Star Dust

National Capital Astronomers, Inc. **http://capitalastronomers.org**

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September Speaker: Dr. Vera C. Rubin, "Polar-Ring Galaxies"

Dr. Vera Rubin, Senior Fellow at the Department of Terrestrial Magnetism, Carnegie Institution of Washington, will present the talk "Polar-Ring Galaxies" at the September 9 meeting of the National Capital Astronomers, 7:30 P.M., at the University of Maryland Observatory, in College Park, Maryland.

Abstract

A polar ring galaxy is encircled over its poles by a ring of matter, a ring that may actually be a massive disk. Although polar ring galaxies constitute only a small fraction of the galaxy population, they offer a unique insight into the formation and evolution of galaxies, and the details of dark matter halos. Polar ring galaxies constitute a fraction of multi-spin galaxies, galaxies with more than one sense of rotation. After a brief discussion of rotation in normal galaxies, Dr. Rubin will describe a few of these curious objects, and what astronomers have learned from them.

Bio

Vera C. Rubin is an observational astronomer who has studied the motions of gas and stars in galaxies and motions of galaxies in the universe for 75% of her life. Her work was influential in discovering that most of the matter in the universe is dark. She is a graduate of Vassar College, Cornell University, and Georgetown University; George Gamow was her thesis professor. A staff member at the Department of Terrestrial Magnetism, Carnegie Institution of Washington, she is now a Senior Fellow. She is a member of the National Academy of Sciences, and the Pontifical Academy of Sciences. President Clinton awarded her the National Medal of Science in 1993. Among other honors, she received the Gold Medal of the Royal Astronomical Society (London) in 1996. The previous woman to receive this medal was Caroline Herschel in 1828. Dr. Rubin is active in encouraging and supporting women in science. Her husband and their four children are Ph.D. scientists.

Annual Election of Officers

Reported by Jeffrey B. Norman

At the June 10, 2006 meeting of National Capital Astronomers, the following officers were elected: President: Dr. Harold Alden Williams; President-elect: Dr. Walter L. Faust; Vice-President: Dr. Walter L. Faust; Vice-President-elect: Dr. John D. Gaffey, Jr.; Secretary: Dr. Nancy Grace Roman; Assistant Secretary: Michael Brabanski; Treasurer: Michael Brabanski; Assistant Treasurer: Jeffrey B. Norman; and Trustee: Jeffrey B. Norman.

Review of Talk by Dr. Robert W. Farquhar: "The Flight of ISEE-3/ICE and the Utilization of Libration Points in Future Space Exploration"

by Dr. David W. Dunham

This is a review of the talk given at the NCA meeting on May 13. I have worked with Bob Farquhar for nearly 30 years, first while he was at the Goddard Space Flight Center, and then, since 1992, at the Johns Hopkins University's Applied Physics Laboratory (APL) in Laurel. My life has been enriched by his vast knowledge of celestial mechanics and spacecraft motion. Bob, having prepared his Ph.D. dissertation on libration-point orbits in the early 1960's, came to hate computers in that age when they were much less user-friendly than they are now. In contrast, I enjoyed computer programming and using computers to solve problems in astronomy and celestial mechanics. I relished solving the problems that Bob posed, almost always proving that his ideas were correct. Bob joked with colleagues at many meetings, including one in Los Angeles in 1985 where he was introduced to my parents, saying: "We have a great relationship: Dave does all the work and I take all the credit." My mother blurted back "I know!" But Bob worked hard, too, and he had most of the ideas, so he deserves the credit. He described many of his ideas during this interesting talk.

Dr. Farquhar started with a disclaimer, stating that some of the material that he would present is not necessarily endorsed by his employer, the Johns Hopkins Applied Physics Laboratory.

He explained how libration points work in a coordinate system rotating with the motion of a secondary body (such as the

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NCA Events This Month

The Public is Welcome!

NCA Home Page: http://capitalastronomers.org

NCA Mirror- and Telescope-making Classes: Fridays, September 1, 8, 15, 22, 29; 6:30 to 9:30 P.M. at the Chevy Chase Community Center, at the northeast corner of the intersection of McKinley Street and Connecticut Avenue, N.W. Contact instructor Guy Brandenburg at 202-635-1860 or email him at gfbrandenburg @yahoo.com. See article below.

Open house talks and observing at the University of Maryland Observatory in College Park on the 5th and 20th of every month at 9 P.M. The talks are non-technical. There is telescope viewing afterward if the sky is clear.

Upcoming NCA Meetings—Saturdays
September 9, NCA dinner and meeting. See Page 1 and Page 7.
October 14: The speaker will be Dr. Coleman Miller from the Astronomy Dept., University of Maryland, who will speak about "Black Holes and Trembling Spacetime".
November 11, TBA.
December 9, TBA.

See Page 6 for other events this month.

Observing with NCA C-14

Mike McNeal

Schedule is open, generally, Saturdays at 7:30 P.M. Call to set up a time.

In Mike McNeal's backyard, 5410 Grove St, Chevy Chase, MD, (Friendship Heights Metro).

Please make reservations by 10 p.m. the Friday before. Call Mike at 301-526-2648 or email him at mcnealmi@verizon.net.

We need a new volunteer to house NCA's C-14, make it available for weekly viewing, and transport it to other sites, e.g., Exploring the Sky and star parties.

