June 2012

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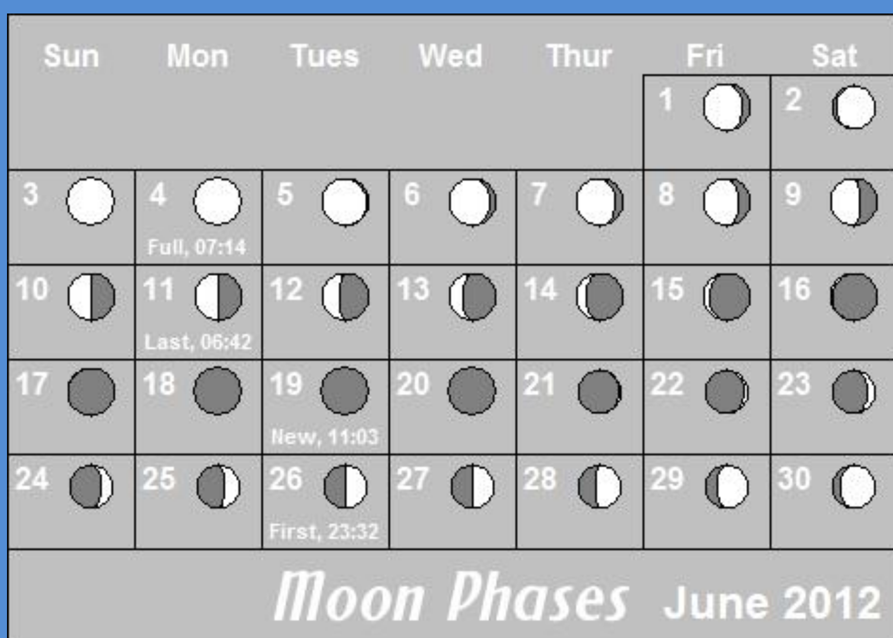
June Meeting

The next meeting of S*T*A*R will be at 8pm on Thursday, June 7th, 2012. Thursday we will have our annual business meeting, at which we will review finances and elect officers for the next season. We will not have a speaker. The meeting is at the Monmouth Museum at 8 p.m.

Calendar

- June 7th, 2012 – Annual business meeting



Are you a S*T*A*R Member?

S*T*A*R, The Society of Telescopy, Astronomy, and Radio, has promoted amateur astronomy since 1957 when it was organized by an energetic group of observers who participated in Project Moonwatch, a program in which a worldwide network of observers tracked the path of Sputnik among the stars of the night sky to obtain information on how the earth's atmosphere affects satellite orbits. This group soon evolved into an amateur astronomy club which was incorporated under its present name in 1969.

Today, S*T*A*R is the focal point for amateur astronomy in Monmouth County, NJ, attracting members of all ages, occupations and educational backgrounds. Its objectives are to promote the enjoyment of astronomy, and to increase the level of astronomical knowledge among its members and the public. The club achieves these goals through its regular meetings, observing nights, field trips, cooperation and exchange of information with other clubs, and special activities such as assisting Bayonet Farm in Holmdel and other park systems in conducting public astronomy programs.

S*T*A*R meetings are held on the first Thursday of the month from September to June, at 8 pm at the Monmouth Museum on the campus of Brookdale Community College, Lincroft, NJ. Programs generally consist of lectures and discussions by members or guest speakers on a variety of interesting topics on astronomy. Refreshments are served during the meeting and, weather permitting, a short observing session may occur afterwards.

The club owns 8" f/8, 13" f/4.5 and 25" f/5 Dobsonian telescopes which are available for use by members. Because of its large size use of the 25" requires the supervision of two qualified operators. To borrow a telescope or become a qualified operator of the 25", please contact the Vice President.

The current officers of S*T*A*R are:

President	Rob Nunn
Vice President	Kevin Gallagher
Secretary	Steve Fedor
Treasurer	Arturo Cisneros
Member at Large	Dave Britz

S*T*A*R is a member of United Astronomy Clubs of New Jersey (UACNJ), the Astronomical League (AL), and the International Dark Sky Association (IDA).

Memberships:
( ) Individual....$35
( ) Family...$45
( ) Student… $15

Name____

Address______________________________________

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Email____

Make checks payable to: S*T*A*R Astronomy Society, Inc. and mail to P.O. Box 863, Red Bank, NJ 07701

Star Party at Middletown Library

Wednesday, June 27, 2012

There will be a star party Wednesday, June 27th at Middletown Library, 55 New Monmouth Rd. Middletown. It will run from 8:00 to 9:30. Set up time is 7:15. The event is open for 100 people to register. The sky is very limited from the observing area in the parking lot but Mars, Saturn, the quarter moon and other objects should still be seen. No elaborate equipment is needed as this will just be a "Point and Look" session. Rain\Cloud date is Thursday, the 28th. Please reply on discussion board or e mail me at richg870@aol.com. Rich G.

May Meeting Minutes

The May 3, 2012 meeting of S*T*A*R Astronomy Society began at 8:00 p.m. The meeting was held in the Nilson Gallery of Monmouth Museum and was attended by about 23 people. President Rob Nunn chaired the meeting and began by presenting the agenda and asking if there were first-time attendees. One new attendee introduced himself. He said that he has a telescope, and Ahmad Jrad suggested that he obtain a solar filter to observe the transit of Venus.

Rob then introduced the speaker for the evening, who made his presentation via a 2-way audio/video link from Seattle. Tom Field is an amateur astronomer who became interested in spectroscopy several years ago. His talk was titled “Spectroscopy for Everyone!” Tom began with a brief history. Robert Bunsen and Gustav Kirchoff conducted experiments using spectroscopy in the 19th century, which led to the discovery of several elements. Niels Bohr later showed that the colors they observed are due to changes in the orbits of the elements’ electrons. Tom then presented a number of results he has obtained. A collection of spectra showed prominent lines related to the temperatures of the stars he observed. Tom used software he developed to convert spectral images into graphs showing spectral density. A graph from an image of Uranus showed absorption lines characteristic of elements in its atmosphere, a graph from a comet showed complex organic molecules, and one from a meteor showed some of the elements it contains. He observed a Doppler shift from the light of a quasar indicating a speed of 16% of c, and measured a speed of 22 million miles per hour of the expanding shell of a supernova. Tom noted that with higher quality equipment astronomers are able to observe the motion of Vega due to its planets, and the rounding of spectral peaks due to the spin of a star. He finished his talk with some discussion of equipment needed for spectroscopy. A star analyzer grating filter costs about $180. The grating that Tom uses has 100 lines per mm. Results can be obtained with almost any type of camera, but a Dobsonian mount telescope without tracking is not suitable. Tom then answered a number of questions. Dave Britz wondered about use of a prism instead of a grating filter. Tom said that light loss and nonlinear effects make a prism less useful. Finally Ed Collett related some history of gratings, such as their evolution from single and double slit devices, and methods of producing gratings.

