# Star Dust

National Capital Astronomers, Inc. Phone: 301/565-3709

Volume 57, Number 10 June, 1999 ISSN 0898-7548


## Stephen J. Kortenkamp to Speak on the Formation of Planetary Systems

*submitted by Nancy Byrd*

The Saturday, June 5, 1999 meeting of National Capital Astronomers (NCA) will be held in the Lipsett Auditorium in Building 10 (Clinical Center) of the National Institutes of Health in Bethesda at 7:30 PM. This month's speaker will be Stephen J. Kortenkamp, of the Department of Terrestrial Magnetism (DTM) of the Carnegie Institution of Washington. He was born in Stevens Point, Wisconsin and obtained his PhD. at the University of Florida studying interplanetary dust.

Dr. Kortenkamp will speak to us on the subject of the "Formation of Planetary Systems," a subject he is actively pursuing at DTM. He submits the following abstract of his upcoming talk:

"Recent discoveries of extra-solar planets, including the three planet system around the star Upsilon Andromedae, have revived interest in theories of how planetary systems form. A couple of the currently fashionable theories will be explored. The influence of recent observations on the evolution of these theories will also be discussed. Special emphasis will be placed on the formation of terrestrial planets and asteroids."

Our last NCA meeting will have a full agenda: Annual elections will the held, the Science Fair winners who were not able to present last month will do so this month, and there should be a lively discussion about the upcoming total solar eclipse in August, the biggest occultation of all. ❍

## Space Astronomy in the 21st Century: A Talk by John Mather

*reviewed by Nancy Grace Roman*

Dr. Mather started by summarizing the ways astronomers measure characteristics of objects in the Universe: distances by trigonometric parallaxes, radial velocities by the Doppler shift, masses from orbits, ages by radioactive isotopes and theory of stellar evolution, etc., and composition from spectra. However, we do not observe the expected number of neutrinos from the Sun.

Because light has a finite velocity, we look back in time by looking back in distance. Hubble's discovery of the distance/redshift relation showed that we cannot consider ourselves to be in the center of the Universe; in fact, there is no center but everything appears to come from a point that has expanded for ten to fifteen billion years. Dr.

*MATHER, continues on page 2*

## NCA Honors Science Fair Winners

*by Jim Roy and Nancy Byrd*

National Capital Astronomers honored its 1999 Science Fair Winners at its annual Pizza Party celebration, and at the subsequent meeting where the winners presented their projects. There are eight science fair winners chosen by NCA this year: two from Washington, DC schools, two from Montgomery County, three from Prince George's County and one from Fairfax County. Other Washington area school jurisdictions were not covered. NCA awarded the science fair winners with framed certificates, and a year's membership in NCA.

The students demonstrated a firm grasp of the scientific principles relevant to their projects, and of the scientific

*WINNERS, continues on page 5*

## NCA Slate of Officers

The Nominating Committee presents the following slate of NCA officers for 1999-2000, who are willing to serve for the second term. Nominations may also be made from the floor.

| | |
|---|---|
| President | Andrew Seacord |
| Vice-President | Nancy Byrd |
| Secretary | Nancy Roman |
| Treasurer | Jeffrey Norman |
| Trustee | Jay Miller |

# Calendar of Monthly Events

## The Public is Welcome!

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

**Fridays, June 4, 11, 18, and 25, 7:30 PM** - Telescope making classes at American University, McKinley Hall Basement. Information: Jerry Schnall, 202/362-8872.

**Fridays, June 4, 11, and 18, July 2, 9, 16, and 23 9:00 PM** - Open nights with NCA's Celestron C-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. Call before 6:00 PM.

**Saturday, June 5, 5:30 PM** - Dinner with the speaker, at Costa del Sol, 4906 Fairmont Ave., Bethesda, MD. *See* map and directions on back page.

**Saturday, June 5, 7:30 PM** - NCA meeting, at Lipsett Auditorium in Building 10 at NIH, will feature Stephen J. Kortenkamp, speaking on "The Formation of Planetary Systems." Continuation of Science Fair winners presentations. *See* map and directions on back page.

**Mondays, June 7, 14, 21, and 28, 7:30 PM** - Public nights at U.S. Naval Observatory (USNO), in Northwest Washington, D.C. (off Massachusetts Avenue). Includes orientation on USNO's mission, viewing of operating atomic clocks, and glimpses through the finest optical telescopes in the Washington-Baltimore region. Held regardless of cloud cover. Information: USNO Public Affairs Office, 202/762-1438. Home page: http://www.usno.navy.mil.

**Saturday, June 12, and July 10, 9:00 PM, August 14, 8:30 PM** - Exploring the Sky at Rock Creek Park in the field south of the intersection of Military and Glover Roads near the Nature Center. Information: 202/426-6829.

**Tuesdays, June 8, 15, 22, and 29** - Telescope making classes at Chevy Chase Community Center, Connecticut Avenue and McKinley Street, NW. Information: Jerry Schnall, 202/362-8872.

**Saturday, September 11, 7:30 PM** - John Graham will speak on calibration of the Hubble constant and its implications for cosmology

*See* page 8 for more Washington area astronomical events.

*MATHER, continued from page 1*

Mather showed a nice cartoon of a man watching a tortoise moving away at one mile per hour and a hare moving away at two miles per hour to demonstrate how each appears to be at the center of an expansion.

Astronomers would like to think that this expansion has been constant with time or slowing gradually as a result of gravitational attraction but during the past year observations of distant supernovae indicate that they are 20-30% fainter than we expected them to be at the observed red shifts. This indicates that the rate of expansion is increasing with time. If this holds up, it is evidence that we do not understand how matter behaves.

