SIRIUS ASTRONOMER

www.ocastronomers.org

The Newsletter of the Orange County Astronomers

May 2008 *Free to members, subscriptions $12 for 12 issues* **Volume 35, Number 5**

Better known for discovering the absorption lines in the solar spectrum, Joseph von Fraunhofer also developed the workhorse German equatorial mount. Read all about it on page 6!

OCA CLUB MEETING

The free and open club meeting will be held Friday, May 9th at 7:30 PM in the Irvine Lecture Hall of the Hashinger Science Center at Chapman University in Orange. This month, recent UCI Physics and Astronomy Department graduate Brian Hart discusses his findings regarding the large-scale structure of galactic clusters

NEXT MEETING: June 13th

STAR PARTIES

The Black Star Canyon site will be open on May 31st. The Anza site will be open on May 3rd and May 31st. 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, May 2nd at the Centennial Heritage Museum at 3101 West Harvard Street in Santa Ana.
GOTO SIG: TBA (contact coordinator for details)
Astro-Imagers SIG: May 20th, June 17th
EOA SIG: May 28th. June 25th
Astrophysics SIG: May 16th, June 20th
Dark Sky Group: TBA (contact coordinator for details)

President's Message

By Barbara Toy

Well, after a promising start to the rainy season, the rains abruptly stopped in March, and everything started drying out. As seems to be the case with every type of rainy season we have in Southern California (based on the warnings that issue from the Powers That Be whether we have a very wet year, a very dry year, or anything in between), this will undoubtedly contribute to the danger of fire in the upcoming fire season. We mainly talk about Anza when we talk about fire, but wherever you are, please take appropriate precautions to minimize any fire danger to yourself and those around you, and make your surroundings as fire resistant as possible.

As to Anza in particular, the deadline for weed clearance is the end of May for pad and observatory holders, but usually the weed growth doesn't stop with the weed clearance in May. The few structural items we lost in the fire at our Anza site a few years ago were surrounded by grasses or weeds that had not been cut back – this was particularly noticeable with the electrical box that was damaged on Mars Hill. So keeping the weeds cleared away from all of the structures and equipment can really pay off!

MESSIER MARATHON

Although we had the April Anza star party as a back-up to the March star party for the Messier Marathon, it was a wash-out – it's hard to see anything through thick fog, and we had thick fog out there most of the night according to those optimistic souls who stayed the full night. If any of you were holding onto your Messier Marathon forms until after the April star party to see if you could do better than the first time around (or for any other reason), please send them in to the club's P.O. box or give them to me when you see me, so I can get you your official 2008 OCA Messier Marathon certificate!

ANZA INTERNET

If you visit our Anza site regularly or check our website for weather information from Anza, you've probably noticed that we've had a lot of problems with our Internet service over the last few months, and lost service entirely for several weeks. Rick Wiggins kindly took the lead in contacting the satellite company that provides our Internet service to make arrangements for repair of the equipment on site, and he and Vance Tyree have put a lot of time and energy into resolving the problem. At this point, it seems that their efforts have been successful and we currently have reliable Internet service, but we're not yet sure that all of these problems are now behind us.

In case you're interested in the details of what's been going on, here are some excerpts from the information Rick Wiggins sent to the satellite company and to those of us in the club who are involved in the issue, starting with his account of events leading to complete failure of the system:

> We currently [as of March 29] have complete outage as of approximately 8AM March 22. The outage gradually developed over several weeks with the following signature. After replacement of the LNB and amplifier…, the system worked fairly well. However, within a few days, we would still experience outages ranging from 10 secs to 10 minutes. Then we had an outage of over 24 hours, which gradually recovered. Similar scenarios repeated over the last several weeks. Many of the long outages were correlated with rain or high humidity and the return to service [was] several hours after the humidity became lower. The signature is that the service starts losing bandwidth up to the point where the only thing that will work is an occasional ping, then it goes out. Recovery is the reverse. This last and permanent outage started on a night with 95% humidity, [the system] started to recover as the weather became dry several days later, but then dropped out completely and remained [out].
>
> Events & problems leading to the [failure] (Nov. 2007-Mar. 2008):
>
> The main problems began after some construction to [Anza House] in November, 2007. The roofing contractor needed to temporarily move the antenna tower (two 4 inch square metal supports) several inches away from the building and bent the metal in doing so. He later cut the steel supports and re-welded them straight, leaving the antenna in approximately the same vertical position, but necessitating realignment of the antenna by the service technician (Alan Maretsky). The service then worked for a few hours and went down completely. Alan was called again to realign the antenna and did so, resulting in the system returning to work, but with the gradual fade and outage situation described in the previous paragraph. During the last two trips, Alan has replaced the modem, the LNB, and the transmit amplifier…. We do not know of anything inherent in the [roofing] work…(other than the temporary pointing problem) that could be causing the outage….

A different technician came out to the site and met with Vance, Rick and their crew on April 4 – I don't know who all was there from the club, but they were able to do any necessary repair, welding or other construction that might be needed on request of the technician. This is Rick's account of what was done:

The satellite technician arrived a little before 1PM as planned and went on the roof to assess the system. He was unable to get a steady signal using his signal strength meter attached behind the LNB. In addition, he noted that the flashing lights on the modem indicated loss of signal sync.

We informed [him] that we had all the resources required to make any changes that he wanted with the installation… include[ing] installation of new metal supports, fixtures, or anything required and that we had the ability to do metal construction including welding. We instructed him…to make any repairs he deemed necessary including antenna placement and mounting. We also requested…that he replace the feed-horn and waveguide assembly including the polarizer to ensure that these parts were not part of our ongoing problems. He informed us that he had no parts other than the connectors, which he did replace….

