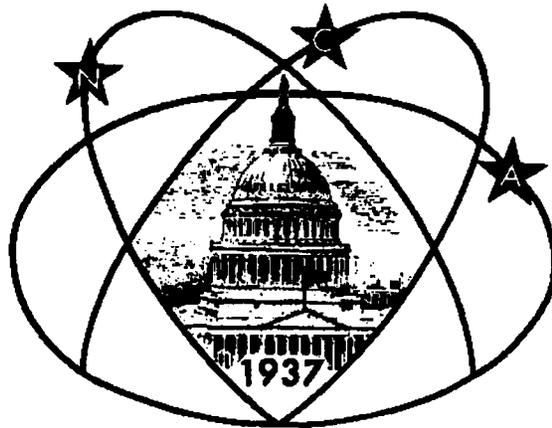


Star



Dust

National Capital Astronomers, Inc.

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Demosthenes Kazanas to speak on “Alternatives to Dark Matter.”

by Harold Williams

The next meeting of the National Capital Astronomers will be held on Saturday May 6 at 7:30 P.M., in the Bunim room on the ninth floor of the Clinical Center (building 10) at the National Institutes of Health (NIH). Demosthenes Kazanas, an astrophysicist in the Laboratory for High Energy Astrophysics of the National Aeronautics and Space Administration (NASA)/Goddard Space Flight Center (GSFC), will speak on “Alternatives to Dark Matter.” The speaker sent the following abstract:

“The deviation of the observed accelerations in extragalactic systems (galaxies and clusters of galaxies) has been interpreted, by a minority of researchers, as the signal of the breakdown of Newtonian (and for that matter Einsteinian) gravity at these distance scales rather than the presence of large amounts of “dark matter.” A number of such proposals are reviewed with particular emphasis on a conformal theory of gravity which, besides the Newtonian $1/r$ potential, produces from first principles a linear potential between gravitating objects.”

The flat rotation curves of disk galaxies, the X-ray gas held by clusters of galaxies, and the velocity dispersion of galaxy redshifts within a cluster of galaxies are all generally taken as an indication of the existence of large amounts of

underluminous matter—“dark matter.” The gravity can be detected through the motion of material around the gravitator. The larger the scale, the larger the percentage of the universe that seems to be composed of dark matter. In individual galaxies the composition seems to be 90% dark matter; in clusters of galaxies the ratio often increases to 99%. These numbers are not really well constrained, other than to indicate that it is evident that there must be much more dark matter than luminous matter. More significantly, however, they are derived with the assumption that we understand the way that the gravitational potential, or its derived force, falls off with distance. Since the dark matter percentage seems to change with distance—with the structural size of the object—perhaps it is worthwhile to see how changing the currently accepted theories of the relationship of gravitational fields to distance would alter the conclusions that much matter must be dark and that the distribution of the type of dark matter must change with distance.

The search for the dark matter candidates known as MACHOs (massive compact halo objects), which are detected by gravitational lensing effects, found so few of these objects that, at best, MACHOs could account for only 20% of the underluminous matter.

Furthermore, there is also a problem with Hubble’s constant (H_0); the measured distance of Cepheid variable stars seems to give a value for Hubble’s constant of 80 km/sec Mpc, which implies that the age of the universe is only 8.3 billion years—but 12- to 15-billion-year-old stars seem to be observed according to the prevailing theory of stellar nucleosynthesis in stars. Perhaps the theory of gravity, the general theory of relativity in this case, which gives us the age of the universe as $2/3 H$, is in error.

The general theory of relativity is a gaugelike particle field theory, a type of theory that is somewhat more complicated than the simple gauge theories of electromagnetism, which are based upon U(1), the simple unitary one-dimensional group. The other two fundamental forces of nature can also be modeled as gauge field theories, but the gauge group is more complex: the weak force is modeled on SU(2), the special unitary two-dimensional group, and the strong force modeled is on SU(3), the special unitary three-dimensional group. Since the theory of gravity is a theory about space and time, the gauge group that generates this force must be a space-time group. The Einsteinian general theory of relativity is only one way of choosing the particular space-time

See DARK MATTER, on Page 4

Calendar of Monthly Events

The Public is Welcome!

