Sonoma Skies

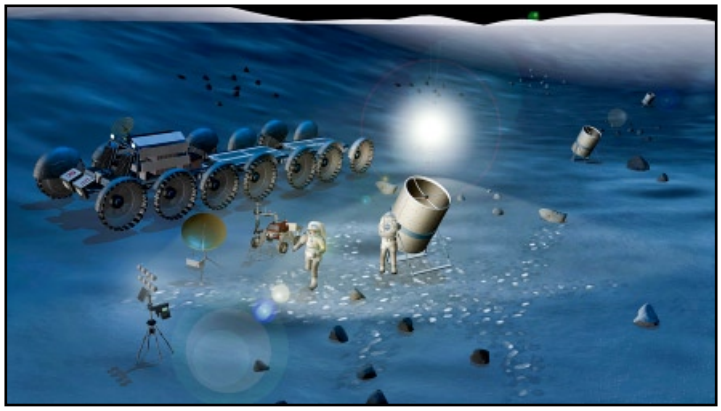
Newsletter of the Sonoma County Astronomical Society
A nonprofit scientific and educational organization

August 2008 | *www.sonomaskies.org* | **Volume XXXI No. 8**

A Telescope Made of Moondust

A gigantic telescope on the Moon has been a dream of astronomers since the dawn of the space age. A lunar telescope the same size as Hubble (2.4 meters across) would be a major astronomical research tool. One as big as the largest telescope on Earth—10.4 meters across—would see far more than any Earth-based telescope because the Moon has no atmosphere. But why stop there? In the Moon's weak gravity, it might be possible to build a telescope with a mirror as large as 50 meters across, half the length of a football field—big enough to analyze the chemistry on planets around other stars for signs of life.

That's the dream of Peter C. Chen, astrophysicist at NASA Goddard Space Center. And he wants to build it using lunar dust —because that might just be the most economical approach.



Astronauts erect a telescope on the Moon, an artist's concept.

"If we lift all materials from Earth, we're limited by what a rocket can carry to the Moon," Chen explains. "But on the Moon, you're surrounded by lunar dust"—a prized natural resource in the eyes of Chen, an expert in composite materials.

Composite materials are synthetic materials made by mixing fibers or granules of various materials into epoxy and letting the mixture harden. Composites combine two valuable properties: ultralight weight and extraordinary strength. On Earth, for example, bicycle frames made of a composite of carbon fibers and epoxy are favorites of racing cyclists.

"Why not make a composite using lunar dust?" asks Chen, who is also adjunct research professor at the Catholic University of

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Young Astronomers See page 6

SCAS Star-B-Que! August 23

Come to the SCAS Annual Star-B-Que at the Robert Ferguson. Observatory in Sugarloaf Ridge State Park! Get to know your fellow astronomers and their families in daylight! After dark there will be a sky tour, pointing out the different constellations and many interesting features in our Summer Sky. It's a good time for beginners to get help learning the sky or using a telescope. Striking Sparks winners can get help adjusting their new telescopes. Bring your scope and its instruction manual, your planisphere, and a list of questions.

Times and what to bring: We are allowed in at noon. Solar viewing will begin at 2 PM. See the 24" reflector in the daylight and have your photo taken with it! The barbecue fire will be started about 5 PM so we can begin cooking around 6 PM. SCAS will provide the barbecue fire and marshmallows. You bring food to barbecue, a favorite potluck dish to share, other food, drinks and utensils, red celophane for your flashlight, and a measure of good cheer.

To camp overnight: Adjacent to the Observatory is the Group Campground parking area, campsites, running water, large barbecue pits, and outhouses. You may camp overnight (no RV hookups). Everyone must leave by noon Sunday. The Star-B-Que is intended for SCAS and YA members, Striking Sparks winners, their families and a few guests.

Directions to Sugarloaf Ridge State Park: Take Hwy. 12 from Santa Rosa toward Sonoma. Turn left onto Adobe Canyon Rd. just before you reach Kenwood. It is 8.6 miles from Fourth and

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Remember, there is *no August meeting* at Proctor Terrace School.

