Catskills Astronomy Club News
July 2008

Catskills Astronomy Club

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7/1/08

Club News:

The observation sessions scheduled for June 7th and 28th were canceled due to poor weather forecasts.

July observation sessions are scheduled for the 5th and 26th. Midweek makeup sessions may be held if there is interest.

Discussions are currently underway for another dinner and a movie meeting at Morgan Outdoors.

Anyone interested in submitting an astronomical observation or photograph for the newsletter, please contact John at kocis@verizon.net.

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: 2008-094 June 3, 2008

Two of the Milky Way's Spiral Arms Go Missing

St. Louis, Mo. -- For decades, astronomers have been blind to what our galaxy, the Milky Way, really looks like. After all, we sit in the midst of it and can't step outside for a bird's eye view.

Now, new images from NASA's Spitzer Space Telescope are shedding light on the true structure of the Milky Way, revealing that it has just two major arms of stars instead of the four it was previously thought to possess.

"Spitzer has provided us with a starting point for rethinking the structure of the Milky Way," said Robert Benjamin of the University of Wisconsin, Whitewater, who presented the new results at a press conference today at the 212th meeting of the American Astronomical Society in St. Louis, Mo. "We will keep revising our picture in the same way that early explorers sailing around the globe had to keep revising their maps."

An artist's concept of the structure of our two-armed Milky Way is online at **http://www.nasa.gov/mission_pages/spitzer/multimedia/20080603a.html** .

Since the 1950s, astronomers have produced maps of the Milky Way. The early models were based on radio observations of gas in the galaxy, and suggested a spiral structure with four major star-forming arms, called Norma, Scutum-Centaurus, Sagittarius and Perseus. In addition to arms, there are bands of gas and dust in the central part of the galaxy. Our sun lies near a small, partial arm called the Orion Arm, or Orion Spur, located between the Sagittarius and Perseus arms.

"For years, people created maps of the whole galaxy based on studying just one section of it, or using only one method," said Benjamin. "Unfortunately, when the models from various groups were compared, they didn't always agree. It's a bit like studying an elephant blind-folded."

Large infrared sky surveys in the 1990s led to some major revisions of these models, including the discovery of a large bar of stars in the middle of the Milky Way. Infrared light can penetrate through dust, so telescopes designed to pick up infrared light get better views of our dusty and crowded galactic center. In 2005, Benjamin and his colleagues used Spitzer's infrared detectors to obtain detailed information about our galaxy's bar, and found that it extends farther out from the center of the galaxy than previously thought.

The team of scientists now has new infrared imagery from Spitzer of an expansive swath of the Milky Way, stretching 130 degrees across the sky and one degree above and below the galaxy's mid-plane. This extensive mosaic combines 800,000 snapshots and includes over 110 million stars.

Benjamin developed software that counts the stars, measuring stellar densities. When he and his teammates counted stars in the direction of the Scutum-Centaurus Arm, they noticed an increase in their numbers, as would be expected for a spiral arm. But, when they looked in the direction where they expected to see the Sagittarius and Norma arms, there was no jump in the number of stars. The fourth arm, Perseus, wraps around the outer portion of our galaxy and cannot be seen in the new Spitzer images.

The findings make the case that the Milky Way has two major spiral arms, a common structure for galaxies with bars. These major arms, the Scutum-Centaurus and Perseus arms, have the greatest densities of both young, bright stars, and older, so-called red-giant stars. The two minor

arms, Sagittarius and Norma, are filled with gas and pockets of young stars. Benjamin said the two major arms seem to connect up nicely with the near and far ends of the galaxy's central bar.

"Now, we can fit the arms together with the bar, like pieces of a puzzle," said Benjamin, "and, we can map the structure, position and width of these arms for the first time." Previous infrared observations found hints of a two-armed Milky Way, but those results were unclear because the position and width of the arms were unknown.

Though galaxy arms appear to be intact features, stars are actually constantly moving in and out of them as they orbit the center of the Milky Way, like London commuters in a busy traffic circle. Our own sun might have once resided in a different arm. Since it was formed more than 4 billion years ago, it has traveled around the galaxy 16 times.

