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Astronomy & Physics Weekly News

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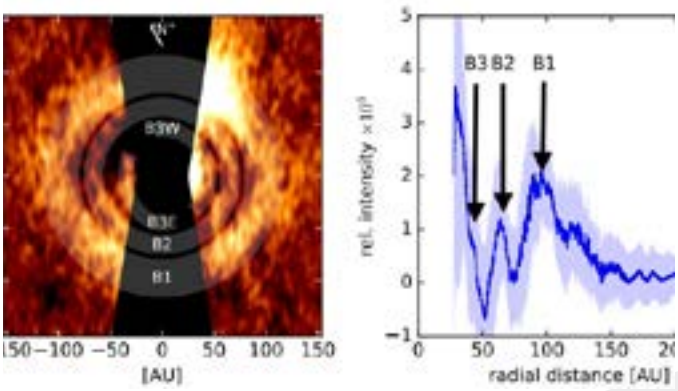
Top News

Happy New Year 2017

IT Support Issam Jami

Designed by Mohamed Bakir

Concentric rings found in the debris disk of a young nearby star



Structures detected in the disk of HIP 73145. Left: The features under discussion are denoted with semi-transparent rings and labeled B1, B2, B3E, and B3W. The black mask covers the area that is too close to the coronagraph and the large negative ADI artifacts. Right: Intensity of all pixels in the image to the left plotted versus their radial separation from the center. The dark blue line is formed by applying a 100 point wide running mean to all pixel intensities after sorting according to their distance to the center. The light-blue shaded area represents the standard deviation across 100 neighboring points at each separation. The two major features B1 and B2 are easily identified. The B3 feature is less obvious, as it is close to the inner edge of the usable area and not circular. Credit: Feldt et al., 2016.

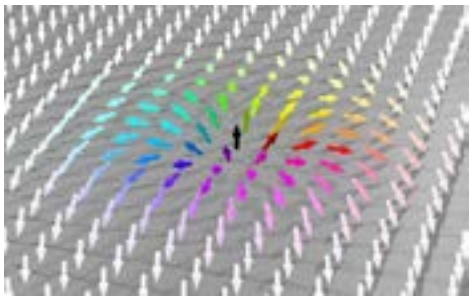
An international team of researchers reports the discovery of a series of concentric rings in the debris disk around a young nearby star known as HIP 73145. These unusual substructures could provide new details about the evolution of circumstellar disks around young stars. The findings were presented in a paper published Dec. 22 on arXiv.org.

Located some 400 light years away, HIP 73145 (also known as HD 131835) is a 15-million-year-old star with a spectral type of A2IV. It belongs to the Upper Centaurus Lupus (UCL) moving group, which is part of the Scorpius-Centaurus association. The star is about 70 percent more massive than the sun and has a radius of 1.38 solar radii. Importantly, HIP 73145 is known to host a debris disk with a radius of approximately 96 AU.

HIP 73145's disk was first detected in scattered light in the near-infrared, and at far-infrared wavelengths in 2015. However, no substructures were spotted during these observations. This year also, a team of astronomers led by Markus Feldt of the Max Planck Institute for Astronomy in Heidelberg, Germany, has conducted a multi-wavelength observational campaign which allowed them to distinguish concentric rings in the star's debris disk.

These observations were carried out in May 2015 using the European Southern Observatory's extreme adaptive optics coronagraphic instrument, known as the Spectro-Polarimetric High-contrast Exoplanet REsearch (SPHERE). They were part of the SpHere INfrared survey ..Read More...

