Star Dust

National Capital Astronomers, Inc.

November 2009

Volume 68, Issue 3

http://capitalastronomers.org

Next Meeting

When: Sat. Nov. 14, 2009

Time: 7:30 pm

Where: UM Observatory

Speaker: Alice Harding, GSFC

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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 Metzerott 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.

November 2009: Dr. Alice K. Harding
NASA Goddard Space Flight Center
Pulsar Discoveries by the Fermi Gamma-Ray Telescope

Abstract: Soon after its launch last June, 2008, the Fermi Gamma-Ray Space Telescope began discovering new pulsars from their gamma-ray pulsations alone. The pulsations had not been seen at any other wavelength but are coming from the locations of many previously unidentified Galactic gamma-ray sources. The first of these newly discovered pulsars lies inside the shell of the supernova remnant CTA1 and apparently powers the central compact X-ray nebula imaged by Chandra. Fermi has since discovered at least fifteen more pulsars using a novel technique to perform blind frequency searches. In follow-up radio searches, faint radio pulsations have been detected from only a few, indicating that we are either seeing the outer edge of the radio beam or are missing it altogether. The gamma rays must therefore be emitted in a much larger beam that we can view from many directions. I will describe these results that highlight what has been a very exciting first year of Fermi observations.

Biography: Alice Harding has been an Astrophysicist in the Astrophysics Science Division at Goddard Space Flight Center since 1980, after receiving a Ph.D. from the University of Massachusetts-Amherst in 1979. Her interests include pulsars, highly magnetized neutron stars (magnetars), gamma-ray bursts and supernova remnants. She has been modeling gamma-ray pulsars for 30 years and wrote one of the first papers in this field. She was awarded a NASA Medal for Exceptional Scientific Achievement for her work on pulsars in 1994. Presently a member of the Fermi collaboration, she served as science coordinator for Galactic Sources from 2006 - 2009.

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.

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Thank you!

This month's theme of the International Year of Astronomy is "The Lives of Stars".

The Life Cycles of Stars

November, 2009

By Tom Koonce

Antelope Valley Astronomy Club, Inc.
Lancaster, California

"The bigger they are, the harder they fall." This is certainly true of stars. When single stars condense from a star forming nebula, their life history is pre-written based upon their initial mass and the cloud's composition. High mass stars burn very hot, have very short stellar lifetimes then explode in spectacular Supernovae, forming either Neutron Stars or Black Holes. On the other end of the mass scale, low mass single stars have relatively cool temperatures, but live extremely long lifetimes and may radiate dimly for many, many billions of years

Over time, higher density regions within giant nebulae like the Orion Nebula or the Eagle Nebula begin to contract gravitationally, and as they do, the cloud rotates. As the gas contracts and rotates faster, the gas begins to heat up to become a Protostar. Once its temperature reaches approximately 15,000,000 Celsius, nuclear fusion initiates in the cloud's center causing the Protostar to begin to radiate brightly. The smallest stellar objects that form in the star forming regions are called Sub-Stellar Objects. These form with masses between 0.013 and 0.08 times the mass of our own Sun (our Sun = one solar mass). These stars radiate briefly as a dim star, but gradually collapse, cool as they evolve further into Brown Dwarf stars. Eventually the Brown Dwarf will cool further and it will cease radiating at all.

The stars known as "Red Dwarf" stars have between 0.08 and 0.4 solar masses when they form. These are the most common type of stars in the observable universe and have lifetimes longer than 13 billion years. As these small, long living stars eventually cool, they die and become Black Dwarf stars.

Stars approximately the size of our Sun with 0.4 to 8 solar masses are called "Intermediate" stars and will swell into Red Giant stars as their fuel is expended. Eventually, these stars will end their lives as White Dwarf stars.

Nebulae and stars are typically composed of 74% hydrogen, 25% helium and 1% everything else in the periodic table by mass. A star's initial mass is determined by the amount of material available within the nebula from which the star forms. Very dense nebulae can produce the most massive stars - true giants with 8 times (or greater than) our Sun's mass. Those stars with between 8 and 25 solar masses will expand into Super Giant stars then explode as supernovae and end their lives as Neutron Stars; those stars with greater than 25 solar masses will expand into Super Giant stars, explode as supernovae and become Black Holes. It isn't known what the upper limit is to a star's initial mass is, but in the early 1990's, a star nicknamed the "Pistol Star" was discovered by the Hubble Space Telescope near the center of the Milky Way galaxy with a mass of 100 solar masses and a radius of 100 million miles, comparable to the Earth-Sun distance of 93 million miles. The Pistol Star is called a Blue Hyper Giant and is so hot that its gravity can't stabilize it and it is expected to go supernova within only 1 to 3 million years. A great deal of gas and matter is expelled during these supernovae explosions which then give rise to future generations of stars, repeating the cycle of stellar birth.

