THE STAR

THE NEWSLETTER OF THE
MOUNT CUBA ASTRONOMICAL GROUP
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OUR PROGRAMS ARE HELD THE SECOND TUESDAY OF EACH MONTH AT 7:30 P.M. UNLESS INDICATED OTHERWISE
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NEXT MEETING:
There will be no meeting in March or April due to the reformatting of the MCAG mission. The next meeting will be in May.

ASTRONOMICAL TERMS AND NAMES OF THE MONTH:

The Mission of the Mt. Cuba Astronomy Group is to increase knowledge and expand awareness of the science of astronomy and related technologies.

When reading the articles in the STAR, you will come across various terms and names of objects you may not be familiar with. Therefore, in each edition of the STAR, we will review terms as well as objects related to Astronomy and related technologies. These topics are presented on a level that the general public can appreciated.

gravitational waves: In physics, gravitational waves **are ripples in the curvature of space-time which propagate as** waves**, traveling outward from the source. Predicted in 1916 by Albert Einstein on the basis of his theory of general relativity,** gravitational waves **transport energy as** gravitational **radiation.**

general relativity: General relativity (GR, also known as the general theory of relativity or GTR) is the geometric theory of gravitation published by Albert Einstein in 1915 and the current description of gravitation in modern physics.

superclusters are large groups of smaller galaxy clusters or galaxy groups and are among the largest known structures of the cosmos. The Milky Way is in the Local Group galaxy cluster (that contains more than 54 galaxies), which in turn is in the Laniakea Supercluster. This supercluster spans over 500 million light years, while the Local Group spans over 10 million light years. The number of superclusters in the observable universe is estimated to be 10 million

Carina Nebula:

The Carina Nebula (also known as the Great Nebula in Carina, the Eta Carinae Nebula, NGC 3372, as well as the Grand Nebula) is a large bright nebula that has within its boundaries several related open clusters of stars. It contains the large OB association Carina OB1. Carina OB1 contains the star clusters Trumpler 14 and Trumpler 16.

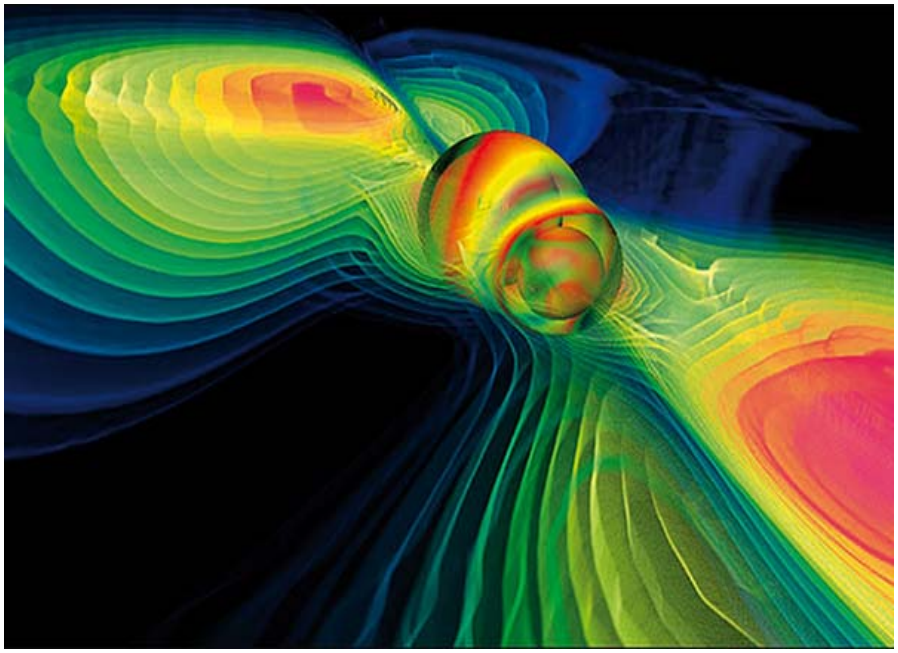
Trumpler 15, Collinder 228, Collinder 232, NGC 3324, and NGC 3293 are also considered members. Trumpler 14 is one of the youngest known star clusters, at half a million years old. Trumpler 16 is the home of WR 25, currently the most luminous star known in our Milky Way galaxy, together with the less luminous but more massive and famous Eta Carinae star system, and HD 93129A. NGC 3293 is the oldest and furthest from Trumpler 14, indicating sequential and ongoing star formation. The nebula lies at an estimated distance between 6,500 and 10,000 light years from Earth. It appears in the constellation of Carina, and is located in the Carina–Sagittarius Arm. The nebula contains numerous O-type stars.

