

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

Star Dust

Newsletter of National Capital Astronomers, Inc.

capitalastronomers.org

March 2017

Volume 75, Issue 7

Next Meeting

When: Sat. Mar. 11th, 2017

Time: 7:30 pm

Where: UMD Observatory

Speakers: Richard Mushotzky

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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 Metzertott 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.

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.

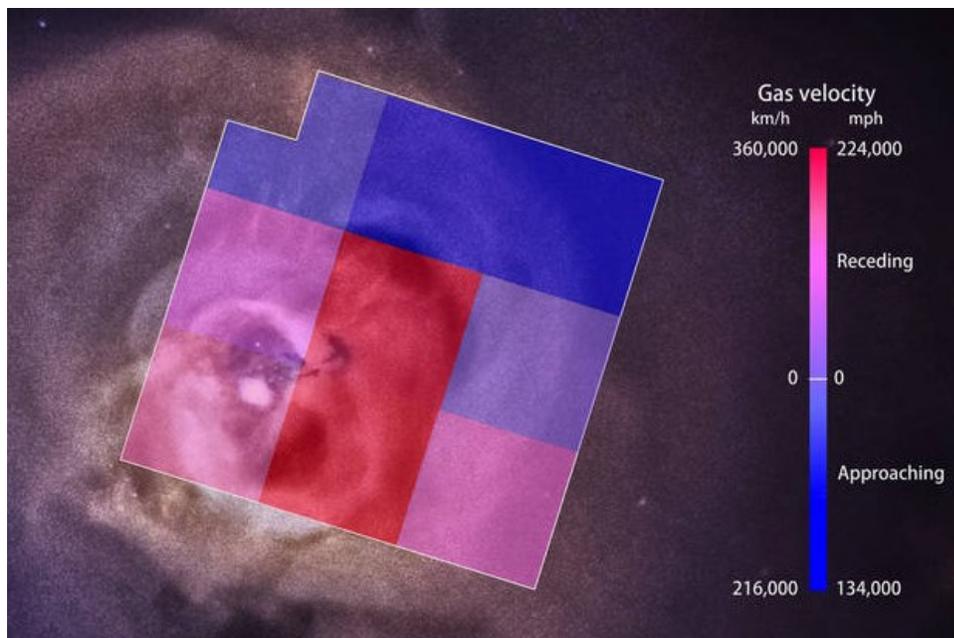
Results from Hitomi – The Perseus Cluster and a Little Bit More

Richard F. Mushotzky

University of Maryland

Abstract: Clusters of Galaxies are the largest gravitationally-bound objects in the Universe.

Before the tragic loss of the spacecraft, the Soft X-ray Spectrometer on the Hitomi/Astro-H observatory observed the Perseus cluster of galaxies, producing X-ray spectral data with unprecedented spectral resolution and sensitivity. The scientific impact of these transformational data on our understanding of both the physics of clusters of galaxies and the physics central to active galaxies in that cluster will be briefly reviewed. Also, some of Hitomi's observations of other objects will be discussed.



*Courtesy NASA Goddard and NASA/CXC/SAO/E. Bulbul, et al.
Perseus Galaxy Cluster image from Chandra X-ray Observatory and X-ray-emitting gas (with direction & velocity) captured by Hitomi's SXS (Soft X-ray Spectrometer). The SXS square's span is about 195,000 light years.*

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X-Ray Vision



Courtesy Red Finch Kanji Dictionary
"Hitomi" in Kanji

ASTRO-H was the 6th in a series of X-ray astronomy satellites developed by the Institute of Space and Astronautical Science (ISAS) of the Japan Aerospace Exploration Agency (JAXA). The craft was placed into Earth orbit on an HII-A rocket fired from the Yoshinobu Launch Complex at Japan's Tanegashima Space Center. The launch occurred Feb. 17, 2016, at 3:45 a.m. EST (5:45 p.m. local time).