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 Robert Leyland at *r.leyland@verizon.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@yahoogroups.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 10 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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Visit us on the web at:
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August Observing Notes

All August and into early September, there will be remarkable conjunctions low in the western sky during early twilight. Very challenging for northern observers. However, the view should reward efforts if you are able to detect these objects. Venus, and later Mercury, will be easiest.

8/1 New Moon 3 AM; Total Solar Eclipse, viewable via webcast at *http://www.exploratorium.edu/eclipse/2008/*

8/5 Double Shadow Transit of Jupiter. Jupiter sets before event concludes.

Time	*Sat*	*Event*	*alt/az Jupiter*
0126	Io	TrIn	21/212
0130	Cal	ShIn	21/213
0204	Io	ShIn	17/220
0342	Io	TrEx	2/238

8/12 Perseids Peak, 4 AM. Waxing gibbous moon sets at 0201, after which viewing should be excellent.

8/13 Occultation phi Scorpii, 2:30 AM, mag 3.2. Disappears behind dark limb at ~0242. Moon alt/az: 7/227

8/13 Venus very near Saturn. Very challenging; use binoculars. Locations at 2020:

Obj	*alt/az*	*Obj*	*alt/az*
Ven	6.86/276.4	Mer	5/279
Sat	6.82/276.9	Mar	14/261

8/13 Occultation of 51&52 Sagittarius, 12 Midnight. Both stars disappear behind the dark limb.

Star	*mag*	*Time*	*alt/az Moon*
51Sgr	5.6	0010	26/194
52Sgr	4.6	0042	24/202

8/15 Neptune Opposition, 1 AM. Magnitude 7.8; Disk 2.3 "; Capricornus

8/15 Mercury in West thru 9/14. Poor evening apparition. Mercury remains low in early twilight. Challenging to observe, but is involved in several conjunctions. Begin viewing at about 2015.

8/16 Mercury very near Saturn. Challenging to observe. Use binoculars. Locations at 2020:

Obj	*alt/az*	*Obj*	*alt/az*
Ven	6/275	Sat	5/278
Mer	5/276	Mar	13/261

8/22 Mercury near Venus. Very challenging. Use binoculars. Locations at 2015:

Obj	*alt/az*	*Obj*	*alt/az*
Ven	6/271	Mar	11/261
Mer	5/270	(Sat	1.5/280)

8/28 Zodiacal Light in East thru 9/10. Tapering triangle of light along Ecliptic viewable just before astronomical twilight from very dark sites.

8/30 New Moon

8/31 Algol Eclipse. A good night to observe Algol eclipsing. Eclipse maximum is at 0137. Evident portion of eclipse from about 2230 to 0430. Variation: mag 2.1 to 3.4

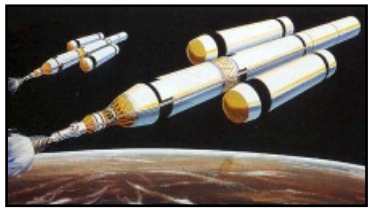
—Above courtesy of Jack Welch

Werner Von Braun's Mission to Mars

Editor's Note: I thought a history of Von Braun's proposed Mars expedition would be interesting for those who don't remember that time and the disappointment felt when the plan was abandoned. The following was exerpted from Wikipedia:

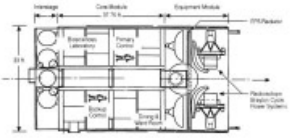
Werner Von Braun's final vision for a manned expedition to Mars was a robust plan that eliminated much of the risk of other scenarios. Two ships would fly in convoy from earth orbit to Mars and back. They were entirely reusable for future expeditions, the only element being expendable being the Mars Excursion Module used to visit the planet's surface. This was Von Braun's last attempt to convince the American government to finance his dream.

