From the Officers

Report From the Officers on the January Meeting:
The January meeting featured a video presentation from the PBS series, ORIGINS and an excellent turnout of almost 20 people, including a number of new members. If membership dues continue to come in at the normal rate for the next 2 months, we should easily surpass last year’s total and possibly set a new record for the last 10 years! Congratulations to everyone involved in keeping the club active and aware.

For next month, we have one of our own members, Dr. Karen Camarda of Washburn University, giving a presentation on The Gravity Probe B. Dr. Camarda’s expertise is in general relativity so you can expect an informative and entertaining talk. Come prepared to ask all those questions that you always wanted answered about spacetime and black holes. (Note: we again managed to avoid a basketball game, so parking shouldn’t be a problem.)

Returning to the issue of observing, the Memorial Stadium site (Continued on page 2)

ANNUAL DUES
The last issue contained the form and envelope for completing and returning your annual dues. If you have sent your dues and I’ve received them, your address label will be printed in boldface font. If you haven’t sent them in yet, please do so soon, after the Feb. issue, the newsletter will only be mailed to those that have paid their dues. If you’ve lost your form, a copy of the previous newsletter and/or a membership form is accessible at the Club web site.

If you are interested in observing and want to know if it’s going to be worth going out and setting up given the weather, you may want to check out the following web site: http://cleardarksky.com. It allows you to determine if the sky conditions are likely to change over the next few hours and how they will change.
is still under construction and, though it was hoped that they would be finished by the end of January, the weather has not cooperated. Thus we still don’t know when we will have the next open house. There is a strong possibility that we will have one by the end of February, but exactly when, we don’t know. We will forward the info via the web site and via email as soon as we have a definite date and time.

Don’t forget that those of you who were on the membership lists as of the summer 2004 are also members of the Astronomical League (which is why you get the national newsletter, The Reflector.) We update our lists to them each summer, so whatever happens, make sure your membership dues are in by then. The national office of the Astronomical League is based in Kansas City and, this summer, their annual convention will be in Kansas City, from Aug. 12/13. This is a great event for speakers on all topics related to amateur astronomy, instrumentation, club activities, etc. with plenty of vendors hawking their wares. For more info about the AL and this event, check their web site: http://www.astroleague.org. You may want to work toward one of their observing certificates—it’s a nice way to become familiar with the sky.

As noted last month, astronomical activity in the region has increased dramatically this year. In particular, two new telescopes of significant size and capability are coming on line. From Gary Hug in Topeka we received the following: “After clearing a couple of hurdles, the date for a dedication ceremony for the new 0.7 meter Tombaugh telescope is set for April 2nd (Saturday). The event will likely be scheduled for late afternoon or early evening at Farpoint Observatory on the grounds of Mission Valley High School near Eskridge, KS. “ This is the telescope that uses the 27-inch mirror from the former KU Pitt telescope. From Mike Ford of Holton High School, Holton, KS, we also received the following note at the start of the year: “I wanted you to know that the 20" Ritchey-Chretien scope is finally here!! It is HUGE!! Anyway, we are still trying to do some tweaking on the balancing, etc. We should be up and running with imaging within a couple of weeks.” Rick Heschmeyer has spoken with the Topeka group and we hope to have a presentation from them in March!

If you have any suggestions for talks, speakers, or public events, please feel free to contact us, particularly Rick Heschmeyer, the events coordinator for the club.

ALL for now. See you in a couple of weeks. We will, as always, have refreshments so bring a friend and socialize.

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**From the Officers, continued**

About the Astronomy Associates of Lawrence

The club is open to all people interested in sharing their love for astronomy. Monthly meetings are typically on the second Friday of each month and often feature guest speakers, presentations by club members, and a chance to exchange amateur astronomy tips. Approximately the last Sunday of each month we have an open house on Memorial Stadium. Periodic star parties are scheduled as well. For more information, please contact the club officers: Hannah Swift at hkswift@ku.edu, Gary Webber at gwebber@ku.edu, our faculty advisor, Prof. Bruce Twarog at btwarog@ku.edu, or our events coordinator, Rick Heschmeyer at RCJBM@aol.com. Because of the flexibility of the schedule due to holidays and alternate events, it is always best to check the Web site for the exact Fridays and Sundays when events are scheduled. The information about AAL can be found at http://www.ku.edu/~aal.

