SIRIUS ASTRONOMER

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The Newsletter of the Orange County Astronomers

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GET YOUR GRILL ON! STARBECUE JULY 10TH!

This month's main speaker, Dr. Marc Rayman, is seen in the clean room with NASA's Dawn spacecraft prior to launch. Dawn is using an ion engine to travel to and within the main asteroid belt and will enter orbit around the asteroid Vesta in August 2011.

OCA CLUB MEETING

The free and open club meeting will be held July 9th at 7:30 PM in the Irvine Lecture Hall of the Hashinger Science Center at Chapman University in Orange. This month, Dr. Marc Rayman of JPL will discuss NASA's Dawn Mission to the main Asteroid Belt.

NEXT MEETING: Aug. 13th

STAR PARTIES

The Black Star Canyon site will be open on July 3rd. The Anza site will be open on July 10th. 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, July 2nd at the Centennial Heritage Museum at 3101 West Harvard Street in Santa Ana.
GOTO SIG: TBA
Astro-Imagers SIG: July 20th, Aug. 17th
Remote Telescopes: July 26th, Aug. 23rd
Astrophysics SIG: July 16th, Aug. 20th
Dark Sky Group: TBA

July 2010 President's Message

by Craig Bobchin

Well here it is July and the summer is in full swing. July symbolizes the birth of our nation and of course BBQs and Fireworks on the $th of July weekend. This year as in years past we have the club's annual Star-B-Que. The Star-B-Que is a potluck so bring food to share with the other members.

In years past we've had some wonderful dishes and more food than we knew what to do with.

As for the Fireworks, well you have the entire Milky Way galaxy and billions of galaxies outside ours to observe. Of course no clear night at Anza is without at least one shooting star. So keep your eyes open.

While on the subject of Anza the end of June is upon us as I write this and it is time to clean up the site that we all use and love. This means that we need to trim weeds and other plant life around the pads and observatories to help create defensible perimeters around the flammable portions of the property. This also means that we have to be wary of any critters such as snakes, spiders and rodents that might not like us disturbing their homes.

When you clean up your pad or observatory area remember that you need to pack your trash out with you as we have no on site trash pick up. You can take your trash to the receiveing station in the town of Anza a few miles away from the property.

Anza house is also in need of cleaning and removal of some broken appliances and furniture. While we appreciate members donating no longer needed items, we do ask that you not use Anza as a dumping ground. If you want to donate a chair or appliance please make sure it is is usable condition.

I've heard from a few members and visitors about a few things that would be nice to have at Anza house. Among these are some towels and extra blankets. I've seen some towels in the bathrooms in the past and I know some people may have used them and took them to wash after wards. If you have ay extras please consider leaving a couple at Anza house and return those that you take home to wash on your next trip back to the site. Also we do occasionally have visitors come to the site who maybe unprepared for the conditions there, and at night would like a blanket to keep warm while in the house. If you have an extra blanket or two please consider donating them as well.

You may have noticed that there is an interesting addition to the football field at Anza. As part of the inspection for the new observatories we were required by Riverside County to provide Handicapped specific parking. Gary Shones who has been instrumental in keeping Anza a place we all like to hang out put in the signs and marked out the parking spots with blue chalk. By the time you read this the chalk marks may have been blown away or otherwise weathered away in the dirt, but the signs are there as a reminder of where the spots are.

Coming up in the Month of July we have the following events:

Beginner's Class which is also the Learn how to use your telescope class on 7/2
Blackstar Canyon Star Party on 7/3
The general meeting on 7/9
Anza Star Party/Star-B=Que on 7/10

And the board meeting on 7/25

If you want to see how the club is run I encourage you to attend the board meeting. I attended my first one almost 10 years ago and it inspired me to join the board as soon as I was able.

Until next month, clear dark skies!

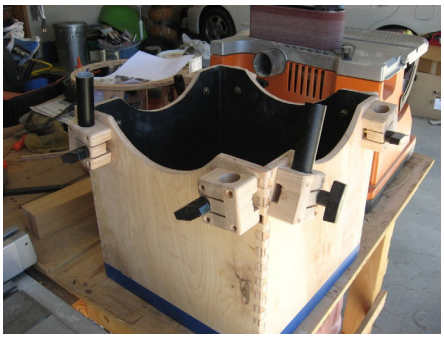
"Telescope Transformation – Making Observing Easier"
July, 2010
By Tom Koonce and Don Bryden
Antelope Valley Astronomy Club, Inc.
Lancaster, California

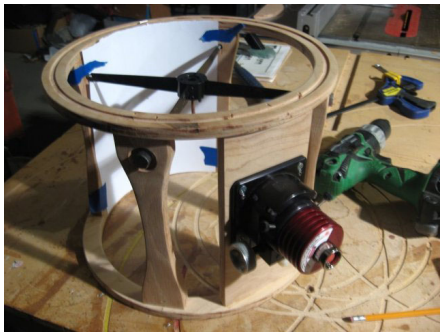
What if the sky was clear and steady, the temperature was comfortable, and all that kept you from observing the stars was that you couldn't physically move your telescope outside? What if you were unable to stand for long periods of time at the eyepiece without significant pain? What if manipulating small parts with your hands made it difficult and frustrating to assemble your telescope for the night's viewing? Situations like these are more common than major telescope manufacturers seem to acknowledge. The reality is that amateur astronomy has a 'mature' demographic, and many of us have physical limitations like these that hinder us from being the best observers that we can be. The good news is that there are ways to maximize our enjoyment of astronomy through modification of commercial telescope equipment, adaptation, and innovation.