Mondays, May 1, 8, 15, and 22, 8:30 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. Information: USNO Public Affairs Office, 202/653-1541

Tuesdays, May 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.

Wednesday, May 3-May "Sky Watch" column, by Blaine P. Friedlander, Jr., appears in *The Washington Post* "Style" section. It lists many other events for the month.

Fridays, May 5, 19, and 26, 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.

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

Saturday, May 6, 5:30 PM-Dinner with the speaker at the La Posada Restaurant, 8117 Woodmont Avenue, Bethesda, MD., before the monthly meeting. Reservations are for 5:30 p.m., sharp. Refer to map and description on back page.

Saturday, May 6, 7:30 PM-NCA meeting, featuring Demosthenes Kazanas speaking about "Alternatives to Dark Matter." Meeting will be held in the Bunim Room at the Clinical Center (building 10) at the National Institutes of Health (NIH). For directions, refer to map and description on back page.

Thursdays May 11, 18, 25, and June 1, 7:30 PM-Daniel Costanzo (NCA), "Astronomy O! O! O!: You, The Universe & Everything In Between." See page 4 for details.

Saturday, May 13, 7:00 PM-"The Search for Extra-Terrestrial Intelligence." Montgomery College's Public Planetarium. The planetarium is attached to the Science South building on the ground level and has a conspicuous silver-colored domed roof. Montgomery College Planetarium, Montgomery College, Takoma Avenue and Fenton Street, Takoma Park, MD 20912-4197. Phone: 301/650-1463

Tuesday, May 16, 6:30 PM-Wendy Freeman will be speaking on "Measuring the Expansion Rate of the Universe" at the Carnegie Institution of Washington, DC. Information: 202/328-6988 or 202/265-2752.

Saturday, May 20, Night-Waning crescent Moon provides this month's *second longest* Saturday night "deep night" period, including all Moonless skies between dusk and 1:00 a.m. EDT. See May 27 listing.

Saturday, May 20, 9:00 PM-"Exploring the Sky", Rock Creek Park. Coordinator will be either Bob Bolster or Joe Morris. See March issue for details.

Saturday, May 27, Night-New Moon provides this month's *longest* Saturday night "deep night" period (i.e., continuous time interval with neither daylight, twilight, nor Moonlight), with Moonless skies all night long. Several relatively dark-sky sites are available for NCA members' use. Information: Daniel Costanzo, 703/841-4765.

Saturday, June 3, 11:00 AM to 4:00 PM-NCA and the Smithsonian Institution, National Air and Space Museum (NASM), free consumer Workshop: "Binoculars! Telescopes! Astronomy!." NASM, Briefing Room. NCA Volunteers still needed. See page 4 for details.

Saturday, June 3, 7:30 PM-The June NCA meeting will feature Wayne Warren, David Dunham, and Tom Van Flandern speaking about "The Solar Eclipse Expedition on November 1994 to Chile and Bolivia." We will also have brief reports on some of the NCA science fair winners.

Wednesday, June 7-"Sky Watch" column appears in *The Washington Post* "Style" section. It lists many other events for the month.

Talk on Solar Eclipse Exhibition Postponed Until June

by Harold Williams

On Saturday April 1, 1995 at the National Institutes of Health (NIH) in the Lipsett Amphitheater we did not see the videos by Wayne Warren and David Dunham on the exciting November 1994 solar eclipse expedition to Chile and Bolivia as advertised. Unfortunately we had total failure of our understanding of the video projection equipment. We will show these videos at our June 3 meeting. This time we will have some video backup equipment, as I shall bring my television and VCR from home, but let us hope the auditorium's equipment can be made to work. The delay will enable us to show another eclipse video besides Wayne and David's, as Tom Van Flandern's video will be ready by then.

