Star Dust

National Capital Astronomers, Inc.

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Dr. Nolan Walborn to talk to NCA on "Insights into Massive Star Formation from the Hubble Space Telescope"

submitted by Gary Joaquin

Dr. Nolan Walborn will present the featured talk for the November 4 meeting of National Capital Astronomers, "Insights into Massive Star Formation from the Hubble Space Telescope". The meeting will be held in the Lipsett Amphitheater in Building 10 (Clinical Center) of the National Institutes of Health in Bethesda at 7:30 P.M. Dr. Walborn has provided us with a synopsis of his talk as well as a brief biography:

Synopsis

New views of giant nebulae, or H II regions, from both imaging and spectroscopy, at ultraviolet, optical, and infrared wavelengths by the Hubble Space Telescope, will be displayed and discussed. These regions are the birthplaces and residences of massive stars, some of which are more than 100 times as massive as the Sun. They synthesize many of the chemical elements, including those essential for life, in their nuclear furnaces and then disperse them into the interstellar medium through stellar winds and their final supernova explosions. A key idea supported by the HST observations is the triggering of second-generation star formation around the peripheries of such regions, by the action of the energetic outflows from the original central cluster on surrounding dust clouds. Giant dust pillars oriented toward the central cluster are sculpted by this process, in the heads of which new stars are formed and born. The resulting structures enable the relative ages of particular regions to be estimated, and developmental or evolutionary sequences among different regions to be recognized. Relatively nearby, galaxy-wide starbursts can be decomposed into such regions of varying ages, which in turn aid in the interpretation of starbursts at cosmological distances that cannot be resolved directly. Observations of the giant Carina Nebula in the southern Milky Way and of the

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Zooming Around Neutron Stars and Black Holes

Presented by Jean Swank

Reviewed by Wayne H. Warren Jr.

The monthly NCA meeting of October 7, 2000 was highlighted by a lecture on observational X-ray astronomy given by Dr. Jean Hebb Swank of Goddard Space Flight Center's Laboratory for High Energy Astrophysics. As Project Scientist for the Rossi X-ray Timing Explorer (RXTE), Dr. Swank has been intimately associated with that mission since its inception.

Dr. Swank began by telling us that the currently planned future of X-ray astronomy, as with many other astronomical disciplines, lies with imaging techniques, both direct and spectroscopic. Such techniques are already being used by the Hubble Space Telescope (HST), as described to us by Dr. George Sonneborn in March 1999 when he talked about his observations of SN 1987A with the STIS (Space Telescope Imaging Spectrograph). However, it is the Chandra Observatory that images in the X-ray region and most of us have seen some of the results. We also heard about NASA's plans to image the regions around black holes with the MAXIM Pathfinder (Micro-Arcsecond X-ray Imaging Mission Pathfinder) mission when Dr. Nick White gave the NCA lecture in June 2000. RXTE, on the other hand, does not carry imaging instruments and studies compact objects by measuring velocities and by detecting X-radiation emanating from the vicinities of neutron stars and black holes.

The RXTE satellite is the largest X-ray telescope flown to date. It contains an array of five proportional counters and an all-sky monitor consisting of three imaging proportional counters that rotate about the satellite's axis to survey the sky. There is also a higher energy detector inside the satellite where it can detect X-rays that have enough energy to penetrate the blankets that cover the body. RXTE was specifically designed to study X-ray variability on the dynamical time scales of neutron stars and black holes. For this reason, count rates of up to 150,000 counts per second are possible to allow adequate resolution of phenomena that occur on millisecond and sub-millisecond time scales. However, other X-ray phenomena that take place on time scales of hours, days, and years are also studied. Periodic variations associated with orbital motion in binary systems and mass transfer phenomena are examples, as are repeat appearances of

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NCA Events This Month

The Public is Welcome!

NCA Home Page: http://capitalastronomers.org

Fridays, November 3, 10, 17, and 24, from 7:00 - 10:00 P.M.: Telescope-making and mirror-grinding classes at American University, McKinley Hall, Basement (Room 9), Nebraska and Massachusetts Avenues, NW. However, on November 3 and 24, if the weather is clear, class may be canceled so that the instructor can go out star-gazing himself, instead, because the Moon will be near new or 3rd quarter. Call or email Guy Brandenburg to confirm: 202-635-1860 or gfbranden@earthlink.net.

Fridays, November 3, 24, 8:30 P.M. Open nights 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, November 4, 5:30 P.M. - Dinner with the speaker and NCA members at

Frascati Ristorante Italiano
4806 Rugby Ave
Bethesda, MD
301-652-9514

See the map and directions on Page 6.

