Journal of Cosmology, Vol. 30, No. 2, pp. 30020 - 30024

Life beyond the limits of our planetary system

N. Chandra Wickramasinghe[1,2,3,4]

1.Buckingham Centre for Astrobiology, University of Buckingham, UK
2.Centre for Astrobiology, University of Ruhuna, Matara, Sri Lanka
3.National Institute of Fundamental Studies, Kandy, Sri Lanka
4.Institute for the Study of Panspermia and Astroeconomics, Gifu, Japan

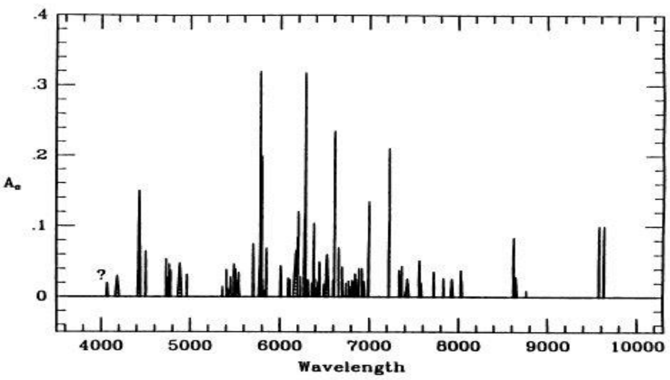
Summary

Evidence for the widespread distribution of biologically relevant molecules widely throughout the Galaxy and beyond has been in existence for many decades. The recent discovery of a nucleobase uracil adds to an already impressive body of evidence that supports a cosmic origin of the complex building blocks of life.

Keywords: Carbonaceous asteroids, organic molecules in space, origin of life, panspermia

The distance from Earth of the much publicised carbonaceous asteroid 162173 Ryugu (1999 JU3) at 2-3 AU in which biologically related organic monomers have been discovered (Oba et al, 2023) (1) pales into insignificance compared to the astronomical distances at which similar organic molecules have been discovered in the past. As early as the 1920's the discovery of the "diffuse interstellar bands" DIB's in the optical spectra of reddened stars pointed to organic molecules associated with interstellar dust extending over tens of kiloparsecs (Wickramasinghe, N.C., 1967(2); Herbig, G.H. 1995 (3)). This is shown in Fig.1 the absorption band at 4430A being the strongest and most persistent feature, with other strong features located at the wavelengths 5780, 5797, 6284 and 6614A.

In 1967 F.M. Johnson pointed out to the consternation of the astronomical community that a molecule related to chlorophyll, magnesium tetrabenzoporphirine ($MgC_{46}H_{30}N_6$) had an absorption spectrum that was fitted the DIB's to a remarkable degree of precision (Johnson, 1967 (4); Johnson et al, 1973(5)). Whilst this identification remains in dispute, other authors have considered the possibility of interstellar extinction arising from polyaromatic hydrocarbons (Donn, 1968 (6)), a possibility that appears to have been vindicated with the discovery of a broad 3.3 micrometre emission feature in a number of reflection nebulae (4. Sellgren et al, 1983)(7).



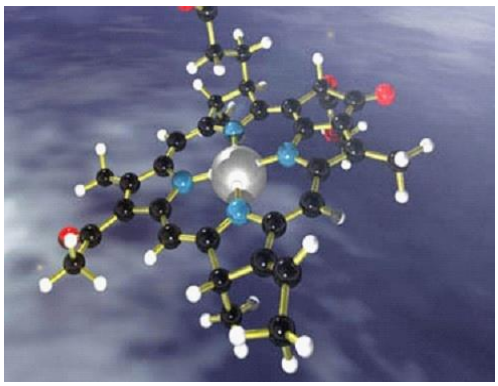


Fig. 1 The diffuse interstellar bands *(L)* attributed by F.M. Johnson to magnesium tetrabenzoporphirine ($MgC_{46}H_{30}N_6$) *(R)*

From 1984 onwards the detection of discrete interstellar emission features in the infrared particularly those at wavelengths 3.3, 6.2, 7.7, 8.6, and 11.3 μm that have been generally attributed aromatic features such as exist in the combustion of biological products. These are found in both galactic and extragalactic sources has led to the acceptance of polyaromatic hydrocarbon molecules having a widespread cosmic prevalence (Wilner et al, 1977(8); Wilner, 1984(9)). One particular class of source that show these bands are planetary nebulae of which the source NGC2027 is a typical example at a distance close to 1 kpc. The IR spectrum of this source is shown in Fig. 2.