NCA Dues Drastically Reduced

Reported by Jeff Norman, Trustee and former Treasurer

At its August 19, 2006 meeting, the NCA Board of Directors voted to drastically reduce the basic NCA annual dues from $27 to $10 for regular members and from $15 to $5 for student members. Those NCA members who wish to get *Sky & Telescope* magazine will continue to pay an extra $33 a year, which is passed through to the Sky Publishing Corporation.

Board members recognized that NCA's membership has been steadily declining for several years. In 1992, the membership was 223, the highest number in recent years. After some modest decreases and partial recoveries, it was 174 in 2000. Since then, it has steadily declined every year from 174 in 2000 to only 115 in 2006. The Board decided to do a one year experiment of dues reduction to try to stop the losses.

The new dues took effect in August 2006. The Board will re-evaluate this policy at its meeting next summer. I estimate that NCA will probably lose about $1800 over the next year; but fortunately, we have a reserve fund of about $12,000.

From July 1, 2005 until June 30, 2006 (NCA's 2006 Fiscal Year), NCA received $814 in gifts. NCA is registered with the IRS as a tax exempt, tax deductible non-profit organization. Contributions in any amount are welcome at any time.

The deadline for the October Star Dust is September 27. Please send your material to Elliott Fein by that date to ensure inclusion. Send submissions to Elliott Fein at elliott.fein@verizon.net.

Articles submitted may be edited to fit the space available.

News and Notes from the NCA Mirror- and Telescope-Making Workshop

by Guy Brandenburg

Various NCA members (and non-members) have recently completed telescopes and mirrors. Over the summer, Mike Alick completed a very professional-looking truss-tube 12.5" f/5 Dobsonian-mounted Newtonian telescope. Space prevents us from showing pictures, but his workmanship was excellent, and he had completed the mirror with an excellent figure in just a few months, putting in a lot of time on his own at home. Tim Sirk and his wife Hanh, who were in town just for the summer, worked hard together and finished an 8-inch mirror in less than 2 months (its figure could have been improved, but they had no time). Joe Martin has now finished two mirrors (a 6" and an 8") with excellent figures, to add to his already-large collection of telescopes. Steve LaPrade, who finished an outstanding 8" f/8 mirror for his brother (with some help from his daughter Erica) some time ago, is now almost finished with the telescope itself (or at least, the photos he sent me made it look like it was almost done). Carrie Pledger finished assembling her 6-inch telescope at the beginning of the summer; the mirror had been finished quite some time before. John Palmer finished a 6-inch mirror for the second time (long story, mea culpa - the coating on the original mirror was way too thick {my fault entirely} and I thought it would be easy to polish it off; unfortunately it was way too thick for that, and we found out that the work we did messed up his excellent figure, and we then had to chemically strip the aluminum and had to refigure it all over again.) There are other finished projects as well, but my memory has failed me.

A few months ago, with a lot of help from my son, Josef, I took delivery of an entire surplus 12-inch heliostat that some folks at NASA-Goddard were trying to get rid of. A heliostat has a flat mirror that follows

To be continued next month

Review of Talk by Dr. Robert W. Farquhar

(Continued from page 1)

Earth) about a much larger primary body (the Sun). If the Sun-Earth line is kept as a horizontal line, there are three collinear libration points along the line where the forces of gravity from the Sun and the Earth and the centrifugal force of the coordinate system cancel. Although first described by Euler a few years earlier, these libration points are usually attributed to Lagrange. In principle, a spacecraft placed at one of these points would stay there, it would be "balanced." In the Sun-Earth system, the "L1" libration point is 0.01 AU (1.5 million km or about 4 times the Earth-Moon distance) from the Earth towards the Sun while the "L2" point is a similar distance behind the Earth away from the Sun. "L3" is almost at the Earth's distance from the Sun but directly behind the Sun as seen from the Earth. There are also triangular libration points in the Earth's orbit 60° ahead of and behind the Earth, forming an equilateral triangle with the Sun and Earth; they are called "L4" and "L5". At the triangular points, not only do the forces in the rotating system cancel, but for small motions about these points, the motion remains bounded – the points are stable, as proven by the Trojan asteroids that circulate around the L4 and L5 points of the Sun – Jupiter system.

Motion with small amplitudes about the libration points have different periods. In the Earth-Moon system, the period of orbits about L1 and L2 is about 2 weeks (half a month). The period about L3 is a month, while motion around L4 and L5 have periods of 1 and 3 months. In the early 1960's, Dr. Farquhar proposed using a "halo" orbit about the Earth-Moon L2 point to provide continuous communication between the Earth and the back side of the Moon. From the Moon, the comsat would stay in approximately the same place in the sky, almost like geosynchronous satellites of the Earth. But the Apollo program ran out of funding before a back-side mission could be accomplished so the proposed lunar comsat was never built.

