COMING EVENTS

Discovering Pluto
THURSDAY, FEB. 03
6:30 - 9:30 PM
Kansas Union Ballroom
PUBLIC OBSERVING
8:30 - 9:30 PM
Kansas Union

Regular Schedule
SUNDAY Feb. 27
8:00 - 9:30
Prairie Park Nature Center

President:
Rick Heschmeyer
rcjbm@sbcglobal.net

University Advisor:
Dr. Bruce Twarog
btwarog@ku.edu

Webmaster:
Gary Webber
gwebber@ku.edu

Observing Clubs
Doug Fay
dfay@ku.edu

Report from the Officers:
The time has come. As part of the sesquicentennial celebration of statehood for Kansas, we will be honoring Clyde Tombaugh, Kansan and KU alum who made a unique mark in the history of astronomy through his discovery of the planet Pluto before ever attending college. After the discovery, Clyde returned to Lawrence to get a BA and MA in Astronomy before embarking on a long and distinguished career in astronomy, primarily in New Mexico. We hope to fill the Kansas Union Ballroom to learn a little about astronomy in Kansas at 6:30, followed at 7:30 PM by a talk by author Michael Byers about his novel, Percival’s Planet, which features Clyde and the search for Planet X as a major element in the narrative. Wear your Pluto T-shirt (available at the KU Bookstore) to the event. Also Michael (Continued on page 2)

Volume 37 Number 02 February 2011

Report from the Officers:
The time has come. As part of the sesquicentennial celebration of statehood for Kansas, we will be honoring Clyde Tombaugh, Kansan and KU alum who made a unique mark in the history of astronomy through his discovery of the planet Pluto before ever attending college. After the discovery, Clyde returned to Lawrence to get a BA and MA in Astronomy before embarking on a long and distinguished career in astronomy, primarily in New Mexico. We hope to fill the Kansas Union Ballroom to learn a little about astronomy in Kansas at 6:30, followed at 7:30 PM by a talk by author Michael Byers about his novel, Percival’s Planet, which features Clyde and the search for Planet X as a major element in the narrative. Wear your Pluto T-shirt (available at the KU Bookstore) to the event. Also Michael (Continued on page 2)

Insider News

INSIDE THIS ISSUE

Public Access (continued)
Swift finds Missing Galaxies
NASA Space Place
Discovering Pluto POSTER
HST: Space Oddity
Swift (continued)
WISE (continued)
WISE - Dancing Galaxies
Galactic City
Space Oddity (continued)

Public access for telescope data in works
By VICTORIA BLUTE - Arizona Daily Star

The Large Synoptic Survey Telescope is an impressive astronomy project that will allow scientists to conduct sophisticated research with cutting-edge data. But another major goal is engaging those with no professional astronomy experience - the public. The University of Arizona is a founding member of the project, which involves creating a robotically operated telescope and camera that will survey the sky and take panoramic photographs of tens of millions of stars and other objects per night. One project aim is to ensure the public has access to that data, said Suzanne Jacoby, head of the Tucson-based LSST Corp.’s education and public outreach program. The data will be used in science centers and museums nationwide, updated in nearly real time, Jacoby said. The program already is working with several institutions, including the Adler Planetarium in Chicago. Leaders also are in contact with their counterparts with the Hubble Space Telescope. Jacoby said the group plans to give the public access to data on the Web, too.

In developing public outreach, the team members are considering who examines data and what they want to do with it, she said. The public will likely want to use everyday tools such as computers and cell phones as well as large screens at planetariums to access LSST’s data, she said. But new technology may exist by the time the project is completed at the end of the decade, and the team will try to use that, too. In the meantime, the LSST project funded an iPhone application in July called "Transient Events" that allows users to examine the sky through telescope data from the Catalina Real-Time Transient Survey. The application monitors events it receives from the survey, such as changes in brightness or positioning of objects, and then alerts users.

Jacoby said the group also has an e-mail newsletter to raise awareness, as well as pages on Twitter, Facebook and YouTube. The group also has been brain-
Byers will be available after the talk to sign copies of his novel which can be purchased at the event for a 15% discount. On the same evening, starting at 8:30 PM, after Michael Byers’ talk, we will have our next public observing session from the 6th floor deck of the Kansas Union, weather permitting. We will return to our normal schedule on Sunday Feb. 27 at Prairie Park Nature Center.

