

# Sonoma Skies

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

December 2011 [www.sonomaskies.org](http://www.sonomaskies.org) Volume XXXIV No. 12

## We need 2012 Striking Sparks Sponsors

There is an opportunity for you or your organization to sponsor a telescope and participate in this worthwhile program. The cost to sponsor a "Striking Sparks" telescope is \$250. The program can not be successful without the support of sponsors.

This will be the 27th year Sonoma County Astronomical Society plans to award telescope to Sonoma County students. Our program's goal is to focus student interest in science and astronomy.

For the 2011-2012 school year, we will be awarding the contest winners telescopes at the Wednesday, March 14, 2012 meeting at Proctor Terrace Elementary School.

Students that have been nominated by their teachers or by SCAS members, write essays about their interest in astronomy and attend SCAS meetings or the Robert Ferguson Observatory between now and February 8, 2012 are eligible to enter the contest. All contest entries must be postmarked no later than Saturday, February 18, 2012. For information see [sonomaskies.org](http://sonomaskies.org) for additional information or [rfo.org](http://rfo.org) for schedules and locations.

Contact Larry McCune, Striking Sparks Coordinator, at: [llmccune\(at\)comcast.net](mailto:llmccune(at)comcast.net)

—Larry McCune, SCAS Striking Sparks Coordinator

## Questionnaire

If you haven't already responded to our questionnaire, please do so right away.

Many members have already responded, but we want to hear from more of you.

Your Board will meet next week to compile all the responses and plan for next year.

Thank you for supporting your club!

## 2012 Venus Transit

with John Whitehouse  
SCAS December 14 Meeting, 7:30 PM  
at Proctor Terrace School

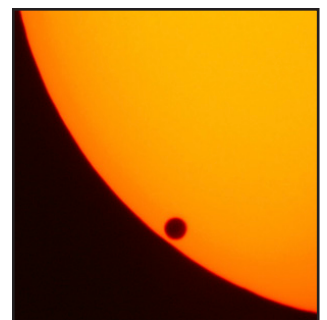
Every once in a while, the master clockwork in the sky gives us the chance to see something coming between us and Sol, our sun. When the moon passes between us, we call that a solar eclipse. When one of the inner planets passes (Mercury and Venus), it's called a transit. (Obviously the outer planets can't transit because they're never between us and the sun).

On June 5, 2012 we should be able to witness the rarest of transits, that of Venus. For our December meeting, SCAS VP John Whitehouse will gather some interesting factoids and tidbits about what makes the Venus transit special.



John Whitehouse and John Dobson viewing the transit of Mercury in 2006 at SRJC.

Because of slight differences in orbital inclinations, Venus transits occur in pairs, separated by about 8 years. But that only happens once in over a century! The last pairs of transits happened about 130 years ago. The first of this set of transit pairs happened in 2004, but since they only last about 6 hours or so, you have to be able to see the Sun, obviously.



2004 Venus transit

That means daytime, a concept confusing to many astronomers, I know. That's not usually the time we're used to seeing stars and planets! So the 2004 transit

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## President's Message

Hello SCAS Members,

I have had the honor of acting as your president for two years, coming before you at each meeting with an attempt to provide you with an entertaining and educational experience before Vice President John Whitehouse, introduces our main speaker.

Trying to provide an interesting first half-hour has been tough at times and perhaps some feel that we should just skip it and get on with the main event so all can go home. But, I felt and feel that most that attend want more than, but trying to lay a finger on exactly what that it should consist of has been challenging.

Two months ago, I suggested that we fly a questionnaire by our membership to see what was wanted. Many good suggestions have emerged and the board will be reviewing them for common themes and new ideas. In the course of 2012, new directions will be tried to catch the imagination, educate and inspire our members.

Keep in mind though that as members, you too need to do your part to make this happen by stepping forth to bring before the SCAS those areas of astronomy that excite you. I am sure you will find that many others will share your interest and be grateful that you were moved to come forward and to be part of the minority that wants to step out of its comfortable shell to take on some level of leadership of the SCAS. Rewards for doing so will surely follow.

Be sure to come to the December 14th for a full program and to express your opinion on the future of the SCAS and elect a new president to light the way into 2012. It will be a year when the Mayan world view will end ((or not) and in which we will witness a transit of the Sun by Venus and, with a relatively short drive from the Bay Area, an annular eclipse of the Sun.

May clear skies await you on your astronomical ventures!

—Len Nelson, SCAS President

## Venus Transit *(from page 1)*

happened while we were either sleeping or observing nighttime stars, because it was happening on the other side of the earth. This year will be better for us, and here in California, we should be able to see most of the transit as the sun is starting to set in the west. This will be the second of this pair, and since the next one will be in the year 2117, this will “probably” be our last chance to see it!

In addition to being a rare and special event to view (using safe solar filters, of course), Venus transits have some interesting history associated with them. We'll look at the scientific significance attached to the transit in the past as well as the present. Also there have been some interesting historical figures associated with the transit, with some interesting stories. Hopefully we'll have some stories to share about some of the interesting figures among the members of SCAS after the transit, too! Be sure not to miss it!

We will talk about the Venus transit at our next meeting on December 14th, 7:30 p.m. at Proctor Terrace School.

—John Whitehouse, SCAS VP

## Solar System, Milky Way, Local Group, Extragalactic Observing

by Jane Houston Jones



Comet/2010 G2 (HILL)

I love to take my telescope out to observe the sky, and I find that the objects studied or discovered by scientists (from the past or the present) make for an even more rich observing (and learning) experience. Here are just a few observations from a fantastic night at Amboy Crater October 22, 2011. Amboy Crater is well worth a visit for daytime hikes as well as for spectacular stargazing at night.

IAU circular No. 9134, issued on 2010, April 11, announced the discovery by R. E. Hill of a new comet on Apr. 10, 2010, in the course of the Catalina Sky Survey. After posting on the Minor Planet Center's NEOCP webpage, many observers checked out this 19.5 magnitude object, designated C/2010 G2 (HILL). (HILL) is well known and well respected Rik Hill of the Lunar and Planetary Lab at University of Arizona, Tucson.