An excellent example of such modification and innovation was Antelope Valley Astronomy Club (Palmdale, CA) President, Don Bryden's recent project undertaken for a close observing friend. His friend, Duane, has some significant physical limitations and found it cumbersome, and sometimes even dangerous, to lift his C10, 10" f/4.7 newtonian onto his CG-5 mount. The manual non-GoTo mount had small controls and locking levers that were difficult for Duane to manipulate. The telescope provided great views, but because of its weight, lack of handholds, and slippery sides, it had been dropped on occasion, luckily without serious damage, but it was clearly not the right telescope configuration for the user.

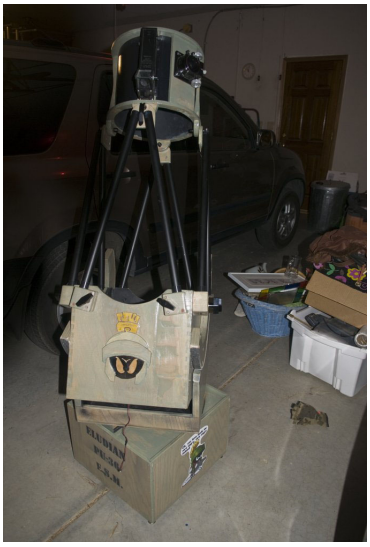
Don Bryden and another mutual friend first thought to help Duane with this project by simply mounting the newtonian in a dobsonian-style cradle mount. But as they thought this through, they realized that a solid tube dobsonian would present transportability problems and be hard for Duane to store. Since Don had recently finished building a truss-tube dobsonian for himself and had enjoyed the work, he suggested converting the C10 into a truss-tube scope. High level design considerations were that the resulting telescope would have to be simple for Duane to setup, use, and store. Other considerations were that since Duane has difficulty with the use of his hands, any hardware should be easy to manipulate, but hard to lose.

During the build process, the truss-tube dob emerged and incorporated further considerations of the user's needs. The focuser was set at a 45 degree angle from the plane of the altitude motion for ease of use and the focuser height was tailored to a convenient height for Duane when in a seated position. A stable 14" base was added and dimensioned so that the secondary cage fits into the mirror box which fits into the base for convenient transport and storage. Each individual section is light weight with easy ways to hold onto them.





Large knobs and thoughtful design details make the scope easy to use



The spider and mirror cell were from the original design and required an allen wrench for adjustment. Don made a slot in the side of the secondary cage so that the allen wrench was always available. No other tools are required for setup and adjustments. A major design decision was the method to attach the truss tubes in four groups of two at the top to wooden fittings that in turn receive the secondary cage. To make the attachment of the secondary cage to the truss-tube wooden fittings, bicycle seat post quick-release clamps were used which are simple to operate and impossible to lose.

The resulting scope was dubbed "Marvin the Martian" for its green color and custom Marvin the Martian emblem. It took approximately 20 hours of Don's labor spread over three months, allowing him time to think through the design challenges that arose. The telescope holds collimation well, is comfortable to use for Duane and is considered a resounding success by him. The telescope was entered in the 2010 Riverside Telescope Makers Conference contest and won a special Merit Award.

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TOP TWENTY THINGS AN ASTRONOMER SHOULD SEE

15 A Total Lunar Eclipse

By Helen Mahoney

Unlike their cousins, the solar eclipses, you usually don't have to go far to see a lunar eclipse—they come to you. The curved shadow of the limb of the earth darkens the face of the moon, so it can be seen from anywhere that the moon can be seen. It's a hemisphere-wide spectacle.

A lunar eclipse happens when the moon moves into the shadow of the earth. This only happens during a full moon, when the moon is directly opposite the sun. And, due to the inclination of the moon's orbit relative to the plane of the earth's orbit around the sun, this only happens about twice a year.

The shape of the Earth's shadow as observed during the August 20, 2008 lunar eclipse. Photo courtesy Anthony Ayiomamitis via Astronomy Picture of the Day (http://apod.nasa.gov/apod/)

Sometimes, the moon only skims the shadow, and this makes a partial lunar eclipse. More rare is a total lunar eclipse, when the moon moves completely into the shadow. When it does, the moon usually does not disappear. While passing through the earth's atmosphere on the edges of the earth (that is, the areas of the earth experiencing sunrise and sunset) the sunlight is refracted. Similarly to the way the sun appears reddened at sunrise and sunset from earth, the reddened rays bend and hit the moon's face. This gives the totally eclipsed moon a copper glow, like a big penny hanging in the sky. A beautiful representation of this effect can be seen in the APOD picture of July 26, 2000 (of the July 16,2000 eclipse), taken from Palmerston North, New Zealand by my friend Noel Munford.

With binoculars, the totally eclipsed moon has a distinct 3-dimensional appearance against the background stars. It's the best way to appreciate the moon as a ball.The earth's shadow at the distance of the moon is about 3 lunar diameters. This makes the arc of the curve of the earth's shadow wider than that of the terminator of a crescent moon. It is subtle, but it can be appreciated during a partial lunar eclipse or the partial phases of a total lunar eclipse. (A great demonstration of this can be seen in the APOD picture of August 20, 2008.)

A lunar eclipse is one of the few times when it is relatively easy to see the actual movement of the moon, as it slips into and out of the shadow. When we see the moon rise and set, we are actually seeing the earth's motion. During a lunar or solar eclipse, and when the moon occults a planet or bright star, we can see the moon's actual west-to-east motion.

I have seen many partial and total lunar eclipses, but two stand out in my memory. One was the total lunar eclipse of September 6, 1979. OCA member Bill Hall, some of my other friends and I were up on Mount Wilson for the eclipse. When it was completely immersed in the earth's shadow, and the bright moonlight was thus subdued, the Milky Way was revealed about 60 degrees to the west of the copper moon. With Los Angeles clouded over by the marine layer, the sight was spectacular! Another memorable eclipse was the one of May 16, 2003. The moon was already in eclipse when it rose. I had set up in the parking lot of Community Hospital, which has a great eastern view. As the sun set, I could see the earth's shadow rise. In addition, there were crepuscular rays, all converging on the spot where the eclipsed moon was emerging from the haze. It was neat to realize that those cloud shadows were traveling all the way to the moon.