Co-investigators of this research include Ed Churchwell, Marilyn Meade and Brian Babler of the University of Wisconsin, Madison; Barbara Whitney of the Space Science Institute, Madison, Wis.; Rémy Indebetouw of the University of Virginia, Charlottesville; and Christer Watson of Manchester College, Ind. NASA's Jet Propulsion Laboratory, Pasadena, Calif., manages the Spitzer mission for NASA's Science Mission Directorate, Washington. Science operations occur at the Spitzer Science Center at the California Institute of Technology, also in Pasadena. For more information about Spitzer, visit **http://www.spitzer.caltech.edu/spitzer** and **http://www.nasa.gov/spitzer** .

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IMAGE ADVISORY: 2008-095 June 3, 2008

Spitzer Captures Stellar Coming of Age in Our Galaxy

More than 800,000 snapshots from NASA's Spitzer Space Telescope have been stitched together to create a new "coming of age" portrait of stars in our inner Milky Way galaxy.

The image, which depicts an area of sky 120 degrees wide by two degrees tall, can be viewed at http://www.nasa.gov/mission_pages/spitzer/multimedia/20080603.html . It was unveiled today at the 212th meeting of the American Astronomical Society in St. Louis, Mo.

"This is the highest-resolution, largest, most sensitive infrared picture ever taken of our Milky Way," said Sean Carey of NASA's Spitzer Science Center at the California Institute of Technology, Pasadena, Calif. Carey is lead investigator for one of two teams responsible for the new picture. "Where previous surveys saw a single source of light, we now see a cluster of stars. With this data, we can learn how massive stars form, map galactic spiral arms and make a better esti-

mate of our galaxy's star-formation rate," Carey explained.

"I suspect that Spitzer's view of the galaxy is the best that we'll have for the foreseeable future. There is currently no mission planned that has both a wide field of view and the sensitivity needed to probe the Milky Way at these infrared wavelengths," said Barbara Whitney of the Space Science Institute, Madison, Wis. Whitney is a member of the second astronomy team.

Because Earth sits inside our dusty, flat, disk-shaped Milky Way, we have an edge-on view of our galactic home. We see the Milky Way as a blurry, narrow band of light that stretches almost completely across the sky. With Spitzer's dust-piercing infrared eyes, astronomers peered 60,000 light-years away into this fuzzy band, called the galactic plane, and saw all the way to the other side of the galaxy.

The result is a cosmic tapestry depicting an epic coming-of-age tale for stars. Areas hosting stellar embryos are identified by swaths of green, which are organic molecules, called polycyclic aromatic hydrocarbons, illuminated by light from nearby newborn stars. On Earth, these molecules are found in automobile exhaust and charred barbeque grills, essentially anywhere carbon molecules are burned incompletely.

The regions where young stars reside are revealed as "bubbles," or curved ridges in the green clouds. These bubbles are carved by the winds from young starlets blowing away their natal dust. The starlets appear as yellow and red dots, and the wisps of red that fill most bubbles are composed of graphite dust particles, similar to very small pieces of pencil lead.

Blue specks sprinkled throughout the photograph are individual older Milky Way stars. The bluish-white haze that hovers heavily in the middle two panels is starlight from the galaxy's older stellar population. A deep, careful examination of the image also shows the dusty remnants of dying and dead stars as translucent orange spheres.

"With these Spitzer data, we've been able to catalogue more than 100 million stars," said Edward Churchwell of the University of Wisconsin, at Madison. Churchwell is principal investigator of one of the teams.

"This picture shows us that our Milky Way galaxy is a crowded and dynamic place. We have a lot to learn. I've definitely found a lot of things in this map that I didn't expect to see," said Carey.

This infrared composite incorporates observations from two Spitzer instruments. Data from the infrared array camera were collected and processed by The Galactic Legacy Infrared Mid-Plane Survey Extraordinaire team, led by Churchwell. The Multiband Imaging Photometer for Spitzer Galactic Plane Survey Legacy team, led by Carey, processed observations from Spitzer's multiband imaging photometer. Blue represents 3.6-micron light, green shows light of 8 microns and red is 24-micron light.

NASA's Jet Propulsion Laboratory, Pasadena, Calif., manages the Spitzer Space Telescope mission for NASA's Science Mission Directorate, Washington. Science operations are conducted at the Spitzer Science Center at the California Institute of Technology, also in Pasadena. Caltech manages JPL for NASA.

For more information about Spitzer, visit **http://www.spitzer.caltech.edu/spitzer** and **http://www.nasa.gov/spitzer**.

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NEWS RELEASE: 2008-101 June 6, 2008

NASA Mars Lander Scoops First Soil Sample for Laboratory Analysis

TUCSON, Ariz. -- NASA's Phoenix Mars Lander made its first dig into Martian soil for science studies and is poised to deliver the scoopful to a laboratory instrument on the lander deck.