David Dunham though did tell us about the value of doing lunar grazing occultations of stars for getting a better profile of the lunar valleys. The lunar valley profile is used in the timing of Baily's Beads, the last of the photosphere of the Sun that shines through the bottom of deep lunar valleys during a total eclipse of the Sun. Baily's Bead timing is used near the eclipse edge path to calculate the diameter of the photosphere. This photospheric diameter will tell us whether the Sun's photosphere is shrinking or expanding with time.

As luck would have it, during the meeting a lunar graze was in progress in North Carolina, but the weather was evidently bad, which made David Dunham feel somewhat consoled for his missing the graze. Between April 1 and our next meeting on May 6 four more lunar grazes of fairly bright stars will occur in the Northern Virginia, D.C., and MD regions, as was reported on page 4 of last month's *Star Dust* by David Dunham. David provided updated ephemeris tracks for these events with several handouts for all who were interested. He also showed us tracks, captured a few years ago, across an asteroid occultation of a star.

As it became more evident that the video equipment was not going to work, I filled in with slides and talk about the

earlier great eclipse of July 11, 1991. These slides were from Montgomery College's expedition of twelve people who went with Tom Van Flandern's large group, the *Eclipse Edge*, which spent the eclipse day in Sayulita, a fishing village in the state of Nayarit, where the eclipse was total. This eclipse was very long, so even on the edge we enjoyed two minutes of darkness during which four planets could be seen while the Sun was less than one degree from directly overhead. Four Baily's Beads could be seen strung out along the edge of the Moon in three separate pictures taken by the Montgomery College Questar telescope in rapid succession. Had I realized the importance during this event of Baily's Beads, I would have taken timings, but I didn't understand this at that time. I was foolishly trying to capture δ Geminorum, which was within a solar diameter of the edge of the Sun and whose image was shifted by about half of a star diameter's seeing disk by the bending of starlight near the surface of the Sun—an already well-studied effect of the general theory of relativity. Not only was this attempt somewhat futile, even in theory, since the deflection was within the instrumental seeing, but δ Geminorum either did not show in the glare or was more likely just off of the frame when the pictures were taken. An eclipse is very exciting and you do not have any time to think. Everything must be done after practicing until it becomes automatic during the adrenaline rush that comes during totality as the shadow rushes at you across the ground at more than 1600 kilometers per hour (1000 miles per hour). The fill-in slides showed that interesting things can still be done with a 35-millimeter camera, a Questar telescope, and some curious people. Wayne Warren slyly and accurately observed that Harold Williams can talk for at least a class period at the drop of a hat or the failure of a video projector. In this case, it proved useful.

As usual, we are indebted to NIH and NCA member Jay Miller for arranging to meet at NIH, where he works.

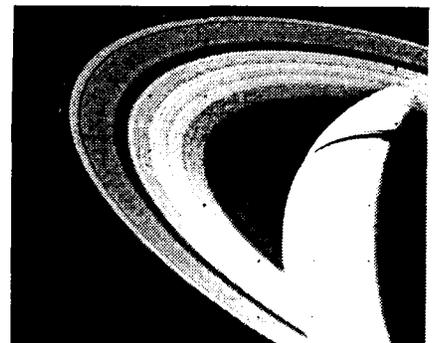
Attention Saturn Watchers!

Beginning this May, Saturn begins a rare sequence of events where the rings appear edge-on, and briefly disappear, as viewed from Earth. Just as "the Crash of '94" (the now famous impact of Comet Shoemaker-Levy 9 into Jupiter) was the Solar System observing event of last year, this triple ring crossing will be this year's event. For details, see *Sky & Telescope's* May issue, pp. 65-66, 68-72, and 92-95. (This fine periodical is available, at a discount, with NCA membership.)

As these articles point out, the last time this triple ring crossing occurred was in 1979-1980, half a Saturnian year ago (Saturn's full year is about 29 Earth years long). But it won't occur again until 2038-2039. That would be around the official start of World War Two's centennial anniversary. So the events of coming months are not to be missed. They will continue through February of next year.

Let's face it; the rings are what make Saturn the most beautiful sight in the heavens visible from Earth-based telescopes. Saturn without rings is just a bland, creamy colored ball. But this triple ring crossing offers patient and persistent telescopic observers many opportunities completely unaffected by light pollution, meaning the view from even the heart of the Nation's Capital can be as good as anywhere else.

