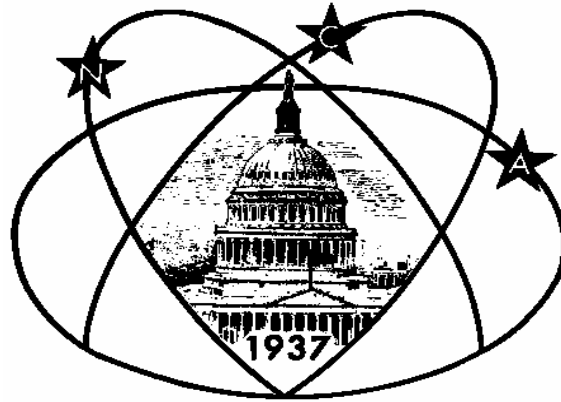


Star



Dust

National Capital Astronomers, Inc.

<http://capitalastronomers.org>

Volume 61, Number 4

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December Talk: Dr. Carey M. Lisse: “Understanding the Different Kinds of Comet Impact Hazards” *Submitted by Gary Joaquin*

Dr. Carey M. Lisse will present the featured talk for the December 7 meeting of the National Capital Astronomers: “Understanding the Different Kinds of Comet Impact Hazards”. The meeting will be held at 3:00 P.M. in the Bethesda-Chevy Chase Regional Services Center of Montgomery County, 4805 Edgemoor Lane (Second Floor), Bethesda, MD.

Synopsis

The population of comets represents a small, but finite, and largely uncharacterized, impact hazard to the Earth. Dr. Lisse will present the results relevant to impact hazard mitigation from a survey of the nuclear surface properties and emitted dust of the brightest near-Earth comets over the last 11 years.

The largest threat of Earth impacts in

terms of highest probability comes from the short-period (SP) comets; the highest potential for a major impact with little advanced notice comes from the Oort cloud long-period (LP) and dynamically new comets. Little can be done to chart the latter hazard, other than maintain a number of sensitive all-sky searches for incoming objects. The SP comets, however, are a much more tractable problem. In this presentation, Dr. Lisse will tend to emphasize new studies of SP comets.

The present population of ~200 short-period (SP) comets, daughters of the Kuiper-Edgeworth (K-E) planetisimals found outside Neptune's orbit, have been shown to be the known component of a population of approximately 500 to 1000 total comets with radius ≥ 300 meters. Furthermore, the SP comets evolve due to the ef-

fects of solar insolation until they become devolatilized and dormant C- or D-type asteroids. The SP comet population thus has ties to both the K-E and asteroidal populations. The SP population is dynamically unstable in its present day configuration to ejection from the inner Solar System on timescales of $\sim 10^5$ years. Therefore, the current population of SP comets is a relatively recent sampling of the K-E belt. Study of the links between these populations by large statistical surveys over many different SP ages will yield the evolutionary path taken by the K-E planetisimals in the present day solar system, and thus help determine the nature of the impact hazard presented by a given type of SP comet.

(Continued on page 2)

“The Sun: More Than Just a Star - Effects on Life and Society” A Talk by Dr. Nicola J. Fox *Reviewed by Gary Joaquin*

At our October NCA meeting, Dr. Nicola J. Fox, a senior staff scientist at the John Hopkins University Applied Physics Laboratory (JHU/APL), gave a marvelous presentation entitled “The Sun: More Than Just a Star - Effects on Life and Society”. Her presentation focused upon the International Solar Terrestrial Physics Mission sponsored by JHU/APL, NASA, and GSFC. Accompanying Dr. Fox was Dr. John B. Sigwarth, a project scientist from the University of Iowa's Department of Physics and Astronomy, who is working directly with the Polar Plasma Laboratory (POLAR) space-

craft's Visible Imaging System (VIS), an instrument upon which Dr. Fox's work relies heavily. This was a rare opportunity for NCA to have two experts present to explain some fascinating work.

