Star Dust

National Capital Astronomers, Inc.

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David Dunham on Space Rocks!

by Nancy Byrd

Dr. David Dunham will present the featured talk for the June 3, 2000 meeting of National Capital Astronomers. The June 3 meeting will be held in the Lipsett Auditorium in Building 10 (Clinical Center) of the National Institutes of Health in Bethesda at 7:30 P.M. As most NCA members know, David and his wife Joan are active members of NCA, regularly contributing to Star Dust, announcing and showing their doings at our monthly meetings. They have observed occultations anywhere they can get to in the world, with incredible dedication over many years. David's talk, entitled "Space Rocks: Observed Hitting the Moon, Covering Stars, & by NEAR", is in response to my request that he share with us not only the where and when of occultations, but also his vision of why observing occultations is important and interesting.

Dr. Dunham is president of IOTA (International Occultation Timing Association) and a frequent contributor to Sky & Telescope. He especially calls attention to his article in the January issue of S&T on Planetary Occultations for 2000, and the article by Kelly Beatty on lunar Leonids in the June S&T. Dr. Dunham will also describe re-analysis of the occultations by Eros in 1975 and by Kleopatra in 1991 based on the new information that we now have about those asteroids.

Web sites that have more information about these occultations, NEAR and related items are

http://iota.jhuapl.edu
http://www.lunar-occultations.com/iota
http://near.jhuapl.edu

Elections at June Meeting

Jay Miller

The nominating committee of Jay Miller(chairman), John Graham, and Michael Brabanski has drawn up the following slate of officiers:
President: Nancy Byrd
Vice President: Gary Joaquin
Secretary: Nancy Grace Roman
Treasurer: Jeffrey Norman
Trustee: Andrew W. Seacord II
Elections will be held at the June NCA meeting.

Nicholas White's Talk on "Cosmic Journeys: To the Edge of Gravity, Space and Time"

by Nancy Grace Roman

About a year ago, Daniel Goldin, the NASA administrator, challenged the agency to determine what we would see perched 1000 km. above a black hole. This led to the Cosmic Journey's program. The best image we have currently of the vicinity of a black hole is of the center of the galaxy M87. The center of this galaxy is very bright, overwhelming the brightness of the surrounding galaxy. Like most black hole candidates, we observe a jet coming out of it at nearly the speed of light. However, simulations show that to resolve the black hole itself, silhouetted on a bright background, would require an angular resolution of 4 - 8 microarcseconds, a million times better than the resolution of the HST. Surprisingly, the best way to achieve this is with X-ray interferometry because the material near a black hole is at millions or tens of millions of degrees and hence emits primarily in X-rays. A mission has been invented called the Microarcsecond X-ray Imaging Mission (MAXIM) to obtain an angular resolution of 0.1 microarcseconds.

Black holes are an extreme manifestation of gravity. If an ice-cream cone were dropped into a black hole, the release of energy would produce an enormous explosion. There are many books about black holes ranging from those based on sound physical theory to highly speculative ideas including worm holes and white holes. These are theoretically possible but there is no evidence that they exist. It has been suggested that black holes are other universes. Again there is no proof but the origin of our universe may have been similar to a black hole. Stephen Hawkings has theorized that black holes can slowly lose mass and shrink until they vanish in an explosion. Again, there is no evidence of this. In theory, energy could be extracted from spinning black holes and could become a source of energy once other sources have been consumed.

Gravity is the longest range force in the universe but it is insignificant on atomic scales for which much stronger short range forces predominate. There is no antigravity and gravity cannot be screened. Einstein described gravity as the curvature of space and time around a mass. There are many proofs that light, traveling in a "straight" line follows this curvature. There are three questions that the Cosmic Journeys pro-

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NCA Events This Month

The Public is Welcome!

NCA Home Page: http://capitalastronomers.org

Fridays, June 2, 9, 16, 23, 30; July 7, 14, 21, 28; August 4, 11, 18, 25 from 7:00-9:30 P.M. Telescope making and mirror grinding classes at American University, McKinley Hall Basement (Room 9), Nebraska and Massachusetts Avenues, N.W., Washington, D.C. However, on June 2 and 30, July 28, August 4 and 25 if the weather is clear, class may be canceled so that the instructor can go out star-gazing himself, instead, because the Moon will be near new. Call or e-mail to confirm on those dates. Information: Guy Brandenburg, 202-635-1860 or gfbranden@earthlink.net.

Friday, June 2, 23, 30, July 7, 21, 28, 9:30 P.M. - Open night with NCA's 14-inch telescope at Ridgeview Observatory near Alexandria, Virginia; 6007 Ridge View Drive (off Franconia Road between Telegraph Road and Rose Hill Drive). Call Bob Bolster, (703) 960-9126 before 6:00 p.m.

Saturday, June 3, 5:30 P.M. - Dinner with the speaker and NCA members at La Panetteria, 4921 Cordell Avenue, Bethesda MD. See the map and directions on Page 6.

June 3, 7:30 P.M. - NCA meeting, at Lipsett Auditorium in Building 10 at NIH, will feature Dr. David Dunham.

See Page 4 for more National Capital area astronomical doings. To join NCA, use the membership application on Page 7.

