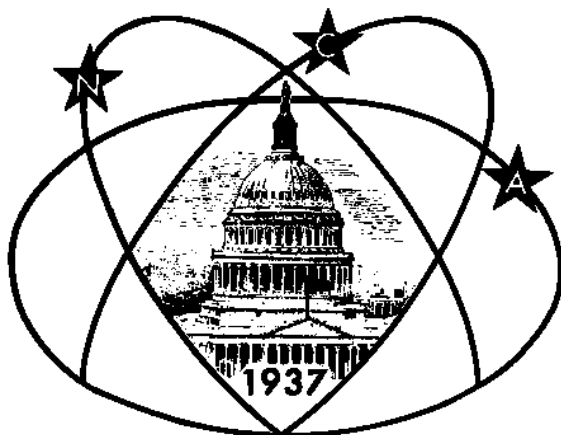


Star



Dust

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Dr. Kenneth Johnston to talk to NCA on “Recent and Future Advances in Astrometry”

by Nancy Byrd

Dr. Kenneth Johnston, Scientific Director for the U.S. Naval Observatory (USNO), will present the featured talk for the March 4, 2000 meeting of National Capital Astronomers. The March meeting will be held in the Lipsett Auditorium in Building 10 (Clinical Center) of the National Institutes of Health in Bethesda at 7:30 PM. The talk, entitled “Recent and Future Advances in Astrometry,” draws on Dr. Johnston’s considerable experience in the field of astrometry and radio astronomy, and on the current efforts he directs at USNO. He is “responsible for the scientific oversight of precise time, time interval and astrometry programs,” and is “developing

the areas of radio and optical interferometry for astrometric and imaging applications with both ground and space instruments.” The Astrometry Department at USNO has many functions: producing numerous astronomical catalogs, establishing reference frames, maintaining and improving the International Celestial Reference Frame (ICRS), investigating new techniques of observation while performing observations and investigating methods of optical and infra-red interferometry, including continued development of the Navy Prototype Optical Interferometer.

The President’s Corner

It is time to consider officers for the coming year. The election of officers will take place at the beginning of the June 3 meeting. I am now looking for a few NCA members to form a nominating committee. Please consider being a member of this committee or serving as an officer. In particular, we will need a Vice President. If you can serve, or you have suggestions for possible candidates, please contact me soon. I can (sometimes!) be reached by telephone (301.805.9741) or by e-mail (aseacord@erols.com). I would like to the nominating committee established no later than the end of March. I thank you all.

Andrew W. Seacord, II
President

Radio Astronomy and The Very Large Array Sky Survey Review of Talk by James J. Condon

by Andrew W. Seacord, II

At the February 2000 meeting of NCA, Dr. James J. Condon, of The National Radio Astronomy Observatory (NRAO) and project scientist for the new 100-meter Green Bank Telescope, presented an excellent overview of the history of radio astronomy, what it has taught us, and a current look at the NRAO Very Large Array (VLA) Sky Survey. The following paragraphs are a synopsis of his talk.

Introduction

Radio astronomy has always been the science of the unexpected. Radio sky surveys have led to the discovery of new classes of celestial objects such as radio galaxies, quasars, and pulsars, none of which were

predicted. They have provided some of the first evidence that the Universe is evolving. Following these initial discoveries, newer radio sky surveys with a qualitative improvement of sensitivity and resolution do not only give more of the same sources, but also reveal new classes of radio sources. The latest generation sky survey includes the NVSS which detected two million radio sources visible from the northern hemisphere (declinations greater than -40 degrees). NVSS stands for the National Radio Astronomy Observatory (NRAO) Very Large Array (VLA) Sky Survey. The amount of data collected is so large, no group of principal investigators can possibly analyze all of it. So, the sur-

vey images are available on the web for all to use.

Following this introduction, Dr. Condon talked about the early history of radio astronomy.

How Radio Astronomy Began

It all started with Karl Jansky, an engineer for Bell Laboratories, who was assigned the task of determining the source of static encountered with 20-MHz transatlantic communications. For this study, he built a 20-MHz (wavelength of 15 meters) radio direction finder whose antenna was mounted on a wheeled carriage so that it could be rotated 360 degrees. His study,

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NCA Events This Month

The Public is Welcome!

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

Fridays, March 3, 10, 17, 24, and 31, 7:00 - 9:30 P.M.

Telescope-making classes at American University, McKinley Hall Basement, Nebraska and Massachusetts Avenues, Washington, D.C. However, on March 3, 10, and 31, if the weather is clear, there might not be a class, because the instructor may be out stargazing; call or e-mail to confirm on those dates. Information: Guy Brandenburg, 202-635-1860, or gfbranden@earthlink.net

Fridays, March 3, 24, 31, 8:30 P.M. - Open night with NCA's 14-inch telescope at Ridgeview Observatory near Alexandria, Virginia; 6007 Ridge View Drive (off Franconia Road between Telegraph Road and Rose Hill Drive). Call Bob Bolster, (703) 960-9126 before 6:00 P.M.

