SIRIUS ASTRONOMER

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Solar panels on the Hubble Space Telescope make for some unique window shades in this scene photographed from the flight deck of the Earth-orbiting Space Shuttle Atlantis. Just below the "shaded" pair of windows are panels of displays and controls very instrumental in the success of the work being done on the giant observatory. (photo credit: NASA)

OCA CLUB MEETING

The free and open club meeting will be held Friday, June 12th at 7:30 PM in the Irvine Lecture Hall of the Hashinger Science Center at Chapman University in Orange. This month, Mike Hoffert will be speaking on the 48-inch High-Efficiency Ritchey-Chrétien Reflector.

NEXT MEETING: July 10th

STAR PARTIES

The Black Star Canyon site will be open on June 13th. The Anza site will be open on June 20th. Members are encouraged to check the website calendar, for the latest updates on star parties and other events.

Please check the website calendar for the outreach events this month! Volunteers are always welcome!

You are also reminded to check the web site frequently for updates to the calendar of events and other club news.

COMING UP

The next session of the Beginners Class will be held on Friday, June 5th at the Centennial Heritage Museum at 3101 West Harvard Street in Santa Ana.
GOTO SIG: TBA
Astro-Imagers SIG: June 16th, July 21st
Remote Telescopes SIG: June 24th, July 22nd
Astrophysics SIG: June 19th, July 17th
Dark Sky Group: TBA

June 2009 President's Message

By Barbara Toy

Well, we're rapidly approaching the summer solstice, after which the days will start getting shorter even though the heat of summer has not fully set in – in spite of the heat waves in April and May. It remains to be seen whether we will have a lot of "June Gloom," and how intense the summer monsoon season will be. Some of us are hoping that the current drought will at least give us more clear, dry nights than in some recent summers, particularly around the new moon; it won't make up for the water rationing some of us are facing but would be a kind of silver lining to the cloud of drought.

If you like to observe in reasonable comfort, this is the perfect season for you! I hope you take advantage of the warmer nights to enjoy yourself under the stars at Black Star Canyon or Anza. The bright winter constellations are gone, for the most part, but we have the summer Milky Way to enjoy with a bit more of the southern sky that we're used to seeing. In particular, Alpha Centauri, a spectacular globular, is visible for a period in spring and early summer from our Anza site, as it rolls across the foothills to the south of us. It's easily visible in binoculars, but to really appreciate how big it is and how many stars it has, it pays to observe it through a larger telescope. Because it's so low, it doesn't photograph as well from Anza as it would from further south, but it's a great sight to enjoy.

Starbecue in July

Our annual Starbecue potluck will be at the July Anza star party. If you haven't been out to Anza yet, that would be a great time to come, as the Starbecue gives you a chance to meet and socialize with fellow members and get comfortable with the site in daylight. We hold the party in front of the club observatory (i.e. on the eastern side), where we have shade in the late afternoon and evening, and we'll fire up the club's barbecue for grilling anything people want to bring for grilling.

We usually start to set up around 5:00, aiming to start eating by around 6:00 (though often the eating starts earlier – who can resist all that great food?). We have a new picnic table in addition to the club's three folding tables – we'll need two for food, but this year we should have two available for sitting and eating. Most people bring their own chairs, though, and either eat sitting in their chairs or wandering around talking to people. What with people congregating around the barbecue, the food tables, and in various continually shifting groups (sometimes in chairs, sometimes not), this is an event that is filled with camaraderie as well as good food.

As a guideline, we suggest you bring a dish or something to grill for six to eight people. The club provides drinks and plates, eating implements and other necessities for holding and eating the food. We have a microwave in the observatory warming room, if needed, and there are electrical outlets if you bring your contribution to the feast in a crock pot or something else that needs some power. We've never tried to organize this to the point that we've had people sign up for specific categories of food (such as main dish, appetizers, salads, desert), but we've always wound up with a reasonable balance anyway – and a lot of variety!

We do ask that you take any leftovers of what you brought with you when the party's over, as we have no good way to save or use leftovers at Anza, and spoiled food only encourages the rodents and other vermin. We'll have trash bags out during the party, and could use some volunteers to take them away when the party's over, as well.

The Starbecue is a great way to get the evening off to a good start – an excellent meal and good company followed by a night of observing (or imaging) – who could ask for more?

OPT's Southern California Astronomy Expo Returns – Better Than Ever!

Oceanside Photo and Telescope started the Southern California Astronomy Expo (SCAE) a few years ago, and it's been growing every year. This year they're adding a swap meet on the first Saturday of the event, July 11. Vendors, OPT itself, and local clubs will be bringing various items they'd like to sell off, with a chance of some good bargains for savvy shoppers. We're planning on having a booth there for OCA – we haven't decided yet what we'll be selling at the booth (maybe we'll clean out more of the club's storage area…), but if you have something astronomical you've been thinking of donating to the club, this would be a good time to do it – if we can't use it in one of our programs, we may be able to raise some cash with it at the swap meet. We're an educational non-profit, so anything you donate would be tax-deductible.

