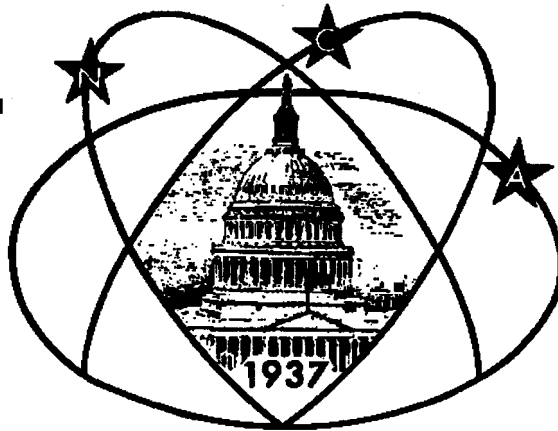


# Star



# Dust

National Capital Astronomers, Inc.

Phone: 301/320-3621

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## Vera Rubin to Speak on “What Hubble Didn’t Know About Galaxies”

by *Harold Alden Williams*

On May third in the Lipsett auditorium in the Clinical Building of the National Institutes of Health, Vera Copper Rubin will speak to us on “What Hubble Didn’t Know About Galaxies.” Vera was a junior member of the National Capital Astronomers when she was in high school. She graduated from Coolidge High School in Washington, DC. She then went on to get a BA from Vassar College, an MA from Cornell University, and a Ph.D. from Georgetown University, where George Gamow, who was a faculty member at George Washington University, was her dissertation advisor. Her MA thesis was on non uniformity in the Hubble (expansion of the universe) flow—work that would later bring her student, Sandra Faber, who was one of the so called seven samurai, fame for discovering the great attractor.

Vera has been on the forefront or ahead of the front in Galactic astronomy since her MA work. She is a member of the National Academy of Sciences and has been awarded numerous honorary D.Sc. degrees from Harvard, Yale, Williams, and other schools. She has been awarded the National Medal of Science by President Clinton. She has even been awarded medals by the Pope in Rome. She is a much sought after speaker. On her resume, she lists the Ph.D. in science of her four children before her own degrees. She and Robert Rubin, the

famous applied mathematician, have produced an astronomer daughter, Judith Young, an imminent abstract mathematician, Karl Rubin, and two more geoscientist sons. Since 1965 she has been an employee of the Department of Terrestrial Magnetism, DTM, of the Carnegie Institution of Washington, CIW, and was the first women to be allowed to observe at the Palomar Observatory. When she was hired by Merle Tuve of DTM to use Kent Ford’s developing imaging phototubes, Kent was told that they had hired a house wife to help him with his astronomy. Two Carnegie scientist are reported to have gotten in a kicking fight where blood was drawn at the shin over holding a meeting in the Cosmos Club, that at the time did not admit women to membership and therefore discriminated against Vera. When Vera daughter, Judy, was young, and heard of this she replied incredulously, “Mother, do grown men do these things.” When important contributions to astronomy are listed and persons grouped according to obstacles that they over come based upon the stupidity of men Hypathia, Henrietta Leavitt, Annie Jump Cannon, Charlotte Sitterly, Nancy Grace Roman, and Vera Copper Rubin will be listed along with others.

Vera Rubin and Kent Ford measured the rotation curves of stars in disk galaxies using imaging phototubes on a

two dimensional spectra across the long axis of the galaxies. What they discovered is the most perplexing unresolved problem in all of physics and astronomy. In what amount to a test of Kepler’s third law (the so called harmonic law), the semimajor axis of rotation cubed divided by the period of rotation squared should be proportional to the mass enclosed by the rotation. While this is observed for the planets orbiting the sun and the moons orbiting around their planets; it is not observed to be the case for disk galaxies—at least not if mass traces light. The conventional interpretation is that most of the mass of galaxies are not what we see in stars, gas, and dust; but that most of the galaxy is made up of under luminous matter, the so called “dark matter.” This cosmic embezzlement of light, not being able to see the mass that is responsible for the gravitational binding rotation of stars in galaxies, is not a small thing. Around 90% of the universe is “dark matter” in the conventional interpretation. Vera has said that it is the responsibility of galactic astronomers to set some limits on this under luminous matter. When you have 90% of the universe missing theorists can imagine too many things to be contributors to the “dark matter.” Having discovered that the velocity of the rotation curves are

