EYEPIECE

Journal of the Amateur Astronomers Association of New York
October 2011
Volume 59 Number 10 ISSN 0146-7662

NASA Ups the Ante - Juno Mission to Jupiter Launches

By Evan Schneider

Many of us have viewed Jupiter through our telescopes and astronomical binoculars. Our fifth planet from the Sun has captured the imagination of amateur astronomers and NASA over the years, and its latest $1.1 billion mission, Juno, a part of the New Frontiers Program will explore Jupiter from an entirely different perspective. On August 5th an Atlas V-551 rocket lifted Juno into space on its five year journey (see NASA's complete status and overview at www.nasa.gov/mission_pages/juno/main/index.html).

Understanding the origin and evolution of this gas giant will provide a new perspective of our solar system and newly discovered planetary systems being studied by distant probes and ground/space based telescopes.

"Jupiter is the Rosetta Stone of our solar system," said Scott Bolton, Juno's principal investigator from the Southwest Research Institute in San Antonio. "It is by far the oldest planet, contains more material than all of the other planets, asteroids and comets combined and carries deep inside it the story of not only the solar system but of us. Juno is going there as our emissary – to interpret what Jupiter has to say."

Using a spinning, solar-powered spacecraft to traverse the 1,740 million miles, Juno will make 33 eleven-day orbits. As with earlier Pioneer spacecraft, spinning makes the spacecraft's pointing stable and easy to control. Traveling within 3,100 miles of Jupiter's cloud tops, its mission will include making maps of the gravity, magnetic fields and atmospheric composition from a unique elliptical polar orbit and sampling its full range of latitudes and longitudes. Juno will carry precise high-sensitivity radiometers, vector magnetometer, gravity/radio science system, a six-wavelength microwave radiometer for atmospheric sounding, composition plasma and energetic particle detectors and an ultraviolet imager/spectrometer.

With Jupiter receiving 25 times less sunlight than the Earth, Juno will be the first solar powered spacecraft to operate this far from the Sun. The 66 foot span of the three solar panels is designed to capture sufficient energy to operate all on board systems. To protect the sensitive electronics, Juno carries the first ever radiation shielded electronics vault. This design will be used for future missions in hostile environments. To protect against the build up of electrostatic charges while traveling through space, Juno utilizes leading edge design carbon nanotube -based sheet material, EMSHIELD, developed by Nanocomp Technologies in partnership with Lockheed Martin (www.spaceref.com/news/viewpr.html?pid=34312).

By positioning the spacecraft in a polar orbit, it will be able to look down on the auroras, most likely created by charged particles emanating from Io's volcanic emissions reacting with the Jovian atmosphere. A second area of interest is measuring the amount of water in the atmosphere. The University of Colorado Boulder has contributed to the Juno through mission co-investigator Professor Fran Bagenal of the Laboratory for Atmospheric and Space Physics. "One of the biggest questions left after the Galileo mission was how much water there is in Jupiter's atmosphere," said Bagenal. "The amount of water is key, because water played a huge role in the formation of the solar system. Most of us know that water absorbs microwaves. We are going to be using a microwave detector and fly just over the clouds of Jupiter, looking down at different cloud depths to measure the amounts of water below. It's a bit like doing a CT scan of Jupiter's dense clouds."

On the non-technical side, Juno is also carrying three aluminum LEGO figures representing Galileo and Roman gods Juno and Jupiter. There will also be a plaque in Galileo's honor, emblazoned with his likeness and his own handwritten notes concerning his observations of Jupiter's moons

Contact with Jupiter began in1973 with the robotic space

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What's Up In The Sky

AAA Observer's Guide for October 2011

By Richard Rosenberg

October's Evening Planets. Jupiter dominates the sky. It is at opposition on the 28th at magnitude -2.9. With binoculars you can see Jupiter as a ball of light, not a point. But it is best through a telescope. Check out its alternating dark and light horizontal bands. Watch its four bright moons change position each night, sometimes their shadows onto Jupiter

Coming into view this month is Venus, visible in the west. In early October it sets only a half hour after the Sun. As the month progresses Venus slowly moves away from the Sun, setting one hour after and easily seen by the end of October. As a bonus, Mercury appears only 2° below Venus in the last week of October. See October 27 below.

October's Evening Stars. The stars of the Summer Triangle still dominate the evening. Look low on the southern horizon to see Sagittarius and Scorpius. On October 1st Antares lies closely below a crescent Moon! By 8PM Pegasus, autumn's signature constellation has risen in the east. Face its Great Square, four bright stars enclosing a nearly star-free region. Andromeda can be seen as a string of bright stars extending left from the square, leading in turn to Cassiopeia, Cepheus and Perseus, the major constellations of autumn.

October's Morning Planets. Jupiter is up nearly all night. Rising around 1:30AM is the planet Mars. Make an effort to look at Mars on the morning of the first day of the month – it will be in the middle of the Beehive Cluster! Mars slowly brightens this month from magnitude 1.3 to 1.1.

Saturn was in conjunction with the Sun on the 13th, but quickly entered the morning sky (due to the favorable angle of the ecliptic). By the end of October it will rise 1½ hours before the Sun.