Saturday, November 4, 7:30 P.M. - NCA meeting, at the Lipsett Auditorium in Building 10 at NIH, will feature Dr. Nolan Walborn talking to NCA on "Insights into Massive Star Formation from the Hubble Space Telescope".

See Page 4 for more National Capital area astronomical doings. To join NCA, use the membership application on Page 7.

Meteor Showers

November Radiants

Full Moon: November 11

Major Activity

Radiant	Duration	Maximum
Leonids (LEO)	November 14-20	Nov. 18 03:44 UT

Minor Activity

Radiant	Duration	Maximum
Andromedids	September 25-December 6	November 14/15
Alpha Monocerotids (AMO)	November 13-December 2	November 21
Alpha Pegasids	October 29?-November 17?	November 1-12
Northern Taurids (NTA)	October 12-December 2	November 4-7
Southern Taurids (STA)	September 17-November 27	Oct. 30-Nov. 7

Daylight Activity

None

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

Dr. Nolan Walborn

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supergiant 30 Doradus Nebula in the Large Magellanic Cloud will be emphasized, but several other objects at key stages of the evolutionary sequence will also be included to illustrate the complete concept.

Biography

I was born in Bloomsburg, Pennsylvania in 1944. When I was 8 years old, my family moved to Argentina, where I attended local primary schools and became fluent in Spanish. I lived in Argentina until I finished high school.

I graduated from the American Community High School, Buenos Aires, in 1962; from Gettysburg College, Pennsylvania with a B.A. and physics major in 1966; and from the University of Chicago with a Ph.D. in astronomy and astrophysics in 1970.

Most of my graduate career was spent at the Yerkes Observatory in Williams Bay, Wisconsin, and I did my thesis observations at the Kitt Peak National Observatory outside Tucson, Arizona. My thesis advisor was Dr. W. W. Morgan.

I was a postdoctoral fellow at the David Dunlap Observatory of the University of Toronto 1971-1973, and I observed frequently with their southern telescope at the Las Campanas Observatory, Chile, during that time. I was a staff astronomer at the Cerro Tololo Inter-American Observatory in La Serena, Chile 1973-1981. Then I was a National Research Council Senior Associate at the Goddard Space Flight Center, Greenbelt, Maryland for two years, where I was introduced to space astronomy through the International Ultraviolet Explorer. I joined the scientific staff of the Space Telescope Science Institute in January 1984.

I am a stellar spectroscopist specializing in the optical and ultraviolet spectra of hot, massive (O- and B-type) stars; the stellar and nebular structures of the regions in which they are formed; and the interstellar absorption lines seen in their spectra. I have worked extensively in the Carina Nebula of the southern Milky Way and the 30 Doradus Nebula (and other regions) of the Large Magellanic Cloud, which are the nearest and hence most powerful laboratories for investigation of the formation and evolution of the most massive stars.

Review of Swank Presentation, continued

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transients. Varying peak amplitudes, widths, and shapes demonstrate many different types of transient phenomena.

The dynamical time scales of phenomena in the regions of neutron stars and black holes are so vastly different from what we are accustomed to that they are difficult to imagine. Four examples are: (1) an object in a Keplerian orbit, (2) an object in free fall toward the surface of a neutron star, (3) an ordinary pendulum, and (4) seismic waves propagating inside the star. These phenomena differ in time scale by factors of 2 to 5 or so. As examples of comparisons with familiar objects, consider a satellite in a minimum stable orbit around each of the following objects:

Although it is hard to imagine a body revolving around a neutron star 2500 times per second, we must keep in mind that neutron stars rotate in the millisecond range as well, as demonstrated by the periods of many pulsars.

Object	Mass (⊙)	Period(s)
Earth	---	5400
Sun (⊙)	1	10800
Neutron star	1.4	4×10^{-4}
Black hole	16.	7×10^{-3}

One neutron star studied by RXTE, identified as XTE J1808-369 (SAX J1808.4-3658), turned out to be a rather unusual and interesting object. First, it is a transient X-ray source that has been seen to become active three times about 18 months apart. RXTE first saw it in 1998, while BeppoSAX (an Italian X-ray satellite) discovered a transient there in 1996. The companion is losing mass to the disk around the neutron star. When the source is seen to be active, the disk is dumping onto the neutron star, as in a dwarf nova outburst a disk is dumping material onto the surface of a white dwarf. The matter that accumulates on the star's surface is compressed and intensely heated. After a few hours, a thermonuclear detonation occurs, and a burst of X-rays results. While the gas is falling onto the neutron star, the observed X-ray flux contains coherent pulses every 2.5 ms, identified with the rotation period of the star itself. This system seems to be a link between neutron-star X-ray sources and what are known as low-mass X-ray binaries. There may also be a link to the older millisecond pulsars, which we think result from spin-up as a result of mass accretion. When a neutron star is born as a result of a supernova explosion, it is rotating at a very high rate. This rotation slows over time from magnetic braking, then increases in binary systems as mass accretion occurs.

