Calendar of Events

October Meeting
FRIDAY OCT. 23
7:30 PM—2001 Malott
Bruce Twarog
Cosmic Rays

LOCAL PUBLIC OBSERVING
FALL ASTRONOMY DAY
October 25
1:00-4:00 PM SOLAR OBS.
8:00—9:30 PM
Prairie Park Nature Center

November 22
8:00—9:30 PM

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As seen in the photo above, our monthly observing session was blessed by clear weather, quarter moon, and a nice crowd, but hindered by the lighting at the Nature Center. Hopefully, we can get this corrected by the session on OCT. 25. Note that Oct. 25 is Fall ASTRONOMY DAY and Rick will be set up in the afternoon (1-4PM) for Solar Observing, weather permitting. If you can help in the afternoon or evening, please contact Rick.

Our next meeting is a little later than usual, Friday Oct. 23, due to Fall break at KU the previous weekend. The speaker will be Dr. Twarog discussing Cosmic Ray Astronomy and what it means for Astronomy and, surprisingly, (Continued on page 2)

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Report from the Officers:
The September meeting was well attended with an informative lecture by Dave Kolb providing insight into the tricks of the trade for those interested in quality imaging and video with a small telescope and off-the-shelf hardware and software. A few references are cited at the end of this column for those interested in more.

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A Cosmic Welcome to new AAL Member and KU student: Paula Hawman

Of Regional Interest: HST ALIVE and WELL

Astronomers declared NASA’s Hubble Space Telescope a fully rejuvenated observatory with the release Wednesday of observations from four of its six operating science instruments.

Topping the list of new views are colorful, multi-wavelength pictures of far-flung galaxies, a densely packed star cluster, an eerie "pillar of creation," and a "butterfly" nebula. Hubble's suite of new instruments allows it to study the universe across a wide swath of the light spectrum, from ultraviolet all the way to near-infrared. In addition, scientists released spectroscopic observations that slice across billions of light-years to probe the cosmic-web structure of the universe and map the distribution of elements that are fundamental to life as we know it.

"This marks a new beginning for Hubble," said Ed Weiler, associate administrator for NASA's Science Mission Directorate at NASA Headquarters in Washington. "The telescope was given an extreme makeover and now is significantly more powerful than ever, well-equipped to last into the next decade."

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for Kansas! Join us for some refreshments and entertaining conversation. Our Nov. meeting will be the usual Cub Scout education session which should draw ~250 people. The tentative date is Friday Nov. 13, but we should have all the scheduling info resolved by the next newsletter. Make a note about this since it does require significant participation by club members to pull this off. As always, if you have a telescope you feel unsure about using, bring it to one of the observing sessions and one of the talented and experienced club members will be more than happy to supply some expert advice on improving your telescope experience. If anyone has any ideas, suggestions, or input on how we can make the club better, please contact Rick (rcjbm@sbcglobal.net).

References Provided by Dave Kolb

QuickCam and Unconventional Imaging Astronomy Group  http://www.qcuiag.co.uk/
Introduction to Webcam Astrophotography by Robert Reeves, Willmann-Bell, Inc.  http://www.willbell.com
How to Process Planetary Images by Don C. Parker, Sky & Telescope, Jan. 2007, p. 129
The Handbook of Astronomical Image Processing by Richard Berry and James Burnell, Willmann-Bell, 2nd ed., 2005
High Resolution Astrophotography by Jean Dragesco, Cambridge University Press, 1995
Observing and Photographing the Solar System by Thomas Dobbins, Don Parker, and Charles Reinhart, Willmann-Bell, 1992

The new instruments are more sensitive to light and, therefore, will improve Hubble’s observing efficiency significantly. It is able to complete observations in a fraction of the time that was needed with prior generations of Hubble instruments. The space observatory today is significantly more powerful than it ever has been.

“We couldn’t be more thrilled with the quality of the images from the new Wide Field Camera 3 (WFC3) and repaired Advanced Camera for Surveys (ACS), and the spectra from the Cosmic Origins Spectrograph (COS) and the Space Telescope Imaging Spectrograph (STIS),” said Keith Noll, leader of a team at the Space Telescope Science Institute in Baltimore, which planned the early release observations. “The targets we’ve selected to showcase the telescope reveal the great range of capabilities in our newly upgraded Hubble.”

