EYEPIECE

Journal of the Amateur Astronomers Association of New York
February 2010
Volume 58 Number 2, ISSN 0146-7662

Ground Telescopes Have a Bright Future, AAA Speaker Says

By Dan Harrison

Space telescopes may get the sexy headlines, but ground-based telescopes have a future, NASA scientist Jerry Bonnell told an AAA lecture audience January 8.

Answering a question after his talk on "Skyscapes 2009," at which a selection of Astronomy Picture of the Day images was shown, Bonnell said that while you can escape Earth's atmosphere in space, "on the ground, we can build really big telescopes, really big light buckets. People are talking about 30 meters or more, so ground-based still wins on aperture. You can also build scopes using adaptive optics to defeat atmospheric distortions."

Bonnell also noted that while some want to put scopes on the Moon, there are dust problems, and electrostatic levitation of the dust.

The speaker was hardly unenthusiastic about space scopes. Answering another question, he waxed enthusiastic about the upcoming James Webb Space Telescope: "With Hubble, you look back in time but run out of galaxies because they're redshifted too far into the infrared, so Webb is intended to look into the infrared and fill in our gaps."

NASA's Fermi telescope, which probes gamma-ray bursts, sees "short bursts of incredibly high energies," Bonnell noted. "At these very high energies, the speed of light may not be constant, but we haven't seen this. The source of short gamma-ray bursts is a mystery," although Fermi reveals the best-ever view of the gamma-ray sky. Bonnell also observed that gravitational lensing enables us to see the distant universe,.

Since 2009 was the International Year of Astronomy, honoring Galileo's use of the telescope, Bonnell highlighted some of his pictures by noting what Galileo would have seen and what he wouldn't. For example, he wasn't sure what Saturn's rings were. When he looked at the Milky Way with a scope, he saw innumerable stars. He saw that the Moon wasn't perfectly smooth.

Bonnell also presented dual images. These included a twofer in Cassiopeia: M52 and the Bubble Nebula. The nebula is blown by a star with strong winds. The edges create a bubble. Another image showed the Ring Nebula. Wind at the nebula's edge indicates a latter phase; a distant galaxy's in the field of view.

An image of Comet Lulin showed X-ray and ultraviolet tails. An picture of Milky Way's plane showed no stars in gamma-ray wavelengths. "Some pulsars are shown only at gamma-ray energies," Bonnell noted.

Another picture showed the arc of the Milky Way, a constructed image in which land and space shots were "mosaiced." An additional mosaic showed the galactic center, with the Milky Way on the right and a band of reflected sunlight on the left.

A picture of the Moon showed a crater and the space station flying across the Sea of Serenity. In this image, the space station was 250 miles from Earth and the Moon 250,000, yet it hardly looked that way.

Last year's Jupiter impact was shown through a small scope. The impact, from a large asteroid or a comet -like object, was reflected in a debris plume.

Saturn and its rings were images from 2004 to 2009. Bonnell said that while Saturn is always impressive, 2009 wasn't a good year. He also showed a shot of Saturn at equinox, which couldn't be seen if using a scope on Earth. ■

What's Up

By Tony Hoffman

The Sky for February 2010

Mars and Saturn Rule--and Venus Gets Into the Act. Mars and Saturn are near their best this month. Mars, which reached opposition January 29, starts the month at magnitude -1.3, almost as bright as Sirius. It fades somewhat during the month, to a still-brilliant magnitude -0.6. Its disk is still large enough (12 arc-seconds by the end of the month) to afford observers fine telescopic views in moments of good seeing, aided by the planet's high northerly declination; it spends the month in northern Cancer. Meanwhile, Saturn is in Virgo, just south of the Realm of Galaxies, shining at magnitude 0.7. The planet will reach opposition in March. Saturn's rings are still nearly edge on, but will open over the course of a year. Venus should become visible in bright evening twilight around February 10 and pass close to Jupiter six days later, an event best viewed by binoculars. By month's end, Venus still sets less than an hour after the Sun. Our sister world's visibility will improve dramatically during the next few months.

An Easy Asteroid. Asteroid observing is a fun challenge. A handful of minor planets come within binocular range for urban observers when at their best, yet even Vesta--the most consistently bright among them--can be tricky to find when in a star-poor region of the sky. Not so in mid-February, when Vesta is prominent in western Leo near the 2nd-magnitude star Algeiba (Gamma Leonis). On the night of February 16-17, 6th-magnitude Vesta is almost begging to be found, as it slides between Algeiba and 40 Leonis, a 5th-magnitude star 22 arc-minutes (a bit less than a Moon's diameter) south of Algeiba. Never seen an asteroid? This is a perfect chance to remedy that. The following night, Vesta--still close to Algeiba--reaches opposition.

February 2 Moon lies near Saturn.
February 5 Last-quarter Moon at 6:48 p.m.
February 7 Moon lies near Antares.
February 13 New Moon at 9:51 p.m.
February 16 Vesta passes between Algeiba and 40 Leonis.
February 18 Asteroid 4 Vesta at opposition *(see above).*
February 21 First-quarter Moon at 7:42 p.m
February 25 Moon lies near Mars.
February 27 Moon at perigee, 222,344 miles from Earth, 4:39 p.m.
February 28 Full Moon at 11:38 a.m.