Basics Concepts

To begin to understand the Sun-Earth connection we must realize that:

- The properties of the Sun are dynamic;
- The Earth exists within the atmosphere of the Sun called the heliosphere;
- The Earth's response to our changing Sun is known as space weather; and

- Auroras are physical signs of space weather.

Failure to understand the Sun-Earth connection and to predict and warn against threatening space weather events can have dire consequences to satellites, spacecraft, global communication, and human life.

Space weather reveals itself to the unaided (but protected) eye in several ways:

- Total solar eclipses reveal clues about the structure of the solar corona;
- Comet ion tails reveal the direction of

(Continued on page 3)

NCA Events This Month

The Public is Welcome!

NCA Home Page: <http://capitalastronomers.org>

Fridays, December 6, 13, 20, and 27, 6:30 to 9:30 P.M., NCA Telescope-making Classes at the Chevy Chase Community Center, at the northeast corner of the intersection of McKinley Street and Connecticut Avenue, N.W. See more information at right. Contact instructor Guy Brandenburg at gbranden@earthlink.net or 202-262-4274.

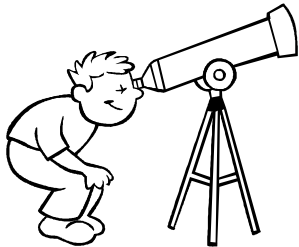
Fridays, December 6, 13, and 27, 8:30 P.M. Open nights with NCA's 14-inch telescope at Ridgeview Observatory near Alexandria, Virginia. See below.

Saturday, December 7, 3:00 P.M. NCA meeting in the Bethesda-Chevy Chase Regional Services Center of Montgomery County, 4805 Edgemoor Lane, (Second Floor), Bethesda, MD. See map and directions on Page 6.

Dr. Carey M. Lisse will give the featured talk, "Understanding the Different Kinds of Comet Impact Hazards."

Saturday, December 7, following the meeting, dinner with the speaker and NCA members at

The Athenian Plaka Restaurant
7833 Woodmont Ave.
Bethesda, MD
301/986-1337



The deadline for the January *Star Dust* is December 15.

(Please have your material Elliott Fein by December 15 to ensure inclusion in the January *Star Dust*.)

Please send submissions to Elliott Fein at elliott.fein@erols.com. Text must be in ASCII, MS Word, or WordPerfect.

All articles submitted may be edited to fit the space available.

Thank you.

Observing with the NCA C-14 by Bob Bolster

Date, Time: All 8:30 p.m.

Friday, December 6
Friday, December 13
Friday, December 27

Prime Objects

Double Cluster, M15, M31
Gibbous Moon
M31, M42, Double Cluster, Saturn
(after 9:30)

At Ridgeview Observatory in Bob Bolster's backyard, 6007 Ridge View Drive, Franconia, Virginia (off Franconia Rd. between Telegraph Rd. and Rose Hill Dr.). Call Bob at 703-960-9126 before 6:00 p.m., to let him know you are coming.

Dr. Carey M. Lisse

(Continued from page 1)

Biography

Dr. Carey M. Lisse of the University of Maryland's Department of Astronomy is the Senior Research Scientist of the Deep Impact Discovery Mission. Dr. Lisse is a prolific writer and an exceptional speaker who last gave a presentation to NCA on May 4, 1996. His current research areas emphasize small bodies, planetesimals, and dust in solar systems with particular emphasis upon:

- Measurement of the physical properties of cometary nuclei using radio, IR, and optical observations;
- Measurement of the composition, particle size distribution, and emission history of cometary dust using dynamical modeling and optical/IR imaging photometry;
- Study of the thermal behavior of asteroids and the interplanetary dust cloud;
- Phenomenological study of the comet-asteroid transition and fragmenting comets;
- X-ray emission from comets; and
- Evidence for cometary gas and dust in exo-solar systems.

