Calendar of Events

December Meeting
Friday, Dec. 09, 2005
7:30 PM
1001 Malott
The Search for Exoplanets
Dr. Stephen Shawl

PUBLIC OBSERVING
Sunday Dec. 04
8:00PM
Memorial Stadium

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From the Officers

Report From the Officers on the November Meeting:
WOW!

In place of our usual meeting last month, Rick Heschmeyer coordinated a lecture/presentation for the Scouts/Webelos in the area. The turnout was amazing. 1001 Malott, which normally holds 160, was filled to overflowing with over 200 parents, kids, and scouts. After completing a series of exercises to learn a little about astronomy, the sky, and the solar system, the group headed outside to sample the sky near Malott using four telescopes set up and manned by club members. The skies had some slight haze, but the Moon and Mars were up and beautiful to see. The evening was also uncommonly warm for November so, all in all, the kids and parents had a great time. Many thanks to those of you who brought a telescope or helped up with the organization and management of the crowd, in particular, Scott Cregg, Dave Kolb, Wonne Kroes, Rex Powell, and William Winkler. Kudos to Rick for arranging a wonderful event; we should consider doing this on a regular basis.

Photos of the event are sprinkled throughout the newsletter; for the full color effect, check the web site for higher quality images.

Our next public observing session at Memorial Stadium is Sunday
Dec. 04 at 8PM. This is the session that was shifted due to the Thanksgiving weekend. So, weather permitting, come on out.

For December 09, our speaker will be Dr. Steve Shawl, who will give a presentation on the Search for Exoplanets—Planets Outside Our Solar System. This may be the hottest topic in Astronomy and the driving force behind many of the planned NASA missions of the next decade. The presentation is based upon a four-part lecture series on Clyde Tombaugh and the discovery of planet Pluto offered this semester by the Osher program at KU and the Astronomy faculty at KU. Since it is the December meeting, we will have our usual refreshments and some holiday cheer in the form of door prizes.

On regional news, it is now possible to sign up for the 2006 Texas Star Party, one of the biggest in the country. The great tradition of dark sky observing continues with the 28th Annual TEXAS STAR PARTY, April 23 - 30, 2006! For the latest info, visit their site at http://www.texasstarparty.org/. We have also received the following email from Gordon Bond: A little over twelve years ago, I started my own magazine for amateur astronomers, The Practical Observer (TPO), to fill what I saw as a void in the popular literature for the serious, active amateur astronomer. It enjoyed a modest success in the US and abroad. I am pleased to announce that TPO has made the successful transition from a print publication to an on-line magazine! I would like to invite you and the members of your club to check it out. Please visit www.tpoastronomy.com for information, sample articles, back issue lists and subscription information. If you have any questions or would like further details, please feel free to contact me via this email address: tpoastro@yahoo.com.

The Astronomical League has many activities to encourage amateur astronomy including Observing Clubs. The Observing Clubs offer certificates of accomplishment for demonstrating observing skills with a variety of instruments and objects. Each Club offers a certificate based upon achieving certain observing goals. These are usually in the form of a specific number of objects of a specific group with a given type of instrument. Occasionally there are multiple levels of accomplishment within the club. There is no time limit for completing the required observing, but good record keeping is required. When you have reached the requisite number of objects, your observing logs are examined by the appropriate authority and you will receive a certificate and pin to proclaim to all that you have reached your goal. Many local astronomical societies even post lists of those who have obtained their certificates. This month we feature the details on the Planetary Nebula Club. One hundred ten planetary nebulae were chosen for this program. Among them are some of the most famous showpieces in the northern sky, but the list contains examples across the entire range of planetary nebula morphology. Some are tiny star-like points that will challenge you to pick them out of their crowded star fields. Others will appear as ghostly apparitions that will severely test your powers of observation. In addition, we have included four examples of "proto-planetary nebulae" as additional challenges. For info about the club and the observing list, visit http://www.astroleague.org/al/obsclubs/planetarynebula/planetneb1.html.