These results are compelling evidence of the success of the STS-125 servicing mission in May, which has brought the space observatory to the apex of its scientific performance. Two new instruments, the WFC3 and COS, were installed, and two others, the ACS and STIS, were repaired at the circuit board level. Mission scientists also announced Wednesday that the Near Infrared Camera and Multi-Object Spectrometer was brought back into operation during the three months of calibration and testing.

“On this mission we wanted to replenish the ‘tool kit’ of Hubble instruments on which scientists around the world rely to carry out their cutting-edge research,” said David Leckrone, senior project scientist for Hubble at NASA’s Goddard Space Flight Center in Greenbelt, Md. “Prior to this servicing mission, we had only three unique instrument channels still working, and today we have 13. I’m very proud to be able to say, ‘mission accomplished.’ ”

For the past three months, scientists and engineers at the Space Telescope Science Institute and Goddard have been focusing, testing, and calibrating the instruments. Hubble is one of the most complex space telescopes ever launched, and the Hubble servicing mission astronauts performed major surgery on the 19-year-old observatory’s multiple systems. This orbital
NASA Instruments Reveal Water Molecules on Lunar Surface
NASA PRESS RELEASE

NASA scientists have discovered water molecules in the polar regions of the moon. Instruments aboard three separate spacecraft revealed water molecules in amounts that are greater than predicted, but still relatively small. Hydroxyl, a molecule consisting of one oxygen atom and one hydrogen atom, also was found in the lunar soil. The findings were published in Thursday's edition of the journal Science.

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NASA's Moon Mineralogy Mapper, or M3, instrument reported the observations. M3 was carried into space on Oct. 22, 2008, aboard the Indian Space Research Organization's Chandrayaan-1 spacecraft. Data from the Visual and Infrared Mapping Spectrometer, or VIMS, on NASA's Cassini spacecraft, and the High-Resolution Infrared Imaging Spectrometer on NASA's Epoxi spacecraft contributed to confirmation of the finding. The spacecraft imaging spectrometers made it possible to map lunar water more effectively than ever before. The confirmation of elevated water molecules and hydroxyl at these concentrations in the moon's polar regions raises new questions about its origin and effect on the mineralogy of the moon. Answers to these questions will be studied and debated for years to come.

"Water ice on the moon has been something of a holy grail for lunar scientists for a very long time," said Jim Green, director of the Planetary Science Division at NASA Headquarters in Washington. "This surprising finding has come about through the ingenuity, perseverance and international cooperation between NASA and the India Space Research Organization." From its perch in lunar orbit, M3's state-of-the-art spectrometer measured light reflecting off the moon's surface at infrared wavelengths, splitting the spectral colors of the lunar surface into small enough bits to reveal a new level of detail in surface composition. When the M3 science team analyzed data from the instrument, they found the wavelengths of light being absorbed were consistent with the absorption patterns for water molecules and hydroxyl.

"For silicate bodies, such features are typically attributed to water and hydroxyl-bearing materials," said Carle Pieters, M3's principal investigator from Brown University, Providence, R.I. "When we say 'water on the moon,' we are not talking about lakes, oceans or even puddles. Water on the moon means molecules of water and hydroxyl that interact with molecules of rock and dust specifically in the top millimeters of the moon's surface. The M3 team found water molecules and hydroxyl at diverse areas of the sunlit region of the moon's surface, but the water signature appeared stronger at the moon's higher latitudes. Water molecules and hydroxyl previously were suspected in data from a Cassini flyby of the moon in 1999, but the findings were not published until now.

"The data from Cassini's VIMS instrument and M3 closely agree," said Roger Clark, a U.S. Geological Survey scientist in Denver and member of both the VIMS and M3 teams. "We see both water and hydroxyl. While the abundances are not precisely known, as much as 1,000 water molecule parts-per-million could be in the lunar soil. To put that into perspective, if you harvested one ton of the top layer of the moon's surface, you could get as much as 32 ounces of water."

