Catskills Astronomy Club News
March, 2008

Catskills Astronomy Club News

3/1/08

Club News:

The image below is an advertisement for our next dinner and a movie night. An observation session will be held after the movie.

See the club website at www.catksillastro.org for reserve seating information. The following program description was taken from http://www.pbs.org/wgbh/nova/listseason/29.html#2901.

In 1967, a United States satellite network intended to monitor Soviet compliance with the Nuclear Test Ban Treaty detected unusual signals coming from outer space. Defying astronomers' expectations, these turned out to be unimaginably violent bursts of gamma-ray radiation located at the far edges of the known universe. The titanic explosions are so far back in time that they conceal clues to the birth of the very first stars and black holes, back when the cosmos had barely begun. "Death Star" is an intimate detective story of the quest by leading astronomers to solve the riddle of the gamma-ray bursts—the most energetic events ever detected and brighter than a billion billion suns.

There is a companion website to the program as well at http://www.pbs.org/wgbh/nova/gamma/.

The observation sessions for February were canceled due to poor weather and snow conditions at Walnut Mountain Park.

The March observation sessions are scheduled for the 1st and the 9th. The March 1st session will be held after the movie night at the Covered Bridge Park in Livingston Manor.

The club has selection of astronomy books and DVDs in our library to lend to members. A Meade eight inch reflector and Edmund three inch reflector are also available 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: 2008-027 Feb. 17, 2008

Many, Perhaps Most, Nearby Sun-Like Stars May Form Rocky Planets

Astronomers have discovered that terrestrial planets might form around many, if not most, of the nearby sun-like stars in our galaxy. These new results suggest that worlds with potential for life might be more common than we thought.

University of Arizona, Tucson, astronomer Michael Meyer and his colleagues used NASA's Spitzer Space Telescope to determine whether planetary systems like ours are common or rare in our Milky Way galaxy. They found that at least 20 percent, and possibly as many as 60 percent, of stars similar to the sun are candidates for forming rocky planets.

Meyer is presenting the findings at the annual meeting of the American Association for the Advancement of Science in Boston. The results appear in the Feb. 1 issue of Astrophysical Journal Letters.

The astronomers used Spitzer to survey six sets of stars, grouped depending on their age, with masses comparable to our sun. The sun is about 4.6 billion years old. "We wanted to study the evolution of the gas and dust around stars similar to the sun and compare the results with what we think the solar system looked like at earlier stages during its evolution," Meyer said.

The Spitzer telescope does not detect planets directly. Instead it detects dust -- the rubble left over from collisions as planets form -- at a range of infrared wavelengths. The hottest dust is detected at the shortest wavelengths, between 3.6 microns and 8 microns. Cool dust is detected at the longest wavelengths, between 70 microns and 160 microns. Warm dust can be traced at 24-micron wavelengths. Because dust closer to the star is hotter than dust farther from the star, the

"warm" dust likely traces material orbiting the star at distances comparable to the distance between Earth and Jupiter.

"We found that about 10 to 20 percent of the stars in each of the four youngest age groups shows 24-micron emission due to dust," Meyer said. "But we don't often see warm dust around stars older than 300 million years. The frequency just drops off.

"That's comparable to the time scales thought to span the formation and dynamical evolution of our own solar system," he added. "Theoretical models and meteoritic data suggest that Earth formed over 10 to 50 million years from collisions between smaller bodies."

In a separate study, Thayne Currie and Scott Kenyon of the Smithsonian Astrophysical Observatory, Cambridge, Mass., and their colleagues also found evidence of dust from terrestrial planet formation around stars from 10 to 30 million years old. "These observations suggest that whatever led to the formation of Earth could be occurring around many stars between three million and 300 million years old," Meyer said.

Kenyon and Ben Bromley of the University of Utah, Salt Lake City, have developed planet formation models that provide a plausible scenario. Their models predict warm dust would be detected at 24-micron wavelengths as small rocky bodies collide and merge. "Our work suggests that the warm dust Meyer and colleagues detect is a natural outcome of rocky planet formation. We predict a higher frequency of dust emission for the younger stars, just as Spitzer observes," said Kenyon.

The numbers on how many stars form planets are ambiguous because there's more than one way to interpret the Spitzer data, Meyer said. The warm-dust emission that Spitzer observed around 20 percent of the youngest cohort of stars could persist as the stars age. That is, the warm dust generated by collisions around stars three to 10 million years old could carry over and show up as warm dust emission seen around stars in the 10- to 30- million-year-old range and so on. Interpreting the data this way, about one out of five sun-like stars is potentially planet-forming, Meyer said.

There's another way to interpret the data. "An optimistic scenario would suggest that the biggest, most massive disks would undergo the runaway collision process first and assemble their planets quickly. That's what we could be seeing in the youngest stars. Their disks live hard and die young, shining brightly early on, then fading," Meyer said.

"However, smaller, less massive disks will light up later. Planet formation in this case is delayed because there are fewer particles to collide with each other."

If this is correct and the most massive disks form their planets first and the wimpiest disks take 10 to 100 times longer, then up to 62 percent of the surveyed stars have formed, or may be forming, planets. "The correct answer probably lies somewhere between the pessimistic case of less

than 20 percent and optimistic case of more than 60 percent," Meyer said.