Dr. Lisse has received numerous awards including the 2001 Space Foundation Space Achievement Award of the Space Telescope Science Institute (STScI) and the 2000 STScI Science Merit Award. He even had an asteroid named after him in 2001, Asteroid 12226 CareyLisse.



Star Dust is Now Available Electronically

Any member wishing to receive *Star Dust*, the newsletter of the National Capital Astronomers, via e-mail as a PDF file attachment, instead of hardcopy via U.S. Mail, should contact Nancy Grace Roman, the NCA Secretary, at nancy.roman6@verizon.net or 301-656-6092 (home).

Review of Dr. Nicola J. Fox talk, continued

(Continued from page 1)

the prevailing solar wind;

- Sunspot counts reveal the level of solar activity along the continuum of the 11-year solar cycle; and
- Auroras describe the intensity of the Earth's response to space weather.

Sources of Data

To conduct her research, Dr. Fox analyzes data received from many instruments; however, the three primary instruments upon which she relies are:

- The POLAR/VIS camera, which provides about 1500 images a day of the northern aurora in the visible light spectrum. POLAR revolves about the Earth in an elliptical orbit once about every 18 hours;
- The Solar and Heliospheric Observatory (SOHO) whose mission is to study the internal structure, its extensive outer atmosphere, and the origin of the solar wind. SOHO is located about one million miles from Earth, orbiting the L1 Lagrangian point between the Earth and the Sun; and
- The Advanced Composition Explorer (ACE), also orbiting about the L1 point, acts as a windsock, providing additional data to complement SOHO, so that the direction and strength of the solar wind may be measured.

Anatomy of One Solar Event

With imagery and data from these instruments and several creative animations, Dr. Fox described the anatomy of an especially severe solar weather event, one that took place on July 16, 2000, Bastille Day, otherwise known as the "Bastille-Day Eruption". This eruption was classified as an "X-class" flare, the most severe, by the National Oceanographic and Atmospheric Agency (NOAA), whose responsibility is to classify space weather events, just as it does hurricanes. A-, B- and C-Class events are small flares with few noticeable consequences on Earth. M-class flares are medium-sized, generally causing brief radio blackouts that affect the Earth's polar regions and are sometimes followed by brief radiation storms. X-class events are major events, triggering global radio blackouts and long lasting radiation storms.

Cause and Effect of Solar Flares

Solar flares usually originate in highly magnetic regions of the solar surface populated by numerous sunspots at peak solar activity periods. Twisted magnetic fields

often erupt into a solar flare, which produces what Dr. Fox classified as the "Three Ps":

- Photons embodied in the initial flash of light;
- Protons which are both highly energetic particles; and
- Plasma which is literally an expelled part of the outer coronal region.

The flash of photons initially discharged alerts us that a flare has occurred about 8 minutes after the event, the time required for light to travel from the Sun to Earth. Along with the photons are high energy bursts of ultraviolet (UV) and x-rays which are absorbed by Earth's atmospheric particles, raising them to excited states and increasing the density of our low altitude ionosphere, resulting in Short Wave Fadeouts (SWF) or blackouts in radio communication. SWFs can last for a few minutes to hours and are most severe in equatorial regions where the Sun is directly overhead.

Soon after the initial flash, about 30 minutes later, accelerated protons and electrons moving at speeds on the order of half the speed of light, reach Earth. These particles possess huge amounts of energy and are very dangerous to living cells. During times of peak solar activity, where such discharges are anticipated, shuttle launches and Exterior Vehicular Activities (EVAs) are canceled. Less than one hour after the first protons arrived at the POLAR/VIS imager, the instrument was saturated and remained so for almost a day. These energetic particles can seriously damage and disable spacecraft and satellites, disrupting global communication like television and making common hand held devices like cell phones, pagers and GPS systems inoperative, creating both civilian and military liabilities. In addition, Dr. Fox noted that back in 1972 between Apollo 16 and 17 one of the largest proton events ever recorded arrived at Earth. Had astronauts been in orbit they would have absorbed lethal doses of radiation within 10 hours *inside their spacecraft*.

