LIFETIMES OF THE $\tilde{A}$ STATES OF C$_3$

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Fluorescence lifetimes have been measured for 66 $\Pi$$_u$ and 16 $\Sigma$$_u^+$ vibronic levels of the $\tilde{A}$$\Pi$$_u$ state of C$_3$ under nearly collision-free conditions. The vibrational levels studied were $v_1=0$–5, $v_2=0$–22, and $v_3=0$–4, covering the energy range up to 6000 cm$^{-1}$, and for most of them only the R(0) line was investigated. The measurements are estimated to be accurate to better than ±3 ns. General features of the lifetimes are as follows: Pure bending levels with $\Pi$$_u$-symmetry have shorter lifetimes (as short as 190 ns). With increasing excitation of the stretching vibrations, the lifetimes increase. Bending excitation generally reduces the lifetimes, though exceptions occur for $v_1=1$. Levels with $v_1+v_3 \geq 3$ or with vibrational energy greater than 4000 cm$^{-1}$ have lifetimes longer than 300 ns; some of these levels even have a long-lived component with a lifetime of up to several microseconds. This implies that the predicted dark states, ($\tilde{B}$$\Sigma$$_u^-$ and $\tilde{B}'$$\Delta$$_u$), lie at least 4000 cm$^{-1}$ above the 0 0 0 level of the $\tilde{A}$ state. It is interesting to note that most of the $\Sigma$$_u^+$-symmetry levels lying above 4000 cm$^{-1}$ also have lifetimes longer than 300 ns.