For additional confirmation, scientists turned to the Epoxi mission while it was flying past the moon in June 2009 on its way to a November 2010 encounter with comet Hartley 2. The spacecraft not only confirmed the VIMS and M3 findings, but also expanded on them. "With our extended spectral range and views over the north pole, we were able to explore the distribution of both water and hydroxyl as a function of temperature, latitude, composition, and time of day," said Jessica Sunshine of the University of Maryland. Sunshine is Epoxi's deputy principal investigator and a scientist on the M3 team. "Our analysis unequivocally confirms the presence of these molecules on the moon's surface and reveals that the entire surface appears to be hydrated during at least some portion of the lunar day." NASA's Jet Propulsion Laboratory, Pasadena, Calif., manages the M3 instrument, Cassini mission and Epoxi spacecraft for NASA's Science Mission Directorate in Washington. The Indian Space Research Organization built, launched and operated the Chandrayaan-1 spacecraft.
Spitzer, the Sequel

The Spitzer Space Telescope is getting a second chance at life. The liquid helium “lifeblood” that flows through the telescope has finally run out, bringing Spitzer’s primary mission to an end. But a new phase of this infrared telescope’s exploration of the universe is just beginning.

Even without liquid helium, which cooled the telescope to about 2 degrees above absolute zero (-271°C), Spitzer will continue to do important research—some of which couldn’t easily be done during its primary mission. For example, scientists will use Spitzer’s “second life” to explore the rate of expansion of the universe, study variable stars, and search for near-Earth asteroids that could pose a threat to our planet.

“We always knew that a ‘warm phase’ of the mission was a possibility, but it became ever more exciting scientifically as we started to plan for it seriously,” says JPL’s Michael Werner, Project Scientist for Spitzer. “Spitzer is just going on and on like the Energizer bunny.”

Launched in August 2003 as the last of NASA’s four Great Observatories, Spitzer specializes in observing infrared light, which is invisible to normal, optical telescopes. That gives Spitzer the power to see relatively dark, cool objects such as planet-forming discs or nearby asteroids. These objects are too cold to emit light at visible wavelengths, but they’re still warm enough to emit infrared light.

In fact, all warm objects “glow” with infrared light—even telescopes. That’s why Spitzer had to be cooled with liquid helium to such a low temperature. Otherwise, it would be blinded by its own infrared glow.

As the helium expires, Spitzer will warm to about 30 degrees above absolute zero (–243°C). At that temperature, the telescope will begin emitting long-wavelength infrared light, but two of its short-wavelength sensors will still work perfectly.

And with more telescope time available for the remaining sensors, mission managers can more easily schedule new research proposals designed for those sensors. For example, scientists have recently realized how to use infrared observations to improve our measurements of the rate of expansion of the universe. And interest in tracking near-Earth objects has grown in recent years—a task for which Spitzer is well suited.

“Science has progressed, and people always have new ideas,” Werner says. In its second life, Spitzer will help turn those ideas into new discoveries.

For kids, The Space Place Web site has a fun typing game using Spitzer and infrared astronomy words. Check it out at spaceplace.nasa.gov/en/kids/spitzer/signs.
COSMIC RAYS: Postcards from WHAT Edge?

Bruce Twarog
Physics & Astronomy, KU
FRIDAY Oct. 23, 2009
7:30 PM
2001 Malott Hall
University of Kansas
FREE AND OPEN TO THE PUBLIC
The verification phase was interrupted briefly July 23 to observe Jupiter in the aftermath of a collision with a suspected comet.

Hubble now enters a phase of full science observations. The demand for observing time will be intense. Observations will range from studying the population of Kuiper Belt objects at the fringe of our solar system to surveying the birth of planets around other stars and probing the composition and structure of extrasolar planet atmospheres. There are ambitious plans to take the deepest-ever near-infrared portrait of the universe to reveal never-before-seen infant galaxies that existed when the universe was less than 500 million years old. Other planned observations will attempt to shed light on the behavior of dark energy, a repulsive force that is pushing the universe apart at an ever-faster rate.

