The Celestial Mechanic

The Official Newsletter of the Astronomy Associates of Lawrence

Volume 31 Number 03 **MARCH 2005**

Calendar of Events

***FRIDAY* March 11**
1001 Malott—7:30 PM
The New 27-inch Telescope—Graham Bell, NEKAAL
No Open House at Memorial Stadium in March—YET

FRIDAY April 15—8PM
Royall Hall, UMKC
TOM CRAVENS—KU
Cassini-Huygens

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From the Officers

Report From the Officers on the February Meeting:

The February meeting featured an intriguing presentation on the basic ideas behind general relativity and the means of testing them from Dr. Karen Camarda of Washburn University. The technological challenges of testing some of the more subtle effects of GR are extraordinary and are difficult to detect even using the entire Earth as a source. Gravity Probe B required decades of effort but now appears to be approaching the level of data gathering required to justify its expense.

For next month, we have Graham Bell of the Topeka Club, NEKAAL, to provide a history of the 27-inch telescope and its resurrection for research. The Pitt telescope was originally used by Clyde Tombaugh to do his Master's Thesis, when he came to KU after finding Pluto, an anniversary celebrated in February. The Pitt telescope survived on the KU campus for almost 60 years until its recent demise on the roof of Lindley Hall. While the superstructure was trashed, the mirrors were save and donated to the Topeka club. After a number of years of fundrais-

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MID-AMERICAN REGIONAL ASTROPHYSICS CONFERENCE
April 15/16, 2005
Linda Hall Library
5109 Cherry Street
Kansas City, Missouri

All professional scientists involved in *teaching and/or research* in astronomy/astrophysics/space science are cordially invited to present papers in ANY field of astronomy, astrophysics, or space science. *Students are especially welcome*. Advanced amateurs are also invited to attend.

MARAC WEB SITE:

http://www.physics.ku.edu/marac/marac.shtml

INSIDE THIS ISSUE

From the Officers, continued

ing and, with the support of a NASA grant, the mirror has been placed back into action within a new telescope optical tube assembly and mount. The new research telescope should see first light within the next two months and Graham will fill us in on the status of the project and the research plans. (Note: we again have managed to avoid a home basketball game, so parking shouldn't be a problem.)

For April, our monthly meeting will technically be cancelled, in part because April 15/16 will be the two days scheduled for the regional astrophysics conference in Kansas City, but also because there is a public lecture on **Friday, April 15**, associated with this conference at Royall Hall at UMKC. The public talk will be by **Dr. Tom Cravens** of KU on the Cassini-Huygens Mission to Saturn and the latest results from this extraordinarily successful mission. Tom is an INMS Cassini team member and has extensive experience in planetary magnetic fields and atmospheric compositions. All members who can are encouraged to attend this talk at 8PM on the 15th. More in the next newsletter.

Returning to the issue of observing, the Memorial Stadium site is still under construction and, though it was hoped that they would be finished by the end of January, the weather has not cooperated. Thus, we still don't know when we will have the next open house. As of the last meeting, construction was still about three weeks behind, so observations at the stadium could begin in March, if all goes well, but exactly when, we don't know. We will forward the info via the web site and via email as soon as we have a definite date and time.

Don't forget that those of you who were on the membership lists as of the summer 2004 are also members of the Astronomical League (which is why you get the national newsletter, The Reflector.) We update our lists to them each summer, so whatever happens, make sure your membership dues are in by then. The national office of the Astronomical League is based in Kansas City and, this summer, their annual convention will be in Kansas City, from Aug. 12/13.

If you have any suggestions for talks, speakers, or public events, please feel free to contact us, particularly Rick Heschmeyer, the events coordinator for the club.
ALL for now. See you a week from Friday. We will, as always, have refreshments so bring a friend and socialize.