Copies of the *Celestial Mechanic* can also be found on the web at http://www.ku.edu/~aal/celestialmechanic
An outburst of energy emanated from the black hole at the center of the Milky Way Galaxy just 350 years ago Earth-time, astronomers announced on Jan. 26.

Though the eruption was seen only indirectly, a similar one could occur in the future and would be detectable by space-orbiting telescopes. The finding confirms suspicions that the relatively calm black hole is not always quiescent.

Most large galaxies contain a central black hole. When gas spirals in toward such an immense gravity sinkhole, a portion of the gas is consumed while some is spat back out. Along the way, the material is superheated and gives off X-rays and other radiation in a highly turbulent region. This causes the cores of very active galaxies to shine brilliantly.

The Milky Way, however, seems to be on a diet. Other than some intense radio emissions, its central black hole, called Sgr A* (pronounced 'Sagittarius A star') emits surprisingly little.

### Tricky detection

The new study, using data from the European Space Agency's orbiting Integral observatory, found that compared to today, the black hole released nearly a million times more energy during the outburst, which lasted about a decade.

The radiation storm moved away from the black hole at the speed of light, but technology was not able to witness the event at the time. The eruption was detected now because it is currently interacting with a cloud of hydrogen gas that's 350 light-years from the black hole. A light-year is the distance light travels in a year, about 6 trillion miles (10 trillion kilometers).

Figuring out where the radiation came from is a bit like spotting oversized waves on a sunny beach and tracing their origin to a hurricane way out in the Atlantic, measurably away in time and space.

X-rays and gamma rays spat out from the black hole are now "washing ashore" on the gas cloud, which is known as Sgr B2. In a convenient cosmic twist, the cloud absorbs and re-emits the radiation in a characteristic manner, sending some of it right at us.

"About 350 years ago, the region around Sgr A* was literally swamped in a tide of gamma rays," said study leader Mikhail Revnivtsev of the Space Research Institute in Moscow and the Max Planck Institute for Astrophysics in Germany. "We are now seeing an echo from a sort of natural mirror near the galactic center -- the giant cloud Sgr B2 simply reflects gamma rays emitted by Sgr A* in the past."

The glowing of the gas cloud was first noted by X-ray astronomers. The analysis of Integral's gamma-ray data allowed Revnivtsev's team to reconstruct the relationship of the event to the previous eruption of the black hole.

The whole scene is about 26,000 light-years from Earth. In reality, the black hole's outburst occurred some 26,350 years ago. But it has taken the black hole's radiation 26,350 years to hit the gas cloud, be redirected, and reach Earth.

The researchers expect the Milky Way's black hole will become bright again "in the foreseeable future." If such an eruption occurs, it will be the first notable change in the black hole since X-ray and gamma-ray telescopes were in position above Earth's atmosphere to record the activity.
The Astronomy Associates of Lawrence present a lecture on

TESTING EINSTEIN:
Gravity Probe B
Dr. Karen Camarda
Assistant Professor of Physics, Washburn University

FRIDAY, Feb. 18, 2005
7:30 PM,
1001 Malott Hall
University of Kansas
FREE & OPEN TO THE PUBLIC
The Fight Begins Once Again for Hubble's Life
By Leonard David, Space.com

A White House decision to cut funding for a Hubble Space Telescope servicing mission and dump the observatory into a remote stretch of ocean waters at a future date is sure to incite debate in scientific, engineering, and policy making circles.

Intensive work has been underway at the NASA Goddard Space Flight Center to develop telerobotic servicing skills for the Hubble Space Telescope (HST) in the event that a space shuttle crew is never again sent to the orbiting facility. Aerospace firms in the United States and in Canada have teamed with NASA to develop a Hubble Robotic Vehicle Deorbit Module.

