EYEPIECE

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A Busy Century of Cosmological Challenge and Discovery

By Jason Kendall

Launching the AAA's 2009-10 lecture series with a talk on "100 Years of Cosmology: From Spiral Nebulae to the Cosmic Microwave Background" October 2 at the AMNH, NASA's Dr. Michael Way began by noting what he wouldn't do: He wasn't going to give a physics-laden talk burdened with equations.

Rather, he provided a very human journey about the path science takes as ideas overreach observation and experiment. It's been a particularly compelling period, as cosmology moved from a field of philosophers and religion into a field of quantitative study. Way described the trials that helped us understand the universe as we know it--or think we know it--today.

Way is a noted cosmologist whose research leads him to contemplate the nature of the universe. But like all great researchers, he stands on the shoulders of giants. Way started at the dawn of the science of cosmology. He discussed Vesto Slipher's first measurements of redshifts in 1912 and Henrietta Leavitt's discovery of the period-luminosity relationship of cepheid variables the same year.

Way frequently emphasized how theorists and observers seldom spoke each other's languages. In fact, he pointed out numerous instances of fellow researchers not even talking to each other.

With the advent of Einstein's theory of general relativity, research began in earnest. In 1917, he and Willem deSitter came up with cosmological models, including Einstein's self-proclaimed greatest blunder: adding the cosmological constant to his equations to make the universe static.

In that year, Slipher made more redshift observations of distant galaxies. Way pointed out that Carl Wilhelm Wirtz in 1918 first put together the idea that redshifts might have something to do with cosmology, although his contributions are frequently overlooked.

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Eyepiece Going Electronic

Torn or missing *Eyepiece* issues will be a thing of the past for some AAA members. The club is adding the alternative of receiving *Eyepiece* by e-mail.

Initially, members would receive a PDF attachment and a link to a free downloadable Adobe PDF reader. Displaying the attachment, you'd see the paper looking the same as now. You could print out the issue or read it on screen.

Members who elect not to receive the electronic version will continue to receive *Eyepiece* in the mail.

The change to electronic copies of *Eyepiece* means lower printing and postage costs, less time spent by mailing volunteers and an aid to a greener planet.

Down the road, the online version of *Eyepiece* will be enhanced to include color pictures, star charts and graphics. If a topic discussed in *Eyepiece* piques your interest, the online copy will contain links to websites containing more information.

If you'd like to receive the electronic version of *Eyepiece* and enjoy these enhancements, while benefiting the club and the environment, e-mail Rich Rosenberg at president@aaa.org.--*Edward J. Fox*

What's Up

By Tony Hoffman
The Sky for November 2009

Good Prospects for Leonids. The Moon is new at the time of this year's Leonid meteor shower, raising prospects for a good show. The morning of November 17 is a good time to look. What's more, some astronomers have predicted enhanced rates (perhaps several hundred meteors an hour) later on November 17 when the Earth passes near or through a debris stream ejected by Comet Tempel-Tuttle (the shower's parent comet, which takes 33 years to circle the Sun) in 1466 AD. The only catch is that the estimated, very short-lived peak occurs around 22:00 UT, before sunset in the U.S. Asia should have the best view of this event. Leo doesn't even rise until around midnight, but it's well worth a look then, as the Leonids often produce surprises.

The Return of Mars. The Red Planet has been largely incognito since it vanished from the evening sky late last year, but now Mars is returning with a vengeance. As November opens, Mars rises shortly before midnight; by the end of the month, by around 9:30 p.m. It starts the month amid the Beehive Cluster (M44) in Cancer. While Mars then shines at magnitude 0.4, you'll need binoculars to see the relatively faint cluster stars, but this conjunction should be a magnificent sight with even modest optical aid, and a good target for astrophotographers. By the end of the month, the Red Planet will have crossed into Leo, and blazes at magnitude -0.1. Coincidentally, when Mars reaches the zero-magnitude mark, its disk will have grown to 10 arc-seconds in diameter. This is the threshold where surface features start to become visible in medium-sized telescopes under excellent sky conditions, marking the start of prime viewing season of our neighboring world. The white north polar cap should be a conspicuous sight.

November 1 Venus lies near Spica; Mars crosses the Beehive Cluster in Cancer.
November 2 Full Moon at 2:14 p.m.; Jupiter lies 0.3 degrees from Iota Capricorni.
November 7 Moon at perigee (229,226 miles from Earth), 2:25 a.m.
November 9 Moon lies near Mars; last-quarter Moon at 10:56 a.m.
November 12 Moon lies south of Saturn.
November 16 New Moon at 2:14 p.m.
November 17 Leonid meteor shower peaks.
November 23 Moon lies near Jupiter.
November 24 First-quarter Moon at 4:59 p.m. Earth, 8:24 a.m.; Venus lies near Saturn.