Sun Continues Inactive

By Joseph A. Fedrick

December was cold and snowy, and January has also been cold. In fact, the cold has extended south into Texas and Florida. Europe and Asia have also been cold. The Sun continues to be rather inactive. I saw a small group of sunspots by image projection with my 60mm refractor December 27 at 9:45 a. m. The previous day on which I saw sunspots was October 25. I observed the Sun on several occasions between those days, but saw no sunspots.

In April 1999, nearly 11 years ago, the Sun was much more active. Bruce Kamiat set up a scope at Battery Park and shoewed people many sunspots using an 8-inch Schmidt-Cassegrain with a neutral-density solar filter. Perhaps we're entering a sunspot minimum similar to the Maunder and Dalton minima that occurred during the little ice age of the 17th, 18th and 19th centuries.

Mars rose earlier and shined more brightly during December and January as it approached opposition. On January 4 at around 9:30 p. m., I glimpsed some dark features on the ruddy Martian disk including Syrtis Major, a huge dark triangular region, using my 60mm refractor at 100x. The northern polar cap was also barely visible. Features on the Martian disk weren't very clear because the Mars' small disk shimmered somewhat in the turbulent frigid night air.

It appears observing Mars will be challenging this year, just as it was during Mars' last close approach in the stormy winter of 2007-08. Things will probably be even worse this year if the more pessimistic forecasts of the coldest, stormiest winter in 30 years are correct. ■

Kudos for Tyson

Hayden Planetarium director Neil de Grasse Tyson has been named EarthSky's Science Communicator of the Year. EarthSky's content is seen or heard 15 million times a day on multiple platforms via traditional and new -media outlets. ■

A Message from AAA President Richard Rosenberg

Hello, members:

There's some interesting planetary activity going on. Come to our gathering in the south end of the Great Lawn in Central Park starting at 7 p. m. on Friday, January 29. Mars will be at opposition that evening.

Join us on the Brooklyn Heights Promenade to see two terrific events on the same night. At 5 p. m. on Tuesday, February 16, locate the beautiful crescent Moon in the southwest. Look 22 degrees below it for a bright object barely shining through the twilight (you may need binoculars). That's Venus, just beginning its appearance in the evening sky. Only a half degree to Venus' upper right is Jupiter, ending its apparition.

Take a break and follow us to nearby Cadman Plaza, where we'll have a clear view to the east. By 7 p. m., Leo the Lion should come into view. The brightest star in Leo is Regulus, and above Regulus is a fairly bright star, Algieba. Only half a degree below Algieba is the fainter star 40Leonis. On this night there's an interloper between the two: the asteroid Vesta, at sixth magnitude easily visible in binoculars. It may be the best chance you'll have to spot an asteroid so easily.

For both events, charts and more info can be found on our website at www.aaa.org/month1002 after Feb 1.

The rangers at Fire Island have expressed an interest in setting up an astronomy program there. If you're interested, contact me.

From 4:30 to 7:30 p. m. on Wednesday, February 10, there will be an educators' event called "Journey to the Stars" at the Museum of Natural History. More than 300 teachers will be present. This will be an opportunity for the club to get involved in educational programs in and around the city. If you wish to participate, let me know.

Again, thanks for your renewals and donations, which continue to pour in. If you haven't renewed yet, please take a moment to do so. Checks, hopefully with a donation, should be sent to the AAA at Gracie Station, P. O. Box 383, New York, NY 10028.

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

Columbia Professor to Discuss Liquid-Mirror Telescopes

Dr. Arlin Crotts, professor of astronomy at Columbia University, will address the AAA on "Liquid Mirror Telescopes Are Looking Up" on Friday, February 5. The free public lecture begins at 6:15 p. m. in the Kaufmann Theater of the AMNH.

"We've designed and built several large astronomical telescopes, up to 6 meters in diameter, very inexpensively, and improved them to the point where they operate with seeing-limited performance," Crotts says. "This means huge telescopes can be built for small investments, allowing several kinds of observations that might otherwise have been difficult or impossible. These involve zenith-pointing, liquid-mirror primary mirrors."

Crotts has been on Columbia's astronomy faculty for 20 years. He publishes research in a wide range of topics, from dark energy to lunar science.

Other lectures in the AAA's 2009-10 lecture series:

March 5: John Gianforte, Blue Sky Observatory, "In the Footsteps of the Master: Discovering the Contributions of Galileo."

April 9: Glynnis Farrar, NYU, "High-Energy Astrophysics with a Neutrino Telescope in New York City."

May 7: Ruben Kier, Advanced Radiology Consultants, "Best Targets for Amateur Astrophotography and What They Reveal About Our Universe." ■

Members to Make Presentations at Club's Seminar

By Jason Kendall, Chair, AAA Recent Advances Seminar

The new direction of the Recent Advances in Astronomy Seminar is to have members make short presentations with Power-Point slides. My first "victim" at the January seminar was Evan Schneider, who discussed the Kepler mission. There are a few more presentations set for February. Members are encouraged to contact me about areas they'd like to discuss.