*See RUBIN, Continued on Page 2*

## Calendar of Monthly Events

### The Public is Welcome!

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

**Fridays, May 2, 9, 16, 23, and 30, 7:30 PM**-Telescope making classes at American University, McKinley Hall Basement. Information: Jerry Schnall, 202/362-8872.

**Fridays, May 9, 16, and 30, 9:30 PM**-Open nights with NCA's Celestron-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.

**Saturday, May 3, 5:30 PM**-Dinner with the speaker and other NCA members at O'Donnel's Seafood Restaurant at 8301 Wisconsin Avenue, Bethesda, MD. See map and description on back page.

**Saturday, May 3, 7:30 PM**-NCA meeting, will feature Vera Rubin speaking on "What Hubble Didn't Know About Galaxies" For directions, see map and description on back page.

During questionable weather, call the IOTA Hotline (Phone: 301/474-4945) for NCA meeting status. The absence of a cancellation notice on the Hotline means the meeting will take place.

**Mondays, May 5, 12, and 19, 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, May 6, 13, 20 and 27, 7:30 PM**-Telescope making classes at Chevy Chase Community Center, Connecticut Avenue and McKinley Street, NW. Information: Jerry Schnall, 202/362-8872.

**Saturday, May 24, 9:00 PM**-Exploring the Sky, Rock Creek Park, near the Nature Center. Information: 202/426-6829

See page 6 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 1996*, the *Observer's Handbook 1996*, in numerous software packages, and other links available on the NCA Home Page (see above for address). NCA members can purchase all these (and much more) at a discount. To join NCA, use membership application on page 7.

### RUBIN, Continued from Page 1

flat at large distances well beyond most of the ponderable matter were it had been thought that the velocity of rotation curves must fall, Vera has set herself the task of setting some limits in the distribution of the 90% of the universe that seems to be missing.

Her abstract for "What Hubble Didn't Know About Galaxies" is as follows:

In a spiral galaxy, gas clouds and stars move about the center of their galaxy on circular orbits, with periods of hundreds of millions of years. Over the last few decades, studies of orbital velocities in galaxies have convinced most as-

tronomers that the universe contains mostly dark matter. The luminous stars and galaxies that we observe with our eyes and with our sophisticated telescopes comprise less than 10% of the matter.

More recently, astronomers have discovered that in some galaxies, the orbital motions are complex. In a few galaxies, stars and gas are observed to orbit with opposite senses of rotation; in a few others, some stars orbit prograde, some retrograde. I will discuss the important clues concerning the history with more than one axis of rotation.

The identification of the "dark matter" problem via rotation curves of stars

in galaxies will one day occupy the same place in the history of human scientific thought that the absence of interference fringes in the Michelson-Morley experiment, and the subsequent falsification of the luminous ether, did. I suspect that we are at the stage where the Michelson-Morley like experiment has been done and Lorentz and Poincar'e invariance have been written out by their respective authors, but an Einstein has not yet come along and invented or reinterpreted Lorentz and Poincar'e invariance into the theory of special relativity, yet—or if they have, the general scientific community has not embraced their radical theory yet. The talk this May third will probably be one of the more intellectually stimulating talks in any one's life time. ○

# Hale-Bopp and Other Recent Comets

by Wayne H. Warren Jr.