The next critical test of the assertion that terrestrial planets like Earth could be common around stars like the sun will come next year with the launch of NASA's Kepler mission.

Meyer's 13 co-authors include John Carpenter of the California Institute of Technology in Pasadena. NASA's Jet Propulsion Laboratory in Pasadena manages the Spitzer Space Telescope mission for NASA's Science Mission Directorate, Washington. Science operations are conducted at the Spitzer Science Center at Caltech. Caltech manages JPL for NASA. More information about Spitzer is at http://www.spitzer.caltech.edu/spitzer and http://www.nasa.gov/spitzer .

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NEWS RELEASE: 2008-024 Feb. 12, 2008

Astronomers Eye Ultra-Young, Bright Galaxy in Early Universe

NASA's Hubble and Spitzer space telescopes, with a boost from a natural "zoom lens," have uncovered what may be one of the youngest and brightest galaxies ever seen in the middle of the cosmic "dark ages," just 700 million years after the beginning of our universe.

The detailed images from Hubble's Near Infrared Camera and Multi-Object Spectrometer reveal an infant galaxy, dubbed A1689-zD1, undergoing a firestorm of star birth during the dark ages, a time shortly after the Big Bang but before the first stars reheated the cold, dark universe. Images from NASA's Spitzer Space Telescope's Infrared Array Camera provided strong additional evidence that it was a young star-forming galaxy in the dark ages.

"We certainly were surprised to find such a bright young galaxy 12.8 billion years in the past," said astronomer Garth Illingworth of the University of California, Santa Cruz, and a member of the research team. "This is the most detailed look to date at an object so far back in time."

"The Hubble images yield insight into the galaxy's structure that we cannot get with any other telescope," added astronomer Rychard Bouwens of UC Santa Cruz, a co-discoverer.

The new images should offer insights into the formative years of galaxy birth and evolution and yield information on the types of objects that may have contributed to ending the dark ages. The faraway galaxy also is an ideal target for Hubble's successor, the James Webb Space Telescope, scheduled to launch in 2013.

During its lifetime, the Hubble telescope has peered ever farther back in time, viewing galaxies at successively younger stages of evolution. These snapshots have helped astronomers create a scrapbook of galaxies from infancy to adulthood. The new Hubble and Spitzer images of A1689-zD1 show a time when galaxies were in their infancy.

Current theory holds that the dark ages began about 400,000 years after the Big Bang, as matter in the expanding universe cooled and formed clouds of cold hydrogen. These cold clouds pervaded the universe like a thick fog. At some point during this era, stars and galaxies started to form. Their collective light reheated the foggy, cold hydrogen, ending the dark ages about a billion years after the Big Bang.

"This galaxy presumably is one of the many galaxies that helped end the dark ages," said astronomer Larry Bradley of Johns Hopkins University in Baltimore, Md., and leader of the study. "Astronomers are fairly certain that high-energy objects such as quasars did not provide enough energy to end the dark ages of the universe. But many young star-forming galaxies may have produced enough energy to end it."

The galaxy is so far away it did not appear in images taken with Hubble's Advanced Camera for Surveys, because its light is stretched to invisible infrared wavelengths by the universe's expansion. It took Hubble's near infrared camera/spectrometer, Spitzer, and a trick of nature called gravitational lensing to see the faraway galaxy. The astronomers used a relatively nearby massive cluster of galaxies known as Abell 1689, roughly 2.2 billion light-years away, to magnify the light from the more distant galaxy directly behind it. This natural telescope is called a gravitational lens.

Though the diffuse light of the faraway object is nearly impossible to see, gravitational lensing has increased its brightness by nearly 10 times, making it bright enough for Hubble and Spitzer to detect. A telltale sign of the lensing is the smearing of the images of galaxies behind Abell 1689 into arcs by the gravitational warping of space by the intervening galaxy cluster.

The images reveal bright, dense clumps of hundreds of millions of massive stars in a compact region about 2,000 light-years across, which is only a fraction of the width of our Milky Way Galaxy. This type of galaxy is not uncommon in the early universe, when the bulk of star formation was taking place, Bradley and Illingworth said.

Spitzer's images show the galaxy's mass is typical of galaxies in the early universe. Its mass is equivalent to several billions of sunlike stars, or just a tiny fraction of the mass of the Milky Way. "This observation confirms previous Hubble studies that star birth happens in very tiny regions compared with the size of the final galaxy," Illingworth said.

Even with the increased magnification from the gravitational lens, Hubble's sharp "eye" can only see knots of the brightest, heftiest stars in the galaxy. The telescope cannot pinpoint fainter, lower-mass stars, individual stars, or the material surrounding the star-birthing region. To see those things, astronomers will need the infrared capabilities of the Webb Telescope. The planned infrared observatory will have a mirror about seven times the area of Hubble's primary mirror and will collect more light from faint galaxies. It also will be able to view even more remote galaxies whose light has been stretched deep into infrared wavelengths that are out of the reach of Hubble.

Team member Holland Ford of Johns Hopkins University said this galaxy will be one of the first objects the Webb Telescope will observe, saying, "This object is a pathfinder for the James Webb Space Telescope for deciphering what is happening in young galaxies." The astronomers noted that the faraway galaxy also would be an ideal target for the

Atacama Large Millimeter Array, which, when completed in 2012, will be the world's most powerful radio telescope.

