EXTENDED OBSERVATION AND ANALYSIS OF THE FIRST OVERTONE SPECTRUM OF SOLID PARAHYDROGEN

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The first overtone spectrum of solid parahydrogen with various low ortho impurity levels has been studied in detail using a White-type external multireflection system [a]. For the $Q_{2\leftarrow 0}(0)$ transition we have observed the fully resolved threefold splitting due to the crystal field effect. Furthermore we have obtained a rich satellite spectrum associated with the transitions $Q_{2\leftarrow 0}(0)$ and $Q_{2\leftarrow 0}(1)$ at different ortho-H_2 contents revealing information about the ortho-H_2 pair interaction in the second vibrationally excited state of the hydrogen molecule. A preliminary analysis and assignment of these satellite transitions will be presented. Another point of study was the spectral region around 8300 cm^{-1}, where the double transitions of the type $Q_{1\leftarrow 0}(n) + Q_{1\leftarrow 0}(n')$ $(n, n' = 0,1)$ are located. The most remarkable features here are the $Q_{1\leftarrow 0}(1) + Q_{1\leftarrow 0}(1)$ transition which consists entirely of fine structure and the $Q_{1\leftarrow 0}(0) + Q_{1\leftarrow 0}(0)$ transition for which no mechanism has so far been suggested. Finally the thermal shift of all of the above mentioned transitions was investigated by lowering the sample temperature from the triple point at 13.8 K down to 6.5 K while taking spectral data. The influence of the change of temperature on the line positions, line widths and line strengths of solid hydrogen will be discussed.

[a] R. Steinhoff, K. V. S. R. M. Winnewisser, Appl. Optics 32, 6577-6581 (1993).