Saturn Returns to Morning Sky

By Joseph A. Fedrick

Saturn emerged from the solar glare on the morning of October 6 to be visible in my 10x50 binoculars two degrees below and slightly left (northward) of Mercury in the morning twilight. Mercury was quite bright and visible with the unaided eye while Saturn was much dimmer but still easily visible with the binoculars. Saturn was just clearing trees to my east that morning as the twilight brightened. Mercury was approximately at dichotomy (half-lit phase in my 6mm refractor at 100x), but I was unable to see Saturn in my telescope in rapidly brightening skies. Venus was six degrees above and to the right of Mercury, and was dazzling bright and nearly fully illuminated as seen in my refractor at 100x.

The morning of October 8 dawned with a spectacular conjunction of Mercury and Saturn. Saturn was approximately 1/3 a degree above and to the left (northward) of Mercury. Saturn and Mercury were barely separable with the unaided eye and a very close pair in binoculars. In fact, Saturn and Mercury appeared in the same field of view in both my 50x eyepiece and the high-power 100x eyepiece in my 60mm scope. Saturn revealed its still nearly edge-on rings in my refractor at 100x. The rings appeared as tiny needles protruding from either side of the planet. The shadow of the rings was easily visible on the disk of the planet as it cleared the turbulent skies near the horizon. The north and south equatorial belts were barely visible on Saturn's pale tan-yellow disk. Mercury was slightly gibbous and its surface much bright that the disk of Saturn. Venus was six degrees above the Mercury -Saturn pair and nearly fully illuminated. ■

Contacting the AAA

If you want to join, volunteer, participate in events, have a question or change your address, e-mail members @aaa.org, or leave a message at: (212) 535-2922. Also, visit us on the web at www.aaa.org. ■

A Message from AAA President Richard Rosenberg

Hello, members:

As we approach the end of the year, it will soon be time to renew your membership. Preparing and mailing letters to all our members involves a significant effort and cost. We'd greatly appreciate it if you'd send your renewal without prodding. Send a check or money order to the Amateur Astronomers Association, Box 383, Gracie Station, New York, NY 10028. Dues remain $25. Yearly subscriptions to *Sky & Telescope* and *Astronomy* magazines remain unchanged at $32.95 for S&T and $34 (one year) and $60 (two years) for Astronomy. Of course, a donation to the club would be very welcome.

This month marks the first issue of *Eyepiece* to be sent online to members who have requested it *(see article on page 1)*. We hope to be able to save money, effort and a tree all at once. If you want to participate, e-mail me.

It's been another busy year. We've moved headquarters, added the High Line and North-South Lake as observing sites, made appearances on television and radio promoting astronomy and the club, and fought light pollution.

We'll also give talks and hold observing sessions in Central Park at Belvedere Castle December 20, the Charles Dana Discovery Center on the north end of Central Park January 31 and the Avenue U Salt Marsh in Brooklyn (date TBA).

We're inaugurating a DVD library for members. We've acquired a number of DVDs, including several from Astronomy magazine's Infinite Cosmos series as well as a few from NASA. Members will be able to borrow a DVD for two weeks. No charge is involved. A list of the DVDs is on our website, www.aaa.org. If you're not online, call me.

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

MIT's Guth to Address AAA on Inflationary Cosmology

Dr. Alan H. Guth, Victor F. Weisskopf professor of physics at MIT, will deliver the AAA's annual John Marshall Memorial Lecture on Friday, November 6 when he discusses "Inflationary Cosmology: Is Our Universe Part of a Multiverse?" The free public lecture begins at 6:15 p. m. at the Kaufmann Theater of the American Museum of Natural History.

Guth is one of the most eminent authorities on cosmology. Most of his research has centered on the application of theoretical particle physics to the early universe: What can particle physics tell us about the history of the universe, and what can cosmology tell us about the fundamental laws of nature?

In 1981, Guth proposed that many features of our universe, including how it came to be so uniform and why it began so close to the critical density, can be explained by a new cosmological model, inflation. Inflation is a modification of the conventional Big Bang theory, proposing that the expansion of the universe was propelled by a repulsive gravitational force generated by an exotic form of matter. Although Guth's initial proposal was flawed, as he pointed out in his original paper, the flaw was soon overcome by the invention of "new inflation" by others. After more than 20 years of development and scrutiny, evidence for the inflationary universe model now looks better than ever, he says.

One of the intriguing consequences of inflation is that quantum fluctuations in the early universe can be stretched to astronomical proportions, providing the seeds for the large-scale structure of the universe. The predicted spectrum of these fluctuations was calculated by Guth and others in 1982. These fluctuations can be seen today as ripples in the cosmic background radiation, but the amplitude of these faint ripples is only about one part in 100,000. Nonetheless, these ripples were detected

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Gravity Gets Scrutinized at Recent-Advances Seminar

By Mary Carlson

Chair, AAA Recent Advances Seminar

The success of LCROSS *(see page 8)* and the possibility of water-ice on the Moon and Mars were much discussed at the seminar. Powerful lightning storms on Saturn, with resulting massive radio waves, and details of CoRoT-7b, one of the first rocky planets discovered outside our solar system, also attracted our attention.