The nebula is one of the largest diffuse nebulae in our skies. Although it is some four times as large and even brighter than the famous Orion Nebula, the Carina Nebula is much less well known, due to its location in the southern sky. It was discovered by Nicolas Louis de Lacaille in 1751–52 from the Cape of Good Hope.

Observation data: J2000.0 epoch	
Right ascension	$10^h\ 45^m\ 08.5^s$[1]
Declination	−59° 52′ 04″[1]
Distance	~6500-10000[1] ly
Apparent magnitude (V)	+1.0
Constellation	Carina
Physical characteristics	
Radius	~460 [2] ly (~140 pc)
Notable features	Includes dark nebula Keyhole Nebula
Designations	NGC 3372,[3] ESO 128-EN013,[1] GC 2197,[1] Caldwell 92[4]

FROM THE WORLD OF ASTRONOMY:

Why that gravitational wave discovery is so IMPORTANT.



People around the world cheered Thursday morning (Feb. 11) when scientists announced the first direct detection of gravitational waves — ripples in the fabric of space-time whose existence was first proposed by Albert Einstein, in 1916.

The waves came from two black holes circling each other, closer and closer, until they finally collided. The recently upgraded Large Interferometer Gravitational Wave Observatory (LIGO) captured the signal on Sept. 14, 2015. Not every scientific discovery gets this kind of reception, so what exactly is all the hype about, and what's next for LIGO now that it has spotted these elusive waves?

First of all, detecting two colliding black holes is thrilling by itself — no one knew for sure if black holes actually merged together to create even more-massive black holes, but now there's physical proof. And there's the joy of finally having direct evidence for a phenomenon that was first predicted 100 years ago, using an instrument that was proposed 40 years ago. [Gravitational Waves Detected by LIGO: Complete Coverage]

But what is truly monumental about this detection is that it gives humanity the ability to see the universe in a totally new way, scientists said. The ability to directly detect gravitational waves — which are generated by the acceleration or deceleration of massive objects in space — has been compared to a deaf person suddenly gaining the ability to hear sound. An entirely new realm of information is now available.

"It's like Galileo pointing the telescope for the first time at the sky," LIGO team member Vassiliki (Vicky) Kalogera, a professor of physics and astronomy at Northwestern University in Illinois, told Space.com. "You're opening your eyes — in this case, our ears — to a new set of signals from the universe that our previous technologies did not allow us to receive, study and learn from."

"Up until now, we've been deaf to gravitational waves," LIGO Executive Director David Reitze, of the California Institute of Technology (Caltech), said during an announcement ceremony in Washington, D.C. "What's going to come now is we're going to hear more things, and no doubt we'll hear things that we expected to hear … but we will also hear things that we never expected."

With this new sensory view of the universe, here are some of the things scientists hope to discover.

New windows on the universe

LIGO is particularly sensitive to gravitational waves that come from violent cosmic events, such as two massive objects colliding or a star exploding. The observatory has the potential to locate these objects or events before light-based telescopes can do so, and in some cases, gravitational-wave observations could be the only way to find and study such events.

For example, in yesterday's announcement, scientists reported that LIGO had identified two black holes spinning around each other and merging together in a final, energetic collision. As their name suggests, black holes don't radiate light, which means they are invisible to telescopes that collect and study electromagnetic radiation. Some black holes are visible with light-based telescopes, because material in their immediate vicinity radiates, but scientists haven't seen examples of merging black holes with radiating material around them.

In addition, the black holes spotted by LIGO are 29 and 36 times the mass of the sun, respectively. But Reitze said that as LIGO's sensitivity continues to improve, the instrument could be sensitive to black holes that are 100, 200 or even 500 times the mass of the sun that are further away from Earth. "There could be a really nice discovery space that opens up once we get out there," he said.