The successful landing on the moon of Apollo 11 brought a brief period of political enthusiasm for manned spaceflight. A new Space Task Group was formed to recommend a post-Apollo manned space program. On 4 August 1969 NASA Administrator Paine briefed the Space Task Group, with Vice President Agnew chairing, on Marshall's proposed post-Apollo integrated plan. Von Braun briefed the plan for a manned expedition to Mars as a follow-on to Apollo. The Integrated Plan foresaw first flight of a manned space shuttle by 1975, an earth orbit space station soon thereafter, with production and improvement of the Saturn V continuing, and the NERVA nuclear thermal upper stage completing development. All of these projects would mean a Mars spacecraft like that proposed by Boeing in 1969 could be developed, with the only new unique hardware being the Mars Excursion Module (the Mission Module would be one of the modules already proven on the earth orbit station). Testing in earth orbit of the first Mars Excursion Module would begin in 1978, with the first Mars landing coming in 1982.



Von Braun had tweaked his original Mars Expedition scenario between 1952 and 1956 to halve the size of his original Mars expedition spacecraft. He used the same methods in 1969 to come up with Mars spacecraft under half the mass of Boeing's 1968 IMIS. This allowed two Mars expedition spacecraft to travel in convoy on the mission together, providing Von Braun's preferred mutual support and back-up. The Nuclear Shuttles used for propulsion were essentially the same as Boeing's Primary Propulsion Modules, and had 38 metric tons less propellant. But due to lower delta-V's at Mars orbit, only three of the NERVA Primary Propulsion Modules (now called Nuclear Shuttles) were needed per spacecraft as opposed to five in Boeing's study. The spacecraft consists, from fore to aft:

- Two lateral PPM's. These were only partially fuelled, enough for the necessary delta-V to set the spacecraft toward Mars on 12 November 1981. They then separated, and maneuvered back to rendezvous and docking with the earth orbit station. There they were refueled and reused for earth-moon shuttle service or a future Mars expedition.
- A central PPM. This provided all of the remaining delta-V for the mission - insertion into Mars orbit, trans-Earth injection, and a braking maneuver back into earth orbit at the end of the mission. Significant savings were obtained by braking into and leaving a high-altitude elliptical Mars orbit rather than a low-altitude circular orbit.
- A Planetary Mission Module. This was the result of Phase B studies to identify a module that could be used for both earth and lunar space



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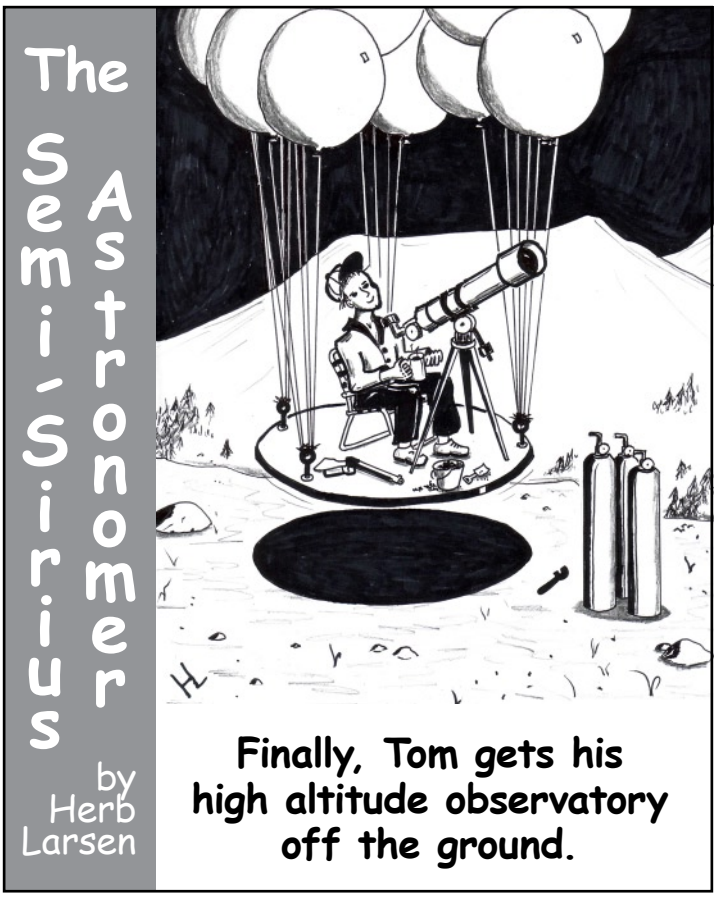


Social Amenities

Many thanks to David Simons for providing refreshments at the July meeting.