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NASA's Space Place

Black Holes No Joke

by Dr. Tony Phillips

Kip Thorne: Why was the black hole hungry?
Stephen Hawking: It had a light breakfast!

Black hole humor—you gotta love it. Unless you're an astronomer, that is. Black holes are among the most mysterious and influential objects in the cosmos, yet astronomers cannot see into them, frustrating their attempts to make progress in fields ranging from extreme gravity to cosmic evolution. How *do* you observe an object that eats light for breakfast?

Laser Interferometer Gravitational-wave Observatory in Livingston, Louisiana. Each of the two arms is 4 kilometers long. LIGO has another such observatory in Hanford, Washington.

"Black holes are creatures of gravity," says physicist Marco Cavaglia of the University of Mississippi. "So we have to use gravitational waves to explore them."

Enter LIGO—the NSF-funded Laser Interferometer Gravitational-wave Observatory. According to Einstein's Theory of General Relativity, black holes and other massive objects can emit gravitational waves—ripples in the fabric of space-time that travel through the cosmos. LIGO was founded in the 1990s with stations in Washington state and Louisiana to detect these waves as they pass by Earth.

"The principle is simple," says Cavaglia, a member of the LIGO team. "Each LIGO detector is an L-shaped ultra-high vacuum system with arms four kilometers long. We use lasers to precisely measure changes in the length of the arms, which stretch or contract when a gravitational wave passes by."

Just one problem: Gravitational waves are so weak, they change the length of each detector by just 0.001 times the width of a proton! "It is a difficult measurement," allows Cavaglia.

Seismic activity, thunderstorms, ocean waves, even a truck driving by the observatory can overwhelm the effect of a genuine gravitational wave. Figuring out how to isolate LIGO from so much terrestrial noise has been a major undertaking, but after years of work the LIGO team has done it. Since 2006, LIGO has been ready to detect gravitational waves coming from spinning black holes, supernovas, and colliding neutron stars anywhere within about 30 million light years of Earth.

So far the results are … nil. Researchers working at dozens of collaborating institutions have yet to report a definite detection. Does this mean Einstein was wrong? Cavaglia doesn't think so. "Einstein was probably right, as usual," he says. "We just need more sensitivity. Right now LIGO can only detect events in our little corner of the Universe. To succeed, LIGO needs to expand its range."

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

AstroSpace Update

July 2010

Gathered by Don Lynn from NASA and other sources

Kepler (exoplanet finder) has been observing 156,000 stars in Cygnus since May last year, looking for the dips in light level caused by planets transiting (passing in front of) their stars. The first 1.5 months of data has finally been released (only partially) and there are over 750 possible exoplanets in the data. Normally NASA releases all data within a year of being observed, but numerous delays in handling and following up this torrent of data from Kepler have kept the Kepler scientists from being able to positively identify planets and publish their results. So in a compromise move, the data on 350 possible planets was released, and the Kepler scientists were given 6 more months to publish results on the other 400. A number of things can disguise themselves to look like a planet to Kepler, such as brown dwarf stars, double stars, and pulsating stars, so much ground-based or Hubble or Spitzer follow-up observation has to be made to weed out the non-planets. To put the amount of follow-up in perspective, only about 550 planets had been discovered in all of history before this Kepler data release. Experts believe roughly half of the possible planets will be weeded out. The stars with possible planets make up quite a range of temperatures, sizes and ages. They include stars that are stable, pulsating (unstable), spotted, and flaring. The diameters of the planets range from about that of Earth to that of Jupiter, with the average being less than half Jupiter's. Five of the stars appear to have multiple planets. When follow-up observations are combined with Kepler data, the planet's diameter, mass, orbit, and density are usually determined. Sometimes its temperature or atmosphere can be detected. Kepler will continue to observe until at least November 2012, and roughly similar rates of planet discovery should continue.

Exoplanet orbiting – After a probable planet at the star Beta Pictoris was imaged in 2003, one of very few exoplanets directly imaged, further imaging attempts (to confirm it was indeed a planet) turned up empty. But now the planet has reappeared. It was just passing too close to the star in its orbit to be seen, and the reappearance was on the other side of the star. Its orbit was found to be about the size of Saturn's, the smallest orbit of any exoplanet that has been imaged. The planet's mass is about 9 times that of Jupiter. Beta is only 12 million years old, so obviously giant planets can form this quickly.

