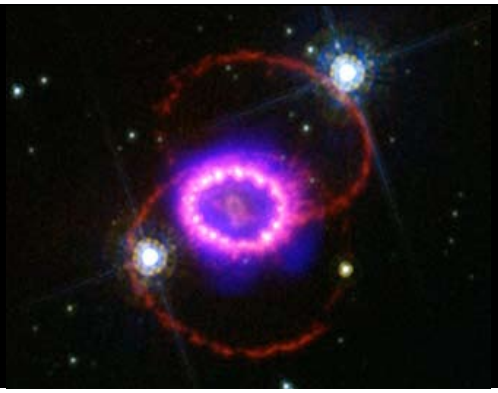
PRIMEFOCUS

Tri-Valley Stargazers

September 2010



Meeting Info:

What: WISE Astronomy with NASA's Wide-field Infrared Survey Explorer

Who: Dr. Bryan J. Mendez

When:
September 17, 2010
Doors open at 7:00 p.m.
Lecture at 7:30 p.m.

Where:
Unitarian Universalist Church in Livermore
1893 N. Vasco Road

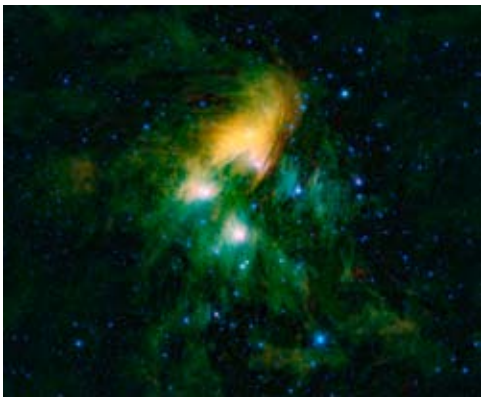
Inside

September Meeting

WISE Astronomy with NASA's Wide-field Infrared Survey Explorer

Dr. Bryan J. Mendez

NASA's Wide-field Infrared Survey Explorer, or WISE, is mapping the entire sky at four infrared wavelengths, searching for asteroids, the nearest and coolest stars, the origins of stellar and planetary systems, and the most luminous galaxies in the Universe. WISE is a space telescope in low-Earth orbit cooled by solid hydrogen. It was launch in December of 2009 and completed a full scan of the sky in July 2010. As the end of the survey draws near, the WISE science team are preparing to release the WISE data to the public starting in the spring of 2011. When the mission is completed, WISE will have delivered an atlas of the sky containing more than 4 million images in four infrared wavelengths and a catalog of approximately 500 million sources detected in the survey. Find out the latest about WISE at http://wise.astro.ucla.edu



This is an image of the Pleiades as you've never seen them before, thanks to the infrared eyes of WISE. Blue and cyan represent infrared light at wavelengths of 3.4 and 4.6 microns, which is dominated by light from stars. Green and red represent light at 12 and 22 microns, which is mostly light from warm dust. Image Credit: NASA/JPL-Caltech/UCLA

Bryan hails from Traverse City, Michigan where the dark sky enthralled him from a very early age and inspired him to study astronomy. He graduated from the University of Michigan in 1997 with degrees in Astronomy, Physics, and Saxophone Performance. Bryan continued his education at the University of California at Berkeley, where he researched the large-scale flow of galaxies in the nearby Universe by measuring their distances. He received a Ph.D. in Astrophysics from UC Berkeley in 2002. Bryan now works at the Center for Science Education at UC Berkeley's Space Sciences Laboratory to educate and inspire others about the wonder and beauty of the Universe. His work in space science education and public outreach involves developing programs for the public through the web and museums, developing classroom materials for students in K-12 classrooms, and conducting professional development for science educators.

News & Notes

2010 TVS Meeting Dates

The following lists the TVS meeting dates for 2010. The lecture meetings are on the third Friday of the month, with the Board meetings on the Monday following the lecture meeting.

