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MICROWAVE DETECTION OF $H_2{}^{18}O$

Francis X. Powell* and Donald R. Johnson
National Bureau of Standards, Washington, D. C. 20234
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Laboratory detection of a microwave absorption in $H_2{}^{18}O$ near 5.33 cm is reported. This observed signal has been assigned to a pure rotational transition between the 6_{16} and 5_{23} levels in the ground vibrational state of $H_2{}^{18}O$. Signals from these same two rotational levels for $H_2{}^{16}O$ have been detected in emission from several sources in the galaxy.

Emission from the 5_{23}-6_{16} rotational transition in $H_2{}^{16}O$ at a wavelength of 1.35 cm has been detected from at least eight sources in the galaxy.[1] In this communication we report a laboratory observation of the transition between these same two rotational levels for the isotopic species $H_2{}^{18}O$ at a wavelength of 5.33 cm.

The eventual observation of this $H_2{}^{18}O$ transition in the galaxy should provide unique information on the $^{18}O/^{16}O$ galactic distribution and possibly give some insight into problems related to nucleogenesis. Terrestrial isotopic abundance for ^{18}O compared with ^{16}O is about 1/490. Observations on ^{16}OH and ^{18}OH in absorption in one particular source by Rogers and Barrett[2] give an estimate of the stellar abundance ratio of $^{18}O/^{16}O$ of 1/500 with some reservations due to the low intensity of the ^{18}OH signals. Since the observed $H_2{}^{16}O$ emission is very intense, with the strongest lines in the W49 source implying a brightness temperature possibly larger than 50 000°K, the chances of detection of signals from $H_2{}^{18}O$ may be more favorable than for the signals from ^{18}OH.

Our laboratory measurement was based on a recent report by Fraley, Rao, and Jones[3] of the infrared spectrum of $H_2{}^{18}O$. Their reported values for the 6_{16} and 5_{23} levels yield a difference of 0.194 cm^{-1} or about 5820 MHz. We have conducted a search of this region employing a Stark modulated parallel-plate microwave spectrometer and detected a transition in ^{18}O-enriched water at

$$\nu = 5625.147 \pm 0.015 \text{ MHz}.$$

The intensity of the observed transition is in good agreement with the intensity of the $6_{16} \leftarrow 5_{23}$ transition in $H_2{}^{16}O$ at 22 235.08 MHz if one takes into consideration the differences in frequency and the enrichment of the sample (40 at.% ^{18}O normalized to 0.02 at.% D). The Stark effect appears comparable with that for $H_2{}^{16}O$. However, a detailed dipole-moment measurement has not yet been made. The indicated error limits are actual measured values obtained by varying the frequency of the standard oscillator over the limits indicated.

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*Present address: The Catholic University of America, Washington, D. C.

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[3]P. E. Fraley, K. N. Rao, and L. H. Jones, J. Mol. Spectry. 29, 312 (1969).