PRECISE FREQUENCIES OF $H_2{}^{16}O$ LINES PROTECTED FOR RADIO ASTRONOMY

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Water is a key molecular species throughout the universe, which is why the International Astronomical Union and the Panel on Frequency Allocations of the US National Academy of Sciences have established lists of protected radio lines of water isotopologues. The focus of this talk will be on the improvement of the accuracy of these lines with respect to previous direct radio-frequency measurements for all the protected lines of $H_2{}^{16}O$ between 750 and 3000 GHz. .

To achieve this purpose, high-precision Lamb-dip measurements of rovibrational lines of $H_2{}^{16}O$ were performed (see Figure 1 for two examples) using the noise-immune cavity-enhanced optical-heterodyne molecular spectroscopy (NICE-OHMS)[1] method in the wavelength range of 1.2 – 1.4 µm. The accuracy of the transition frequencies measured is estimated to be 2 kHz. These new measurements, combined with a spectroscopic network[2,3,4] built from a large set of previous rovibrational Lamb-dip lines, has lead to a significant improvement of 51 purely rotational microwave lines used for $H_2{}^{16}O$ in radio astronomy. While their accuracy was at the level of 10-200 kHz, it has now been improved to well below 10 kHz for all lines.

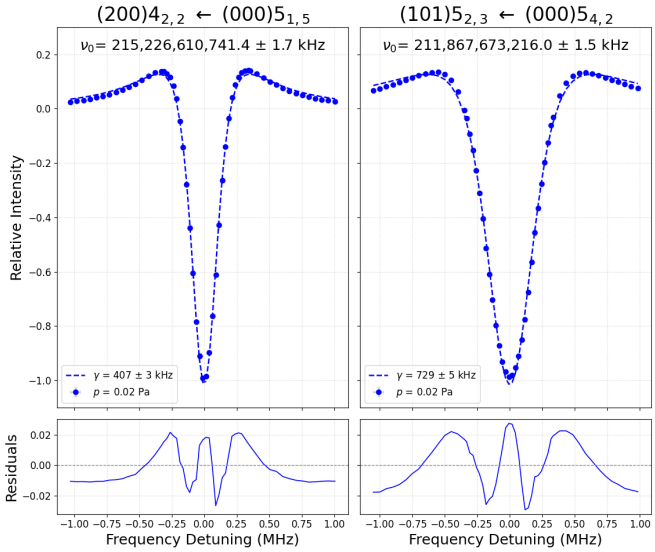

Figure 1: Experimental Lamb-dip spectra of two (ro)vibrational transitions measured *via* our ultrasensitive NICE-OHMS setup for $H_2{}^{16}O$.

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