Dr. Farquhar showed the 7 Libration points near the Earth to scale. These include all 5 of the Earth-Moon. He became most interested in L1 & L2 of the Sun-Earth. In the late 1960's, he thought about keeping a spacecraft near the Sun-Earth L1 point to monitor the solar wind before it interacted with the Earth. The International Sun-Earth Explorer (ISEE) program was going to study Sun-Earth interactions with particles and fields instruments; one of the spacecraft of the series should measure the solar wind input to the Earth's magnetosphere. Dr. Farquhar convinced Norman Ness and other scientists that a spacecraft near L1 should be included in the ISEE program. But for a spacecraft at L1, tracking antennae on the Earth would look right into the Sun, which is too noisy for effective communication. A spacecraft placed in a circular orbit about L1, with in-plane and out-of-plane components, would evolve into a Lissajous pattern that would cross the "solar exclusion zone" where communication is impossible since the in-plane and out-of-plane frequencies are slightly different. But if the amplitudes of the motion are large enough, higher-order terms change the frequencies. Dr. Farquhar found that with the right amplitudes, the frequencies could be made equal so that the motion would be a "halo" around the libration point that would always avoid the solar exclusion zone. Only small propulsive maneuvers would be needed approximately every three months to maintain the halo orbit, which is unstable (so there's no danger of space debris collecting there like it can at the triangular points). The third spacecraft of the ISEE program was conceived for the halo orbit as a spinning cylindrical spacecraft with dimensions just under 2 meters, but with wire antennae extending over 90 meters, tip to tip. ISEE-3 has a robust suite of particles and fields instruments. ISEE-3 was launched on August 12, 1978, at 12:12:12 EDT on Delta rocket #144 (= 12 squared); Dr. Farquhar reveled in this as 12 is his lucky number. It took 100 days to reach the halo orbit with the help of three small delta-V maneuvers. ISEE-3's halo orbit is 50 degrees wide, tip to tip, as seen from the Earth.

Dr. Farquhar, along with some operations personnel and scientists, became tired of the halo orbit after the 4 years of the planned mission. He wanted to retarget ISEE-3 to a comet, a possibility with a spacecraft with a relatively large maneuvering capacity in an orbit balanced between interplanetary and near-Earth space. It would be possible to go to Halley's Comet, but data rates were too low with ISEE-3. However, another comet, Giacobini-Zinner (GZ), was at half the distance so the data rates would be high enough. Starting from GZ where it crossed the ecliptic plane, it was easy to target a trajectory backward to the Moon, where it could be "captured" (in the backward sense) into orbit about the Earth, and, captured more strongly with a second lunar swingby in October 1983. It looked easy, but it proved to be more difficult in the real solar system with solar and planetary perturbations, etc. Dr. Farquhar felt it had to be possible, but we didn't have a solution by June 1982, when Dr. Farquhar convinced NASA and project scientists to perform a small 4.5 m/sec delta-V maneuver that caused ISEE-3 to fall out of the halo orbit and loop around the Earth, to eventually reach the Moon in late March 1983. Between March and October, it would be necessary to rotate the line of apsides (the major axis of the orbit) to keep the s/c in the geomagnetic tail (behind the Earth from the Sun), which would provide valuable science in its own right. Using only propulsive maneuvers, it would cost 400 m/sec/month, but ISEE-3 only had enough fuel for one month.

A couple of years earlier, Dr. Farquhar conceived a double lunar swingby trajectory that would keep the line of apsides fixed in the rotating frame, in alternating low and high orbits that used lunar swingbys to transfer between them. There are several classes of these periodic orbits with different numbers of months in the inner and/or outer orbits. It's doubly periodic, in both the Earth-Moon and Sun-Earth rotating frames. Some of the outer-loop trajectories even go out beyond the Sun-Earth L2 point. David Dunham calculated the basic orbits using patched conics, but in reality the motion is more complex with solar perturbations. There were 7 months to hook up the backwards trajectory from GZ to the lunar "capture" swingbys with ISEE-3's actual trajectory targeted to the March 1983 lunar swingby. Dr. Farquhar showed a worksheet with several different double-lunar swingby orbit possibilities and assigned coworkers to see how much fuel would be needed to make them work with realistic solar system models. It was a long trial and error process to see how well each sequence worked. Ed Siefert was assigned the one that finally was made to work, with only a 5-month outer loop and two 1-month inner loops. All of us on the ISEE-3 trajectory design team made contributions that optimized the trajectory enough to really navigate it. Several papers

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Review of Talk by Dr. Robert W. Farquhar

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were published on the scientific results learned during these magnetotail excursions. For example, the observations showed that charged particles were trapped in the geomagnetic tail and could be triggered to cascade down to the Earth's ionosphere in the polar regions to cause aurorae.

