Southwest Florida Astronomical Society
SWFAS

The Eyepiece
February 2016

Contents:

A MESSAGE FROM THE PRESIDENT

I hope everyone has been able to stay dry this winter. It sure has not been conducive to observing. This El Nino weather pattern is a real problem to us for observing.

Speaking of observing, if you haven't gotten out to see the planets in the morning, you need to. Everyone is hyping it as seeing 5 planets naked eye. They are wrong. You get to see 6, we can't forget the good old Earth!

February is one of our busier months. There is our club star party on the 6th at CRP. Following that we have the STEMtastic/Edison Festival on the 13th and the Burrowing Owl Festival on the 27th along with several major school star parties on the 19th. Hopefully the weather will co-operate with us for all these events! We can use help at these events. You don't need to bring equipment, we have enough traffic that just having people to give out handouts or explain exhibits is a great help.

The Oasis Middle Star Party was moved because of the weather to February 19th. This also is the same night that Bruce has scheduled an event at Sunshine Elementary in Lehigh. He is looking for some help there. He has a powerpoint program planned for them as well.

We follow February up with our major public star party at Rotary Park on the 4th of March. We have a club star party at the CRP the next night. (With the meeting that Thursday, we have a three night in a row set of events!)

Jupiter is moving towards the evening sky and will become well placed for observing starting this month. Any small scope will readily show the moons and as you get larger, the bands and other details will start to appear.

Public observing at the Moore Observatory at Florida Southwestern State College in Punta Gorda occurs on the 2nd Friday night of each month. We have several members involved in this including Tony Heiner, Tom Segur and Tom Burkett along with Dave Hanson. (http://www.fsw.edu/charlotte/observatory)

It is dues renewal time. Dues for 2016 are $20.00 and can be paid at the meeting or via mail to: SWFAS, Inc PO Box 100127 Cape Coral, FL 33910-0127.

The program this month will again be before the business meeting.

Brian

In the Sky this Month

Moon: February – Last Quarter- Jan 31st; New- Feb 8th; 1st Quarter-15th; Full-22nd.

The Planets: Most planetary action continues in the early dawn hours All five bright planets will be visible in the morning sky for the entire month.

Mercury shines near Venus all month long.

Venus shines at -4.0 magnitude as its disc increases from 85% to 90% lit.

Saturn rises in the early morning hours all month and shines at 0.5 magnitude.

Mars shines between Spica and Antares in morning hours, brightening and growing from 6.8" to 8.6" during the month.

Jupiter rises around 8:30 pm at beginning of month, to nearly sunset by end of month while shining at -2.5 magnitude.

International Space Station: The ISS returns to the evening sky late this month. Best evening dates are Feb 20-22. See this link for specific times: http://www.heavens-above.com/

Future Events

Star Party and Event Schedule

Date	Event	Location	Time	Info/Contact
February 4th Monthly Meeting	Program: Celestial Marine Navigation by Ray Wlodyka Business meeting follows	Calusa Nature Center & Planetarium	7:30 pm	Brian Risley
February 6th	Star Party	CRP	Dusk	Bruce Dissette
February 12th	Public Observing	Moore Observatory FSW Punta Gorda	Dusk	Tony Heiner/Tom Segur
February 13th	STEMtastic/Edison Day of Discovery	Centennial Park/ Harborside Event Center Fort Myers	10am-3pm (8am setup)	Brian Risley
February 19th	Star Party	Oasis Middle School	6:30 pm	Johnnie Royal & Carol Stewart
February 19th	Star Party	Sunshine Elementary School Lehigh	6:00 pm	Bruce Dissette
February 27th	Burrowing Owl Festival	Rotary Park Cape Coral		Brian Risley
February 27th	Solar Observing (4th Saturday)	Gilchrist Park, Punta Gorda	9am- 12	Tom Segur
March 3rd Monthly Meeting		Calusa Nature Center & Planetarium	7:30 pm	Brian Risley
March 4th	SWFAS Rotary Park Star Party	Rotary Park Cape Coral	7-10pm	Brian Risley
March 5th	Star Party	CRP	Dusk	Bruce Dissette
April 9th	Star Party	CRP	Dusk	Bruce Dissette
May 7th	Star Party	CRP	Dusk	Bruce Dissette

February Program –

On Thursday, February 4, 2016, Ray Wlodyka, assistant education officer for the Cape Coral Power Squadron, will speak on navigation techniques used by the ancient mariners including development of the sextant and learning to determine longitudinal position on the high seas. He will explain to us the technique of taking and reducing sightings for position determination. This presentation will discuss the rise of celestial navigation techniques and the present day demise of this skill as GPS tracking and other modern techniques replace the need to read the stars.