After launch, JAXA officials released a statement indicating that, since ASTRO-H was "the eye to study the hot and energetic universe," they were renaming the spacecraft *Hitomi*, which is Japanese for "pupil" (entrance-window or aperture) of the eye. JAXA went on to state that the new name fits an old Japanese legend of a painter of dragons. The artist painted 4 white dragons without eyes. People who saw the art told the artist that his work was incomplete; they said "Why don't you paint hitomi?" So, under the people's

"Hitomi refers to the aperture of the eye, the part where incoming light is absorbed. From this, Hitomi reminds us of a black hole. We will observe Hitomi in the universe using the Hitomi satellite!"

JAXA Officials after ASTRO-H launch

continued on page 3

Hitomi – continued from page 1

Biographical Sketch:

Dr. Mushotzky is presently a professor of Astronomy at the University of Maryland, and was previously a staff member of the Laboratory for High Energy Astrophysics at NASA's Goddard Space Flight Center.

He has been involved in numerous NASA X-ray astronomy missions. His roles include Mission Scientist on the team for the XMM spacecraft, Interdisciplinary Scientist for the Chandra spacecraft, member of the science working groups for the ASCA and Suzaku spacecraft, and co-chair of the science working group for the Astro-H spacecraft (which, on orbit, was re-named Hitomi).

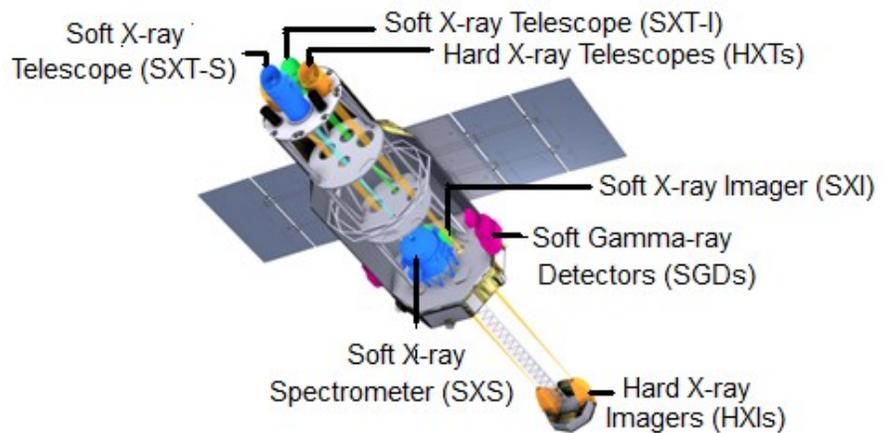
He was the US project scientist for XMM from 1989-2009. He has been involved in more than 410 referred papers on high energy astrophysics; those papers have been cited by other scientific papers more than 30,000 times.

He was also a member of the National Academy of Science's *Astro2010 Panel* on 'Galaxies Across Cosmic Time', as well as a member of the 2016 National Academy of Science's *Mid-Decadal Review*.

Dr. Mushotzky received the NASA Distinguished Service Medal, and has twice received the NASA Medal for Exceptional Scientific Achievement. He has also received the NASA Exceptional Achievement Award, the GSFC Lindsay Award, and the Robert Goddard Award.



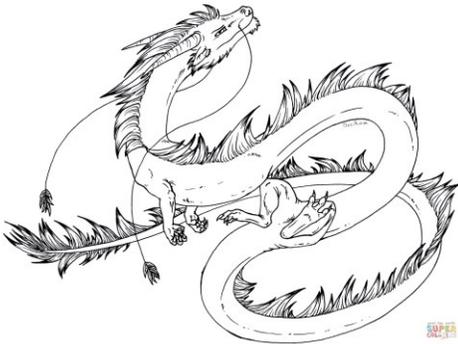
Courtesy R. Mushotzky



Hitomi's Instruments

X-Ray Vision – continued from page 2

pressure, he added eyes to 2 of the dragons, who immediately animated and flew skyward, leaving the eyeless dragons behind as inanimate art. The lesson in the legend is that hitomi is considered the “one last, but most important part.”