ISEE-3's fifth and last lunar swingby, a very close one only 120 km above the surface, occurred on Dec. 22, 1983. A couple of months before, JPL navigators figured out that ISEE-3 would hit the moon, to possibly cause a crater that was dubbed Dr. Farquhar's furrow. But we planned a small maneuver a month before that would cause ISEE-3 to fly above the surface, and the swingby occurred without a hitch. After that, the spacecraft was on an interplanetary trajectory and was renamed the International Cometary Explorer (ICE). He showed how the path looped away from the Earth in the Sun-Earth rotating frame to encounter Comet GZ on Sept. 11, 1985. Dr. Farquhar wanted to get there on his birthday, Sept. 12, but that cost too much fuel. It was the first spacecraft to visit a comet, six months before other spacecraft reached Halley's Comet, as shown on a cover of Science News. ICE passed through the tail of Comet GZ, passing through bow shocks, and crossed the neutral sheet in the center, as proven by the change of polarity seen at the predicted time in ICE's magnetometer measurements. In March 1986, ICE measured the solar wind input to Halley's Comet from a location about 0.2 AU sunward from that comet. After that, ICE was retargeted to a lunar swingby that will occur on Aug. 10, 2014, after the spacecraft drifts all the way around the Sun in the rotating frame. Dr. Farquhar noted three possibilities: 1) Instead of swinging by the Moon, ICE could be retargeted to swing by the Earth to reach Comet GZ in 2019. 2) Many of ISEE-3's scientists wanted to keep the spacecraft in the Sun-Earth L1 halo orbit. So after the Aug. 2014 swingby, the spacecraft could be returned to the halo orbit to satisfy those scientists. In that case, Dr. Farquhar said the spacecraft was not highjacked out of the halo orbit, it was just borrowed, to be returned in 2014! 3) The spacecraft could be targeted to the Earth's atmosphere, to use aerobraking to capture it into low Earth orbit, a complex series of maneuvers that could be an educational exercise for college students. From low orbit, the spacecraft could be retrieved with the new crew exploration vehicle and given to the National Air and Space Museum (NASM). In 1986, NASA signed an agreement to turn the spacecraft over to NASM.

Dr. Farquhar summarized ISEE-3's many firsts: The first to use a halo orbit, the first to use double-lunar swingbys, and the first to visit a comet. Dr. Farquhar noted that he suffered a heart attach within a month of when ISEE-3's battery died (it relied entirely on its solar cells after that, before the geomagnetic tail excursions). Dr. Farquhar is concerned that his time might be up when ISEE-3 returns to Earth in 2014.

After ISEE-3, Wind (a spacecraft launched in 1994 to study the solar wind) looped around the Sun-Earth L1 point in 1995 and 1997. Starting in 1986, SOHO entered a halo orbit identical to ISEE-3's (that's no accident; we did the early orbit designs for that mission) and with its spectacular solar observations is currently the most famous halo orbiter.

Other successful libration-point missions include ACE, MAP, and Genesis. Future missions include Herschel, Planck, GAIA, James Web Space Telescope, Darwin, Constellation X, and Terrestrial Planet Finder.

A major emphasis of NASA is now on human missions, especially the Vision for Space Exploration that will first build a lunar base and later go to Mars. Dr. Farquhar and others in the International Academy of Astronautics (IAA) have a different plan for the next steps in exploring deep space. He volunteered to lead the IAA study, which proposes a science-driven program to first use Sun-Earth L2 orbits for large telescopes that would be serviced with human missions. Telescopes at L2 are better than on the Moon, which is plagued with ubiquitous dust and limits the amount of the sky that can be observed. After a station is established at L2, it is not too difficult to send from there manned expeditions first to a near-earth asteroid, then to Phobos, and then to Mars. The IAA team believes this is a more cost-effective, lower risk, extension to other exploration destinations. The infrastructure now on drawing boards to land on the Moon can also be used for L2 since the delta-V costs are similar for manned missions, but lower for slower cargo missions. Why go to cul-de-sac of the Moon? ISEE-3 used a slow transfer, which is good for cargo, but for humans; faster transfers are possible, taking only 2-4 weeks. A "Deep Space Shuttle" (DSS), virtually the same as the currently planned Crew Exploration Vehicle, would be used for exploration beyond L2. Re-usable systems would be used rather than expendable ones. The DSS can be used over and over again, using aerobraking to get back into low-earth orbit, or possibly lunar swingby orbits. It would use drop tanks for fuel and a return capsule to return astronauts quickly before the aerobraking phase started. Dr. Farquhar showed that the round-trip to L1 or L2 (fast transfers for humans) costs the same as going to lunar orbit and to geosynchronous orbit, so one system could do all of these. He also showed how an interplanetary transfer vehicle can be assembled at L2 and then leave at the right time to go to a near-earth asteroid, using lunar and Earth swingbys to get the timing right. That can be done without people onboard. The astronauts would be put into elliptical orbit to rendezvous with the interplanetary transfer vehicle just before it leaves the Earth. Upon return, the crew would come straight back using a return capsule, while the vehicle would use lunar swingbys to get back to L2 months later. Some details have already been computed for a mission to the near-Earth asteroid 1999 AO10 starting in 2025. That trajectory goes no further than 0.08 AU from Earth, taking about half a year, with 30 days on the asteroid. A mission like this could give valuable experience for a possible future mission to neutralize an asteroid that threatened the Earth. If something went wrong a week into the flight, there would be enough fuel onboard to return to Earth in three days. The total delta-V is similar to what would be needed for a mission to Phobos, a logical next step.

Dr. Farquhar handed out a few copies of Volume 49, No. 1 (January-March 2001 issue) of the Journal of the Astronautical Sciences, a special issue devoted to libration-point missions, including Dr. Farquhar's article, "The Flight of ISEE-3/ICE: Origins, Mission History, and a Legacy." More information about libration-point and double-lunar swingby orbits is at our Web site at http://highorbits.jhuapl.edu.

Transit of Mercury

By Harold Williams

There will be a visible transit of Mercury across the disk of the Sun in the Washington, D.C. Metro area on Wednesday, November 8, 2006 a little after 2:00 P.M. until sunset (around 5:00 P.M.), which we will view on the roof of the King Street Parking Garage at the Takoma Park/Silver Spring campus of Montgomery College in Silver Spring, at the corner of Fenton and King Street.