I spoke about several topics presented at the AAS' January meeting in Washington I attended. I gave a paper about efforts I and the club did for the International year of Astronomy. We received kudos at the AAS over having lights turned out at Dyckman Fields.

I discussed the Kepler's early science findings, including five Jovian-scale planets. All have orbital periods of a few days and, due to tidal locking, have day-night temperature variations of thousands of degrees. These objects provide good tests of the scope's ability to find planets, to hone techniques for weeding out false positives and decipher signals due to stellar variability.

I also reviewed enhancements on the Hubble. The most striking finding has been re-examination of the GOODS field, replicating the Hubble Ultra-Deep Field Survey. These findings reveal objects far fainter and more distant than any quasar, giving us pictures of the universe 300 million years after the Big Bang. These early galaxies should have formed more heavy elements by 300 million years than they appear to have.

I talked about use of millisecond pulsars found by the Fermi Gamma-ray telescope as a galactic GPS system in the hunt for gravitational waves, and incremental release of COROT-7b data. This Earth-sized planet orbits too close to its star to be anything other than a molten slag heap; the side facing away from its star is colder than Pluto. Sounds of rocks cracking and breaking as it librates in its tidally-locked orbit must be amazing. ■

Cold Didn't Stop Intrepid AAA Observers

By Evan Schneider

On December 16, a bunch of intrepid members who'd taken the AAA's class headed for the deep, dark, frigid woods of Pound Ridge, in northern Westchester, for observing. Having joined our spirited group the previous week in an act of blind faith--and it was blind faith because all we saw were swirls of fog around us and no sign of the sky--we hoped for a better evening this time.

Jupiter was just setting and Mars hadn't popped above the horizon yet, but as I gazed upward, I was greeted with an amazing sight. Not since my days at summer camp had I seen such a clear sky and so many stars! Exclamations flew from my mouth as I craned my neck in every direction to drink in each constellation. Sirius was brightest, Orion tilted over slightly to its left with Castor and Pollux of Gemini further east, all waiting for the Big Dipper and Mars.

It took several minutes of gazing before I realized I hadn't put on my coat; it was 27 degrees with a wind chill that made it feel like the teens. I took out my starter scope to begin the reassembly process. Taking it apart in my warm house was easy. But I hadn't considered the difficulties setting it up in dark and cold while wearing layers. The challenge was time, keeping my gloves off for several minutes and trying to turn tiny screws to secure the scope to the mount before my fingers froze. Finally, I was ready to set my sights on the Orion Nebula.

Tom Haeberle got his 8-inch scope up and we found the nebula. Seeing gas and dust around the two stars below Orion's belt was amazing, as my face froze.

Rich Rosenberg took us through various constellations and stars as we intermittently used his large binoculars to check some sights. The combination of education and sharing the sky as a group was a wonderful experience.

The cold finally got the best of us. Returning to Manhattan, I kept thinking about that first sight of the sky as I got out of my car, and the great gas and dust details of my first nebula.

I look forward to the warmer months when we can visit again and stay longer. ■

Does Europa's Diverse, Active Environment Support Life?

By Katherine Avakian

It's easy to see why Richard Greenberg calls Europa his "favorite moon in the solar system." The University of Arizona professor of planetary science, a member of the imaging team for the Galileo mission to the Jupiter system, has for decades studied Europa images from that mission and the earlier Jupiter flyby by Voyager 2. In his December 7 Hayden lecture, and in his book, "Unmasking Europa: The Search for Life on Jupiter's Ocean Moon," he outlined why he thinks its "permeable ice crust makes the ocean and crust quite habitable."

Europa orbits Jupiter every 3 1/2 Earth days. It's about as close to its planet as the Moon is to Earth. But Jupiter's 300 times more massive than Earth, so it engenders great tides on Europa. In addition, Europa orbits in synchronous motion, always keeping one face to Jupiter, and its orbit is eccentric and elliptical. With each orbit, Europa is stretched and unstretched, and the shape of the moon, whose diameter is 3,300 km., can be distorted by as much as one kilometer. Describing Jupiter's effect on its two innermost large moons, Greenberg said, "That's why there's volcanism on Io and....this liquid water ocean on Europa."

Tides on Europa cause internal friction. "Europa gets heated from inside out," creating its global ocean, which holds more than twice the water of Earth's oceans. Internal heating also creates chaotic terrain, such as Conamara Chaos, where the crust briefly melted, moving fragments around before the area refroze.

Tides also cause tectonic changes in Europa's thin ice shell. Ice plates move easily. They move apart, creating new surface; they crunch together, destroying surface; and they shear past each other.

One of Europa's most prominent tectonic features is its system of double ridges, which covers much of its surface. During each Europan day, cracks in the ice allow ocean water from below to rush in and freeze. When the walls of the cracks close, newly-formed ice is squeezed to the surface. Repeating this process over thousands of years has caused these ridges to build up.