Investigations of the skyrmion Hall effect reveal surprising results (Update)



The magnetic structure of a skyrmion is symmetrical around its core; arrows indicate the direction of spin. Credit: ill./©: Benjamin Krüger, JGU

Researchers at Johannes Gutenberg University Mainz (JGU) and the Massachusetts Institute of Technology (MIT) have made a breakthrough in the field of future magnetic storage devices. In March 2016, the international team investigated structures that could serve as magnetic-shift register or racetrack memory devices. This type of storage promises low access times, high information density, and low energy consumption. Now, the research team has achieved the billion-fold reproducible motion of special magnetic textures, so-called skyrmions, between different positions, a key process needed in magnetic shift registers, thereby taking a critical step toward the application of skyrmions in devices. The work was published in the research journal Nature Physics.

The experiments were carried out in specially designed thin film structures, i.e., vertically asymmetric multilayer devices exhibiting broken inversion symmetry, which stabilized special spin structures called skyrmions. Those structures are similar to a hair whorl, and are relatively difficult to destroy. This grants them a unique stability, which is another argument for the application of skyrmions in such spintronic devices.

Skyrmions can be shifted by electrical currents and feel a repulsive force from the edges of the magnetic track as well as from single defects in the wire. Thus, they can move relatively undisturbed through the track. This is a key property for racetrack devices, which are proposed to consist of static read and write heads, while the magnetic bits are shifted in the track. However, skyrmions do not only move parallel to the applied current, but also perpendicular to it. This leads to an angle between the skyrmion direction of motion and the current flow called the skyrmion Hall angle. This has been predicted theoretically. As a result, the skyrmions should move under this constant angle until they are repelled by the edge of the material and then keep a constant distance from it.

Scientists of JGU and MIT have now proved that the billion-fold reproducible displacement of ..Read More...

Hubble gazes at a cosmic megamaser

This megamaser galaxy is named IRAS 16399-0937 and is located over 370 million light-years from Earth. This NASA/ESA Hubble Space Telescope image belies the galaxy's energetic nature, instead painting it as a beautiful and serene cosmic rosebud. The image comprises observations captured across various wavelengths by two of Hubble's instruments: the Advanced Camera for Surveys (ACS), and the Near Infrared Camera and Multi-Object Spectrometer (NICMOS). Credit: ESA/Hubble & NASA, Acknowledgement: Judy Schmidt (geckzilla)

This galaxy has a far more exciting and futuristic classification than most—it hosts a megamaser. Megamasers are intensely bright, around 100 million times brighter than the masers found in galaxies like the Milky Way. The entire galaxy essentially acts as an astronomical laser that beams out microwave emission rather than visible light (hence the 'm' replacing the 'l').

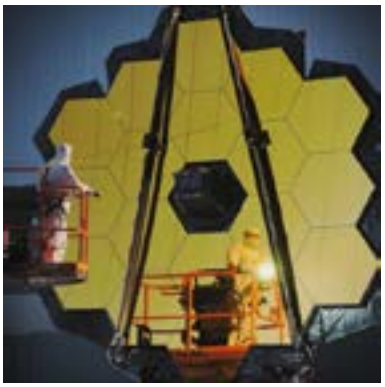
A megamaser is a process that involves some components within the galaxy (like gas) that is in the right physical condition to cause the amplification of light (in this case, microwaves). But there are other parts of the galaxy (like stars for example) that aren't part of the maser process.

This megamaser galaxy is named IRAS 16399-0937 and is located over 370 million light-years from Earth. This NASA/ESA Hubble Space Telescope image belies the galaxy's energetic nature, instead painting it as a beautiful and serene cosmic rosebud. The image comprises observations captured across various wavelengths by two of Hubble's instruments: the Advanced Camera for Surveys (ACS), and the Near Infrared Camera and Multi-Object Spectrometer (NICMOS).

NICMOS's superb sensitivity, resolution, and field of view gave astronomers the unique opportunity to observe the structure of IRAS 16399-0937 in detail. They found it hosts a double nucleus—the galaxy's core is thought to be formed of two separate cores in the process of merging. The two components, named IRAS 16399N and IRAS 16399S for the northern and southern parts respectively, sit over 11,000 light-years apart. However, they are both buried deep within the same swirl of cosmic gas and dust and are interacting, giving the galaxy its peculiar structure.

