

Sonoma Skies

Newsletter of the Sonoma County Astronomical Society
A nonprofit scientific and educational organization

May 2011

www.sonomaskies.org

Volume XXXIV No. 5

BJ Yeager

It is with great sadness that we tell you of BJ's death the morning of April 26. She died suddenly, at home, from a heart attack. Our hearts go out to Dickson and their family, and to all of us—we will miss her.

A public viewing will be held Saturday, April 30 from 11AM to 5PM at Lafferty & Smith Colonial Chapel, 4321 Sonoma Highway, Santa Rosa. A Memorial Service and Internment of Ashes will be held Monday, May 2, at 11AM at the Church of the Incarnation, 550 Mendocino Ave., Santa Rosa. Reception to follow in the Parish Hall.

It's Time to Renew Your SCAS Membership

What an exciting time to be interested in Astronomy! New, ever larger telescopes, exploration by NASA and other space agencies around the world and research by talented scientist are providing new information every day about our wonderful universe.

Here in our small place in the Universe, the Sonoma County Astronomical Society is promoting a better understanding of the wonders of the universe in an increasing number of ways:

Monthly Meetings: Offer a wide array of expert speakers specializing in explaining astronomy to the general public .

Public Star Parties: Members share their enthusiasm for astronomy with school children and other local organizations. This is one of the most popular activities and gives seasoned veterans a chance to share their telescopes and knowledge with the public and new members get a chance to get hands-on information on the workings of telescopes and stargazing.

SCAS Newsletter: Our members receive *Sonoma Skies*, our Award Winning Newsletter providing up-to-date listings of local astronomy happenings and events, information important to Young Astronomers, observing highlights for the month and concise information on important astronomical research.

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The New View of the Sun with SDO—Inside and Out

with Dr. Philip Scherrer
SCAS May 11 Meeting, 7:30 PM
at Proctor Terrace School

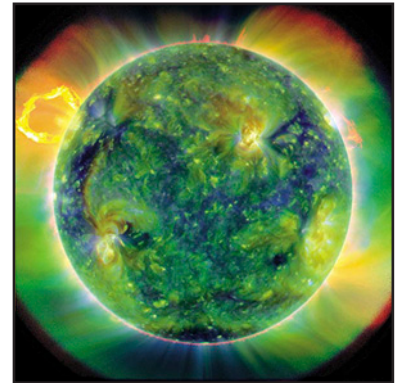
For something as constant as the sun, we often take it for granted. But these are exciting times under the sun. Under, inside and out! First of all, we know it's our nearest star, so gives us a ringside seat for understanding what stars are and how they behave. And given that all life is defined by and depends on the sun, does it comes as a surprise that for such a "normal" star, the sun is a very dynamic body that can be, shall I say, moody?

We have never had such a wealth of information coming our way in terms of what we're learning about our star. Especially these days thanks to all the solar observatories, especially the one of newest and most powerful, the Solar Dynamics Observatory (SDO).

At our May meeting we are fortunate to have Dr. Philip Scherrer from Stanford University visit us to talk about the SDO. Dr. Scherrer worked with the Lockheed Martin group to develop the SDO's Helioseismic and Magnetic Imager (HMI), just one of several detectors and experiments on board the space based SDO observatory. Hmmm...Helioseismic? Sunquakes? Well it seems our sun does indeed shake and vibrate, and have the occasional temper tantrums!

SDO with Dr. Scherrer's HMI instrument has just finished its first year of observations. He says the HMI is an improved version of the SOHO/MDI instrument package which has just

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President's Message

Beyond Begins!

I was there at the April 16th Petaluma Butter & Eggs Parade. In the grand procession were the Star Wars storm troopers and Darth Vader, with the banner proclaiming the imminent beginning of the "Beyond—Visions of Planetary

Landscapes" exhibition at the Petaluma Historical Library and Museum on May 7th, Astronomy Day.

Prior to this moment, I was at the Museum taking images of these characters and managed to get my own image amongst them. Darth Vader, otherwise better known as Joe Noriel, the director of the Petaluma Museum, did his level best to get into character to get the advertising for this exhibit off to a great start.



Eric Swanson and I helped in the days that followed with some carpentry labor and thereby gained some in-close views of the set up for this exhibit. It promises to be quite a show and should surely act as a catalyst to attract new members to the SCAS and attendees to the Robert Ferguson Observatory's public star parties this summer.

This exhibit, will also feature weekly star parties (weather permitting) on a small property adjacent to the museum. This location is only a block or so from Petaluma's theater district and I suspect we should draw quite a crowd from many directions. Help will be needed and Young Astronomer presence would be most welcome. Many young people will be attracted to this 'Beyond' star party and the Young Astronomers would serve to attract good Striking Sparks candidates for our 2012 Sparks event.

On Astronomy day, the waxing crescent Moon will be in Gemini in the western sky and Saturn will be in the SE sky in Virgo. Even through bright city lights these two fine objects will look great in our scopes in Petaluma. At the RFO, much more will be available to see in its dark sky environment and "Beyond" attendees will be encouraged to head there for the best sky show and much more.

Weekly speaker events will be held at the Museum and the line up is shown on page 4 of this newsletter. The Museum's web address is www.petalumamuseum.com

Clearly, May will be a busy month for the SCAS and we should have many stories to tell in the June issue of *Sonoma Skies!*

—Len Nelson, SCAS - President

New View of the Sun *(from page 1)*

completed 15 years of impressive service. He will discuss with us the SDO mission, what it is and why, talk about a few of the other instruments on board, and what results they are giving us.



In addition to a wealth of information and new knowledge SDO is giving us, it is returning some of the most amazing images of the sun we have ever seen. Be sure not to miss this one.

And be sure to check the April edition of *Smithsonian* magazine, "Something New Under the Sun," which features SDO and Dr. Scherrer's contribution to it.

Philip Scherrer is a Professor of Physics at Stanford University, and is a Principal Investigator for SDO/HMI and the SOHO/MDI observatories! He received his PhD from UC Berkeley in 1973, and has been at Stanford since then.

Please join your fellow sun worshippers, and see what's new under, inside and outside the sun!