In the case of a black hole, no coherent pulse period is expected because of the absence of a magnetic field. However, quasi-periodic oscillations are seen. These could be due to emission from individual clumps of gas in orbit about the condensed object. They could also be a result of phenomena taking place in the accretion disk, such as oscillations and/or disk precession.

In the millisecond pulsars, seven bursters have displayed fleeting glimpses of pulses produced by thermonuclear burning. The bursts last about 10 seconds, during which coherent oscillations are seen. It appears that the thermonuclear burning starts at a single spot on the star and spreads over the surface. The coherent frequency seems to be changing during a burst, however. The changing frequency is interpreted as due to the lifting of a shell of material from the stellar surface and the slightly different rotation of that shell. As a burst subsides, the shell settles back to the surface and the frequency increases again.

Twenty-two low mass X-ray binaries have shown kilohertz quasi periodic oscillations. Characteristically, there are two frequencies with differences of 300-400 Hz that track each other. These objects all seem to be the progenitors of the millisecond radio pulsars.

Dr. Swank also mentioned that RXTE is observing about 10 to 15 of the brightest cataclysmic variables and about 10 "ordinary" stars, in particular the interesting RS Canum Venaticorum type. These are stars that are both eclipsing binaries and are variable outside of eclipse. They are generally of spectral type G, but there are some F and K types as well. Intense coronae around these stars produce variable X-ray emission, while visible light variability is thought to be caused by star spots that appear and disappear as the stars rotate. Although sunspots cause small variability in the solar flux, the Sun's activity is much smaller than that of the RS CVn stars.

Returning to the X-ray binaries, there are three principal theories that attempt to explain the millisecond oscillations and the multiple beat frequencies:

The dominant theory, sometimes called the Sonic Point Beat Frequency model, assumes that blobs of gas on the inner part of the accretion disk increase their velocities as they approach the star, surpassing the velocity of sound, after which they become unstable and spiral down to the surface, where they generate X rays at the frequency of the Keplerian orbit. As the poles rotate, they perturb the clumps and produce beats at the spin frequency of the poles. One of the problems with this theory is that the observations appear similar for black holes, but the above explanation doesn't work for those.

The relativistic precession model uses the fact that material is in various elliptical orbits around the neutron star. The orbits precess in the Einstein Gravitational Field, much like the precession of Mercury's orbit, and the multiple orbits produce beat frequencies when observed against the Keplerian orbit frequencies.

Another theory has the accretion disk going all the way to the surface of the star and plasma (charges) oscillating in the rotating dipole magnetic field.

The RXTE team is working to understand the predictions of the above theories and to relate the observed frequencies to luminosities in an attempt to distinguish among the three theories. There is still a lot of work to be done along those lines.

A plot of pulsar magnetic field against period shows that the longer-period objects have larger fields. The low-mass X-ray binaries appear in the lower left and seem to reinforce the idea that these objects evolve into the millisecond radio pulsars.

The distribution of sources in the Galaxy shows, as expected, a high density in the plane and toward the center, where there are many black hole candidates concentrated around the physical center. However, many transients are also being discovered outside the plane and in the galactic bulge. Several new classes of transient objects have been seen at high latitudes and are presently being observed and studied.

Many of the transients in and around the galactic center have been discovered to be sources of radio emission in jets that surround the sources, which are mainly sus-

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Other National Capital Area Meetings, etc.

U.S. Naval Observatory (USNO)
Monday nights at 8:00 p.m., except on Federal holidays: USNO public nights in Northwest Washington, D.C. (off Massachusetts Avenue). 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 of Washington Seminars
The Department's location in the national capital area offers many advantages for training, study, and cooperative activities in the natural sciences. The Department holds weekly seminars; speakers include visitors and members of the staff. Topics range from astrophysics and planetary sciences to geochemistry and seismology.
November 8 Ian N. Reid, Space Telescope Science Institute, "Brown Dwarfs and Dark Matters"
November 15 Fouad Tera, Department of Terrestrial Magnetism, "A New Pb-isotope Procedure for Accurate Dating of Messed Up (that is most) Geologic Systems: Implications to Early Solar System and Planetary Evolution"
November 29 William F. McDonough, Department of Geology, University of Maryland, "The Earth's Core: Composition, Nature, and Origins"
Seminars are held on Wednesdays at 11:00 a.m. in the Seminar Room of the Main (old) Building. Coffee and tea will be served at 10:45 a.m. Please call or email Rosa Maria Esparza to confirm that there have been no cancellations.
DTM is located on 32nd Street one block south of its intersection with Military Road. Proceed south on 32nd Street one block to Jocelyn Street, turn left on Jocelyn and right into the parking lot.
Carnegie Institution of Washington
Department of Terrestrial Magnetism
5241 Broad Branch Road, N.W.
Washington, D.C. 20015
(202) 686-4370 (Extension 4378 or 4383)
Call (202) 686 4370 to confirm that there have been no cancellations.