The instrument will bake and sniff the soil to assess its volatile ingredients, such as water.

Commands were received by Phoenix Friday, June 6, for the spacecraft's Robotic Arm to dump the sample into an opened door on the instrument called the Thermal and Evolved-Gas Analyzer, or TEGA.

"It's looks like a good sample for us," said Peter Smith, Phoenix principal investigator at the University of Arizona, Tucson. "Over the next few days, and it may be as much as a week, the TEGA instrument will be analyzing this sample."

Phoenix's Robotic Arm collected the sample of clumpy, reddish material from the top 2 to 4 centimeters (0.8 to 1.6 inches) of surface material at a site informally named "Baby Bear" on the north side of the lander. In the past week, engineers had used the arm to collect two practice scoops adjacent to Baby Bear and dump those scoopfuls back onto the surface. They have prepared for years with simulations and versions of the arm on Earth.

"It's like being on a football team and having a pre-season that lasted five years, and now we're finally playing first game," said Matt Robinson, of NASA's Jet Propulsion Laboratory, Pasadena, Calif. He is the robotic arm flight software lead for the Phoenix team.

The move was calculated to get enough material to be sure to get some delivered into the instrument without inundating the instrument with unnecessary extra soil. "We're ecstatic that we got a quarter to a third of a scoopful," Robinson said.

The TEGA instrument will begin analyzing the sample for water and mineral content after it has analyzed a sample of the Martian atmosphere. Water can be bound to minerals, such as clays or carbonates, and it takes more heat to drive the water off some minerals than others. This is how the instrument can identify some minerals in the soil.

"We are particularly interested in minerals that are formed or altered by the action of liquid water in the soil," Smith said.

The Phoenix mission is led by Smith at the University of Arizona with project management at JPL and development partnership at Lockheed Martin, Denver. International contributions come from the Canadian Space Agency; the University of Neuchatel, Switzerland; the universities of Copenhagen and Aarhus, Denmark; Max Planck Institute, Germany; and the Finnish Meteorological Institute. For more about Phoenix, visit: http://www.nasa.gov/phoenix and

http://phoenix.lpl.arizona.edu.

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NEWS RELEASE: 2008-109 June 13, 2008

NASA's Phoenix Mars Lander Inspects Delivered Soil Samples

TUCSON, Ariz. -- New observations from NASA's Phoenix Mars Lander provide the most magnified view ever seen of Martian soil, showing particles clumping together even at the smallest visible scale.

In the past two days, two instruments on the lander deck -- a microscope and a bake-and-sniff analyzer -- have begun inspecting soil samples delivered by the scoop on Phoenix's Robotic Arm.

"This is the first time since the Viking missions three decades ago that a sample is being studied inside an instrument on Mars," said Phoenix Principal Investigator Peter Smith of the University of Arizona, Tucson.

Stickiness of the soil at the Phoenix site has presented challenges for delivering samples, but also presents scientific opportunities. "Understanding the soil is a major goal of this mission and the soil is a bit different than we expected," Smith said. "There could be real discoveries to come as we analyze this soil with our various instruments. We have just the right instruments for the job."

Images from Phoenix's Optical Microscope show nearly 1,000 separate soil particles, down to sizes smaller than one-tenth the diameter of a human hair. At least four distinct minerals are seen.

"It's been more than 11 years since we had the idea to send a microscope to Mars and I'm absolutely gobsmacked that we're now looking at the soil of Mars at a resolution that has never been seen before," said Tom Pike of Imperial College London. He is a Phoenix co-investigator working on the lander's Microscopy, Electrochemistry and Conductivity Analyzer.

The sample includes some larger, black, glassy particles as well as smaller reddish ones. "We may be looking at a history of the soil," said Pike. "It appears that original particles of volcanic glass have weathered down to smaller particles with higher concentration of iron."

The fine particles in the soil sample closely resemble particles of airborne dust examined earlier by the microscope.

Atmospheric dust at the Phoenix site has remained about the same day-to-day so far, said Phoenix co-investigator and atmospheric scientist Nilton Renno of the University of Michigan, Ann Arbor.

"We've seen no major dust clouds at the landing site during the mission so far," Renno said. "That's not a surprise because we landed when dust activity is at a minimum. But we expect to see big dust storms at the end of the mission. Some of us will be very excited to see some of those dust storms reach the lander."