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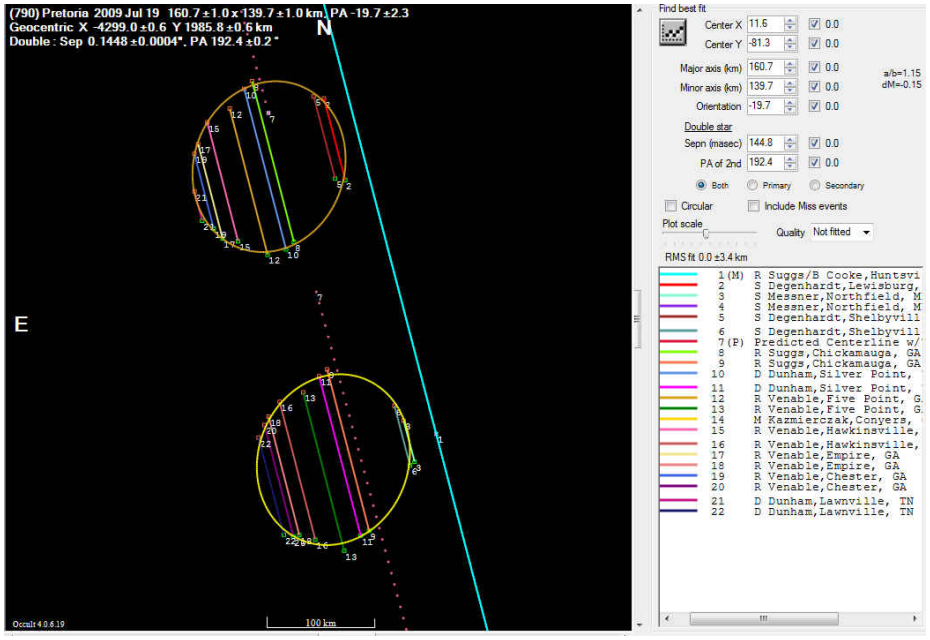
Smaller stars burn dimly, but may burn for billions and billions of years. Giant stars burn with incredible intensity, but go through their hydrogen and helium fuel in as little as millions of years, and then end their lives in dramatic supernovae explosions. I can think of a few analogous Hollywood situations…but that's for another type of "Star" article altogether.

Occultation Expedition Reports

Dr. David Dunham

Pretoria asteroidal occultation

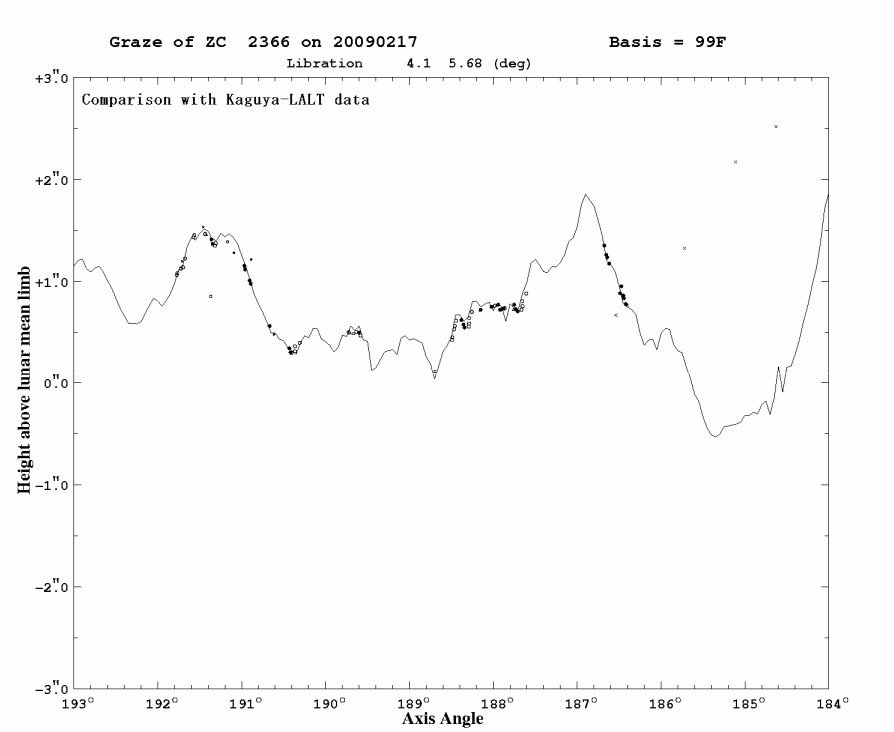
On 2009 July 19, the asteroid (790) Pretoria occulted a 10th-mag. star in Pegasus. Wayne Warren and David Dunham travelled to Tennessee to observe the occultation. They set up 4 stations across the eastern half of the path. Two of them were clouded out, but the occultation was successfully recorded at the other two stations with 80mm short-tube refractors. The star turned out to be a close double star with nearly equally-bright components separated approximately in the direction of motion of Pretoria, so two occultations by Pretoria were recorded at most stations. The figure shows the asteroid's shape (two of them, one for each component of the double star) by plotting the paths of the star behind the asteroid for each station. Other observers of the occultation were in Alabama, Georgia, farther west in Tennessee, and Minnesota. Roger Venable in southern Georgia managed to record the occultation from 4 stations, obtaining 8 chords across the asteroid by himself.