New business and upcoming events were discussed following a break. Rob noted that the auction for the 25-inch telescope yielded no bids, and the postings on Cloudy Nights and Astromart have also been unsuccessful. The board had considered reconfiguring the telescope to make it shorter and lighter, but Ed Collett said that that would not be practical. Steve Seigel suggested selling or trading it through High Point Scientific. Jay Respler announced a star party to be held at Buck’s Mill Park on May 12. Ahmad Jrad described planning for a transit of Venus observing session at Dorbrook Park on June 5. The park will determine if there are events planned for the area where we observe. There will be power available from a nearby source. There was some discussion of the wisdom of inviting the public. If the public is invited, safety is a primary concern, and it might be helpful to segregate public viewing devices from telescopes members do not wish the public to use.

The final event of the evening was the 50/50 drawing, which was won by Al Wright. The meeting concluded about 10:15 p.m.

11.5 billion years old: Stellar archaeology traces Milky Way's history

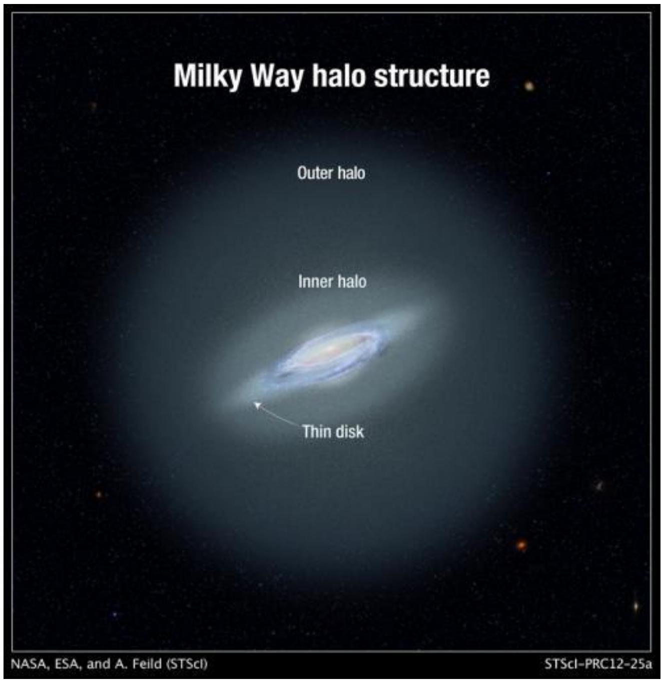
(Phys.org) -- Unfortunately, stars don't have birth certificates. So, astronomers have a tough time figuring out their ages. Knowing a star's age is critical for understanding how our Milky Way galaxy built itself up over billions of years from smaller galaxies.

Jason Kalirai of the Space Telescope Science Institute and The Johns Hopkins University's Center for Astrophysical Sciences, both in Baltimore, Md., has found the next best thing to a star's birth certificate. Using a new technique, Kalirai probed the burned-out relics of Sun-like stars, called white dwarfs, in the inner region of our Milky Way galaxy's halo. The halo is a spherical cloud of stars surrounding our galaxy's disk.

Those stars, his study reveals, are 11.5 billion years old, younger than the first generation of Milky Way stars. They formed more than 2 billion years after the birth of the universe 13.7 billion years ago. Previous age estimates, based on analyzing normal stars in the inner halo, ranged from 10 billion to 14 billion years.

Kalirai's study reinforces the emerging view that our galaxy's halo is composed of a layer-cake structure that formed in stages over billions of years.

"One of the biggest questions in astronomy is, when did the different parts of the Milky Way form?" Kalirai said. "Sun-like stars live for billions of years and are bright, so they are excellent tracers, offering clues to how our galaxy evolved over time. However, the biggest hindrance we have in inferring galactic formation processes in the Milky Way is our inability to measure accurate ages of Sun-like stars. In this study, I chose a different path: I studied stars at the end of their lives to determine their masses and then connected those masses to the ages of their progenitors. Given the nature of these dead stars, their masses are easier to measure than Sun-like stars."



This illustration shows the Milky Way galaxy's inner and outer halos. A halo is a spherical cloud of stars surrounding a galaxy. Astronomers have proposed that the Milky Way's halo is composed of two populations of stars. The age of the stars in the inner halo, according to measurements by the Paranal Observatory, is 11.5 billion years old. The measurements suggest the inner-halo stars are younger than the outer-halo population, some of which could be 13.5 billion years old. Credit: NASA, ESA, and A. Feild (STScI)

Kalirai targeted white dwarfs in the galaxy's halo because those stars are believed to be among the galaxy's first homesteaders. Some of them are almost as old as the universe itself. These ancient stars provide a fossil record of our Milky Way's infancy, possessing information about our galaxy's birth and growth. "The Milky Way's halo represents the premier hunting ground in which to unravel the archaeology of when and how the galaxy's assembly processes occurred," Kalirai explained.

His results will appear online May 30 in a letter to the journal *Nature*.

White dwarfs divulge their properties so freely because they have a distinct spectral signature. Kalirai analyzed their signatures using archival spectroscopic data from the European Southern Observatory's Very Large Telescope at the Paranal Observatory in Chile. The spectroscopic data are part of the SN Ia Progenitor Survey (SPY), a census of white dwarf stars in the Milky Way. Spectroscopy divides light into its constituent colors, yielding information about a star's characteristics, including its mass and temperature. In his study, Kalirai first analyzed the spectra of several newly minted white dwarfs in the galaxy's inner halo to measure their masses. "The hottest white dwarfs are the descendants of Sun-like stars that have just extinguished their hydrogen fuel," he explained. "The masses of these white dwarfs are proportional to the masses of their progenitors, and we can use that mass to establish the age of the parent stars."

To measure the halo's age, Kalirai compared the masses of the halo stars with those of six newly formed white dwarfs in the ancient globular star cluster M4. Fortunately, the cluster is one of Hubble's favorite targets, and astronomers have a reliable age for when it formed, 12.5 billion years ago. Kalirai found these dead cluster stars in archival visible-light images of nearly 2,000 white dwarfs taken by the Advanced Camera for Surveys aboard NASA's Hubble Space Telescope.

