SF\textsubscript{6}: THE FORBIDDEN BAND UNVEILED

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Sulfur hexafluoride (SF\textsubscript{6}) is a greenhouse gas of anthropogenic origin, whose strong infrared absorption in the $\nu_3$ S–F stretching region near 948 cm\textsuperscript{-1} induces a global warming potential 23900 times bigger than CO\textsubscript{2}. This heavy species features many hot bands at room temperature (at which the ground state population is only 30 %), especially those originating from the $\nu_5 = 1$ state. Unfortunately, the $\nu_6$ band itself (near 347 cm\textsuperscript{-1}) being, in first approximation, both infrared and Raman inactive, no reliable information could be obtained about it up to now. A long time ago, some authors suggested\textsuperscript{a} that this band may be slightly activated through Coriolis interaction and may appear as a very faint band, with an integrated intensity about 2 millionths of that of $\nu_3$. Using a new cryogenic multipass cell with 93 m optical path length and regulated at $165 \pm 2$ K temperature, we recorded a spectrum of the $\nu_6$ far-infrared region thanks to the performances of the AILES Beamline at the SOLEIL French synchrotron facility. Low temperature was used to avoid the presence of the $2\nu_6 - \nu_6$ hot band and to reduce the neighboring, stronger $\nu_4 - \nu_2$ difference band. We are thus able to confirm that the small feature in this region, previously viewed at low-resolution is indeed $\nu_6$. We present its fully resolved spectrum. It appears to be activated thanks to unidentified faint interactions resulting in the presence of a first-order dipole moment term that induces unusual selection rules. This spectrum was analyzed thanks to the XTDS software package\textsuperscript{b}, leading to accurate molecular spectroscopic parameters that should be useful to model the hot bands of SF\textsubscript{6}.