At the April 5, 1997 meeting of the National Capital Astronomers, Dr. Malcolm B. Niedner, Jr., of the Laboratory for Astronomy and Solar Physics, NASA Goddard Space Flight Center, spoke about comets and recent results from the Hubble Space Telescope (HST). Dr. Niedner's topics were very timely, not only because of the current visibility of one of the intrinsically brightest comets of all time, but also because of the recently completed HST Second Servicing Mission. Almost exactly 3 years ago (April 2, 1994), Dr. Stephen P. Maran, then of the same laboratory at Goddard, described the HST First Servicing Mission and what might be expected from the repaired instrument. In turn, Dr. Niedner appropriately described some of what the repaired HST has been doing and what might be expected during the next phase of the mission, with two new instruments, the Near-Infrared Camera and Multiobject Spectrograph (NICMOS) and the Space Telescope Imaging Spectrograph (STIS).

Dr. Niedner reminded us that comets, in addition to being spectacular objects to watch, demonstrate how dynamic the solar system is. They are important from a scientific standpoint because they are thought to be the only objects left that are representative of the solar nebula. This is, of course, because comets formed in a region far out from the Sun and have spent almost all of their time in that region. When they approach the inner reaches of the system, however, all kinds of exciting things begin to happen as their nuclei are heated by the Sun's radiation. These changes were illustrated by images of Halley's comet that were collected as part of the International Halley Watch program that was coordinated by NASA's Jet Propulsion Laboratory and Goddard Space Flight Center. The images showed how cometary ices and dust result in the growth of an increasingly larger coma surrounding the nucleus as a comet approaches the Sun. The coma can become quite large (up to 100,000 km (1 km  $\approx$  .62 mi)) even before a visible tail appears. The size of the coma depends

on the amount of gas and dust expelled from the nucleus, which, in turn, depend on the comet's size and how many times it has been through the inner solar system. Soon, a tail appears and increases in size to the point at which rather complex structures develop if the comet is large and active enough.

When considering fully-developed tails, we must again change our size scale because these are enormous structures of length up to several tenths of an astronomical unit (1 au  $\approx$  93 million miles), meaning that they are by far the largest objects in the solar system. The amazing thing is that these structures all developed from the relatively tiny nucleus, which, in P/Halley's case, measures about 20 km long by 8 km wide, as seen clearly in images taken by ESA's Giotto spacecraft that flew within about 600 km from the nucleus. A comet's nucleus can be thought of as what Fred Whipple called a "dirty snowball", essentially consisting of a large percentage of water ice mixed with gas, dust, and other ices such as carbon monoxide.

Dr. Niedner next turned to the comet of the hour, C/1995 O1, more popularly known as Hale-Bopp (H-B), comparing some of its properties with those of P/Halley. Even though the latter is relatively large as comets go, H-B is in another league, with a nucleus more like 35-40 km in size. The latter also has a considerably longer period and has probably made many fewer trips through the perihelion of its orbits. Thus, it still contains prodigious amounts of gas and dust, making it one of the intrinsically brightest comets of all time. HST images taken in September 1995 showed how much the coma has developed, even 1.5 years before perihelion. At this time, even though H-B was 6-7 au from the Sun, a great amount of activity could be seen, clearly revealing that the comet would almost certainly become a spectacular object. (The March 28, 1997 issue of the weekly magazine *Science* has several papers on H-B, according to Dr. Niedner.)

Using a very nice image of H-B retrieved over the Internet, Dr. Niedner illustrated and explained the difference

between the dust and plasma (ion) tails of a comet. While the dust tail is very prominent, yellowish in color, and curves away behind the nucleus, the plasma tail projects straight back from the nucleus (with respect to the Sun) and glows a faint bluish-green from fluorescence. The former tail is composed of dust particles in the range 1-10  $\mu$ m in diameter that are blown away from the nucleus by solar radiation pressure. The plasma tail, on the other hand, is formed by ionized gases that are ejected at high velocity from the nucleus. These ions, such as CO<sup>+</sup>, H<sub>2</sub>O<sup>+</sup>, etc., spiral out from the comet along lines of magnetic field in the solar wind.

The orbit of comet H-B was discussed next. It is a very high inclination orbit that intersects Earth's orbit at essentially 90°; thus, the comet passes over the poles of the Sun and comes in at high declination, which has resulted in its high visibility from the Earth. On the other hand, this orbit results in no close approach of the comet to Earth. In fact, H-B never came any closer than about 1.2 au from Earth, and no closer than 0.91 au from the Sun.