Scientists already know that studying the sky in different wavelengths of light can reveal new data about the cosmos. For many centuries, astronomers could only work with optical light. But relatively recently, researchers built instruments allowing them to study the universe using X-rays, radio waves, ultraviolet waves and gamma-rays. Each time, scientists got a new view of the universe.

In the same way, gravitational waves have the potential to show scientists totally new features of cosmic objects, LIGO team members said. [Study of Gravitational Waves Could Unravel Many Mysteries (Video)]

"If we're ever lucky enough to have a supernova in our own galaxy, or maybe in a nearby galaxy, we will be able to look at the actual dynamics of what goes on inside the supernova," said LIGO co-founder Rainer Weiss of MIT, who spoke at the announcement ceremony. While light is often blocked by dust and gas, "gravitational waves come right out [of the supernova], boldly unimpeded," Weiss said. "As a consequence, you really find out what's going on inside of these things."

Other exotic objects scientists hope to study with gravitational waves are neutron stars, which are mind-bogglingly dense, burned-out stellar corpses: A teaspoon of neutron-star material would weigh about a billion tons on Earth. Scientists aren't sure what happens to regular matter under such extreme conditions, but gravitational waves could provide extremely helpful clues, because these waves should carry information about the interior of the neutron star all the way to Earth, LIGO scientists said.

LIGO also has a system set up to alert light-based telescopes when the detector seems to have spotted a gravitational wave. Some of the astronomical events that LIGO will study, such as colliding neutron stars, may produce light in all wavelengths, from gamma-rays to radio waves. With LIGO's alert system in place, it's possible that scientists could observe some astronomical events or objects in various wavelengths of light, plus gravitational waves, which would provide a "very complete picture" of those events, Reitze said.

"When that happens, that'll be, I think, the next big thing in this field," he said.

Relativity

Gravitational waves were first predicted by Einstein's theory of general relativity, which was published in 1916. That famous theory has stood up to all kinds of physical tests, but there are some aspects that scientists haven't been able to study in the real world, because they require very extreme circumstances. The extreme warping of space-time is one example of this.

"Until now, we have only seen warped space-time when it is very calm — as though we had only seen the surface of the ocean on a very calm day, when it's quite glassy," Kip Thorne of Caltech, another founding member of LIGO and an expert on warped space-time, said at yesterday's ceremony. "We had never seen the ocean roiled in a storm, with crashing waves. All that changed on Sept. 14. The colliding black holes that produced these gravitational waves created a violent storm in the fabric of space and time." [The History & Structure of the Universe (Infographic)]

"This observation tests that regime beautifully, very strongly," Thorne continued. "And Einstein comes out with beaming success."

But the study of general relativity via gravitational waves is far from over. Questions remain about the nature of the graviton, the particle believed to carry the gravitational force (just like the photon is the particle that carries the electromagnetic force). And

scientists have many questions about the inner workings of black holes, which gravitational waves may help illuminate (so to speak). But all of that, the scientists said, will be revealed slowly, over the course of many years, as LIGO and related instruments collect more data on more events.

A legacy for the future

Looking toward the next three years, Reitze said the collaboration is focused on increasing LIGO's sensitivity to its full potential. This will make the observatory — which consists of two big detectors, one in Louisiana and the other in Washington state — more sensitive to gravitational waves. But scientists don't know how many events LIGO will see, because they don't know how often many of these events occur in the universe.

LIGO detected the binary black hole merger even before the instrument began its first official observation campaign after its recent upgrade, but it's possible that this was a lucky break. To get the gravitational astronomy train rolling, LIGO simply needs more data.

When asked to comment on LIGO's impact on the world beyond the scientific community, and about how gravitational-wave science might influence people's daily lives, Reitze simply said, "Who knows?"

"When Einstein predicted general relativity, who would have predicted that we'd use it every day when we use our cell phones?" he said. (General relativity provides an understanding how gravity influences the passing of time, and this information is necessary for GPS technology, which uses satellites that orbit further away from the gravitational pull of the Earth than people on the surface).