Studying dust on Mars helps scientists understand atmospheric dust on Earth, which is important because dust is a significant factor in global climate change.

"We've learned there is well-mixed dust in the Martian atmosphere, much more mixed than on Earth, and that's a surprise," Renno said. Rather than particles settling into dust layers, strong turbulence mixes them uniformly from the surface to a few kilometers above the surface.

Scientists spoke at a news briefing today at the University of Arizona, where new color views of the spacecraft's surroundings were shown.

"We are taking a high-quality, 360-degree look at all of Mars that we can see from our landing site in color and stereo," said Mark Lemmon, Surface Stereo Imager lead from Texas A&M University, College Station.

"These images are important to provide the context of where the lander is on the surface. The panorama also allows us to look beyond our workspace to see how the polygon structures connect with the rest of the area. We can identify interesting things beyond our reach and then use the camera's filters to investigate their properties from afar."

The Phoenix mission is led by Smith at the University of Arizona with project management at JPL and development partnership at Lockheed Martin, Denver. International contributions come from the Canadian Space Agency; the University of Neuchatel, Switzerland; the universities of

Copenhagen and Aarhus, Denmark; Max Planck Institute, Germany; and the Finnish Meteorological Institute. For more about Phoenix, visit: http://www.nasa.gov/phoenix and

http://phoenix.lpl.arizona.edu.

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NEWS RELEASE: 2008-119 June 25, 2008

NASA Spacecraft Reveal Largest Crater in Solar System

PASADENA, Calif. -- New analysis of Mars' terrain using NASA spacecraft observations reveals what appears to be by far the largest impact crater ever found in the solar system.

NASA's Mars Reconnaissance Orbiter and Mars Global Surveyor have provided detailed information about the elevations and gravity of the Red Planet's northern and southern hemispheres. A new study using this information may solve one of the biggest remaining mysteries in the solar system: Why does Mars have two strikingly different kinds of terrain in its northern and southern hemispheres? The huge crater is creating intense scientific interest.

The mystery of the two-faced nature of Mars has perplexed scientists since the first comprehensive images of the surface were beamed home by NASA spacecraft in the 1970s. The main hypotheses have been an ancient impact or some internal process related to the planet's molten subsurface layers. The impact idea, proposed in 1984, fell into disfavor because the basin's shape didn't seem to fit the expected round shape for a crater. The newer data is convincing some experts who doubted the impact scenario.

"We haven't proved the giant-impact hypothesis, but I think we've shifted the tide," said Jeffrey Andrews-Hanna, a postdoctoral researcher at the Massachusetts Institute of Technology in Cambridge.

Andrews-Hanna and co-authors Maria Zuber of the Massachusetts Institute of Technology, and Bruce Banerdt of NASA's Jet Propulsion Laboratory in Pasadena, Calif., report the new findings in the journal Nature this week.

A giant northern basin that covers about 40 percent of Mars' surface, sometimes called the Borealis basin, is the remains of a colossal impact early in the solar system's formation, the new analysis suggests. At 8,500 kilometers (5,300 miles) across, it is about four times wider than the next-biggest impact basin known, the Hellas basin on southern Mars. An accompanying report calculates that the impacting object that produced the Borealis basin must have been about 2,000 kiolometers (1,200 miles) across. That's larger than Pluto.

"This is an impressive result that has implications not only for the evolution of early Mars, but

also for early Earth's formation," said Michael Meyer, the Mars chief scientist at NASA Headquarters in Washington.

This northern-hemisphere basin on Mars is one of the smoothest surfaces found in the solar system. The southern hemisphere is high, rough, heavily cratered terrain, which ranges from 4 to 8 kilometers (2.5 to 5 miles) higher in elevation than the basin floor.

Other giant impact basins have been discovered that are elliptical rather than circular. But it took a complex analysis of the Martian surface from NASA's two Mars orbiters to reveal the clear elliptical shape of Borealis basin, which is consistent with being an impact crater.

One complicating factor in revealing the elliptical shape of the basin was that after the time of the impact, which must have been at least 3.9 billion years ago, giant volcanoes formed along one part of the basin rim and created a huge region of high, rough terrain that obscures the basin's outlines. It took a combination of gravity data, which tend to reveal underlying structure, with data on current surface elevations to reconstruct a map of Mars elevations as they existed before the volcanoes erupted.

