Star Dust

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253 Mathilde: Spacecraft Imaging of a C-Type Asteroid

by Dr. Lucy McFadden

The next meeting of the National Capital Astronomers will be held the first Saturday, June 6, at 7:30 P.M. in the Lipsett Auditorium of Building 10, the Clinical Center, at the National Institutes of Health (NIH). Our speaker, Dr. Lucy McFadden, will be speaking on the results of the Near Earth Asteroid Rendezvous (NEAR) spacecraft's flyby of Mathilde en route to Eros.

Abstract

The NEAR spacecraft was launched on February 17, 1996 with a Delta II rocket. The purpose of the NEAR mission is to rendezvous with the near-Earth asteroid 433 Eros and orbit the S-type asteroid for 13 months, during which time data on its size, mass and composition will be obtained. The trajectory to Eros was designed to take advantage of another asteroid, 253 Mathilde, a C-type asteroid in the main asteroid belt. On June 27, 1997, the NEAR spacecraft made a flyby of Mathilde.

Biography

Dr. Lucy McFadden is a planetary scientist at the University of Maryland's Astronomy Department. Her field of expertise is the solar system. She received her undergraduate degree from Hampshire College, Amherst, MA, in 1974, an MS from the Massachussetts Institute of Technology, 1977 and a PhD in Geology & Geophysics from University of Hawaii, 1983. She has been a National Science Foundation Visiting Professor and is currently faculty director of the Science, Discovery & the Universe Program of the College Park Scholars.

In addition to teaching and research she has served on the National Research Council's Committees on Data Management and Computation (CODMAC), and Planetary and Lunar Exploration (COMPLEX) as well as the editorial board of Icarus, the International Journal of Solar System Research.

Dr. McFadden has coauthored over 50 research papers in refereed publications. She played a lead role in coordinating the worldwide effort to observe Comet Shoemaker-Levy 9's collision with Jupiter in 1994. She is currently a member of NASA's science team for NASA's NEAR mission, which will orbit asteroid 433 Eros beginning January, 1999. She is presently the Vice President of Explore-It-All Science Center, a non-profit informal science education center for children of all ages under development in Montgomery County. ○

NCA Science Fair Winners

1. Andrew Waterman, from Montgomery Blair High School, Silver Spring, Maryland, project: "Morphology and Rotation Stability of Virgo Cluster Spiral Galaxies: A Study of the Relation Between Galaxy Evolution and Cluster Structure."

2. Meredith C. Kratzer, from Madison High School, Vienna, Virginia, project: "The Research and Analysis of Solar Activity and Its Effects."

3. Anne Gaumond, from Oxon Hill High School, Oxon Hill, Maryland, project: "Chaos in the Asteroid Belt II."

4. David Tucker, from Eleanor Roosevelt High School, Greenbelt, Maryland, project: "Phenomena of Earth-Like Bodies."

NCA Election Results

All officers for 1998-99 were elected by unanimous vote.

Andrew Seacord — President
Nancy Byrd —Vice President
Nancy Roman — Secretary
Jeff Norman — Treasurer
Wayne Warren — Trustee
John Menke —Trustee

Calendar of Monthly Events

The Public is Welcome!

NCA Home Page: http://myhouse.com/NCA/home.htm

Mondays, June 1, 8, 15, 22, and 29, 7:30 PM - Public nights at U.S. Naval Observatory (USNO), 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. Home page: http://www.usno.navy.mil.

Tuesdays, June 2, 9, 16, 23, and 30, 7:30 PM - Telescope making classes at Chevy Chase Community Center, Connecticut Avenue and McKinley Street, NW. Information: Jerry Schnall, 202/362-8872.

Fridays, June 5, 12, 19, and 26, 7:30 PM - Telescope making classes at American University, McKinley Hall Basement. Information: Jerry Schnall, 202/362-8872.

Saturday, June 6, 5:30 PM-Dinner with the speaker, science fair winners, and other NCA members at Shakey's Pizza at the corner of East-West Highway and Wisconsin Ave., Bethesda, MD. *See* map and directions on back page.

Saturday, June 6, 7:30 PM-NCA meeting, will feature Dr. Lucy McFadden, NASA/Goddard Space Flight Center, speaking on the results of the NEAR spacecraft's flyby of Mathilde en route to Eros. For directions, *see* map and directions on back page.

Fridays, June 12, 19, 26, July 3, 17, 24, 31; 9:30 PM Open nights with NCA's Celestron C–14 telescope at Ridgeview Observatory; near Alexandria, Virginia; 6007 Ridgeview Drive (off Franconia Road between Telegraph Road and Rose Hill Drive). Information: Bob Bolster, 703/960-9126. Call before 6:00 PM.

Saturdays, June 20*, July 25, 9:00 PM, and Aug 22, 8:30 PM - Exploring the Sky. Sessions are held at Rock Creek Park, in the field south of the intersection of Military and Glover Roads, near the Nature Center. Free to the public. Information: 202/426-6829. *Father's Day and Summer Solstice June 21.