There are approximately 13 Mercury transits per century. The previous transit of Mercury was on May 7, 2003. There will not be another transit of Mercury across the disk of the Sun until May 9, 2016. On November 8 at MC, telescopes with solar filters will be pointed at the Sun to view any sunspots and the transit from 2:00 P.M. until sunset. Mercury will have an angular diameter of 9.95 arcsec; the Sun will have an angular diameter of 31 arcmin, 17 arcsec. This means that Mercury will be 0.005 the size of the sun in angular diameter. First contact is at 2:12 P.M., and second contact (when the whole planet covers a small part of the Sun) occurs at 2:14 P. M. The greatest transit occurs at 4:41 P. M., but the Sun will be only approximately 3 deg above the horizon (compensating for refraction of the atmosphere) and may be behind a building. (See Fred Espenak, NASA/GSFC, transit of Mercury pages at http://sunearth.gsfc.nasa.gov/eclipse/OH/transit06.html for more information about the transit.)

If it is cloudy, we will still hold the event, but we will view the event from the first floor of the parking garage instead of the roof of the parking garage. This will be possible with a computer with an internet connection to a telescope further west, where it will be clear, a video projector, and a screen. In the summer of 2004 when the transit of Venus occurred, a similar set up was available, but good weather that morning made it unnecessary.

Other NCA members may be setting up events elsewhere. Guy Brandenburg, who teaches at Alice Deal Junior High School, will hold events at the school and at nearby Fort Reno Park about 3:30 P.M. Observing will occur somewhere at the University of Maryland at College Park, too, Elizabeth Warner informs me. Stay alert for announcements in October.

NCA Treasurer's Report

July 1, 2005 to June 30, 2006

INCOME		
Dues	$	5441.99
Gifts		814.00
Interest		338.78
Telescope-making Classes		70.00
Total Income	$	6664.77
EXPENSES		
Dues (AL - 620.00 + IDA - 100.00)	$	720.00
Insurance		327.00
Miscellaneous (DC form - 75 + flowers - 46 + Treasurer - 8.79)		129.79
Secretary		208.61
Sky & Telescope Subscriptions		2576.09
Speakers' Dinners		397.47
Star Dust		2410.69
Total Expenses	$	6769.65
Balance - July 1, 2005	$	12170.67
Excess Expenses over Income		104.88
Balance - June 30, 2006	$	12065.79

Total number of paying members joining or renewing from 7-1-04 to 6-30-05	123*
Total number of paying members joining or renewing from 7-1-05 to 6-30-06	115*
Decrease in Membership (6.5%)	8

MEMBERSHIP REVIEW

Total Paying Memberships as of 6-30 of Each Fiscal Year

1992 - 223	1995 - 201	1998 - 169	2001 - 162	2004 - 135
1993 - 184	1996 - 179	1999 - 173	2002 - 154	2005 - 123
1994 - 163	1997 - 194	2000 - 174	2003 - 146	2006 - 115

* This does not include life members or science fair winners because they receive free memberships.

NCA BUDGET - FISCAL 2007

Income	
Dues	3700
Gifts	800
Interest	300
Telescope-making Classes	100
Total Income	4900
Expenses	
Dues (AL - 600 + IDA - 100)	700
Insurance	300
Miscellaneous	100
Secretary	200
Sky & Telescope subscriptions	2600
Speakers Dinners	400
Star Dust	2400
Total Expenses	6700
Deficit	1800
	(Estimated)

Jeffrey Norman, Treasurer

Some Upcoming Star Parties

By Harold Williams

Besides the opportunity to see the night sky at the University of Maryland's Observatory after the NCA meeting on the second Saturday of the month, more formal star parties in darker spots are coming.

The Almost Heaven Star Party (URL http://www.ahsp.org) at The Mountain Institute (TMI), on Spruce Knob in West Virginia, August 24 through 28, will be over before you read this. Spruce Knob is probably the darkest place on this side of the Mississippi river in the United State of America. I went last year, but this year I waited too late to register and it was sold out. Maybe this gives you some idea of how good this star party can be. Last year was the first year for this star party, and we had only one clear night; it was well attended, but it was worth it for me, and it did not sell out. But there are several other Star Parties coming up after you read this.

Blackwater Falls Astronomy Weekend 2006 is September 22-24 (URL http://www.kvas.org/astronomyweekend.htm). The lodge here is great (pool and hot tub) and the talks that I went to last year were memorable. The falls are beautiful even in the rain, which was a partial compensation last year for the rainy weather. We never did see stars at night. We occasionally did see the sun in the daytime. The altitude here did not cause a problem for my wife. Several NCA members go to this yearly event every year. Get together and traveling with other NCA members is a great way to go, too, as several NCA members did last year.

The Mason Dixon Star Party, which I went to last year, is October 18 through 22 this year in York County, Pennsylvania, at the Shreveport Airport and Footlight Ranch (URL http://masondixonstarparty.org/) entails camping and is not quite as dark, but offers nice fellowship; my wife has not gone with me to this place yet (not a high altitude).

The Mid-Atlantic Star Party 2006 is October 16 through 22 (URL http://www.masp.org/). This is probably darker than York, Pennsylvania. I have never been, but this is a very major famous star party place for North Carolina.