Lecture Meeting	Board Meeting	Prime Focus Deadline
Sep. 17	Sep. 20	
Oct. 15	Oct. 18	Sep. 24
Nov. 19	Nov. 22	Oct. 29
Dec. 17	Dec. 20	Nov. 26

Money Matters

Treasurer David Feindel indicates that as of the May 17, 2010 the TVS account balances are:

Checking	$5,130.32	
CD #1	$3,761.41	rolled over 5/17/2010
CD #2	$2,654.36	rolled over 2/27/2010

TVS Volunteers Needed

We still need a volunteer to take on the duties of the club Secretary. We also could use more members on the Board of Directors. If you wish to help with any of these positions, please contact any officer or board member.

New webmaster

Hilary Jones has taken on the role of webmaster for TVS. He has begun sprucing up the website, including streamlining the access to the newsletters. Also, look for a collection of his great astroimages at: http://www.darklights.org/gallery/ which can also be accessed via the TVS website.

Journal Club by Ken Sperber

boom, Boom, BOOM! (Part II)

This supernova column has become like a new car; once you buy one, suddenly you see the same car everywhere you go. I've been running across a slew of articles that provide further insight into these massive explosions and their progenitors, so I've decided to add a 3rd installment next month.

Last month I discussed Type Ia supernovae, which explode after reaching the Chandrasekar limit via accretion (Fig. 1, top) or collision and coalescence with their binary companion. This month I will talk about all other supernovae, which are of the core-collapse variety (Fig. 1, bottom), being composed of stars that are born with more than 8-10 solar masses. These

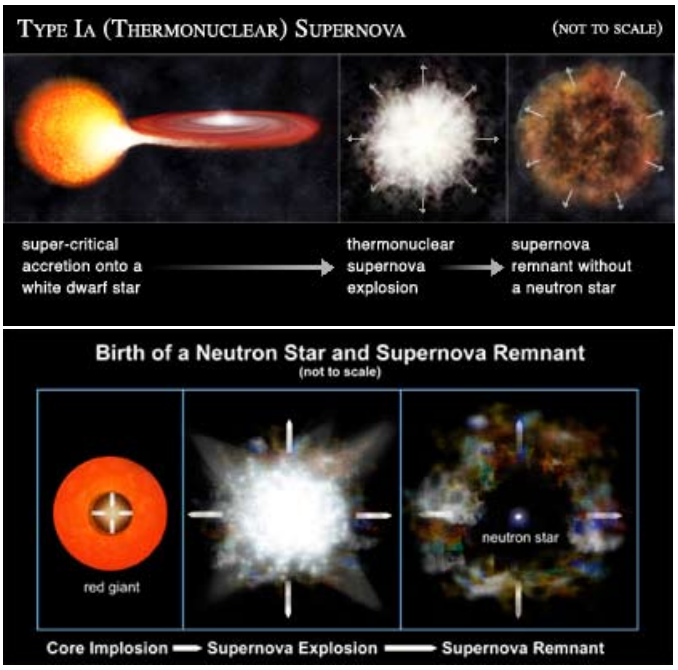


Figure 1: Schematics showing the explosion mechanisms of Type 1A supernova (top) and core-collapse supernova. Image credit: NASA/CXC/SAO; see http://chandra.harvard.edu/photo/2009/typingsnrs/ for more information.

high mass stars typically evolve into red supergiants, and have sufficient mass and high enough internal temperatures to fuse elements all the way to iron. Each stage of fusion releases energy, but because the protons and neutrons within an iron nucleus are the most tightly bound of all elements, additional energy would be required for it to fuse. Thus, iron is the heaviest element created by fusion. A cross-section of the core of a red supergiant star would look like an onion, with the iron core surrounded above by layers of successively lighter elements (if the outer layer is hydrogen when the star goes supernova it is known as a Type II; if the hydrogen is absent it is known as a Type Ib, and if hydrogen and helium are both absent then it is a Type Ic supernova). Each deeper layer is the fusion ash of the layer above. As the silicon layer undergoes fusion it contributes more and more iron to the core. When the iron core reaches the Chandrasekar limit, the electron degeneracy is insufficient to support the iron

Header Image: This composite image shows the effects of a powerful shock wave moving away from the explosion. Bright spots of X-ray and optical emission arise where the shock collides with structures in the surrounding gas. These structures were carved out by the wind from the destroyed star. Hot-spots in the Hubble image (pink-white) now encircle Supernova 1987A like a necklace of incandescent diamonds. The Chandra data (blue-purple) reveal multimillion-degree gas at the location of the optical hot-spots. These data give valuable insight into the behavior of the doomed star in the years before it exploded.