"In addition to the elliptical boundary of the basin, there are signs of a possible second, outer ring -- a typical characteristic of large impact basins," Banerdt said.

JPL manages the Mars Reconnaissance Orbiter for NASA's Science Mission Directorate, Washington. For more information about the mission, visit: **http://www.nasa.gov/mro** .

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NEWS RELEASE: 2008-120 June 25, 2008

NASA's Phoenix Mars Lander Puts Soil in Chemistry Lab, Team Discusses Next Steps

TUCSON, Ariz. -- NASA's Phoenix Mars Lander placed a sample of Martian soil in the spacecraft's wet chemistry laboratory today for the first time. Results from that instrument, part of Phoenix's Microscopy, Electrochemistry and Conductivity Analyzer, are expected to provide the first measurement of the acidity or alkalinity of the planet's soil.

The analysis of this soil sample and others will help researchers determine whether ice beneath the soil ever has melted, and whether the soil has other qualities favorable for life.

The Phoenix team is discussing what sample to deliver next to the lander's other analytical instrument, which bakes and sniffs soil to identify volatile ingredients. Engineers have identified

possible problems in the mechanical and electrical operation of that instrument, the Thermal and Evolved-Gas Analyzer, or TEGA.

Scientists are studying information provided by TEGA's analysis of the first Martian soil sample put in that instrument. The instrument has eight single-use oven cells; each cell can analyze one sample. When doors for a second TEGA oven were commanded open last week, the doors opened only partway. Later, the team determined that mechanical interference may prevent doors on that oven and three others from opening fully. The remaining three ovens are expected to have one door that opens fully and one that opens partially, as was the case with the first oven used.

"The tests we have done in our test facility during the past few days show the robotic arm can deliver the simulated Martian soil through the opening with the doors in this configuration," said William Boynton of the University of Arizona, Tucson, lead scientist for TEGA. "We plan to save the cells where doors can open wider for accepting ice samples."

Scientists believe the first soil sample delivered to TEGA was so clumpy that soil particles clogged a screen over the opening. Four days of vibration eventually succeeded at getting the soil through the screen. However, engineers believe the use of a motor to create the vibration may also have caused a short circuit in wiring near that oven. Concern about triggering other short circuits has prompted the Phoenix team to be cautious about the use of other TEGA oven cells.

Subsequent soil samples for TEGA will be delivered with a different method than the first. The new method will sprinkle soil into the instrument to make it easier for particles to get through the screens.

The Phoenix mission is led by Peter Smith at the University of Arizona with project management at NASA's Jet Propulsion Laboratory in Pasadena, Calif., and the development partnership at Lockheed Martin in Denver. International contributions are from the Canadian Space Agency; the University of Neuchatel, Switzerland; the universities of Copenhagen and Aarhus, Denmark; Max Planck Institute, Germany; and the Finnish Meteorological Institute.

For more about Phoenix, visit: http://www.nasa.gov/phoenix and http://phoenix.lpl.arizona.edu.

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NEWS RELEASE: 2008-122 June 27, 2008

Cassini to Earth: 'Mission Accomplished, But New Questions Await!'

PASADENA, Calif.—NASA's Cassini mission is closing one chapter of its journey at Saturn and embarking on a new one with a two-year mission that will address new questions and bring it

closer to two of its most intriguing targets—Titan and Enceladus.

On June 30, Cassini completes its four-year prime mission and begins its extended mission, which was approved in April of this year.

Among other things, Cassini revealed the Earth-like world of Saturn's moon Titan and showed the potential habitability of another moon, Enceladus. These two worlds are primary targets in the two-year extended mission, dubbed the Cassini Equinox Mission. This time period also will allow for monitoring seasonal effects on Titan and Saturn, exploring new places within Saturn's magnetosphere, and observing the unique ring geometry of the Saturn equinox in August of 2009 when sunlight will pass directly through the plane of the rings.

"We've had a wonderful mission and a very eventful one in terms of the scientific discoveries we've made, and yet an uneventful one when it comes to the spacecraft behaving so well," said Bob Mitchell, Cassini program manager at NASA's Jet Propulsion Laboratory, Pasadena, Calif. "We are incredibly proud to have completed all of the objectives we set out to accomplish when we launched. We answered old questions and raised quite a few new ones and so our journey continues."

A new addition to the Cassini science team is Bob Pappalardo who will step into the role of Cassini Project Scientist in July, taking over for Dennis Matson, a multi-year veteran on the project who will be working on future flagship mission studies to the outer solar system. "I am honored and humbled to be able to work with such a scientifically rich mission, and with the outstanding scientists and engineers who are the backbone of Cassini," said Pappalardo.