The nuclei are very different. IRAS 16399S appears to be a starburst region, where new stars are forming at an incredible rate. IRAS 16399N, however, is ...Read More...

James Webb Space Telescope observatory is assembled



Inspecting JWST's primary mirror. Image courtesy NASA-C. Gunn.

With less than two years remaining before its scheduled launch, the James Webb Space Telescope (JWST) has passed several major milestones, including the completion of its huge primary mirror and integration of its four science instruments with the payload module.

The first milestone was reached in February 2016, with the completion of the 6.5 metre diameter primary mirror, the largest mirror structure ever designed to fly in space. The 18th and final hexagonal segment, which measures 1.3 metres across, was moved into position on the telescope structure using a specially developed robotic arm.

In order to fit inside the protective fairing of the Ariane 5 launch vehicle, the primary mirror is installed on a structure that folds up like a drop-leaf table. Once JWST begins its operational mission in space, all the primary mirror segments can be moved and their curvature changed to make sure that they act like a single, giant mirror.

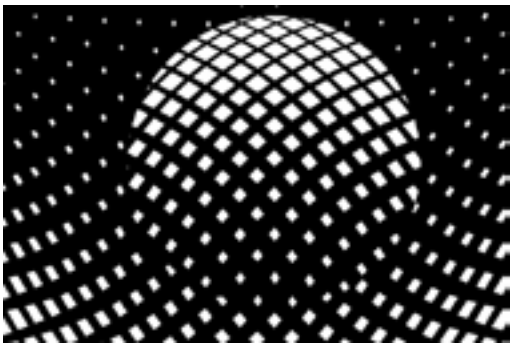
At this stage, all of the primary mirror segments were wearing a protective cover to keep them clean and prevent any damage to their meticulously shaped, gold-coated surfaces. The primary mirror only appeared in its full splendour in May when the covers were removed.

A few weeks later, the single secondary mirror was installed onto the telescope at NASA's Goddard Space Flight Center (GSFC) in Greenbelt, Maryland. The convex mirror is perfectly rounded and designed to reflect light arriving from the primary mirror towards another set of smaller mirrors.

The observatory's optics were completed on 6 March 2016, when the third set of mirrors - the tertiary mirror and the fine steering mirror - were installed. These two mirrors were located inside the Aft Optics Subsystem (AOS), a phone booth-sized beryllium structure which is located in the centre of the primary mirror.

After incoming light hits the primary mirror, it is directed onto the smaller, circular secondary mirror, which reflects it back in the direction of the primary mirror ...Read More...

New atom interferometer could measure inertial forces with record-setting accuracy



MIT researchers describe a way to make atom interferometry with Bose-Einstein condensates even more precise by eliminating a source of error endemic to earlier designs. Credit: Massachusetts Institute of Technology

Atom interferometry is the most sensitive known technique for measuring gravitational forces and inertial forces such as acceleration and rotation. It's a mainstay of scientific research and is being commercialized as a means of location-tracking in environments where GPS is unavailable. It's also extremely sensitive to electric fields and has been used to make minute measurements of elements' fundamental electrical properties.

The most sensitive atom interferometers use exotic states of matter called Bose-Einstein condensates. In the latest issue of Physical Review Letters, MIT researchers present a way to make atom interferometry with Bose-Einstein condensates even more precise, by eliminating a source of error endemic to earlier designs.

Interferometers using the new design could help resolve some fundamental questions in physics, such as the nature of the intermediate states between the quantum description of matter, which prevails at very small scales, and the Newtonian description that everyday engineering depends on.

"The idea here is that Bose-Einstein condensates are actually pretty big," says William Burton, an MIT graduate student in physics and first author on the paper. "We know that very small things act quantum, but then big things like you and me don't act very quantum. So we can see how far apart we can stretch a quantum system and still have it act coherently when we bring it back together. It's an interesting question."