He proceeded to disassemble the entire antenna structure and realign it including making the dish mount post vertical. We (the OCA staff) added a brace to the antenna mount post to form a tripod support. This provided tremendous stability and reduced any movement due to wind by a factor of 10 to 100. The mount is now extremely stable…. The technician then performed a final alignment and checked the signal by having the satellite service office perform a check. He indicated that the signals measured by the satellite company indicated a very strong signal that was as good, as or slightly better than average for this location….

Don't forget to send in your Messier Marathon forms!

The current satellite connection is much better than it's been for several months, but we still have concerns about its long-term reliability. Rick's email setting up the service call with the technician specifically asked that the technician who was to come out on April 4 replace all portions of the system on site that hadn't yet been replaced, to eliminate them as possible sources of the problem, but, as he noted, the technician didn't bring the necessary parts. Since the past failures occurred during extended periods of high humidity, we probably won't know if we still have a problem for several months, after the start of the next rainy season; even if we have a lot of thunderstorms this summer (which we hope won't be the case), that humidity won't last long enough to give us the necessary assurance. For now, however, you should be able to access the Internet from the Anza site when you're out there – if you have problems with this, please let Vance Tyree or me know about it.

MORE ON RTMC

I mentioned the RTMC Astronomy Expo last month, specifically the fact that the club will have its usual booth and needs volunteers to help run it. Besides volunteers at our booth, we generally have a number of OCA members who volunteer in different capacities for RTMC itself. This year, one of our members is the keynote speaker – I'm sure none of you will want to miss Chris Butler's presentation Saturday night! In addition, one of our astroimagers, Alan Smallbone will be giving a beginning astroimaging class at 4:00 on Saturday.

As general information, RTMC started as the Riverside Telescope Makers' Conference, and has been held at Camp Oaks near Big Bear City for many years. Telescope making is still an important aspect of the conference, and one of the major events is the contest among various telescopes that were designed and built by their owners; winning recognition in this event is a major honor, and years after a telescope has won an award, you'll still hear it identified as an RTMC award winner. You can see the different telescopes that are entered in the contest dotted around the Telescope Field and other observing areas, and you should check them out if you have a chance, as they often have very innovative designs and it's interesting to see what people are doing in this aspect of the hobby.

RTMC is also known for its vendors, and for its history as a place to get bargains on various types of gear. In addition to the commercial vendors, attendees bring astronomical and other gear they want to dispose of to the swap meet that's also an important part of the event. People who bring things to sell generally set up tables along the walk near the dining hall, and the greatest amount of swap meet activity seems to be early in the mornings on Saturday and Sunday. Actually, I understand that a lot of selling goes on after RTMC opens on Friday, but I've never been able to get there early enough to see this for myself.

Besides all this, there are lectures and other events during the day both Saturday and Sunday, including tours of the Big Bear Solar Observatory, a scale model of the solar system to explore, and activities such as swimming, hikes, horseback riding and archery. A lot of people camp for the weekend, in tents, RVs or vans, and there are some beds available in cabins on site – for details, please see the RTMC website (http://www.rtmcastronomyexpo.org/). You can also come as a day visitor, or stay in a hotel in Big Bear City rather than at the campground itself. Breakfast, lunch and dinner are served in the dining hall at set times, but you should get tickets in advance to be sure you'd will be seated. There is also a hamburger stand on the grounds where you can get hot food, and many people bring their own food with them.

Another long-standing and very popular tradition at RTMC is the raffle that is held both Saturday and Sunday after dinner. There are different tickets for children and adults (so the prizes are age-appropriate), everyone there gets one ticket, and you have to be

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AstroSpace Update

May 2008
Gathered by Don Lynn from NASA and other sources

Swift (gamma-ray burst satellite) detected on March 19 the first known gamma-ray burst that produced an afterglow in visible light so bright that it was visible to the naked eye. The Very Large Telescope in Chile and the Hobby-Eberly Telescope in Texas immediately took spectra of the afterglow and determined by its redshift (0.94) that it was so distant that light took 7.5 billion years to get here. The intrinsic brightness was determined to be 2.5 million times brighter than the brightest supernova recorded. Gamma-ray bursts are the brightest objects since the Big Bang, but this one was particularly bright even for a gamma-ray burst. Long duration bursts, such as this, are believed to result when massive stars run out of nuclear fuel, collapse at their cores, emit a burst of gamma rays, and eject particle jets that plow into surrounding material to form the afterglow. Analysis is just getting under way, so it is not yet known why this burst was so bright. One possibility is that the collapsing star had a particularly large mass, spin or magnetic field. Another is that a jet happened to be aimed directly at us. The burst was not the only surprise that day – 3 other gamma-ray bursts were seen, the most Swift has ever detected in one day.

Arthur C. Clarke, author, inventor and visionary, died at age 90, also on March 19. He was the first to suggest geosynchronous orbits (where satellites appear to hover over one spot on Earth) for communications satellites, more than a decade before the first satellite was launched. Hence geosynchronous orbits are sometimes called Clarke orbits. Clarke wrote the classic science fiction book and movie "2001" and 3 sequels, among scores of other books, both science and science fiction. He foresaw cell phones, the internet, and the method used to land on the Moon. He was knighted by his native Britain in 2000, and had a nebula and an asteroid named after him. He lived the majority of his life in Sri Lanka to enjoy the underwater wonders there seen by scuba divers.

John A. Wheeler, physicist and cosmologist, died in April at age 96. He studied quantum physics under Neils Bohr, argued with Einstein about quantum physics, worked with Oppenheimer on the first atomic bomb, and taught Feynman and Kip Thorne. He coined the term "black hole" at a conference where physicists were still calling them "gravitationally completely collapsed objects". "Wormholes" and "quantum foam" were also his terms. Wheeler was a professor at Princeton and later Texas. He remained active in cosmological research into his 90s.

Cassini (Saturn mission) has discovered evidence that points to the existence of an underground ocean of water and ammonia of Saturn's moon Titan. Cassini's radar has found that key features whose precise location can be measured appear in the wrong place (by up to 19 miles), based on Titan's rotation rate previously measured. No means is known to change the rotation rate enough to cause this, but it is possible if only the surface is changing its rotation, while floating on an ocean. The solid crust would have to be roughly 60 miles thick. Measurements will continue to see if the change in rotation is seasonal, which would indicate that seasonal winds are causing the change.