Credit: X-ray: NASA/CXC/PSU/S.Park & D.Burrows.; Optical: NASA/STScI/CfA/P.Challis

core, and the electrons are forced into the protons creating neutrons and neutrinos. Confirmation of this process came from the neutrinos that we observed in conjunction with the Type II Supernova 1987A (see the newsletter header image on page 1). In about 1 second or less the Earth-size iron core collapses to form a 6-mile-diameter neutron star. The act of collapsing from an Earth-size iron core to a 6-mile-wide neutron star also liberates a large amount of gravitational potential energy. During collapse the outer core experiences a bounce as the inner core material stiffens. The inner core stiffens because neutron degeneracy is the force that supports the neutron star against the force of gravity. Though the detailed mechanism has yet to be defined, this bounce impacts the infalling material from above, and forms a shockwave that propagates outward. Numerical models suggest that the shockwave is typically not strong enough to cause the star to go supernova. It is possible that neutrino production provides the extra kick to form the supernova. Through neutron capture elements heavier than iron are created.

Stars born with masses of about 10-40 solar masses form neutron stars while those born with 40-100 solar masses form black holes. Core-collapse supernovae reach maximum brightness in a day or so, and maintain high brightness for a year or so, much longer than the Type Ia supernova discussed earlier. Indications are that the interaction of the shockwave with the extended envelopes of these massive stars powers much of the visible emission from the core-collapse supernovae. Despite the fact that the supernova is bright enough to outshine its host galaxy, the visible light only accounts for 0.01% of the total energy emitted. 99% of the energy is emitted in the form of neutrinos, and ~1% is in the form of kinetic energy of the ejected material.

Core-collapse supernovae preferentially occur in spiral galaxies, where active star formation is occurring, since they are massive stars that must form in environments where there is a large amount of gas and dust available for star formation. Their progenitor stars live for only a few million years and thus complete their life-cycle in the vicinity of their birth. Type Ia supernovae can occur anywhere, since their progenitors are of lower mass and can live for billions for years before going supernova. Indeed, many Type Ia supernovae are found in elliptical galaxies, where star formation has long ago ceased because the gas and dust have been used up and/or stripped out during the galactic mergers that lead to the formation of elliptical galaxies (but that's another story).

Recently, two intrinsically dim supernovae were discovered. The below-normal brightness of these calcium-rich supernova has been attributed to the progenitor stars being in the 8-10 solar mass range at birth-that is they were just barely large enough to explode. Though both supernovae had similar light curves, and thus presumably similar explosion mechanisms, each research group came to different conclusions regarding the mechanism of explosion. Kawabata et al. (2010) conclude the Supernova 2005cz was a core-collapse event that only produced a small amount of Nickel^{56} because the star only had a very thin oxygen and silicon layer above the core. Perets et al. (2010) suggest that the Supernova 2005E was a white dwarf in a binary system that underwent a helium detonation. They argue against it being a core-collapse supernova since the progenitor star was located in the outskirts of an elliptical galaxy in a region that was devoid of star formation. Additionally, they state "a radio signature, expected from core-collapse supernovae, has not been observed."

Gel-Yam et al. (2009) report the first observed pair-instability supernova. This type of explosion has been predicted by

continued page 4

models, but not observed because birth of their very massive progenitors is rare. Stars born with >140 solar masses develop oxygen cores that may exceed 50 solar masses. The temperature is very high but the density is low compared to their red supergiant brethren. In these very massive stars the pressure due to outflowing photons is the primary force that counteracts the pull of gravity. Above a critical temperature the gamma-ray photons are so energetic that they spontaneously convert to electron-positron pairs. Once this occurs there is insufficient outflow of photons to counteract gravity, and core collapse ensues. The violent contraction sets off a runaway thermonuclear explosion that "unbinds" the star, resulting in its total destruction. Crowther et al. (2010) has identified candidate stars that will likely undergo pair-instability core collapse, including several >150 solar mass stars in the R136 cluster that is part of Tarantula Nebula (30 Doradus) in the Large Magellanic Cloud.

