High resolution Spectroscopy of small organic molecules and astrophysical molecules

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This talk will first give a short introduction to the spectroscopy molecules containing one or two methyl internal rotors. One of the goals of our work is to describe with our theoretical method and codes (using effective Hamiltonians describing the rotation-torsion-vibration interactions) the energy levels for this type of molecules. That way we can provide reliable predictions of line positions and intensities for astrophysical molecules containing one internal rotor CH_3, such as the isotopic species of methyl formate $HCOOCH_3$, methanol CH_3OH, acetic acid CH_3COOH, acetaldehyde CH_3CHO or acetamide CH_3CONH_2. The major new facilities, the Atacama Large Millimeter Array (*ALMA*), in Chili, or the NOrthern Extended Millimeter Array (*NOEMA*) in France have now opened the sub-millimeter region up to a few THz for astronomical observations by making investigations with unprecedented high sensitivity and resolution. Molecules which undergo internal rotation of a methyl group present thousands of lines in this spectral range and therefore their spectra are particularly important to model. They are also important tools to help determining the conditions existing in the interstellar medium. I will show some of the recent results in the microwave, millimeter or infrared range for those molecules. In particular I will present recent results for the study of a two-top internal rotor, the methyl acetate molecule CH_3-O-C(=O)-CH_3, which has been very detected in the interstellar cloud Orion thanks our prediction and recent results on the sulfur-containing molecules such as dimethyl sulfide CH_3SCH_3 a potential astrophysical molecule

Another goal is to get some knowledge of the structural properties of small organic molecules or biomimetic molecules. Fourier transform microwave spectroscopy in the gas phase coupled with high level quantum chemical calculations or ab initio calculations has recently led to the precise and detailed determination of molecular structures for the lowest energy conformers of a number of molecules. In this talk, we will show results from molecules which can be considered as prototypes of odorant molecules emitted by plants, such as linalool, an acyclic mono-terpene or methyl jasmonate, a phytohormone.