It's that magic time of the year, i.e. our annual dues collection. We normally collect dues once per year in January. If you joined the club in the last few months, don’t worry, you’re fine. Despite what I said last newsletter, the rest of you will be receiving your annual notice over the next few weeks. Sorry for the delay.

Hope to see all of you in the huge crowd on Thursday.

(Continued from page 1)

storming different ways to heighten involvement. Edward Prather, an associate professor of astronomy at the UA and an LSST education and public outreach board member, explained that while it's one thing to have a lot of data, it's another to make it worthwhile for users.

"There's been careful thought about creating an investigative pathway that someone can enter on a cursory level," he said. "They'll be seeing stuff no one's seen, and there will be questions that can be answered for the first time ever." Prather said the project also has an emphasis on inspiring those at the earliest point of career paths to investigate fields such as science and potentially become the next innovators.

Jacoby agreed that involving students in the project will help pique their interest in science. "It's known that having students work on research projects is the best way to learn," she said. It isn't the first astronomy venture to include the public, Jacoby said. Data from the Sloan Digital Sky Survey in New Mexico is used in a project called Galaxy Zoo that allows members of the public to classify pictures of galaxies on their home computers, she said.

But the public isn't just doing busy work. Jacoby said that with enough citizen scientists, appropriate and correct classifications can be given to objects. "Hundreds of thousands of people look at it," she said. "It turns out if you have enough citizen scientists, they can do it with the same validity as a grad student or an expert."

The LSST board also has reached out to Zooniverse, a citizen science collaboration that involves researchers at the University of Oxford and Yale University, which developed Galaxy Zoo and work with scientists in many fields. Galaxy Zoo website users noticed strange green blobs in pictures that they dubbed “green peas,” which were actually dense, star-forming regions, Jacoby said. Scientists became interested in them and have asked for observing time around the world to follow up on those objects, she said. She said the work of citizen scientists has led to more than a million classifications used by astronomers. In turn, astronomers have published more than 20 scientific papers. It couldn't have been done without the public’s assistance, she said.

**LSST Facts**

* What will the LSST do? The telescope will collect 30 terabytes of data per night and store it in a database. One image will capture an area 49 times the size of the moon.

* How big is its camera? 3,200 megapixels.

* Where will it be located? The scope will be built in Cerro Pachon, Chile.

(Continued from page 1)
Swift Survey Finds 'Missing' Active Galaxies

Seen in X-rays, the entire sky is aglow. Even far away from bright sources, X-rays originating from beyond our galaxy provide a steady glow in every direction. Astronomers have long suspected that the chief contributors to this cosmic X-ray background were dust-swaddled black holes at the centers of active galaxies. The trouble was, too few of them were detected to do the job.

An international team of scientists using data from NASA's Swift satellite confirms the existence of a largely unseen population of black-hole-powered galaxies. Their X-ray emissions are so heavily absorbed that little more than a dozen are known. Yet astronomers say that despite the deeply dimmed X-rays, the sources may represent the tip of the iceberg, accounting for at least one-fifth of all active galaxies.

"These heavily shrouded black holes are all around us," said Neil Gehrels, the Swift principal investigator at NASA's Goddard Space Flight Center in Greenbelt, Md., and a co-author of the new study. "But before Swift, they were just too faint and too obscured for us to see."


Most large galaxies contain a giant central black hole, and those observed in the Swift study weigh in at about 100 million times the sun's mass. In an active galaxy, matter falling toward the supermassive black hole powers high-energy emissions so intense that two classes of active galaxies, quasars and blazars, rank as the most luminous objects in the universe.

The X-ray background led astronomers to suspect that active galaxies were undercounted. Astronomers could never be certain that they had detected most of even the closest active galaxies. Thick clouds of dust and gas surround the central black hole and screen out ultraviolet, optical and low-energy (or soft) X-ray light. While infrared radiation can make it through the material, it can be confused with warm dust in the galaxy's star-forming regions.

However, some of the black hole's more energetic X-rays do penetrate the shroud, and that's where Swift comes in.