October's Morning Stars. The Orion group of constellations still holds our attention. Leo appears in the east shortly before sunrise.

October Day-by-Day

October 1 – This morning Mars is within the Beehive Cluster. Use binoculars.
October 1 – Antares is 2° below a crescent Moon this evening.
October 3 – First Quarter Moon at 11:15 PM.
October 8 – Draconid meteor shower. Unfortunately the Moon is nearly full.
October 11 – Full Moon occurs at 10:06 PM.
October 12, 13 – The Moon passes Jupiter.
October 13 – Saturn is in conjunction with the Sun, entering the morning sky.
October 15 – The Moon passes the Pleiades and Hyades star clusters in Taurus.
October 19 – Last Quarter Moon at 11:30 PM.
October 21 – Orionid meteor shower peaks.
October 26 – New Moon at 3:56 PM.
October 27 – Find Venus low in the southwest. With telescope or binoculars look for Mercury 2° below Venus. If successful, look for a very thin crescent Moon 3° at five o'clock from Mercury.
October 28 – Jupiter is at opposition.

For more information on the Internet, go to www.aaa.org/month1109.

Analysis Says Prevailing Asteroid View May be Wrong

By Dr. Denton S. Ebel, Curator (Meteorites), AMNH

A new analysis of one of the most well-known meteorites on Earth provides strong evidence that the prevailing view of many asteroids is wrong. Rather than randomly formed blobs of rock and dust stuck together, it appears the asteroid that was the source of the Allende meteorite was large enough to have had a molten core, although its surface remained cold and solid. The new view also suggests astronomers' view of how planets like Earth formed may need revision.

The Allende meteorite fell in Mexico in 1969, shattering into thousands of fragments as it slammed into Earth's

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A Message from AAA President Richard Rosenberg

Hello Members:

A few weeks ago Ron McCullough and I travelled to Camp Simcha, where seriously ill children can enjoy the outdoors in a protected camp environment. We were lucky to have clear skies, which we showed off to the children. The campers were excited about astronomy and asked us question after question. It was a fulfilling personal experience to see young minds so involved in an observing session, despite their severe medical problems. As I mentioned last month, I hope that the AAA can build a long term relationship with the camp. During the summer there are four groups of campers; each group spends two weeks at the camp. This is a mutually beneficial situation – campers learn astronomy and the night sky and after they go to sleep we can view deep-sky objects in a dark sky environment. Stay tuned.

Our annual Urban Starfest Central Park observing session will take place from dusk to 10PM on Saturday, October 22, at the Sheep Meadow. Rain date is the following evening. Don't miss this gathering of large and small scopes. We urge our AAA members to join us in observing and also recommend bringing your scopes to share with others. The featured object will be Jupiter, only a week before it's at opposition. Please visit our web page on the event at http://www.aaa.org/starfest.

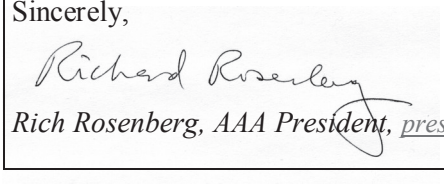
AAA member Laird Whitehill will teach our Fall class beginning Wednesday, November 2, 9, 16, 30, December 7, 14 (no class on Nov 23). Laird has a doctorate in astronomy from Cornell University; his thesis advisor was Carl Sagan. The class will be six-weeks long and broken into three parts as described below. Emphasis will be on evolution of our solar system over billennia. Location of the class will be determined shortly.

Please see aaa.org for complete class descriptions. Laird's internal notes from which topics will be chosen:

The Solar System Part I (up to Earth/Moon)
The Solar System Part II (the inner solar system)
The Solar System Part III (the rest of the solar system)

We hope to see many of you at a AAA event soon.

Sincerely,



Rich Rosenberg, AAA President, president@aaa.org (718) 522-5014

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probe Pioneer 10 and then Pioneer 11 using Jupiter as a gravitational assist to reach Saturn. But not until 1979 would Voyager 1 provide 19,000 pictures and Voyager 2 another 33,000 images, displaying the physical, geological, and atmospheric processes in the planet, its satellites, magnetosphere and the discovery of active volcanism on the satellite Io which surprised scientists and astrophysics alike (for incredible views of Jupiter in photos and video, visit http://www.boston.com/bigpicture/2008/07/views_of_jupiter.html).

In 1992, the Ulysses spacecraft reached Jupiter en route to study our Sun. Ten years after Hubble's early pictures of Jupiter were transmitted to Earth, Cassini-Huygens' December 2000 trip to Saturn included the closest pass of Jupiter at 6.2 million miles away, the Galileo spacecraft entered the Jovian atmosphere in 2003 to avoid crashing into Europa and possibly contaminating that moon. NASA's New Horizons spacecraft, now half way to Pluto for a 2015 encounter, looked at Jupiter's atmosphere during a gravity assist boost in 2007. Our interest in understanding this planet has continued to evolve. Now it is time to really get serious – Juno is on its way.■

Vesta Fiesta! Spacecraft Dawn Arrives at Vesta

By Jason Kendall

Dawn, the ion-propelled, strive-against-impossible-odds spacecraft has arrived at asteroid Vesta, 117 million miles from Earth, lodged snugly in the 344 million mile expanse between Mars and Jupiter. It is the first spacecraft to visit the second-largest body in our asteroid belt (Ceres, a future Dawn target is the largest). Dawn's mission is to orbit the 300-mile-wide asteroid to analyze and document its composition, properties and history.