Above: By measuring from different points on the Earth's surface how long an asteroid blocks the light of a star during an occultation, it is possible to reconstruct the shape of the asteroid's shadow on the Earth. The shadow provides detailed information about the asteroid's original shape. Asteroidal occultations can also be used to determine whether an asteroid is being orbited by a smaller asteroid.

Antares graze in Western Australia in February

Last February, David Dunham travelled to Western Australia to observe a spectacular grazing occultation of Antares by the southern edge of the crescent Moon that took place on the 17th UT. He joined several Australian observers to record the graze from 7 locations across the predicted graze zone north of Kalgoorlie. The figure, by Dr. Mitsuru Soma of the Japanese National Observatory, shows the lunar profile for the graze based on data from the Japanese Kaguya spacecraft with the horizontal scale being degrees of "axis angle" measured around the Moon's disk from the lunar north pole and the vertical scale being in seconds of arc at the Moon's mean distance above the standard lunar radius of 1738 km. The contact points for both components of Antares, determined from the video recordings obtained at the 7 stations, are plotted as dots on the profile. The agreement with the Kaguya profile is remarkably good.



Occultation of 45 Capricorni by Jupiter from Bermuda

On 2009 August 4, Jupiter occulted 6th-mag. 45 Capricorni. David Dunham travelled to Bermuda, where he was met by Eddie MacGonagle, president of the Bermuda Astronomical Society. In the first picture, they are shown loading a 14-inch Meade SCT into Eddie's small car. In the second, Eddie is wearing a light blue shirt. In the third, David is relaxing the morning after the occultation.

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

Dr. David Dunham

Asteroidal Occultations

Date	Day	EDT	Star	Mag.	Asteroid	dmag	dur. s	Ap. "	Location
Nov 12	Thu	3:25	ZC 1374	8.3	1996 OQ	11.2	0.4	2	sOH,WV,nVA,MD,DC
Nov 17	Tue	22:44	2UC46644361	12.6C	Silvretta	0.8	6	9	VA,sWV,KY;MD,DC?
Nov 20	Fri	19:46	2UC40459409	12.0C	Emma	0.7	17	8	NJ,ePA,DE,MD,eVA
Nov 20	Fri	22:38	SAO 114865	7.5	Barbara	5.6	8	2	Bermuda,cen.FL
Nov 21	Sat	5:41	TYC18791092	10.0	Montefiore	4.6	2	5	neNC,cenVA,WV,OH
Nov 22	Sun	2:24	2UC40322329	11.2C	Nemesis	0.2	24	9	sNJ,MD,DC,nVA,PA
Nov 23	Mon	18:08	TYC05591859	10.5	Hirundo	4.0	2	6	WV,MD,sePA,nNJ
Nov 25	Wed	5:02	2UC36825470	12.3C	Aurora	1.0	12	8	TN,swVA,NC,nSC
Dec 2	Wed	20:03	2UC25902707	12.5	Etheridgea	2.6	3	9	VA,DC,MD,DE,NJ
Dec 4	Fri	5:17	TYC18671604	11.8	Nemesis	0.5	18	7	neNC,sVA,WV,sOH
Dec 11	Fri	6:45	TYC49960001	10.0	Hertzsprung	6.7	1	5	neOH,swPA,MD,DE

Lunar Grazing Occultations (*, Dunham plans no expedition)