Minutes of the Southwest Florida Astronomical Society – January 7th, 2016

Will appear in a future issue

Notable February Events in Astronomy and Space Flight History

Compiled by Mike McCauley

February 1, 2003: Shuttle Columbia destroyed during reentry. The Space Shuttle Columbia disintegrated over Texas and Louisiana as it reentered Earth's atmosphere, killing all seven crew members. During the launch of STS-107, Columbia's 28th mission, a piece of foam insulation broke off from the Space Shuttle's external tank and struck the left wing of the orbiter. A few previous shuttle launches had seen minor damage from foam shedding, but some engineers suspected that the damage to Columbia was more serious. When Columbia reentered the atmosphere of Earth, the damage allowed hot atmospheric gases to penetrate and destroy the internal wing structure, which caused the spacecraft to become unstable and slowly break apart. After the disaster, Space Shuttle flight operations were suspended for more than two years, similar to the aftermath of the Challenger disaster. Construction of the International Space Station (ISS) was put on hold; the station relied entirely on the Russian Federal Space Agency for resupply for 29 months until Shuttle flights resumed with STS-114, and 41 months for crew rotation until STS-121. Several technical and organizational changes were made, including adding a thorough on-orbit inspection to determine how well the shuttle's thermal protection system had endured the ascent, and keeping a designated rescue mission ready in case irreparable damage was found. Except for one final mission to repair the Hubble Space Telescope, subsequent missions were flown only to the ISS so that the crew could use it as a haven in case damage to the orbiter prevented safe reentry.

February 3, 1966: Luna 9 lands on moon. Luna 9, internal designation Ye-6 No.13, was an unmanned space mission of the Soviet Union's Luna program. The Luna 9 spacecraft became the first spacecraft to achieve a soft landing on the Moon, or any planetary body other than Earth, and to transmit photographic data to Earth from the surface. The lander had a mass of 99 kilograms (218 lbs.). It used a landing bag to survive the impact speed of 22 kilometers per hour (6.1 m/s; 14 mph). It was a hermetically sealed container with radio equipment, a program timing device, heat control systems, scientific apparatus, power sources, and a television system. Luna 9 was the twelfth attempt at a soft-landing by the Soviet Union. It was also the first successful space probe built by the Lavochkin design bureau, which ultimately would design and build almost all Soviet (later Russian) lunar and interplanetary spacecraft.

February 4, 1906: Clyde Tombaugh born in Streator, Illinois. Clyde William Tombaugh was an American astronomer. He discovered Pluto in 1930, the first object to be discovered in what would later be identified as the Kuiper belt. At the time of discovery, Pluto was considered a planet but was later reclassified as a dwarf planet. Tombaugh also discovered many asteroids. He called for serious scientific research of unidentified flying objects, or UFOs. Following his discovery of Pluto, Tombaugh earned bachelors and master's degrees in astronomy from the University of Kansas in 1936 and 1938. During World War II he taught naval personnel navigation at Northern Arizona University. He worked at White Sands Missile Range in the early 1950s, and taught astronomy at New Mexico State University from 1955 until his retirement in 1973. The asteroid 1604 Tombaugh discovered in 1931, is named after him. He discovered hundreds of asteroids, beginning with 2839 Annette in 1929, mostly as a by-product of his search for Pluto and his searches for other celestial objects. The Royal Astronomical Society awarded him the Jackson-Gwilt Medal in 1931.

In August 1992, JPL scientist Robert Staehle called Tombaugh, requesting permission to visit his planet. "I told him he was welcome to it," Tombaugh later remembered, "though he's got to go on one long, cold trip." The call eventually led to the launch of the New Horizons space probe to Pluto in 2006. Following the passage on July 14, 2015 of Pluto by the New Horizons spacecraft, the "Cold Heart of Pluto" was named Tombaugh Regio. Tombaugh died on January 17, 1997, in Las Cruces, New Mexico, at the age of 90. A small portion of his ashes was placed aboard the New Horizons spacecraft. The container includes the inscription: "Interned herein are remains of American Clyde W. Tombaugh, discoverer of Pluto and the solar system's 'third zone'. Adelle and Muron's boy, Patricia's husband, Annette and Alden's father, astronomer, teacher, punster, and friend: Clyde W. Tombaugh (1906–1997)". Tombaugh was survived by his wife, Patricia (1912–2012), and their children, Annette and Alden.

February 5, 1971: Apollo 14 lands on moon. Apollo 14 was the eighth manned mission in the United States Apollo program, and the third to land on the Moon. Commander Alan Shepard, Command Module Pilot Stuart Roosa, and Lunar Module Pilot Edgar Mitchell launched on their nine-day mission on January 31, 1971 after a 40-minute, 2 second delay due to launch site weather restrictions, the first such delay in the Apollo program. Shepard and Mitchell made their lunar landing on February 5 in the Fra Mauro formation – the original target of the aborted Apollo 13 mission. During the two lunar EVAs, 42.80 kilograms (94.35 lb.) of Moon rocks were collected, and several scientific experiments were performed. Shepard hit two golf balls on the lunar surface. Shepard and Mitchell spent 33½ hours on the Moon, with almost 9½ hours of EVA. In the aftermath of Apollo 13, several modifications were made to the Service Module electrical power system to prevent a repeat of that accident, including redesign of the oxygen tanks and addition of a third tank. While Shepard and Mitchell were on the surface, Roosa remained in lunar orbit aboard the Command/Service Module Kitty Hawk, performing scientific experiments and photographing the Moon, including the landing site of the future Apollo 16 mission. He took several hundred seeds on the mission, many of which were germinated on return, resulting in the so-called Moon trees. Shepard, Roosa, and Mitchell landed in the Pacific Ocean on February 9. Mitchell is the only surviving member of the crew; Roosa died in 1994; Shepard in 1998.