The second Saturday of SCAE (July 18) is their annual astronomy fair, with club booths, vendor booths and demonstrations of different equipment in the parking area, talks and images in the display area/gallery that's in the downstairs part of OPT's building, a raffle and various other events all day. Unfortunately, that's also the day of our Starbecue, so Alan and I have to be out at Anza by late afternoon with the drinks, plates, etc., that the club supplies for the event – which means that we won't be able to handle the OCA booth that day (though we may be able to be there for a couple hours in the morning). So, if you're not planning to be at Anza for the Starbecue, we could really use your help with the OCA booth on July 18 – please send me an email to btoy@cox.net if you can help out with this.

How To Use Your Telescope Class

Our next "How To Use Your Telescope" class is on July 3, 2009. Unfortunately, this is the day before the Fourth of July holiday itself, and a day that many people have off as part of the Fourth of July weekend, so many of our usual volunteers won't be available – if you're going to be around, we could really use your help!

The purpose of the class is to help people who are having problems with their telescopes get through those initial problems and become more comfortable in using their telescopes. There are a lot of people who get really excited about astronomy and doing some observing, go out and buy a telescope, and then discover that it's a lot more complicated to use than they thought. That's when a lot of them lose interest, their telescopes sit unused, and they miss out on a lot of opportunities to enjoy the heavens. We

want to help them get through that stage, so that they don't lose enthusiasm for the hobby – after all, every astronomer out there is a potential ally on issues of importance to us, such as preservation of the night sky, as well as a potential new club member (not that we want to be mercenary about this…).

This particular class is part of the club's ongoing Beginners Astronomy Class. The people who come include people who've attended other sessions of the Beginners Class, members of the general public and club members – they all bring their equipment and their questions, and our volunteers help them learn to set up their telescopes and use them to find some objects. At least, that happens if the weather cooperates, but we hold the class whether it does or not, even if it rains (in that case, we hold it inside the classroom rather than parking lot). It's usually something of a cross between a series of individual tutoring sessions and an informal public star party, and everyone has a lot of fun as well as learning a lot.

The location is the Heritage Museum of Orange County, formerly known as the Centennial Heritage Museum. The formal start time is 7:30 p.m., the gate should be open by seven o'clock, and a lot of people show up well before 7:30. The museum is at 3101 W. Harvard Street, about a half block west of Fairview; Harvard is located about midway between Edinger and Warner. This is in south Santa Ana, not far from Costa Mesa, and the museum is actually on the south side of Centennial Park.

You don't have to be what you might consider an expert in the use of any type of telescope. Any knowledge you have from working with whatever telescopes you've used would be helpful. The problem most people have is they don't even know where to start, and, if you've been doing observing at all, you can certainly help them get started in the right direction. And, if you're one of those people who could use a bit of help learning to use your telescope, or dealing with some problem you've been finding with it, do come and bring your telescope with you! The class is free and open to the public and, if you know anyone you think might benefit from it, please encourage them to come, as well.

September and October General Meetings

As a "heads up" so you can get the changes on your calendars well in advance, the general meeting dates for September and October have had to be changed. Our usual meeting dates are the second Friday of the month, but for those two months Chapman University needs the Irvine Auditorium for their own activities, so our meetings for those two months will be moved to the third Friday of the month. So, you should plan to be at the Irvine Auditorium for the general meeting on September 18 instead of September 11, and on October 16 instead of October 9.

Because our Astrophysics group usually meets on the third Friday of the month, and many of the regular attendees at those meetings also attend the general meetings, the Astrophysics meetings will also be moved in September and October. Those new dates are September 11 (the second Friday of the month) instead of September 18, and October 23 (the fourth Friday of the month) instead of October 16.

Observatory Procedures and Standards

You may have noticed that a draft of the Procedures and Standards for member observatories has been posted on the "Members" section of the club website (the caption on the home page calls the "Observatory Approval Process," but the formal title at this point is "Procedures And Standards For Member Observatory Approval And Maintenance Of Observatory Licenses") and have asked for comments.

This is an attempt to bring together all of the policies, procedures and standards that apply to member observatories at the Anza site, so they can be found in one place without having to comb through multiple documents and minutes of board meetings, or by talking to board members about policies that have always been applied as a matter of practice but not necessarily written down in comprehensive form. We have already had some helpful suggestions for areas where clarification is needed and where some items should be added, and will post the modified version, which will also include correction of some typos. When this is finalized and formally adopted by the board, we will post a copy of the final version in the "Members" section of the website, and also will ask that Observatory holders acknowledge that they have received and reviewed the document as part of the licensing process. Once this is finalized as to the observatories, we expect to compile a similar comprehensive set of rules and procedures related to member pads, which will also be made available for comment before the board formally adopts the final version.

