
YOUNG ASTRONOMERS NEWSLETTER

TWO NEUTRON STARS COLLIDE. GENERATE GRAVITY WAVES AND ELECTROMAGNETIC WAVES

In the constellation Hydra, some 130 million light years away, two neutron stars spiraled into each other and generated a huge amount of energy. The collision was so intense that it sent out a ripple in the fabric of spacetime in the form of gravity waves as well as gamma rays, x-rays, and visible light. The LIGO (Laser-Interferometer Gravitational-Wave Observatory) system detected the gravity pulse on August 17. And it was also detected by Virgo, the Italian gravity wave detector that just recently came on line. Within seconds, the world's ground-based and space-based observatories directed their telescopes toward the region and detected the energy in a spectrum of wavelengths, from gamma rays to the visible. The Hubble telescope observed the visible flash. The collision was so massive that it is labeled a "kilonova"

This is the fifth gravity wave pulse detected by LIGO. But, this one was also detected in the full electromagnetic spectrum and it lasted much longer than the first four. Instead of a fraction of a second for the earlier detections, this one lasted ninety seconds.

The neutron stars weighed 1.6 and 1.1 times the mass of the Sun. Each was about the size of a city, a radius of about 10 miles. As they approached each other, they whirled around each other at hundreds of times per second, at speeds not far below the speed of light.

Neutron stars are the remnant of a supernova, the explosive demise of an old giant star. Depending on the size of the original exploding star, the supernova can produce a white dwarf, a neutron star or a black hole. The original stars

that produced the two colliding neutron stars were not large enough to produce a black hole. But the combined lump formed by the neutron-neutron collision, could possibly produce a black hole. This remains to be seen.

If you consider the mass and size of a neutron star, you realize that its density must be huge. It consists essentially of pure neutrons, the neutral particles in the nuclei of atoms. Such a body will have a density in the range of 1×10^9 to 1×10^{17} grams per cc. Neutron stars spin rapidly and generate electromagnetic pulses. Since their discovery, these bodies became known as pulsars.

The density of a typical neutron star is so immense, that a thimble full would weigh as much as 100 million tons. If dropped onto the Earth, this thimble of neutrons would penetrate right through, like a lead shot dropped onto whipped cream.

The magnetic field of a neutron star is also impressive; on the order of 10^{12} that of Earth's magnetic field.

The energy and ejection of particles that occurred with the neutron star collision produce heavy elements such as gold, platinum and lead. With all the neutrons flying about, heavier elements can be synthesized in the violent explosion.

All the things we learn from these observations will help us understand and verify Einstein's descriptions of spacetime. [space.com; npr.org]

RINGS FOUND AROUND DWARF PLANET HAUMEA

In January, astronomers in Spain have discovered rings around the dwarf planet Haumea. This was accomplished by observing

Haumea as it occulted a distant star. Pablo Santos Sanz and his team at the Instituto de Astrofísica de Andalucía, used 12 telescopes to observe the event.

The rings are about 43 miles wide and extend about 620 miles out from the surface.

The scientists were also able to make other, more definitive measurements of the dwarf planet. It is extremely non-spherical, with the long axis of 1,430 miles being about twice that of the short axis. It has a density similar to Pluto's, and it has a very fast rotation. One day on Haumea lasts only 4 hours. This makes it the fastest spinning object in the Solar System. It was known previously to have two moons.

Both Haumea and Pluto are in the Kuiper Belt, a region beyond Neptune. They have orbits that are at an angle relative to the eight major planets. These findings were published in the October 11 issue of Nature. [Space.com, Oct. 11, 2017].

LAVA TUBES ON THE MOON MAY SERVE AS SHELTER FOR LUNAR ASTRONAUTS

The Japanese lunar orbiter, SELENE (Selenological and Engineering Explorer) has studied the echo pattern in the area of the Marius Hills "skylight" and found a strong suggestion that there is a significant hollow cavity beneath the surface. This is believed to be a lava tube, which remains when lava flow channels cool and leave behind their rocky shells. JAXA, the Japanese space agency and NASA's GRAIL orbiter will continue to study the area.

Preliminary measurements indicate that the subsurface cavity could be large enough to house a city.

Subsurface living quarters would provide welcome protection from solar radiation as well as a barrier to the widely fluctuating temperatures on the lunar surface. The absence of an atmosphere and magnetic field

on the Moon exposes surface dwellers to harsh conditions. [Livescience.com; Oct. 20]

THE DISCOVERY OF WATER ON OUTER SOLAR SYSTEM BODIES LEADS TO SPECULATIONS ABOUT POSSIBLE EXISTENCE OF LIFE

Dr. Alan Stern, principal investigator for the New Horizons mission to Pluto has stated that there has been a shift in our view of the solar system. It is teeming with oceans. Before the Space Age, no one predicted this.