Meteor Showers
June Radiants
Full Moon: June 16
Major Activity – None

Minor Activity

Radiant	Duration	Maximum
June Aquilids	June 2-July 2	June 16/17
June Bootids	June 27-July 5	June 28/29
Corvids	June 25-July 3	June 27/28
Tau Herculids	May 19-June 19	June 9/10
June Lyrids	June 10-21	June 15/16
Ophiuchids	May 19-July 2	June 20/21
Theta Ophiuchids	May 21-June 16	June 10/11
Sagittariids	June 10-16	June 10/11
Phi Sagittariids	June 1-July 15	June 18/19
Chi Scorpiids	May 6-July 2	May 28-June 5
Omega Scorpiids	May 19-July 11	June 3-6
June Scutids	June 2-July 29	June 27/28

Daylight Activity

Radiant	Duration	Maximum
Arietids	May 22-July 2	June 7/8
Zeta Perseids	May 20-July 5	June 13/14
Beta Taurids	June 5-July 18	June 29/30

Source:http://comets.amsmeteors.org/meteors

Nicholas White, continued

(Continued from page 1)

gram is seeking to answer: How can gravity and quantum mechanics be combined? Are black holes described by general relativity? Does Einstein's Theory of General Relativity really describe the universe? There are three extremes of gravity: near a black hole, in the early universe, and on the universal scale. Black holes are interesting because they possess the most extreme gravity we can study. Because the laws of physics as we understand them break down, they may tell us some new physics. By imaging a black hole, we will see how the jet is formed and the details of the energy release in the vicinity.

The current state of the art in X-ray imaging is reached by the Chandra Observatory that produces 0.5 arcsecond images and is the X-ray counterpart to the HST. Dr. White showed pictures from Chandra of supernovae remnants, active galaxies, and the accretion disk and jet in the Crab Nebula. Chandra is also finding black holes everywhere it looks. Many of these appear in optical wavelengths as quasars or even apparently normal galaxies that were not suspected to be active. In about a third of the black holes, there is no optical image. We think that these are very distant objects from which the visible light has been shifted out of the optical window.

The MAXIM concept is based on a collection of x-ray mirrors one kilometer apart, situated 10 km from a combiner that, in turn, is 500 km from the detector. We will reach this mission in steps. After Chandra, and the European X-ray spectroscopy mission, XMM, we will fly Constellation X, a group of Chandra-like telescopes, with 100 times the Chandra or XMM collecting area. This will be followed by the MAXIM Pathfinder that will be 1000 times better than Chandra. Finally, 25 - 30 years in the future, will be MAXIM with 10,000 times better angular resolution than Chandra.

Constellation X will study the spectra of black holes and observe the structure and evolution of dark matter structure throughout the universe. It will consist of several identical telescopes launched one or two at a time to guard against launch vehicle problems. Thus, the collecting area will build up gradually, starting in about 7 or 8 years. The spectra of black holes evince, from Doppler effects, the speed of rotation and distribution of material around black holes as well as the gravitational redshifts of light from very near the holes. It will also observe flares near black holes and determine from these how the light is distorted as it moves away.

If X-rays hit a mirror nearly perpendicularly, they are absorbed rather than reflected. For reflection, the rays must skim the surface at an angle of about 1 degree or less. This means that

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Nicholas White, continued

(Continued from page 2)

only a very small part of the diameter of the mirror is used. Chandra, with four nested mirrors, uses only 1/330 to 1/700 of their area. Constellation X will use more mirrors with poorer angular resolution but, together, larger light gathering capability. Moreover, to save money and difficulty, at the expense of excellent imaging, the mirrors will be flat. The combiner simply serves as the second mirror in a Cassegrain system.

In the MAXIM Pathfinder, multiple telescopes will have multiple mirrors, about a meter apart, functioning as an interferometer from which the fringes at the detector can be inverted to give good images. The detector will be 500 km from the combiner. To point the telescope, it is necessary to swing the entire system. MAXIM, itself, will have 32 sets of elements. NASA is seriously considering this, in spite of its difficulty. Not only will these techniques be used for X rays, but in the optical range, a similar system will be used for finding extra-solar planets.

Two other missions are much closer in time. SWIFT will fly in 2003 to observe gamma-ray bursts. It can maneuver within a minute to zero in on a burst. From Beppo SAX we have learned that there is a flash of light associated with these bursts and the sources appear to be at large cosmological distances. They may be the signatures of the birth of black holes. The hope is to observe 1000 bursts in great detail. GLAST will be launched in 2005. This will replace the Compton Gamma Ray Observatory, which will reenter the atmosphere soon, but GLAST will be 30 - 100 times better. It can look down the jets of black holes and look for the gamma-ray signature of the decay of exotic particles.

Two black holes in mutual orbit should emit gravitational waves. If two black holes merge, the gravity wave signature would be spectacular. LISA (Laser Interferometer Space Array) is planned to detect such radiation. It will consist of three spacecraft in orbit around the sun, separated by 5,000,000 km. Each spacecraft will have a proof mass with a completely isolated shielding spacecraft and a laser. The laser will be used to measure the distances between each pair of spacecraft within 10 picometers, a distance 100 times smaller than the diameter of an atom. The biggest challenge is the isolation of the proof mass from the remainder of the spacecraft. The system will be tested first but NASA hopes to launch it about 2010.

COBE observed the universe when it was 300,000 years old. We cannot observe photons from any earlier time but we would like to get information from the period of inflation when the universe was 10-32 seconds old, and even, possibly from the period in which all forces were united. This might be done in two ways. We may be able to observe gravitational radiation from this period since gravitational waves can traverse the entire universe. This will require a system with the ability to detect 1 second periods. Also, we have observed very high energy cosmic ray particles that may have come from the period when the universe was only 10-27 seconds old.

A mission, OWL, is being designed to observe the air showers in the earth's atmosphere caused by these particles. Ten such showers have been observed from the ground but only a limited portion of the sky can be studied at a time. OWL will observe almost a third of the earth's atmosphere and thus greatly increase the efficiency of the detection. We should observe enough showers with OWL to determine the types of particles involved. Another mission is being designed to detect the polarization of the microwave background that will reflect the passage of gravity waves. Both of these missions are at least 15 to 25 years in the future.