Courtesy Angel-design.net

The Hitomi spacecraft was built by an international collaboration led by JAXA, with contributions from NASA’s Goddard Space Flight Center and institutions in Japan, Canada and Europe. NASA Goddard is also responsible for developing the analysis software, the data processing pipeline, and Guest Observer Facility to support guest observer programs. Hitomi had instruments covering a wide energy range, from soft X-rays to gamma rays, and provided the highest energy resolution ever achieved in the 3 to 10 keV X-ray band.

The craft was lost in March, 2016, as a result of attitude control and sensor problems. High-speed reaction wheels were initiated by attitude control to counteract a non-existent spin around the z-axis when the craft was actually stable. This caused an extreme spin. When corrective measures were initiated with rocket thrusters, a faulty thruster system setting caused the craft to spin faster in the problematic direction. The high-speed rotation caused Hitomi to spin off parts of the craft. Japanese officials stated that at least 10 pieces came off of the main body of the craft. Investigative engineers were certain that one of the larger pieces was part of Hitomi’s primary structure.

Sky Watchers

Early Spring Schedule

March

12	10:54 am – Full Moon , Global. Other Moon Names: <i>Full Worm Moon</i> (earthworm casts appear, heralding the return of robins), <i>Full Sap Moon</i> (maple tree sap begins to flow).
14	11:00 pm – Asteroid , N. Hemisphere. <i>Pallas</i> in conjunction with Sun.
18	1:25 pm – Moon , Global. (apogee at 251,438 miles).
20 – 29	Evening – Globe at Night , Global. Features: <i>Constellations Leo</i> (N. Hemisphere) & <i>Canis Major</i> (S. Hemisphere).
20	6:00 am – Planets , N. Hemisphere. Saturn 3° south of Moon. 6:24 am – Vernal Equinox (N. Hemisphere). Autumnal Equinox (S. Hemisphere).
29	3:00 am – Planets , N. Hemisphere. Mercury 7° north of Moon.
30	8:32 am – Moon , Global. (perigee at 226,088 miles).

Times EDT

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!

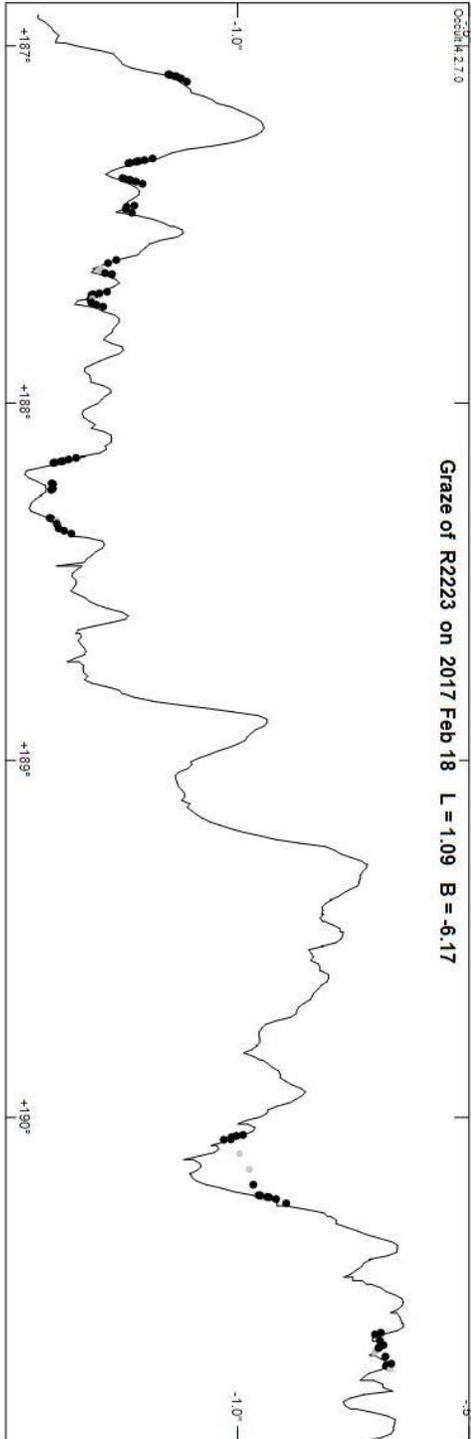


The Program will return in April 2017!