Joining Burton on the paper are his advisor, professor of physics Wolfgang Ketterle, who won the 2001 Nobel Prize in physics for his pioneering work on Bose-Einstein condensates, and four other members of the MIT-Harvard Center for Ultracold Atoms, which Ketterle directs.

Carving up condensates

Bose-Einstein condensates are clusters of atoms that, when cooled almost to absolute zero, all inhabit exactly the same quantum state. This gives them a number of unusual properties, among them extreme sensitivity to perturbation by outside forces. A common approach to building a Bose-Einstein condensate interferometer involves suspending a cloud of atoms—the ...Read More...

NASA Might Build an Ice House on Mars

Artist concept of the Mars Ice Home. Credit: NASA.

At first glance, a new concept for a NASA habitat on Mars looks like a cross between Mark Watney's inflatable potato farm from "The Martian" and the home of Luke's Uncle Owen on Tatooine from "Star Wars."

The key to the new design relies on something that may or may not be abundant on Mars: underground water or ice.

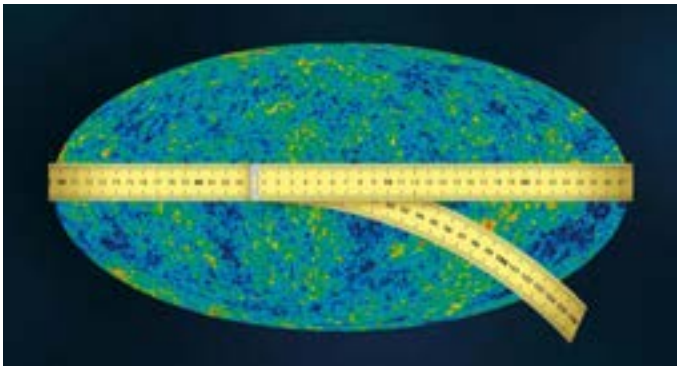
The "Mars Ice Home" is a large inflatable dome that is surrounded by a shell of water ice. NASA said the design is just one of many potential concepts for creating a sustainable home for future Martian explorers. The idea came from a team at NASA's Langley Research Center that started with the concept of using resources on Mars to help build a habitat that could effectively protect humans from the elements on the Red Planet's surface, including high-energy radiation.

Langley senior systems engineer Kevin Vipavetz who facilitated the design session said the team assessed "many crazy, out of the box ideas and finally converged on the current Ice Home design, which provides a sound engineering solution," he said.

The advantages of the Mars Ice Home is that the shell is lightweight and can be transported and deployed with simple robotics, then filled with water before the crew arrives. The ice will protect astronauts from radiation and will provide a safe place to call home, NASA says. But the structure also serves as a storage tank for water, to be used either by the explorers or it could potentially be converted to rocket fuel for the proposed Mars Ascent Vehicle. Then the structure could be refilled for the next crew.

Other concepts had astronauts living in caves, or underground, or in dark, heavily shielded habitats. The team said the Ice Home concept balances the need to provide protection from radiation, without the drawbacks of an underground habitat. The design maximizes the thickness of ice above the crew quarters to reduce radiation exposure while also still allowing light to pass through ice and surrounding materials. ...Read More...

Physicists measure the loss of dark matter since the birth of the universe



The discrepancy between the cosmological parameters in the modern Universe and the Universe shortly after the Big Bang can be explained by the fact that the proportion of dark matter has decreased. The authors of the study could calculate how much dark matter could have been lost and what the corresponding size of the unstable component would be. Researchers may explore how quickly this unstable part decays and say if dark matter is still disintegrating. Credit: MIPT

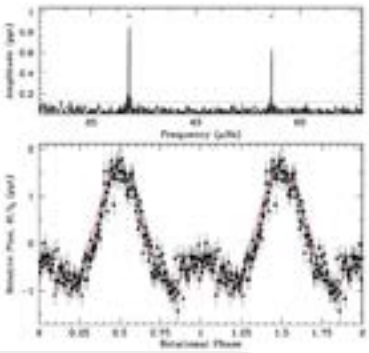
Russian scientists have discovered that the proportion of unstable particles in the composition of dark matter in the days immediately following the Big Bang was no more than 2 percent to 5 percent. Their study has been published in Physical Review D.