As NASA's new program to test new technologies on a reduced-gravity aircraft is underway, we looked at an article from A*stronomy* on another side of gravity.

Of the four universal forces, the weakest is gravity. Yet, it holds us tenaciously to Earth. Newton asserted that gravitational force centered on two things: the masses of interacting bodies and their distances apart. The larger the mass, the greater the force. The greater the separation, the weaker the force.

In the Earth-Moon relationship, this is quite evident. The Moon's tidal tug on the one side of the Earth creates not only a bulge on that side, but an equally apparent bulge on the opposite side. Earth exacts a similar force on the Moon, leaving the Moon's near side somewhat swollen. Enhanced by the Earth's rotation, this tidal lock causes our tides to ebb and flow and, under a new or full Moon, produces an occasional fault line to react with an earthquake.

Farther out in the solar system, Jupiter inflicts far more havoc on its moons. Io, closest to Jupiter, has a tidal bulge hundreds of feet high and an extremely violent volcanic environment. It's subjected to the planet's intense gravitational grasp on the near side and to the tidal tug of its large lunar companions--Europa, Ganymede and Callisto--on the other. Gravity rears its ugly head.

As harsh as it is on its own satellites, Jupiter is even more relentless with other bodies coming within its gravitational influence. Comet Shoemaker-Levy 9 experienced tidal disruption as it got close to Jupiter. The comet fragmented into more than 20 pieces before plummeting into the planet's dense atmosphere in 1994.

On a grand scale, the Milky Way exudes its lethal dose of gravity to the less powerful. A wandering globular cluster or a small galaxy, often with millions of stars, might cross its path. The Milky Way will strip away the closest stars, leaving the smaller group weakened with less mass and less self-gravity. Deterioration starts and soon the smaller galaxy will appear stretched beyond recognition. It will ultimately be assimilated into the much larger Milky Way. This is common galactic history throughout the universe.

So the gravity that holds us so protectively to Earth and keeps our solar system in sync also tears and shreds when the proper conditions arise.

Join us on the second Thursday of each month for dinner and the seminar. See page 11 for details. ■

AMNH's SciCafe: Informal Learning

By Mary Carlson

A mood-evoking hall, the Hall of Planet Earth, whose exhibits hold the mysteries of early Earth, saw the launching of an exciting new endeavor by the American Museum of Natural History, the SciCafe. Formed to bring together questioning minds for an informal evening, the SciCafe is hosted by scientists in their fields of expertise, a happy hour with a twist.

Ben Oppenheimer from the museum's astrophysics department, a brown-dwarf discover, explained one process of detecting both brown dwarfs and extrasolar planets. A team, using a coronograph blocks out brilliant starlight enabling a much smaller body to faintly shine through. He explained that scientists study the spectra of the planet or brown dwarf to determine its chemical makeup. Elements in its atmosphere can then be measured. The presence of oxygen, water, methane, carbon dioxide and the like wouldn't be there unless biological forces were in play.

Oppenheimer discussed the necessity of observing

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Columbia's Crotts Says Water Is Widespread on the Moon

The following is excerpted from an article on space.com.

Many experts were shocked by the recent discovery of water on the Moon. But not everyone was surprised.

Astrophysicist Arlin Crotts of Columbia University has been working for years on research he says predicted this finding. In a paper he submitted recently to the *Astrophysical Journal* with graduate student Cameron Hummels, Crotts hypothesizes the existence of widespread water on the lunar surface, and offers an idea for how it got there.

"I am predicting something that just happened, that nobody else was predicting," Crotts said. "I hope people recognize this is a true prediction of the spatial distribution of water around the Moon."

Until recently, many scientists thought the lunar surface was almost completely dry, and shadowed craters near the poles offered the only chance for small stores of water. But new data uncovered evidence of water molecules all over the Moon's surface.

Experts behind the new findings said they don't know the source of this water. According to one hypothesis, charged hydrogen ions carried from the Sun to the Moon by the solar wind could combine with oxygen on the Moon to form water molecules. Another idea is the water is left over from comets that have impacted the Moon.

But Crotts has a different idea in mind. Previous research uncovered some water trapped in minerals deep inside the Moon, Crotts said. According to his model, this water is likely to travel through fissures to the surface along with other gases escaping the pressure of the Moon's dense interior. "We now know there's water in the interior. There's no particular reason to think it doesn't get out."

One piece of evidence for interior water: A 2008 study by Brown University [scientists], identified water between 260 and 745 parts per million in pebbles of hardened moon lava brought back by Apollo astronauts. Other work on similar samples also indicates the Moon could harbor subsurface water.

While Crotts thinks those amounts are enough to produce the observed surface water, other experts are skeptical.

