TIME DEPENDENT MEASUREMENTS OF DICKE NARROWING OF A WATER LINE AT 7.84 MICRONS USING A FREQUENCY DOWN-CHIRPED QC LASER SPECTROMETER

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The K doublet $15_{1,15} \leftarrow 16_{0,16}$ and $15_{0,15} \leftarrow 16_{1,16}$of the ν_2 of water lies within the tuning range of our frequency down-chirped long pulse 7.84μm quantum cascade laser. At the best instrumental resolution of our spectrometer, ca. 0.004 cm^{-1}, the pair of transitions are unresolved, and appear as a single line strongly affected by Dicke narrowing. Using a pulse duration of 1.3 microseconds the chirp rate varies from approximately 130 MHz/ns at the beginning of the pulse to about 20 MHz/ns at the end. The time taken to sweep through a Doppler broadened half width then varies from 1 ns to about 8 ns. We have exploited these time windows to study the effects of collisions between water and the inert gases helium, neon and argon, and also the molecules nitrogen and carbon dioxide. Analysis of these results has led to a semi-quantitative comparison between the effect of chirp rate and the atomic and molecular collision partners. The experimental signals have also been compared with those calculated by numerical solution of the coupled Maxwell-Bloch equations.