Although galaxies become harder to see as we look at greater distances, we can see back to the time that the density was high enough that scattering of light prevented it from reaching us. This background was observed from the Cosmic Background Explorer (COBE) as it was produced when the universe was only about 300,000 years old. This showed that the background was very accurately a blac kbody at a temperature of 2.725 +/- 0.002 degrees but that there were variations in density of +/- 0.01%. These variations probably led both to the creation of galaxies, as material in slightly denser regions condensed, and to variations in the distribution of galaxies. The latter are not randomly distributed in space. Instead there are not only clusters of galaxies but there are large regions in which galaxies are more abundant than the average and other regions that appear to be holes in the distribution. However, we do not really know how galaxies form from these density variations. We would like to be able to look back far enough in time to see them forming.

Another puzzle is that if matter is distributed as COBE indicates we are only seeing 1-10% of the matter in the Universe, that is, only 1-10% of the matter in the universe is the kind that emits light. There are also other signs of dark matter including the rotation curves of galaxies that show the amount of matter as a function of distance from the center, and X-rays emitted from clusters of galaxies.

In the far infrared, the Microwave Anisotropy Probe (MAP) will be launched to study this dust. Because it is both more sensitive than COBE and has better resolution, it can distinguish be-

*MATHER, continues on page 3*

*MATHER, continued from page 2*

tween normal matter and two kinds of dark matter. In 2001, the Space Infrared Telescope Facility (SIRTF) will be launched into an orbit that will gradually take it away from the earth. About the same time, SOFIA, a Boeing 747 with a huge hole cut in its fuselage will start flying, carrying a 3-meter telescope optimized for the infrared and flying frequently with various auxiliary instruments.

The Hubble Space Telescope (HST) is expected to operate for another 10 years. The plan is to follow this with the Next Generation Space Telescope (NGST). Unlike the HST, this will be located far from Earth (to avoid its heat) and hence cannot be serviced. It must be able to operate reliably without help or dependence on servicing. We hope to be able to see how galaxies looked when they were very young and even how fragments of matter came together to form galaxies. Because these events are very distant, their light has been strongly red shifted as a result of the expansion of the Universe. This telescope will be optimized for observations in the infrared rather than for the ultraviolet and optical observations for which the HST was designed. In addition, the infrared light will penetrate the dust in galaxies more easily. With the HST, this dust is often seen as regions shadowing the background light. Observations of very distant supernovae will also indicate when the first massive stars formed since we can estimate how long they take to develop.

In addition to direct observations of distant galaxies, we can also see even more distant galaxies because some of them are nearly in the same direction as massive, nearer galaxies and galaxy clusters. According to Einstein, gravity bends light toward the massive object and hence these galaxies and clusters of galaxies act as a lens to magnify and brighten the light from the galaxies beyond them. Because the amount of magnification depends on the mass of the lensing object, we might also learn more about dark matter in the early Universe from these systems.

Nearer to home, we are anxious to learn more about how stars form. They form in dense dust clouds that hide their birth from visible light but are more transparent in the infrared.

HST is not cold enough to work efficiently in the infrared. We would like a cold telescope eight meters in diameter (with ten times the HST area) that will cost less than the HST. It is impossible to launch an eight-meter telescope in a single piece, so it will be made of very light segments deployed in orbit. It will be protected from the Sun by a deployed shield as large as a tennis court that will remain between the open telescope and the Sun at all times.

Currently, NASA is soliciting bids on the telescope that they plan to launch in 2008. They will choose two contractors this year from which one will be selected in 2001. In 2003, they will ask Congress for permission to proceed with construction of the instrument. They are now testing a 1.5-meter mirror, about as thick as a dinner plate with adjustable supports

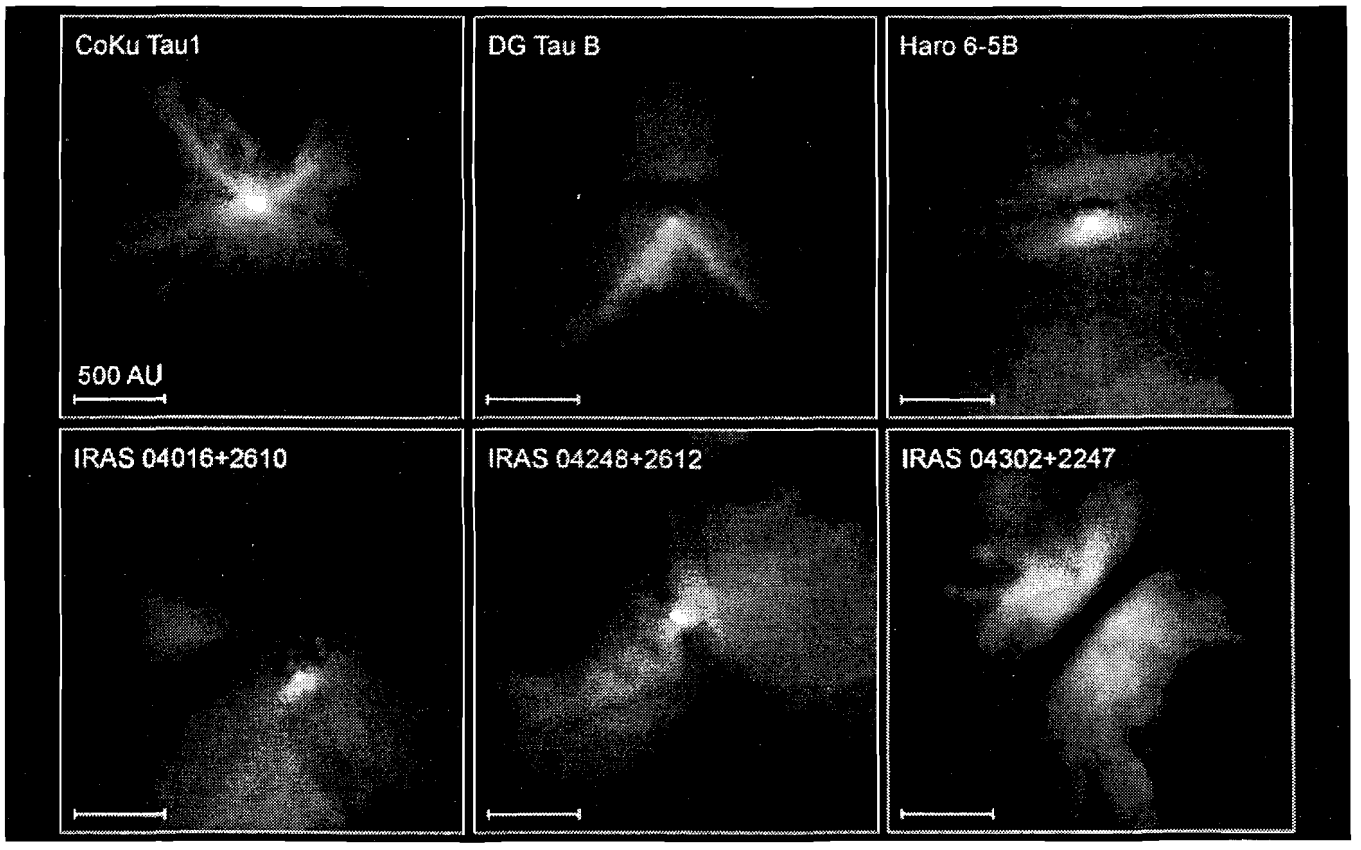
Daniel Goldin, the NASA administrator, seems to think that Congressional aproval is a "sure thing" and has asked NASA scientists to think about what should come next (called the N-NGST by Mather). Although we do not yet know how science will evolve in the next decade, NASA has talked about thin membrane telescopes. These are not yet practical but the hope is that other users will continue to advance the technology. Most of the radiation from the Galaxy is emitted in visible light and in the far infrared (~0.1mm). For the latter, a telescope even colder than the NGST must be farther from the Sun.