The results will appear in the Astrophysical Journal, with followup observations planned with Hawaii's Keck telescope. Images and additional information are at http://spitzer.caltech.edu/media/mediaimages/index.shtml and http://hubblesite.org/news/2008/08 . More information about Spitzer is at http://www.nasa.gov/spitzer and http://www.spitzer.caltech.edu/spitzer .

The Space Telescope Science Institute conducts science operations for Hubble, a project of international cooperation between NASA and the European Space Agency. The institute is operated for NASA by the Association of Universities for Research in Astronomy, Inc., Washington. The Jet Propulsion Laboratory, Pasadena, Calif., manages Spitzer for NASA's Science Mission Directorate. Science operations are conducted at the Spitzer Science Center at the California Institute of Technology, which manages JPL for NASA. More contacts: Larry Bradley-Johns Hopkins University, Baltimore, 410-516-5108/Garth Ilingworth-UC Observatories/UC Santa Cruz , 831-459-2843

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NEWS RELEASE: 2008-025 Feb. 13, 2008

Titan's Surface Organics Surpass Oil Reserves on Earth

Saturn's orange moon Titan has hundreds of times more liquid hydrocarbons than all the known oil and natural gas reserves on Earth, according to new data from NASA's Cassini spacecraft. The hydrocarbons rain from the sky, collecting in vast deposits that form lakes and dunes.

The new findings from the study led by Ralph Lorenz, Cassini radar team member from the Johns Hopkins University Applied Physics Laboratory, Laurel, Md., are reported in the Jan. 29 issue of the Geophysical Research Letters.

"Titan is just covered in carbon-bearing material—it's a giant factory of organic chemicals," said Lorenz. "This vast carbon inventory is an important window into the geology and climate history of Titan."

At a balmy minus 179 degrees Celsius (minus 290 degrees Fahrenheit), Titan is a far cry from Earth. Instead of water, liquid hydrocarbons in the form of methane and ethane are present on the

moon's surface, and tholins probably make up its dunes. The term "tholins"was coined by Carl Sagan in 1979 to describe the complex organic molecules at the heart of prebiotic chemistry.

Cassini has mapped about 20 percent of Titan's surface with radar. Several hundred lakes and seas have been observed, with each of several dozen estimated to contain more hydrocarbon liquid than Earth's oil and gas reserves. The dark dunes that run along the equator contain a volume of organics several hundred times larger than Earth's coal reserves.

Proven reserves of natural gas on Earth total 130 billion tons, enough to provide 300 times the amount of energy the entire United States uses annually for residential heating, cooling and lighting. Dozens of Titan's lakes individually have the equivalent of at least this much energy in the form of methane and ethane.

"This global estimate is based mostly on views of the lakes in the northern polar regions. We have assumed the south might be similar, but we really don't yet know how much liquid is there," said Lorenz. Cassini's radar has observed the south polar region only once, and only two small lakes were visible. Future observations of that area are planned during Cassini's proposed extended mission.

Scientists estimated Titan's lake depth by making some general assumptions based on lakes on Earth. They took the average area and depth of lakes on Earth, taking into account the nearby surroundings, like mountains. On Earth, the lake depth is often 10 times less than the height of nearby terrain.

"We also know that some lakes are more than 10 meters or so deep because they appear literally pitch-black to the radar. If they were shallow we'd see the bottom, and we don't," said Lorenz.

The question of how much liquid is on the surface is an important one because methane is a strong greenhouse gas on Titan as well as on Earth, but there is much more of it on Titan. If all the observed liquid on Titan is methane, it would only last a few million years, because as methane escapes into Titan's atmosphere, it breaks down and escapes into space. If the methane were to run out, Titan could become much colder. Scientists believe that methane might be supplied to the atmosphere by venting from the interior in cryovolcanic eruptions. If so, the amount of methane, and the temperature on Titan, may have fluctuated dramatically in Titan's past.

"We are carbon-based life, and understanding how far along the chain of complexity towards life that chemistry can go in an environment like Titan will be important in understanding the origins of life throughout the universe," added Lorenz.

Cassini's next radar flyby of Titan is on Feb. 22, when the radar instrument will observe the Huygens probe landing site.

For images and more information visit: http://www.nasa.gov/cassini and http://saturn.jpl.nasa.gov .

The Cassini-Huygens mission is a cooperative project of NASA, the European Space Agency and the Italian Space Agency. JPL, a division of the California Institute of Technology in Pasadena, manages the Cassini-Huygens mission for NASA's Science Mission Directorate, Washington. The Cassini orbiter was designed, developed and assembled at JPL. The radar instrument was built by JPL and the Italian Space Agency, working with team members from the United States and several European countries.

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NEWS RELEASE: 2008-031 Feb. 22, 2008

International Solar Mission to End Following Stellar Performance

WASHINGTON - The joint NASA and European Space Agency Ulysses mission to study the sun and its influence on surrounding space is likely to cease operations in the next few months. The venerable spacecraft, which has lasted more than 17 years or almost four times its expected mission lifetime, is succumbing to the harsh environment of space.

Ulysses was the first mission to survey the space environment above and below the poles of the sun. The reams of data Ulysses returned have forever changed the way scientists view our star and its effects.

