ABSORPTION SPECTRA OF LIQUID HYDROGEN AND THE DEVELOPMENT OF A NEW OPTICAL MASS GAUGE SENSOR FOR ROCKET FUEL

MARKUS MENGEL, *Department of Physics, The Ohio State University, 174 West 18th Ave., Columbus OH 43210, USA*; BRENDA P. WINNEWISSER and MANFRED WINNEWISSER, *Physikalisch-Chemisches Institut, Justus-Liebig-Universität, Heinrich-Buff-Ring 58, D-35392 Giessen, Germany*; JOHN F. JUSTAK and FRANK M. CAIMI, *Justak Research Inc., P.O. Box 442, Stuart, FL 34995, USA.*

Only a few papers on the absorption spectra of liquid hydrogen have been published after its first observation in 1955[a], and none of them addresses vibrational excitations higher than the fundamental band (4000–5000 cm^{-1}). The most comprehensive study so far has been performed by McKellar and Clouter[b], which also includes the spectra of liquid deuterium. The reason for this relative lack of interest in the spectroscopy of liquid hydrogen compared to its solid state counterpart lies in the poor understanding of induced absorption mechanisms for molecules in the liquid phase.

We will present the results of our observations of liquid parahydrogen at various orthohydrogen impurity levels in the first (8000–9600 cm^{-1}) and second (11800–13000 cm^{-1}) overtone regions using a Bruker IFS 120 Fourier transform spectrometer at a resolution of typically 1 cm^{-1} and optical pathlengths up to 34 cm. We will furthermore indicate analogies between the spectrum of the liquid and the corresponding spectrum of the solid phase of hydrogen.

Since the second overtone spectrum of liquid hydrogen reaches into the visible wavelength region, this work has been helpful in the current development of an optical mass gauge sensor for rocket fuel under zero-g conditions. The basic priciple of this new device will be presented.

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[a] E.J. Allin, W.F.J. Hare, and R.E. MacDonald, Phys. Rev. 98, 554 (1955)

[b] A.R.W. McKellar and M.J. Clouter, Can. J. Phys. 72, 51 (1994)