

Newly repaired Hubble telescope releases first images

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In May 2009, the Hubble Space Telescope received its final upgrade. The billion dollar effort bore its first fruit on September 9, when NASA released the most recent pictures from Hubble, a dazzling combination of planetary nebulae, star clusters and galaxies.

Among the images released is the planetary nebula catalogued as NGC 6302, but more commonly known as the Bug or Butterfly Nebula. Taken with the Wide Field Camera 3, it is roughly 3,800 light years away in the constellation Scorpius. The radiant gas is produced by the star that NGC 6302 was formed from, approximately 2,200 years ago. The “wings of the butterfly” stretch out an extraordinary distance—approximately two light years, or about half the distance from the Sun to the nearest star, Alpha Centauri.

The spectrum of NGC 6302 reveals that the central star is one of the hottest in our own Milky Way galaxy, in excess of 200,000 K (close to 400,000 degrees Fahrenheit). This central star has never been observed and is surrounded by a dense cloud of gas and dust around its equator. The extreme density of this disk is hypothesized to have caused the bipolar structure of the nebula.

The complex structure of the nebula is a product of its history. According to NASA, the star at the center evolved into a “red giant,” with a diameter 1,000 times that of the Sun. Some of the gas in the outer layers was ejected from the equator at a low speed, creating the relatively small disc perpendicular to the “rings.” The wings were formed by gases ejected at higher speeds. “Later, as the central star heated up, a much faster stellar wind, a stream of charged particles traveling at

more than 2 million miles an hour, plowed through the existing wing-shaped spectrum, further modifying its shape.”

Another image is of the Carina Nebula, a pillar of gas and dust forming a stellar nursery located 7,500 light years away in the southern constellation Carina. The image gives a more complete view of the pillar and its interior when fine details are uncovered using near-infrared wavelengths. Energetic radiation from within the gas cloud creates the luminous emissions seen from the top of the structure. Inside, the immense heat and pressure trigger the birth of new stars.

It is in this nebula that the hypergiant binary star known as Eta Carina resides. The more massive of the pair that make up the binary system has a mass ranging from 100-150 times the mass of the Sun, and a luminosity almost 4 million times the Sun. Due to its extreme size, the star will go gamma ray burst or hypernova in the near future (astronomically speaking). The partner will likely be destroyed in the resulting implosion or sucked into the inevitable black hole born from the event.

The barred spiral galaxy NGC 6217 was the first celestial object photographed with the Advanced Camera for Surveys, which was restored during Hubble Servicing Mission 4 (STS-125).

The galaxy lies 6 million light years away in the constellation Ursa Major. In 2001, a possible X-ray emission was detected, classifying this galaxy as a “starburst” galaxy.

The photos of Galaxy Cluster Abell 370, 5 billion light years away, were taken with the aid of gravitational lensing. Gravitational lensing is a phenomenon that results from Einstein's general relativity and the curvature of spacetime, which forces the path of light to bend around massive objects. This focuses the light if the viewer has the correct vantage point. Using a galactic cluster as a focus, Hubble is able to peer far deeper into the universe and with more clarity than is normally possible.

This distortion in spacetime is what causes the streaks and arcs in the background of the picture.

Gravitational lensing is an extremely important tool for astrophysics. For example, it allows astronomers to observe dark matter, since its mass bends spacetime just as any mass would, and the reconstruction of the mass distribution reveals the places where the dark matter exists.

Another image shows a quintet of galaxies, revealing what happens when massive structures of galaxies collide. While it seems that these five galaxies occupy nearby regions of space, the two dimensional image conceals the fact that the galaxy in the upper left is actually seven times closer than the other four. This is known from the wavelengths of light received from all five galaxies, and from the fact that the one on the left is less redshifted than the other four. Redshift is a direct result of the distance of galaxies from Earth and the expansion of spacetime itself.

The other four galaxies, masquerading as two, collided recently (again astronomically speaking), and are slowly reshaping themselves. The white points are the former cores of the galaxies, most likely active black holes which will eventually merge and release a massive energy burst into their respective galaxies when they do.

The tendrils seen from the two forming galaxies are remnants of the old spiral arms and have a high probability of getting flung into interstellar space from

the gravitational interactions caused by two galaxies merging. It is not uncommon for this to happen to stars in a galactic merging, and may happen to our Sun when the Milky Way merges with the Andromeda Galaxy in approximately two billion years.

More than a hundred thousand stars are captured in Hubble's viewing of the Omega Centauri Globular Cluster, located within the Milky Way. Edmond Hailey originally classified the cluster as a nebula, and it wasn't until the 1830s that John William Herschel recognized the cluster for what is truly is. It is also visible to the naked eye, which led the ancient Greek astronomer Ptolemy to believe that it was a single star.

The cluster itself is extremely old, approximately 12 billion years. However, the cluster has a range of stellar ages, which implies that it did not form at the same time, in contrast to what astronomers believe is generally the case with globular clusters. Due to recent evidence pointing to a black hole in the center of the cluster, it is possible that the stars are the remnants of a small galaxy which was "eaten" by the Milky Way long ago.



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