Vesta is the source of a significant fraction of all meteorites found on Earth. By remotely comparing the spectra of Vesta to that of discovered meteorite samples Eucrite Camel Donga and Howardite Dar al Gani (http://www.saharamet.com/meteorite/gallery/HED/index.html), NASA determined that there was a relationship to be explored. The driving force behind the Dawn mission was that these 4.5 billion year old meteorites were all igneous rocks formed by processes not much different than the magmatic processes of Earth. The impact event that liberated these meteorites from Vesta sent us proof of conditions that existed at the origin of our Solar System. A key mission goal will be to examine these conditions on Vesta and Ceres up close for the first time in our history as explorers.

Dawn arrived on July 16th by the gentlest of engines, its ion-propulsion drive. Getting into orbit was not a matter of the traditional "Main Engine Burn." Instead, the spacecraft eased into orbit, much like two planes aligning to fly in tandem. But this is only the first stop. Dawn will orbit Vesta for one year, mapping its topography in multiple colors, gathering spectral signatures using a spectrometer capable of seeing and imaging in infrared and visible light, and examining the elemental composition with a gamma-ray and neutron spectrometer. The interior will also be probed with gravitational experiments hoping to determine how extensively this planetesimal differentiated its interior.

Still early in its mission, Dawn has already captured detailed images of grooves running around the equator like shock waves in rock. The science team remains baffled by the huge color variations and extreme albedo differences across the surface. Its South Pole is one giant crater that may reveal the exposed mantle of the asteroid. On Earth, this would be the equivalent of excavating the entire Pacific basin to a depth of 50 miles (visit http://dawn.jpl.nasa.gov/ for a complete mission overview).

In addition to the highly technical aspects of space exploration, there is also a personal side to the Dawn mission and the celebration of reaching Vesta. In my role as a NASA/JPL Solar System Ambassador I have participated in numerous phone briefings and information sessions with the Dawn science and Education and Public Outreach Team. After the conclusion of our training, Joe Wise, Manager of the E/PO Team, thought it would be fun to have a song contest to promote a nationwide "Vesta Fiesta." Seizing the opportunity, I offered to speak with my wife Donna, a composer and award-winning songwriter. They immediately agreed to the concept. Within two weeks Donna had written the lyrics and created a basic jingle. Using a local producer, a professional recording and sheet music was prepared for review. The Dawn team responded favorably and asked that the song be presented at the event in Pasadena, offering to upload it as well onto NASA's Dawn Mission website (hear Donna's song: http://www.DonnaStearns.com).

In support of Vesta Fiesta and NASA outreach I gave informational presentations at The New York City Public Library, The Inwood Hill Nature Center and NYSkies, a NY based astronomy resource and collaborative organization. At each event, Donna and recording partner Tony Imgrund performed her song live.

But the best was yet to come. On August 6th we flew to LA to attend the live event in Pasadena. Upon arrival at the LA Convention Center, members of the Dawn outreach team greeted us, again praising Donna for writing her song. She was their star (no pun intended here). The conference hosted 300 people and provided numerous activities for children and adults featuring scale models of Dawn and its ion engines, interactive rides, iron meteorites from Vesta and asteroid model making.

At the end of the celebration's events, the science team presented its latest findings. The audience watched in

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This Month's Book Review "The Sun's Heartbeat…"

By Edward J. Fox

"If the Sun is a star, why can't you see it at night?" High School Senior

Bob Berman answers this question and provides a wide variety of interesting and useful information about our nearest star in his new book, "The Sun's Heartbeat and Other Stories from the Life of the Star That Powers Our Planet." (Little, Brown and Company, $25.99).

"The best way to respond to the low level of public space knowledge is not to recite figures and facts; it's to make the Sun real. To make people start afresh, like a newborn fawn looking up at that brilliant fire for the first time," Berman tells us. That is exactly what he does in a friendly conversational writing style, telling stories to engage his readers. With a liberal sprinkling of timely humor (at times quite corny) he consistently makes his tongue-in-cheek point.

Berman's book describes the many ways the Sun affects Earth and our life thereon. His stories are lessons in the history of the study of the Sun and of astronomy, filled with familiar historic names, intrigues and back-stories.

Beginning at the time ancient cultures around the world considered the Sun to be a god, the book recounts many of the related fears and superstitions surrounding this stigma. By touching on the many aspects of solar physics including stellar life cycles, sun spots, fusion, neutrinos, climate changes, ice ages, the aurora, and rainbows, and then adding the mystical effects of astrology, we gain a unique perspective of ancient cultures and how they reacted to astronomical phenomena.

One of the most fascinating stories tells us how orbital geometry and mathematics was used to first verify Kepler's theory of the ratios of the various distances of the planets from the Sun. The distance of the Earth to the Sun was established as "the unit," one astronomical unit, or 1 AU. Once the concept of the AU was established, international competitions and cooperation used eclipses as a tool to establish the mean distance of the Earth from the Sun – 92,955,807 miles.