LIGO is "the most sensitive instrument ever built," said Reitze, and the technological advances that have been made while building the observatory may feed into technologies that will be used in ways people can't yet predict.

Thorne said he sees the larger contribution of LIGO slightly differently.

"When we look back on the era of the Renaissance, and we ask ourselves, 'What did the humans of that era give to us that's important to us today?' I think we would all agree it's great art, great architecture, great music," he said.

"Similarly, when our descendants look back on this era, and they ask themselves, 'What great things came to us?' … I believe there will be an understanding of the fundamental laws of the universe and an understanding of what those laws do in the universe, and an exploration of the universe," Thorne added. "LIGO is a big part of that. The rest of astronomy is a big part of that. And I think that cultural gift to our future generations is really much bigger than any kind of technological spin-off, than the ultimate development of technology of any kind. I think we should be proud of what we give to our descendants culturally."

Strange radio bursts from space come in clusters: study

Marlowe Hood,AFP

Paris (AFP) - Mysterious and powerful radio waves from deep space are coming in clusters, scientists revealed on Wednesday, having only discovered their existence a decade ago.

The repeated pulses emanate from well beyond the edge of the Milky Way Galaxy, according to a study published in the journal Nature.

It was previously thought that these so-called fast radio bursts (FRBs) -- which can emit as much energy in a millisecond as the Sun emits in 10,000 years -- were one-off phenomena.

Less than 20 have been detected since 2007, though more than 10,000 are suspected to occur every day.

Their origins remain unknown. Up to now, astronomers speculated that they were produced by cataclysmic events such as stars exploding into a supernovas, or neutron stars collapsing into black holes.

But none of these scenarios are consistent with multiple pulses, leaving scientists at a loss as to how to interpret the new data.

Peter Scholz, a graduate student at the McGill Space Institute at McGill University in Montreal and a co-author of the paper, discovered evidence of the bursts in November while sifting through data gathered by the Arecibo telescope in Puerto Rico.

"I knew immediately that the discovery would be extremely important in the study of FRBs," Scholz said in a statement.

The telescope, the largest of its kind, had picked up a total of 10 radio wave pulses, all grouped within the space of a minute.

"Not only did these bursts repeat, but their brightness and spectra also differ from those of other FRBs," said Laura Spitler, lead author and a researcher at the Max Planck Institute for Radio Astronomy in Bonn, Germany.

The latest findings appear to be at odds with research published only last week in Nature that concluded that FRBs are generated by one-off cataclysms.

But it is now thought that there could be two or more sources for frequent radio bursts.

The researchers speculated that multiple pulses could come from an "exotic object" such as a hugely powerful, rotating neutron star.

Locating the galaxy from which the serial burst came would be "critical to understanding its properties," said Jason Hessels, a co-author of the study and a professor at the University of Amsterdam.

Pinpointing the source could also tell astronomers how long it took for the waves to reach Earth, a voyage likely measured in billions of light years.

Comparing theoretical travel time in a vacuum with actual travel time could shed light on the distribution of matter in the universe.

News from the Milkway.

We've found evidence the Milky Way is one of hundreds of galaxies being sucked in by a mysterious force called the 'Great Attractor'

Credit: Peter Farquhar, Business Insider Australia

The Milky Way and hundreds of galaxies surrounding it are being drawn toward a mysterious force scientists call the "Great Attractor".

And it took the Commonwealth Scientific and Industrial Research Organization's (CSIRO) Parkes telescope to see them.

The force was first revealed back in the 1970s, when it was discovered that the Milky Way was one of hundreds of galaxies deviating from the "universe is expanding" model.

But a new receiver on the radio telescope has enabled the team to see more clearly through the fog of stars and dust crowding the outer plane of the Milky Way, where they found 883 galaxies. It's so crowded out there that it's even got a name: the "Zone of Avoidance".

A third of the galaxies had never been seen before, according to a study published on Tuesday in *Astronomical Journal*, and their discovery has made the trail toward the Great Attractor a little clearer.

"The Milky Way is very beautiful, of course, and it's very interesting to study our own galaxy, but it completely blocks out the view of the more distant galaxies behind it," Professor Lister Staveley-Smith, from The University of Western Australia, said.

