Calendar of Events
KU STADIUM OBSERVING
Sunday
December 03, 2006
8:00 PM—10:00PM

Fall Meeting Schedule
Friday, Nov. 17
1001 Malott—7:30 PM
CUB SCOUTS
Understanding Astronomy

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Observing Clubs
Doug Fay

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Report From the Officers on the October Meeting:

Our meeting last month went well, with the usual group of stalwarts and a pair of visitors sitting in on a presentation by Dr. Twarog on the view of the Universe at X-ray wavelengths as revealed by the Chandra X-ray telescope. The X-ray emissions have shed new light on virtually every aspect of astronomy from solar system objects (comets!) to the large-scale structure of the Universe and galaxy collisions. If you were fortunate enough to watch the NOVA episode on the Monsters of the Milky Way, you saw an excellent example of the way in which X-ray observations can reveal the existence of those elusive objects, black holes, anywhere in the Galaxy.

This month, instead of the usual meeting, the session will be turned over to Astronomy education. Rick Heschmeyer will lead another Boy Scout astronomy tutorial, to be followed by observing on the hill outside Wescoe. We did this last year and it proved extremely successful. As of this week, we had over 100 people planning on coming, with an expectation that 1001 Malott will be filled to overflowing again. It is an outstanding way to get younger people excited about science in general and astronomy specifically. What we need most (Continued on page 2)

NASA PLANS HST REPAIR MISSION

On Oct. 31, NASA announced plans for a fifth servicing mission to the Hubble Space Telescope. Shuttle astronauts will visit the telescope to extend and improve the observatory’s capabilities through 2013.

Hubble precisely measured the age of the universe. It found evidence of dark energy. It delivered images of distant galaxies in the young universe. And now, with the state-of-the-art instruments to be installed during Servicing Mission 4 (SM4), Hubble will look into the universe with new eyes, surpassing even its previous vision.

NASA’s most famous observatory, the Hubble Space Telescope, will get a much anticipated life extension after all. NASA Administrator Michael Griffin announced on Tuesday that a space shuttle will be sent to upgrade Hubble and add a few years to the lifetime of the venerable queen of the sky.

“We are going to add a shuttle servicing mission to the Hubble Space Telescope to the shuttle’s manifest to be flown before it retires [in 2010],” Griffin said to applause at NASA’s Goddard Space Flight Center in Greenbelt, Maryland, US.

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of all is the usual collection of telescope observers to help run the outdoor session. If you have a portable telescope and can bring it, please do so. The more we have set up, the quicker we can meet the needs of the crowd. It will be dark time (no moon), so we will need to rely on some fainter objects to keep it interesting. We do have a large Dobsonian that we can easily haul out to the hill; if you’d like to work with this rather than bring your own scope (or if you just want to help), please contact Dr. Twarog. At minimum, the more people we have, the better crowd management we can arrange.

We lucked out again on the weather with an open observing session at the stadium on the last Sunday in October—the 29th. The skies were clear and the temperatures comfortable, totally unlike the current frigid values. Thanks to the students from Lawrence High in Kent McDonald’s class, we again had a nice turnout. Thanks to Steve Shawl for filling in, and all those who helped him with setup and observations. Our next scheduled public observing session is Sunday Dec. 03. Note, this is a week later than usual to avoid conflicts with Thanksgiving weekend. The time period for the observing is set for 8:00—10 PM. If this changes and/or we have an update on the schedule for the remainder of the semester, we will inform you via the newsletter, at minimum, via email, and through the web site. If you are unsure and would like to come by on the 3rd, weather permitting, please check the web site or call the observatory number (864-3166), as usual for a recorded message. Our final meeting of the year will also be the following Friday, Dec. 8, with our speaker, Dr. Steve Shawl, our Holiday Celebration and door prizes—Mark Your Calendar!

On news within the Astronomical League, the Rose City Astronomers of Portland Oregon will host the 2007 60th annual Astronomical League Convention and Exposition in Portland, Oregon on August 3rd and 4th, 2007 (ALConExpo 2007). If you think you might be in the northwest around this time, consider attending—you’re a member of the League!

