COMING EVENTS

Public Observing
Sunday March 25
Prairie Park Nature Center
9:00 PM

AAL Meeting
Friday, March 30, 2012
2001 Malott - 7:30 PM
Dr. Edward O. Wiley

Double Star Observing
for the Amateur

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Report from the Officers:
As visual proof that the skies in Lawrence do occasionally clear, we present the image at left taken by Howard Edin at our last public observing session at the Prairie Park Nature Center. We will try again at the end of March, Sunday the 25th to be specific. Note that because of the delayed monthly meeting due to Spring Break, this observing session will take place before the next AAL meeting, so don’t forget.

Speaking of meetings and public observing, one of the items discussed at the meeting in February was the option of doubling the rate of public observing sessions to twice a month to increase the likelihood that we will get at least one clear session per month. We currently schedule 7 monthly sessions at Prairie Park between Sept. and April. Of these, 3-4 get clouded out, leaving large gaps between successful events and providing one explanation for why the public turnout is less than overwhelming when it is clear. We will set up an on-line poll and ask that the members vote on this option, with the implication that if we schedule more observing, those who agree with this change will also

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A Cosmic Welcome to new club members
Josh Johnson and Chris Wright

Of Local Interest
Research links uplifting continents to crashes in biodiversity on Earth

Following up on our last club meeting, attendees may be interested in the recent research of Dr. Adrian Melott at KU. In a press release from February detailing their work published in the Journal of Geology, Dr. Melott and his collaborators found that mysterious cycle of booms and busts in marine biodiversity over the past 500 million years could be tied to a periodic uplifting of the world’s continents. The researchers discovered periodic increases in the amount of the isotope strontium-87 found in marine fossils. The timing of these increases corresponds to previously discovered low points in marine biodiversity that occur in the fossil record roughly every 60 million years. Adrian Melott, professor of physics and astronomy at the University of Kansas and lead author, thinks these periodic extinctions and the increased amounts of strontium-87 are linked. “Strontium-87 is produced by radioactive decay of another element, rubidium, which is common in igneous rocks in continental crust,” Melott said. “So, when a lot of this type of rock erodes, a lot more Sr-87 is dumped into the ocean, and its fraction rises compared with another strontium isotope, Sr-86.” An uplifting of the continents, Melott explains, is the most likely explanation for this type of massive erosion event. The full press release can be found at http://www.news.ku.edu/2012/february/21/continents.shtml.
be more willing to volunteer to help out, if they aren’t already doing so. An email will be sent once the poll is set up.

The AAL sponsored an exhibit table at the USD 497 Science Fair and EXPO at South Middle School on Saturday, Feb. 11 from 2:00 - 4:30 PM. The primary contribution to the event from AAL was solar observing set up outside at the entrance to the school. It was cold but clear and we drew a respectable stream of viewers to use the solar telescope manned by Bill Wachspress (at left) or the solar projection manned by Dr. Barbara Anthony-Twarog. Other AAL attendees included Bill Winkler, who worked at a table on the weather, and George Brenner. Unlike the KU Chemistry Club working the school auditorium, we couldn’t generate any local explosions, but the public still seemed thrilled to have a close up (and safe) view of the sun, some sunspots, and a prominence or two with slightly more explosive impact.

Our next club meeting of the year is FRIDAY, March 30 in 2001 Malott Hall. Please note the unusual date. Our guest speaker will be Dr. Ed Wiley of KU, a faculty member in Ecology and Evolutionary Biology who is also an avid and skilled amateur astronomer. Ed will discuss a project to do some amateur double-star observing, a very classical field that may be more accessible to the amateur community than most people may realize. (The date has been chosen with care - the Final Four weekend is that weekend, but the games take place on Saturday, so the possibility of missing KU, if they make it that far, is zero.) So, bring a friend and relax with some pleasant conversation and refreshments.