"The discrepancy between the cosmological parameters in the modern universe and the universe shortly after the Big Bang can be explained by the fact that the proportion of dark matter has decreased. We have now, for the first time, been able to calculate how much dark matter could have been lost, and what the corresponding size of the unstable component would be," says co-author Igor Tkachev of the Department of Experimental Physics at INR.

Astronomers first suspected that there was a large proportion of hidden mass in the universe back in the 1930s, when Fritz Zwicky discovered "peculiarities" in a cluster of galaxies in the constellation Coma Berenices—the galaxies moved as if they were under the effect of gravity from an unseen source. This hidden mass, which is only deduced from its gravitational effect, was given the name dark matter. According to data from the Planck space telescope, the proportion of dark matter in the universe is 26.8 percent; the rest is "ordinary" matter (4.9 percent) and dark energy (68.3 percent).

The nature of dark matter remains unknown. However, its properties could potentially help scientists to solve a problem that arose after studying observations from the Planck telescope. This device accurately measured the fluctuations in the temperature of the cosmic microwave background radiation—the "echo" of the Big Bang. By measuring these fluctuations, the researchers were able to calculate key cosmological parameters using observations of the universe in the recombination ...Read More...

Pulsations detected in a hot, helium-atmosphere white dwarf



The top panel shows the low-frequency FT of PG 0112+104. We identify two significant peaks, marked with red dots, which describe photometric modulation at the rotation period and its first harmonic. The bottom panel shows the K2 light curve binned into 200 points, folded at the rotation period of 10.17404 hr, and repeated for clarity. A simple spot model is underplotted in red and described in the text. Credit: Hermes et al., 2016.

Astronomers have recently discovered non-radial oscillations in a hot, helium-atmosphere white dwarf designated PG 0112+104. The newly detected 11 independent pulsation modes in this white dwarf could be essential for researchers testing the radial differential rotation and internal compositional stratification of highly evolved stellar remnants. The findings were presented in a paper published Dec. 22 on the arXiv pre-print server.

PG 0112+104 was first identified as a helium-atmosphere (DB) white dwarf with a mass of about 0.5 solar masses and an effective temperature of over 30,000 K. Now, a team of astronomers led by J. J. Hermes of the University of North Carolina has found that its luminosity varies due to non-radial pulsations that resulted in reclassification of this star to a variable DB white dwarf (DBV).

The researchers used NASA's Kepler space telescope in order to find pulsations of PG 0112+104. The white dwarf was observed for nearly three months in mid-2016 during Campaign 8 of Kepler's prolonged mission known as K2.

"We present the detection of non-radial oscillations in a hot, helium-atmosphere white dwarf using 78.7 d of nearly uninterrupted photometry from the Kepler space telescope," the scientists wrote in the paper.

Thanks to Kepler, the team detected 11 independent pulsation modes, the majority of which have solid mode identifications and corroborate the surface rotation period. The observational campaign allowed them to distinguish five low-order dipole modes and three quadrupole modes, all of which show rotationally split multiplets and probe the internal rotation at different depths. The researchers added that the amplitude of the newly identified pulsations is so low that previous observations were simply not sensitive enough to detect this variability. ...Read More...

Scientists plan to send greetings to other worlds

This is the "South Pillar" region of the star-forming region called the Carina Nebula. Like cracking open a watermelon and finding its seeds, the infrared telescope "busted open" this murky cloud to reveal star embryos tucked inside finger-like pillars of thick dust. Credit: NASA

After decades of fruitless scanning the skies for alien messages, scientists say it's time to try a basic rule of etiquette: Say "hello" first.