He applied the same techniques that he used on the halo white dwarfs to these cluster white dwarfs. The spectroscopic observations for these stellar remnants came from the W.M. Keck Observatory in Hawaii. His measurements revealed that the halo white dwarfs are heavier than those in M4, indicating the progenitor stars that are evolving into white dwarfs today are also heavier. Therefore, these stars are younger than the M4 stars. More massive stars consume their hydrogen fuel at a faster rate and therefore end their lives more quickly than lighter-weight stars.

Although Kalirai's result is based on a small sample of stars, it does support recent work proposing that the halo is composed of two different populations of stars.

According to the research, the Milky Way's construction schedule began with the oldest globular star clusters and dwarf galaxies, which formed a few hundred million years after the big bang, settling into what is now the galaxy's halo. These populations merged over billions of years to form the structure of our Milky Way. Stars in the inner halo were born during the assembly process. Over time, the Milky Way gobbled up older dwarf galaxies that formed less than 2 billion years after the big bang. Their ancient stars settled into the outskirts of the halo, creating the outer halo.

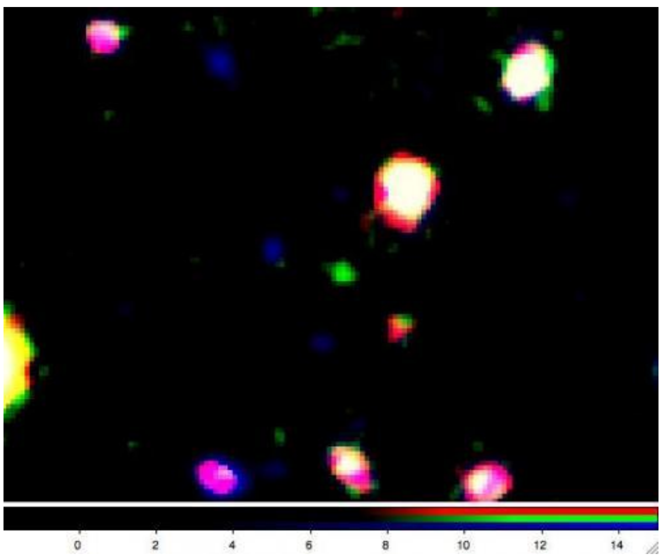
"In the previous work, the inner population was shown to be different from the outer population in terms of the velocities and chemical abundances of the stars," Kalirai said. "There were no constraints, however, on whether there was an age difference between the two populations. Now, our work suggests an age for the inner halo stars.

"We know some of the remote globular clusters in the outer halo are much older than the inner halo stars, perhaps around 13.5 billion years old," Kalirai contined. "So, our prediction is that if you find white dwarfs in the outer halo, they would have formed from older generations of Sun-like stars. The present day masses of stars in the generation that are now forming white dwarfs would be lower, and therefore the white dwarf masses -- which we can measure -- will also be lower."

Kalirai hopes to apply his new technique on more halo white dwarfs in his quest to help uncover our galaxy's history.

"One of the interesting questions about the inner halo stars is, did all of them form at the same time, or did they form over a span of time?" Kalirai said. "A sample of 20 to 30 white dwarfs would allow us to see if the inferred ages from the white dwarf masses span from 11 billion to 13 billion years. That could tell us that the accretion events that helped build up the Milky Way kept happening for several billion years, as opposed to all predominantly happening at one epoch."

ASU astronomers discover faintest distant galaxy



This is a false color image of the galaxy LAEJ095950.99+021219.1 . In this image, blue corresponds to optical light (wavelength near 500 nm), red to near-infrared light (wavelength near 920 nm), and green to the narrow range of wavelengths admitted by the narrow bandpass filter (around 968 nm). LAEJ095950.99+021219.1 appears as the green source near the center of the image cutout. The image shows about 1/6000 of the area that was surveyed. Credit: James Rhoads

Astronomers at Arizona State University have found an exceptionally distant galaxy, ranked among the top 10 most distant objects currently known in space. Light from the recently detected galaxy left the object about 800 million years after the beginning of the universe, when the universe was in its infancy.

A team of astronomers, led by James Rhoads, Sangeeta Malhotra, and Pascale Hibon of the School of Earth and Space Exploration at ASU, identified the remote galaxy after scanning a moon-sized patch of sky with the IMACS instrument on the Magellan Telescopes at the Carnegie Institution's Las Campanas Observatory in Chile.

The observational data reveal a faint infant galaxy, located 13 billion light-years away. "This galaxy is being observed at a young age. We are seeing it as it was in the very distant past, when the universe was a mere 800 million years old," says Rhoads, an associate professor in the school. "This image is like a baby picture of this galaxy, taken when the universe was only 5 percent of its current age. Studying these very early galaxies is important because it helps us understand how galaxies form and grow."

The galaxy, designated LAEJ095950.99+021219.1, was first spotted in summer 2011. The find is a rare example of a galaxy from that early epoch, and will help astronomers make progress in understanding the process of galaxy formation. The find was enabled by the combination of the Magellan telescopes' tremendous light gathering capability and exquisite image quality, thanks to the mirrors built in Arizona's Steward Observatory; and by the unique ability of the IMACS instrument to obtain either images or spectra across a very wide field of view. The research, published in the June 1 issue of The *Astrophysical Journal Letters*, was supported by the National Science Foundation (NSF).

The recently discovered LAEJ095950.99+021219.1 galaxy is extremely faint and was detected by the light emitted by ionized hydrogen. The search employed a technique ASU professors James Rhoads and Sangeeta Malhotra pioneered that uses special narrowband filters that allow a small wavelength range of light through. In this photo, a narrowband filter is being mounted in a filter holder for use in the instrument IMACS (the Inamori-Magellan Areal Camera & Spectrograph). IMACS was built by a team at the Observatories of the Carnegie Institute of Washington, led by Alan Dressler. Credit: James Rhoads

This galaxy, like the others that Malhotra, Rhoads, and their team seek, is extremely faint and was detected by the light emitted by ionized hydrogen. The object was first identified as a candidate early-universe galaxy in a paper led by team member and former ASU postdoctoral researcher Hibon.

The search employed a unique technique they pioneered that uses special narrow-band filters that allow a small wavelength range of light through.

A special filter fitted to the telescope camera was designed to catch light of narrow wavelength ranges, allowing the astronomers to conduct a very sensitive search in the infrared wavelength range. "We have been using this technique since 1998 and pushing it to ever-greater distances and sensitivities in our search for the first galaxies at the edge of the universe," says Malhotra, an associate professor in the school. "Young galaxies must be observed at infrared wavelengths and this is not easy to do using ground-based telescopes, since the Earth's atmosphere itself glows and large detectors are hard to make."