Our current millimeter telescopes have images comparable in resolution to those from Galileo's telescope. To get reasonable resolution for these wavelengths, we need instruments 100 times larger than telescopes built for visible light. To get this size, it is necessary to use two or more instruments separated by an appropriate distance. To image extra-solar planets, the instrument must be the size of a football field. The precursor will be the Space Interferometer Mission (SIM) that will be launched before the NGST (in 2005) to look for astrometric wobbles caused by such planets. It will be a ten-meter optical interferometer with a global pointing accuracy of four microarcseconds and a relative accuracy of one microarcsecond. The image resolution will be ten milliarcseconds. The ability to diminish the light of the star by a factor of 1000 may permit direct detection of a planet.

The Terrestrial Planet Finder (TPF) with a hoped for launch in 2012-2014 is being designed to study planets. It is not known exactly what this will be but the plan is to be able not only to see the planet but also to obtain its spectrum. If ozone is detected, the probability is that life is present because life makes molecular oxygen from which ozone is derived. If we are lucky in finding out how to design this instrument, it might be possible to fly it fairly soon. We can dream of even larger telescopes with which we can obtain images of planets! Beyond these missions, all planning is blue-sky dreaming. We might look for life in our solar system directly as, for example, on Europa.

Dr. Mather's talk was followed by a lively question and answer session characterised by these exerpts that follow: COBE does not give exactly the same map of density variations as those we see when we look back two billions years although they are similar. We can only see the results of the big bang after about 300,000 years. Astronomers think that there is an ocean on Europa because geologists see the same features on Europa as are formed by ice motion on Earth. Also, the surface is quite young because there are fewer craters than on most satellites. We would probably use retrorockets to land on Europa. Mather had not thought about whether our instruments would freeze to the surface. The ice on Europa is probably a few meters to kilometers thick. We could tell if we landed a seismometer. The Lagrangian points, L4 and L5, (ahead of the Earth and behind it by sixty degrees) are stable but there is not much debris there at present. The L1 and L2 points are not stable. Hence, debris would not accumulate there. The L2 point for Jupiter is in the planet's shadow and may be the darkest place in the solar system. However, it could be bothered by lightning on Jupiter. Europa is warmed by tidal friction because its orbit is not exactly circular. The elements of a giant interferometer might be connected by string but we have not been very successful with string so far.

The author of this summary thanks Dr. Mather for reviewing it and for correcting several errors. ○