Events

Robert Ferguson Observatory Public Viewing

Saturday, August 2
Solar Viewing: Noon - 4:00 PM
Night Viewing begins 9:00 PM

The Observatory features three telescopes: A 14-inch SCT with CCD camera in the East wing, an 8-inch refractor under the dome and a 24-inch Dobsonian 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 $6 per vehicle for entry. A $3 donation is requested from adults 18 and over for admission to the observatory during night viewing sessions.

Night Sky Summer Series

Session #5—Aug. 4 28;
Session #6—August 26

Classes held Mondays at 7:30 PM. Each class includes a lecture on the constellations of the season, their history and mythology, and how to find objects within them. **Fees:** $75 for the series of six presentations. (Single session fee is $23). 10% discount for VMOA members. Classes are held at the Observatory. For information or to register: (707) 833-6979, *http://www.rfo.org* or *nightsky@rfo.org*

Reserve 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 any time more than a week away from a Full Moon.

In addition to $111 charged by the RFO for use of the observatory facilities, the State Park System charges $111 for use of the *Group Campground*. Because it is adjacent to the Observatory, the group camp must be reserved for private events. Total Cost: $222. For information on how to reserve, visit *www.rfo.org* or contact George Loyer at *gloyer@rfo.org*.

SSU Observatory Public Viewing

Aug. 29, 9-11 PM: Jupiter, Trifid Nebula, Little Gem Nebula

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*

SCAS Star-B-Que *(from Page 1)*

Farmer's to the Adobe Canyon Rd. turnoff. From Sonoma, it's a right turn after Kenwood. The Park is 3.4 miles farther.

Fees and Parking: At the Park entrance kiosk, identify yourself as part of the Sonoma County Astronomical Society headed for the Star-B-Que at the Observatory. There will be no individual fees. Pets must be kept on a leash, with a $1.00 charge for each animal. Parking is limited, so carpool if possible. To minimize jarring white light from backup lights after dark, please park by backing in. Park close together, with just enough room to open your door. Parking on pavement is prohibited. If you arrive after 8:30 PM, or if campground parking is full, park next to the group campsite entrance gate, about 100 yards away.

Call Len Nelson at 763-8007 or email *lennelsn@comcast.net* if you have questions. Hope to see you there!

Fremont Peak Star Party

Saturday, August 2, 2008

Meet amateur astronomers and enjoy a potluck, contests, raffles, kids activities and dark sky observing. Anyone interested in astronomy or Fremont Peak State Park is welcome.

Potluck begins at 5:00 p.m. in the area below the observatory. We will provide meat (hamburgers and chicken), condiments, soft drinks and utensils.

Keynote speaker Dr. Peter Jenniskens, Research Scientist with the Carl Sagan Center at the SETI Institute and NASA/Ames Research Center, will present "Meteor Showers and their Parent Comets", and describe the related NASA-funded research program to be carried out at the Fremont Peak Observatory. Bring pads for seating on the amphitheater steps. After dark you can look through the 30-inch Challenger Telescope.

RSVP at (831) 623-2465 or *info@fpoa.net* with your name, number of guests and number of cars. Visit *www.fpoa.net* for detailed directions to Fremont Peak. Cosponsored by the Astronomical Association of Northern California and The Fremont Peak Observatory Association.

Mt. Tamalpais Astronomy

Aug. 9, 8:30 PM: "Astrobiology, Planetary Protection and the Search for ET Life"—Dr. Margaret S. Race, SETI Institute

What are the ecological and ethical questions to be considered when planning and executing inter-planetary explorations? Come and hear Dr. Margaret Race of the SETI Institute explain why there is more than rocket science involved in NASA missions.