Maybe it's time to move to the Southern Hemisphere!

Next month I'll talk about the synthesis of heavy elements in supernovae, add some tidbits on the details of Type Ia supernova explosions, and discuss a new method for identification of the different supernovae types.

For more information see: Burrows (1987, Physics Today, September issue, 28-37); Crowther et al. (2010, Mon. Not. R. Astron. Soc., arXiv:1007.3284v1, submitted); Filippenko, A. (2007, Understanding the Universe: An Introduction to Astronomy, 2nd Edition, The Teaching Company, http://www.teach12.com); Gal-Yam et al. (2009, Nature, 462: 624-627, doi:10.1038/nature08579); Kawabata et al. (2010, Nature, 465, 326-328, doi:10.1038/nature09055); Perets et al. (2010, Nature, 465, 322-325, doi:10.1038/nature09056); http://imagine.gsfc.nasa.gov/docs/science/know_l2/supernovae.html; and yes, Wikipedia.

Calendar of Events

September 15, 12:00 - 1:00 pm

What: From the Earth to Mars: Lessons for Mars Science and Exploration from the Haughton-Mars Project, Devon Island, High Arctic
Who: Pascal Lee, SETI Institute, Mars Institute, & NASA Ames Research Center
Where: SETI in Mountain View, Clocktower Cafe Conference Room, 425 N. Whisman Road, Mountainview
Cost: Free

The Haughton impact crater site on Devon Island, High Arctic, is one of the most Mars-like places on Earth. Since 1997, the Haughton-Mars Project (HMP) has been conducting science and exploration research at the site, and established the HMP Research Station, now the largest privately operated polar research station in the world. Geology and astrobiology investigations have led to the formulation of the "Mars, Always Cold, Sometimes Wet" Model. Dr. Lee will describe how Haughton is being used to conduct exploration investigations which are helping to pave the way towards the first human mission to Mars.

This lunchtime talk is part of the SETI Institute Colloquium Series. For more info, visit their web site http://www.seti.org/csc/lectures, e-mail info@seti.org, or phone 650-961-6633.

September 18, 11:00 am

What: Nature in the Hot Seat
Who: Prof. Tony Barnosky, UC Berkeley
Where: Room 100, Genetics and Plant Biology Building, UC Berkeley
Cost: Free, Doors open at 10:30am, first come, first serve seating

Prof. Barnosky has been on the faculty at the University of California, Berkeley since 1990, and currently holds the posts of Professor of Integrative Biology, Curator of Fossil Mammals in the Museum of Paleontology, and Research Paleoecologist in the Museum of Vertebrate Zoology. Author of numerous scientific publications, he studies how changing climate impacts earth's ecosystems and the evolution and extinction of species. His new book, "Heatstroke: Nature in the Age of Global Warming," (2009) explores what global warming means for nature itself, for the wild places we love, and for our future.

For more information please see: http://scienceatcal.berkeley.edu/lectures

September 22, 12:00 - 1:00 pm

What: Titan: Past, Present and Future
Who: Chris McKay, Space Science Division, NASA Ames Research Center
Where: Conference Room adjacent to Symantec Cafe, 360 Ellis St., Mountainview
Cost: Free

No abstract available.

This lunchtime talk is part of the SETI Institute Colloquium Series. For more info, visit their web site http://www.seti.org/csc/lectures, e-mail info@seti.org, or phone 650-961-6633.

September 26, 5:30-9:30 pm

What: Exoplanets Galore
Who: Dr. Alex Filippenko, UC Berkeley
Where: Chabot Space & Science Center
Cost: Advanced Reservations Required: $20, Call the Box Office at (510) 336-7373 to register

Dr. Alex Filippenko, Distinguished Professor of Astronomy at UC Berkeley, will share the latest discoveries in the field of extra-solar planets: how we are looking, what has been

found so far, and the prospects of discovering Earth-like Exoplanets. The exciting evening will begin with an Interactive Reception, where guests can explore exhibits and learn about other Astro Alliances, all while enjoying a selection of hors d'oeuvres and beverages from Italian Colors Restaurant. There will be time for Q&A, and a Complimentary Raffle (everyone receives one free ticket). The evening concludes under the stars, as we look through Chabot's large telescopes and additional smaller scopes. Coffee and dessert will be served.