***NICMOS PEERS THROUGH DUST TO REVEAL YOUNG STELLAR DISKS***

*The following images were taken by NASA's Hubble Space Telescope's Near-Infrared Camera and Multi-Object Spectrometer (NICMOS). All of the objects are extremely young stars, 450 light-years away in the constellation Taurus. Most of the nebulae represent small dust particles around the stars, which are seen because they are reflecting starlight. All photo credits: D. Padgett (IPAC Caltech), W. Brandner (IPAC), K. Stapelfeldt (JPL) and NASA* ***[Top left]: CoKu Tau/1.*** *This image shows a newborn binary star system, CoKu Tau/1, lying at the center of four "wings" of light extending as much as 75 billion miles from the pair. The "wings" outline the edges of a region in the stars' dusty surroundings, which have been cleared by outflowing gas. A thin, dark lane extends to the left and to right of the binary, suggesting that a disk or ring of dusty material encircles the two young stars.* ***[Top center]: DG Tau B*** *An excellent example of the complementary nature of Hubble's instruments may be found by comparing the infrared NICMOS image of DG Tau B to the visible-light Wide Field and Planetary Camera 2 (WFPC2) image of the same object. WFPC2 highlights the jet emerging from the system, while NICMOS penetrates some of the dust near the star to more clearly outline the 50 billion-mile-long dust lane (the horizontal dark band, which indicates the presence of a large disk forming around the infant star). The young star itself appears as the bright spot at the corner of the V-shaped nebula.* ***[Top right]: Haro 6-5B*** *This image of the young star Haro 6-5B shows two bright regions separated by a dark lane. As seen in the WFPC2 image of the same object, the bright regions represent starlight reflecting from the upper and lower surfaces of the disk, which is thicker at its edges than its center. However, the infrared view reveals the young star just above the dust lane.* ***[Bottom left]: I04016*** *A very young star still deep within the dusty cocoon from which it formed is shown in this image of IRAS 04016+2610. The star is visible as a bright spot at the base of a bowl-shaped nebula about 100 billion miles across at the widest point. The nebula arises from dusty material falling onto a forming circumstellar disk, seen as a partial dark band to the left of the star. The necklace of bright spots above the star is an image artifact.* ***[Bottom center]: I04248*** *In this image of IRAS 04248+2612, the infrared eyes of NICMOS peer through a dusty cloud to reveal a double-star system in formation. A nebula extends at least 65 billion miles in opposite directions from the twin stars, and is illuminated by them. This nebula was formed from material ejected by the young star system. The apparent "pinching" of this nebula close to the binary suggests that a ring or disk of dust and gas surrounds the two stars.* ***[Bottom right]: I04302*** *This image shows IRAS 04302+2247, a star hidden from direct view and seen only by the nebula it illuminates. Dividing the nebula in two is a dense, edge-on disk of dust and gas which appears as the thick, dark band crossing the center of the image. The disk has a diameter of 80 billion miles (15 times the diameter of Neptune's orbit), and has a mass comparable to the Solar Nebula, which gave birth to our planetary system. Dark clouds and bright wisps above and below the disk suggest that it is still building up from infalling dust and gas.*

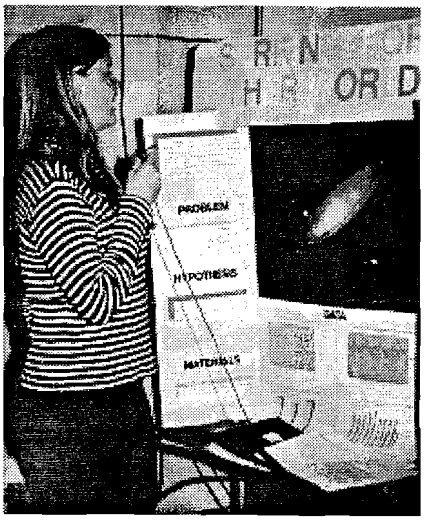
*WINNERS, continued from page 1*

method. Indeed, their grasp was sometimes astonishing, giving us renewed hope that there will be people able and willing to address some of the exciting challenges of the 21st century.

After the meeting, they engaged in lively discussions with our speaker, Dr. John Mather of NASA, and with NCA members. Gregory Holston, Alicia Singer and Sarah F. Zelechoski will present their projects this month or early next fall.

The five science fair winners who were present at the meeting gave brief reports on their projects, as follows:

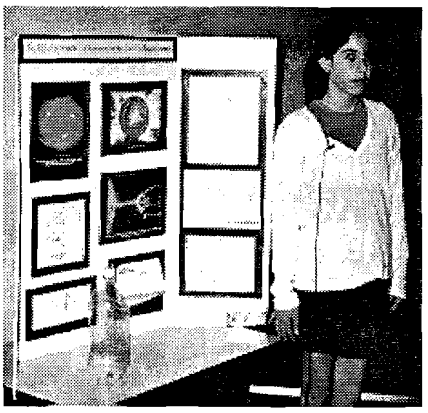
**Sabrina C. Snell, Stuart-Hobson Middle School - *Surfing for Other Worlds.***




*- Photo by Jim Roy*

Sabrina used the Hipparcos catalog, that she found on the Web, to look for the range of measured positions in right ascension and declination in 50 stars chosen at random and 10 stars known to have planetary companions (host stars). She suggested that the ten of the randomly chosen stars with the largest position ranges might also have planetary companions. The deviations were similar to those of the host stars.

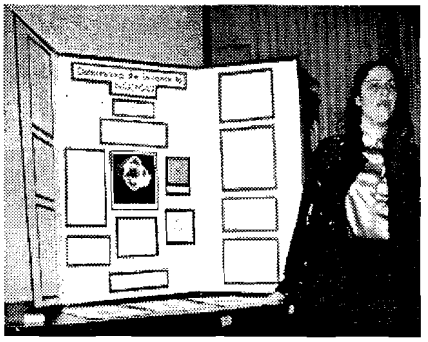
**Kimberly B. Reed, Redland Middle School - *The Effects of Number of Sunspots on the Earth's Magnetosphere.*** Kimberly built a magnetometer by mounting a small magnet on a card and reflecting a laser beam from the card. She then correlated the change in direction of the magnetic field near



*- Photo by Jim Roy*

Washington with the number of sunspots that she found on the Web. She found a correlation of 0.5. She suggested that perhaps there were other effects disturbing the correlation but that there was probably some effect.