The Hubble Space Telescope is a project of international cooperation between NASA and the European Space Agency. Goddard manages the telescope. The Space Telescope Science Institute conducts Hubble science operations. The institute is operated for NASA by the Association of Universities for Research in Astronomy, Inc. in Washington, and is an International Year of Astronomy 2009 program partner.

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Because nuclei of superheavy elements are rare and short-lived, both the Dubna group and the Berkeley group use gas-filled separators, in which dilute gas and tuned magnetic fields sweep the copious debris of beam-target collisions out of the way, ideally leaving only compound nuclei with the desired mass to reach the detector. The Berkeley Gas-filled Separator had to be modified for radioactive containment before radioactive targets could be used.

In sum, says Gregorich, "The high beam intensities from the 88-Inch Cyclotron, together with the efficient background suppression of the BGS, allow us to look for nuclear reaction products with very small cross-sections – that is, very low probabilities of being produced. In the case of element 114, that turned out to be just two nuclei in eight days of running the experiment almost continuously."

Tracking the isotopes of 114

The researchers identified the two isotopes as $^{286}\text{114}$ (114 protons and 172 neutrons) and $^{287}\text{114}$ (114 protons and 173 neutrons). The former, $^{286}\text{114}$, decayed in about a tenth of a second by emitting an alpha particle (2 protons and 2 neutrons, a helium nucleus) – thus becoming a “daughter” nucleus of element 112 – which subsequently spontaneously fissioned into smaller nuclei. The latter, $^{287}\text{114}$, decayed in about half a second by emitting an alpha particle to form 112, which also then emitted an alpha particle to form daughter element 110, before spontaneously fissioning into smaller nuclei.

The Berkeley Group’s success in finding these two 114 nuclei and tracking their decay depended on sophisticated methods of detection, data collection, and concurrent data analysis. After passing through the BGS, the candidate nucleus enters a detector chamber. If a candidate element 114 atom is detected, and is subsequently seen to decay by alpha-particle emission, the cyclotron beam instantly shuts off so further decay events can be recorded without background interference.

In addition to such automatic methods of enhancing data collection, the data was analyzed by completely independent software programs, one written by Gregorich and refined by team member Liv Stavsetra, another written by team member Jan Dvořák.

“One surprise was that the 114 nuclei had much smaller cross sections – were much less likely to form – than the Dubna group reported,” Nitsche says. “We expected to get about six in our eight-day experiment but only got two. Nevertheless, the decay modes, lifetimes, and energies were all consistent with the Dubna reports and amply confirm their achievement.”

Says Gregorich, “Based on the ideas of the 1960s, we thought when we got to element 114 we would have reached the Island of Stability. More recent theories suggest enhanced stability at other proton numbers, perhaps 120, perhaps 126. The work we’re doing now will help us decide which theories are correct and how we should modify our models.”

Nitsche adds, “During the last 20 years, many relatively stable isotopes have been discovered that lie between the known heavy element isotopes and the Island of Stability – essentially they can be considered as ‘stepping stones’ to this island. The question is, how far does the Island extend – from 114 to perhaps 120 or 126? And how high does it rise out the Sea of Instability.”

The accumulated expertise in Berkeley Lab’s Nuclear Science Division; the recently upgraded Berkeley Gas-filled Separator that can use radioactive targets; the more powerful and versatile VENUS ion source that will soon come online under the direction of operations program head Daniela Leitner – all add up to Berkeley Lab’s 88-Inch Cyclotron remaining highly competitive in the ongoing search for a stable island in the sea of nuclear instability.

The companion would have to be close in order to move the material around so fast — about one-tenth the distance between Earth and the sun. The astronomers plan to follow up with ground-based telescopes to see if a companion is tugging on the star hard enough to be perceived. Spitzer will also observe the system again in its “warm” mission to see if the changes are periodic, as would be expected with an orbiting companion. Spitzer ran out of coolant in May of this year, and is now operating at a slightly warmer temperature with two infrared channels still functioning.

"For astronomers, watching anything in real-time is exciting," said Muzerolle. "It’s like we’re biologists getting to watch cells grow in a petri dish, only our specimen is light-years away."
Astronomers have witnessed odd behavior around a young star. Something, perhaps another star or a planet, appears to be pushing a clump of planet-forming material around. The observations, made with NASA's Spitzer Space Telescope, offer a rare look into the early stages of planet formation.