How Auroras are Created

About 24 hours later, the blob of plasma arrives, striking the leading edge of the Earth's magnetic field and compressing it. Dr. Fox compared this event of the Earth parting its way through the oncoming plasma to the wake of a boat making its way through the sea. During these events, Earth's magnetic field becomes more elon-

gated than usual. The leading magnetic field loops are on the order of 10 Earth radii in their compressed state, while the trailing loops reach lengths of 100s of Earth radii, resembling a comet or even as Dr. Fox suggested a cosmic gigantic squid. Fortunately, the high-energy protons and electrons are routed around the Earth, traveling along the magnetic field lines and not penetrating them. As the trailing field lines recover their original configuration and snap back to the Earth, these charged particles, still interacting with the magnetic field lines, are injected into the Earth's ionosphere, powering the aurora.

When these particles strike our atmosphere, they excite it and ionize it. As the atmospheric particles lose their energy, they release photons of light. The most common color is green, denoting oxygen. Red denotes lower energy electrons higher up in the atmosphere, and blue denotes Nitrogen lower down in the atmosphere. This event also emits UV that enables spacecraft to detect auroras even during daylight hours when the event is invisible to the unaided eye. The good news is that there is no change to the oxygen atoms or to our atmosphere, which all return back to normal. The bad news is that auroras can have serious impacts on our electrical power grids.

Another Effect of Solar Flares

An aurora is a current system that induces magnetic fields in our atmosphere, which in turn induces currents in our power grid system, sometimes huge currents as large as one million amps. This is not a problem in areas with large scale conductors like the Earth's crust or oceans, but when such currents encounter nonconductors, e.g., igneous rock like that on which the state of New York rests, the current takes the path of least resistance, through the power grid system, often superheating or setting afire transformers and causing blackouts and brownouts across large regions. Dr. Fox noted there have been about five such events globally in the last 20 years, most notably the Hydro Quebec Event in March of 1989 that left 6 million residents without electrical power.

Need for Future Missions

Our current network of spacecraft dedicated to detecting and predicting space weather, at its best gives a very two-dimensional perspective of the solar dynamics at work. Dr. Fox described it as like

(Continued on page 4)

Review of Dr. Nicola J. Fox talk, continued

(Continued from page 3)

standing on a bridge, trying to predict the ebb and flow of traffic, but being able to see only the traffic passing immediately below the bridge.

To correct this vision, Dr. Fox gave a brief introduction to the Living with a Star

(LWS) program whose mission is to understand “the Sun-Earth system that directly affect life and society”. This program will consist of the Solar Dynamics Observatory, the Geospace Missions and the Solar Sentinel Mission, all of which will be welcome and fascinating topics for future presenta-

tions at NCA.

NCA heartily thanks Dr. Fox for a superb presentation and Dr. Sigwarth for his informed comments about the POLAR/VIS instrument. NCA looks forward to learning more about their collaborative work.

University of Maryland Observatory by Elizabeth Warner

New Telescope Owner Nights

The University of Maryland Observatory would like to announce that the dates for its annual New Telescope Owner Nights have been set. We will hold the program on the 15th and 18th of January 2003 from 6-9 p.m. Details and a flier are available at our web site <http://www.astro.umd.edu/openhouse>.

Open House

Reminder that the UM Observatory is open to the public on the 5th and 20th of each month. The program is a short lecture followed by a tour of the observatory and observing (weather permitting). <http://www.astro.umd.edu/openhouse/programs/oh.html>

Group Programs

We have slightly revised our group programs. Groups have the option of coming on an Open House night. Their presentation would be an hour before the regular public one. Groups should contact me to arrange which date they'd like to come on. In addition, there will be a few Friday and or Saturday nights available for evening observing only. We have also acquired some solar filters (visible and h-alpha) to use with our 8" SCTs, so we can also do some day programs. Groups interested in coming to the observatory should contact Elizabeth Warner at 301-405-6555 or warnerem@astro.umd.edu to make a reservation. See http://www.astro.umd.edu/openhouse/obs_info/groups.html

