

Star Dust

National Capital Astronomers, Inc.

January 2012

Volume 70, Issue 5

<http://capitlastronomers.org>

Next Meeting

When: Sat. Jan. 14, 2012
Time: 7:30 pm
Where: UM Observatory
Speaker: Guy Brandenburg, DCPS (retired)

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Directions to Dinner/Meeting

Members and guests are invited to join us for dinner at the Garden Restaurant located in the UMUC Inn & Conference Center, 3501 University Blvd E. The meeting is held at the UM Astronomy Observatory on Metzert Rd about halfway between Adelphi Rd and University Blvd.

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 e-mail at rigel1@starpower.net.

Observing after the Meeting

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.

January 2012: Guy Brandenburg District of Columbia Public Schools (Retired) Amateur Telescope Making – A Talk and Demonstration

Abstract: Making your own telescope provides great satisfaction, as well as the pleasure of learning and using a wide variety of applied and theoretical sciences. In addition, the makers and users of amateur telescopes continue to make significant contributions to astronomy.

But the hobby of amateur telescope making is in transition. As more people are becoming interested in amateur astronomy, and can afford to spend money on equipment, the real prices for Chinese mass-produced telescopes and other gear seem to be coming down, while quality has improved, and apertures are much larger than they were in the 1950's or 1960's. That is affecting decisions on whether to buy a telescope or build it. Pushing in the same direction, the price for Pyrex or equivalent mirror blanks has approximately tripled in the past year, and prices for this glass do not appear to be going down any time soon.

Thus it is now less important than it used to be to try to save money by making your own optics. Amateur telescope making clubs are much smaller than they were half a century ago.

Amateur telescope makers of the future may spend a smaller fraction of their time on making the optics of a new telescope than on new and perhaps hitherto unknown methods of telescope control and image capture, and on perfecting other aspects of their own telescope or observing process.



Star Dust is published ten times yearly September through June, by the National Capital Astronomers, Inc. (NCA).

ISSN: 0898-7548

Editor: Michael Chesnes

Editorial Advisors:

Elizabeth Warner
Jeffrey Norman
Wayne Warren
Harold Williams
John D. Gaffey, Jr.
Marjorie Weissberg

PDF Distributor: Jay Miller

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Thank you!

Reminder

After the meeting, everyone is invited to join us at Plato's Diner in College Park. Plato's is located at 7150 Baltimore Ave. (US Rt. 1 at Calvert Rd.), just south of the university's campus. What if it's clear and you want to stick around and observe? No problem -- just come over when you're through. This is very informal, and we fully expect people to wander in and out.

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Biography: Guy Brandenburg has a French baccalauréat in mathématiques élémentaires, a BA in history from Dartmouth College and a master's degree in secondary math education from University of Maryland at College Park. He is now happily retired after over 30 years of teaching secondary mathematics in the DC public schools, and coaching various successful math and soccer teams.

Like most makers of amateur telescopes, he acquired his telescope-making skills on his own initiative. He sought out hands-on training by other amateur telescope makers, and observed their techniques. He also experimented and read extensively.

While growing up from 1952-1961 on a mixed-use farm in Clarksburg, MD, Guy learned how to use simple tools. He later followed his older brothers in their hobby of manufacturing fireworks for the family 4th of July displays. He tried (without much success) to build a number of devices from C.L. Stong's 1961 book that collected a wide variety of projects from previous Amateur Scientist columns in Scientific American magazine. (He looked wistfully at the articles on home-made atom-smashers, Van de Graaf machines, and X-ray machines....)

It was only much later that he felt he might be able to afford to build a telescope. The direct impetus was hands-on experience he gained in the late 1980s from doing a kitchen renovation, and inspiration from Richard Berry's book on how to make a telescope.

He made his first telescope mirror, a 6" f/8, under the guidance of Jerome (Jerry) Schnall, in 1992, when the NCA Amateur Telescope Making group met at both the Chevy Chase Community Center and the Physics Department at American University. A couple of years later, he made an 8" f/6 in the same way. He also visited the Stellafane convention of 1994 and asked lots of questions of other telescope makers. At Stellafane he was rather embarrassed by how crude his own telescope construction was, in comparison to the incredible mirrors and mounts made by the master machinists and amateur telescope makers who regularly display their craft there.