Saturday, March 4, 5:30 P.M. - Dinner with the speaker and NCA members at the Cesco Trattoria, 4871 Cordell Ave., Bethesda MD. See map and directions on Page 8.

March 4, 7:30 P.M. - NCA meeting, at Lipsett Auditorium in Building 10 at NIH, will feature Dr. Kenneth Johnston to talk to the NCA on "Recent and Future Advances in Astrometry".

Saturday, April 1, 7:30 P.M. - NCA meeting, Dr. Judith Lean, NRL, speaking on solar variation and climate.

See Page 6 for more National Capital area astronomical doings. To join NCA, use the membership application on Page 9.

Radio Astronomy, continued

(Continued from page 1)

which lasted for more than a year, showed that a component of the static had an origin that varied with a sidereal rate with respect to the observing site. In fact, most of it was coming from the center of the Milky Way, making the center of our galaxy the first radio source discovered. Jansky thought that the radiation he detected was thermal because it sounded like the noise generated by a vacuum tube filament. He also learned that most of the 20-MHz static originates from tropical thunder storms. Once he had determined the source of the 20-MHz static, Karl Jansky was put on other tasks and did nothing more with radio astronomy.

Chapter Two

The next chapter of radio astronomy history was written by a radio engineer and ham radio operator, Grote Reber. [Ed. note: Grote Reber was an officer of NCA.] In the late 1930's, Reber constructed a 30-foot parabolic radio telescope antenna in his Wheaton, Illinois, backyard. He started with the assumption that the galactic radiation was thermal. Since the radio intensity of a thermal source varies as the square of the frequency, Reber knew that the galactic radiation would be much brighter at high frequencies and therefore, built a 960-MHz receiver for the telescope. But, when he pointed the dish at the galactic center, he detected nothing. Neither could he detect it with his next receiver built for 400 MHz. Finally, he built a 160-MHz receiver and with it he did detect galactic

radiation. From these observations, he concluded that the spectrum of the galactic center and plane was non-thermal. Reber continued his radio observations and detected several radio sources.

Aside from Reber's activities, radio astronomy languished until after World War II when radar systems became declassified and its technology was used for radio telescopes. During the war, the Americans and British were aware that the sun was a strong radio source. That information, however, was classified because solar radio noise could obliterate radar signals if the sun were in the antenna beam along with the target.

Radio surveys over large areas of the sky took place during the late 1940s and 1950s, from which a dozen or so strong radio sources were discovered. One of these was the Crab Nebula, a supernova remnant in Taurus. Another very strong source was Cygnus A, a radio galaxy, which, when mapped with the VLA, was found to be one million light years across. During the 1960s, second-generation surveys, which were made with a greater sensitivity and resolving power than were their predecessors, detected many active radio galaxies, but did not detect objects, such as stars and normal galaxies like our own, common to "ordinary" astronomy. Since the radio galaxies were very faint and had large red-shifts, they are located at cosmological distances and are, therefore, very old. This tells us that more active galaxies existed in the early Universe than exist today. So, the Universe was

more active in the distant past than it is today. This was the first indication that the universe is evolving. It predates the discovery of the 3° K. microwave background radiation. The new radio-universe seemed to be very different from that of "real" astronomy. It was as though there were two parallel, disconnected universes.

The Green Bank Observatory

To do real astronomy in the radio region, an order-of-magnitude increase of sensitivity was needed. For this reason, the 300-foot telescope was built at the NRAO Green Bank Observatory. In the early 1980's, it was used to make northern hemisphere sky surveys at 1.4 GHz (wavelength = 20 cm) and 4.85 GHz (6 cm). The 6-cm survey detected 75,000 sources. One of the slides we were shown displayed a form of summary of this survey, the sky as it would appear through 300-foot eyes tuned to 4.85 GHz. The unresolved radio sources are distributed isotropically throughout the sky. Some of these are quasars. The average red shift of the bright radio sources is about 1.0. The starburst galaxy M82 is quite visible on this radio sky. Comparing the large M82 radio image with its optical counterpart indicates that most of it is hidden by dust.

In 1988, shortly after the 6-cm survey was completed, the 300-foot telescope antenna collapsed because of metal fatigue. This represented a considerable loss of survey instrumentation and closed

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Radio Astronomy, continued

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off survey work for some time. Not only must a radio survey telescope have high sensitivity, wide bandwidth, and high resolution, it must also be able to avoid the increasing amount of interference from human technology. The 300-foot telescope possessed all of these characteristics and was the only instrument involved with surveys at the time of its collapse.