"I remember when we got those first pictures of Ulysses floating out of the space shuttle Discovery's payload bay back in October of 1990 and thinking we had a great five years ahead of us," said Ed Massey, Ulysses project manager at NASA's Jet Propulsion Laboratory, Pasadena, Calif. "I never dared think that we would be receiving invaluable science data on a near continuous basis for more than 17 years. Ulysses has set the bar on solar science data collection quite high."

Science findings and discoveries from the mission were numerous and unprecedented. Examples include taking the first direct measurements of interstellar dust particles and interstellar helium atoms in the solar system and the discovery that the magnetic field leaving the sun is balanced across latitudes.

"The data and science output of this mission truly deserves to be named after the legendary explorer in Greek mythology," said Arik Posner, Ulysses program scientist, NASA Headquarters, Washington. "My compliments go out to the international team of scientists and engineers who built a spaceship and instrument payload that is highly sensitive, yet durable enough that it withstood the most extreme conditions in the solar system, including a polar passage of the giant planet Jupiter."

Since its Jupiter flyby in 1992, Ulysses has been in a six-year orbit around the sun. Its long path through space carries it out to Jupiter's orbit and back. The farther it ventures from the sun, the colder the spacecraft becomes. If it drops to 2 degrees Celsius (36 degrees Fahrenheit), the spacecraft's hydrazine fuel will freeze. This has not been a problem in the past because Ulysses carries heaters to maintain a workable onboard temperature.

The spacecraft is powered by the decay of a radioactive isotope. Over its 17-plus years, the power has been steadily dropping. The spacecraft no longer can run all of its communications, heating and scientific equipment simultaneously. "We expect certain parts of the spacecraft to reach 2 degrees Celsius pretty soon," said Richard Marsden, ESA project scientist and mission

manager. This temperature drop will block the fuel pipes, making the spacecraft impossible to maneuver.

The NASA/ESA project team approved a plan to temporarily shut off the main spacecraft's X-band transmitter. This would release 60 watts of power, which could be channeled to the science instruments and the heater. The team planned to turn the transmitter back on when data was to be transmitted back to Earth. This would have made it possible to run Ulysses for up to another two years.

Unfortunately, during the first test of this approach in January, the power supply to the radio transmitter failed to turn back on. Engineers believe the fault can be traced to the transmitter's power supply, meaning that the extra energy they hoped to gain cannot be routed to the heater and science instruments. "The decision to switch the transmitter off was not taken lightly. It was the only way to continue the science mission," Marsden said.

After many attempts, the Ulysses project team now considers it highly unlikely that the X-band transmitter will be recovered. As a result, the spacecraft has lost its ability to send large quantities of scientific data back to Earth and is facing the gradual freezing of its fuel lines. The team plans to continue operating the spacecraft in its reduced capacity, using the alternate S-band transmitter, for as long as they can over the next few weeks.

"We will squeeze the very last drops of science out of it that we can," Marsden said. "Ulysses is a terrific old workhorse. It has produced great science and lasted much longer than we ever thought it would."

The Ulysses spacecraft was built by Dornier Systems of Germany for ESA. NASA provided the launch and the upper stage boosters. The U.S. Department of Energy, Washington, supplied the generator that powers the spacecraft; science instruments were provided by both U.S. and European investigators. The spacecraft is operated from JPL by a joint NASA/ESA team and has employed NASA's Deep Space Network for communications.

More information about NASA's Ulysses mission is available on the Web at:

http://ulysses.jpl.nasa.gov

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NEWS RELEASE: 2008-028 Feb. 19, 2008

Cassini Finds Mingling Moons May Share a Dark Past

Despite the incredible diversity of Saturn's icy moons, theirs is a story of great interaction. Some of them are pock-marked, some seemingly dirty, others pristine, one spongy, one two-faced, some still spewing with activity and some seeming to be captured from the far reaches of the solar system. Yet many of them have a common thread -- black "stuff" coating their surfaces.

"We are beginning to unravel the mysteries of these different and strange moons," said Rosaly Lopes, Cassini scientist at NASA's Jet Propulsion Laboratory, Pasadena, Calif. She coordinated a special section of 14 papers about Saturn's icy moons that appears in the February issue of the journal Icarus.

Taken together, the papers bring an idea that Cassini scientist Bonnie Buratti calls "the ecology of the Saturn system" to the forefront. "Ecology is about your entire environment -- not just one

body, but how they all interact," said Buratti. "The Saturn system is really interesting, and if you look at the surfaces of the moons, they seem to be altered in ways that aren't intrinsic to them. There seems to be some transport in this system."

Though the details of that transport are not yet clear, mounting evidence suggests that some mechanism has spread the mysterious dark material found on several of the moons from one to another; the material may even have a common cometary origin. Along those lines, several of the new papers focus on similarities between the dark material found on different moons -- on Hyperion and Iapetus, for example, or between Phoebe and Iapetus.

