

Catskills Astronomy Club News

3/1/05

Club News:

The February 5th observation session could have been held at Walnut Mountain Park. The skies were clear but due to an apparent lack of commitments the session never occurred. Some members did show up and found nobody there. In the future better communication concerning attending an observation session can help us in making sessions happen on favorable nights. Please check email messages concerning the session and reply if you intend to come to an observation session. Confirmation can also be made by calling John at 845-791-5240.

The February 12th observation session was canceled due to poor weather but a solar observing session was held in its place on February 19th. Four members attended the session. We met for lunch at Danny's in Wurtsboro and then observed at the town park in Bloomingburg. Three hydrogen alpha telescopes were present. Two other telescopes were setup for observing the sun in white light. In white light we observed a very large sunspot. That region released an M class solar flare earlier in the day. In hydrogen alpha we observed some small prominences and a very large filament. The filament stretched a distance of approximately 300,000 miles on the surface of the sun. Two of us observed an airplane fly in front of the sun through our telescopes. The image below was taken by Bud Wertheim. It shows John Kocijanski, Mark Rosengarten, and Jim Mckeegan with their solar telescopes.



The Northeast Astronomy Forum will be held at Rockland County Community College on April 16th and 17th. Our club has been offered a free space for a table on the balcony for the show.

Last year we went on Saturday. Anyone wishing to volunteer to man the table can contact John at kocis@verizon.net. The table worked out well for us last year and gave the club some exposure. We handed out observing schedules and newsletters as well as NASA literature. We were considering setting up our table outside in the solar observation area weather permitting.

The March observation sessions are scheduled for the 5th and the 12th.

Each month the photo section of our newsletter will highlight the telescopes and equipment of club members. If you have a photo of your scope or equipment and a brief description of it that you would like to contribute please send it to John at kocis@verizon.net.

The club has selection of astronomy books, Stardate audio CDs, a Macintosh computer with astronomy software, and a Meade 8 inch reflector for members to borrow. Please contact John at 791-5240 or kocis@verizon.net if you are interested in borrowing any of these.

Astronomy News:

Here are some articles from various NASA sources that might be of interest.

News Release: 2005-024

February 9, 2005

NASA Observations Help Determine Titan Wind Speeds

Strong westerly winds of up to about 400 kilometers per hour (250 miles per hour) buffeted the Huygens probe as it descended through Titan's upper atmosphere last month, according to NASA-led observations of the probe transmissions with Earth-based radio telescopes.

The winds eased to a mild breeze near the surface of Titan, Saturn's largest moon.

A preliminary estimate of the wind variations with altitude from about 110 kilometers (68 miles) down to the surface has been recovered by a joint team of researchers from NASA's Jet Propulsion Laboratory, Pasadena, Calif., collaborating with the Huygens Doppler wind experiment team led by Dr. Michael Bird in Bonn, Germany, and with the ground-based European Very Long Baseline Interferometry team led by Dr. Leonid Gurvits.

A network of radio telescope facilities, located around the world, received the radio signals transmitted by the Huygens probe to the Cassini orbiter during the probe's descent and landing on Titan on Jan. 14. "The information from the radio telescopes was originally intended to supplement similar wind data received from the Huygens Doppler wind experiment. However, the onboard experiment failed to return data." said Dr. William Folkner, the JPL principal investigator for the ground-based Doppler wind experiment.

"Our ground-based work salvaged the Doppler wind experiment," said Sami Asmar, a JPL co-investigator on the Huygens Doppler wind experiment. He had reported detecting the signal on the ground from the Green Bank Telescope facility in West Virginia. "The signal from the Huygens probe was not designed to be detected on Earth -- sometimes it pays to eavesdrop," said Asmar.

Winds are determined by the "Doppler shift" of the signal. Doppler shift is a change in the frequency when received at Earth due to the probe's motion in Titan's atmosphere, similar to the change in pitch of a passing train whistle.

"We provided the only real-time confirmation that the probe transmitted a signal at the expected time, released the stabilizer parachute and then impacted the surface," said Asmar. "We did this by monitoring the Doppler shift in the frequency of the signal received at the Green Bank Telescope and the Parkes Telescope in Australia."

"The Huygens Doppler team worked closely with the Joint Institute for Very Long Baseline Interferometry team in Europe, which coordinated the scheduling of many radio telescopes around the globe for complementary measurements that monitored the change in probe position," said Dr. Robert Preston, chief scientist of the Interplanetary Network Directorate at JPL.