February 13, 1852: Johan Dreyer born. Johan Dreyer was a Danish-Irish astronomer who won the Gold Medal of the Royal Astronomical Society in 1916 and served as the society's president from 1923 until 1925. His major contribution was the monumental New General Catalogue of Nebulae and Clusters of Stars (based on William Herschel's Catalogue of Nebulae), the catalogue numbers are still in use, as well as two supplementary Index Catalogues. A crater on the far side of the Moon is named after him.

February 15, 1564: Galileo Galilei was born in Pisa, Italy. Galileo Galilei was an Italian astronomer, physicist, engineer, philosopher, and mathematician who played a major role in the scientific revolution during the Renaissance. Galileo has been called the "father of observational astronomy", the "father of modern physics", and the "father of science". His contributions to observational astronomy include the telescopic confirmation of the phases of Venus, the discovery of the four largest satellites of Jupiter (named Galilean moons), and observation and analysis of sunspots. Galileo also worked in applied science and technology, inventing an improved military compass and other instruments. Galileo's championing of heliocentrism and Copernicanism was controversial within his lifetime, when most subscribed to either geocentrism or the Tychonic system. He met with opposition from astronomers, who doubted heliocentrism due to the absence of an observed stellar parallax. The matter was investigated by the Roman Inquisition in 1615, and they concluded that it could only be supported as a possibility, not as an established fact. Galileo later defended his views in Dialogue Concerning the Two Chief World Systems, which appeared to attack Pope Urban VIII and thus alienated him and the Jesuits, who had both supported Galileo up until this point. He was tried by the Inquisition, found "vehemently suspect of heresy", forced to recant, and spent the rest of his life under house arrest. It was while Galileo was under house arrest that he wrote one of his finest works, Two New Sciences. Here he summarized work he had done forty years earlier, on two sciences now called kinematics and strength of materials.

February 16, 1948: Gerard Kuiper discovers moon of Uranus. Miranda or Uranus V is the smallest and innermost of Uranus's five satellites. Like other large moons of Uranus, Miranda orbits close to its planet's equatorial plane. Because Uranus orbits the Sun on its side, Miranda's orbit is perpendicular to the ecliptic and shares Uranus's extreme seasonal cycle. At just 470 km in diameter, Miranda is one of the smallest objects in the Solar System known to be spherical under its own gravity. Of the bodies that are known to be in hydrostatic equilibrium, only Saturn's moon Mimas is smaller. Miranda was discovered on 16 February 1948 by planetary astronomer Gerard Kuiper using the McDonald Observatory's 82-inch (2,080 mm) Otto Struve Telescope. Its motion around Uranus was confirmed on 1 March 1948. It was the first satellite of Uranus discovered in nearly 100 years. Kuiper elected to name the object "Miranda" after the character in Shakespeare's The Tempest, because the four previously discovered moons of Uranus, Ariel, Umbriel, Titania and Oberon, had all been named after characters of Shakespeare or Alexander Pope. However, the previous moons had been named specifically after fairies, whereas Miranda was a human. Subsequently, discovered satellites of Uranus were named after Shakespearean characters, whether fairies or not.

February 18, 1930: Clyde Tombaugh discovers Pluto. While a young researcher working for the Lowell Observatory in Flagstaff, Arizona, Tombaugh was given the job to perform a systematic search for a trans-Neptunian planet (also called Planet X), which had been predicted by Percival Lowell and William Pickering. Tombaugh used the observatory's 13-inch astrograph to take photographs of the same section of sky several nights apart. He then used a blink comparator to compare the different images. When he shifted between the two images, a moving object, such as a planet, would appear to jump from one position to another, while the more distant objects such as stars would appear stationary. Tombaugh noticed such an object in his search, near the place predicted by Lowell, and subsequent observations showed it to have an orbit beyond that of Neptune. This ruled out classification as an asteroid, and they decided this was the ninth planet, Lowell had predicted. The discovery was made on Tuesday, February 18, 1930, using images taken the previous month. The name "Pluto" was suggested by Venetia Burney, then an 11-year-old English schoolgirl, who died in April 2009, having lived to see reclassification of Pluto as a dwarf planet. It won out over numerous other suggestions because it was the name of the Roman god of the underworld, who was able to render himself invisible, and because Percival Lowell's initials PL formed the first 2 letters. The name Pluto was officially adopted on May 1, 1930.