Roger Clark of the U.S. Geological Survey in Denver goes further, saying, "We see the same spectral signature on all the moons that have coatings of dark material." Clark is lead author of one of the new papers, which focuses on Saturn's moon Dione. His team found the dark material there to be extremely fine-grained, making up only a very thin layer on the moon's trailing side. Its distribution and composition, as measured by the Cassini visual and infrared mapping spectrometer, indicate that the dark material is not native to Dione. And scientists see many of the same signatures there that appear on the moons Phoebe, Iapetus, Hyperion and Epimetheus, and also in Saturn's F-ring.

As for where this material comes from and what the dark material is, Clark said, "It's a mystery, which makes it intriguing. We're still trying to find the exact match." The visual and infrared spectrometer detected unique absorption bands in the dark material within the Saturn system, which scientists have not seen anywhere else in the solar system. "The data keep getting better and better," he said. "We're ruling things out and figuring out pieces." So far, the team has identified bound water and, possibly, ammonia in the dark material.

Ongoing geologic activity is another component of Saturn's ecology as some of the moons continue to feed the planet's rings, which in turn affect many of the moons.

Clark's team reports tentative evidence to support the hypothesis presented earlier this year that Dione is still geologically active. In one series of observations, the infrared spectrometer detected a cloud of methane and water ice encircling Dione in its orbit within the outer portions of Saturn's E-ring.

Of course the big story is the icy plumes spewing from the warm, south polar region of Enceladus. These plumes are believed to be feeding the E-ring. A paper led by Frank Postberg of the Max Planck Institute for Nuclear Physics in Heidelberg, Germany, says there are traces of organic compounds or silicate materials within the water ice-dominated E-ring, close to Enceladus. This implies that the moon's rocky core and liquid water are dynamically interacting. The finding could bolster a theory that Dennis Matson and Julie Castillo of JPL put forth this year, which said that a warm, organic brew might lie just below Enceladus' surface.

Cassini's next close study of an icy moon is the highly-anticipated flyby of Enceladus scheduled for March 12. During that flyby, Cassini will pass by the active moon at a distance of only 50 kilometers (30 miles) at its point of closest approach, and at a distance of around 200 kilometers (120 miles) when it passes through the plumes.

The Cassini-Huygens mission is a cooperative project of NASA, the European Space Agency and the Italian Space Agency. JPL, a division of the California Institute of Technology in Pasa-

dena, manages the Cassini-Huygens mission for NASA's Science Mission Directorate, Washington. The Cassini orbiter was designed, developed and assembled at JPL.

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Scientists Study "Plumbing" in Plumes of Enceladus

Scientists on the Cassini mission have become out-of-this world "plumbers" as they try to piece together what's happening inside the "pipes" feeding the plumes of Saturn's moon Enceladus.

Enceladus is jetting out giant geysers three times the size of the moon, and now scientists are beginning to understand how the ice grains are created and how they might have formed. Knowing the process of how the plume forms and the path the water-ice particles have to travel is giving them an insight into what may be a liquid reservoir or lake lying just beneath the surface.

"Since Cassini discovered the water vapor geysers, we've all wondered where this water vapor and ice are coming from. Is it from an underground water reservoir or are there some other processes at work? Now, after looking at data from multiple instruments, we can say there probably is water beneath the surface of Enceladus," said Juergen Schmidt, team member on Cassini's Cosmic Dust Analyzer at the University of Potsdam, Germany. This study appears in the Feb. 7, 2008, issue of the journal Nature.

The large number of ice particles observed spewing from the geysers and the steady rate at which these particles are produced require high temperatures, close to the melting point of ice, possibly resulting in an internal lake. The lake would be similar to Earth’s Lake Vostok, beneath Antarctica, where liquid water exists locked in ice. The ice grains then condense in the vapor evaporating from the water, streaming through cracks in the ice crust to the surface.

The presence of liquid water inside Enceladus would have major implications for future astrobiology studies on the possibility of life on bodies in the outer solar system.

Scientists have studied the plume dynamics since 2005, collecting data from several Cassini remote sensing instruments and those that sample particles directly, like the Cosmic Dust Analyzer. They conclude that an internal lake at a temperature of about 273 Kelvin (32 degrees Fahrenheit) is the best way to account for the material jetting out of the geysers.

At these warm temperatures, liquid water, ice and water vapor mingle. The vapor escapes to the vacuum of space through cracks in Enceladus’ ice crust. When the gas expands, it cools and the ice grains that make up the visible part of the plumes condense from the vapor. Vapor in the plumes is clocked at roughly the same speed as a supersonic jet, about 300 to 500 meters per

second, or about 650 to 1,100 miles per hour. However, most of the condensed ice particles fail to reach Enceladus' escape velocity of 240 meters per second (536 miles per hour).

Pinball-like physics account for the slow speed of the particles. Shooting up through crooked cracks in the ice, the particles ricochet off the walls, losing speed, while the water vapor moves unimpeded up the crevasse. The vapor reboosts the frozen particles as they pinball off the walls, carrying them upward. Reaching nozzle-like openings at the surface, the faster-moving water vapor shoots high above Enceladus, becoming entrapped in Saturn's magnetosphere. Most of the particles, which have lost energy through collisions in transit, fail to achieve escape velocity and fall back to Enceladus' surface. Only about 10 percent escape Enceladus and form Saturn's E-ring.

"Our model provides a simple concept to understand how particles form, their speed and how they behave as they make their way out into space. If vapor temperature is too low, then the gas density is too small to push the grains out and we would not see such large amounts of particles," said Schmidt. "Therefore, we believe that at the site of evaporation, we must have temperatures near the melting point of water."