The size of the nucleus was discussed next in more detail, as estimated in one of the *Science* articles. By measuring brightness and modeling the light distribution, then taking ratios of the measured versus expected distribution, an estimate of the nuclear size can be made. The result is an approximate lower limit of 27 km, with an estimated maximum of up to 42 km. As mentioned earlier, H-B doesn't rank among the brightest comets of all time unless one compares it on an absolute scale by placing each at a standard distance. (This is similar to measuring absolute stellar brightness by determining their absolute magnitudes.) When this is done, H-B ranks among the brightest comets on record and the brightest in several hundred years (behind only the Comet of 1577 observed by Tycho Brahe, and possibly the great comet of 1811).

See *COMET*, Continued on Page 4

The structures near the nucleus are similar to those seen in past comets, namely, radial shells of bright areas wound into spiral patterns. These are indicators of nonuniform outgassing from pockets or cracks in the nuclear surface and of subsequent winding from the rotation of the nucleus. An analysis of the geometrical patterns over time results in an estimate of 11.5 hours for the rotation period. This compares with about 7.4 days for P/Halley. Thus, it is clear that comets differ not only in their sizes, but also in properties such as rotation rate, shape, etc. One wonders how different they might be in chemical composition, even though they presumably all formed at about the same time and at about the same distance from the Sun.

Photographic images of Comet West (1976), Bennett (1970), and Hyakutake (1996) were then compared. All these comets were not only closer to the Earth at times, but also passed closer to the Sun; thus, they were as bright or brighter than H-B even though they weren't as large and did not have the prodigious dust production that the current comet has. Halley's comet was rather unique for its very prominent plasma tail, which even displayed disconnection events, probably as a result

of crossing sector boundaries (where the magnetic field reverses) in the solar magnetic field. Since H-B is now well above the ecliptic plane, one wouldn't expect these phenomena to occur yet. It will be interesting to see if similar events take place when H-B moves toward lower ecliptic latitudes on its journey south. (The interplanetary neutral sheet, in which the magnetic field reversals occur, stretches almost to the ecliptic poles during maximum solar activity, but is much more restricted to lower latitudes during solar minimum, which we are near at present.)

The connection between disconnecting ion tails and magnetic sector boundaries was made by Niedner and Brandt in 1978 (ApJ, 223, 655) and was discussed for Comet P/Halley by Niedner and Schwingschuh in 1987 (A&A, 187, 103). Ion tails are confined by magnetic flux tubes behind the nucleus until a magnetic field reversal is encountered at a sector boundary, at which time the tail is torn away on a time scale of about 0.25 to 0.5 days and a new ion tail forms on about the same time scale. This happened frequently (19 times) in Comet P/Halley over the month or so that the comet had a visible plasma tail. The sector boundary model can be checked by observing boundaries independently from satellites, then predicting when the boundary should have encountered the comet based on knowl-

edge of the solar rotation and wind propagation. Most of the time, predicted times are in good agreement with observations, but not always because the geometry can sometimes be complex.

Dr. Niedner finished his presentation by showing some recent results from the HST. Images taken during the second servicing mission, carried out by astronauts aboard STS-82, showed the NICMOS and the STIS being installed to replace the Goddard High-Resolution Spectrograph (GHRS), with which much high-quality science has been done. Very high-quality images of Mars, Saturn, and Uranus were shown, with incredible detail visible, especially Mars. Moving outward, we saw images of the globular-cluster field of the Andromeda galaxy (M31), gravitational arcs, and finally, the Hubble Deep Field, which shows objects to magnitude 30. It seems quite clear that, with the next generation instruments now in place, some wonderful new results will be forthcoming from HST on a regular basis. Although the new instruments are still in their commissioning phase, the principal investigator for STIS, a staff member of the Laboratory of Astronomy and Solar Physics at GSFC (where Mal Niedner and I both work), has indicated to me that both instruments seem to be checking out well. ○