Later in the year, and to check details on NOVAC parties, go to URL http://www.novac.com/star-parties/index.php.

Exploring the Sky

by Joe Morris

2006 Schedule

Date	Time	Things of interest
9/30	8:00 P.M.	Rock Creek Park day
10/21	7:30 P.M.	Orionid meteor shower peak
11/4	7:00 P.M.	Moon (in Aries) near full; Pleiades

Exploring the Sky is an informal program that for nearly fifty years has offered monthly opportunities for anyone in the Washington area to see the stars and planets through telescopes from a location within the District of Columbia.

Sessions are held in Rock Creek Park once each month on a Saturday night from April through November, starting shortly after sunset. We meet in the field just south of the intersection of Military and Glover Roads NW, near the Nature Center. A parking lot is located immediately next to the field.

Beginners (including children) and experienced stargazers are all welcome—and it's free!

Questions? Call the Nature Center at (202) 895-6070 or check the Internet sites: http://www.nps.gov/rocr/planetarium or http://www.capitalastronomers.org

A presentation of the National Park Service and National Capital Astronomers.

Other National Capital Area Meetings

Northern Virginia Astronomy Club

The September 10 general meeting program will include a recap of Almost Heaven Star Party.

The NOVAC Star Gaze will be held on September 30 at Crockett Park. Astronaut Tom Jones will speak.

General membership meetings are open to the public, and are held at Enterprise Hall, Room 80, on the campus of George Mason University in Fairfax, Virginia. The meeting hall is in the basement floor of the building. It is best to park in parking Lot B and walk up the hill to the rear of Enterprise Hall.

Meetings start at 7:00 P.M., on the second Sunday of every month. If you come earlier you can do a little socializing. The first part of the meeting is club business, during which the officers make reports about their activities and areas of responsibility. The next part of the meeting usually includes:

- Show and Tell, where members share gadgets, books, techniques, etc.
- The Observing Report, describing the astronomical events for the next month.
- Q&A, where beginning astronomers are encouraged to ask questions to be answered by more experienced members.
- The Sky Tour, describing what's where in the sky for the next month.

The final part of the meeting is a program, usually by one of the members, but sometimes by "outside experts". We've had presenters from all aspects of Astronomy.

There's a good deal of socializing before and after meetings, allowing members to put faces with the voices they've heard in the dark.

Please Join Us For Dinner!
Since February 1995, a number of NOVAC members have been congregating on the night of our regular meetings for dinner. Hopefully this assists in getting to know one another, at a more relaxed location than at the meeting itself. It's also nice to see who it is you're talking to for a change and be able to connect faces with names - unlike the usual observing situation. All are welcome to attend, whether NOVAC members or prospective members, guests or whoever - just be prepared to discuss a little astronomy or any other topic that pops up!

If you'd like to join us, stop by the Red, Hot and Blue restaurant at 5:30 P.M. See you there!

Source: http://novac.com/

Mid-Atlantic Occultations and Expeditions

by Dr. David Dunham

Asteroidal Occultations

Date	Day	EDT	Star	Mag	Asteroid	dmag	dur. s	Ap. in.	Location
Sep 9	Sat	3:32	TYC22541227	10.9	Phocaea	0.5	9	6	NJ,MD,DC,VA,NC
Sep 11	Mon	6:32	TYC32469359	13.4	2002 PN34	6.5	4	12	Americas;Sun-8
Sep 17	Sun	0:16	SAO 165286	9.4	Golia	5.9	1	3	SC, se N.Car.
Sep 17	Sun	20:29	2UC24379070	12.0	Phaeo	2.4	3	8	WV,MD,sePA,NJ
Sep 21	Thu	0:19	2UC46820120	11.6	1999 RK215	12.5	4	8	Americas,Eur.
Sep 24	Sun	3:17	2UC38738790	12.0	Ortrud	2.2	55	8	nVA,MD,sePA
Oct 1	Sun	6:16	TYC06990682	10.0	Vladimir	6.0	4	4	IN,eKY,w&seNC
Oct 2	Mon	20:53	SAO 108610	8.8	Phocaea	1.6	6	3	DE,wNJ,ePA,cNY
Oct 8	Sun	21:07	TYC52301513	11.3	Dynamene	1.4	38	7	CT,nNJ,PA,nOH
Oct 15	Sun	5:09	TYC13300113	11.6	Mathilde	3.5	6	7	eKY,swVA,neNC

Grazing Occultations

DATE	Day	EDT	Star	Mag	% alt	CA	Location
Sep 13	Wed	3:56	SAO 76514	7.2	63- 62	11N	Bethesda & Columbia, MD
Sep 17	Sun	4:49	ZC 1226	9.0	22- 30	7N	UMD,Beltsville&Bethesda,MD
Oct 10	Tue	0:55	Taygeta	4.3	87- 50	9N	Butler, PA & Cambridge, OH
Oct 10	Tue	1:17	Asterope	5.8	87- 54	9N	Pittsburgh,PA & Syracuse,NY
Oct 14	Sat	0:32	76 Gem	5.3	48+ 8	7N	Lewisburg & Bedford, PA