—John Whitehouse, SCAS VP



NASA, ESA and Hubble Heritage team

FROM THE HUBBLE HERITAGE TEAM

NGC 602: Near the outskirts of the Small Magellanic Cloud, a satellite galaxy some 200 thousand light-years distant, lies 5 million year young star cluster NGC 602. Surrounded by natal gas and dust, NGC 602 is featured in this stunning Hubble image of the region. Fantastic ridges and swept back shapes strongly suggest that energetic radiation and shock waves from NGC 602's massive young stars have eroded the dusty material and triggered a progression of star formation moving away from the cluster's center. Follow this link for a high resolution image: <http://apod.nasa.gov/apod/ap070110.html>

Membership Renewal *(from page 1)*

Social Gatherings: Our Annual Star B Que held each August at the Robert Ferguson Observatory open only to members and guests, as well as many other outings including a Yosemite Star Party.

Don't forget some of the other benefits: Membership in The Astronomical League and a subscription to their *Reflector* magazine; Discounted subscriptions for *Sky and Telescope* and *Astronomy* magazines; and access to the SCAS Library of astronomical related material.

So, now is the time not only to renew your membership but to invite your friends to become a part of the exciting field of astronomy by joining the Sonoma County Astronomical Society.

To renew your annual membership, please print the membership form on the last page of this newsletter, and send it with a check payable to SCAS in the amount of \$25 to:

SCAS Membership
P.O. Box 183, Santa Rosa, CA 95402-1083.

This membership renewal period applies to all members. Don't miss a single benefit. Make sure you get your renewal check sent to us now. Thanks for being part of the Sonoma County Astronomical Society.

—Mike Dranginis, SCAS Membership Director



Hubble Space Telescope as seen from Atlantis, May 19, 2009, courtesy of NASA

Seeing the Universe in a Mirror

Robert Zimmerman's saga of the Hubble Space Telescope (or HST) features the visionaries throughout the astronomical and NASA community who conceived, designed, and built it. He writes, "It has without question been the greatest instrument that humans have ever sent into space." Hubble, named after famed astronomer Edwin Powell Hubble [1], was conceived in the 1940s and 1950s, designed in the 1960s, built in the 1970s and 1980s, fixed and maintained in the 1990s, and its mission lengthened beyond the 2000s with a fifth shuttle repair mission conducted in 2009.

The importance of a space telescope cannot be underestimated. Until the late twentieth century, we've been constrained to the

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by
Herb
Larsen

**Yep, it's a sure sign of spring
when the telescopes start
popping up.**

SCAS cartoonist Herb Larsen can be contacted at hlarseni@yahoo.com

WELCOME, NEW MEMBER

The SCAS wishes to welcome new member Michael Dobbins of Sebastopol.

SOCIAL AMENITIES

Many thanks to Loren Cooper for providing refreshments at the April meeting.

Scope City

NEW MEMBER BONUS!

Scope City at 350 Bay Street, San Francisco, is offering a **\$25 merchandise discount to new members.**

Manager Sam Sweiss has supported SCAS and Striking Sparks and offers a huge selection of telescopes, accessories and more. Obtain a receipt from Dickson Yeager, Membership Director, showing you have paid the \$25 SCAS membership dues. To arrange for your merchandise discount, contact Sam at 415/421-8800 or at <http://www.scopecity.com>

Events

ROBERT FERGUSON OBSERVATORY

Public Observing Night

Saturday, May 7

Solar Viewing: Noon - 4:00 PM

Night Viewing begins 9:00 PM

The Observatory features four telescopes: A 14-inch SCT with CCD camera in the East wing, an 8-inch refractor under the dome, a radio telescope for observing Sun activity, and a 24-inch reflector in the West wing. SCAS members may set up telescopes in the observatory parking lot to assist with public viewing. Auto access closes at dusk; late arrivals must carry equipment from the horse stable parking area.

Fees: No admission fee for the solar viewing, but donations are appreciated. The Park charges \$8 per vehicle for entry. A \$3 donation is requested from adults 18 and over for admission to the observatory during night viewing sessions.

Info: www.rfo.org

Night Sky Classes—Summer Series

May 31 June 7 June 28

July 26 Aug. 2 Aug. 23

Classes begin at 7:30 PM. Series of six sessions. Each class includes a lecture on the constellations of the season, their history and mythology, and how to find stars and deep sky objects within them. Includes observing.

Fees: \$75 for the series. (Single session fee is \$23). 10% discount for VMOA members. Classes are held at the Observatory. For information or to register: (707) 833-6979, [nightsky\(at\)rfo.org](mailto:nightsky(at)rfo.org)

RENT THE FERGUSON OBSERVATORY!

Groups of up to 50 can be accommodated. Astronomer docents provide sky interpretation and operate telescopes, and you can stay up as late as you want! Make your reservation at least two weeks prior to your event. Best times for optimal sky gazing are around a week away from a Full Moon.

For information or to make a reservation, visit www.rfo.org or email George Loyer: [gloyer\(at\)rfo.org](mailto:gloyer(at)rfo.org).

SONOMA STATE UNIVERSITY SERIES

“WHAT PHYSICISTS DO”

Mondays at 4:00 PM

Darwin Hall Room 103 (Coffee at 3:30 PM)

May 2: “Atomic and Molecular Manipulation”— Dr. Hari Manoharan, Stanford University

May 9: “Type Ia supernovae/ ‘Calamities of Nature’— Dr. Tony Piro, California Institute of Technology

Information: <http://phys-astro.sonoma.edu/wpd/>

THE SMITHSONIAN PRESENTS

“BEYOND”

VISIONS OF PLANETARY LANDSCAPES

at the Petaluma Museum

May 7 - July 4

A Smithsonian Exhibit featuring 35 large-scale (ranging from 3 feet to 5 feet in width) framed prints containing 59 individual photographs, all digitally processed by artist Michael Benson. The exhibit paints a rarely seen and mesmerizing portrait of our solar system’s diverse worlds and their moons.

The exhibition is divided into several sections, including the Inner Solar System, Mars, Jupiter and Saturn. The show’s compositions include rare pictures of the sand dunes on Mars, storms on Neptune and the fiery eruptions of the sun.

In addition to Benson’s photography the exhibition will include a display of rare meteorites on loan from the California Academy of Science, memorabilia and artifacts concerning space exploration, an Astronomy night and speaker series including noted NASA representatives and scientists.

Each weekend on Saturday at 3:00 PM, a new speaker will come to the fore to lecture on some aspect of astronomy.