As reported here last month, Cassini flew through the plumes of the geysers spewing from Saturn's moon **Enceladus**. Preliminary results are that the geyser material resembles that of comets. This is a surprise, since the larger moons of Saturn are believed to have formed with Saturn, and comets are believed to have formed in the Kuiper Belt, much farther from the Sun. Since the materials out of which a body forms depend on the temperature, which in turn depends on the distance from the Sun, the material in Enceladus should be different from that in comets. Temperatures of much smaller surface features were measured than on previous flybys of Enceladus, and spots at or near the geysers were found to be much hotter than seen previously (minus 135° F, about 200° "hotter" than most of the moon). Warm (relatively) temperatures were found along the entire length of the "tiger stripes", which are known to be cracks in the surface. Gas in the plumes, mostly water vapor, carbon dioxide and carbon monoxide, was found to be 20 times denser than predicted.

Cassini's mission, originally scheduled to end in July, has been extended for 2 more years. The **extended mission** will include 60 additional orbits of Saturn, 26 flybys of Titan, 7 of Enceladus (one possibly within 15 miles), and one each of Dione, Rhea and Helene. Study of the rings, planet and magnetosphere will continue. Saturn's equinox will occur in 2009, so new seasons on the planet, its rings and Titan will be observed. At the end of that period, the spacecraft should have enough fuel to perform another extension. Cassini is working well and has completed 62 orbits, sent about 140,000 images, flown by Titan 43 times, and other moons 12 times.

Mars Odyssey (orbiter), using its infrared instruments, has located about 200 places on Mars where chloride salts are found. The sites range from about half a square mile to 25 times that size. All are found in the southern highlands, the most ancient areas of the planet. The sites are disconnected, so they are unlikely to be remnants of a global ocean. Many of the deposits lie in basins with channels leading into them, which is consistent with salt-pan deposits on Earth, where water flows into basins over long periods of time, then evaporates, leaving the salt behind. Scientists believe the deposits formed 3.5 to 3.9 billion years ago because other lines of evidence suggest that Mars had a thicker atmosphere with intermittent rainy periods during that time. Scientists have previously suggested the best places to look for life or past life in Mars would be the areas covered with clay or sulfate minerals. The chloride salt deposits may be an even better place.

Mars Express (orbiter) – A new analysis of small impact craters found in Mars Express images shows that the planet has undergone 5 episodes of major violent volcanic activity. These occurred at 3500, 1500, 800-400, 200, and 100 million years ago. In between these times, activity was relatively calm. The episodes not only covered large regions of the planet with lava, but also the heat involved caused water to erupt from the interior, causing wide-scale flooding. Using this method of counting craters to determine

how long ago an area was resurfaced has been criticized as inaccurate by some scientists, but the rate of impact cratering has recently been confirmed by the count of new craters that formed during the life of the Mars Global Surveyor. As for why Mars has such volcanic episodes, computer models suggest that the planet has been trying to establish a system of plate tectonics, as there is on Earth, but Mars never quite achieved it. The interior of Mars is not cold yet, so a major volcanic episode could happen again.

Martian meteors – Scientists calculated that the orbit of comet du Toit-Hartley should intersect Mars' orbit, causing meteor showers there. So they looked through old Mars Global Surveyor data from the dates of the predicted meteor showers and found that the ionization levels in the Martian atmosphere rose, as expected during a meteor shower, for a few hours on 2 of the 6 dates. The ionization was at the right altitude and on the correct hemisphere to be caused by meteors.

Hubble Space Telescope (HST) has made the first detection ever of a carbon-based (organic) molecule in the atmosphere of an exoplanet (one orbiting another star). Methane was found in the Jupiter-sized planet HD189733b when it transited (passed in front of) its star and the starlight passed through its atmosphere. The observation also confirmed water vapor in the atmosphere, which had first been found by Spitzer (infrared space telescope) observations. The planet is so close to its star that it revolves about it in only 2 Earth days and is heated to about 1650° F. Astronomers were surprised to find more methane than predicted by theory for "hot Jupiter" type planets. It should have had more carbon monoxide than methane, but it doesn't. Further work is needed to explain.

Ultraviolet images of Jupiter taken by HST sometimes show one or more faint glowing **spots** in front of the Io "footprint", the spot on the planet where ionized sulfur particles from Io's volcanoes rain down on the planet. The newly discovered spots always are accompanied by spots near the point on Jupiter diametrically opposed. The cause is probably a current of electrons formed between the polar regions of Jupiter, following magnetic field lines.

Observations by HST and the Gemini telescope in Chile indicate that the largest globular cluster orbiting our Milky Way, Omega Centauri, has a black hole at its center. Further, the black hole's mass is intermediate, neither stellar sized nor supermassive. Only one other **intermediate-mass black hole** has been firmly established. One implication of this is that Omega likely did not form as a globular cluster, but is the remnant of a dwarf galaxy that has been stripped of its outer stars. This has been proposed previously to explain other properties of Omega, such as its large mass, its faster rotation, its flattened shape, and the several generations of stars in it, all of which other globulars do not possess. The new observations measured the motions of stars near the center and showed that there had to be a mass of about 40,000 Suns about which the stars were orbiting. Explanations for this mass other than a black hole were shown to be unlikely.

Smallest black hole – Using a new technique, scientists have identified the least massive known black hole, having a mass only 3.8 times the Sun's. This is slightly above the minimum theoretical size for a black hole that results from the collapse of a star. Its diameter is calculated to be 15 miles. It is in a binary system known as XTE J1650-500, and lies in the constellation Ara. The Rossi orbiting X-ray telescope discovered it in 2001, but its mass was not measured until now. A relationship has been established between the mass of a black hole and the frequency of emissions from material spiraling into it. The relationship was tested on several black holes whose mass could be calculated by other means. Then the relationship was applied to XTE J1650-500 to come up with its mass. The previous record holder was a black hole of 6.3 times the Sun's mass.