A new San Francisco-based organization called METI, or Messaging Extra Terrestrial Intelligence, plans to send signals to distant planets, rather than waiting for them to call Earth.

By the end of 2018, the project aims to send some conversation-starters via radio or laser signals to a rocky planet circling Proxima Centauri, the nearest star other than the sun, and then to more distant destinations, hundreds or thousands of light years away.

It would be the first effort to send powerful, repeated and intentional messages into space, targeting the same stars over months or years.

"If we want to start an exchange over the course of many generations, we want to learn and share information," said Douglas Vakoch, president of METI and former director of Interstellar Message Composition at the Search for Extraterrestrial Intelligence Institute in Mountain View, Calif., known as SETI.

Founded last year, METI will host two workshops next year, one in Paris and the other in St. Louis. It also plans to start raising the $1 million needed annually to staff and build or borrow a powerful transmitter in a remote location.

Part of the mission will be to figure out how to craft the perfect message to say "Hello."

Like much else in science, the project has turned controversial. Some ask: If aliens are hostile, do we really want them to know where we are? ...Read More...

Pioneering physicist Vera Rubin dies at age 88

Vera Rubin, a physicist who confirmed the existence of dark matter, has died at age 88.

After receiving a BA from Vassar College in 1954, Rubin attempted to enroll in Princeton despite bans on female PhD candidates in astronomy. Eventually she attended Cornell University, earning a masters degree, before completing her studies at Georgetown University.

From there, Rubin and colleague Kent Ford watched the rotation of nearby galaxies, studying the curves as they moved. Eventually, discrepancies between predictions of angular momentum and the actual angular momentum seemed to confirm dark matter.

Dark matter was the "missing mass" of the universe necessary to explain how the universe expanded, so called because it wasn't accounted for by known stars, galaxies, and other objects.

While it had been discussed as early as the 1920s (Jacobus Kapteyn was the first to suggest it) and Fritz Zwicky (who coined the term "dark matter" while studying galactic motion in galaxy clusters in the 1930s), Rubin's work helped solidify the emerging field of dark matter research in the present day, confirming the work of Zwicky, Kapteyn, and others by nailing down precise measurements of the necessary amounts of dark matter to confirm galactic-scale observations. In essence, galaxies were moving faster than they should have been based on the estimated number of stars and other material in spiral galaxies, something that had to be accounted for by unseen forces.

While Rubin's work may have helped usher in the modern age of dark matter research, she was also a tireless advocate for other women in STEM fields, saying, "We all need permission to do science, but, for reasons that are deeply ingrained in history, this permission is more often given to men than to women."

Rubin's work helped carve out a path for other women in astronomy and other science disciplines. While she won numerous awards for her work, calls for Rubin to win a Nobel Prize in Physics went unheeded.

Astrophotography as a gateway to science

Illustration Only

Non-science students enrolled in astrophotography classes created by scientists at the University of California, Riverside reported a better understanding of how to use a telescope and camera and how to process images, according to a recently published paper about the class.

In addition, after taking the classes, the students, most of whom were UC Riverside non-STEM (Science, Technology. Engineering, Mathematics) majors, were eager to take up astrophotography as a hobby, opening the path to become future citizen scientists and amateur astronomers, groups which historically have analyzed a lot of astronomical data and made numerous discoveries.

"We have created a course that non-science students thoroughly enjoyed that can easily and inexpensively be reproduced elsewhere," said Mario De Leo Winkler, a postdoctoral researcher in astrophysics who specializes in public outreach and education of science at UC Riverside and created the courses with two astronomy professors.