Docents Program

Individuals get trained on the telescopes, commit to help with a couple of Open Houses, and then get to use the equipment on our Docents Nights. <http://www.astro.umd.edu/openhouse/amateur/docents.html>

Other Plans

These are maybe things, we'd like feedback - an observation request page . . . people can request observations of a particular

star (i.e., from those buy a star programs), asteroid, or other astronomical object (within the capabilities of our instruments). Once the image is acquired, it could be e-mailed or printed and mailed. Possibly allow individuals/clubs to come in and use the instruments for a particular project.

Last year we held our “Learn the Sky Fridays” program, an intro program for people interested in astronomy. We are planning on holding it again this year. In addition, we are thinking about holding a more advanced program dealing with amateur projects (the “how-to”s, equipment needed for asteroid/comet hunting and observing, SN searches, GRBs, occultations, etc.)

Generally, all of these would be free, but we would gladly accept \$\$ donations!!!

Looking for Guest Speakers

We usually try to have some of the faculty from the UM Astronomy Dept. give presentations at our Open Houses, but if you have a member that is a good speaker and has an interesting talk, we would love for them to give a presentation. I am currently setting up our spring and summer schedule. The dates would be the 5th and 20th of each month.

Need a guest speaker?

Quid pro quo . . . I understand that many clubs are also looking for speakers at their club meetings. I will be happy to give a presentation, either on some astronomical topic (astrophotography, comets, occultations) or, I am also the “Liaison to Amateur Astronomers” for the Deep Impact mission so I could talk about the mission and what amateurs can do to be involved. <http://deepimpact.umd.edu/>

Thank you for your time!

Happy Stargazing!

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

Support
the
IDA

Join the International
Dark-Sky Association

3225 N. First Avenue
Tucson, AZ 85719-
2103

www.darksky.org

Mid-Atlantic Occultations and Expeditions

by David Dunham

Asteroidal Occultations through early January 2003

Date	Day	EST	Star	Mag	Asteroid	dmag	s	in.	Location
Dec 16	Mon	2:36	SAO 137940	9.8	Praxedis	5.2	7	4	e. Mass.
Dec 20	Fri	18:15	HIP 16456	10.6	Iduna	2.0	22	6	n.w. Penn.
Dec 23	Mon	5:15	SAO 119067	10.0	Olga	5.3	5	4	n. VA, s. MD, s. DE
Dec 24	Tue	2:29	TYC13102402	10.6	Saturn	0.0	101m	10	N. America
Dec 24	Tue	4:56	SAO 097327	8.5	Chicago	5.1	13	2	n. MD, s. NJ
Dec 27	Fri	3:28	HIP 21529	10.1	Wilhelmina	3.6	8	5	N. Carolina
Dec 28	Sat	2:24	SAO 76696	9.2	Oort	5.8	5	3	n. VA, DC, MD
Jan 1	Wed	20:14	TAC +5d 62	11.0	Philomela	1.7	7	7	WV, w. MD, PA
Jan 2	Thu	22:16	TYC48482317	10.9	Joella	4.1	4	7	DE, e. MD, n. VA
Jan 4	Sat	4:40	TYC03000136	11.6	Suleika	2.6	3	8	n. OH, PA, n. NJ

Grazing Occultations

DATE	Day	EST	Star	Mag	% alt	CA	Location
Dec 8	Sun	19:35	SAO 190250	9.3	25+	14 13S	s. Alex., VA; And. AFB; s. Bowie, MD
Dec 10	Tue	19:09	ZC 3374	6.1	43+	34 14S	Harmony, PA
Dec 13	Fri	20:08	35 Ceti	6.5	71+	52 14S	n. Hancock, MD; ZC 178