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/*

Events

SCAS Event Horizons

By the time this is published, I'm hoping that there has been a successful star party at the Common Bond summer language camp in Sonoma. At the time of this writing Alan Karbousky, along with Emilio Ricci, John Whitehouse, Walt Bodley, along with Steve Smith from the RFO have pledged to be at the El Verano Elementary School to show about 200 viewers Saturn, Jupiter and some of the brighter M-objects on Wednesday, July 23rd.

There is little else on the horizon beyond Yosemite on Friday and Saturday, August 8 & 9 and the SCAS Star-B-Que on Saturday, August 23.

The one other request I have received is from the Sebastopol Center for the Arts, which is having an art opening called VORTEX: Art, Matter & Motion, on Friday, September 12, from 6:00-8:00 PM. It features science-based art and will include some piece related to astronomy. We should only need one or two telescopes due to the timing for the event being during the twilight hours. The moon will be fairly bright, so, Jupiter may be the only target worth viewing.

If you read this before 3:00 AM on August 1, 2008, don't forget to watch the Total Solar Eclipse webcast from the Exploritorium's website http://www.exploratorium.edu/eclipse/ You might look for me in the crowd.

—Lynn Anderson, SCAS Director of Community Activities

Von Braun *(from Page 3)*

stations and interplanetary flights. It provided six crew with quarters during the mission. It had sufficient consumables that 12 crew could be supported in case one of the spacecraft had to be abandoned anywhere along the route.

• Mars Excursion Module. The variation for this mission had a mass of 43 metric tons. It could descend from the high elliptical orbit, and support three crew on the surface for up to sixty days. Since two ships were in convoy, the two MEM's could land near each other and provide mutual support. All six surface crew could return in one of the MEM's ascent stages if needed.

• 16 unmanned probes. 12 would return samples from various sites on the Martian surface to the orbiting PMM. Four would be dropped into the atmosphere of Venus during the swingby of that planet on the return home.

The mission profile was as follows:

• 12 Nov. 1981: Trans-Mars injection. Each spacecraft had a starting mass in low earth orbit of 727 metric tons. After the 3.8 m/s maneuver, the two lateral PPM's would separate, leaving the single PPM, PMM, MEM, and probes with a total mass of 614 metric tons.

• 9 Aug. 1982: Mars orbit insertion. The spacecraft entered an elliptical Mars orbit. This requires a delta-V of only 2.2 km/s, only 1/3 to 1/8 the amount Boeing assumed in their study for obtaining a circular orbit. This was a huge driver in reducing the total expedition mass. Mass before the maneuver was 295 metric tons, and afterwards around 226 metric tons.

• The MEM's separate and headed for the surface. Meanwhile, the three crew left aboard each PMM drop the 12 sample-return probes and survey the Martian surface and moons from orbit.

• 28 Oct. 1982: Trans-Earth Injection. Having shed the MEM and probes, the mass at the start of the maneuver was 172 metric tons.

• 28 Feb. 1983: Venus swingby. This reduces the velocity at the return to earth, and provided an additional science opportunity. Four probes were dropped into the atmosphere of Venus.

• 14 Aug. 1983: Earth Orbit Insertion. The PPM fired one last time to brake the spacecraft into low earth orbit. It docked with the earth orbiting space station and the crews and their samples were placed in quarantine. Final mass of each ship was 72.6 metric tons. Von Braun preferred this approach to a direct return to earth in an Apollo Command Module. His mission profile made the propellant available for it, and the risk of contamination of the earth by Martian organisms was eliminated.

The Mars spacecraft itself would refurbished via shuttle flights, two additional PPM stages attached, the whole thing resupplied and refueled, in readiness for further expeditions to Mars in 1983, 1986, and 1988—leading to a 50-person Mars base by 1989. With the exception of the MEM, all of the spacecraft was reused. Von Braun estimated this colonization of Mars within 20 years could be accomplished with a peak NASA budget of $ 7 billion per year. This robust, relatively safe plan was the culmination of 20 years of Mars mission planning by the Peenemuende team and took full advantage of the other space infrastructure elements in NASA's master plan. It offered the possibility for Von Braun to witness his long-held dream of a manned expedition to Mars in his lifetime.