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

The Scorpion & the Moon

David Dunham



Courtesy David Dunham
Disappearance & reappearance
observations plotted with LRO's lunar
profile.

On Saturday morning, February 18, Joan Dunham and I set up six small telescopes (8cm and 12cm short-tube refractors) with video cameras spread across the large parking lot and nearby areas of St. Mary's Catholic Church on the south side of Kutztown, PA, to record a grazing occultation of the 3.9-magnitude, orange giant star, gamma Librae (*Zuben el Akrab* – *claws/shears of the Scorpion*), by the southern edge of the last quarter (54% sunlit) Moon.

The graze occurred on the dark side of the Moon, 8° from the southern cusp, so all disappearances (D's) and reappearances (R's) could be clearly recorded, even with the smaller scopes. The location was selected as a safe area crossed by a narrow (150-meters wide) zone. This zone is where lunar features would line up to produce a maximum number of events, as predicted by the lunar profile generated via a digital model of the Moon derived from Lunar Reconnaissance Orbiter (LRO) laser-ranging data.

Seven to nine occultations of the star occurred at each station, each producing a D and R of the star. The reduction profile (left) plots the LRO-derived lunar profile, giving heights in arcseconds at the Moon's mean distance, below its average radius (this

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Thank you!



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 and Planetary Occultations

Date	Day	EDT	Star	Mag	Asteroid	dmag	dur.	Ap.	Location, Notes
Mar 14	Tue	5:55	TYC55670475	10.3	2010 KR59	9.6	7	5	SMX,GT; s USA?
Mar 19	Sun	0:05	SAO 119314	9.2	Brigitta	5.6	3	4	SNY,SCT,nNJ,nPA
Mar 22	wed	22:17	SAO 138098	9.6	Sandra	5.3	3	4	SNJ,nDE,nEMD,PA
Mar 23	Thu	21:50	2UC28729914	12.4	Mashona	1.9	6	8	NJ,nDE,nEMD,PA
Mar 26	Sun	23:26	TYC24061685	12.0	Leto	1.1	6	8	PA,MD,DC,nVA,DE
Mar 28	Tue	23:00	TYC07392340	11.5	Olga	3.7	4	7	w&nTX,AR,STN,NC
Mar 29	wed	20:58	TYC24061895	10.8	Leto	2.0	6	6	SNY,nPA,nNJ,CT
Apr 7	Fri	21:40	TYC18721597	10.1	Marcelle	6.8	1	5	w&sMD,DC;nVA?
Apr 8	Sat	4:24	4UC41556293	11.7	1999 CP133	11.	4	8	TNO; VA,anyUSA?
Apr 10	Mon	5:36	SAO 184216	8.5	Luisa	4.7	11	3	seMD,seVA,enc

Lunar Grazing Occultations

Date	Day	EDT	Star	Mag	% alt	CA	Location & Remarks
Apr 3	Mon	21:53	ZC 1101	7.7	53+ 55	4N	Durham, Wilson, Aurora, NC
Apr 5	wed	21:21	ZC 1360	7.4	74+ 66	3N	MtAiry,W.Frndshp,El'tCity,MD