To be able to detect these very distant objects which were forming near the beginning of the universe, astronomers look for sources which have very high redshifts. Astronomers refer to an object's distance by a number called its "redshift," which relates to how much its light has stretched to longer, redder wavelengths due to the expansion of the universe. Objects with larger redshifts are farther away and are seen further back in time. LAEJ095950.99+021219.1 has a redshift of 7. Only a handful of galaxies have confirmed redshifts greater than 7, and none of the others is as faint as LAEJ095950.99+021219.1.

A team of astronomers led by ASU professors James Rhoads and Sangeeta Malhotra identified a remote galaxy after scanning a large patch of sky with the Magellan Telescopes in the southern reaches of Chile's Atacama Desert, which are among Arizona's telescope resources. Visible in this photo are both Magellan telescopes in the late afternoon, as seen from the path up to the telescopes. The Arizona telescope system provides access to the Large Binocular Telescope on Mt. Graham, the 6.5 meter MMT on Mt. Hopkins, the 2.2 meter Bok telescope on Kitt Peak (all in Arizona), and the twin 6.5 meter Magellan telescopes at Las Campanas Observatories in Chile, along with several smaller telescopes. The Magellan telescopes were built by the Carnegie Institution of Washington on behalf of the Magellan Project, a collaborative effort by the Carnegie Institution, University of Arizona, Harvard University, University of Michigan, and the Massachusetts Institute of Technology. Credit: James Rhoads

"We have used this search to find hundreds of objects at somewhat smaller distances. We have found several hundred galaxies at redshift 4.5, several at redshift 6.5, and now at redshift 7 we have found one," explains Rhoads. "We've pushed the experiment's design to a redshift of 7 – it's the most distant we can do with well-established, mature technology, and it's about the most distant where people have been finding objects successfully up to now."

Malhotra adds, "With this search, we've not only found one of the furthest galaxies known, but also the faintest confirmed at that distance. Up to now, the redshift 7 galaxies we know about are literally the top one percent of galaxies. What we're doing here is to start examining some of the fainter ones – thing that may better represent the other 99 percent."

Resolving the details of objects that are far away is challenging, which is why images of distant young galaxies such as this one appear small, faint, and blurry.

"As time goes by, these small blobs which are forming stars, they'll dance around each other, merge with each other and form bigger and bigger galaxies. Somewhere halfway through the age of the universe they start looking like the galaxies we see today – and not before. Why, how, when, where that happens is a fairly active area of research," explains Malhotra.

In addition to Hibon, Malhotra, and Rhoads, the paper's authors include Michael Cooper of the University of California at Irvine, and Benjamin Weiner of the University of Arizona.

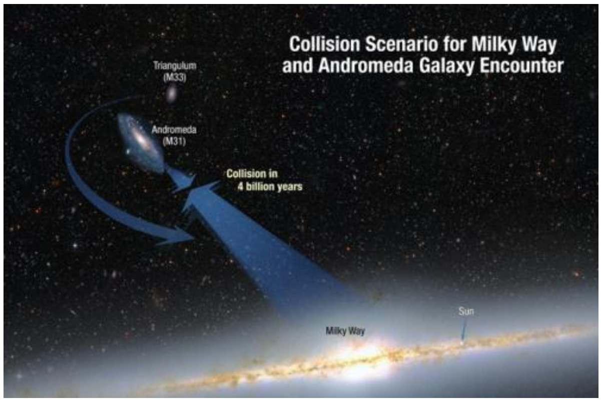
Hubble shows Milky Way is destined for head-on collision with Andromeda galaxy

(Phys.org) -- NASA astronomers announced Thursday they can now predict with certainty the next major cosmic event to affect our galaxy, sun, and solar system: the titanic collision of our Milky Way galaxy with the neighboring Andromeda galaxy.

The Milky Way is destined to get a major makeover during the encounter, which is predicted to happen four billion years from now. It is likely the sun will be flung into a new region of our galaxy, but our Earth and solar system are in no danger of being destroyed.

"Our findings are statistically consistent with a head-on collision between the Andromeda galaxy and our Milky

Way galaxy," said Roeland van der Marel of the Space Telescope Science Institute (STScI) in Baltimore.



This illustration shows the collision paths of our Milky Way galaxy and the Andromeda galaxy. The galaxies are moving toward each other under the inexorable pull of gravity between them. Also shown is a smaller galaxy, Triangulum, which may be part of the smashup. (Credit: NASA; ESA; A. Feild and R. van der Marel, STScI)

The solution came through painstaking NASA Hubble Space Telescope measurements of the motion of Andromeda, which also is known as M31. The galaxy is now 2.5 million light-years away, but it is inexorably falling toward the Milky Way under the mutual pull of gravity between the two galaxies and the invisible dark matter that surrounds them both. "After nearly a century of speculation about the future destiny of Andromeda and our Milky Way, we at last have a clear picture of how events will unfold over the coming billions of years," said Sangmo Tony Sohn of STScI.

The scenario is like a baseball batter watching an oncoming fastball. Although Andromeda is approaching us more than 2,000 times faster, it will take 4 billion years before the strike.

Computer simulations derived from Hubble's data show that it will take an additional two billion years after the encounter for the interacting galaxies to completely merge under the tug of gravity and reshape into a single elliptical galaxy similar to the kind commonly seen in the local universe.

Although the galaxies will plow into each other, stars inside each galaxy are so far apart that they will not collide with other stars during the encounter. However, the stars will be thrown into different orbits around the new galactic center. Simulations show that our solar system will probably be tossed much farther from the galactic core than it is today.

To make matters more complicated, M31's small companion, the Triangulum galaxy, M33, will join in the collision and perhaps later merge with the M31/Milky Way pair. There is a small chance that M33 will hit the Milky Way first.

This illustration shows a stage in the predicted merger between our Milky Way galaxy and the neighboring Andromeda galaxy, as it will unfold over the next several billion years. In this image, representing Earth's night sky in 3.75 billion years, Andromeda (left) fills the field of view and begins to distort the Milky Way with tidal pull. (Credit: NASA; ESA; Z. Levay and R. van der Marel, STScI; T. Hallas; and A. Mellinger)

The universe is expanding and accelerating, and collisions between galaxies in close proximity to each other still happen because they are bound by the gravity of the dark matter surrounding them. The Hubble Space Telescope's deep views of the universe show such encounters between galaxies were more common in the past when the universe was smaller.