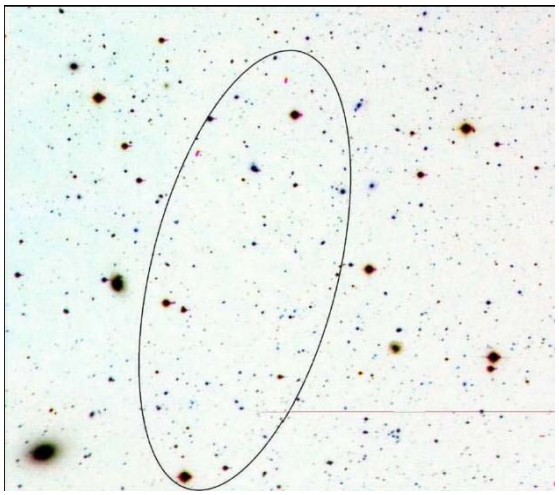
About the Astronomy Associates of Lawrence

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: Hannah Swift at hkswift@ku.edu, Gary Webber at gwebber@ku.edu, our faculty advisor, Prof. Bruce Twarog at btwarog@ku.edu. or our events coordinator, Rick Heschmeyer at RCJBM@aol.com. 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

First Invisible Galaxy Discovered in Cosmology Breakthrough

Robert Roy Britt, Space.com



Astronomers have discovered an invisible galaxy that could be the first of many that will help unravel one of the universe's greatest mysteries. The object appears to be made mostly of "dark matter," material of an unknown nature that can't be seen.

Theorists have long said most of the universe is made of dark matter. Its presence is required to explain the extra gravitational force that is observed to hold regular galaxies together and that also binds large clusters of galaxies. Theorists also believe knots of dark matter were integral to the formation of the first stars and galaxies. In the early universe, dark matter condensed like water droplets on a spider web, the thinking goes. Regular matter -- mostly hydrogen gas -- was gravitationally attracted to a dark matter knot, and when the density became great enough, a star would form, marking the birth of a galaxy.

The theory suggests that pockets of pure dark matter ought to remain sprinkled across the cosmos. In 2001, a team led by Neil Trentham of the University of Cambridge predicted the presence of entire dark galaxies.

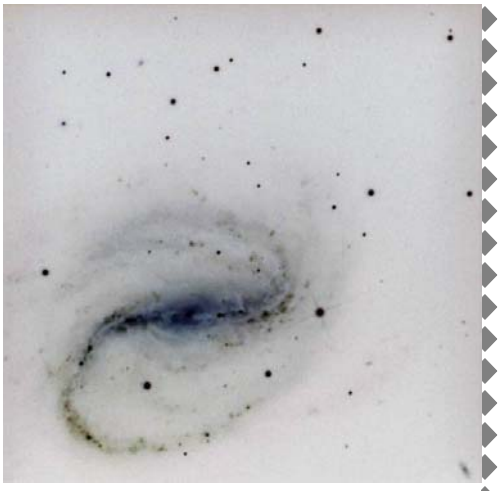
One of perhaps many

The newfound dark galaxy was detected with radio telescopes. Similar objects could be very common or very rare, said Robert Minchin of Cardiff University in the UK.

"If they are the missing dark matter halos predicted by galaxy formation simulations but not found in optical surveys, then there could be more dark galaxies than ordinary ones," Minchin told *SPACE.com*.

In a cluster of galaxies known as Virgo, some 50 million light-years away, Minchin and colleagues looked for radio-wavelength radiation coming from hydrogen gas. They found a well of it that contains a hundred million times the mass of the Sun. It is now named VIRGOHI21. The well of material rotates too quickly to be explained by the observed amount of gas. Something else must serve as gravitational glue.

"From the speed it is spinning, we realized that VIRGOHI21 was a thousand times more massive than could be accounted for by the observed hydrogen atoms alone," Minchin said. "If it were an ordinary galaxy, then it should be quite bright and would be visible with a good amateur telescope."