He literally wrote the book about observing sunspots for the *A.L.P.O. Sunspotter program*. I used this book to sketch sunspots and complete the ALPO Sunspotter program last solar maximum in 2002, and I encourage you to complete this amazing program now, as solar maximum is coming up! I observed Rik's comet on October 22, 2011, when it was magnitude 10.78 and 1.5 AU distant from Earth. It was small, the coma diameter was 6.2' – and it was very hard to find! Here's Mojo's lovely image from that night. In the eyepiece the green color was absent, in fact it was nearly a no-see-um! Here's a *finder chart*. Now, off to explore the Milky Way.



NGC7380 emission nebula and cluster

NGC7380 is an open cluster sometimes referred to as the Wizard Nebula located in the constellation Cepheus. It's about 7,000 light-year away from Earth. The stars of NGC7380 have emerged from the star-forming region in the last 5 million years or so, making it a relatively young cluster. Here's the image from NASA's *WISE Mission* of

NGC7380 in 2010. It's a mosaic of images spanning an area on the sky of about 5 times the size of the full moon. Caroline Herschel discovered this cluster on August 7, 1787 when her brother William Herschel was away in London. She discovered many objects, include comets on the nights she was not recording William's famous observations. Let's check out a galaxy in our local group now.

Everyone with a telescope observes the great Andromeda Galaxy, M31 as soon as convenience and sky conditions allow. It's the

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Sonoma Skies, December 2011

## Observing *(from page 2)*



The Great Galaxy in Andromeda, M31, with M32 and M110 nearby

how big or small the telescope might be. Here's the image from NASA's *Spitzer Space Telescope* which studied our neighbor galaxy. Now let's move out beyond our local group and check out something extragalactic.



The Pegasus 1 galaxy cluster

largest galaxy of our galactic family, the *Local Group*, which consists of not only the Andromeda Galaxy, and our own *Milky Way* galaxy, but also the Triangulum Galaxy, M33, and about 30 other smaller galaxies. It's visible with the unaided eye if you know where to look from a dark sky. It's magnificent in binoculars, and unsurpassed in a telescopic view, no matter

how big or small the telescope might be. Here's the image from NASA's *Spitzer Space Telescope* which studied our neighbor galaxy. Now let's move out beyond our local group and check out something extragalactic.

Pegasus 1 Galaxy Cluster is 250 million light years distant. It's not in the local group! The brightest members are a pair of magnitude 11 elliptical galaxies — NGC7619 and NGC7626 — which you can see in Mojo's first image from October 22. Here's a fascinating (and local) *report* on NGC7619 by Mt. Wilson Observatory's Milton Humason written in 1929. In

the early twentieth century, the construction of big telescopes at Mount Wilson (the 60-inch and 100-inch) allowed astronomers to determine the motions of galaxies for the first time.

Milton Humason used the 100-inch telescope on Mt. Wilson. He writes "During the past year two spectrograms of N. G. C. 7619 were obtained with Cassegrain spectrograph VI attached to the 100-inch telescope. This spectrograph has a 24-inch collimating lens, two prisms, and a 3-inch camera, and gives a dispersion of 183 Angstroms per millimeter at 4500. We present new observational results of NGC 7619, an elliptical galaxy with a prominent X-ray tail and a dominant member of the Pegasus group".

More recently, *Chandra and XMM-Newton* observations confirmed the presence of a long X-ray tail on NGC7619. I love seeing objects our space telescopes study and image! And I often spend many enjoyable hours learning the science behind my stargazing targets when I'm back at the armchair.

Here is Mojo's blog + photos from October 22 at *Amboy Crater*.

Here is Mojo's blog + photos from October 29 at *Red Cloud Road*.

## "WHAT'S UP" PODCAST

Using a combination of NASA images, beautifully clear graphics and her own narration, Jane Houston Jones does an outstanding job of explaining what you can expect to see in the night sky each month. Find Jane's podcasts here: <http://solarsystem.nasa.gov/news/whatsup.cfm>

## The Astronomer's Scissors

by  
Herb  
Larsen



Wow, for a minute there I thought I had discovered a new red giant in Orion. But, it was just Rudolph.

SCAS cartoonist Herb Larsen can be contacted at [hlarsenii@yahoo.com](mailto:hlarsenii@yahoo.com)

## WELCOME, NEW MEMBERS

The SCAS wishes to welcome new members Lisa, Anthony, Alex and Teddy Consani; Russ and Susan Kerby; and Stephen Chavin.

## SOCIAL AMENITIES

Many thanks to Loren Cooper for providing refreshments, and to Jim DeManche for acting as greeter at our November 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

No Public Events in December

Next event: Saturday, January 21

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 solar viewing; donations are appreciated. Observatory night viewing fee: \$3 for adults 18 and over; children admitted free. The Park charges \$8 per vehicle for entry at all times. Info: [www.rfo.org](http://www.rfo.org)

## RFO YOUTUBE CHANNEL

Visit RFO's new YouTube channel at <http://www.youtube.com/user/RFObservatory> to see the YU55 Near-Earth Asteroid videos taken with RFO's CCD camera, along with other interesting astronomy videos.

## SSU OBSERVATORY PUBLIC VIEWING

Dec. 2, 6:00 PM: "Jupiter and the 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>

## MORRISON PLANETARIUM DEAN LECTURE SERIES

Dec. 5, 7:30 PM: "The Dark Side of the Milky Way"—Dr. Leo Blitz, Professor of Astronomy, University of California Berkeley

The Milky Way is both a beautiful sight in the night sky and the nearest galaxy that astronomers can study. It is also home to many of the most spectacular images coming from the Hubble Space Telescope. But in its heart of darkness lurks a black hole with a mass millions of times greater than that of the Sun. In its outermost parts, the Milky Way is cloaked by dark matter: mysterious material of unknown, probably exotic composition that produces strange, observable effects at the Galaxy's periphery. Dr. Blitz will describe the Galaxy we know and see, as well as the black core and dark mantle of the Milky Way we cannot.

Lectures sell out early, so reserve now. Call 800-794-7576 for reservations. Adults \$12, Seniors \$10, Members \$6. <http://www.calacademy.org/events/lectures/>

## SRJC PLANETARIUM

"First Friday Night Sky"—Dec. 2 at 7:00 and 8:30 PM:

Admission Free. Focus is on the stars, constellations, planets and other interesting facts about the current night sky.