During the mid-1990s, Brandenburg had the good fortune to spend a couple of summers working with the OSSE team at the Naval Research Lab, partly as a mentor to a whole bunch of area high school students under the Science and Engineering Apprenticeship Program. (OSSE was part of the Compton Gamma-Ray Space Telescope that de-orbited back to earth about 10 years ago.) Evidently a few NRL scientists thought that that Guy could be taught both to program computers in IDL and to use various tools in their machine shop to make scientific equipment. They soon had him making coded aperture masks from lead and tantalum for a novel germanium gamma-ray and x-ray detector. Later they had him assemble another detector from cesium iodide crystal bars and diodes. The latter device later became the basis for a small part of the Fermi Gamma-Ray Large-Area Space Telescope (formerly known as GLAST).

Around 2000, Guy was informed by Robert (Bob) Bolster that Jerry Schnall wanted to have somebody take his place as head of the NCA's Amateur Telescope Making group. Not at all feeling confident of his ability to fill Jerry's shoes, Guy reluctantly agreed to give it a try. Since then, he has increased his knowledge of telescope making techniques by visiting Stellafane again, and by participating in two of the Delmarva mirror-making marathons, as well as by picking the brains of everyone who decided to come by the current Amateur Telescope Making workshop. (Richard Schwartz, Richard Ozer, and John Dobson are three such visitors.)

Guy has led the DC-area Amateur Telescope Making workshop now for about 10 years. He has supervised and aided the construction of scores of telescopes in that in that time, including five small ones made by students in the Saturday science academy at the main headquarters of the Carnegie Institution for Science. He has learned a little bit about how to use metal and wood lathes, band and table and miter saws, drill presses and mill-drills, and vacuum chambers for aluminizing mirrors. He has had to learn a bit more chemistry in order to strip the coatings off of dirty telescope optics.

He has put his French language skills to use in translating some works on telescope-making into English – including Foucault's original 1859 article in the Comptes Rendus of the French Academy of Sciences on how to make parabolic, silvered glass mirrors.

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2010-2011 Officers

President:

Joseph C. Morris
j.c.morris@verizon.net
 703-620-0996 (h)
 703-983-5672 (w)

Vice-President:

John Hornstein
jshgwave@yahoo.com
 301-593-1095 (h)

Secretary-Treasurer:

Michael L. Brabanski
mlbrabanski@verizon.net
 301-649-4328 (h)

Asst. Secretary-Treasurer:

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jeffreynorman@comcast.net

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Appointed Officers and Committee Heads:

Exploring the Sky
 Joseph C. Morris
j.c.morris@verizon.net

Telescope Making
 Guy Brandenburg
gbrandenburg@yahoo.com
 202-635-1860

NCA Webmaster
 Harold Williams
Harold.Williams@montgomerycollege.edu
 240-567-1463 (w)
 301-565-3709 (h)

Meeting Facilities
 Jay H. Miller
rigel1@starpower.net
 240-401-8693

Star Dust Editor
 Michael Chesnes
m.chesnes@verizon.net
 301-313-0588

Helping the UM Observatory

In these times of ever increasing costs and budget cuts, the UM Observatory has managed to survive off the kindness of others. Fundraising by selling used textbooks and equipment, donations of hardware, and simple cash donations have allowed us to do a number of improvements. This past summer and fall, we were able to repair the 8" astrograph by replacing a broken cable that had to be custom made. We installed a new mount that is on permanent loan from Dr. A'Hearn for use with the 7" refractor. We've gotten new cameras and will soon be purchasing new filters for those cameras. But there are still many projects that need to be done at the Observatory.

And we have experienced loss. One of our undergraduate staff Justin DeSha-Overcash was murdered last January. He had worked at the observatory for several years as one of our regular telescope operators and was near finishing a double major in Physics and Astronomy (he was posthumously awarded his Astronomy degree). We have established a summer research award in his name.

If you have ever asked how you could help the UM Observatory, please consider donating to one or both of these two funds:

Justin DeSha-Overcash Summer Research Award (acct. 21962)

<http://advancement.umd.edu/giving/showFund.php?Fund=bd0cc810b580b35884bd9df37c0e8b0f>

The Justin DeSha-Overcash Summer Research Award assists an undergraduate student pursuing research opportunities in Astronomy, Physics, or Geology and also demonstrates a service component to the community. This award honors the memory of Justin who was one of the UM Observatory's undergraduate staff (telescope operator) by providing an out-of-state student who is financially needy a stipend to conduct summer research here at Maryland while continuing his/her studies.