NGC 7479 is the type of galaxy astronomers would have expected to see based on the measurements taken. Credit: Nik Szymanek/Faulkes Telescope North, Maui, copyright FTLLC

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The Astronomy Associates of Lawrence
present

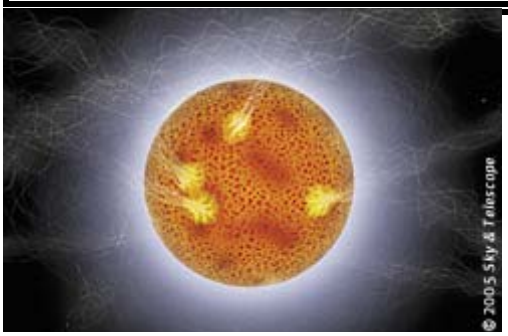
SEARCHING for NEO:

A New Life for the 27-Inch Pitt Telescope

FRIDAY, MARCH 11, 2005
7:30 PM, 1001 Malott Hall
University of Kansas
FREE & OPEN TO THE PUBLIC

The Brightest Blast

By Robert Naeye, Skypub.com



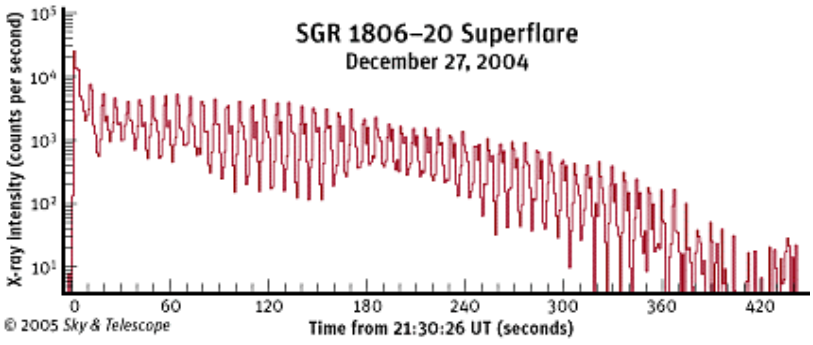
This illustration, which is based on the latest scientific thinking, represents how a magnetar might appear if we could view it up close with X-ray vision. But this is not something anyone would want to do. Magnetars are neutron stars with magnetic fields so powerful that they could kill a person from 1,000 kilometers away by warping the atoms in living flesh. Magnetars can also unleash powerful flares that could kill at much larger distances. S&T: Gregg Dinderman.

On December 27, 2004, more than a dozen spacecraft recorded the brightest event from outside the solar system ever observed in the history of astronomy. The spacecraft, which included Earth-orbiting satellites as well as interplanetary probes such as Cassini, Mars Odyssey, and Ulysses, picked up a powerful burst of gamma rays and X-rays from one of the most exotic beasts in the galactic zoo: a *magnetar*. These bizarre objects are neutron stars possessing magnetic fields a million billion times more powerful than Earth's field, or some 1,000 times greater that those of normal neutron stars.

The "superflare," from a magnetar named SGR 1806–20, irradiated Earth with more total energy than a powerful solar flare. Yet this object is an estimated 50,000 light-years away in Sagittarius, on the far side of the Milky Way galaxy behind dense interstellar clouds. "This is mind-boggling when you think about how far away it is," says Kevin C. Hurley (University of California, Berkeley), one of the lead investigators.

Bryan M. Gaensler (Harvard-Smithsonian Center for Astrophysics), who conducted radio observations of the superflare's afterglow, notes that only the Sun and perhaps a handful of spectacular comets have doused Earth with more total energy than SGR 1806–20's superflare during the two-tenths of a second that it peaked in intensity. During that flicker of time it outshone the full Moon by a factor of two. The magnetar must have let loose as much energy as the Sun generates in 250,000 years, assuming that the distance estimate is accurate.

The burst was so powerful that some of its gamma rays and X-rays reflected off the Moon (a very poor mirror) and were detected by the Russian Helicon-Coronas-F satellite. Amateur radio solar observers with the American Association of Variable Star Observers easily detected the superflare's ionizing effects on Earth's upper atmosphere, even though the radiation smacked into our planet's daylight hemisphere and thus had to compete with the Sun.



NASA's RHESSI satellite, which was designed to observe solar flares, captured this light curve of the superflare at X-ray energies of 20,000 to 50,000 electron volts. It shows the remarkable initial spike of energy (note the logarithmic scale on the vertical axis) followed by a tail that pulsed strongly every 7.56 seconds, the magnetar's rotation period. Source: Steve Boggs / RHESSI Team / NASA / UC Berkeley.