Pappalardo is a geologist whose research focuses on processes that have shaped the icy moons of the outer solar system, including processes that power the geysers of Saturn's moon Enceladus.

He received his bachelor's degree from Cornell University, Ithaca, N.Y., and his Ph.D. in geology from Arizona State University, Tempe. He worked with the Galileo imaging team while a Postdoctoral Researcher at Brown University, Providence, RI. Prior to joining JPL in 2006, he was an assistant professor of planetary sciences at the University of Colorado at Boulder. Currently he resides in Venice, Calif. More information on Pappalardo is at http://science.jpl.nasa.gov/people/Pappalardo .

Cassini launched Oct. 15, 1997, from Cape Canaveral, Fla., on a seven-year journey to Saturn, traversing 3.5 billion kilometers (2.2 billion miles). The mission entered Saturn's orbit on June 30, 2004, and began returning stunning data of Saturn's rings almost immediately. The spacecraft is extremely healthy and carries 12 instruments powered by three radioisotope thermoelectric generators. Data from Cassini's nominal and extended missions could lay the groundwork for possible future missions to Saturn, Titan or Enceladus.

Information about the Cassini Equinox Mission is at http://www.nasa.gov/cassini and

http://saturn.jpl.nasa.gov .

The Cassini Equinox 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 mission for NASA's Science Mission Directorate, Washington, D.C. The Cassini orbiter was designed, developed and assembled at JPL.

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Feature June 27, 2008

100 Years of Space Rock: The Tunguska Impact

At around 7:17 on the morning of June 30, 1908, a man based at the trading post at Vanavara in Siberia is sitting on his front porch. In a moment, 40 miles from the center of an immense blast of unknown origin, he will be hurled from his chair and the heat will be so intense he will feel as though his shirt is on fire. The man at the trading post, and others in a largely uninhabited region of Siberia, near the Podkamennaya Tunguska River, are to be accidental eyewitnesses to cosmological history.

"If you want to start a conversation with anyone in the asteroid business all you have to say is Tunguska," said Don Yeomans, manager of the Near-Earth Object Office at NASA's Jet Propulsion Laboratory. "It is the only entry of a large meteoroid we have in the modern era with first-hand accounts."

While the impact occurred in '08, the first scientific expedition to the area would have to wait for 19 years. In 1921, Leonid Kulik, the chief curator for the meteorite collection of the St. Petersburg museum led an expedition to Tunguska. But the harsh conditions of the Siberian outback thwarted his team's attempt to reach the area of the blast. In 1927, a new expedition, again lead by Kulik, reached its goal.

"At first, the locals were reluctant to tell Kulik about the event," said Yeomans. "They believed the blast was a visitation by the god Ogdy, who had cursed the area by smashing trees and killing animals."

While testimonials may have at first been difficult to obtain, there was plenty of evidence lying around. Eight hundred square miles of remote forest had been ripped asunder. Eighty million trees were on their sides, lying in a radial pattern.

"Those trees acted as markers, pointing directly away from the blast's epicenter," said Yeomans.

"Later, when the team arrived at ground zero, they found the trees there standing upright -- but their limbs and bark had been stripped away. They looked like a forest of telephone poles."

Such debranching requires fast moving shock waves that break off a tree's branches before the branches can transfer the impact momentum to the tree's stem. Thirty seven years after the Tunguska blast, branchless trees would be found at the site of another massive explosion -- Hiroshima, Japan.

Kulik's expeditions (he traveled to Tunguska on three separate occasions) did finally get some of the locals to talk. One was the man based at the Vanara trading post who witnessed the heat blast as he was launched a few yards. His account:

Suddenly in the north sky… the sky was split in two, and high above the forest the whole northern part of the sky appeared covered with fire… At that moment there was a bang in the sky and a mighty crash… The crash was followed by a noise like stones falling from the sky, or of guns firing. The earth trembled.

The massive explosion packed a wallop. The resulting seismic shockwave registered with sensitive barometers as far away as England. Dense clouds formed over the region at high altitudes which reflected sunlight from beyond the horizon. Night skies glowed, and reports came in that people who lived as far away as Asia could read newspapers outdoors as late as midnight. Locally, hundreds of reindeer, the livelihood of local herders, were killed, but there was no direct evidence that any person perished in the blast.