"I feel it's highly unlikely there are significant amounts of water remaining in the Moon's interior," said Darby Dyar of Mount Holyoke College, a co-author on the papers announcing the surface water discovery. "The amounts of water are at the parts per million level, and as such constitute only a very small amount of water as a resource."

However, Denton Ebel, curator of meteorites at the American Museum of Natural History, said trace amounts of interior Moon water so far identified could be enough to produce the signature found at the surface.

"I think amounts of water inferred for the lunar interior from [two studies], coupled with what we know about the lunar core, implies that degassing is a viable cause of the hydrogen signal observed," Ebel said.

"I think [Crotts'] scenario of seepage--slow degassing--is consistent with the findings," Ebel said. "And I think it's more encouraging than the idea of hydrogen implantation by the solar wind. He could turn out to be right."

In fact, the signature of water on the surface could easily result from a combination of processes, Crotts said. His explanation might only account for some of the wa-

Columbia Building Roils Astronomers

When the Northwest Corner Building at Columbia University is completed, it will significantly block views from telescopes at the Rutherford Observatory on the roof of adjacent Pupin Hall.

One-ninth of the night sky will be blocked by the new building, which will be six stories higher than Pupin's roof, astronomy grad student Cameron Hummels told the *Columbia Daily Spectator* last month. "It blocks everything setting since it is on the west. We will not be able to see Mercury or Venus during the evening ever again."

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AMNH's Mac Low: 'Dirty'

Some stars are lonely behemoths, with no surrounding planets or asteroids, while others sport planetary bodies. New research explains why the composition of stars often indicates whether their light shines into deep space, or whether a small fraction shines onto planets.

When a star forms, collapsing from a dense cloud into a luminous ball, it and the disk of dust and gas orbiting it reflect the composition of that original cloud and elements within it. While some clouds are poor in heavier elements, many have a wealth of them. These "dirty" stars are good solar-system hosts.

"When you observe stars, the ones with more heavy elements have more planets," says co-author Mordecai-Mark Mac Low, curator of astrophysics at the AMNH. "What's in the disk reflects what's in the star."

Observation of distant solar systems shows exoplanets are much more abundant around stars with a greater abundance of elements heavier than helium, like iron and oxygen. These elements can turn into rocks or ice.

New simulations by Mac Low and two non-AMNH colleagues compute how planets and other bodies form as pebbles clump into planetesimals. Their new work hinges on their previously published research that explains why rocks orbiting a star within the more slowly-revolving gas disk aren't quickly dragged into the star because of the headwinds they feel. The rocks drift behind each other, so in orbits with more rocks, they feel less drag and drift towards the star more slowly. Rocks orbiting further out drift into those orbits, until there are so many that gravity can form them into mini-planets. When a small group of rocks distorts the flow of gas, others rush to line up and matter accumulates quickly.

The team was able to build this mechanism--drag leading to clumping--into a three-dimensional simulation of gas and rocks orbiting a star. Their results show that when pebbles, made of heavy elements, constitute less than 1% of the gas mass, clumping is weak. But if the fraction of pebbles is increased slightly, the clumping increases dramatically and quickly results in the accretion of sufficient material to make larger-scale planetesimals. These mini planets merge over millions of years to form planets.

There's an extremely steep transition from not being able to make planets at all to easily making planets, by increasing the abundance of heavy elements just a little. The probability of having planets almost explodes.

Put another way, there's an inherent advantage in being born rich, in terms of solid rocks. But less advantaged systems, like our solar system, can still make planets if they work to marshal their resources and hang onto their solids as gas evaporates away. The Sun's abundance of heavy elements suggests its protoplanetary disk had near the critical ratio of pebbles to gas. If heavy ele-

High-School Sophomore Makes Discovery

It's one thing when an amateur astronomer makes a discovery, but a high-school student?

In March, Clarksburg, W. Va., sophomore Lucas Bolyard came across the signature of an object while working on a project that trains students to help analyze astronomical data. Supervising astronomers determined it was probably a rare object known as a rotating radio transient. These strange neutron stars emit sporadic bursts of radio waves. There are only about 30 known.

Bolyard waded through more than 2,000 data plots, finding nothing. He was examining images when "I saw a plot with a pulse, but there was much radio interference. The pulse was almost dismissed as interference."

He reported the pulse as an anomaly worth further investigation. When West Virginia University astronomers took follow-up observations, they found nothing in the spot where the pulse came from. This proved that it wasn't a normal pulsar.

Scientists confirmed the original pulse signal was real, not interference, by reprocessing the raw data. This indicated the strange object was probably a rare rotating radio transient. These are thought to be similar to regular pulsars, but they emit intermittently, one burst a time, instead of continuously. This makes them hard to find; the first was discovered in 2006. ■

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Because of the difficulty in solving Einstein's equations, no real progress was made until 1922, when Alexander Friedmann discovered a solution to a non-static universe. His purely mathematical "toy universe," based on zero observations, and with no contact with observers, gave a "stab in the dark" of the age of the universe at ~10 billion years. Way described the famous battle between Einstein and Friedmann, with Einstein viewing Friedmann's expanding universe as abominable. Their battle, with Einstein's celebrity winning the day, held back the idea of an expanding universe for a later time.