The superflare has generated intense observational and theoretical research around the world, as the astronomical community has been forced to confront the question of how such a tiny object, about 20 kilometers (12 miles) across, could unleash such unmitigated fury.

Although the details remain shrouded in mystery, the energy almost certainly resulted from SGR 1806–20 shedding part of its extraordinary magnetic field. Magnetars, in fact, have the strongest magnetic fields in the universe. Four magnetars, including this one,

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Ice Packs and Methane on Mars Suggest Present Life Possible, European Team Says

Robert Roy Britt, Space.com

A European space probe has found evidence for large blocks of water ice just beneath the Martian surface in relatively warm conditions near the equator. The frozen sea of sorts, if follow-up studies confirm it, would be the first large quantity of water ice on Mars confirmed to exist near the equator, researchers say. And it would be a good place to search for present life.

"This is a historic moment for Mars exploration when a previously neglected region reveals its secrets," Jan-Peter Muller of the University College London said in a statement today. "Speculations that this area might have water close to the surface have been shown to be correct."

The findings could be important for biology, Muller and his colleagues say.

"Higher levels of methane over the same area mean that primitive micro-organisms might survive on Mars today," the statement reads.

Small quantities of methane were previously detected in the Martian atmosphere by the European Space Agency's Mars Express orbiter. Methane could be a byproduct of biological activity, or it could be the result of nonbiological processes, other scientists say. And the methane signature at Mars is tentative for now, researchers have said.

"The methane signature is controversial," Brown University geologist John Mustard told SPACE.com last week.

The new evidence

Scientists know that Mars was once wetter than it is today. Data from NASA's Mars Rovers reveal significant amounts of liquid water must have existed billions of years ago. Since then, the planet has dried up. Scientists have been eager to determine how much water might have remained beneath the surface, either as ice or in occasional pockets of liquid that might support life.

The newfound pack ice, just five degrees from the equator, might have collected millions of years ago when volcanic tempests and water floods brought it down from nearby areas in the Elysium region of the planet, researchers say. Scars to the landscape serve as evidence of those past floods. Until now, however, scientists had assumed any lakes or seas that resulted from the flooding had either evaporated away or, if frozen into icebergs, had "sublimated" directly into the atmosphere.

"We have found evidence consistent with a presently existing frozen body of water, with surface pack-ice," the scientists write in a paper that is scheduled to be published in March in the journal *Nature*.

The journal's contents are normally not released prior to publication. The research was first reported on by *New Scientist* magazine, which says the paper was not under embargo when first viewed by the magazine. *SPACE.com* has reviewed the paper. The research was discussed yesterday at a scientific meeting in Europe.

“The fact that there have been warm and wet places beneath the surface of Mars since before life began on Earth, and that some are probably still there, means that there is a possibility that primitive micro-organisms survive on Mars today," study co-leader John Murray at the Open University in the UK said in today's statement. "This mission has changed many of my long-held opinions about Mars – we now have to go there and check it out."

Other researchers have speculated that if life ever formed on Mars, it could have gone underground and survived to the present day. (Lack of surface water now, plus the harsh radiation at Mars, suggest it's very unlikely there is any modern-day surface life.)

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Many other scientists have said firm proof of life on Mars, if it exists, would require a new mission. The rovers on Mars and spacecraft orbiting there are not equipped to find life directly.

Formed when human ancestors were around

The ice exists in a block that resemble polar ice on Earth, according to the research team. It measures about 497 by 559 miles (800 by 900 kilometers) and averages up to 150 feet (45 meters) deep. The underground iceberg is just 2 million to 5 million years old -- recent in geologic terms. It formed when early hominids were roaming Earth.

The feature suggests that "vast flooding events, which are known to have occurred from beneath Mars' surface throughout its geological history, still happen," the Muller, Murray and their colleagues write. "The presence of liquid water for thousands of millions of years, even beneath the surface, is a possible habitat in which primitive life may have developed, and might still be surviving now. Clearly this must now be considered as a prime site for future missions looking for life."

The researchers propose that the ice has been protected from sublimation by an overlying layer of volcanic ash.

"I think it's fairly plausible," Michael Carr, an expert on Martian water at the U.S. Geological Survey, told *New Scientist*. "We know where the water came from," said Carr, who was not involved in the work. "You can trace the valleys carved by water down to this area."