Astronomy Observatory Gift Fund (acct. 21684)

<http://advancement.umd.edu/giving/showFund.php?Fund=b7892fb3c2f009c65f686f6355c895b5>

Donation account to raise money for the observatory to purchase new hardware and make needed repairs to the facility.

You may donate online using the links above. Or you can send a check made out to

University of Maryland College Park Foundation

Please put the fund name and account number in the "For" line and mail the check to

Elizabeth Warner
 Department of Astronomy
 University of Maryland
 College Park, MD 20742

Thank you!
 Elizabeth Warner
 UM Observatory Coordinator

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Guy has way too many projects going on at the present time. One such project is a thin, 16.5" Pyrex mirror that is once again almost polished out. His biggest optical failure is a relatively complex 8" Lurie-Houghton telescope that doesn't work at all, for reasons yet unknown.

Brandenburg has also joined the team that runs and operates the Hopewell Observatory, a small private observatory on Bull Run "Mountain" near Haymarket, VA, built largely by NCA members (some of whom are deceased). He finds that being a member of Hopewell is almost like having one's own mountain cabin, except it also has telescopes. (But no running water yet.)

Jan. 19 Agamemnon Occultation

Michael Chesnes

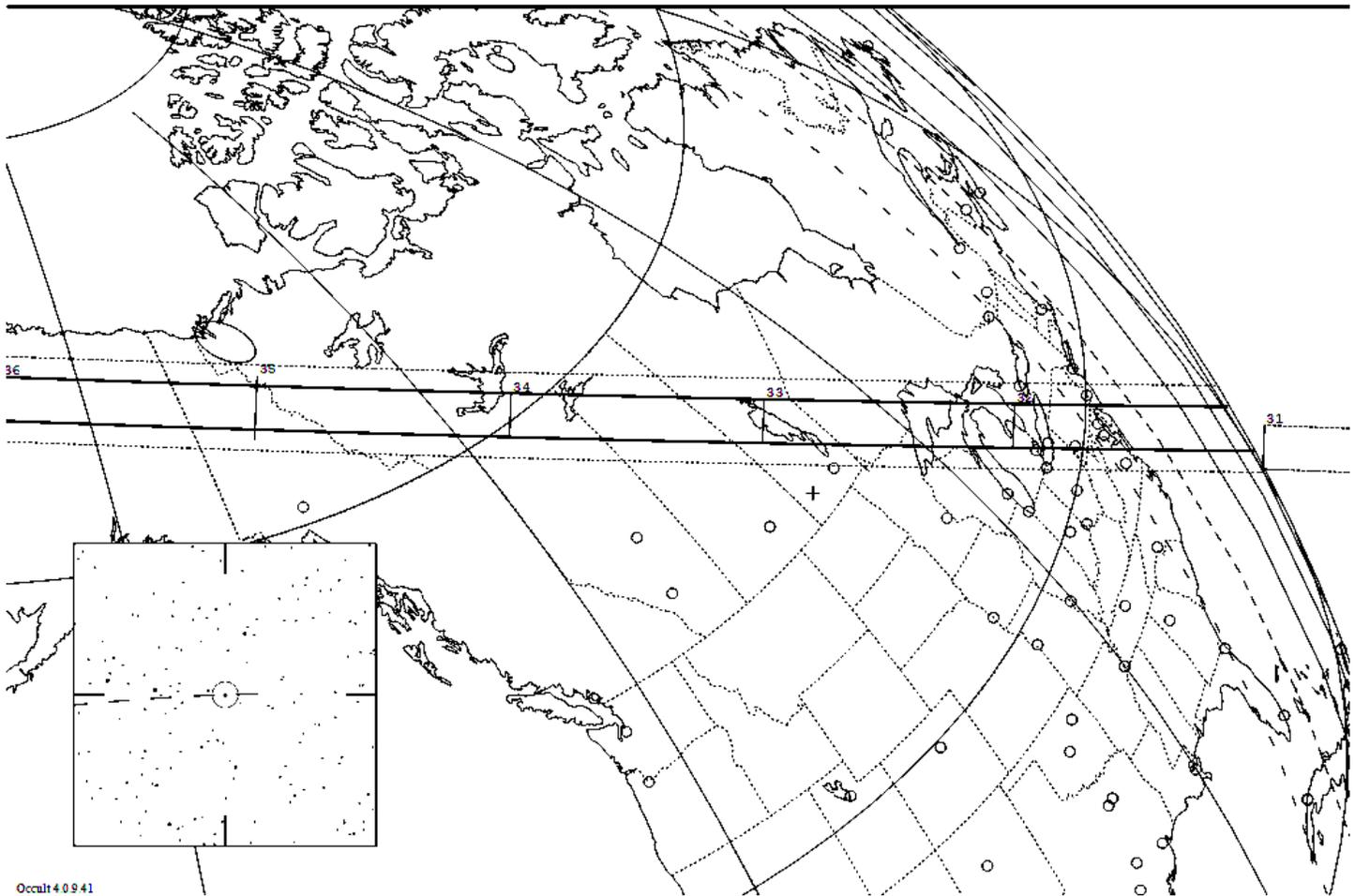
With input from David Dunham

An occultation by the Trojan asteroid 911 Agamemnon will be visible across a wide swath of the mid-Atlantic region at approximately 6:31 AM on the morning of Thursday, January 19. This is an excellent opportunity to observe an 8th magnitude star (visible in most small telescopes) temporarily "disappear" as it is occulted, or blocked, by an asteroid whose orbit crosses the Earth's orbit.

If you are interested in helping members of the International Occultation and Timing Association (IOTA) measure its shape by determining its shadow on the Earth's surface, please visit <http://iota.jhuapl.edu/exped.htm> for more information.

911 Agamemnon occults HIP 41337 on 2012 Jan 19 from 11h 31m to 11h 41m UT