The Deep Space Network lent the JPL team two special Radio Science Receivers and had one shipped to Green Bank from its complex in California and another to Parkes from its complex near Canberra. These receivers allowed for the real-time detection and confirmation of the Huygens radio signal. The same type of receivers were used at Deep Space Network stations for receiving the Cassini signal during Saturn orbit insertion in June 2004 and the Mars Exploration Rover signal during entry, descent and landing in January 2004.

The Green Bank Telescope and other participating U.S. telescopes are part of the National Radio Astronomy Observatory. The Parkes radio telescope is operated by the Australia Telescope National Facility. The radio astronomy support was coordinated by the Joint Institute for Very Long Baseline Interferometry in Europe.

For the latest images and information about the Cassini-Huygens mission, visit:
<http://www.nasa.gov/cassini> and <http://saturn.jpl.nasa.gov>.

The Cassini-Huygens mission is a cooperative mission of NASA, the European Space Agency and the Italian Space Agency. The Jet Propulsion Laboratory, a division of the California Institute of Technology in Pasadena, manages the mission for NASA's Office of Space Science, Washington, D.C. The Cassini orbiter was designed, developed and assembled at JPL. ESA built and managed the development of the Huygens mission and was in charge of Huygens operations.
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Press Release: 2005-020

February 3, 2005

Saturn's Bull's-Eye Marks its Hot Spot

NASA astronomers using the Keck I telescope in Hawaii are learning much more about a strange, thermal "hot spot" on the tip of Saturn's south pole.

In the most precise reading of Saturn's temperatures ever taken from Earth, a new set of infrared images suggests a warm "polar vortex" at Saturn's south pole - the first warm polar cap ever to be discovered in the solar system. The vortex is punctuated by a compact spot that is the warmest place on the planet. The researchers report their findings in the Feb. 4 issue of the journal *Science*.

The images can be viewed at: <http://www.nasa.gov/multimedia/imagegallery/> .

A polar vortex is a persistent, large-scale weather pattern, likened to a jet stream on Earth in the upper atmosphere. On Earth, the Arctic Polar Vortex is typically located over eastern Canada and plunges arctic air to the northern plains in the United States. Earth's cold Antarctic Polar Vortex, centered over Antarctica, traps air and creates unusual chemistry, such as the effects that create the "ozone hole".

Polar vortices on Earth, Jupiter, Mars and Venus are colder than their surroundings. But new images from the W. M. Keck Observatory show the first evidence of such a polar vortex at much warmer temperatures than their surroundings. And the even warmer, compact region at the pole itself is quite unusual.

"There is nothing like this compact warm 'cap' in the Earth's atmosphere," said Dr. Glenn S. Orton, senior research scientist at NASA's Jet Propulsion Laboratory in Pasadena, Calif., and lead author of the paper. "Meteorologists have detected sudden warming of the pole, but on Earth this effect is very short-term. This phenomenon on Saturn is longer-lived because we've been seeing hints of it in our data for at least two years."

Data for these observations were taken in the imaging mode of the Keck facility instrument, the Long Wavelength Spectrometer, on Feb. 4, 2004, by Orton and Dr. Padma Yanamandra-Fisher, the paper's co-author, also a research scientist at JPL.

The puzzle isn't that Saturn's south pole is warm; after all, it has been exposed to 15 years of continuous sunlight, having just reached its summer Solstice late in 2002. But both the distinct boundary of a warm polar vortex some 30 degrees latitude from the southern pole and a very hot "tip" right at the pole were completely unexpected. If the increased southern temperatures are the result of the seasonal variations of sunlight, then temperatures should increase gradually with increasing latitude. But they don't – the tropospheric temperature increases toward the pole abruptly near 70 degrees latitude from 88 to 89 Kelvin (-301 to -299 degrees Fahrenheit) and then to 91 Kelvin (-296 degrees Fahrenheit) right at the pole. Near 70 degrees latitude, the stratospheric temperature increases even more abruptly from 146 to 150 Kelvin (-197 to -189 degrees Fahrenheit) and then again to 151 Kelvin (-188 degrees Fahrenheit) right at the pole.

