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LETTER TO THE EDITOR

Microwave Measurements of $J = 2 \leftarrow 1$, $K = 0, 1$ Ammonia Transitions at 1.215 THz

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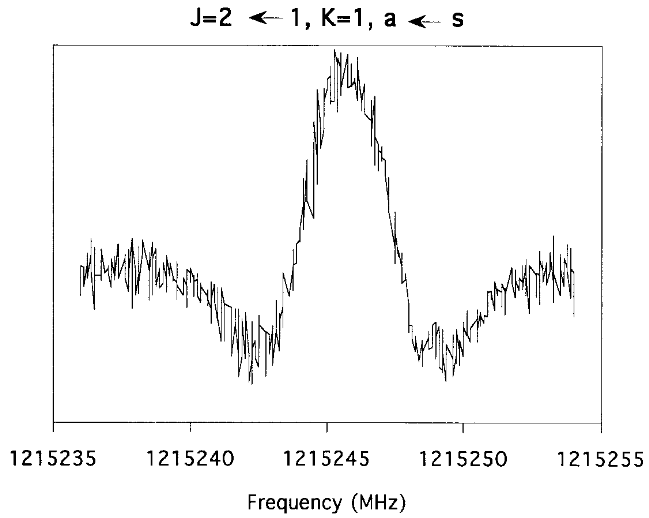

FIG. 1. The submillimeter-wave absorption signal of the $J = 2 \leftarrow 1$ $K = 1$, $a \leftarrow s$ $^{14}NH_3$ ammonia transition.

The first rotational transition of the ammonia molecule at 572 GHz was previously measured by microwave spectroscopy in (*1, 2*). In the present letter, measurements of the two second rotational transitions of the ammonia molecule $J = 2 \leftarrow 1$, $K = 0, 1$ at 1214.8 and 1215.2 GHz are reported.

The experimental apparatus was based on the Lille millimeter-wave/submillimeter-wave spectrometer (*3, 4*), with the addition of a high-frequency Russian-constructed BWO produced by the ISTOK Research and Production Co. This new BWO was phase-locked against an existing Thomson BWO, operating around 405 GHz, using a similar broadband multiplier–mixer to that first used in (*5*). The Thomson BWO was in turn phase-locked as explained in previous articles (*3, 4*).

Neither the geometry of the cell nor the InSb bolometer was optimized for the terahertz frequency region; a 3-m-long cell and nonmagnetically tuned bolometer were used. Nor was any attempt made to reduce power loss by water absorption in the path of the terahertz radiation through the atmosphere. Sample pressures less than 0.5 Pa were used to prevent saturation of the lines.

A typical example of measured spectral lines is presented in Fig. 1. Observed frequencies in MHz are presented in Table 1 together with previously predicted frequencies calculated from simultaneous analysis of the microwave, submillimeter-wave, far-infrared, and infrared–microwave two-photon transitions between the ground and ν_2 inversion–rotation levels of $^{14}NH_3$ (*6*). The calculated frequencies were converted from values quoted in cm^{-1} to seven significant digits and are hence given with eight digits. The observed frequency quoted is the mean of seven independent measurements for each line taken with varying time constants (30–100 msec). No frequency shift correlated to the time constant was observed. The uncertainty quoted for the measured results is the standard deviation of these seven measurements. This standard deviation is comparable to the uncertainty we would predict based on our experiments at lower frequencies. Linewidths observed were close to the Doppler limit at this frequency.

TABLE 1
Observed and Calculated Frequencies of Ground State $^{14}NH_3$ Ammonia Transitions

Ammonia Transitions	Obs. Freq. MHz	Calc. Freq.[a] MHz	O - C MHz
$J = 2 \leftarrow 1$, $K = 0$	1 214 852.874(140)	1 214 852.6	0.3
$J = 2 \leftarrow 1$, $K = 1$	1 215 245.674(178)	1 215 245.3	0.4

[a]Ref.6.

With the addition of these two new transitions measured by microwave techniques the low-J rotational spectrum of ammonia is fixed by three, not one, microwave points for further fits. Although a fit of these microwave transitions alone would not be expected to lead to molecular constants better than those already available, their inclusion in a global fit should give improvements in the quality of future spectral predictions for this molecule. These frequencies may be useful for the calibration of Fourier transform spectrometers in this region.

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