Life from the stuff between stars

DNA bases and amino acids are essential for life

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A team of scientists led by Dr. Sandip Chakrabarti from the Indian Centre for Space Physics has demonstrated the possibility of DNA bases and amino acids, necessary for life, forming in the space between stars, filled with gases and dust clouds.

THE FOCUS: *Both the collapse of gas to form stars and planets and how their chemical composition changed in the process need to be studied.* – PHOTO: AP

This space, called the Interstellar medium (ISM), has been known from observational data to contain methanol, carbon dioxide and water. However, this is the first time research has demonstrated how simple amino acids like alanine and glycine and the more complex nucleobase adenine can form in the ISM. These molecules formed important parts of processes that paved the way for life to form on Earth.

Dr. Chakrabarti's study is set to be published in *New Astronomy* in April 2013. About his motivation for this study, Dr. Chakrabarti said in an email to this Correspondent, "The universe has been built once. We cannot repeat at our will. Now, we need to take the help of fast computers to study both the collapse of gas to form stars and planets and at the same time to understand how their chemical composition changed in the process."

Interest in the chemical origins of life was most famously kindled in recent history by the Urey-Miller experiment conducted in 1952. It concluded that Earth's primitive atmosphere — 4 billion years ago — was not equipped to form amino acids, and by extension, life, fuelling speculation that the biotic molecules must have come from space. This was bolstered by the Murchison meteorite that crashed in Victoria, Australia, 1969. Analysis showed the rock's composition included over 90 different amino acids, only 19 of which were found in Earth-bound life. This suggested that early Earth was bombarded by such meteorites, which seeded the planet with chemicals essential for life.

As an extension of this investigation, Dr. Chakrabarti and his colleagues developed computer models to simulate the vacuum conditions of space, and calculated the probability of complex molecules forming in them. The conditions included the grain and gas chemistry of an environment that contained ten-thousand to one-lakh particles per cubic centimetre (cc) and a temperature of around -263.7 degrees C.

The simulation showed methanol, carbon dioxide, and water from the ISM being heated by cosmic rays originating from distant stars. Consequently, molecules called precursor molecules were formed, such as methyl isocyanate, cyanocarbene, and cyanamide. The precursors were identified by their absorption spectra. Over time, these molecules will go on to form amino acids.

Scientists from the NASA Ames Exploration Centre, California, are speculating that meteorites like the one that crashed in Murchison could inculcate amino acids through this process. The easiest way to verify this, then, would be to look for amino acids in their gas phase in the ISM with millimetre and micrometre radio-waves. Why isn't it being done, then?

"The reason is that the predicted abundance [of amino acids] is low, about 1 gram of amino acid in 10^{17} gm of matter, and we are not yet technologically advanced to detect such trace materials from such a large distance in space," he replied.

The future course pof action is to understand how these amino acids and DNA bases were smuggled out of the solar system by meteors and comets and seeded on distant worlds as they crashed into them, and what role stars like our Sun played in the process.