Coolest brown dwarf, only 660° F. has been discovered 40 light-years away by a team of astronomers using several Earth-based telescopes. Its mass is 15 to 30 times that of Jupiter and is isolated, that is, does not orbit a star. Brown dwarfs are stars that are too small to sustain the nuclear fusion that lights up ordinary stars. They are classified as L (warm) or T (cool), depending on whether they are cool enough to allow methane in their atmospheres. The new object is so cool that it has ammonia in its atmosphere, which no other brown dwarf has. Astronomers have proposed that a new class (Y) be defined for this and future ammonia-bearing brown dwarfs. The first brown dwarf was detected in 1995.

Meteorite crater – Analysis of the site where a meteorite fell in Peru last September, forming a 49-foot wide crater, showed that it was a stony meteorite, and that it struck the ground at roughly 15,000 mph. Theory was that such small stony meteorites would break into pieces and slow to a few hundred mph during travel through our atmosphere. The new theory is that the pieces can get trapped by shock waves inside a fast-moving fireball and continue moving at relatively high speed until impact. This implies there should be considerably more craters on Earth of this size range, perhaps unrecognized as meteorite craters.

Genesis (solar wind sample return mission) crashed into the Utah desert at high speed in 2004 when its parachute opening mechanism failed, and it was feared that some of its most important goals were smashed. The highest priority objective was to measure the ratio of isotopes of oxygen, since these ratios measured on the Earth, Moon and meteorites have varied considerably. The ratio in the solar wind should be unchanged since the Sun formed from a collapsing gas cloud 4.6 billion years ago, and would establish how much change the Earth, Moon and meteorites have experienced. Scientists have salvaged this goal by shaving (using a beam of cesium ions) a tiny amount off the surface of what was left of the particle collectors, thereby ridding them of the contamination that occurred on impact. The collected particles were embedded deeper than the shaved region because of a fortunate choice in the design of the collection system.

Solar cycle – Each solar cycle of about 11 years has sunspots with magnetic polarity reversed from those of the previous cycle. I reported in the February issue that the first sunspot with its polarity reversed had been observed, signaling the beginning of cycle 24. Well, the old cycle (23) is not over yet – several sunspots with the old polarity have developed. Experts say this is fairly common for the old and new cycle to overlap for a few months.

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The story of Joseph von Fraunhofer and the first German Equatorial Mount

by Matt Ota

Little do we generally appreciate the heritage of the modern telescope technology we use today. But over the centuries the designs have made a steady advance from Hans Lipperhey's "instrument for seeing far" to Galileo's crude "telescopium" all of the way to the latest computer driven models that we use today.

But do you know who made the most fundamental and important advance in telescope mountings in history? It was Joseph von Fraunhofer, who despite a suffering a terrible accident in childhood and a short adult life made an impact that reverberates in amateur astronomy to this very day.

Fortunately his accident opened his future. While working as an apprentice ornamental glasscutter and mirror maker in conditions of near slavery, the house of his master collapsed. The accident killed the master's wife, but the young man was pulled from the wreckage. A well heeled Munich entrepreneur and lawyer named Joseph von Utzscneider witnessed the rescue and took him under his wing, providing him with books on physics and mathematics.

Although Fraunhofer still had to work as an apprentice for the glasscutter, he self-educated himself in optical theory and soon became quite skilled. After King Max gave him a present of eighteen ducats, he was able to purchase his way out of his apprenticeship. Then he was hired by Utzscneider's Institute to take advantage of his talents at the young age of 19,

Utzscneider ordered his employee Pierre Guinard to instruct him. Lessons were taught in glass manufacture, lens grinding and even mechanical engineering. But soon the young upstart recognized flaws in his teacher's production methods, and this eventually caused friction between them. Guinard finally left the plant for France in 1814, and by that time Fraunhofer was fully trained in the art of optical glass making. He then continued his optical studies, working on innovative designs for eyepiece lenses and objectives. He also delved into the study of the nature of light itself. His objective lens sizes steadily grew and took advantage of the advances in glass materials of the time.

His big project came when a 9.5 inch objective lens and telescope was ordered from the Dorpat Observatory in Russia (now Tartouo, Estonia) in 1819. At the time, the new refractor was the world's largest. Its 14-foot long tube of wood was attached to a revolutionary mount that made observation a much easier task. We know it today as the German Equatorial Mount (GEM). Before then, telescopes were mounted on simple altazimuth tripod mounts or unusual box frame mounts, or simply propped up against walls.

The brass right ascension drive that was built made the telescope the first in the world to automatically track objects in the sky. Driven by clock weights that were set prior to the observing run, the drive was adjusted and set to keep the objects centered in the eyepiece for uninterrupted study. However, the RA drive lacked rigidity because the drive gear itself was too small - making the mount wobble. This is an engineering and cost tradeoff that is made in the lower end GEMS designs to this day. The declination axis was locked for slow motion adjustments by a long and inconvenient handle, so in most cases it was left unclamped - making it hard to set.

Even with these limitations, staff astronomer F.G. Wilhelm Struve used this instrument to measure over 3,000 double stars with precision of less than one arc second. He was actually impressed with the telescope:

"...undetermined which to admire most, the beauty and elegance of the workmanship in its most minute parts, the propriety of its construction, the ingenious method of moving it, or the incomparable optical power of the telescope, and the precision with which objects are defined."

One wonders about the disparity between the quoted praise versus the design deficiencies, but this is likely due to the fact that this was the first GEM ever built.

Fraunhofer went on to build other telescopes but succumbed to tuberculosis at the age of 39 on June 7, 1826. He pioneered a generation of fine German telescope engineering, and in addition was the discoverer of the absorption lines in the solar spectrum. These are now known today as Fraunhofer lines his honor.

