The Celestial Mechanic

The Official Newsletter of the Astronomy Associates of Lawrence

Volume 30 Number 11 NOVEMBER 2004

Calendar of Events

***FRIDAY* NOV. 12**
STAR PARTY
ADAMS CAMPUS

***FRIDAY* NOV. 19**
1001 Malott—7:30 PM
Dr. Anthony-Twarog

***SUNDAY* NOV. 21**
Public Observing
Memorial Stadium
8:00—9:30 PM

President: Hannah Swift
hkswift@ku.edu
Treasurer: Dr. Steve Shawl
Shawl@ku.edu
University Contact:
Dr. Bruce Twarog
btwarog@ku.edu
Webmaster: Gary Webber
gwebber@ku.edu
Events Coordinator
Rick Heschmeyer
RCJBM@aol.com

From the Officers

Report From the Officers on the October Meeting:

Our October meeting was transferred at the last minute to a new room as the Chemistry Department prepared for their weekend Carnival in 1001 Malott, but Phil Anderson generated his own reactions with a fascinating talk on the pioneering work of Grote Reber. The amazing part of this story, technology aside, was Reber's virtually solo effort to start and develop a new field of astronomy after failing to get professionals interested enough to hire and to work with him in his quest to understand the universe at a new wavelength, one of only 3 regions of the spectrum open to ground-based astronomy. Phil's interest in the field is a by-product of his work on developing radio-wave-based security devices for screening at airports and other key locations. Discovering the challenges of this technology today led him to investigate how observers 70 years ago solved the basic problem, especially given the fact that everything with a temperature above absolute 0 emits radio waves,

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With the holidays approaching, we are often asked about what equipment to buy and where to buy it for people starting out in amateur astronomy or looking to upgrade to bigger and better equipment. There are a number of commercial vendors of telescopes in the region as well as companies that sell via web sites and ship directly to the purchaser. The only store devoted exclusively to the sale of equipment and peripherals for amateur astronomy in the region is LYMAX in Independence, MO., run by Bob Haler and Lisa Emerson. (Bob was our speaker last December.) Bob and Lisa are knowledgeable and always willing to help so, if you are shopping around, give their site/store a look.

LYMAX www.lymax.com

ASTRONOMICAL LEAGUE

INSIDE THIS ISSUE

From the Officers, continued

making radio and infrared astronomy a challenge because of the large background noise in the signal generated by the equipment and the people using it. Thanks again to Phil for his contribution to our understanding.

We have three events coming up this month, including our monthly session at the stadium. In October, the skies cooperated and we had a relatively steady stream of visitors at Memorial stadium, but the cloud cover ruined any options for the lunar eclipse. Our public observing session at Memorial Stadium in Nov. is scheduled for **NOV. 21** to avoid the Thanksgiving holiday. The second major event is our first attempt at a ***Star Party***. We discussed having this on a different Friday at our meeting in Oct., but have settled on **FRIDAY NOV. 12** at the **Adams Campus** site. A poster with the basic info is included, as well as driving instructions to the site. Again, this depends on the weather, but there is a good chance it won't be bitterly cold this early in the season, so come out to an excellent dark site and bring your telescopes. If you don't have one, come out anyway, there should be enough to share.

The third big event of the month is our monthly meeting, taking place on **FRIDAY NOVEMBER 19** in 1001 Malott. Our speaker this month is **Dr. Barbara Anthony-Twarog** of KU Physics & Astronomy, talking about oddities and anomalies linked to timekeeping, a topic that continues to fascinate the public as evidenced by the response generated by periodic changes in the calendar such as leap seconds. Dr. Anthony-Twarog was a recipient of a *Kemper Fellowship* this year for teaching excellence, so you can expect an entertaining and informative talk.

As we close in on the end of the year, please keep in mind that annual dues are normally collected in January. There will be more info in next months newsletter. f 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 two to three weeks. We will, as always, have refreshments so bring a friend and socialize.