The most massive objects in the universe are clusters of galaxies. The hot gas pervading these clusters is much more massive than the stellar galaxies but 95% of the mass required to hold the clusters together, must be dark (i.e., unobserved). We want to understand how the fluctuations seen by COBE turned into the clusters of galaxies we observe today. The universe starts out dark in X-rays, but as the dark matter collapses, the gas gets shocked and heated. Thus, the X-ray universe gets hotter with time. We want to study the evolution of the observed structure to understand the nature of the dark matter. XMM will map the web structure in about 1/3 of the sky. Constellation X will provide spectra of objects behind the web and will show absorption lines from the intervening matter to determine both its composition and its velocity. By looking at material farther and farther from the sun, we can study the evolution of the material with time.

Eventually we should be able to build an X-ray telescope 1000 times better than MAXIM. This will allow us to image the neutron stars in the centers of supernovae remnants. We are on the verge of a new generation in high energy astrophysics, which may well lead to Noble Prize class discoveries.

We thank Dr. White for a most interesting and informative talk.

Eclipse Travel Plans

Sue Bassett

Plans for a June eclipse trip to Zambia have been put on hold, at least temporarily, due to the increased turmoil in the region. Although Zambia itself has not been involved, there is concern that the problems in Zimbabwe might spill across the border. We will continue to monitor the situation.

Exploring the Sky

Exploring the Sky, a joint presentation of the National Park Service and the National Capital Astronomers, is held in Rock Creek Park near the Nature Center, in the fields just south of the intersection of Military and Glover Roads NW. This informal program has for nearly fifty years offered monthly opportunities for anyone in the metropolitan area to see the stars and planets through telescopes from a location within the District of Columbia. Sessions are once each month on a Saturday night from April through November.

The remaining sessions for this year are

6/24 – 9:00 P.M.
7/22 – 9:00 P.M.
8/26 – 8:30 P.M.
9/23 – 8:00 P.M.
10/28 – 7:30 P.M.
11/18 – 7:00 P.M.

Times are EDT except EST in November. NCA members are urged to bring their telescopes to these sessions. Members without telescopes are also needed to answer questions from the public.

For additional information call the Rock Creek Nature Center at (202) 426-6829 or NCA's Joe Morris at joemorriserols.com

You may also check the Internet sites:
http://www.nps.gov/rocr/planetarium
http://www.capitalastronomers.org

Other National Capital Area Meetings, etc.

U.S. Naval Observatory (USNO) Monday nights at 8:00 p.m., except on Federal holidays: USNO public nights in Northwest Washington, D.C. (off Massachusetts Avenue). Includes orientation on USNO's mission, viewing of operating atomic clocks, and glimpses through the finest optical telescopes in the Washington-Baltimore region. Held regardless of cloud cover. Information: USNO Public Affairs Office, 202/762-1438.

U.S. Naval Observatory Colloquia All Colloquia take place in Bldg. 56, Room 200, with coffee and cookies normally at 10:00, talk at 10:30, and lunch at 12:00
Thursday, June 29 Dr. Eliot Horch, Rochester Institute of Technology, "The WIYN Program and RIT Speckle Program"
Information: Call the Scientific Director's office at (202) 762-1513.
Source: http://www.usno.navy.mil.

Department of Terrestrial Magnetism (DTM) Carnegie Institute of Washington 5241 Broad Branch Road, N.W. Washington, D.C. Wednesdays at 11:00 a.m. in the Seminar Room of the Main Building.
June 21 Gerard Williger, Laboratory for Astronomy & Solar Physics – NASA Goddard Space Flight Center, "Peering Through the Mists of Time: Observations of Diffusely Distributed Gas from When the Universe Was Young"
Call (202) 686 4370 to confirm. Source: http://www.ciw.edu/DTM-seminars.html

Goddard Scientific Colloquium — All seminars are held in GSFC Building 3 Auditorium at 3:30 P.M. Contact Carol Krueger, at (301) 286-6878 to confirm.
June 2 Paul Falkowski, Rutgers University, "Remote Sensing of Global Biogeochemical Cycles"
June 9 Andrew Fabian, Cambridge University, John C. Lindsay Memorial Lecture: "Chandra X-ray Observations of the Cores of Clusters of Galaxies"
Source: http://lheawww.gsfc.nasa.gov/users/djt/colloq/

Laboratory for Astronomy and Solar Physics (LASP) — Seminars are on Thursday at 3:30 P.M. in GSFC Bldg. 21, Room 183A.
June 1 10:00 am, special time!
Saul Perlmutter, University of California, Berkeley, "The Super-Nova Acceleration Probe (SNAP)"
Source: http://stars.gsfc.nasa.gov/www/lasp_colloq/index.html

Laboratory for High Energy Astrophysics (LHEA) Tuesday Seminar Series — NASA GSFC Building 2, Ground Floor Conference Room, 3:30 P.M.
June 06 -No seminar. Rochester AAS Meeting
June 13 Dr. Mike Crenshaw, Catholic U. of Amer. and NASA/GSFC/LASP, "Intrinsic UV and X-ray Absorption in Seyfert 1 Galaxies"
June 20 Dr.Beth Brown, NRC & GSFC, "The Effect of Environment on the X-ray Emission from Early-Type Galaxies"
June 27 Dr. Steve Kraemer, Catholic U. of Amer. and NASA/GSFC/LASP, "On the Reddening in X-ray absorbed Seyfert 1 Galaxies"
Source: http://lheawww.gsfc.nasa.gov/docs/lhea/TuesSeminar/Seminar.html