The May through early June line up is:

May 7: NASA scientist Mark Marley’s topic will be “New Frontiers: From the Solar System to Extrasolar Planets”

May 14: From the California Academy of Science, Dr Jean Demouthe’s topic will be “Meteorites, Visitors from Space”

May 21: The creator of the Beyond Exhibit, Michael Benson, will discuss his Beyond creation.

May 28: Apollo 9 Astronaut Russell L. Schweickart will discuss his experiences and outlook

June 4: NASA representative Doris Daou’s topic will be “Galaxies, Nebulae, Solar Systems and Life”

June 11: SSU Professor, Lynn Cominski’s topic will be “Exploring the Extreme Universe with Fermi”

SCAS and RFO astronomers will provide outdoor public observing (see President’s Message on page 2).

The film “The Dream is Alive” focusing on the Space Shuttle missions will be presented every Saturday at 1 PM.

You’ll want to bring the children!

Location: 240 4th Street, Petaluma, 707/778-4398

More info: www.petalumamuseum.com

ALCON 2011

Bryce Canyon National Park Utah

June 29 - July 2, 2011

Registration is now open for ALCon, the Astronomical League Convention at Bryce Canyon. Details and registration information at: <http://alcon.astroleague.org/>

Events

Community Outreach Event Horizons

Extra Innings

April showers—but mainly on star party dates. Both the Binkley Elementary and Guerneville School star parties were canceled at the last minute on their particular dates. As of this writing, it looks like the re-scheduled star party at Sequoia Elementary School will happen. Five SCAS volunteers and three of the recent SPARKS winners (with their mentors) are (were) pledged to be there. Two of the three SPARKS volunteers attend Sequoia.

Lynn Anderson gave a PowerPoint slide show to 63 third graders at Sequoia Elementary School on the morning of April 26. The slide show included a photo of this year's SPARKS winners, two of whom are Sequoia students (not third graders, though). He could hear comments like, "That's my neighbor," and "I know her." We could potentially receive many SPARKS applications from Sequoia next year.

After the slide show, the students went out on the playground and Lynn directed them in the Night Sky Network MOON PHASE activity, which seemed to go well. So well in fact, the teacher in charge later reported that several of the students were using oranges and apples from their lunches to demonstrate the moon phase activity to friends at the outdoor lunch tables.

After that Lynn stopped by the Mark West Charter School to show the teacher, Martie Adams how to do the moon phase activity. Ms. Adams is the teacher of another of this year's SPARKS winners.

The extra innings: As we move toward the summer solstice, with later and later sunset times, we are still receiving star party requests. Thursday, *May 5th* we have been requested to provide a couple of telescopes for viewing after the Alexander Valley School's Open House. Start time will be 8:00 o'clock, with a two-day-old moon and Saturn to view during the twilight hour. Lynn will be there and needs one or two more telescope volunteers to staff this star party.

Another star party inquiry has been received from the principal at Rincon Valley's Austin Creek Elementary School for *May 25th*. Lynn has informed him about the 8:22 sunset time and potential viewing conditions, but he has not yet received a reply from the school's principal.

And, let's not forget about *Astronomy Day*, on Saturday, *May 7th*. All amateur astronomers are encouraged to share their love for exploring the heavens with their neighbors or passers-by on a street corner. If you are not volunteering at the RFO this night, or assisting Len Nelson with the opening star party outside the Petaluma Historical Museum in conjunction with the opening of the BEYOND exhibit, take some time and set up your telescope to share with your neighbors or somewhere where there will be lots of foot traffic.



You don't have to limit this activity to the evening, (although the 4-day old moon and Saturn will be excellent targets) if you have a solar filter, you can share views of our nearest star. Recent sun spot activity has been good. If you are planning on being out in the public for this event, contact a board member and try to get some SCAS information pamphlets to hand out to interested viewers.

—Lynn Anderson, SCAS Director of Community Activities



Last year's crew gathered at the campground. Photo by Len Nelson

SCAS YOSEMITE STAR PARTY August 19 and 20

The SCAS will provide public astronomy at Glacier Point this year on August 19 and 20, and camp at the Bridal Veil group campground. All participants bring their own telescopes. Park entry and campground fees are a gift from the park for our service.

Len Nelson ([lennelsn\(at\)comcast.net](mailto:lennelsn(at)comcast.net)) will coordinate the signups for this event. Let him know who you are, how many in your party and how many telescopes you will be bringing.

GOLDEN STATE STAR PARTY 2011 Wednesday, June 29 through Sunday, July 3

Preregistration is strongly recommended. Space is limited to 400 participants this year in response to overcrowding last year.

The Golden State Star Party is a 4 night dark-sky event held each summer at Frosty Acres Ranch in North-Eastern California, near Mount Lassen, alongside rural Adin, California. GSSP has dark skies from horizon to horizon.



Preregistration Fee: \$70. On-site registration (if space is available): \$75. Kids under 18 are free. <http://www.goldenstatestarparty.org/home>

Events

TAYLOR OBSERVATORY

Located in Kelseyville off Highway 29

May 6: Star Party— This event will give local amateur astronomers an opportunity to share their knowledge with the general public. Please register by email bmcintyre@lakecoe.org or by calling the observatory 707-262-4121.

May 14 Public Event, 8-11 PM: “Ice Giants”—Edward Giannelli. The evening event includes a lecture, a planetarium show and telescope viewing.

These events are held even in cloudy or rainy weather, although telescope viewing will not be possible. There is a suggested donation of \$3 per person. No reservation required. Info: 707/262-4121 or <http://www.taylorobservatory.org>

SSU OBSERVATORY PUBLIC VIEWING

May 6, 9:00 – 11:00 PM: “Saturn and the crescent Moon”

Observatory located inside the stadium area at the SE corner of campus (E. Cotati Ave. and Petaluma Hill Rd., two miles east of US 101). Follow signs to campus. Parking Lot F is most convenient. Call 707/664-2267 if it appears weather may force cancellation.

<http://www.phys-astro.sonoma.edu/observatory/pvn.html>

MT. TAMALPAIS ASTRONOMY

May 7, 8:30 PM: “Tiny Moons Around Small Asteroids”—Dr. Franck Marchis, SETI Institute/ UC Berkeley

Asteroid multiplicity is an astronomical prize for observers and theorists, constraining theories on the origin of the solar system.

