WATER COLLISIONS WITH NORMAL AND PARAHYDROGEN

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Previous pressure broadening results for the normal hydrogen/water system displayed a dramatic reduction in the broadening at low temperature. Theoretical predictions, the basis for which are calculated collisional excitation rates, indicated stronger excitation, with a steady increase in the broadening as the temperature drops. Due to this disagreement, concerns were raised about the stability of the the ortho/para hydrogen ratio (OPR) in the apparatus[1]. The development of a modified injector, as well as improved optics and a parahydrogen generator, have enabled these concerns to be thoroughly investigated for the 556 GHz transition of water. The modified injector has been shown to eliminate the bias between gas and cell temperature. The improved optics allow much better signal-to-noise ratios with smaller amounts of water. Furthermore, a reduction of water injected into the system was found to be critical to stabilize the OPR, which was verified to be dependent upon several system variables. Preparation of parahydrogen in an exterior vessel was useful for testing the OPR stability and full data sets of both parahydrogen and normal hydrogen water broadening at 556 GHz have been collected. The newest results show good qualitative agreement with theory, with the dramatic decreases of broadening at low temperature no longer evident. Other water transitions near 1 THz are also under investigation. We will discuss the new experimental procedures, the experimental results and compare with recent theoretical work.

[1] A.F. Krupnov, Phys. Rev. A 82(3) 036703, 2010.