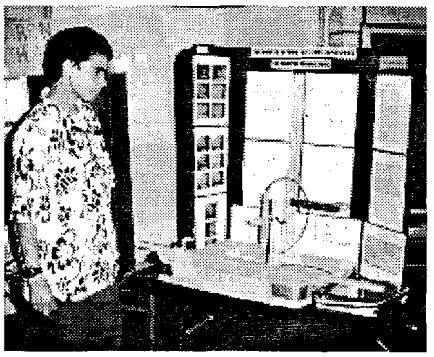
**Tracy L. Klayton, Thomas Jefferson High School for Science and Technology - *Determining the Distance to NGC 6543.*** Tracy studied two pictures of this planetary nebula, taken from the Hubble Space Telescope (HST) in 1994 and 1997 to measure the change in radius of rings seen in two elements. Although the change in position was less than the resolution of the HST, she was able to



*- Photo by Jim Roy*

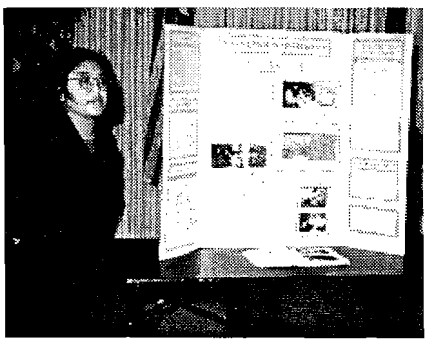
measure it by subtracting the later image from the earlier one. She then compared the tangential expansion with the expansion measured spectroscopically and found that the distance derived from the two elements was 923 parsecs and 913 parsecs, respectively.

**Jason R. Poncheri, Saint Columba - *The Effects of High Altitude Explosions on Crater Formation.*** Jason modeled the effect of a meteor explosion in the atmosphere similar to that of the Tunguska event. He used sand to simulate the Earth, toothpicks for trees and brief blasts of compressed air to simulate the explosions. He then measured the effect on crater size and tree disturbance as a function of the height of the blast. As might be expected the crater size and depth decreased with altitude but the trees were knocked down most strongly by the higher blasts with the maximum effect at 14 inches in height, at which height the crater was shallow.



*- Photo by Jim Roy*

**Jennifer M. Fu, Eleanor Roosevelt High School - *Magnetism in Meteorites.*** Jennifer studied a chondrite meteorite. This meteorite is composed of both chondrules and metallic particles in a matrix. She hypothesized that if the magnetism originated when the meteor was formed, all of the particles should show similar magnetic characteristics. However, the magnetic vectors were almost random. She then realized that easily magnetized material might have been affected later. After demagnetizing this material, she found that the particles that hold their magnetic properties better do indeed have similar characteristics. ❍



*- Photo by Jim Roy*

# Occultations in the Mid-Atlantic States Region, through September, 1999

*by David Dunham*

## Total Lunar Occultations

The better total lunar occultations through early Sept. 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 | EDT | Star | Mag | % | alt o | CA | Notes |
|---|---|---|---|---|---|---|---|---|
| Jun 2 | Wed | 00:14 | R xi1 Sgr. | 5.0 | 92- | 16 | 33N | xi2 miss in DC; see grazes on page 7 |
| Jun 11 | Fri | 04:52 | R ZC 0444 | 5.9 | 9- | 34 | 86S | Sun alt. -9 deg. |
| Jun 17 | Thu | 20:55 | D psi Leonis | 5.4 | 23+ | 34 | 57N | Sun alt. -4 deg. |
| Jun 17 | Thu | 22:58 | D SAO 98773 | 7.5 | 23+ | 11 | 87S | |
| Jun 22 | Tue | 22:11 | D 88 Vir. | 6.6 | 72+ | 41 | 33S | Probable close double |
| Jul 2 | Fri | 01:22 | R iota Cap. | 4.3 | 89- | 24 | 57S | Star is ZC 3126 |
| Jul 3 | Sat | 04:29 | R 45 Aquarii | 6.0 | 82- | 38 | 20S | Star is ZC 3275 |
| Jul 6 | Tue | 03:13 | R ZC 0106 | 6.6 | 52- | 25 | 66N | |
| Jul 8 | Thu | 03:39 | R ZC 0392 | 7.7 | 29- | 16 | 23S | 9.6 mag. secondary, sep.69", PA 214 |
| Jul 10 | Sat | 04:10 | R Aldebaran | 0.9 | 11- | 6 | 88S | 12x; low in n.e., az. 74 deg |
| Jul 17 | Sat | 21:03 | D ZC 1728 | 6.7 | 27+ | 29 | 85N | Red star (sp. M4) |
| Jul 19 | Mon | 23:03 | D 80 Vir. | 5.7 | 47+ | 17 | 78N | Star is ZC 1950 |
| Jul 22 | Thu | 23:59 | D ZC 2280 | 6.5 | 75+ | 21 | 73N | |
| Jul 29 | Thu | 04:26 | R Uranus | 5.7 | 99- | 24 | 62N | Dur. 11s; 10" to terminator |
| Jul 30 | Fri | 05:54 | R iota Aqr. | 4.3 | 96- | 21 | 64S | Sun -3 deg; pos. close double |
| Aug 6 | Fri | 03:12 | R 48 Tauri | 6.3 | 32- | 19 | 49S | Star is ZC 0626 |
| Aug 6 | Fri | 04:50 | R gamma Tau. | 3.7 | 31- | 37 | 16S | 12x; = ZC 0635 in Hyades |
| Aug 18 | Wed | 20:22 | D gamma Lib. | 3.9 | 49+ | 33 | 87S | Sun -5d; 20x Delmarva & NJ |
| Aug 22 | Sun | 21:06 | D xi2 Sgr. | 3.5 | 85+ | 29 | 51S | 20x?; Star is ZC 2759 |
| Aug 25 | Wed | 00:52 | D ZC 3041 | 6.2 | 96+ | 31 | 52N | |
| Aug 25 | Wed | 04:01 | D 19 Cap. | 5.8 | 97+ | 8 | 51S | ZC 3058; az. 239 deg. |
| Aug 29 | Sun | 04:41 | R ZC 0049 | 6.1 | 93- | 43 | 63N | |
| Sep 1 | Wed | 00:40 | R SAO 93228 | 7.5 | 69- | 21 | 50S | More occultations than usual |
| Sep 1 | Wed | 01:10 | R ZC 0444 | 5.9 | 69- | 27 | 80S | tonight; |
| Sep 1 | Wed | 01:33 | R X03990 | 8.3 | 69- | 31 | 53S | 9.4 mag secondary 19", PA 201 |
| Sep 1 | Wed | 02:10 | R SAO 93249 | 8.1 | 68- | 38 | 66S | fainter events included |
| Sep 1 | Wed | 02:10 | R SAO 93253 | 8.3 | 68- | 38 | 32S | R 22s after SAO 93249, DC area |
| Sep 1 | Wed | 04:26 | R ZC 0453 | 7.1 | 68- | 59 | 66N | Spec. M1 |
| Sep 1 | Wed | 04:34 | R SAO 93278 | 8.7 | 68- | 60 | 75N | |
| Sep 4 | Sat | 002:08 | R SAO 95031 | 7.9 | 34- | 11 | 89N | Milky Way; fainter included |
| Sep 4 | Sat | 003:52 | R SAO 95119 | 7.5 | 34- | 30 | 84N | |
| Sep 4 | Sat | 03:58 | R SAO 95128 | 9.1 | 34- | 32 | 85S | |
| Sep 4 | Sat | 04:14 | R SAO 95142 | 8.8 | 33- | 34 | 54S | Spec. K0 |
| Sep 4 | Sat | 04:46 | R 64 Orionis | 5.1 | 33- | 41 | 40N | 24x; Close Dbl; Pittsburgh Graze |
| Sep 6 | Mon | 05:20 | R ZC 1217 | 6.2 | 14- | 25 | 58N | 30x? |
| Sep 18 | Sat | 19:50 | G ZC 2697 | 6.5 | 61+ | 30 | 4N | Sun -8; Graze McLean, VA-Bowie |
| Sep 29 | Wed | 22:42 | R Aldebaran | 0.9 | 72- | 5 | 30S | 12x; Az. 73 Last 1st-mag occultation of a star in the MidAtlantic area until 2005 |