Total Lunar Occultations

DATE	Day	EST	Ph Star	Mag	% alt	CA	Sp.	Notes
Dec 8	Sun	19:30	D SAO 190250	9.3	25+	15 20S	K2	Graze, s. & e. DC suburbs
Dec 12	Thu	22:23	D ZC 0066	7.1	63+	30 43N	A0	
Dec 13	Fri	18:16	D 33 Ceti	6.0	71+	48 71N	K4	ZC 0170
Dec 14	Sat	0:16	D 89 Piscium	5.1	73+	21 82S	A3	ZC 0192
Dec 17	Tue	0:32	D ZC 0517	6.1	93+	51 73N	K1	
Dec 17	Tue	19:14	D omega Tau	4.9	97+	43 86N	A3	ZC 0628; spec. binary
Dec 17	Tue	22:07	D ZC 0642	6.8	97+	71 90S	F5	possible close double
Dec 18	Wed	2:40	D ZC 0665	5.7	98+	38 63N	A5	Very close double
Dec 21	Sat	7:13	R 57 Gem	5.0	97-	19 54N	G8	ZC 1117; maybe close dbl.
Dec 24	Tue	3:33	R eta Leonis	3.5	78-	67 82N	A0	ZC 1484
Dec 25	Wed	2:51	R ZC 1598	6.5	68-	52 74S	F5	maybe close double
Dec 25	Wed	23:36	R nu Vir	4.0	59-	4 36S	M0	ZC 1702; Azimuth 85 deg.
Dec 26	Thu	6:11	R ZC 1725	7.6	56-	56 53N	K0	maybe close double
Dec 31	Tue	5:33	R ZC 2362	7.7	7-	4 57N	F8	Azimuth 122 deg.

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 (but there have been problems with it recently), or check the local IOTA Web site at <http://iota.jhuapl.edu>

For the Dec. 8 graze, contact Wayne Warren, e-mail w.h.warrenjr@att.net, phone 301-474-0814.

David Dunham, e-mail dunham@erols.com, phone 301-474-4722

Getting to the NCA Monthly Meeting

Saturday, December 7

3:00 P.M. - NCA Meeting in the Bethesda-Chevy Chase Regional Services Center of Montgomery County, 4805 Edgemoor Lane (**2nd Floor**), Bethesda, MD.

Dr. Carey M. Lisse will give the featured talk, "Understanding the Different Kinds of Comet Impact Hazards"

Following the meeting, dinner with the speaker and NCA members at

The Athenian Plaka Restaurant
7833 Woodmont Ave.
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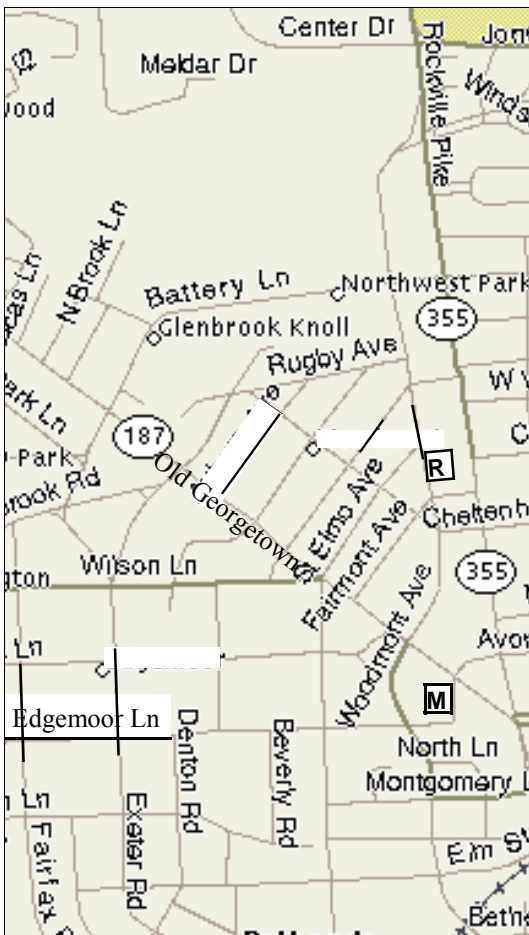
Directions to the Meeting Place From North of Bethesda