The Chabot Space and Science Center is located at 10000 Skyline Blvd, Oakland. For more info, visit their web site http://chabotspace.org/visit/calendar/default.aspx?date=7/23/2010#calendar or call (510) 336-7373.

September 29, 12:00 - 1:00 pm

What: Lakes on Mars: Their Past, Present, and Future Exploration
Who: Nathalie Cabrol
Where: New SETI Headquarters, 189 N. Bernardo Ave., Mountainview
Cost: Free

Lakes are time capsules. On Earth, they are considered sentinels of climate change and may have played the same role on early Mars. Their basins capture the record of geological and environmental fluctuations over a wide range of temporal and spatial scales. Prior to Mars Global Surveyor, the relatively low resolution of orbital imagery made it difficult to confirm Martian paleolakes by direct observations, though their existence was inferred because valley networks had already been identified on Viking and Mariner 9 images. Here, Dr. Nathalie Cabrol will discuss the evidence presented in the book, its environmental significance in terms of climate and habitability, and the questions it still raises.

This lunchtime talk is part of the SETI Institute Colloquium Series. For more info, visit their web site http://www.seti.org/csc/lectures, e-mail info@seti.org, or phone 650-961-6633.

October 4, 7:30 pm

What: Making Sense of the Dynamic Universe in the Synoptic Survey Era
Who: Prof. Joshua S. Bloom, UC Berkeley
Where: California Academy of Science, 55 Music Concourse Dr., Golden Gate Park, San Francisco, CA
Cost: Adults $12, Seniors $10, Academy members $6. Reserve a Space Online or call 800-794-7576

Viewing the night sky with sufficient sensitivity, everything in the Universe appears to change in brightness and position. To understand this rich diversity of time-variable sources, astronomers must tame a data deluge, soon to be explored by projects such as the Large Synoptic Survey Telescope (LSST). Scientists will need to move beyond the point where they themselves can be directly involved in discovery, classification, and even the inference processes. Bloom will discuss this abstraction of the traditional role of astronomer, an emerging revolution and our efforts at extracting novel science from large amounts of data.

For more information please see: http://www.calacademy.org/events/lectures/

October 6, 12:00 - 1:00 pm

What: The Mars dichotomy: Brought to you by a mega impact
Who: Margarita Marinova, NASA Ames Research Center
Where: New SETI Headquarters, 189 N. Bernardo Ave., Mountainview
Cost: Free

No abstract available.

This lunchtime talk is part of the SETI Institute Colloquium Series. For more info, visit their web site http://www.seti.org/csc/lectures, e-mail info@seti.org, or phone 650-961-6633.

October 9, 8:00 pm

What: Terraforming the second home for humanity
Who: Jim Brown, The Mars Society
Where: Mt. Tamalpais, The Cushing Memorial Amphitheater, more commonly known as the Mountain Theater, Rock Spring parking area.
Cost: Free

The ultimate development of a planet as a second home for Earth life is terraforming. Why is Mars the most productive next place to settle and how can it be terraformed?

Fore more information please see: http://www.mttam.net/

October 13, 12:00 - 1:00 pm

What: The Chicken and Egg problem of the Origin of Life
Who: Nick Woolf, Arizona State University
Where: New SETI Headquarters, 189 N. Bernardo Ave., Mountainview
Cost: Free

No abstract available.

This lunchtime talk is part of the SETI Institute Colloquium Series. For more info, visit their web site http://www.seti.org/csc/lectures, e-mail info@seti.org, or phone 650-961-6633.

What's Up by Ken Sperber (adapted from Sky and Telescope)

All times Pacific Daylight unless otherwise noted.