As the summer approaches, the announcements for regional star parties and conventions are beginning to appear. We have already noted the MSRAL meeting in KC at UMKC during the first week in June. All AAL members are also members of the Astronomical League and are eligible to participate. The web site for MSRAL is http://www.msral.org/. If you would be interested in helping out with the regional convention, please contact Eric Bogatin at eric@beTheSignal.com. If you signed up for MSRAL at the last meeting, your name has been passed to Eric. The national convention for the Astronomical League (ALCON 2012) takes place in Chicago from July 4 - 7 and can be checked out at the site http://alcon2012.astroleague.org/. The Rocky Mountain Star Stare takes place from June 13-16 near Gardner, CO. Registration opens on March 16. Their web site is at http://www.rmss.org. The annual Nebraska Star Party will take place from July 15 - 20, 2012 near Valentine, NE. It’s web page can be accessed at www.nebraskastarparty.org. We have some brochures on this is you are interested and we will bring them to the next meeting.

Any suggestions for improving the club or the newsletter are always welcome.

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 at the Prairie Park Nature Center. Periodic star parties are scheduled as well. For more information, please contact the club officers: president, Rick Heschmeyer at rcfjm@sbcglobal.net, webmaster, Howard Edin, at howard@howardedin.com, AlCor William Winkler, at billwink10@yahoo.com, or faculty advisor, Prof. Bruce Twarog at btwarog@ku.edu. 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://groups.ku.edu/~astronomy

Copies of the Celestial Mechanic can also be found on the web at http://groups.ku.edu/~astronomy/celestialmechanic
Astronomers Watch Delayed Broadcast of a Powerful Stellar Eruption

Astronomers are watching a delayed broadcast of a spectacular outburst from the unstable, behemoth double-star system Eta Carinae, an event initially seen on Earth nearly 170 years ago.

Dubbed the "Great Eruption," the outburst first caught the attention of sky watchers in 1837 and was observed through 1858. But astronomers didn't have sophisticated science instruments to accurately record the star system's petulant activity.

Luckily for today's astronomers, some of the light from the eruption took an indirect path to Earth and is just arriving now, providing an opportunity to analyze the outburst in detail. The wayward light was heading in a different direction, away from our planet, when it bounced off dust clouds lingering far from the turbulent stars and was rerouted to Earth, an effect called a "light echo."

Because of its longer path, the light reached Earth 170 years later than the light that arrived directly.

The observations of Eta Carinae's light echo are providing new insight into the behavior of powerful massive stars on the brink of detonation. The views of the nearby erupting star reveal some unexpected results, which will force astronomers to modify physical models of the outburst.

"When the eruption was seen on Earth 170 years ago, there were no cameras capable of recording the event," explained the study's leader, Armin Rest of the Space Telescope Science Institute in Baltimore, Md. "Everything astronomers have known to date about Eta Carin

These images reveal light from a massive stellar outburst in the Carina Nebula reflecting off dust clouds surrounding a behemoth double-star system. The color image at left shows the Carina Nebula, a star-forming region located 7,500 light-years from Earth. The massive double-star system Eta Carinae resides near the top of the image. The star system, about 120 times more massive than the Sun, produced a spectacular outburst that was seen on Earth from 1837 to 1858. But some of the light from the eruption took an indirect path and is just now reaching our planet. The light bounced off dust clouds (the boxed region about 100 light-years away at the bottom of the image) and was rerouted to Earth, a phenomenon called a light echo. The image was taken in February 2000 by the U.S. National Optical Astronomy Observatory's Curtis Schmidt Telescope at the Cerro Tololo Inter-American Observatory (CTIO) in Chile.

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The Hidden Power of Sea Salt, Revealed

By Dauna Coulter

Last year, when NASA launched the Aquarius/SAC-D satellite carrying the first sensor for measuring sea salt from space, scientists expected the measurements to have unparalleled sensitivity. Yet the fine details it's revealing about ocean saltiness are surprising even the Aquarius team. "We have just four months of data, but we're already seeing very rich detail in surface salinity patterns," says principal investigator Gary Lagerloef of Earth & Space Research in Seattle. "We're finding that Aquarius can monitor even small scale changes such as specific river outflow and its influence on the ocean."

Using one of the most sensitive microwave radiometers ever built, Aquarius can sense as little as 0.2 parts salt to 1,000 parts water. That's about like a dash of salt in a gallon jug of water. "You wouldn't even taste it," says Lagerloef. "Yet Aquarius can detect that amount from 408 miles above the Earth. And it's working even better than expected."