Sponsored by the Mt Tamalpais State Park and coordinated by volunteers of the Mt Tam Interpretive Association. FREE and open to the public. Families and students encouraged to come. Presentations held in the Mountain Theatre. Viewing afterwards in Rock Springs Parking Area, provided by San Francisco Amateur Astronomers. Dress warmly and car pool if possible. Bring a flashlight! Info: 415/455-5370; <http://www.mttam.net/>

JANE’S “WHAT’S UP” PODCAST

Jane Houston Jones produces a monthly “What’s Up” podcast that features objects we can observe each month. Find Jane’s podcasts here: <http://solarsystem.nasa.gov/news/whatsup.cfm>

SETI INSTITUTE COLLOQUIUM

May 4: “Tracking and Mitigating Meteoroid Threats to Spacecraft”—Sigrid Close, Aeronautics and Astronautics Department, Stanford University

Whether residing in low-earth orbit or traveling through interplanetary space, spacecraft must shield against environmental threats that could result in minor to catastrophic failure. One such threat is an impact by a meteoroid, which is a natural object ranging from 62 microns to meters in diameter that could cause either mechanical or electrical damage. In this presentation, Dr. Close will discuss current research into meteoroid and meteoroid plasma physics and how these tiny particles may offer insight into the formation of life on Earth.

May 12 (Thurs., 7:30 PM): “Planetary Observations with the James Webb Space Telescope”—Heidi B. Hammel, Space Science Institute

The James Webb Space Telescope is the next in the line of NASA’s Great Observatories, a scientific successor to both the Hubble and Spitzer Space Telescopes. This space observatory will see the first galaxies to form in the universe, and explore how stars are born and give rise to planetary systems. It will study exoplanets, investigating their potential for life. JWST is optimized to detect infrared light, using a segmented mirror more than 6 m in diameter and operating a million miles away in the cold, dark environment of Earth’s Lagrange 2 point. It will carry four science instruments covering wavelengths from 0.6 to 28 microns.

In this talk, Dr. Heidi B. Hammel (JWST Interdisciplinary Scientist) will review JWST’s scientific objectives, its hardware and technology development, and the predicted system performance. She will also provide an overview of the review of JWST that was commissioned by Congress, and discuss the current status of the project.

May 18: “Construction on the 10,000 Year Clock Begins”—Alexander Rose, Executive Director and Clock Project Manager, Long Now Foundation

20 years ago computer scientist Danny Hillis thought up a monument scale slow moving mechanical clock to serve as an icon to long-term thinking. 10 years ago a first prototype was completed and put into the Science Museum of London. 5 years ago the full size clock project began design. A few months ago that project began construction. Project manager Alexander Rose will discuss the process and methods underway in the Clock of the Long Now.

May 25: “Why Can’t Mimas Be More Like Enceladus?”—Bill McKinnon, Department of Earth and Planetary Sciences, Washington University at St Louis

Colloquiums run from Noon to 1 PM on Wednesdays and at 7:30 PM one evening per month. Location: SETI Headquarters at 189 N. Bernardo Ave., Mountain View ([map](#)). Free. Lectures are available on YouTube at: <http://www.youtube.com/setiinstitute>

Young Astronomers



Hello Young Astronomers

Please read the President's Message on Page 2. You will certainly want to visit the *Beyond* exhibit in Petaluma between May 7 and July 4.

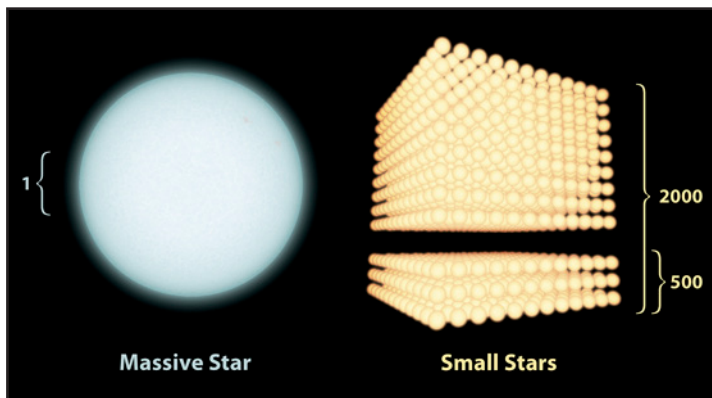
You are also encouraged to contact me to assist at the Saturday evening star party events next to the Museum. My email is [lennelsn\(at\)comcast.net](mailto:lennelsn(at)comcast.net)

There is not much room there and I am not at all certain how many volunteers we can comfortably fit into a small area and allow the public to mingle among us for good views of the crescent Moon and Saturn and to carry on conversations.

The RFO will also most certainly be a good place to go on Saturday, May 7, *Astronomy Day*, to allow you to see more than the Moon and Saturn.

Plan to come and by all means please let me know should you have any questions.

—Len Nelson, SCAS President



Astronomers have recently found that some galaxies have as many as 2000 small stars for every 1 massive star. They used to think all galaxies had only about 500 small stars for every 1 massive star.

Cosmic Recount

by Dr. Tony Phillips

News flash: The Census Bureau has found a way to save time and money. Just count the biggest people. For every NBA star like Shaquille O'Neal or Yao Ming, there are about a million ordinary citizens far below the rim. So count the Shaqs, multiply by a million, and the census is done.

Could the Bureau really get away with a scheme like that? Not likely. Yet this is just what astronomers have been doing for decades.

Astronomers are census-takers, too. They often have to estimate the number and type of stars in a distant galaxy. The problem is, when you look into the distant reaches of the cosmos, the only stars you can see are the biggest and brightest. There's no alternative. To figure out the total population, you count the supermassive Shaqs and multiply by some correction factor to estimate the number of little guys.

The correction factor astronomers use comes from a function called the "IMF"—short for "initial mass function." The initial mass function tells us the relative number of stars of different masses. For example, for every 20-solar-mass giant born in an interstellar cloud, there ought to be about 100 ordinary sun-like stars. This kind of ratio allows astronomers to conduct a census of all stars even when they can see only the behemoths.

Now for the real news flash: The initial mass function astronomers have been using for years might be wrong.



NASA's Galaxy Evolution Explorer, an ultraviolet space telescope dedicated to the study of galaxies, has found proof that small stars are more numerous than previously believed.

"Some of the standard assumptions that we've had—that the brightest stars tell you about the whole population—don't seem to work, at least not in a constant way," says Gerhardt R. Meurer who led the study as a research scientist at Johns Hopkins University, Baltimore, Md. (Meurer is now at the University of Western Australia.)