September

17-19	Fri-	Jupiter and Uranus are within 1 degree of each other (all night)
22	Wed	Jupiter and Uranus are 6 degrees below the Moon (all night)
22	Wed	Autumn Begins (8:09pm)
23	Thu	Full Moon (2:17am)
27	Tue	Regulus and Mercury are within 1 degree of each other in the lower west (Dusk)
30	Thu	Last-Quarter Moon (8:52pm)

October

3	Sun	Algol, an eclipsing binary, is at minimum brightness, magnitude 3.4 for ~2 hours centered at 7:28pm
6-20	Wed-	Zodiacal Light visible in the eastern predawn sky (1-2 hours before sunrise)
7	Thu	New Moon (11:44am)
9	Sat	Venus, crescent Moon, and Mars are visible in the soutwest just above the horizon (Bright twilight)
10-11	Sun-	The moon is to the lower-right (upper-left) of Antares on the 10th (11th)
14	Thu	First-Quarter Moon (2:27pm)
22	Fri	Full Moon (6:37pm)
23	Sat	Algol, an eclipsing binary, is at minimum brightness, magnitude 3.4 for ~2 hours centered at 9:10pm
23	Sat	Europa and Ganymede shadow transits of Jupiter from 6:40pm to 8:04pm
25	Mon	The Pleiades are within 2 degrees of the Moon
26	Tue	Algol, an eclipsing binary, is at minimum brightness, magnitude 3.4 for ~2 hours centered at 8:58pm
30	Sat	Last-Quarter Moon (5:46am)
30	Sat	Europa and Ganymede shadow transits of Jupiter from 9:16pm to 11:59pm

The Turbulent Tale of a Tiny Galaxy

by Trudy Bell and Dr. Tony Phillips

Next time you hike in the woods, pause at a babbling stream. Watch carefully how the water flows around rocks. After piling up in curved waves on the upstream side, like the bow wave in front of a motorboat, the water speeds around the rock, spilling into a riotous, turbulent wake downstream. Lightweight leaves or grass blades can get trapped in the wake, swirling round and round in little eddy currents that collect debris.

Astronomers have found something similar happening in the turbulent wake of a tiny galaxy that is plunging into a cluster of 1,500 galaxies in the constellation Virgo. In this case, however, instead of collecting grass and leaves, eddy currents in the little galaxy's tail seem to be gathering gaseous material to make new stars.

"It's a fascinating case of turbulence [rather than gravity] trapping the gas, allowing it to become dense enough to form stars," says Janice A. Hester of the California Institute of Technology in Pasadena.

The tell-tale galaxy, designated IC 3418, is only a hundredth the size of the Milky Way and hardly stands out in visible light images of the busy Virgo Cluster. Astronomers realized it was interesting, however, when they looked at it using NASA's Galaxy Evolution Explorer satellite. "Ultraviolet images from the Galaxy Evolution Explorer revealed a long tail filled with clusters of massive, young stars," explains Hester.

Galaxies with spectacular tails have been seen before. Usually they are behemoths—large spiral galaxies colliding with one another in the crowded environment of a busy cluster. Tidal forces during the collision pull gas and stars of all ages out of these massive galaxies to form long tails. But in IC 3418, the tail has just young stars. No old stars.

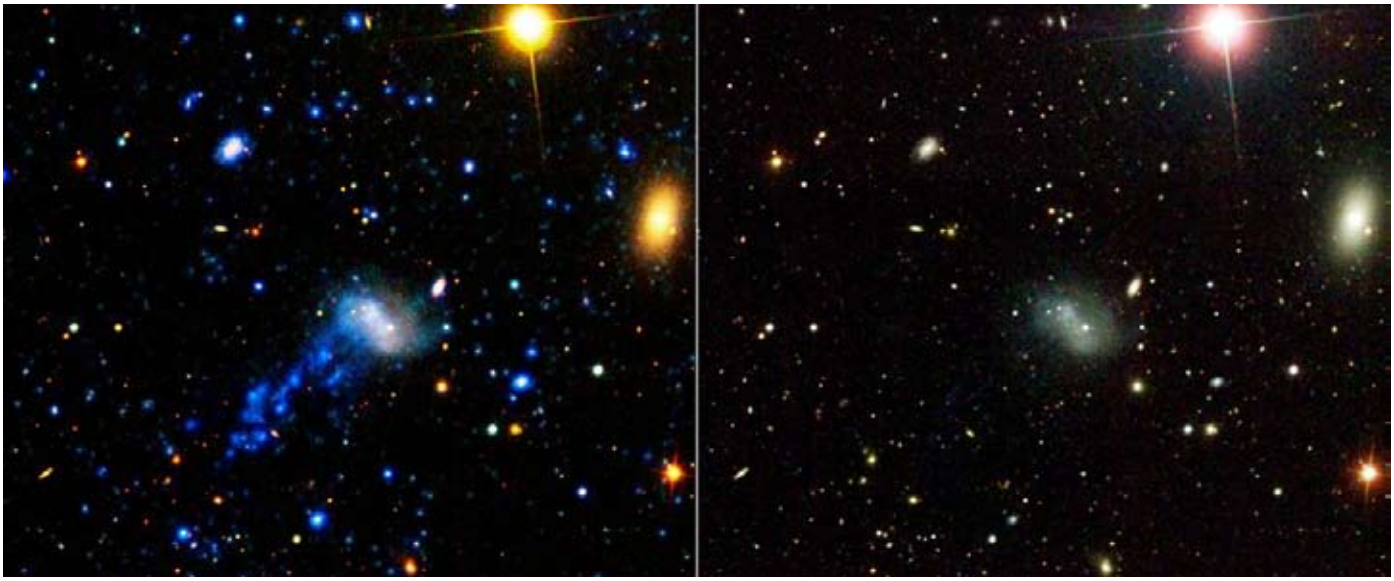
"The lack of older stars was one tip-off that IC 3418's tail isn't tidal," says Hester. "Something else must be responsible for these stars"