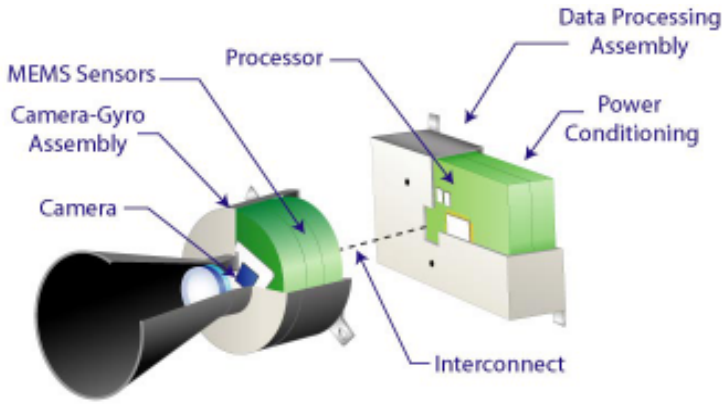
Fortunately, the original telescope and mount still exists. It can be seen today at the Tartouo Observatory. Carefully restored in 1993 under the directorship of Enno Ruusalepp, it sits on its original sturdy wood mounting and is quite elegant in appearance. So the next time you set up your GEM mount, think of this brilliant eighteenth century German engineer and the pioneering work that he did. ■

Stellar Compass for Space Explorers

by Patrick L. Barry

In space, there's no up or down, north or south, east or west. So how can robotic spacecraft know which way they're facing when they fire their thrusters, or when they try to beam scientific data back to Earth? Without the familiar compass points of Earth's magnetic poles, spacecraft use stars and gyros to know their orientation. Thanks to a recently completed test flight, future spacecraft will be able to do so using only an ultra-low-power camera and three silicon wafers as small as your pinky fingernail.

"The wafers are actually very tiny gyros," explains Artur Chmielewski, project manager at JPL for Space Technology 6 (ST6), a part of NASA's New Millennium Program.



Compass is built as two separate assemblies, the camera-gyro assembly and the data processor assembly, connected by a wiring harness. The technology uses an active pixel sensor in a wide-field-of-view miniature star camera and micro-electromechanical system (MEMS) gyros. Together, they provide extremely accurate information for navigation and control.

Traditional gyros use spinning wheels to detect changes in pitch, yaw, and roll—the three axes of rotation. For ST6's Inertial Stellar Compass, the three gyros instead consist of silicon wafers that resemble microchips. Rotating the wafers distorts microscopic structures on the surfaces of these wafers in a way that generates electric signals. The compass uses these signals—along with images of star positions taken by the camera—to measure rotation.

Because the Inertial Stellar Compass (ISC) is based on this new, radically different technology, NASA needed to flight-test it before using it in important missions. That test flight reached completion in December 2007 after about a year in orbit aboard the Air Force's TacSat-2 satellite. "It just performed beautifully," Chmielewski says. "The data checked out really well." The engineers had hoped that ISC would measure the spacecraft's rotation with an accuracy of 0.1 degrees. In the flight tests, ISC surpassed this goal, measuring rotation to within about 0.05 degrees.

That success paves the way for using ISC to reduce the cost of future science missions. When launching probes into space, weight equals money. "If you're paying a million dollars per kilogram to send your spacecraft to Mars, you care a lot about weight," Chmielewski says. At less than 3 kilograms, ISC weighs about one-fifth as much as traditional stellar compasses. It also uses about one-tenth as much power, so a spacecraft would be able to use smaller, lighter solar panels.

Engineers at Draper Laboratory, the Cambridge, Massachusetts, company that built the ISC, are already at work on a next-generation design that will improve the compass's accuracy ten-fold, Chmielewski says. So ISC and its successors could soon help costs—and spacecraft—stay on target.

Find out more about the ISC at nmp.nasa.gov/st6. Kids can do a fun project and get an introduction to navigating by the stars at spaceplace.nasa.gov/en/kids/st6starfinder/st6starfinder.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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Solar wind source – The solar wind consists of a high-speed and a low-speed portion. The slow one travels a mere million mph. The source of these is not known in detail. Observations of the Sun made by the Japanese Hinode spacecraft show that when the magnetic fields from 2 bright active regions on the Sun's surface collide, that allows hot gas to escape from the Sun, becoming the slow solar wind.

Primitive asteroids – Theory has it that the first materials to condense when the solar system formed should be rich in calcium and aluminum. But searches for asteroids rich in these have come up empty until now. Using visible and infrared data from telescopes in Hawaii, astronomers found 3 asteroids that appear relatively unchanged since they were formed. No meteorites have been found that match the composition of the newly discovered asteroids, although many meteorites contain small inclusions that are rich in calcium and aluminum. The 3 asteroids are being recommended for future space missions, since close-up observations of these should tell us about the material in the solar system when solid bodies were first forming.

Comet Holmes – The SuperWASP project monitors millions of stars to catch one being transited by one of its planets. Last October 24 it happened to monitor stars in Perseus just when comet Holmes brightened by a factor of about 1 million. So review of old images has added greatly to our knowledge of how such comet outbursts happen. The first image was 3 hours before the outburst was discovered. Later images allowed accurate measurements of the expansion of the comet for days after the outburst.

Oh yes, I forgot to mention that SuperWASP also does its real job, finding exoplanets. Discovery was announced of **10 exoplanets**, bringing the SuperWASP discovery total to 15. That is 1/3 of all known transiting exoplanets (planets outside our solar system that pass in front of their stars). The newly discovered planets range in mass from half that of Jupiter to 8 times Jupiter. One of them is so close to its star that its year (time to orbit its star) is only about 1 Earth day, and its surface is heated to about 4100° F.

