TOP DOWN CHEMISTRY VERSUS BOTTOM UP CHEMISTRY

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The idea of interstellar top down chemistry (TDC), in which molecules are produced from decomposition of larger molecules and dust in contrast to ordinary bottom up chemistry (BUC) in which molecules are produced synthetically from smaller molecules and atoms in the ISM, has been proposed in the chemistry of PAH [a,b] and carbon chain molecules[c,d] both for diffuse[a,c] and dense clouds[b,d]. A simple and natural idea, it must have occurred to many people and has been in the air for sometime[e]

The validity of this hypothesis is apparent for diffuse clouds in view of the observed low abundance of small molecules and its rapid decrease with molecular size on the one hand and the high column densities of large carbon molecules demonstrated by the many intense diffuse interstellar bands (DIBs) on the other. Recent identification of C_{60}^+ as the carrier of 5 near infrared DIBs with a high column density of 2×10^{13} cm^{-2} by Maier and others[f] confirms the TDC.

This means that the large molecules and dust produced in the high density high temperature environment of circumstellar envelopes are sufficiently stable to survive decompositions due to stellar UV radiaiton, cosmic rays, C-shocks etc. for a long time ($\geq 10^7$ year) of their migration to diffuse clouds and seems to disagree with the consensus in the field of interstellar grains[g]. The stability of molecules and aggregates in the diffuse interstellar medium will be discussed.

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[a] Duley, W. W. 2006, Faraday Discuss. 133, 415

[b] Zhen,J., Castellanos, P., Paardekooper, D. M., Linnartz, H., Tielens, A. G. G. M. 2014, ApJL, 797, L30

[c] Huang, J., Oka, T. 2015, Mol. Phys. 113, 2159

[d] Guzmán, V. V., Pety, J., Goicoechea, J. R., Gerin, M., Roueff, E., Gratier, P., Öberg, K. I. 2015, ApJL, 800, L33

[e] L. Ziurys has sent us many papers beginning Ziurys, L. M. 2006, PNAS 103, 12274 indicating she had long been a proponent of the idea.

[f] Campbell, E. K., Holz, M., Maier, J. P., Gerlich, D., Walker, G. A. H., Bohlender, D, 2016, ApJ, in press

[g] Draine, B. T. 2003, ARA&A, 41, 241