

LEVERAGING DOUBLE-RESONANCE SPECTROSCOPY TO UNDERSTAND TRANS-GLYCIALDEHYDE AND 17 OF ITS VIBRATIONALLY EXCITED STATES

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Rotational spectra of vibrationally excited species are important tracers for the temperature structure of astronomical objects such as high-mass star-forming regions and are also assumed to be the reason for many yet unassigned spectroscopic features observed in line-rich sources. Thus, they bear high astronomical interest but are so far largely unexplored.

Here, the ground state and 17 vibrationally excited states of the trans conformer of glycialdehyde ($C_3H_4O_2$) are examined. The low-lying torsional motion of the aldehyde group trans to the oxirane ring at about $140 \pm 10 \text{ cm}^{-1}$ and the three non-zero dipole moment components lead to a dense and complicated mm-wave spectrum.

High-resolution broadband spectra were recorded in the frequency ranges of 75–170 GHz and 500–750 GHz with an in-house synthesized sample. The broadband spectra alone were not sufficient for identifying the weak rotational transitions of vibrationally excited states high in energy and therefore were supported by double-resonance double-modulation (DM-DR) measurements for which an updated experimental implementation was used.^a DM-DR measurements are a convenient method to derive the relationships of transitions by identifying transitions that share a common energy level. This greatly simplified the assignment of series of perturbed or weak vibrational satellites. Candidates were identified either by visual inspection in Loomis-Wood plots in our LLWP software^b or automated with peaklists.

The preliminary results of the analysis including the interaction analysis of selected states will be presented.

^aO. Zingsheim et al., *J. Mol. Spectrosc.* **381** (2021) 111519

^bL. Bonah et al., *J. Mol. Spectrosc.* **388** (2022) 111674; <https://llwp.astro.uni-koeln.de/>