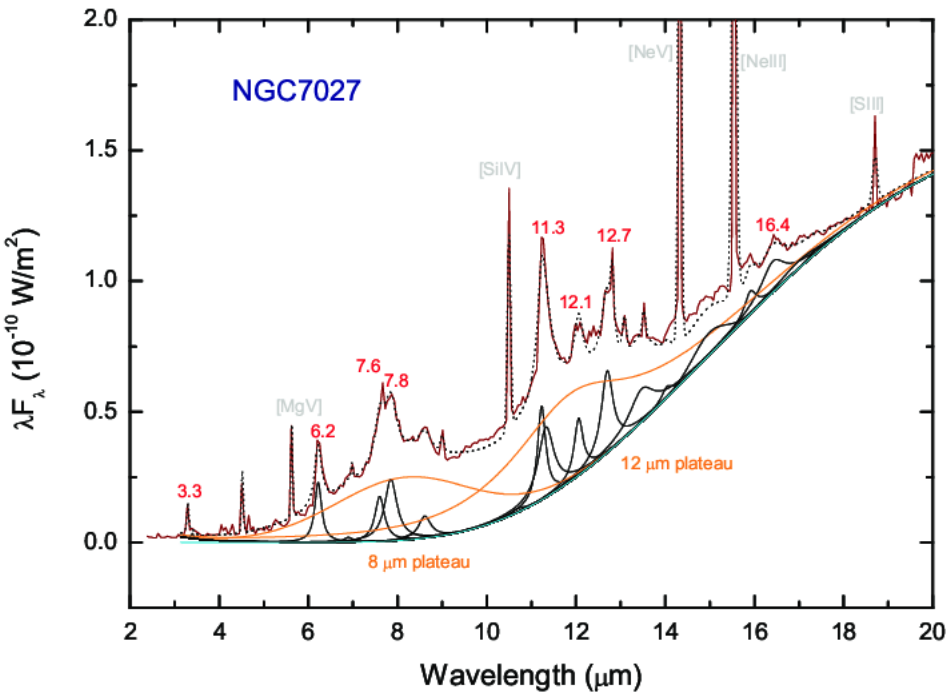


Fig.2 Positions of the PAH bands in the planetary Nebula NGC7027.

Mid-infrared spectra of HII regions within star-forming galaxies M83 and M33 at distances of the order of Mpc. However, it should be noted that any possible biological origin for these molecules in our galaxy and beyond still appears to be vigorously resisted for what the author believes are mainly cultural reasons.

As far back as 1974 present author suggested the identification of organic polymers in interstellar dust and comets typified by polyformaldeyde (Wickramasinghe, 1974 (10); Cooke and Wickramasinghe, 1977 (11); Vanysek and Wickramasinghe, 1977(12)). Whilst these ideas received some support from the detection formaldehyde in the gas coma of Halley's comet (Huebner, 1987 (13); Mitchel et al, 1987 (14), Hoyle and Wickramasinghe (1991) (15) next began to explore the possibility of biological related polymers including polysaccharides forming in the mass flows from stars.

The possibility of biological molecules – indeed entire biological structures such as freeze-dried bacteria existing on a galactic scale – followed from infrared spectroscopy when the absorption by laboratory systems were compared with new observations of astronomical sources at infrared wavelengths. Laboratory spectra of desiccated bacteria by Hoyle et al, 1982 (16) compared with the infrared spectrum of the Galactic Centre source GC-IRS7 obtained by Dayal Wickramasinghe and David Allen showed a fit that caused a sensation amongst astronomers as well as biologists (16).