In particular, the discovery of three galaxy concentrations — NW1, NW2, and NW3 — and two new clusters, CW1 and CW2, will help astronomers understand what the Great Attractor is and why it's pulling us toward it at an estimated 2 million kilometres per hour.

All that scientists understand about the Great Attractor is that it features "a few very large collections of galaxies we call clusters or superclusters", Staveley-Smith said.

Now that a new multi-beam system on the Parkes telescope has enabled the sky to be mapped "13 times faster", Dr Bärbel Koribalski, from CSIRO Astronomy and Space Science, said discoveries would come at a much greater rate.

But even the new attachment is small compared to when results start coming in from WALLABY — the Widefield ASKAP L-Band Legacy All-sky Blind Survey — a major project under way at the Australian Square Kilometre Array Pathfinder in midwest Western Australia.

With the ability to spot more than half a million galaxies, Koribalski told News.Com.au that she hopes the trail toward the Great Attractor will suddenly become clearer.

Uncertainty Surrounds Asteroid Near-Earth Flyby Next Week

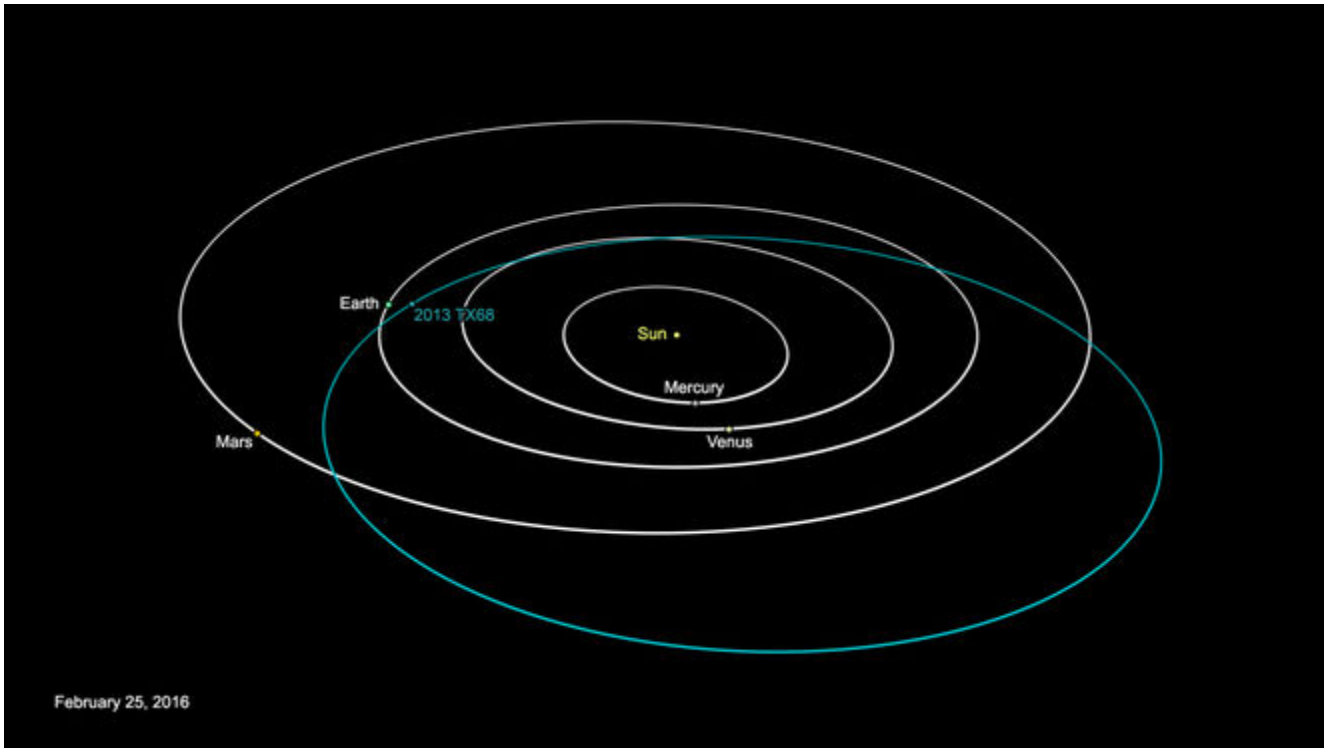
A decent-size asteroid will zoom past Earth next week, but astronomers aren't sure exactly when the flyby will happen, or just how close the space rock is going to get.