LASP Stellar & Extra-Galactic Astronomy Lunch — Talks are Wednesdays at 12:00 Noon in Room 242 of Building 21.
June 7 No speaker – AAS in Rochester
June 14 Tony Danks, GSFC/RITSS, "Variability in the Interstellar Medium"
June 21 Jason Pun, GSFC/NOAO, "Dynamic Structure of SN 1987A Debris"
Tuesday, June 27 Rene Walterbos, NMSU, Baltimore-Washington Starburst Seminar
July - August No Programs
Source: http://hires.gsfc.nasa.gov/~gardner/seal/

Montgomery College's Planetarium Fenton St. in Takoma Park.
September 23 2000 at 7:00 P.M. "When the Sky Falls" Source: http://www.mc.cc.md.us/Departments/planet/

University of Maryland College Park Astronomy Department Colloquia
All Astronomy Colloquia are held in room CSS 2400 at 16:00-17:00 (4:00-5:00 pm) unless otherwise noted.
BIMA Seminar *Note Special Time*
Tuesday June 1, 15:00, CSS 1224, Bikram Phookun, Raman Research Institute, Bangalore, "Kinematic and Morphological Lopsidedness in the HI Distributions of Spiral Galaxies"(301) 405-3001.
Source: http://www.astro.umd.edu/colloquia/

Northern Virginia Astronomy Club (NOVAC) meets at 6:00 p.m., the second Sunday of each month, at Lecture Hall 1 on the Fairfax campus of George Mason University. 703 803-3153.
Source: http://novac.com

University of Maryland Observatory on Metzerott Road. Open house on 5 and 20 of each month.
Each open house program consists of a 20 to 30 minute slide presentation in the lecture hall (which is now air conditioned!) followed by telescope viewing (weather permitting) of various astronomical objects.
Monday, June 5, 9:00 p.m., Dr. Stephen Kortenkamp, "Formation of Planetary Systems"
Tuesday, June 20, 9:00 p.m., Dr. Cole Miller, "Faster, Denser, Hotter: The Extremes of Neutron Stars"
Wednesday, July 5, 9:00 p.m., Dr. Eve Ostriker, "Galactic Star Formation: Putting the squeeze on clouds with spiral arms"
Thursday, July 20, 9:00 p.m., Dr. Stephen White, TBA
Saturday, August 5, 9:00 p.m., Dr. Ed Schmahl, "Gamma Rays from Solar Flares: The Solar Spectroscopic Imager",
Sunday, August 20, 9:00 p.m., Dr. Andy Young, "Explosions in Space"
Info: (301) 405-3001 Source: http://www.astro.umd.edu/openhouse/

Greenbelt Astronomy Club meets on the last Thursday of each month (except holidays) at 7:30 p.m. at the Howard B. Owens Science Center, 9601 Greenbelt Road, Lanham, MD 20706. (Call the Science Center at 301-918-8750 or (301) 441-4605 to confirm meeting dates). Club meetings are open to the general public.
Source: lheawww.gsfc.nasa.gov/docs/outreach/gac/GAC.html

National Air & Space Museum – Free lectures at the Einstein Planetarium and other daily events. 202-357-1550, 202-357-1686, or 202-357-1505 (TTY)
Source: http://www.nasm.edu.
June 14 "Back to the Moon: The Lunar Prospector Mission". Alan Binder, Principal Investigator for Lunar Prospector, offers a first-hand account of the mission: its goals and results, and what its findings mean for the future.
All lectures are free and no tickets or reservations are required. The lectures, which are in the Einstein Planetarium, begin at 7:30 P.M.; doors open 15 minutes prior to the lecture. For more information: 202-357-2700 or www.nasm.si.edu.
Source: Leith Holloway

NASA/GSFC LEP Seminar Laboratory for Extraterrestrial Physics Brown Bag Seminar. The Laboratory for Extraterrestrial Physics (LEP) at NASA's Goddard Space Flight Center conducts weekly science seminars Fridays at noon in Room 8 in Building 2 at Goddard. Since the seminar is conducted during the lunch hour, the audience often brings their lunch.
No information available at press time.
Source: http://lepjas.gsfc.nasa.gov/~seminar/lep_seminar.html

Mid-Atlantic Occultations and Expeditions, June - early September 2000

by David Dunham

Asteroidal Occultations

DATE	Day	EDT	Star	Mag	Asteroid	dmag	Dur s	Ap. in.	Location
Jun 27	Tue	1:30	ZC 2704	6.0	Landgraf	9.9	3	1	Hudson Bay?
Jun 30	Fri	22:49	ACT68470323	11.1	Polana	1.7	7	7	Florida
Jul 10	Mon	21:52	SAO 186303	9.2	Polana	3.8	8	3	Florida
Jul 16	Sun	23:42	SAO 159358	7.2	Marcelle	1.5	8	2	Bermuda
Jul 18	Tue	23:47	PPM 298899	10.4	Bruchsalia	1.3	10	5	Bermuda, Cuba
Jul 19	Wed	22:15	PPM 717475	10.6	Fraternitas	4.7	4	6	Georgia

Grazing Occultations

DATE	Day	EDT	Star	Mag	%	alt	CA	Location
Jul 28	Fri	4:48	SAO 077624	7.8	11-	15	8N	Richmond, VA & Salisbury, MD, Sun-14
Jul 28	Fri	5:43	SAO 077667	7.7	11-	17	8N	Alexandria, VA & Bowie, MD, Sun -5
Jul 28	Fri	6:05	chi1 Ori	4.6	11-	28	-8S	Winchester, VA & Westminster, MD
Aug 23	Wed	3:01	SAO 093927	7.5	44-	27	10N	n. Pittsburgh, PA & n. Ithaca, NY
Aug 23	Wed	4:56	SAO 093963	6.9	44-	53	13N	Nags Head, NC

