MEASUREMENT OF COLLISIONAL SELF-BROADENING AT LOW-TEMPERATURES USING SUB-DOPPLER SPECTROSCOPY

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Collisional energy transfer in volatized exospheric materials dominates the uncertainty of comet models that trace comae composition back to surface composition. Methods for ab initio and semi-empirical calculation of quantum-state dependent collisional efficiencies are typically benchmarked to pressure broadening experiments when available. Here we detail experimental efforts to determine collisional efficiencies for selected transitions of water at temperatures demonstrative of the comet environment and well below the water condensation temperature. The method utilizes a collisional cooling cell with water injected into a bath gas at the target temperature. THz radiation is passed twice through the cooled gas to record a transmission spectrum exhibiting the Lamb dip effect. The sub-Doppler feature is subject to collisional broadening at pressures commensurate with the partial pressure of water in the system. Data analysis involves simultaneous extraction of intensity and pressure broadening information. The method, results and comparisons to calculated values will be discussed.