<p>Star: Mv = 8.0 Mp = 9.0 Mr = 7.5 RA = 8 26 2.3658 (J2000) Dec = 36 58 57.397 [of Date: 8 26 52, 36 56 21] Prediction of 2011 Dec 16.0</p>	<p>Max Duration = 10.4 secs Mag Drop = 6.8 (6.9x) Sun : Dist = 163 deg Moon: Dist = 128 deg : illum = 17 % E 0.046"x 0.024" in PA 115</p>	<p>Asteroid: Mag = 14.8 Dia = 185km 0.062" Parallax = 2.137" Hourly dRA = -1.789s dDec = 0.83"</p>
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Occultation Notes

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.

Some stars in Flamsteed's catalog are in the wrong constellation, according to the official IAU constellation boundaries that were established well after Flamsteed's catalog was published. In these cases, Flamsteed's constellation is in parentheses and the actual constellation is given in the notes following a /.

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 the main IOTA Web site.

Sp. is the star's spectral type (color), O,B,blue; A,F,white; G,yellow; K,orange; M,N,S,C red.

Also in the notes, information about double stars is often given. "Close double" with no other information usually means nearly equal components with a separation less than 0.2". "mg2" or "m2" means the magnitude of the secondary component, followed by its separation in arc seconds ("), and sometimes its PA from the primary. If there is a 3rd component (for a triple star), it might be indicated with "mg3" or "m3". Double is sometime abbreviated "dbl".

Sometimes the Watts angle (WA) is given; it is aligned with the Moon's rotation axis and can be used to estimate where a star will reappear relative to lunar features. The selenographic latitude is WA -270. For example, WA 305 - 310 is near Mare Crisium.

Mid-Atlantic Occultations and Expeditions

David Dunham

Asteroidal Occultations

Date	Day	EST	Star	Mag.	Asteroid	Mag.	d	mag	s	"	Location
Jan 19	Thu	6:31	SAO 60804	8.0	Agamemnon*	6.8	9	2	DE,MD,DC,nVA,PA		
Jan 19	Thu	19:14	ZUC31847282	10.9C	Daphne	0.3	16	8	LI,NJ,PA,nMD,OH		
Feb 5	Sun	1:47	TYC08061475	10.5	Namuratakao	4.6	1	6	eVA,MD,DC,wPA		
Feb 9	Thu	3:00	TYC54810542	11.9	Gonnessia	2.5	7	7	DE,MD,DC,nVA,WW		

* (911) Agamemnon is a large Trojan asteroid; observations very valuable

Lunar Grazing Occultations (*, Dunham plans no expedition)