Salinity is critical because it changes the density of surface seawater, and density controls the ocean currents that move heat around our planet. A good example is the Gulf Stream, which carries heat to higher latitudes and moderates the climate.

"When variations in density divert ocean currents, weather patterns like temperature and rainfall are affected. In turn, precipitation and evaporation, and fresh water from river outflow and melt ice determine salinity. It's an intricately connected cycle."

The atmosphere is the ocean's partner. The freshwater exchange between the atmosphere and the ocean dominates the global water cycle. Seventy-eight percent of global rainfall occurs over the ocean, and 85 percent of global evaporation is from the ocean. An accurate picture of the ocean's salinity will help scientists better understand the profound ocean/atmosphere coupling that determines climate variability.

"Ocean salinity has been changing," says Lagerloef. "Decades of data from ships and buoys tell us so. Some ocean regions are seeing an increase in salinity, which means more fresh water is being lost through evaporation. Other areas are getting more rainfall and therefore lower salinity. We don't know why. We just know something fundamental is going on in the water cycle."

With Aquarius's comprehensive look at global salinity, scientists will have more clues to put it all together. Aquarius has collected as many sea surface salinity measurements in the first few months as the entire 125-year historical record from ships and buoys.

"By this time next year, we'll have met two of our goals: a new global map of annual average salinity and a better understanding of the seasonal cycles that determine climate."

Stay tuned for the salty results. Read more about the Aquarius mission at aquarius.nasa.gov.

Other NASA oceanography missions are Jason-1 (studying ocean surface topography), Jason-2 (follow-on to Jason-1), Jason-3 (follow-on to Jason-2, planned for launch in 2014), and Seawinds on the QuikSCAT satellite (measures wind speeds over the entire ocean). The GRACE mission (Gravity Recovery and Climate Experiment), among its other gravitational field studies, monitors fresh water supplies underground. All these missions, including Aquarius, are sponsors of a fun and educational ocean game for kids called "Go with the Flow" at spaceplace.nasa.gov/ocean-currents.

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DOUBLE STAR RESEARCH
Opportunities for the
Amateur Astronomer

Dr. Edward O. Wiley
Dept. of Ecology & Evolutionary Biology, KU

FRIDAY March 30, 2012
7:30 PM
2001 Malott Hall
University of Kansas

FREE AND OPEN TO THE PUBLIC
NASA’s Hubble Spots a Relic from a Shredded Galaxy

Astronomers using NASA’s Hubble Space Telescope may have found evidence for a cluster of young, blue stars encircling one of the first intermediate-mass black holes ever discovered. Astronomers believe the black hole may once have been at the core of a now-disintegrated unseen dwarf galaxy. The discovery of the black hole and the possible star cluster has important implications for understanding the evolution of supermassive black holes and galaxies.

Astronomers know how massive stars collapse to form black holes but it is not clear how supermassive black holes, which weigh billions of times the mass of our Sun, form in the cores of galaxies. One idea is that supermassive black holes may build up through the merger of smaller black holes. Sean Farrell of the Sydney Institute for Astronomy in Australia discovered a middleweight black hole in 2009 using the European Space Agency’s XMM-Newton X-ray space telescope. Known as HLX-1 (Hyper-Luminous X-ray source 1), the black hole has an estimated weight of about 20,000 solar masses. It lies towards the edge of the galaxy ESO 243-49, 290 million light-years from Earth.

This spectacular edge-on galaxy, called ESO 243-49, is believed to be home to an intermediate-mass black hole that may have been stripped off of a cannibalized dwarf galaxy. The estimated 20,000-solar-mass black hole lies above the galactic plane. This is an unlikely place for such a massive back hole to exist, unless it belonged to a small galaxy that was gravitationally torn apart by ESO 243-49. The circle identifies a unique X-ray source that pinpoints the black hole. The X-rays are believed to be radiation from a hot accretion disk around the black hole. The blue light not only comes from a hot accretion disk, but also from the possible existence of a cluster of hot young stars that formed around the black hole. The galaxy is 290 million light-years from Earth. Hubble can’t resolve the stars individually because the suspected cluster is too far away. Their presence is inferred from the color and brightness of the light coming from the black hole’s location.