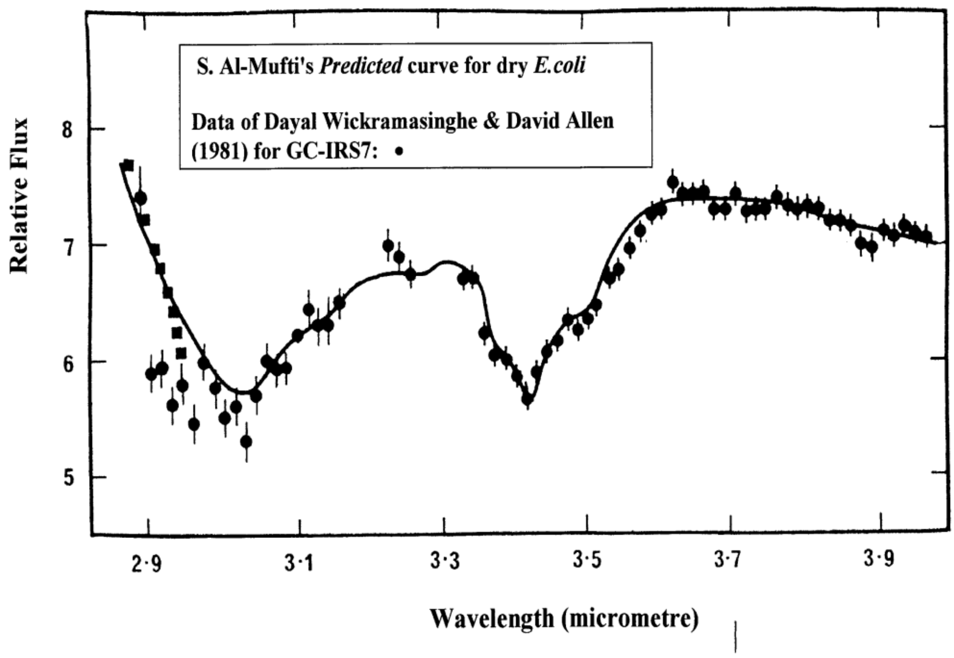


Fig.2. Astronomical data points compared with laboratory spectrum of dessicated bacteria under space-simulated conditions.

This match of the laboratory spectrum to astronomical data points shown in Fig 2 shows clearly that life-related biomolecules are present in cosmic dust over a distance scale of some 10kpc. A similar result obtained a few years later for the dust tail of Comet Halley during its 1986 perihelion (17) showed clearly that comets originating in the Oort cloud at a distance of 10's of thousands of AU from the sun also carried biologically related material. This is already in great excess of the distance of Ryugu (2 AU) at which material that contained biologically related molecules was recently recovered and analysed (1). The more radical position that has to be admitted is that the informationally rich components of life in the form of microscopic biological entities – bacteria and viruses - are present on a scale that transcends the size of planetary systems, star systems, even entire galaxies. It is high time we overcome cultural prejudice and accept that life is a truly cosmic phenomenon. Only then can new data as they become available be judged objectively for what they really mean.

References

1. Obo, Toga, Takano et al, 2023. Uracil in the carbonaceous asteroid 162173 Ryugu, Nature Comms., 14, 1292
2. Wickramasinghe, N.C, 1967, Interstellar Grains (Chapman & Hall, London)
3. Herbig, G.H., 1995. The diffuse interstellar bands, Ann.Rev.Astron.Astrophys., 33, 49-73
4. Johnson, F.M..1967. In J.M. Greenberg and T.P. Roark (eds) Interstellar Grains , NASP-140

5. Johnson, F.M., 1971, Annals N.Y. Acad. Scie., 194, 3
6.Donn, B., 1968. Astrophys.J.Lett., 152, L129
7. Selgren, K. et al, 1983. Astrophys.J., 271, L13
8. Willner, S.P. et al, 1979. Astrophys.J., 229, L65
9. Willner, S.P. 1984. In M.F. Kessler and J.P.Phillips (ed) Galactic and Extragalactic IR spectroscopy
10. Wickramasinghe, N.C., 1974. Nature, 252, 462
11. Cooke, A. and Wickramasinghe, N.C., 1977. Astrophys.Sp.Sci., 50, 43
12. Vanysek, V. and Wickramasinghe, N.C., 1975. Astrophys.Sp.Sci., 33, L19
13. Huebner, W.F., 1987. Science, 237, 628
14. Mitchel, D.L. et al, 1987, Science, 237, 626
15. Hoyle, F., Wickramasinghe, N.C.,1999 The theory of interstellar grain (Kluwer Dordrect)
16. Hoyle, F., Wickramasinghe, N.C., Olavesen, A.H., Al-Mufti, S., and Wickramasinghe, D.T.,1982. Astrophys.Sp.Sci., 83, 405
17. Wickramasinghe, D.T. and Allen, D.A., 1986. Discovery of organic grains in Comet Halley, Nature, 323, 44