IR - MILLIMETER-WAVE DOUBLE RESONANCE FOR PRECISION MOLECULAR SPECTROSCOPY

L. JUPPET, O. PIRALI, *Institut des Sciences Moléculaires d'Orsay, CNRS, Université Paris Saclay, 91405 Orsay*; **J. F. LAMPIN**, *Institut d'Electronique Microélectronique et Nanotechnologie, CNRS, Université de Lille, 59652 Villeneuve d'Ascq cedex*; **B. DARQUIE, M. MANCEAU, Y. LIU, O. LOPEZ**, *Laboratoire de Physique des Lasers, CNRS, Université Sorbonne Paris Nord, 93430 Villetaneuse*

Metrology-grade spectroscopic measurements of molecules are of high importance for numerous applications such as testing fundamental physics[1], molecular physics[2], and astrophysics[3]. In this context, we tested the well-established double resonance technique[4,5,6,7] using both infrared and millimeter wave transitions to provide high resolution and frequency metrology dataset. The hyperfine components of rotational transitions involving both the ground and the $v_2 = 1$ vibrational state of NH_3 as well as the $v_2 = 1$ vibrational state of D_2O have been investigated trough IR-THz Doppler-free and cross-over-free double resonance spectroscopy. Spectra were obtained using both a free running external cavity quantum cascade laser (QCL installed at SOLEIL synchrotron) as well as a sub-Hz QCL[8] (installed at LPL Villetaneuse) frequency-stabilised on the REFIMEV signal[9]. The lasers have been used to optically pump the molecules inducing a velocity class selection. We will present the major interests of this approach for precision spectroscopy and the current limitations we meet.

[1] M. R. Fiecher and al, *The Journal of Physical Chemistry Letters* **13** 42 (2022)
[2] S. P. Belov and al, *The Journal of Chemical Physics* **145** (2016)
[3] C. Puzzarini and al, *PCCP* **12** (2020)
[4] J. Lemaire, *Thèse de l'Université de Lille* (1974)
[5] T. Shimizu and al, *The Journal of chemical Physics* **53** (1970)
[6] S. Ghoshal and al, *The Journal of chemical Physics* **83** (1985)
[7] A. Foltynowicz and al, *PRL* **126** (2021)
[8] R. Santagata and al, *Optica* **6** (2019)
[9] https://www.refimeve.fr

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