

## Rotational spectra of methyl formate in the new vibrational excited states

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The methyl formate molecule ( $\text{HCOOCH}_3$ ) is a typical example of the molecule with high spectral density found in interstellar space. So far, many transitions were found in hot cores in massive star-forming regions and recently, were also found in very young low mass star-forming regions. We have also identified in its first and second torsional excited state in Orion KL. [1][2] The observed intensity suggests the possible detection of transition of this molecule in the higher vibrational state. The methyl formate has several low-lying vibrational states. Figure 1 shows the fundamental band below  $500\text{ cm}^{-1}$  as well as the excited state of the  $\text{CH}_3$  torsion (internal rotation).

The microwave spectral data below 200 GHz were taken at the University of Toyama. Additional measurements including the date below and above 200 GHz have also been carried out. All the date was used to search for the excited state with the aid of the computer program developed at Kanazawa University.

We have assigned series of lines in the two new vibrational excited states. The relative energy to the ground state estimated from the spectral intensities was determined. Based on the results, it is possible that one is COC deform or Skeletal torsion, and another is combination band COC deform or skeletal torsion with internal rotation.

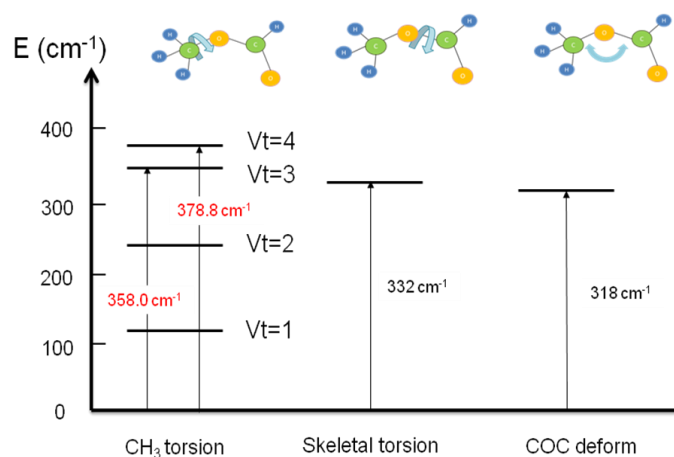


Figure 1: Vibrational energy level of  $\text{HCOOCH}_3$  ( $\sim 500\text{ cm}^{-1}$ ). Red colored energy levels are ab initio MO by Dr. Senent.[3] Black colored energy levels are experiment.[4]

### References

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