The Astronomical League has many activities to encourage amateur astronomy including Observing Clubs. The Observing Clubs offer certificates of accomplishment for demonstrating observing skills with a variety of instruments and objects. Each Club offers a certificate based upon achieving certain observing goals. These are usually in the form of a specific number of objects of a specific group with a given type of instrument. Occasionally there are multiple levels of accomplishment within the club. There is no time limit for completing the required observing, but good record keeping is required. When you have reached the requisite number of objects, your observing logs are examined by the appropriate authority and you will receive a certificate and pin to proclaim to all that you have reached your goal. If you have any interest in submitting the log sheets and materials for an observing club, as detailed on the Astronomical League web site (http://www.astroleague.org/), please communicate with Doug Fay; his email address is dfay@ku.edu. This month we highlight the Planetary Nebulae Club. Planetary Nebulae are perhaps the most interesting and beautiful objects in the heavens. A genre full of wonderful variation, they exhibit complex shapes, and may even show vibrant colors. The last hurrah of a sun-like star, their study is essential to the understanding of stellar evolution. If you don't already have an appreciation for these most magnificent of objects, it is hoped this program will inspire you. One hundred ten planetary nebulae were chosen for this program. Among them are some of the most famous showpieces in the northern sky, but the list contains examples across the entire range of planetary nebula morphology. Some are tiny star-like points that will challenge you to pick them out of their crowded star fields. Others will appear as ghostly apparitions that will severely test your powers of observation. In addition, we have included four examples of "proto-planetary nebulae" as additional challenges. For details, visit http://www.astroleague.org/all/obscubs/planetarynebula/planetneb1.html.

If you have any suggestions for talks, speakers, or public events, please feel free to contact us, particularly Rick Heschmeyer (rcjbm@sbcglobal.net), the events coordinator for the club. Hope to see you later this month at the next meeting on Nov. 17. ALL for now.

About the Astronomy Associates of Lawrence

The club is open to all people interested in sharing their love for astronomy. Monthly meetings are typically on the second Friday of each month and often feature guest speakers, presentations by club members, and a chance to exchange amateur astronomy tips. Approximately the last Sunday of each month we have an open house on Memorial Stadium. Periodic star parties are scheduled as well. For more information, please contact the club officers: Luis Vargas at lcvargas@ku.edu, Gary Webber at gwebber@ku.edu, our faculty advisor, Prof. Bruce Twarog at btwarog@ku.edu, our events coordinator, Rick Heschmeyer at rcjbm@sbcglobal.net. Because of the flexibility of the schedule due to holidays and alternate events, it is always best to check the Web site for the exact Fridays and Sundays when events are scheduled. The information about AAL can be found at http://www.ku.edu/~aal.

Copies of the Celestial Mechanic can also be found on the web at http://www.ku.edu/~aal/celestialmechanic
HST OBSERVES MASS SEGREGATION IN GLOBULAR CLUSTERS

NASA’s Hubble Space Telescope has provided astronomers with the best observational evidence to date that globular clusters sort out stars according to their mass, governed by a gravitational billiard ball game between stars. Heavier stars slow down and sink to the cluster’s core, while lighter stars pick up speed and move across the cluster to its periphery. This process, called "mass segregation," has long been suspected for globular star clusters, but has never before been directly seen in action.

A typical globular cluster contains several hundred thousand stars. Although the density of stars is very small in the outskirts of such stellar systems, the stellar density near the center can be more than 10,000 times higher than in the local vicinity of our Sun. If we lived in such a region of space, the night sky would be ablaze with 10,000 stars that would be closer to us than the nearest star to the Sun, Alpha Centauri, which is 4.3 light-years away (or approximately 272,000 times the distance between Earth and the Sun).

[Left] - A photo of the globular star cluster 47 Tucanae taken with the Very Large Telescope in Chile. It is one of the densest globular clusters in the Southern Hemisphere. The cluster contains 1 million stars.

[Right] - A NASA Hubble Space Telescope color photo of the core of 47 Tucanae. Multiple photos of this region allowed astronomers to track the "beehive swarm" motion of stars. Precise velocities were obtained for nearly 15,000 stars in this cluster. This image was taken with Hubble’s Advanced Camera for Surveys.
The Planet in the Machine
By Diane K. Fisher and Tony Phillips

The story goes that a butterfly flapping its wings in Brazil can, over time, cause a tornado in Kansas. The “butterfly effect” is a common term to evoke the complexity of interdependent variables affecting weather around the globe. It alludes to the notion that small changes in initial conditions can cause wildly varying outcomes. Now imagine millions of butterflies flapping their wings. And flies and crickets and birds. Now you understand why weather is so complex.