Various missions, such as the Voyager missions, New Horizons, Cassini and others, have produced enough evidence that many outer Solar System bodies harbor surface or sub-surface bodies of water.

Even though these distant bodies are extremely cold, well below the freezing point of pure water, there can be sufficient heat generated by volcanism and gravitational flexing to maintain fluidity and hydrological action. Furthermore, some measurements have found these aqueous bodies to be salty. This would tend to raise the freezing point of the solutions.

So, if we see an aqueous medium with sufficient heat and nutrients, we can speculate that some types of living organisms could exist in these solutions.

These types of conditions have been found on Jupiter's moon Europa, which has a glistening surface of ice and fracture patterns that suggest flexing by a subsurface ocean. Another Jovian moon, Ganymede is also believed to have a vast ocean under a frozen crust. Saturn's moon Titan has a complex interaction between icy mountains and pools of hydrocarbons. Likewise, the Saturnian moon, Enceladus releases geysers of a mixture of salt water and hydrocarbons. Even the dwarf planet Pluto has indications of a subsurface ocean.

Further missions are needed which can specifically identify living organisms on these bodies. [Astronomy, Nov. 2017].

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BIRTHDAYS IN NOVEMBER: **Edwin Hubble:** (Amer.); b. Nov. 20, 1889, d. Sept. 28, 1953. Proved that there are galaxies outside our Milky Way, that galaxies are moving apart more rapidly at increasing distances (Hubble Law); classified galaxies. **Frederick William Herschel:** (Eng., German born); b. Nov. 15, 1738, d. Aug. 25, 1822. Proposed that the Milky Way was a flattened disk. He was the father of John Herschel, discoverer of Uranus (1781). **Carl Sagan:** (Amer.); b. Nov. 9, 1934, d. Dec. 20, 1996. Astronomer who popularized astronomy for the public. **Christian Doppler:** (Austrian); b. Nov. 29, 1803, d. Mar. 17, 1853. Mathematician – physicist, who demonstrated that the frequency of light depends on the relative speeds of the source and observer. **Edmond Halley:** (Eng.); b. Nov. 8, 1656, d. Jan. 14, 1742. Mathematician – meteorologist – astronomer. Computed the orbital path of Halley’s Comet. **Harlow Shapley:** (Amer.); b. Nov. 2, 1885, d. Oct. 29, 1972. Studied the Milky Way shape and size as well as globular clusters and Cepheid variables.

MOON PHASES IN NOVEMBER: Full: Sat. the 4th; Last Qtr.: Fr. The 10th; New: Sat. the 18th; First Qtr.: Sun. the 26th.

THE PLANETS IN NOVEMBER: **Venus and Jupiter** will appear in the east right before sunrise. Jupiter is gradually rising throughout the month, while Venus is dropping. The two bodies produce a stunning conjunction on the 13th and will put on a beautiful triplet show with the crescent Moon on the 16th. Venus disappears by the end of the month. **Mars** rises 3 to 4 hours before the Sun throughout the month in the constellation Virgo. Later in the month, **Saturn** becomes harder to see in the southwest as it sags into the glow of the setting Sun. **Mercury** also hovers in the southwest after sunset. You may need to use binoculars to pick out this rapidly changing inner planet. Use the brighter object, Saturn as a guide to help you find it.

LEONID METEOR SHOWER: Conditions should be good to see as many as 10 meteors per hour during the peak barrage of the Leonid meteors on the 17th. The moon should not be a problem since New Moon comes on the 18th.

ANIMALS IN THE CONSTELLATIONS.: Place a letter in the blank which matches the constellation name to the animal it represents. (answers below).

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|---------------------|---------|
| 1) AQUILA _____ | A LION |
| 2) ARIES _____ | B BEAR |
| 3) CANCER _____ | C BULL |
| 4) CANIS _____ | D WOLF |
| 5) COLUMBA _____ | E FISH |
| 6) LEO _____ | G RAM |
| 7) LEPUS _____ | H EAGLE |
| 8) LUPUS _____ | I FOX |
| 9) PISCES _____ | J HARE |
| 10) TAURUS _____ | K CRAB |
| 11) URSA _____ | L DOVE |
| 12) VULPECULA _____ | M DOG |

Forsyth Astronomical Society website: <http://www.fas37.org> Kaleideum phone: 336-767-6730

Bob Patsiga, editor Answers: 1-H; 2-G; 3-K; 4-M; 5-L; 6-A; 7-J; 8-D; 9-E; 10-C; 11-B; 12- I