Meurer says that the discrepancy could be as high as a factor of four. In other words, the total mass of small stars in some galaxies could be four times greater than astronomers thought. Take that, Shaq!

The study relied on data from Galaxy Evolution Explorer to sense UV radiation from the smaller stars in distant galaxies, and data from telescopes at the Cerro Tololo Inter-American Observatory to sense the "H-alpha" (red light) signature of larger stars. Results apply mainly to galaxies where stars are newly forming, cautions Meurer.

"I think this is one of the more important results to come out of the Galaxy Evolution Explorer mission," he says. Indeed, astronomers might never count stars the same way again.

Find out about some of the other important discoveries of the Galaxy Evolution Explorer at <http://www.galex.caltech.edu/>. For an easy-to-understand answer for kids to "How many solar systems are in our galaxy?" go to The Space Place at: <http://tiny.cc/I2KMa>

—Article provided by JPL/NASA

SPECTACULAR AURORA VIDEO

Far north photographers have been taking photos of the amazing aurora activity last month due to increased solar storms. See the video and links to other images at: <http://www.space.com/11371-video-northern-lights-aurora-amazing-sorgejerd.html>

The Universe in a Mirror (from page 3)

surface of our planet. As humanity has gazed at the heavens, since Galileo's use of the telescope in the seventeenth century, our view has been hampered by the blurring and translucent atmosphere. This one hundred mile-wide band of hazy and undulating air also obliterates large portions of the electromagnetic spectrum, including the majority of the infrared and all of the ultraviolet, x-ray, and gamma ray wavelengths. Consequently, Earth-based spectroscopy [2] is handicapped because the most interesting elements have a spectral signature found in these shorter wavelengths.

Naysayers of space-based telescopes cited many reasons for their resistance during the 1960s. These negatives, many of which made sense, included:

- The two hundred-inch Hale Telescope had not yet been fully mined by the astronomical community
- Money spent in space would cannibalize earth-based telescopes and their funding
- The proposed \$100M cost of building the first Large Space Telescope or LST could, instead, be used to build ten more Hale telescopes
- Such a vast investment could be lost during launch
- The myriad of technical challenges of simply building a telescope that could survive launch and its subsequent operation in space
- The difficulty in ensuring a stable platform in space to aim the telescope and lock onto its target

Such objections were underscored by Gerald Kuiper, in 1953, when he first heard of Lyman Spitzer, Jr.'s proposal [3] for a space-based telescope, "I would regard the [funding] of this project hazardous and probably undesirable." Kuiper later became the driving force behind the early build-out of Earth-based telescopes on the Hawaiian Islands in the 1960s [4].

The Large Space Telescope is Born

Then Sputnik happened, in 1957, and the United States was driven into a satellite development frenzy. The greatest technical challenge for an orbiting telescope was its ability to stay on target for thousands of seconds at a time as it traveled at 17,500 miles per hour. Then the captured images would have to be returned to the Earth's surface. In 1965, the Woods Hole Summer Study produced a 600-page report that led to the establishment of a committee in 1966 to build the Large Space Telescope. Most of the earlier objections were overcome.

Budget wrangling at NASA, political foes and advocates doing battle over the merits of telescopes in space, coupled with technology advances over the next decade, eventually led to a July 1977 appropriation bill, which included \$475 million for the LST. Two main contractors were also chosen:

1. Perker-Elmer of Danbury, Connecticut for the optical telescope assembly holding the mirror, its frame, and the fine guidance sensors needed to keep the telescope locked on target [5] for \$69 million.
2. Lockheed Missiles and Space Company of Sunnyvale, California for the telescope support systems module, including the gyros, power supply, and body for \$83 million.

Needless to say, these bids were symptomatic of undercutting competing bids to secure the contract with hopes of recouping the company's real costs later – Hubble would eventually cost more than \$900 million.

One of the technology advances came from the field of video imaging and the ability to beam images from space. This technology was being perfected with the use of still image capture on space probes to Mars (Project Viking) and for those making the Grand Tour of the outer planets of the Solar System (Project Voyager).

Astronomers came to appreciate that the space telescope was essential to the future of astronomy. From here, the astronomy community got behind the program for launching the first general optical observatory into space. Jim Westphal became the Principal Investigator for the LST's camera. He proposed the use of an emerging technology – Charge Coupled Devices or CCDs – as the detector. Westphal overcame the 1976 limitation of 400 x 400 pixels by stitching together an array of four of them to build a 2,000 x 2,000 solution, and he found a way to overcome poor sensitivity to ultra-violet radiation by using a new coating material. The Wide Field/Planetary Camera or WF/PC was born, affectionately called "wiffpic" by its creators. Two subsequent iterations would find their way into orbit on the space telescope in the form of upgrades over the years to come.

Hubble Takes to the Sky

The LST was renamed as the Hubble Space Telescope (HST) in 1983 prior to its eventual launch on April 24, 1990 aboard shuttle Discovery. A four-year delay occurred due to the shuttle Challenger explosion in 1986. First light occurred on May 20, 1991 at 11:12 am when the WF/PC took its first exposure. Something was wrong: the telescope was out of focus. Hubble's mirror, built to produce the sharpest and most clear images for astronomers, was ground wrong. Subsequent software simulations of the received images precisely defined the problem. Such precision led to two actions, one immediate and another two years out.

First, software was developed to autocorrect for the out-of-focus images, thus allowing Hubble to be used for some imaging and, of course, for spectroscopy. Second, a corrective mirror unit had to be quickly developed, launched into space on one of the planned servicing missions, and used as a replacement for one of the science instruments – the High Speed Photometer. Corrective Optics Space Telescope Axial Replacement, or simply COSTAR, built by Ball Aerospace, emerged as the "corrective eyewear" solution. It would redirect light from Hubble's secondary mirror to three different instruments, without blocking light to the camera (WF/PC). COSTAR housed ten mirrors and four adjustable pick off arms needed to align to within one millionth of a meter in support of the required science instruments using the incoming light.

HST needed more than COSTAR to become fully operational. New, more rigid solar panels were needed to stop the telescope's jitter in space as it passed through solar terminations every few hours of its orbit. Three of six gyros needed replacing, two of six memory units in the telescope's computer had to be replaced, and two failed magnetometers, required to help the telescope find its orientation in space, had to be swapped out.