Beyond explaining the technical aspects of a total eclipse and its uses in astronomical science, Berman paints a minute-by-minute picture of the conditions experienced during an eclipse. He says it is something that no camera can capture, due to the subtleties of the lighting, and that it can impart a "life-changing" experience.

The moon is 400 times smaller than the Sun, but also 400 times closer. This makes the two appear to be exactly the same size in the sky, thereby allowing the moon to totally block out the Sun during an eclipse. In explaining this phenomenon, Berman tells us of the many expeditions launched to experience a total eclipse and the scientific studies that were carried out under those conditions. With the moon moving away from Earth at a rate of approximately 1-1/2 inches per year, in about 70,000 years it will not be possible to experience a total eclipse from the Earth. How lucky are we to experience the odd coincidence that makes a total eclipse possible at all?

Current lifestyles and fear of the Sun are having a negative effect on us all. More frequent time spent indoors and the "over-application" of sunscreen is contributing to "alarmingly" low levels of Vitamin D. This is a real conundrum of health maintenance. Avoiding Sun to prevent skin cancer has created a population deficient in Vitamin D, the most important anti-carcinogen. Berman strongly supports lobbying the FDA to increase its currently recommended daily dose of Vitamin D to levels three or four times the current 400 Units standard.

Berman has written a very informative book in a light, friendly style. The stories are steeped in historical facts, but presented in a humorous manner. Read through the chapters and discover the book's true tone filled with chapters such as "Yon Flaming Orb," "A Strange History of Seeing Spots," "Why Jack Loved Carbon," and "I'm an Aquarius, Trust Me." These titles speak to his experience as a science writer reaching general audiences. For seventeen years Berman honed his skills as an astronomy writer covering the "Night Watchman" column in Discover. He is currently a columnist and editor for Astronomy, a host for the Northeast Public Radio network and astronomy editor for The Old Farmer's Almanac.

From my perspective, this book was a pleasure to read, and since it was all about the Sun, quite "illuminating."■

Shuttle Atlantis Crew Lands at AMNH

By Maya Kushner

Excitement filled the room on August 16th as the young and young-at-heart watched the Atlantis shuttle crew enter Cullman Hall at the AMNH. Launched on July 8th, STS-135 delivered equipment and supplies to the International Space Station (ISS) and returned safely to Earth after thirteen days in space. The flight represented a milestone in space exploration, capping an unprecedented 30 year shuttle program. Mission Specialist Sandy Magnus noted her perspective on NASA "We've got a lot of experience in low Earth orbit and we are ready to go beyond."

Neil deGrasse Tyson introduced the crew, describing the importance of the shuttle program. This was a unique time for NASA when a reusable spacecraft could send a payload into orbit and bring it back, where "aeronautics met space exploration." This "space plane" had the capability of being a rocket at liftoff and an airplane when maneuvering to land. Over 350 astronauts went into orbit, conducted cutting-edge research, contributed to construction of the largest structure in space, and launched, recovered and repaired numerous satellites and probes including most notably the Hubble Telescope.

In the standing-room only crowd of Cullman Hall filled mostly with children, we ask why a young child would be interested in an up close meeting with NASA's last space shuttle crew. Perhaps some see themselves as having a future career at NASA. When a young girl named Marion asked how much training one needed to go to space, Pilot Doug Hurley answered "All through college and flight school…you have to love to learn because you're going to constantly be training and learning new things." Mission Specialist Sandy Magnus responded that she had to learn medicine, photography, and the Russian language (see Sandy's interview at http://www.youtube.com/watch?v=tQa_Wzu9GH4).

Future astronauts dream of doing things in space that are not possible on Earth. Commander Chris Ferguson described his experience: "Being in space is your opportunity to be a fish. You can use every available cubic inch of space, not just floor space." Specialist Rex Walheim's favorite experience was being able to fly "Just like Superman, from one corner of the shuttle to the other." He also recalls how cool it was during one of his last space walks to be able to glance down at his home town in California. When asked about eating, Pilot Hurley revealed that his favorite food was shrimp, but also explained that the NASA provided a wide variety of meals for astronauts. Since keeping the shuttle's weight down is important for liftoff, food is dehydrated for transport and re-hydrated when eaten. Most foods are ready-to-eat military food (MRE's) or dehydrated food like the freeze-dried ice cream sold at the Museum's gift shop.

After the presentation, some of the younger children described why they liked the shuttle program. Richard, a seventh grader from Lake George Jr.-Sr. High School said he came to see the astronauts because it is the career he wants to have as an adult. Abigail, a ten year old fifth grader from School 10 in Linden, NJ said she was interested in science. Edward, a NYC eight and a half year old ("I'm going into third grade") from The Parkside School wanted to meet the shuttle crew and has attended Space Camp at AMNH. Astronaut supporter William from NYC, a first grader at the Dalton School "just wanted to be there to meet real astronauts." Even though these aspiring future astronauts may not understand the complexities of working in space, they understand that something special has occurred. They want to be a part of that magic. Mankind's potential to reach beyond Earth excites all of our imaginations.