See page 8 for more Washington area astronomical events. Other events too numerous to list in *Star Dust* are listed in the publications, *Sky & Telescope*, the *Astronomical Calendar 1998*, the *Observer's Handbook 1998*. NCA members can purchase all these (and much more) at a discount. Information can also be found in numerous software packages, and links available on the NCA Home Page (*see* above for address). To join NCA, use the membership application on page 9.

Speakers Review, May 1998

by Nancy Byrd

In the wake of a mix-up concerning our meeting date, not one, but two speakers informed and entertained NCA members on the evening of May 9, 1998 in Lippsett Auditorium. First, David Dunham introduced Yasuhiro Kawakatsu, chief mission designer for the SELENE project, who spoke to us about this impressive Japanese space effort. The second was our own Harold Williams, who gallantly made up for NCA's solar information deficit with a replacement talk of his own on the role of the Sun in climate change. We hope that Kenneth Shatten, the originally scheduled speaker, will be able to talk to us on the same subject in the coming year. Certainly, Harold's talk gave us a much better foundation for Dr. Shatten's topic.

The SELENE Project

Dr. Kawakatsu described the SELENE project, a joint project of two Japanese space agencies: the Institute of Space and Astronautical Science (ISAS) and the National Space Development Agency of Japan (JASDA). The name, SELENE, an acronym for "SELenological and Engineering Explorer", is taken from "Selene," the name of the moon goddess and wife of Zeus in Greek mythology. The SELENE project's objective is to obtain scientific data about the origin and evolution of the Moon and to build Japanese space technology for future lunar exploration and exploitation. SELENE is scheduled to launch in 2003.

SELENE will consist of a lunar orbiter in polar orbit at 100 km altitude

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SELENE, continued from page 2

and a relay satellite which will orbit the Moon at the apolune altitude of 2400 km. The orbiter consists of two parts: a propulsion module and a mission module. These two parts will function together for the first year, with the mission module performing the mapping part of the mission and the propulsion module supplying the required power. At the end of the year, the propulsion module will separate from the mission module and land on the Moon. This phase will demonstrate several technologies: soft-landing, and thermal control and energy storage to facilitate survival in the extreme temperature differences found on the Moon.

SELENE will carry 14 different instruments:

- an x-ray spectrometer for measuring Al, Si, Mg, and Fe distribution,
- a gamma-ray spectrometer to measure U, Th, and K distribution,
- a multiband imager for imaging in 9 spectral bands ranging from 0.4 to 1.6 υm (spanning from ultraviolet (UV) to the infrared (IR) wavelengths),
- a spectral profiler for producing a continuous spectral profile ranging from 0.5 to 2.6 υm,
- a high resolution stereo terrain camera,
- a RADAR sounder for mapping lunar subsurface structure,
- a LASER altimeter,
- differential VLBI radio source for selenodesy and gravitational field measurements (can use all three modules),
- a relay satellite transponder to aid measuring far-side gravimetry,
- a magnetometer for the measuring of the lunar magnetic field,
- a plasma imager for measuring the Earth's plasmasphere from lunar orbit,
- a charged particle spectrometer for measurement of high energy particles (ranging from 1 - 30 MeV and 8 - 300 MeV) and an alpha particle detector (4 - 6.5 MeV),
- a plasma analyzer, and
- a device for measuring the tenuous lunar ionosphere using S and X-band carriers.

Data from the SELENE project should greatly increase our understanding of the Moon, hopefully leading to the goal of solving the mystery of how this Moon came to be in orbit around the Earth.

The Sun - Earth Connection and HESSI

Our president, Dr. Harold Williams gave us a talk entitled, "The Sun-Earth Connection and HESSI," where HESSI stands for "High Energy Solar Spectroscopic Imager." He began by talking about sunspots and described these as magnetic storms. Sunspots were among the first features noticed about the Sun after the telescope was invented and astronomers pointed them at the Sun, about 1611. Dr. Williams showed the north and south poles of sunspots and described the differences in polarity between sunspots in the southern and the northern hemispheres. This polarity reverses every 11 years. He also presented a diagram showing a loop structure of magnetic lines between sunspots which represents current understanding of their nature. Although sunspots are roughly 1000K cooler than their surroundings, periods with many active sunspots correspond to higher average temperatures on the Sun. This is also a time of increased magnetic activity.

The Sun is a differential rotator, with a two or three day difference in period between the rotation of the equator and poles. This rotation can be mapped by looking at the positions of sunspots on the surface. Horace Babcock, in the sixties or before, showed that because the plasma is so hot, the Sun's magnetic field is roughly polar (field lines want to point North-South). Because the Sun has a differential rotation, the magnetic field lines become stretched, with maximum stretching at the equator, in the direction of rotation. When the field lines become dense, they inhibit the motion of the plasma in the convection zone. Eventually the magnetic field lines relax. This relaxation produces cooling.

We don't know why the sunspot cycle is roughly 11 years (22 years full cycle) or why there is considerable variation in the cycle. We observed that sunspots start in high latitudes and move to low latitudes, and that some solar maxima (highest number of sunspots) are bigger than others.