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IGR J17091-3624: NASA'S Chandra Finds Fastest Wind From Stellar-Mass Black Hole

Astronomers using NASA's Chandra X-ray Observatory have clocked the fastest wind yet discovered blowing off a disk around a stellar-mass black hole. This result has important implications for understanding how this type of black hole behaves.

The record-breaking wind is moving about 20 million mph, or about 3 percent of the speed of light. This is nearly 10 times faster than had ever been seen from a stellar-mass black hole. Stellar-mass black holes are born when extremely massive stars collapse. They typically weigh between five and 10 times the mass of the sun. The stellar-mass black hole powering this super wind is known as IGR J17091-3624, or IGR J17091 for short.

“This is like the cosmic equivalent of winds from a category five hurricane,” said Ashley King from the University of Michigan, lead author of the study published in the Feb. 20 issue of The Astrophysical Journal Letters. "We weren't expecting to see such powerful winds from a black hole like this.”

The wind speed in IGR J17091 matches some of the fastest winds generated by supermassive black holes, objects millions or billions of times more massive.

"It's a surprise this small black hole is able to muster the wind speeds we typically only see in the giant black holes," said co-author Jon M. Miller, also from the University of Michigan. "In other words, this black hole is performing well above its weight class."

Another unanticipated finding is that the wind, which comes from a disk of gas surrounding the black hole, may be carrying away more material than the black hole is capturing.

"Contrary to the popular perception of black holes pulling in all of the material that gets close, we estimate up to 95 percent of the matter in the disk around IGR J17091 is expelled by the wind," King said.

Unlike winds from hurricanes on Earth, the wind from IGR J17091 is blowing in many different directions. This pattern also distinguishes it from a jet, where material flows in highly focused beams perpendicular to the disk, often at nearly the speed of light. Simultaneous observations made with the National Radio Astronomy Observatory's Expanded Very Large Array showed a radio jet from the black hole was not present when the ultra-fast wind was seen, although a radio jet is seen at other times. This agrees with observations of other stellar-mass black holes, providing further evidence the production of winds can stifle jets.

The high speed for the wind was estimated from a spectrum made by Chandra in 2011. Ions emit and absorb distinct features in spectra, which allow scientists to monitor them and their behavior. A Chandra spectrum of iron ions made two months earlier showed no evidence of the high-speed wind, meaning the wind likely turns on and off over time.

Astronomers believe that magnetic fields in the disks of black holes are responsible for producing both winds and jets. The geometry of the magnetic fields and rate at which material falls towards the black hole must influence whether jets or winds are produced.

IGR J17091 is a binary system in which a sun-like star orbits the black hole. It is found in the bulge of the Milky Way galaxy, about 28,000 light years away from Earth.
nae's outburst is from eyewitness accounts. Modern observations with science instruments were made years after the eruption actually happened. It's as if nature has left behind a surveillance tape of the event, which we are now just beginning to watch. We can trace it year by year to see how the outburst changed.

Located 7,500 light-years from Earth, Eta Carinae is one of the largest and brightest star systems in our Milky Way galaxy. Although the chaotic duo is known for its petulant outbursts, the Great Eruption was the biggest ever observed. During the 20-year episode, Eta Carinae shed some 20 solar masses and became the second brightest star in the sky. Some of the outflow formed the system's twin giant lobes. Before the epic event, the stellar pair was 140 times heftier than our Sun.

Because Eta Carinae is relatively nearby, astronomers have used a variety of telescopes, including the Hubble Space Telescope, to document its escapades. The team's study involved a mix of visible-light and spectroscopic observations from ground-based telescopes.

The observations mark the first time astronomers have used spectroscopy to analyze a light echo from a star undergoing powerful recurring eruptions, though they have measured this unique phenomenon around exploding stars called supernovae. Spectroscopy captures a star's "fingerprints," providing details about its behavior, including the temperature and speed of the ejected material.

The delayed broadcast is giving astronomers a unique look at the outburst and turning up some surprises. The turbulent star system does not behave like other stars of its class. Eta Carinae is a member of a stellar class called Luminous Blue Variables, large, extremely bright stars that are prone to periodic outbursts. The temperature of the outflow from Eta Carinae's central region, for example, is about 8,500 degrees Fahrenheit (5,000 Kelvin), which is much cooler than that of other erupting stars. "This star really seems to be an oddball," Rest said. "Now we have to go back to the models and see what has to change to actually produce what we are measuring."