Either a robotic or shuttle-based servicing option reportedly would cost in excess of $1 billion. That pricetag is viewed by the White House, according to sources, as not affordable given other high-priority and more expensive efforts, such as the return-to-flight of the space shuttle program, as well as moving forward on NASA's Moon, Mars and beyond agenda.

White House plans to scuttle Hubble is part of NASA's 2006 budget request, sources said, with some money in the budget allocated to using a propulsion module coupled to Hubble for its safe but destructive deorbiting.

Leading the fight

Senator Barbara Mikulski (D-Md.), a fervent Hubble supporter whose state is home to both the Goddard Space Flight Center and the Space Telescope Science Institute, issued a statement late January 21 in which she vowed to continue advocating an HST servicing mission.

"It is essential that we have a safe and reliable servicing mission to Hubble," Mikulski said, that is consistent with the findings of the Columbia Accident Investigation Board and last month's findings of a National Academy of Sciences (NAS) panel on the Hubble issue.

On December 8, in the NAS final report released by the Committee on the Assessment of Options for Extending the Life of the Hubble Space Telescope, a blue ribbon group of experts said that NASA should reinstate a space shuttle mission to refurbish the Earth-orbiting telescope.

"I led the fight to add $300 million to NASA's budget last year for a Hubble servicing mission, and I plan to lead the fight again this year. This is what the American people expect and deserve," Mikulski said in a statement.

In defense of Hubble

Response to the White House decision has engendered a wait-and-see attitude in some astronomical quarters, while others have been quick to react.

Hubble’s best days lie ahead, predicted John Bahcall, a professor of natural sciences at the Institute for Advanced Study in Princeton, New Jersey. In 1998, he was a recipient of the National Medal of Science for his pioneering efforts in neutrino astrophysics and his contributions to the development and planning of the Hubble Space Telescope.

"President Nixon cancelled in 1973 the Hubble Telescope while it was still in the development phase. The reason was similar: other activities in the NASA budget took priority," Bahcall told SPACE.com. "As a result of intense lobbying efforts by astronomers and other citizens, the situation was reversed and the Hubble Telescope -- then known as the Large Space Telescope -- was restored to the budget by

(Continued on page 8)
The Celestial Mechanic

Like discarded lumber and broken bricks around a construction site, comets scattered at the edge of our solar system are left-over bits from the “construction” of our solar system.

Studying comets, then, can help scientists understand how our solar system formed, and how it gave rise to a life-bearing planet like Earth.

But comets have long been frustratingly out of reach -- until recently. In January 2004 NASA’s Stardust probe made a fly-by of the comet Wild 2 (pronounced "vilt"). This fly-by captured some of the best images and data on comets yet ... and the most surprising.

Scientists had thought that comets were basically “rubble piles” of ice and dust -- leftover “construction materials” held together by the comet's feeble gravity. But that's not what Stardust found. Photos of Wild 2 reveal a bizarre landscape of odd-shaped craters, tall cliffs, and overhangs. The comet looks like an alien world in miniature, not construction debris. To support these shapes against the pull of gravity, the comet must have a different consistency than scientists thought:

"Now we think the comet's surface might have a texture like freeze-dried ice cream, so-called 'astronaut ice cream': It's solid and can assume odd, gravity-defying shapes, but it's basically soft and crumbles easily," says Donald Brownlee of the University of Washington, principal investigator for Stardust.

Scientists are currently assembling a 3-D computer model of this surface from the photos that Stardust took. Those photos show the sunlit side of the comet from many angles, so its 3-dimensional shape can be inferred by analyzing the images. The result will be a "virtual comet" that scientists can examine from any angle. They can even perform a virtual fly-by. Using this 3-D model to study the comet's shape in detail, the scientists will learn a lot about the material from which the comet is made: how strong or dense or brittle it is, for example.

Soon, the Stardust team will get their hands on some of that material. In January 2006, a capsule from Stardust will parachute down to Earth carrying samples of comet dust captured during the flyby. Once scientists get these tiny grains under their microscopes, they'll get their first glimpse at the primordial makings of the solar system.