Shortly after sunspots were discovered, they disappeared. This period from about 1650 to 1720, is known as the Maunder minimum, after the 18th century British astronomer. Sunspots were so infrequent at this time that each time one was observed, somebody published a paper on it. During this time, the Earth became significantly colder, a mini ice age. It became so much colder that you could walk from Denmark to Sweden every winter; this doesn't happen now. Moreover, during Viking times, several hundred years earlier, it appeared there was an exceptionally warm period, as documented in tree rings of the exceptionally long-lived Bristlecone Pine. (Trees grow more in warm years than in cold years.) Was this also a period of high sunspot activity?

We think we can answer this question: when the sun is active, it has a larger magnetic field. This magnetic field shields us from cosmic rays. As Harold Williams explained, high energy cosmic rays transmute naturally occurring ^{14}N (a stable atmospheric component, nitrogen) to ^{14}C (a long-lived radioactive nuclide, half-life 5730 years). We see from measurements of ^{14}C in tree rings that the Maunder Minimum corresponds to a sharp increase in ^{14}C abundance, but we also see that ^{14}C abundance was low during Viking times. Dr. Williams noted that short term variations in solar output may not greatly affect our weather, but that these longer variations (e.g., 70 years) do, pointing out that weather is greatly influenced by the oceans and their averaging of the energy input to the Earth. Harold issued a plea for more study of the Sun in order to protect ourselves and so that we can separate solar effects from anthropogenic effects such as increased greenhouse gases from burning fossil fuels.

Dr. Williams guided NCA on a rich picture tour of the Sun, calling attention to the many different features which have been observed at visible and other wavelengths. Among these, he showed spectra from solar flares, and models of the interior of the Sun, showing the core, the convection zone, the radiation zone, etc.

Dr. Williams concluded his talk with a description of HESSI, one of NASA's new smaller-faster-cheaper

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Mars!

A Review of a Presentation Given By Douglas P. Hamilton

Reviewed by Andrew W. Seacord, II

Dr. Hamilton, Assistant Professor of Astronomy at the University of Maryland, presented an excellent talk on Mars at the April 4th NCA meeting. He introduced Mars with a globe of the red planet, calling our attention to the polar caps. The main theme of his talk was the history of the Martian climate and water budget. He noted that Mars is a promising place to find life, past and present.

We were given a brief history of observations of Mars. First he showed a chart, or map, of Mars made by Giovanni Schiaparelli and pointed out the linear features which Schiaparelli called canals. He also noted that Schiaparelli observed that some features showed seasonal variations. Another slide presented Percival Lowell's map of Mars which showed linear features connecting dark areas. Lowell interpreted these linear features as being canals made by an intelligent civilization for the purpose of bringing water from the polar caps to the dark, arid regions which showed seasonal color variations. Lowell concluded that they were areas of vegetation. The Schiaparelli and Lowell maps were followed by photographs made through Earth-based telescopes which disclosed more detail of the polar caps. They showed, for example, that in 1971, the polar caps were larger than they were in 1973.

Photographs of the polar caps taken from the Mariner 7 and 9 spacecraft show that the northern cap has a layered structure. A slide presenting an artist's conception of the polar cap surface suggests that the rocky surface under the cap is terraced with an ice layer on top of each terrace.

Mars rotates on an axis which makes an angle of about 25° with the plane of its orbit. This tilt, or obliquity, causes the seasons. It is well-known that the size of each cap changes with the season, being larger during the winter in the respective hemisphere. Dr. Hamilton discussed answers to the questions,"Where do the polar caps go in the off-season" and "What are the polar caps made of"?

The polar caps have two components. In the winter, each cap has a water ice cap on the bottom with a carbon dioxide ice ("dry ice") cap over it. Under the atmospheric pressure of Mars (and Earth, also), carbon dioxide sublimates; that is, it changes directly from the solid phase (dry ice) to the gas phase without becoming a liquid.

Dr. Hamilton explained the seasonal variation of polar cap size. Mars orbits the sun in an ellipse, the sun being located at one focus of the ellipse. When Mars is closest to the sun (perihelion), the southern cap is pointed toward the sun. The solar radiation is enough to sublimate the dry ice cap (and melt some of the water ice cap) leaving a residual water ice cap. At this time, the northern cap points away from the sun and receives less radiation and the temperature becomes cold enough that carbon dioxide "freezes" out, forming a dry ice cap over the water ice cap. Consequently, the southern cap gets smaller and the northern cap gets larger. At perihelion, Mars is moving with its largest orbital speed, so this condition lasts for a relatively short time, limiting the buildup, or size, of the northern cap. As Mars moves to its largest distance from the sun (aphelion), the polar alignment is reversed so that the northern cap becomes pointed toward the sun and the southern cap pointed away. Therefore the southern dry ice cap builds up and the northern cap decreases in size; the dry ice cap sublimates into the atmosphere. At aphelion, Mars is moving with the slowest orbital velocity and, therefore, it spends relatively more time with the southern cap pointing away from the sun. Consequently, there is longer time for the southern dry ice cap to build up and northern cap to sublimate. The southern dry ice cap is, therefore, larger than the northern dry ice cap. The northern water ice cap, however, remains larger than the southern water ice cap.