The VLA

During the late 1990s, it became possible to use the VLA for survey work. The VLA consists of twenty-seven 25-meter telescopes (elements), distributed in a Y-configuration. These elements are used together to synthesize an aperture having the same resolving power as that of a single dish one kilometer in diameter. With the VLA, the stability of observed source position does not depend on the pointing of the individual elements, but, rather, on the characteristics of the waveguide connecting the system. The stability of the waveguide system is much easier to maintain than is the pointing of each element. A VLA sky requires about 200,000 observations.

The 1.49 GHz VLA northern sky survey detected about two million sources.

Analysis of the survey maps shows no apparent signs of source clustering; the maps are, in fact, extraordinarily bland. This is a confirmation of the Cosmological Principle: the Universe is uniform throughout on a large enough scale.

It is well known that the Earth is not at rest in the Universe. The component of the Doppler shift observed in radio-source spectra due to the Earth's motion should result in observing one-tenth of one percent more radio sources in the direction of motion than in the opposite direction. It is hoped that a future project will use the NVSS data to measure the motion of Earth.

The VLA survey has detected objects with smaller luminosities than have been found in previous surveys. Thousands of "normal" and starburst galaxies were seen as radio sources. When these new galaxies were compared to those in the Uppsala catalog of galaxies, it was discovered that one third of the VLA/Uppsala galaxies are radio sources powered by stars.

Also, true radio stars were detected. These are very active stars; in some cases the

entire star is a gigantic sunspot. Stars like the sun, however, are still too weak to have been observed. However, planetary nebulae, the remnants of low-mass stars like the sun, were detected in the VLA survey. Their distribution provides a tracer of the history of star formation in our galaxy. Planetary nebulae can be observed in the radio band even though they may be obscured with dust and, therefore, not observable visually. From the death rate determined from these planetary nebulae, we can draw conclusions about the birthrate when our galaxy was younger.

A major benefit of the VLA survey is the accuracy to which source positions are determined. This allows identification with objects detected at other wavelength bands for which source positions are not as well known. For an example, a large fraction of x-ray sources found by the ROSAT survey have been identified with VLA survey sources.

Replacement for the 300-foot Telescope

The new 100-meter Green Bank Telescope (GBT) is almost completed. First light is expected to occur this summer. Before discussing this new telescope, Dr. Condon spoke about an interesting aspect of the demise of its predecessor. Analysis of the 300-foot telescope data obtained a month before the event showed evidence of the impending collapse. By this time, the hysteresis of source position had increased from 10 to 50 arc seconds and the north-south dimension of the antenna main lobe had become wider. On the day before the collapse, the beam was 50% wider than its nominal width. The change of the antenna beam shape resulted from distortion in the shape of the parabolic reflector. As the reflector supports deteriorated from metal fatigue, their orientation or position changed enough to distort the dish. The reflector must remain parabolic to within 1/16 of a wavelength in order to preserve the radiation pattern.

The GBT Secondary Mirror

The GBT is a Gregorian system. The subreflector (secondary mirror) is mounted above and to the side of the primary reflector on a long, thick arm attached to the side of the primary reflector. This arm provides a stable subreflector support that does not block any of the primary reflector. The antenna feed and receiver front ends are mounted in a box

attached to the support boom mounted below the subreflector. An advantage to this system is that subreflector and the receiver box do not contribute to antenna beam side lobes. The existing side lobes are much smaller than those of a centered reflector and, consequently, the interference from the outside environment entering the telescope through side lobes is much less. The GBT is designed to be as insensitive as possible to any radiation not entering through the antenna main lobe. This is an important consideration for a survey instrument operating in an unprotected region of the radio spectrum as it will be doing. Unfortunately, it is only a matter of time before interference from human technology will wipe out even this system.

The GBT Primary Mirror

The GBT primary reflector will have an active surface constructed of 2000 separate panels, each controlled by a motor-driven screw attached to one corner of the panel. This system is designed to compensate for deformation resulting from a variety of causes. The surface control system uses a network of lasers which, by means of precise measurements of distance between points in the network, provide control data for actuating the panel motors.

One goal of a GBT survey is to find all compact, massive objects (collapsed stars and black holes) in our galaxy. Since the luminosity of these objects changes up and down with a time scale in the order of one day, the galactic plane will be scanned each day. It will be possible to obtain a complete census of these objects.

The amount of data collected by this survey will be enormous, certainly more than a few astronomers can analyze. Therefore, the raw telescope data will be processed into images which will be placed on the web for anyone to access. A user will submit the central right ascension and declination of the desired region and will be given a list of sources in that region or an isophote contour map of it.

Dr. Condon concluded his presentation with an invitation for us to visit NRAO in Green Bank this summer and see the GBT. He then answered questions from the audience.