(Continued on page 8)
Astronomers find the biggest stars
A team of astronomers led by Philip Massey of Lowell Observatory reports finding three red supergiant stars bigger than any known. The previous record-holder, Mu Cephei, now ranks fourth in size.

The three largest stars are KW Sagittarii (distance: 9,800 light-years), V354 Cephei (9,000 light-years), and KY Cygni (5,200 light-years); all have diameters roughly 1,500 times the Sun’s. The well-known red supergiant star Betelgeuse is comparatively small, at just 650 times bigger than the Sun. If any of the newly identified big stars replaced the Sun, its surface would reach to between the orbits of Jupiter and Saturn.

The team’s observations, made using telescopes in Arizona and Chile, yielded the most accurate temperatures for this kind of star, finally reconciling theory with observations. The coolest stars’ temperatures were about 3,450 kelvins, or 5,720° F. This is about 10 percent warmer than previously thought. By combining distance estimates with the new temperature measurements, the astronomers were able to calculate the stars’ sizes.

“These stars aren't the most massive known,” says team member Emily Levesque, an undergraduate student at MIT. Nor, she says, are these the most luminous — or even the coolest. "But the combination of modestly high luminosities and relatively low temperatures does make them the biggest stars known,” she says.

The team’s next step will be to look at stars in the Large and Small Magellanic Clouds, where stars have fewer heavy elements (“metals” in astrophysicists’ jargon) than those in the Milky Way. "We expect these stars will prove even bigger,” says Levesque. "Metal-poor stars tend to be larger."

Surfing a wave in space-time
Hot gas falling into a spinning black hole is surfing a wave in space-time, according to two astronomers. The black hole GRS 1915+105, which weighs about 14 suns and lies about 40,000 light-years away, is dragging the framework of space-time forward as it spins, producing a wave predicted by Albert Einstein's theory of general relativity.

According to Jon Miller of the Harvard-Smithsonian Center for Astrophysics, lead author of the study, “The black hole draws matter off the companion star which settles into an accretion disk around the black hole.” Looking at the innermost part of the disk, the astronomers study X-ray emission as matter becomes extremely heated through gravitational compression. At that point, Miller says, the material is making hundreds of revolutions every second.

Using the Rossi X-ray Timing Explorer satellite, Miller and coworker Jeroen Homan of MIT identified quasi-periodic pulses in the X-ray emission, which came from extremely hot iron atoms. The periodic changes, about one each second, hinted time was running differently for the material close to the black hole compared to the rest of the accretion disk (and universe).

One solution to the puzzle, Miller and Homan suggest, is that the extreme velocities in the inner accretion disk show the "frame-dragging" effect predicted by general relativity. In essence, the 1-second periodicity is the signature of the spinning wave of space-time close to the black hole. Each time the infalling, hot iron gas hits the space-time wave, it gets a jolt and the X-ray emission changes. Even if this model doesn't prove out, says the pair, the close coupling of the periodicity and the emission will help astronomers better understand black holes.

Miller and Homan's report will be published in an upcoming issue of the Astrophysical Journal Letters.

Recent collision at Vega
Astronomers have found a dusty disk around the bright star Vega is the relatively recent product of a collid-
compromise action in the Congress."

Bahcall said that Hubble has contributed enormously to scientific knowledge and to America’s respect abroad. The telescope represents achievements of which all Americans can be proud, he said.

"I am confident that Americans of all walks of life will come to the defense of the Hubble and cause the Congress to restore the repair of the telescope to the NASA budget," Bahcall said.

Telerobotic progress

Excellent progress is being made on a telerobotic approach to servicing the Hubble, said Jim Crocker, vice president of civil space at Lockheed Martin Space Systems of Denver. The firm has supported NASA’s planning and then repair and servicing of the HST via four space shuttle missions to date.

The telerobotics team at work at Goddard Space Flight Center “have a good shot at pulling this off,” Crocker told SPACE.com the day before the Space News story on the White House HST decision appeared.