The Space Task Group made its final report on 15 September 1969, recommending the whole vast infrastructure envisioned by Von Braun. It was not to be—every element of the NASA plan, except for a much-compromised space shuttle design, would be stripped away by Nixon's budget office. There was no public support for such a grand scheme. The view of Mars as a seemingly barren, lifeless, and uninteresting world in any case was reinforced by the Mariner 7 mission which flew by the planet the day after Von Braun's presentation was made. His ultimate dream crushed, Von Braun was sidelined to a headquarters post at NASA seven months later. He left NASA in 1972 and died in 1977.

Young Astronomers

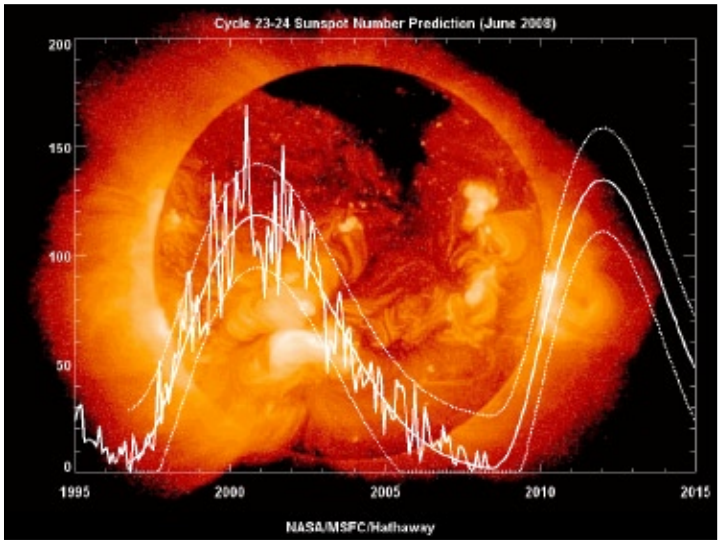
What's Wrong with the Sun? (Nothing)

Stop the presses! The sun is behaving normally.

So says NASA solar physicist David Hathaway. "There have been some reports lately that Solar Minimum is lasting longer than it should. That's not true. The ongoing lull in sunspot number is well within historic norms for the solar cycle."

This report, that there's nothing to report, is newsworthy because of a growing buzz in lay and academic circles that something is wrong with the sun. Sun Goes Longer Than Normal Without Producing Sunspots declared one recent press release. A careful look at the data, however, suggests otherwise.

But first, a status report: "The sun is now near the low point of its 11-year activity cycle," says Hathaway. "We call this 'Solar Minimum.' It is the period of quiet that separates one Solar Max from another."



The solar cycle, 1995-2015. The "noisy" curve traces measured sunspot numbers; the smoothed curves are predictions. Credit: D. Hathaway/NASA/MSFC.

During Solar Max, huge sunspots and intense solar flares are a daily occurance. Auroras appear in Florida. Radiation storms knock out satellites. Radio blackouts frustrate hams. The last such episode took place in the years around 2000-2001.

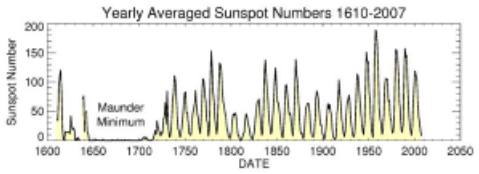
During Solar Minimum, the opposite occurs. Solar flares are almost non-existant while whole weeks go by without a single, tiny sunspot to break the monotony of the blank sun. This is what we are experiencing now.

Although minima are a normal aspect of the solar cycle, some observers are questioning the length of the ongoing minimum, now slogging through its 3rd year.