Questions and Answers

One question was related to the accuracy

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Radio Astronomy, continued

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of the primary reflector. When the active reflector is fully operational, it is expected to have a surface with an RMS deviation from a perfect parabola of 0.2 mm; this is less than 1/16 of the shortest wavelength at which the GBT is designed to observe. There is some uncertainty in the RMS surface error because the tests were not performed at the actual telescope site and the thermal environments of the test and telescope sites are different. It is expected, however, that the GBT primary reflector will give good performance at wavelengths down to 3 mm. The performance of the telescope system, however, will be degraded by humidity during the summer months to the extent that the telescope will not be useful at 3 mm.

Another question was about the white color of the dish. Each panel consists of an aluminum skin bonded to a honeycomb fiber backing. The reflecting surface has been painted with a special white paint that is a low-loss dielectric at the observing wavelengths. It is white in visible light in order to reflect light and reduce thermal stresses. At infrared wavelengths, however, it becomes black so that the reflecting surface becomes a good infrared radiator, allowing it to maintain a uniform and relatively constant temperature.

Finally, there were some questions that pertained to the use of the GBT with other radio telescopes, including the VLA. The GBT will be used as a "virtual interferometer" with the VLA by means of a technique called Very Long Baseline Interfer-

ometry. The signal received by the GBT and time ticks from its precision clock will be combined with those from the VLA, creating the virtual interferometer. The GBT will provide an increase in sensitivity to the combined system. After processing of the combined data, the resolution of the system is expected to be independent of the source radio brightness. We thank Dr. Condon for a splendid presentation and look forward to a follow-up lecture concerning the results of the GBT survey.

"Drop a Ball" or What I Found on the USNO Web Site

by Elliott Fein

Following a suggestion by Nancy Byrd, I visited the United States Naval Observatory web site at www.usno.navy.mil, to see what I could learn about the Naval Observatory prior to hearing Dr. Johnston speak on March 4.

There was much to look at on the web site, but I especially enjoyed what I read on a page titled "**U.S. NAVAL OBSERVATORY HOSTS ROUND-THE-WORLD TIME BALL DROP**" (dated December 16, 1999)

I've abstracted some of that for you here.

Everyone knows about the famous time ball in New York City Times Square, but where did this tradition begin? The answer, for the United States, is at the U.S. Naval Observatory in Washington, D.C. In 1844, the Secretary of the Navy ordered the Superintendent of the Observatory "to devise some signal by which the mean time may be made known every day to the inhabitants of the city of Washington." The Superintendent responded the following year with a time ball, based on those first used in Portsmouth, England in 1829, and Greenwich in 1833. Dozens more were placed into operation around the world during the 19th century. Aside from church bells, the visual signal provided by the time ball was the first method for disseminating accurate time, both for the general public and for navigation. This historical worldwide network of

time balls provides the core for the current worldwide project.

Time balls in the United States were sometimes dropped by a signal from Washington. Beginning in 1877, a time ball atop the Western Union Building in New York City was dropped by telegraphic signal from the Naval Observatory. In the era before time zones, the signal for New York was issued 12 minutes before that for Washington to take into account the longitude difference. Historically time balls in the United States were hoisted half staff at 10 minutes before noon, to the top of the pole at 5 minutes before noon, and dropped precisely at noon for the signal. The accuracy was a few tenths of a second at best; today the Naval Observatory disseminates time via GPS with an accuracy of a few tens of billionths of a second.

Time balls were eventually superseded by telegraph and radio time signals. The last time ball in Washington was dropped in 1936 atop what is now known as the Old Executive Office Building, next to the White House. By order of Secretary of the Navy Richard Danzig, the Naval Observatory time ball will be dropped once again in 2000 and 2001.

Other sites dropping time balls (or some variation), representing 6 continents, include Lyttelton (Christchurch), New Zealand; McMurdo, South Pole, and Palmer

Station, Antarctica; Sydney, Melbourne, Adelaide, Kangaroo Island, and Fremantle, Australia; National Physical Laboratory in New Delhi, India; Cape Town, South Africa; Göteborg and Karlskrona Naval Base, Sweden; and Royal Observatory Greenwich, UK. In the United States participating sites include New York City Times Square; South Street Seaport Museum, New York City; the Bruce Museum in Greenwich, CT; Miami, Florida; USNO Washington, D.C., and Doane College in Crete, Nebraska.

There are some interesting variations on the time ball theme; Miami will raise an orange, Kangaroo Island will fire a time cannon, and Fremantle and Cape Town will both drop a ball and fire a cannon. Cannons were also used historically to signal time, but the speed of sound had to be taken into account. The New York City time ball signals midnight when it reaches the bottom of the pole, rather than the ball's first movement from the top.

The event is also sponsored by the History of Astronomy Commission of the International Astronomical Union.

More information is available on the Naval Observatory Millennium pages. Answers to general questions about the Millennium are also found at this site.

