AN ABSORPTION SURVEY OF C_3H^+ AND C_4H IN DIFFUSE CLOUDS TOWARD GALACTIC CONTINUUM REGIONS

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Observations of the diffuse interstellar gas over the past few decades have revealed a surprisingly rich molecular inventory comprising over 25% of all known interstellar molecules. While the molecules observed in diffuse clouds are small relative to ones found in dark clouds, considerable progress has been made in recent years towards detecting larger, more complex molecules.[a,b] There is also clear evidence at optical wavelengths for a very large molecule—the fullerene ion C_{60}^+—in the diffuse gas.[c] Using the 100-m Green Bank Telescope, we undertook observations of 8 sightlines toward bright centimeter continuum regions in the Galaxy, and detected the C_3H^+ ion and the C_4H radical in absorption from foreground diffuse clouds along 7 sightlines.[d] Both molecules are thought to be key intermediates in the carbon chemistry of the interstellar medium, and to our knowledge C_3H^+ is currently the largest carbon chain ion and C_4H the largest carbon chain radical detected by radio astronomy in the diffuse gas. I will discuss our results within the context of understanding hydrocarbon chemistry, establishing the limits of molecular complexity, and bridging the gap between small molecules and very large molecules in the diffuse gas. I will also discuss the prospects of enlarging the molecular inventory of diffuse clouds, particularly large polyatomic ions and radicals,[e] by means of absorption surveys exploiting long pathlengths toward bright continuum sources.

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[a] Liszt, H. S., Gerin, M., Beasley, A., & Pety, J., 2018, Astrophysical Journal, 856, 151; *and references therein.*

[b] Gerin, M., Liszt, H., Neufeld, D., et al. 2019, Astronomy & Astrophysics, 622, A26; *and references therein.*

[c] Maier, J. P. & Campbell, E. K. 2016, Phil. Trans. R. Soc. A, 374, (issue 2076), 1

[d] Our sample includes two sightlines where millimeter-wave absorption from C_3H^+ has previously been detected.[b]

[e] Molecular ions such as C_3H^+ are far more challenging to produce in the laboratory than carbon chain radicals, and might first be found in space.