Confirmation could come soon

Evidence from the High Resolution Stereo Camera on the European Space Agency's Mars Express craft show characteristics in craters that suggest the water ice remains.

The pack-ice floes appear to have drifted into obstacles and become grounded on islands when the water level dropped, the scientists say. But the case is not closed.

"The question remains as to whether the frozen body of water is still there, or whether the visible floes are preserved in a sublimation residue draped over the substrate," the scientists write in their journal article. A firm answer could come soon. The Mars Express probe will finally deploy its delayed MARSIS experiment in May. The ground-penetrating radar instrument is designed to look for ice or water beneath the surface.

"If water ice is confirmed, this site represents a prime target for exobiology landers from the European Space Agency planned for the end of this decade," today's statement said.

If the ice exists, it would add to other frozen water stores on Mars. Both polar regions of the red planet are capped by large areas of water ice. In the southern hemisphere, frozen carbon dioxide, or dry ice, covers the water ice. NASA's Mars Odyssey probe found strong evidence for ice embedded in the soil away from polar regions, but scientists are awaiting confirmation of the extent of that ice. Researchers stress that while liquid water is a key ingredient for life as we know it, the presence of water does not mean life ever got started.

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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 .

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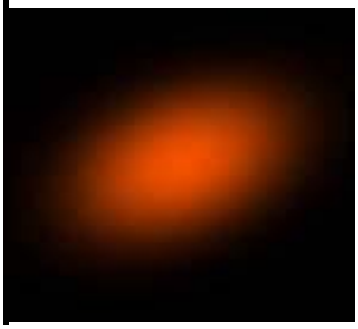
are known as *soft gamma repeaters*, or SGRs, because they occasionally release powerful flares of low-energy (soft) gamma rays. But the December 27th event was roughly 100 times more powerful than any previously observed SGR flare.

Magnetic field lines weaving through the star probably flex its solid crust and heat its interior, leading to stress that is occasionally relieved in sudden "starquakes." Such an event allows the magnetic field to jerk pieces of the crust around and rearrange itself to a lower-energy state. This rearrangement, which is a vastly scaled-up version of a solar flare (a "reconnection event" in the magnetic field), releases a huge amount of magnetic energy in the form of gamma rays, electrons, and positrons (the antimatter counterpart of electrons). It's this radiation that was responsible for the initial spike, which contained 99.7 percent of the superflare's total energy.

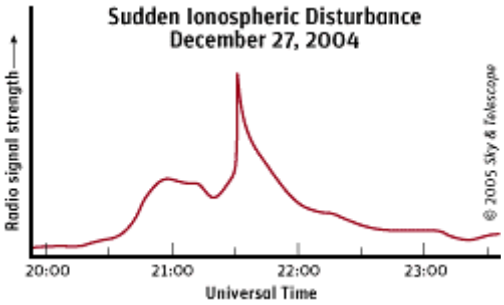
Electrons and positrons confined by the magnetar's magnetic field annihilate one another over the next several minutes, accounting for a fading tail of emission after the initial 0.2-second spike. This "trapped fireball" model was developed in the mid-1990s by Robert C. Duncan (University of Texas, Austin) and Christopher Thompson (Canadian Institute of Theoretical Astrophysics), who also predicted the existence of magnetars in 1992. The SGR superflare might partially explain a long-standing mystery surrounding gamma-ray bursts (GRBs). These mega-powerful explosions fall into two distinct classes: long events lasting several seconds to several minutes, and short bursts, which last no more than two seconds.



This image, which is a model based on radio observations from the Very Large Array, shows the fading afterglow of SGR 1806–20's superflare. This afterglow gives astronomers a more detailed view of the more distant and energetic afterglows arising from gamma-ray bursts. Courtesy NRAO / CfA / Bryan Gaensler.