Mid-Atlantic Occultations and Expeditions

March 2000

by David Dunham

Asteroidal Occultations

DATE	Day	EST	Star	Mag	Asteroid	dmag	s	in.	Location*
Mar 13	Mon	2:42	SAO 117588	9.0	Fredegundis	4.1	6	2	New York
Mar 23	Thu	4:16	SAO 186050	9.4	Fides	3.5	8	3	New York

*The location can change by hundreds of miles with astrometric updates.

Grazing Occultations

DATE	Day	EST	Star	Mag	% alt	CA	Location
Mar 28	Tue	4:50	30 Sgr	6.3	47-	10 13S	cen. NJ; near Allentown, PA

Total Lunar Occultations

The better total lunar occultations visible from throughout the Washington-Baltimore greater metropolitan area are listed below. They can be accurately timed by aiming a camcorder into a low-power eyepiece of your telescope and recording WWV with the audio.

DATE	Day	EST	Star	Mag	% alt	CA	Notes
Mar 1	Wed	5:22	R ZC 2802	6.4	21-	14	88S Spectral type K0
Mar 8	Wed	19:30	D SAO 109952	7.4	9+	14	52S Spectral type K0
Mar 11	Sat	22:05	D 55 Tauri	6.9	36+	22	42S dbl., mags 7.4&8.0, 0.4", PA 313
Mar 11	Sat	23:29	D 63 Tauri	5.6	37+	7	79S ZC 0650, spec. bin., Az. 286
Mar 14	Tue	1:46	D 16 Gem	6.2	61+	5	72N ZC 0991, Sp. A2, Az. 292 deg.
Mar 14	Tue	22:37	D 56 Gem	5.1	70+	51	81S ZC 1113, Sp. type M0
Mar 15	Wed	0:28	D SAO 79376	6.9	71+	30	51N double with SAO 79375
Mar 15	Wed	1:00	D 61 Gem	5.9	71+	24	89S Probable close double, Sp. F2
Mar 18	Sat	23:11	D ZC 1625	5.8	99+	59	51S 15" from terminator; pos. dbl.
Mar 28	Tue	4:09	R 31 Sgr	6.6	46-	20	76N Sp. type A3

Phone the IOTA occultation line, 301-474-4945, for updates and details, or check IOTA's Web site at <http://www.lunar-occultations.com/iota> which now has an asteroidal occultation section with finder charts and updated path maps. On February 15, in the morning, the occultation of 6.8-mag. ZC 1154 was timed from 4 stations in the northern suburbs and from one station in Ellicott City, the brightest asteroidal occultation ever predicted for our region. Then early that evening, the brightest grazing occultation of the year in the area, of the 4.1-mag. star nu Geminorum, was observed from two stations south of Largo, MD.

**Deadline for
April Star Dust:**
March 15



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

Text must be in ASCII or Word. Graphics submitted must be in TIFF, GIF, or JPEG. Thank you.

Support
the
IDA

Join the
International
Dark-Sky
Association
3225 N. First
Avenue Tucson,
AZ 85719-2103
www.darksky.org

Other National Capital Area Meetings, etc.

U.S. Naval Observatory (USNO)

Mondays, March 6, 13, 29, 27 7:30 PM - USNO public nights in Northwest Washington, D.C. (off Massachusetts Avenue). Includes orientation on USNO's mission, viewing of operating atomic clocks, and glimpses through the finest optical telescopes in the Washington-Baltimore region. Held regardless of cloud cover. Information: USNO Public Affairs Office, 202/762-1438. Source: <http://www.usno.navy.mil>.

Department of Terrestrial Magnetism (DTM) Carnegie Institute — Wednesdays at 11:00 a.m. in the Seminar Room of the Main Building. Call (202) 686 4370 to confirm. No info for March available at press time. Source: <http://www.ciw.edu/DTM-seminars.html>

Goddard Scientific Colloquium — All seminars will be held in GSFC Building 3 Auditorium at 3:30 P.M. Contact Carol Krueger, at (301) 286-6878 to confirm.

March 3 Craig Bohren, Penn State University, "Green Thunderstorms"
March 10 Sharon Nicholson, Florida State University, "The Influence of Land Surface Changes, Natural and Anthropogenic, on Climatic Change in West Africa";

March 17 Martin Weisskopf, MSFC, "Early Results from the Chandra Observatory";

March 24 Dava Sobel, "Galileo's Daughter";

March 31 Richard Somerville, Scripps Institute of Oceanography, "Global Warming: Can Climate Models Be Trusted?"

Source: <http://lheawww.gsfc.nasa.gov/users/djt/colloq/>

Laboratory for Astronomy and Solar Physics (LASP) — Seminars are on Thursday at 3:30 PM in GSFC Bldg. 21, Room 183A.