Where does NASA go from here? Near term missions include the 2011 launch of the GRAIL mission (Gravity Recovery and Interior Laboratory) to determine the structure of the lunar interior from crust to core and the NPP mission (measuring Earth's atmospheric and sea surface temperatures, humidity sounding, land and ocean biological activity, and cloud and aerosol properties). In November, the Mars Science Lab will launch a two year mission with rover Curiosity aboard to investigate whether environmental conditions there favor microbial life and preserve evidence of life. Private enterprise Space Exploration Technologies has partnered with NASA for an unmanned November launch to dock its

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Briefs in Astronomy

By Dan Harrison

Asteroid Dust Clears Up Meteorite-Origin Mystery: The mystery of where most meteorites come from has been solved by the first asteroid samples a spacecraft has returned to Earth. The unmanned Japanese probe Hayabusa returned a capsule containing over 1,500 grains of asteroid dust last year after its visit to 25143 Itokawa, a stony S-type and the most common kind of asteroid in the inner asteroid belt. Scientists long suspected that ordinary chondrites originated from such rocky asteroids, but as far as telescopes could tell, the chemistry of these meteorites and asteroids didn't match. This first close look at asteroid samples revealed how cosmic impacts altered their surfaces. Rocky particles recovered from the asteroid are identical to ordinary chondrites.

NASA Lunar Launch: On September 10th NASA launched twin robotic spacecraft to create the most precise lunar gravity map ever. The GRAIL mission will allow scientists to discern what's beneath the surface all the way to the core and also identify optimal landing sites for human or mechanical explorers. Utilizing a low-powered rocket, the 2 million-mile trip will bring the probes to the Moon by the end of the year. They will orbit the poles, circling 34 miles above the surface. For nearly three months, the craft will chase one another around the Moon, maintaining a distance of 40 - 140 miles between them. Scientists will measure variations in the gap, providing indications of shifting masses below or at the lunar surface--mountains in some places, enormous lava tubes and craters in others. When the mission ends in late spring, the craft will be within 10 miles of the surface before finally crashing into the Moon.

Solar Storm Observation: For the first time, scientists have watched the evolution of a huge solar storm, from its origin until its collision with Earth. Utilizing one of two spacecraft orbiting the Sun for 3D mapping, Stereo-A watched the storm cloud shift and change as it moved through space toward Earth at 3 million miles per hour. It scooped up solar-wind particles in its path, morphing into a towering wall of plasma by the time it neared us. Studying a coronal mass ejection (CME) should help researchers better understand how solar storms evolve as they approach Earth. That, in turn, should improve space-weather forecasts. Scientists have seen CMEs erupt before, but they've generally only gotten head-on looks as they plow into Earth.

New NASA Technologies Chosen: NASA has picked a deep space atomic clock, a giant solar-sail design and a laser-communications system as must-have technologies to help future space exploration. Launches are anticipated by 2015. The solar-sail demonstration mission will deploy a sail seven times larger than any ever flown in space, 125 by 125 feet. The atomic-clock project will fly and validate a miniature mercury-ion atomic clock 10 times more accurate than today's systems. The optical in-space communication system will send information encoded in laser beams, letting spacecraft transmit data up to 100 times faster than before.

Mars Phoenix Lander Update: The soil on Mars may be more capable of supporting life than previously thought. Researchers have long suspected the surface is full of oxidizing compounds, making it difficult for complex molecules like organic chemicals to exist. But a new study analyzing data from Phoenix, suggests that instead, the surface is very similar to moderate soils on Earth. Dirt tested at its landing site was mildly basic, not overly acidic. It also detected minerals that could serve as nutrients for life forms, including magnesium, potassium and chloride.

ESA Mars Express Satellite News: Evidence that a 40-mile-wide crater was once a water-filled lake has been confirmed by the ESA Mars Express satellite. The find was revealed in the discovery of a fan-shaped delta, where flowing water deposited dark sediments. The delta is in the Eberswalde crater in the southern highlands. The crater looks like a semi-circle indentation on the right side of the image. Scientists think it was formed more than 3.7 billion years ago by an asteroid impact. Only the right side of the crater is intact. The rest has been covered by the larger Holden crater, formed by a space rock that impacted that area at a later time. Enough of Eberswalde was preserved so that the forms of the 44 square-mile delta can still be seen. Near the top of the crater thin, jagged lines represent feeder channels that would have carried water and sediment.

Mars Rover Opportunity Hints at Water: While studying its first rock on the rim of the huge Endeavour Crater NASA's Mars rover Opportunity has found another spot where warm water may have flowed or percolated long ago. The rock has high levels of zinc and bromine, elements often deposited by water, especially hot water. Endeavour's region looks completely different than areas Mars Spirit and Opportunity have explored. Although warm water in other Martian systems was likely very acidic, rocks and soil around Endeavour might be more benign, as evidenced by clay minerals observed by spacecraft orbiting Mars. Clay minerals do not form in acidic conditions.