Venus Express has measured highly variable amounts of sulfur dioxide in the atmosphere of Venus. The variations were found at an altitude of about 45-55 miles, while amounts at lower altitudes have not varied much. The variations probably indicate that volcanic activity was spewing out the gas, but the possibility that processes in the atmosphere vary the amounts still has to be ruled out. It has been calculated that sulfur dioxide should take about 10 million years to dissipate by reacting with surface rocks under the conditions found on Venus. This probably indicates that volcanic activity has taken place within the last 10 million years. But the new observation of variability may mean volcanic activity is occurring now. Further observations looking for evidence of current volcanic activity, measuring local concentrations of sulfur dioxide and local hot spots, will be made by the spacecraft.

Spitzer (infrared space telescope) has made follow-up observations of newly discovered gamma-ray bursts, and in many cases has been able to image the galaxy in which the burst occurred, even in cases where they lie so far that they are near the edge of the visible Universe. The host galaxies of gamma-ray bursts are generally not visible in other wavelengths of light. The brightnesses allowed estimates to be made of the galaxies' masses. The result is that distant gamma-ray bursts tend to occur in the less massive galaxies, ones that are not even seen in wavelengths other than infrared. The earliest galaxies (seen earliest in their lives because the light took the longest to reach us), about a billion years after the Big Bang, were found to contain less than 10% of the heavier elements found in galaxies today. The host galaxies to bursts will be compared over a range of distances, and therefore ages, to see how such galaxies evolved in the history of the Universe.

Binary yellow supergiants - The first binary yellow supergiant star ever seen was found, and soon after another was found to have been observed years ago, but misclassified. A supergiant star happens at the end of the life of a massive star, when it swells to huge size. Most of the supergiant period is spent in a red phase or a blue phase, but a yellow phase is passed through briefly in between these. Because so little time is spent in the yellow phase, finding them is rare, and binary ones were unheard of until now. The first was discovered using the new Large Binocular Telescope in Arizona and lies in Holmberg IX, a satellite galaxy to M81. The stars are so close together that they share the outer parts of their atmospheres in the region between them, giving them a peanut shape. They also eclipse each other as they orbit. Each has 15 to 20 times the Sun's mass. The other binary pair was found in old observations of the Small Magellanic Cloud, a satellite galaxy to our own Milky Way. They are the same mass as the other pair and also share outer atmosphere. Of all the supernovas ever observed, only 2 are thought to have occurred to yellow supergiants. Theory said that the yellow phase was so brief that the odds were that a supernova of a yellow supergiant would never happen. The discovery of binary yellow supergiants brings up the possibility that binary ones stay in the yellow phase long enough to allow a chance of going supernova.

Massive stars – Theory says that massive stars that rotate fast should cause powerful currents within that churn material from the core up to the surface. A new survey of 800 massive stars in the Magellanic Clouds made with the Very Large Telescope in Chile found that this theory is correct in the bare majority of those stars. The majority showed considerable nitrogen at their surfaces, which had to have been churned up from the core where it is created. But 20% of those observed were slow rotators, so should not have much churning, yet still showed considerable nitrogen on the surfaces. The theorists' new guess is that magnetic fields in a slow rotator will cause churning, but the details of how are still unclear. Another 20% were fast rotators without nitrogen, so must not be churning. Theorists are still arguing this one.

Red supergiants (RSGs) – Using the Spitzer infrared space telescope, 2 rare clusters of RSG stars have been discovered on the edge of the bar near the center of our Milky Way, in the constellation of Scutum. Together they contain 40 RSGs, nearly 1/5 of all

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present to win. Generally, the grand prizes have been large telescopes generously donated by Meade and Celestron, and there are a lot of other very nice prizes as well donated by different vendors and clubs.

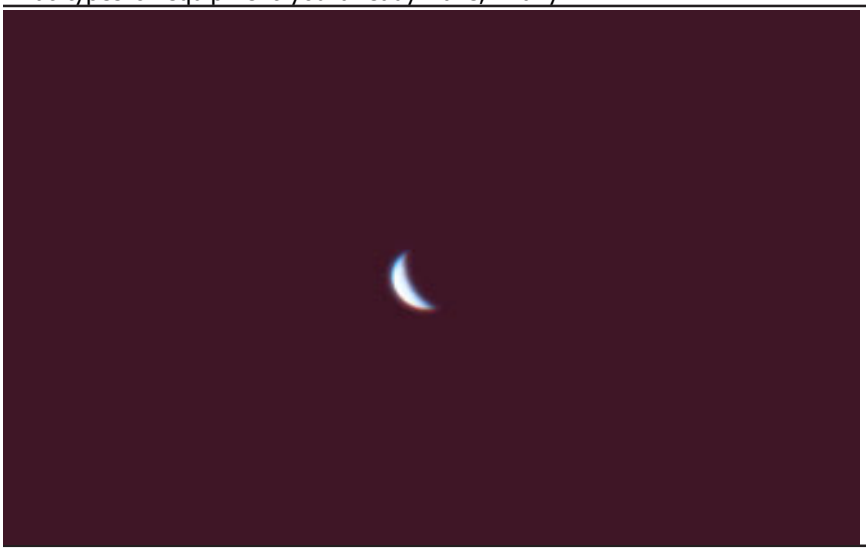
We'll be taking the annual club picture at the OCA booth on Saturday at 1:00 p.m., so please plan to join us there! And, if you can spend an hour or two helping with the booth on Friday afternoon, any time on Saturday or on Sunday morning, please contact Karen at Karen@Schnabel.net. Kyle Coker has kindly agreed to bring tables, etc., from the booth back on Sunday, and Bob Buchheim will be taking the canopy and tables out there on Friday, but we may still need some people to take things for the booth out on Friday or early Saturday – please contact Karen to see what help she needs if you can help out with this.