Long-time members will note that these policies incorporate a different approach toward financing development of new areas of the site than was used in the earlier development. In the past the club has paid for grading, but as the Board considered the expenses we expected to have with development of the northwest section of the property and our annual budget, we concluded after a lot of discussion that we couldn't justify spending general club funds for something that would primarily benefit only a few members, those who would be building pads or observatories in the newly-developed areas. Under the policy we adopted as a result of these discussions, the members who would be the main beneficiaries of the development would bear that cost instead of the general membership, as a partial return to the club for the privilege of having their own facility on the club's property. This policy will apply to all future construction at Anza, except for construction meant for general member use.

The Procedures and Standards also make the nature of the relationship between the observatory holders and the club clear – the member observatories (and pads) are all held by license from the club, not by any rental or leasehold type of arrangement. I don't know when this was first established, but it was definitely part of the policies adopted by the Board on March 3, 1996. Another aspect of the relationship with the club that has been in place from the time the first member pads were built is that all permanent structures are the property of the club. In the past, observatories and other member structures were necessarily permanent because of the construction techniques, but with the development of different types of modular observatories that can be disassembled and reassembled elsewhere (two of the dome observatories on the current observatory level and the extruded aluminum roll-off

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AstroSpace Update

June 2009
Gathered by Don Lynn from NASA and other sources

Herschel is the infrared space telescope launched in May by the European Space Agency, with substantial participation by NASA. It is now on its way to the L_2 Lagrangian point, a place where gravity of the Earth and Sun balance, which lies about 1 million miles from Earth directly away from the Sun. The spacecraft will orbit about L_2 as it performs its observations, which are scheduled to begin in November. The telescope name was chosen because William Herschel, among other scientific discoveries, first recognized that light exists with wavelengths too long to be visible, which has come to be known as infrared. Its objective mirror, at 3.5 meters, is about 50% larger in diameter than the Hubble telescope, making Herschel the largest diameter telescope in space. The mirror is made of silicon carbide, due to its stable expansion properties at extremely low temperatures. It was designed to observe longer wavelengths of infrared light than the Spitzer space telescope, and so will complement its observations. Herschel is scheduled for a 3-year mission, but has enough (over 600 gallons) liquid helium aboard to last about 4 years. The helium cools the detectors in the telescope to only 0.5° F above absolute zero to increase sensitivity. Objectives of the telescope are to study star formation, which usually occurs inside clouds of dust and gas that hide the process from visible light, look at very distant galaxies, and therefore back in time, to study galaxies forming in the first few billion years after the Big Bang, study planets forming about young stars, and probe the composition of comets. Herschel has the sensitivity to see stars forming in nearby galaxies, not just in our own galaxy.

Planck is the successor to WMAP, which mapped the cosmic microwave background (CMB) in recent years. Planck was launched on the same rocket as Herschel, and is also going to orbit the L_2 Lagrangian point as it makes its observations, which are scheduled to begin in August. In 15 months, it is expected to survey the entire sky twice. The CMB is the light released just 380,000 years after the Big Bang, when the Universe had expanded and cooled enough for hydrogen to become transparent. WMAP and its predecessor COBE were able to find the age of the Universe, the speed of expansion, the acceleration of that expansion, the fraction of dark matter and dark energy, and other properties of the Universe by analyzing the ripples in the CMB. Planck covers 10 times the wavelength range that WMAP does, and is more sensitive to faint signals. This sensitivity is gained in part by cooling the detectors to only 0.2° F above absolute zero. It is expected to refine the precision of WMAP findings, and additionally confirm Inflation Theory, and distinguish between some of the variations of Inflation. Planck is also a European spacecraft, with substantial NASA participation. It was named after Max Planck, one of the pioneers in quantum theory.


Hubble Space Telescope
NASA

Hubble Space Telescope (HST) received its fifth and final repair and upgrade by astronauts on the Space Shuttle mission in May. It is believed that this will restore it to better-than-new condition, since technology in the cameras and spectrographs has improved. Hubble, probably the most productive scientific instrument every built, is expected to last another 5 years with these repairs. The mission had been delayed since last October because one of the 2 data manager computers had failed just before then. Operations performed during the mission include: add the Wide Field Camera 3, covering ultraviolet through visible to near infrared (replaces the Wide Field and Planetary Camera 2); add the Cosmic Origins Spectrograph; repair the Imaging Spectrograph (failed power supply); repair the Advanced Camera for Surveys; replace 1 of the 3 guiding sensors, replace 1 data handling computer, replace all 6 gyros (3 are broken and 2 acting up), replace all 6 rechargeable batteries (all were original, now 20 years old), add new heat insulation, and add a grappling handle so that a robotic mission can push the telescope into the Pacific Ocean when Hubble's operating life is over.

Astronaut John Grunsfeld, who has on past Hubble repair missions taken **mementos of Edwin Hubble** into space, decided to take Hubble's basketball on this trip. Hubble played on the University of Chicago's Big Ten champion basketball teams in 1908 & 1909, before he became an astronomer and discovered that what are now called galaxies lie outside the Milky Way and later showed the expansion of the Universe.

