SPECTROSCOPY OF HYDROCARBONS RELEVANT TO THE ATMOSPHERES OF HOT JUPITER EXOPLANETS IN THE 1.6-1.7 μm RANGE: UNAMBIGUOUS ASSIGNMENT OF ETHYLENE TRANSITIONS

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Accurate knowledge of the absorption fingerprint of the species expected in the atmospheres of the hot Jupiter exoplanets is required to allow their detection. Methane[a] and acetylene[b] were already detected in such environments, and the presence of other small hydrocarbons such as ethylene (C_2H_4) is expected. However, spectral assignment of C_2H_4 transitions is not available at wavenumbers higher than 3500 cm^{-1}, partly due to its highly congested absorption spectrum at room temperature. To provide accurate assignments of the cold transitions, we perform cavity ring-down spectroscopy of a jet-cooled ethylene gas sample in the 1.6-1.7 μm spectral range. The gas contained in a high pressure reservoir is expanded into a low-pressure chamber through an 8.5cm-long slit with a tunable opening width ranging from 0 to 350 μm. This process induces a simplification of the absorption spectrum by reducing drastically the rotational temperature and by narrowing the absorption line widths. Three spectra were recorded with a vibrational temperature of about 220K but different rotational temperatures: 5K, 35K and 75K. Unambiguous assignment of the observed lines is performed using the TheoReTS *ab initio* line list[c] and the temperature dependence of the transition intensities.

[a] M. R. Swain, G. Vasisht, G. Tinetti, Nature, 463 (7281), 637-639 (2008)

[b] P. Giacobbe, et al., Nature, 592 (7853), 205-208 (2021)

[c] M. Rey, A. V. Nikitin, Y. L. Babikov, and V. G. Tyuterev, J. Mol. Spectrosc., 327, 138–158 (2016)