Analysis of the Martian atmosphere shows it to be composed of 95% carbon dioxide, 3% nitrogen, 1.5% argon, and 0.5% water vapor, carbon monoxide, and hydrogen. The average Martian atmospheric density is about 1% of the Earth's. Even though water makes up less than 0.5% of the Martian atmosphere, it can be seen in clouds which also contain dry ice crystals.

The Martian atmosphere contains a considerable amount of dust. Dust storms have been known to cover most of the Martian globe. The Viking 1 and 2 lander photographs show clear evidence of dust which gives the surroundings a reddish haze.

When carbon dioxide sublimates from a polar cap, it becomes part of the Martian atmosphere. During the southern hemisphere summer (at perihelion),

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spacecraft. HESSI is a spacecraft with an imaging spectrometer for obtaining high fidelity color movies of solar flares in hard x-rays and gamma rays, the first of its kind. The primary mission objective is to explore the physics of particle acceleration and energy release in solar flares. It will be launched in mid 2001 into a circular orbit of 600 km altitude and 38 degrees inclination to the equator. With this timing, the mission should operate throughout the next solar maximum during its 3 year lifetime. The instrument will have 9 segmented germanium crystal detectors cooled to 75K and will have new technology, rotating, fine grids for imaging. There is much to learn about the Sun. For instance, we don't know which way the energy moves in a solar flare. HESSI will have sufficient resolution to be able to answer this and many other questions about high energy solar flares.

The talk was followed by a lively debate of the relative importance of various climate factors. Thanks, Harold and Yasuhiro, for converting the mix-up of the meeting date into a most pleasant and informative evening. ○

the sublimation of the dry ice cap releases carbon dioxide fast enough that a wind develops from the pole toward the equator. Enough gas is released to increase the atmospheric pressure by 30%. In other words, at aphelion, about one third of the Martian atmosphere forms the south polar cap. The wind picks up dust from the surface, causing dust storms. Since the atmospheric pressure is so low, the wind speed must be high in order to move the dust.

The next part of Dr. Hamilton's presentation took us to the Martian surface and the well-known attractions Olympus Mons and Valles Marineris. Olympus Mons is the largest known volcano in the solar system. The concern with volcanism here is its influence on the Martian atmosphere during the time when the volcano was active. Exactly what the volcanoes pumped into the atmosphere is unknown, but the gas from volcanic eruptions may have contributed significantly to the atmosphere so that the pressure was enough to allow liquid water to flow in large quantities.

Another surface feature discussed is Valles Marineris (the Mariner Valley). It is a large canyon feature about 5000 km long and 2 km deep in places. Was it created by flowing water as in the case of the Earth's Grand Canyon? Although there is evidence of water having flowed through parts of it, the question is "Was there enough water flowing for a long enough time to carve out such a feature?" It is thought that Valles Marineris may have been created by a tear in the surface as part of the crust contracted or shifted.

There is, however, other evidence of flowing water. Other surface photographs taken by orbiting spacecraft clearly show dendritic (branched) channels reminiscent of streams or rivers. One might question whether these were due to lava flows rather than flowing water. For water flow, the channels would become wider down-stream, whereas for lava flows, the width of the channels would remain fairly constant. Also, water flow channels would meander whereas lava channels are usually relatively straight. Since the dendritic channels do show a noticeable widening and meandering, we can conclude that they were probably created by water. Also, we were shown a slide with teardrop shaped flow pattern in the soil around a small crater, a feature reminiscent of large-scale water flow.

The major questions are now: "Why is there no water flowing now" and "Where did the water, flowing in the past, go"? The answer to the first question is that, at the present time, the atmospheric pressure is much too low for liquid water to exist on the surface. So, where did all of the water go? We know that some of it is permanently stored in the polar caps and we see water ice crystal clouds. Some of the water must have escaped into space as the atmosphere pressure dropped. It is suspected, however, that a significant amount of water exists in the surface as permafrost and some water may be chemically bound in surface rocks.

Dr. Hamilton discussed the effect of satellites on the stability of the planet's rotation axis and atmosphere. Mars has two satellites Deimos and Phobos. Phobos, the inner satellite, is nonspherical, and has a major diameter of about 27 km. Spacecraft photographs show a large crater (Stickney), many small craters, and striations on its surface. The striations are presumably stretch marks resulting from stretching or compressions of the surface. Deimos, the outer satellite, is also nonspherical, and has a major diameter of about 15 km. Because of their small size and distance from Mars, neither satellite can cause a solar eclipse. From the surface of Mars, they make "dandy transits". The shadow of Phobos disappears at about one half of its distance from Mars. The orbital period of Phobos (7.3 hours) is less than the rotation period of Mars (24.5 hours). So, Phobos rises in the west and sets in the east. The orbital period of, Deimos (30.3 hours) is greater than the Martian day; so it rises in the east and sets as the Earth's moon does. The main importance here, however, involves their tidal interaction with Mars. The tidal interaction of both satellites alters the shape of Mars as well as the length of the Martian day and the direction of the Martian spin axis. Also as result of this tidal interaction and its orbital period being less than the Martian rotation period, Phobos is spiraling in toward Mars and will break up or impact in about 40 million years. Meanwhile, Deimos is spiraling outward.