Seating is on a first-come, first-served basis; so arrive early enough to pick up your free parking permit, return it to your vehicle, and arrive back in the planetarium by the scheduled start time. Info: 527-4372, <http://www.santarosa.edu/planetarium/>

## Community Outreach

### Event Horizons

The Changing of the Seasons  
(Rainy season, that is)

The Austin Creek star party on Wednesday, November 2nd, was another success. Lynn Anderson, Frank Siroky, Emilio Ricci, Len Nelson Loren Cooper, Len Nelson and Sparks winner Conner Nielson provided telescope viewing for around 100 of the school's students and family members. One more November star party (Old Adobe on Wednesday the 30th,) will probably have already happened by the time you read this, but the deadline to get this to the bulletin editor came first.

**In December** we have another Petaluma area school hoping for a clear night to view the stars. That would be Valley Vista Elementary, on Tuesday, December 13th, with Thursday the 15th as a back-up date.

**January** again has Petaluma area schools on the star party calendar with Mary Collins Charter on Friday, Jan. 20th, Dunham Elementary on Wednesday, Jan. 25th, and River Montessori on Friday the 27th.

With Lynn's "promotion" to the office of SCAS President, there is a need for a new Director of Community Activities.

The primary duty of the DoCA is to coordinate the outreach calendar – the scheduling of astronomy activities and events and recruiting of volunteers to staff these events, including the Yosemite weekend. Most (if not all) of the potential school star party dates have already been booked for the remainder of the school year. Lynn and Len will still be available for classroom presentations. The DoCA will also attend the monthly SCAS Board meetings and submit a monthly article for Sonoma Skies.

If you have an interest in participating in public astronomy (or have the time to take over the DoCA duties) and are not already on the volunteer list, contact Lynn at [astroman\(at\)sonic.net](mailto:astroman@sonic.net) to receive email announcements about upcoming volunteer opportunities. If you know of a teacher who might be interested in an evening star party, solar viewing or a classroom presentation, do share Lynn's contact information with them.

—Lynn Anderson, SCAS Director of Community Activities



# Events

## SETI INSTITUTE COLLOQUIUM

**Dec. 7, 7:00pm: “The Search for Habitable Exoplanets in the Kepler Era and Beyond”**—Sara Seager, Planetary Science and Physics, MIT

For centuries people have wondered, “Are we alone?” With hundreds of planets now known to orbit other stars, we are finally able to begin answering the ancient questions, “Do other Earths exist? Are they common? Do any have signs of life? NASA’s Kepler space telescope will soon tell us the statistical numbers of Earth-size planets orbiting sun-size stars. Beyond Kepler is the search for potentially habitable worlds around nearby, sun-like stars. Professor Seager will discuss how astrobiology and space engineering research will come together to enable us to discover and identify other Earth-like worlds.

**Dec. 14, 12:00pm: “Resonances and the Angular Momentum of the Earth-Moon System”**—Matija Cuk, SETI Institute

The prevailing theory for the formation of the Moon is a giant collision between proto-Earth and a Mars-sized protoplanet, with the Moon being mainly made from the impactor’s material. It is now known that the composition of the Moon is too similar to Earth’s mantle to be derived from the impactor, seriously questioning the giant impact theory. However, this is a problem only if we assume that little or no angular momentum was lost from the system since its formation. While lunar tides keep the angular momentum in the system, certain resonances can transfer angular momentum to Earth’s heliocentric orbit. These resonances are important if the Earth-Moon system formed with a much larger angular momentum, and can evolve the system to the present state. Dr. Cuk will show how it is likely that the Moon likely formed in a impact-triggered fission different from the “classical” giant impact scenario.

**Colloquiums** run from Noon to 1 PM on Wednesdays and at 7:00 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>

## TAYLOR OBSERVATORY

Located in Kelseyville off Highway 29

**“Mystery of the Christmas Star” Planetarium Shows:** November 24, 2011- January 7, 2012 (Fri. & Sat. only 7pm, 7:45pm & 8:30pm) Show prices: \$6/Adult \$3/Children under 12yrs; not recommended for children under 5yrs; \*Reservations recommended.

Info: 707/262-4121 or <http://www.taylorobservatory.org>

## Comets and Habitability

On October 12, 2011, the Sonoma County Astronomical Society (SCAS) hosted Kamal S. Prasad [1], who is part of NASA’s Public Outreach. Prasad spoke on “Comets and Habitability.” Occasionally people have looked up into the night sky and observed strange, glowing objects trailing luminous tails behind them as they moved slowly among the stars. Sometimes these moving bodies have terrified people with their mysterious comings and goings, but they always brought some sense of awe and wonder. Today, many researchers believe that comets may have had something to do with life arising on earth.

Prasad shared his thoughts about comets and habitability. When we look for where life might exist, most biologists simply, “follow the water.” It seems that the evolution of life depends on a planet having liquid water – a

*“Comets are a library of our history,” says Thomas Duxbury of NASA’s Jet Propulsion Laboratory in Pasadena, California. This simple fact drives scientists to study comets and deduce clues as to the formation of the Solar System and determine how life on Earth began.*  
– January 2006

planet located in the so-called “Goldilocks zone” or habitable zone. So, if life depends on water, where did it all come from? Many theorize that some water came from comets flying around the solar system and asteroids straying from their orbit between Mars and Jupiter, striking Earth, and releasing water and other organics that life depends upon to arise and thrive.

### Comet History

The term comets come from the Greek word kometes, meaning hairy. It was used originally with the word aster, meaning star. The Greeks tied the origin of this name for comet, “hairy star,” to the Egyptians.

Democritus, not Aristotle, accurately described the origin of comets. He believed that comets were produced when one “star” passed by another [2]. Given present day knowledge of the Oort cloud and the subtle gravitational tugs that can precipitate a cometary event, Democritus seems to have been on the right track. His idea was better than Aristotle’s, who postulated that since the heavens were perfect and unchanging, comets were merely atmospheric phenomena.