A century ago astronomers did not realize that M31 was a separate galaxy far beyond the stars of the Milky Way. Edwin Hubble measured its vast distance by uncovering a variable star that served as a "milepost marker."

Hubble went on to discover the expanding universe where galaxies are rushing away from us, but it has long been known that M31 is moving toward the Milky Way at about 250,000 miles per hour. That is fast enough to travel from here to the moon in one hour. The measurement was made using the Doppler effect, which is a change in frequency and wavelength of waves produced by a moving source relative to an observer, to measure how starlight in the galaxy has been compressed by Andromeda's motion toward us.

Previously, it was unknown whether the far-future encounter will be a miss, glancing blow, or head-on smashup. This depends on M31’s tangential motion. Until now, astronomers had not been able to measure M31's sideways motion in the sky, despite attempts dating back more than a century. The Hubble Space Telescope team, led by van der Marel, conducted extraordinarily precise observations of the sideways motion of M31 that remove any doubt that it is destined to collide and merge with the Milky Way.

"This was accomplished by repeatedly observing select regions of the galaxy over a five- to seven-year period," said Jay Anderson of STScI.

"In the worst-case-scenario simulation, M31 slams into the Milky Way head-on and the stars are all scattered into different orbits," said Gurtina Besla of Columbia University in New York, N.Y. "The stellar populations of both galaxies are jostled, and the Milky Way loses its flattened pancake shape with most of the stars on nearly circular orbits. The galaxies' cores merge, and the stars settle into randomized orbits to create an elliptical-shaped galaxy."

The space shuttle servicing missions to Hubble upgraded it with ever more-powerful cameras, which have given astronomers a long-enough time baseline to make the critical measurements needed to nail down M31's motion. The Hubble observations and the consequences of the merger are reported in three papers that will appear in an upcoming issue of the *Astrophysical Journal.*

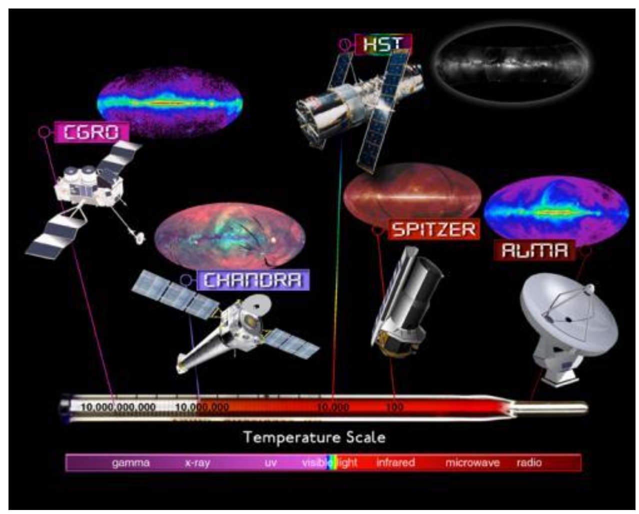
A pinwheel in many colors

This image of the Pinwheel Galaxy, or also known as M101, combines data in the infrared, visible, ultraviolet and X-rays from four of NASA's space-based telescopes. This multi-spectral view shows that both young and old stars are evenly distributed along M101's tightly-wound spiral arms. Such composite images allow astronomers to see how features in one part of the spectrum match up with those seen in other parts. It is like seeing with a regular camera, an ultraviolet camera, night-vision goggles and X-ray vision, all at the same time.

(Phys.org) -- This image of the Pinwheel Galaxy, or also known as M101, combines data in the infrared, visible, ultraviolet and X-rays from four of NASA's space-based telescopes. This multi-spectral view shows that both young and old stars are evenly distributed along M101's tightly-wound spiral arms. Such composite images allow astronomers to see how features in one part of the spectrum match up with those seen in other parts. It is like seeing with a regular camera, an ultraviolet camera, night-vision goggles and X-ray vision, all at the same time.

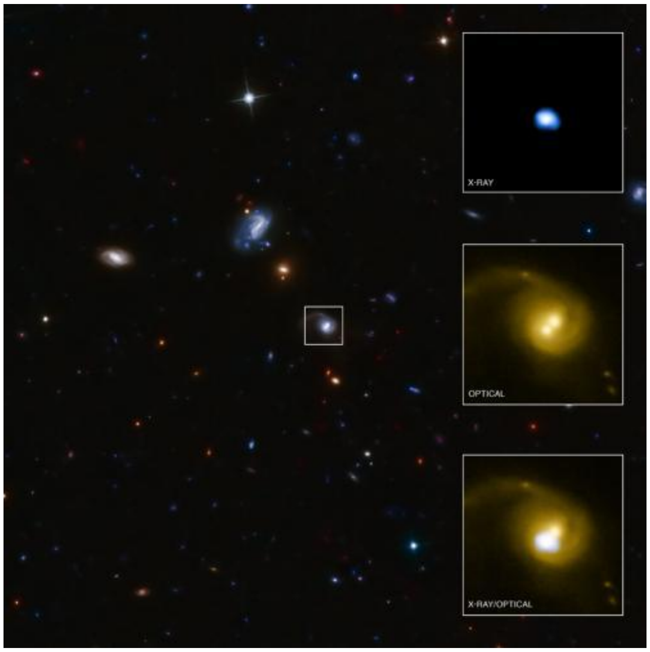
The Pinwheel Galaxy is in the constellation of Ursa Major (also known as the Big Dipper). It is about 70% larger than our own Milky Way Galaxy, with a diameter of about 170,000 light years, and sits at a distance of 21 million light years from Earth. This means that the light we're seeing in this image left the Pinwheel Galaxy about 21 million years ago - many millions of years before humans ever walked the Earth.

The hottest and most energetic areas in this composite image are shown in purple, where the Chandra X-ray Observatory observed the X-ray emission from exploded stars, million-degree gas, and material colliding around black holes.



The Electromagnetic Spectrum. Wavelengths and energies from gamma rays to radio.
The red colors in the image show infrared light, as seen by the Spitzer Space Telescope. These areas show the heat emitted by dusty lanes in the galaxy, where stars are forming.
The yellow component is visible light, observed by the Hubble Space Telescope. Most of this light comes from stars, and they trace the same spiral structure as the dust lanes seen in the infrared.
The blue areas are ultraviolet light, given out by hot, young stars that formed about 1 million years ago, captured by the Galaxy Evolution Explorer (GALEX).