Greenberg said thermal and tectonic processes wipe out what was there before, adding that Europa's surface is "less than 50 million years old, less than 1% of the age of the solar system," and undergoes continual change.

"The ocean is often exposed to the surface. This has major implications for life." Greenberg used as his model a working ridge-forming crack in the ice. The area within 10 cm. of the surface would be lethal for any organism due to bombardment by charged particles from Jupiter's magnetosphere. But "Charged particles break up water and leave the oxygen, which mixes into ice at the surface." And cometary particles falling on the surface contain organic compounds."

Since sunlight can penetrate several feet down, photosynthetic organisms can inhabit this zone, either in the ice or clinging to the sides of the crack. And as the crack opens and closes each Europan day, "Warm tidal water pumped up and down through the crack on a daily basis would link the ocean and the surface, bringing nutrients, oxygen, light and warmth." Various creatures as well as organisms that can exploit and thrive in an area of tidal flow could inhabit this environment.

"Oxygen can get [to the ocean] in ways completely independent of photosynthesis." Greenberg explained that ridge formation, as well as other resurfacing processes, play their part. As ridges are formed, new icy material on top gets bombarded and oxygenated. Layer upon layer is pushed up and oxygenated, the ridge gets thicker and after a while what was on top gets to the bottom and enters the ocean. He speculated enough oxygen may enter the ocean "to support 3 million tons of fish."

In his book, Greenberg explains why the surface is ideal to look for life. "Everything on Europa's surface came up from the ocean not long ago. If we were to land at a random place, we could hardly go wrong. But in light of the geological processes that bring oceanic materials to the surface, some landing sites would be better than others....Chaos, ridges and dilation bands make up so much of the surface that a spacecraft landing at a random site would have a better than even chance of examining some fairly fresh oceanic material....If there's life on Europa, it may be hard to miss it." ■

Review: Sleuthing Out the Greatest Comets in History

By Tony Hoffman

When amateur astronomers get together to observe a comet, the discussion often gets around to the most notable comets each observer has seen. Fortunately, we've been blessed with many impressive comets in recent decades. And six comets in the past half-century (1965's Ikeya-Seki, Comet Bennett from 1970; West in 1976; Hyakutake and Hale-Bopp in 1996 and 1997; and 2007's Comet McNaught) were spectacular enough to be widely (if unofficially) regarded as "great comets."

Yet how do these comets compare with history's finest comets, and do any of the recent crop deserve to be numbered among the greatest of the great?

Australian comet discoverer/researcher David Seargent applies his expertise to these questions in "The Greatest Comets in History: Broom Stars and Celestial Scimitars" (Springer, paper, 34.95). In the preface, he describes a cometary "scale of importance" devised by D. Justin Schove. It ranges from 1 to 9, with 1 "A minor comet, noted only by experienced skywatchers," and 9 "Created terror. Remembered for generations."

Seargent chose to include comets he rated 7 or higher as among history's greatest. (7 is "Noted as remarkable even in short annals" and 8 is "Created consternation. Remembered for generations.") He based his ratings on Gar Kronk's huge catalog, Cometography.

The book's first chapter is on the physical nature of comets, their structure (nucleus, coma and tails), chemical composition, motion and brightness, and how knowledge of them has evolved over the centuries. From there, Seargent details the numerous appearances of history's most famous comet, Halley's, and counts half a dozen of them as among history's greatest cometary appearances, including the encounter of 1910, when Earth may have passed through the outskirts of the comet's tail, and the exceptionally close passage of 837 A.D., when the comet's huge (~14 times the moon's diameter) head must have shown nearly as bright as Venus and the tail extended across much of the sky.

Seargent then takes the reader through more than two millennia of exceptional comets, starting with the great comet of ~372 B.C., which Aristotle saw as a child. Although the comet's path through the heavens is not known well enough for an orbit to be calculated, astronomers have speculated--based on physical descriptions of the object--that it may have been the parent object that fragmented into the great daylight Kreutz sungrazing comets such as Ikeya-Seki as well as the myriad micro-comets being found in SOHO and STEREO images.

Many descriptions Seargent worked from, particularly for comets before 1500, are sketchy, so he had to decide whether they qualify as comets at all, or some phenomenon such as aurorae or novae. Many comets he chose are well known to comet enthusiasts, but he also includes many unsung yet remarkable comets noted in records from China and other cultures.

He devotes a chapter to Kreutz comets, including as among the greatest the comets of 1843, 1882 and 1965. I probably know more about them than other types, yet there were some surprises, such as his debunking of a poetically eloquent description of the Great Comet of 1882, attributed in several recent books to Sir David Gill, who observed the comet from South Africa. This was apparently a concoction of some more recent writer.

The last chapter is on those comets that have been visible in daylight, the most recent being Comet McNaught. Which takes us back to the six "modern" great comets I led off with. All but one (Bennett) met Seargent's criteria to be numbered among history's greatest. Seargent wrote of the omission, "…Comet Bennett, though a magnificent object and great by any reasonable definition, was not sufficiently outstanding to be included with the likes of those listed here."