In 1924, Ludwik Silberstein, a noted observer, published a work on the distance to globular clusters and their relationship to redshift in deSitter's cosmological model. He was roundly ridiculed for his data-analysis methods, with people criticizing him for tossing out bad data, which amounted to nearly half his observations. However, he was on to something. He eventually ran afoul of most of the physics community with the statement that it was only Einstein, Arthur Eddington and himself who understood relativity.

In the prior year, Edwin Hubble had quietly used Henrietta Leavitt's amazing work to determine the distance to M31 using a cepheid variable, effectively ending the Heber Doust Curtis-Harlow Shapley debates. In 1925, Hubble's ongoing efforts continued, and Georges Lemaitre's independently rediscovered Friedmann's expanding universe. Way told of a Swedish astronomer in 1925 who published a paper that would have scooped Hubble, but refused to put a line in his data to show a trend.

Way noted Friedmann's and Lemaitre's toy universes were largely forgotten, even as observers were building supporting evidence for them. In 1928, Howard Robertson again independently derived the nonstatic universe without knowledge of the others who had done the same before him. However, he added the data of Hubble's measurement of the spiral nebulae. In 1929, Hubble mixed recession velocity/redshift measurements with the cepheids' luminosity to show a distance relationship. In 1931, Einstein did what few others have done and declared he had made mistakes. He called the cosmological constant the biggest blunder of his career given Hubble's observations.

Also in 1931, Lemaitre and Jan Oort conceived of a "primeval atom," and Richard Tolman predicted that such a fireball should leave a black-body spectrum afterglow. Eddington came to the fore as a major proponent of the non-static universe. Still, most held onto the older ideas, not conceiving of a finite universe.

The march of knowledge halted until 1946 due to lack of new observations or theoretical work. This huge gap in time, Way observed, allowed the static-but-expanding universe debate to sit on the back burner. Then Robert Dicke measured the CMB, but declared it to be noise. George Gamow applied stellar physics to the primeval atom. In a famous paper, they predicted the chemical abundance of the early universe and a background radiation.

Combating that notion, with great derision, Fred Hoyle, Hermann Bondi and Thomas Gold in 1948 created the steady-state model, and Hoyle dismissed the primeval atom as "that big bang." The name stuck. Its greatest detractor gave it its most enduring name.

In 1955 and 1957, measurements of the CMB were taken but not understood as such. In the 1960s, the race to discover the CMB continued. Dicke and his Princeton colleagues were unaware of a paper written behind the Iron Curtain, while Arno Penzias and Robert Wilson learned about the CMB from this paper. In fact, Dicke's group was only 35 miles from Penzias and Wilson, and neither group knew of the other's building a CMB-detecting telescope. Most of the world learned of the CMB discovery through a leaked version of the paper in *The New York Times*. ■

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Negotiations have occurred between the university and the astronomy department about possibly moving the telescopes to another building, the *Spectator* reported.

Astronomy chair David Helfand told the *Spectator* that "astronomers were disappointed that zero consideration was given to moving the observatory to this new structure, as it would have been an ideal location." He noted that blocking the scopes "is a major problem both for our educational program and for our very active public outreach programs." ■

Briefs: 32 Extrasolar Planets Discovered; Count Passes 400

Astronomers last month announced the discovery of 32 extrasolar planets, some just five times the mass of Earth and others five times heftier than Jupiter. The findings significantly boost the number of planets closer to Earth in size and help astronomers better understand what types of stars birth what kinds of planets. The planets bring the count beyond 400. A program surveyed 2,000 stars over five years to look at solar-type stars for low-mass planets. Most known exoplanets found previously are typically many times the size of Jupiter. The newfound smaller planets boost the known population of lower-mass planets by 30%. It isn't known if any are Earth-like, however. Researchers can't see a planet's surface or detect potential atmosphere. Several planets are in multiple-planet systems. The planets have orbital periods of five Earth days to several thousand days. The survey also showed that solar-type stars have plenty of low-mass planets. Data suggest at least 40% of solar-type stars have these smaller planets. The finding showed giant planets can still exist around metal-poor stars. The survey also found four exoplanets around M-dwarf stars, which are relatively cool, low-mass stars. This challenges planet-formation theory, as models suggest it's hard for planets to form around such stars.