Planets form out of swirling disks of gas and dust. Spitzer observed infrared light coming from one such disk around a young star, called LRLL 31, over a period of five months. To the astronomers’ surprise, the light varied in unexpected ways, and in as little time as one week. Planets take millions of years to form, so it’s rare to see anything change on time scales we humans can perceive.

One possible explanation is that a close companion to the star — either a star or a developing planet — could be shoving planet-forming material together, causing its thickness to vary as it spins around the star.

"We don't know if planets have formed, or will form, but we are gaining a better understanding of the properties and dynamics of the fine dust that could either become, or indirectly shape, a planet," said James Muzerolle of the Space Telescope Science Institute, Baltimore, Md. Muzerolle is first author of a paper accepted for publication in the Astrophysical Journal Letters. "This is a unique, real-time glimpse into the lengthy process of building planets."

One theory of planet formation suggests that planets start out as dusty grains swirling around a star in a disk. They slowly bulk up in size, collecting more and more mass like sticky snow. As the planets get bigger and bigger, they carve out gaps in the dust, until a so-called transitional disk takes shape with a large doughnut-like hole at its center. Over time, this disk fades and a new type of disk emerges, made up of debris from collisions between planets, asteroids and comets. Ultimately, a more settled, mature solar system like our own forms. Before Spitzer was launched in 2003, only a few transitional disks with gaps or holes were known. With Spitzer's improved infrared vision, dozens have now been found. The space telescope sensed the warm glow of the disks and indirectly mapped out their structures.

Muzerolle and his team set out to study a family of young stars, many with known transitional disks. The stars are about two to three million years old and about 1,000 light-years away, in the IC 348 star-forming region of the constellation Perseus. A few of the stars showed surprising hints of variations. The astronomers followed up on one, LRLL 31, studying the star over five months with all three of Spitzer's instruments. The observations showed that light from the inner region of the star's disk changes every few weeks, and, in one instance, in only one week. "Transition disks are rare enough, so to see one with this type of variability is really exciting," said co-author Kevin Flaherty of the University of Arizona, Tucson.

Both the intensity and the wavelength of infrared light varied over time. For instance, when the amount of light seen at shorter wavelengths went up, the brightness at longer wavelengths went down, and vice versa. Muzerolle and his team say that a companion to the star, circling in a gap in the system's disk, could explain the data. "A companion in the gap of an almost edge-on disk would periodically change the height of the inner disk rim as it circles around the star: a higher rim would emit more light at shorter wavelengths because it is larger and hot, but at the same time, the high rim would shadow the cool material of the outer disk, causing a decrease in the longer-wavelength light. A low rim would do the opposite. This is exactly what we observe in our data," said Elise Furlan, a co-author from NASA's Jet Propulsion Labora-
Superheavy Element 114 Confirmed: A Stepping Stone To The 'Island Of Stability'

Scientists at the U.S. Department of Energy’s Lawrence Berkeley National Laboratory have been able to confirm the production of the superheavy element 114, ten years after a group in Russia, at the Joint Institute for Nuclear Research in Dubna, first claimed to have made it. The search for 114 has long been a key part of the quest for nuclear science’s hoped-for Island of Stability.

Heino Nitsche, head of the Heavy Element Nuclear and Radiochemistry Group in Berkeley Lab’s Nuclear Science Division (NSD) and a professor of chemistry at the University of California at Berkeley, and Ken Gregorich, a senior staff scientist in NSD, led the team that independently confirmed the production of the new element, which was first published by the Dubna Gas Filled Recoil Separator group.

Using an instrument called the Berkeley Gas-filled Separator (BGS) at Berkeley Lab’s 88-Inch Cyclotron, the researchers were able to confirm the creation of two individual nuclei of element 114, each a separate isotope having 114 protons but different numbers of neutrons, and each decaying by a separate pathway.

"By verifying the production of element 114, we have removed any doubts about the validity of the Dubna group’s claims," says Nitsche. "This proves that the most interesting superheavy elements can in fact be made in the laboratory."