All kidding aside, insects are not in control. The real “butterfly effect” is driven by, for example, global winds and ocean currents, polar ice (melting and freezing), clouds and rain, and blowing desert dust. All these things interact with one another in bewilderingly complicated ways. And then there’s the human race. If a butterfly can cause a tornado, what can humans cause with their boundlessly reckless disturbances of initial conditions?

Understanding how it all fits together is a relatively new field called Earth system science. Earth system scientists work on building and fine-tuning mathematical models (computer programs) that describe the complex interrelationships of Earth’s carbon, water, energy, and trace gases as they are exchanged between the terrestrial biosphere and the atmosphere. Ultimately, they hope to understand Earth as an integrated system, and model changes in climate over the next 50-100 years. The better the models, the more accurate and detailed will be the image in the crystal ball.

CloudSat is one of the Earth observing satellites collecting data that will help develop and refine atmospheric circulation models and other types of weather and climate models. CloudSat’s unique radar system reads the vertical structure of clouds, including liquid water and ice content, and how clouds affect the distribution of the Sun’s energy in the atmosphere. See animation of this data simulation at www.nasa.gov/mission_pages/calipso/multimedia/cloud_calip_mm.html.

NASA’s Earth System Science program provides real-world data for these models via a swarm of Earth-observing satellites. The satellites, which go by names like Terra and Aqua, keep an eye on Earth’s land, biosphere, atmosphere, clouds, ice, and oceans. The data they collect are crucial to the modeling efforts.

Some models aim to predict short-term effects—in other words, weather. They may become part of severe weather warning systems and actually save lives. Other models aim to predict long-term effects—or climate. But, long-term predictions are much more difficult and much less likely to be believed by the general population, since only time can actually prove or disprove their validity. After all, small errors become large errors as the model is left to run into the future. However, as the models are further validated with near- and longer-term data, and as different models converge on a common scenario, they become more and more trustworthy to show us the future while we can still do something about it—we hope.

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The move, though not unexpected, still had astronomers on the edge of their seats. The telescope is enormously popular and has brought back a wealth of data since its launch aboard a space shuttle in 1990.

"The Hubble Space Telescope has been the greatest telescope since Galileo invented the first one," said US Senator Barbara Mikulski, who pushed NASA to reconsider a final servicing mission. The space shuttle Discovery could launch to Hubble as early as May 2008 with a crew of seven. Astronauts Scott Altman, Gregory Johnson, Andrew Feustel, Michael Good, John Grunsfeld, Mike Massimino and Megan McArthur were tapped to pay one more visit to Hubble. Johnson, Feustel, Good and McArthur are all rookies, while Grunsfeld will be making his third shuttle trip to Hubble.

A fifth shuttle mission to service the Hubble telescope was cancelled by former NASA chief Sean O'Keefe in 2004, citing astronaut safety following the Columbia accident. Robotic missions to fix the telescope were considered but dropped because of the time and difficulty involved in mounting them.

Then Griffin replaced O'Keefe and said NASA would study whether it could reduce the risk of sending astronauts back to Hubble. "We had a number of tasks before us as an agency if we were going to figure out a way to get to yes," Griffin says.

If anything went wrong at or on the way to Hubble, the astronauts could not take refuge aboard the International Space Station. The Hubble mission will be the only shuttle flight to a destination other than the International Space Station. As many as 16 shuttle flights will be sent to service and complete construction of the ISS by 2010, when the shuttles are retired.

On those missions, if in-flight inspections of an orbiter's heat shield reveal significant damage, the problem that felled Columbia, the crew could wait on the ISS for another shuttle to come and pick them up at the station. The station usually has about 70 to 80 days' worth of supplies for a large crew.

If the same situation occurred during a Hubble mission, the astronauts could not take refuge on the ISS, because the telescope and the station are in very different orbits. They would have only about 25 days worth of supplies in the cramped shuttle quarters, depending on how supplies were rationed.