Since 2004, Swift's Burst Alert Telescope (BAT), developed and operated at NASA Goddard, has been mapping the entire sky in hard X-rays with energies between 15,000 and 200,000 electron volts -- thousands of times the energy of visible light. Gradually building up its exposure year after year, the survey is now the largest, most sensitive and most complete census at these energies. It includes hundreds of active galaxies out to a distance of 650 million light-years.

From this sample, the researchers eliminated sources less than 15 degrees away from the dusty, crowded plane of our own galaxy. All active galaxies sporting an energetic particle jet were also not considered, leaving 199 galaxies. Although there are many different types of active galaxy, astronomers explain the different observed properties based on how the galaxy angles into our line of sight. We view the brightest ones nearly face on, but as the angle increases, the surrounding ring of gas and dust absorbs increasing amounts of the black hole's emissions.

Astronomers assumed that there were many active galaxies oriented edgewise to us, but they just couldn't be detected because the disk of gas attenuates emissions too strongly. "These extremely obscured active galaxies are very faint and difficult to find. Out of a sample of 199 sources, we detected only nine of them," said Davide Burlon, the lead author.
Red star, blue star, big star, small star—planets may form around virtually any type or size of star throughout the universe, not just around mid-sized middle-aged yellow stars like the Sun. That’s the surprising implication of two discoveries in 2006 from the 0.85-meter-diameter Spitzer Space Telescope, which is exploring the universe from orbit at infrared (heat) wavelengths blocked by the Earth’s atmosphere.

At one extreme are two blazing, blue “hypergiant” stars 180,000 light-years away in the Large Magellanic Cloud, one of the two companion galaxies to our Milky Way. The stars, called R 66 and R 126, are respectively 30 and 70 times the mass of the Sun, “about as massive as stars can get,” said Joel Kastner, professor of imaging science at the Rochester Institute of Technology in New York. R 126 is so luminous that if it were placed 10 parsecs (32.6 light-years) away—a distance at which the Sun would be one of the dimmest stars visible in the sky—the hypergiant would be as bright as the full moon, “definitely a daytime object,” Kastner remarked.

Such hot stars have fierce solar winds, so Kastner and his team are mystified why any dust in the neighborhood hasn’t long since been blown away. But there it is: an unmistakable spectral signature that both hypergiants are surrounded by mammoth disks of what might be planet-forming dust and even sand.

At the other extreme is a tiny brown dwarf star called Cha 110913-773444, relatively nearby (500 light-years) in the Milky Way. One of the smallest brown dwarfs known, it has less than 1 percent the mass of the Sun. It’s not even massive enough to kindle thermonuclear reactions for fusing hydrogen into helium. Yet this miniature “failed star,” as brown dwarfs are often called, is also surrounded by a flat disk of dust that may eventually clump into planets. (This brown dwarf discovery was made by a group led by Kevin Luhman of Pennsylvania State University.)

Although actual planets have not been detected (in part because of the stars’ great distances), the spectra of the hypergiants show that their dust is composed of forsterite, olivine, aromatic hydrocarbons, and other geological substances found on Earth.

These newfound disks represent “extremes of the environments in which planets might form,” Kastner said. “Not what you’d expect if you think our solar system is the rule.”

Hypergiants and dwarfs? The Milky Way could be crowded with worlds circling every kind of star imaginable—very strange, indeed.

Artists rendering compares size of a hypothetical hypergiant star and its surrounding dusty disk to that of our solar system.

Keep up with the latest findings from the Spitzer at www.spitzer.caltech.edu. Kids and their grownup friends can enjoy beautiful images from Spitzer while playing Spitzer Concentration at The Space Place (spaceplace.nasa.gov/en/kids/spitzer/concentration). This article was provided by the Jet Propulsion Laboratory, California Institute of Technology, under contract with the National Aeronautics and Space Administration.
Discovering Pluto

An Evening with Michael Byers
Author of Percival’s Planet - A Novel

Thursday, February 3, 2011
6:30 - 9:30 pm, Kansas Union Ballroom

Co-sponsored by KU Bookstore, KU Memorial Unions, KU Department of Physics & Astronomy, KU Hall Center for the Humanities, and The Commons

Celebrating Kansan Clyde Tombaugh and the discovery of Pluto

Introduction by Steven A. Hawley, KU Professor of Physics & Astronomy, former NASA Astronaut

