Precision Spectroscopy and Comprehensive Analysis of Perturbations in the $A^1\Pi(v=0)$ State of $^{13}C^{18}O$

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We have reanalysed the $A^1\Pi(v=0)$ level of $^{13}C^{18}O$ by investigating the high-resolution spectra obtained via multi-photon laser excitation as well as with synchro- tron-based Fourier-transform absorption spectroscopy of the $A^1\Pi - X^1\Sigma^+(0,0)$, $e^3\Sigma^- - X^1\Sigma^+(1,0)$, $d^3\Delta - X^1\Sigma^+(4,0)$, $a'^3\Sigma^+ - X^1\Sigma^+(9,0)$, and $a^3\Pi - X^1\Sigma^+(11,0)$ bands. In addition, Fourier-transform emission spectroscopy in the visible range is performed on the $B^1\Sigma^+ - A^1\Pi(0,0)$ band. Spectra of the $B^1\Sigma^+ - X^1\Sigma^+$ band are measured in order to tie information from the latter emission data to the level structure of $A^1\Pi(v=0)$. The high pressures in the absorption cell at the synchrotron and the high temperatures in the emission discharge permitted monitoring of high rotational quantum levels in $A^1\Pi(v=0)$ up to $J=43$. All information, in total over 900 spectral lines, was included in an effective-Hamiltonian analysis of the $A^1\Pi(v=0,J)$ levels that are directly perturbed by the $e^3\Sigma^-(v=1)$, $d^3\Delta(v=4)$, $a'^3\Sigma^+(v=9)$, $D\,^1\Delta(v=0)$, $I\,^1\Sigma^-(v=0,1)$ close-lying levels and the $e^3\Sigma^-(v=0,2)$, $d^3\Delta(v=3,5)$, $a'^3\Sigma^+(v=8,10)$ remote levels, as well being indirectly influenced by the $a^3\Pi(v=10,11)$ state. The influence of six further perturber states and their interactions was investigated and are not significant for reproducing the present experimental data. This analysis leads to a much improved description in terms of molecular constants and interaction parameters, compared to previous studies of the same energy region for other CO isotopologues. This work is the next stage of the global project [2,3,1,4,5,6] of precise and comprehensive deperturbation analysis of the $A^1\Pi$ state in carbon monoxide using complementary spectroscopic techniques.

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