Source: http://www.ciw.edu/DTM-seminars.html

Goddard Scientific Colloquium — Due to construction in the Building 3 auditorium, the colloquia will be held at 3:30 p.m. on Fridays in the Goddard Space Flight Center Building 8 auditorium. Coffee and tea will be served in the Lobby at 3:00 p.m., courtesy of GEWA. If you plan to attend and do not have a NASA badge, please contact Carol Krueger, at (301) 286-6878, at least 24 hours beforehand.
November 3 Lynn Margulis, University of Massachusetts, William Nordberg Memorial Lecture: "New Gaia: Living Earth from Space"
December 1 Barbara Thompson, NASA/GSFC, "Sun Storms - The Science of Space Weather Eruptions"
Source: http://lheawww.gsfc.nasa.gov/users/djt/colloq/

Montgomery College's Planetarium
Fenton St. in Takoma Park, MD.
Saturday, November 18 at 7:00 P.M.
"Total Solar Eclipses"
Source: http://www.mc.cc.md.us/Departments/planet/

Northern Virginia Astronomy Club
(NOVAC) meets at 6:00 p.m., the second Sunday of each month, at Lecture Hall 1 on the Fairfax campus of George Mason University. 703 803-3153.
November 12 Tom Dietz, "Buying a Telescope" Just in time for the holidays, come hear what Ironman Tom has to say about purchasing a telescope, particularly for the first time or as a gift. There are a bewildering array of telescopes out there, and Tom will help you navigate the maze and make a wise choice, no matter what your budget.
Source: http://novac.com

University of Maryland Observatory
on Metzerott Road. Open house on 5 and 20 of each month. Each open house program consists of a 20 to 30 minute slide presentation in the lecture hall (which is now air conditioned!) followed by telescope viewing (weather permitting) of various astronomical objects.
Info: (301) 405-3001 Source: http://www.astro.umd.edu/openhouse/

Greenbelt Astronomy Club meets on 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

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.
November 3 Kristi Keller, NRC at NASA/GSFC
November 16 (*** Special Seminar, Thursday at 12 p.m. ***) Ken-ichi Nishikawa, Rutgers University, New Jersey, "Global Particle Simulations of Substorm Onset with a Southward IMF"
November 17 Scott Boardsen, HSTX, "A New Empirical Model of the Earth's Magnetopause"
December 1 Mei-Ching Fok, USRA at NASA/GSFC, TBD
Source: http://lepjas.gsfc.nasa.gov/~seminar/lep_seminar.html

Goddard Engineering Colloquia
All colloquia are held at 3:30 p.m. on Mondays in the Building 3 Auditorium, unless otherwise indicated below. Coffee and tea will be provided in the auditorium lobby starting at 3:00 p.m., courtesy of the Goddard Employee Welfare Association.
November 6 Lynn Harper, NASA/Ames, "The Living Universe at the Millennium"
November 13 Michael King, GSFC, "The Earth Observing System: Status of the First Series and Early Science Investigations"
November 20 Kathleen Howell, "Halo Orbits"
November 27 Joseph E. Riedel, Jet Propulsion Lab, "Deep Space 1: A High-Tech, High-Risk, High-Success NASA Test-Mission into the Solar System"
Note: Individuals not badged for entry into Goddard should obtain the current procedure by contacting Main Gate security at 301-286-7211. Source:http://ecolloq.gsfc.nasa.gov/sched.html

Space Telescope Science Institute (STScI) Come to the free public lectures at the STScI. Each month a noted scientist discusses a different cosmic topic.