Comets were thought by the ancients to be associated with death and destruction, omens of doom. They invoked instinctive fear of the unknown. As Homer’s Iliad suggests:

*“Like the red star, that from his flaming hair  
Shakes down diseases, pestilence, and war.”*

Greek historian Nicetus Acominatos, described the comet of 1182 AD, “After the Latins had been driven from Constantinople, an omen was seen of the rages and crimes to which Adronicus was about to abandon himself. A comet appeared in the sky: like a coiled snake, it sometimes stretched out and sometimes bent back on itself. Sometimes, to the horror of the onlookers, it opened its enormous snout, as though, greedy for human blood, it was about to drink its fill.”

Understanding began to replace ignorance once Tycho Brahe, in 1577, determined that comets were further away from Earth than the Moon, proving that Aristotle was wrong and that a comet could not be an “exhalation” occurring in the Earth’s atmosphere.

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# Young Astronomers

## Total Lunar Eclipse

A solar eclipse of the annular kind is in the stars for you in late May of 2012 and a transit of the Sun by Venus in early June.

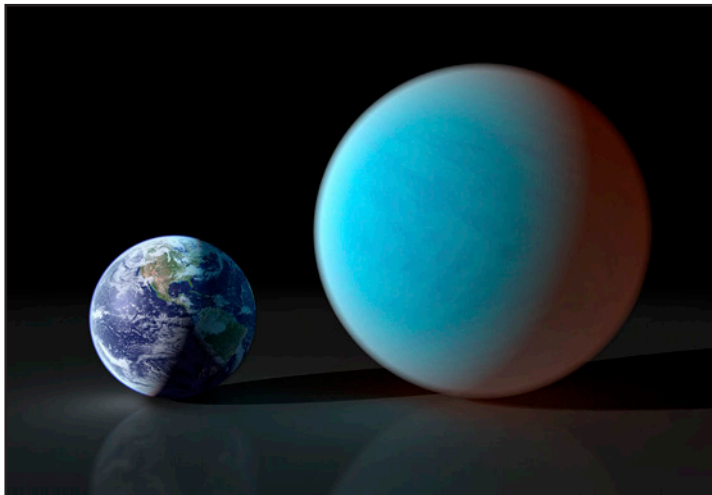
But, what's new and exciting a bit sooner you ask? That would be a total lunar eclipse the morning of December 10 and all you'll need to do is get up a bit earlier than usual that day to catch it in the deep western sky around 7:00 AM.

Your challenge, assuming the sky is clear that morning (or at least the western sky) is to locate, in advance, a place to go that gives you an unimpeded view of the west. The Moon will set at 7:21 AM and the Sun will rise at 7:16 AM so the Moon will be right on the horizon for the eclipse.

Only a spot on the Pacific shore comes to my mind at this moment as a good possibility so I suspect I'll be driving out that way at about 5:00 AM to be ready and hope for the best. Should you wish to join me, let me know and we will coordinate the venture. Should be fun! I'll leave it up to you to arrange for clear skies that morning. Keep your fingers crossed too. :-)

Clear Skies,

—Len Nelson, SCAS President



Artist's rendering compares the size Earth with the rocky "super-Earth" 55 Cancri e. Its year is only about 18 hours long!

## Re-thinking an Alien World: The Strange Case of 55 Cancri e

Forty light years from Earth, a rocky world named "55 Cancri e" circles perilously close to a stellar inferno. Completing one orbit in only 18 hours, the alien planet is 26 times closer to its parent star than Mercury is to the Sun. If Earth were in the same position, the soil beneath our feet would heat up to about 3200 F. Researchers have long thought that 55 Cancri e must be a wasteland of parched rock.

Now they're thinking again. New observations by NASA's Spitzer Space Telescope suggest that 55 Cancri e may be wetter and weirder than anyone imagined.

Spitzer recently measured the extraordinarily small amount of light 55 Cancri e blocks when it crosses in front of its star. These transits occur every 18 hours, giving researchers repeated opportunities to gather the data they need to estimate the width, volume and density of the planet.

According to the new observations, 55 Cancri e has a mass 7.8 times and a radius just over twice that of Earth. Those properties place 55 Cancri e in the "super-Earth" class of exoplanets, a few dozen of which have been found. Only a handful of known super-Earths, however, cross the face of their stars as viewed from our vantage point in the cosmos, so 55 Cancri e is better understood than most.



When 55 Cancri e was discovered in 2004, initial estimates of its size and mass were consistent with a dense planet of solid rock. Spitzer data suggest otherwise: About a fifth of the planet's mass must be made of light elements and compounds—including water. Given the intense heat and high pressure these materials likely experience, researchers think the compounds likely exist in a "supercritical" fluid state.

A supercritical fluid is a high-pressure, high-temperature state of matter best described as a liquid-like gas, and a marvelous solvent. Water becomes supercritical in some steam turbines—and it tends to dissolve the tips of the turbine blades. Supercritical carbon dioxide is used to remove caffeine from coffee beans, and sometimes to dry-clean clothes. Liquid-fueled rocket propellant is also supercritical when it emerges from the tail of a spaceship.

On 55 Cancri e, this stuff may be literally oozing—or is it steaming?—out of the rocks.

With supercritical solvents rising from the planet's surface, a star of terrifying proportions filling much of the daytime sky, and whole years rushing past in a matter of hours, 55 Cancri e teaches a valuable lesson: Just because a planet is similar in size to Earth does not mean the planet is like Earth.

It's something to re-think about.

Get a kid thinking about extrasolar planets by pointing him or her to "Lucy's Planet Hunt," a story in rhyme about a girl who wanted nothing more than to look for Earth-like planets when she grew up. Go to <http://spaceplace.nasa.gov/story-lucy>.

The original research reported in this story has been accepted for publication in *Astronomy and Astrophysics*. The lead author is Brice-Olivier Demory, a post-doctoral associate in Professor Sara Seager's group at MIT.

—Article provided by JPL/NASA

## Comets & Habitability *(from page 5)*

Tycho Brahe collaborated with other astronomers across Europe to observe the great comet of 1577. Upon comparing multiple measurements, the European astronomers found none of the parallax that would surely be evident had comets in fact been as close as Aristotle predicted.