Date	Day	EDT	Star	Mag.	%	alt	CA	Location
Nov 13	Fri	3:59	SAO 138786	7.9	13-	5	12S	Richmnd,Wilmsbrg,Cheapside,VA
Nov 22	Sun	18:09	SAO 163862	9.0	32+	30	17S	PaonSpgVA;Urbna,Wstmr,MD;York
Dec 5	Sat	3:38	ZC 1171	6.5	87-	69	13S	Hgrstwn,Wodbine,ElctCt,BWI,MD
Dec 7	Mon	1:03	SAO 98671	7.7	69-	34	5S	Brookeville, APL, Jessup, MD

Total Lunar Occultations

DATE	Day	EDT	Ph	Star	Mag.	%	alt	CA	Sp.	Notes
Nov 13	Fri	4:45	R	ZC 1788	6.8	12-	13	75N	G0	Az. 113
Nov 14	Sat	6:31	R	ZC 1918	6.8	6-	19	48N	K5	Sun alt. -4 deg.
Nov 19	Thu	17:38	D	ZC 2637	8.2	9+	11	78S	K2	Sun -9, Az. 223
Nov 20	Fri	18:42	D	SAO 187744	8.3	16+	11	58N	K5	Azimuth 227
Nov 22	Sun	18:05	D	ZC 3033	7.7	32+	31	54S	G5	
Nov 22	Sun	18:46	D	X176377	8.3	32+	28	20N	K0	mg2 8.3,sep.4",PA 291dg
Nov 22	Sun	19:22	D	SAO 163888	7.8	32+	24	86N	F5	
Nov 22	Sun	19:45	D	ZC 3036	7.0	32+	21	42N	F5	
Nov 23	Mon	17:46	D	SAO 164451	8.0	41+	39	46N	F8	Sun alt. -11 deg.
Nov 23	Mon	18:50	D	ZC 3155	6.7	41+	35	21N	K5	maybe close double
Nov 24	Tue	17:51	D	theta Aqr	4.2	50+	43	79S	G8	Star ZC 3269 = Ancha
Nov 25	Wed	17:28	D	SAO 146434	7.8	60+	45	32N	F5	Sun -8,mg2 10, sep 0.7"
Nov 27	Fri	20:58	D	ZC 77	7.9	79+	59	61S	G5	
Nov 29	Sun	19:33	D	AD Arietis	7.4	93+	54	89S	F0	ZC 336
Nov 30	Mon	3:36	D	26 Arietis	6.1	95+	17	25N	A9	ZC 370 = UU Ari; dobl?
Dec 1	Tue	2:56	D	66 Arietis	6.2	98+	37	52S	K0	ZC 501,dbl?,TrmDist 18"
Dec 4	Fri	2:36	R	ZC 1024	7.4	94-	72	24S	F5	WA 204, TermntrDist 19"
Dec 4	Fri	5:35	R	SAO 78707	7.2	94-	42	60N	K2	WA 301
Dec 4	Fri	6:02	R	ZC 1036	6.5	94-	37	77S	G8	WA 258
Dec 4	Fri	21:24	R	ZC 1143	6.8	89-	21	83N	G5	maybe close double
Dec 6	Sun	1:36	R	SAO 98033	7.8	79-	54	85N	F0	
Dec 6	Sun	2:34	R	ZC 1306	7.8	79-	62	51N	A0	
Dec 7	Mon	2:49	R	ZC 1423	6.7	68-	52	82S	A3	
Dec 8	Tue	3:20	R	32 Sex	7.1	57-	45	69S	K0	ZC 1546, close double?
Dec 10	Thu	4:01	R	SAO 138674	8.0	35-	27	16N	G5	2nd*(ZC1761) 7" away
Dec 10	Thu	4:01	R	ZC 1761	8.3	35-	27	17N	G5	R 6s after SAO 138674
Dec 10	Thu	5:05	R	ZC 1764	7.9	34-	36	32N	K0	
Dec 11	Fri	7:00	R	SAO 157749	8.0	24-	36	44N	K0	Sun alt. -4 deg.

Explanations & more information are 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 in their schedule, so we hope that you might be able to. Information on timing occultations is at: http://iota.jhuapl.edu/timng920.htm.

Good luck with your observations.

Science News from the Naval Research Lab

Walter Faust found a couple of excellent articles in the September 28, 2009 issue of the NRL newsletter *Labstracts*. The newsletter is not on the Web, but I have included some relevant links with these summaries.