Rest's team first spotted the light echo while comparing visible-light observations he took of the stellar duo in 2010 and 2011 with the U.S. National Optical Astronomy Observatory's Blanco 4-meter telescope at the Cerro Tololo Inter-American Observatory (CTIO) in Chile. He obtained another set of CTIO observations taken in 2003 by astronomer Nathan Smith of the University of Arizona in Tucson, which helped him piece together the whole 20-year outburst.

The images revealed light that seemed to dart through and illuminate a canyon of dust surrounding the doomed star system. "I was jumping up and down when I saw the light echo," said Rest, who has studied light echoes from powerful supernova blasts.

"I didn't expect to see Eta Carinae's light echo because the eruption was so much fainter than a supernova explosion. We knew it probably wasn't material moving through space. To see something this close move across space would take decades of observations. We, however, saw the movement over a year's time. That's why we thought it was probably a light echo."

Although the light in the images appears to move over time, it's really an optical illusion. Each flash of light is reaching Earth at a different time, like a person's voice echoing off the walls of a canyon.

The team followed up its study with spectroscopic observations, using the Carnegie Institution of Washington's Magellan and du Pont telescopes at Las Campanas Observatory in Chile. That study helped the astronomers decode the light, revealing the outflow's speed and temperature. The observations showed that ejected material was moving at roughly 445,000 miles an hour (more than 700,000 kilometers an hour), which matches predictions.

Rest's group monitored changes in the intensity of the light echo using the Las Cumbres Observatory Global Telescope Network's Faulkes Telescope South in Siding Spring, Australia. The team then compared those measurements with a plot astronomers in the 1800s made of the light brightening and dimming over the course of the 20-year eruption. The new measurements matched the signature of the 1843 peak in brightness.

The team will continue to follow Eta Carinae because light from the outburst is still streaming to Earth. "We should see brightening again in six months from another increase in light that was seen in 1844," Rest said. "We hope to capture light from the outburst coming from different directions so that we can get a complete picture of the eruption."
Young Stars Flicker Amidst Clouds of Gas and Dust

Astronomers have spotted young stars in the Orion nebula changing right before their eyes, thanks to the European Space Agency's Herschel Space Observatory and NASA's Spitzer Space Telescope. The colorful specks -- developing stars strung across this image -- are rapidly heating up and cooling down, speaking to the turbulent, rough-and-tumble process of reaching full stellar adulthood.

The rainbow of colors represents different wavelengths of infrared light captured by both Spitzer and Herschel. Spitzer is designed to see shorter infrared wavelengths than Herschel. By combining their observations, astronomers get a more complete picture of star formation. NASA's Jet Propulsion Laboratory in Pasadena, Calif., manages the Spitzer mission for NASA, and also plays an important role in the European Space Agency-led Herschel mission.

In the portion of the Orion nebula pictured here, the telescopes' infrared vision reveals a host of embryonic stars hidden in gas and dust clouds. These stars are at the very earliest stages of evolution. A star forms as a clump of this gas and dust collapses, creating a warm glob of material fed by an encircling disk. In several hundred thousand years, some of the forming stars will accrete enough material to trigger nuclear fusion at their cores, and then blaze into stardom.

Herschel mapped this region of the sky once a week for six weeks in the late winter and spring of 2011. To monitor for activity in protostars, Herschel's Photodetector Array Camera and Spectrometer probed long infrared wavelengths of light that trace cold dust particles, while Spitzer gauged the warmer dust emitting shorter infrared wavelengths. In this data, astronomers noticed that several of the young stars varied in their brightness by more than 20 percent over just a few weeks. As this twinkling comes from cool material emitting infrared light, the material must be far from the hot center of the young star, likely in the outer disk or surrounding gas envelope. At that distance, it should take years or centuries for material to spiral closer in to the growing starlet, rather than mere weeks.

A couple of scenarios under investigation could account for this short span. One possibility is that lumpy filaments of gas funnel from the outer to the central regions of the star, temporarily warming the object as the clumps hit its inner disk. Or, it could be that material occasionally piles up at the inner edge of the disk and casts a shadow on the outer disk.