Habitable Planets May be Rare: A German-British team led by Professor Pavel Kroupa of the University of Bonn has suggested that long-ago collisions between clouds of gas and dust could explain why many solar systems have planets with strange, highly tilted orbits, and why habitable worlds may be rare in the universe. Newly forming solar systems may be jostled by interactions with nearby clumps of matter, leading to systems where planets have dramatically tilted orbits and smaller, potentially habitable worlds are ejected. Most planets in our solar system have relatively circular orbits, line up along a plane close to the Sun's equator, and orbit in the same direction around the Sun as it spins. But many solar systems harbor planets that move in the opposite direction of their stars on highly tilted orbits. Using computer models, researchers showed protoplanetary disks can become considerably tilted if they encounter another nearby cloud of material and absorb some of its mass. These collisions can also reverse the disks' spin, leading to the odd orbits in many solar systems. Most planetary systems form in clusters of stars where member stars are close together, so these encounters may be very common.

Spotting Sunspots Early: Scientists have found a way to spot active regions of the Sun below the surface, a day or two before they erupt as sunspots. The method, which measures acoustic waves, could spur more accurate ways to forecast space weather and solar storms. Previously, sunspot regions could only be observed on the surface. Scientists examined sound waves and vibrations generated by movement of plasma inside the Sun. Specific regions were targeted, with surface reference points selected to measure the time it takes for sound waves to travel between the two locations from a depth of 37,300 miles. When acoustic waves crossed a sunspot, they propagated faster. After astronomers identified active areas, large emerging sunspot regions became visible on the surface one day later and smaller sunspot regions two days.

Moon Redux: The Moon is either younger than thought or has evolved much differently over time, a new study suggests. Scientists estimate the Moon formed about 4.5 billion years ago in the aftermath of a collision between a Mars-size object and Earth. Many researchers have suggested the newborn moon's molten crust solidified after just tens of thousands to a few million years, but not everyone believes it cooled that rapidly. So scientists investigated Moon-rock samples. They discovered the rocks apparently crystallized 4.36 billion years ago, well after the Moon is thought to have formed. This means the Moon might be significantly younger than suspected, or the prevailing notion of a quickly cooling global ocean of magma might be wrong. Instead, perhaps the crust formed over an extended period of time through crystallization of small pods of magma. "After many years of trying, we have found a way to reliably date the ages of lunar crustal rocks with high precision," said study lead author Lars Borg, a planetary scientist at the Lawrence Livermore National Laboratory in California. "We can apply this technique to address many questions regarding the timing of ancient events on the moon."

Titan's Arrow: The mystery of a giant arrow-shaped cloud on Titan may be solved. It was likely caused by a massive wave rippling through the atmosphere. Cassini detected the cloud at Titan's equator in 2010. The cloud is huge, with each side running about 930 miles. To understand how such a cloud might have formed, scientists simulated the moon's atmosphere. They discovered waves at Titan's equator could organize clouds into this shape. These cloud patterns can result in downpours with up to 20 times average rainfall and may be key to shaping Titan's surface by erosion. Studying these patterns may provide insight into weather patterns on Earth.

Kepler Finds The Dark Side: The darkest planet known in our galaxy has been discovered. Kepler detected the Jupiter-size giant around a Sun-like star some 750 light-years away towards Draco. The star reflects less than 1% of the sunlight falling on it. It apparently lacks reflective clouds, superheated as its atmosphere is to more than 1,800 degrees by a star 3.1 million miles away. But it's

so hot it emits a faint red glow. Light-absorbing chemicals such as vaporized sodium and potassium or gaseous titanium oxide could explain the planet's darkness.

Diamond Planet Discovered: A newly discovered planet called a millisecond pulsar, five times the size of Earth and formed from a dead supernova has had its carbon crystallized into diamond material. The star's system is located 4,000 light-years away in Serpens the Snake. Rotating over 10,000 times a minute with a diameter of 12 miles, its mass is a 1.4 times that of our Sun. It transformed from an average star to a radio pulsar when a dying star in its binary system exploded. When the second star reached the end of its life, it became a red giant and then a white dwarf. The pulsar absorbed mass from its companion, causing a faster spin. Astronomers think the core of the dwarf failed to merge with its companion. When they got close, the star lost much of its matter and moved out to a distance of a solar radius. Having lost more than 99.9% of its original mass and no longer engaged in fusion reactions, the dead core is classified as a planet. The star-turned-planet is 3,000 times larger than the pulsar it orbits in little more than two hours. The system would fit within the diameter of our Sun.

Black Hole Witnessed in Action: For the first time, a black hole has been caught tearing apart and swallowing a star that got too close. Scientists, who until now had witnessed only the aftermath of such events, say the observation is shedding light on relativistic jets, bursts of matter that shoot out at nearly the speed of light. In the past, scientists missed the fact that relativistic jets could form as black holes ripped apart stars.