The repair mission was filmed with 3-D IMAX cameras aboard the Shuttle, and the footage will be used in an upcoming IMAX/Warner Bros. movie entitled "**Hubble 3D**". It will also include lots of images taken through the Hubble.

Hubble constant – A team of astronomers has refined the Hubble constant, that is, the speed at which the Universe is expanding. They observed, using the Hubble Telescope, galaxies that contained Cepheid variable stars and Type Ia supernovas, the best near and far distance indicators. This allowed directly linking these 2 methods of determining astronomical distances. The Cepheids were observed in near-infrared, which gets more consistent results than visible light. One of the galaxies had its distance determined accurately by radiotelescope observations. The new result for the Hubble constant is 74.2 ±3.6 km/sec/megaparsec. This agrees well with the previously best determination, which was 72 ±8.

Analysis of archived Hubble observations of 3 dwarf galaxies has found a greater variety of star ages than expected. It shows that star bursts, that is, sudden formation of lots of new stars, happens not as a single short-lived burst, but as a long-lived wave that proceeds inward from the edges. Past **star bursts** in these galaxies had to have lasted 200 to 400 million years, up to 100 times longer than previous estimates. This analysis will continue with more dwarf galaxies.

Spitzer (infrared space telescope) has run out of gas (actually liquid helium). Its detectors are kept about 2° F above absolute zero by the helium in order to reduce noise and increase sensitivity. Spitzer was launched with enough helium (95 gallons) to last at least 2.5 years, but careful operations had stretched that to 5.5 years. So the instruments are in the process of warming to a projected 55° above absolute zero (-404° F). The shorter wavelength parts of the infrared array camera will still operate well at this temperature, though the photometer and spectrograph will not. So observations using the camera will resume in late June in what is being called the warm mission. Projects planned for this phase include refining the Hubble constant, assessing the frequency of hazardous asteroids near Earth, probing star-forming regions within the Milky Way, staring at the very distant Universe, and following up on expected exoplanet discoveries by the Kepler spacecraft. Operations should be able to continue until about 2013, when Spitzer will reach a point so far from Earth that its low-gain antenna will no longer be heard. It is planned that the James Webb Space Telescope will be launched and take over infrared observations that year.

In infrared, the disks of galaxies appear remarkably smooth. Yet star formation theory says that nearly all stars form in clusters, so the galaxy disks should have lumpiness left over from the formation clusters. There are several competing theories for how the lumpiness gets smoothed out. New observations of galaxies with **Spitzer** (before it ran out of helium) caught star streams that appear to be caused by relative motions within the galaxy rotation, which are distributing former members of clusters about the galaxy. These streams had not been seen before because it required looking in the right infrared color to distinguish stars of the proper age, and then applying mathematical filtering to show up the streams. So this is probably the answer to how galaxies become smooth.

Spitzer observed 50 **white dwarf** stars and found many of them contaminated with heavier elements like calcium and magnesium. These contaminants could come from either an interstellar cloud or from asteroids or planets that fell into the stars. No interstellar clouds were found near the stars studied. In addition, 14 of the studied stars had dusty disks about them, which probably were created by tidal forces tearing apart asteroids. What this implies is that asteroids, and therefore probably planets, often survive the transition from ordinary star to giant star to white dwarf. One of the studied stars had 17 contaminant elements identifiable in it, and the composition of those closely matched the combined Earth and Moon composition.

New class of white dwarf – 24 white dwarf stars have been found near the center of the globular cluster NGC 6397 that have only about half the mass of typical white dwarfs and are made of helium rather than the usual carbon and oxygen. Globular clusters are known to sort lighter mass stars to the outside by gravitational interactions, and yet these are lighter stars found at the center. Being at the center implies that they must be binary pairs each with a massive companion star. This is also the solution to how they formed. The companion star must have stolen the outer envelope, leaving a helium core, less massive than a normal white dwarf. This theft must have occurred during the red giant phase, which occurs before the white dwarf phase. That would lower the mass of the star below that required to fuse the helium into carbon and oxygen, explaining those missing elements. Simulations of this process imply that the study should have found even more of these helium white dwarfs. So further research needs to be done to determine if they form less often or more slowly, or if they sometimes get destroyed.

Mars rover Spirit sunk its wheels about halfway in soft soil during its traverse around the plateau called Home Plate to examine interesting geology on the other side. Controllers in early May stopped all attempts to drive when the rover just seemed to be sinking deeper. A replica of the area is being built at Jet Propulsion Laboratory in which to try various techniques for unsticking a rover, using a spare rover here on Earth. The Mars rovers have been stuck before, and controllers have managed to free them. It has been more difficult though since 1 of Spirit's front wheel motors failed 3 years ago, and the remaining 5 wheels have been dragging the immobile wheel. Controllers are prepared to take weeks to solve the problem. In the mean time, Spirit is making observations of everything it can see and reach from its current position. The problems Spirit experienced in April, loss of memory and computer resets, have not reoccurred. Investigation into these continues, not having yet completely explained them.