## Planned Grazing Occultation Expeditions

| DATE | Day | EDT | Star | Mag | % | alt o | CA | Notes |
|---|---|---|---|---|---|---|---|---|
| Jun 2 | Wed | 00:09 | xi2 Sgr | 3.6 | 92- | 13 | 14S | Emmaus, PA; Bordent'n & Trenton, NJ |
| Jun 7 | Mon | 05:02 | ZC 3447 | 7.6 | 48- | 33 | -1N | Hughesville, MD; Sun -7 deg. |
| Aug 7 | Sat | 03:35 | ZC 0787 | 7.1 | 21- | 14 | 6N | VA Beach, VA & Raleigh, NC |
| Aug 11 | Wed | 06:30 | The Sun | -27 | 0 | | | Germany, France, Austria, Hungary |
| Sep 2 | Thu | 05:44 | SAO 93760 | 7.8 | 57- | 64 | 10D | Thurmont, MD & York, PA; Sun -11 |
| Sep 4 | Sat | 04:30 | 64 Orionis | 5.2 | 34- | 35 | 10N | Pittsburgh, PA area |
| Sep 18 | Sat | 19:50 | ZC 2697 | 6.5 | 60+ | 30 | 4N | Reston, McLean,VA; Largo, s Bowie, MD |

*Notes:*
June 2: 5.0-mag. xi1 Sagittarii will reappear near the end of the graze observing period at 0:15.
Aug. 7: There will be no DC-area expedition for this, but local efforts are probable if the weather is favorable.
Aug. 11: A few of us will be attending the European Symposium on Occultation Projects meeting in Stuttgart the weekend before the eclipse, and to observe the eclipse from southern Germany, or points east or west, depending on the weather.
Sept. 4: We plan to join a local effort.

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## Asteroidal Appulses, 1999 late April - early June

| DATE | Day | EDT | Star | Mag | Asteroid | dmag | dur. s | ap. in. | Occultation Location |
|---|---|---|---|---|---|---|---|---|---|
| Aug 15 | Sun | 22:17 | SAO 211561 | 10.0 | Virtus | 3.4 | 11 | 7 | Gulf coast |
| Aug 16 | Mon | 02:46 | ACT05870376 | 10.6 | Iphigenia | 2.3 | 22 | 8 | Gulf coast |
| Sep 3 | Fri | 03:25 | HIP 116206 | 8.6 | Hermentaria | 2.2 | 11 | 4 | Bahamas |
| Sep 6 | Mon | 04:31 | SAO 111458 | 9.5 | Prokne | 2.5 | 14 | 6 | Georgia |
| Sep 8 | Wed | 05:44 | GSC18480430 | 11.0 | 1995 WY2 | 12.9 | 16 | 8 | James Bay |

*Notes:*
Sep 8: The path prediction for this Kuiper-Belt object is very uncertain.