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

TYCHO’s 1572 Supernova Origin Revealed

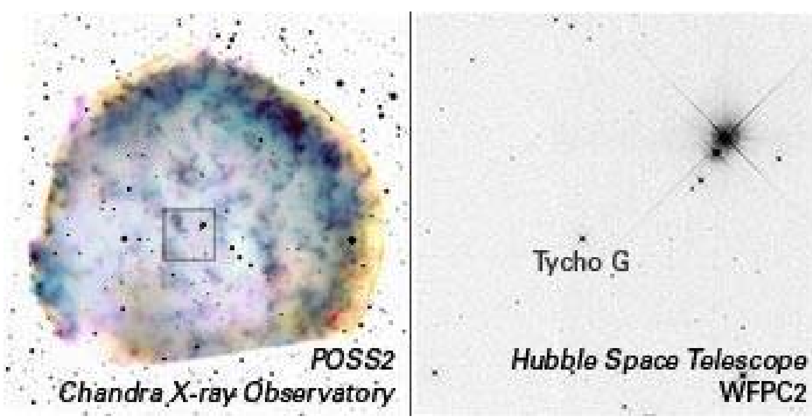
Release from Space Telescope Science Institute

An international team of astronomers is announcing today that they have identified the probable surviving companion star to a titanic supernova explosion witnessed in the year 1572 by the great Danish astronomer Tycho Brahe and other astronomers of that era.

This discovery provides the first direct evidence supporting the long-held belief that Type Ia supernovae come from binary star systems containing a normal star and a burned-out white dwarf star. The normal star spills material onto the dwarf, which eventually triggers an explosion.

The results of this research, led by Pilar Ruiz-Lapuente of the University of Barcelona, Spain, are being published in the Oct. 28 British science journal Nature. "There was no previous evidence pointing to any specific kind of companion star out of the many that had been proposed. Here we have identified a clear path: the feeding star is similar to our Sun, slightly more aged," Ruiz-Lapuente says. "The high speed of the star called our attention to it," she added.

Type Ia supernovae are used to measure the history of the expansion rate of the universe and so are fundamental to helping astronomers understand the behavior of dark energy, an unknown force that is accelerating the expansion of the universe. Finding evidence to confirm the theory as to how Type Ia supernovae explode is critical to assuring astronomers that the objects can be better understood as reliable calibrators of the expansion of space. The identification of the surviving member of the stellar duo reads like a crime scene investigation tale.



Even though today's astronomers arrived at the scene of the disaster 432 years later, using astronomical forensics they have nabbed one of the perpetrators rushing away from the location of the explosion (which is now enveloped in a vast bubble of hot gas called Tycho's Supernova Remnant). For the past seven years the runaway star and its surroundings were studied with a variety of telescopes. The Hubble Space Telescope played a key role by precisely measuring the star's motion against the sky background. The star is breaking the speed limit for that particular region of the Milky Way Galaxy by moving three times faster than the surrounding stars. Like a stone thrown by a sling, the star went hurtling off into space, retaining the velocity of its orbital motion when the system was disrupted by the white

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The Astronomy Associates of Lawrence

present

Leap Seconds, Analemmas and Other Arcana of Astronomical Timekeeping

Dr. Barbara Anthony-Twarog

Professor, Physics & Astronomy

KU 2004 Kemper Fellow

KU 2004/5 Woman of Distinction

FRIDAY, November 19, 2004

7:30 PM,

1001 Malott Hall

University of Kansas

FREE & OPEN TO THE PUBLIC

AAL STAR PARTY

FRIDAY, NOVEMBER 12, 2004
8:00 - 12 PM
ADAMS CAMPUS

Bring your telescopes & a Friend!

Call 864-3166 if Weather is Questionable.

Driving Directions to Adams Campus

· Drive south from Lawrence on KS 59 (Iowa St.) to N 1200 Rd, the Lone Star road. Turn right (west) follow this blacktop road as it zigzags toward Lone Star.

· Three miles west, south on E 1000 Rd. for 2 miles, west on N 1000 Rd. for 1.5 miles, south on E 850th Rd. 0.5 miles, west again on N 950th Rd.

· One-half mile after turning onto N 950th Rd. you will see a sign and the turnoff to E 800th Rd. and Lone Star on your left. Do not turn here, continue one-half mile farther and turn right (north) on E 750th Rd. This is a gravel road.

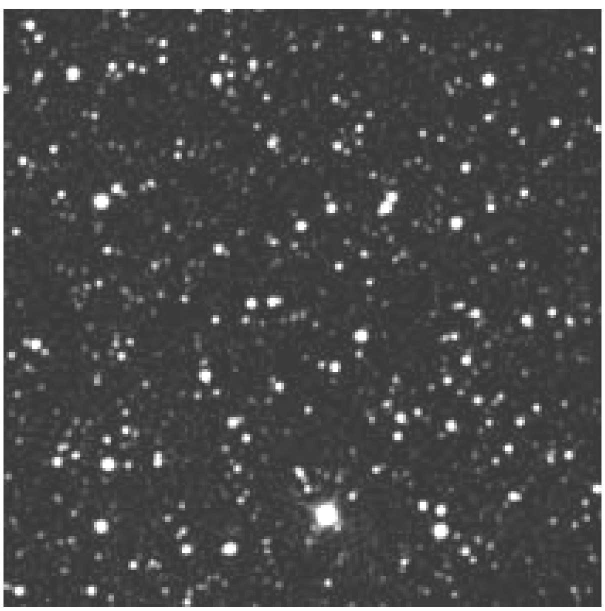
· Follow this road north approximately 1/2 mile, the Adams dark sky site will be on your right just before the road turns west again.