As NCA members, you have free access to several high quality telescopes capable of showing these events in fine detail. Please take advantage of the great privilege these instruments, and Saturn, make available to you. Forty-three years is a long time to wait for another look.



DARK MATTER, from Page 1

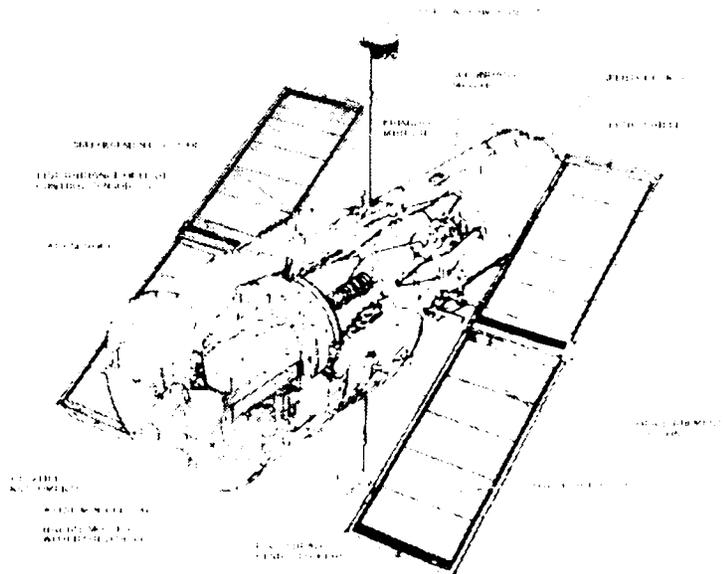
gauge group. What if you chose a different space-time gauge group, such as the simplest space-time gauge group? Obviously, "simplest" is a matter of taste to some degree, and we don't know Nature's taste in space-time groups—He seems to have not communicated this to mankind in any of the sacred scriptures. Herman Weyl's conformal invariance, which is just space-time global invariance of the origin of space-time transformed into local invariance of the original space-time, leads to fourth-order Weyl gravity. This introduces two extra constants into the solution of the simplest Lagrangian. The Lagrangian is the object that makes up the field theory. Regular general relativity is second order in the field variables, while Weyl gravity is fourth order.

What difference does this fourth order make? Newton's laws of motion are second order in the derivatives of position, which means that to arrive at a general solution for all time you must know only the position and the velocity for an instant in time. For the fourth order in the derivatives of position, to arrive at the general solution for all time you must know the position, velocity, acceleration, and jerk (second derivative of the acceleration) for an instant in time. More integration constants means more wiggle room for theorists to model the universe. Are the results correct? To

find out, we must compare the results of calculations with the results of experiment and observations—that is science.

Our speaker, Demosthenes Kazanas, was born in Kavala, Greece. Since he was named after the greatest orator of ancient Greece, perhaps we should expect a good talk. He received his B.Sc. in physics with honors from Aristotelian University, Thessaloniki, Macedonia, Greece and his Ph.D. from the University of Chicago, supervised by David N. Schramm. His earlier research was on competition between neutrino radiation in weak interactions (this is what blows up the supernova

when the star's matter becomes opaque to neutrinos during collapse) and gravitational radiation. Cosmology and the interplay of particle physics with symmetry breaking during the first moment of the big bang, leading to the inflationary scenario, was explored by our speaker in print as early as 1980 in *Astrophysical Journal Letters*. He has published many papers on the high-energy astrophysics of compact accreting objects such as active galaxies, quasars, X-ray binaries, γ -ray bursts, and on particle acceleration processes in these objects to the very highest energies.



Hubble Space Telescope Configuration

Astronomy O! O! O! You, The Universe & Everything In Between

Learning-friendly alternative to Astronomy 101. Practical lessons explore the wonders of the Cosmos. Includes guidebook and handouts, plus planetarium and outdoor observing sessions. Four weekly Adult Education classes, Thursday Nights, 7-9 p.m. Optional weekend museum tour.