"A century later some still debate the cause and come up with different scenarios that could have caused the explosion," said Yeomans. "But the generally agreed upon theory is that on the morning of June 30, 1908, a large space rock, about 120 feet across, entered the atmosphere of Siberia and then detonated in the sky."

It is estimated the asteroid entered Earth's atmosphere traveling at a speed of about 33,500 miles per hour. During its quick plunge, the 220-million-pound space rock heated the air surrounding it to 44,500 degrees Fahrenheit. At 7:17 a.m. (local Siberia time), at a height of about 28,000 feet, the combination of pressure and heat caused the asteroid to fragment and annihilate itself, producing a fireball and releasing energy equivalent to about 185 Hiroshima bombs.

"That is why there is no impact crater," said Yeomans. "The great majority of the asteroid is consumed in the explosion."

Yeomans and his colleagues at JPL's Near-Earth Object Office are tasked with plotting the orbits of present-day comets and asteroids that cross Earth's path, and could be potentially hazardous to our planet.

Yeomans estimates that, on average, a Tunguska-sized asteroid will enter Earth's atmosphere

once every 300 years. On this 100th anniversary of the Tunguska event, does that mean we have 200 years of largely meteor-free skies?

"Not necessarily," said Yeomans. "The 300 years between Tunguska-sized events is an average based on our best science. I think about Tunguska all the time from a scientific point of view, but the thought of a another Tunguska does not keep me up at night."

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Middle Evening Observing Highlights for July

Jupiter is low in the southeastern sky next to the constellation Sagittarius. The bright stars Vega, Altair, and Deneb are high in the eastern sky. The three stars makeup the Summer Triangle. Vega is in the constellation Lyrae, Altair is in Aquila, and Deneb is in Cygnus. High in the western sky the constellation Bootes can be seen. It contains the bright star Arcturus. Lower in the southwestern sky is the bright star Spica. It is found in the constellation Virgo. Low in the southern sky the constellation Scorpius contains another bright star named Antares. Vega, Deneb, Altair, and Spica all appear white in color. Arcturus has a pale yellow tint. Antares has a deeper orange color. All can be easily seen as the sky darkens after sunset. The image below shows the locations of Jupiter and Antares just after sunset. Full moon will occur on July 18th. New moon is on July 2nd.

NASA Space Place

Space Buoys

By Dr. Tony Phillips

Congratulations! You're an oceanographer and you've just received a big grant to investigate the Pacific Ocean. Your task: Map the mighty Pacific's wind and waves, monitor its deep currents, and keep track of continent-sized temperature oscillations that shape weather around the world. Funds are available and you may start immediately.

Oh, there's just one problem: You've got to do this work using no more than *one* ocean buoy.

"That would be impossible," says Dr. Guan Le of the Goddard Space Flight Center. "The Pacific's too big to understand by studying just one location."

Yet, for Le and her space scientist colleagues, this was exactly what they have been expected to accomplish in their own studies of Earth's magnetosphere.
The

magnetosphere is an "ocean" of magnetism and plasma surrounding our planet. Its shores are defined by the outer bounds of Earth's magnetic field and it contains a bewildering mix of matter-energy waves, electrical currents and plasma oscillations spread across a volume billions of times greater than the Pacific Ocean itself.

"For many years we've struggled to understand the magnetosphere using mostly single spacecraft," says Le. "To really make progress, we need many spacecraft spread through the magnetosphere, working together to understand the whole."

Enter Space Technology 5.

In March 2006 NASA launched a trio of experimental satellites to see what three "buoys" could accomplish. Because they weighed only 55 lbs. apiece and measured not much larger than a birthday cake, the three ST5 "micro-satellites" fit onboard a single Pegasus rocket. Above Earth's atmosphere, the three were flung like Frisbees from the rocket's body into the magnetosphere by a revolutionary micro-satellite launcher.

Space Technology 5 is a mission of NASA's New Millennium Program, which tests innovative technologies for use on future space missions. The 90-day flight of ST5 validated several devices crucial to space buoys: miniature magnetometers, high-efficiency solar arrays, and some strange-looking but effective micro-antennas designed from principles of Darwinian evolution. Also, ST5 showed that three satellites could maneuver together as a "constellation," spreading out to measure complex fields and currents.

"ST5 was able to measure the motion and thickness of current sheets in the magnetosphere," says Le, the mission's project scientist at Goddard. "This could not have been done with a single spacecraft, no matter how capable."