The abrupt temperature changes may be caused by a concentration of sunlight-absorbing particulates trapping heat in Saturn's upper atmosphere. This theory would explain why the hot spot appears dark in visible light and contains the highest measured temperatures on Saturn. However, this alone would not explain why the particles themselves are constrained to a compact area at Saturn's south pole. One possible explanation would be downwelling of dry air, which is also consistent with deeper clouds observed at the southern pole. Researchers plan more observations to check that possibility.

More detail about the temperatures and possible chemical changes in these regions may be available from an infrared spectrometer on the Cassini spacecraft, in orbit around Saturn. The discovery of the hot spot at Saturn's south pole has prompted Cassini's composite infrared spectrometer science team, including Orton, to redirect some future observations to this area.

"One of the obvious questions is whether Saturn's north pole is abnormally cold and whether a cold polar vortex has been established there. That's something we can't see from Earth, and Cassini's instruments will be in a unique position to observe it," said Orton.

Funding for this research was provided by NASA's Office of Space Sciences and Applications, Planetary Astronomy Discipline, and the NASA Cassini project. The Cassini-Huygens mission is a cooperative project of NASA, the European Space Agency and the Italian Space Agency. The Jet Propulsion Laboratory, a division of the California Institute of Technology in Pasadena, manages the Cassini-Huygens mission for NASA's Science Mission Directorate, Washington, D.C.

The W.M. Keck Observatory is operated by the California Association for Research in Astronomy, a non-profit scientific partnership of the California Institute of Technology, the University of California, and NASA. On the Web at www.keckobservatory.org.

Press Release: 2005-030

February 18, 2005

Saturn's Moons Titan and Enceladus Seen by Cassini

NASA's Cassini spacecraft has had a busy week, snapping stunning new images of two of Saturn's moons -- smoggy Titan on Feb. 15 and wrinkled Enceladus on Feb. 16.

Visible in radar images released today are a crater, channels, and terrain similar to the area where the European Space Agency's Huygens probe landed on Jan. 14.

The crater is approximately 60 kilometers (37 miles) in diameter. Earlier this week, the radar team released an image of a giant impact crater dubbed "Circus Maximus," about 440 kilometers wide (273 miles).

"The appearance of the small crater and the extremely bright, hence rough, blanket of material surrounding it is indicative of an origin by impact," said Dr. Jonathan Lunine, Cassini interdisciplinary scientist from the University of Arizona, Tucson.

From the crater's size, scientists estimate that it was created when a comet or asteroid roughly 5 to 10 kilometers (3 to 6 miles) in size slammed into the surface of Titan. The feature lacks a central peak, suggesting that it has been eroded or otherwise modified since formation. Rainfall, wind erosion, and softening of the solid material in which the crater formed are all possible processes that might have altered this impact feature.

Also visible in the radar images are channels located just east of Circus Maximus, the large impact crater. The longest channel is approximately 200 kilometers long (124 miles). The channels appear to flow from the slopes of the crater. The fluid was most likely liquid methane, given the extremely cold ambient conditions at the surface of Titan. The area somewhat resembles the rubble-strewn plains in the region where the Huygens probe landed.

Just one day after the Titan flyby, Cassini turned its sights on Saturn's moon Enceladus, revealing a fascinating, tortured world of ice. The spacecraft swept within 1,180 kilometers (730 miles) of the moon's wrinkled surface, providing the first-ever high resolution images of this world with the brightest, most reflective surface in the solar system.

Since NASA's Voyager spacecraft flew past Enceladus in 1980 and 1981, planetary scientists have been intrigued by the moon's wrinkled terrain and smooth plains, some of which appeared to be relatively free of impact craters. Smooth, crater-free surfaces on moons and planets indicate geologically young ages, while wrinkles may indicate tectonic activity or volcanism.

"Cassini has now viewed these terrains at almost 10 times better resolution than Voyager," said Dr. Carolyn Porco, Cassini imaging team leader based at the Space Science Institute in Boulder, Colo. "Interestingly, the icy surface of Enceladus appears to have similarities to both Europa and Ganymede -- two prominent icy satellites of Jupiter -- and topographic relief of about 1 kilometer [.6 mile]. Both Europa and Ganymede are thought to have subsurface water layers, or 'oceans,' so the similarities with Enceladus are intriguing."

One view released today is a high-resolution mosaic showing complex systems of fractures and resurfaced terrain. Among the most intriguing features in the images are a series of small, dark spots, which in many places seem to be aligned in chains parallel to narrow fractures.