March 2 Mark Wolfire, University of Maryland "Stars, Cars, and PDRs: Photodissociation Regions from the Local Universe to High-z Starbursts"

March 9 David Neufeld, Johns Hopkins University, "The Submillimeter Wave Astronomy Satellite"

March 16 Joe Dolan, GSFC, "UV Spectral Variability and the Ly-Alpha Forest in the Lensed Quasar

Q0957+561"

March 23 no speaker, Washington Area Astronomer's Meeting

March 30 Xiaolei Zhang, GSFC/Raytheon ITSS, "Spiral Density Waves and the Secular Evolution of Galaxies"

Source: http://stars.gsfc.nasa.gov/www/lasp_colloq/index.html

Laboratory for High Energy Astrophysics (LHEA) Tuesday Seminar Series — NASA GSFC Building 2, Ground Floor Conference Room, 3:30 P.M.

March 7 Dr. Ming Zhang, U. Chicago, "Three-dimensional propagation of cosmic rays in interplanetary magnetic fields"

March 14 Dr. J. Martin Laming, NRL, "Electron Energization at SNR Collisionless Shocks: Devils in the Details"
March 21 Dr. Raymond White, University of Alabama, "Implications of Abundance Gradients in Intracluster Gas",

March 28 Dr. Jean-Pierre Lasota, Institut d'Astrophysique de Paris, "X-Ray Transients: A Model at Last?" (Wednesday, March 29, 4:00 P.M., Dr. Richard Mushotzky, LHEA/GSFC "Solving the X-Ray Background", at U. Maryland, CSS 2400). Source: <http://lheawww.gsfc.nasa.gov/docs/lhea/TuesSeminar/Seminar.html>

LASP Stellar & Extra-Galactic Astronomy Lunch — Talks are Wednesdays at 12:00 Noon in Room 242 of Building 21.

March 1 Ian Jordan, STScI, "Imaging Extrasolar Substellar Objects: UM-BRAS"

March 8 Harvey Moseley, GSFC, "Far-Infrared Imaging with SOFIA"

March 15 Tony Danks, GSFC/RITSS, "The ISM in the Carina Nebula"

Tuesday, March 21 Susan Stewart, USNO FUV, "Observations of HI shells in Dwarf Galaxies (BWSS)"

March 29 Nick Gorkavyyi, GSFC/NRC, "The Zodiacal Emission" Source: <http://hires.gsfc.nasa.gov/~gardner/seal/>

Maryland Space Grant Observatory — Open House every Friday evening (weather permitting), Bloomberg Center of Physics and Astronomy, Johns Hopkins University, Baltimore, MD. Information: 401/516-6525 or

www.pha.jhu.edu/facilities/observatory/telescope.html.

Montgomery College's Planetarium Fenton St. in Takoma Park. Monday, March 20 at 7:00 P.M. "The Rites of Spring, the Vernal Equinox" 301-650-1463. Source: <http://www.mc.cc.md.us/Departments/planet/>

University of Maryland College Park Astronomy Department Colloquia — March 1 4:00 pm, CSS 2400, Dr. Andrey Kravtsov, Ohio State University, "The Abundance of Galactic Satellites in Hierarchical Models: Problems and Possible Solutions". Source: <http://www.astro.umd.edu/colloquia/>

Northern Virginia Astronomy Club (NOVAC) meets the second Sunday of each month at Lecture Hall 1 on the Fairfax campus of George Mason University. The Lecture Hall is next to Fenwick Library, on the North side of campus across Patriot Circle from the parking lots G and F. Parking in these lots is free on Sundays. Meetings start at 6:00 p.m.

March 12 Dr. John Rummel: "Looking for Life in All the Wrong Places"

Source: <http://astro.gmu.edu/~novac>

University of Maryland Observatory on Metzert Road. Open house on 5 and 20 of each month. Info: (301) 405-3001

Source: <http://www.astro.umd.edu/openhouse/>

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

• Useful Web Sites

The February Meteor (Greenbelt Astronomy Club) includes the following information from Joel Miller. Two useful Web sites: At <http://www.otterbein.edu/dept/PHYS/is410/plan.html>, you can download the frames for a planisphere

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Other National Capital Area Meetings, continued

(Continued from page 6)

for latitude 40 deg. (and others). You must have Adobe, a free software program.

At <http://www.stargazing.net/astrope/> you can plot star charts from any of a number of catalogs. It includes planetary, solar, lunar, asteroid, and comet positions.

Source: Nancy Grace Roman

National Air & Space Museum – Free Lectures at the Einstein Planetarium and Other daily events. 202-357-1550, 202-357-1686, or 202-357-1505 (TTY)

Source: <http://www.nasm.edu>.