Guided Display by the KU Astronomy Department

Byers Book Signing

Birthday Cake for Clyde Tombaugh, Discoverer of Pluto

Telescope Observing Session: Union 6th floor deck

7:30 pm
Michael Byers Presentation

8:30 pm
Telescope Observing Session: Union 6th floor deck
Hubble Zooms in on a Space Oddity

One of the strangest space objects ever seen is being scrutinized by the penetrating vision of NASA’s Hubble Space Telescope. A mysterious, glowing green blob of gas is floating in space near a spiral galaxy. Hubble uncovered delicate filaments of gas and a pocket of young star clusters in the giant object, which is the size of our Milky Way galaxy.

The Hubble revelations are the latest finds in an ongoing probe of Hanny’s Voorwerp (Hanny’s Object in Dutch), named for Hanny van Arkel, the Dutch teacher who discovered the ghostly structure in 2007 while participating in the online Galaxy Zoo project. Galaxy Zoo enlists the public to help classify more than a million galaxies catalogued in the Sloan Digital Sky Survey. The project has expanded to include the Hubble Zoo, in which the public is asked to assess tens of thousands of galaxies in deep imagery from the Hubble Space Telescope.

In the sharpest view yet of Hanny’s Voorwerp, Hubble’s Wide Field Camera 3 and Advanced Camera for Surveys have uncovered star birth in a region of the green object that faces the spiral galaxy IC 2497, located about 650 million light-years from Earth. Radio observations have shown an outflow of gas arising from the galaxy’s core. The new Hubble images reveal that the galaxy’s gas is interacting with a small region of Hanny’s Voorwerp, which is collapsing and forming stars. The youngest stars are a couple of million years old.

“The star clusters are localized, confined to an area that is over a few thousand light-years wide,” explains astronomer William Keel of the University of Alabama in Tuscaloosa, leader of the Hubble study. “The region may have been churning out stars for several million years. They are so dim that they have previously been lost in the brilliant light of the surrounding gas.”

Recent X-ray observations have revealed why Hanny’s Voorwerp caught the eye of astronomers. The galaxy’s rambunctious core produced a quasar, a powerful light beacon powered by a black hole. The quasar shot a broad beam of light in Hanny’s Voorwerp’s direction, illuminating the gas cloud and making it a space oddity. Its bright green color is from glowing oxygen.

(Continued on page 10)
Messier 82 (top of image) is also a spiral galaxy. However, it is seen edge-on from our point of view. It was originally classified as an irregular galaxy, until 2005, when astronomers were able to tease out spiral structure in near-infrared images (similar to wavelengths that WISE sees). Viewed in visible wavelengths, this galaxy appears to have a long thin bar shape, hence its common name, the Cigar Galaxy.

Messier 82 is also a starburst galaxy, meaning it is currently forming stars at an exceptionally high rate. This huge burst of activity was caused by its close encounter with Messier 81, whose gravitational influence caused gas near the center of Messier 82 to rapidly compress. This compression triggered an explosion of star formation, concentrated near the core. The intense radiation from all of the newly formed massive stars creates a galactic "supernova" that is blowing massive amounts of gas and dust out perpendicular to the plane of the galaxy. This ejected material (seen as the orange/yellow areas extending up and down) is made mostly of polycyclic aromatic hydrocarbons, which are common products of combustion here on Earth. It can literally be thought of as the smoke from the cigar.

A third, smaller galaxy, NGC 3077, can be seen at lower left. This spiral galaxy belongs to the same group as Messier 81 and Messier 82 -- a group that includes at least a dozen gravitationally linked galaxies. NGC 3077 is also experiencing a burst of new star birth, likely triggered by its interaction with Messier 81.

Messier 81 and Messier 82 are both very bright galaxies and can be seen on a clear, dark night with binoculars in the northern constellation Ursa Major, which contains the Big Dipper. In visible light, Messier 81 is one of the brightest galaxies that can be seen. Messier 82 is not as bright at visible wavelengths, but in infrared light, it is by far the brightest galaxy in the entire night sky.

This image was made from observations by all four infrared detectors aboard WISE. Blue and cyan (blue-green) represent infrared light at wavelengths of 3.4 and 4.6 microns, which is primarily light from stars. Green and red represent light at 12 and 22 microns, which is primarily emission from warm dust.