On the other hand, Terry Lovejoy, a comet observer and discoverer who observed the last three great comets under near-ideal conditions, said of McNaught that it "…left Hyakutake and Hale-Bopp for dead!"

This book should appeal to anyone who wants to know more about the exceptional comets that have struck awe (and sometimes terror) in mankind throughout recorded history. ■

AMNH's Mac Low Notes Equilibrium in Planet Formation

How Earth survived the process of its birth without suffering an early demise by falling into the Sun has been a mystery to astronomers, but a new model has figured out what protected our planet when it was still a vulnerable, baby world. Temperature differences in the space around the Sun 4.6 billion years ago caused Earth to migrate outward as much as gravity was trying to pull it inward, and so it found equilibrium in a very habitable orbit.

The classic picture of planet migration suggests that planets like (and including) the Earth should have plummeted into the Sun while they were still planetesimals. "This contradicts basic observational evidence, like We. Are. Here," said astronomer Mordecai-Mark Mac Low of the AMNH, speaking at the American Astronomical Society meeting last month in Washington, D. C. He and colleagues investigated this apparent paradox and came up with a new model that explains how planets can migrate as they're forming and still avoid a fiery premature death.

One problem with the classic view of planet formation and migration is that it assumed the temperature of the proto-planetary disk around a star is constant in temperature across its whole span, Mac Low explained. But portions of the disk are actually opaque and so cannot cool quickly by radiating heat out to space. This creates temperature differences across the disk, and these differences have not been accounted for before in models. So Mac Low and colleagues created new model simulations of planet migration that include a disk with variations in temperature.

Temperature changes in the disk can completely alter the nature of planet migrations, causing planets to migrate outward instead of inward. "That is a major development," Mac Low said, because you can put it in the model and see if outward migration cancels inward migration "and allows us to survive, or at least our progenitors."

That seems to be the case. Within the disk, zones of inward and outward migration develop that meet at equilibrium zones. Once planets reach these, "they more or less sit there," Mac Low said. Eventually the disk dissipates to a point where its gravity can no longer influence the planets to pull or push them into new orbits.--*Andrea Thompson, space.com*

Other news at the AAS meeting:

A newly discovered planet just four times the mass of Earth is the second smallest exoplanet found. HD156668b sits in a star system 80 light-years away in Hercules and orbits its parent star once every four days. It's the latest exoplanet to join the ranks of Super-Earths, worlds slightly larger than our own. It's been a long-standing goal to find low-mass planets similar to Earth, though their size makes them difficult to detect. The Eta-Earth Survey for Low Mass Planets has found two such planets.

A rocky extrasolar planet with wild temperature extremes may also be covered in volcanoes. CoRoT-7b was confirmed to be orbiting a star 480 light-years away in October. While it has a rocky surface, it's unlikely to harbor life because it sits so close to its star. And unless its orbit is almost perfectly circular, it could be undergoing fierce volcanic eruptions.

We owe our existence to a star that exploded long ago. So says a study that aimed to determine why the solar system is enriched with a rare form of oxygen. The study suggests the Sun and material for what became the eight major planets formed in the vicinity of one or more supernovas and were enriched with the matter stellar explosions left behind, including that rare oxygen. Astronomers knew the solar system has a peculiarly high ratio of the two rarest forms of oxygen, but not why. One possibility: While values for the solar system came from observations of one star, the Sun, those for elsewhere in the galaxy came from stars across swaths of the Milky Way.

A massive white dwarf in the Milky Way, long overdue for its next eruption, is closer to our solar system than thought and could threaten Earth if it explodes in about 10 million years. New observations of the white dwarf and its Sun-like stellar companion illuminate the star's position as a possible supernova. The two stars are

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in a binary system in Pyxidis. The system is 3,260 light-years away, far closer than thought. Gamma radiation from the supernova could threaten Earth with energy equivalent to 1,000 simultaneous solar flares. Gamma-ray production of nitrous oxides in Earth's atmosphere could destroy the ozone layer.

Astronomers have discovered 33 sets of double black holes in distant galaxies, indicating dual supermassive black-hole systems are much more common than thought. Pairs of black holes are thought to result when two galaxies collide and merge. Most newly discovered pairs were found through observation of 50,000 galaxies. Astronomers detected the pairs by noting their relative motion to each other.

The first observations of NASA's Kepler Space Telescope found five new lightweight planets. They're much larger than Earth-sized bodies Kepler was designed to find, with one around the size of Neptune and the other four larger than Jupiter. All orbit very close to their stars, with orbital periods three to four days. The Neptune-sized planet has one of the lowest densities of any planet ever discovered, less than water. Kepler also observed a system where the light curve from the orbiting body dips more during occultation than during transit, suggesting it's much hotter than its parent star, an odd situation for a planet-star system.

Recycled piles of stardust, and stars that suck them up and spit them out, are shown in a new image of the Small Magellanic Cloud. The image provides an opportunity to study the life cycle of stars, as well as environments in which stars form. Research shows the Large and Small Magellanic Clouds aren't orbiting the Milky Way as thought, but are passing through.