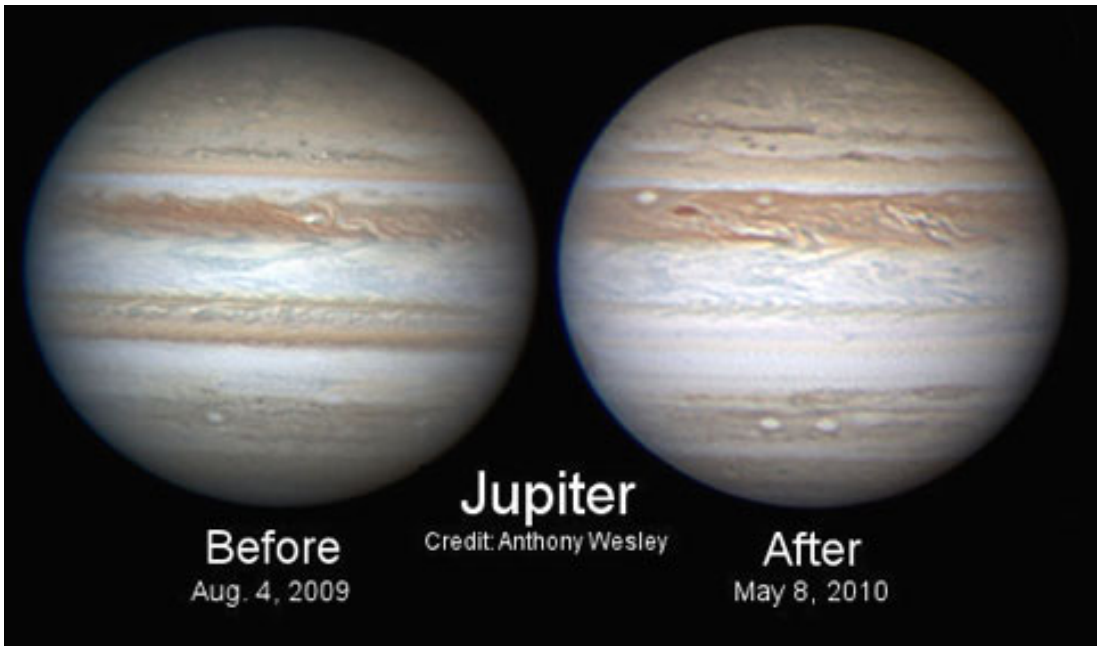
Exoplanet tilt – Astronomers have measured the tilt of the orbits of 2 exoplanets and found them to be at an angle of 30° to each other. This contradicts planet formation theory that says all planets at a given star form out of a single disk of dust and gas, so that all those planets orbit essentially in the same plane. The planets orbit the star Upsilon Andromedae, which lies about 44 light-years away. Observations from both ground-based telescopes and the Hubble Space Telescope were needed to pin down the orbit positions. Both radial velocity (red/blue shift in the spectrum) and precise positional measurements (astrometry) were needed to calculate the orbits. A 3rd planet is known to orbit closer to the star, but astrometry on it was not nearly precise enough to allow calculating its orbit. Disturbances of the 3 indicate a 4th planet may be farther out in the system. Theories to explain how 2 planets ended up in different planes include: inward migration of planets could have resulted in an encounter between planets that flung one of them out of plane, disruption of a planet's orbit by the companion star (Upsilon is a binary star), or unstable orbits resulting in an encounter. The current configuration of planets is just barely stable, that is, able to avoid planetary encounters that further disrupt orbits. Earlier observations had calculated minimum masses on the 2 inclined planets of 2 and 4 Jupiter masses. The new observations pinned down the masses accurately at 14 and 10 Jupiter masses respectively. Thus the planet previously thought to be more massive is now known to be the lighter of the 2. The Hubble observations confirmed that there is indeed a companion star to Upsilon, and that it is a dim red dwarf.

More exoplanets – CoRot (orbiting planet search telescope) has discovered 6 new planets (and a non-planet), with a variety of characteristics: a rather small one at 70% the size of Saturn, whose internal structure should be an ice giant like Uranus; a gas giant with a very elongated orbit, such that its "sunlight" varies by a factor of 10 during its year of length 13 Earth days; a planet whose host star rotates very fast (40 hours); a gas giant smaller than Jupiter, but twice as dense, probably indicating a rocky core; a "bloated Jupiter", in which proximity to its star heats it so much that it expands to about 50% larger than Jupiter; and a "hot Jupiter", also heated up by its star, but not swelled up, probably due to its mass of 7.5 times that of Jupiter; and one that turned out too massive to be a planet, so is actually a brown dwarf star, with a density of 40 times that of Jupiter.

Keck Telescopes in Hawaii were linked interferometrically to obtain very high resolution images of 15 protoplanetary disks, the swirling clouds of gas and dust where planets are made around newly forming stars. Spectro-astrometry, a technique that distinguishes locations by spectral characteristics, was used to gain further resolution. The result was the first direct observation of how a growing star accumulates material. The observations in most cases support the theory that accumulation occurs by magnetic fields bunching up material, which then travels into the star along field lines. Other cases, however, supported the theory that accumulation occurs directly out of a closely spinning accretion disk. So apparently both methods can occur. Further observations using these techniques will be made to help understand how the planets form in protoplanetary disks.

Jupiter impact – Scientists have determined from Hubble Space Telescope observations of Jupiter that the spot discovered there July of last year by Australian amateur Anthony Wesley was caused by the impact of an asteroid approximately 1500 feet across. The spot differed from the spots caused by the impact in 1994 of Comet Shoemaker-Levy 9 (SL9) in that it did not have a halo when seen in ultraviolet (caused by comet dust), faded more rapidly, and was more elongated. The first 2 characteristics distinguished the impactor as an asteroid, and the last implied that it struck at a low angle. The probable angle of impact is consistent with the impactor being from the Hilda family of asteroids. The energy of last year's impact was equivalent to that of the medium-sized fragments of SL9, thus yielding the size estimate.

And another – Wesley (same guy) recorded a bright flash on Jupiter, lasting a few seconds, on June 3, which was confirmed in video taken by another amateur astronomer. Further observations by amateurs and professionals failed to find a dark spot on the planet this time. Analysis of images taken soon after by the Hubble Space Telescope (HST) concluded that the flash was a meteor that burned up high in Jupiter's atmosphere, so that it did not leave a blemish lower, where the clouds are. The impacting meteoroid was also much smaller than the asteroid impact last year and the SL9 comet pieces. When SL9 hit Jupiter, it was thought that impacts there of large objects were quite rare – after all, it was the first time something like that had been seen. Astronomers are now wondering if detectable impacts at Jupiter are quite common, and that we should be monitoring the planet to see them.