If you have any suggestions for talks, speakers, or public events, please feel free to contact us, particularly Rick Heschmeyer (rcjbm@sbcglobal.net), the events coordinator for the club. Hope to see you next week at the December meeting. ALL for now.

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@sbcglobal.net. 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.
Powerful Magnetar Blast from Another Galaxy
By Robert Naeye, skypub.com

On December 27, 2004, astronomers were stunned when more than a dozen spacecraft picked up a powerful burst of gamma rays from the other side of our galaxy. For two-tenths of a second, it doused Earth with a higher rate of energy than any previous observed object outside the solar system. The culprit was a highly magnetized neutron star — a magnetar — known as SGR 1806–20.

Fortunately, astronomers didn’t have to wait long for their next magnetar giant flare. On November 3rd, at least six spacecraft picked up a powerful burst of gamma rays coming from an area in Ursa Major in the general direction of M81 and M82, two relatively large galaxies located about 12 million light-years away. Most of the flare’s energy was packed into a pulse lasting just one-tenth of a second. If the burst originated in M81 or M82, the total energy and spectrum closely resemble the December 2004 giant flare from SGR 1806–20.

"All evidence is consistent with the interpretation that this was a magnetar flare in the M81 group of galaxies," says Robert C. Duncan (University of Texas, Austin), who along with Christopher Thompson (Canadian Institute of Theoretical Astrophysics) first conceived of magnetars in the early 1990s.

"Nearby galaxies like M81 and M82 are so rare in the sky, and the energetics of the flare are so well suited to it being at M81’s distance, that we are definitely taking the M81/M82 possibility very seriously," adds Daniel A. Perley (University of California, Berkeley). He calculates that there is only a 3 percent probability that an event like the November 3rd burst would occur so near a bright galaxy such as M81 or M82 merely by chance.

But Perley’s Berkeley colleague Kevin C. Hurley stresses that the area of uncertainty also includes much more distant galaxies. "While the burst profile does resemble a magnetar giant flare, we still can’t prove that this is an extragalactic magnetar flare," he says. "I do believe that extragalactic magnetar flares are out there, and I’m as anxious as anyone to find the first one. But I think we need to be cautious about claiming victory."

(Continued on page 8)
The Astronomy Associates
of Lawrence

DR. STEPHEN J. SHAWL
Professor, Physics & Astronomy, KU

The Hunt for Extrasolar Planets

FRIDAY, DECEMBER 09, 2005
7:30 PM, 1001 Malott Hall
University of Kansas
Hubble, Sloan Quadruple Number of Known Optical Einstein Rings

HST PRESS RELEASE

As Albert Einstein developed his theory of general relativity nearly a century ago, he proposed that the gravitational field from massive objects could dramatically warp space and deflect light. The optical illusion created by this effect is called gravitational lensing. It is nature's equivalent of having a giant magnifying lens in space that distorts and amplifies the light of more distant objects. Einstein described gravitational lensing in a paper published in 1936. But he thought the effect was unobservable because the optical distortions produced by foreground stars warping space would be too small to ever be measurable by the largest telescopes of his time.

Now, almost a century later, astronomers have combined two powerful astronomical assets, the Sloan Digital Sky Survey (SDSS) and NASA's Hubble Space Telescope, to identify 19 new "gravitationally lensed" galaxies, adding significantly to the approximately 100 gravitational lenses previously known. Among these 19, they have found eight new so-called "Einstein rings", which are perhaps the most elegant manifestation of the lensing phenomenon. Only three such rings had previously been seen in visible light.

In gravitational lensing, light from distant galaxies can be deflected on its way to Earth by the gravitational field of any massive object that lies in the way. Because of this, we see the galaxy distorted into an arc or multiple separate images. When both galaxies are exactly lined up, the light forms a bull's-eye pattern, called an Einstein ring, around the foreground galaxy.

The newly discovered lenses come from an ongoing project called the Sloan Lens ACS Survey (SLACS). A team of astronomers, led by Adam Bolton of the Harvard-Smithsonian Center for Astrophysics in Cambridge, Mass., and Leon Koopmans of the Kapteyn Astronomical Institute in the Netherlands, selected the candidate lenses from among several hundred thousand optical spectra of elliptical galaxies in the Sloan Digital Sky Survey. They then used the sharp eyes of Hubble's Advanced Camera for Surveys to make the confirmation.