February 19, 1473: Nicholas Copernicus was born. Nicolaus Copernicus was a Renaissance mathematician and astronomer who formulated a model of the universe that placed the Sun rather than the Earth at the center of the universe. The publication of this model in his book De Revolutionibus Orbium Coelestium (On the Revolutions of the Celestial Spheres) just before his death in 1543 is considered a major event in the history of science, triggering the Copernican Revolution and making an important contribution to the Scientific Revolution. Sometime before 1514 Copernicus made available to friends his "Commentariolus" ("Little Commentary"), a forty-page manuscript describing his ideas about the heliocentric hypothesis. Thereafter he continued gathering data for a more detailed work. About 1532 Copernicus had basically completed his work on the manuscript of De Revolutionibus Orbium Coelestium; but despite urging by his closest friends, he resisted openly publishing his views, not wishing to risk the scorn "to which he would expose himself on account of the novelty and incomprehensibility of his theses." Copernicus was still working on De Revolutionibus Orbium Coelestium (even if not certain that he wanted to publish it) when in 1539 Georg Joachim Rheticus, a Wittenberg mathematician, arrived in Frombork. Philipp Melanchthon, a close theological ally of Martin Luther, had arranged for Rheticus to visit several astronomers and study with them. Rheticus became Copernicus' pupil, staying with him for two years and writing a book, Narratio Prima (First Account), outlining the essence of Copernicus' theory. In 1542 Rheticus published a treatise on trigonometry by Copernicus (later included in the second book of De Revolutionibus). Under strong pressure from Rheticus, and having seen the favorable first general reception of his work, Copernicus finally agreed to give De Revolutionibus to his close friend, Tiedemann Giese, bishop of Chełmno (Kulm), to be delivered to Rheticus for printing by the German printer Johannes Petreius at Nuremberg, Germany. While Rheticus initially supervised the printing, he had to leave Nuremberg before it was completed, and he handed over the task of supervising the rest of the printing to a Lutheran theologian, Andreas Osiander. Osiander added an unauthorized and unsigned preface, defending the work against those who might be offended by the novel hypotheses. He explained that astronomers may find different causes for observed motions, and choose whatever is easier to grasp. As long as a hypothesis allows reliable computation, it does not have to match what a philosopher might seek as the truth. Toward the close of 1542, Copernicus was seized with apoplexy and paralysis, and he died at age 70 on 24 May 1543. Legend has it that he was presented with the final printed pages of his De Revolutionibus Orbium Coelestium on the very day that he died. He is reputed to have awoken from a stroke-induced coma, looked at his book, and then died peacefully.

February 19, 1986: Mir space station launched. Mir was a space station that operated in low Earth orbit from 1986 to 2001, owned by the Soviet Union and later by Russia. Mir was the first modular space station and was assembled in orbit from 1986 to 1996. Until 21 March 2001 it was the largest artificial satellite in orbit, succeeded by the International Space Station after Mir's orbit decayed. The station served as a microgravity research laboratory in which crews conducted experiments in biology, human biology, physics, astronomy, meteorology and spacecraft systems with a goal of developing technologies required for permanent occupation of space. Mir was the first continuously inhabited long-term research station in orbit and held the record for the longest continuous human presence in space at 3,644 days until 23 October 2010 when it was surpassed by the ISS. It holds the record for the longest single human spaceflight, with Valeri Polyakov spending 437 days and 18 hours on the station between 1994 and 1995. Mir was occupied for a total of twelve and a half years out of its fifteen-year lifespan, having the capacity to support a resident crew of three, or larger crews for short term visits. The first module of the station, known as the core module or base block, was launched in 1986, and followed by six further modules. Proton rockets were used to launch all of its components except for the docking module, which was installed by space shuttle mission STS-74 in 1995. When complete, the station consisted of seven pressurized modules and several unpressurised components. Power was provided by several photovoltaic arrays attached directly to the modules and backed by uranium reactor steamed electric recharger. The station was maintained at an orbit between 296 km (184 mi) and 421 km (262 mi) altitude and traveled at an average speed of 27,700 km/h (17,200 mph), completing 15.7 orbits per day. Near the end of its life, there were plans for private interests to purchase Mir, possibly for use as the first orbital television/movie studio. The privately funded Soyuz TM-30 mission by MirCorp, launched on 4 April 2000, carried two crew members, Sergei Zalyotin and Aleksandr Kaleri, to the station for two months to do repair work with the hope of proving that the station could be made safe. This was, however, to be the last manned mission to Mir. While Russia was optimistic about Mir's future, its commitments to the International Space Station project left no funding to support the aging station. Mir's deorbit was carried out in three stages. The first stage involved waiting for atmospheric drag to reduce the station's orbit to an average of 220 kilometers (140 mi). This began with docking of Progress M1-5, a modified version of the Progress-M carrying 2.5 times more fuel in place of supplies. The second stage was transfer of the station into a 165 × 220 km (103 × 137 mi) orbit. This was achieved with two burns of Progress M1-5's control engines on 23 March 2001. After a two-orbit pause, the third and final stage of Mir's deorbit began with the burn of Progress M1-5's control engines and main engine. Reentry into Earth's atmosphere (100 km/60 mi AMSL) of the 15-year-old space station occurred near Nadi, Fiji. Major destruction of the station began and most of the unburned fragments fell into the South Pacific Ocean.