Spirit dug in
Courtesy NASA/JPL-Caltech

Fermi (gamma-ray space telescope) has its observations of gamma rays polluted by high-energy electrons in cosmic rays. The good news (for gamma-ray astronomers) is that

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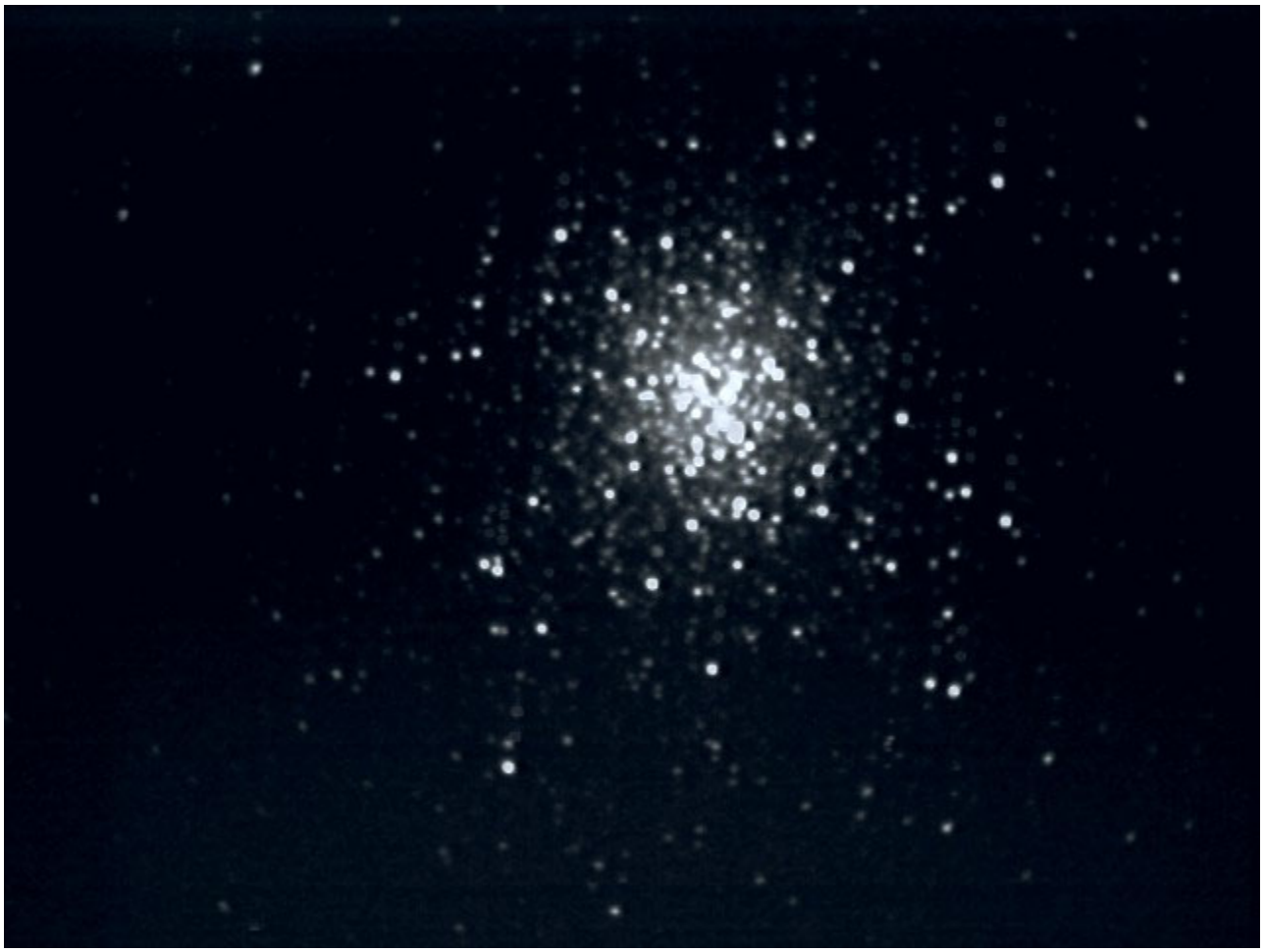

A favorite summer object, M13 is visible throughout the evening in May and June. Rob Roberson created this image using a Meade LX90 8-inch SCT with an SAC8 imager while observing from Anaheim on 8/1/04.

One of the more impressive feats of planetary imaging seen in this club, Bill Warden was able to capture Neptune (lower right) using a Celestron Nexstar 8 GPS with a Canon Digital Rebel from Los Alamitos on 8/25/04. Triton may be seen at the extreme lower right corner of the image! For those of you ambitious enough to attempt this for yourself, Jupiter and Neptune are in conjunction throughout the summer, staying within three degrees of one another. If you want to find Neptune, just look for Jupiter!