Total Lunar Occultations

DATE	Day	EDT	Ph	Star	Mag	% alt	CA	Sp.	Notes
Sep 9	Sat	3:37	R	ZC 53	6.9	97- 51	56N	B8	WA 301 deg.
Sep 10	Sun	5:01	R	ZC 203	6.8	90- 53	37N	K0	
Sep 13	Wed	3:51	D	SAO 76514	7.2	62- 62	4N	G5	Graze,Bethesda&Balto.MD
Sep 13	Wed	4:02	R	SAO 76514	7.2	62- 63	19N	G5	&Princeton,NJ &LongIs.
Sep 14	Thu	1:51	R	ZC 773	7.0	52- 29	49S	F8	mag2 8.7 14", PA 352dg.
Sep 16	Sat	3:47	R	47 Gem	5.8	31- 29	9S	A4	ZC 1088
Sep 16	Sat	4:50	R	ZC 1093	6.6	30- 41	69N	F8	m2 7,1",311;m3 7,14",88
Sep 27	Wed	14:33	R	pi Scorpii	2.9	24+ 19	-70N	B1	Sun alt. 44 deg.;WA 294
Sep 27	Wed	20:42	D	ZC 2318	6.6	26+ 5	84N	A*	Azimuth 229 degrees
Sep 28	Thu	20:23	D	SAO 185017	7.6	35+ 13	70N	B9	Azimuth 215 degrees
Sep 29	Fri	20:20	D	W Sgr	4.7	45+ 18	80S	G0	ZC 2609 prob.close dbl.
Sep 29	Fri	21:00	D	SAO 186256	7.3	45+ 14	33N	A2	Azimuth 211 deg.
Oct 2	Mon	23:25	D	27 Cap	6.3	78+ 25	61N	F2	ZC 3092
Oct 4	Wed	0:21	D	ZC 3240	6.7	87+ 30	58N	A2	
Oct 7	Sat	19:55	R	pi Piscium	5.5	99- 11	82N	F0	ZC 240; Az. 83; WA 269
Oct 7	Sat	20:03	R	ZC 241	6.8	99- 12	72S	G5	Az. 84; WA 243
Oct 9	Mon	21:18	R	9 Tauri	6.7	88- 12	57S	A2	ZC 521; Pleiades follow
Oct 10	Tue	1:00	R	Electra	3.7	86- 54	69S	B6	ZC 537; close double?
Oct 10	Tue	1:06	R	Celaeno	5.5	86- 55	76N	B7	ZC 536; close double?
Oct 10	Tue	1:14	R	Taygeta	4.3	86- 56	43N	B6	ZC539;close dbl;grazePA
Oct 10	Tue	1:37	R	Asterope	5.8	86- 60	40N	B8	ZC 542, 21 Tauri
Oct 10	Tue	1:39	R	Maia	3.9	86- 61	83N	B8	ZC 541, 20 Tauri
Oct 10	Tue	1:45	R	ZC 543	6.4	86- 62	53N	A0	May be close double
Oct 10	Tue	2:15	R	ZC 553	6.8	86- 67	45S	A0	Very close double?
Oct 10	Tue	2:20	R	ZC 548	6.8	86- 68	78N	B9	May be close double
Oct 10	Tue	2:42	R	ZC 557	7.0	86- 71	32S	A1	May be close double
Oct 10	Tue	2:56	R	ZC 562	6.6	86- 72	10S	B9	Terminator dist. 14"
Oct 10	Tue	5:14	R	ZC 574	6.8	85- 67	31N	G0	May be close double
Oct 13	Fri	0:04	R	ZC 1035	6.7	58- 13	79N	K3	Az. 285;close double?
Oct 15	Sun	0:41	R	76 Gem	5.3	48- 9	30N	K5	Az64; ZC1169; PA graze

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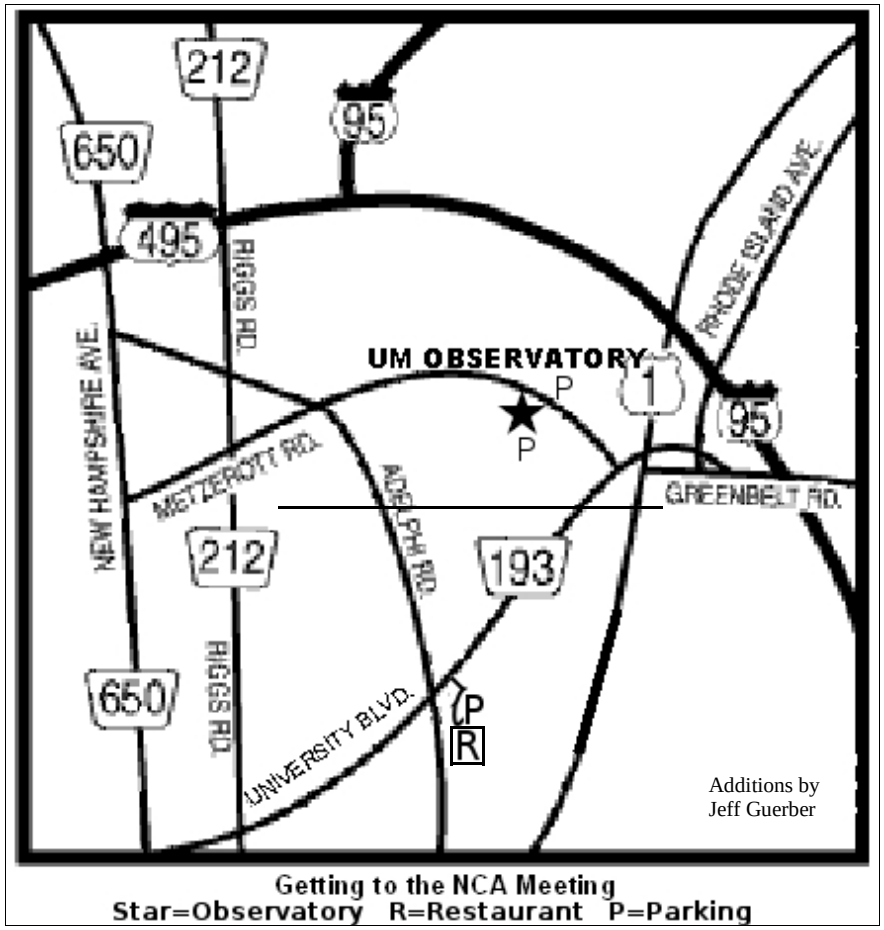
2006 IOTA meeting will be at Mt. Cuba Observatory, Del., Sept. 30 & Oct. 1
David Dunham, e-mail dunham@starpower.net, more info. http://iota.jhuapl.edu
Phone home 301-474-4722; office 240-228-5609; cell 301-526-5590