The Martian rotation axis is now about 25 degrees with respect to the Martian orbit; that is, its obliquity is about 25 degrees. However, the obliquity is far from constant and will vary between 0 and 60 degrees during the next few million years. The Earth's obliquity, by contrast, is about 23.5 degrees and will remain relatively constant. The relevant difference between the cases of Mars and the Earth is the size of the satellite(s) relative to the size of the planet. The Earth's Moon is very large in relation to the Earth's size and mass and has a stabilizing influence on the Earth's rotation axis, keeping the Earth's obliquity fairly constant. Partly as a consequence of this, changes to its atmosphere are relatively small over a long period of time, allowing the development of advanced life forms (us!). In contrast to this is the case of Mars which has two dinky satellites that are too small to provide rotation axis stability. The resulting wobble has had, and will have, a dramatic effect on the Martian atmosphere and climate by the amount of sunlight received on a particular unit of surface area.

The remainder of Dr. Hamilton's presentation consisted of responses to questions from the audience. One question was "How old was Mars when its liquid water disappeared?" The answer was that liquid water might have been there for at least the first 100 million to a billion years or so when the volcanoes were active. Volcanic gases would have maintained the atmosphere pressure large enough to allow water to remain in the liquid state.

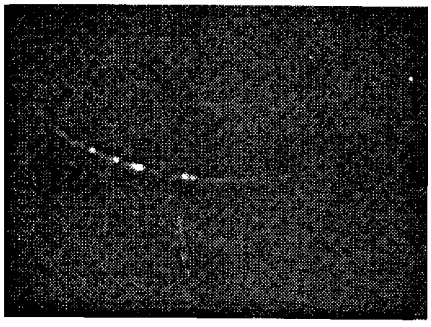
Another question was about the origin of Deimos and Phobos: "Were they captured asteroids?" The answer to this is still open. They do not have orbits that would have resulted from a capture; a large, eccentric, retrograde orbit with, probably, a significant inclination to the Martian equator.

We thank Dr. Hamilton for an informative presentation, very well done. ○

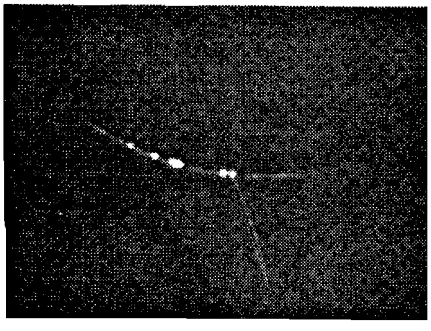
Newsletter Deadline for September *Star Dust*, August 15, 1998

Some Like It Out On The Edge

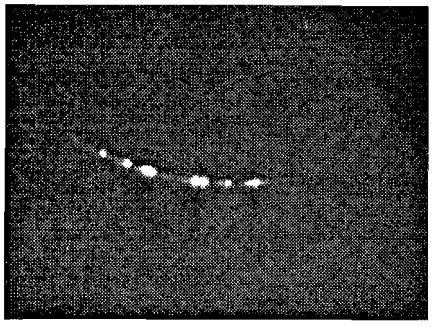
by Wayne H. Warren, Jr.