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The Universe in a Mirror *(from page 8)*

Servicing-in-Orbit Becomes a Reality

NASA's Ed Weiler drove the servicing-in-orbit plan for HST and had spent years working with principal investigators on building upgraded science instruments too. An improved Wide Field/Planetary Camera was built (WF/PC2), a new spectrograph dubbed the Space Telescope Imaging Spectrograph (STIS), and an infrared camera imager, dubbed the Near Infrared Camera and Multi-Object Spectrometer (NICMOS).

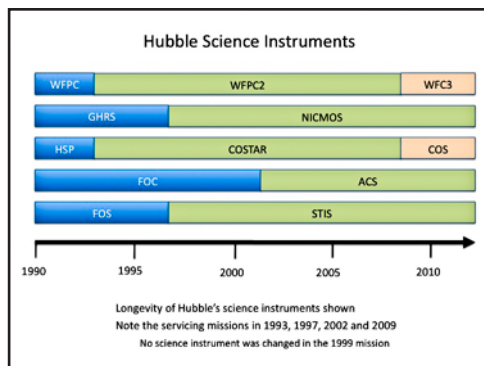
Shuttle Endeavour was launched on December 2, 1993 and successfully repaired Hubble with COSTAR and the upgraded WF/PC2, along with the other fixes. It proved that in-orbit maintenance and repairs of unmanned spacecraft by humans was not only possible, but also doable, a concept first proposed by the creators of the space telescope in the 1960s. Second light on December 18, 1993, proved that Hubble was fixed. Great science began almost immediately.

Servicing missions followed in 1997, 1999, 2002, and 2009 as envisioned by the original plan and conceived during the design phase of Hubble when it was thought shuttle flights would be commonplace.

In 1997, both NICMOS and STIS were installed, replacing the Faint Object Spectrograph and the Goddard High Resolution Spectrograph, respectively. Two gyros and one fine guidance sensor were replaced too and a new solid-state recorder was installed.

In 1999, this third servicing mission became an emergency repair one advanced from June 2000. Three gyros had failed and when a fourth one failed in November 1999, HST went into safe mode, cutting off further science work. The emergency mission, launched on December 19, 1999 led to all six gyros being replaced plus a second fine guidance sensor. Astronauts also installed a new computer, a new voltage and temperature kit for the spacecraft's batteries, a new transmitter, and a new solid-state recorder. Improvised installation of thermal insulation blankets was added to the telescope's outer layers when damage from micro-meteorites was noticed.

During the 2002 servicing mission, two more gyros were replaced as well as Hubble's main power unit and the more rigid solar panels that were installed in 1993. A new permanent cooling unit was installed on NICMOS to bring it back to life after the cryogen in the original cooling unit had sublimated away faster than expected. The Faint Object Camera was replaced with the new Advanced Camera for Surveys (ACS), possessing a field of view two-times the size of WF/PC2 with five-times the sensitivity. It subsequently ceased to operate in 2007 due to a failed power supply.



Graphic courtesy of R.K. Kostrowsky

The Final and Major Overhaul in 2009

In 2009, the servicing mission was driven, in part, by the failure of Hubble's Science Instrument Control and Data Handling Unit. The back-up unit kicked in, but not to have redundancy for a unit that transmits almost all of the telescope's scientific data, including images, to the ground is a serious exposure. Since the data handling unit was an orbital replacement one, it was included on the fifth Hubble servicing mission, which began with the launch of Atlantis on May 11, 2009. Upgrades included the replacement of the now 16-year-old WF/PC2 with the Wide Field Camera 3 and a new set of rechargeable batteries [6]. The data handling unit was replaced as well as the gyroscopes. The STIS repair included the replacement of a failed circuit board, which required the removal and reinsertion of 110 screws to complete the job. The ACS repair required the replacement of four boards in the electronic box and a new power supply box, which was installed on the outside of the instrument.

The Cosmic Origins Spectrograph (COS) replaced COSTAR, the module that corrected Hubble's original blurred vision during the first servicing mission in 1993. Since then, all of Hubble's science instruments were designed with that correction built-in, so COSTAR was no longer needed. This freed up space for COS, a spectrograph with two channels, one to examine far-ultraviolet light, and one to examine near-ultraviolet light. Its streamlined design limits the number of times light bounces off a surface before hitting a detector. Since every time light bounces a little of it is scattered away, the design ensures that the instrument observes the greatest amount of ultraviolet light.

Hubble's Achievements

If we consider the past twenty years or so of operation, Hubble leaves a wonderful legacy of achievement:

- CCD's developed for HST helped kick-start a revolution in photography
- An unending flow of knowledge has helped transform astronomy and change humanity's perception of the universe
- Proved that black holes are ubiquitous throughout the universe
- Unified a number of theories showing that all electro-magnetic radiation is caused by the in-fall of matter into a black hole
- Detected gamma ray bursts and helped show they were linked to unusual supernovae called hypernovae
- Discovered exoplanets with its photometer and their atmospheric elements
- Supported planetary science, revealing auroras above the poles of Saturn and Jupiter
- In cosmology, HST extended the work of Edwin Hubble by determining the precise age of the Universe at 13.7 billion years old
- Determined that the expansion of the universe is accelerating
- Made the early universe accessible with its Deep Field and Ultra-Deep Field imaging
- Introduced an operational model for astronomers that is more democratic and produces more consistent results
- Any researcher can secure access
- More useable data produced
- HST's clarity has led to a passionate increase in the public's interest in astronomy

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The Universe in a Mirror (from page 9)

Humans have an innate need to see a clear image of something. It's wired in our biology with brains tightly coupled to our eyesight. To make sense of something, no matter how much supporting information we have, we need to see it. Hubble made this happen. As author Robert Zimmerman writes, "Before Hubble the human race could not see the sky as it really was, and after Hubble no one wants to return to that state."

—Submitted by R.K. Koslowsky, SCAS Member
<http://worldperspective.bravehost.com/astronomy.html>

Notes:

[1] The Hubble Space Telescope was named in Edwin Powell Hubble's (1889–1953) honor. HST's contributions to cosmology are considered by astronomers to be its most significant contribution; an extension of the work of Edwin Hubble. Recognized by his peers in the scientific community as a giant among them, Edwin Powell Hubble's contributions to astronomy are many and of great significance, including the existence of other galaxies, an expanding universe, and the determination of the age of the universe.