FOR THOSE INTERESTED IN GETTING STARTED IN ASTROIMAGING

If you don't know much about astroimaging but think you might like to try it out, Kyle Coker has been doing a session on the basics of astroimaging for the Beginners Astronomy Class for the last couple years. This gives an overview of the various aspects of imaging – basic considerations regarding mounts and tracking, different types of telescopes and cameras, software that can be used to control the mount and cameras and for collecting images, focusing, and basic information about processing. The next time he'll be giving this class is August 1, as the last session of the current cycle of the Beginners Class. If you don't want to wait until August, as mentioned above, Alan Smallbone will be giving a beginning astroimaging class at RTMC this year, currently set on Saturday, May 24, at 4:00 p.m.

Both of these sessions are good ways to cover the basics, learn what's required, and get a better sense of how you can successfully tackle the rather steep learning curve inherent in getting good images – it's a lot to pull together, but the images are worth it! Both Alan and Kyle are experienced imagers and have been active in our Astroimaging SIG for several years, and they both have used a wide range of cameras, from lower-cost types through upper-end models. They have also both used DSLRs for astroimaging, which is something many people are interested in because DSLRs can be used for more than just astroimaging.

The AstroImaging SIG is considering whether it should do another more in-depth imaging class that would have an emphasis on hands-on training. How they would do this depends in part on what people who would sign up for the course want to learn, specifically as to the types of cameras and types of imaging (planetary and solar imaging, for instance, are much different than deepsky imaging). If you are interested in attending such a class, please contact Tom Kucharski (TomRigel@aol.com), the coordinator for the Astroimaging group, and let him know about your interest, and also what type of imaging you are interested in doing and what types of equipment you already have, if any.



Mercury as seen during its last apparition, December 27, 2007. By the time you receive this issue, Mercury will be approaching maximum elongation on May 14; by May 22 it will look similar to this photograph and shine at approximately magnitude 1.7. Look for Mercury in the northwest sky after sunset this month! (photo credit: Ed Robertson)

FOR SALE: Starmaster 10" EL f5 with Zambuto optics and full Argo Navis computer, with encoders. This is a great portable scope, sets up in minutes. The mirror is in excellent shape and comes with certifications,this Zambuto mirror is a 10"f5, S/N SM10-027, with a strehl ratio of 0.986, so a premium mirror. Also included is a laser collimator, JMI focuser, Rigel Quickfinder, Argo Navis computer with encoders installed,data cables, and a pc cable to update the Argo Navis catalogs. The scope is in like new condition, the wood is in perfect shape and the mirror is in perfect shape, two wooden dust covers and a cap cover for the secondary are included. This scope has been kept indoors and covered and was hardly used. That is why I am selling it. I am asking $3000 delivered or best reasonable offer. Pics can be seen at http://www.pbase.com/snowlep/starmaster. I can be reached on my cell at 818-237-6293 or email at asmallbone@earthlink.net Thanks for looking.

FOR SALE: Pentax K10 D w/18-55mm F3.5-5.6 AL zoom lens, charger, 4 GB memory, T-mount, remote cable CS-205, carrying case. All in original boxes w/warranty papers and software. Cost over $1400.00. Sell $900.00. Jim Leonard 760-377-3474

FOR SALE: Meade 10" LX200 Schmidt Cassegrain with SBIG ST-8 CCD Digital for computer imaging. TeleVue lens, 31mm Nagler, 35mm and 22mm Panoptic, 14mm and 8mm Radian, 2x Celestron Barlow, 12mm Meade Illuminated Reticle. Pelican 1500 hard case, one portable stand and one bolt-down stand. Over $12,000 in equipment. Asking $4500.00 Ray Vega 661-264-6627

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known RSGs in the Milky Way. All 40 are on the brink of exploding as supernova; that is, about 1 every 5000 years is expected to explode. Astronomers think that interaction of the bar rotating through the disk of the galaxy triggered formation of so many massive stars at once. The 2 clusters are about 20,000 light-years from us and about 800 light-years apart. The first cluster is 12 million years old and has 14 RSGs, while the other has 26 and is 17 million years old.

Galaxy evolution – Astronomers used the UKIRT infrared telescope in Hawaii to observe very distant galaxies. It is known that more dark matter in the halo about galaxies makes the galaxies in a galaxy cluster clump together more tightly, so the clumping was measured to calculate the amount of dark matter. Some of the galaxies seen were so distant that the light left them only 4 billion years after the Big Bang, yet they had already evolved fully, consisting of old red stars. Fully evolved galaxies were theoretically supposed to occur later in the life of the Universe. But those galaxies were calculated to have extremely massive dark matter halos, so that probably caused the faster evolution. Further, the size of those dark matter halos corresponds to those found today around giant elliptical galaxies, the largest galaxies known. The supposition then is that the fully evolved galaxies 4 billion years after the Big Bang are the same ones that became the giant ellipticals today.

Galaxy Zoo is a project to have members of the public use a program over the internet to classify about a million galaxies imaged by the Sloan Digital Sky Survey. Preliminary results of this project, still ongoing, indicated that there are somewhat more spiral galaxies with counterclockwise arms than with clockwise ones. To assure there was no mistake in the finding, project leaders inserted two different mirror imaged copies (top-to-bottom and diagonally) of each of about 90,000 galaxies into the data. In a mirror image, the direction of the arms is reversed. Both the originals and the mirror images were classified with more counterclockwise galaxies. So the counterclockwise preference is not a property of galaxies, but of the people doing the classification. Further investigation will be done to see where the bias lies.

International Space Station (ISS) – Two new crew members for the ISS Expedition 17 arrived April 10 by Russian Soyuz spacecraft, along with South Korean astronaut So-Yeon Yi, who is staying only 9 days, and returning with the Expedition 16 crew. Yi, age 29, is the youngest woman ever in space. One of the new crew, Sergei Volkov, is the son of cosmonaut Alexander Volkov, and is the first second-generation person in space. Garret Reisman, the last of Expedition 16 to arrive (in March), will remain on the station as the 3rd crew member until June.