Sending a rescue flight would also require a lot of work on the ground. Because of the need to save the stranded crew, NASA will have a rescue shuttle waiting on the other shuttle launch pad at Florida's Kennedy Space Center. That launch pad was supposed to be turned over to the rocket for the shuttle’s successor, the Ares I, for test flights, but programme managers agreed to let it be used for a Hubble rescue mission. Also, there would not be time for significant design changes between flights, so the rescue shuttle could run the same risk of being damaged as the Hubble flight.

A rescue flight would rendezvous in the vicinity of the damaged shuttle, and a tether would connect the two vehicles. Astronauts would make spaceswalks to move to the new shuttle. Since the Columbia disaster, the heat shields of shuttles are inspected in-orbit using the craft's robotic arm. If inspections revealed something amiss with the heat shield, before automatically mounting a rescue flight, the astronauts could make a spaceswalk to examine and possibly repair the damaged site. The past three shuttle flights have tested these new repair methods, which include putties, patches and paint-like material to patch holes or cracks in the thermal protection system.

During Discovery’s flight in July 2006, astronauts also tested the stability of working on the end of an extra-long robotic arm. It wobbled slightly, but not as much as they had expected, giving hope for a stable work platform should a repair be needed under the shuttle. One of the challenges for NASA will be cramming another shuttle flight into an already tight launch schedule. The shuttles will be retired in 2010. With a servicing mission, that would give NASA a total of at least 15 shuttle missions – with the possibility of two extra ISS supply missions – before they are forever grounded. The next shuttle, Discovery, is scheduled to begin its construction mission to the ISS in December 2006.

The servicing mission, if successful, could keep Hubble operational until at least 2013. Without a shuttle flight, Hubble’s instruments would have eventually started to shut down. The gyroscopes that point Hubble and keep it steady could last until 2008 and the batteries until 2010. The servicing mission will add six new batteries, six gyroscopes, a flight guidance sensor, the Cosmic Origins Spectrograph and the Wide Field Camera 3. They will be by far the best instruments ever sent to Hubble. Astronauts might also try to fix the Space Telescope Imaging Spectrograph by replacing an electronics board. Astronauts will attach handles on the back end of Hubble to make it easier to grab later, in preparation for its de-orbit, probably after 2020.
A mysterious surplus of energetic particles called cosmic rays is striking the Earth from the direction of the constellation Cygnus, suggests a controversial new study. If confirmed, the detection of this excess may help scientists figure out what produces these enigmatic high-speed particles.

Cosmic rays are speeding charged particles that appear to hit Earth in roughly equal numbers from all directions. Lower energy cosmic rays are thought to come from the shock waves around supernovae, but the source of the higher energy ones is still a mystery.

When a cosmic ray hits Earth's atmosphere, it produces a burst of charged particles and light. Sensitive detectors on the ground measure either the secondary particles or the light to try to determine the direction from which each cosmic ray came.

However, no one has been able to unequivocally trace cosmic rays to a specific object like the expanding shell of a supernova. Now, observations have revealed what appears to be a broad area of enhanced cosmic ray activity in the sky. The data comes from the Tibet Air Shower Arrays, which detects the secondary particles produced when cosmic rays or high-energy radiation slams into the atmosphere. Researchers led by Michihiro Amenomori of Hirosaki University in Japan plotted the direction of 37 billion cosmic rays and found a slight excess of 1 part in 1000 coming from a patch of sky roughly centered on the constellation Cygnus.

This suggests there is a source of cosmic rays inside our own galaxy coming from that direction, says team member Yi Zhang of the Institute of High Energy Physics in Beijing, China.

The excess is in the same part of the sky that exhibits an unexplained excess of high-energy photons called gamma rays in observations by the Milagro gamma ray detector in Los Alamos, New Mexico, US, and other instruments.

Both types of observation might be caused by one or more cosmic ray sources in the Cygnus region, Zhang says. "It would mean that those sources should not be too far from us, and this would provide us a good laboratory to study the cosmic ray acceleration," he told New Scientist.