The ST5 mission is finished but the technology it tested will key future studies of the magnetosphere. Thanks to ST5, hopes Le, lonely buoys will soon be a thing of the past.

Learn more about ST5's miniaturized technologies at nmp.nasa.gov/st5. Kids (and grownups) can get a better understanding of the artificial evolutionary process used to design ST5's antennas at spaceplace.nasa.gov/en/kids/st5/emoticon.

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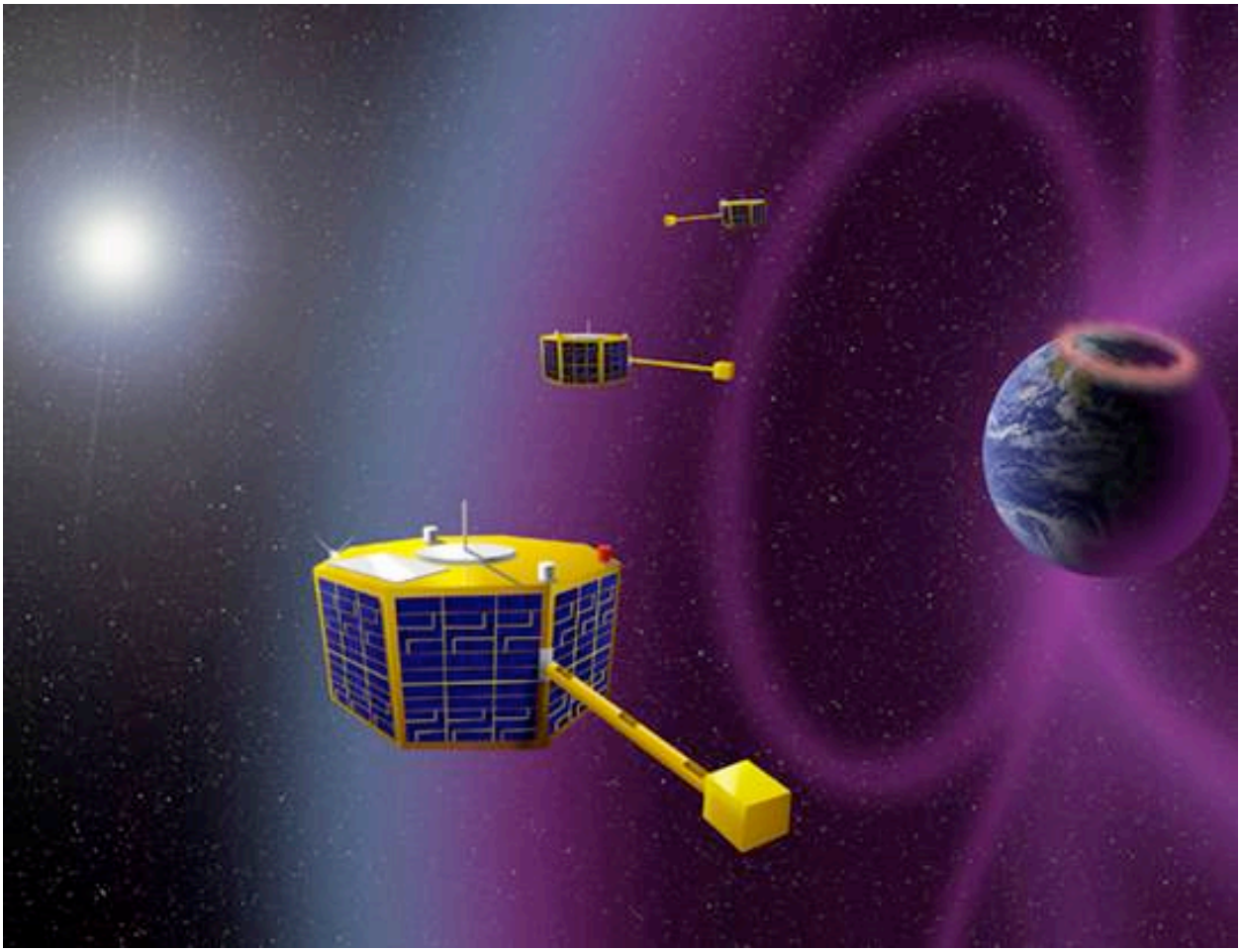

Caption:

The Space Technology 5 micro-satellites proved the feasibility of using a constellation of small spacecraft with miniature magnetometers to study Earth's magnetosphere.