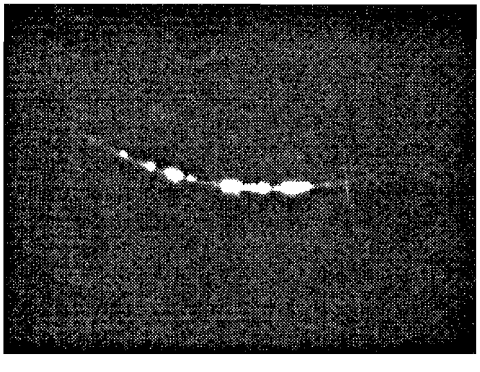
181400 UT



181402 UT



181407 UT

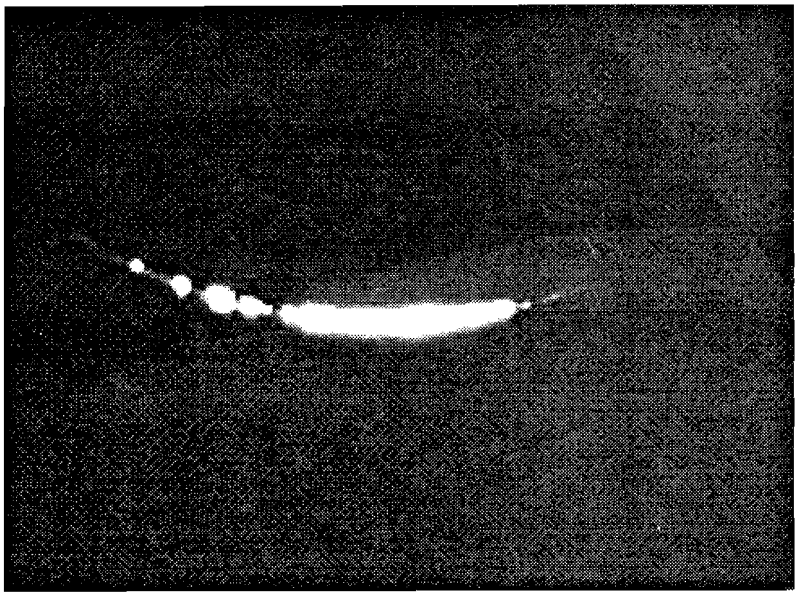


181411 UT

A small group of our eclipse expedition observers went to the southern edge of the February 26 eclipse path to accurately record and time the Baily's bead phenomena that occur near the beginning and end of totality (2nd and 3rd contacts). Accurate timings from the edges of the eclipse path can be compared against lunar limb topography to deduce highly accurate path edges, which give a measure of the solar diameter with respect to the Moon at the time of eclipse. Diameter measurements at different eclipses can in turn be correlated with the solar luminosity and, thus, the solar irradiance and amount of energy striking the Earth at different times. Since there are strong indications from other studies that the Sun's diameter changes over the solar cycle and that there are, possibly, longer term variations, studies of solar radius changes over long periods of time can give us some indication as to whether or not global climatic changes are strictly a result of recent increases in greenhouse gases in our atmosphere, or may be due also to intrinsic changes in solar energy output.

Most of us are familiar with grazing occultations of stars by the Moon. The path edges of a solar eclipse provide similar geometries; i.e., they are grazing incidence occultations of the Sun by the Moon. While the Baily's beads are seen only very briefly toward the center line, the edge geometry provides several minutes of visible bead phenomena. Such is also the case with the chromosphere, which can be observed only in a flash near the center (thus the term 'flash' spectrum), but can be seen for much longer periods from the edges.

The accompanying series of images shows the progression of bead phenomena at the southern edge of the February 26 eclipse in Curaçao. They are single frames from the video record of Richard Nugent, an IOTA member from Houston, Texas. Richard used a frame grabber to select particular frames that demonstrate the formation of beads by different lunar valleys as totality approached. IOTA edge expeditions in Curaçao included NCA members Jay Miller, Irv Price, and Martha and Wayne Warren; in Venezuela, David Dunham went to the northern edge on the island of Los Monjes with Venuzuelan astronomers, while Joan and William Dunham observed from the mainland at the southern edge. Video records were obtained at all sites, so a considerable amount of data reduction work must be done. ❍



181419 UT

Grazing Occultations, 1998 June - September

DATE	Day	EDT	Star	Mag	%	alt	CA	Location
Jul 29	Wed	00:19	Porrima	2.9	28+	21	1N	Red Rock Canyon, CA (double)
Jul 31	Fri	21:44	xi1 Lib	5.8	55+	31	2N	Beaufort, NC (& Benson, NC)
Aug 17	Mon	05:14	SAO 94927	7.1	23-	34	6N	Harrisburg, PA
Sep 12	Sat	00:58	ZC 680	6.7	60-	17	8N	north of Bedford, PA
Sep 12	Sat	03:29	Aldebaran	0.8	59-	45	10N	Bedford, PA
Sep 12	Sat	05:28	SAO 94056	8.3	59-	64	8N	east of Hancock, MD

Porrima (gamma Virginis) is a double star, consisting of two equal 3.5-mag. components separated by 2.0" in P.A. 271 deg. September 12 offers a rare chance to observe 3 grazes in one night, including the best graze of Aldebaran in the current series for the Midatlantic region. The annual IOTA meeting will be held that weekend, Sep. 12 pm to Sep. 13 am, in Nashville, TN, so we might observe there if the weather forecast is better farther west.

Asteroidal Appulses, 1998 June - August

DATE	Day	EDT	Star	Mag	Asteroid	dmag	dur. s	ap. in.	Location
Jul 21	Tue	01:21	T-10d 6880	11.1	Elpis	1.0	16	8	Florida
Aug 2	Sun	00:40	T-02d 14637	11.2	Veritas	1.9	14	8	Outer Banks
Aug 20	Thu	21:36	SAO 210535	9.1	Argentina	4.9	19	3	New England

The path location is rather uncertain for each of these, since none of the stars involved are in either of the accurate star catalogs (Hipparcos and ACT) that are now available; so for each, there is a chance that they could occur in the Maryland - DC - Virginia area. Astrometry during the month before each event will enable the paths to be predicted more accurately. There are no grazes or asteroidal appulses worth trying in the DC region during June.

Phone the IOTA occultation line, 301-474-4945, for updates and details; for asteroidal occultations, these and finder charts can be found on IOTA's Web site at http://www.anomalies.com/iota/splash.htm.

International Occultation Timing Association (IOTA) Meeting

This year's annual meeting of the International Occultation Timing Association (IOTA) will be held in Nashville, Tennessee, on Saturday, September 12 and Sunday, September 13. The meeting will begin at 3 pm Saturday, to give observers of that morning's grazing occultation of Aldebaran time to recuperate or to travel from possibly distant locations. An informal reception will start at 1 pm for those already in the Nashville area. The Aldebaran graze passes only about 20 miles northwest of Nashville and there will bea local expedition that others can join, weather permitting. The meeting will last until 10 pm, with a break for dinner. The after dinner part of the meeting will probably be conducted as an occultation workshop. The formal meeting will resume at 9 am Sunday morning, concluding by noon to give attendees a chance to return home that afternoon and evening. Scott Degenhardt (e-mail dega@nashville.com; phone 615-895-0244) is the local organizer for the meeting, more information about which will soon be available on IOTA's Web site (http://www.sky.net/~robinson/iotandx.htm).