Hubble has revealed some of the earliest galaxies to form after the Big Bang. The images peer back as far as Hubble can look, 600 million-800 million years after the Big Bang. Galaxies are invisible in visible light, but stand out in infrared. The very first galaxies will take a telescope like the upcoming James Webb Space Telescope to find. Hubble scientists also assembled a color panoramic view of 7,500 galaxies in various stages of assembly. The image covers galaxies that existed from 650 million years after the Big Bang to 1 billion years ago. The galaxies are faint and just 5% the size of the Milky Way, and 1% of its mass.

A newly discovered trove of strange spinning stars in our galaxy could help find evidence for Einstein's prediction of gravitational waves, theorized fluctuations in the curvature of space-time predicted by his theory of general relativity. The stars are very dense, strongly magnetic stars called millisecond pulsars, which rotate hundreds of times per second. Seventeen were identified. Scientists hope that by monitoring the pulse rate of a large network of pulsars over an extended time, they can create a kind of galactic GPS to find evidence for gravitational waves.

New X-ray images of the supermassive black hole at the center of the Milky Way are helping astronomers determine why the black hole is starving. Star clusters in the vicinity of the black hole are visible. Particle-laden winds expelled by the stars fuel the black hole. The new images, along with revamped models of black-hole feeding, show the black hole devours only 0.01 percent of stellar winds in its vicinity. The type of feeding frenzy with more active galactic black holes likely petered out long ago in the Milky Way. Conduction causes some heat in gas to travel outwards, reducing the strength of radiation that results from the black hole's consumption. It also creates pressure that helps some stellar winds avoid the black hole's gravitational grasp.

New observations provide evidence for planet formation around stars much more massive than the Sun, as well as dusty debris thought to be leftovers from collisions between rocky planetary embryos. But the dust, in a star system 500 light-years away, has a different chemical makeup from our solar system. The parent star, HD 131488, is surrounded by warm dust in a terrestrial planet zone, where the star heats dust to temperatures similar to Earth's. Scientists haven't identified what species the dust is. The most plausible explanation is a recent collision between rocky planetary-mass bodies. While the warm dust is at a distance from HD 131488 comparable to that between Earth and the Sun, the team also found cooler dust 45 times farther out. Detection of cold and warm dust around a young star is unusual. The cooler dust likely didn't result from planetary collisions, and is probably leftovers of planet formation. ■

Briefs: Significant Light Structure of Exoplanet is Detected

For the first time, astronomers have directly detected the light signature of a planet orbiting an almost Sun-like star. The signature can provide the planet's chemical makeup, which can help them understand how it formed and could be used to look for signs of life on other planets. The planet is 10 times as massive as Jupiter, and orbits between two other giants around a star similar to our Sun. The three giant companions' mass is 7-10 times Jupiter's, with orbits 20-70 times as far from their star as Earth's from the Sun.

Astronomers have detected a giant magnetic loop sweeping out from a pair of binary stars in the Milky Way, the first time they've seen such a feature in the magnetic field of a star except the Sun. The pair, in Perseus, has a star three times more massive than the Sun and a less-massive companion. The two are 93 light-years away. The smaller star orbits the larger at a distance of 5.8 million miles. The magnetic loop emerges from the poles of the mini star and stretches outward in the direction of the primary star.

New data contradict explanations astronomers had advanced to account for years-long variations in the brightness of one-third of Sun-like stars in the later stages of their lives. Such variations are believed caused by stellar pulsations, where a giant star swells and shrinks, becoming brighter and dimmer in a pattern. However, one third of these stars show an unexplained added periodic variation on timescales up to five years. To plumb this feature, astronomers monitored 58 stars in the Large Magellanic Cloud for two and a half years. But instead of backing up ideas for why these stars see additional fluctuations, the data show stellar pulsations are an extremely unlikely explanation. The team also found that whatever the cause of these unexplained variations, it also causes the giant stars to eject mass in clumps or as an expanding disc.

A snapshot of Betelgeuse has revealed two enormous bright spots, the first direct evidence of Sun-like heat transportation on another star. The infrared view shows two bright blotches near Betelgeuse's center. They're hotter than the surrounding area, indicating regions of convection--heat moving through matter currents--where heat rises from the interior of the star to its surface. The convection may play a role in Betelgeuse's prolific weight loss. The star sheds the equivalent of one Sun's worth of mass every 10,000-100,000 years.

A new supercomputer model has predicted roughly the relative numbers of spirals and ellipticals in the universe. The model reproduces 13 billion years of cosmic evolution, resulting in a surprisingly accurate tally. The model was based on observational data and the Lambda Cold Dark Matter theory of the universe. Inclusion of dark matter was likely crucial to the results because theory predicts that galaxies sit inside larger spheres of the invisible matter. The behavior of a galaxy's dark-matter halo could affect its evolution and help determine if it becomes spiral or elliptical. Meanwhile, scientists, using a new simulation of galaxy and star formation, have determined why small galaxies don't have as many stars and matter in their centers as predicted. A new supercomputer model includes cold dark-matter theory. Key to the model is it includes stellar wind. When enough gas is expelled from the center of galaxies, the gravitational pull there is diminished and dark matter, and normal matter, drifts away. Dwarf galaxies have a harder time holding on to their mass than larger galaxies.