Date	Day	EST	Star	Mag.	% alt	CA	Location
Jan 14	Sat	5:52	SAO 138378	7.5	71- 42	5S	*IAD,Burk,W.Spgfd,VA;Wldrf,MD
Jan 15	Sun	1:59	SAO 138830	7.2	62- 25	5S	*York, PA & North East, MD
Jan 15	Sun	3:55	SAO 138854	9.0	61- 39	7S	*Rstn&Alexndra,VA;Matawomn,MD
Jan 18	Wed	4:12	ZC 2206	7.0	27- 13	6S	*Gum Tree & Ordinary, VA
Jan 25	Wed	18:20	X182674	11.1	7+ 19	6N	*Frederick,Gamber, & Sparks,MD
Jan 31	Tue	21:06	delta Ari	4.4	58+ 52	6N	*Clvlnd,OH;Alnwd&Milvil,PA;LI
Feb 2	Thu	0:17	SAO 76467	9.1	68+ 27	13N	*IAD,Frfr,Hntgtn,VA;Brdywn,MD
Feb 2	Thu	23:34	X 71837	9.2	77+ 45	13N	*MtAiry,ElicotCt,Linthicum,MD
Feb 4	Sat	2:31	ZC 905	6.9	85+ 21	15N	*Barborsvl,Mchnvll,Langley,VA
Feb 14	Tue	3:08	SAO 183232	7.2	54- 21	5S	*MtJackson,Mitchells,Poplar,VA

Under Location, if two numbers are given, the first is the distance of the northern (for cusp angles, or CA, with N) or southern (for CA with S) limit (the graze line) from Greenbelt, MD and the second number is the bearing (azimuth) of that distance in deg.

Total Lunar Occultations

DATE	Day	EST	Ph	Star	Mag.	% alt	CA	Sp.	Notes
Jan 14	Sat	5:58	R	SAO 138378	7.5	71- 41	15S	F4	close double
Jan 14	Sat	6:26	R	SAO 138384	7.7	71- 38	71N	F2	Sun-11, close double
Jan 15	Sun	0:12	R	ZC 1788	6.8	62- 8	28S	G0	Az.108
Jan 15	Sun	3:47	R	21 Vir	5.5	61- 38	42S	A0	ZC 1800; OH & NC graze
Jan 18	Wed	4:25	R	ZC 2206	7.0	27- 14	27S	K0	Az.133
Jan 18	Wed	5:44	R	SAO 183495	7.2	27- 23	69N	K0	
Jan 20	Fri	7:16	R	SAO 185512	7.4	9- 19	64N	F0	Sun -2, double?
Jan 26	Thu	17:35	D	ZC 3410	7.6	13+ 37	77S	G6	Sun -3
Jan 29	Sun	18:50	D	SAO 92500	8.0	39+ 56	47S	K0	
Jan 29	Sun	22:49	D	SAO 92548	8.1	40+ 13	54N	A3	Az.278
Jan 30	Mon	20:27	D	ZC 348	6.8	48+ 50	83S	A2	1-line spec. binary
Jan 31	Tue	18:44	D	ZC 460	6.9	58+ 71	84S	A0	double?
Jan 31	Tue	20:47	D	Botein	4.4	58+ 56	35N	K2	ZC 465 = delta Ari
Feb 1	Wed	1:32	D	SAO 93394	6.9	60+ 4	46N	K0	Az.293
Feb 1	Wed	18:16	D	SAO 76373	7.6	67+ 68	63N	K0	Sun alt. -10 deg.
Feb 1	Wed	21:33	D	SAO 76421	8.0	68+ 57	12S	A2	
Feb 3	Fri	3:07	D	105 Tauri	5.8	78+ 6	61S	B2	Az.294,ZC 766,double?
Feb 3	Fri	22:33	D	SAO 77678	7.7	85+ 65	47S	G5	maybe close double
Feb 4	Sat	17:59	D	SAO 78632	7.4	90+ 37	44N	G5	Sun alt. -6 deg.
Feb 5	Sun	4:14	D	ZC 1060	7.3	92+ 10	42S	K2	Az.286, close double?
Feb 5	Sun	19:54	D	74 Gem	5.0	96+ 47	54S	M0	ZC1158, close double?
Feb 7	Tue	4:52	D	FX Cnc	6.7	99+ 19	55S	M3	ZC1320, Term.Dist. 7"
Feb 9	Thu	0:08	R	RX Sex	6.7	97- 51	74S	A3	AA 271,dbl?,ZC1528
Feb 9	Thu	3:50	R	1543	6.6	97- 41	19S	K0	AA 215, Term.Dist. 6"
Feb 10	Fri	0:03	R	ZC 1639	7.1	93- 40	49S	F8	AA237,mg2 8,10",254
Feb 10	Fri	3:37	R	ZC 1655	6.8	92- 45	69N	A5	
Feb 10	Fri	6:57	R	87 Leonis	4.8	91- 14	85N	K4	Sun -2,Az.255,ZC1670
Feb 11	Sat	23:51	R	1885	7.3	77- 15	49N	K2	Az.119
Feb 12	Sun	5:33	R	ZC 1906	7.8	75- 33	73S	K0	mg2 10.6,48",PA 102