A NASA probe slammed into the Moon October 9 in a bid to blast out a curtain of debris in which scientists hope to detect signs of water ice. The Lunar Crater Observation and Sensing Satellite (LCROSS) spacecraft hit at the large south pole crater Cabeus. LCROSS and the Lunar Reconnaissance Orbiter launched in June to hunt for evidence of water and ice. Scientists think pockets of water ice might exist in permanently shadowed craters of the south pole. Even if LCROSS doesn't turn up proof of water ice, it could mean ice on the Moon isn't as uniformly distributed as suspected, or that water exists in concentrations too low to be measured. In September, scientists announced proof that small amounts of water exist elsewhere on the Moon in molecular form attached to dirt. Scientists scanned the plume from space and Earth to determine if water ice was present in the debris cloud. Within the ultraviolet/visible and near infrared spectrometer and camera data was a faint but distinct debris plume created by the impact.

Using updated information, NASA scientists have slashed the likelihood that the Apophis asteroid, about the size of two-and-a-half football fields, will encounter Earth on April 13, 2036 from one in 45,000 to about four in a million. They pored over hundreds of previously unreleased images of the night sky and made improved measurements of Apophis' position. The info provided a more accurate glimpse of Apophis' orbit into the latter part of this century. It was also found that another close encounter by asteroid 2068 with chance of impact is three in a million. It's expected the 2068 encounter will diminish in probability as more information about Apophis is acquired. Initially, Apophis was thought to have a 2.7% chance of impacting Earth in 2029. Additional observations ruled out any possibility of an impact.

Cosmic magnetic fields, which can channel condensing interstellar gas, play a more important role in star birth than thought. When a molecular cloud collapses, only a small fraction of its material forms stars, and scientists haven't been sure why. Since gravity favors star formation, another force must be hindering the process. The two leading candidates are turbulence and magnetic fields. Magnetic fields channel flowing gas, making it hard to draw it in from all directions. Turbulence stirs the gas and induces outward pressure that counteracts gravity. A team studied 25 cloud cores, each about a light-year in size. The cores, which act as seeds from which stars form, were within molecular clouds as much as 6,500 light-years away. Researchers studied polarized light, which has electric and magnetic components aligned in specific directions. From the polarization, they measured magnetic fields in each cloud core and compared them to the fields in the surrounding tenuous nebula. The magnetic fields tended to line up in the same direction, even though relative size scales and densities were different by orders of magnitude. Since turbulence would tend to churn the nebula and mix up magnetic-field directions, magnetic fields dominate turbulence in influencing star birth.

Although it may take millions of years for swirling clusters of interstellar gas and dust to become a planet, scientists have discovered rapid changes can be observed within a fraction of that time. Over five months, they observed that infrared light from a disk of gas and dust around LRLL 31, a young star, tended to vary in unexpected ways. This suggests another star, or perhaps a

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Briefs: This Just In! The Red Planet Wasn't Always Red!

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planet, is shoving the clump of planet-forming material around, which causes its thickness to vary as it spins around the star. Some theorize that as dusty grains swirl around a star in a disk, and begin to bulk up before becoming a planet, they carve gaps in the dust until a transitional disk takes shape. Eventually, this disk fades and a new type of disk emerges, made of debris from collisions between planets, asteroids and comets. A companion to the star circling in a gap within the system's disk could explain the findings.

Mars wasn't always red, according to a new theory for how it took on its ruddy hue. Until recently, Mars' color was thought to be a product of water, which scientists think flowed over its surface billions of years ago, rusting rocks. But after rovers Spirit and Opportunity landed in 2004, they found evidence of minerals that would have been destroyed by water, suggesting the red dust never made contact with flowing water. Now new research has found a possible mechanism to explain Mars' rusty color without water. In fact, the study implies red tones on Mars are a relatively recent development. A simple grinding down of rocks from erosion could produce a red mineral that stains the dust on Mars.

NASA's Mars rover Opportunity has found another meteorite. Opportunity stumbled on it less than three weeks after driving away from a larger meteorite that the rover examined for six weeks. The newly found meteorite is a pitted rock 18.5 inches long.

New insight could change how scientists search for signs of life in Martian rocks. By studying lab fossilization of microorganisms, scientists have caught a glimpse into how early Earth and potential Martian life might be preserved in rocks. They focused on extremophiles which thrive in very hot, oxygen-lacking environments. Some believe this is where life may have originated on Earth and perhaps even on Mars. Environmental conditions were similar on young terrestrial planets and traces of early Martian life may have been similarly preserved as silicified microfossils, scientists say. On Earth, some fossils are created when microorganisms are caught in concentrated flows of silica and other minerals near hydrothermal sources. Instead of studying existing hydrothermal ocean vents or hot springs, scientists imitated this fossilization process in the lab. This allowed them to more closely mirror the oxygen-lacking environments of Mars and early Earth. Even though organisms in the study didn't fossilize well, many ancient fossils have been found preserved in silica.

