Electronic transitions of the $\text{C}_5\text{H}^-$ anion

Authors: M. Tulej$^a$; T. Pino$^a$; M. Pachkov$^a$; J. P. Maier$^a$

Abstract

Electronic transitions of the triplet chain $\text{C}_5\text{H}^-$ anion were studied using detachment spectroscopy. The system detected in the vicinity of the electron detachment threshold is assigned to the $b^3A \leftarrow a^3A$ transition with a dipole bound state (DBS) character. The second system measured by autodetachment spectroscopy is attributed to the $c^3A \leftarrow a^3A$ Feshbach electronic transition. Negative anharmonicity of the vibrational progression built upon the low frequency CCC in-plane bending mode $v_{12}$ is observed in both DBS and Feshbach states. This indicates a barrier to linearity on the potential energy surface in both excited states. The triplet chain $\text{C}_5\text{H}^-$ anion exhibits similar electronic properties to $\text{C}_3\text{H}^-$. Renner-Teller and vibronic effects between the $^3A$ DBS and Feshbach states are inferred and may explain the stabilisation of the DBS. This interaction is weaker in $\text{C}_5\text{H}^-$ than $\text{C}_3\text{H}^-$ leading to smaller barrier heights on the potential energy surface.

Keywords: dipole bound states; Feshbach state; Renner-Teller effect; photodetachment spectroscopy; carbon chains; interstellar chemistry

Affiliation: $^a$ Department of Chemistry, University of Basel, Klingelbergstrasse 80, CH-4056 Basel, Switzerland

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