Starts Thursday, May 11

Astronomy O! O! O! was created by Daniel Costanzo (NCA), and is taught by him at the Arlington Planetarium, in Arlington, Virginia (within walking distance of the Ballston Metrorail Station). To register, call Arlington Adult Education: 703/276-6990, 6991, or 2506, and sign up for course number GI-711 (General Interest).

The Case for a Hubble Constant of 30 km per second per Megaparsac

Science, February 17, 1995, pages 980-983: Joseph Silk et al.

by **John B. Lohman**

A case is made for a Hubble constant. 30 km/s/Mpc, that is even smaller than the lower bound of the accepted range (40-90 km/s/Mpc). Such a value for Hubble constant cures all of the ills of the current theoretical orthodoxy; that is, a spatially flat universe composed predominantly of cold dark matter. Possible sources of the discrepancy are discussed.

Hubble Observes an New Saturn Storm

This NASA Hubble Space Telescope image of the ringed planet Saturn shows a rare storm that appears as a white arrowhead-shaped feature near the planet's equator. The storm is generated by an upwelling of warmer air, similar to a terrestrial thunderhead. The east-west extent of this storm is equal to the diameter of the Earth (about 7,900 miles). Hubble provides new details about the effects of Saturn's prevailing winds on the storm. The new image shows that the storm's motion and size have changed little since its discovery in September 1994.

The storm was imaged with Hubble's Wide Field Planetary Camera 2 (WFPC2) in the wide field mode on December 1, 1994, when Saturn was 904 million miles from the Earth. The picture is a composite of images taken through different color filters within a 6 minute interval to create a "true-color" rendition of the planet. The blue fringe on the right limb of the planet as an artifact of image processing used to compensate for the rotation of the planet between exposures.

The Hubble images are sharp enough to reveal that Saturn's prevailing winds shape a dark "wedge" that eats into the western (left) side of the bright central cloud. The planet's strongest eastern winds (clocked at 1,000 miles per hour

from analysis of Voyager spacecraft images taken in 1980-81) are at the latitude of the wedge.

To the north of this arrowhead-shaped feature, the winds decrease so that the storm center is moving eastward relative to the local flow. The clouds expanding north of the storm are swept westward by the winds at higher latitudes. The strong winds near the latitude of the dark wedge blow over the northern part of the storm, creating a secondary disturbance that generates the faint white clouds to the east (right) of the storm center.

The storm's white clouds are ammonia ice crystals that form when an upward flow of warmer gases shoves its way through Saturn's frigid cloud tops.

This current storm is larger than the white clouds associated with minor storms that have been reported more frequently as bright cloud features.

Hubble observed a similar, though larger, storm in September 1990, which was one of three major Saturn storms seen over the past two centuries. Although these events were separated by about 57 years (approximately 2 Saturnian years) there is yet no explanation why they apparently follow a cycle - occurring when it is summer in Saturn's northern hemisphere.

Credit: Reta Beebe (New Mexico State University), D. Gilmore, L. Bergeron (STScI), and NASA



Newsletter Deadline for

June Star Dust

May 15, 1995

Send Submissions to Gary & Alisa Joaquin, at 7821 Winona Ct., Annandale, VA, 22003, Leave a message on voice mail 703/750-1636 or send an ASCII file via E-Mail at 71561.1747 @compuserve.com or fax to 703/658-2233. Submissions must be on time or they may not get in. Have a good Memorial Day Weekend

Montgomery College's Public Planetarium Programs

Exciting public planetarium programs are offered at Takoma Park's own planetarium. Astronomy is one of the few sciences accessible to any inquiring mind. All programs begin at 7:00 p.m. There is no admission charge.

Saturday, May 13 — "The Search for Extra-Terrestrial Intelligence"

The planetarium is attached to the Science South building on the ground level and has a conspicuous silver-colored domed roof. Montgomery College Planetarium, Montgomery College, Takoma Avenue and Fenton Street, Takoma Park, MD 20912-4197. Phone: 301/650-1463

Searching for Biographical Sketches of NCA Members

By Alisa Joaquin

If you would like members to know you better, please submit a biographical sketch consisting of an article approximately one to two columns in length plus a photo. The photo should be provided on disk in gif or tiff format for the PC. Please submit biographies and photos at the same time as regular articles. The article and photo can be sent through compuserve. Our E-mail address is provided on the back page of *Star Dust* in the copyright box. Deadlines always fall on the 15th of each month.