Scientists say that particles seen in the plumes are too numerous to have started from processes described in one existing model that requires low temperatures, proposing that gases may be trapped inside ice crystals. Another model suggests that water ice, suddenly exposed to the vacuum of space, sublimes, or boils, directly into vapor without liquefying first. But this would mean there are short bursts of activity, rather than the steady production of particles. The new model of grains condensing in a vent that evaporates from a liquid body is consistent with a steady production of particles, ejected from a localized source.

This research provides fundamental knowledge about solar system bodies, in particular those that, like our home planet, are homes to oceans – environments where life might evolve.

The next Enceladus flyby is in March 2008. The spacecraft closest approach will be at a mere 50 kilometers (30 miles) from the surface and the altitude will increase to about 200 kilometers (124 miles) as the spacecraft passes through the plumes. Cassini will sample the plumes directly and find out more about their makeup.

More information on the Cassini-Huygens mission is available at: http://saturn.jpl.nasa.gov and http://www.nasa.gov/cassini .

The Cassini-Huygens mission is a cooperative project of NASA, the European Space Agency and the Italian Space Agency. JPL, a division of the California Institute of Technology in Pasadena, manages the Cassini mission for NASA's Science Mission Directorate, Washington, D.C. JPL designed, developed and assembled the Cassini orbiter.

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NEWS RELEASE: 2008-026 Feb. 15, 2008

Mars Rovers Sharpen Questions About Livable Conditions

BOSTON -- Like salt used as a preservative, high concentrations of dissolved minerals in the wet, early-Mars environment known from discoveries by NASA's Opportunity rover may have thwarted any microbes from developing or surviving.

"Not all water is fit to drink," said Andrew Knoll, a member of the rover science team who is a biologist at Harvard University, Cambridge, Mass.

Opportunity and its twin, Spirit, began their fifth year on Mars last month, far surpassing their prime missions of three months. Today, at a meeting of the American Association for the Advancement of Science in Boston, scientists and engineers discussed new observations by the rovers, recent analysis of some earlier discoveries, and perspectives on which lessons from these rovers' successes apply to upcoming missions to Mars.

"The engineering efforts that have enabled the rovers' longevity have tremendously magnified the science return," said Steve Squyres of Cornell University, Ithaca, N.Y., principal investigator for the rovers' science payload. "All of Spirit's most important findings, such as evidence for hot springs or steam vents, came after the prime mission."

Opportunity spent recent months examining a bright band of rocks around the inner wall of a crater. Scientists previously hypothesized this material might preserve a record of the ground surface from just before the impact that excavated the crater. Inspection suggests that, instead, it was at the top of an underground water table, Squyres reported.

Experiments with simulated Martian conditions and computer modeling are helping researchers refine earlier assessments of whether the long-ago conditions in the Meridiani area studied by Opportunity would have been hospitable to microbes. Chances look slimmer. "At first, we focused on acidity, because the environment would have been very acidic," Knoll said. "Now, we also appreciate the high salinity of the water when it left behind the minerals Opportunity found. This tightens the noose on the possibility of life."

Conditions may have been more hospitable earlier, with water less briny, but later conditions at Meridiani and elsewhere on the surface of Mars appear to have been less hospitable, Knoll said. "Life at the Martian surface would have been very challenging for the last 4 billion years. The best hopes for a story of life on Mars are at environments we haven't studied yet -- older ones, subsurface ones," he said.

NASA's current rovers and orbiters at Mars pursue the agency's "follow the water" theme for

Mars exploration. They decipher the roles and fate of water on a planet whose most striking difference from Earth is a scarcity of water. "Our next missions, Phoenix and Mars Science Laboratory, mark a transition from water to habitability -- assessing whether sites where there's been water have had conditions suited to life," said Charles Elachi, director of NASA's Jet Propulsion Laboratory, Pasadena, Calif. "Where conditions were habitable, later missions may look for evidence of life."

Elachi cited the achievements of Spirit and Opportunity. "They have worked 16 times longer than planned, driven 20 times farther than planned, and, most important, found diverse geological records of the effects of water in ancient Martian environments," he said. "We must not let these successes lull us into thinking this type of exploration is easy. Fifty years into the Space Age, we are still in the golden age of robotic exploration of our solar system, when each mission is unprecedented in some way as we push the limits of what is possible. Each mission presents new challenges."

The Phoenix lander, on course to reach Mars on May 25, will assess habitability of a shallow subsurface environment of icy soil farther north than any earlier mission has landed. It revives technology from missions launched before Spirit and Opportunity. The following mission, the Mars Science Laboratory rover, will incorporate many lessons from the current rovers, said that project's manager, Richard Cook of JPL. "The next rover will be much bigger to carry the instruments necessary for meeting its goals, but it would be laughable to consider doing Mars Science Laboratory without the experience gained from doing the Mars Exploration Rovers," he said.