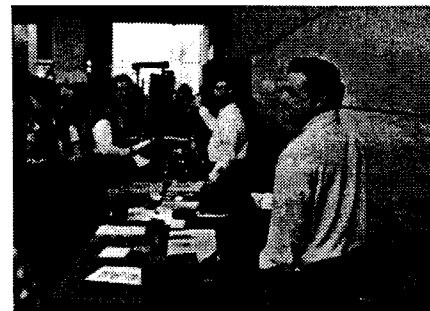
## NCA Members at the NASM Binocular and Telescope Seminar



1



2



3

- 1) Jay Miller and Jim Roy with the C8 (Comet pictures on table).
- 2) Jay Miller assisting viewers of all ages.
- 3) Dan Costanzo and Gary Hand (foreground) promoting NCA and S\*T\*A\*R\*S

# Grazing Occultations and Asteroidal Appulses

by David Dunham

## Grazing Occultations, 1997 June (none in May)

Date	Day	EDT	Star	Mag	%	alt	CA	Location
June 26	Thu	2:56	96 Agr	5.7	64-	27	1N	Westminster, MD
June 28	Sat	3:28	Saturn	1.0	40-	59	4N	Cape Hatteras, NC (Sun alt. 30°)

## Asteroidal Appulses, 1997 May

Date	Day	EDT	Star	Mag	Asteroid	dmag	dur sec.	ap. in.	Location
May 2	Fri	5:10	SAO 122258A	8.1	Eunike	4.4	16	2	Nova Scotia
May 12	Mon	0:20	SAO 184086	9.3	Rosa	5.2	7	3	New England
May 21	Wed	23:34	PPM 163336	9.8	Eleonora	1.2	14	5	Newfoundland*

\*Updated prediction; a full Moon 26° away will hinder locating the star.

Phone the IOTA occultation line, 301/474-4945, for updates and details. The times for these events in the April *Stardust* were in EDT, not EST (except for April 1 events). (We apologize for any inconvenience — ed.)

## NCA Officer Nominations

The nominating committee, consisting of Wayne Warren, John Graham, and Jay Miller, has selected the following slate of nominees for positions as officers of the National Capital Astronomers for the 1997-1998 year. As is customary, elections will be held at the May meeting.

### President:

Dr. Harold A. Williams

### Vice President:

Dr. Andrew W. Seacord II

### Secretary:

Leith Holloway

### Treasurer:

Jeffrey B. Norman

### Audio-Visual Engineer:

Vacant

### Trustee:

Nancy Byrd



Trustees whose terms do not expire this year are: Bob Bolster, John Graham, and Jay Miller.

The membership may nominate additional candidates via a petition signed by at least ten NCA members.

## NCA Welcomes These New Members

**Donald H. Atha**  
**Lynne M. Atha**  
1078 Pipestem Place  
Rockville, MD 20854

**Michael A. Feldman**  
2000 Sweetgum Circle, Apt. 44  
Germantown, MD 20874

**Donald G. Fowles**  
23736 Woodfield Road  
Gaithersburg, MD 20882

**Manuel Munoz**  
6980 Maple St. NW, Apt. 2  
Washington, DC 20019

**Thomas W. Robinson**  
1437 Laburnum Street  
McLean, VA 22101-2524

**David R. Ticehurst**  
(Junior member)  
4421 Puller Drive  
Kensington, MD 20895-4070

**Murad K. Ureksoy**  
12503 Connecticut Ave.  
Silver Spring, MD 20906

**Len Paul Valenti**  
16004 Charles Hill Drive  
Gaithersburg, MD 20878

**Marge Weissberg**  
1024 Noyes Drive  
Silver Spring, MD 20910

**Mark E. Whiting**  
13116 Scarlet Oak Drive  
Darnestown, MD 20878-3552

## Moving Update

We are all moved in and we have been slowly getting our house and studio in order. Yes, we will host an Open House for those interested in seeing the new place. The date will be June 14, the time from 1:00 pm until whenever. We are also hosting a potluck playreading (a group that has been going on for more than 30 years.). If you are interested in staying and participating or just listening, bring a potluck dish you can share. Call within two weeks of the event and we will send you a map with directions. All are welcome. We will look forward to seeing you. — Alisa Joaquin, ed.

