Large Organic Molecules in the Laboratory and in Space

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Discoveries of large new organic molecules in space help provide a foundation for understanding the role of the chemical bond and organic chemistry on a cosmic scale, and by extension, an opportunity to begin to address the interesting questions of biological and chemical origins and the issues that relate to them.

Most of the large organic molecules so far detected in the interstellar gas and circumstellar shells are carbon chains, a configuration of linear carbon which is unstable at high density, and therefore unfamiliar on Earth. Laboratory detection of long carbon chains was until recently extremely difficult or impossible, but more than 25 have now been detected over the past two years in this laboratory with a very sensitive Fourier transform microwave spectrometer. The largest molecule so far discovered is a chain ($HC_{17}N$) with 19 atoms and a molecular weight of 219 amu — more than three times that of glycine, the simplest amino acid. All are good candidates for astronomical detection with radio telescopes, and four have already been found in space, including the largest interstellar molecule $HC_{11}N$; with large telescopes under construction or the discovery of better astronomical sources, it is possible that nearly all can be found. Laboratory detection of other known and postulated astrophysical carbon chains and rings should be possible if we exploit the nearly two orders of magnitude between the detection sensitivity of our present microwave spectrometer and the fundamental limit set by modern technology — the same technology routinely exploited by radio astronomers.