- ASM Lecture Series on Exploring Earth's Moon

Following the 30th anniversary of the Apollo 11 and 12 Moon landings, the Exploring Space Lecture Series 2000 will look at the history of lunar exploration, what we learned about the Moon, and what we continue to learn. The four lectures in this series at the Smithsonian's National Air and Space Museum on the Mall beginning on March 1, 2000 will be the following:

"A Man on the Moon", on Wednesday, March 1 at 7:30 PM, in the Langley IMAX Theater. Andrew Chaikin, author of the acclaimed book, "A Man on the Moon", will discuss the Apollo astronaut experience.

"Apollo and Lunar Evolution", on Tuesday, April 25 at 7:30 PM, in the Langley IMAX Theater. From the unique perspective of the only geologist to walk on the Moon, Apollo 17 astronaut and former Senator Harrison H. Schmitt will describe theories of the Moon's origin and the events that shaped the lunar surface.

"Lunar Samples and the Story of the Moon", on Wednesday, May 24 at 7:30 PM, in the Einstein Planetarium. Graham Ryder, staff scientist at the Lunar and Planetary Institute in Houston, Texas, will discuss what the carefully preserved lunar samples still teach us about the Moon.

"Back to the Moon: The Lunar Prospector Mission", on Wednesday, June 14 at 7:30 PM, in the Einstein Planetarium. Alan Binder, Principal Investigator for Lunar Prospector, offers a first-hand account of the mission: its goals and results, and what its findings mean for the future.

All lectures are free and no tickets or reservations are required. Lectures begin at 7:30 PM and doors open 15 minutes prior to the lecture. For more infor-

mation, call 202-357-2700 or access the Museum's Internet web site: www.nasm.si.edu.

Source: Leith Holloway

NASA/GSFC LEP Seminar Laboratory for Extraterrestrial Physics Brown Bag Seminar

The Laboratory for Extraterrestrial Physics (LEP) at NASA's Goddard Space Flight Center conducts weekly science seminars Fridays at noon in Room 8 in Building 2 at Goddard. Since the seminar is conducted during the lunch hour, the audience often brings their lunch.

March 3 Dr. Vladimir A. Osherovich, HSTX at NASA/GSFC,

March 10 Dr. Thomas Sotirelis, JHU/APL, Laurel, Maryland

March 17 Dr. William M. Farrell,

NASA/GSFC; March 24 available;

March 31 Dr. Adolfo Vinas, NASA/GSFC

Source: <http://lepjas.gsfc.nasa.gov/>

[~seminar/lep_seminar.html](http://www.nasm.si.edu/~seminar/lep_seminar.html)

Washington Area Astronomers Meeting

The spring 2000 Washington Area Astronomers Meeting will be held on Thursday, March 23, 2000 at the University of Maryland, College Park, MD, Computer and Space Sciences Building (#224). Contact Mary Ann Phillips at the University of Maryland, maryann@astro.umd.edu, (301) 405-1505. Source: <http://aa.usno.navy.mil/waa/>

Delmarva Stargaze

On April 6-9, there will be a star party/ astronomy meeting called the Delmarva Stargaze in Tuckahoe State Park on the Maryland Eastern Shore. I think this is less than 80 miles east of Washington, so it might be of interest to some in NCA, especially those in the eastern suburbs. More information is at their Web site, <http://www.delmarvastargazers.org> Source: David Dunham

Meteor Showers

Full Moon: March 20

Major Activity: None

Minor Activity

Radiant	Duration	Maximum
Eta Draconids	March 22-April 8	Mar. 29-31
Beta Leonids	February 14-April 25	Mar. 19-21
Rho Leonids	February 13-March 13	Mar. 1-4
Leonids-Ursids	March 18-April 7	Mar. 10/11
Delta Mensids	March 14-21	Mar. 18/19
Gamma Normids (GNO)	March 11-21	Mar. 16/17
Eta Virginids	February 24-March 27	Mar. 18/19
Pi Virginids	February 13-April 8	Mar. 3-9
Theta Virginids	March 10-April 21	Mar. 20/21

Daylight Activity

Radiant	Duration	Maximum
March Aquarids	February ??-April ??	Mar. 15-18

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

Getting to the NCA Monthly Meeting

Saturday, March 4

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

Cesco Trattoria
4871 Cordell Ave.
Bethesda MD
phone: 301-654-8333

The restaurant has valet parking. Also, there is 2-hour metered parking on Cordell and Norfolk Avenues. (The meters are in use 9 AM – 10 PM except Sunday). The meters take nickels, dimes and quarters; 50¢ per hour.