Edmond Halley applied Newton's principles and made predictions of comet reappearances. He noted that the comet of 1531 seen by Appian, the comet of 1607 seen by Kepler, and the third one seen by him in 1682 were one in the same. His fame was cemented because he dared to identify the periodicity of comets. He predicted that this comet, named Halley's Comet [3], would return in 1758. It did, arriving on Christmas of that year and remained visible for five months. Professor Alice Farnsworth created a jingle to help students remember the pertinent details of the famous comet:

*"Of all the objects in the sky  
There's none like Comet Halley.  
We see it with the naked eye  
And periodically.  
The first to see it was not he  
But still we call it Halley.  
The notice that it should return  
Was his originally."*

Fred Whipple proposed the "dirty-iceberg" theory of composition of comets in the 1950s. His ideas that the volatile substances are all expelled after a long period, leaving only solid mineral, were confirmed in 1986.

### Comets Come Into Being

Comets were formed during the early Solar System, when there was just a proto-planetary disk of rotating material. Higher-density material like iron was closer to the Sun, and the lower-density materials, such as ices, were further out. Comets formed from the leftover material.

However, there have been comet oddities recently observed. A number of comets have two ends that contain varying amounts of dry ice suggesting that the two halves were probably formed in separate places in the early Solar System, and likely later collided and stuck together. The two differing halves of Hartley 2's nucleus are an example of this hybrid type of comet.

Astronomers also believe that there is a second source of comets, established when the Sun was still a young star. It may have gravitationally captured the "dusty" Oort cloud comets formed elsewhere in the galaxy. The birthplace of the majority of the famous comets, including Halley, Hale-bopp and McNaught is likely the Oort cloud. Researchers conclude that more than 90 percent of the observed Oort cloud comets have an extra-solar origin.

### Comets Seed the Planets

Comets were a water source for thirsty Earth. Numerous comets existed during Earth's early orbit. They wouldn't have vaporized since their in-orbit velocities would have matched closely with that of Earth and thus collided with the planet by catching up or being overtaken instead of slamming into it. Consequently, water and other organic material would have seeded Mother Earth.

Validation for this view was recently given credence when the higher ratios of heavy water seen in Oort Cloud comets

compared to Earth's oceans was detected. Astronomers previously believed the contribution by comets to Earth's total water volume was about 10 percent. Asteroids, found mostly in a band orbiting between Mars and Jupiter that occasionally stray into Earth's orbit, looked like the major depositors. The new results, however, point to Kuiper Belt comets as having performed a previously underappreciated service in bringing water to Earth.

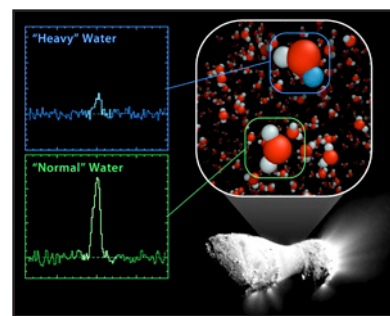


Image of Hartley 2 and analysis of water  
courtesy of NASA

Comets come from both the Kuiper Belt and Oort Cloud, the latter possessing a 100,000 AU diameter. Neptune is a big influence on the Kuiper belt with many an asteroid pushed out of its orbit and into a trajectory heading toward the Sun. Stars are the big influence on objects in the Oort Cloud and, as the Solar System approaches other star systems, and their gravitational pushes and pulls, comets are similarly hurtled toward the Sun. So, Democritus was right. Today, in fact, most comets are believed to have extra-solar origins, that is, comets coming from other star systems.

Using spectrography, it is known that comets are made largely of compounds of carbon, oxygen, nitrogen, and hydrogen. These compounds include water, ammonia, methane, carbon monoxide, and smaller amounts of other, more complex compounds. The dust in comets is composed of silicates and some metals. Recently, ethane gas was detected in comet Hyakutake (C/1996 B2).

The tail of a comet is an indication of material lost. The comet literally wears itself out as it returns to swing around the Sun time and time again, losing somewhere between 0.1 and 1 percent of its mass with each approach. It is estimated that comets can return between 100 and 1,000 times before all of its volatile material is driven off.

### Comet Components

Comets consist of three main parts, the coma, the nucleus, and the tail. The coma is the fuzzy envelope that varies with size of the comet and its proximity to the Sun. This property distinguishes the comet from an asteroid. A comet's coma lengthens and expands as it approaches the Sun, sometimes reaching tens of thousands of miles in diameter. A sharp nucleus is at the heart of the comet, only a few miles or less in diameter and located near the center of the coma.

Many comets have two tails, a dust tail and an ion (or gas) tail as shown in the image below; some have three tails. The comet is encased in a hydrogen envelope as it orbits the Sun.

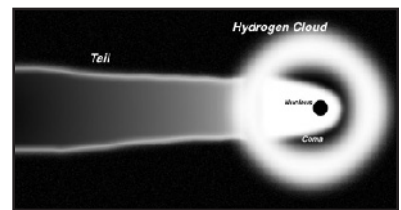


Image courtesy Smithsonian

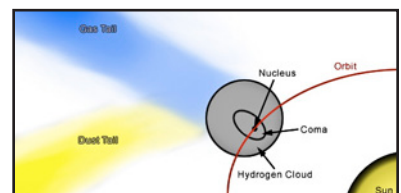


Image courtesy of Robbins

*continued Page 8*

## Comets & Habitability *(from page 7)*

The tails of a comet form because of the sun's solar wind that peppers the orbiting body. The solar wind dislodges gas and dust from the comet and forces the material into relatively narrow tails, which always point away from the sun. This directionality occurs even when the comet is traveling away from the sun, so that it is, in effect, following its tail.

The tails of a comet tails are often very long. When the Great Comet of 1843 was nearest the Sun, its tail was measured to be about 300 million miles long, extending beyond the orbit of Mars. The comet tail shown in blue below is the ion tail, and the green glow is the hydrogen cloud surrounding the coma of Comet 12p/Holmes observed in 2007.



Comets can follow an elliptical, parabolic, or hyperbolic path. Only the elliptical paths allow for their return for repeated visits to the inner planets of our Solar System as they orbit the Sun. Comet Halley returns every 76 years.