Total Lunar Occultations

DATE	Day	EDT		Star	Mag	%	alt	CA	Notes
Jun 5	Mon	22:14	D	SAO 97869	7.4	18+	16	50S	Sp. A3
Jun 5	Mon	22:26	D	ZC 1276	6.5	18+	14	65S	Sp. K0
Jun 7	Wed	23:09	D	SAO 99157	7.3	38+	23	84S	Sp. F2
Jun 17	Sat	23:59	R	28 Sgr	5.4	99-	22	60N	ZC 2725; 1998 Saturn event
Jul 8	Sat	23:11	D	80 Vir	5.7	56+	23	16S	ZC 1950; Sp. G6
Jul 14	Fri	0:34	D	58 Oph	4.9	95+	27	81S	ZC 2547; possible close double
Jul 24	Mon	3:29	R	ZC 0291	6.8	51-	33	48N	Sp. G5
Jul 29	Sat	4:54	R	ZC 1051	6.5	4-	6	79N	Az. 68; Sp. K1
Aug 6	Sun	22:59	D	FY Librae	7.1	50+	15	52N	ZC 2135; Sp. M5
Aug 11	Fri	21:16	D	ZC 2785	6.9	91+	25	83S	Sp. G8
Aug 17	Thu	0:48	R	psi3 Aqr	5.0	96-	35	73N	ZC 3428; Sp. A0
Aug 22	Tue	4:53	R	ZC 0516	6.9	54-	56	21S	Sp. G5
Aug 23	Wed	1:55	R	63 Tauri	5.6	44-	17	36S	Sp. A1
Aug 23	Wed	2:38	R	SAO 93913	7.0	44-	25	84S	Sp. F6
Aug 23	Wed	3:24	R	SAO 93938	6.9	44-	33	20S	Sp. K5
Aug 23	Wed	5:15	R	SAO 93962	7.0	43-	54	85S	Sp. F7
Aug 27	Sun	5:21	R	ZC 1287	6.7	6-	12	88N	Sp. A5; in southern Praesepe
Aug 27	Sun	6:15	R	ZC 1297	6.8	5-	22	59N	Sp. A9; Sun -4; in Praesepe
Sep 1	Fri	20:01	D	SAO 139528	7.2	16+	20	39N	Sp. K0; Sun -6
Sep 3	Sun	21:44	D	ZC 2208	7.2	34+	12	67N	Sp. K5
Sep 5	Tue	23:24	D	SAO 185116	6.8	54+	7	71N	Azimuth 236 deg.; Sp. K1
Sep 7	Thu	21:14	D	SAO 187331	7.2	72+	28	40S	Sp. G5
Sep 7	Thu	23:56	D	nu1 Sgr	4.9	72+	15	45S	ZC 2747; K1; mag. 11 2.5" sep.
Sep 8	Fri	0:26	D	nu2 Sgr	5.0	72+	11	57S	ZC 2749; K1; pos. close dbl.

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.

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 http://www.lunar-occultations.com/iota. **Sp**. is spectral type-color, **O, B**, blue; **A, F**, white; **G**, yellow; **K**, orange; **M, N, S, C** red.

Phone the IOTA occultation line, 301-474-4945, for updates and details, or check IOTA's Web site at http://www.lunar-occultations.com/iota which now has an asteroidal occultation section with finder charts and updated path maps. Good luck with your observations.

David Dunham, home 301-474-4722; office 240-228-5609; car 301-526-5590 dunham@erols.com

Meteor Showers
July Radiants

Full Moon: July 16

Major Activity

Radiant	Duration	Maximum
Southern Delta Aquarids (SDA)	July 14-August 18	July 28/29

Minor Activity

Radiant	Duration	Maximum
Alpha Lyrids	July 9-20	July. 14/15
July Phoenicids (PHE)	July 9-17	July. 14/15
Alpha Pisces Australids	July 16-August 13	July. 30/31
Sigma Capricornids	June 18-July 30	July. 10-20
Tau Capricornids	June 2?-July 29	July. 12/13
Omicron Draconids	July 6-28	Jul. 17/18

Daylight Activity – None

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Meteor Showers
August Radiants

Full Moon: August 15

Major Activity

Radiant	Duration	Duration
Perseids (PER)	July 23-August 22	Aug. 12 at 02:40 UT
Northern Iota Aquarids (NIA)	August 11-September 10	August 25/26
Southern Iota Aquarids (SIA)	July 1-September 18	August 6/7
Alpha Capricornids (CAP)	July 15-September 11	August 1/2

Minor Activity

Radiant	Duration	Maximum
Northern Delta Aquarids (NDA)	July 16-September 10	August 13/14
Kappa Cygnids (KCG)	July 26-September 1	August 18
August Eridanids	August 2-27	August 11/12
Upsilon Pegasids	July 25-August 19	August 8/9
Alpha Ursa Majorids	August 9-30	August 13/14

Daylight Activity

Radiant	Duration	Maximum
Gamma Leonids	August 14-September 12	August 25/26

Source:http://comets.amsmeteors.org/meteors

IDA Awarded NSF Grant

At their annual meeting today, the International Dark-Sky Association (IDA) announced a grant from the National Science Foundation.. The IDA seeks to preserve dark skies for the benefit of both professional and amateur astronomers, as well as the general public, by promoting outdoor lighting that focuses light only where it's needed -- toward the ground. The grant totals $150,000, and it will be given to promote organizational development of the IDA.

"The improper use of outdoor lighting is a serious problem for astronomers, the economy, as well as the general public," said Tom Gergely, NSF's director of electromagnetic spectrum management programs. "The nation's leading astronomers agree that, if we want to continue our exploration of the skies, we need systematic efforts to address light pollution. At the same time, communities and businesses can benefit from substantial energy savings, and the public may regain access to the beauty of the night sky."