When a front moves in on a distant extrasolar planet, small rocks rain down on the surface, a new study suggests. Exoplanet COROT-7b recently became the first exoplanet to be confirmed as a rocky body. It's nearly twice the size of Earth and about five times its mass. It has a density about that of Earth's, which means it's likely made up of silicate rocks, as Earth's crust is. The planet is likely much less hospitable to life, though, as it's only 1.6 million miles from its star. Because of this, it's gravitationally locked to it. One side of the planet always faces its star. This star-facing side's temperature of about 4,220 degrees is hot enough to vaporize rock. Unlike the much cooler Earth, COROT-7b has no volatile gases in its atmosphere. Its atmosphere consists of so-called vaporized rock. The only atmosphere it has is produced from vapor arising from hot molten silicates in a lava lake or lava ocean. Through modeling, scientists determined COROT-7b's atmosphere is made up of ingredients of rocks and when a front moves in, pebbles condense out of the air and rain into lakes of molten lava.

A large asteroid in our solar system called 2 Pallas is actually a protoplanet, a Moon-sized body that might have formed into a planet under different circumstances. With a diameter of 165 miles, it's one of the largest bodies in the asteroid belt between Mars and Jupiter. A recent study of the object's surface and shape suggests 2 Pallas is more dynamic than the chunks of rock that make up most of the asteroid belt. Although not perfectly round, it has enough gravity to have become almost a sphere shape, much rounder than most rocky asteroids around it. 2 Ceres and Vesta are also protoplanets. Objects like these might have become planets if not for the gravitational tugs of Mars and Jupiter, which kept most material in the asteroid belt as rubble. Researchers think 2 Pallas has remained intact and largely unchanged since its birth. It seems to have hosted water in its past and possibly still does. This water would likely be ice buried

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under the surface.

Galactic cosmic rays have hit a space-age high. In 2009, cosmic-ray intensities have increased 19% beyond anything seen in the past 50 years. The increase could mean we need to rethink how much radiation shielding astronauts take with them on deep-space missions. The cause of the surge is the solar minimum, a deep lull in the Sun's activity that began around 2007. Researchers have long known that cosmic rays go up when solar activity goes down, because strong solar activity inflates and bolsters a protective bubble around the solar system. Three aspects of the solar minimum are combining to create the perfect storm: The Sun's magnetic field is weak, the solar wind is flagging and the heliosphere's so-called current sheet is flattening. Earth is in no great peril from the extra rays since our atmosphere and magnetic field form a shield against space radiation. Even with the recent surge, cosmic rays are much weaker than at times in the past millennium.

The Planck mission captured its first rough images of the sky as part of its mission to measure light from the dawn of time. Planck will survey the entire sky to learn more about the universe's history and evolution. Planck's in orbit around the second Lagrange point of the Earth-Sun system, a relatively stable spot. It's seeking temperature variations 1 million times smaller than one degree in the cosmic microwave background.

An enormous new ring has been discovered around Saturn, made up of debris from its distant moon Phoebe. Before the discovery of this ring, 12.5 times the average distance between Earth and the Moon in width and six times that distance in thickness, the largest known planetary rings were Jupiter's gossamer rings and Saturn's E ring. Astronomers have long suspected the presence of this ring, which orbits Saturn at a radius of about 8 million miles, 200 times the radius of the planet. One hint was the unusual coloring of Saturn's moon Iapetus, which had one dark side and one light side. Some astronomers suspected the dark side, which looked suspiciously similar in composition to Phoebe, was actually debris dust from Phoebe stuck to Iapetus' surface.

To hunt for dim objects between planets and stars, scientists are building a space telescope called the Wide-field Infrared Survey Explorer (WISE). It will scan the entire sky in infrared, creating the most comprehensive catalog yet of dark and dim objects in the cosmos: vast dust clouds, brown-dwarf stars, asteroids--even nearby asteroids that might pose a threat to Earth. Surveys of nearby asteroids based on visible-light telescopes could be skewed toward asteroids with more-reflective surfaces. WISE's full-sky infrared map will reveal even darker asteroids, mapping locations and sizes of roughly 200,000 and giving a clearer idea how many large, possibly dangerous asteroids are nearby. WISE will also help answer questions about star formation and the evolution and structure of galaxies, including the Milky Way.

Crater patterns on Vesta and Ceres could help pinpoint when Jupiter began to form during the evolution of the early solar system. A study modeling the cratering history of the two largest objects in the asteroid belt, believed to be among the oldest in the solar system, indicates that type and distribution of craters would show marked changes at different stages of Jupiter's development. The study explored the hypothesis that one or both objects formed during Jupiter's formation by modeling their cratering histories during the birth of the planet.