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

Total Lunar Occultations

Date	Day	EDT	Ph Star	Mag	% alt	CA	Sp.	Notes
Mar 18	Sat	5:12	R SAO159702*	8.1	71- 35	51N	A6	
Mar 19	Sun	3:44	R ZC 2426	7.7	62- 23	68N	K0	
Mar 21	Tue	4:18	R SAO 161643	8.0	43- 14	75N	F5	Azimuth 130 degrees
Mar 21	Tue	4:48	R X 44331	8.3	43- 18	24N	B9	
Mar 21	Tue	5:01	R X 44341	7.5	43- 20	29N	K5	
Mar 21	Tue	5:35	R SAO 161680	7.9	43- 24	74N	K1	
Mar 24	Fri	6:00	R 29 Cap	5.3	16- 10	81N	M2	Azimuth 118, ZC 3108
Mar 31	Fri	19:54	D SAO 93806	7.7	20+ 42	52N	A0	Sun -6, close double
Mar 31	Fri	22:02	D 48 Tauri*	6.3	20+ 18	47S	F5	ZC 626
Mar 31	Fri	23:33	D gamma Tau	3.7	21+ 1	80S	G8	Azimuth 289, ZC 635
Apr 2	Sun	20:28	D ZC 943	6.6	41+ 58	68N	B8	Sun altitude -12 deg.
Apr 2	Sun	21:57	D ZC 951	6.6	42+ 42	26S	K2	Close double
Apr 2	Sun	22:25	D SAO 95484	8.2	42+ 37	59S	G5	
Apr 2	Sun	22:30	D SAO 95487	8.0	42+ 36	52N	G5	
Apr 2	Sun	23:08	D SAO 95512	8.4	42+ 29	78S	K0	
Apr 4	Tue	0:23	D SAO 96791	7.8	54+ 25	62S	K0	Close double??
Apr 4	Tue	0:27	D SAO 96794	8.0	54+ 25	67S	A0	Close double??
Apr 4	Tue	22:06	D ZC 1238*	6.0	64+ 59	8S	G8	Very close double
Apr 5	wed	1:18	D ZC 1247*	7.0	65+ 24	24S	A0	
Apr 5	wed	1:24	D SAO 97731*	7.6	65+ 23	69S	K5	
Apr 5	wed	2:28	D ZC 1258	6.7	66+ 11	90S	K0	Azimuth 282 deg.
Apr 5	wed	21:14	D ZC 1360	7.4	74+ 66	13N	K0	
Apr 7	Fri	23:34	D GY Leonis	7.4	91+ 57	41N	K0	SAO 118578

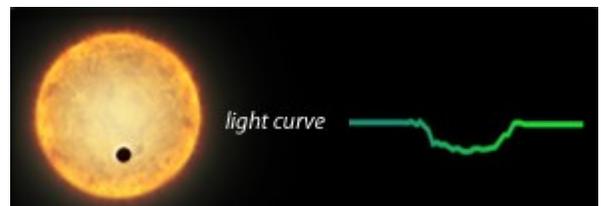
* The star is in the Kepler 2 exoplanet search program so lightcurves of the occultation are desired to check for close stellar duplicity.

Further explanations & more information is at <http://iota.jhuapl.edu>

David Dunham, dunham@starpower.net

How does Kepler find Planets?

kepler.nasa.gov/



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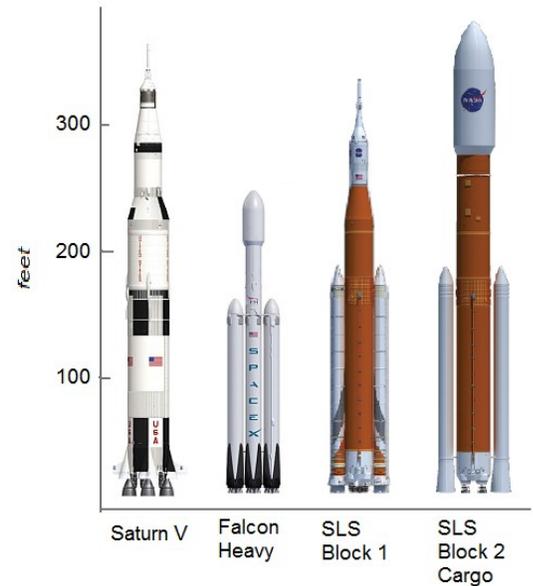
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Planetary Destinations

Space X (Space Exploration), headed by Elon Musk, has plans to send tourists into orbit around the Moon in late 2018. Two people have requested to be sent on this week-long journey. The current plan is to have the two individuals (trained for emergency situations) lift off in an automated Dragon 2 spacecraft powered by a Falcon Heavy rocket to make “a long loop around the Moon,” according to Musk. The Falcon Heavy is bigger than the Falcon 9, but not as big as NASA’s SLS. The price of the trip is unspecified; but, pricing for a 2018 Falcon Heavy launch is \$90 million (a Falcon 9 launch for 2018 is \$62 million).