## 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

**May 5, 8:00 PM**-“Jets From Young Stars” by Dr. James Stone, University of Maryland, Department of Astronomy, College Park.

**May 9, 7:00-9:00 PM**-“Northern Lights” at Patuxent River Park. (Se Habla Espanol.) Transportation provided, reservations required. Call Geof Lane for more information at 301/927-2163.

**May 14, 8:00-9:30 PM** “Moon Observation Night,” Ages 6 to Adult, \$2.00 fee. Black Hill Regional Park, Visitor’s Center, Boyds, MD. Information: 301/972-3476.

**May 17, 7:00 PM**-“The Search for Extraterrestrial Intelligence.” Montgomery College’s Planetarium, Takoma Park, MD. Information: 301/650-1463.

**May 20, 9:00 PM**-“Explosions on the Sun - In Radio & X-Rays” by Dr. Mukul Kundu, University of Maryland, Department of Astronomy, College Park.

**May 21, 7:00-9:00PM**-“Full Moon Dinner Cruise” Adults only, \$5.00 fee. Black Hill Regional Park, Visitor’s Center, Boyds, MD. Information: 301/972-3476.

**Special Upcoming Event, July 20, 10:00 AM - 3:00 PM**-Goddard Model Rocket Contest in conjunction with the 29th anniversary of the Apollo 11 moon landing. Register on day of event. Information: 301/286-3978.

(More calendar events will be listed as soon as we are reconnected to the internet — ed.)

## Attention Space-Time Travelers!!

### Free Public Presentation

*Sunday May 4, 1997*

*8:00 PM*

*in the Main Auditorium of  
The Inn and Conference Center  
University of Maryland,  
University College in  
College Park, MD*

### “Charting the Cosmos to the Edge of Time”

*by Science Author and Journalist*

*Marcia Bartusiak*

Ms. Bartusiak will provide a guided multimedia tour of the galaxian universe, showcasing its fantastic structure and the latest thinking on its distant past and ultimate future. Her talk will be aimed at middle-school and higher levels. A reception will follow Ms. Bartusiak’s presentation.

Marcia Bartusiak is the author of popular science books including “Thursday’s Universe” and “Through a Universe Darkly.” Her articles frequently appear in *Discover*, *Astronomy*, and other popular science magazines.

Co-sponsored by Hughes STX Corporation, NASA Goddard Space Flight Center, and the University of Maryland

## Web Page Sites

*For more detailed events and information check out these web sites*

**Guide to Star Gazing and Planetarium Programs:** [http://128.183.127.48/pl\\_guide.html](http://128.183.127.48/pl_guide.html) (This is a complete guide for the Baltimore/Washington area.)

**Goddard Space Flight Center:** <http://pao.gsfc.nasa.gov/vc/events/JAN-JUN97.htm>

**Montgomery College’s Planetarium:** <http://myhouse.com/mc/planet.htm>

**NCA Home Page:** <http://myhouse.com/NCA/home.htm>

**University of Maryland Department of Astronomy:** <http://www.astro.umd.edu/openhouse/speakers.html>

## Newsletter Deadline for

### June Star Dust

### May 15, 1997

**\*\*\*DO NOT BE LATE!!!\*\*\***

Send Submissions to Alisa & Gary Joaquin, at 4910 Schuyler Dr, Annandale, VA, 22003-5144, Leave a message on voice mail 703/750-1636. Text files or graphic files in .GIF or .TIFF may be sent via E-Mail to [ajglj@erols.com](mailto:ajglj@erols.com) or fax submissions to 703/658-2233. **No submissions will be accepted after the 20th.** There will be no exceptions. We need a reasonable amount of time to design, edit, and review this newsletter. We would appreciate everyone’s help in this matter. Thank you.