1. Take Rockville Pike/MD-355 South.
2. Rockville Pike/MD-355 S becomes MD-355/Wisconsin Ave.
3. Shortly after Cheltenham Dr. (and one block before reaching Rt. 410), turn right onto Commerce Lane.
4. Commerce Lane becomes Edgemoor Lane.
5. After crossing Old Georgetown Rd., 4805 is the second entrance on the right. (See **M** on map.)
6. To get to public parking, continue on Edgemoor Lane which will make a sharp right turn. The parking garage is then on your right. See note below.

From South of Bethesda

1. Take MD-355/Wisconsin Ave. North.
2. Turn slight left onto MD-187/Old Georgetown Rd.
3. Turn next left onto Edgemoor Ln. 4805 is the second entrance on the right. (See **M** on map.)
4. To get to public parking, continue on Edgemoor Lane which will make a sharp right turn. The parking garage is then on your right.

Note: there are two parking lots. The one on Woodmont is for the apartments and may have a fee. The one on Edgemoor is marked "Public" and does not charge on weekends.



Directions to the Restaurant

Because Woodmont Ave. is one-way Southbound coming out of the parking garage, we are offering you what may appear to be circuitous, but is actually a fairly efficient way of getting to the restaurant after the NCA meeting

1. Following the meeting, turn left out of the parking garage. If you are on Woodmont Ave., turn left at the next intersection, which is Edgemoor Lane.
2. Continue on Edgemoor Lane to Old Georgetown Road.
3. Turn left on Old Georgetown Rd. and then turn right on Woodmont Ave.
4. Continue North on Woodmont Ave, passing Cheltenham Ave.
5. Continue North on Woodmont Ave. for another 1.5 blocks to the restaurant, which is on the right side of Woodmont Ave.

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Editor: Elliott Fein, Co-editor: Adele Fein, Editorial Advisor: Nancy Byrd. Consultant: Jeffrey Norman
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NCA Web Page: <http://capitalastronomers.org/>.

Appointed Officers and Committee Heads: Exploring the Sky - Joseph C. Morris; Meeting Facilities - Jay H. Miller;

Observing - Robert N. Bolster; Telescope Making - Guy Brandenburg; Travel Director - Sue Bassett; *Star Dust* Editor - Elliott Fein

SERVING SCIENCE & SOCIETY SINCE 1937

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 semiannual 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 schoolteacher 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. Contact: Sue Bassett wb3enm@amsat.org

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, and others. Contact: Joe Morris. joemorris@erols.com or (703) 620-0996.

Members-Only Viewing Programs periodically, at a dark-sky site.

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 Telescope, 14-inch aperture, see “Calendar of Monthly Events”.

Yes! I'd like to join the NATIONAL CAPITAL ASTRONOMERS

Date:

Name(s): _____

Address: _____

Telephone: _____ E-mail: _____

Other family members who should receive a membership card: _____

Dues:

___ \$57 With *Star Dust* and a discount subscription to *Sky & Telescope*.

___ \$27 With *Star Dust* ONLY.

___ \$45 Junior membership with *Star Dust* and a discount subscription to *Sky & Telescope*.

___ \$15 Junior membership with *Star Dust* ONLY.

___ \$100 Contributing member (with *Sky & Telescope*) (\$43 tax-deductible).

___ \$150 Sustaining member (with *Sky & Telescope*) (\$93 tax-deductible).

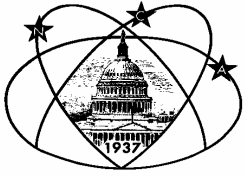
Junior members only: Date of Birth: _____ Only members under the age of 18 may join as juniors.

Tax deductible contribution: _____ Thank You.

_____ I prefer to receive *Star Dust* by e-mail.

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