If one took SGR 1806–20 and moved it to another galaxy, the superflare would mimic a short gamma-ray burst (GRB). Previous generations of satellites would have detected the initial 0.2-second spike, but they would not have been sensitive enough to detect the fading tail. Astronomers have long suspected that that the short bursts are triggered by the merging of two neutron stars or a neutron star and a black hole. But as Duncan points out, "These theories remain speculative. We've seen that SGRs can produce short GRBs." NASA's recently launched Swift satellite could detect an event like SGR 1806–20's out to about 100 million light-years, which future observations should enable astronomers to determine what fraction of short GRBs are caused by SGR superflares.

Thanks to the magnetar's great distance, the superflare posed no threat to humanity or Earth's biosphere. The International Space Station was on the opposite side of Earth when the flare hit our planet, but even if the astronauts had faced the full fury of the blast, they would have received a radiation dose less than a dental X-ray. An SGR superflare's pulse of high-energy radiation could seriously damage a planet's atmosphere only if it occurred within about 6 light-years, according to Adrian L. Melott (University of Kansas).



AAVSO solar observer Paul Campbell of Edmonton, Alberta, recorded this sudden disturbance in Earth's upper atmosphere (the ionosphere) at the very moment that the burst of high-energy radiation from SGR 1806–20 hit our planet on December 27, 2004. Campbell's homemade antenna and receiver setup was monitoring the 24.8-kilohertz radio signal from the US Navy's 250-kilowatt transmitter in Jim Creek, Washington, when it recorded a sharp increase in the signal's strength. Courtesy Paul Campbell / AAVSO.

Numerous papers about the event have already appeared on the preprint server Astro-ph. A number of other papers, including theoretical research that might explain the outburst, are currently being peer-reviewed prior to publication in professional journals. Because of embargoes imposed by some of these journals, astronomers have not been allowed to communicate their results to other scientists, which has hindered progress in understanding this event so far. More details about the superflare, including amateur observations of the atmospheric disturbance, will appear in the May *Sky & Telescope*.

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The ratio of dark matter to regular matter is at least 500-to-1, which is higher than I would expect in an ordinary galaxy," Minchin said. "However, it is very hard to know what to expect with such a unique object -- it may be that high ratios like this are necessary to keep the gas from collapsing to form stars."

Other potential dark galaxies have been found previously, but closer observations revealed stars in the mix. Intense visible-light observations reveal no stars in VIRGOHI21. The invisible galaxy is thought to lack stars because its density is not high enough to trigger star birth, the astronomers said.

The discovery was made in 2000 with the University of Manchester's Lovell Telescope, and the astronomers have worked since then to verify the work. It was announced today.

"The universe has all sorts of secrets still to reveal to us, but this shows that we are beginning to understand how to look at it in the right way," said astronomer Jon Davies of Cardiff University in the UK. It's a really exciting discovery."

Additional radio observations were made with the Arecibo Observatory in Puerto Rico. Follow-up optical work was done with the Isaac Newton Telescope in La Palma. Astronomers from the UK, France, Italy and Australia contributed to the research. The project is now searching for other possible dark galaxies.

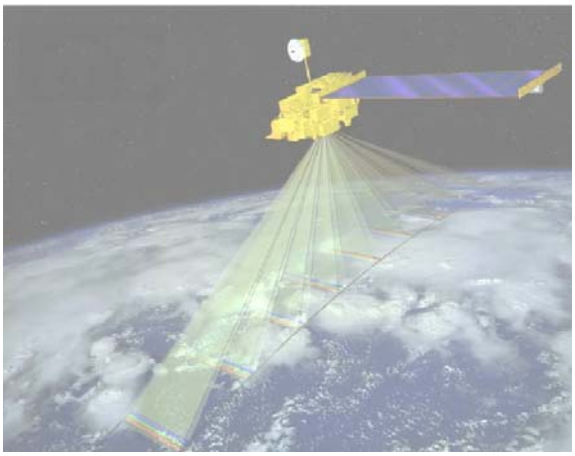
Dark matter makes up about 23 percent of the universe's mass-energy budget. Normal matter, the stuff of stars, planets and people, contributes just 4 percent. The rest of the universe is driven by an even more mysterious thing called dark energy.

NASA's 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



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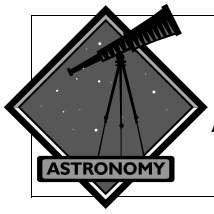

AAL

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