During its most recent flyby of Mercury, NASA's MESSENGER spacecraft caught a third glimpse of the planet's mysterious bright spot. The flyby is the last of three designed to guide the spacecraft into orbit in 2011. At the center of the bright halo is an irregular depression,

Observers' Handbook Is Available

The 2009 Observers' Handbook from the Royal Astronomical Society of Canada is available to club members at a discounted price of $17.45. The club will distribute the handbooks on a first-come, first-served basis. Contact president@aaa.org. The handbook is a unique annual compendium of astronomical information and highlights for the coming year. ■

Rodger Doxsey Dies at 62

Dr. Rodger Doxsey, head of the Space Telescope Science Institute's (STScI) Hubble Mission Office, died October 13 at 62. Doxsey oversaw Hubble science operations at STScI for nearly three decades. ■

Events on the Horizon
November 2009

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.

Tuesdays, November 3, 10, 17, 24, 6:30-9:45 p.m. Stargazing, High Line, Manhattan, P, T, C
Near the entrance at 14th Street and 10th Avenue. High Line info: http://thehighline.org.

Wednesdays, November 4, 11, 18, 25, 6:30-8:30 p.m. AAA class on descriptive astronomy, P, HQ
Four remaining sessions. Registration required.

Wednesdays November 4, 11, 25, and Saturdays, November 7, 14, 21, 28, 8:30-10:30 p. m.
Observing, Inwood Hill Park, Manhattan, P, T, C
Next dates: Wednesdays and Saturdays in December.

Friday, November 6, 6:15 p.m.
AAA's John Marshall Memorial Lecture, (FREE), P
Dr. Alan Guth of MIT will speak on "Inflationary Cosmology: Is Our Universe Part of a Multiverse?" in the Kaufmann Theater of the American Museum of Natural History. Next lecture: December 4.

Friday, November 6, 8-10 p. m. Observing, Floyd Bennett Field, Brooklyn, P, T, C On the model airplane flying field. Next date: December 4, 7:30-9:30 p. m.

Thursday, November 12, 6:30-8:30 p.m. Recent Advances in Astronomy Seminar, M, HQ
Pre-meeting dinner at 5:15 at the Gee Whiz Diner, Warren and Greenwich streets. Next date: December 10.

Monday, November 16, 7:30 p.m.
Hayden Planetarium lecture, P, AMNH In "The Medea Hypothesis," paleontologist Peter Ward proposes a vision of life's relationship with the Earth's biosphere.

Wednesday, November 18, 8:30-10:30 p.m. Observing, The Cloisters, Manhattan, P, T, C
Next date: December 16.

Thursday, November 19, 7-9 p.m.
Quarterly AAA board meeting, HQ
All members are invited to attend. Note change of date.

Saturday, November 21, 10-noon
Solar Observing, Central Park, P, T, C
At the Conservatory Waters. Next date: December 19.

Saturday, November 21, dusk. Observing, Great Kills Gateway National Park, Staten Island, P, T, C
Please note that the observing site has changed. Consult modified directions and map at aaa.org.

Tuesday, November 24, 6:30-8:30 p.m.
Observers' Group, M, HQ
Pre-meeting dinner at 5:15 at Gee Whiz Diner, Warren

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many planets since while the age and mass of several planets might easily be the same, their characteristics could be quite different. This provides the impetus to see as many Jupiter-sized planets as possible. To accomplish this, extremely good imaging is necessary. This underscores the importance of the coronograph and of additional aids such as adaptive optics. He wondered what an Earth-type planet would look like at 1 billion and 8 billion years.

He talked of the Gemini Planet System Imager and of NASA's future plan for a solar sail and of wondrous discoveries that lay ahead. ■

Lectures continued from page 3

by the COBE satellite in 1992, and they have now been measured to much higher precision by the WMAP and other experiments. The properties of the radiation are found to be in excellent agreement with the predictions of the simplest models of inflation.

Guth has explored whether it's in principle possible to ignite inflation in a hypothetical laboratory, thereby creating a new universe. The answer is a definite maybe. It can't be done classically, but with quantum tunneling it might be possible. The new universe, if created, wouldn't endanger our universe. Instead it would slip through a wormhole and rapidly disconnect completely.

Another intriguing feature of inflation is that almost all versions of inflation are eternal; once inflation starts, it never stops completely. Inflation has ended in our part of the universe, but very far away one expects that inflation is continuing, and will continue forever. Guth believes the inflating region of space time must have a past boundary, and that some new physics, perhaps a quantum theory of creation, would be needed to understand it.

Much of Guth's current work also concerns the study of density fluctuations arising from inflation.

Guth, who holds a Ph.D. in physics from MIT, has been on its faculty since 1980.

The AAA's annual John Marshall Lecture commemorates Marshall, who served the club as president and executive director. He's considered a key figure in the association's growth. Marshall died in 1997.

Other dates and speakers are:

December 4: Charles Baltay, Yale University, "Exploring the Dark Side of the Universe: Accelerating Universes, Dark Matter, Dark Energy and All That."
January 8: Jerry Bonnell, NASA, "Best Astronomy Pictures of the Day, 2008."
February 5: Arlin Crotts, Columbia University, "Liquid Mirror Telescopes Are Looking up."
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." ■

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Correction Requested

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