"Herschel's exquisite sensitivity opens up new possibilities for astronomers to study star formation, and we are very excited to have witnessed short-term variability in Orion protostars," said Nicolas Billot, an astronomer at the Institut de Radioastronomie Millimétrique (IRAM) in Grenada, Spain who is preparing a paper on the findings along with his colleagues. "Follow-up observations with Herschel will help us identify the physical processes responsible for the variability."

This new view of the Orion nebula highlights fledgling stars hidden in the gas and clouds. It shows infrared observations taken by NASA’s Spitzer Space Telescope and the European Space Agency’s Herschel mission, in which NASA plays an important role. A star forms as a clump of this gas and dust collapses, creating a warm glob of material fed by an encircling disk. These dusty envelopes glow brightest at longer wavelengths, appearing as red dots in this image. In several hundred thousand years, some of the forming stars will accrete enough material to trigger nuclear fusion at their cores and then blaze into stardom. The nebula is found below the three belt stars in the famous constellation of Orion the Hunter, which appears at night in northern latitudes during fall and then throughout winter. At a distance of around 1,500 light-years away from Earth, the nebula cannot quite be seen with the naked eye. Binoculars or a small telescope, however, are all it takes to get a good look in visible light at this stellar factory. Spitzer is designed to see shorter infrared wavelengths than Herschel. By combining their observations, astronomers get a more complete picture of star formation. The colors in this image relate to the different wavelengths of light, and to the temperature of material, mostly dust, in this region of Orion. Data from Spitzer show warmer objects in blue, with progressively cooler dust appearing green and red in the Herschel datasets. The more evolved, hotter embryonic stars thus appear in blue. The combined data traces the interplay of the bright, young stars with the cold and dusty surrounding clouds. A red garland of cool gas also notably runs through the Trapezium, the intensely bright region that is home to four humungous blue-white stars, and up into the rich star field.
Farrell then observed HLX-1 simultaneously with NASA's Swift observatory in X-ray and Hubble in near-infrared, optical, and ultraviolet wavelengths. The intensity and the color of the light may indicate the presence of a young, massive cluster of blue stars, 250 light-years across, encircling the black hole. Hubble can’t resolve the stars individually because the suspected cluster is too far away. The brightness and color is consistent with other clusters of stars seen in other galaxies, but some of the light may be coming from the gaseous disk around the black hole.

"Before this latest discovery we suspected that intermediate-mass black holes could exist, but now we understand where they may have come from," Farrell said. "The fact that there seems to be a very young cluster of stars indicates that the intermediate-mass black hole may have originated as the central black hole in a very-low-mass dwarf galaxy. The dwarf galaxy might then have been swallowed by the more massive galaxy, just as happens in our Milky Way."

From the signature of the X-rays, Farrell's team knew there would be some blue light emitted from the high temperature of the hot gas in the disk swirling around the black hole. They couldn't account for the red light coming from the disk. It would have to be produced by a much cooler gas, and they concluded this would most likely come from stars. The next step was to build a model that added the glow from a population of stars. These models favor the presence of a young massive cluster of stars encircling the black hole, but this interpretation is not unique, so more observations are needed. In particular, the studies led by Roberto Soria of the Australian International Centre for Radio Astronomy Research, using data from Hubble and the ground-based Very Large Telescope, show variations in the brightness of the light that a star cluster couldn't cause. This indicates that irradiation of the disk itself might be the dominant source of visible light, rather than a massive star cluster.

"What we can definitely say with our Hubble data is that we require both emission from an accretion disk and emission from a stellar population to explain the colors we see," said Farrell. Such young clusters of stars are commonly found inside galaxies like the host galaxy, but not outside the flattened starry disk, as found with HLX-1. One possible scenario is that the HLX-1 black hole was the central black hole in a dwarf galaxy. The larger host galaxy may then have captured the dwarf. In this conjecture, most of the dwarf's stars would have been stripped away through the collision between the galaxies. At the same time, new young stars would have formed in the encounter. The interaction that compressed the gas around the black hole would then have also triggered star formation. Farrell theorizes that the possible star cluster may be less than 200 million years old. This means that the bulk of the stars formed following the dwarf's collision with the larger galaxy. The age of the stars tells how long ago the two galaxies crashed into each other.