Meetings at the University of Maryland Observatory

Feb 09 **Lindy Elkins-Tanton** (DTM), Magma and Water Oceans in the Early Solar System

Mar 09 **Paul Ray** (NRL), X-ray Pulsars

Apr 13 **Holly Gilbert** (GSFC), Results from the Solar Dynamics Observatory

National Capital Astronomers Membership Form

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

Address: _____ **ZIP Code:** _____

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

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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
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First Class
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Next NCA Mtg:

Feb. 9

7:30 pm

@ UMD Obs

Lindy Elkins-Tanton (DTM)

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