(Continued from page 8)

of the study and a graduate student at the Max Planck Institute for Extraterrestrial Physics in Munich. "But even Swift's BAT has trouble finding these highly absorbed sources, and we know that the survey undercounts them," Burlon explained. "When we factored this in, we found that these shrouded active galaxies are very numerous, making up about 20 to 30 percent of the total."

"With Swift we have now quantified exactly how many active galaxies there are around us -- really, in our back yard," said Marco Ajello at the SLAC National Accelerator Laboratory, Menlo Park, Calif. "The number is large, and it agrees with models that say they are responsible for most of the X-ray background." If the numbers remain consistent at greater distances, when the universe was substantially younger, then there are enough supermassive black holes to account for the cosmic X-ray background.

The team then merged Swift BAT data with archived observations from its X-Ray Telescope in an effort to study how the intensity of the galaxies' emissions changed at different X-ray energies. "This is the first time we could investigate the average spectrum of heavily absorbed active galaxies," said Ajello. "These galaxies are responsible for the shape of the cosmic X-ray background -- they create the peak of its energy."

All of this is consistent with the idea that the cosmic X-ray background is the result of emission from obscured supermassive black holes active when the universe was 7 billion years old, or about half its current age.

(Continued from page 9)

of more than 30 million suns. Massive black holes are common in present-day galaxy clusters, but this is the first time a feeding black hole of this heft has been linked to a cluster that is so young.

Finally, the Institut de Radioastronomie Millimétrique's interferometer telescope in France and 30-meter (about 100-foot) telescope in Spain, along with the National Radio Astronomy Observatory's Very Large Array telescope in New Mexico, measured the amount of gas, or fuel for future star formation, in the cluster. The results indicate the cluster will keep growing into a modern city of galaxies.

"It really did take a village of telescopes to nail this cluster," said Capak. "Observations across the electromagnetic spectrum, from X-ray to millimeter wavelengths, were all critical in providing a comprehensive view of the cluster's many facets."

COSMOS-AzTEC3, located in the constellation Sextans, is named after the region where it was found, called COSMOS after the Cosmic Evolution Survey. AzTEC is the name of the camera used on the James Clerk Maxwell Telescope; this camera is now on its way to the Large Millimeter Telescope located in Mexico's Puebla state.
WISE Beholds a Pair of Dancing Galaxies

This image from NASA's Wide-Field Infrared Survey Explorer, or WISE, features two stunning galaxies engaged in an intergalactic dance. The galaxies, Messier 81 and Messier 82, swept by each other a few hundred million years ago, and will likely continue to twirl around each other multiple times before eventually merging into a single galaxy. The relatively recent encounter triggered a spectacular burst of star formation visible in both galaxies.

Messier 81 (bottom of image) is a prototypical "grand design" spiral galaxy with its pronounced and well-defined arms spiraling into its core. At the wavelengths WISE sees, these beautiful arms show areas of compressed interstellar gas and dust, which go hand-in-hand with areas of increased star formation. The spiral density waves that create this compression and star formation have been enhanced by the close gravitational interaction with its partner galaxy, Messier 82, causing the arms to appear more prominent than what is typically seen in other isolated spiral galaxies.

(Continued on page 7)
Galactic City at the Edge of the Universe

Astronomers have uncovered a burgeoning galactic metropolis, the most distant known in the early universe. This ancient collection of galaxies presumably grew into a modern galaxy cluster similar to the massive ones seen today. The developing cluster, named COSMOS-AzTEC3, was discovered and characterized by multi-wavelength telescopes, including NASA's Spitzer, Chandra and Hubble space telescopes, and the ground-based W.M. Keck Observatory and Japan's Subaru Telescope.

"This exciting discovery showcases the exceptional science made possible through collaboration among NASA projects and our international partners," said Jon Morse, NASA's Astrophysics Division director at NASA Headquarters in Washington.

Scientists refer to this growing lump of galaxies as a proto-cluster. COSMOS-AzTEC3 is the most distant massive proto-cluster known, and also one of the youngest, because it is being seen when the universe itself was young. The cluster is roughly 12.6 billion light-years away from Earth. Our universe is estimated to be 13.7 billion years old. Previously, more mature versions of these clusters had been spotted at 10 billion light-years away. The astronomers also found that this cluster is buzzing with extreme bursts of star formation and one enormous feeding black hole.