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Other National Capital Area Meetings, etc., continued

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Lectures are at 8 p.m. the first Tuesday of every month in the STScI auditorium, on the campus of Johns Hopkins University. Free parking is available. For directions, call 410-338-4700.
Want to see some of the wonders of our universe? Come peer into the heavens with the Johns Hopkins University's Bloomberg telescope. The telescope is open to the public every Friday evening, weather permitting. For more information, contact the observatory at (410)-516-6275 or email at altan@pha.jhu.edu.
Source: http://hubble.stsci.edu/about_us/open-night.shtm

Laboratory for Astronomy and Solar Physics Seminar Series
November 2 Karl Misselt, GSFC/NRC, "Modeling Dust in Starburst Galaxies"
November 9 Adolf Witt, University of Toledo, "Photoluminescence by Interstellar Nanoparticles"
November 16 Rogier Windhorst, Arizona State University, "Near-UV Imaging of Nearby Galaxies as Templates for High Redshift Galaxy Classifications"
November 30 Karl Glazebrook, Johns Hopkins University, "The 2dF Galaxy Redshift Survey: Well Past Halfway"
December 7 Bruce Margon, University of Washington, The Simultaneous Discovery of the Nearest and Farthest Stars: Very Faint Carbon Stars in the Sloan Digital
Sky Survey"
Coffee, tea, and cookies served before the seminar. For additional information contact Eli Dwek at 301-286-6209 (edwek@stars.gsfc.nasa.gov) or Jon Gardner at 301-286-3938 (gardner@harmony.gsfc.nasa.gov)
Source:http://stars.gsfc.nasa.gov/www/lasp_colloq/index.html

Smithsonian National Air and Space Museum
Public Information: (202) 357-2700
Address: National Air and Space Museum Sixth Street and Independence Avenue, SW Washington, D.C. 20560
All programs are free unless otherwise noted.
Thursdays, November 2, 9, 16, 30 3 p.m., Einstein Planetarium: "What's New", free planetarium program. Curators, researchers and astronomers gather every Thursday at 3:00 p.m. in the Einstein Planetarium to discuss the latest developments in astronomy and space exploration. Each Thursday a new topic will be discussed. This ongoing program is free and open to the public.
Saturday, November 11, 10 a.m. - 4 p.m. Astronomy Fair, Independence Ave. Lobby. Learn to wisely choose, use and care for astronomical instruments from local experts. Telescopes, accessories and educational materials will be on display and experts will be on hand to answer questions.
Saturday, November 25 6:00 p.m., Monthly Star Lecture: "The History of the Universe in 60 Minutes or Less". Albert Einstein Planetarium. Astronomer and author Eric Schulman will conduct an hour-long slide presentation that details the history of the Universe. Schulman is the author of *A Briefer History of Time*. The show will be followed by a discussion with the audience and a book signing. NOTE: Public telescopic observing will follow any Monthly Star Lecture, weather permitting. During some months public telescopic observing may be omitted due to late sunsets.
Source: http://www.nasm.edu.

Time to Order Observer's Handbook for 2001

From: Nancy Byrd

If you have not already placed an order for the Royal Astronomical Society of Canada's Observer's Handbook ($15), Beginner's Observing Guide ($15), or Observer's Calendar ($12), you can do so at the November NCA meeting or you can email Nancy Byrd at Nancy@pangean.com telling her what you want. No money is required until you pick up your copies at an NCA meeting after the order arrives. Nancy will bring them to two meetings; after that, contact her to see if she still has them.

Deadline for December *Star Dust*: November 15

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

Text must be in ASCII, MS Word, or WordPerfect. Graphics in BMP are best. Thanks.

IDA-MD Meeting Announcement

by David Corum

[startraveler@stealthaccess.net]

The next meeting of the International Dark-Sky Association-Maryland Section will be at 7 p.m., November 13, 2000, at the Silver Spring Community Library, 8901 Colesville Rd., near downtown Silver Spring, Maryland. The following items are on the agenda for the meeting:

1. Update on Maryland Task Force proposal
2. Update on local efforts
   - Baltimore County
   - Montgomery County
   - Gaithersburg
3. Obtaining/purchasing relevant IESNA documents
   - RP8 - Roadway Lighting
   - RP33 - Exterior Lighting
   - RP20 - Parking Lots
4. Communication/web site issues
5. Participation at Astronomical League Convention and IDA meeting, July 24-28, 2001, in Frederick, Maryland

I hope to see you on November 13.

Directions to the Silver Spring Community Library: Take the Georgia Avenue South exit off the Capital Beltway (I-495). Go approximately 1.1 miles and turn left onto Spring Street. Take Spring Street about 0.4 miles and turn left onto Colesville Road. The library is about 100 yards on the right. Parking is behind the building.

Review of Swank Presentation, continued

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pected black holes. It is also found that when the X-ray emission changes, the radio emission changes as well. These black hole candidates have been called microquasars because they are the stellar counterparts of the massive black holes found at the centers of galaxies that are thought to be the classical quasi-stellar objects (QSOs or quasars).