February 20, 1962: John Glenn becomes first American to orbit earth. Glenn became the first American to orbit the Earth, aboard Friendship 7, on the Mercury-Atlas 6 mission, circling the globe three times during a flight lasting 4 hours, 55 minutes, and 23 seconds. This made Glenn the third American in space and the fifth human being in space after cosmonauts Yuri Gagarin and Gherman Titov and the sub-orbital flights of Mercury astronauts Alan Shepard and Gus Grissom. During the first mission there was concern over a ground indication that his heat shield had come loose, which could allow it to fail during re-entry through the atmosphere, causing his capsule to burn up. Flight controllers had Glenn modify his re-entry procedure by keeping his retrorocket pack on over the shield in an attempt to keep it in place. He made his splashdown safely, and afterwards it was determined that the indicator was faulty. As the first American in orbit, Glenn became a national hero, met President Kennedy, and received a ticker-tape parade in New York City, reminiscent of that given for Charles Lindbergh.

February 24, 1968: Discovery of first pulsar announced. The first pulsar was observed on November 28, 1967, by Jocelyn Bell Burnell and Antony Hewish. They observed pulses separated by 1.33 seconds that originated from the same location on the sky, and kept to sidereal time. In looking for explanations for the pulses, the short period of the pulses eliminated most astrophysical sources of radiation, such as stars, and since the pulses followed sidereal time, it could not be man-made radio frequency interference. When observations with another telescope confirmed the emission, it eliminated any sort of instrumental effects. At this point, Burnell notes of herself and Hewish that "we did not really believe that we had picked up signals from another civilization, but obviously the idea had crossed our minds and we had no proof that it was an entirely natural radio emission. It is an interesting problem—if one thinks one may have detected life elsewhere in the universe, how does one announce the results responsibly?" Even so, they nicknamed the signal LGM-1, for "little green men". It was not until a second pulsating source was discovered in a different part of the sky that the "LGM hypothesis" was entirely abandoned. Their pulsar was later dubbed CP 1919, and is now known by a number of designators including PSR 1919+21, PSR B1919+21 and PSR J1921+2153. Although CP 1919 emits in radio wavelengths, pulsars have, subsequently, been found to emit in visible light, X-ray, and/or gamma ray wavelengths. The word "pulsar" is a portmanteau of "pulsating star". It first appeared in print in 1968.

February 27, 1897: Bernard Lyot was born in Paris and was a French astronomer. From 1920 until his death he worked for the Meudon Observatory, where in 1930 he earned the title of Joint Astronomer of the Observatory. After gaining the title, he earned a reputation of being an expert of polarized and monochromatic light. Throughout the 1930s, he labored to perfect the coronagraph, which he invented to observe the corona without having to wait for a solar eclipse. In 1938, he showed a movie of the corona in action to the International Astronomical Union. In 1939, he was elected to the French Academy of Sciences. He became Chief Astronomer at the Meudon Observatory in 1943 and received the Bruce Medal in 1947. He suffered a heart attack while returning from an eclipse expedition in Sudan and died on 2 April 1952, at the age of 55.

February 28, 1966: Gemini 9 primary crew, Bassett and See, killed in plane crash. Gemini 9A (officially Gemini IX-A) was a 1966 manned spaceflight in NASA's Gemini program. It was the 7th manned Gemini flight, the 13th manned American flight and the 23rd spaceflight of all time. The original crew for Gemini 9, command pilot Elliot See and pilot Charles Bassett, were killed in a crash on February 28, 1966 while flying a T-38 jet trainer to the McDonnell Aircraft plant in St. Louis, Missouri to inspect their spacecraft. They were flying from Texas to inspect the Gemini 9 spacecraft at the McDonnell Aircraft plant in St. Louis, Missouri. The conditions at Lambert Field were poor and, as a consequence, in attempting a visual approach and landing, See hit one of the assembly buildings of the factory and caused the aircraft to crash, killing himself and Bassett instantly. As a consequence, the backup crew was promoted to prime crew, the first time this had occurred since the flight of Mercury-Atlas 7 in 1962. The mission was flown June 3–6, 1966 by backup command pilot Thomas P. Stafford and pilot Eugene Cernan. The astronauts rendezvoused with the Augmented Target Docking Adaptor, but were unable to dock with it because the nose fairing failed to eject from the docking target due to a launch preparation error. Cernan performed a two-hour extravehicular activity, during which he was planned to demonstrate free flight in a self-contained rocket pack, the Astronaut Maneuvering Unit. He was unable to accomplish this due to stress, fatigue.

