SNAPS & HUBS

R. TÓBIÁS, *MTA-ELTE Complex Chemical Systems Research Group, H-1518 Budapest 112, P.O. Box 32, Hungary*; **A. G. CSÁSZÁR**, *Institute of Chemistry, ELTE Eötvös Loránd University, H-1117 Budapest, Pázmány Péter sétány 1/A, Hungary & MTA-ELTE Complex Chemical Systems Research Group, H-1518 Budapest 112, P.O. Box 32, Hungary*; **M. L. DIOUF, P. BLOEM, F. M. J. COZIJN, W. UBACHS**, *Department of Physics and Astronomy, LaserLaB, Vrije Universiteit, De Boelelaan 1081, 1081 HV Amsterdam, The Netherlands*

The theory of spectroscopic networks[1] offers a powerful instrument for the intelligent design and validation of precision-spectroscopy experiments, as well as the subsequent derivation of accurate rovibrational energies,[2,3,4,5] in particular those associated with hubs (high-degree nodes) of the network. Through a joint experimental and theoretical approach, absolute energies have been determined for a large number of hubs in the experimental spectroscopic networks of $H_2^{16}O$ and $H_2^{18}O$, with an accuracy of a few times 10^{-7} cm^{-1}. The Lamb-dip measurements utilized two noise-immune cavity-enhanced optical heterodyne molecular spectroscopy (NICE-OHMS) apparata[6,7] and three probe lasers covering different wavenumber ranges. The observed lines, whose lower states belong to the vibrational ground state and the bending fundamental, were selected *via* the spectroscopic-network-assisted precision spectroscopy (SNAPS) approach.[2] The accurately known energy levels are involved in thousands of unique transitions already measured, though at much lower accuracy, for $H_2^{16}O$ and $H_2^{18}O$. From the ultraprecise absolute energies a large number of benchmark-quality predicted transitions has been deduced, which could be employed as frequency standards in high-resolution Fourier-transform infrared spectroscopy.

[1] A. G. Császár and T. Furtenbacher. *J. Mol. Spectrosc.*, **266**, 99–103, (2011), DOI.

[2] R. Tóbiás, T. Furtenbacher, I. Simkó, A. G. Császár, M. L. Diouf, F. M. J. Cozijn, J. M. A. Staa, E. J. Salumbides, and W. Ubachs, *Nat. Commun.*, **11**, 1708 (2020), DOI.

[3] M. L. Diouf, R. Tóbiás, I. Simkó, F. M. J. Cozijn, E. J. Salumbides, W. Ubachs, and A. G. Császár. *J. Phys. Chem. Ref. Data*, **50**, 023106 (2021) DOI.

[4] M. L. Diouf, R. Tóbiás, T. S. van der Schaaf, F. M. J. Cozijn, E. J. Salumbides, A. G. Császár, and W. Ubachs. *Mol. Phys.*, **120**, e2050430 (2022) DOI.

[5] R. Tóbiás, M. L. Diouf, P. Bloem, F. M. J. Cozijn, W. Ubachs, and A. G. Császár, *Nat. Chem. to be submitted* (2023).

[6] F. M. J. Cozijn, P. Dupré, E. J. Salumbides, K. S. E. Eikema, and W. Ubachs, *Phys. Rev. Lett.*, **120**, 153002 (2018) DOI.

[7] F. Cozijn, M. Diouf, and W. Ubachs. arXiv preprint, arXiv:2303.17818 (2023), Link.