### Comet Missions – the Probes

Comet composition has been determined using spectroscopy on the trailing material and by collecting dust from a number of them. The European Space Agency's (ESA's)

Giotto spacecraft [4], for example, passed closest to the nucleus of a comet. Its images of comets Halley and Grigg–Skjellerup showed for the first time the shape of a comet nucleus and found the first evidence of organic material. Most of the comets' surface was dark black in color, with only a 4 percent albedo. Giotto was ESA's first deep-space mission.

This spacecraft observed particles of carbon (C), hydrogen (H), oxygen (O), and nitrogen (N) streaming from comet Halley. The chemical mix was surprising since the comet possessed almost identical proportions to those found in humans. Gene Shoemaker [5] had already confirmed in 1960 that meteors (comets or asteroids striking Earth) formed most of the craters found on Earth, and on the Moon for that matter. Could it be that these elements delivered by comet strikes millions of years ago, enabled life to begin? Many cosmologists believe a rain of comets striking Earth, as the Solar System formed, planted the seeds of life. In a 1991 Marcus and Olsen paper, "Biological Implications of Organic Compounds in Comets," the elemental percentages of C, H, O, and N were almost identical. Furthermore, some scientists believe that phosphorus (P) found in all living cells arrived on Earth from comets bearing a more reactive form of phosphorus - phosphinate. Researchers at the University of Leeds bolstered these claims by verifying that phosphinates were found in a fragment of the 1516 AD Nantan meteorite discovered in China. Comets appear to have played a key role in diversifying life on earth - a veritable celestial rolling of the evolutionary dice.

*Stardust and Stardust-NExT – Two Missions in One and More*  
Another mission, NASA's Stardust comet hunter, was initially developed to explore comet Wild-2. Launched on February 7, 1999, Stardust flew past the asteroid named Annefrank and

traveled halfway to Jupiter to collect particle samples from the coma of comet Wild 2 on January 2, 2004. The spacecraft returned to Earth's vicinity on January 15, 2006 to drop off a sample return capsule eagerly awaited by comet scientists [6].

Stardust flew through a hail of rocks and dust that make up comet Wild 2's coma, collecting invaluable samples of cometary particles that are helping scientists decipher the history of the Solar System. During its long voyage Stardust also picked up miniscule particles of interstellar dust that entered our solar system from distant stars. This secondary aspect to the mission provided excitement for another group of planetary scientists.

Stardust collected these interstellar particles between February and May 2000, and then again between August and December 2002, while passing through a stream of dust that flows into the Solar System from interstellar space. The stream was discovered by NASA's Galileo spacecraft, in 1993, as it traveled to Jupiter. When Stardust flew through this same stream it extended its aerogel collector [7] for a total of 195 days, picking up and storing the interstellar particles to accompany the already collected cometary particles [8]. No particles from distant stars had ever been collected before.

Researchers are convinced that the study of cometary particles will explain how ancient materials in conjunction with certain conditions spawned life on Earth. This analysis of the dust particles continues today.

### Deep Impact

NASA's Deep Impact mission [9] to comet Tempel 1 revealed that water exists in comets and suggested that water on Earth must have come from comets.

The Deep Impact spacecraft was launched in January 2005 to intercept Tempel 1. Its impactor contained a targeting sensor that relayed images as it descended to the surface before being vaporized at impact. The initial vapor burst sped out at 5 km/sec, followed by an expanding dust plume moving at 1 km/sec. Tempel 1 is charcoal in color with a number of features. It has large, smooth, young surfaces as well as impact craters, striped terrain (old material), and scarps (retreating highlands). The comet is 70 percent porous, meaning that it is primarily empty. Its density is only 0.4 g/cm<sup>3</sup> and Tempel 1 could easily float in water if there was a dish large enough to hold it. After the impact, the development of the impactor's crater took about five minutes, suggesting the comet had a very weak internal structure.

These missions have informed new conclusions to be drawn about comets and asteroids. Comets are a weak collection of talcum-powder-sized silicate dust. They are comprised of about 30 percent of ices (mostly water) found below the surface dust. Tempel 1, for example, does not have a uniform composition either as most of its southern side is made up of carbon dioxide. Asteroids, on the other hand, range from wimpy ex-comet fluff to solid slabs of iron. They can be rubble piles of rocks such as asteroid Itokawa or shattered, but coherent rock structures like Eros.

### Comets and Popular Culture

Comets continue to be featured in popular culture. Building upon the long-held tradition of viewing comets as harbingers of doom and as omens of impending Armageddon. Halley's Comet

*continued Page 9*

## *Comets & Habitability* (from page 8)

alone caused a torrent of frightening and incredulous publications and media reports during its 1910 and 1986 reappearances. Furthermore, the birth and death of some notable persons coincided with separate appearances of the comet, including Mark Twain, who accurately predicted that he'd "go out with the comet" of 1910, and others. In science fiction, the impact of comets on Earth has been depicted as a threat overcome by technology and heroism (Deep Impact, 1998), or as the beginning of a global apocalypse (Lucifer's Hammer, 1979) or marking the arrival of waves of zombies (Night of the Comet, 1984). Near impacts have been depicted in books like Jules Verne's *Off on a Comet*, or in movies such as *Armageddon*, 1998.

What do comets, these orbiting rocks in space, have in store for the future, besides providing more fodder for books and movies? They can provide humanity's future sources of raw material. This makes economic sense, since to send material into low earth orbit to build space cities currently costs \$10,000 per pound. The most efficient way to build in space is to use the raw materials already there. Returning comets and also asteroids have both the required fuel (water can be broken down into oxygen and hydrogen) and the necessary water to quench the thirst of carbon-based organisms.

From the very earliest of analyses of comet dust, the percent molecular composition of comet dust matched closely with the percent molecular composition of humans on Earth. Other scientists are trying to unveil the secrets of the start of life on Earth. They are being aided by space probes, which have become "the archaeologists of the heavens." The rich saga of the comet continues to be written.

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

### Notes:

[1] Kamal S. Prasad got his undergraduate degree in Physics from University of California, Santa Cruz with minors in Astronomy and Education. He has taught high school physical science and written a science picture book about gravity. He works at the NASA Education and Public Outreach group at Sonoma State University. Outside of work, he is an environmental and animal rights activist.