New Star Questions Formation Theory: A primordial star at the outer edges of the Milky Way may upset current theories of star formation. The star shouldn't exist. It lacks materials astronomers have long thought necessary for low-mass stars to form and was formed after the supernova-explosion deaths of a few of the short-lived original stars. Using simulations and observations of other low-mass stars, astronomers have determined the minimum levels of various elements needed for a star's mass to pull together under gravity. But the composition of the primordial star weighs falls significantly below those numbers. Current theory dictates that carbon and oxygen are needed to cool material so gas can collapse into a star. The quantity of both elements is in sufficient in the new star. Before this find, astronomers thought stars such as this would need to wait longer before forming, waiting for more supernova star deaths to provide the materials needed.■

Next Month in Eyepiece

Here's a peek at November for you all: Maya Kushner reviews AAA board member Tony Hoffman's presentation at Custer Institute's 33rd Annual Astronomy Jamboree; Alan Rude presents a fascinating article on gamma ray bursts and a review of the Freeman Dyson lecture; Anne Kiefer covers the AMNH Frontiers in Astrophysics Lecture Series "Knocking on Heaven's Door" with Lisa Randall; Evan Schneider covers the latest on the Lunar Reconnaissance Orbiter presentation at AMNH with Carter Emmart and Apollo historian Andrew Chaikin; Jordan Kushner covers his observing session participation on the USS Intrepid; Ed Fox provides us with an insider's view on the NASA Zero Gravity experiments performed by his niece, Kerry Brennan and her teacher colleagues; Dan Harrison sends us his Briefs in Astronomy and more…

Atlantis continued from page 6

Dragon capsule with the ISS. NASA is working with Space X to assess its last two demonstration flights and approve docking the Dragon capsule at the International Space Station.

Together, we look forward to the new wonders these missions will reveal. Somewhere in the crowd today may be a future astronaut who will come back to AMNH to share his or her personal experience. If so, Eyepiece will be there as well. ■

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amazement as raw, unprocessed images streamed live from Dawn itself, downloading through NASA's Deep Space Network. During the Q&A session the Dawn Mission Science Team applauded us again for creating and bringing the song to so many people. They asked Donna, "Will you write a song for the Ceres Celebration in 2015 when Dawn arrives?" Judging by how happy she was that night and how soundly she slept on the plane coming home, I think the answer is an emphatic "Yes." ■

Editorial: AAA – The Next Generation

By Evan Schneider

AAA members, can you feel the winds of change coming? It is subtle to most of you, but it is most definitely coming. Born out of years of progress made by a dedicated board of directors and many members who have selflessly volunteered their professional services, personal time, observing equipment, and perspectives on how to enrich the AAA membership experience and to create outreach opportunities to the public, we can now see the Next Generation of our club clearly on the horizon.

Two years ago, at a chance meeting with Neil deGrasse Tyson at a Swann Gallery space-memorabilia auction, I was directed to contact our dedicated president Richard Rosenberg to join AAA and follow my personal goal of learning more about astronomy. Since that introduction, I have been an enthusiastic AAA member, a writer for Eyepiece under the experienced guidance of former editor Dan Harrison, became a new board member in June, and now represent AAA as the editor of Eyepiece as of this issue. I can only hope that, over time, more of you have the opportunity to work with fellow members as I have; to grow our club's presence, and to advance our collective knowledge of astronomy.

During my short time as a AAA member I have witnessed the development of new ideas and concepts put into active discussion by our intrepid board of directors focused on expanding our membership and introducing new programming and broader opportunities for existing and prospective members to learn more about the science of astronomy, our club's core mission. Through the focused technical professionalism of Marcelo Cabrera I have seen our website (www.aaa.org) develop into a sophisticated information center, our own electronic hub, reflecting all we do as a club and the many benefits we offer to our members. Through the ongoing efforts of Jason Kendall, NASA/JPL Solar System Ambassador, I have watched his development of the Inwood Astronomy Project, bringing observing sessions and educational programs to children and adults in his community and throughout New York City. With the guidance of the AAA board, club finances have been carefully managed by financial secretary Joe Delfausse and treasurer Tom Haeberle. Daily interactions of board members through our Google Groups communications network resonate every day with new ideas. All of these efforts are made to support our loyal membership, more than 400 strong and growing steadily.

The purpose of this article is not to highlight specific programs or commitments. It represents a pivotal marker in time. It is a reminder to each of us that behind the scenes, countless hours are being spent on your behalf to create innovative ways to experience astronomy. Our growing relationship with the Hayden Planetarium will present new opportunities to host joint events benefiting our club and AMNH members alike. Planned outreach to other astronomical and scientific organizations will give us new paths to explore and access to others like us who are excited about field work being performed by astrophysicists, other scientists and fellow amateur astronomers. There are a significant number of events being planned for the upcoming year (watch for updates in future issues of Eyepiece), and you can all be a part of this exciting time in our development.

We urge you to visit our website weekly, to read Eyepiece monthly (even write for it if this is your passion) and to join us at observing sessions, lectures and classes that are available for our members throughout the year. Wherever you can, get involved. Ask your friends to join you and become AAA members. Email us to participate in AAA sponsored events. Live your membership as amateur astronomers. It's all there in front of you to experience every day.

We are all fortunate to be a part of a dynamic group of diverse members with common interests in astronomy and our universe. Take a moment to look in the mirror - you are part of AAA - the Next Generation. ■

Astronomical Facts of the Month

The universe is in constant motion. Our Earth rotates at 1,070 mph; the Moon orbits the Earth at 2,288 mph; the Earth orbits the Sun at 66,614 mph; and our solar system rotates around the center of the Milky Way at 514,496 mph.