The interpretation of the microquasar phenomenon, as made from multi-wavelength observations of the object GRS J1915+105, indicates that a black hole is surrounded by an accretion disk that fills with material that is stolen away from a stellar companion. At a certain point, instabilities at the disk's inner edge cause an ejection of material, producing a jet that moves away from the system. As it moves out into interstellar space, it emits in the infrared and then in radio wavelengths; the latter coming from synchrotron radiation.

The physical picture described by Dr. Swank is that of a disk with instabilities that loses its inner part when it escapes in the form of a jet. Material in the outer disk then collapses inward as the outer disk acquires more mass from the companion and the cycle repeats. This sequence of events was shown in a video simulation – the entire sequence occurs in only about one half hour.

Summarizing her talk, Dr. Swank described the motivation for the RXTE work as an attempt to learn more about the laws of general relativity and how they govern events on the time scales being observed near condensed objects. In addition, new classes of objects are being discovered and studied, and relationships between different classes of objects are being found, such as the probable evolution of low-mass X-ray binaries to millisecond pulsars.

The key to understanding the Universe lies in relating different kinds of objects to one another in order to build a picture of how the primary building blocks of the Universe fit together and evolve. This understanding encompasses the formation of galaxies in the early Universe and the birth, evolution, and death cycles of stars within the galaxies. Results from the RXTE mission have significantly increased our understanding of the late stages of stellar evolution that result eventually in the formation of highly condensed objects that either die out slowly while providing us with many phenomena to study (white dwarfs and neutron stars) or disappear quickly and violently from the visible Universe (black holes), leaving only their remnants from which to study them.

The NCA extends its thanks to Dr. Swank for an interesting and fascinating lecture.

The reviewer wishes to thank Dick Byrd for video-taping the lecture and lending him the tapes. Appreciation is also expressed to Jean Swank for reviewing this write up and making suggestions for improvement.

Exploring the Sky

Exploring the Sky, a joint presentation of the National Park Service and the National Capital Astronomers, continues Rock Creek Park near the Nature Center, in the fields just south of the intersection of Military and Glover Roads N.W.

The remaining session for this year is

11/18 – 7:00 P.M. EST

NCA members are urged to bring their telescopes to these sessions. Members without telescopes are also needed to answer questions from the public.

For additional information, call the Rock Creek Nature Center at (202) 426-6829 or NCA's Joe Morris at joemorris@erols.com

You may also check the Internet sites:
http://www.nps.gov/rocr/planetarium
http://www.capitalastronomers.org

Mid-Atlantic Occultations and Expeditions, November 2000

by David Dunham

Asteroidal Occultations

DATE	Day	EST	Star	Mag	Asteroid	dmag	Dur s	Ap. in.	Location
Nov 20	Mon	4:40	mu Geminorum	2.9	Sulamitis	10.6	13	0	swOH; swVA; Carolinas
Nov 26	Sun	0:19	ACT13171061	10.0	Pamela	4.5	6	5	Georgia?
Dec 1	Fri	19:21	TAC+20d 709	10.9	Geraldina	3.1	6	8	Florida?
Dec 3	Sun	4:19	ACT08831211	9.9	Herculina	1.2	6	6	Carolinas

Lunar Grazing Occultations

DATE	Day	EST	Star	Mag	%	alt	CA	Location
Nov 3	Fri	18:41	SAO 189638	7.7	46+	31	4S	Williamsburg, VA & Raleigh, NC
Nov 5	Sun	18:44	ZC 3284	7.0	65+	35	3S	Germantown, Mt.Airy, Woodbine, MD
Nov 7	Tue	20:40	30 Psc	4.4	83+	42	4S	near Youngstown, OH
Nov 17	Fri	3:41	SAO 080426	7.7	65-	64	3N	Chester, VA (s. of Richmond)
Nov 19	Sun	1:07	ZC 1553	7.8	43-	11	8N	Gettysburg & York, PA
Nov 19	Sun	1:56	SAO 099227	8.2	43-	20	6N	Beltsville & Bethesda, MD
Dec 4	Mon	16:59	ZC 3484	6.9	57+	35	5S	I-83 exit 2, PA, Sun alt. -4