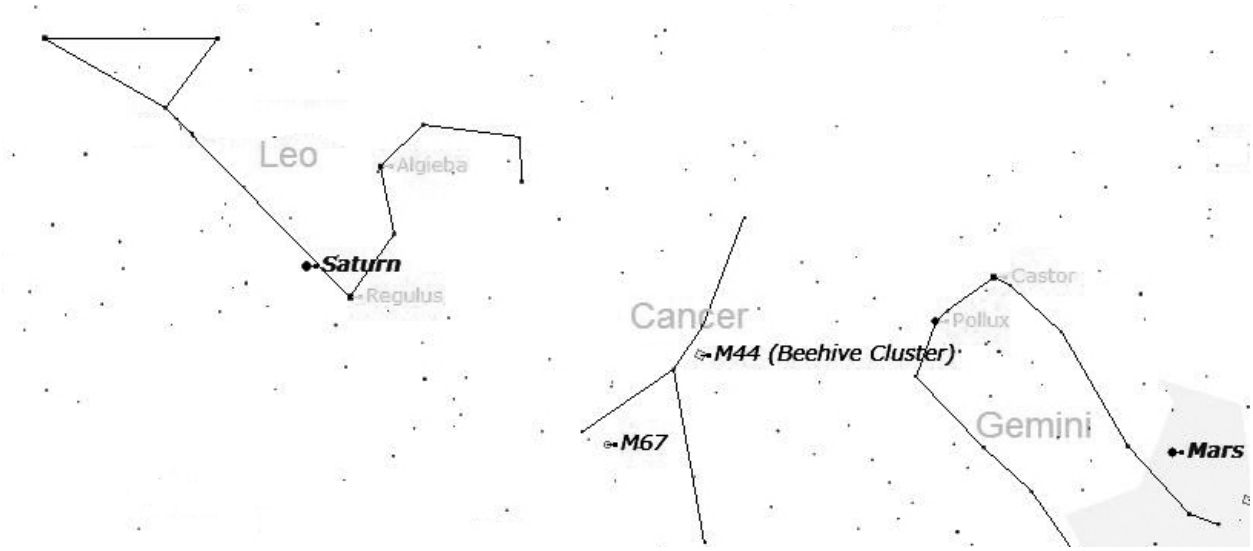
The Mars Science Laboratory rover will weigh about four times as much as Spirit or Opportunity. "There's no way we could use an airbag landing," said JPL's Rob Manning, chief engineer for the future rover. Instead, a rocket-powered hovering stage will lower it to the surface on a tether. Lessons from Spirit and Opportunity will come into play when it starts driving, though. "With the current rovers, we've learned we can trust the autonomous navigation technology to a level we never expected, so now we can include that as a capability in our mission design for Mars Science Laboratory," Manning said.

JPL, a division of the California Institute of Technology, Pasadena, built and manages the rovers for NASA's Science Mission Directorate. For images and information about Spirit and Opportunity, visit **http://www.nasa.gov/rovers** and **http://marsrovers.jpl.nasa.gov** .

end

Mid Evening Observing Highlights for March

Saturn can be found in the eastern sky next to the bright star Regulus in Leo. Mars is in Gemini and is still bright in the western sky. There are many open clusters that can be viewed in the southern sky east of Canis Major. Some are M46, M47, M48, and M50. The open cluster M41 can be found within Canis Major just below the bright star Sirius. Virgo is 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. Orion is in the southwestern sky. Taurus and the Pleiades are in the western sky. The open cluster M44 can be found in the constellation Cancer which lies between Leo and Gemini. The image below shows its location as well as Saturn and Mars. The smaller open cluster M67 is also shown. Full moon is on March 21st and new moon is on March 7th. The Spring Equinox begins on March 20th at 1:48 AM EDT.



Member Photos:

The image below shows a partial phase of the lunar eclipse that occurred on February 20th. It was taken afocally by John Kocijanski with an Olympus D-550 digital camera through a 32mm plossl eyepiece using an Orion XT4.5 dobsonian reflector telescope.

NASA Space Place

Invisible Spiral Arms

by Patrick Barry

At one time or another, we've all stared at beautiful images of spiral galaxies, daydreaming about the billions of stars and countless worlds they contain. What mysteries—and even life forms—must lurk within those vast disks?

Now consider this: many of the galaxies you've seen are actually much larger than they appear. NASA's Galaxy Evolution Explorer, a space telescope that "sees" invisible, ultraviolet light, has revealed that roughly 20 percent of nearby galaxies have spiral arms that extend far beyond the galaxies' apparent edges. Some of these galaxies are more than three times larger than they appear in images taken by ordinary visible-light telescopes.

"Astronomers have been observing some of these galaxies for many, many years, and all that time, there was a whole side to these galaxies that they simply couldn't see," says Patrick Morrissey, an astronomer at Caltech in Pasadena, California, who collaborates at JPL.

The extended arms of these galaxies are too dim in visible light for most telescopes to detect, but they emit a greater amount of UV light. Also, the cosmic background is much darker at UV wavelengths than it is for visible light. "Because the sky is essentially black in the UV, far-UV enables you to see these very faint arms around the outsides of galaxies," Morrissey explains.

These "invisible arms" are made of mostly young stars shining brightly at UV wavelengths. Why UV? Because the stars are so hot. Young stars burn their nuclear fuel with impetuous speed, making them hotter and bluer than older, cooler stars such as the sun. (Think of a candle: blue flames are hotter than red ones.) Ultraviolet is a sort of "ultra-blue" that reveals the youngest, hottest stars of all.