"It does seem like it's taking a long time," allows Hathaway, "but I think we're just forgetting how long a solar minimum can last." In the early 20th century there were periods of quiet lasting almost twice as long as the current spell. Most researchers weren't even born then.

Hathaway has studied international sunspot counts stretching all the way back to 1749 and he offers these statistics: "The average period of a solar cycle is 131 months with a standard deviation of 14 months. Decaying solar cycle 23 (the one we are experiencing now) has so far lasted 142 months--well within the first standard deviation and thus not at all abnormal. The last available 13-month smoothed sunspot number was 5.70. This is bigger than 12 of the last 23 solar minimum values."In summary, "the current minimum is not abnormally low or long."

The longest minimum on record, the Maunder Minimum of 1645-1715, lasted an incredible 70 years. Sunspots were rarely observed and the solar cycle seemed to have broken down completely.



The period of quiet coincided with the Little Ice Age, a series of extraordinarily bitter winters in Earth's northern hemisphere. Many researchers are convinced that low solar activity, acting in concert with increased volcanism and possible changes in ocean current patterns, played a role in that 17th century cooling.

For reasons no one understands, the sunspot cycle revived itself in the early 18th century and has carried on since with the familiar 11-year period. Because solar physicists do not understand what triggered the Maunder Minimum or exactly how it influenced Earth's climate, they are always on the look-out for signs that it might be happening again.

The quiet of 2008 is not the second coming of the Maunder Minimum, believes Hathaway. "We have already observed a few sunspots from the next solar cycle," he says. This suggests the solar cycle is progressing normally."

What's next? Hathaway anticipates more spotless days, maybe even hundreds, followed by a return to Solar Max conditions in the years around 2012.

YA Information

Meetings: 7:30 PM the second Friday of each month of the school year, at Apple Blossom School, 700 Water Trough Road, Sebastopol, in the Multipurpose Hall. Open to all Sonoma County students. Telescope viewing is held in the upper parking lot after the meeting. Directions: From Hwy. 116 in Sebastopol, go west onto Bodega Ave. Continue almost two miles to Water Trough Rd. Turn left and go about 1/3 mile to the school, on your right.

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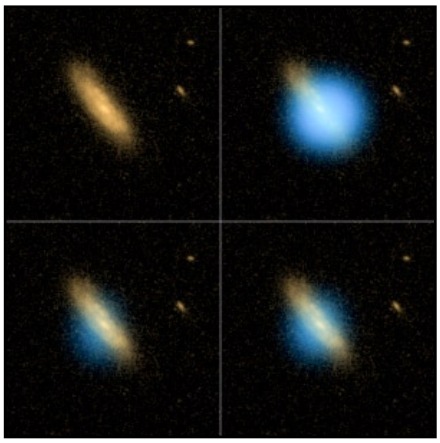
NASA SpacePlace

Death of a Supergiant

By all outward appearances, the red supergiant appeared normal. But below the surface, hidden from probing eyes, its core had already collapsed into an ultra-dense neutron star, sending a shock wave racing outward from the star's center at around 50 million kilometers per hour. The shock wave superheated the plasma in its path to almost a million degrees Kelvin, causing the star to emit high-energy ultraviolet (UV) radiation. About six hours later, the shock wave reached the star's surface, causing it to explode in a Type IIP supernova named SNLS-04D2dc.



Sequence of images shows supernova start to finish. The top left image shows the galaxy before the supernova. At top right, the bright UV flash called the shock breakout indicates a red supergiant has collapsed. At bottom left, moments later, the flash is mostly gone. As the debris expands, it heats up again and becomes brighter (bottom right). The supernova became 10 times the size of the original over the following few days, thus becoming visible to supernova hunters.

Long before the explosion's visible light was detected by telescopes on Earth, NASA's Galaxy Evolution Explorer (GALEX) space telescope captured the earlier pulse of UV light — scientists' first glimpse of a star entering its death throes. "This UV light has traveled through the star at the moment of its death but before it was blown apart," explains Kevin Schawinski, the University of Oxford astrophysicist who led the observation. "So this light encodes some information about the state of the star the moment it died."