Instant AstroSpace Updates

Another result was announced from the **WMAP** (cosmic microwave background [CMB] satellite) data, in addition to that reported here last month: The Universe is 13.73 billion years old, plus or minus 0.12 billion years. This is the most precise age result yet obtained.

The **smallest exoplanet** known, 5 times the Earth's mass, has been discovered about 30 light-years away through its gravitational pull on another planet already known orbiting the red dwarf star GJ436. It orbits in about 5 Earth days.

Arrays of radiotelescopes have imaged for the first time a **planet still in formation** in a disc of gas and debris surrounding the star HL Tauri, which is less than 100,000 years old and lies 520 light-years away.

Observations with the RHESSI and Hinode spacecraft of a small **solar flare** that occurred on the Sun last June showed that essentially all of its energy went into heating, while such flares normally discharge energy into both heating and accelerating electrons. The result was a peak temperature of 27 million ° F, instead of the normal 18.

After NASA sent a memo to JPL warning that they should expect a $4 million reduction in **Mars rover funding** for next year, which would have necessitated turning off one or both rovers for part of the year, NASA soon after retracted the statement, indicating both rovers should continue to operate normally.

Phoenix will land in a far northern region of Mars on May 25, and will dig into what is believed to be ice-rich soil to determine its constituents. Mars Reconnaissance Orbiter images of the landing site have provided the location of 5 million rocks hazardous to landing, and Phoenix has been targeted to miss them.

Mars Reconnaissance Orbiter has imaged the tracks left by **rocks** rolling down hill. One rock about 4 yards across hit a small crater rim, launched upward, and bounced several times.

Using a combination of visible light and X-ray observations, scientists were able to determine that a **supernova** remnant in the Large Magellanic Cloud was from a Type Ia supernova that occurred about 400 years ago (Earth observation time), and to determine its total energy, which agreed with theoretical supernova models.

A new device called a **laser comb** produces a series of spectral lines at precisely spaced frequencies. It is believed that using it for a frequency standard in a spectrograph would allow measuring star motions 60 times more precisely, resulting in detection of planets orbiting those stars 60 times smaller than is now possible. Tests begin in June.

NASA is preparing a spacecraft named **LADEE** for launch to orbit the moon in 2011 to study the thin lunar atmosphere and the dust lofted above the surface. It will ride piggyback during launch on the GRAIL spacecraft, which will measure lunar gravity.

The European Space Agency will make a decision later this year on which of 2 proposed spacecraft will get funded: **Laplace** to study Jupiter and its moon Europa, or **Tandem** to study Saturn and its moon Titan and Enceladus. Either would launch in 2018 and might include landers or penetrators.

An Australian geologist found a meteorite impact **crater** roughly 900 feet across while roaming in Google Earth looking for iron ore. It was confirmed by a crater expert who visited the site, and it has been named Hickman crater after the geologist.

Scientists using new adaptive optics and a Lyot coronagraph (which blocks the light of a star to see the dim surroundings) on the Air Force telescope on Maui have imaged a disk about a young star with disturbances that seem to indicate a **planet** is **forming** and a speck within the disk that may be the planet. Further work is required to rule out that it is a brown dwarf rather than a planet.

Astronauts tested **shuttle repair** "goo" and its applicator during a spacewalk on the March visit of the shuttle to the International Space Station, to prepare for the possibility of needing repairs of launch damage on some future mission. The goo bulged more than in ground tests, but worked adequately when tamped into place.

Astronaut Takao Doi threw a **boomerang** inside the International Space Station and concluded that its returning to the thrower worked in zero gravity. A video of the experiment will be released.

IAYC 2008, July 20th - August 9th
44th International Astronomical Youth Camp
Sayda, Germany

Every year, for 39 years now, the International Astronomical YouthCamp (IAYC) takes place somewhere in Europe. About seventy people frommany different countries live together for three weeks. They are aged between 16 and 24 years old and share the same interest:astronomy.

The IAYC is different from most astronomical camps for tworeasons: the international character and the fact that you do your ownsmall research project, not just accepting facts but ratherdiscovering them yourself. The IAYC is also not like a hotel where one follows a summer school or an astronomy course. Every participant withhis or her own cultural background forms an important piece in thecomplex puzzle of camp life.This year's camp will take place in the *Jugendgastehaus Mortelgrund*, a youth hostel in southeastern Germany. The house is located about 2.5 km from the small village of Sayda, which has about 2.300 inhabitants.

It is a pleasant wooded area in the *Erzgebirge*, about 45 km from Dresden. The IAYC is an international youth camp with participants from about 20 different countries. As a participant you work for three weeks inone of the 8 working groups - together with other young people - on astronomy related projects. These projects are done in a working groupof your choice and also depend on your own interest. The working groups themselves will be led by young scientists from the IAYC teamand concentrate on a specific field in astronomy. This year these are: Ancient Astronomy, Astrogenesis, Basics of Astronomy, Compact Objects, Extragalactic astrophysics, Observational Astronomy, RadioAstronomy and Imaging processing.

Of course apart from theastronomical program, there are many non-astronomical activities suchas group games, sport events, singing evenings, hiking tours and an excursion. The house offers plentyof space for all participants and working groups and there will alsobe a darkroom available to the people who want to develop astropictures. At walking distance there is a field which can be used for observations. The remote location of the house promises excellent observing conditions.

Since it is an international camp, the camp language is English. Youshould be able and willing to speak English throughout the camp although it is not necessary to speak English fluently. Anyone from 16 to 24 years old and able to communicate in English may participate inthe IAYC 2008. The fee for accommodation, full board and the wholeprogram, including the excursion, will be 550 Euro. For interested persons who cannot pay the camp fee themselves, a limited number of grants are available.More information about IAYC 2008 and the working groups is availableon our website, http://www.iayc.org/next_camp.php. There you can also download the application form.

If you have any questions or wish to order, free of charge, aninformation booklet including an application form, please contact our info-person:

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