Jupiter belt missing – The South Equatorial Belt on the planet, normally brown, faded from view a few months ago until it matched the surrounding white clouds. The fading began last year, and one of the first to report it was Wesley (same guy). The HST images taken after the flash afforded the best views of the missing belt. It is still there, but just covered by higher white clouds of ammonia ice. In fact edges of the belt were seen in some places, which in past Jupiter belt disappearances indicate that the belt will reappear in the next few months as the white clouds break up.

Titan (Saturn's moon) – Scientists reported finding that there is a downward movement of hydrogen in Titan's atmosphere, not accompanied by a return upward, and that there is a shortage of acetylene low in the atmosphere. They stated that one possible explanation (of many) was that a form of life based on liquid methane rather than water would probably consume acetylene and hydrogen. This was, of course, blown out of proportion by certain news organizations. The scientists were quick to react to this and explain that there are at least 3 more likely explanations than having to invent a new form of life.

Spirit (Mars rover) examined a rock outcrop called Comanche in late 2005, and it was suspected then that it contained carbonate rocks. It took until now to confirm that the rocks are about ¼ by volume magnesium iron carbonate. The significance is that carbonate rocks form in wet conditions, with neutral, not acidic, water. Evidence of (past) water on Mars previously obtained by the rovers has been for water that was probably quite acidic. It is thought that neutral water would have been more conducive to the development of microbes. One of the delays in confirming the carbonate is that the rover instrument with the

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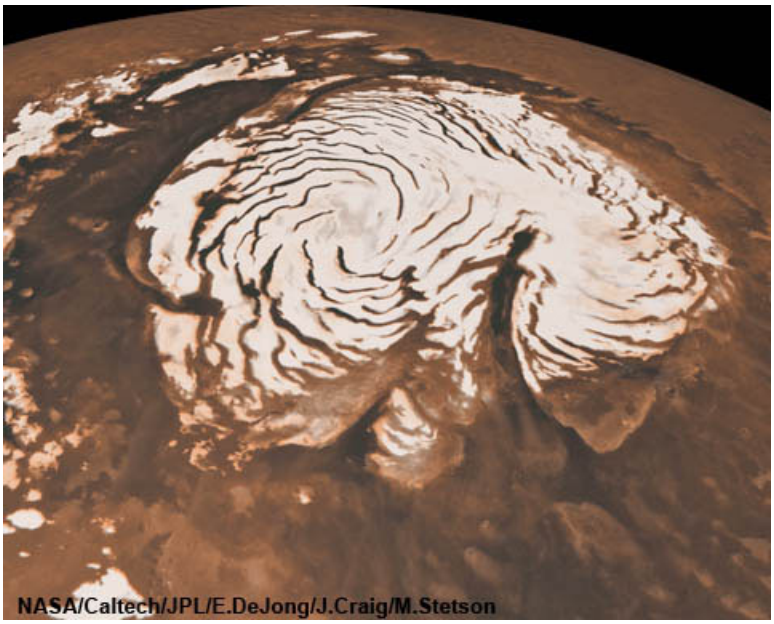
best capability for identifying such is the Thermal Emission Spectrometer. However its mirror had become contaminated with dust. Scientists had to develop techniques to remove the effects of the mirror dust from the measurements made.



Mars Reconnaissance Orbiter (MRO) – Analysis of MRO radar data has revealed the structure within and under the north polar ice cap, and from this a history of the cap's creation has emerged. The cap is up to 2 miles deep and is larger than Texas. The biggest canyon in the cap, known as Chasma Boreale, is somewhat larger than Earth's Grand Canyon. It slashes through a spiral pattern of many smaller canyons in the cap. The radar data showed that Chasma Boreale formed in an ancient ice sheet billions of years ago, before the spiral canyons formed. Wind patterns kept the canyon open as the ice sheet grew thicker around it. The radar data found another canyon of similar size to Boreale, but it had later filled up with ice and so had gone undiscovered until now. This new canyon probably filled up because winds there became too weak to keep it open. The smaller spiral canyons were found to have formed over millions of years, also primarily by wind. The prevailing winds flow generally across the canyons, evaporating or blowing ice on the lead side, and depositing ice as wind climbs the opposite side to exit. This causes the canyons to migrate in the upwind direction over millions of years. Coriolis effects cause the canyons to take on their curved shapes. The Coriolis effect is that wind moving toward or away from the north (or south) pole will curve in order to obey the law of conservation of angular momentum. Similar canyons in the Earth's south polar cap exist, which migrate slowly from the same wind process. Earth's polar canyons are not curved, however, because local topography breaks up the Coriolis winds. Besides answering many questions about the ice cap and Martian climate history, the radar data brought up new questions, such as what changed to start the formation of the spiral canyons?