Explanations & more information is at <http://iota.jhuapl.edu/exped.htm>. David Dunham, dunham@starpower.net, phone 301-526-5590. Timing equipment and even telescopes can be loaned for most expeditions that we actually undertake; we are always shortest of observers who can fit these events into their schedules, so we hope that you might be able to.

Information on timing occultations is at: <http://iota.jhuapl.edu/timng920.htm>.

NASA News from Frank Reddy

NASA's Fermi Shows That Tycho's Star Shines in Gamma Rays 12.13.11

http://www.nasa.gov/mission_pages/GLAST/news/tycho-star.html

In early November 1572, observers on Earth witnessed the appearance of a "new star" in the constellation Cassiopeia, an event now recognized as the brightest naked-eye supernova in more than 400 years. It's often called "Tycho's supernova" after the great Danish astronomer Tycho Brahe, who gained renown for his extensive study of the object. Now, years of data collected by NASA's Fermi Gamma-Ray Space Telescope reveal that the shattered star's remains shine in high-energy gamma rays.

The detection gives astronomers another clue in understanding the origin of cosmic rays, subatomic particles -- mainly protons -- that move through space at nearly the speed of light. Exactly where and how these particles attain such incredible energies has been a long-standing mystery because charged particles speeding through the galaxy are easily deflected by interstellar magnetic fields. This makes it impossible to track cosmic rays back to their sources.

In 1949, physicist Enrico Fermi -- the satellite's namesake -- suggested that the highest-energy cosmic rays were accelerated in the magnetic fields of interstellar gas clouds. In the decades that followed, astronomers showed that supernova remnants may be the galaxy's best candidate sites for this process.

When a star explodes, it is transformed into a supernova remnant, a rapidly expanding shell of hot gas bounded by the blast's shockwave. Scientists expect that magnetic fields on either side of the shock front can trap particles between them in what amounts to a subatomic ping-pong game.

Recent Astronomy: Early Universe January 2012

Nancy Grace Roman

It has been well established that the big bang created only hydrogen, helium, and some lithium. Everything heavier has been made in stars and supplied to the intergalactic medium by winds from red giants and supernovae. It has been assumed that the first stars were very large, perhaps 100 solar masses, because of the lack of heavier elements. Because these stars are so heavy, they evolve very quickly, thus seeding the intergalactic medium with a variety of heavy elements. The rapidity of the seeding explains our inability to observe stars made only of hydrogen and helium.

The December 2 issue of *Science* has two interesting articles, one observational and the other theoretical, that complicate this picture. The theoretical paper by Takashi et al. discusses a radiation-hydrodynamics simulation that followed the growth of a primordial protostar through early stages leading up to nuclear burning. They assumed that the star formed by accretion from a circumstellar disk. As the protostar grows, shock waves arise with outflow from the star hindering accretion. The circumstellar accretion disk is also evaporated by ultraviolet light from the protostar. When this reaches a mass 45 times that of the sun accretion stops. This lower mass limit explains the observation that there are no signatures of pair-instability supernovae in metal weak stars. Interestingly, because there are no heavy elements to permit the carbon cycle, nuclear burning starts with the proton-proton cycle, normally active only in low mass stars. The entire process from the birth of the embryo protostar to nuclear burning requires only about 100,000 years.

Because of the rapid formation of these heavy stars, the intergalactic medium is rapidly enriched in metals, i.e. elements heavier than lithium. Thus the observation by Michele Fumagalli et. al. of two clouds with no discernable metals two billion years after the big bang, near $Z = 3$, is surprising. They estimate that the upper limit to the abundance of metals is 0.0001 that of the sun. Until now, no clouds or stars had been observed with a relative abundance of metals less than 0.001 that of the Sun. In one of the clouds the H/D ratio is that predicted for the initial formation of nuclei. The clouds have the sizes and densities compatible with the formation of Population III stars. These clouds at this late time can only be explained if the metal enrichment in the intergalactic medium is inefficient and inhomogeneous. This is consistent with the prediction that the metals from supernovae are likely to be confined to small bubbles.