A false-color view shows some linear features on Enceladus with a slightly different color from their surroundings. Different colors of ice may be caused by varying compositions or varying ice crystal sizes. Either one can indicate different formation mechanisms or different ages. Another early highlight from the flyby is a high-resolution stereo view of Enceladus. Stereo views are helpful in interpreting the moon's complex topography.

Other preliminary results from the visual and infrared mapping spectrometer show a surface composed of only pure water ice, with no other compounds detected. Ammonia or ammonium compounds and carbon dioxide were expected, but not seen in the data. Further analysis may find trace amounts. "The spectra look like laboratory fabricated water ice, indicating the ice is quite pure," said Dr. Roger N. Clark, Cassini science team member at the U.S. Geological Survey in Denver.

During the latest flybys, Cassini was 1,577 kilometers (980 miles) above Titan, and 1,180 kilometers (730 miles) above Enceladus. Cassini will conduct an even closer flyby of Enceladus on March 9, coming within approximately 500 kilometers (310 miles) of its surface. More than 40 additional Titan flybys are planned.

The pictures are available at <http://saturn.jpl.nasa.gov>, <http://www.nasa.gov/cassini> and <http://ciclops.org>.

The Cassini-Huygens mission is a cooperative project of NASA, the European Space Agency and the Italian Space Agency. The Jet Propulsion Laboratory, a division of the California Institute of Technology in Pasadena, manages the Cassini-Huygens mission for NASA's Science Mission Directorate, Washington, D.C. The Cassini orbiter and its two onboard cameras were designed, developed and assembled at JPL. The imaging team is based at the Space Science Institute, Boulder, Colo.

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Press Release: 2005-022

February 7, 2005

Astronomers Discover Beginnings of 'Mini' Solar System

Moons circle planets, and planets circle stars. Now, astronomers have learned that planets may also circle celestial bodies almost as small as planets.

NASA's Spitzer Space Telescope has spotted a dusty disc of planet-building material around an extraordinarily low-mass brown dwarf, or "failed star." The brown dwarf, called OTS 44, is only

15 times the mass of Jupiter. Previously, the smallest brown dwarf known to host a planet-forming disc was 25 to 30 times more massive than Jupiter.

The finding will ultimately help astronomers better understand how and where planets – including rocky ones resembling our own – form.

"There may be a host of miniature solar systems out there, in which planets orbit brown dwarfs," said Dr. Kevin Luhman, lead author of the new study from the Harvard-Smithsonian Center for Astrophysics, Cambridge, Mass. "This leads to all sorts of new questions, like 'Could life exist on such planets?' or 'What do you call a planet circling a planet-sized body? A moon or a planet?'"

Brown dwarfs are something of misfits in the astronomy world. These cool orbs of gas have been called both failed stars and super planets. Like planets, they lack the mass to ignite and produce starlight. Like stars, they are often found alone in space, with no parent body to orbit.

"In this case, we are seeing the ingredients for planets around a brown dwarf near the dividing line between planets and stars. This raises the tantalizing possibility of planet formation around objects that themselves have planetary masses," said Dr. Giovanni Fazio, an astronomer at the Harvard Smithsonian Center for Astrophysics and a co-author of the new study.

The results were presented today at the Planet Formation and Detection meeting at the Aspen Center for Physics, Aspen, Colo., and will be published in the Feb. 10th issue of *The Astrophysical Journal Letters*.

Planet-forming, or protoplanetary, discs are the precursors to planets. Astronomers speculate that the disc circling OTS 44 has enough mass to make a small gas giant planet and a few Earth-sized, rocky ones. This begs the question: Could a habitable planet like Earth sustain life around a brown dwarf?

"If life did exist in this system, it would have to constantly adjust to the dwindling temperatures of a brown dwarf," said Luhman. "For liquid water to be present, the planet would have to be much closer to the brown dwarf than Earth is to our Sun."

"It's exciting to speculate about the possibilities for life in such a system, of course at this point we are only beginning to understand the unusual circumstances under which planets arise," he added.

Brown dwarfs are rare and difficult to study due to their dim light. Though astronomers recently reported what may be the first-ever image of a planet around a brown dwarf called 2M1207, not much is understood about the planet-formation process around these odd balls of gas. Less is understood about low-mass brown dwarfs, of which only a handful are known.