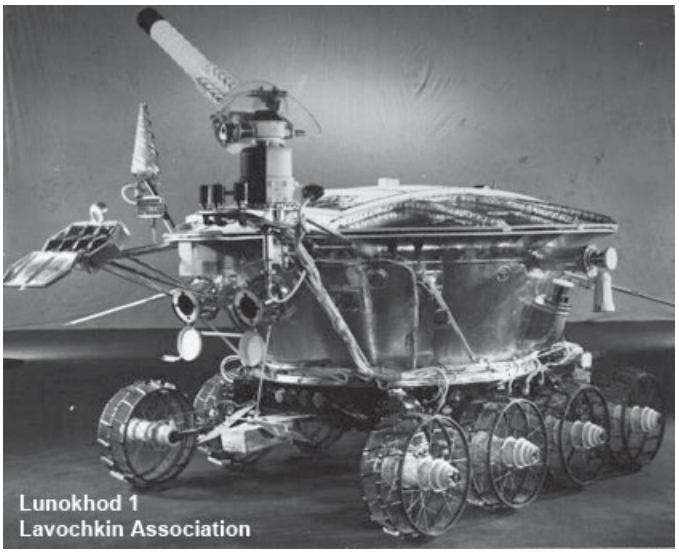
Martian ocean – A new study has supported the theory that the entire northern part of Mars was covered by an ocean billions of years ago. The study analyzed water-related features including scores of delta deposits and thousands of river valleys. More than half of the 52 river delta deposits were at about the same elevation, and so likely marked the boundaries of the proposed ocean. It would have covered 36% of the planet and contained about 30 million cubic miles of water. This is about 10 times less than the volume of Earth's oceans, but Mars is a smaller planet. A related study identified 40,000 river valleys, which were the sources for sediment that was carried down to form the deltas. This complex would have required considerable precipitation, which in turn had to be fed by a huge source of evaporation, namely the ocean. Thus all the parts of an Earth-like hydrological cycle are in evidence. River deltas on Earth rapidly bury organic material for life, so the ones on Mars should be targets at which to search for present or past Martian life.

WISE (orbiting infrared observatory) is surveying the entire sky, building up a catalog of everything seen in infrared, including distant galaxies, brown dwarfs, comets and asteroids. About a million images have been beamed down. WISE is finding an impressive collection of asteroids, some know and some never seen before. Most are in the Main Belt of asteroids between Mars and Jupiter, but some are near-Earth ones. By studying a small sample of near-Earth objects, WISE will learn more about the population as a whole. So far the mission has observed more than 60,000 asteroids, of which more than 11,000 were previously unknown. About 180 near-Earth asteroids have been observed, of which more than 50 are new discoveries. Some of the near-Earth asteroids found are dark in visible light, but it's too early to say what percentage. Since asteroid size is estimated from brightness, the dark ones get incorrect sizes. The brightness of infrared, however, correlates well with diameter, so the WISE data should improve estimates of sizes. WISE will study Trojans, those asteroids in Jupiter's orbit, either leading or trailing the planet. The mission has seen 800 of them, and expects to spot half the 4500 known Trojans by mission end, which is planned for October. WISE has found about a dozen new comets, including both long-period and short-period ones.

Galex (orbiting ultraviolet telescope) has discovered a galaxy tail studded with bright knots of new stars. The tail was created as the galaxy IC 3418 plunged into the neighboring Virgo cluster of galaxies. The tail formed in a very different way from tails formed by galaxy collisions. IC 3418 is mingling not with one galaxy, but with the entire Virgo cluster of galaxies. This massive cluster, which contains about 1500 galaxies, and is permeated by hot gas, is pulling in IC 3418, causing it to plunge through the cluster's gas at 2 million mph. The little galaxy's gas is being shoved back into a choppy tail by the cluster's gas. Clusters of massive young stars speckle the tail, and these stars glow with ultraviolet light. The tail is not seen in visible light. This is the

first time astronomers have found solid evidence that clouds of molecular hydrogen can form under the violent conditions present in a turbulent wake.

Moon's age – The Moon is generally believed to have formed when a planet about the size of Mars impacted the Earth shortly after the solar system formed. The best estimates of the timing of this impact were about 30 million years after the planets formed. A new study of isotopes of tungsten and hafnium shows that the hafnium in the Earth had nearly entirely decayed radioactively before the collision occurred. This would have taken considerably more than 30 million years, perhaps as much as 150 million years, changing the estimate of when the Moon-forming collision happened.


Lunokhod 1
Lavochkin Association

Lunokhod 1 was soft landed on the Moon in 1970 by the Soviet Union and it proceeded for nearly a year to rove about 7 miles taking thousands of pictures and testing the soil. Its precise landing location was never determined, and so efforts to bounce laser light off its retroreflector were unsuccessful. Timing the light bounced off the 3 American reflectors (placed by Apollo astronauts) and the other Soviet one has continued until today, resulting in a number of discoveries and precision measures. The Lunar Reconnaissance Orbiter recently returned a high resolution image that showed Lunokhod 1 and some of the tracks it left as it rolled over lunar soil. So the McDonald Observatory in Texas sent a laser beam to the location seen, and received the strongest reflection ever seen in lunar lasering. A reflection was seen even when the reflector on the Moon was in daylight, a feat never before performed. All the other lunar reflectors have degraded in their reflectance over the years, apparently due to dust or space weathering. No explanation has been found for why Lunokhod 1's reflector works so well.

Faint Sun paradox – Stellar evolution theory says that the Sun was as much as 30% less luminous during Earth's early history. Yet the Earth at that time maintained liquid oceans in which early life developed, though the dimmer Sun should have made it too cold for that. This has become known as the Faint Sun paradox. A new study says that the thick haze now found around Saturn's moon Titan should also have formed about the early Earth. The haze is made of byproducts from chemical reactions with methane and nitrogen, fueled by sunlight. Such haze would prevent ultraviolet light from breaking down greenhouse gases, such as ammonia, resulting in a considerable rise in temperature. This may solve the Faint Sun paradox. It would also have protected emerging life forms from damage by ultraviolet light. This was before ozone developed to provide such protection.

Star motions – Observations made by Hubble (HST) of the nebula NGC 3603 have measured the motions of the stars in the massive cluster within the nebula since HST studied the same area a decade earlier. Theory said that such a massive star cluster this old (about 1 million years) should have settled into motions such that lower mass stars move faster and higher mass ones more slowly. However the observations showed all masses of stars moving the same.