A large family of stars has been revealed in detail by a technique that removes blurring effects of Earth's atmosphere. The young star cluster Trumpler 14 can be seen clearly in the largest patch of sky imaged with adaptive optics. The technique counteracts interference from Earth's atmosphere by making swift, real-time changes in the shape of a telescope's mirror during observations. At 500,000 years, Trumpler 14 is the youngest star cluster in the Carina Nebula. The image's quality showed Trumpler 14 is one of Carina's most populous star clusters. Astronomers counted about 2,000 stars, spanning stellar sizes. The star field is just six light-years across.

NASA's Wide-field Infrared Survey Explorer (WISE) captured its first look at the starry sky it will soon survey in infrared. Launched in December, WISE will scan the entire sky for millions of hidden objects, including asteroids, failed stars and powerful galaxies. A WISE infrared image showed 3,000 stars in Carina. The image covers a patch of sky three times larger than the full Moon. WISE should be useful in detecting unknown

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near-Earth objects such as asteroids and comets that could pose a danger to Earth. WISE will capture 5,700 pictures a day.

NASA's orbiting Chandra X-ray Observatory has a new lease on life that could extend its mission through 2013, and possibly longer. NASA prolonged the 10-year-old mission by extending its science-support contract by $172 million, which will fund the effort through 2013. There are options for two more three-year extensions. Chandra was initially built for a five-year mission that was extended by five years in 2004.

Our solar system is passing through a cloud of interstellar material that shouldn't be there. The cloud, called local fluff, is 30 light-years wide, made up of hydrogen and helium. Stars that exploded nearby about 10 million years ago should have crushed the fluff or blown it away. Scientists discovered a strong magnetic field just outside the solar system that holds the cloud together. The fluff is held at bay just beyond the edge of the solar system by the Sun's magnetic field, which is inflated by solar wind into a magnetic bubble 6.2 billion miles wide. This bubble protects the inner solar system from galactic cosmic rays and interstellar clouds.

European Space Agency (ESA) governments in December gave final approval to a two-part Mars exploration program to be conducted with NASA, confirming their commitment to spend $1.23 billion on missions in 2016 and 2018. ESA's hardware will include a Mars orbiter and lander to be launched in 2016, and a rover vehicle to be launched in in 2018.

Two curtains of the aurora borealis have been caught in a collision by NASA cameras, creating a spectacular explosion of light. The collisions had never been seen before or known to exist. The aim was to see why some auroras occasionally explode in light.

Astronomers have spotted an object less than a mile wide 4.2 billion miles away in the Kuiper Belt. Seen in visible light by the Hubble, it's about 3,200 feet across. Previously, the smallest object seen by reflected visible light in the Kuiper Belt was 30 miles wide. The discovery is the first observational evidence for comet-sized bodies in the Kuiper Belt that are being ground down through collisions. Since the object is 100 times dimmer than Hubble can see directly, the discovery was made from a 0.3-second-long occultation event. The object's distance was estimated from the occultation's duration, and the dimming was used to calculate its size.

Cassini has seen sunlight reflecting off a hydrocarbon lake on Saturn's moon Titan, confirming the presence of liquid on part of the surface of a moon with many lake-shaped basins. The image is the first showing such a glint of light off liquid from another world. The liquid is methane and ethane. The image also communicates a thick atmosphere and surface lakes. Although Titan's surface is usually shrouded from view, infrared light can pass through, enabling Cassini to see the glint.

A distant galaxy with a giant black hole in its center has been acting up, making the galaxy the brightest source of gamma rays in the sky and boosting its brightness to more than 10 times its regular luminosity. One jet of the galaxy, 3C 454.3, 7.2 billion light-years away in Pegasus, is aimed at us, so is easy to spot. Despite its distance, the galaxy is brighter than the Vela pulsar, a dense rotating star usually the brightest source in the gamma-ray sky, some 1,000 light-years away.

The Moon appears to have at least one deep hole, and it could serve as a protective base for astronauts. The pit on the Moon's near side is as big as a city block and as deep as a modest skyscraper. It's believed a collapsed lava tube, created perhaps billions of years ago when the Moon was warmer and volcanically active. The hole is nearly circular, about 213 feet across, with a depth of 262-289 feet. It's in the Marius Hills region, an area which was volcanic.

Vast lakes of melted ice that might have been habitats existed on Mars more recently than thought during a warm, wet spell, new images suggest. They reveal a network of winding channels linking several depressions in the surface. Researchers say those channels could only have been caused by lake water running between the depressions some 3 billion years ago, 1 billion years later than thought. The images suggest lakes as big as 12 miles wide dotted equatorial regions. Scientists say that 3 billion years ago, Mars could have been warmed by volcanic activity, meteorite impacts or orbital shifts. The result would be a temporary increase in temperature as gases created thickened the atmosphere. ■

Events on the Horizon
February 2010

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

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

Tuesday, February 2, 6 p. m.
In the dome of the Hayden Planetarium, AAA board member Jason Kendall will speak on "The Farthest Reaches of the Cosmic Ocean: the Virtual Universe at the Hayden Planetarium." Info: http://www.facebook.com/event.php?eid=209949199.

