Water dimer detection at ambient conditions

M. Yu. Tretyakov, M. A. Koshelev, E. A. Serov, V. V. Parshin

Institute of Applied Physics, Russian Academy of Sciences, 46 Ulyanova str. 603950, Nizhniy Novgorod, Russia, Tel.: +7(831)4164866, E-mail: trt@appl.sci-nnov.ru

Water dimer $(H_2O)_2$ is known as an elusive atmospheric species, which is believed to affect Earth's radiation balance and climate, homogeneous condensation, and atmospheric chemistry. Moreover, the pairwise interaction which binds the dimer appears to be of paramount importance for expounding a complete molecular description of the liquid and solid phases of water. However, there have been no secure, direct observations of water dimers at environmentally relevant temperatures despite decades of studies. We succeeded in the first unambiguous observation of the dimer spectrum in equilibrium water vapor at room temperature [1]. A sequence of four peaks corresponding to the dimer rotation was detected near the limit of sensitivity of the resonator spectrometer [2] in the 105-150 GHz range. Now we report the continuation of this study. The water vapor spectrum was studied in the 190-260 GHz range containing six rotational features of the dimer. The features were observed with better signal to noise ratio than reported in [1]. Variation of the observed spectrum intensity with temperature will be presented.

Signal to noise ratio of observed dimer features allows us to make the second and final key step toward understanding the role of the dimer in atmospheric processes. Spectra of water vapor diluted by air clearly demonstrate expectable pressure broadening of the dimer features without noticeable reduction of their integrated intensity. This suggests the conclusion that the dimer equilibrium constant in the atmosphere is about the same as in pure water vapor.

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[2] M. Yu. Tretyakov, A. F. Krupnov, M. A. Koshelev, D. S. Makarov, E. A. Serov, V. V. Parshin, *Rev. Sci. Instrum*. **2009**, *80*, 093106.