Star-forming regions – A team of astronomers using the Spitzer infrared space telescope and 2 large radiotelescopes have completed a search of our Milky Way for star-forming regions. Infrared and radio light penetrate dust that hides much of our galaxy from view in visible light and other wavelengths. The regions were detected by searching for ionized hydrogen, since newly formed hot stars ionize the gas around them. A large number of previously unknown star-forming regions were found, and they tended to concentrate, as expected, near the ends of the bar across the center of the galaxy and in the spiral arms. 25 of the regions seen were found to be in the outer parts of the galaxy, that is, farther from the center than our solar system is. There appears to be a correlation between distance from the center and abundances of certain heavier elements, and this will be pursued in future observations.

Binary star formation – The majority of stars in our galaxy are binary stars. How binaries form is an ongoing question in astronomy. Does a cloud of gas collapse in two pieces to form them, or does it collapse in one piece that later divides? New observations by Spitzer reveal the early birth process of close binary stars. In a study of 20 star-birth clouds, it found that nearly all of them were asymmetrical blobs. This asymmetry should cause fragmentation of the star-forming disk to result in 2 stars. Thus the "divide" theory is supported, at least for close binary stars. The team was not trying to determine the means of binary star formation, but was studying the effects of jets on the envelopes of gas around forming stars. Then they stumbled on the asymmetric shapes. Further study of the gas envelopes, examining the velocity of material falling onto the forming stars using radiotelescopes is already in progress.

(continued next page)

Different supernova – A faint supernova (designated 2005E) analyzed by a team of scientists differs from previous supernovas. It appears like a Type Ia supernova, which is a white dwarf star exploding when mass is added to bring it over the limit of stability, but has helium instead of the usual carbon and oxygen in its spectrum. Since white dwarf stars are largely composed of carbon and oxygen, the lack of them in 2005E is puzzling. The supernova did not create sufficient debris to have been a Type II (exploding very massive star). 2005E also had unusually high levels of calcium and titanium, which are products of nuclear reactions involving helium. The best explanation seems to be that a companion star dumped a lot of helium onto a white dwarf, thus changing the usual elements seen in a Type Ia. One other supernova (2002bj) has been found with similarities, and thus may also be a helium-dump supernova.

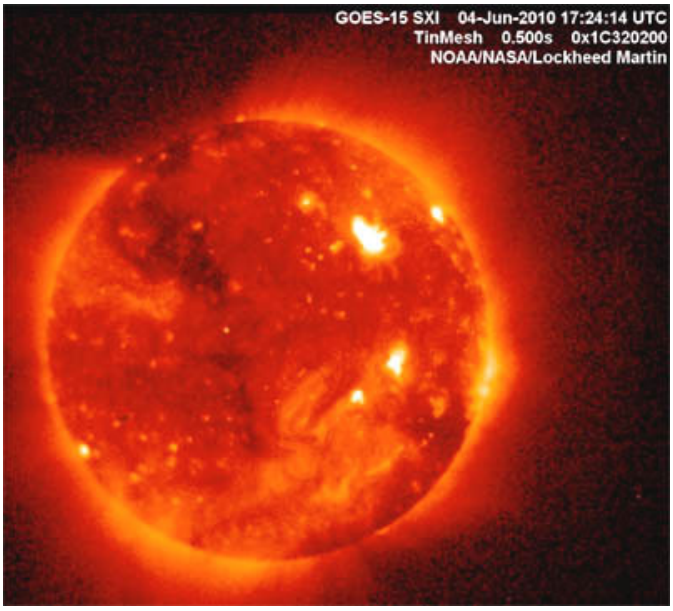
Black hole spin – Recently studies have shown that black holes that spin in the direction opposite (called retrograde) to their accretion disks produce more powerful jets. A new study shows that more distant galaxies have more retrograde supermassive black holes at their centers than nearby galaxies do. The more distant galaxies are seen as they were when the light left there, so they represent how galaxies were earlier in the history of the Universe. The implication is that over billions of years, many retrograde black holes, or their accretion disks, have switched their direction of spin from retrograde to prograde (spinning in the same direction).

Black hole position – The elliptical galaxy M87 is known for the jet of radiation that is streaming from the supermassive black hole at its center. Observations made with HST show that the black hole is actually off center by about 23 light-years. Two theories have been proposed as to how it got off center: 1) that merging with another galaxy, which causes their black holes to merge, gave the black hole a kick, or 2) that the jet is powering the black hole to move. The motion off center in M87 was indeed opposite to the direction of the jet. The measurement of M87's black hole was part of a continuing study of the positions of supermassive black holes. It will be interesting to see if other galaxies have their black holes off center also in the direction opposite a jet, in which case the second theory would be supported. However, if the first theory becomes supported, then measuring the positions of supermassive black holes will tell us something about the history of merging with other galaxies.

Active black holes – About 1% of the supermassive black holes at the centers of galaxies are active, that is, quasars or blazars which emit huge amounts of light, as much as 10 billion times as bright as our Sun. There are many theories as to why these are so bright and the other 99% are not. Data from an ongoing survey by Swift (gamma-ray, X-ray and ultraviolet orbiting observatory) showed that about ¼ of the active galaxies are merging or are close pairs. This implies that galaxies doing flybys or mergers are a major cause of the black holes becoming active. By searching in hard X-rays, Swift is finding active galaxies that other wavelengths of light have missed. Hard X-rays penetrate almost anything blocking our view in other wavelengths. Surveys of active galaxies in visible light and other wavelengths have not found a significant correlation with mergers, probably because they were missing too many active galaxies. This Swift survey appears to be finding all active galaxies out to a distance of about 650 million light-years.

Phoenix (Mars lander) – As reported here last month, the Mars Odyssey orbiter has been listening for radio signals from the Phoenix lander in case it somehow survived the harsh winter. The effort was unsuccessful. The orbiting MRO found one reason why. Images taken by MRO show that the shadow of one of Phoenix's solar panels has disappeared, where it was clearly seen in images taken during the lander's operation. This means that the solar panel broke off under the weight of winter ice. Images taken during the height of winter showed the lander practically disappeared under a coating of ice. Quite likely other fatal damage also occurred to Phoenix during the winter.