Meteor Shower Events

Note: Though there are three events in June, they are too close to the sun for observation.

Shower	Duration	Maximum	R.A.	Dec.	ZHR
Pegasids	July 7-13	July 10	22h 40m	+15	3
Phoenicids	July 10-16	July 13	02h 08m	-43	3-10
Piscis Austrinids	July 15-Aug. 10	July 28	22h 44m	-30	5
Delta Aquarids (South)	July 12-Aug. 19	July 28	22h 36m	-16	20
Alpha Capricornids	July 3-Aug. 15	July 30	20h 28m	-10	4
Delta Aquarids (North)	July 15-Aug. 25	Aug. 8	22h 02m	-05	4
Iota Aquarids (North)	Aug. 11-31	Aug. 20	21h 48m	-06	3
Perseids	July 17-Aug 24	Aug. 12	03h 04m	+57	110-400

National Capital Area Astronomical Events

Free Lectures at the Einstein Planetarium and Other Daily Events
National Air & Space Museum

202/357-1550, 202/357-1686, or 202/357-1505 (TTY)
Home page: http://www.nasm.edu

Other Area Astronomical Events

Carnegie Institution of Washinton/Department of Terrestrial Magnetism (CIW/DTM) — Seminars are held on Wednesdays at 11:00 AM in the Seminar Room of the Main Building.

"Terrestrial Planet and Asteroid Formation in the Presence of Giant Planets," Speaker Stephen Kortenkamp, Dept. of Terrestrial Magnetism, CIW, June 10.

Maryland Space Grant Observatory — Open House every Friday evening (weather permitting), Bloomberg Center of Physics and Astronomy, Johns Hopkins University, Baltimore, MD. Information: 401/516-6525 or check their web site at www.pha.jhu.edu/facilities/observatory/telescope.html

NASA/Goddard Space Flight Center, Laboratory for Astronomy and Solar Physics (LASP) Seminar — All seminars will take place in Bldg. 21, Room 183A and will begin at 3:30 PM.

"Astronomy with a Small Telescope: Starburts and Active Glaxies," speaker Kiran Singh Baliyan, Physical Research Lab, Ahmedabad, India.

Scientific Colloquia, Goddard Space Flight Center — All colloquia will be held in the Building 3 Auditorium at 3:30 PM.

"Our Sun: Puzzles and Surprises," speaker: John C. Lindsay Memorial Lecture, Eric Priest, University of St. Andrew's, June 5.

Space Telescope Science Institute (STScI) — Free lectures held the first Tuesday of each month at 8:00PM in the STScI Auditorium at Johns Hopkins University. Following the lecture visit the Maryland Space Grant Observatory. Free parking is available

"Astrophysical Collisions: How Catastrophes Shape the Cosmos," speaker: Mike Shara, STScI, June 2.

University of Maryland Department of Astronomy Campus Observatory, College Park, MD — "The Birth and Death of Our Universe: A Long Journey Through Time", speaker Dr. Sylvain Veilleux, June 5, 9:00 PM,

"Peering at the Universe Through a Lens of Gravity", speaker Dr. Kevin Rauch, June 20, 9:00 PM. (*See* web site at http://www.astro.umd.edu)

U.S. Naval Observatory Colloquia — "All colloquia will be held in the Building 52, Room 300 and will begin at 10:30 AM.

"Low Cost Time Synchonization: 30 nsec for $500 anywhere in the world," speaker: Dr. Tom Clark, NASA-Goddard Space Flight Center. June 5.

Fellow Astronomers

The Amateur Astronomers' Association of Princeton (AAAP) presents the 9th annual Jersey Starquest. This year's event will be held at the Hope Conference and Renewal Center in Hope, NJ from 5:00 p.m. June 19th through 12:00 p.m. June 21st, 1998.

Contact Greg Cantrell at cantrell@princeton.edu for additional information. You can also reach him at 732-308-3488 evenings and weekends. Or, visit the AAAP Jersey Starquest web site at:

http://idt.net/~lewycky/starquest.html

Greg Cantrell, AAAP

Annapolis Workshop on Magnetic Cataclysmic Variables (MCV2)

Annapolis MD, July 13-17

The meeting will be discussion oriented, not merely presentations, on all aspects of MCVa. Attendance i slimited to~100. The meeting will be held at St. John's College in downtown Annapolis. In addition to the meeting room, the College can provide dormitory accommedation for up to 40 participants. Final registration is July 3, 1998 at the websit at the address below. If you would like to give a presentation, fill out the website presentation request form by June 15, 1998

http:www.gsfc.nasa,gov/~mcv2

Don't throw this newsletter away. If you're finished with it, pass it on to someone else to read or recycle it. It's right for astronomy and the environment.