NEW NEARBY GLOBULAR CLUSTER FOUND
Skypub.com

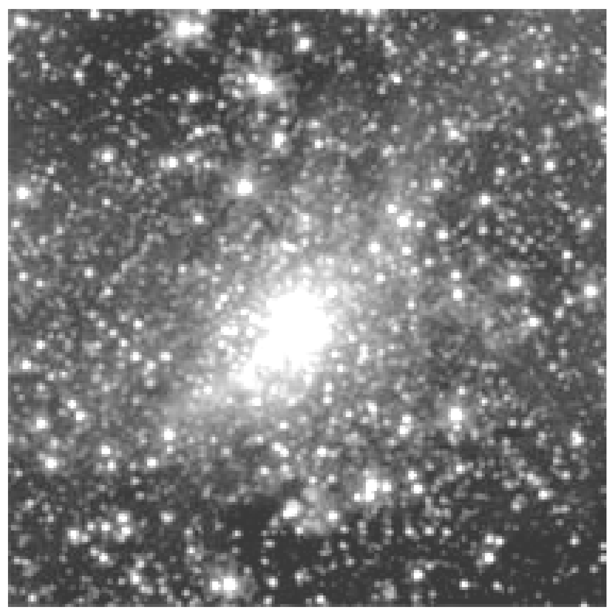
An astronomer-in-training has discovered a new globular cluster in Aquila by trolling through images taken by the Spitzer Space Telescope.

If it weren't hidden behind interstellar dust, the cluster would shine at 4th magnitude — making it one of the most spectacular deep-sky objects anywhere. Unfortunately, backyard stargazers won't be spotting GLIMPSE-C01 any time soon, even though it may be one of the closest globular clusters (roughly 10,000 light-years from Earth) and one of the most luminous (pouring out the light of some 200,000 Suns). That's because interstellar matter blocks all but one millionth of the cluster's Earthbound visible light.

However, the dusty molecular clouds that lie between us and GLIMPSE-C01 are much more transparent to the cluster's mid-infrared light — the kind Spitzer senses. Therein lies the key to Andrew J. Monson's discovery. The University of Wyoming graduate student owes his good fortune to Spitzer's GLIMPSE survey, which now has imaged nearly two-thirds of the Milky Way's dust-clotted midplane. "I had him scanning through the images" for unusual objects, says Monson's research advisor, Henry A. Kobulnicky, a GLIMPSE coinvestigator, "and he called me over and said, 'What's this? It looks like a globular cluster.'"



Field in Visible Light



Field Seen in Infrared via Spitzer Space Telescope

And so it seems. Monson, Kobulnicky, and their colleagues observed the object last July 31st with the University of Wyoming's 2.3-meter reflector. The resulting images revealed lots of old giant stars but no short-lived supergiants — just as one would expect for a globular cluster, which typically is at least 10 billion years old. The ground-based infrared images also confirmed that GLIMPSE-C01's stars are tightly packed into an ellipsoidal clump only a few light-years wide.

New Images of Titan Baffle Astronomers

By Henry Bortman—Astrobiology Magazine

Instruments aboard the Cassini spacecraft have sent back the most detailed images ever captured of the surface of Saturn's giant moon, Titan. They've also presented scientists with a major mystery. There's a huge cloud formation over the moon's south pole, spanning 620 miles (1,000 kilometers) at its widest. That's no surprise; scientists expected it to be there. But they also expected it to be made of methane. And it isn't.

There's lots of methane in Titan's atmosphere. It was detected many years ago by spacecraft that flew past the ringed planet. So when recent images from the Keck Observatory in Hawaii showed clouds at Titan's south pole, scientists assumed they were methane clouds. According to their model, Titan is so cold that methane can form liquid pools on its surface.

When this liquid is heated by the sun, it evaporates, forming methane clouds. Water clouds on Earth work the same way. The sun heats the ocean, water evaporates and clouds form in the atmosphere. Because Titan's south pole is currently pointed toward the sun, it is receiving the greatest amount of heat right now. So a massive cloud form over the south pole fits the model perfectly - if the cloud is made of methane.