NASA's Space Place

Scoring More Energy from Less Sunlight

For spacecraft, power is everything. Without electrical power, satellites and robotic probes might as well be chunks of cold rock tumbling through space. Hundreds to millions of miles from the nearest power outlet, these spacecraft must somehow eke enough power from ambient sunlight to stay alive.

That's no problem for large satellites that can carry immense solar panels and heavy batteries. But in recent years, NASA has been developing technologies for much smaller microsatellites, which are lighter and far less expensive to launch. Often less than 10 feet across, these small spacecraft have little room to spare for solar panels or batteries, yet must still somehow power their onboard computers, scientific instruments, and navigation and communication systems.

Space Technology 5 was a mission that proved, among other technologies, new concepts of power generation and storage for spacecraft.

Helen Johnson, a spacecraft technician at NASA's Goddard Space Flight Center, works on one of the three tiny Space Technology 5 spacecraft in preparation for its technology validation mission.

"We tested high efficiency solar cells on ST-5 that produce almost 60 percent more power than typical solar cells. We also tested batteries that hold three times the energy of standard spacecraft batteries of the same size," says Christopher Stevens, manager of NASA's New Millennium Program. This program flight tests cutting-edge spacecraft technologies so that they can be used safely on mission-critical satellites and probes. "This more efficient power supply allows you to build a science-grade spacecraft on a miniature scale," Stevens says.

Solar cells typically used on satellites can convert only about 18 percent of the available energy in sunlight into electrical current. ST-5 tested experimental cells that capture up to 29 percent of this solar energy. These new solar cells, developed in collaboration with the Air Force Research Laboratory in Ohio, performed flawlessly on ST-5, and they've already been swooped up and used on NASA's svelte MESSENGER probe, which will make a flyby of Mercury later this year.

Like modern laptop batteries, the high-capacity batteries on ST-5 use lithium-ion technology. As a string of exploding laptop batteries in recent years shows, fire safety can be an issue with this battery type.

"The challenge was to take these batteries and put in a power management circuit that protects against internal overcharge," Stevens explains. So NASA contracted with ABSL Power Solutions to develop spacecraft batteries with design control circuits to prevent power spikes that can lead to fires. "It worked like a charm."

Now that ST-5 has demonstrated the safety of this battery design, it is flying on NASA's THEMIS mission (for Time History of Events and Macroscale Interactions during Substorms) and is slated to fly aboard the Lunar Reconnaissance Orbiter and the Solar Dynamics Observatory, both of which are scheduled to launch later this year. Thanks to ST-5, a little sunlight can go a really long way.

Find out about other advanced technologies validated in space and now being used on new missions of exploration at nmp.nasa.gov/TECHNOLOGY/scorecard. Kids can calculate out how old they would be before having to replace lithium-ion batteries in a handheld game at spaceplace.nasa.gov/en/kids/st5_bats.shtml.

This article was provided by the Jet Propulsion Laboratory, California Institute of Technology, under a contract with the National Aeronautics and Space Administration.

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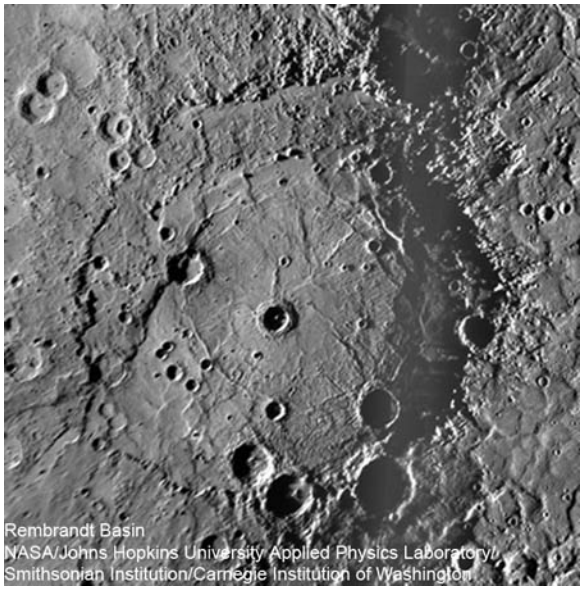
the electrons can be separated from the gamma rays, and the further good news (for cosmic ray astronomers) is that the separated electron incidents amount to a cosmic ray telescope for free. Analysis of 4.5 million Fermi electron events shows no spike in the number of cosmic rays at an energy of 500 Gev (billion electron volts), in contradiction to results presented recently from the ATIC balloon-borne cosmic ray experiment. Fermi did show an excess in cosmic rays with energies above 100 Gev. This suggests that there is source of cosmic rays relatively nearby, since particles with these energies lose energy when they travel over long distances. Unlike any form of light, which travels in straight lines, cosmic rays can ricochet off gas atoms or become deflected by magnetic fields, randomizing the paths and making it difficult to tell where they originated. A nearby source would probably be a pulsar, but has also been postulated to be dark matter annihilating with anti dark matter. Fermi will follow up with observations over different parts of the sky to try to localize the probable nearby source of cosmic rays.