Binoculars! Telescopes! Astronomy!

Free Consumer Workshop

Summer season thoughts of astronomy? Consumer beware! "Bargains" on binoculars and telescopes are just as risky as other "great deals." Learn to wisely choose, use, and care for astronomical instruments from NCA. Their experts are available any time between 11:00 a.m. and 4:00 p.m. with myth-breaking information, guidance, and demonstrations.

Saturday, June 3

National Air & Space
Museum

Briefing Room

This workshop is a joint gift of NCA and the Smithsonian Institution, National Air & Space Museum (NASM). See article in *Star Dust*, 1994 October issue, p. 5. NCA volunteers are still needed! NASM provides all volunteers with free parking. Information: Daniel Costanzo (NCA), 703/841-4756; Cheryl Bauer (NASM), 202/357-1529.

Important Information Numbers

Smithsonian Sky Watchers' Report: Non-technical information recording on astronomical events, objects, and phenomena in the Washington, D.C. region's sky. Updated weekly. 202/357-2000

Sky & Telescope "Skyline": Moderately technical information recording on latest in space technology, astronomy, and related sciences. Updated weekly, or sooner if necessary. 617/497-4168

McDonald Observatory "Star Date": Non-technical information on space technology, astronomy, and related subjects. Broadcast weeknights, around 8:00 PM, by listener-supported public radio station WAMU-FM 88.5.

Accurate Time Services (via phone line): Eastern Time (in 24 hour mode) and Universal Time given via the U.S. Naval Observatory and the National Institute of Standards and Technology. Excellent for synchronizing clocks and watches. (Voice Recordings) 202/653-1800, 900/410-TIME, and 303/499-7111; (Modem Time Service) 202/653-0351

"Space Weather" Indices: Highly technical, but quite useful voice recording on Solar activity and its effect on Planet Earth, given via the National Oceanic and Atmospheric Administration. Updated every three hours. 303/497-3235 (anytime) or WWV at 2.5, 5, 10, 15, and 20 MHz (at 18 minutes after every hour)

Local Weather, Sunrise/Sunset, and UV Index: Recording of latest weather forecast out to five days, plus Sunrise/Sunset times, and forecasted Solar ultraviolet radiation index. Covers Washington, DC and vicinity. 703/260-0307

NCA Artificial Satellite Prediction Service: Free customized prediction of viewing opportunities. Satellites frequently are clearly visible to unaided eyes or binoculars, even from heavily light polluted areas. Contact Walter I. Nissen, Jr., (voice phone) 216/243-4980, (e-mail) dk058@cleveland.freenet.edu

NCA Jupiter Galilean Moon Prediction Service: Free customized prediction of viewing opportunities for Jupiter's four Galilean moons. They are clearly visible in small telescopes and binoculars, even from heavily light-polluted areas. Contact John Lohman (voicephone) 703/820-4194 at least one week prior to anticipated viewing.

Occultation Line: Highly technical, but quite useful voice recording with latest updates on occultations and grazings of stars by the Moon, planets, and asteroids; from the International Occultation Timing Association. Many of these events are visible with the unaided eye, binoculars, and small telescopes. 301/474-4945

Other Free Public Science & Technology Lectures: National Air and Space Museum (NASM): 202/357-1552 (ask to receive NASM bimonthly calendar by mail); University of Maryland (Astronomy Department): 301/405-3001; Goddard Space Flight Center (Goddard Visitor Center): 301/286-8981; Carnegie Institution of Washington: 202/328-6988 or 202/265-2752

Science & Technology Public Radio Programs: Quality, informative, and educational radio programs featuring space technology, astronomy, and related sciences are presented at irregular intervals on WAMU-FM 88.5. For program listing, call WAMU Public Radio Listener Talk Show Hotline: 202/885-1200 and Press 3.