"We think the starbursts and black holes are the seeds of the cluster," said Peter Capak of NASA's Spitzer Science Center at the California Institute of Technology in Pasadena. "These seeds will eventually grow into a giant, central galaxy that will dominate the cluster -- a trait found in modern-day galaxy clusters." Capak is first author of a paper appearing in the Jan. 13 issue of the journal Nature.

Most galaxies in our universe are bound together into clusters that dot the cosmic landscape like urban sprawls, usually centered around one old, monstrous galaxy containing a massive black hole. Astronomers thought that primitive versions of these clusters, still forming and clumping together, should exist in the early universe. But locating one proved difficult-until now.

Capak and his colleagues first used the Chandra X-ray Observatory and the United Kingdom's James Clerk Maxwell Telescope on Mauna Kea, Hawaii, to search for the black holes and bursts of star formation needed to form the massive galaxies at the centers of modern galaxy cities. The astronomers then used the Hubble and Subaru telescopes to estimate the distances to these objects, and look for higher densities of galaxies around them. Finally, the Keck telescope was used to confirm that these galaxies were at the same distance and part of the same galactic sprawl.

Once the scientists found this lumping of galaxies, they measured the combined mass with the help of Spitzer. At this distance, the optical light from stars is shifted, or stretched, to infrared wavelengths that can only be observed in outer space by Spitzer. The lump sum of the mass turned out to be a minimum of 400 billion suns -- enough to indicate that the astronomers had indeed uncovered a massive proto-cluster. The Spitzer observations also helped confirm that a massive galaxy at the center of the cluster was forming stars at an impressive rate.

Chandra X-ray observations were used to find and characterize the whopping black hole with a mass

(Continued on page 7)
"We just missed catching the quasar, because it turned off no more than 200,000 years ago, so what we're seeing is the afterglow from the quasar," Keel says. "This implies that it might flicker on and off, which is typical of quasars, but we've never seen such a dramatic change happen so rapidly."

The quasar's outburst also may have cast a shadow on the blob. This feature gives the illusion of a gaping hole about 20,000 light-years wide in Hanny's Voorwerp. Hubble reveals sharp edges around the apparent opening, suggesting that an object close to the quasar may have blocked some of the light and projected a shadow on Hanny's Voorwerp. This phenomenon is similar to a fly on a movie projector lens casting a shadow on a movie screen. Radio studies have revealed that Hanny's Voorwerp is not just an island gas cloud floating in space. The glowing blob is part of a long, twisting rope of gas, or tidal tail, about 300,000 light-years long that wraps around the galaxy. The only optically visible part of the rope is Hanny's Voorwerp. The illuminated object is so huge that it stretches from 44,000 light-years to 136,000 light-years from the galaxy's core. The quasar, the outflow of gas that instigated the star birth, and the long, gaseous tidal tail point to a rough life for IC 2497. "The evidence suggests that IC 2497 may have merged with another galaxy about a billion years ago," Keel explains. "The Hubble images show in exquisite detail that the spiral arms are twisted, so the galaxy hasn't completely settled down."

In Keel's scenario, the merger expelled the long streamer of gas from the galaxy and funneled gas and stars into the center, which fed the black hole. The engorged black hole then powered the quasar, which launched two cones of light. One light beam illuminated part of the tidal tail, now called Hanny's Voorwerp. About a million years ago, shock waves produced glowing gas near the galaxy's core and blasted it outward. The glowing gas is seen only in Hubble images and spectra, Keel says. The outburst may have triggered star formation in Hanny's Voorwerp. Less than 200,000 years ago, the quasar dropped in brightness by 100 times or more, leaving an ordinary-looking core.

New images of the galaxy's dusty core from Hubble's Space Telescope Imaging Spectrograph show an expanding bubble of gas blown out of one side of the core, perhaps evidence of the sputtering quasar's final gasps. The expanding ring of gas is still too small for ground-based telescopes to detect.

"This quasar may have been active for a few million years, which perhaps indicates that quasars blink on and off on timescales of millions of years, not the 100 million years that theory had suggested," Keel says. He added that the quasar could light up again if more material is dumped around the black hole.