Getting to the NCA Monthly Meeting and the Dinner Before the Meeting

Jeff Guerber

NCA meetings are now held at 7:30 p.m. at the University of Maryland Observatory, in College Park on Metzerott Rd. between University Blvd. (MD-193) and Adelphi Rd. To get there from the Capital Beltway (I-495), either take US Rt. 1 south about a mile, turning right onto MD-193 West, then at the first light turn right onto Metzerott; or, take New Hampshire Ave. (MD-650) south, turn left at the second light onto Adelphi Rd., two more lights, turn left onto Metzerott, and proceed about a mile to the observatory. The observatory is on the south side of Metzerott Rd., directly opposite the UM System Administration building; you can park there if the observatory lot is full, but be careful crossing Metzerott Rd.

At 5:30 p.m., before the meeting, please join us for dinner at the Garden Restaurant in the UMD University College Inn and Conference Center, 3501 University Blvd. East at Adelphi Rd. From the Beltway, either take New Hampshire Ave. south, turn left onto Adelphi, and at the third light (passing Metzerott) turn left onto University then immediately right into the garage; or, take US-1 south, turn right onto University Blvd. west, and take it to the intersection with Adelphi Rd. Park either in the garage (costs), or in Lot 1 nearby (free). To get to the Observatory, exit to the right onto University Blvd. (MD-193) east, and at the second light turn left onto Metzerott Rd.



Getting to the NCA Meeting
Star=Observatory R=Restaurant P=Parking

Observing after the Meeting

Elizabeth Warner

Following the meeting, members and guests are welcome to tour through the Observatory.

Weather permitting, several of the telescopes will also be set up for viewing.

Are You Coming to Dinner?

If you are planning to come to the dinner before the meeting, please tell Benson J. Simon, telephone: 301-776-6721, e-mail bjs32@cornell.edu so that we can make reservations for the right number of people.

Do You Want to Get *Star Dust* Electronically?

Any member wishing to receive *Star Dust*, the newsletter of the National Capital Astronomers, via e-mail as a PDF file attachment, instead of hardcopy via U.S. Mail, should contact Nancy Grace Roman, the NCA Secretary, at nancy.roman6 @verizon.net or 301-656-6092 (home).

Do You Need a Ride?

Please contact Jay Miller, 240-401-8693, if you need a ride from the metro to dinner or to the meeting at the observatory. (Please try to let him know in advance by email at rigel1@starpower.net.)

Support the IDA

Join the International Dark-Sky Association

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www.darksky.org

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

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Dr. Harold Williams, NCA President, Harold.Williams@montgomerycollege.edu, 301-650-1463 (planetarium), 301-565-3709 (home).
Dr. Walter L. Faust, NCA Vice-president, program chair, and President-elect, wlfaust1370@direcway.com, 301-217-0771.
Dr. John D. Gaffey, Jr., Vice-President-elect.
Dr. Nancy Grace Roman, NCA Secretary, nancy.roman6@verizon.net, 301-656-6092 (home).
Mr. Michael L. Brabanski, NCA Treasurer, Assistant Secretary, 10610 Bucknell Dr., Silver Spring, MD 20902-4254, 301-649-4328 (home), mlbrabanski@verizon.net
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Elliott Fein, NCA *Star Dust* Editor, elliott.fein@verizon.net, 301-762-6261 (home), 5 Carter Ct., Rockville, MD 20852-1005.
Appointed Officers and Committee Heads: Exploring the Sky - Joseph C. Morris; Meeting Facilities - Jay H. Miller;
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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. NCA is an IRS Section 501(c)(3) tax-deductible organization. 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.

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).

Classes: Some NCA members are available for educational programs for schools and other organizations. The instruction settings include star parties, classroom instruction, and school-teacher 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, 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.

Fine Quality Telescope, 14-inch aperture, see "Calendar of Monthly Events."

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FIRST CLASS
DATED MATERIAL

NCA Will Meet on September 9!

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