The IDA organization works with communities, businesses, and professional lighting experts to develop strategies that both reduce the light pollution that hinders observations from optical telescopes and save energy for businesses and communities. It has been estimated that proper lighting – which eliminates light directed skyward that contributes nothing to safety – could result in savings of over a billion dollars yearly for the United States as a whole.

IDA's work is performed almost entirely by volunteers. This grant from NSF will help the IDA expand its membership, develop a firm financial basis, and further develop public awareness of practical solutions to light pollution.

Founded in 1988 as a nonprofit educational organization, the International Dark-Sky Association promotes quality outdoor lighting to control glare, to conserve energy, and to preserve the beauty of our night skies. IDA also works to protect radio astronomers from ever increasing radio frequency interference.

In the past ten years, IDA has gained members from all 50 states and 70 countries, and it is growing rapidly. Working with thousands of volunteers around the world, IDA is committed to solving the problems of light pollution by raising awareness of better outdoor lighting techniques. Everyone wins with energy savings, reduced glare, less light trespass, and improved safety. IDA's members include lighting designers, government planners and zoning officials, environmentalists, lighting manufacturers, astronomers, and other concerned citizens. This broad based membership yields very strong bipartisan support in implementing solutions.

Last summer, IDA coordinated a meeting of the International Astronomical Union to address the problem of light pollution. Held at the United Nations facilities in Vienna, Austria, this special symposium included scientists, engineers, and

(Continued on page 7)

Student Science Fair Projects

Nancy Grace Roman

NCA honored the winners of the 2000 science fair judging at the May NCA meeting by inviting them to dinner before the meeting and having them present their projects at the meeting. President Andrew Secord presented a certificate to each student. NCA also gave each student a one-year membership in NCA which included a one-year subscription to *Sky and Telescope*.

Information on the science fair winners, their project titles, and schools, is listed below, followed by a synopsis of each presentation:

Abigail Fraeman, *Twinkle Twinkle Variable Star: Observing Delta Cephei,* Takoma Park Middle School. Abigail observed δ Cephei for 6 months. She used a program to find it and then compared its brightness with ζ and ε Cep. She recorded the date, time, and weather as well as the brightness. Then she used the published period to superimpose her estimates and thus determine the shape of the light curve. It agreed well with the AAVSO curve.

Brittany M. Hertzog, *Effects of Light Pollution on the Study of the Stars,* Hayfield High School. Brittany studied the effect of light pollution on the number of stars observable in photographs of Orion with identical exposures and printing. She observed the field from three locations: Washington, D.C., Springfield, VA, and Sky Meadows. She divided the field into four areas and counted the stars in each area on each photograph. In Area 4, she counted 203 stars in the picture taken in the country and only 32 on the city picture. In the four areas, the number of stars decreased 42% in the suburb and 80% in the city compared to the country.

Elizabeth Epstein, *Sensitivity of Gaussian Orbit Reduction to Time Spacing,* Montgomery Blair High School. Elizabeth studied the sensitivity of the Gaussian orbit reduction method to the spacing of the observations as well as the number of observations. She observed the asteroids with a 12-inch telescope in California, taking 10-minute exposures. Using three positions from three plates, the accuracies of the elements were about 98% for most of the elements. Using five positions improved the accuracies substantially. She determined that for the best results, the observations should be about 20-22 days apart. In all, she had 4-5 months of observations for 32 asteroids.

Darjush M. Badiei-Boushehri, *Experimental X-Ray Telescope Mirrors,* Eleanor Roosevelt High School. Darjush worked on the development of experimental X-ray telescope mirrors. The mirrors on Chandra are large, heavy glass. They are also expensive. The mirrors under development are only 100 micrometers thick, too thin to sustain a parabolic or hyperbolic shape. But, by making the system long, Darjush and his mentors were able to use flat mirrors packing 300 into the space used by the four Chandra mirrors. A hot wire was used to eliminate problems with edge effects, but burrs must still be removed by hand polishing. These mirrors can be used for either hard or soft X-rays.

Jessica Webbon, *Fe Emissions from K-Shell Vacancies,* Eleanor Roosevelt High School. Jessica determined the Augier spectra of Fe XVI and Fe XVII. (Augier spectra are emitted from the K shell of atoms.) The complete spectra were obtained theoretically in order to identify the lines in X-ray spectra. Lines of Fe XVII from the L shell can also be strong and must be taken into account in interpreting astronomical spectra.

Nathan Kelley, *Star Cluster and Gas Cloud Interaction* Eleanor Roosevelt High School. Nathan observed the interaction of open star clusters and molecular clouds, measuring the velocity difference between the cluster and the cloud. He used Sky View to obtain infrared images. The cloud is so large that the cluster must be behind it in all observed cases. In all cases in the Northern Hemisphere, the cluster is moving away from the cloud.

Sabrina C. Snell, *Improper Motions,* School Without Walls. Sabrina explained that for proper motions, the Nautical Almanac will start soon to use Hipparcos proper motions. There are three groups of binaries for which the Hipparcos motions are in error. She selected 110 stars from each problem group and 110 randomly selected stars in both Hipparcos and ACT that confirmed the problems. The problem groups are doubles in which one star is variable, binaries with periods near 10 years, and long period binaries that show some orbital motion during the Hipparcos measurements.

NSF Grant to IDA, Cont.

(Continued from page 6)

teachers from 25 countries. Humans are cutting themselves off from knowledge about the rest of the universe by enveloping the Earth in a fog of light and radio emissions.

"These problems are global in scale and effect, and long-term in nature. International efforts are needed to resolve them, as the UN already has done for the oceans and the Antarctic continent," said Dr. Johannes Andersen, General Secretary of the IAU.