Dawn (asteroid mission) has set the record for the greatest speed change of a spacecraft under its own power (which excludes launch or gravity slingshots) of 9600 mph. It did this accelerating at 15 mph per day, using its ion engines. It uses only 9 ounces of xenon fuel per day. It will set the record for longest powered flight in August. The old records were held by the Deep Space 1 spacecraft. Dawn will go into orbit about Vesta in about a year.



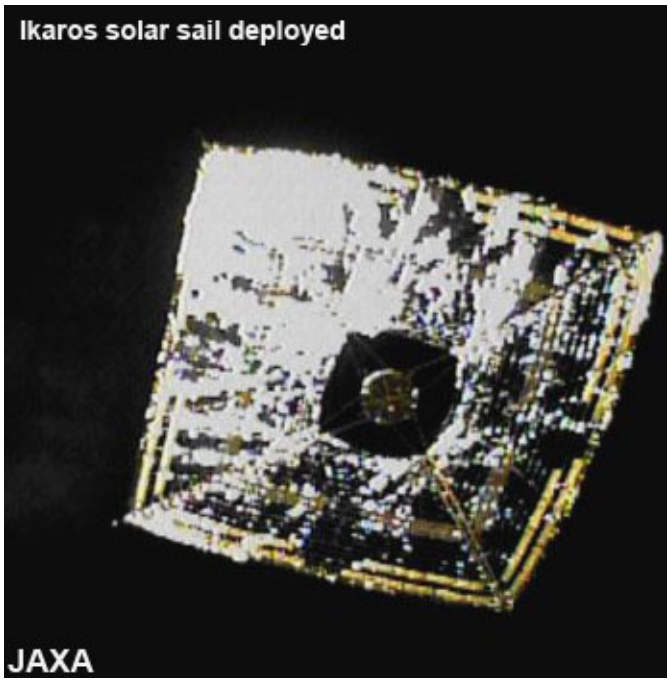
GOES 15 (weather satellite) was launched in March, and included a solar X-ray telescope besides the usual weather imagers. Unfortunately, in-orbit tests showed there was a short circuit in the power to the solar telescope, causing its complete failure. Months of trying every command and work-around all failed. Spacecraft controllers were able to pin down which unit contained the short circuit, and it was found that everything in that unit was to some extent expendable. Since there was no way to turn off the unit without turning off the telescope, they did the opposite,

and applied full power. After 16 hours, the unit overheated and blew out the short circuit. The solar telescope is now operating normally.

Pan-STARRS 1 (72-inch telescope on Maui) announced that the system is now fully functional and began full dusk-to-dawn nightly operations. The plan is to image 1/6 of the entire sky every month, complete to magnitude 24, with various filters, and subtract new images from archived ones to isolate everything that moved or changed brightness. It is expected to discover a torrent of asteroids, Kuiper Belt objects, comets, supernovas, novas, and variable stars. It automatically discards satellites and airplanes. The camera is 1.4 gigapixels (world's largest), covering a roughly circular field 3 degrees across. It reaches limiting magnitude in 30 seconds. It produces enough data every night to fill 1000 DVDs. It uses adaptive optics with no moving parts by shifting the image in the detectors during exposure. The eventual plan is to build 4 duplicates of this scope (to be called Pan-STARRS 4) on a single mount and shoot 2/3 of the entire sky every month.

Instant AstroSpace Updates

Ikaros (solar sail) was launched by Japan in late May and the sail was successfully deployed by a spinning mass system. It is the first solar sail successfully unfurled in space, and propulsion by light will soon be tested by flying to Venus.



Voyager 2 (outer planet mission, now exploring the outer heliosphere) developed a problem in the scientific data that it is transmitting to Earth, as reported here last month. The wrong bit in its memory, probably caused by a cosmic ray or other radiation, was reset, and full operation was restored.

SOFIA (airborne 100-inch infrared telescope) has seen its first light, that is, made its first in-flight nighttime observations. The stability and pointing accuracy exceeded expectations.

The **Solar Dynamics Observatory** has observed a number of very small flares that have generated magnetic instabilities and waves that are seen to affect large portions of the Sun. It was not previously known that such small events have such large effects.

A new study of moon rocks has found that some contain a few parts per million of **water**, far more than found in previous studies. The scientists making this study believe that this finding applies to much of the interior, so that the **Moon** would contain as much water embedded in rocks as the water in the Great Lakes.

Methane-eating bacteria, which do not need oxygen, have been found in Lost Hammer Spring in extreme northern Canada, which remains liquid throughout winter due to its high salt content. The conditions there are much like Mars, raising the possibility that bacteria could survive in places on that planet.

New research shows that ice should collect and remain stable in **caves** over much of **Mars**, including lava tube caves of the Martian volcanoes. Cold air sinks into such caves and protects the ice from evaporating, a process seen on Earth also.

A new geologic map of parts of Mars shows evidence of sedimentary deposits in the giant **Hellas** impact basin that is consistent with it having once been filled with liquid water, that is, a lake, probably roughly 4 billion years ago, when the Martian atmosphere was believed to be denser, warmer and wetter.

New computer simulations show that many **comets** in the Oort Cloud, and therefore many that pass through our inner solar system, were captured from other stars, where they formed. Thus studying comets may tell us not only about the early Sun, but about other stars that formed near the Sun.

Japan's space agency has announced plans to build a **robotic Moon base** by 2020. Previously they had announced intentions to build a manned lunar base a decade later than that, so the robotic base would be a precursor to the manned base.

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