Giant black hole kicked out of home galaxy



Chandra and other telescopes have shown that the galaxy CID-42 likely contains a massive black hole being ejected at several million miles per hour. The main panel is a wide-field optical image of CID-42 and the area around it. The outlined box represents the more localized view of CID-42 that is shown in the three separate boxes on the right-hand side of the graphic. An image from Chandra (top box) shows that the X-ray emission is concentrated in a single source, corresponding to one of the two sources seen in deep observations by Hubble (middle box). The precise Chandra data helps astronomers narrow their ideas about what is happening in this galaxy, supporting the ejected black hole theory. Credit: X-ray: NASA/CXC/SAO/F.Civano et al; Optical: NASA/STScI; Optical (wide field): CFHT, NASA/STScI

(Phys.org) -- Astronomers have found strong evidence that a massive black hole is being ejected from its host galaxy at a speed of several million miles per hour. New observations from NASA's Chandra X-ray Observatory suggest that the black hole collided and merged with another black hole and received a powerful recoil kick from gravitational wave radiation.

"It's hard to believe that a supermassive black hole weighing millions of times the mass of the sun could be moved at all, let alone kicked out of a galaxy at enormous speed," said Francesca Civano of the Harvard-Smithsonian Center for Astrophysics (CfA), who led the new study. "But these new data support the idea that gravitational waves -- ripples in the fabric of space first predicted by Albert Einstein but never detected directly -- can exert an extremely powerful force."

Although the ejection of a supermassive black hole from a galaxy by recoil because more gravitational waves are being emitted in one direction than another is likely to be rare, it nevertheless could mean that there are many giant black holes roaming undetected out in the vast spaces between galaxies.

"These black holes would be invisible to us," said co-author Laura Blecha, also of CfA, "because they have consumed all of the gas surrounding them after being thrown out of their home galaxy."

Civano and her group have been studying a system known as CID-42, located in the middle of a galaxy about 4 billion light years away. They had previously spotted two distinct, compact sources of optical light in CID-42, using NASA's Hubble Space Telescope.

More optical data from the ground-based Magellan and Very Large Telescopes in Chile supplied a spectrum (that is, the distribution of optical light with energy) that suggested the two sources in CID-42 are moving apart at a speed of at least 3 million miles per hour.

Previous Chandra observations detected a bright X-ray source likely caused by super-heated material around one or more supermassive black holes. However, they could not distinguish whether the X-rays came from one or both of the optical sources because Chandra was not pointed directly at CID-42, giving an X-ray source that was less sharp than usual.

"The previous data told us that there was something special going on, but we couldn't tell if there were two black holes or just one," said another co-author Martin Elvis, also of CfA. "We needed new X-ray data to separate the sources."

When Chandra's sharp High Resolution Camera was pointed directly at CID-42, the resulting data showed that X-rays were coming only from one of the sources. The team thinks that when two galaxies collided, the supermassive black holes in the center of each galaxy also collided. The two black holes then merged to form a single black hole that recoiled from gravitational waves produced by the collision, which gave the newly merged black hole a sufficiently large kick for it to eventually escape from the galaxy. The other optical source is thought to be the bright star cluster that was left behind. This picture is consistent with recent computer simulations of merging black holes, which show that merged black holes can receive powerful kicks from the emission of gravitational waves.

There are two other possible explanations for what is happening in CID-42. One would involve an encounter between three supermassive black holes, resulting in the lightest one being ejected. Another idea is that CID-42 contains two supermassive black holes spiraling toward one another, rather than one moving quickly away.

Both of these alternate explanations would require at least one of the supermassive black holes to be very obscured, since only one bright X-ray source is observed. Thus the Chandra data support the idea of a black hole recoiling because of gravitational waves.

The source is located in the Cosmic Evolution Survey (COSMOS) field, a large, multi-wavelength survey.

These results will appear in the June 10 issue of *The Astrophysical Journal.*

Soviet find of water on the Moon in the 1970s ignored by the West

by Lin Edwards

Luna 24

(Phys.org) -- In August 1976 Luna 24 landed on the moon and returned to Earth with samples of rocks, which were found to contain water, but this finding was ignored by scientists in the West.

US missions to the moon brought back a total of around 300 kilograms of moon rocks. Many samples were found to contain traces of water, but NASA believed the water was a contaminant originating on Earth, because lunar dust had clogged the seals of some of the containers and prevented them from being closed properly.

The presence of water on the moon will be important if a moon base is ever to be established, but for many decades the moon was believed by Western scientists to be dry. Three articles by Professor Arlin Crotts, an astrophysicist from Columbia University in New York, has now examined the history of scientific research on the presence of water on the moon and discovered that the Russians had found water in moon rocks in 1976.

The US sent Clementine to the moon in 1994 to use radar to look for water ice by analyzing the reflected radio waves beamed at the surface, and it provided the first Western proof of crystals of water ice under the lunar surface. The Lunar Prospector mission in 1998 also looked for water, this time by comparing the amount of neutrons emitted from the surface with the amount that should be present if there was no water to absorb them. Even more recently, in 2009, the Indian mission Chandrayaan-I found evidence of water on the moon by using infrared photography.

NASA also carried out an experiment in 2009 in which the upper stage of an empty Centaur rocket was crashed into a permanently shadowed lunar crater (the most likely place to find water ice). The Centaur hit the moon at 2.5 km/s and formed a crater four meters deep and 25 meters wide. The plume of ejected material was analyzed and found to contain around 5.6 percent water.

The Soviet Luna 24 mission of 1976 drilled two meters down and extracted 170 grams of lunar soil, which it brought back to Earth for analysis, taking every possible precaution to avoid contamination. The scientists found that water made up 0.1 percent of the mass of the soil, and published their results in the journal *Geokhimiia* in 1978. The journal does not have a wide readership among Western scientists even though it was also available in English, and Crotts said the work was never cited by any scientist in the West.

More information: Water on The Moon, I. Historical Overview - http://arxiv.org/abs/1205.5597
Water on The Moon, II. Origins & Resources - http://arxiv.org/abs/1205.5598
Water on The Moon, III. Volatiles & Activity - http://arxiv.org/abs/1205.5599

via ArXiv Blog

Teenager reportedly finds solution to 350 year old math and physics problem

by Bob Yirka

(Phys.org) -- In Isaac Newton's *Principia Mathematica* published in 1687, the man many consider the most brilliant mathematician of all time used a mathematical formula to describe the path taken by an object when it is thrown through the air from one point to the next, i.e. an arc based on several factors such as the angle it is thrown at, velocity, etc. At the time, Newton explained that to get it completely right though, air resistance would need to be taken into account, though he could not figure out himself how to factor that in. Now, it appears a 16 year old immigrant to Germany has done just that, and to top off his work, he's also apparently come up with an equation that describes the motion of an object when it strikes an immobile surface such as a wall, and bounces back.