The problem But, according to data gathered by Cassini, the particles that make up the cloud are too big to be methane. "I don't believe it," says Chris McKay, a planetary scientist with the NASA Ames Research Center in Moffett Field, California. "What else can they be? It would be like flying over Earth and saying the clouds are not water. If those clouds are really not methane, then a lot of the things we think about Titan are wrong. A lot of things we think about those clouds are wrong - the whole explanation of why they're there."

The Cassini science team has not yet had time to fully analyze the data sent back by the spacecraft, so they don't yet know what the clouds are made of. One possibility, McKay speculates, is ethane. But ethane, he says, is a photochemical product that is produced in the upper atmosphere and rains downward. So it wouldn't make sense that a massive ethane cloud would appear at the south pole.

Organic goo? Another possibility, he says, is that "it's some sort of organic goo. It could be some sort of organic polymer, essentially plastic particles. Maybe little polystyrene foam balls. Who knows?" But, as with ethane, these would form from above. There's no known reason why a massive cloud of them should form at Titan's south pole.

And so, McKay concludes, freely admitting that his off-the-cuff theory is "based on no data," that the clouds "are formed of methane, and that there's some process which is hiding the spectral signatures of the methane."

One plausible scenario is that the cloud particles could start out as methane, produced as expected on the ground and carried aloft. Once airborne, however, they become coated with some other substance, perhaps ethane. Further study of the spectral data collected by Cassini, together with lab-based experiments should enable scientists to unravel the mystery, but it will take some time for them to do so.

Meanwhile, down on Titan's surface, another mystery is unfolding. Recent images have revealed stunning surface detail, never before seen. But, according to Caroline Porco, team leader for the imaging science subsystem, "we don't know exactly what we're looking at." The "don't know" part applies both to the moon's surface composition and to its topography.

Figuring out what the moon is made of should be relatively easy, using data from Cassini's VIMS (Visual and Infrared Mapping Spectrometer) instrument. Different materials reflect light at different frequencies. Each pixel captured by VIMS records the strength of the light reflected at each of 352 distinct frequen-

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Testing General Relativity—Skypub.com

Yet another prediction by Einstein's general theory of relativity seems to be holding true: a rotating body, such as Earth, should slightly twist the space in which it is embedded. Two physicists who have been tracking satellites orbiting Earth claim to have made the first reliable measurement of this effect. Others remain unconvinced — but a different experiment should soon settle the question once and for all.

The effect in question is called "frame dragging," a very slight twisting of space-time induced by any rotating mass. (Think of a ball bearing spinning in syrup.) The phenomenon is more formally known as the Lense-Thirring effect, after the Austrian physicists Joseph Lense and Hans Thirring, who predicted it in 1918 two years after Einstein published general relativity. Frame dragging is a form of "gravitomagnetism," a set of secondary space-warping effects that should be caused by mass in motion — somewhat analogous to the way magnetism stems from electric charges in motion. (The parallelism here may have helped keep Einstein on his futile life quest for a unification of gravity and electromagnetism.)

Writing in the October 20th issue of *Nature,* Ignazio Ciufolini (University of Lecce, Italy) and Erricos C. Pavlis (Joint Center for Earth Systems Technology, Maryland) claim to have made the first reasonably accurate measurement of frame dragging. They tracked the paths of the two Laser Geodynamics Satellites (LAGEOS I and II) for 11 years using laser rangefinders. They find that Earth's rotation twists the fabric of space enough to displace the satellites by 1.9 meters per year from where they would otherwise be, matching the amount predicted by general relativity with a measurement precision of about 10 percent. Ciufolini has previously reported signs of frame dragging in the LAGEOS satellites' orbits, but this finding met with skepticism (*Sky & Telescope:* July 1998, page 22). Since then, Earth's irregular gravitational field has been mapped about 50 times more accurately, thanks to the GRACE satellite mission. However, independent LAGEOS expert John C. Ries (University of Texas) is still not convinced. "It is uncertain if the GRACE gravity models are good enough yet," he says.

NASA's Gravity Probe B satellite will soon provide a more direct measurement of frame dragging that should also be much more accurate. Launched last April after 40 years of planning and development, Gravity Probe B was designed primarily for this purpose. Its results, which should be announced in mid- to late 2005, are expected to be good to 1 percent.

Large amounts of frame dragging have already been inferred indirectly from the behavior of matter in the extreme gravitational environments near spinning black holes.