The first article was about the Extreme Ultraviolet Imaging Spectrometer (EIS) on the Japanese satellite Hinode. This British instrument can now create full-disk mosaic images of the Sun by using a scanning technique developed by scientists from NRL's Space Sciences Division. To see an example of these full-disk images at different wavelengths, corresponding to different temperatures, visit:

http://msslxr.mssl.ucl.ac.uk:8080/SolarB/gallery/images/fsize/eis_fullsun_20090627_IUU.png

Another article from *Labstracts* is pertinent to Alice Harding's talk at the next NCA meeting. The article, also available as an NRL press release:

http://www.nrl.navy.mil/pressRelease.php?Y=2009&R=67-09r

describes how the Large Area Telescope (LAT), one of two instruments on the Fermi Space Telescope, has discovered 16 pulsars, as well as gamma-rays from 8 previously known millisecond pulsars.

Science News

Thank you Nancy Grace Roman for finding these articles.

Neutron Star Strength

By Phil Berardelli
ScienceNOW Daily News
8 May 2009

Talk about a hard body. New supercomputer simulations of the crusts of neutron stars--the rapidly spinning ashes left over from supernova explosions--reveal that they contain the densest and strongest material in the universe. So dense, in fact, that the gravity of the mountain-sized imperfections on the surfaces of these stars might actually jiggle spacetime itself. If so, neutron stars could offer new insights into a mysterious phenomenon known as gravity waves.

Computing the effects of the star's titanic gravity on the structure of its constituent atoms, researchers report that the material in the star's crust is at least 10 billion times stronger than the toughest steel. It has to be, to contain the immense electromagnetic forces building up within the whirring star. For example, gamma-ray bursts originating from magnetars--the most highly magnetized versions of neutron stars--arise when energy buildups periodically cause the crust to rupture, in phenomena called starquakes. To hold in that much energy, their crusts must be as strong as the simulations suggest.

That incredible strength also means that when neutron stars form they can tolerate some imperfections on their surfaces. In this case, such imperfections can be mountain-sized bumps as heavy as Earth. As those bumps ride the fast-spinning stars, their mass disturbs spacetime enough to generate gravity waves.

Asteroids May have Accelerated Life on Earth

From NASA News, May 20, 2009
Dwayne Brown and Jim Scott

A NASA-funded study indicates that an intense asteroid bombardment nearly 4 billion years ago may not have sterilized the early Earth as completely as previously thought. The asteroids, some the size of Kansas, possibly even provided a boost for early life.

The study focused on a particularly cataclysmic occurrence known as the Late Heavy Bombardment, or LHB. This event occurred approximately 3.9 billion years ago and lasted 20 to 200 million years. Results from a computer modeling project show that while the Late Heavy Bombardment might have generated enough heat to sterilize Earth's surface, microbial life in subsurface and underwater environments almost certainly would have survived. The new results point to the possibility life could have emerged about the same time that evidence for our planet's oceans first appears," said Stephen Mojzsis, principal investigator of the project.

Star Dust Speaker Reviews

By Michael Chesnes

I warmly encourage NCA members to write reviews for the talks at our meetings, so that they can be published in Star Dust. We have an excellent lineup of speakers every year, and our reviews are both a valuable historical record of our activities and a way to recognize our speakers.

Reminder

After the meeting, everyone is invited to join us at Plato's Diner in College Park. Plato's is 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.

Calendar of Events

NCA Mirror- and Telescope-making Classes: Fridays, Nov. 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 gfbrandenburg@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, Nov. 14 at 5:30 pm, preceding the meeting, at the *Garden Restaurant* in the University of Maryland University College Inn and Conference Center.

Upcoming NCA Meetings at the University of Maryland Observatory

Nov. 14, 2009
Alice Harding (GSFC)
Pulsar Discoveries by the Fermi Gamma-Ray Telescope
IYA theme of the month: The Lives of Stars. (Featured Object: Crab Nebula)

Dec. 12, 2009
S. Harvey Moseley Jr. (GSFC)
The Very First Stars, as Observed with Spitzer
IYA theme of the month: Discovering New Worlds. (Featured Object: Orion Nebula)

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All members receive Star Dust, the monthly newsletter announcing NCA activities. The basic dues cover an electronic copy of Star Dust; paper copies are $10 extra. You may also choose to get Sky & Telescope magazine at the discounted rate of $33.

Student Membership	$ 5
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Sky & Telescope	$33
Total	_____

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Nov. 14

7:30 pm

@ UM Obs

Dr. Alice K. Harding

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