The problem of light pollution affects much more than astronomers. Wasted light costs billions of dollars that otherwise could be spent for more productive uses. One report presented at the symposium, showed, for example, that **the costs of wasted light measured from space** amount to at least US$720,000 annually in Vienna, $2.9 million in London, $4.2 million in Washington, D.C., and $13.6 million in New York City.

Already, many worldwide communities are facing the problem of light pollution and taking action to solve it. For example, the governor of New Mexico signed the "Night Sky Protection Act" on April 6, 1999. In a similar move last summer, Texas Governor George W. Bush signed HB 916, "Regulation of Outdoor Lighting for All State Funded Activities." The problem is being addressed internationally, with new light pollution laws in Japan, Italy, Australia and Germany.

For additional information, visit IDA's web site at www.darksky.org.

Press Contact: Bob Gent, IDA Public Relations Officer
e-mail: BobGent@aol.com
(703) 751-6805, Washington, D.C. IDA Office
(520) 293-3198, IDA Main Office in Tucson Arizona

Deadline for September *Star Dust*: August 15

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Please send submissions to Elliott Fein at elliott.fein@erols.com.

Text must be in ASCII, MSWord, or WordPerfect. Graphics in BMP is best. Thanks.

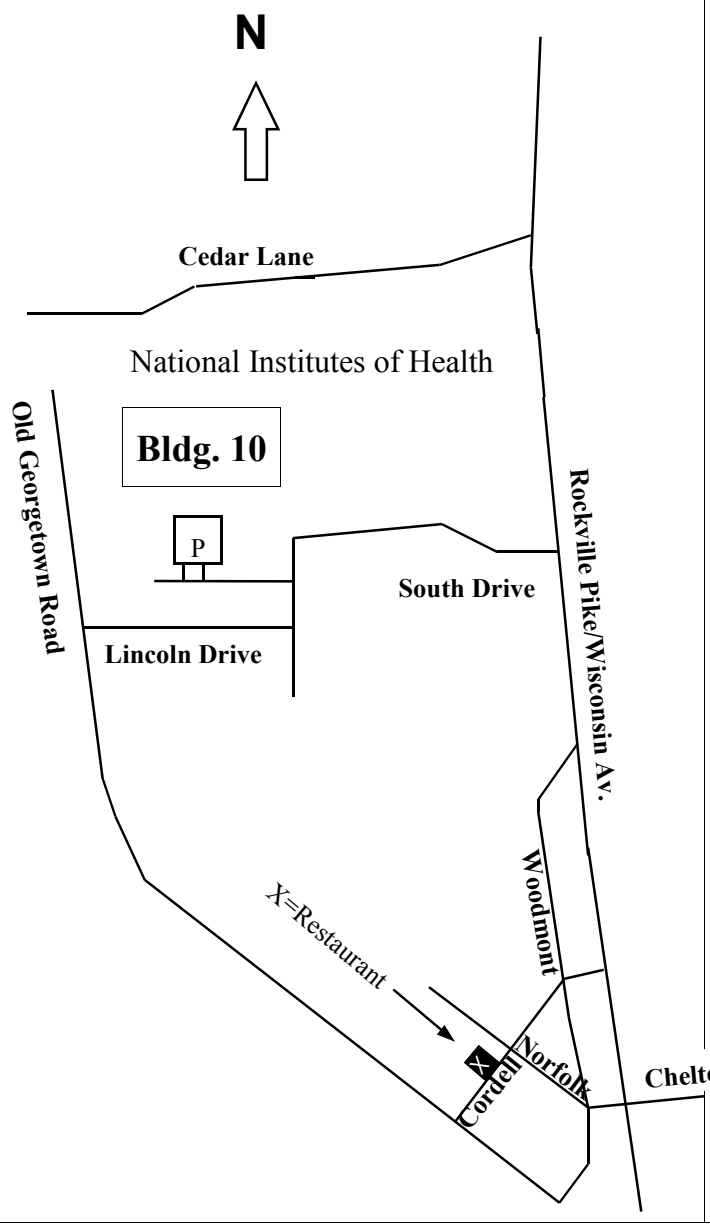
Getting to the NCA Monthly Meeting

Saturday, June 3

5:30 P.M. - Dinner with the speaker and NCA members at

La Panetteria,
4921 Cordell Avenue,
Bethesda MD
301-951-6433

7:30 P.M. - NCA Meeting at Lipsett Auditorium in Building 10 at NIH. Guest speaker: Dr. David Dunham on "Space Rocks: Observed Hitting the Moon, Covering Stars, & by NEAR".



Directions to the Meeting Place

From Rockville Pike (Wisconsin Ave., Rt. 355)
To get to the parking lot at the South entrance (this will be the entrance for the next three years or so until they finish the new wing) from Rockville Pike, enter NIH at the Metro Entrance: South Drive (traffic light). Go straight ahead. At the third stop sign you will be at the parking lot, but you will have to make a left turn then a right to get to the entrance to the lot. Make a right turn into the lot.

From Old Georgetown Rd., enter at Lincoln Drive (traffic light nearest to Suburban Hospital). Go straight ahead. The second stop sign is at a T. Bear left and the lot will be on the right. Make a right turn into the lot.

Metrorail Riders - From Medical Center Metro Station: Walk down the hill, past the bus stops. Continue straight past the anchor. At the second stop sign after the anchor, bear right up the incline into the entrance of Building 10, the tallest building on campus (walking time less than 10 minutes).

Taking the J2 or J3 buses from Silver Spring, get off at the Metro stop and follow the directions given for motorists from that point. If coming from Montgomery Mall, get off at the first stop in NIH, before the Clinical Center. There are signs near the ramp for the garage directing you into the side entrance. Walk straight through the building to the amphitheater.