Hester and eight coauthors published their findings in the June 10, 2010, issue of The Astrophysical Journal Letters. The team described the following scenario: IC 3418 is speeding toward the center of the Virgo cluster at 1,000 kilometers per second. The space between cluster galaxies is not empty; it is filled with a gaseous atmosphere of diffuse, hot hydrogen. Thus, like a bicyclist coasting downhill feels wind even on a calm day, IC 3418 experiences "a stiff wind" that sweeps interstellar gas right out of the little galaxy, said Hester—gas that trails far behind its galaxy in a choppy, twisting wake akin to the wake downstream of the rock in the babbling brook. Eddy currents swirling in the turbulent wake trap the gas, allowing it to become dense enough to form stars.

"Astronomers have long debated the importance of gravity vs. turbulence in star formation," Hester noted. "In IC 3418's tail, it's ALL turbulence."

To many astronomers, that's a surprising tale indeed.

See other surprising UV images from the Galaxy Evolution Explorer at http://www.galex.caltech.edu. Kids (and grown-ups) can play the challenging new Photon Pileup game at http://spaceplace.nasa.gov/en/kids/galex/photon/



In the ultraviolet image on the left, from the Galaxy Evolution Explorer, galaxy IC 3418 leaves a turbulent star forming region in its wake. In the visible light image on the right (from the Sloan Digital Sky Survey), the wake with its new stars is not apparent.

Tri-Valley Stargazers
P.O. Box 2476
Livermore, CA 94551

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Tri-Valley Stargazers Membership Application

Member agrees to hold Tri-Valley Stargazers, and any cooperating organizations or landowners, harmless from all claims of liability for any injury or loss sustained at a TVS function.

Name _____ Phone _____ e-mail _____

Address _____

Do not release my: _____ address, _____ phone, or _____ e-mail information to other TVS members.

Membership category:
_____ $5 Student.
_____ $30 Basic. You will receive e-mail notification when the PDF version of Prime Focus is available for download off the TVS web site.
_____ $10 Hidden Hill Observatory (H2O) yearly access fee. You need to be a key holder to access the site.
_____ $20 H2O key holder fee. (A refundable key deposit—key property of TVS).
_____ $40 Patron Membership. Must be a member for at least a year and a key holder.
_____ $34 One year subscription to Astronomy magazine.
_____ $60 Two year subscription to Astronomy magazine.
_____ $32.95 One year subscription to Sky & Telescope magazine. Note: Subscription to S&T is for new subscribers only. Existing subscribers please renew directly through S&T.
$ _____ Tax deductible contribution to Tri-Valley Stargazers.

$ _____ TOTAL – Return to: Tri-Valley Stargazers, P.O. Box 2476, Livermore, CA 94551

Membership information: Term is one calendar year, January through December. Student members must be less than 18 years old or still in high school.