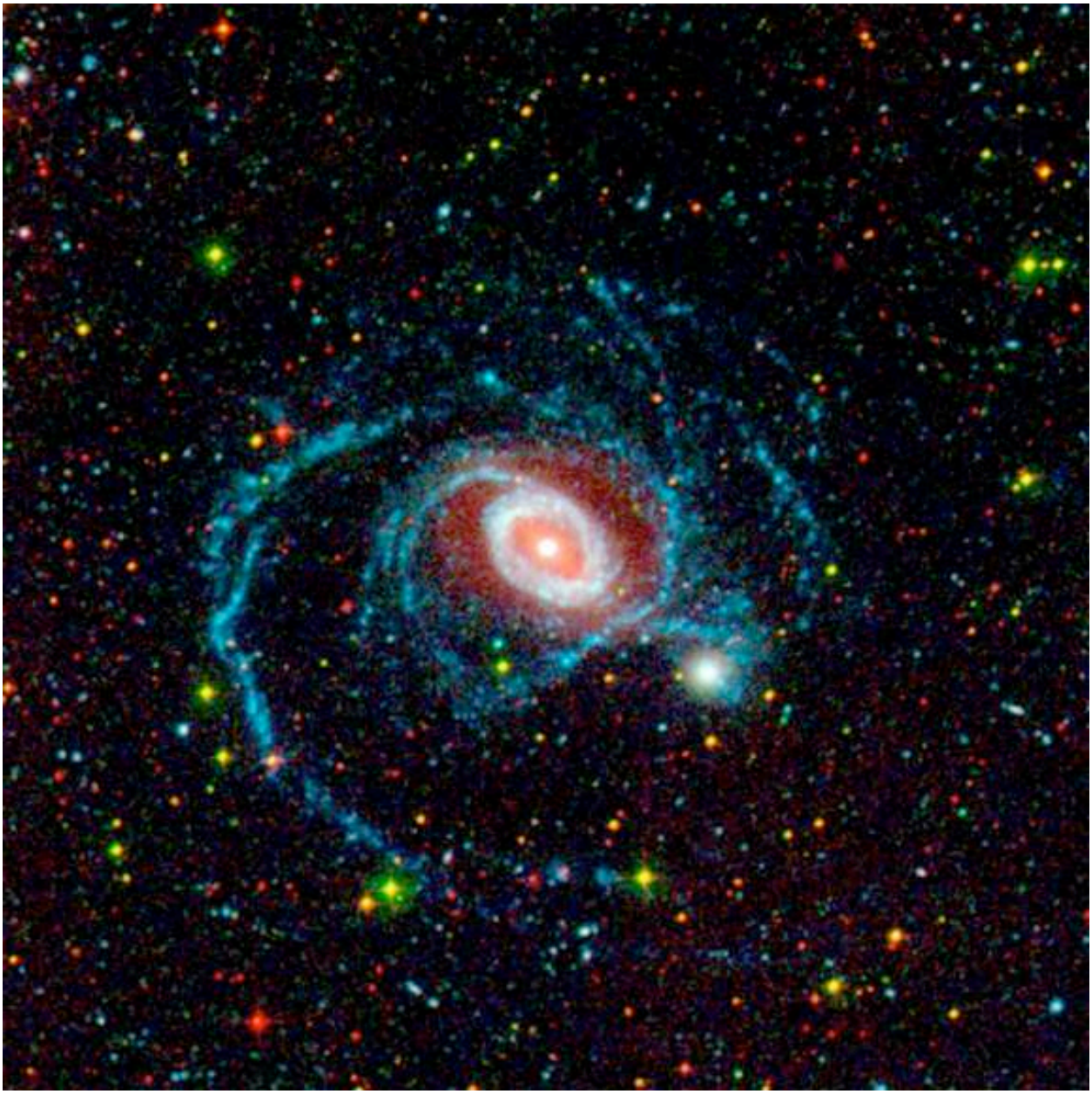
"That's the basic idea behind the Galaxy Evolution Explorer in the first place. By observing the UV glow of young stars, we can see where star formation is active," Morrissey says.

The discovery of these extended arms provides fresh clues for scientists about how some galaxies form and evolve, a hot question right now in astronomy. For example, a burst of star formation so far from the galaxies' denser centers may have started because of the gravity of neighboring galaxies that passed too close. But in many cases, the neighboring galaxies have not themselves sprouted extended arms, an observation that remains to be explained. The Galaxy Evolution Explorer reveals one mystery after another!

"How much else is out there that we don't know about?" Morrissey asks. "It makes you wonder."

Spread the wonder by seeing for yourself some of these UV images at www.galex.caltech.edu. Also, Chris Martin, principle scientist for Galaxy Evolution Explorer —or rather his cartoon alter-ego—gives kids a great introduction to ultraviolet astronomy at spaceplace.nasa.gov/en/kids/live#martin.

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



Caption (color image):
In this image of galaxy NGC 1512, red represents its visible light appearance, the glow coming from older stars, while the bluish-white ring and the long, blue spiral arms show the galaxy as the Galaxy Evolution Explorer sees it in ultraviolet, tracing primarily younger stars. (Credit: NASA/JPL-Caltech/DSS/GALEX).