[2] Democritus of Abdera argued that comets are a 'coalescence of two or more stars so that their rays unite.' Thinking along similar lines, Anaxagoras of Clazomenae held that 'two or more stars being in conjunction by their united light make a comet, when they appear to touch each other because of their nearness.'

[3] Comet Halley is estimated to have a mass of 25 million tons, which is only about 5 percent of the amount of material excavated during the building of the Panama Canal. It is an airy structure with a miniscule average density of half an ounce per cubic mile.

[4] Giotto spacecraft encounter with Comet Halley: [http://www.esa.int/esaSC/120392\\_index\\_0\\_m.html](http://www.esa.int/esaSC/120392_index_0_m.html)

[5] Gene Shoemaker (1928 - 1997), the 'Father of the Science of Near Earth Objects,' made a significant contribution to twentieth century science by challenging the status quo and establishing a new branch of science - Astrogeology. He brought together his experiences as a geologist and his desire to study celestial

objects in the mapping of planets and the tracking of comets and asteroids. Prior to his accidental death in 1997, Gene contributed more than thirty years of discoveries about the Solar System. A significant contribution was made through a decade-long survey of the heavens for earth-crossing comets and asteroids. Comet Shoemaker-Levy 9 (S-L9) was jointly discovered by Gene, his wife Carolyn, and David H. Levy as a result - the comet that eventually struck the planet Jupiter.

[6] NASA re-named and re-tasked the spacecraft as Stardust-NExT, reprogramming it to perform a bonus mission and fly past comet Tempel 1, which was struck by the Deep Impact mission in 2005. This added mission had Stardust-NExT collect images and other scientific data to compare with images of that comet previously collected by the Deep Impact mission in 2005. Stardust traveled approximately 13 million miles around the sun in the weeks after the successful Tempel 1 flyby. Stardust-NExT mission met its mission goals, completing the economical "two missions for the price of one." NASA's Stardust spacecraft sent its last transmission to Earth at 4:33 pm PDT on March 24, 2011, shortly after depleting fuel and ceasing twelve years of flight operations. The Stardust team performed a final burn to deplete the remaining fuel because the comet hunter was running on fumes. The operation was designed to fire Stardust's rockets until no fuel remained in the tank or fuel lines. The spacecraft sent acknowledgment of its last command from approximately 194 million miles away in space. From launch until final rocket engine burn, Stardust travelled approximately 3.54 billion miles through the solar system.

[7] On how to find dust particles in Stardust's aerogel probe: [http://www.planetary.org/programs/projects/innovative\\_technologies/stardustathome/stardustathome\\_story.html](http://www.planetary.org/programs/projects/innovative_technologies/stardustathome/stardustathome_story.html)

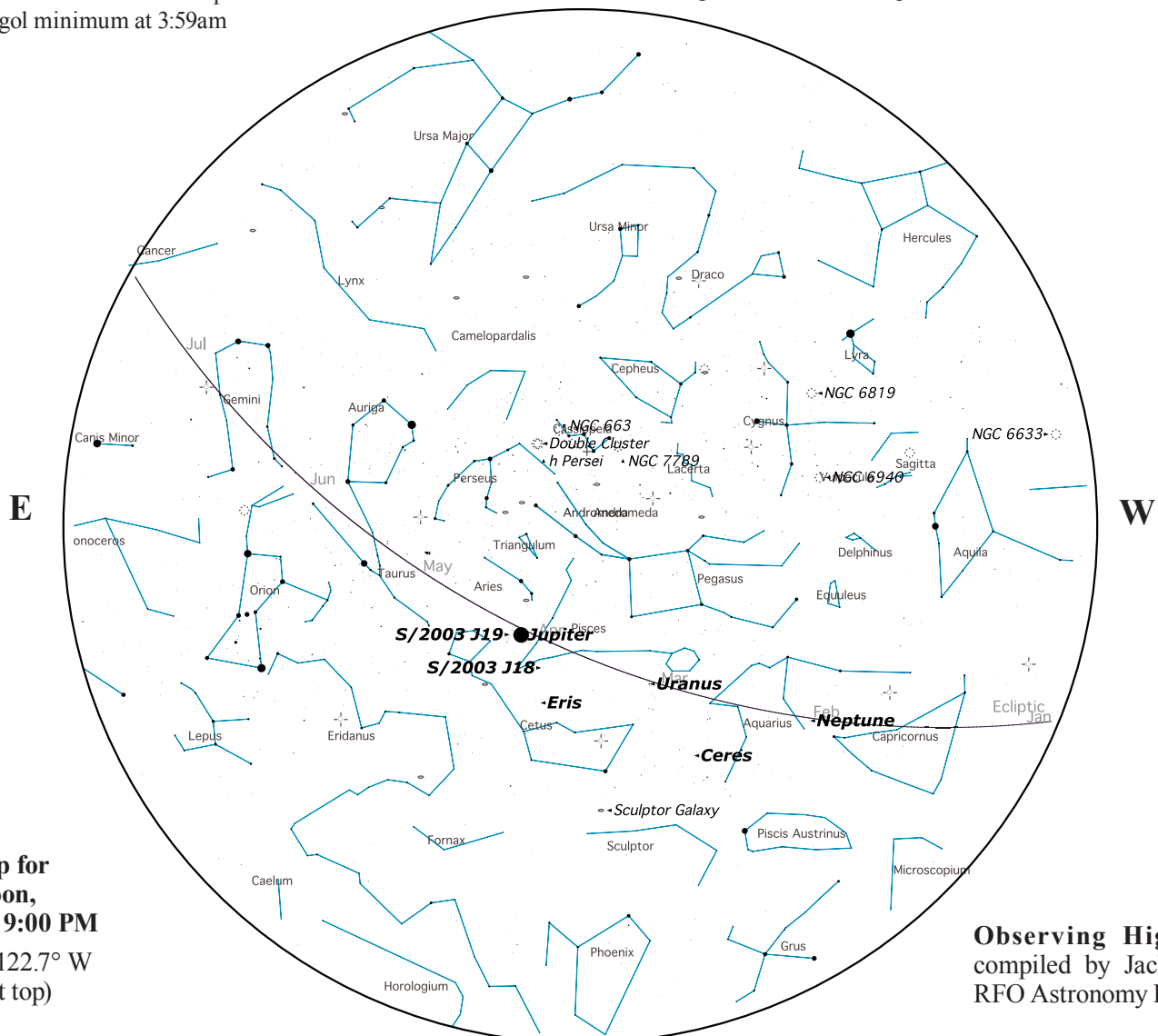
[8] The cometary samples are relatively easy to extract from the aerogel collectors, however, the interstellar dust samples are difficult to extract. First, there are very few interstellar dust particles, around 40, compared to thousands of cometary particles. Second, the interstellar particles are miniscule grains, only a few microns in size. Third, the interstellar particles are embedded in more than a square foot of aerogel, which after years in space is filled with cracks and flaws. Stardust returned more than a million particles, weighing less than a fraction of an ounce. Of these, two thousand or so are as large as the diameter of human hair, more than large enough for subsequent microscopic analysis. Scientists will be occupied for decades analyzing this treasure trove.