And that's exactly why astronomers are so excited. Observing the beautiful nebula left behind by a supernova doesn't reveal much about what the star was like before it exploded; most of the evidence has been obliterated. Information encoded in these UV "pre-flashes" could offer scientists an unprecedented window into the innards of stars on the verge of exploding.

In this case, Schawinski and his colleagues calculated that just before its death, the star was 500 to 1000 times larger in diameter than our sun, confirming that the star was in fact a red supergiant. "We've been able to tell you the size of a star that died in a galaxy several billion light-years away," Schawinski marvels.

"GALEX has played a very important role in actually seeing this for a few reasons," Schawinski says. First, GALEX is a space telescope, so it can see far-UV light that's blocked by Earth's atmosphere. Also, GALEX is designed to take a broad view of the sky. Its relatively small 20-inch primary mirror gives it a wide, 1.2-degree field of view, making it more likely to catch the UV flash preceding a supernova.

With these advantages, GALEX is uniquely equipped to catch a supernova before it explodes. "Just when we like to see it," Schawinski says.

For more information, visit www.galex.caltech.edu, "Ultraviolet Gives View Inside Real 'Death Star'." Kids can check out how to make a mobile of glittering galaxies at: http://*spaceplace.nasa.gov/en/kids/galex_make1.shtml*

—Article provided by JPL/NASA

Moondust Telescope *(from Page 1)*

America in Washington, D.C. So in his laboratory, he mixed NASA's simulated lunar dust called JSC-1A Coarse Lunar Regolith Simulant with epoxy and a small quantity of carbon nanotubes, a relatively recently discovered form of carbon that has many unusual and useful properties. The result? "It came out as hard, dense, and strong as concrete."

Excited, Chen made a small telescope mirror using a long-known technique called spin-casting. First he formed a 12-inch (30-cm) diameter disk of lunar-simulant/epoxy composite. Then he poured a thin layer of straight epoxy on top, and spun the mirror at a constant speed while the epoxy hardened. The top surface of the epoxy assumed a parabolic shape—just the shape needed to focus an image. When the epoxy hardened, Chen inserted it into a vacuum chamber to deposit a thin layer of reflective aluminum onto the parabolic surface to create a 12-inch telescope mirror.

The carbon nanotubes make the composite a conductor. Conductivity would allow a large lunar telescope mirror to reach thermal equilibrium quickly with the monthly cycle of lunar night and day.

To make a Hubble-sized moondust mirror, Chen calculates that astronauts would need to transport only 130 pounds (60 kg) of epoxy to the Moon along with 3 pounds (1.3 kg) of carbon nanotubes and less than 1 gram of aluminum. The bulk of the composite material—some 1,300 pounds (600 kilograms) of lunar dust—would be lying around on the Moon for free. "I think we've discovered a simple method of making big astronomical telescopes on the Moon at 'non-astronomical' prices."

"It's a great idea in principle, but nothing is simple on the Moon," cautions physicist James F. Spann, who leads the Space and Exploration Research Office at Marshall Space Flight Center. "Launching a big spinning table to the Moon would be a challenge. If we got the machine spinning in the Moon's dusty environment, how long would it take the dust to settle?" he asks. Sputtering aluminum vapor onto a large mirror in the presence of ambient dust would be another challenge, because "coating mirrors on Earth is done in a clean environment. There are practical issues about manufacturability to be resolved."

Despite his concerns, Spann sees real promise in Chen's work and he's enthusiastic about starting out to make simple composite structures on the Moon, such as casting basic blocks from epoxy and lunar dust. "The blocks could be useful for building igloos or habitats for the lunar astronauts," he points out. Then astronauts could work up to making rods, tubes, and other composite structures, to learn how epoxy cures in the Moon's vacuum, and how robust the composites are under solar ultraviolet light. In the end, telescopes might prove practical. "We have a lot of work to do to find out what's possible," he says.

One thing is clear: The sky's the limit, especially when you have so much moondust to work with.

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Sonoma Skies

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Star-B-Que!