Lockheed Martin’s role in the rocket-launched Hubble Robotic Vehicle Deorbit Module (HRVDM), Crocker said, is providing all the sensors to do the rendezvous and docking with the Hubble, as well as provide the liquid-fueled propellant module that would later deorbit the telescope.

For their part, Canada’s MacDonald, Dettwiler and Associates (MDA) Ltd. -- through its MD Robotics group in Brampton, Ontario -- is providing the Dextre robot that’s part of the HRVDM. It is being specially configured to replace batteries, gyroscopes, and perhaps an instrument on the HST to extend its life.

NASA’s Goddard Space Flight Center is overseeing and integrating the HRVDM work.

Crocker said that simulations performed at NASA’s Goddard Space Flight center have converted doubters, including him, that performing many of the scheduled Hubble servicing tasks through the tender loving care of telerobotics is feasible.

"That’s not to say it’s not challenging," Crocker said, "but the team is making a convincing story."

There’s also good news to report in keeping Hubble in an operating mode. Worry centers on HST’s gyroscopes, batteries, or other gear that might fail early, negating the observatory’s useful lifetime.

"The team continues to pull rabbits out of the hat," Crocker said. For instance, a two gyro science mode, along with the needed software has been worked out. HST’s original design had to have three gyros working to do science. Additionally, a new battery management approach is being adopted.

"That’s good news," Crocker said. "I’m hearing we’re likely to be able to get [HST] into 2008 now."

At the end of the day, Crocker concluded, whatever option is decided upon for Hubble servicing and its ultimate reentry, "everyone on the team wants the best chance of success possible."

Here's heading our way: ancient, hard-won, possibly surprising and definitely precious dust from the construction zone.

Find out more about the Stardust mission at stardust.jpl.nasa.gov. Kids can read about comets, play the “Tails of Wonder” game about comets, and hear a rhyming story about aerogel at http://spaceplace.nasa.gov/en/kids/stardust/. This article was provided by the Jet Propulsion Laboratory, California Institute of Technology, under a contract with the National Aeronautics and Space Administration.
A Rare Glimpse of Mare Orientale

By Charles A. Wood, Sky & Telescope

Spectacular Orientale is the youngest large basin on the Moon, but it’s centered at 95° west longitude, just beyond the western limb of the Moon. Fortunately, favorable librations tip the Moon so that Orientale’s main rings and mare lava flows occasionally come into view. This time around the Orientale observing season begins in November 2004 and ends in March 2005 — the exact dates are listed at the bottom of this page. The prime time for viewing falls early in 2005 — from January 29th to February 2nd and February 27 to March 2 inclusive.

In fact, William K. Hartmann discovered the true multi-ring nature of the basin by examining Earth-based photographs projected onto a sphere. But we had to wait for the spectacular Lunar Orbiter photographs in 1967 to appreciate the full glory of the Orientale basin.

Orientale has two large concentric rims — the 930-kilometer-diameter Cordillera Mountains and 620-km-wide Rook Mountains. The Cordillera peaks rise 1.25 kilometers above the surrounding highlands, and the floor of Mare Orientale is about 6 km below the peaks. Thus, this vast hole — more than 900 km wide — is very shallow, with only 6 km of total relief.

Finding Orientale should be straightforward. Simply look along the limb just to the south of the well-defined dark patch of the crater Grimaldi. The long strips of dark lavas making up the two lakes will confirm your sighting of Orientale. With a high Sun over the western limb the dark mare lava flows stand out distinctly against the bright crust. Lacus Autumni is a patch of mare just inside the northern part of the Cordillera Mountains, while Lacus Veris is a much longer ribbon of mare that follows the inside of the Outer Rook Mountains. When librations are very favorable, Mare Orientale itself can be seen bordered by a low white range: the Inner Rooks. Profile views of the Rooks and Cordillera Mountains are sometimes visible as bumps on the limb of the Moon.

Charles Wood is a veteran lunar scientist, an amateur Moon watcher, and the author of The Modern Moon: A Personal View (available from Sky Publishing). He also maintains a “Lunar Photo of the Day” Web site that provides daily images and commentary about the Moon.