OTS 44 was first discovered about six months ago by Luhman and his colleagues using the Gemini Observatory in Chile. The object is located 500 light-years away in the Chamaeleon constellation. Later, the team used Spitzer's highly sensitive infrared eyes to see the dim glow of OTS 44's dusty disc. These observations took only 20 seconds. Longer searches with Spitzer could reveal discs around brown dwarfs below 10 Jupiter masses.

Other authors of this study include Dr. Paola D'Alessia of the Universidad Nacional Autonoma de Mexico; and Drs. Nuria Calvet, Lori Allen, Lee Hartmann, Thomas Megeath and Philip Myers of the Harvard-Smithsonian Center for Astrophysics.

NASA's Jet Propulsion Laboratory, Pasadena, Calif., manages the Spitzer Space Telescope mission for NASA's Science Mission Directorate, Washington, D.C. Science operations are conducted at the Spitzer Science Center, Pasadena, Calif. JPL is a division of Caltech. The infrared array camera, which spotted the protoplanetary disc around OTS 44, was built by NASA Goddard Space Flight Center, Greenbelt, Md.; its development was led by Fazio.

Artist's conceptions and additional information about the Spitzer Space Telescope are available at <http://www.spitzer.caltech.edu>.

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News Release: 2005-027

February 15, 2005

NASA's Twin Mars Rovers Continue Exploration

NASA's Spirit rover found a new class of water-affected rock, while its twin, Opportunity, finished inspecting its own heat shield and set a new martian driving record. The rovers successfully completed their three-month primary missions in April 2004 and are working on extended exploration missions.

"This is probably the most interesting and important rock Spirit has examined," said Dr. Steve Squyres of Cornell University, Ithaca, N.Y., principal investigator for the rovers. The rock, dubbed "Peace," is an exposure of bedrock in the Columbia Hills. The hills are in Gusev Crater, where Spirit landed 13 months ago. "This may be what the bones of this mountain are really made of. It gives us even more compelling evidence for water playing a major role for altering the rocks here," Squyres added.

Peace contains more sulfate salt than any other rock Spirit has examined. Dr. Ralf Gellert, of Max-Planck-Institut fur Chemie, Mainz, Germany, said, "Usually when we have seen high levels of sulfur in rocks at Gusev, it has been at the very surface. The unusual thing about this rock is that deep inside, the sulfur is still very high. The sulfur enrichment at the surface is correlated with the amount of magnesium, which points to magnesium sulfate."

Observations by Spirit show the rock contains significant amounts of the minerals olivine, pyroxene and magnetite, all of which are common in some types of volcanic rock. The rock's texture appears to be sand-size grains coated with a material loosely binding the rock together. Spirit's rock abrasion tool dug about 1 centimeter deep (0.4 inch) in two hours.

"It looks as if you took volcanic rocks that were ground into little grains, and then formed a layered rock with them cemented together by a substantial quantity of magnesium-sulfate salt," Squyres said. "Where did the salt come from? We have two working hypotheses we want to check by examining more rocks. It could come from liquid water with magnesium sulfate salt dissolved in it, percolating through the rock, then evaporating and leaving the salt behind. Or it could come from weathering by dilute sulfuric acid reacting with magnesium-rich minerals that were already in the rock. Either case involves water."

Opportunity used its microscopic imager to examine a cross section of the heat shield that protected the spacecraft as it slammed into Mars' atmosphere. This is the first time experts have

been able to examine a heat shield after it entered another planet's atmosphere. Engineers expect the findings to aid design for future missions.

"We've identified each broken piece of the heat shield. We know there's a lot of data there, but we still need to analyze it," said Ethiraj Venkatapathy of NASA's Ames Research Center, Moffett Field, Calif.

Christine Szalai, a spacecraft engineer at NASA's Jet Propulsion Laboratory, Pasadena, Calif., said, "We are examining the images to determine the depth of charring in the heat shield material. In the initial look, we didn't see any surprises. We will be working for the next few months to analyze the performance of the heat shield."

Since leaving the heat shield, Opportunity has been traveling south to explore new sites. The rover set a single-day martian driving record, covering 154.65 meters (507.4 feet) on Jan. 28. Two days later, it drove even farther, 156.55 meters (513.6 feet). The first 90 meters (295 feet) of each drive were performed in blind-drive mode, following a route planners created from stereo images from the rover and maps created from orbital imagery. The rest was autonomous driving, with the rover choosing its own route to avoid any hazards it perceived in stereo images taken along the way.

