NATURE’S MARVELS

Universe’s First Molecule Found
Helium Hydride

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Image of planetary nebula NGC 7027 with an illustration of Helium Hydride molecules
Image Credit: NASA/ESA/Hubble
The universe today is filled with stars, planets and galaxies, but what came before? After the big bang, the early universe was so hot and only had a few types of atoms, mostly Lithium, Helium and Hydrogen. The big bang theory explains the birth of the universe. In simple words, the universe evolved from the single molecules which then transformed for billions of years, becoming a complex place.

Molecular hydrogen is the constituent gas from which stars, galaxies and other complex structures in the universe emerged. It is also the most abundant gas in the universe. Scientists believe that the helium and hydrogen began to combine to form the universe’s first molecule called Helium Hydride (HeH+). These molecules led to the creation of new molecules that helped create the early universe. Helium Hydride is a positively charged stable molecule. Helium Hydride should be present in the modern universe but it has never been found in space till now.

But recently, Helium Hydride was found on a planetary nebula namely NGC-7027, a remnant of the sun-like star, located 3,000 light-years away near the constellation Cygnus. The NGC 7027 is about 600 years old and its condition allows the formation of this mystery molecule.

As mentioned in an article on the NASA website, Rolf Guesten of the Max Planck Institute for Radio Astronomy, in Bonn, Germany, said, “It was so exciting to be there, seeing Helium Hydride for the first time in the data.” “This brings a long search to a happy ending and eliminates doubts about our understanding of the underlying chemistry of the early universe,” he adds.

Planetary nebulae are glowing, expanding shells of ionised gases, blasted off by Sun-like stars in the end stages of their lives. They represent the closest astronomical analogues for post-Big Bang chemistry, which could hold clues about the properties of the early universe.

In 1925, scientists were able to synthesise Helium Hydride molecule in a laboratory by inducing helium to share one of its electrons with a hydrogen ion. But the existence of Helium Hydride in the interstellar space was always a dilemma for astronomy for decades.

During the 1970s, while examining the planetary nebula NGC-7027 scientists thought the environmental conditions, ultraviolet radiation and the heat of the ageing star might be just apt for the formation of Helium Hydride. But these observations were inconclusive because of the lack of evidence. The space telescopes used to detect the signal of Helium Hydride did not have the technology to pick out the specific signal from the pool of other molecules in the nebula.

However, NASA’s Stratospheric Observatory for Infrared Astronomy, or SOFIA, helped the scientists to find out this elusive molecule. Flying high in the earth’s atmosphere with SOFIA, the world’s largest airborne observatory, scientists finally detected this elusive molecule. SOFIA, a partnership of NASA and the German aerospace centre uses cutting edge technology. Its instruments can be easily upgraded. Unlike other space telescopes, it returns after every flight.

Scientists upgraded SOFIA’s instruments, called the German Receiver at Terahertz Frequencies, or GREAT — a heterodyne instrument for high-resolution spectroscopy, by adding a specific channel for the detection of Helium Hydride. The instrument works like a radio receiver. Scientists set the frequency of the molecule they were searching for, similar to tuning an FM radio to the right station. When SOFIA took off on flight, scientists were onboard reading the data from the instrument in real time. The signal of Helium Hydride was finally detected clearly for the first time.

A paper on the discovery was published on 17 April 2019 in Nature.

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