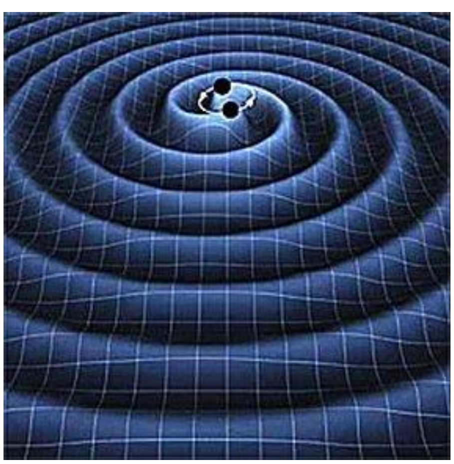
About The LIGO Gravitational-Wave Rumor. . .

By: Shannon Hall from S&T

The physics and astronomy world is all agossip: has LIGO heard its first black-hole merger? Well, not so fast.

LIGO consists of two L-shaped interferometers, one in Hanford, Washington (shown here), and one in Livingston, Louisiana. Each arm of each L is 2½ miles (4 km) long. Lasers look for changes in each arm's length as small as a millionth the diameter of a proton. Passing gravitational waves might distort space-time by that much. *LIGO Laboratory*

Rumors are swarming on social media that the newly upgraded LIGO, the Advanced Laser Interferometer Gravitational-Wave Observatory or aLIGO, has finally seen the gravitational-wave signature of two stellar-mass black holes spiraling together and merging. Maybe even two such events since September. Or not.
Such an observation would confirm one of the most elusive predictions of Einstein's general theory of relativity, and it would also open a new field of cosmic observation: gravitational-wave astronomy.



Artist's concept of gravitational waves produced by closely orbiting black holes embedded in a 2-dimensional sheet. *K. Thorne (Caltech) / T. Carnahan (NASA GSFC)*

First, the background: According to general relativity, any accelerating mass should produce weak ripples in the fabric of spacetime itself. But it would take enormous, dense masses accelerating extremely fast to emit a significant amount of them. Neutron stars or black holes spiraling together and merging would qualify, and LIGO was built with those events particularly in mind.

As gravitational waves pass by, they stress and compress time and distance. But after traveling millions of light-years across the universe, they would be extremely weak. The typical expected signal strength would stretch and squeeze the distance from the Earth to the Sun, for instance, by the width of a hydrogen atom. Yet even that weak an effect could be detected by the laser beams bouncing back and forth along LIGO's 4-kilometer-long vacuum pipes. It would be the first *direct* detection of gravitational radiation. (We already know it exists by its indirect effect of draining orbital energy away from close neutron-star binaries.) A Nobel Prize probably awaits the first direct observation. If it ever happens.

The tunnel for one of the LIGO arms in Livingston, Louisiana. Having two units nearly 2,000 miles apart provides essential error checking and would help triangulate to find the incoming direction of any gravitational waves. A third detector in Italy, named VIRGO, is scheduled to join the network. *LIGO Laboratory*.

Such a feat "will open up a new window into the way we see the universe," says astronomer Takamitsu Tanaka (Stony Brook University). Take gamma-ray bursts, for instance. These are quick, incredibly powerful explosions that are presumed to come, in some cases, from a pair of neutron stars spiraling together and merging, and in other cases from the fraction-of-a-second disruption of a dying star's neutron-star-like core. Both kinds of cataclysm should be violent enough to send detectable gravitational waves far across the universe. "If we could see such events from gravitational-wave and conventional telescopes [both], then we can learn a lot more about the physics and what's really going on with those events," says Tanaka.

Still, the rumors remain just rumors. And they're really bothering the LIGO people.

Gravitational Whispers

The gossip started spreading in physics circles just a week after the upgraded aLIGO began running in September. The rumors escaped from physics circles when cosmologist Lawrence Krauss (Arizona State University) tweeted about them on September 25th: *"Rumor of a gravitational wave detection at LIGO detector. Amazing if true. Will post details if it survives."* More recently he commented that he's 60% sure the story will pan out. Yesterday he noted the caveat that he is not one of the 900-plus members of the LIGO scientific collaboration, nor does he represent anyone there.

Steinn Sigurdsson (Pennsylvania State University), who has also speculated on the rumors via social media, says "I have absolutely no inside information on what is going on. I hear stories, I can make inferences, I can see patterns in activity. And there has been a consistent whisper for several months now that [aLIGO] saw something as soon as they turned it on."

Researchers work on a LIGO detector in Livingston in 2014. Michael Fyffe / LIGO

Those whispers grew to a lively babble after further tantalizing clues. First, Sigurdsson points to a flurry of papers that have appeared this week on the arXiv preprint server that were curiously specific. Astronomers, says Sigurdsson, "posted somewhat different scenarios for ways in which you could have black hole binaries form, all of which coincidentally predicted almost the exact same final configuration, and said 'Gosh our model predicted that this very specific sort of thing will be the most likely thing that LIGO sees.' " And Sigurdsson isn't the only one who has noticed. Derek Fox (Pennsylvania State University) pointed to one paper, for example, tweeting "this seems a rather specific GW [gravitational wave] scenario to pull out of thin air?"