Total Lunar Occultations

DATE	Day	EST		Star	Mag	%	alt	CA	Notes
Nov 7	Tue	0:07	D	psi3 Aqr.	5.0	76+	18	77S	Sp. A0; ZC 3428
Nov 7	Tue	18:57	D	ZC 3529	6.6	83+	37	65N	Sp. G5; possible double
Nov 11	Sat	2:39	D	ZC 0398	6.5	99+	39	58S	Sp. K0; near terminator
Nov 11	Sat	3:06	D	ZC 0401	6.3	99+	34	88S	Sp. A2; prob. close dbl.
Nov 12	Sun	20:21	R	delta1 Tau	3.8	98-	26	69S	Sp. G8; Hyades; WA 261
Nov 12	Sun	20:39	R	delta2 Tau	4.8	98-	30	26S	Sp. A7; near term., WA 218
Nov 12	Sun	21:36	R	delta3 Tau	4.3	98-	41	80N	Sp. A2
Nov 13	Mon	4:08	R	SZ Tau	6.5	97-	47	38S	Sp. F5; Ceph. var., 6.3-6.8
Nov 14	Tue	2:21	D	zeta Tau	3.0	92-	72	-77N	Sp. B4
Nov 14	Tue	4:41	R	zeta Tau	3.0	92-	63	84S	
Nov 15	Wed	2:32	R	ZC 1021	6.1	85-	71	58S	Sp. G9
Nov 15	Wed	21:52	R	ZC 1143	6.8	77-	12	35S	Sp. G5
Nov 17	Fri	0:24	R	38 Cancri	6.7	65-	28	65S	Sp. F0; Praesepe passage
Nov 17	Fri	0:27	R	ZC 1295	6.4	65-	29	62N	Sp. K0 info. for more
Nov 17	Fri	0:33	R	40 Cancri	6.6	65-	30	71N	Sp. A1
Nov 17	Fri	0:38	R	ZC 1298	6.4	65-	31	43S	Sp. K0
Nov 17	Fri	0:43	R	ZC 1303	6.8	65-	32	17S	Sp. A6
Nov 17	Fri	0:51	R	42 Cancri	6.8	65-	33	57S	Sp. A9; poss. close dbl.
Nov 17	Fri	1:23	R	ZC 1305	6.9	65-	39	85N	Sp. K0
Nov 20	Mon	2:30	R	SAO 118905	7.8	31-	15	76N	Sp. K0
Dec 3	Sun	19:01	R	ZC 3358	6.9	48+	37	79N	Sp. K2

D following the time denotes a disappearance, while R indicates that the event is a reappearance. When a power (x; actually, zoom factor) is given in the Notes, the event can probably be recorded directly with a camcorder of that power with no telescope needed. The times are for Greenbelt, MD, and will be good to within +/-1 min. for other locations in the Washington-Baltimore metropolitan areas unless the cusp angle (CA) is less than 30 deg., in which case, it might be as much as 5 minutes different for other locations across the region. **Mag** is the star's magnitude. **%** is the percent of the Moon's visible disk that is sunlit, followed by a **+** indicating that the Moon is waxing and **-** showing that it is waning. So **0** is new moon, **50+** is first quarter, **100+** or **-** is full moon, and **50-** is last quarter. The Moon is crescent if **%** is less than 50 and is gibbous if it is more than 50. **Cusp Angle** is described more fully at http://www.lunar-occultations.com/iota. **Sp.** is spectral type-color, **O,B**,blue; **A,F,**white; **G,**yellow; **K,**orange; **M,N,S,C** red

Phone the IOTA occultation line, 301-474-4945, for weather go/cancel decisions, and other updates and details, or check IOTA's Web site at http://www.lunar-occultations.com/iota.

David Dunham, e-mail dunham@erols.com, 2000 Oct. 15
Phone home 301-474-4722; office 240-228-5609; car 301-526-5590.