Events on the Horizon
October 2011

M: members; P: open to the public; T: bring your telescopes, binoculars, etc.;
C: cancelled if cloudy; AMNH: For ticket information, call (212) 769-5200
HQ: at AAA headquarters, Downtown Community Center, 120 Warren St.

For directions to AAA observing events, check the club's website, www.aaa.org.

Saturday, October 1 (rain date Oct 2), 7:30-11 PM P, T, C
Observing at Gateway National Park, Rockaway, Queens
Next date: November 19.

Monday, October 3, 7:30 PM, P, AMNH -- Frontiers in Astrophysics Lecture Series
"Strange New Worlds" with Ray Jayawardhana
Hayden Planetarium Space Theater, Enter at 81st Street
Next date: November 14

Tuesdays October 4, 11, 18, 25, dusk-10 PM P, T, C
Observing on the High Line, Manhattan
Enter at 14th Street.
Next dates: April 2012.

Wednesday, October 5, 8-10 PM , P, T, C
Observing at Brooklyn Heights Promenade
At end of Montague Street.
Last session of 2011.

Thursdays October 6, 13, 20, 27, sunset-10 PM, P, T, C
Observing and movie, Pier 1, Brooklyn
Contact Rich Rosenberg at president@aaa.org or 718-522-5014 to check whether observing is on. Info: www.aaa.org/movieswithaview. — *Last sessions of 2011.*

Friday, October 7, 8:30-11 PM, P, T, C
Observing at Floyd Bennett Field, Brooklyn
Next date: November 4.

Fridays October 7 and 21, Monday October 31, 8-11 PM, P, T, C
Observing at Inwood Hill Park, Manhattan
Next dates: November 11, 18.

Friday, October 14, 8:30-11 PM, P, T, C
Observing at Carl Schurz Park, Manhattan

Wednesday, October 19, dusk-11 PM, P, T, C
Observing at Prospect Park, Brooklyn

Friday, October 21, AAA John Marshall Lecture, 6:15 – 8 PM, FREE, P
Freeman Dyson of the Institute for Advanced Study will speak on "Other Ways of Looking for Life in the Sky"
Next date: November 16.

Saturday, October 22 (rain date Oct 23), dusk to 10 PM, P, T, C
Urban Starfest, Sheep Meadow, Central Park
See president's letter page 3.

Saturday, October 22 (rain date Oct 29), dusk to when you want to leave, M, T, C
Observing at North-South Lake in the Catskills.
Next date: Last session of 2011.

Saturday, October 29, 7:30-11 PM, P, T, C
Observing at Great Kills Gateway National Park, SI
Next date: November 19.

Saturday, October 29, 10 AM-noon, P, T, C
Solar observing in Central Park.
At the Conservatory Water.
Next date: November 19.

Highlight: Freeman Dyson Lecture

Dr. Freeman J. Dyson, one of the nation's most renowned physicists and professor emeritus at the Institute for Advanced Study in Princeton, N. J., will open the AAA's 2011-12 lecture series Friday, October 21 when he speaks on "Other Ways of Looking for Life in the Sky." The free public lecture begins at 6:15 p. m. in the Kaufmann Theater of the AMNH.

Asteroids continued from page 2

atmosphere and strewing them across dozens of miles of desert.

When the solar system formed, planets built up through accretion of smaller objects colliding and sticking together. When these collections reached a certain size, radioactive elements within them heated up enough so the rock melted, and heavier elements sank toward their cores. This separating process, known as differentiation, ended up producing concentric layers of different composition. In the metallic cores of these bodies, swirling eddies of molten metal produced a magnetic field.

Scientists have long thought asteroids that formed cores must have completely differentiated and melted throughout their interiors. New findings suggest that may not be the case. Many asteroids with cores might be partially differentiated, with their outer regions largely unmelted.

The shift in thinking comes from lab work and theoretical modeling. Lab studies found evidence for magnetization built up over millions of years, in a piece of the Allende meteorite. A separate study showed how magnetization could have occurred, and why that changes not just our view of asteroids, but also of how all the planets formed and where Earth's oceans came from.

The Allende meteorite was a carbonaceous chondrite. "Chondrites are conglomerates of tiny rocky pieces stuck together, and individual components such as chondrules formed by poorly understood processes in the primordial solar nebular disk," says the AMNH's Denton Ebel, an AAA member, who participated in the study. "They're not interstellar material."

The new analysis shows that while newly formed asteroids melted from the inside out because of their radioactive elements, their surfaces, exposed to space and continuing to accumulate layers of cold fragments, remained cold. Computer modeling shows this disparity of a molten interior and cold, unmelted crust.

Decisive evidence came from studies on how mineral grains within the meteorite magnetize. The magnetic orientations of all the grains line up, showing they became magnetized after all material had stuck together rather than being a remnant of earlier magnetic fields in the swirling cloud of dust from which the object formed. In addition, using a form of radiometric dating, scientists could determine the magnetization took place over millions of years. That rules out a theory that the grains could have become magnetized as a result of a brief pulse of magnetism in the cloud of dust. ■

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