National Capital Astronomers, Inc.

SERVING SCIENCE & SOCIETY SINCE 1937

NCA is a non-profit, membership supported, volunteer run, public-service corporation dedicated to advancing space technology, astronomy, 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 as skilled observers frequently deploying to many parts of the National Capital region, and beyond, on campaigns and expeditions collecting vital scientific data for astronomy and related sciences. They also serve locally by assisting with scientific conferences, judging science fairs, and interpreting astronomy and related subjects during public programs.

Discussion Groups exchange information, ideas, and questions on preselected topics, moderated by an NCA member or guest expert.

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

NCA Information Service answers a wide variety of inquiries about space technology, astronomy, and related subjects from the public, the media, and other organizations.

Consumer Clinics on selection, use, and care of binoculars and telescopes, provide myth-breaking information, guidance, and demonstrations for those contemplating acquiring their first astronomical instrument.

Dark-Sky Protection Efforts educate society at large about the serious environmental threat of light pollution, plus seek ways and means of light pollution avoidance and abatement. NCA is an organizational member of the International Dark-Sky Association (IDA), and the National Capital region's IDA representative.

Classes teach about subjects ranging from basic astronomy to hand-making a fine astronomical telescope. NCA's instructors also train educators in how to better teach astronomy and related subjects.

Tours travel to dark-sky sites, observatories, laboratories, museums, and other points of interest around the National Capital region, the Nation, and the World.

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 space technology, astronomy, and related sciences through discounted memberships, mentorship from dedicated members, and NCA's annual Science Fair Awards.

Fine Quality Telescopes up to 36-cm (14-inch) aperture are available free for member's 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:

[ ] Regular
- [ ] *Sky & Telescope* and *Star Dust.* ($54 per year)
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Junior members pay a reduced rate.
- [ ] *Sky & Telescope* and *Star Dust.* ($42 per year)
- [ ] Star Dust only ($15 per year)

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_____ _____ _____ _____ _____-_____
Street or Box Apartment City State Zip Code + 4

If family membership, list names of additional participating immediate family members in same household, with birthdates 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!**

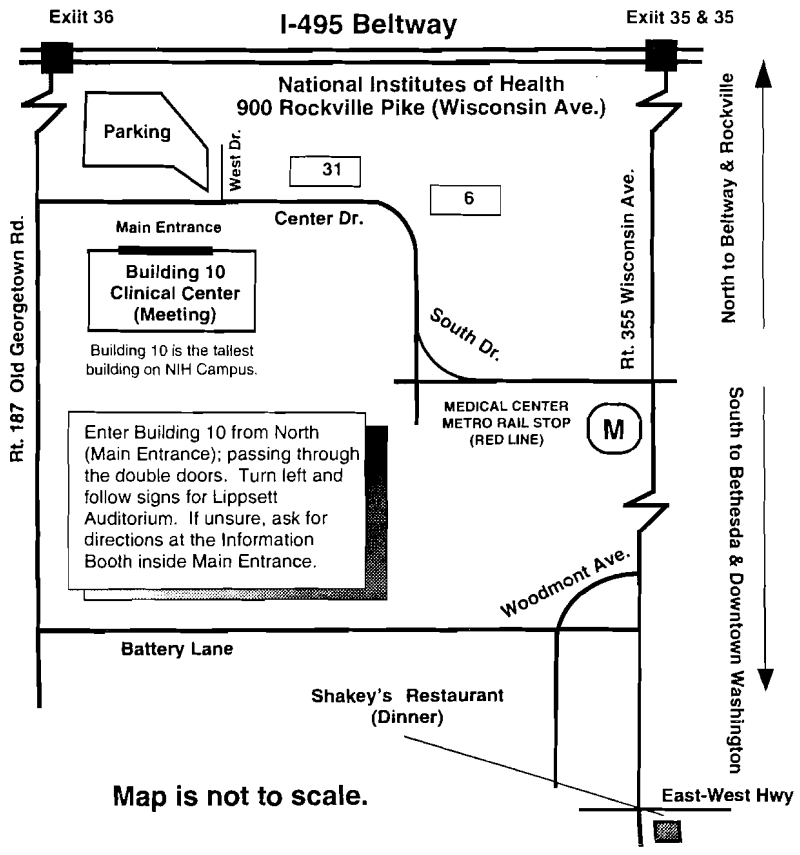
_____

_____

Getting to the NCA Monthly Meeting

Metrorail Riders - From Medical Center Metro Station: Walk down the hill, pass the bus stops and turn right at the anchor onto Center Drive. Continue uphill to Building 10, the tallest building on campus (walking time about 10 minutes). Also, the J2 bus line connects the Bethesda (7:16 PM) and NIH (7:23 PM) Metro stops with Building 10 (7:25 PM).

To Shakey's Resaurant- From 495, take Wisconsin Avenue south past Woodmont Avenue and Battery Lane. It is located on the corner of East-West Highway and Wisconsin Avenue on the east side of the street There is free parking in the area. Seats are not guaranteed after 5:30 PM.



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National Capital Astronomers, Inc.

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