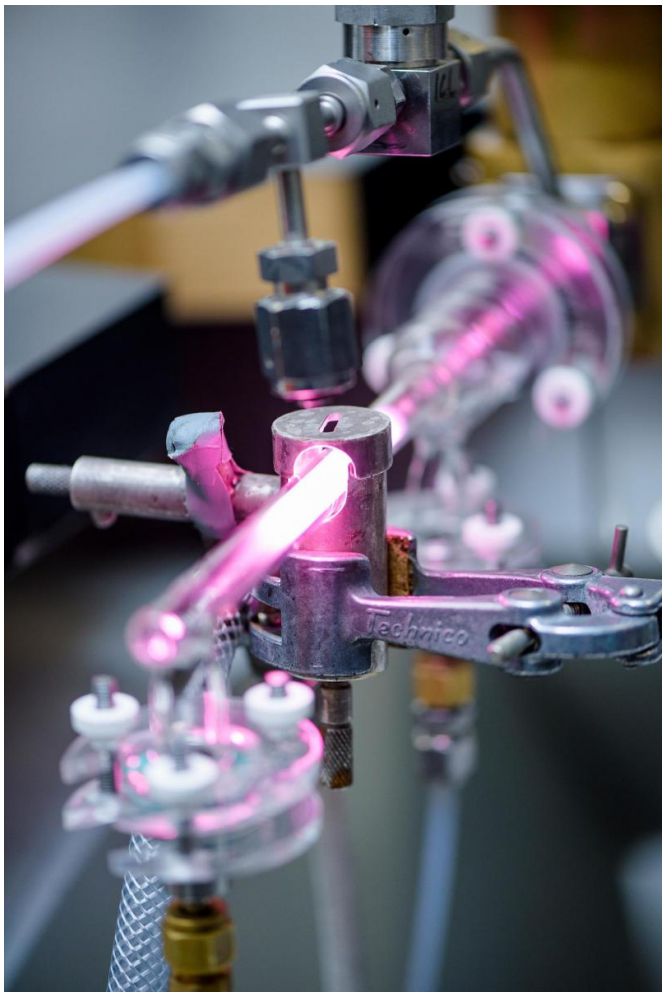
Astrochemistry: how life may have begun in space

10 April 2017



How researchers replicate space radiation in the lab: a light source stimulates hydrogen and thus creates energy-rich ultraviolet radiation. Credit: RUB, Damian Gorczany

We usually imagine comet impacts as a threat and not as the source of life. But perhaps they were precisely that. Researchers in Bochum are looking for evidence for this theory.

What chemical processes in space could have created the building blocks of life is being researched by chemists at Ruhr-Universität Bochum (RUB) in Prof Dr Wolfram Sander's team. In their experiments, the scientists are simulating the conditions in space to understand in detail how certain chemical reactions occur. They report on the results in the RUB's science magazine *Rubin*.

One theory says that the building blocks of life were not created on Earth. Cometary impacts may have brought amino acids, the basic units of proteins, to our planet. How such complex molecules could have formed in space is a question being investigated by Sander's team. The scientists are interested in processes in a condensed phase, i.e. in liquids, solids or on surfaces, into which there has been little research.

A precursor of amino acids

Besides hydrogen and oxygen, the icy core of comets usually also contains nitrogen and carbon – all the elements needed for an amino acid. A possible precursor of amino acids in space could be the molecule hydroxylamine (NH2–OH), which consists of one nitrogen, one oxygen and three hydrogen atoms. However, it has not yet been possible to verify this in space.

RUB PhD student Yetsedaw Tsegaw investigated in an experiment whether the conditions in space would actually allow this molecule to form. He adjusted the conditions in the comet ice in the lab, brought ammonia (NH3) and oxygen (O2) together in this environment and treated the mixture with high-energy radiation, such as that found in space. He observed the reactions that occurred with a special form of infrared spectroscopy.

Hidden molecule

Tsegaw took the measurements as a guest researcher in the working group of Prof Dr Ralf Kaiser at "WM Keck Research Laboratory in Astrochemistry" in Hawaii. He then analysed the

data at RUB. The result: hydroxylamine was actually created in the experiment. However, it was not visible at first sight. The bands of hydroxylamine were overlaid in the infrared spectrum by the bands of other molecules. Only when Tsegaw gradually warmed the sample and the interfering substances evaporated was he able to identify hydroxylamine.

In theory, the molecule could thus form in comet ice. The chemist presumes that people had not been searching for it using the right methods until now.

Provided by Ruhr-Universitaet-Bochum