Verification of element 114 is reported in Physical Review Letters. In addition to Nitsche and Gregorich, the Berkeley Lab team included Liv Stavestra, now at the Institute of Energy Technology in Kjeller, Norway; Berkeley Lab postdoctoral fellow Jan Dvořák; and UC graduate students Mitch André García, Irena Dragojević, and Paul Ellison, with laboratory support from UC Berkeley postdoctoral fellow Zuzana Dvořáková.

The realm of the superheavy

Elements heavier than uranium, element 92 – the atomic number refers to the number of protons in the nucleus – are radioactive and decay in a time shorter than the age of Earth; thus they are not found in nature (although traces of transient neptunium and plutonium can sometimes be found in uranium ore). Elements up to 111 and the recently confirmed 112 have been made artificially – those with lower atomic numbers in nuclear reactors and nuclear explosions, the higher ones in accelerators – and typically decay very rapidly, within a few seconds or fractions of a second.

Beginning in the late 1950s, scientists including Gertrude Scharff-Goldhaber at Brookhaven and theorist Władysław Swiatecki, who had recently moved to Berkeley and is a retired member of Berkeley Lab’s NSD, calculated that superheavy elements with certain combinations of protons and neutrons arranged in shells in the nucleus would be relatively stable, eventually reaching an "Island of Stability" where their lifetimes could be measured in minutes or days – or even, some optimists think, in millions of years. Early models suggested that an element with 114 protons and 184 neutrons might be such a stable element. Longtime Berkeley Lab nuclear chemist Glenn Seaborg, then Chairman of the Atomic Energy Commission, encouraged searches for superheavy elements with the necessary "magic numbers" of nucleons.

"People have been dreaming of superheavy elements since the 1960s," says Gregorich. "But it’s unusual for important results like the Dubna group’s claim to have produced 114 to go unconfirmed for so long. Scientists were beginning to wonder if superheavy elements were real."

To create a superheavy nucleus requires shooting one kind of atom at a target made of another kind; the total protons in both projectile and target nuclei must at least equal that of the quarry. Confirming the Dubna results meant aiming a beam of $^{48}$Ca ions – calcium whose nuclei have 20 protons and 28 neutrons – at a target containing $^{242}$Pu, the plutonium isotope with 94 protons and 148 neutrons. The 88-Inch Cyclotron’s versatile Advanced Electron Cyclotron Resonance ion source readily created a beam of highly charged calcium ions, atoms lacking 11 electrons, which the 88-Inch Cyclotron then accelerated to the desired energy.

Four plutonium oxide target segments were mounted on a wheel 9.5 centimeters (about 4 inches) in diameter, which spun 12 to 14 times a second to dissipate heat under the bombardment of the cyclotron beam.

"Plutonium is notoriously difficult to manage," says Nitsche, "and every group makes their targets differently, but long experience has given us at Berkeley a thorough understanding of the process." (Experience is especially long at Berkeley Lab and UC Berkeley – not least because Glenn Seaborg discovered plutonium here early in 1941.)

When projectile and target nuclei interact in the target, many different kinds of nuclear reaction products fly out the back.

(Continued on page 7)
TELESCOPE for SALE (Minimal Cost)
from AAL Member George Brenner

After I sold my 10" SCT I was scouting around for a lighter scope and saw a refractor for sale on Craig's list. I bought it for $100 just to give it a try, but have found it less than ideal for my purposes. The scope is a Meade 90mm DS series refractor with AutoStar Computer Control system. I replaced its broken 0.965" star diagonal with one that takes 1.25" eyepieces. The optical tube is probably the best part of the scope, as the altitude lock is finicky and doesn't hold position easily, the Autostar system is a bit difficult to use, and one of the guide motor attachments needs a better attachment mechanism. I would say the scope might be a good starter scope if someone wanted to use it as a "point and shoot" scope. Having sold most of my other eyepieces, I only have a rather heavy adjustable Zeiss 12.5mm, but I would include it with the scope. I am more interested in finding someone who might really use it than in making money, so the price would be minimal.

If interested, please contact George via email at gbrenner@sunflower.com.

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