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cies. Some of these frequencies are visible to human eyes, others are in the infrared.

By analyzing this spectral data, scientists should be able to figure out Titan's surface composition. The analysis requires intensive computation, matching the observed spectra to standards stored in spectral libraries here on Earth. Early results should be available within a few days.

Surface mysteries Titan's topography will be a tougher nut to crack. Because of the global haze layer, Porco says, "we do not see shadows on the surface of Titan. And because we don't see shadow, we can't look at an image and immediately deduce what's up and what's down." There could be massive mountains and deep valleys there, or the surface could be completely flat. At this point, there's no way to tell. Titan is unlike Mars and the icy moons of Jupiter, which have little or no atmosphere. So the "techniques that we've used for interpreting airless bodies, all those methods of examining solid surfaces from planetary spacecraft that we have learned over the last half century," don't apply, says Porco. "We can't use that on Titan, because it's a very different environment."

What scientists can use is a combination of data from several different Casssini instruments, collected over a long period of time. During its 4-year mission, Cassini will make many more close passes by Titan, 45 in all.

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dwarf's explosion. This alone is only circumstantial evidence that the star is the perpetrator because there are alternative explanations to its suspicious behavior. It could be falling in at a high velocity from the galactic halo that surrounds the Milky Way's disk. But spectra obtained with the 4.2-meter William Herschel Telescope in La Palma and the 10-meter W.M. Keck telescopes in Hawaii show that the suspect has the high heavy-element content typical of stars that dwell in the Milky Way's disk, not the halo. The star found by the Ruiz-Lapuente team is an aging version of our Sun. The star has begun to expand in diameter as it progresses toward a red-giant phase (the end stage of a Sun-like star's lifetime). The star turns out to fit the profile of the perpetrator in one of the proposed supernova conjectures. In Type Ia supernova binary systems, the more massive star in the pair will age faster and eventually becomes a white dwarf star. When the slower-evolving companion star subsequently ages to the point where it begins to balloon in size, it spills hydrogen onto the dwarf. The hydrogen accumulates until the white dwarf reaches a critical and precise mass threshold, called the Chandrasekhar limit, where it explodes as a titanic nuclear bomb. The energy output of this explosion is so well known that it can be used as a standard candle for measuring vast astronomical distances. (An astronomical "standard candle" is any type of luminous object whose intrinsic power is so accurately determined that it can be used to make distance measurements based on the rate the light dims over astronomical distances).

"Among the various systems containing white dwarfs that receive material from a solar-mass companion, some are believed to be viable progenitors of Type Ia supernovae, on theoretical grounds. A system called U Scorpii has a white dwarf and a star similar to the one found here. These results would confirm that such binaries will end up in an explosion like the one observed by Tycho Brahe, but that would occur several hundreds of thousands of years from now," says Ruiz-Lapuente.

An alternative theory of Type Ia supernovae is that two white dwarfs orbit each other, gradually losing energy through the emission of gravitational radiation (gravity waves). As they lose energy, they spiral in toward each other and eventually merge, resulting in a white dwarf whose mass reaches the Chandrasekhar limit, and explodes. "Tycho's supernova does not appear to have been produced by this mechanism, since a probable surviving companion has been found," says Alex Filippenko of the University of California at Berkeley, a co-author on this research. He says that, nevertheless, it is still possible there are two different evolutionary paths to Type Ia supernovae.

On November 11, 1572, Tycho Brahe noticed a star in the constellation Cassiopeia that was as bright as the planet Jupiter (which was in the night sky in Pisces). No such star had ever been observed at this location before. It soon equaled Venus in brightness (which was at -4.5 magnitude in the predawn sky). For about two weeks the star could be seen in daylight. At the end of November it began to fade and change color, from bright white to yellow and orange to faint reddish light, finally fading away from visibility in March 1574, having been visible to the naked eye for about 16 months. Tycho's meticulous record of the brightening and dimming of the supernova now allows astronomers to identify its "light signature" as that of a Type Ia supernova. Tycho Brahe's supernova was very important in that it helped 16th-century astronomers abandon the idea of the immutability of the heavens. At the present time, Type Ia supernovae remain key players in the newest cosmological discoveries. To learn more about them and their explosion mechanism, and to make them even more useful as cosmological probes, a current Hubble Space Telescope project led by Filippenko is studying a sample of supernovae in other galaxies at the very time they explode.

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University of Kansas
Malott Hall
1251 Wescoe Hall Dr, Room 1082
Lawrence, KS 66045-7582