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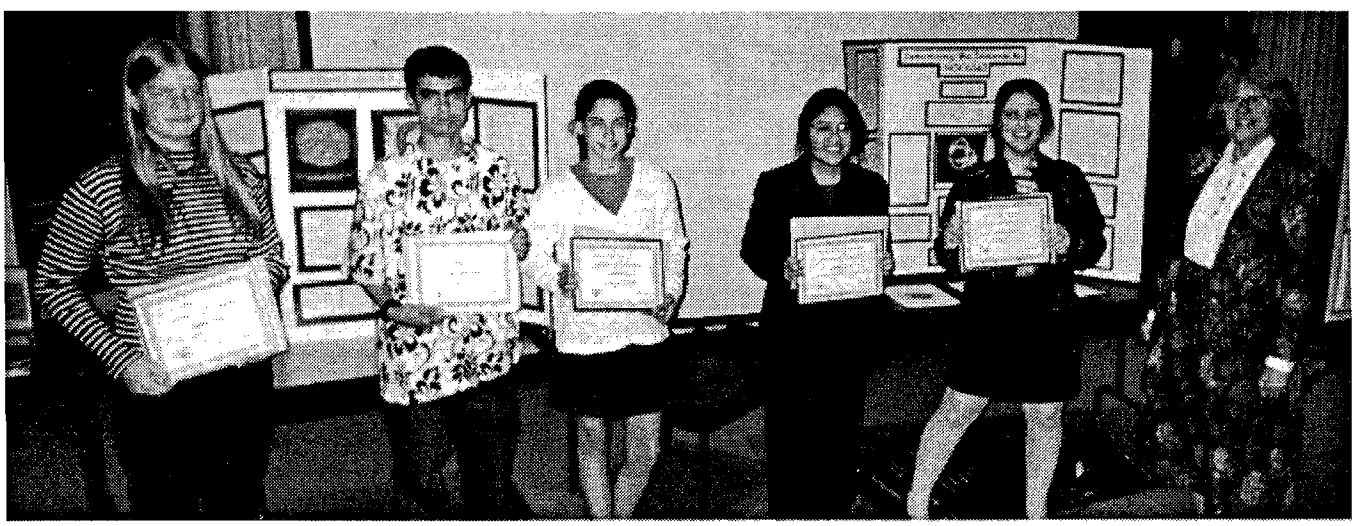


*From left to right: Science Fair winners, Sabrina C. Snell, Jason R. Poncheri, Kimberly B. Reed, Jennifer M. Fu, Tracy L. Klayton, and the Vice President of NCA Nancy Byrd. - Photo by Jim Roy*

## National Capital Area Astronomical Events

**Free Lectures at the Einstein Planetarium and Other Daily Events**
**National Air & Space Museum**

**202/357-1550, 202/357-1686, or 202/357-1505 (TTY)**
**Home page: http://www.nasm.edu**

### Other Area Astronomical Events

**CIW/DTM Seminars** — All seminars are held on Wednesdays at 11:00 a.m. in the Seminar Room of the Main (old) Building located the Carnegie Institute at 5241 Broad Branch Rd., N.W., Washington, DC.

"Shock Metamorphic Effects in Martian Meteorites", Speaker, Nabil Boctor, June 16.

**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 check their web site at www.pha.jhu.edu/facilities/observatory/telescope.html.

**NASA Goddard Scientific Colloquia** — All Colloquia will take place in Bldg. 3 Auditorium, with coffee and cookies at 3:30 PM.

"John C. Lindsay Memorial Lecture, Galaxies, Cosmology, and Unsolved Problems in Astrophysics", Speaker, Jeremiah Ostriker, June 4.

**U.S. Naval Observatory** — All Colloquia will take place in Bldg. 52 Auditorium, with coffee and cookies at 10:00 AM, talk at 10:30 AM, and lunch at noon:

"Overview of NIMA/NSWCDD GPS Orbit and Clock Estimation", Speaker Dr. Everett Swift, June 22.

**University of Maryland, Dept. of Astronomy Open House** — "Monster in the Sky: Quasars and Supermassive Black Holes", Speaker, Dr. Sylvain Veillieux, June 5, 9:00 PM.

"Surfing the Universe on Gravity's Waves" Speaker, Dr. Kevin Rauch, June 20, 9:00 PM.

Information: 301/405-3001 (days), 303/405-0355 (evenings).

## Meteor Showers

### Major Activity

**None**

### Minor Activity

| | | |
|---|---|---|
| **June Aquilids** | **June 2-July 2** | **June 16/17** |
| **June Bootids** | **June 27-July 5** | **June 28/29** |
| **Corvids** | **June 25-July 3** | **June 27/28** |
| **Tau Herculids** | **May 29-June 19** | **June 9/10** |
| **June Lynids** | **June 10-21** | **June 15/16** |
| **Ophiuchids** | **May 19-July 2** | **June 20/21** |
| **Theta Ophiuchids** | **May 21-June 16** | **June 10/11** |
| **Sagittariids** | **June 10-16** | **June 10/11** |
| **Phi Sagittariids** | **June 7-July 15** | **June 18/19** |
| **Chi Scorpiids** | **May 6-July 2** | **May 28-June 5** |
| **Omega Scorpiids** | **May 19-July 11** | **June 3-6** |
| **June Scutids** | **June 2-July 29** | **June 27/28** |

### Daylight Activity

**None**

**Instruments and Cosmology**: A Symposium to celebrate Jim Gunn's 60th Birthday —Astrophysical Sciences and the Department of Physics, Princeton University, and the School of Natural Science, the Institute for Advance Study. The Conference will take place in the new Cumputer Science building on the campus of Princeton,University. For more information, email gunnfest@astro.princeton.edu or check out the website at: http://www.astro.princeton.edu/gunnfest/

Other events too numerous to list in *Star Dust* are listed in the publications, *Sky & Telescope*, the *Astronomical Calendar 1999*, the *Observer's Handbook 1999*. NCA members can purchase all these (and much more) at a discount. Information can also be found in numerous software packages, and links available on the NCA Home Page (*see* above for address). To join NCA, use the membership application on page 9.

**Newsletter Deadline for September *Star Dust*, August 15, 1999**

Send Submissions to Alisa & Gary Joaquin, at ajglj@erols.com or fax submissions to 703/658-2233. **Text may be in ASCII or Microsoft Word and graphics submitted must be in TIFF, GIF, or JPEG.** Thank you.

Don't throw this newsletter away. If you're finished with it, pass it on to someone else to read or recycle it. It's right for astronomy and the environment.

