HOW MANY VIBRATIONAL LEVELS DOES THE GROUND ELECTRONIC STATE OF THE SODIUM DIMER SUPPORT?

PHOTOS G. HAJIGEORGIOU, *Department of Life and Health Sciences, University of Nicosia, Nicosia 1700, Cyprus*.

Over a decade ago, Raman molecular beam experiments[a] were employed to detect the asymptotic vibrational levels of the ground electronic state of the sodium dimer, and identified $\upsilon = 65$ as the highest bound vibrational level. This result is in contrast to the recent prediction[b] that the vibrational index at dissociation is $\upsilon_D = 66.9(2)$. An attempt is made to resolve this issue, using a direct potential fitting method that considers highly precise term values and a potential energy model that takes full account of the accurately known long-range dispersion energy coefficients in extrapolating the potential reliably to the dissociation asymptote. The principal end-product of this procedure, the complete potential energy curve, is employed to furnish accurate vibrational energies, rotational constants, and centrifugal distortion constants for all bound vibrational levels. These are then transformed appropriately according to Le Roy-Bernstein long-range theory to yield an independent WKB estimate of the vibrational index at dissociation.

[a] A. Crubellier, O. Dulieu, F. Masnou-Seeuws, M. Elbs, H. Knöckel, and E. Tiemann, Eur. Phys. J. D 6, 211-220 (1999).
[b] P. G. Hajigeorgiou, J. Mol. Spectrosc. in press (2013).