Image: Welt.de

Shouryya Ray, a modest student who just four years ago was living in Calcuta, has been on an accelerated learning course and is taking his Abitur exams two years early. His math equations won him first place in a state science competition and second place in the national Math and IT section at finals. He's told the press that figuring out how to come up with his formulas was more due to school-boy naivety than genius, which the German press has been suggesting.

Ray moved with his family to Germany when his father landed a job as a research assistant at the Technical University of Freiburg. He has apparently shown great aptitude for math from an early age, learning calculus from his dad when he was still just six years old. He's told the press that he got the idea of trying to develop the two formulas after visiting Dresden University on a field trip where he was told that no one had been able to come up with equations to describe the two dynamics theories.

Ray's story has generated a lot of press around the world, highlighting the young lad's ability to come up with a math formula that not even the great Isaac Newton could find, despite the fact that no one other than a few local people have seen the formulas he's created; thus, in the math and physics world there remains a great deal of skepticism regarding what he's actually accomplished and most are holding off judgment until the formulas are published and reviewed.

Blowing bubbles in the Carina Nebula

The Carina Nebula, by ESA's Herschel space observatory. The image shows the effects of massive star formation - powerful stellar winds and radiation have carved pillars and bubbles in dense clouds of gas and dust. The image covers approximately 2.3 x 2.3 degrees of the Carina Nebula complex and was mapped using Herschel instruments PACS and SPIRE at wavelengths of 70, 160, and 250 microns, corresponding to the blue, green, and red channels, respectively. North is to the upper left and east is to the lower left. Credits: ESA/PACS/SPIRE/Thomas Preibisch, Universitäts-Sternwarte München, Ludwig-Maximilians-Universität München, Germany.

(Phys.org) -- Giant bubbles, towering pillars and cascading clouds of dust and gas fill the star-forming nursery of the Carina Nebula seen here in a stunning new view from Herschel to launch ESA Space Science's image of the week feature.

The Carina Nebula is some 7500 lightyears from Earth and hosts some of the most massive and luminous stars in our Galaxy, including double-star system eta Carinae, which boasts over 100 times the mass of our Sun.
The total amount of gas and dust traced by ESA's Herschel space observatory in this image is equivalent to some 650 000 Suns. Including warmer gas not well traced by Herschel, the total mass may be as high as 900 000 Suns.

Surrounding pillars of gas and dust point towards the bright central region of nebulosity – home to eta Carinae and numerous other massive stars.

The pillars are carved by intense stellar winds and radiation blasted out by these stars, eating away at the surrounding material.

Above and to the left is a chaotic web of bubbles and broken bubble arcs molded by individual regions of star formation that have swept up shells of dense clouds around them.

At top right is the Gum 31 nebula, which has blown a giant bubble out of the surrounding dense clouds thanks to winds and radiation emitted by the young stellar cluster NGC 3324 that sits at its heart.

This latest Herschel image launches ESA Space Science's new image of the week series, which will present a variety of images and animations capturing all aspects of space science from the Sun, planets, stars, and galaxies to the edge of the Universe, along with the spacecraft that provide us with these spectacular views.

There's more star-stuff out there but it's not dark matter

A radio image of a small nearby galaxy, the Large Magellanic Cloud, made with CSIRO radio telescopes. The bright areas are where the most atomic hydrogen gas is found. Credit: S. Kim et al. / CSIRO

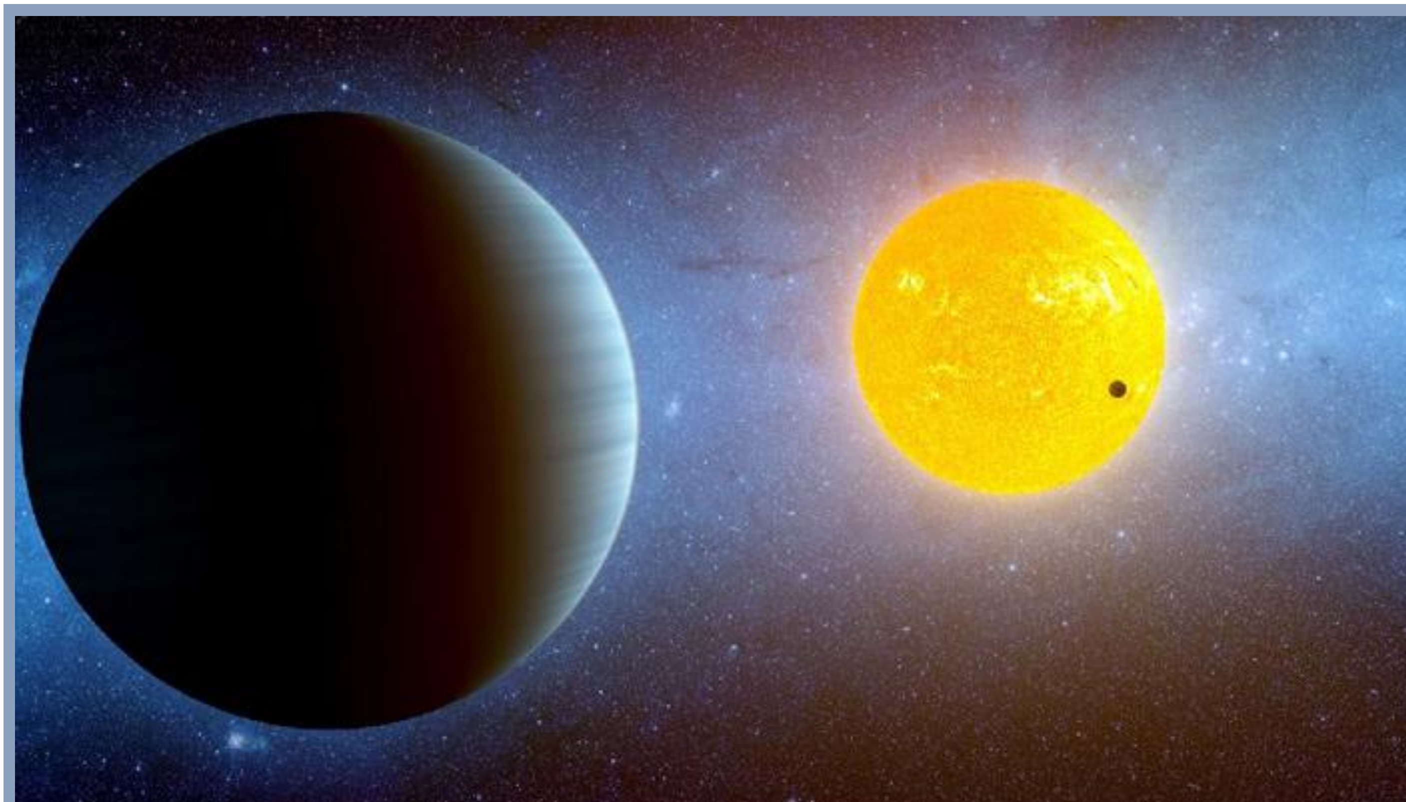
(Phys.org) -- More atomic hydrogen gas — the ultimate fuel for stars — is lurking in today's Universe than we thought, CSIRO astronomer Dr. Robert Braun has found.

