IDENTIFICATION OF THE LOWEST-LYING BENDING VIBRATIONAL LEVELS OF THE $\tilde{A}\ ^1A_u$ STATE OF ACETYLENE, C_2H_2

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Acetylene is linear in its ground state, but becomes *trans*-bent in its $\tilde{A}\ ^1A_u$ state. The vibrational structure of the $\tilde{A} \leftarrow \tilde{X}$ system consists[a] of long progressions in the ν_3' (*trans*-bending) vibration based on the origin and the ν_2' (C-C stretch) fundamental. These progressions become irregular at a vibrational energy of about 5000 cm^{-1}, with many extra bands appearing[b]. Spectra of jet-cooled acetylene showed recently[c] that extra bands can also be found at much lower energy. Two of the extra levels were identified as the a_g combinations $1^1 3^1$ and $2^2\ 3^1$, but the other levels are combinations involving the two low frequency bending vibrations, ν_4 (torsion) and ν_6 (in-plane bending).

Two types of high resolution spectra have been recorded in order to assign these extra levels. Infrared-ultraviolet double resonance spectra via the $\tilde{X}$, ν_3 level have identified large numbers of *ungerade* vibrational levels at energies of 2000-7000 cm^{-1}, while high sensitivity laser-induced fluorescence spectra of jet-cooled acetylene have given the positions of many low-lying *gerade* levels. The low-lying bending levels are affected by strong *a*-axis Coriolis coupling, which distorts their *K*-structures considerably. In addition, there is very strong Darling-Dennison resonance between ν_4 and ν_6, with $k_{4466} \approx 50\ \mathrm{cm}^{-1}$. Nevertheless a good fit to the structures of the pure bending polyads can be obtained, allowing for both the Darling-Dennison resonance and the Coriolis coupling.

[a] J.K.G. Watson, M. Herman, J.C. Van Craen and R. Colin, *J. Mol. Spectrosc.*, **95**, 101 (1982).
[b] J.C. Van Craen, M. Herman, R. Colin and J.K.G. Watson, *J. Mol. Spectrosc.*, **111**, 185 (1985).
[c] A.J. Merer, N. Yamakita, S.Tsuchiya, J.F. Stanton, Z. Duan and R.W. Field, *Mol. Phys.*, **101**, 663 (2003).