Swift (gamma-ray burst satellite) has detected a gamma-ray burst that turned out to be the most distant object seen: its light left it just 630 million years after the Big Bang. This burst itself lasted only 10 seconds, but afterglows from bursts last a few days. The redshift of this object is so large (8.2) that visible light that it gave off is seen as infrared. Efforts to find the afterglow in visible light failed. But in infrared it was visible and spectra were taken to determine its redshift, and therefore its distance. Most gamma-ray bursts occur when massive stars run out of fuel and explode as supernovas. This produces jets that shoot out into space, striking gas previously shed by the star. The jets produce the burst of gamma rays and heat the surrounding gas, which produces the afterglow.

APEX submillimeter telescope in Chile (submillimeter light lies between radio and infrared) surveyed the same section of the sky where Chandra previously made a deep-field X-ray image, and over a hundred galaxies were found which were undergoing bursts of star formation. Most are very distant, and therefore seen as they were when the light left them many billions of years ago. The most distant was seen as it was only 1 billion years after the Big Bang. The large number found surprised experts because other observations looking for early galaxies have not found these numbers.


Rembrandt Basin
NASA/Johns Hopkins University Applied Physics Laboratory/
Smithsonian Institution/Carnegie Institution of Washington

Messenger (Mercury mission) – Analysis has been released of observations made by Messenger in its flyby of Mercury last October. The atmosphere, magnetosphere and geological past were all found to have greater levels of activity than previously believed. One of the biggest surprises was the discovery of a large and unusually well preserved impact basin, which has been named Rembrandt (artists and authors are the theme for new crater/basin names on Mercury). It is more than 430 miles across and formed about 3.9 billion years ago, a little later than the other basins on the planet. This is why some of Rembrandt's floor appears unchanged since its formation, while all the other basins had their floors obliterated by lava flows and impacts. Magnesium was found in the very thin atmosphere, which means the element is present on the surface, since atmospheric particles are believed to be ejected from the surface. Finding the magnesium was expected, but the amounts and distribution about the planet were unexpected. Leakage of magnetic field through the dayside magnetosphere was found to be about 10 times larger than the corresponding phenomena ever seen at Earth. Stronger plasma waves and larger magnetic structures were measured than expected. With the images taken during this flyby we have now seen 90 % of Mercury's surface up close, and scientists are beginning global analysis of its geology. About 40% is covered by smooth plains, believed to be caused by lava flows, and they are found all over the planet. This contrasts with our Moon, where essentially all the smooth plains are on one side. There is no counterpart on Mercury to the lunar highlands, a feldspar-rich area that is believed to have formed when lighter material floated atop the molten surface as it cooled after forming. Much of Mercury appears of volcanic origin, more like Mars than the Moon. Next Messenger flyby is the end of September.

Unusual asteroid designated 2009 HC92 was discovered in April by the Catalina Sky Survey in Arizona. It orbits retrograde (opposite the direction of all the planets and nearly all asteroids), spins on its axis retrograde, has a very eccentric (elongated) orbit, and is highly inclined to the plane of the planets. These properties are not that unusual for a comet, leading astronomers to suggest that it might have been a comet that lost all its ice and gases, so no longer emits a coma or tail, features that would make it a comet. It orbits the Sun every 3.39 years and comes uncomfortable close to Earth (about 2.2 million miles). Astronomers are surprised that it has not been seen on previous close approaches.

Earth-like exoplanet – Researchers announced the discovery of a rocky planet with a mass 1.9 times that of Earth orbiting the star Gliese 581. It is known to have 3 other planets, but they are much larger, having 5 to 16 times the Earth's mass. The newly discovered planet is too close to it star and therefore too hot to have liquid water, so it is not entirely Earth-like. But one of its other planets is in the water zone. Gliese 581 is 1/3 the mass of the Sun, and much cooler and dimmer. The planet was discovered as a result of measuring the motions of its star using a telescope in Chile.

Exoplanets – In late 2008 images were released of 7 exoplanets, that is, planets orbiting other stars, while none had been imaged before. Critics have pointed out that the methods of determining masses are subject to great error on all but the planet orbiting

the star Fomalhaut. Most masses were estimated by the planet's temperature, using planet formation theory and the age of the star. If the masses of the planets are a bit larger than thought, then they are probably brown dwarfs, or failed stars, rather than planets. The method of determining if a body orbits a star is also subject to error. Planets far enough from their stars to be imaged have such long orbital periods that we usually cannot observe a substantial part of the orbit, and must rely on the object and its star sharing the same motion through space. Sharing the same motion occasionally happens with objects not orbiting. The bottom line is that the skeptics among astronomers want to see more evidence for 6 of the 7 purported images of exoplanets.