[9] The Deep Impact mission successfully impacted comet Tempel 1: [http://www.nasa.gov/mission\\_pages/deepimpact/main/index.html](http://www.nasa.gov/mission_pages/deepimpact/main/index.html)

# December 2011 Observing Highlights

- 12/1** Occultation of 51 Aquarii: At about 1906 the mag 5.8 double star 51 Aquarii (5.8, 6.0, 0.45", 35°) will disappear behind the dark limb of the 47% moon 78° from the north cusp.
- 12/2** Algol minimum at 2:15am
- 12/4** Algol minimum at 11:04pm
- 12/6** Moon near Jupiter, 6:00pm
- 12/7** Algol minimum at 7:53pm
- 12/8** Occultation of Botein: At about 0147 the mag 4.4 star Botein (delta Arietis) will disappear behind the dark limb of the 95% moon 90° from the south cusp.
- 12/10** Total Lunar Eclipse, 3:30am
  - 03:35 Moon enters penumbra
  - 04:47 Moon enters umbra
  - 05:41 Astro twilight begins
  - 06:07 Totality starts
  - 06:57 Totality ends
  - 07:16 Sunrise
  - 07:21 Moon sets
- 12/10** Uranus stationary, ends retrograde motion.
- 12/10** Algol minimum at 4:42pm
- 12/17** Moon near Mars, 5:00am
- 12/21** Winter Solstice is at 9:30pm
- 12/22** Algol minimum at 3:59am





- 12/22** 6% crescent moon near Mercury, the bright red star Antares is below this pair nearer the horizon. Start looking shortly before 7:00am.
- 12/23** A challenging 1.7% crescent moon is below Mercury, nearer the horizon. Start looking by 6:50am.
- 12/24** New Moon, 10:06am
- 12/25** Algol minimum at 12:48am
- 12/26** Jupiter is stationary at 3:00am, ending retrograde motion.
- 12/26** 7% crescent moon makes a lovely pairing with bright Venus in the southwest at 6:00pm.
- 12/27** Double shadow transit of Jupiter, Transit of Europa already in progress at sunset.
  - 06:00p Nautical twilight ends
  - 06:05p Ganymede's shadow begins transit
  - 06:32p Astro twilight ends
  - 07:44p Io is occulted by Jupiter
  - 07:51p Europa's shadow begins transit
  - 07:52p Europa transit ends
  - 07:55p Ganymede's shadow transit ends
  - 10:15p Europa's shadow transit ends
  - 11:07p Io reappears from eclipse
- 12/27** Algol minimum is at 9:37pm
- 12/30** Algol minimum at 6:27pm



**Sky Map for  
New Moon,  
Nov. 24, 9:00 PM**  
38.4° N 122.7° W  
(North at top)

**Observing Highlights**  
compiled by Jack Welch,  
RFO Astronomy Instructor

# December 2011

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
				<b>1</b>	 <b>2</b>	<b>3</b>
				Occultation of 51 Aquarii	Algol Minimum	
<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>9</b>	 <b>10</b>
Algol Minimum		Moon near Jupiter	Algol Minimum	Occultation of Botein		Algol Minimum Total Lunar Eclipse Uranus stationary
<b>11</b>	<b>12</b>	<b>13</b>	<b>14</b>	<b>15</b>	<b>16</b>	 <b>17</b>
			<b>SCAS Meeting 7:30 PM</b>			Moon near Mars
<b>18</b>	<b>19</b>	<b>20</b>	<b>21</b>	<b>22</b>	<b>23</b>	 <b>24</b>
			Winter Solstice	Crescent moon near Mercury Algol Minimum	Crescent Moon near Mercury	
<b>25</b>	<b>26</b>	<b>27</b>	<b>28</b>	<b>29</b>	<b>30</b>	<b>31</b>
Algol Minimum	Jupiter Stationary Crescent Moon pairs with Venus	Algol Minimum Double Shadow Transit on Jupiter			Algol Minimum	

*See Page 4 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](mailto: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](mailto: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](mailto:publications@sonomaskies.org)

### SCAS Elected Board

- President:** Len Nelson 763-8007 [lennelsn@comcast.net](mailto:lennelsn@comcast.net)  
**Vice-President & Program Director:** John Whitehouse 539-5549  
[jmw@sonic.net](mailto:jmw@sonic.net)  
**Treasurer:** Larry McCune, (415)492-1426 [llmccune@comcast.net](mailto:llmccune@comcast.net)  
**Secretary:** Eric Swanson, 762-3118 [emswanson@comcast.net](mailto:emswanson@comcast.net)  
**Membership Director:** Mike Dranginis 523-4373  
[mike880@comcast.net](mailto:mike880@comcast.net)  
**Director of Community Activities:** Lynn Anderson 433-1154  
[astroman@sonic.net](mailto:astroman@sonic.net)  
**Publications Director:** Cecelia Yarnell 569-9663  
[publications@sonomaskies.org](mailto:publications@sonomaskies.org)

### SCAS Appointed Positions

- Striking Sparks Program Coordinator:** Larry McCune  
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**Amateur Telescope Making:** Steve Follett 542-1561  
[follett@sonic.net](mailto:follett@sonic.net)  
**Librarian:** David Simons 537-6632 [davidsimons@planetatm.com](mailto:davidsimons@planetatm.com)

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