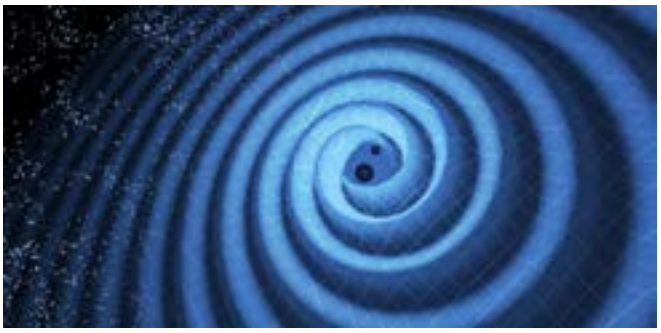
The idea of the classes was to engage students majoring in fields such as social sciences, humanities, business and arts in science. Astronomy is considered by many a gateway into science. More than 200,000 non-science majors enroll in an introductory astronomy class every year in the United States, but this will likely be their only interaction with a natural science during their undergraduate studies.

Astrophotography is a great way to teach science in a visual and hands-on manner, De Leo Winkler said. It also provides a way to break through the mathematical anxiety that many non-science majors experience.

The researchers created two versions of the astrophotography class.

The first was as an extra credit component of two introductory, undergraduate astronomy courses. This version was comprised of four classes that addressed the basics of astrophotography and astrophysics, how ...Read More...

2016—the year in space and astronomy



The discovery of the year was the first detection of gravitational waves. Credit: LIGO/T. Pyle

The achievements of astrophysicists this year were as groundbreaking as they were varied. From reuniting a lander with a mothership on a comet, to seeing the most extreme cosmic events with gravitational waves, 2016 was truly out of this world for science.

Here are some of the highlights of the year that was.

1. Gravitational Waves

The spectacular announcement that ripples in the very fabric of spacetime itself had been found (and from surprisingly massive black holes colliding) sent similarly massive ripples through the scientific community. The discovery was made using the Laser Interferometer Gravitational-Wave Observatory (LIGO) and represents a fundamentally new sense with which to see the universe.

The gravitational waves cause one arm of the LIGO detector to stretch relative to the other by less than a thousandth of the width of a proton in the centre of the atom. Relatively speaking, that's like measuring a hair's-width change in the distance to the nearest star.

This discovery was the end of a century-long quest to prove Einstein's final prediction that these gravitational waves are real. It also allows us to directly "see" that famously and fundamentally invisible entity: the black hole (as well as definitively proving its existence). The fact that the two black holes collided 1.3 billion years ago and the waves swept through Earth just days after turning the detector on only add to the incredible story of this discovery.

2. SpaceX lands (and crashes) a rocket

The year started so well for SpaceX with the incredible achievement of sending a satellite into orbit, which is no mean feat itself at such low cost, before then landing that launch rocket on a barge in the ocean. A seemingly unstoppable sequence of launches and landings made it appear that a new era of vastly cheaper ..Read More...

This Week's Sky at a Glance - Dec. 31 - Jan. 06

Jan. 02 Moon at descending node (22:14)
Jan. 03 Quadrantids' Meteor Shower
Jan. 04 Earth at Perihelion 19:17 (0.98331 AU)
Jan. 05 First Quarter Moon (23:46)

Happy New Year 2017

M45: The Pleiades Star Cluster

Image Credit & Copyright: Hermann von Eiff

Explanation: Have you ever seen the Pleiades star cluster? Even if you have, you probably have never seen it as dusty as this. Perhaps the most famous star cluster on the sky, the bright stars of the Pleiades can be seen without binoculars even from the heart of a light-polluted city. With a long exposure from a dark location, though, the dust cloud surrounding the Pleiades star cluster becomes very evident. The featured image was a long duration exposure taken last month from Namibia and covers a sky area many times the size of the full moon. Also known as the Seven Sisters and M45, the Pleiades lies about 400 light years away toward the constellation of the Bull (Taurus). A common legend with a modern twist is that one of the brighter stars faded since the cluster was named, leaving only six stars visible to the unaided eye. The actual number of visible Pleiades stars, however, may be more or less than seven, depending on the darkness of the surrounding sky and the clarity of the observer's eyesight.