"The terrain we're crossing is so flat we can see a long way ahead," said JPL rover planner Frank Hartman, who teamed with Jeff Biesiadecki to plot the drive. "Opportunity has paused for some trenching, but in a few days we'll put the pedal to the metal again."

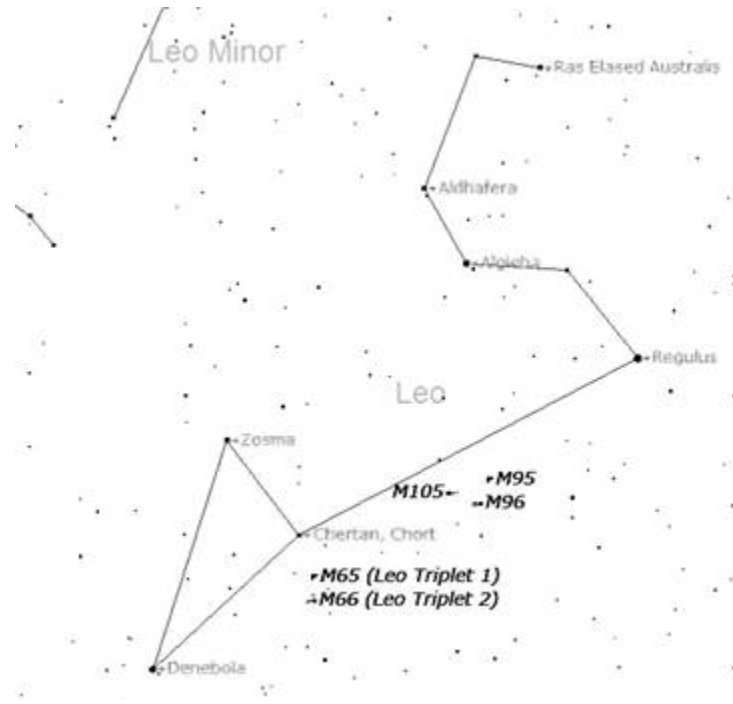
JPL, a division of the California Institute of Technology in Pasadena, has managed NASA's Mars Exploration Rover project since it began in 2000.

Images and additional information about the rovers and their discoveries are available on the Internet at http://www.nasa.gov/vision/universe/solarsystem/mer_main.html and <http://marsrovers.jpl.nasa.gov> . For information about NASA and agency programs on the Internet, visit <http://www.nasa.gov> .

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Mid Evening Observing Highlights for March

Saturn can be found almost directly overhead. Jupiter is low in the eastern sky. The dimming Comet Machholz can still be found just above Polaris. The Beehive Cluster (M44) in Cancer is directly overhead. There are many open clusters that can be viewed in the southern sky such as M41, M46, M47, M48, and M50. Leo and Virgo are rising in the eastern sky. The Big Dipper is standing on its handle in the northeastern sky. The bright star Arcturus can be seen rising in the east just above the horizon. Spring is the time of year to observe galaxies. Many can be found in Leo, Virgo, and Coma Berenices. The image below shows the location the galaxies M65, M66, M105, M95, and M96 in Leo. Full moon is on March 25th and new moon is on March 10th.



The moon will occult the bright star Antares on the morning of March 3rd. Check the link below for more details.

<http://SkyandTelescope.com/observing/objects/occultations/>

Member's Telescopes and Equipment

John Kocijanski has written a comparison review of the Televue Telepod, Universal Astronomics Microstar, and Universal Astronomics Unistar Light telescope mounts for the Cloudy Nights website. The review has a picture from our last solar observation session in it. Check out the link below for the review.

<http://www.cloudynights.com/mounts2/telepod.htm>

BARLOW BOB'S CORNER

Barlow Bob is a member of the Rockland Astronomy Club.

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AMATEUR SOLAR ASTRONOMY***

**THE ROCKLAND ASTRONOMY CLUB
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APRIL 16 AND 17, 2005

At Rockland Community College in Suffern, NY

NEAF attendees are invited to observe the Sun with attitude, through a variety of Hydrogen-alpha and sunspot solar filters.