Brown dwarfs – The OGLE project stares at a huge number of stars to see microlensing events, that is, the effect of gravity bending light when a massive object passes in front of a source of light. One of the lensing events seen by OGLE was caused by a brown dwarf, as determined by the mass. From the light curve of the event, astronomers calculated that the object has a mass of 1/18 that of the Sun, is 525 light years away, and traveled in front of a more distant star at a speed of 70 miles per second. From the estimated number of brown dwarfs in our galaxy, and the number of stars being watched and how long they have been watched, the odds are extremely small that even a single brown dwarf event would be seen. So either the OGLE project got lucky or there are many more brown dwarfs than astronomers estimate. If OGLE or another microlensing survey catches another brown dwarf, then we will probably have our answer as to which.

Cool brown dwarf – A survey using the UK Infrared Telescope in Hawaii has found about 40 light-years away one of the coolest brown dwarfs known, only about 570° F. It orbits the red dwarf star Wolf 940 at a distance of 440 AU (an AU is the distance at which the Earth orbits the Sun) and takes 18,000 Earth years to complete its year. It has a mass 20 to 30 times that of Jupiter, which places it too massive to be a planet and not massive enough to be an ordinary star.

International Space Station (ISS) – Follow up analysis of the salmonella bacteria grown in an experiment on ISS has determined why they became 3 to 7 times more virulent than samples kept on the ground. Zero gravity feels the same to the bacteria as being lodged in the lining of an intestine, which stimulates activity of genes that promote infecting the owner of those intestines. The bacteria detect lack of surrounding fluid motion. The scientists have found which genes and proteins are involved in the infecting process, and are working on means to slow or stop this. They already have a candidate treatment that involves ions, including potassium, chloride and phosphate.

Instant AstroSpace Updates

Grains of material formed under high heat, and therefore close to the Sun, have been found in the past **in comets** that formed far from the Sun, puzzling scientists. A new study shows that infrared radiating from a forming planetary disk pushes larger grains up out of the disk, where a star's light will push the grains to the outer parts of the disk, solving the puzzle.

Scientists have a few competing theories on how **silicate crystals** form that are found in comets. Observations of the variable star EX Lupi both before and after one of its flare ups showed the infrared spectrum of silicate crystals in the dust disk about the star after the flare, but not before, thus answering the question, at least for this one star.

Cassini (Saturn mission) found that the ice particles being thrown off by the **geysers on** the moon **Enceladus** are electrically charged, some positive and some negative, probably caused by frictional static where the particles are emitted. The magnetic field around Saturn then sorts these particles by mass, acting like nature's mass spectrometer.

Using the IRAM submillimeter telescope in Spain, astronomers have discovered the 2 most **complex molecules** yet found in interstellar clouds of gas: ethyl formate, with 11 atoms, and n-Propyl cyanide, with 12. Each has more atoms than the simplest amino acid (glycine), raising hopes that astronomers will soon find an amino acid in space.

The most complete census of the **Orion Molecular Cloud** (star formation region including and around the Orion Nebula) has been made in infrared (from both ground-based and space telescopes) and submillimeter light, cataloging young stars and mapping dust and gas, and measuring the motion of more than 100 jets. Infrared and submillimeter penetrate the obscuring material that prevents us from seeing most of the contents of the Cloud in visible light.

Chandra (X-ray space telescope) has made observations of a small piece of so-called **galactic ridge X-ray background**, and found, as expected, that at least 80%, and probably all of it is composed of discrete point-like sources that blended together in earlier observations. The individual sources are mostly white dwarf stars accreting matter from a companion, and the rest are probably stars with high magnetic activity producing flares.

THEMIS (fleet of 5 aurora spacecraft) has flown through and measured funnels which span a volume as large as the Earth consisting of rotating plasmas of hot ionized gas flowing at a speed of more than a million mph, producing electrical currents exceeding 100,000 amps. These "space tornadoes" channel the electrical current along twisted magnetic field lines into the ionosphere to spark auroras.

NASA has selected 2 projects to be placed on European Space Agency missions: radio tracking of the **ExoMars** spacecraft (to launch in 2016) to measure the rotation and interior properties of Mars, and a mass spectrometer on **BepiColombo** (to launch in 2013) to measure the atoms and molecules in Mercury's extremely thin atmosphere, which are believed to have been ejected from the planet's surface.

(continued next page)

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Caltech has announced that it will decommission its **Submillimeter radio telescope** in Hawaii in 2016 to use the operating budget instead on the Cornell Caltech Atacama Telescope being constructed in Chile.

Computer simulations of merging black holes shows that the process often kicks black holes out of their galaxies at high speed, so wandering **rogue black holes** should exist, perhaps in the halos of large galaxies. They drag a number of stars with them, so they could be detected by their accompanying star clusters.

Don Lynn created this image of NGC 253 using images captured by an SBIG ST2000C and STL 6303 imagers connected to an internet telescope based in New Mexico. Imaged between 9/25 and 10/1/08, the image was created from a 15-minute luminosity exposure and a 12-minute color exposure.

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