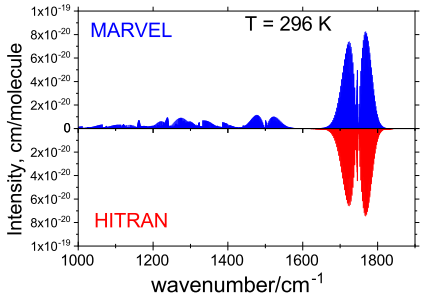
LINE LISTS FOR HIGH RESOLUTION STUDIES OF EXOPLANETS

JONATHAN TENNYSON, SERGEI N. YURCHENKO, *Department of Physics and Astronomy, University College London, London, UK.*

The ExoMol project (www.exomol.com) provides comprehensive line lists for the study of exoplanets and other hot bodies. As part of the ERC-funded ExoMolHD project these line lists are being refactored to facilitate their use in characterization of exoplanets using high resolution Doppler shift spectroscopy. This technique is based the use of MARVEL (measured active rotation vibration energy level) to obtain empirical energy levels and illustrated by a recent study on formaldhyde (H_2CO).[a]

For formaldehyde we analysed of 16 596 non-redundant transitions from 43 experimental sources and resulted in the determination of 5029 empirical energy levels. As part of this work new measurements were performed in Bologna yielding high-accuracy rotational transitions within the ground, ν_3, ν_4 and ν_6 vibrational states, significantly improving the overall accuracy of the network. Eleven artificial transitions determined from effective Hamiltonian fits were added to the network to both fix the gap between ortho and para levels, and to join free-standing networks of transitions to the main network.

The empirical energies were used to update the AYTY ExoMol line list for formaldehyde. This yielded 367 779 transition frequencies determined using the empirical energy levels of which 183 673 lie above the dynamic HITRAN intensity cutoff, see the example in the figure.



The generation of line lists which combine empirically-determined transition wavenumbers with *ab initio* transition dipoles is suitable for high resolution studies of both the Earth's and exoplanetary atmospheres. High resoltion line lists for other molecules starting with AlO, VO and the isotopologues of H_3^+ are currently being prepared.

[a] A. R. Al-Derzi, S. N. Yurchenko, J. Tennyson, M. Melosso, Ningjing Jiang, C. Puzzarini, L. Dore, T. Furtenbacher, R. Tobias and A G. Császár, 2021, J. Quant. Spectrosc. Radiat. Transf., doi = 10.1016/j.jqsrt.2021.107563