The cosmic rays from this region could be generated in supernova shock waves, jets of matter spewing from the discs around black holes, or even decaying dark matter particles, says David Kieda of the University of Utah in Salt Lake City, US.

However, the result is not iron-clad. The Tibet detectors cannot distinguish between cosmic rays and gamma rays, so it might simply be seeing a gamma ray excess similar to that observed previously in this region, Kieda says.

Still, he says some of the gamma rays would probably be created by a surplus of cosmic rays hitting clumps of gas in the region. "There is obviously some kind of origin in that region, which is very exciting," he told New Scientist. But Gus Sinnis, a member of the Milagro gamma ray detector team, says the new observations may simply be due to a mysterious source of gamma rays detected by Milagro and that an extra source of cosmic rays may not be involved at all.

Zhang counters that the excess seen by the Tibet detector covers a much broader patch of the sky than the previously observed gamma ray excess and so must have an additional source. "The large-scale excess towards the Cygnus region has to be attributed to charged cosmic rays," he argues.

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X-ray survey finds dozens of giant, ravenous black holes

NewScientist.com, David Shiga

About 160 supermassive black holes have been found feasting on matter at the centres of nearby galaxies, reveals an X-ray survey of the entire sky by NASA's Swift satellite.

More than 300 X-ray sources were found in the survey. Some were galaxy clusters and some have yet to be identified, while 158 were identified as active galactic nuclei (AGN). These are strongly radiating objects at the centres of galaxies that are thought to be black holes as massive as millions or billions of times the Sun that are devouring nearby matter.

Many of the black holes would not have been found with surveys probing visible light or other wavelengths, which cannot pass through the thick dust surrounding many of them. So Swift's X-ray survey, which is ongoing, provides a complete census of relatively nearby AGNs.

"We are confident that we are seeing every active, supermassive black hole within 400 million light years of Earth," says study leader Jack Tueller of NASA's Goddard Space Flight Center in Greenbelt, Maryland, US. "With each passing month, we are able to probe deeper into the universe, and the census becomes richer."

Swallowing dust

The researchers were surprised to find that the brightest supermassive black holes very rarely had thick dust around them. Thick dust was more often found around intrinsically dimmer sources.

The team is not sure why the brighter black holes are less obscured. "Somehow maybe the higher luminosity objects are able to clear out their environment," says team member Richard Mushotzky of Goddard. Another possibility is that the black holes have swallowed the dust, rather than blowing it away, he says.

The survey results were presented at a meeting of the High Energy Astrophysics Division of the American Astronomical Society in San Francisco, California, US.

Gravitational lens

At the same meeting, another team of astronomers led by Xinyu Dai of Ohio State University in Columbus, US, reported that it probed closer than ever before into the inner regions of two strongly radiating supermassive black holes, or quasars.

Because the quasars were behind another galaxy in space as seen from Earth, their light was magnified and bent in a process called gravitational lensing. The researchers studied how individual stars in the intervening galaxy affected the quasar's light, allowing them to see its central region in exquisite detail.

They found that the hot gas surrounding – and feeding – one of the quasars extends about eight times the size of Uranus's orbit around the Sun, while the gas around the other stretches to less than the size of Uranus's orbit.

Other results presented at the meeting include signs that a supermassive black hole called MCG-6-30-15 is spinning at 90% of the maximum theoretical rate, storing huge amounts of energy. The work was led by Andy Fabian of Cambridge University, UK.

And researchers led by Rita Sambruna of Goddard found evidence that jets shooting out the "poles" of quasars are made of ordinary protons and electrons, rather than a mixture of matter and antimatter in the form of electrons and positrons. The work will provide insight into how the jets form.
The Celestial Mechanic

HUBBLE ZEROES IN ON NEAREST KNOWN EXOPLANET

NASA's Hubble Space Telescope, in collaboration with ground-based observatories, has provided definitive evidence for the existence of the nearest extrasolar planet to our solar system.

The Jupiter-sized world orbits the Sun-like star Epsilon Eridani, which is only 10.5 light-years away (approximately 63 trillion miles). The planet is so close it may be observable by Hubble and large ground-based telescopes in late 2007, when the planet makes its closest approach to Epsilon Eridani during its 6.9-year orbit.