This is the first accurate measurement of this gas in galaxies close to our own.

Just after the Big Bang the Universe's matter was almost entirely hydrogen atoms. Over time this gas of atoms came together and generated galaxies, stars and planets — and the process is still going on. Astronomers want to understand where, when and how the atomic gas is transformed to better understand the Universe in which we live.

By taking a new look at some archival data, Dr. Braun, Chief Scientist at CSIRO Astronomy and Space Science in Sydney, Australia, has discovered that galaxies around us are hiding about a third more atomic hydrogen gas than previously calculated.

Year of the Solar System
Discovering New Worlds

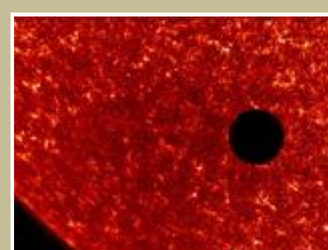


This artist's conception depicts the Kepler-10 star system, where Kepler has discovered two planets. Kepler-10b (the dark spot in front of the yellow star) is the smallest planet outside our solar system. Kepler-10c, the larger planet to the left is much bigger. Both planets would be blistering hot worlds. (Credit: NASA/Ames/JPL-Caltech)

Many explorers of "new worlds" set out seeking knowledge. The Discovery Expedition to Antarctica was organized to carry out scientific research and geographical exploration. Lewis and Clark's expedition to the Pacific Ocean was to learn more about the American West; they returned with careful records, maps and samples of the plants and animals they encountered. Captain James Cook's expedition on the Endeavour to Tahiti was sent both to explore the South Pacific, but also to observe the 1769 transit of Venus across the sun in order to calculate the distance to Venus, and set the scale of the solar system.

Many modern explorers are using telescopes to discover new worlds. These telescopes can search the skies, finding and studying planets that orbit other stars in our galaxy. The NASA mission Kepler has a spacecraft which trails the Earth as it orbits the sun, observing stars and looking for planets that may cross in front of the star (transiting) and blocking some of that star's light. It is sensitive enough to detect Earth-sized planets -- including some that may have life!

Don't forget to watch the transit of Venus on June 5 -- after that, there will not be another Venus transit until 2117!



Join us this month to observe a rare transit of Venus, just like the 1769 transit observed by Captain Cook, and learn more about how distant worlds are being discovered through the Kepler and other missions! Check out transit activities in the Classrooms and Organizations and Clubs sections, and find a variety of powerpoints, articles, videos, interactives, and more under Educational Resources.

June 2012 Celestial Events

supplied by J. Randolph Walton (Randy)

Day	Date	Time (EDT)	Event
Mon	4	05:36	Moon Set
		07:03	**Partial lunar eclipse** (not visible in NJ)
		07:12	**Full Moon**
Tue	5	18:09	**Contact I of Transit of Venus across the face of the Sun**
		18:28	**Contact II of Transit of Venus**
		20:26	Sunset (at about 1/3 of Transit of Venus)
Sat	9	01:27	Mars Sets
		02:58	Saturn Sets
		04:25	Jupiter Rises
		05:15	Venus Rises
		05:31	Sunrise
		11:13	Moon Set
		20:28	Sunset
		21:40	Mercury Sets
Mon	11	06:41	**Last Quarter Moon**
		13:17	Moon Set
Sat	16	01:07	Mars Sets
		02:30	Saturn Sets
		04:05	Jupiter Rises
		04:40	Venus Rises
		05:31	Sunrise
		18:04	Moon Set
		20:31	Sunset
		22:05	Mercury Sets
Tue	19	11:02	**New Moon**
		20:35	Moon Set
Wed	20	19:09	**Summer Solstice**
Sat	23	00:45	Mars Sets
		02:05	Saturn Sets
		03:40	Jupiter Rises
		04:10	Venus Rises
		05:32	Sunrise
		20:33	Sunset
		22:10	Mercury Sets
		23:00	Moon Set
Tue	26	12:46	Moon Rise
		23:30	**First Quarter Moon**
Wed	27	21:00	**Lunar Straight Wall visible**
Sat	30	00:25	Mars Sets
		01:35	Saturn Sets
		03:17	Jupiter Rises
		03:50	Venus Rises
		05:35	Sunrise
		17:26	Moon Rise
		20:33	Sunset
		22:05	Mercury Sets

In the Eyepiece

Here is a list of objects for this month. This is reproduced from www.skyhound.com with the kind permission of its creator and author of SkyTools Greg Crinklaw.

Object(s)	Class	Con	RA	Dec	Mag
Mu Boo	Multiple Star System	Bootes	15h24m30.9s	+37°22'38"	4.3+7.2
M5	Globular Cluster	Ser	15h18m15.4s	+02°05'00"	5.7
NGC 5897	Globular Cluster	Libra	15h17m24.0s	-21°03'26"	8.4
NGC 6207	Galaxy	Hercules	16h43m03.9s	+36°49'58"	12.1
NGC 6144	Globular Cluster	Scorpius	16h27m14.0s	-26°01'18"	9
NGC 6210	Planetary Nebula	Hercules	16h44m29.5s	+23°47'59"	9.3
A 39	Planetary Nebula	Hercules	16h27m33.9s	+27°54'29"	13.7
The Rumpled Starfish (NGC 6240)	Interacting Galaxy	Ophiuchus	16h52m59.0s	+02°24'02"	13.8
Me 2-1	Planetary Nebula	Libra	15h22m18.6s	-23°37'35"	11.6
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Coordinates are epoch 2000.0