The latest observations suggest that the 100-foot-wide (30 meters) near-Earth asteroid 2013 TX68 will come within about 3 million miles (5 million kilometers) of Earth's surface on March 8, NASA researchers said. But it's also possible that the space rock will get much, much closer — 15,000 miles (24,000 km) or so, which is inside the planet's ring of geostationary satellites.

Despite all of the uncertainty — researchers originally thought the flyby was going to happen on Saturday (March 5) — there is nothing to fear from 2013 TX68, scientists said. The space rock has no chance of hitting Earth on this pass, or on any future close approaches over the next century.

"There is no concern whatsoever regarding this asteroid — unless you were interested in seeing it with a telescope," Paul Chodas, manager of NASA's Center for Near-Earth Object Studies at the Jet Propulsion Laboratory in Pasadena, California, said in a statement.

"Prospects for observing this asteroid, which were not very good to begin with, are now even worse because the asteroid is likely to be farther away and therefore dimmer than previously believed," Chodas added.



This graphic depicts the orbit of asteroid 2013 TX68, which will fly by Earth on March 8, 2016. The asteroid poses no threat to Earth during this flyby or in the foreseeable future.

2013 TX68 was discovered in October 2013 by astronomers working with the Catalina Sky Survey in Arizona. The asteroid orbits the sun every 780 days or so; two years ago, 2013 TX68 flew by Earth at a distance of 1.3 million miles (2 million km).

However, observations of the asteroid remain limited, which explains the uncertainty associated with its orbit.

2013 TX68 isn't particularly big as far as space rocks go, and it wouldn't do serious, widespread damage if it did hit Earth. (Most researchers think asteroids must be at least 0.6 miles, or 1 km, wide to cause problems for humanity on a global scale.)

But a collision between 2013 TX68 and Earth would be dramatic: The asteroid would probably explode above Earth's surface in an airburst twice as powerful as the 2013 Chelyabinsk event, which damaged buildings and injured more than 1,200 people in the Russian city of Chelyabinsk, NASA officials said.

Scientists think the Chelyabinsk airburst was caused by a near-Earth object about 65 feet (20 m) wide.

PUBLIC NIGHTS AT MCAO:

If you know of anyone who is interested in Astronomy or someone who would like to learn more, please do not hesitate to extend an invitation to them to attend our meetings. If they have an interest in joining, our application is below

Monday Mar. 07th	**8:00 PM**	**Stan Owocki**	**Cosmic Evolution From Big.**
Monday Mar. 21st	**8:00 PM**	**Billie Westergard**	**Hubble Ultra Deep Filled-The Most Distant Planets**
Monday April 11th	**8:00 PM**	**Carolyn Stankiewicz**	**To Be Determined**
Monday April 18th	**8:00 PM**	**Lynn King**	**Asterisms, What are They? Where can I find them?**
Monday May 9th	**8:00 PM**	**Hank Bouchelle**	**Light and Stars**
Monday May 23rd	**8:00 PM**	**Hank Bouchelle**	**Motions in the Solar System**
Monday June 13th	**8:00 PM**	**Greg Lee**	**Moonstruck**
Monday June 27th	**8:00 PM**	**Greg Weaver**	**To Be Determined**

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Mount Cuba Astronomical Group

Membership Form

The Mission of the Mt. Cuba Astronomy Group is to increase knowledge and expand awareness of the science of astronomy and related technologies. Benefits include:

Monthly newsletter that includes details about the groups activities and articles on astronomy as well as other related subjects.

Monthly programs on subjects and topics of astronomical interest.

Free or discounted subscriptions to astronomy related publications.

Free registration to MCAG workshops and classes.

Mention Mount Cuba Astronomical Group and receive a 5% discount at Manor Books in New Castle (http://www.yelp.com/biz/manor-used-books-New Castle)

Name_____

Email Address_____

Home Address_____

Phone (optional)_____

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