The Hubble observations were achieved by a team led by G. Fritz Benedict and Barbara E. McArthur of the University of Texas at Austin. The observations reveal the planet's true mass, which the team has calculated to be 1.5 times Jupiter's mass.

Hubble also found that the planet's orbit is tilted 30 degrees to our line of sight, which is the same inclination as a disk of dust and gas that also encircles Epsilon Eridani. This is a particularly exciting result because, although it has long been inferred that planets form from such disks, this is the first time that the two objects have been observed around the same star.

The research team emphasized that the alignment of the planet's orbit with the dust disk provides compelling direct evidence that planets form from disks of gas and dust debris around stars. The planets in our Solar System share a common alignment, evidence that they were created at the same time in the Sun's disk. But the Sun is a middle-aged star – 4.5 billion years old – and its debris disk dissipated long ago. Epsilon Eridani, however, still retains its disk because it is young, only 800 million years old.

McArthur originally detected the planet in 2000 by measurements that were interpreted as a rhythmic, back-and-forth wobble in Epsilon Eridani caused by the gravitational tug of an unseen planet. However some astronomers wondered if in fact the turbulent motion of the young star's atmosphere was mimicking the effects of the star being nudged by a planet's gravitational pull.

The Hubble observations settle any uncertainty. The Benedict-McArthur team calculated the planet's mass and its orbit by making extremely precise measurements of subtle changes in the star's location in the sky, a technique called astrometry. The slight variations are unmistakably caused by the gravitational tug of the unseen companion object. Benedict's team studied over a thousand astrometric observations from Hubble collected over three years."You can't see the wobble induced by the planet with the naked eye," Benedict said. "But Hubble's fine guidance sensors are so precise that they can measure the wobble. We basically watched three years of a nearly seven-year-long dance of the star and its invisible partner, the planet, around their orbits. The fine guidance sensors measured a tiny change in the star's position, equivalent to the width of a quarter 750 miles away."

The astronomers combined these data with other astrometric observations made at the University of Pittsburgh's Allegheny Observatory. They then added those measurements to hundreds of ground-based radial-velocity measurements made over the past 25 years at McDonald Observatory at the University of

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A Planet that Runs Hot and Cold
by Robert Naeye, skypub.com

Thanks to NASA's infrared Spitzer Space Telescope, astronomers have made the first measurement of the difference between an extrasolar planet's daytime and nighttime temperatures. They found that the innermost of three known planets orbiting the star Upsilon Andromedae is 1,400°C (2,550°F) hotter on its dayside.

"This is a seminal result and will change the way we think about hot Jupiters," says team member Sara Seager (Carnegie Institution of Washington). The group, led by Brad Hansen (University of California, Los Angeles), reports its results in Science for October 27, 2006.

The term "hot Jupiter" stems from the planet's proximity to its host star. It orbits Upsilon Andromedae every 4.6 days at a distance of only 6% the Earth–Sun separation. The searing inferno of the nearby star raises the planet's daytime temperature to 2,000 to 2,500 Kelvins (3,100° to 4,000°F). The large temperature swing means that gas radiates its energy before atmospheric currents can circulate the heat to the nightside. In contrast, Jupiter has nearly the same daytime and nighttime temperature.

Spitzer observed the star over a five-day period and found that its infrared emission (a measure of heat) brightened and dimmed in sync with the planet's orbital motion — a result of the planet showing different hemispheres to Spitzer as it went around the star. The planet is so close to Upsilon Andromedae that it must be tidally locked, meaning it always shows the same hemisphere to the star, just as the Moon shows only one face to Earth. The Spitzer observations do not reveal the actual temperatures, just the difference between the two hemispheres.

Upsilon Andromedae's inner planet is baked to high temperatures due to its proximity to the host star. But the planet's nightside is much cooler, meaning it must radiate this heat quickly. Astronomer-artist Robert Hurt shows what this planet might look like if we could view it up close.

NASA / JPL / Caltech / Robert Hurt / Spitzer Science Center.

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For a listing and more information on each of NASA's (and their partners') Earth data-gathering missions, visit science.hq.nasa.gov/missions/earth.html. Kids can get an easy introduction to Earth system science and play Earthy word games at spaceplace.nasa.gov/en/kids/earth/wordfind.

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