"The massive scale of the SDSS, together with the imaging quality of the Hubble telescope, has opened up this unprecedented opportunity for the discovery of new gravitational lenses," Bolton explained. "We've succeeded in identifying the one out of every 1,000 galaxies that show these signs of gravitational lensing of another galaxy."

Besides producing odd shapes, gravitational lensing gives astronomers the most direct probe of the distribution of dark matter in elliptical galaxies. Dark matter is an invisible and exotic form of matter that has not yet been directly observed. Astronomers infer its existence by measuring its gravitational influence. Dark matter is pervasive within galaxies and makes up most of the total mass of the universe. By searching for dark matter in galaxies, astronomers hope to gain insight into galaxy formation, which must have started around lumpy concentrations of dark matter in the early universe.

"Our results indicate that, on average, these 'elliptical lensing galaxies' have the same special mass-density structure as that observed in spiral galaxies," Bolton continued. "This corresponds
to an increase in the proportion of dark matter relative to stars as one moves away from the center of the lensing galaxy and into its fainter outskirts. And since these lensing galaxies are relatively bright, we can solidify this result with further ground-based spectroscopic observations of the stellar motions in the lenses."

"Being able to study these and other gravitational lenses as far back in time as several billion years allows us to see directly whether the distribution of dark [invisible] and visible mass changes with cosmic time," Dr. Koopmans added. "With this information, we can test the commonly held idea that galaxies form from collision and mergers of smaller galaxies."

The Sloan Digital Sky Survey, from which the SLACS lens-candidate sample was selected, was begun in 1998 with a custom-built ground-based telescope to measure the colors and brightnesses of more than 100 million objects over a quarter of the sky and map the distances to a million galaxies and quasars. "This type of gravitational-lens survey was not an original goal of the SDSS, but was made possible by the excellent quality of the SDSS data," said Scott Burles of the Massachusetts Institute of Technology in Cambridge, Mass., a SLACS team member and one of the creators of the SDSS.

"An additional bonus of the large size of the SDSS database is that we can design our search criteria so as to find the lenses that are most suitable for specific science goals," said SLACS team member Tommaso Treu of the University of California, Santa Barbara. "Whereas until now we have selected the largest galaxies as our targets, in the next stages of the survey we are targeting smaller lens galaxies. There have been suggestions that the structure of galaxies changes with galaxy size. By identifying these rare objects 'on demand,' we will soon be able for the first time to test whether this is true."
Astronomers theorize magnetic fields located in the innermost regions of accretion disks force material inward, toward a central star. While models of the magnetic influence exist, no field examples of this phenomenon have been detected. For the first time, astronomers have observational evidence supporting this theory.

A team of astronomers led by Jean-François Donati used the Canada-France-Hawaii Telescope atop Mauna Kea in late 2004 to study light coming from the FU Orionis system—a young central star outshined by a brilliant surrounding disk. The group found that light from the protostar is being rotated by magnetic fields in the disk.

Young stars, such as this one, can beef up by devouring material from accretion disks. The magnetic field inside slows the disk's rotation, causing material to move toward the central star. Magnetic fields have been found in external regions of a few protostar disks, but this marks the first time the action has been measured inside a central, dense area.

Before the FU Orionis observations, astronomers had theorized magnetic energy flux pushes surface plasma away from the disk, creating a wind or jet shooting from the object. In measuring the FU Orionis polarization, the team found that magnetism slows down disk material much more than models predict. This could explain why FU Orionis fails to create jets. The team's findings appear in the November 24, 2005, *Nature*. 
If further analysis confirms that the event is a giant magnetar flare in M81 or M82, it will be a major boon to scientists. With just one observed outburst of this magnitude (the December 2004 event), astronomers couldn’t say how often magnetars unleash such stupendous flares. But taken together these two flares suggest that such blasts occur once every few decades in a large spiral galaxy such as the Milky Way.