The meeting of the arms. The light pipes and the equipment in their ends (seen here) are kept in an ultrahigh vacuum. *LIGO Laboratory.*

But again, Krauss, Sigurdsson, and Tanaka claim to have no privileged information. “It’s the equivalent of watching for pizza deliveries at the Pentagon,” says Sigurdsson. He’s referring to the open-source intelligence technique that Washington reporters reportedly used to spot when big events were about to emerge based on the number of late-night pizzas delivered to the White House. “You can play the same game with physicists,” he says. (Unfortunately there have been no reports of LIGO ordering an overabundance of Domino's.)

Second, it’s a small community. So when a few collaborators — who all happen to be members of LIGO — duck out of a future conference due to new overlapping commitments, it doesn’t go unnoticed. A similar pattern played out right before physicists announced the discovery of the Higgs boson. Based on dates cancelled, Sigurdsson speculates that an announcement will come from the team on February 11th.

Details of the supposed detection, however, were not publicly bandied about until Monday, when theoretical physicist Luboš Motl posted on his blog the latest version of the rumor: that aLIGO has picked up waves produced by two colliding black holes each with 10 or more solar masses. He also said he’s been told that *two* events have been detected.

Reason for Silence

There’s a good reason why LIGO’s people refuse to confirm or deny that something is going on. Scientists really want to get things right before they announce a major finding to the world, whether positive or negative. LIGO’s data-analysis task alone is vast and full of potential gotchas, and the most likely gravitational-wave detections would be buried deep in the noise. The experiment is looking for changes in the distance between mirrored blocks of metal 4 km apart as slight as 10^{-22} meter, about a millionth the diameter of a proton. In other words, changes in measurement of 1 part in 10^{25}. What could possibly go wrong?

Fresh on the minds of everyone in astronomy and physics is an announcement fiasco that blew up spectacularly in 2014. The astronomers of the Harvard-based BICEP2 collaboration announced to the world's media, at a packed press conference, that they had very likely discovered primordial gravitational waves from the earliest instant of the Big Bang. The signal was unexpectedly strong. It would have been the much-sought, crowning evidence for the inflationary-universe theory of how the Big Bang happened. Not until later did their work go through full peer review. The discovery literally turned to dust — leaving a very public mess and a lot of criticism. Many dread a repeat.

The current excitement could easily be a false alarm. Even if LIGO has a promising signal, it may be a false test signal planted as a drill. It's been done before, in 2010 near the end of LIGO's last pre-upgrade run. Three members of the LIGO team are empowered to move the mirrored blocks by just the right traces in just the right way. Only they know the truth, and the test protocol is that they not reveal a planted signal until the collaboration has finished analyzing it and is ready to publish a paper and hold a press conference. "Blind tests" like this are the gold standard in all branches of science.

So we'll just have to cool our heels. But probably not for long — a matter of weeks or months, not years.

"Essential to the Process"

A premature "discovery" getting loose, and then being denied or retracted, could diminish the public's trust in scientists — and the scientific process — in general. "We live in a crazy time when it comes to science and the public, as the ongoing 'debate' about climate change shows us again and again," wrote astronomer Adam Frank (University of Rochester) in his NPR blog on the BICEP2 fiasco in 2014. "I wish they'd have let the usual scientific process run its course before they made such a grand announcement. If they had, odds are, it would have been clear that no such announcement was warranted — at least not yet — and we'd all be better off."

Sigurdsson, however, disagrees. When the BICEP2 team announced their results, he used it as an example in his Cosmology 101 class, encouraging students to view it as an uncertain result in mid-discovery phase. "I think most of the public appreciates the fact that you can make mistakes for the right reasons and that's part of the process," says Sigurdsson. "We proceed by falsification. We make conjectures, we test them, and some of the time we find that things were wrong and we throw them out. But that's still essential to the process. We need to get that across."