Friday, February 5, 6:15 p. m.
AAA lecture, FREE, P
Arlin Crotts of Columbia University will discuss "Liquid Mirror Telescopes are Looking Up" in the Kaufmann Theater of the AMNH. Next lecture: March 5.

Saturdays February 6, 13, 20, 27
Observing at Inwood Hill Park, Manhattan, P, T, C
Time and locations vary. See aaa.org for details. Next dates: Saturdays in March.

Monday, February 8, 7:30 p. m.
Hayden Planetarium lecture, P, AMNH
Jonathan Arenberg, deputy observatory systems engineer for Northrop Grumman Aerospace Systems, will discuss "Design and Performance of the James Webb Space Telescope: The First Light Machine."

Thursday, February 11, 6:30-8:30 p. m.
Recent Advances in Astronomy seminar, M
At NYU conference room, 726 Broadway, two blocks below 8th Street, 6th floor. Next date: March 11.

Wednesday, February 17, 6:30 p. m.
AAA board meeting, M
Quarterly board meeting. All club members are invited to attend.

Saturday, February 20, 7:30-11 p. m.
Observing at Great Kills Gateway National Park, Staten Island, P, T, C Next date: March 20.

Tuesday, February 23, 6:30-8:30 p. m.
Observers' Group, M, HQ
Pre-meeting dinner at 5:15 at the Gee Whiz Diner, Warren and Greenwich streets. Next date: March 23.

Saturday, February 27, 10-noon
Solar Observing, Central Park, P, T, C
At the Conservatory Water. Next date: March 27.

'NOVA' to Train Its Lens on Pluto

Based on Hayden director Neil de Grasse's Tyson's book of the same name, "The Pluto Files" will air on PBS "NOVA" Tuesday, March 2 at 8 p. m. The program, hosted by Tyson, discusses Pluto's status as a planet with people on both sides of the issue. ■

Hayden Becomes an Opera House

Gotham Chamber Opera, in partnership with the AMNH and in association with American Repertory Theater, presented "Il Mondo Della Luna" (The World on the Moon), an opera by Haydn, at the Hayden Planetarium for five performances in the planetarium in late January. This was the first time the Hayden had been used as an opera house. Taking advantage of laser and light technology, "Il Mondo Della Luna" fused live opera and stargazing, using the 180-degree dome with projections courtesy of NASA. Hayden's favorite opera, "Il Mondo Della Luna" tells the story of a nobleman who refuses to let his daughters marry their true loves. With the help of a fake astronomer and a sleeping potion, the daughters trick their father into believing he's been sent to the Moon, where he discovers that things are done differently, especially when it comes to courtship. ■

Southampton Enacts Light-Pollution Bill

The Southampton Town Board December 8 passed outdoor-lighting legislation that requires fully shielded light fixtures for most residential and non-residential uses. The law generally applies only to new lighting and to pre-existing lighting that is altered or expanded.

For residential properties, there are three exclusions from this rule: a fixture with light output of 900 lumens or less (50 watts incandescent), a fixture with light output of 1800 lumens or less that's motion-activated and meets certain operating standards, and a spotlight/floodlight with light output of 1800 lumens or less that's aimed no more than 45 degrees above straight down and doesn't cause "nuisance lighting."

Height for a building-mounted fixture can't exceed 12 feet from the surface below; height for a freestanding fixture may not exceed 10 feet. Freestanding lights must be set back from side and rear property lines a distance equal to three times the mounting height of the fixture. Non-essential outdoor lighting should not remain on continuously from midnight to dawn.

For non-residential properties, height for a building-mounted fixture may not exceed 12 feet from the natural grade; height for a freestanding fixture may generally not exceed 14 feet. Freestanding lights installed within 10 feet of side or rear property lines can't be mounted higher than 10 feet and require full shielding and additional glare control. Non-essential outdoor lighting shouldn't remain on continuously from midnight until dawn. Certain types of bulbs are prohibited or restricted.

Illumination of structures, building facades or sculptures is prohibited unless approved by the Planning Board. In general, light levels can't exceed minimums recommended by the Illuminating Engineering Society. Light crossing property lines so as to trespass on neighboring properties can't exceed specified limits.

Pre-existing lighting, light trespass or glare that creates a nuisance, as defined in the law, may have to be abated upon complaint by an affected neighbor.

A light fixture that's altered or repaired after enactment of the new legislation must comply with its requirements. Significant expansion on residential or non-residential properties after enactment may require all outdoor lighting on the property to come into compliance. ■

Amateur Astronomers Association
Gracie Station
P. O. Box 383
New York, NY 10028

Forwarding and Address
Correction Requested

First Class