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No star party entrance fee or registration required.**

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<http://www.sungazer.net/field.html>

Barlow Bob

SSP AT SSP

The 2005 Second Annual NEAF Solar Star Party will continue at the Rockland Astronomy Club Summer Star Party and Family Camping Vacation. The Summer Star Party is held from From July 29 to August 7, 2005, at the private Shady Pines Campground, in Savoy, MA.

For further information check our web site www.rocklandastronomy.com, call 201-768-6575, or send email to SummerStarParty@RocklandAstronomy.com

NASA Space Place

A Different Angle on Climate Change

by Patrick L. Barry

Look toward the horizon in almost any major city, and you'll clearly see the gray-brown layer of smog and air pollution. Yet when you look straight up, the sky can appear perfectly blue; you might think there's no smog at all!

The smog is overhead as well, but it's much harder to see. Why is there such a difference?

It comes down to viewing angles: A vertical line straight up through the atmosphere crosses much less air than a line angled toward the horizon. Less air means less smog, so the sky overhead looks blue. On the other hand, when you look toward the horizon, you're looking through a lot more air. The smog is easier to see.

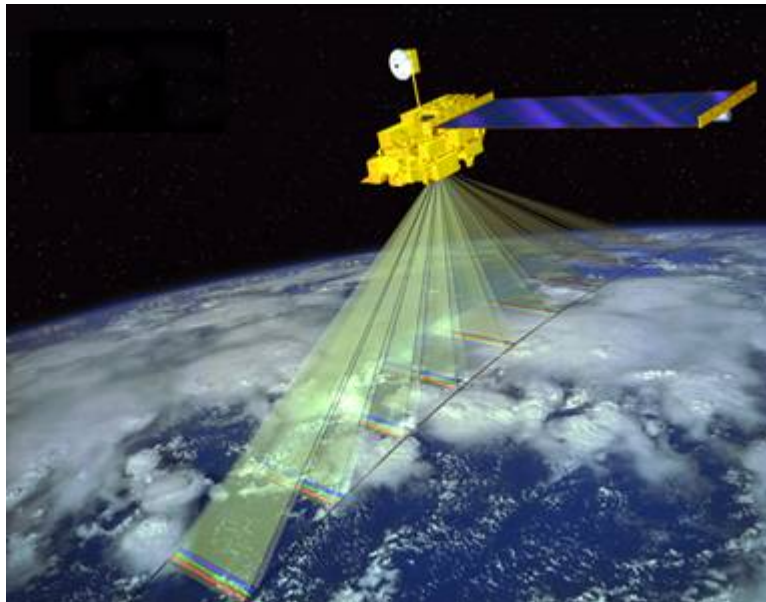
A one-of-a-kind sensor aboard NASA's Terra satellite capitalizes on this angle effect to get a better view of how clouds and air pollutants scatter and absorb sunlight. By doing so, this sensor—called the Multi-angle Imaging SpectroRadiometer (MISR for short)—is helping scientists fill in a major piece of the climate change puzzle.

Most satellite instruments look only straight down at the Earth. Layers of airborne particles (called aerosols) and smog are harder to see with this vertical view, and clouds often appear only as two-dimensional sheets of white. Clouds and aerosols both can reflect incoming sunlight back out to space, thus cooling the planet. But they can also absorb sunlight and trap heat rising from below, thus helping warm the planet.

What is the net effect? MISR helps scientists figure this out by looking at the atmosphere at several angles—nine to be exact. Its nine cameras fan out across a range of angles from steeply looking forward (70.5 degrees from vertical), to straight down, to the same steep angle backwards. As the Terra satellite passes over a region, the cameras successively view the region at nine different angles.

From these data, scientists can construct a three-dimensional picture of the cloud cover, revealing much more about cloud dynamics than a flat image alone. They can also see light bouncing off aerosol pollution from nine different directions, thus getting a fuller picture of how aerosols scatter sunlight. And they can even spot thin layers of heat-trapping air pollutants that might go unnoticed by other satellites.

All this information comes just from looking at the atmosphere from a different angle. For more information, see <http://www-misr.jpl.nasa.gov> . Kids can learn about MISR, see MISR images, and do an online MISR crossword at http://spaceplace.nasa.gov/en/kids/misr_xword/misr_xword2.shtml .



Caption:

The MISR instrument on the Terra satellite views the atmosphere and Earth's surface from nine different angles.