Although making such a trip may be technically possible for Space X, the Coalition for Deep Space Exploration isn’t sure that the company can be ready by 2018. Some specific concerns are that automation can develop faults, non-astronaut passengers would be on a trajectory that would take them 300,000 miles from Earth and testing still needs to be done for crewless flights.



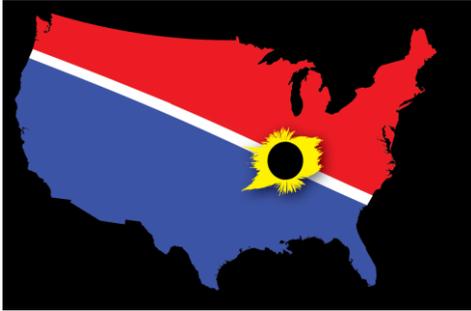
Relative sizes of the heavy workload rockets of Space X and NASA

Scorpion & Moon – continued from page 4

was a low area of the Moon) for the ordinate and position angle measured around the Moon’s limb from its axis of rotation for the abscissa.

As can be seen, the observed points (black dots for each D and R) match the LRO profile well. Note that there is an approximately 20-to-1 exaggeration of the vertical scale relative to the horizontal scale, needed to show the (actually gentle) topography well. Some previous observations indicated that the star may be a close double; however, there was no evidence (no stepped D’s or R’s) indicating that. All of the events were gradual to some extent, due to Fresnel diffraction of the star’s light enhanced some by the angular diameter of the star. The reduction profile was generated with IOTA’s free *Occult 4* software.

The Great North American Eclipse



Aug 21st 2017

www.greatamericaneclipse.com

The submission deadline for the April issue of Star Dust is March 25th.

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 or email him at gfbrandenburg@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
- **Mid-Atlantic Senior Physicists Group:** "Why Do Black Holes Shine?" with Christopher Reynolds (UMD), Wed. Mar. 8*, at 1 pm at the American Center for Physics (1st floor conference room). www.aps.org/units/maspg/
• **Note: This is the 2nd Wed. of the month.*
- **Owens Science Center Planetarium:** "Figure it Out: Women's Contributions to Astronomy," Fri. Mar. 10, 7:30 pm; \$5/adult; \$3/students/senior/teachers /military; children under 3 free. www1.pgcps.org/howardbowens
- **Steven F. Udvar-Hazy Center** in Chantilly, VA: Family Heritage Days "Women in Aviation & Space," Sat. Mar. 18, 10 am – 3 pm, FREE (parking \$15). airandspace.si.edu/visit/events
- **Lockheed Martin IMAX Theater** in DC: "Cassini to Saturn: The Journey & the Legacy," with Carolyn Porco (Space Science Institute), Thur. Mar. 23, 8 pm, FREE (tickets required). airandspace.si.edu/visit/events
- **Upcoming NCA Meetings** at the University of Maryland Observatory:
8 Apr: Karen Yang (UMD), What are the Fermi Bubbles?

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.?

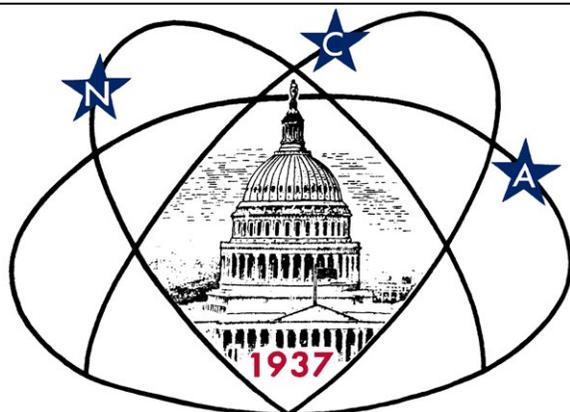
Are you interested in volunteering for: Telescope making, Exploring the Sky, Star Dust, NCA Officer, etc.?

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*Celebrating 80 Years of Astronomy
1937-2017*

Next NCA Meeting:

2017 March 11th

7:30 pm

@ UMD Observatory

Richard F. Mushotzky

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