Don’t throw this newsletter away. If your 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. For information: 301/320-3621 or 703/841-4765.

## 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*. (\$51 per year)

*Star Dust* only (\$24 per year)

Junior (Only open to those under age 18) Date of birth: \_\_\_\_\_

Junior members pay a reduced rate.

*Sky & Telescope* and *Star Dust*. (\$42 per year)

*Star Dust* only (\$15 per year)

_____	_____	_____	(____) _____
First name	Middle	Last name	Telephone
_____	_____	_____	_____
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 \$22 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.**

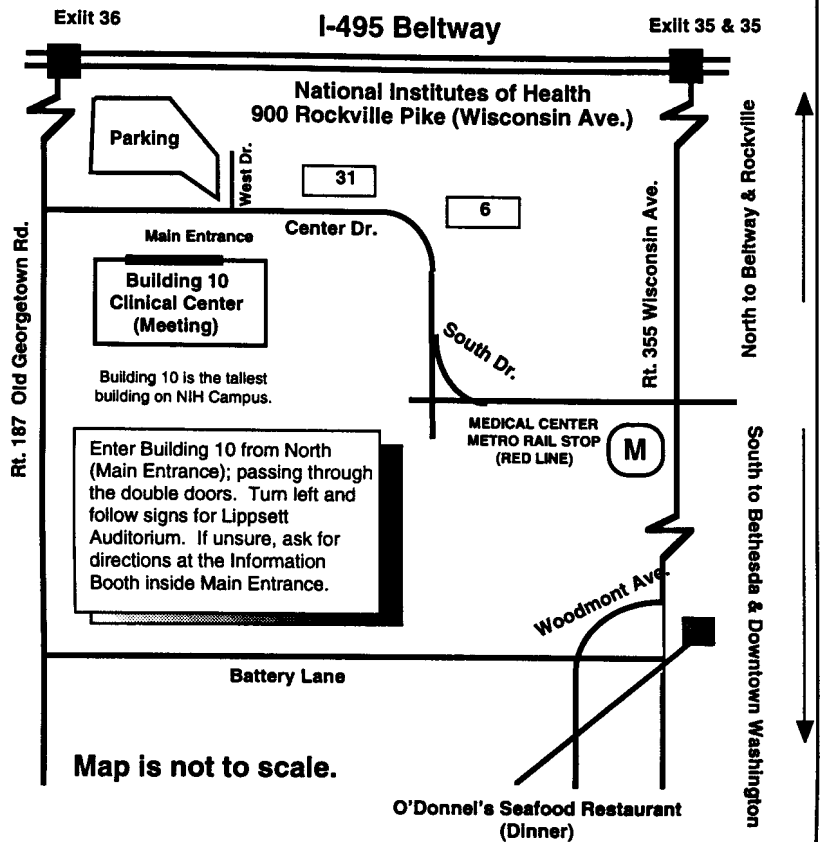
The following information is optional. Please indicate briefly any special interests, skills, education, experience, or other resources which you might contribute to NCA. **Thank you, and welcome to NCA!**

\_\_\_\_\_

# Getting to the NCA Monthly Meeting

**Metrorail Riders** - From Medical Center Metro Stop: 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).

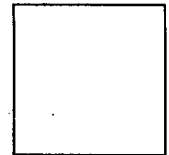
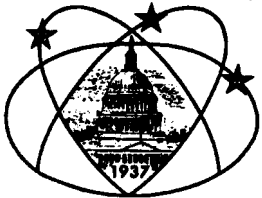
**To O'Donnel's Seafood Restaurant** - Take Wisconsin Avenue past Woodmont Ave. toward Battery Lane. It is located on the corner of Rosedale and Wisconsin Ave., on the left side of the street. There is free parking across the street on Rosedale. The address is 8301 Wisconsin Ave., Bethesda, MD. Seats are not guaranteed after 5:30 PM.



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