His work profoundly shaped the way the rest of the world viewed the universe, just as many of his predecessors' contributions had influenced him. Copernicus, Kepler, Galileo, Newton, and Herschel defined Hubble's outlook; he studied them at every opportunity. One of the great thinkers of the twentieth century, Albert Einstein, attributed his change of view of the universe to Hubble, from static to dynamic—something his own relativistic equations could not do. While Einstein's theoretical physics defined the expanding universe concept, Hubble's comprehensive telescope work laid its observational basis.

[2] Long before the arrival of the Mariner and Viking spacecraft, astronomers knew from Earth-based spectroscopy, for example, that the Martian atmosphere was quite thin and composed primarily of carbon dioxide. In 1964, Mariner 4 confirmed these results, finding that the atmospheric pressure is only about 1/150 the pressure of Earth's atmosphere at sea level and that carbon dioxide makes up at least 95 percent of the Martian atmosphere.

With the arrival of Viking, more detailed measurements of the Martian atmosphere could be made. Its composition is now known to be 95.3 percent carbon dioxide, 2.7 percent nitrogen, 1.6 percent argon, 0.13 percent oxygen, 0.07 percent carbon monoxide, and about 0.03 percent water vapor. Note that the Morgan-Keeman spectral classification, still used today, puts most stars into spectral types O, B, A, F, G, K, and M ("Oh, Be A Fine Girl, Kiss Me.").

[3] Spitzer wrote the paper, *Astronomical Advantages of an Extra-Terrestrial Observatory* in 1946, emphasizing that it could be built using technology that was either available then or would be in the 1950s.

[4] Dr. Gerard Kuiper worked with NASA and the Department of Defense to test sites on Haleakalā. He was eager to explore possibilities on the Big Island for more earth-based telescopes. While Haleakalā was considered a good site, and telescopes were subsequently developed there, Kuiper preferred to find a

site further above the cloud layer. Having flown over Mauna Kea on the Big Island, Kuiper became interested in its potential and developed a plan for site testing. To support this testing, Dr. Kuiper secured funds to establish a jeep trail to the summit area. In 1964, a NASA-funded 12.5-inch telescope was installed on Pu'ū Poli'ahu and Kuiper's team began "seeing" studies.

Kuiper concluded that "The mountaintop is probably the best site in the world... from which to study the moon, the planets, and stars." With this exclamation, a new industry was born in Hawaii. However, it is evident that the popularity of the Hubble Space Telescope with the public and now the politicians of all stripes have actually resulted in funding for more space-based telescopes over the intervening years of Hubble service and repair missions. Many are specialized telescopes such as Spitzer (infrared astronomy), Galex (ultraviolet astronomy), Swift (gamma ray, x-ray, and a small 12-inch ultraviolet/optical set of detectors), and Kepler (optical photometer detection of a fixed patch of sky), to name a few.

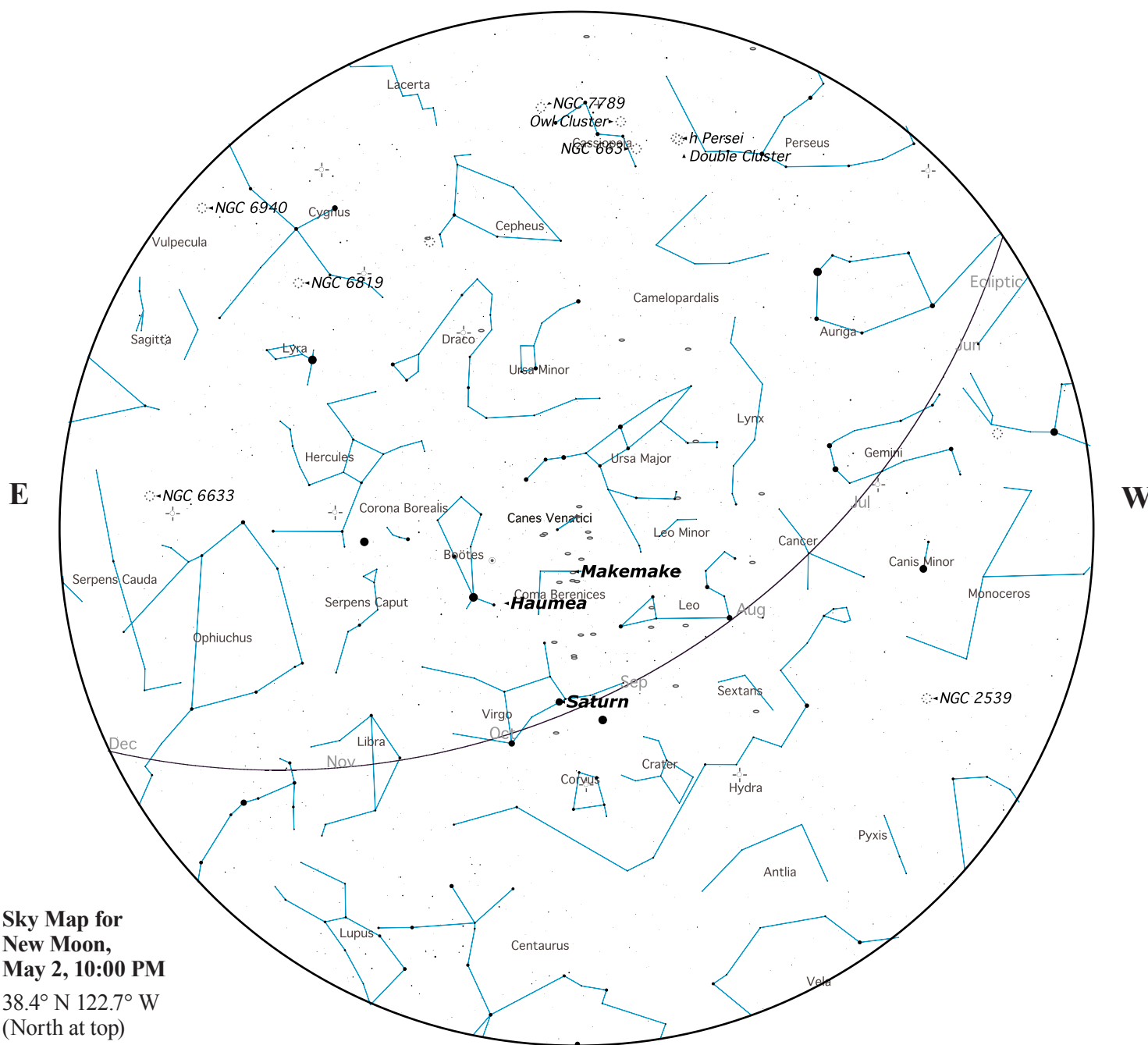
The success found with the many new scientific discoveries of Hubble has also led to funding of more ground-based telescopes as well. As of this writing, the University of Hawaii has just announced plans to build a 30-meter telescope at the summit of Mauna Kea on the Big Island. The Thirty Meter Telescope or TMT will be the size of a blue whale, the largest mammal on Earth. It is being billed as the world's most advanced optical/infrared observatory with capabilities such as observing dark energy and dark matter, connections between black holes and galaxies, and the search for life outside the solar system.

