CYANOPOLYYNE CATIONS AS CARRIERS OF A SET OF DIFFUSE INTERSTELLAR BANDS

JAMES K. G. WATSON, *Steacie Institute for Molecular Sciences, National Research Council of Canada, Ottawa, Ontario, Canada K1A 0R6.*

It is proposed that a set of diffuse interstellar bands (DIBs) can be attributed to the $\widetilde{B}^2\Pi - \widetilde{X}^2\Pi$ electronic transitions of the cyanopolyyne cations, $HC_{2n+1}N^+$, based on comparisons with laboratory observations in Ne matrices by Forney et al.[1] For HC_7N^+ the DIB $\lambda 6614$ is assigned as the 0_0^0 origin band, and $\lambda\lambda 6426$, 6196, 5982, and 5850 to transitions to upper-state fundamental vibrations. The three-peaked structure of $\lambda 6614$ under high resolution[2,3] is assigned as P and R branches of the two subbands ${}^2\Pi_{1/2} - {}^2\Pi_{1/2}$ and ${}^2\Pi_{3/2} - {}^2\Pi_{3/2}$, with the central pair of branches overlapping. The 0_0^0 band of HC_9N^+ is assigned to $\lambda 7562$, with vibrational bands at $\lambda\lambda 7358$, 6919, and 6521, while the 0_0^0 band of $HC_{11}N^+$ is assigned to $\lambda 8531$, with vibrational bands too weak to identify. These are all relatively sharp DIBs, with full widths at half maximum (FWHMs) in the range 1.7–3.1 cm^{-1}. Assignments are less satisfactory for shorter members of the series. The 0_0^0 bands of HC_5N^+ and HC_3N^+ may be $\lambda\lambda 5797$ and 5110, respectively, but the former seems to have a rather narrow PR separation under high resolution, although its FWHM of 2.9 cm^{-1} lies in the above range, while the latter is much broader (FWHM = 45 cm^{-1}) than higher members of the series. The first member of the series, HCN^+, does not have a $\ldots\pi^3\pi^4 \leftarrow \ldots\pi^4\pi^3$ electronic transition of this type.

1. D. Forney, P. Freivogel, J. Fulara, and J. P. Maier, J. Chem. Phys., 102, 1510 (1995).
2. P. J. Sarre, J. R. Miles, T. H. Kerr, R. E. Hibbins, S. J. Fossey, and W. B. Somerville, Mon. Not. Roy. Astron. Soc. 277, L41 (1995).
3. P. Ehrenfreund and B. H. Foing, Astron. Astrophys., 307, L25 (1996).