Directions to the Restaurant

Dinner before the meeting will be at 5:30 PM at

La Panetteria,
4921 Cordell Avenue,
Bethesda MD

301-951-6433

If coming from the District, when going north on Wisconsin Avenue, ignore all signs for Woodmont Avenue until you pass Old Georgetown Road on your left. (Those signs put you on the wrong end of Woodmont Ave., which becomes one-way against you.) Once past Old Georgetown Rd., follow the directions below.

If coming from south of Bethesda, go north on Wisconsin Ave., turn left onto Cheltenham (traffic light). Go straight to go onto Norfolk Ave. Turn left on Cordell Ave. The restaurant will be on your right, half-way down the block..

If coming from north of Bethesda, go south on the Rockville Pike (Rt. 355). As you pass NIH, make a right onto Woodmont Ave. Turn right onto Cordell Avenue. The restaurant is on your right, one-half block past Norfolk Ave.

After dinner, go North (Northeast) on Cordell Ave. to Woodmont Ave. Make a left onto Woodmont. Take Woodmont Ave. north to the traffic light at Rockville Pike (=Wisconsin Avenue) and turn left. Proceed north on the Rockville Pike and follow "directions to the meeting place" at the top of this page.

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Editor: Elliott Fein, Editorial Advisor: Nancy Byrd, Artistic Advisor: Adele Fein.

National Capital Astronomers, Inc.

Andrew W. Seacord, II, NCA President, aseacord@erols.com, 301-805-9741 home.
Nancy Byrd, NCA Vice-president, byrd@cais.com, 703-978-3440 home.
Nancy Grace Roman, NCA Secretary, ngroman@erols.com, 301-656-6092 home, 301-286-7537 GSFC.
Jeffrey Norman, NCA Treasurer, jeffrey.norman@ferc.fed.us, 5410 Connecticut Avenue, NW, Apt. #717, Washington, D.C. 20015-2837
Harold Williams, NCA Webmaster, hwilliam@mc.cc.md.us, 301-650-1463 planetarium, 301-565-3709 home.
Leith Holloway, NCA contact for Junior members, jleithh@aol.com, 301-564-6061, please no calls during 6-8 pm.
Elliott Fein, NCA Star Dust Editor, elliott.fein@erols.com, 301-762-6261 home.
NCA Web Page: http://capitalastronomers.org/

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NCA is a nonprofit, membership-supported, volunteer-run, public-service corporation dedicated to advancing astronomy, space technology, and related sciences through information, participation, and inspiration, via research, lectures, presentations, publications, expeditions, tours, public interpretation, and education. NCA is the astronomy affiliate of the Washington Academy of Sciences. All are welcome to join NCA.

SERVICES & ACTIVITIES:

Monthly Meetings feature presentations of current work by researchers at the horizons of their fields. All are welcome; there is no charge. *See* monthly *Star Dust* for time and location.

NCA Volunteers serve in a number of capacities. Many members serve as teachers, clinicians, and science fair judges. Some members observe total or graze occultations of stars occulted by the Moon or asteroids. Most of these NCA members are also members of the International Occultation Timing Association (IOTA).

Publications received by members include the monthly newsletter of NCA, *Star Dust*, and an optional discount subscription to *Sky & Telescope* magazine.

Consumer Clinics: Some members serve as clinicians and provide advice for the selection, use, and care of binoculars and telescopes and their accessories. One such clinic is the semi-annual event held at the Smithsonian Institution National Air and Space Museum.

Fighting Light Pollution: NCA is concerned about light pollution and is interested in the technology for reducing or eliminating it. To that purpose, NCA is an Organization Member of the International Dark Sky Association (IDA). Some NCA members are also individual members of IDA.

Classes: Some NCA members are available for educational programs for schools and other organizations. The instruction settings include star parties, classroom instruction, and school-teacher training programs that provide techniques for teaching astronomy. NCA sponsors a telescope-making class, which is described in the Star Dust "Calendar of Monthly Events".

Tours: On several occasions, NCA has sponsored tours of astronomical interest, mainly to observatories (such as the National Radio Astronomy Observatory) and to the solar eclipses of 1998 and 1999.

Discounts are available to members on many publications, products, and services, including *Sky & Telescope* magazine.

Public Sky Viewing Programs are offered jointly with the National Park Service, the Smithsonian Institution, the U.S. Naval Observatory, and others.

NCA Juniors Program fosters children's and young adults' interest in astronomy, space technology, and related sciences through discounted memberships, mentoring from dedicated members, and NCA's annual Science Fair Awards.

Fine Quality Telescopes up to 36-cm (14-inch) aperture are available free for members' use. NCA also has access to several relatively dark-sky sites in Maryland, Virginia, and West Virginia.

YES! I'D LIKE TO JOIN THE NATIONAL CAPITAL ASTRONOMERS

Enclosed is my payment for the following membership category:

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  [ ] *Sky & Telescope* and *Star Dust*. ($45 per year)
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Street or Box Apartment City State Zip Code + 4

If this is for a family membership, please list the names of the additional participating immediate family members in same household with birth dates of all those under 18 years old: _____

Note: If you already subscribe to ***Sky & Telescope***, please attach a recent mailing label. You may renew this subscription through NCA for $27 when it expires.

Make check payable to: **National Capital Astronomers, Inc.**, and send with this form to:

NCA c/o Jeffrey B. Norman, 5410 Connecticut Avenue, NW, Apt. #717, Washington, D.C. 20015-2837.

The following information is optional. Please indicate briefly any special interests, skills, education, experience, or other resources which you might contribute to NCA. **Thank you, and welcome to NCA!**

_____

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Inside this issue

- David Dunham to speak on "Space Rocks: Observed Hitting the Moon, Covering Stars, & by NEAR"
- Review of Nicholas White's talk: "Cosmic Journey to the Edge of Gravity, Space, and Time".
- NCA Science Fair Winners' Presentations