[5] NASA claims that, "if the telescope was in Los Angeles, it could hold a beam of light on a dime in San Francisco without the beam straying from the coin's diameter."

[6] The original Hubble batteries are considered the best rechargeable batteries ever made. By 2004, the telescope had been in orbit for nearly fifteen years and its batteries, manufactured in the 1980s, were almost 25-years-old. More than 75,000 charge and recharge cycles had been completed since launch and the batteries were about ready to be changed out as a decline in their recharge capacity was noted by Hubble operators.

May 2011 Observing Highlights

- 5/2 Mercury in East through 5/20, 05:30. Poor morning apparition. Mercury will be about 4° high 30 minutes before sunrise. Mercury is within 2° of Venus the entire time. Greatest elongation west is on 5/7.
- 5/2 New Moon, 24:00
- 5/3 0.8% Crescent Moon. 4° altitude 23° north of due west at 20:30
- 5/4 3.4% Crescent Moon. 8° altitude 22° north of due west at 21:00
- 5/7 Astronomy Day
- 5/9 Mercury, Venus and Jupiter will be within 3° from 5/9 to 5/13 low in east about 30 minutes before sunrise. Mars is nearby but lower.
- 5/10 First Quarter Moon, 13:30
- 5/17 Full Moon, 04:00
- 5/19 Mercury, Venus and Mars are within 3° about 30 minutes before sunrise low in the east. Jupiter is nearby higher in the sky.
- 5/24 Last Quarter Moon, 12:00



**Sky Map for
New Moon,
May 2, 10:00 PM**
38.4° N 122.7° W
(North at top)

May 2011

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
1	2  Mercury in East	3 0.8% Crescent Moon	4 3.4% Crescent Moon	5 School Star Party Alexander Valley School	6	7 “Beyond” exhibit opens RFO Public Observing Solar: Noon-4 Night: 9PM > Astronomy Day
8 Mercury, Venus, Jupiter together thru 5/13	9	10 	11 SCAS Meeting 7:30 PM	12	13	14
15	16	17 	18	19 Mercury, Venus, Mars together thru 5/23	20	21
22	23	24 	25 School Star Party Austin Creek (tentative)	26	27	28
29	30	31 RFO Night Sky Class (Summer Series Begins) 7:30 PM				

See Pages 4-6 for more detailed information on events.

SCAS Membership Application/Renewal

Annual Membership dues are \$25 due June 1.
(New members joining after Nov. 30 pay \$12.50)

Please complete this form and give to the Membership Director or a Board member with your check, payable to "SCAS," at the next meeting, or mail your dues to: SCAS, P.O. Box 183, Santa Rosa, CA 95402-0183.

New Renewal Family (no extra charge)

Name(s): _____

Email: _____
(Required for *Sonoma Skies*)

Address: _____

City/State/Zip: _____

Telephone: _____

I am interested in serving in one or more of these areas:

- School Star Parties SCAS Board
 Newsletter Striking Sparks
 Mentoring Young Astronomers
 Yosemite Star Party Other _____

New Members please note interests and hobbies you would like us to know about:

New Members please share your reason(s) for joining SCAS, and how you heard about the club:

Your dues include our monthly newsletter *Sonoma Skies*, membership in the Astronomical League and its *Reflector* magazine, discounted subscriptions for *Sky and Telescope* and *Astronomy* magazines, great guest speakers at our monthly meetings, the annual Star-B-Que, and opportunities to meet new and interesting people who share your passion for the night sky and many aspects of astronomy and science.

Welcome to the SCAS!

Sonoma County Astronomical Society (SCAS)

Membership Information

Meetings: 7:30 PM on the second Wednesday of each month, in the Multipurpose Room of Proctor Terrace Elementary School, 1711 Bryden Lane at Fourth Street, Santa Rosa, unless otherwise announced in this publication. The public is invited.

Dues: \$25, renewable June 1 of each year. New members joining between December 1 and May 31 pay partial-year dues of \$12.50.

Star Parties: See the Events section for dates and times.

Rental Telescope: Members are eligible to borrow the club's 80mm refractor with tripod. Contact any Board member listed below.

Egroup URL: Connect with other members about going observing, observing reports and chat about astronomy and news items from AANC and *Sky & Telescope*. Hosted by Keith Payea at kpayea@bryantlabs.net. Any SCAS member is welcome to join. Visit <http://groups.yahoo.com/group/scas> and click the "Join" button, or send an email to scas-subscribe@yahoo.com

Discount Subscriptions: For *Sky & Telescope*, new subscribers may send a check for \$32.95 payable to "SCAS", with your complete mailing address, directly to: Larry McCune, 544 Thyme Place, San Rafael, CA 94903. Once you have received the discount rate, you may renew your subscription by sending your personal check with the renewal notice directly to Sky Publishing. Discount subscriptions to *Astronomy* Magazine occur annually in October. Check *Sonoma Skies* for details.

Library: SCAS Librarian David Simons hosts a library of astronomy books that may be checked out by members at SCAS meetings, to be returned at the next meeting. Videotaped lectures on astronomy may be rented for \$3 per month.

Sonoma Skies is the monthly newsletter of the Sonoma County Astronomical Society (SCAS). Subscription is included as part of membership. Articles and member announcements are welcome and are published on a first come, first served basis, space permitting, and may be edited. **The deadline for submissions is 7 days prior to the end of each month.** Mail to: Editor, SCAS, P.O. Box 183, Santa Rosa, CA 95402, or email publications@sonomaskies.org

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