"Star Hustler": Completely non-technical, frequently outrageous, but always informative presentation on astronomical events, objects, and phenomena. Broadcast every night, just before sign-off (generally shortly before 1:00 AM) on Maryland Public Television (MPT) stations. Check your local TV guide for your local MPT Channel. Updated weekly. (MPT can also be picked up in the District and Virginia.

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, judge 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 Workshops 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:

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Star Dust only (\$24 per year)

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

Junior members pay a reduced rate.

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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.

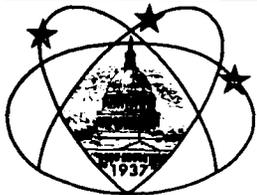
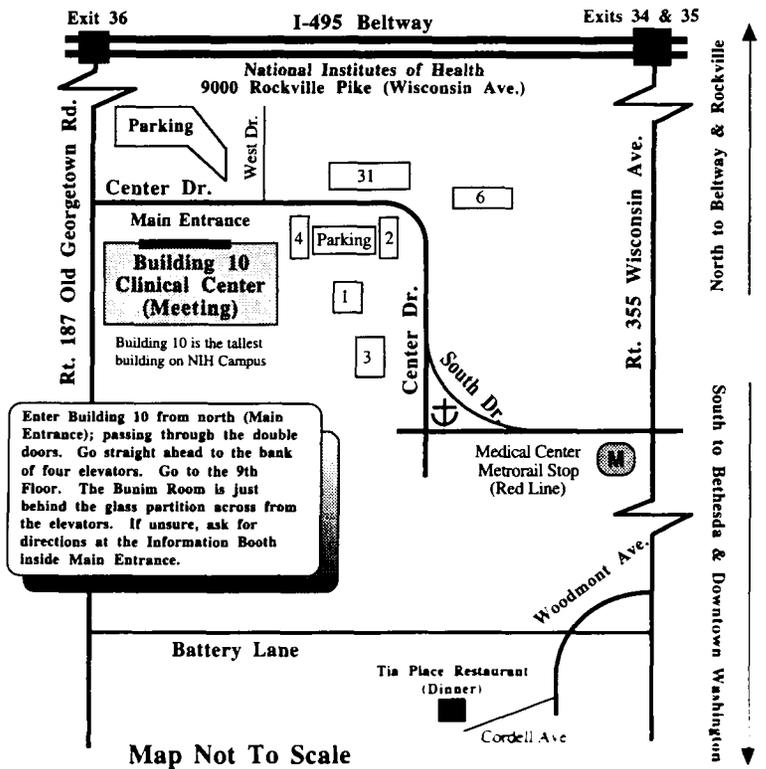
The following information is optional. Please indicate briefly any special interests, skills, education, experience, or other resources which you might contribute to NCA. **Thank you, and welcome to NCA!**

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 (walking time about 10 minutes), the tallest building on campus. Also, the J2 bus line connects the Bethesda (7:16 PM) and NIH (7:23 PM) Metro stops with Building 10 (7:25 PM).

La Posada Restaurant - Take Wisconsin Avenue toward Bethesda and bear right onto Woodmont Avenue (8117 Woodmont Avenue). There should be adequate parking in area garages (free on weekends). Seats are not guaranteed after 5:30 PM.

Star Dust is published ten times yearly (September through June) by the National Capital Astronomers, Inc. (NCA), a non-profit, astronomical organization serving the entire National Capital region, and beyond. NCA is the astronomy affiliate of the Washington Academy of Sciences and the National Capital region's representative of the International Dark-Sky Association. NCA's Phone Numbers: 301/320-3621 or 703/841-4765. President, Wayne H. Warren, Jr., 301/474-0814. Deadline for *Star Dust* is the 15th of the preceding month. Editors Alisa & Gary Joaquin, 7821 Winona Ct., Annandale, VA 22003, 703/750-1636, E-mail-71561.1747@compuserve.com. *Star Dust* © 1995 may be reproduced with credit to National Capital Astronomers, Inc.



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Exp. 7/96

May 1995