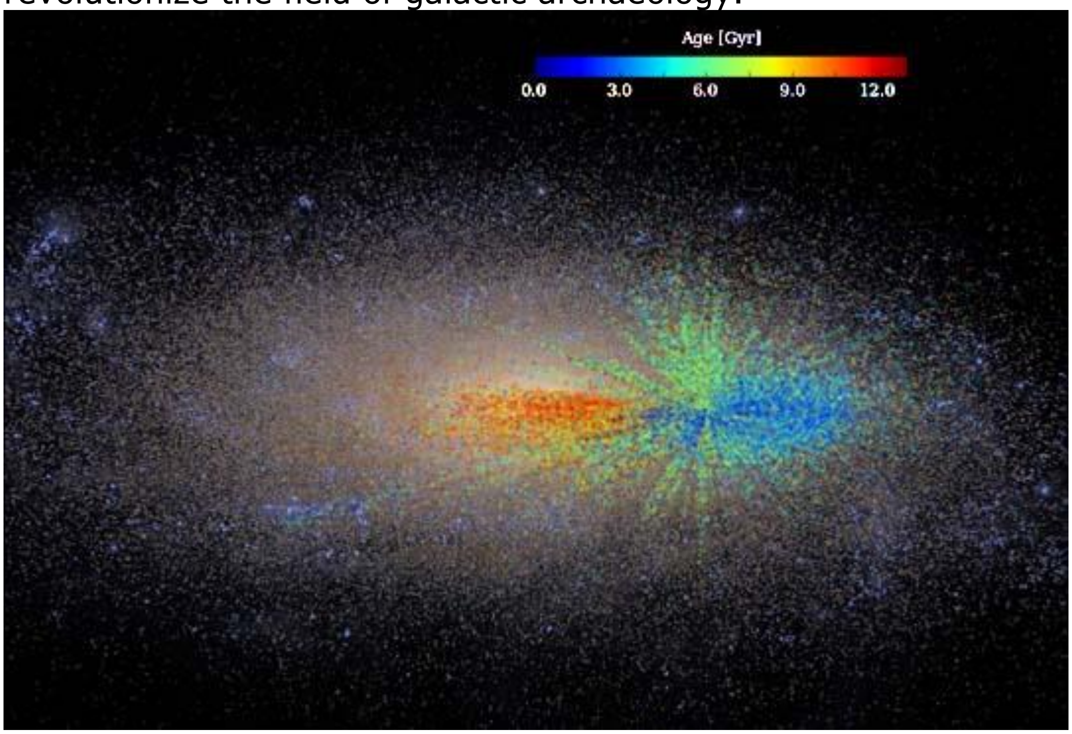
Charting 70,000 Stars in the Milky Way

By: Monica Young | from S&T

Astronomers have mapped the ages of 70,000 stars spanning our galaxy, ushering in a new era of galactic archaeology.

In an archaeological dig, scientists sift through the shards and bones that lay scattered in the dirt. They carefully brush off layers of dust, note each item's position, and take samples for carbon dating. Now, with a new technique in hand, astronomers are doing much the same, but their dig site is a bit bigger: the Milky Way Galaxy.

At the American Astronomical Society meeting in Kissimmee, Florida, Melissa Ness (Max Planck Institute for Astronomy, Germany) announced her team's release of a catalog that maps the ages of 70,000 red giant stars scattered throughout our galaxy. Like carbon-dating, these luminous beacons and the new method of measuring their ages will revolutionize the field of galactic archaeology.



This image shows 70,000 red giant stars as colored dots embedded in a simulation of the Milky Way Galaxy. The color scale shows stellar age: red denotes the oldest stars, which formed some 12 billion years ago when the Milky Way was young and small, while blue shows younger stars that formed more recently, when the Milky Way was big and mature. *G. Stinson (MPIA)*

Digging Up the Milky Way

"Big Data" has become a buzzword everywhere from the corner office to the genetics lab, but astronomy's been in the business of big data since the advent of the Sloan Digital Sky Survey (SDSS) in 2000. In recent years, the Sloan telescope turned its watchful eye from the farthest reaches of the cosmos to our own galaxy. Since 2011, a survey dubbed APOGEE has sighted 150,000 red giant stars across the Milky Way, splitting starlight across the visible-light range to collect detailed spectra for every star.

But sifting through all that data isn't easy. And that's particularly true when it comes to measuring something more indirect like age — stars are secretive about the number of years under their belt.

One way to date a star is to measure the seismic waves that ripple across its surface. These starquakes create pulsations in brightness that change as the star ages. But doing these observations requires time — the kind of time that Kepler had when it stared at hundreds of thousands of stars for four years.

Another way is more indirect. The outer layers of stars like the Sun boil with convective fervor, and when these stars evolve to become red giants, that roiling plasma extends its reach down to scrape the star's core. Just-fused elements get dredged up from the core and carried to the surface, theoretically revealing how long the star has been around.

Marie Martig (also at the Max Planck Institute for Astronomy) and colleagues took the best of both worlds when they examined 1,475 red giants with both seismic masses from Kepler and dredged-element data from Sloan spectra. This set of overlapping data became the training set for an algorithm dubbed "The Cannon" (named in honor of Annie Jump Cannon). After teaching The Cannon to classify stars' ages by their spectra, Ness, Martig, and colleagues set it loose on the full dataset. It returned the age for some 70,000 stars strewn throughout the Milky Way.

Galactic Archaeology

Star dating, like the carbon dating that revolutionized archaeology, provides astronomers with an essential tool to piece together our galaxy's history. In a way, it's still a crude tool — the mass estimates for any given star can be off by as much as 40%. But combined, tens of thousands of stars beat those errors down and provide useful insight. Already, the team has been able to confirm that our galaxy's spiral disk formed from the inside out, bolstering accepted theory.

The youngest red giant stars assemble along the galactic plane, a skeleton of sorts that's encased by older stars. Farther from the galaxy's center, this "backbone" of younger stars flares outward, away from the plane. These patterns are the hallmark of a disk that started small and grew slowly outward, as though whoever was pouring the pancake batter first ladled into the center and then added more and more batter on the outer edges.

These results prove The Cannon works and lay the foundation for future studies, says Daniel Majaess (St. Mary's University and Mount St. Vincent University, Canada). And Ness, who has already had lots of requests for the catalog, expects those future studies will be coming out soon.

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