They also provide a connection to gamma-ray bursts (GRBs), powerful explosions emanating from deep space. About one in six GRBs have durations less than 2 seconds; these are collectively known as short GRBs. In just the past few months astronomers have collected powerful evidence that most short GRBs are triggered by the merger of two neutron stars or a neutron star and a black hole in distant galaxies. (Most astronomers think that long GRBs occur when the cores of massive stars collapse to form black holes.)

But magnetar giant flares, with their short but intense pulses of gamma rays, appear to be another class of short GRBs. After the December 2004 giant flare, astronomers immediately realized that if that event had occurred in a relatively nearby galaxy, it would have looked similar to a typical short GRB. The occurrence of two magnetar events in less than a year suggests that about 10 to 20 percent of short GRBs could be extragalactic magnetar giant flares, though astronomers have not observed enough of them to gain a firm handle on the statistics. As Hurley states, "It's all very speculative at this point."

Magnetar giant flares are presumably triggered when magnetic-field lines within the star stress the thin crust past its breaking point, causing a sudden, large-scale crustal shift that allows field lines outside the star to reorient themselves into a lower-energy state. This powerful "starquake" transforms huge quantities of magnetic energy into gamma rays and subatomic particles.

NASA's Swift, HETE-2, RHESSI, and Mars Odyssey spacecraft, the European Space Agency's Integral satellite, and the Russian Konus-Wind satellite detected the November 3rd burst. Astronomers are also studying data from a short GRB picked up on September 6th, which might have been a magnetar giant flare in the much more distant galaxy IC 328 in Eridanus.
Voices from the Cacophony
By Trudy E. Bell and Dr. Tony Phillips

Around 2015, NASA and the European Space Agency plan to launch one of the biggest and most exacting space experiments ever flown: LISA, the Laser Interferometer Space Antenna. LISA will consist of three spacecraft flying in a triangular formation behind Earth. Each spacecraft will beam a laser at the other two, continuously measuring their mutual separation. The spacecraft will be a mind-boggling 5 million kilometers apart (12 times the Earth-Moon distance) yet they will monitor their mutual separation to one billionth of a centimeter, smaller than an atom’s diameter.

LISA’s mission is to detect gravitational waves—ripples in space-time caused by the Universe’s most violent events: galaxies colliding with other galaxies, supermassive black holes gobbling each other, and even echoes still ricocheting from the Big Bang that created the Universe. By studying the shape, frequency, and timing of gravitational waves, astronomers believe they can learn what’s happening deep inside these acts of celestial violence.

The problem is, no one has ever directly detected gravitational waves: they’re still a theoretical prediction. So no one truly knows what they “sound” like.

Furthermore, theorists expect the Universe to be booming with thousands of sources of gravitational waves. Unlike a regular telescope that can point to one part of the sky at a time, LISA receives gravitational waves from many directions at once. It’s a cacophony. Astronomers must figure how to distinguish one signal from another. An outburst is detected! Was it caused by two neutron stars colliding over here or a pair of supermassive black holes tearing each other apart in colliding galaxies over there?

“It’s a profound data-analysis problem that ground-based astronomers don’t encounter,” says E. Sterl Phinney, professor of theoretical physics at the California Institute of Technology in Pasadena.

Profound, but not hopeless: “We have lots of good ideas and plans that work—in theory,” he says. “The goal now is to prove that they actually work under real conditions, and to make sure we haven’t forgotten something.”

To that end, theorists and instrument-designers have been spending time together brainstorming, testing ideas, scrutinizing plans, figuring out how they’ll pluck individual voices from the cacophony. And they’re making progress on computer codes to do the job.

Says Bonny Schumaker, a member of the LISA team at the Jet Propulsion Laboratory: “It’s a challenge more than a problem, and in fact, when overcome, a gift of information from the universe.”

For more info about LISA, see lisa.nasa.gov. Kids can learn about black holes and play the new “Black Hole Rescue!” game on The Space Place Web site at http://spaceplace.nasa.gov/en/kids/blackhole/. This article was provided by the Jet Propulsion Laboratory, California Institute of Technology, under a contract with the National Aeronautics and Space Administration.