7:30 P.M. - NCA Meeting at Lipsett Auditorium in Building 10 at NIH. Guest speaker: Dr. Kenneth Johnston, USNO

Directions to the Meeting Place

From Rockville Pike (Wisconsin Ave., Rt. 355)

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

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

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

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

Directions to the Restaurant

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

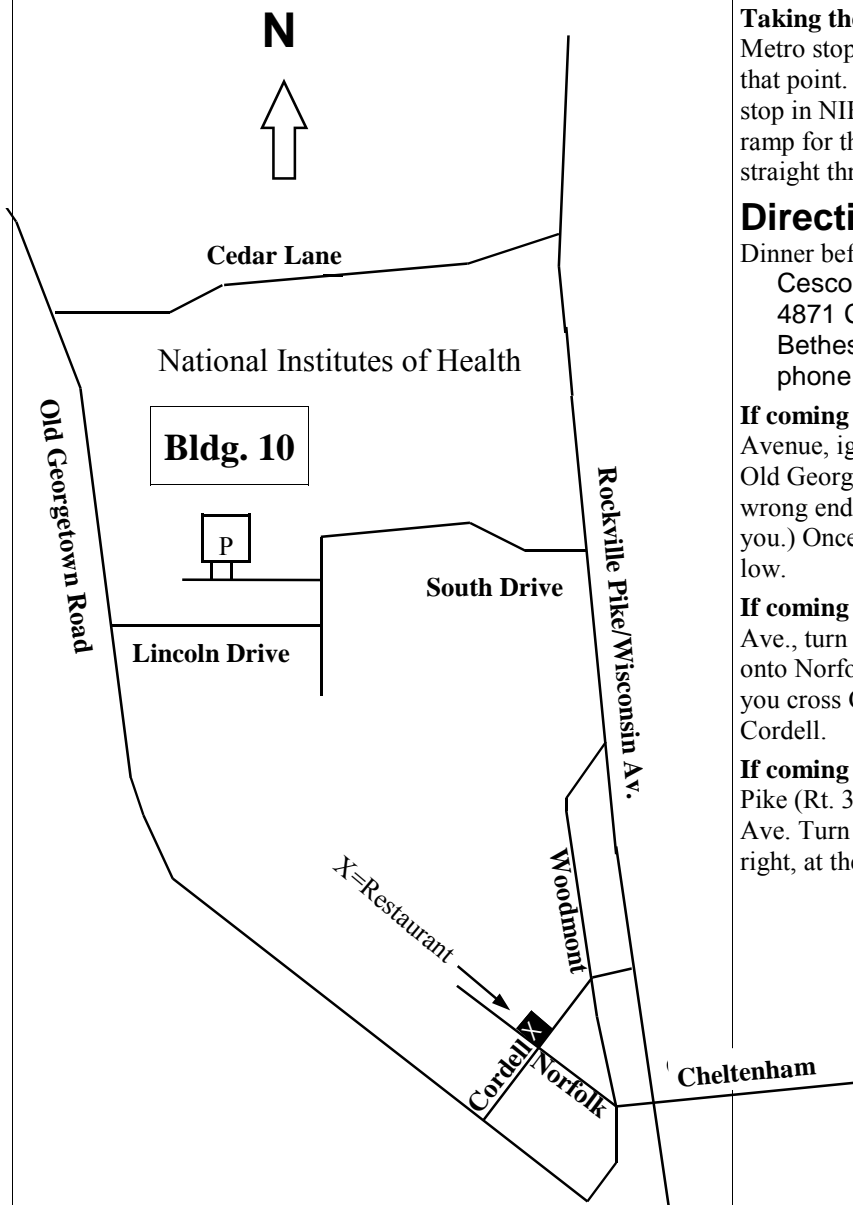
Cesco Trattoria
4871 Cordell Ave.
Bethesda MD
phone: 301-654-8333

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

If coming from south of Bethesda, go north on Wisconsin Ave., turn left onto Cheltenham (traffic light). Go straight to go onto Norfolk Ave. The restaurant will be on your right as soon as you cross Cordell Ave. The entrance to the restaurant is on Cordell.

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

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



National Capital Astronomers, Inc.

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

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.

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

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

NCA Juniors Program fosters children's and young adults' interest in astronomy, space technology, and related sciences through discounted memberships, 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 members' use. NCA also has access to several relatively dark-sky sites in Maryland, Virginia, and West Virginia.

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

Enclosed is my payment for the following membership category:

- Regular
 Sky & Telescope and *Star Dust*. (\$57 per year)
 Star Dust only (\$27 per year)
 Junior (Only open to those under age 18) Date of birth: _____
 Sky & Telescope and *Star Dust*. (\$45 per year)
 Star Dust only (\$15 per year)

First name(s) Last name (_____) Telephone E-mail

Street or Box Apartment City State Zip Code + 4

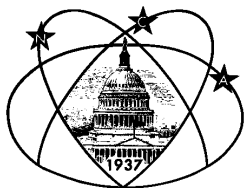
If family membership, list names of additional participating immediate family members in same household with birth dates of all those under 18 years old: _____

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

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

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

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



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If Undeliverable, Return to
NCA c/o Nancy Roman
4620 N. Park Ave., #306W
Chevy Chase, MD 20815-4551

FIRST CLASS

DATED MATERIAL

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