National Capital Area Skeptics

Saturday, January 14, 2012, 1:30pm

National Science Foundation

Room 110

4201 Wilson Boulevard, Arlington, VA

National Capital Area Skeptics is very pleased to present world renowned physicist Lawrence Krauss talking about his new book "A Universe from Nothing: Why There Is Something Rather than Nothing." Like all NCAS events, this will be free and open to the public. In his new book, a cosmological story that rivets as it enlightens, Krauss explains the groundbreaking new scientific advances that turn the most basic philosophical questions on their heads. Krauss, a renowned cosmologist and popularizer of modern science, is director of the Origins Project at Arizona State University.

DO WE NEED THE STARS??

Save the Date and find out!
On Saturday, February 25, 2012
at 6:30pm,
NCA will co-host the
Northern Virginia Premiere
Screening of the film:



*This 60-minute documentary film has
screened at festivals, theatres,
planetariums, and community venues
worldwide.*

Founders Hall Auditorium
GMU – Arlington Campus
3351 Fairfax Drive, Arlington, VA

Q&A discussion and telescope
viewing (weather permitting)
will follow the film.

Calendar of Events

NCA Mirror- and Telescope-making Classes: Tuesdays Jan. 3, 10, 17, 24, 31 and Fridays, Jan. 6, 13, 20, 27, 6:30 to 9:30 pm 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 gfbrendenburg@yahoo.com. In case there is snow, call 202-282-2204 to see if the CCCC is open.

Open house talks and observing at the University of Maryland Observatory in College Park on the 5th and 20th of every month at 8:00 pm (Nov-Apr) or 9:00 pm (May-Oct). There is telescope viewing afterward if the sky is clear.

Dinner: Saturday, Jan. 14 at 5:30 pm, preceding the meeting, at the [Garden Restaurant](#) in the University of Maryland University College Inn and Conference Center.

Montgomery College Planetarium: Saturday, Jan. 28 at 7 pm. 7621 Fenton Street, Takoma Park, MD (240) 567-1463. ["How Are Stars Born?"](#)

Howard B. Owens Science Center Planetarium: Friday, Jan. 20 at 7:30 pm. 9601 Greenbelt Road, Lanham, MD (301) 918-8750 howardb.owens@pgcps.org "Discovering the Solar System through New Horizons"

- Upcoming NCA Meetings** at the University of Maryland Observatory
- Jan. 14, 2012 **Guy Brandenburg** (DCPS ret.) - *Making Your Own Telescope*
 - Feb 11, 2012 **Jacqueline Fischer** (NRL), *Gas-Rich Galaxy Mergers: Multi-Wavelength Views Become An Elliptical Galaxy*
 - Mar 10, 2012 **Jennifer Wiseman** (GSFC), *Protostellar Disks and Jets*

National Capital Astronomers Membership Form

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Home Phone: ___-___-___ E-mail: _____ Age: _____

Present or Former Occupation (Or, If Student, Field of Study): _____

Academic Degrees: _____ Field(s) of Specialization: _____

Employer or Educational Institution: _____

Student Membership: \$ 5

Standard Individual or Family Membership: \$10

Optional additional contribution to NCA: \$__

Total Payment (circle applicable membership category above): \$__

Members receive Stardust, the monthly newsletter announcing NCA activities, by e-mail. If you would like to receive a paper copy of Stardust via regular mail, please check here: _____

Please mail this form with check payable to National Capital Astronomers to:
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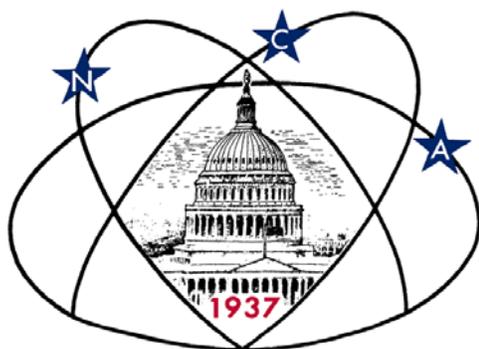
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10610 Bucknell Dr.
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First Class

Dated Material



Next NCA Mtg:

Jan. 14

7:30 pm

@ UM Obs

Guy Brandenburg

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