# National Capital Astronomers, Inc.

**SERVING SCIENCE & SOCIETY SINCE 1937**

NCA is a non-profit, membership supported, volunteer run, public-service corporation dedicated to advancing space technology, astronomy, and related sciences through information, participation, and inspiration, via research, lectures, presentations, publications, expeditions, tours, public interpretation, and education. NCA is the astronomy affiliate of the Washington Academy of Sciences. All are welcome to join NCA.

**SERVICES & ACTIVITIES:**

**Monthly Meetings** feature presentations of current work by researchers at the horizons of their fields. All are welcome; there is no charge. *See* monthly *Star Dust* for time and location.

**NCA Volunteers** serve as skilled observers frequently deploying to many parts of the National Capital region, and beyond, on campaigns and expeditions collecting vital scientific data for astronomy and related sciences. They also serve locally by assisting with scientific conferences, judging science fairs, and interpreting astronomy and related subjects during public programs.

**Discussion Groups** exchange information, ideas, and questions on preselected topics, moderated by an NCA member or guest expert.

**Publications** received by members include the monthly newsletter of NCA, *Star Dust*, and an optional discount subscription to *Sky & Telescope* magazine.

**NCA Information Service** answers a wide variety of inquiries about space technology, astronomy, and related subjects from the public, the media, and other organizations.

**Consumer Clinics on** selection, use, and care of binoculars and telescopes, provide myth-breaking information, guidance, and demonstrations for those contemplating acquiring their first astronomical instrument.

**Dark-Sky Protection Efforts** educate society at large about the serious environmental threat of light pollution, plus seek ways and means of light pollution avoidance and abatement. NCA is an organizational member of the International Dark-Sky Association (IDA), and the National Capital region's IDA representative.

**Classes** teach about subjects ranging from basic astronomy to hand-making a fine astronomical telescope. NCA's instructors also train educators in how to better teach astronomy and related subjects.

**Tours** travel to dark-sky sites, observatories, laboratories, museums, and other points of interest around the National Capital region, the Nation, and the World.

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

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

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

**Fine Quality Telescopes** up to 36-cm (14-inch) aperture are available free for member's use. NCA also has access to several relatively dark-sky sites in Maryland, Virginia, and West Virginia.

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

**Enclosed is my payment for the following membership category:**

[ ] Regular
- [ ] *Sky & Telescope* and *Star Dust*. ($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 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 $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!**

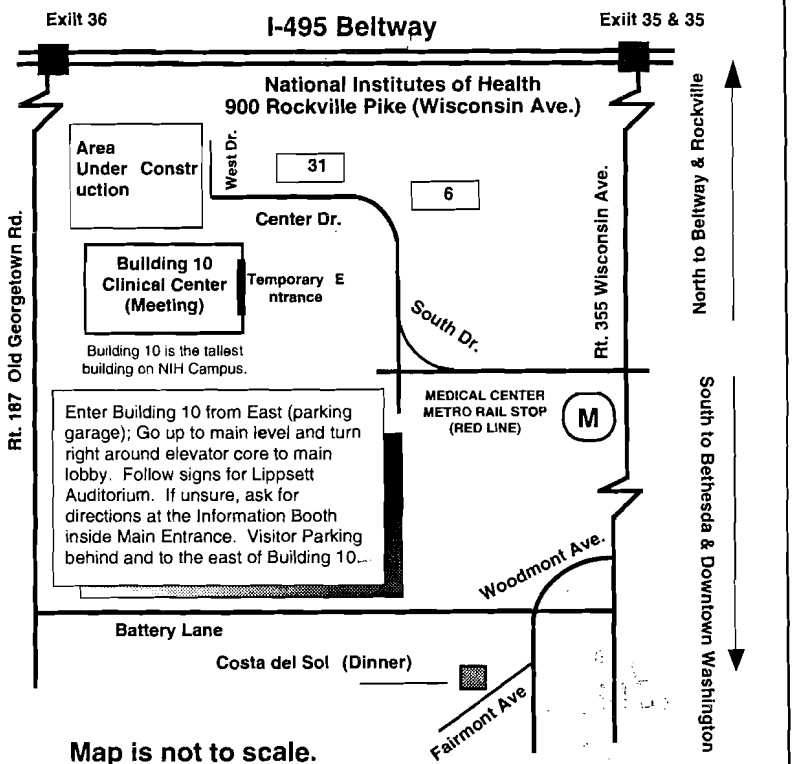
_____

_____

# Getting to the NCA Monthly Meeting

**Metrorail Riders** - From Medical Center Metro Station: Walk down the hill, pass the bus stops and turn right at the anchor onto Center Drive. Continue uphill to Building 10, the tallest building on campus (walking time about 10 minutes). Also, the J2 bus line connects the Bethesda (7:16 PM) and NIH (7:23 PM) Metro stops with Building 10 (7:25 PM).

**To Costa del Sol** - From the beltway, take Wisconsin Avenue toward Bethesda. Take a right onto Woodmont Avenue. The take a right onto Fairmont. The address is 4906 Fairmont Ave. (301/656-2561). There are parking garages nearby. Seats are not guaranteed after 5:30 PM.



A more current map for parking at NIH may be found at:
www.cc.nih.gov/ccc/waytogo/update1.html

***Star Dust*** **is published ten times yearly (September through June) by the National Capital Astronomers, Inc. (NCA), a nonprofit, 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. President: Andrew Seacord, 301/805-9741. Deadline for *Star Dust* is the 15th of the preceding month. Editors: Alisa & Gary Joaquin, 4910 Schuyler Dr., Annandale, VA 22003, 703/750-1636, E-mail: ajglj@erols.com. Editoral Advisor: Nancy Byrd**


**National Capital Astronomers, Inc.**
If Undeliverable, Return to
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