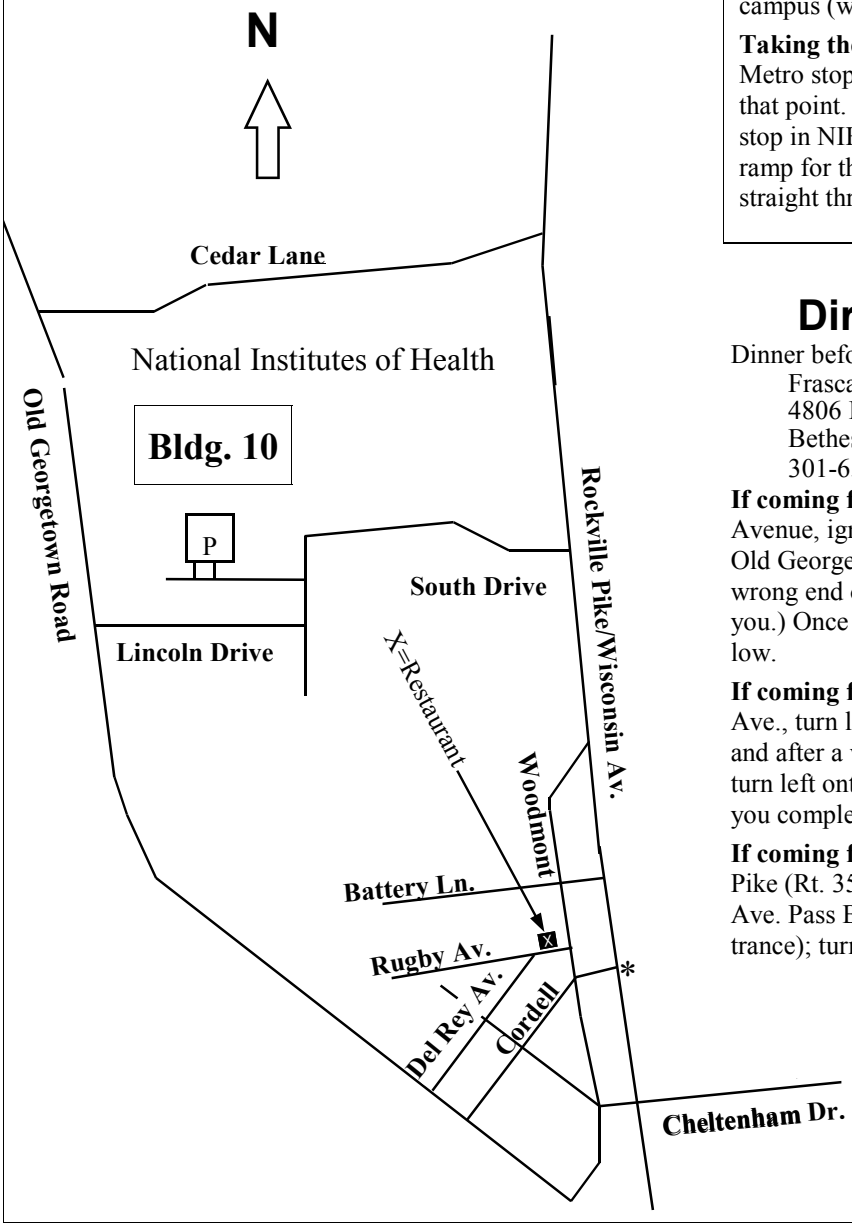
Getting to the NCA Monthly Meeting

Saturday, November 4

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

Frascati Ristorante Italiano
4806 Rugby Ave
Bethesda, MD
301-652-9514

7:30 P.M. - NCA Meeting at Lipsett Auditorium in Building 10 at NIH. Guest speaker: Dr. Nolan Walborn, "Insights into Massive Star Formation from the Hubble Space Telescope".



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. Building 10 is just north of the parking lot. Enter the building and follow the signs to the Lipsett Auditorium.

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 Lipsett amphitheater.

Directions to the Restaurant

Dinner before the meeting will be at 5:30 P.M. at

Frascati Ristorante Italiano
4806 Rugby Ave
Bethesda, MD
301-652-9514

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 Cordell (traffic light), right onto Woodmont, and after a very short distance (way before the next traffic light) turn left onto Rugby Ave. The restaurant will be your left when you complete the turn.

If coming from north of Bethesda, go south on the Rockville Pike (Rt. 355). As you pass NIH, make a right onto Woodmont Ave. Pass Battery Lane, and the next light (next to the garage entrance); turn right onto Rugby Ave. The restaurant is on your left.

After dinner, 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.

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Editor: Elliott Fein, Co-editor: Adele Fein, Editorial Advisor: Nancy Byrd.

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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 semi-annual event held at the Smithsonian Institution National Air and Space Museum.

Fighting Light Pollution: NCA is concerned about light pollution and is interested in the technology for reducing or eliminating it. To that purpose, NCA is an Organization Member of the International Dark Sky Association (IDA). Some NCA members are also individual members of IDA.

Classes: Some NCA members are available for educational programs for schools and other organizations. The instruction settings include star parties, classroom instruction, and schoolteacher training programs that provide techniques for teaching astronomy. NCA sponsors a telescope-making class, which is described in the *Star Dust* "Calendar of Monthly Events".

Tours: On several occasions, NCA has sponsored tours of astronomical interest, mainly to observatories (such as the National Radio Astronomy Observatory) and to the solar eclipses of 1998 and 1999. Contact: Sue Bassett wb3enm@amsat.org

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

Public Sky Viewing Programs are offered jointly with the National Park Service, and others. Contact: Joe Morris. joemorris@erols.com or (703) 620-0996.

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

NCA Juniors Program fosters children's and young adults' interest in astronomy, space technology, and related sciences through discounted memberships, mentoring from dedicated members, and NCA's annual Science Fair Awards.

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